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International Standard



7176/1

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## Wheelchairs — Part 1: Determination of static stability

*Fauteuils roulants — Partie 1: Détermination de la stabilité statique*

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Descriptors : wheel chairs, static tests, determination, stability.

## 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7176/1 was prepared by Technical Committee ISO/TC 173, *Technical systems and aids for disabled or handicapped persons*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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# Wheelchairs — Part 1: Determination of static stability

## 0 Introduction

ISO 7176 at present consists of the following parts:

- Part 1: Determination of static stability.
- Part 2: Determination of dynamic stability of electric wheelchairs.
- Part 3: Determination of the efficiency of brakes.
- Part 4: Determination of energy consumption of electric wheelchairs.
- Part 5: Determination of overall dimensions, mass and turning space.
- Part 6: Determination of maximum speed, acceleration and retardation of electric wheelchairs.
- Part 7: Determination of seating dimensions — Definitions and measuring methods.
- Part 8: Static, impact and fatigue strength for manual wheelchairs.
- Part 9: Climatic tests for electric wheelchairs.
- Part 10: Determination of the obstacle climbing ability of electric wheelchairs.
- Part 11: Test dummies.
- Part 12: Determination of tracking characteristics of manual wheelchairs.
- Part 13: Determination of the coefficient of friction of test surfaces.

## 1 Scope and field of application

This part of ISO 7176 specifies methods for determining the static stability of wheelchairs.

## 2 References

ISO 6440, *Wheelchairs — Nomenclature, terms and definitions*.

ISO 7176/11, *Wheelchairs — Part 11: Test dummies*.<sup>1)</sup>

ISO 7176/13, *Wheelchairs — Part 13: Determination of the coefficient of friction of test surfaces*.<sup>1)</sup>

ISO 7930, *Wheelchairs — Type classification based on appearance characteristics*.

## 3 Definitions

For the purposes of this part of ISO 7176, the definitions given in ISO 6440 apply.

## 4 Principle

The wheelchair, loaded with a test dummy and with the parking brake(s) engaged, is placed on a test plane in specified orientations. The test plane is tilted and, as appropriate to the particular test method, one or the other of the following criteria is used to establish stability:

- sliding of at least one wheel due to insufficient friction between the wheel and the test plane;
- tipping of the wheelchair.

## 5 Test plane

The tests shall be carried out on a flat and hard plane, the slope of which shall be adjustable. The surface of the plane shall have a coefficient of friction as defined in ISO 7176/13.

## 6 Test wheelchair

**6.1** Unless otherwise specified and wherever appropriate, the conditions specified in 6.2 to 6.7 shall be fulfilled during testing.

**6.2** The wheelchair shall be fully equipped for normal use including armrests and leg supports with footrests, but excluding cushions.

**6.3** If the wheelchair is of the variable wheelbase design, the stability values at both extremes of its stability shall be given. If the wheels can be attached in more than one way, the least favourable shall be used.

<sup>1)</sup> At present at the stage of draft.

**6.4** If the wheelchair has pneumatic tyres, the air pressure in them shall be adjusted in accordance with the manufacturer's instructions. If a pressure range is specified, the highest recommended pressure shall be used.

**6.5** If the braking force is adjustable, the parking brake shall be adjusted to prevent rotation of the wheel during testing. If necessary, the braking force may be supplemented by other mechanical devices to prevent rotation of the braked wheel; this shall be noted in the test report. If there are no brakes, the wheels should be locked relative to the frame.

**6.6** During the tests, the wheelchair shall be loaded with a test dummy of appropriate size constructed in accordance with ISO 7176/11. The dummy shall be positioned as far as possible to the back of the seat, equidistant from either side. The "legs" of the dummy shall be positioned such that its rear edge coincides with the rear edge of the footrest. The dummy shall be secured to prevent movement from the position described above during the tests.

**6.7** If the body support system (or parts of it) is adjustable, the test shall be performed as specified in 6.7.1, 6.7.2 and/or 6.7.3, as appropriate.

**6.7.1** The body support system shall be set to correspond to natural sitting posture, with the lowest part of the leg support/footrest 50 mm above the test plane and the seat corresponding to the mid-point sitting height. Pivoting body support systems shall be set in the forward position. The slope of the seat relative to the horizontal shall be as close as possible to 4°. The slope of the backrest relative to the vertical shall be as close as possible to 10°. The angle between the seat and the leg support shall be as close as possible to 90°.

All other parts of the body support system shall be set at their middle positions.

**6.7.2** Without changing the seat setting or the length of the leg support (see 6.7.1), the backrest shall be fully reclined and the leg support fully elevated.

**6.7.3** The body support system (or adjustable parts of it) shall, in each test, be set at the least favourable position. The position of each component shall be noted in the test report.

