

Australian/New Zealand Standard™

Wheelchairs

Part 8: Requirements and test methods for static, impact and fatigue strengths



AS/NZS ISO 7176.8:2015

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee ME-067, Assistive Technology Products for Persons with Disability. It was approved on behalf of the Council of Standards Australia on 4 September 2015 and on behalf of the Council of Standards New Zealand on 10 September 2015. This Standard was published on 28 September 2015.

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Australian/New Zealand Standard™

Wheelchairs

Part 8: Requirements and test methods for static, impact and fatigue strengths

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME-067, Assistive Technology Products for Persons with Disability, to supersede AS/NZS 3696.8:1998.

The objective of this Standard is to specify requirements and test methods for static, impact, and fatigue strength of wheelchairs including scooters. It also specifies requirements for disclosure of the test results. This Standard applies to wheelchairs, including scooters, intended to carry one person, with a maximum speed not exceeding 15 km/h.

This Standard is identical with, and has been reproduced from, ISO 7176-8:2014, *Wheelchairs, Part 8: Requirements and test methods for static, impact and fatigue strengths*.

As this Standard is reproduced from an International Standard, the following applies:

- (a) In the source text ‘this part of ISO 7176’ should read ‘this Australian/New Zealand standard’.
- (b) A full point substitutes for a comma when referring to a decimal marker.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>	<i>Australian/New Zealand Standard</i>
ISO	AS/NZS
7176 Wheelchairs	3696 Wheelchairs
7176-6 Part 6: Determination of maximum speed, acceleration and deceleration of electric wheelchairs	3696.6 Part 6: Determination of maximum speed, acceleration and retardation of electric wheelchairs
7176-11 Part 11: Test dummies	3696.11 Part 11: Test dummies
	AS/NZS ISO
7176 Wheelchairs	7176 Wheelchairs
7176-26 Part 26: Vocabulary	7176.26 Part 26: Vocabulary

Only normative references that have been adopted as Australian or Australian/New Zealand Standards have been listed.

The term ‘informative’ has been used in this Standard to define the application of the annexes to which it applies. An ‘informative’ annex is only for information and guidance.

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INTRODUCTION

This part of ISO 7176 has been an important part of the strength testing of wheelchairs since its publication in 1998. It contains test methods and sets minimum requirements for static, impact, and fatigue strength of both the overall wheelchair and individually stressed components.

Several parts of this International Standard have been reviewed. In particular:

- the fatigue testing elements, including the speed and size of slot of the two-drum test machine, and the number of test cycles for both two drum and drop tests have been reviewed through empirical testing and confirmed;
- the failure criteria have been clarified, and permissible adjustments and repairs more clearly defined to minimize variation between laboratories;
- a more precisely defined setup procedure for the reference configuration of adjustable wheelchairs as given in ISO 7176-22;
- static, impact, and repeated load test procedures for Postural Support Devices (PSDs) have been revised and are contained in ISO 16840-3.

It is anticipated that all parts of this International Standard will continue to be developed and future revisions may include the results of ongoing work in the following areas:

- consideration of whether the fatigue test requirements should be revised for wheelchairs intended for use in less resourced settings;
- review of the test methods and apparatus to facilitate testing in less resourced settings;
- further development of the test dummies to improve the way in which they load the backs of test wheelchairs and, in particular, to improve their suitability for use with wheelchairs with low back supports.

NOTES

AUSTRALIAN/NEW ZEALAND STANDARD

Wheelchairs**Part 8:
Requirements and test methods for static, impact and fatigue strengths****1 Scope**

This part of ISO 7176 specifies requirements for static, impact, and fatigue strength of wheelchairs including scooters. It specifies the test methods for determining whether the requirements have been met. It also specifies requirements for disclosure of the test results.

The test methods can also be used to verify the manufacturers' claims that a product exceeds the minimum requirements of this part of ISO 7176.

This International Standard applies to occupant- and attendant-propelled manual wheelchairs and electrically powered wheelchairs intended to provide indoor and outdoor mobility for people with disabilities.

NOTE 1 For the purposes of this part of ISO 7176, "wheelchair(s)" is used as an abbreviation for manual wheelchair(s) or electrically powered wheelchair(s), including scooter(s), to which the requirements and test methods are applied.

NOTE 2 Clauses of this part of ISO 7176 will be used as a basis for developing requirements and test methods for wheelchairs not covered by 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 7176-6, *Wheelchairs — Part 6: Determination of maximum speed, acceleration and deceleration of electric wheelchairs*

ISO 7176-7, *Wheelchairs — Part 7: Measurement of seating and wheel dimensions*

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

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

ISO 7176-22, *Wheelchairs — Part 22: Set-up procedures*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7176-7, ISO 7176-11, ISO 7176-26, and the following apply.

3.1**fracture**

unintentional separation (of a component) into two or more pieces

3.2

operator adjustable

intended to be adjusted, moved, or set up by the operator without the help of tools or with the help of tools if those tools are supplied with the wheelchair

3.3

visible crack

break, without complete separation into parts, visible to the naked eye and which has occurred during a test

4 Requirements

4.1 Strength requirements

When tested in accordance with [Clauses 8, 9, and 10](#), a single wheelchair shall meet all the following requirements at the conclusion of the tests.

- a) No component shall show evidence of visible cracks, be fractured, or have become detached, with the following exceptions.
 - 1) Readjustment of postural supports is allowed after each of the tests in [Clauses 8 and 9](#).
 - 2) Re-tightening, readjusting, or refitting of components that are identified in the operator's manual as operator-adjustable components is allowed at 25 % intervals during each of the multi drum, drop, and manual brake fatigue testing procedures ([Clause 10](#)). Operator adjustable components, as identified in the operator's manual, may not be adjusted using tools unless the tools are supplied with the wheelchair. If there are operator adjustable components, fatigue test equipment may be stopped at 25 % plus or minus 5 % intervals, to determine if re-tightening, readjusting, or refitting of operator-adjustable components is required. Re-tightening, readjusting, or refitting shall then be performed, following the procedures outlined in the operator's manual. Restart the test equipment after re-tightening, readjusting, or refitting has been performed.
 - 3) Re-tightening, readjusting, or refitting of any other component is not allowed.
 - 4) During the fatigue testing ([Clause 10](#)), the following wear items, if they are identified in the operator's manual, may be replaced no more than twice per item: tyres (including solid tyres), inner tubes, drive belts, castor wheel rubber. In the case of castor wheels that are a single integral part, replacement is only permitted because of wear or failure of the running surface, but not for failure of the wheel structure or other elements (e.g. bearings). No other wear items may be replaced.
 - 5) Cracks in surface finishes, such as paint, that do not extend into the structural material do not constitute a failure.
- b) No externally visible electrical cable shall be cut, abraded, or crushed. No externally visible electrical connector shall be crushed or disconnected.
- c) All parts intended to move, rotate or be removable, folding or adjustable shall operate as described by the manufacturer.
- d) All power-operated systems shall operate as described by the manufacturer.
- e) Handgrips shall not be displaced.
- f) No component or assembly of parts shall exhibit visible plastic deformation, free play, or loss of adjustment that adversely affects the function of the wheelchair.
- g) The brake mechanism shall not have moved from the pre-set positions.

