BS ISO 7176-22:2014

BSI Standards Publication

Wheelchairs

Part 22: Set-up procedures

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National foreword

This British Standard is the UK implementation of ISO 7176-22:2014. It supersedes BS ISO 7176-22:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CH/173/1, Wheelchairs.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Wheelchairs —

Part 22: Set-up procedures

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 173, *Assistive products for persons with disability*, Subcommittee SC 1, *Wheelchairs*.

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.

This second edition cancels and replaces the first edition (ISO 7176-22:2000), all clauses of which have been technically revised.

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 effectiveness of brakes*

— *Part 4: Energy consumption of electric wheelchairs and scooters for determination of theoretical distance range*

— *Part 5: Determination of dimensions, mass and manoeuvring space*

— *Part 6: Determination of maximum speed, acceleration and deceleration 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 electrically powered wheelchairs*

— *Part 11: Test dummies*

— *Part 13: Determination of coefficient of friction of test surfaces*

— *Part 14: Power and control systems for electrically powered wheelchairs and scooters — Requirements and test methods*

— *Part 15: Requirements for information disclosure, documentation and labelling*

— *Part 16: Resistance to ignition of postural support devices*

— *Part 19: Wheeled mobility devices for use as seats in motor vehicles*

— *Part 21: Requirements and test methods for electromagnetic compatibility of electrically powered wheelchairs and scooters, and battery chargers*

— *Part 22: Set-up procedures*

— *Part 25: Batteries and chargers for powered wheelchairs*

— *Part 26: Vocabulary*

— *Part 28: Requirements and test methods for stair-climbing devices*

A Technical Report (ISO/TR 13570-1) is also available giving a simplified explanation of these parts of ISO 7176.

Introduction

Many wheelchairs have adjustable or optional features, which, depending upon their setting, can have significant effects on the results from test methods in different wheelchair testing standards.

When used in combination with other wheelchair standards the procedure presented within this standard will produce test results which permit comparison between different wheelchairs and give comparable results between different test laboratories.

If a wheelchair is configured in a specific way, some clauses of ISO 7176-22 might not apply.

INTERNATIONAL STANDARD ISO 7176-22:2014(E)

Wheelchairs —

Part 22: Set-up procedures

1 Scope

This part of ISO 7176 specifies a set-up procedure to be used as a part of the preparation of adjustable wheelchairs for testing. This procedure takes the manufacturer's instructions into account.

This part of ISO 7176 is applicable to manual wheelchairs and electric wheelchairs (including scooters) intended to provide indoor and/or outdoor mobility.

NOTE Other parts of ISO 7176 may have specific requirements for the adjustment of the wheelchair. In such cases, the individual part of ISO 7176 takes precedence over this part of ISO 7176.

2 Normative references

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

ISO 7176-11, *Wheelchairs — Part 11: Test dummies*

ISO 7176-26, *Wheelchairs — Part 26: Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7176-26 apply.

4 Test apparatus

4.1 Test dummy, as specified in ISO 7176-11.

4.2 Means for measuring linear dimensions up to 2 000 mm, to an accuracy of ±1 mm.

4.3 Means for measuring the angles of surfaces to each other and/or to vertical or horizontal, to an accuracy of ±0,2°.

4.4 Means of measuring forces, between 25 N and 250 N to an accuracy of ±5 % of the measurement

4.5 Means of measuring torque, between 2 Nm and 100 Nm to an accuracy of ±10 % of the measurement.

4.6 Means to inflate pneumatic wheelchair tyres, up to 10 bar with an accuracy of ±0,2 bar.

4.7 A hard horizontal test plane, of sufficient size to support the wheelchair during testing, such that the whole surface is contained between two imaginary parallel planes 5 mm apart.

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

4.8 Means to secure the torso and thigh segment of the test dummy, so that the dummy will remain in the intended position, without deformation of the wheelchair or the dummy.

It is important that the means do not prevent rotation of the hip, knee and ankle pivot.

Straps made of Nylon webbing of sufficient strength may be used.

NOTE For some designs of wheelchairs, care is needed to avoid bending the tubes of the back support towards each other.

4.9 Means to secure the feet of the test dummy to the foot supports, so that they will remain in the intended position, without deformation of the wheelchair or dummy.

It is important that the means do not affect the strength of the foot support(s).

The feet of the test dummy may be clamped to the foot support(s) of the wheelchair, or holes may be drilled no greater than 8 mm in diameter and the feet bolted in position, providing the strength of the foot support(s) is not affected.

5 Set-up levels

Other documents that refer to the set-up procedures specified in this document may use or modify parts of the set up procedure contained within this standard according to their own purposes. Other test standards may reference a limited number of the requirements of this standard. This standard provides specific set-up information in 6.2.2 and 6.2.3. The different test standards may choose a set of setup requirements from this standard based on the three set-up levels specified in 6.2.2, 6.2.3 and in Annex C. Set-up-level 3 (from 6.2.2 and 6.2.3) shall be used if there is no reference to another set-up level (see Annex C) or subset of requirements within a specific test standard.

The Reference set-up tables contained in this standard each contain three different occupant mass groups, less than 50 kg, 50 kg to 125 kg and more than 125 kg. Use the maximum occupant mass specified by the manufacturer to determine the occupant mass group.

Reference set-up tables for set-up level 1 and set-up level 2 are presented in Annex C.

NOTE Guidance for wheelchair selection is presented in Annex D.

6 Preparation of the test wheelchair

6.1 Wheelchair equipment

Where a particular standard specifies equipment to be fitted to the wheelchair, use the equipment specified in that particular part. All other equipment shall be used in accordance with this subclause.

Unless specified otherwise in this document or by those commissioning the tests and unless noted in the test report the wheelchair shall be complete and ready for use. It shall comprise all following components or parts, where applicable: seat, back support, arm supports, lower leg support assemblies, posterior lower leg supports, posterior foot supports, frame, wheels, hand rims, motors and drive trains, braking system, battery sets, controllers, steering mechanisms, push handle(s), anti-tip devices, curb-climbing device.

NOTE 1 Some tests can require a part of a wheelchair to be dismantled.

Unless they are an integral part of the wheelchair, or necessary for the successful conduct of a test, the following components or parts, including the means to connect them to the wheelchair, shall be removed:

— cushions,

— postural support device components such as head supports, lateral trunk supports etc.,

— storage unit such as baskets, backpacks, transfusion containers, urine collection bags and oxygen bottles.

NOTE 2 A component or part that is supplied with the wheelchair and is removable but fixed with hook and loop fastener is not deemed an integral part.

