DRAFT INTERNATIONAL STANDARD ISO/DIS 7176-1

ISO/TC **173**/SC **1** Secretariat: **SABS**

Voting begins on **2012-10-15** Voting terminates on **2013-01-15**

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Wheelchairs —

Part 1: Determination of static stability

Fauteuils roulants —

Partie 1: Détermination de la stabilité statique

[Revision of second edition (ISO 7176-1:1999)]

ICS 11.180.10

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 7176-1 was prepared by Technical Committee ISO/TC 173, *Assistive products for persons with disability*, Subcommittee SC 1, *Wheelchairs*.

This third edition cancels and replaces the second edition (ISO 7176-1:1999), all clauses, sub-clauses, tables, figures, and annexes of which have been technically revised.

ISO 7176 consists of the following parts, under the general title *Assistive products for persons with disability — Wheelchairs*:

— *Part 1: Determination of static stability*

— *Part 2: Determination of dynamic stability of electric wheelchairs*

— *Part 3: Determination of the effectiveness of brakes*

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

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

— *Part 6: Determination of maximum speed, acceleration and 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 electric wheelchairs*

— *Part 11: Test dummies*

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

— *Part 14: Power and control systems for electric wheelchairs - Requirements and test methods*

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

— *Part 16: Resistance to ignition of upholstered parts – Requirements and test methods*

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

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

— *Part 22: Set-up procedures*

— *Part 23: Requirements and test methods for attendant-operated stair-climbing devices*

— *Part 24: Requirements and test methods for user-operated stair-climbing devices*

— *Part 25: Requirements and test methods for batteries and their chargers for electrically powered wheelchairs and motorized scooters*

— *Part 26: Vocabulary*

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

Introduction

It is important to know the static-stability characteristics of a wheelchair for prescription and adjustment purposes. Some users need large reserves of stability to ensure their safety while others prefer finely balanced wheelchairs which have better manoeuvrability. Wheelchair users and prescribers should take into consideration that static stability is only one factor affecting dynamic stability, others being the position of the wheelchair user in the wheelchair, the skill of the wheelchair user, the manner in which the wheelchair is propelled and the environment in which the wheelchair is operated.

This part of ISO 7176 specifies tests in which static stability is measured with wheel locks applied (e.g. by parking brakes), as is the case if the wheelchair is standing on a slope. Tests are also made with the wheels unlocked, simulating the situation where the wheelchair is standing on a slope with the wheels against obstacles, the situation on a level surface with the wheels unlocked and the wheelchair user reaching for an object, or instability while rolling. These tests also give information about the ease with which a wheelchair can be tipped about its rear wheels, such as happens when negotiating curbs or balancing on the rear wheels. Tests are also made that determine the static stability of the wheelchair when it is protected against tipping over by a forward and/or rearward anti-tip device, and the effectiveness of those anti-tip devices should the wheelchair tip in that direction.

Wheelchairs —

Part 1:
Determination of static stability

1 Scope

This part of ISO 7176 specifies test methods for determining the static stability of wheelchairs. It is applicable to manual and electrically powered wheelchairs, including scooters, with a maximum speed not greater than 15 km/h, intended to provide indoor and/or outdoor mobility for one disabled person whose mass is within the range represented by ISO 7176-11.

This part of ISO 7176 provides a method for the measurement of the tipping angles (either wheelchair tipping angle or anti-tip device tipping angle). It is not applicable to wheelchairs with lateral anti-tip devices and does not consider sliding on the ground.

This document also includes requirements for test reports and information disclosure.

2 Normative references

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

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 7176-26 and the following apply.

3.1
anti-tip device
device which limits the extent of tipping of a wheelchair

Anti-tip devices may operate in forward, rearward or lateral directions. Some anti-tip devices have a spring suspension. Some running wheels can act as anti tip devices but their primary function is to be running wheels. The foot supports can serve as anti-tip devices if the manufacturer designates that they are intended to serve in that capacity. A change in the wheelchair configuration or control characteristics to enhance stability is not considered an anti-tip device.