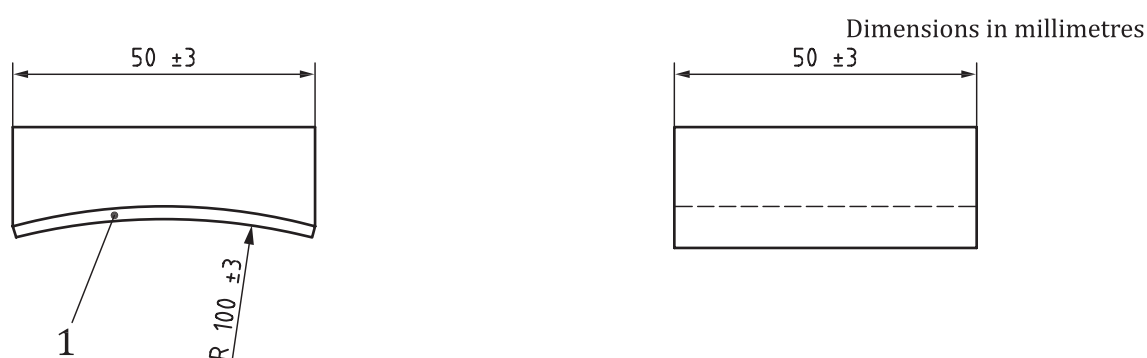
4.2 Disclosure requirements

Manufacturers shall disclose in their specification sheets, in the manner and sequence specified in ISO 7176-15, if the wheelchair meets the strength requirements of this part of ISO 7176.

5 Test apparatus

5.1 Loading device, shall be capable of applying forces (compressive or tensile) to the wheelchair in the range 15 N to 2 000 N to an accuracy of $\pm 3\%$.

5.2 Concave loading pad, shall be made of metal or hard wood as shown in [Figure 1](#). If suitable, the concave loading pad specified in ISO 16840-3 may be used in place of the concave loading pad shown in [Figure 1](#).



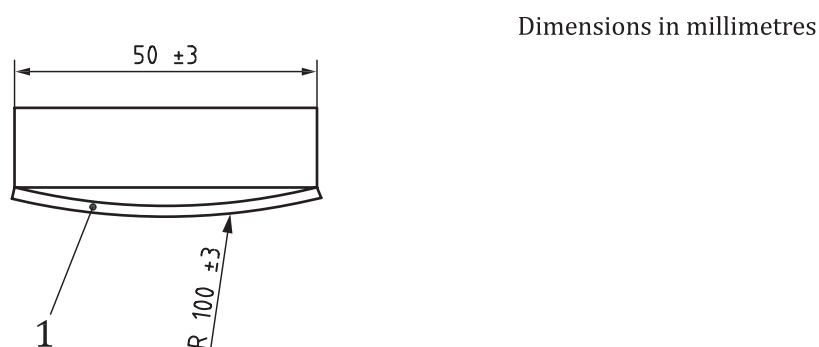
Key

1 loading surface

NOTE The loading surface may be covered with non-slip material up to 3 mm thick, e.g. plastic foam.

Figure 1 — Concave loading pad

5.3 Convex loading pad, has a cylindrical loading surface and shall be made of metal or hard wood, as shown in [Figure 2](#).



Key

1 loading surface

NOTE The loading surface may be covered with non-slip material up to 3 mm thick, e.g. plastic foam.

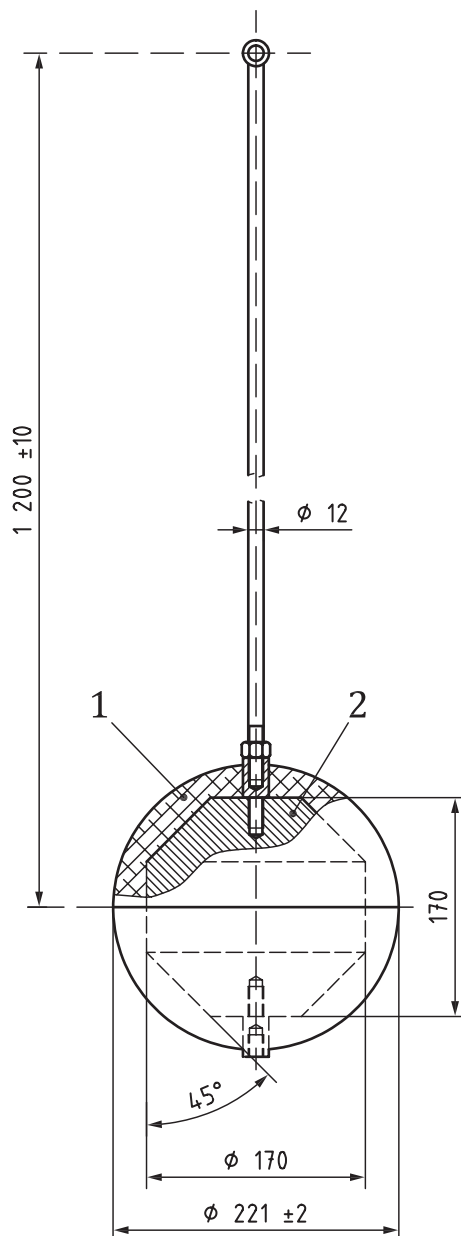
Figure 2 — Convex loading pad

5.4 Horizontal test plane, as specified in ISO 7176-22 shall be used.

5.5 Back support impact test pendulum, shall meet the requirements shown in [Figures 3](#) or [4](#) or achieve equivalent inertial performance.