Where a support surface would not normally be used without a cushion (e.g. a solid ply seat support base), an appropriate cushion, such as one provided by the wheelchair manufacturer, should be fitted to the wheelchair.

NOTE 3 For specific tests there are exclusions from this statement (see NOTE in 8.5).

6.2 Wheelchair adjustment

6.2.1 General

This standard shall take precedence in setting up a wheelchair in readiness for testing except:

— when a particular test standard has specific adjustment requirements, then the adjustment procedure specified in that particular standard shall be used. All other adjustments not specified in that standard shall be made in accordance with this subclause.

— when the manufacturer specifies particular requirements or limitations to the setup, then such variations shall be followed to the extent necessary, and such variations used shall be detailed in the test report.

Set-up can be done in any order that is most practicable for each part of ISO 7176.

If the seat is capable of swivelling to more than one position around the vertical axis (e.g. in a scooter), adjust the seat to the forward facing position, so that the longitudinal axis of the seat is parallel to the longitudinal axis of the wheelchair with an accuracy of ±2°. If this position or accuracy is not achievable set the axes as close as possible and document the variation in the test report.

If the seat can be attached in a forward or rearward facing position, attach the seat to the default position specified by the manufacturer, or, where there is no such specification attach it so that the wheelchair has a rear wheel drive.

In the case of an adjustable component with no defined greatest and or smallest position or dimension, the mid position shall be half way between the position fully contracted or inserted and the position fully extended or expanded.

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.

If head supports are an integral part of the body support system and are adjustable in height, the “head support height above seat” shall be set to (680 ± 5) mm for occupant mass group I and (780 ± 5) mm for occupant mass group II and III. If this is not possible set it as close as possible to the reference value.

If the characteristics of wheel suspensions can be adjusted, adjust them to the default setting specified by the manufacturer, or, where there is no such specification adjust it so that the wheelchair has the shortest and hardest spring suspension.

Adjust the brakes in accordance with Annex A.

Record all adjustments in accordance with Annex B.

6.2.2 Wheelchairs with handrims

NOTE 1 Wheelchairs with handrims include wheelchairs with manual handrim propulsion and handrim activated power assisted wheelchairs (HAPAW).

Set any adjustable dimensions of the wheelchair to the reference set-up values specified in Table 1, with an accuracy of ±3 mm for longitudinal dimensions or ±1° for angular dimensions, except where otherwise stated. If this is not possible set it as close as possible to the reference value.

If the reference set-up value is not available/possible (e.g. the two nearest positions are centred above and below the reference set-up value with equal distance), give preference to the next smaller value.

NOTE 2 An active wheelchair might not have castor sizes as indicated in Table 1.

Adjust the anti-tip devices (where applicable) to the following position:

— Set the rising to (25 ± 3) mm (see ISO 7176-5).

— When the wheelchair is standing on level ground the anti-tippers protrude to the rear as far as possible.

— If it is not possible to achieve both settings at one time, give priority to the setting of the rising.

— If this is not possible set it as close as possible to the reference value.

— If the manufacturer recommends more than one setting, use the recommended setting closest to these default settings.

If any of the adjustments results in an unwanted setting, e.g. the castor wheels contact any other part of the wheelchair, increase/decrease the adjustment just enough to ensure a proper function of the wheelchair and record the actual dimension together with the reason in accordance with Annex B.

Table 1 — Reference set-up values for wheelchairs with handrims (LEVEL 3)

Item	**Reference set-up values**		
	Occupant mass group I (<50 kg)	**Occupant mass group II** (50 kg to 125 kg)	**Occupant mass group III** (>125 kg)
Properties for seating and ergonomics (see NOTE 1)			
Seat plane angle	4°	4°	4°
Effective seat depth	340	450	450
Effective seat width	In accordance with formula in NOTE 2		
Seat surface height at front edge	470	520	520

NOTE 1 All dimensions in millimetres unless otherwise indicated.

NOTE 2 For the purpose of establishing the reference value for the effective seat width or back support width use the formula:

$$W = 42 \times \sqrt{M_0} + 35$$

where

W is the desired width (effective seat width or back support width);

M_0 is the maximum occupant mass (kg).

NOTE 3 When any of these adjustments are in conflict with any seating adjustments, correct the setting to the minimum extent.

NOTE 4 If the mid-position is not available/possible, set as close as possible to the mid-position. If this is not possible (e.g. there are only two positions), set to the position next smaller than the mid-position. If two positions are equally distant from the mid position, set to the smaller of the two.

NOTE 5 If a set value is in conflict with the test, adjust to closest setting not to interfere.

Table 1 *(continued)*

Item	Reference set-up values		
	Occupant mass group I (<50 kg)	**Occupant mass group II** (50 kg to 125 kg)	**Occupant mass group III** (>125 kg)
Back support angle	10°	10°	10°
Back support height	340	420	420
Handgrip height	820	950	950
Back support width	In accordance with formula in NOTE 2		
Foot support to seat	340	450	450
The foot support clearance shall not be less than.	50	40	40
Foot support length	150	150	150
Foot support to leg angle	90°	90°	90°
Leg to seat surface angle	90°	97°	97°
Arm support height	160	200	200
Front of arm support to back support	200	320	320
Handrim diameter	490	530	530
Manoeuvring wheels, diameter	560	610	610
Wheelbase	340	400	400
Camber	−3°	0°	0°
Manoeuvring wheels, horizontal position	20	20	20
Manoeuvring wheels, vertical position	166	184	184
Castor wheels, diameter	150	175	175
Properties of the chassis (see NOTE 3)			
Manoeuvring wheels, track	mid-position (see NOTE 4)		
Castor wheels, track	mid-position (see NOTE 4)		
Castor stem housings, horizontal position	mid-position (see NOTE 4)		
Castor stem housings, vertical position	mid-position (see NOTE 4)		
Castor wheel axle, vertical position in fork	mid-position (see NOTE 4)		
Castor rake	0° +1° / −0°		

NOTE 1 All dimensions in millimetres unless otherwise indicated.

NOTE 2 For the purpose of establishing the reference value for the effective seat width or back support width use the formula:

$$W = 42 \times \sqrt{M_0} + 35$$

where

W is the desired width (effective seat width or back support width);

M_0 is the maximum occupant mass (kg).

NOTE 3 When any of these adjustments are in conflict with any seating adjustments, correct the setting to the minimum extent.

NOTE 4 If the mid-position is not available/possible, set as close as possible to the mid-position. If this is not possible (e.g. there are only two positions), set to the position next smaller than the mid-position. If two positions are equally distant from the mid position, set to the smaller of the two.