3.2
anti-tip device tipping angle
angle of the test platform from the horizontal at which the wheelchair starts to tip about the anti-tip device

3.3
contact point
point at which a wheel or post contacts the ground

When a wheel has a contact area, the contact point is defined as the midpoint of this area. When there is a post that has a contact area, the contact point is at the most downhill point of this area.

NOTE In the test procedures specified in this standard the ground may be the test platform or the flexible underlay that lies between the test platform and the wheel or the post.

3.4
lockable wheels
wheels equipped with parking brakes, or wheels whose rolling motion is locked by the means of propulsion (e.g. by hands, levers, motors)

3.5
non-lockable wheel
wheels neither equipped with parking brakes, nor with means of propulsion (e.g., by hands, levers, motors) to lock their rolling motion

3.6
point of zero force detection
point at which the force under an uphill wheel is monitored to detect when it becomes zero

Note: May be determined as the point at which a sheet of paper will slide between the wheel and the contact surface.

3.7
running wheels
all wheels that are normally running on the surface while the wheelchair is travelling without acceleration or deceleration, on a level surface.

3.8
wheelchair tipping angle
the angle of the test platform from the horizontal at which the vertical projection of the centre of mass moves outside of a polygon connecting the ground contact points of all the running wheels.

NOTE 1 The instant at which the wheelchair starts to tip is reached when the forces become zero under all uphill running wheels (i.e. there is only force through one side of the polygon).

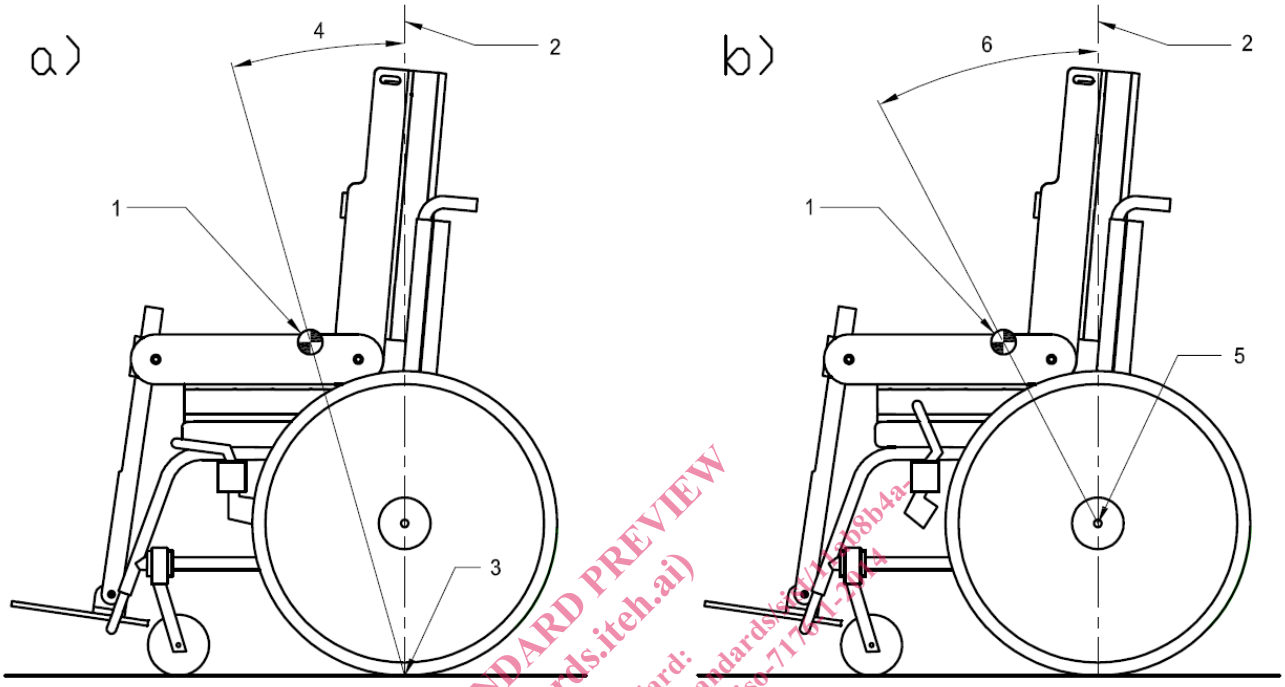
NOTE 2 A number of methods is available with which to determine when the forces become zero under the uphill wheels. These include, but are not limited to, the following: the ability to pull pieces of paper from beneath the wheels, visual identification of when the wheels lift from the test platform or the use of force-sensing instrumentation.