The total mass of the ball/sphere shall be $25\text{ kg} \pm 0,5\text{ kg}$.

Dimensions in millimetres

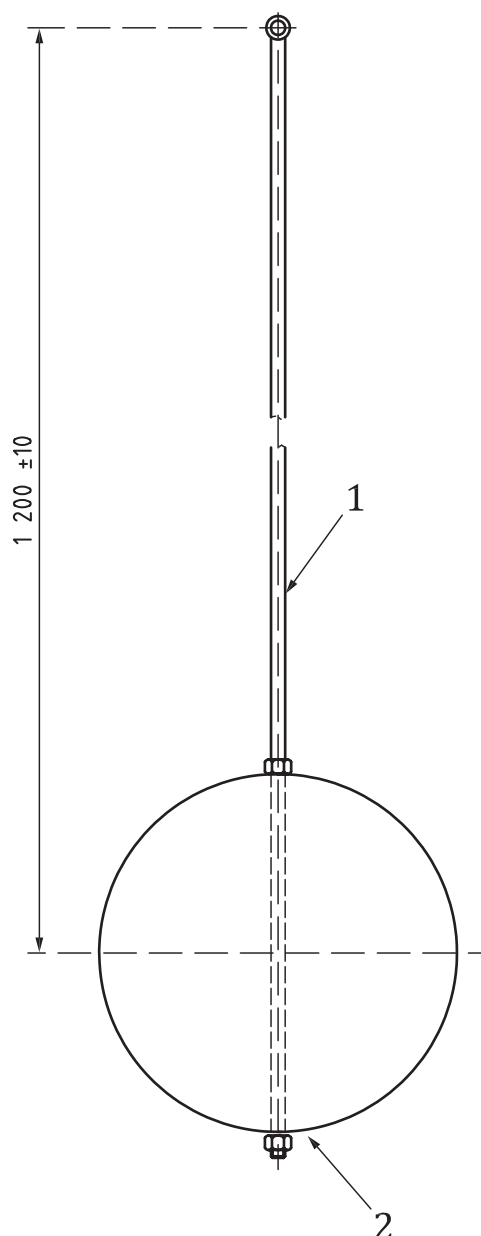


Key

- 1 polyurethane sphere with the following specifications: density $1\,150\text{ kg/m}^3$; hardness 80+ shore A; resilience 20 %
- 2 steel

Figure 3 — Back support pendulum

Dimensions in millimetres

**Key**

Regulation association football with nominal diameter 220 mm (size 5 soccer ball), filled with lead shot $3,5 \pm 1$ mm diameter and lined with closed cell high-density foam of density $75 \text{ kg/m}^3 \pm 15 \text{ kg/m}^3$ (ISO 845) and hardness $325 \text{ N} \pm 60 \text{ N}$ (ISO 2439).

- 1 threaded bar
- 2 washer

Figure 4 — Alternate back support pendulum

5.6 Handrim impact test pendulum and castor and foot support impact test pendulum, shall

- a) have a total mass of $10 \text{ kg} \pm 0,20 \text{ kg}$, and
- b) meet the dimensional requirements shown in [Figure 5](#).

The steel block shall be capable of being rotated about the longitudinal axis of the steel tube.

The reference dimension and the position of the steel block on the tube shall be adjusted so that the distance (d_1) from pivot to position of the centre of percussion is 1 000 mm $\pm$ 1 mm when calculated using Formula (1):

$$d_1 = \frac{I}{MR} \quad (1)$$

where

- d_1 is the distance from the pivot to the centre of percussion, expressed in metres;
- I is the moment of inertia of the pendulum about its pivot, expressed in kilogram meters squared (kg m²);
- M is the pendulum mass, expressed in kilograms;
- R is the distance from the pivot to the centre of mass, expressed in metres.

NOTE 1 The same impact test pendulum shown in [Figure 5](#) may be used for handrim, foot support, and castor impact testing, although other shapes or orientations may be required to accommodate small castors.

NOTE 2 See [Annex A](#) for the application of Formula (1).

