INTERNATIONAL STANDARD

ISO 7176-6

Second edition
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Wheelchairs —

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

Fauteuils roulants —
Partie 6: Détermination de la vitesse, de l'accélération et du ralentissement maximaux des fauteuils roulants électriques

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 part of ISO 7176 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 7176-6 was prepared by Technical Committee ISO/TC 173, *Technical systems and aids for disabled or handicapped persons*, Subcommittee SC 1, *Wheelchairs*.

This second edition cancels and replaces the first edition (ISO 7176-6:1988), clauses and tables 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 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 22: Set-up procedures*

The following parts are also on the work programme:

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

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

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

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

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

Introduction

Maximum speed, acceleration and deceleration can be important factors in the selection of the most appropriate wheelchair for individual people.

Maximum speed can have an influence on whether a wheelchair may be used on footpaths, on roads, or both, depending upon local legislation. Some people's main concern may be to travel as fast as possible, whereas other people may be apprehensive of higher speeds. In addition, other tests in the ISO 7176 series may require the determination of maximum speed in order to carry out their procedures.

Maximum acceleration and deceleration are primarily of concern with regard to the comfort of the user, where high values can be very disturbing and lead to postural stability problems.

These tests specify a consistent method of determining maximum values of speed, acceleration and deceleration to provide comparable results.

Wheelchairs —

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

1 Scope

This part of ISO 7176 specifies test methods for determining the maximum speed, acceleration and deceleration of electrically powered wheelchairs, including scooters, intended to carry one person, with a maximum nominal speed not exceeding 15 km/h (4,167 m/s).

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 7176. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 7176 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

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*

3 Terms and definitions

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

4 Apparatus

4.1 Instrumentation that may need to be added to the test dummy, in which case its mass shall not exceed 5 % of the total dummy mass.

4.2 Horizontal test plane made up of a rigid, flat, horizontal surface of sufficient size to conduct the tests and with a coefficient of friction sufficient to allow only wheel slippage during performance of the tests.

NOTE The floor of a typical large building used for manufacturing or indoor leisure with, for example, a concrete, asphalt or wooden floor is acceptable.

4.3 Speed measurement device to measure and record speed up to 5 m/s, with an accuracy of ± 0,1 m/s and a sample rate of at least 60 Hz. It shall include the facility to detect 10 % and 90 % values of the maximum speed measured in 6.1.

4.4 Acceleration/deceleration measurement device to measure and record acceleration/deceleration with the following properties:

a) a range up to 5 m/s^2;

b) an accuracy of ± 0,2 m/s^2;

c) a sample rate of at least 60 Hz;

d) a frequency response such that frequencies above 30 Hz are rejected.

NOTE A trailing wheel with an optical rotation transducer is recommended as an appropriate piece of equipment. A mechanical accelerometer, laser, ultrasonic or similar type of equipment may also be used. If an accelerometer is used, the sensor should be mounted in a fore-aft alignment and on a rigid structure as near as possible to the fore-aft centreline of the seat. Electronic means may also be used to determine acceleration/deceleration.

4.5 Test ramp, made up of a rigid, flat, inclined plane with the same surface characteristics as the test plane (4.2), with inclination adjustable to 3° ± 0,5° and 6° ± 0,5° relative to the horizontal.

NOTE 1 This may be either a ramp with adjustable inclination or two separate fixed ramps.

NOTE 2 An area of approximately 10 m × 3 m is normally of sufficient size for each ramp.

4.6 Test dummy, as specified in ISO 7176-11, or a human test driver. If a dummy is used, a remote controller may be used to operate the wheelchair controls. This may be done by a telemetry system, by an operator running alongside or by other similar means.

NOTE Mass added to the wheelchair for the purposes of control or instrumentation should not significantly affect the overall mass distribution of the wheelchair. The overall mass of the loaded wheelchair may be adjusted to compensate for any such added mass.

4.7 Supplementary weights to add to the human test driver to give the mass distribution equivalent to the relevant dummy.

5 Preparation of the test wheelchair

Prepare the test wheelchair as follows before commencing the sequence of tests.

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

b) Set any controls which are accessible to the user without special tools and which influence the maximum speed, rate of acceleration and/or deceleration to provide maximum values in each case.

NOTE These may include programmable controls, touch pads, computer interfaces etc.

6 Determination of maximum speed

WARNING — This testing is potentially hazardous to a human test driver and test personnel. Appropriate safety precautions should be taken to avoid injury. Any additional weights should be firmly secured.

6.1 On a horizontal surface

a) Ensure that the electrical driving system reaches a temperature typical of working conditions.

NOTE 1 This may be done, for example, by driving the wheelchair for a distance of approximately 1,5 km.

b) Within 5 min of completing a), place the wheelchair on the horizontal test plane.

c) Drive the wheelchair forwards in a straight line on the horizontal test plane with its control device set to full speed command ensuring that it achieves its maximum speed.

d) Measure the maximum speed achieved with the means specified in 4.3 and record this value, V_m, in m/s.

e) Repeat a) to d) for an additional two runs.

f) Determine and record the value of the arithmetic mean, V_{mm}, of the three values of V_m measured in d) and e).

g) Repeat a) to f) but driving with the wheelchair travelling in reverse.

NOTE 2 It may be necessary to fix the castor orientations for this test to maintain a straight line of travel.

6.2 On a plane inclined at 3°

a) Repeat 6.1, driving up the test ramp set at 3° ± 0,5°.

b) Repeat 6.1, driving down the test ramp set at 3° ± 0,5°.

6.3 On a plane inclined at 6°

a) Repeat 6.1, driving up the test ramp set at 6° ± 0,5°.

b) Repeat 6.1, driving down the test ramp set at 6° ± 0,5°.

7 Determination of acceleration

WARNING — This testing is potentially hazardous to a human test driver and test personnel. Appropriate safety precautions should be taken to avoid injury. Any additional weights should be firmly secured.

a) Ensure that the electrical driving system reaches a temperature typical of working conditions.

NOTE This may be done by driving the wheelchair for a distance of approximately 1,5 km.

b) Within 5 min of completing a), place the wheelchair on the horizontal test plane.

c) Whilst recording speed and acceleration/deceleration with the means specified in 4.3 and 4.4, drive the wheelchair in a straight line on the horizontal test plane with its control device set to full speed command in a forwards direction until it achieves a speed within 3 % of its mean maximum speed, V_{mm}, as determined in 6.1.

d) Measure the time, T, in seconds taken for the wheelchair to accelerate from 10 % ± 3 % to 90 % ± 3 % of its mean maximum speed V_{mm} (m/s).

e) Determine the overall acceleration, A_o, in m/s^2, of the wheelchair using the following formula:

$$A_o = \frac{0,8}{T} \cdot V_{mm}$$