4 Principles

4.1 Static stability

Theoretically, a loaded wheelchair is statically stable as long as the gravity force line from the centre of mass is inside the base of support (area on the ground that is confined by the outline of the contact points (3.3) of its wheels). A wheelchair becomes more stable as the angle between a vertical plane through the axis of tip and a plane that contains the centre of mass and the axis of tip increases. A wheelchair will tip when it is tilted beyond this angle. The wheelchairs can either tip about the contact point when the wheels are locked or about the wheel axle when the wheels are unlocked (see Figure 1).

Since the location of the centre of mass is not known, it is not possible to measure the tipping angle directly. Therefore it is determined with the wheelchair on a test platform the slope of which can be adjusted. The angle of the slope on which the wheelchair starts to tip is measured. The angle of the test platform represents the desired tipping angle.



Key

a)	Wheelchair with wheels locked	3	Axis of tip when wheel is locked
b)	Wheelchair with wheels unlocked	4	Wheelchair tipping angle when wheel is locked
1	Centre of mass of wheelchair plus dummy	5	Axis of tip when wheel is unlocked
2	Vertical	6	Wheelchair tipping angle when wheel is unlocked

Figure 1 – Demonstration of wheelchair tipping angles (example in rearward direction)

In the case of a test with unlocked wheels, the axis of tip lies in the wheel axle and the relevant centre of gravity is that of the loaded wheelchair excluding the mass of the unlocked wheels about the wheelchair tips.

NOTE Since this is a rather minor effect it is not explicitly shown in the Figures of this standard.

4.2 Quasi-static stability

The wheelchair is brought to a situation in which it is in an unstable balanced position about an axis between the two running wheels nearest the anti-tip device(s). From this state, the wheelchair should be able to freely tip until its anti-tip device(s) contact the test surface. It is observed whether the anti-tip device is capable of preventing the wheelchair from tipping over completely.

5 Apparatus

5.1 Flat, hard test platform with adjustable slope that is large enough to accommodate the wheelchair to be tested, with a test surface that lies between two imaginary parallel planes 5 mm apart and has no more than 0.5 degrees of variation in slope or cross slope throughout the test.

NOTE 1 The imaginary planes are intended to provide a measure of control on the flatness of the test platform.

NOTE 2 Visible lines parallel and normal to the hinge of the test platform can assist in positioning the wheelchair.

5.2 Means by which the slope of the test platform can be adjusted.

5.2.1 The slope of the test platform may be increased in a stepwise or continuous fashion. If the slope is increased in a stepwise fashion, during the last two to three degrees of slope inclination the steps should not be greater than 0,5° and should not be so abrupt that they affect the validity of the tipping angle (either wheelchair tipping angle or anti-tip device tipping angle). Between the steps, pauses should be made, that are long enough to allow settling of any rocking of the wheelchair. Any means to dampen rocking of the wheelchair should not be so that they affect the validity of the tipping angle (either wheelchair tipping angle or anti-tip device tipping angle). If otherwise the slope of the test platform is increased in a continuous fashion, during the last two to three degrees of slope inclination the rate of increase in the slope should not exceed 0,5°/s.

5.3 Means to prevent an unlocked wheel or anti-tip device from rolling that does not affect the wheelchair's freedom to tip about the axle of the restrained wheel (roll restraints). Roll restraint surfaces that contact a wheel shall be perpendicular to the test plane. The height of the roll restraint shall be sufficiently large to prevent rolling of the wheels during testing (see fig 2).