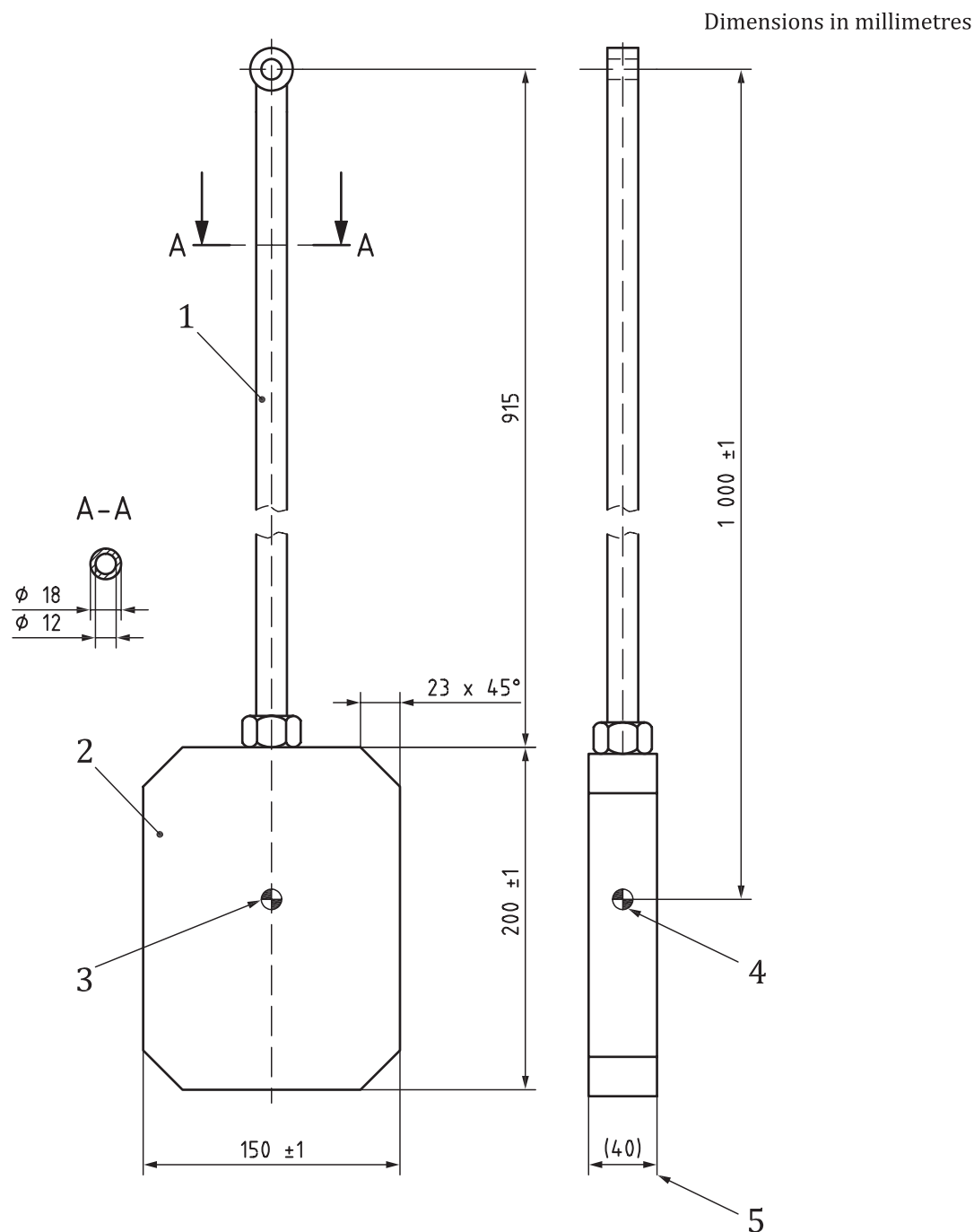


Figure 5 — Example of handrim impact test pendulum and castor and foot support impact pendulum

5.7 Test dummy, corresponding to the specifications of ISO 7176-11 shall be used.

5.8 Multi-drum test machine, shall consist of the following.

a) Drum specifications

- 1) Metal horizontal parallel cylindrical drums of 250 mm $\pm$ 25 mm diameter, one of which is the reference drum. All drums shall be parallel to the reference drum to align with all load-bearing wheels or castors. The top surface of all drums, prior to slat installation, shall be in the same horizontal plane.
- 2) The distance between the drums shall be capable of being set to the same dimensions as the wheelbase of the wheelchair to be tested. If a smaller wheelchair wheelbase must be tested than can be accommodated on the specified drums (in 1 above), then smaller drums may be used. Where smaller drums are used, those drums should operate with a similar surface speed as the reference drum. Smaller drums can thus operate at higher rotational frequency, resulting in extra impact cycles on that set of wheels.
- 3) Every wheel that normally runs on the surface while the wheelchair is travelling at a constant speed on a level surface (running wheel) shall be supported by a drum.
- 4) Each drum shall have sufficient slats for each wheel to encounter a slat once each revolution of the drum. Multiple slats on the same drum shall be spaced at equal intervals around the drum. In the case of two slats, they shall be located as specified in [Figure 6](#). Slat dimensions shall be as specified in [Figure 6](#).
- 5) There shall be a provision for the drums to be driven with a mean surface speed of the "reference drum" of 1,0 m/s $\pm$ 0,1 m/s over any 10 revolutions.
- 6) All drums on a multi drum tester shall have different bump frequencies to vary the synchronization of the slat impact. The difference in bump frequency of other drums shall be at least 2 % and not greater than 7 % higher than the reference drum. The slat impacts need to be randomized so that the bump frequency varies from axle to axle on the wheelchair.

NOTE 1 This can be accomplished by having the drums of equal diameter rotate at different speeds and/or by slightly varying the drum size. Pulleys or sprockets of different diameters can be used to maintain different speeds between the drums.

b) Mass and stiffness of multi-drum test machine

The mass, stiffness, and securement of the multi-drum test machine (and its components) must be sufficient that they do not affect the validity of testing under this part of ISO 7176.

NOTE 2 The use of drums and slats made from steel or aluminium, precision bearings for mounting the drums, and the securement of the machine to a concrete floor will usually meet the requirements for this subclause.

c) Attachment of wheelchair

There shall be provision to mount the wheelchair with its driven wheels or, for manual wheelchairs, the manoeuvring wheels, or if the wheels are the same diameter the rear wheels, on the "reference drum" and its other wheels on the second drum (and further drums for chairs with additional wheels).

A suitable restraint structure or system with a minimum longitudinal stiffness of 100 N/mm shall be available to restrain the wheelchair as required in [10.3.1 c\)](#).

d) Speed, monitoring, and control of wheelchair shall meet the following requirements.

- 1) There shall be provision to measure the speed of the "reference drum" to enable the calculation of the surface speed of the drum to an accuracy of $\pm$ 0,05 m/s.
- 2) There shall be provision to count the number of revolutions of the "reference drum".

