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Wheelchairs —

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

Fauteuils roulants —
Partie 4: Consommation d'énergie des fauteuils roulants et des scooters électriques pour la détermination de la distance théorique

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 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 7176-4 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 7176-4:1997), which has 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 electric 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 upholstered parts — Requirements and test methods*

— *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 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 26: Vocabulary*

Introduction

The distance range of an electrically powered wheelchair is affected by energy consumption and battery condition. Energy consumption is affected by a number of factors such as ambient temperature, total weight and weight distribution of the occupant, topography, surface characteristics and tyres. Battery condition is affected by factors such as temperature, age, charging history and discharging history. Hence the result obtained from the tests specified in this part of ISO 7176 cannot be used to derive an accurate range estimate for a particular wheelchair and occupant. However, it can be used to give a basis for comparison between different wheelchairs under similar test conditions.

Distance range is also strongly dependent on the way in which a wheelchair is driven, and a single value for theoretical range can be insufficient to provide an understanding of the performance of a wheelchair. Two methods for determining theoretical range are provided in this part of ISO 7176, for driving and for manoeuvring. These values are intended to facilitate wheelchair comparison in a manner analogous to the extra-urban and urban fuel consumption figures published for motor vehicles.

Wheelchairs —

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

1 Scope

This part of ISO 7176 specifies methods for determining the theoretical distance range of electrically powered wheelchairs, including scooters, using measurements of energy consumed while driving and the nominal energy capacity of the wheelchair's battery set. It is applicable to electrically powered wheelchairs with a maximum nominal speed no 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 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
wheelchair
electrically powered wheelchair

NOTE A scooter is an electrically powered wheelchair.

4 Principle

Energy consumption is measured for two types of driving: continuous driving and manoeuvring. For continuous driving, the wheelchair is driven around a test track ten times clockwise and ten times anti-clockwise, and the energy consumed is measured. For manoeuvring, the wheelchair is driven in a circuit between two markers 5 m apart, stopping and turning outside them, ten times in each direction while the energy consumed is measured. Theoretical range values are calculated from the energy consumed, the nominal distance travelled, and the battery capacity.

In the manoeuvring test, the total energy consumed by the wheelchair is measured, including both the energy consumed while it is between the markers and the energy consumed while it is outside them. However, the distance used to calculate the theoretical manoeuvring range is the nominal distance travelled between the markers; the distance travelled outside them is ignored. This implies that more-manoeuvrable wheelchairs will tend to have higher values of theoretical manoeuvring distance range than similar but less-manoeuvrable wheelchairs.

5 Test equipment

5.1 Test track, as shown in Figure 1, marked upon a flat, hard, horizontal surface in an area free from draughts, in a location where the temperature is between 18 °C and 25 °C.

The length of the centreline of the test track shall be between 50 m and 100 m. Each long side, L, shall be of sufficient length that the wheelchair can achieve its maximum speed. Each short side, W, shall be of sufficient length that the wheelchair can turn without stopping.

NOTE 1 The use of a shorter test track within the specified range will result in a lower theoretical range.

NOTE 2 The floor of a typical large building used for manufacturing or indoor leisure activities with, for example, a concrete, asphalt or wooden floor is acceptable. Any minor deviations from flat or horizontal are accommodated by reversing the direction of the test after the first ten laps, and starting and finishing the test in the same place on the track.

The test track shall contain two markers across one side, perpendicular to the centreline and 5,00 m ± 0,01 m apart. It shall also contain a circular central marker, of diameter 0,13 m ± 0,03 m, the centre of which shall be located within 0,03 m of a point half way between the two markers on the centreline of the test track (see Figures 1 and 2).

