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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 scooters électriques pour la détermination de la distance théorique

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Contents

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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.

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 7176-4 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 7176-4:1988), 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 efficiency 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 retardation of electric wheelchairs
Part 7: Measurement of seating and wheel dimensions
Part 8: Static, impact and fatigue strengths — Requirements and test methods
Part 9: Climatic tests for electric wheelchairs
Part 10: Determination of the 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

The following parts are also on the programme of work:

Part 17: Serial interface for electric wheelchair controllers
Part 18: Stair-traversing devices
Part 19: Wheeled mobility devices for use in motor vehicles
Part 20: Determination of the performance of stand-up type wheelchairs
Part 21: Electromagnetic compatibility of powered wheelchairs and motorized scooters — Requirements and test methods
Part 22: Setup procedures

A technical report will also be made available giving a simplified explanation of these parts of ISO 7176.

Introduction

Energy consumption is affected by a number of factors such as ambient temperature, weight of the user, topography, surface, tyres and battery condition. Hence the results obtained from the test specified in this part of ISO 7176 cannot be used to derive an accurate range for a particular wheelchair and user. However, it can be used to give a basis for comparison between different wheelchairs and scooters. Tests of the same models of several wheelchairs have been conducted by several test institutions and have demonstrated that the wide tolerance on the length of the test track does not have a significant effect on the accuracy of the test result.

Wheelchairs —

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

1 Scope

This part of ISO 7176 specifies a method for determining the energy consumption, expressed as a theoretical distance range, of electric wheelchairs and scooters intended for users whose mass does not exceed 100 kg.

It applies to wheelchairs and scooters with a maximum speed of 15 km/h and intended to carry only one person.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 7176. At the time of publication the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 7176 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6440:1985, *Wheelchairs - Nomenclature, terms and definitions.*

ISO 7176-6:1988, *Wheelchairs - Part 6: Determination of maximum speed, acceleration and retardation of electric wheelchairs.*

ISO 7176-7: –[1], *Wheelchairs - Part 7: Measurement of seating and wheel dimensions.*

ISO 7176-15:1996, *Wheelchairs - Part 15: Requirements for information disclosure, documentation and labelling.*

3 Definitions

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

3.1 maximum user mass:
Maximum mass of user as specified by the wheelchair manufacturer.

3.2 specification sheets:
Manufacturer's pre-sale literature that gives wheelchair pre-sale information.

3.3 wheelchair:
Electrically powered wheelchair or scooter.

[1] To be published.

4 Principle

The wheelchair is driven around the test track at maximum speed 10 times clockwise and 10 times anticlockwise, and the ampere-hours used are measured.

5 Test equipment

5.1 **Test plane**, comprising a flat hard horizontal surface in an area free from draughts in a location where the temperature can be maintained between 18 °C and 25 °C, upon which is marked a rectangular test track.

The test track shall be 2 m wide, with the length of its centreline between 50 m and 100 m. Each long side is to be of sufficient length so that the wheelchair can achieve its maximum speed. See figure 1.

NOTE 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 10 laps, and starting and finishing the test in the same place on the track.

5.2 **Energy consumption meter**, capable of measuring the electric charge, in ampere hours, used by the wheelchair to an accuracy of ± 5% and which does not itself use more than 0,5% of the electric charge used by the wheelchair.

5.3 **Measuring device**, capable of measuring the length of the centreline of the test track with an accuracy of ± 100 mm.

NOTE A tape measure is a suitable measuring device.

5.4 **Camera and film**.

6 Preparation of test wheelchair

6.1 Fit any appropriate armrest and/or footrest available from the wheelchair manufacturer.

6.2 If the wheelchair has pneumatic tyres, inflate them to the pressure recommended by the manufacturer. If a pressure range is given, inflate to the highest pressure in the range.

6.3 Position any adjustable parts to any manufacturer's recommendations for driving.

6.4 For parts for which there are no manufacturer's recommendations for driving, set the adjustable parts of the wheelchair so that as many as possible of the following settings are achieved, with priority given to those earliest in the sequence:

NOTE When adjusting parts of a wheelchair, it is often the case that an adjustment to one part changes another e.g. changing the wheel position may also change the seat angle. Thus it may be necessary to make several re-adjustments to some parts to compensate for the interaction of others. It may also be the case that in order to achieve one setting it is impossible to achieve another.

a) Set any castor stem vertical with a tolerance $^{0°}_{-1°}$

NOTE A negative castor stem angle is that where the top of the stem is to the rear of the bottom of the stem.

b) If the position of the body support systems relative to the frame can be adjusted horizontally and/or vertically, set them at the midposition or, where there is no provision for a middle setting, at the nearest position to the rear of and/or below the midposition respectively.

c) Set adjustable seats so that the seat reference plane, as determined by the method and tolerances specified in ISO 7176-7, slopes at 8° to the horizontal with its forward edge higher than the rear.

d) Set adjustable backrests so that the back reference plane, as determined by the method and tolerances specified in ISO 7176-7, is at 10° to the vertical with the top behind the bottom.

e) Position adjustable foot supports so that the angle between the leg reference plane and the seat reference plane, as specified in ISO 7176-7, is as close as possible to, but not less than, 90°.