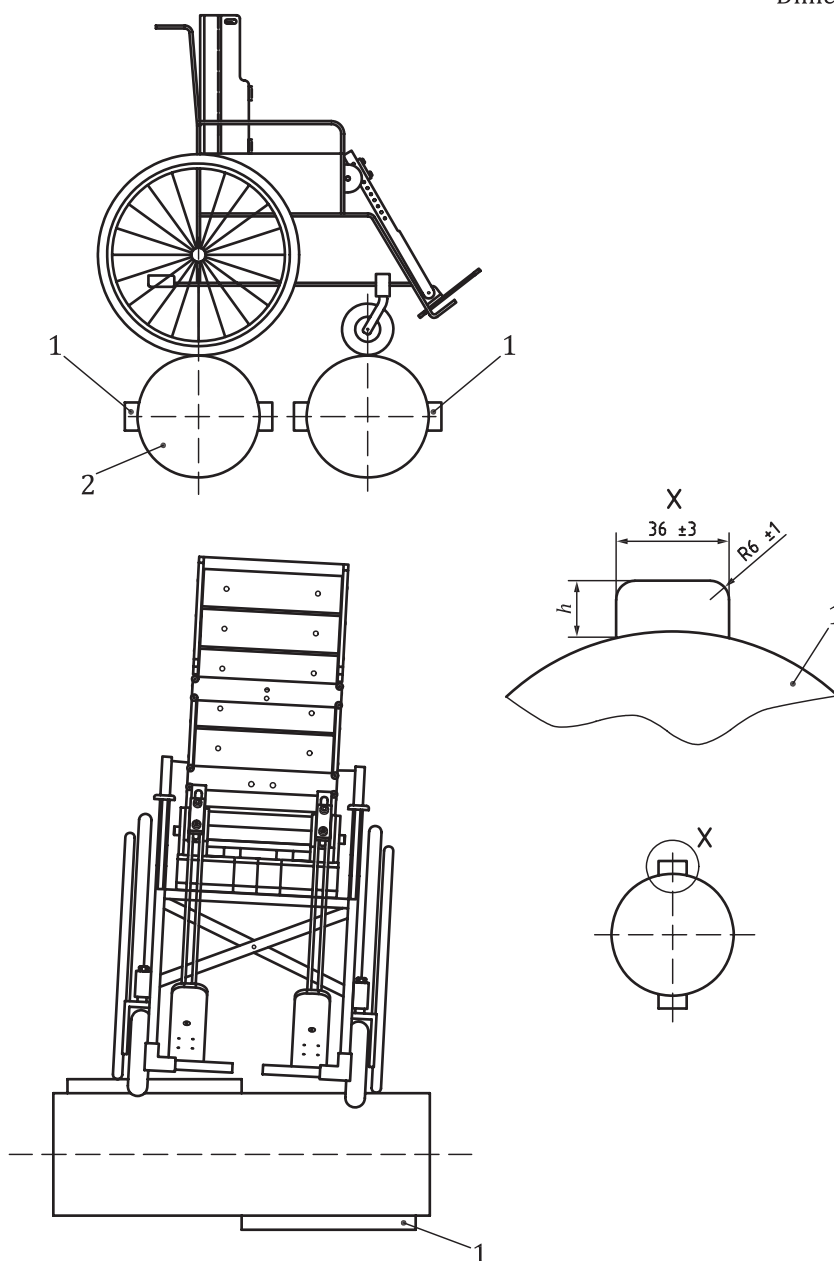
- 3) There shall be provision for an electrically powered wheelchair to drive the reference drum using its own drive system when the drive wheel(s) have a common axis of rotation and provision to drive all other drum(s) at the appropriate speed as specified above. Supplemental power using battery chargers or a remote power supply may be provided to the batteries to run the wheelchair. If supplemental power is provided, it shall be connected to the battery terminals so that all current from the battery set flows through the corresponding connectors of the wheelchair as in normal use.

NOTE 3 The control input device is most often fixed in the forward position and the speed control is adjusted to attain the desired speed. For scooters, the tiller may be positioned with elastic fasteners to maintain a forward direction.

- 4) There shall be provision for the turning resistance of the drums to be adjusted in such a way that the power drawn by the wheelchair's motors (where applicable) can be maintained at a set value with the roller speed maintained within the limits above.

NOTE 4 Usually it will be necessary to drive the drums in order to obtain the correct value of power drawn from the wheelchair's battery set (see [10.3.3](#)).

Dimensions in millimetres

**Key**

- h 6 mm for wheel diameters up to and including 75 mm, 9 mm for wheel diameters larger than 75 mm up to and including 100 mm, and 12 mm for all other wheels greater than 100 mm. Tolerance $\pm 8\%$.
- 1 slat
- 2 drum

Figure 6 — Multi-drum test machine

5.9 Drop test machine, shall be capable of lifting and dropping the wheelchair from $50 \text{ mm} \pm 5 \text{ mm}$ onto a rigid horizontal test plane. Examples are shown in [Figure 31](#).

NOTE A surface is considered to be sufficiently rigid if its displacement is less than or equal to 0,1 mm upon impact of the wheelchair. Reinforced concrete is acceptable.

5.10 Means to prevent the wheelchair from tipping, during the static tests shall be provided that

- a) it does not apply force to the wheelchair in the unloaded condition, and
- b) it applies any restraining forces to the following:
 - 1) thigh segment of the test dummy when it is in place;
 - 2) seat surface of the wheelchair or the seat support structure when a test dummy is not fitted.

EXAMPLE [Figure 7](#) illustrates the use of horizontal bars which are positioned to touch, but not apply force to, the test dummy or seat surface.

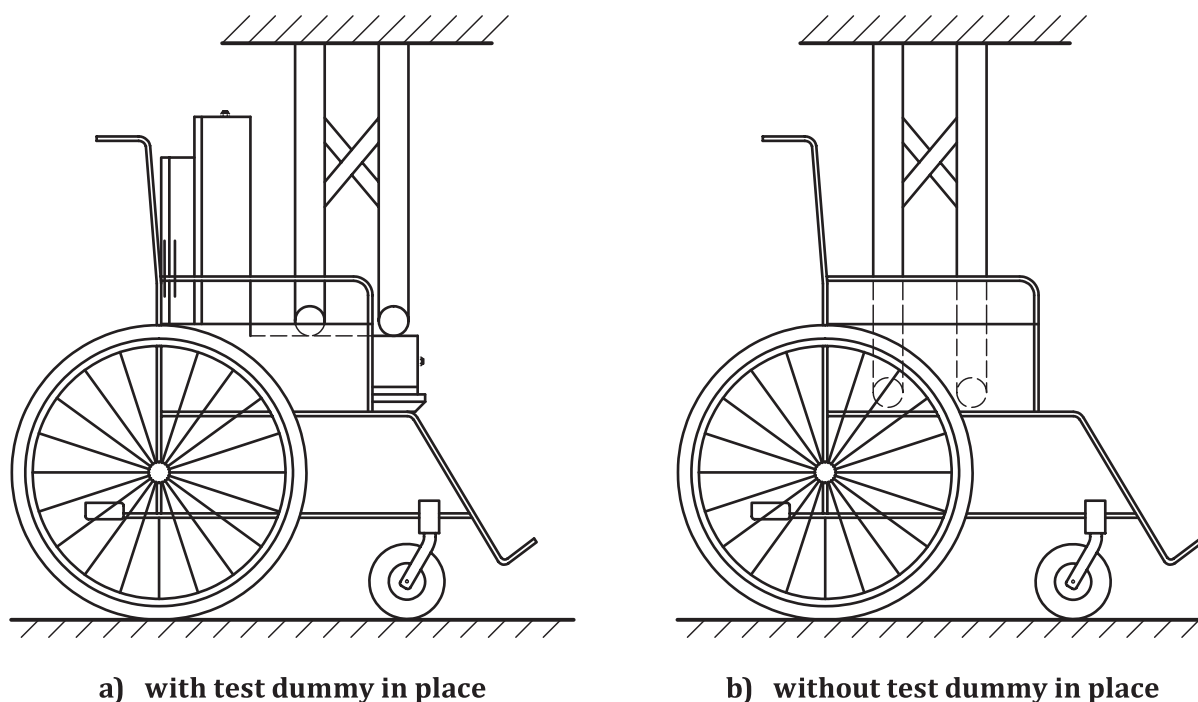


Figure 7 — Method of preventing wheelchair from tipping

5.11 Means to prevent the wheelchair from moving, in the fore-and-aft direction during the static and impact tests shall be provided which