NOTE 5 If a set value is in conflict with the test, adjust to closest setting not to interfere.

Table 1 *(continued)*

Item	Reference set-up values		
	Occupant mass group I (<50 kg)	**Occupant mass group II** (50 kg to 125 kg)	**Occupant mass group III** (>125 kg)
Castor cant	0° ± 0,5°		
Castor trail	50		

NOTE 1 All dimensions in millimetres unless otherwise indicated.

NOTE 2 For the purpose of establishing the reference value for the effective seat width or back support width use the formula:

$$W = 42 \times \sqrt{M_0} + 35$$

where

W is the desired width (effective seat width or back support width);

M_0 is the maximum occupant mass (kg).

NOTE 3 When any of these adjustments are in conflict with any seating adjustments, correct the setting to the minimum extent.

NOTE 4 If the mid-position is not available/possible, set as close as possible to the mid-position. If this is not possible (e.g. there are only two positions), set to the position next smaller than the mid-position. If two positions are equally distant from the mid position, set to the smaller of the two.

NOTE 5 If a set value is in conflict with the test, adjust to closest setting not to interfere.

6.2.3 Wheelchairs without handrims

NOTE Wheelchairs without handrims include electrically powered wheelchairs, manual wheelchairs with lever propulsion and push wheelchairs.

Set any adjustable dimensions of the wheelchair to the reference set-up values specified in Table 2, with an accuracy of ±3 mm for longitudinal dimensions or ±1° for angular dimensions respectively, except where otherwise stated. If this is not possible set it as close as possible to the reference value.

If the reference set-up value is not available/possible (e.g. the two nearest positions are centred above and below the reference set-up value with equal distance), give preference to the next smaller value.

Adjust the anti-tip devices (where applicable) as close as possible to the following position.

— Set the rising to (50 ± 3) mm (see ISO 7176-5).

— When the wheelchair is standing on level ground the anti-tippers protrude to the rear as far as possible.

— If it is not possible to achieve both settings at one time, give priority to the setting of the rising.

— If this is not possible set it as close as possible to the reference value.

— If the manufacturer recommends more than one setting, use the recommended setting closest to the default setting.

Adjust any kerb-climbing devices to their working position as recommended by the manufacturer.

If the wheelchair has a tiller, adjust the horizontal distance between the tiller and the back support as recommended by the manufacturer. If there is no recommendation, adjust to (460 ± 25) mm for wheelchairs intended for occupant mass group I and (640 ± 25) mm for wheelchairs intended for occupant mass group II or III. If this is not possible set it as close as possible to the reference value.

If more than one setting is recommended, use the recommended setting that is closest to these preferred settings.

If any of the adjustments results in an unwanted setting, e.g. the wheels contacting any other part of the wheelchair, increase/decrease the adjustment just enough to ensure a proper function of the wheelchair and record the actual dimension together with the reason in accordance with Annex B.

Table 2 — Reference set-up values for wheelchairs without handrims (LEVEL 3)

Item	Reference set-up values		
	Occupant mass group I (<50 kg)	**Occupant mass group II** (50 kg to 125 kg)	**Occupant mass group III** (>125 kg)
Properties for seating and ergonomics (see NOTE 1)			
Seat plane angle	4°	4°	4°
Effective seat depth	340	450	450
Effective seat width	In accordance with formula in NOTE 2		
Seat surface height at front edge	470	520	520
Back support angle	10°	10°	10°
Back support height	400	500	500
Handgrip height	820	950	950
Back support width	In accordance with formula in NOTE 2		
Foot support to seat	340	450	450
BUT NO LESS THAN: Foot support clearance	50	40	40
Foot support length	150	150	150
Foot support to leg angle	90°	90°	90°
Leg to seat surface angle	90°	97°	97°
Arm support height	160	200	200
Front of arm support to back support	200	320	320
Properties of the chassis (see NOTE 3)			
Fixed wheels, diameter	largest diameter		
Fixed wheels, horizontal position	mid-position (see NOTE 4)		
Fixed wheels, vertical position	mid-position (see NOTE 4)		
Fixed wheels, camber	0°		

NOTE 1 All dimensions in mm unless otherwise indicated.

NOTE 2 For the purpose of establishing the reference value for the effective seat width or back support width use the formula:

$$W = 42 \times \sqrt{M_0} + 55$$

where

W is the desired width (effective seat width or back support width);

M_0 is the maximum occupant mass (kg).

NOTE 3 When any of these adjustments are in conflict with any seating adjustments, correct the setting to the minimum extent.

NOTE 4 If the mid-position is not available/possible, set as close as possible to the mid-position. If this is not possible (e.g. there are only two positions), set to the position next smaller than the mid-position. If two positions are equally distant from the mid position, set to the smaller of the two.

Table 2 *(continued)*

Item	Reference set-up values		
	Occupant mass group I (<50 kg)	**Occupant mass group II** (50 kg to 125 kg)	**Occupant mass group III** (>125 kg)
Fixed wheels, track	mid-position (see NOTE 4)		
Movable wheels, diameter	largest diameter		
Movable wheels, horizontal position	mid-position (see NOTE 4)		
Movable wheels, vertical position	mid-position (see NOTE 4)		
Movable wheels, track	mid-position (see NOTE 4)		
Movable wheel axles, vertical position in fork	mid-position (see NOTE 4)		
Castor rake (where applicable)	0° +1° / −0°		
Castor cant (where applicable)	0° ± 0,5°		
Castor trail (where applicable)	50		

NOTE 1 All dimensions in mm unless otherwise indicated.

NOTE 2 For the purpose of establishing the reference value for the effective seat width or back support width use the formula:

$$W = 42 \times \sqrt{M_0} + 55$$

where

W is the desired width (effective seat width or back support width);

M_0 is the maximum occupant mass (kg).

NOTE 3 When any of these adjustments are in conflict with any seating adjustments, correct the setting to the minimum extent.

NOTE 4 If the mid-position is not available/possible, set as close as possible to the mid-position. If this is not possible (e.g. there are only two positions), set to the position next smaller than the mid-position. If two positions are equally distant from the mid position, set to the smaller of the two.

6.2.4 Electrical equipment

6.2.4.1 Batteries

Where a manufacturer specifies more than one battery set, the heaviest battery set recommended should be fitted.

Charge the batteries to at least 75 % of their rated nominal capacity.

NOTE Some tests can require a different amount of charge.

If, for a given test, it is recommended to replace the battery by a substitute mass in order to prevent spilling of battery acid, a substitute mass shall be used with the same dimensions, mass and location of centre of mass.