## 7 Test procedures

### 7.1 Static stability with locked brakes in the fore and aft directions

This test is concerned with the stability of a wheelchair either stationary on a slope or being propelled up or down a slope.

Position the wheelchair, under the conditions specified in clause 6, on the test plane, and increase the slope gradually and at a uniform rate until the uphill wheels just lift away from the test plane. Determine and record the slope (within  $\pm 1^\circ$ ) by gently pulling a piece of paper at right angles from under the uphill wheels. Perform the test in both the fore and aft directions.

If the wheelchair slides before the uphill wheels lift away, note the slope (within  $\pm 1^\circ$ ) at which this occurs in the test report. Repeat the procedure, preventing the wheelchair from sliding by placing a rectangular bar placed against the downhill wheels. Initially the height of the bar shall be 40 mm, but if the wheelchair continues to slide, the height of the bar may be increased. Note the height of the bar used in the test report.

### 7.2 Static stability with unlocked brakes in the aft direction

This test is concerned with the stability of a wheelchair being balanced on its rear wheels by its occupant or being tipped backwards by an attendant.

Position the wheelchair, under the conditions specified in clause 6, on the test plane, and increase the slope gradually and at a uniform rate until the uphill wheels just lift away from the test plane. Determine and record the slope (within  $\pm 1^\circ$ ) by gently pulling a piece of paper at right angles from under the uphill wheels. During the test, prevent the wheelchair from rolling by placing a 100 mm high rectangular bar against the downhill wheels.

### 7.3 Static stability with locked brakes in the transverse direction

This test is concerned with the stability of a wheelchair either stationary on a slope or being propelled transversally across a slope.

Position the wheelchair, under the conditions specified in clause 6, on the test plane, and increase the slope gradually and at a uniform rate until the uphill wheels just lift away from the test plane. Determine and record the slope (within  $\pm 1^\circ$ ) by gently pulling a piece of paper at right angles from under the uphill wheels. Perform the test with the wheelchair perpendicular to the slope. Ensure that castor wheels (if fitted) are free to swivel.

If the wheelchair slides (in any way) before the uphill wheels lift away, note the slope (within  $\pm 1^\circ$ ) at which this occurs in the test report. In practice, sliding will normally occur during this test because freely mounted castor wheels will swivel and induce rotation of the wheelchair. Repeat the procedure, fixing the freely mounted castors in the position giving the least favourable wheelbase, for example by inserting a small wedge between the castor fork and the wheelchair frame. If the wheelchair continues to slide, place a 40 mm high rectangular bar against the downhill wheels in order to prevent this.

### 7.4 Static stability with locked brakes in other critical directions

This test is concerned with the stability of a wheelchair either stationary on a slope or being propelled at an angle across a slope. It should be carried out only if there are indications that the previous tests have not revealed the maximum degree of instability of the wheelchair.

If there is also risk that the static stability is poorer in some direction other than the fore, aft and transverse directions, the following test shall be carried out.

Position the wheelchair, under the conditions specified in clause 6, on the test plane, and increase the slope gradually and at a uniform rate until the uphill wheels just lift away from the test plane. Determine and record the slope (within  $\pm 1^\circ$ ) by gently pulling a piece of paper at right angles from under the uphill wheels. Perform the test with the wheelchair at the least favourable angle to the slope. Ensure that castor wheels (if fitted) are free to swivel.

If the wheelchair slides (in any way) before the uphill wheels lift away, note the slope (within  $\pm 1^\circ$ ) at which this occurs in the test report. Repeat the procedure, preventing the wheelchair from sliding by placing a 40 mm high rectangular bar against the downhill wheel(s). However, if sliding occurs because castor wheels swivel and induce rotation of the wheelchair, prevent this by fixing the castors in the position giving the least favourable wheelbase, for example by inserting a small wedge between the castor fork and the wheelchair frame.

## 8 Test report

The test report shall contain the following information:

- a) a reference to this part of ISO 7176;
- b) the product type and type designation (see ISO 7930);
- c) the name and address of the manufacturer;
- d) a photograph of the wheelchair equipped as during test;
- e) the name and address of the testing institution;
- f) the static stability limits, with locked brakes in both the fore and aft directions, in accordance with 7.1;
- g) the static stability limits, with unlocked brakes in the aft direction, in accordance with 7.2;
- h) the static stability limits, with locked brakes in the transverse direction, in accordance with 7.3;
- i) if applicable, the static stability limits, with locked brakes in other critical directions, in accordance with 7.4;
- j) the static stability limits, achieved during the above tests before action (if any) was taken to prevent the wheelchair sliding down the inclined plane, together with details of that preventive action;
- k) the test dummy used;
- l) the information specified in 6.5 and 6.7.3.

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