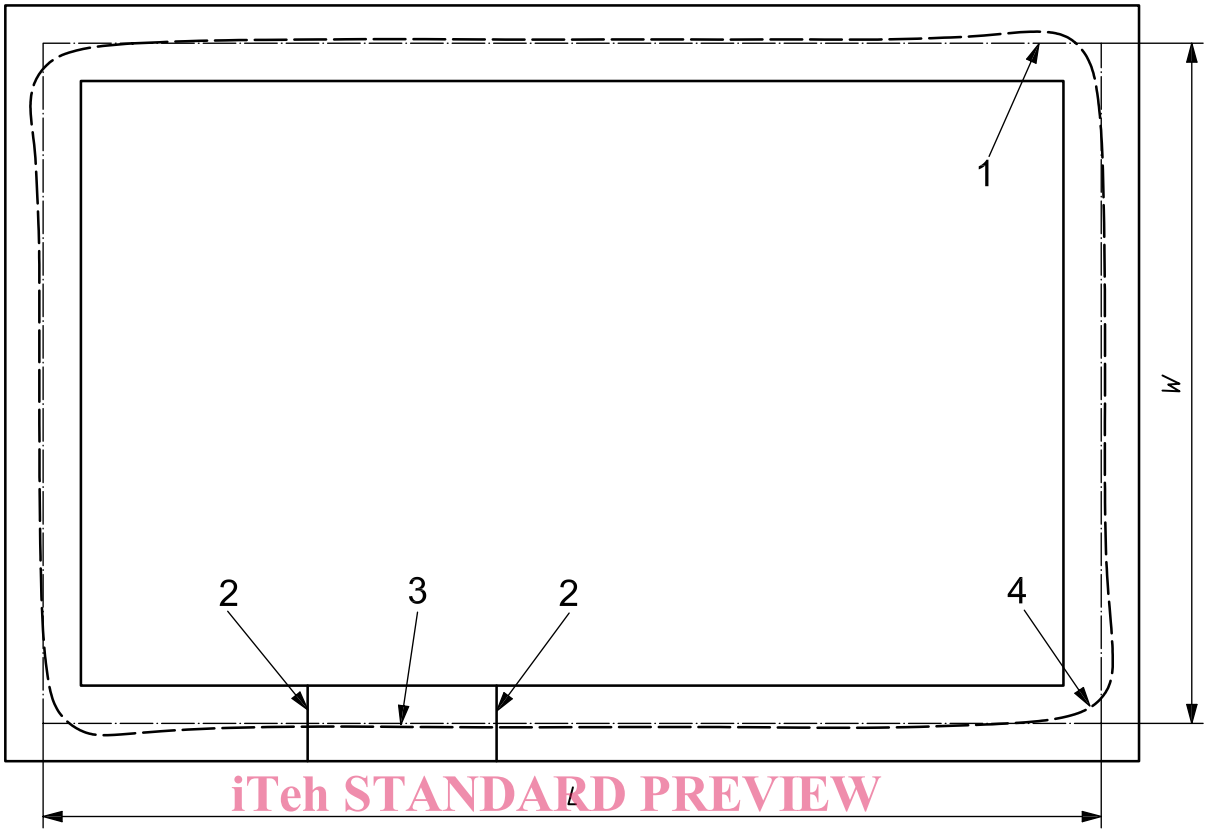
The preferred width of the test track is 2,0 m ± 0,1 m. No part of the track shall be wider than 2,1 m. The track shall not be narrower than 1,9 m in places where it would affect the performance of a test (e.g. the region containing the markers), or be narrower than 1,2 m at any point.

5.2 Energy consumption measurement apparatus, capable of measuring the electrical energy, expressed in watt hours, supplied by the terminals of the wheelchair's battery set, to an accuracy of ± 2 % and which does not itself use more than 0,5 % of the electrical energy supplied. A positive measurement shall represent energy supplied by the battery set to the wheelchair, while a negative measurement shall represent energy returned to the battery set by the wheelchair. Where the apparatus acquires discrete samples, the sampling period shall not be greater than that necessary to provide the required accuracy.

EXAMPLE 100 ms.

For simplicity of analysis it is recommended that the apparatus integrate the power consumption of the wheelchair over time. Annex A gives guidance on energy consumption measurement apparatus.

5.3 Distance measuring device, capable of measuring the length of the centreline of the test track to an accuracy of ± 100 mm.



Key

1 centreline of test track
2 marker
3 centre marker
4 example of wheelchair path (when driving around the track in an anticlockwise direction)
L length of long sides of test track
W length of short sides of test track

NOTE The group of markers 2 and 3 is at any position along the track convenient for performing the manoeuvring test.

Figure 1 — Test track

6 Preparation

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

b) If the wheelchair is fitted with a controller that has adjustable settings accessible to the operator by means provided with the wheelchair, set each of them to the value that provides the maximum magnitude of speed and/or acceleration.

c) Make provision for the wheelchair to be loaded and controlled using one of the following:

1) a human test driver whose mass, when combined with weights if needed, conforms to the requirements for selection and fitting of dummies specified in ISO 7176-22;

2) a dummy selected and fitted as specified in ISO 7176-22, together with means for the wheelchair to be driven automatically or by remote control.