WARNING — If the wheelchair is equipped with free-electrolyte-type batteries, some tests can be hazardous due to the risk of spillage. In such cases, the batteries may be replaced with the closest non-spillable batteries, using supplementary weights to provide equivalent mass distribution where necessary.

6.2.4.2 Position of the control device

For electrically powered wheelchairs with a control device that can be placed in different positions in the lateral direction, set it to the mid-position. Where there is no provision for this position, use the position that gives the mid-setting nearest to the axis centreline of the arm support.

If the control device can be placed in different positions in the fore-aft direction, set it to 450 mm for occupant mass group I and 540 mm for occupant mass group II and III in front of the back support with an accuracy of ±3 mm. If this is not possible set it as close as possible to the reference value.

If the control device can be placed at different heights, set its lever top to 40 mm above the armrest with an accuracy of ±3 mm. If this is not possible set it as close as possible to the reference value.

6.2.4.3 Operator adjustable electrical settings

Set all operator-accessible adjustments that affect the response of the wheelchair, such as the maximum speed control, sensitivity and other user-adjustable settings for maximum response. Record the settings in accordance with Annex B.

EXAMPLE Maximum forward speed, maximum reverse speed, maximum sensitivity, maximum acceleration, maximum deceleration, maximum braking and minimum time delay.

6.2.4.4 Adjustable electrical control devices

Set any other adjustable electrical control devices, adjustments of which do not require the use of tools, to the manufacturer's recommended setting. If there is no recommended setting for any such controls, set them to the mid-setting.

NOTE 1 There can be different settings for the same wheelchairs depending on the drive mode.

NOTE 2 There can also be specific settings for individual tests in different parts of ISO 7176.

6.2.5 Other adjustable components

Set mechanically adjustable components of the wheelchair, which are not covered by Tables 1 and 2 respectively as close as possible to the mid-position of their range with an accuracy of ±3 mm. If this is not possible (e.g. there is no adjustment point at the mid-position or there are only two positions), set to the position next smaller than the mid-position

7 Final adjustments

After completing the requirements in Clause 6, make the following final adjustments with priority given to those last in the list, but not in conflict with the manufacturer's instructions.

If the dimensions of Tables 1 and 2 are not available or possible, adjust the dimension as close as possible to the reference set-up value. If this is not possible, set to the position next smaller than the mid-position.

Make every effort to minimize castor shimmy during test performances. There may be several ways of doing this including adjusting castor rake and castor cant.

If the parking brakes are adjustable, adjust the parking brakes as specified by the manufacturer. If there are no manufacturer's specifications, adjust the brakes in accordance with the measurements taken in Annex A.

Ensure that all fasteners disturbed during adjustment are tightened in accordance with the manufacturer's recommendations. If there are no manufacturer's recommendations, tighten in accordance with Annex A.

8 Loading of the wheelchair

8.1 General

Where the referring document specifies a load for the wheelchair other than those specified in this document, select, fit and restrain the load as specified in the referring document.

If the referring document requires the use of a test dummy as specified in ISO 7176-11, follow the procedure specified in 8.2. If the referring document requires the test dummy to be restrained, follow the procedure specified in 8.3.

If the referring document specifies a human test occupant, follow the procedure specified in 8.4.

8.2 Test dummy

WARNING — Take care when handling the test dummy, as it can be very heavy.

Where a referring document specifies a method for selecting and positioning the test dummy, select and position the test dummy as specified in that document. Otherwise use the following method.

Use the following procedure for selecting and positioning the dummy.

a) Measure the actual seat plane angle and the actual back support angle that result from the final adjustments in Clause 7. Calculate the angle between the seat plane and the back support as follows:

$$A = 90 + B - S$$

where

A is the angle between seat plane and back support plane;

B is the back support angle;

S is the seat plane angle.

Then record the result, in degrees (°).

b) Select a test dummy including loading plates of mass equal to the maximum occupant mass that is specified by the manufacturer. Consider the mass of any other accessories that is included in the rated load of the wheelchair.

Select a thigh loading plate according to ISO 7176-11 that will fill as much of the seat support surface of the wheelchair as possible with a minimum clearance of 12 mm between the edge of the thigh loading plate and anything adjacent to the thigh loading plate. If the wheelchair has sling type seat, the thigh loading plate must not rest on the seat rails of the wheelchair. To prevent unnatural loading of the upholstery, the thigh loading plate must sit inside of the seat rails of the wheelchair. If the loading plate specified in ISO 7176-11 is too big select the next smallest specified in ISO 7176-11.

Select a torso loading plate that will fill as much of the back support of the wheelchair as possible with a minimum clearance of 12 mm between the edge of the torso loading plate and anything adjacent to the torso loading plate. If the wheelchair has sling type backrest, the torso loading plate must not rest on the back support frame members of the wheelchair. To prevent unnatural loading of the upholstery, the torso loading plate must sit inside of the back support frame members of the wheelchair. If the loading plate specified in ISO 7176-11 is too big select the next smallest specified in ISO 7176-11.

Attach the loading plates to the test dummy in accordance with ISO 7176-11 and record the mass of the dummy and the sizes of the loading plates used.

c) If there is a tiller, take 5 % of the mass from the test dummy torso and add it evenly over the two handles of the tiller. Adjust the tiller to keep it straight during the test.

d) Place the selected test dummy in the wheelchair.

e) Position the dummy symmetrically with a tolerance of ±10 mm about the wheelchair reference plane.

f) Ensure that the hip pivots between the torso segment and thighs segment of the dummy rotate freely.

g) Adjust the fore-aft position of the dummy to give an angle between the seat plane and the back support plane within ±3° of angle A (as determined in a).

NOTE If the dummy has to be removed from the wheelchair during the test procedure and then be replaced, a reference mark on the wheelchair frame, perpendicular to the dummy hip pivot point, can be used to aid rapid replacement.

h) Perform the positioning of the feet of the test dummy as follows.

— If the wheelchair has two separate foot supports, position the dummy's foot loading pads in a direction parallel and centrally on each foot support, viewed from the side of the wheelchair.

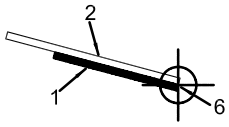
— If the wheelchair has a one piece foot support, position the dummy's foot loading pads in a direction parallel to and at a distance of (100 ± 20) mm to both sides of the centre line of the foot support seen from the sideways direction of the wheelchair.