- a) does not apply force to the unloaded wheelchair, and
- b) applies reaction forces to the circumference of the wheels (i.e. the tyres).

EXAMPLE Stops may be positioned to touch but not apply force to the wheels of the unloaded wheelchair.

5.12 Angular measurement device, capable of measuring the angle of the longitudinal axis of either test pendulum relative to the vertical prior to an impact test to an accuracy of $\pm 2^\circ$.

5.13 Test dummy securement, so that the test dummy is restrained according to the test procedure without deforming the wheelchair (see [10.3](#)).

5.14 Means to measure the power delivered from the battery, will typically be a dedicated power meter that can show in real time the power being drawn by the wheelchair from the onboard battery/power source. Alternatively, a true r.m.s voltmeter combined appropriately with a true r.m.s current meter may also be used. The power measurements should be accurate to $\pm 10\%$

NOTE ISO 7176-4 provides details of a new approach.

5.15 Repetitive brake operating system, to operate the parking brakes from the brake-off position to the brake-on position and return to the brake-off position 60 000 times at a frequency not exceeding 0,5 Hz such that the means does not apply forces in excess of 1,5 times the force required to operate the brakes.

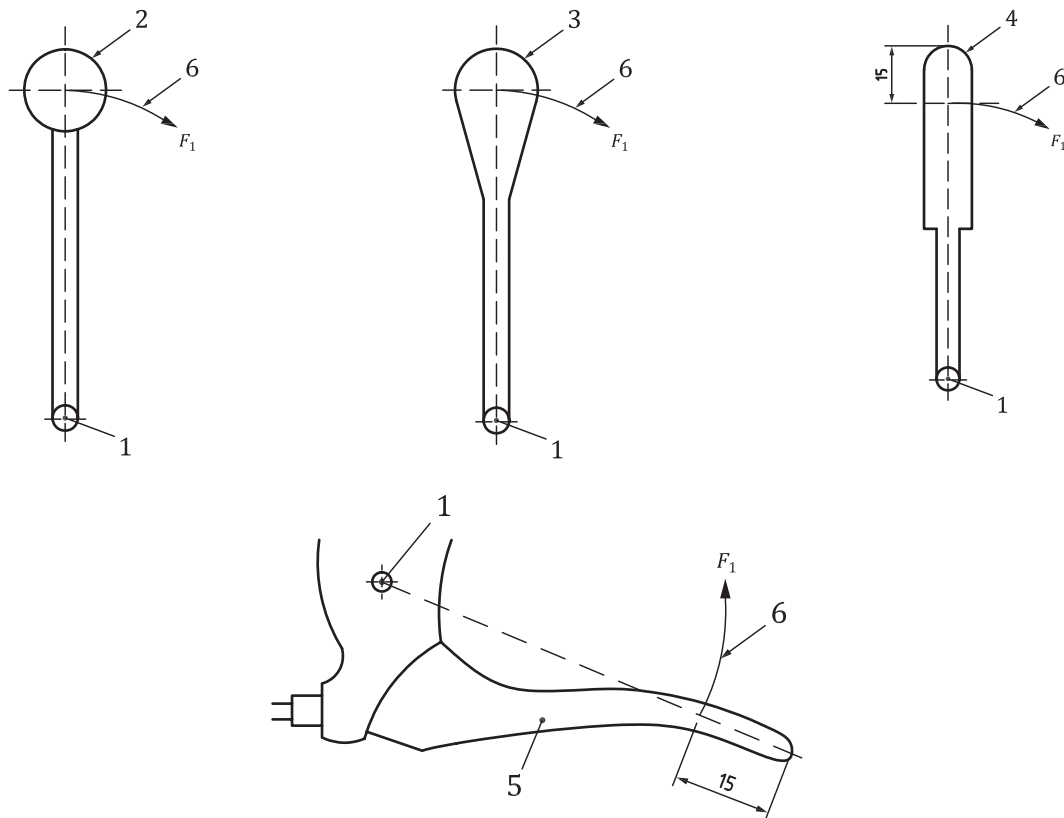
The system shall be capable of applying the test force:

- tangentially to the midpoint of the path of the force application point (shown as key 6 in [Figure 8](#));
- skewed laterally at a skew angle between 15,0° and 22,5° at the midpoint;
- not apply any twisting or compressive forces to the handle.

EXAMPLE 1 Ball joints and similar attachment hardware would be an acceptable solution.

NOTE End points relate to the direction of typical force application by the operator. For the identification of FAP, see [Figure 8](#). The device for moving the brake lever (such as a pneumatic or hydraulic cylinder) shall have a minimum length of 1 m.

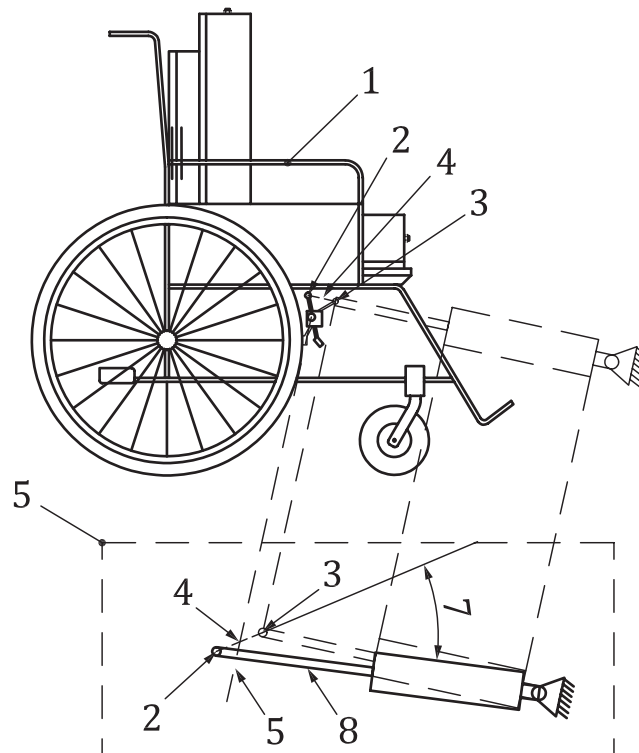
EXAMPLE 2 [Figure 9](#) provides an example of a test system that would meet these requirements.