f) Set wheels with adjustable camber to the midposition or, where there is no provision for a middle setting, the nearest midposition between vertical and maximum negative camber.

g) If the position of the drive wheels can be adjusted horizontally, set them in the midposition ± 1 mm or, where there is no provision for a middle setting, the nearest position to the rear of the middle.

h) If the position of the drive wheels can be adjusted vertically, set them in the midposition ± 1 mm or, where there is no provision for a middle setting, the nearest position below the middle.

i) If the position of castor wheels can be adjusted horizontally, set them in the midposition ± 1 mm or, where there is no provision for a middle setting, the nearest position to the rear of the middle.

j) If the position of castor wheels can be adjusted vertically, set them in the midposition ± 1 mm or, where there is no provision for a middle setting, the nearest position below the middle.

k) If the width between any castors can be adjusted, set it to its maximum value.

l) If the position of any castor wheel is adjustable for height within the castor fork, set it to the midposition ± 1 mm or, where there is no midposition, the nearest position to the middle which gives the greatest distance between fork and wheel.

m) Set any remaining physical adjustments as near as possible to their midposition. If increments do not permit a unique midposition, select the midposition which gives the largest dimension of the adjustment.

NOTE Electrical adjustments, such as are on speed controllers, are not included.

n) Position the lowest part of the leg support/footrest as close as possible to, but not less than 50 mm above, the test plane.

o) Check that all fasteners are secured in accordance with the manufacturer's specification.

6.5 If the wheelchair is fitted with a controller with adjustable settings that need a tool to make changes, set them as specified by the manufacturer for initial marketing.

6.6 If the wheelchair is fitted with a controller with adjustable settings that are accessible to the user, set the speed and acceleration to their maximum.

6.7 Record the wheelchair equipment settings used during the test.

6.8 Record the position of any adjustable parts.

7 Test procedure

7.1 Using the measuring device (5.3), measure the length of the centreline of the test track to an accuracy of ± 100 mm.

7.2 Using the energy consumption meter (5.2), measure the electric charge, in ampere hours, consumed by the wheelchair batteries.

7.3 Condition the test wheelchair by maintaining it at a temperature of between 18°C and 25°C for not less than 8 h.

7.4 Fully charge the batteries in accordance with the manufacturer's instructions at an ambient temperature of between 18°C and 25°C.

NOTE Conditioning the wheelchair and charging the batteries may be done at the same time.

7.5 Make provision for a wheelchair driver whose mass is as specified in table 1 to drive the wheelchair.

7.6 Photograph the wheelchair and retain the photograph for the test report (see clause 8).

Table 1 — Driver mass

Maximum user mass specified by wheelchair manufacturer kg	Mass of test wheelchair driver kg
⩽ 25	$25\ ^{+4}_{-2}$
⩾ 26 and ⩽ 50	$50\ ^{+5}_{-2}$
⩾ 51 and ⩽75	$75\ ^{+5}_{-2}$
⩾ 76 and ⩽ 100	$100\ ^{+5}_{-2}$

NOTE 1 Weights may be added on the seat of the wheelchair to supplement the mass of a small driver (sandbags or similar items are recommended).

NOTE 2 The wheelchair may be loaded with a dummy of mass as specified in table 1 and a remote-control system used instead of a human driver.

7.7 Drive the wheelchair around the test track 10 times to warm up the wheelchair drive system.

7.8 Measure the maximum speed of the wheelchair by the method specified in ISO 7176-6.

7.9 Ensure that the dimensions of the test track enable the wheelchair to reach its maximum speed on each side of the track.

7.10 Drive the wheelchair around the test track at the maximum speed possible whilst staying within the confines of the track. Drive 10 times in a clockwise direction and 10 times in an anti-clockwise direction, starting and stopping the test in the same place. Measure the electric charge, in ampere hours, used by the wheelchair to an accuracy of ± 10 %.

NOTE This test will not normally totally discharge the battery(ies) of a wheelchair, but care should be taken not to discharge battery(ies) below the level recommended by the manufacturer.

7.11 Calculate the distance range *R* of the wheelchair from the formula

$$R = \frac{CD}{1000E}$$

where

R is the theoretical distance range, in kilometres;
C is the capacity of the battery, in ampere hours, at a five-hour rate of discharge as declared by the battery manufacturer;
D is 20 times the length of the centreline of the test track, expressed in metres;
E is the electric charge, in ampere hours, used during the test.

8 Test report

The test report shall contain at least the following information.

a) A statement that the tests conform to the requirements of ISO 7176-4;
b) manufacturer's product description;
c) name and address of the wheelchair manufacturer;
d) a photograph of the wheelchair equipped as during the tests;
e) serial number or manufacturer's other identification of the wheelchair;
f) name and address of the testing institution;
g) battery type and capacity at a five-hour rate of discharge as declared by the battery manufacturer;
h) the wheelchair settings recorded in 6.7 and 6.8;
i) the theoretical range of the wheelchair, in kilometres, as calculated in 7.11, expressed to two significant figures;
j) a unique test report reference.

9 Disclosure of results

Manufacturers shall disclose in their specification sheet(s), in the manner and sequence specified in ISO 7176-15, the theoretical distance range(s) determined from the energy consumption as calculated to two significant figures, and in addition the corresponding total battery capacity(ies) at the five-hour rate of discharge.