— Position the dummy's foot loading pads on the foot supports in the fore/aft direction as specified in Figure 1. If this position of the feet of the test dummy is not possible or if there is an indication that it would give an unrealistic seating position for a human test occupant, correct to a possible and realistic position and record the position and reason why it was necessary

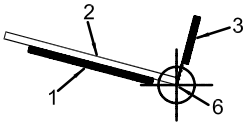
— In case of tubular foot supports align the dummy's foot loading pads at (15 ± 1)° to the horizontal (front upwards)

— When the test dummy is installed in the wheelchair, the distance from the knee pivot to the ankle pivot shall be locked after the lower legs segment is placed with its weight supported solely by the foot supports.

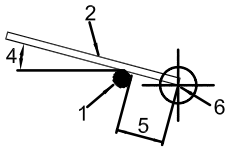
i) If the foot support clearance becomes less than 50 mm for occupant mass group I and less than 40 mm for occupant mass group II or III when the foot supports are loaded, adjust the foot support to seat distance so that the applicable minimum is achieved.



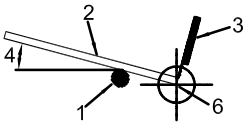
a) Flat foot support without posterior heel support



b) Flat foot support with posterior heel support



c) Tubular foot support without posterior heel support



d) Tubular foot support with posterior heel support

Key

1 foot support
2 dummy's foot loading pad
3 posterior lower leg support or posterior foot support
4 (15 ± 1)°
5 (63 ± 5) mm for occupant mass group I and (100 ± 5) mm for occupant mass group II and III
6 alignment point

Figure 1 — Position of the dummy's feet on various foot supports

8.3 Test dummy securement

Where the referring document specifies a method for restraining the test dummy, restrain the test dummy, as specified in that document. Otherwise, secure the segments of the test dummy, using the means specified in 4.8 and 4.9, so that the segments retain the position specified in 8.2.

8.4 Human test occupant

Where a referring document specifies a method for selecting and positioning the human test occupant, select and position the human test occupant as specified in that document. Otherwise use a human test occupant with supplementary weights, weighted garments and spacers as applicable, to give a mass and mass distribution equivalent to the applicable dummy when assessed in accordance with ISO 7176-11.

It is preferable that the proportion of the supplementary weights does not exceed 10 % of the applicable test dummy mass.

WARNING — It is essential that appropriate precautions be taken to ensure the test personnel's safety.

8.5 Accessories that contribute to the rated load

For some specific tests the following items can be used at the discretion of the commissioner of the test.

EXAMPLE Specific tests (tests under worst case conditions) can be in ISO 7176-1, ISO 7176-2, ISO 7176-3, ISO 7176-6, ISO 7176-8 and ISO 7176-10 (static and dynamic stability, brakes, speed, strength and obstacle climbing).

NOTE This subclause gives an exclusion from a general statement (see NOTE 2 in 6.1).

When the wheelchair is delivered with a storage unit (e.g. basket), or the manufacturer specifies that it is intended/permitted to carry storage units on the wheelchair, fix the storage unit to the wheelchair and load it with a mass as specified by the manufacturer or if there is no such specification, load it with a mass of 7 kg.

When the manufacturer specifies that it is intended or permitted to carry a backpack on the wheelchair, make provision to load the wheelchair with a substitute backpack in accordance with the manufacturers specification. If there is no such specification, hang a mass of 7 kg from the backpack carrier or, when there is no carrier specified, hang a mass of 7 kg from the back support at the most convenient location (e.g. handgrips or top of back support), so that its centre of mass is (300 ± 20) mm below the point of attachment.

When the manufacturer specifies that it is intended/permitted to carry transfusion containers or urine collection bags etc. on the wheelchair, fix the item on the wheelchair as specified by the manufacturer and load it with a mass as specified by the manufacturer or if there is no such specification, with a mass of (2 ± 0,1) kg.

When the manufacturer specifies that it is intended/permitted to carry an oxygen bottle on the wheelchair, fix the bottle to the wheelchair as specified by the manufacturer and load it with a mass as specified by the manufacturer or if there is no such specification, load it with a mass of (7 ± 0,1) kg.

All options shall lie within the limits recommended by the manufacturer.

When the manufacturer specifies any accessories the total allowable mass stated by the manufacturer shall still be within stated limits of the maximum occupant mass that is specified by the manufacturer.

9 Records

Record all equipment fitted, added or removed in accordance with Annex B.

Record adjustments and loading settings of the test wheelchair (Clauses 6 to 9).

Record any deviation from the specifications in Clauses 6 to 9 and reasons for deviation in accordance with Annex B.

Record any options selected, and justifications for selecting them.

NOTE A template for the records is given in Annex B.

Annex A
(normative)

Wheelchair brakes and fasteners

Adjust the brakes so that:

— where the manufacturer's instructions for use specify the method for adjustment of the brakes, adjust the brakes in accordance with those instructions;

— if there are no specifications adjust the brakes so that the operating forces lie within the ranges specified in Table A.1;

— where brakes cannot be adjusted to give operating forces as specified in Table A.1; adjust the brakes so that the operating forces are as close as possible to those in Table A.1.

For scooters, Table A.1 applies only to adjustment of means to operate parking brakes.

Table A.1 — Operating forces

Means of operation	Operating force N
hand/arm operation[a]	60 ± 5
foot, push	100 ± 10
foot, pull	60 ± 5
finger	5 ± 1
hand[b]	13,5 ± 2

[a] An operation where the strength of the combined hand and arm can be used.

[b] An operation where only the strength of a single hand can be used, that can include two or more fingers.

The operating forces are derived from ISO 9355-3 where maximum recommended force for a normal adult is given, considering the direction of force applied.

Adjustable components are normally located and retained by knobs, hand wheels, levers and bolts.

If the manufacturer has not specified torque figures, Table A.2 gives guidance for torque settings for particular types.

Table A.2 — Maximum torque settings

Fastener	**Dimension** mm	**Maximum torque** Nm
Turning knobs or hand wheels operated by one hand	$D \leq 25$ $D > 25$	$T = D \times 0{,}025$ (where D is the knob overall diameter in mm) $T = D \times 0{,}05$ (where D is the knob overall diameter in mm)
Levers operated by one hand		$T = L \times 0{,}1$
Hexagon bolts and nuts	7 (M4) 8 (M5) 10 (M6) 13 (M8) 17 (M10) 19 (M12)	3 5,9 10 25 49 85
NOTE These values for tightening hexagon bolts and nuts are based on a coefficient of friction of $\mu = 0{,}14$.		

Annex B
(informative)

Record of the actual equipment, adjustments and loading settings

Tables B.1 to B.6 show records of actual equipment, adjustments and loading settings.