Key

- 1 axis of brake lever
- 2 generally spherical knob
- 3 tapered lever
- 4 parallel lever
- 5 gripped by the finger of one hand
- 6 arc of typical force application

Figure 8 — Identification of the force application point (FAP)



Key

- 1 wheelchair (in a view along the axis of the brake lever)
- 2 near end point of the path of the FAP
- 3 remote end point of the path of the FAP
- 4 connecting line between the end points
- 5 plane parallel to the axis of the brake lever and containing the end points
- 6 axis of the brake lever
- 7 angle of skew force application
- 8 extended actuator (example)
- 9 contracted actuator (example)

Figure 9 — Illustrative setup of a repetitive brake operating system

6 Preparation of the test wheelchair

6.1 Setup and adjustment of the wheelchair

Set up the wheelchair and accessories for testing as specified in ISO 7176-22.

On a wheelchair with a tilt seating mechanism, tilt the seat/back support system so that the mechanism bears the load of the seat system, but not more than 5° tilt. If an electrically powered wheelchair will not drive in this position, reduce the tilt until it does.

NOTE This requirement aims to ensure that the tilt seating mechanism is loaded during testing without adversely affecting the wheelchair centre of mass position.

Adjust the manually applied parking brakes in accordance with the manufacturer's instructions for use without exceeding the maximum operating forces stated in [Table 1](#).

Table 1 — Maximum operating forces

	Force
Single finger operation	5 N
Lever gripped by more than one finger	13,5 N
Whole hand operation	60 N
Combined hand and arm operation	60 N
Foot operation, pushing direction	100 N
Foot operation, pulling direction	60 N

6.2 Test dummies

Select a test dummy of mass equal to the maximum occupant mass that is specified by the manufacturer.

Set up and restrain the test dummy in the wheelchair as specified in ISO 7176-22.

6.3 Preparation of wheelchair

Immediately prior to the test, condition the wheelchair by maintaining it at a temperature between 20 °C and ± 5 °C for not less than eight hours.

6.4 Records

Record details of the wheelchair as required in ISO 7176-22.

6.5 Safety during testing

This International Standard calls for the use of procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the manufacturer or test house from legal obligations relating to health and safety at any stage.

Centres undertaking these tests should consider the appropriate use equipment, procedures, and systems to manage the hazards involved. This can include protective cages or barriers, systems to stop tests upon failure or in an emergency, and personal protective equipment.

7 Sequence of tests

The sequence of tests shall be performed on one wheelchair as follows:

- static strength tests ([Clause 8](#)) which may be performed in any order;
- impact strength tests ([Clause 9](#)) which may be performed in any order;
- the multi-drum test ([10.3](#));
- the drop test ([10.4](#));
- the fatigue test of manually operated parking brakes ([10.5](#)).

8 Test methods for static strength

8.1 Principle

The wheelchair is positioned on the horizontal test plane and loads representing the minimum requirements are applied to various parts. If manufacturer claims that the wheelchair exceeds the requirements, the test loads are increased accordingly to verify the claim.

NOTE The forces applied by operators and/or occupants to various parts of the wheelchair have been calculated and then multiplied by a safety factor to derive minimum strength requirements. Details are in [Annex A](#).

8.2 Wheelchair preparation

Before each test, check the adjustment of the wheelchair and position of the test dummy in accordance with the instructions in [Clause 6](#) and correct if necessary.

8.3 Selection of loading pad

Where the following test methods specify the use of a loading pad at the point of application of the test load, select, and if necessary, modify, one of the loading pads specified in [5.2](#) and [5.3](#) as follows:

- if the surface to be loaded is flat and greater than 20 mm wide, or concave, use the convex loading pad (see [5.3](#));
- if the surface to be loaded is convex, or flat and 20 mm or less in width, use the concave loading pad (see [5.2](#));
- if the part of the wheelchair which is to be loaded is close to other parts of the wheelchair so that there is insufficient room for the loading pad, cut away the smallest section of the pad that will give clearance from the surrounding structure.

The force may be applied to the loading pad as a compressive force from an actuator or a tension force using a strap.

8.4 Arm supports: Resistance to downward forces

Remove the test dummy during this test.

Downward forces to be applied to the arm supports are based on the maximum occupant mass. For a maximum occupant mass more than 125 kg, 125 kg shall be used to calculate the force.

Calculate the downward forces using Formula (2):

$$F_1 = \frac{M_d \times S \times g}{2 \times \cos 15^\circ} \quad (2)$$

where

F_1 is the force to be applied, expressed in newtons;

M_d is the maximum occupant mass, expressed in kilograms up to 125 kg;

S is the safety factor equal to 1,5;

g is the gravitational constant = 9,807 m/s²;

NOTE 1 For examples, see calculations in [Annex A](#).

NOTE 2 If the manufacturer claims that the wheelchair exceeds the appropriate minimum requirement determined by the formula, apply the force claimed to -0 %/+3 %.

With the wheelchair standing on the horizontal test plane, set up a means for applying the test force, so that its line of action intersects the support surface of the arm support as shown in [Figure 10](#) using a loading pad selected as specified in [8.3](#).

NOTE 3 [Figure 10](#) shows the configuration of the loading equipment at the start of the test. This configuration will change as the test deforms the wheelchair.

Before commencing the test, set up the means to prevent the wheelchair from tipping and the means to prevent the wheelchair from moving fore-and-aft (see [5.10](#) and [5.11](#)).

Load may be applied to both arm supports simultaneously (if two loading pads are available) or one at a time.