NOTE Placing a rigid barrier in contact with the downhill wheels is an acceptable method for testing when the downhill wheels are unlocked.

5.4 Means to prevent a locked wheel or anti-tip device from sliding that does not affect the wheelchair's freedom to tip about the contact point (3.3) of the restrained wheel or post (slide restraints).

NOTE 1 See annex A.

NOTE 2 Placing a rigid barrier in contact with the downhill wheels is NOT acceptable for the tests when the downhill wheels are locked, because it changes the axis of tip.

5.5 Means to limit the extent of tipping of the wheelchair relative to the test platform that does not affect the stability of the wheelchair, restrict the wheelchair's freedom to deform or restrict the wheelchair's freedom to tip sufficiently to detect a zero force under the uphill wheels of the wheelchair or in the case of Clause 11.2.9 from tipping onto its anti-tip wheels (tipping limiter) (see fig 2).

5.6 Means to measure the angle of the slope of the test platform with respect to the horizontal with an accuracy of ± 0,5°.

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

5.8 Means to secure the torso and thigh portions, and feet of the test dummy as specified in ISO 7176-22.

6 Set up procedure

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

Select and fit a test dummy as specified in ISO 7176-22.

Ensure that the total mass of the test dummy and the location of the centre of mass conform to the requirements of ISO 7176-11 for the applicable dummy mass.

Do not load the wheelchair with a human test person, except as approved for clinical evaluations.

7 General test procedure

Perform the general test procedure as follows:

a) Increase the slope of the test platform until the tipping angle (either wheelchair tipping angle or anti-tip device tipping angle) is reached, and then prevent further movement of the platform.

NOTE 1 The slope of the test platform may be increased in a stepwise or continuous fashion. If the slope is increased in a stepwise fashion, during the last two to three degrees of slope inclination the steps should not be greater than 0,5° and should not be so abrupt that they affect the validity of the tipping angle (either wheelchair tipping angle or anti-tip device tipping angle). Between the steps, pauses should be made, that are long enough to allow settling of any rocking of the wheelchair. Any means to dampen rocking of the wheelchair should not be so that they affect the validity of the tipping angle (either wheelchair tipping angle or anti-tip device tipping angle). If otherwise the slope of the test platform is increased in a continuous fashion, during the last two to three degrees of slope inclination the rate of increase in the slope should not exceed 0,5°/s.

b) Ensure that the result is not affected by inadvertent contact between the wheelchair and the test equipment or floor.

c) Recheck the positions of the test dummy and wheelchair to ensure that no inadvertent movement has occurred. If the configuration of the wheelchair reproducibly or irreversibly changes during the test (e.g. if the tyre rolls off the rim or the wheelchair partially folds),

— record the nature of the occurrence and the angle of the test platform at which this occurs in the comments section of the test report (12.j); and

— complete the test.

d) Measure and record the tipping angle (either wheelchair tipping angle or anti-tip device tipping angle) to the nearest 1°.

e) Lower the test platform to horizontal.

f) Where applicable (e.g. in the tests for static stability with anti-tip devices) allow the running wheels of the wheelchair to drop back onto the test platform.

8 Test for static stability in the forward direction

8.1 General

NOTE 1 The test methods specified in clauses 8 to 11 of this part of ISO 7176 may be performed in any sequence.

, For wheelchairs with:

a) non-lockable front wheels, measure the forward wheelchair tipping angles as specified in 8.2 and 8.4 only, or

b) lockable front wheels, measure the forward wheelchair tipping angles as specified in 8.2 to 8.5.

NOTE 2 If the wheelchair has a single front wheel or if the two front wheels are very close together, the wheelchair will tip in a more lateral direction. In such cases, omit the tests specified in clause 8. This aspect of stability is measured in clause 10.

CAUTION — These tests can be hazardous. It is essential that appropriate safety precautions be taken to protect the test personnel.

8.2 Wheels unlocked and the wheelchair in the least stable configuration

NOTE This test is applicable to all wheelchairs.