Wheelchair identification (type, model, serial number etc.):

Manufacturer:

Address:

Type class (A, B or C):

Rated load and/or maximum occupant mass:

Drive wheel position (rear, front or mid):

Table B.1 — Actual equipment

Equipment	Type of equipment (Size, article number etc.)	Value/Position/Measure
Body support system		
Seat		
Back support		
Head support		
Cushion		
Wheel suspensions		
Tyres		
Braking system		
Motor		
Batteries		
Storage unit (f.i. basket)		
Backpack carrier or permission		
Oxygen bottle carrier		
Transfusion container carrier		
Urine collection bag carrier		
NOTE Cite NA for items that are not adjustable or applicable.		

Table B.2 — Actual dimensions for seating and ergonomics

Adjustable part	Type of equipment (Size, article number etc.)	Value/Position/Measure
Seat plane angle		
Effective seat depth		
NOTE Cite NA for items that are not adjustable or applicable.		

Table B.2 *(continued)*

Adjustable part		Type of equipment (Size, article number etc.)	Value/Position/Measure
Effective seat width			
Seat surface height at front edge			
Back support angle			
Back support height			
Handgrip height			
Back support width			
EITHER Footrest to seat			
OR Foot support clearance			
Foot support length			
Foot support to leg angle			
Leg to seat surface angle			
Arm support height			
Front of arm support to back support			
Wheelchairs with handrims	Handrim diameter		
	Manoeuvring wheels, diameter		
	Wheelbase		
	Camber		
	Manoeuvring wheels, horizontal position		
	Manoeuvring wheels, vertical position		
	Castor wheels, diameter		
NOTE Cite NA for items that are not adjustable or applicable.			

Table B.3 — Actual adjustments of the chassis

Adjustable part		Type of equipment (Size, article number etc.)	Value/Position/Measure
Wheelchair with handrims	Manoeuvring wheels, track		
	Manoeuvring wheels, air pressure		
	Castor wheels, track		
	Castor stem housings, horizontal position		
	Castor stem housings, vertical position		
	Castor wheel axle, vertical position in fork		
	Castor wheels, air pressure		
NOTE Cite NA for items that are not adjustable or applicable.			

Table B.3 *(continued)*

Adjustable part		Type of equipment (Size, article number etc.)	Value/Position/Measure
Wheelchair without handrims	Fixed wheels, diameter		
	Fixed wheels, horizontal position		
	Fixed wheels, vertical position		
	Fixed wheels, camber		
	Fixed wheels, track		
	Fixed wheels, air pressure		
	Movable wheels, diameter		
	Movable wheels, horizontal position		
	Movable wheels, vertical position		
	Movable wheels, track		
	Movable wheel axles, vertical position in fork		
	Movable wheel axles, air pressure		
Castor rake			
Castor cant			
Castor trail			
Anti-tip device			
Kerb climber			
Tiller distance to back support			
Other adjustable components			
Distance between the brake blocks and their contact surfaces			
NOTE Cite NA for items that are not adjustable or applicable.			

Table B.4 — Actual electrical settings

Adjustable part	Type of equipment (Size, article number etc.)	Value/Position/Measure
Batteries		
Position of the joystick		
Electrical settings		
Other electrical control devices		
Other adjustable components		
NOTE Cite NA for items that are not adjustable or applicable.		

Table B.5 — Final adjustment

Adjustable part	Type of equipment (Size, article number etc.)	Value/Position/Measure
Castor rake, left castor wheel (see NOTE 1)		
Castor rake, right castor wheel (see NOTE 1)		
Difference between left and right (see NOTE 1)		
Castor cant, left castor wheel (see NOTE 2)		
Castor cant, right castor wheel (see NOTE 2)		
Asymmetry between left and right (see NOTE 2)		
Distance between the brake blocks and their contact surfaces		
NOTE 1 The measurement method is in ISO 7176-5, A.18. See also NOTE 1 in Clause 7. NOTE 2 The measurement method is in ISO 7176-5, A.19. See also NOTE 2 in Clause 7. NOTE 3 Cite NA for items that are not adjustable or applicable.		

Table B.6 — Loading of the wheelchair

Adjustable part	Type of equipment (Size, article number etc.)	Value/Position/Measure
Rated load OR		
Maximum occupant mass		
Dummy size		
Torso loading plate		
Thighs loading plate		
Calculated seat-to-back angle (see 8.2, a)		
Dummy's actual seat-to-back angle		
Test dummy securement		
Human test occupant, mass + supplemental mass		
Accessory mass (see 8.5)		
NOTE Cite NA for items that are not adjustable or applicable.		

Annex C
(normative)

Reference set-up values

Tables C.1 to C.4 give reference set-up values.

Table C.1 — Reference set-up values for wheelchairs with handrims (LEVEL 1)

Item	Reference set-up values		
	Occupant mass group I (<50 kg)	**Occupant mass group II** (50 kg to 125 kg)	**Occupant mass group III** (>125 kg)
Properties of the chassis (see NOTE 1)			
Manoeuvring wheels, diameter	560	610	610
Manoeuvring wheel, horizontal position	20	20	20
Castor wheels, diameter	150	175	175
Castor assembly, horizontal position	mid-position (see NOTE 2)		
Castor rake	0° +1° / −0°		
Castor cant	0° ± 0,5°		

NOTE 1 All dimensions in mm unless otherwise indicated.

NOTE 2 If the mid-position is not available/possible, set as close as possible to the mid-position. If this is not possible (e.g. there are only two positions), set to the position next smaller than the mid-position. If two positions are equally distant from the mid position, set to the smaller of the two.

NOTE 3 When any of these adjustments are in conflict with any seating adjustments, correct the setting to the minimum extent.

Table C.2 — Reference set-up values for wheelchairs with handrims (LEVEL 2)

Item	Reference set-up values		
	Occupant mass group I (<50 kg)	Occupant mass group II (50 to 125 kg)	Occupant mass group III (>125 kg)
Properties for seating and ergonomics (see NOTE 1)			
Seat plane angle	4°	4°	4°
Effective seat depth	340	450	450
Effective seat width	In accordance with formula in NOTE 2		
Seat surface height at front edge	470	520	520
Back support angle	10°	10°	10°
Back support height	340	420	420
Foot support to seat	340	450	450
BUT NO LESS THAN: Foot support clearance	50	40	40
Leg to seat surface angle	90°	97°	97°
Manoeuvring wheels, diameter	560	610	610
Wheelbase	340	400	400
Camber	−3°	0°	0°
Manoeuvring wheels, horizontal position	20	20	20
Manoeuvring wheels, vertical position	166	184	184
Castor wheels, diameter	150	175	175
Properties of the chassis (see NOTE 3)			
Manoeuvring wheels, track	mid-position (see NOTE 4)		
Castor wheels, track	mid-position (see NOTE 4)		
Castor stem housings, horizontal position	mid-position (see NOTE 4)		
Castor stem housings, vertical position	mid-position (see NOTE 4)		
Castor wheel axles, vertical position in fork	mid-position (see NOTE 4)		
Castor rake	0° +1° / −0°		
Castor cant	0° ± 0,5°		

NOTE 1 All dimensions in mm unless otherwise indicated.