Slowly increase the load until the force, F_1 , reaches the value specified in Formula (2), or the greater value specified by the manufacturer. Maintain the load for a period of between 5 s and 10 s.

Remove the load.

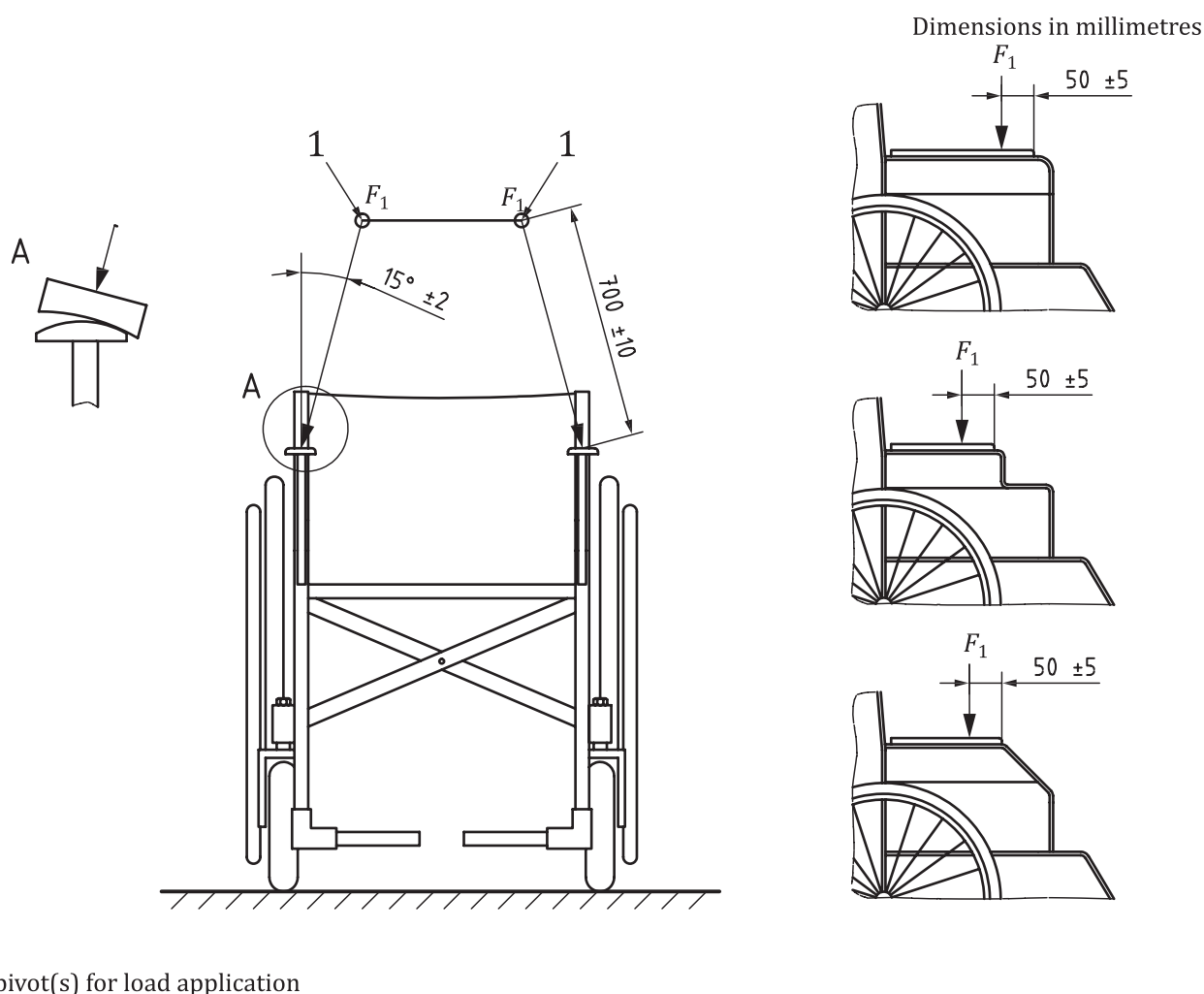


Figure 10 — Downward forces and arm supports

8.5 Foot supports: Resistance to downward forces

Remove the test dummy during this test.

Downward forces are based on the maximum occupant mass. For maximum occupant mass more than 125 kg, 125 kg shall be used to calculate force, except when testing scooters.

Calculate downward forces to be applied to the foot support using Formula (3):

$$F_2 = M_d \times g \quad (3)$$

where

F_2 is the force to be applied, expressed in newtons;

M_d is the maximum occupant mass, in kilograms;

g is the gravitational constant = 9,807 m/s².

NOTE 1 For examples, see calculations in [Annex A](#).

NOTE 2 If the manufacturer claims that the wheelchair exceeds the minimum requirements determined by Formula (3), apply the force claimed to $\pm 3\%$.

With the wheelchair standing on the horizontal test plane, set up a means for applying the forces determined by Formula (3), or any greater force specified by the manufacturer, at the appropriate foot support location illustrated in [Figure 11](#) and [Figure 12](#).

At the point of application of the load, use a convex loading pad (see [5.3](#)) on flat foot supports and foot supports consisting of two or more tubes and use a concave cylindrical loading pad (see [5.2](#)) on foot supports consisting of a single tube. In some cases where it can be done without weakening the foot support, it may be necessary to drill a hole in the foot plate to secure the loading actuator.

If there is a risk that the foot supports are so flexible that they will touch the test plane during the test, ensure that there is sufficient clearance for the foot support to deform without touching the test plane, i.e. raise the wheelchair by placing rigid blocks of equal height between each wheel and the test plane.

If tubular foot supports or other constructions are used which do not have a flat foot support surface, apply the force at an angle of $15^\circ \pm 3^\circ$ to the vertical inclined towards the seat as illustrated in [Figure 11](#) (Type G). For all other foot supports, apply the force at $90^\circ \pm 5^\circ$ to the foot support surface.

If foot supports are of open construction such that a standard loading pad cannot transmit load to the structure (as in [Figure 11](#) — Type E), fit a suitable rigid plate to the foot support so that load is carried by the parts of the foot support nearest to the loading point.

If any other form of foot support is used, select a loading pad as specified in [8.3](#).

If two separate foot supports are used, apply the load to each foot support in turn.

For scooters, apply the load as close as possible to each of the locations shown in [Figure 12](#) in turn.