NOTE 2 For the purpose of establishing the reference value for the effective seat width use the formula:

$$W = 42 \times \sqrt{M_0} + 35$$

where

W is the desired width (effective seat width or back support width);

M_0 is the maximum occupant mass (kg).

NOTE 3 When any of these adjustments are in conflict with any seating adjustments, correct the setting to the minimum extent.

NOTE 4 If the mid-position is not available/possible, set as close as possible to the mid-position. If this is not possible (e.g. there are only two positions), set to the position next smaller than the mid-position. If two positions are equally distant from the mid position, set to the smaller of the two.

Table C.3 — Reference set-up values for wheelchairs without handrims (LEVEL 1)

Item	Reference set-up values		
	Occupant mass group I (<50 kg)	**Occupant mass group II** (50 kg to 125 kg)	**Occupant mass group III** (>125 kg)
Properties of the chassis (see NOTE 1)			
Fixed wheels, diameter	largest diameter		
Fixed wheels, horizontal position	mid-position (see NOTE 2)		
Movable wheels, diameter	largest diameter		
Movable wheels, horizontal position	mid-position (see NOTE 2)		
Castor rake (where applicable)	0° +1° / −0°		
Castor cant (where applicable)	0° ± 0,5°		

NOTE 1 All dimensions in mm unless otherwise indicated.

NOTE 2 If the mid-position is not available/possible, set as close as possible to the mid-position. If this is not possible (e.g. there are only two positions), set to the position next smaller than the mid-position. If two positions are equally distant from the mid position, set to the smaller of the two.

NOTE 3 When any of these adjustments are in conflict with any seating adjustments, correct the setting to the minimum extent.

Table C.4 — Reference set-up values for wheelchairs without handrims (LEVEL 2)

Item	Reference set-up values		
	Occupant mass group I (<50 kg)	**Occupant mass group II** (50 kg to 125 kg)	**Occupant mass group III** (>125 kg)
Properties for seating and ergonomics (see NOTE 1)			
Seat plane angle	4°	4°	4°
Effective seat depth	340	450	450
Effective seat width	In accordance with formula in NOTE 2		
Seat surface height at front edge	470	520	520
Back support angle	10°	10°	10°

NOTE 1 All dimensions in mm unless otherwise indicated.

NOTE 2 For the purpose of establishing the reference value for the effective seat width use the formula:

$$W = 42 \times \sqrt{M_0} + 55$$

where

W is the desired width (effective seat width or back support width);

M_0 is the maximum occupant mass (kg).

NOTE 3 When any of these adjustments are in conflict with any seating adjustments, correct the setting to the minimum extent.

NOTE 4 If the mid-position is not available/possible, set as close as possible to the mid-position. If this is not possible (e.g. there are only two positions), set to the position next smaller than the mid-position. If two positions are equally distant from the mid position, set to the smaller of the two.

Table C.4 *(continued)*

Item	Reference set-up values		
	Occupant mass group I (<50 kg)	**Occupant mass group II** (50 kg to 125 kg)	**Occupant mass group III** (>125 kg)
Back support height	400	500	500
Foot support to seat	340	450	450
BUT NO LESS THAN: Foot support clearance	50	40	40
Leg to seat surface angle	90°	97°	97°
Properties of the chassis (see NOTE 3)			
Fixed wheels, diameter	largest diameter		
Fixed wheels, horizontal position	mid-position (see NOTE 4)		
Fixed wheels, vertical position	mid-position (see NOTE 4)		
Fixed wheels, camber	0°		
Fixed wheels, track	mid-position (see NOTE 4)		
Movable wheels, diameter	largest diameter		
Movable wheels, horizontal position	mid-position (see NOTE 4)		
Movable wheels, vertical position	mid-position (see NOTE 4)		
Movable wheels, track	mid-position (see NOTE 4)		
Movable wheel axles, vertical position in fork	mid-position (see NOTE 4)		
Castor rake (where applicable)	0° +1° / −0°		
Castor cant (where applicable)	0° ± 0,5°		

NOTE 1 All dimensions in mm unless otherwise indicated.

NOTE 2 For the purpose of establishing the reference value for the effective seat width use the formula:

$$W = 42 \times \sqrt{M_0} + 55$$

where

W is the desired width (effective seat width or back support width);

M_0 is the maximum occupant mass (kg).

NOTE 3 When any of these adjustments are in conflict with any seating adjustments, correct the setting to the minimum extent.

NOTE 4 If the mid-position is not available/possible, set as close as possible to the mid-position. If this is not possible (e.g. there are only two positions), set to the position next smaller than the mid-position. If two positions are equally distant from the mid position, set to the smaller of the two.

Annex D
(informative)

Wheelchair selection

D.1 Selection for testing

D.1.1 General

It is common practice for wheelchair manufacturers to produce groups of wheelchairs with a common designation, such as a model name. The wheelchairs in the group will share a product identity, but can have different characteristics. For example, the manufacturer may offer a selection of seat widths for a particular model. It is also common for a single specification sheet to cover an entire model range.

Manufacturers make claims about the performance of their wheelchairs, in response to demands for regulatory compliance, customer information, contractual requirements and competitive pressure. Again, it is common for these claims to be made for an entire wheelchair model range. Wheelchair testing is an essential tool in validating such claims.

The combinations of options available for a model range can number in the thousands or more. It will be impractical for the manufacturer or test house to test all of them. Since testing is necessary, it therefore becomes important to decide which wheelchairs should be tested.

It is appropriate to select a wheelchair, from the combinations of options that are available for that model, that is least favourable for a particular test or set of tests. This will give a high level of confidence that

— where a pass criterion is applied to a test result, all members of the model range would pass if the wheelchair under test passes;

— where the test provides a performance measure, all members of the model range would provide performance at least equal to that of the wheelchair under test.

Since the manufacturer is responsible for performance claims, it is reasonable to expect the manufacturer to decide which wheelchairs will be least favourable for particular tests and to produce specimens for testing in accordance with these decisions. However, problems can arise when there is disagreement between interested parties over the selection process, or where the specimens selected are not the least favourable.

It is not considered feasible to resolve such problems by specifying selection procedures. There is significant diversity in wheelchair design. It is likely that, in attempting to address this diversity, selection procedures would be complicated and error-prone. There is also a risk that they would be inappropriate for unusual or novel designs. Inappropriate selection methods would lead to invalid claims being made for a wheelchair model.

The preferred alternative is to provide guidance on the principles relating to selection, and to require appropriate disclosure of information by the manufacturer. In particular, the manufacturer is required to

— provide a documented justification for the selection of a particular wheelchair for testing;

— provide a record of the options selected.

D.1.2 Options and accessories

It is important to distinguish between options and accessories.

Options are features of a wheelchair which can be chosen by the purchaser, but which relate to parts of the wheelchair which are essential to it being ready for use.

EXAMPLE Seat width.

Accessories are discretionary items which can be added to the wheelchair, but where the wheelchair can be ready for use (by some operators) without them.

EXAMPLE Cup holder.

Options are items which are determined by the selection process. Once the wheelchair has been selected, the options are not changed. Accessories can be selected in addition, in accordance with the general set-up procedure in this document or additional preparation instructions in a wheelchair testing standard.

D.1.3 Representative specimens

It is important that any wheelchair selected for testing is representative of a product which is currently on the market, or intended to be put on the market. No combination of options should be selected which is not representative of a real product.

EXAMPLE A combination of seat dimensions that would not be suitable for any occupant.

D.1.4 Custom-made wheelchairs

Where a custom-made wheelchair is to be tested, there is no need for a selection procedure. The custom-made wheelchair, or an identical specimen, is tested.

D.1.5 Wheelchairs involved in incidents

If a wheelchair has been involved in an accident or other incident, it might be necessary to investigate the performance of the wheelchair. In such cases it is appropriate to select a wheelchair for testing with options identical, or as close as practicable, to those of the wheelchair involved.

D.1.6 Sampling

Selection should not be confused with sampling. Sampling is the process whereby a specimen is obtained once its options have been selected. Ideally, test specimens would be obtained from series production. However, wheelchair tests often have to be conducted prior to release of a new model, and it is expected that test specimens will sometimes have pre-production status.

Generally, wheelchair tests are applied to a single test specimen unless otherwise specified.

D.1.7 Product changes and quality control

Regulatory agencies, certification bodies and manufacturing quality systems can require manufacturers to conduct regular tests to determine whether wheelchairs continue to meet specified levels of performance. Similarly, where design changes are made to wheelchairs the manufacturer has to decide which, if any, product qualification tests should be repeated. No additional recommendations are made concerning selection of wheelchairs for such tests.

D.1.8 Selection and wheelchair standards

Wheelchair testing standards often contain a number of test methods. The least favourable selection of wheelchair options for one test might not be the least favourable for another. In order that the test results represent the least favourable outcome, it can be necessary to select a set of test specimens, where each specimen is least favourable for one or more of the tests. Depending on the requirements of a testing standard, the manufacturer could have the option to apply each test to one of the specimens. However, where a standard requires all tests to be applied to a single test specimen, there might be no option but to conduct all of the tests on the entire set of specimens.

D.2 Selection for comparison

One of the objectives of wheelchair standards is to facilitate comparison between different models of wheelchair. A selection process can influence the information produced by wheelchair testing, and it is natural to ask whether this will affect comparability.

Some factors that can be considered when comparing wheelchairs, such as price and visual appearance, are not covered by standards. The information that standard tests provide can be used to compare wheelchairs in relation to the following areas:

— whether a wheelchair will meet the client's needs;

— whether a wheelchair meets industry requirements;

— whether a wheelchair performs better than another.

A typical example of information used to determine whether a wheelchair is suitable for a particular client is a dimension, where the largest and smallest values for a particular measurement are disclosed. The dimension can be used in an assessment of whether one wheelchair would be a better fit for the client than another. Providing the selection process allows the full range of this dimension for a wheelchair model to be properly determined, then the selection process will have no effect on comparability.

Wheelchair standards with pass criteria are used to evaluate a wheelchair's safety and suitability. These standards usually require a fixed level of performance, instead of testing to the performance limit. The selection process should ensure that the results will apply to an entire wheelchair model range, and therefore not affect comparability. However, in the case that all wheelchairs are expected to meet a standard before they can be put onto the market, a pass result does not help choose between them.

Some wheelchair standards provide performance information rather than pass/fail results. If the selection process leads to the least favourable wheelchair in a model range being tested, the result of a test should be the worst case for the entire range. Another model in the range could perform better, but unless it is tested it will not be known how much better. For that reason, a comparison of two different models of wheelchair on the basis of the worst-case performance for their respective model ranges might not be valid.

Some standards allow for verification of a manufacturer's claim that a wheelchair can meet a higher level of performance than the basic requirement, producing both a pass/fail result and a performance result. As with the previous examples, caution is needed in drawing conclusions from this information. For example, a wheelchair which meets the basic requirement could perform better than another wheelchair for which higher performance is claimed, if both were tested to their performance limits.

It will be evident from these examples that the selection process will ideally have no effect on comparability. Nonetheless, careful judgement is necessary when comparing wheelchairs based on the worst case performance for their model ranges.

D.3 Selection characteristics

Table D.1 provides guidance on some characteristics that should be considered when selecting wheelchairs for particular tests. It is not claimed that this information is complete nor that it is applicable to any particular wheelchair.

Table D.1 — Relevant characteristics for particular tests

Type of test	Select for	Relevant characteristics
static stability	minimum	high seat, short wheelbase, small width, large occupant mass
dynamic stability	minimum	high seat, short wheelbase, small width, large occupant mass, high speed, fast response
brake effectiveness	minimum	-
range	minimum	small batteries, low efficiency motors and gearboxes, large wheelchair mass, large occupant mass
dimensions	maximum	large size
mass	maximum	large mass
manoeuvring space	maximum	long wheelbase, large width, small steering angle
speed	maximum	
acceleration	maximum	
deceleration	maximum	
strength	minimum	
climatic	minimum	
obstacle climbing	minimum	small wheels, high seat, short wheelbase, large wheelchair mass, large occupant mass, low motor power, high gear ratio, low motor current
power and control systems	minimum	
resistance to ignition	minimum	support surface materials
electromagnetic compatibility	minimum	dimensions that influence the length(s) of wiring used in the wheelchair, any options that use, distribute or control electric power

Bibliography

[1] ISO/TR 13570-1, *Wheelchairs — Part 1: Guidelines for the application of the ISO 7176 series on wheelchairs*

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