INTERNATIONAL STANDARD

ISO 7176-14

Second edition
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Wheelchairs —

Part 14: Power and control systems for electrically powered wheelchairs and scooters — Requirements and test methods

Fauteuils roulants —
Partie 14: Systèmes d'alimentation et de commande des fauteuils roulants et des scooters électriques — Exigences et méthodes d'essai

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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 7176-14 was prepared by Technical Committee ISO/TC 173, *Assistive products for persons with disability*, Subcommittee SC 1, *Wheelchairs*.

This second edition cancels and replaces the first edition (ISO 7176-14:1997), all clauses 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 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 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

This part of ISO 7176 specifies some wheelchair tests that are conducted on an inclined test plane. The intention of these tests is not to evaluate the performance of a wheelchair at the maximum gradient on which it is capable of operating. Instead, the objective is to reveal any changes in the wheelchair's behaviour that might occur under fault conditions, and these changes are more readily discovered when it is operated on a slope. For convenience, the inclined test plane has a fixed gradient, representative of those on which the wheelchair might be used.

The range of ambient temperatures under which testing is carried out is limited to allow comparison between the performance of a wheelchair in normal operation and performance when faults are introduced.

Wheelchairs —

Part 14: Power and control systems for electrically powered wheelchairs and scooters — Requirements and test methods

WARNING — This part of ISO 7176 calls for the use of procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve those carrying out or commissioning the tests from legal obligations relating to health and safety. For tests that could cause the wheelchair to exhibit dangerous behaviour, it is recommended that prior to carrying out those tests, the likely outcome is assessed to establish appropriate arrangements to minimize any risks.

1 Scope

This part of ISO 7176 specifies requirements and associated test methods for the power and control systems of electrically powered wheelchairs and scooters. It sets safety and performance requirements that apply during normal use and some conditions of abuse and failure. It also specifies methods of measurement of the forces necessary to operate controls and sets limits on the forces needed for some operations.

This part of ISO 7176 is applicable to electrically powered wheelchairs and scooters with a maximum speed no greater than 15 km/h intended to provide indoor and/or outdoor mobility for one disabled person whose mass lies in the range specified in ISO 7176-11.

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 3287, *Powered industrial trucks — Symbols for operator controls and other displays*

ISO 7176-3, *Wheelchairs — Part 3: Determination of effectiveness of brakes*

ISO 7176-4, *Wheelchairs — Part 4: Energy consumption of electric wheelchairs and scooters for determination of theoretical distance range*

ISO 7176-6, *Wheelchairs — Part 6: Determination of maximum speed, acceleration and deceleration of electric wheelchairs*

ISO 7176-9, *Wheelchairs — Part 9: Climatic tests for electric wheelchairs*

ISO 7176-11, *Wheelchairs — Part 11: Test dummies*

SO 7176-13, *Wheelchairs — Part 13: Determination of coefficient of friction of test surfaces*

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

ISO 7176-21, *Wheelchairs — Part 21: Requirements and test methods for electromagnetic compatibility of electrically powered wheelchairs and motorized scooters*

ISO 7176-22, *Wheelchairs — Part 22: Set-up procedures*

ISO 7176-26, *Wheelchairs — Part 26: Vocabulary*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60601-1, *Medical electrical equipment — Part 1: General requirements for basic safety and essential performance*

IEC 60601-1-2, *Medical electrical equipment — Part 1-2: General requirements for basic safety and essential performance — Collateral standard: Electromagnetic compatibility — Requirements and tests*

IEC 61032, *Protection of persons and equipment by enclosures — Probes for verification*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

EN 563, *Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces*

EN 12182, *Technical aids for disabled persons — General requirements and test methods*

EN 30993-1, *Biological evaluation of medical devices — Part 1: Guidance on selection of tests*

UL 94, *Tests for flammability of plastic materials for parts in devices and appliances*

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
nominal voltage
suitable approximate value of the voltage used to designate or identify a battery

[Adapted from IEV 482-03-31]

3.2
command signal
electrical signal from the control device

3.3
control device
device with which the operator indicates the desired speed and/or direction of movement of the wheelchair

NOTE A control device can be an integral part of a controller.

3.4
controller
electrical devices, circuits, and the case(s) in which they are housed that are used to convert the operator's indication of desired speed and/or direction of movement into the appropriate power to be supplied to the motor(s)

3.5
pinch point
location at which a moving part comes into contact with or close proximity to another part such that another object at that location would be cut or crushed

3.6
battery
one or more cells fitted with devices necessary for use, for example case, terminals, marking and protective devices

[IEV 482-01-04]

3.7
battery compartment
removable or non-removable enclosure for one or more batteries

3.8
battery pack
removable battery compartment that contains one or more batteries

NOTE If there are no removable battery compartments, a battery pack consists of a single battery.

3.9
battery set
set of interconnected batteries used to power a wheelchair

3.10
battery charger
device that is connected to supply mains and to a battery set for the purpose of charging the batteries

3.11
cut-off voltage
specified voltage at which the discharge of a battery is considered finished

3.12
hazardous situation
circumstance in which people, property or the environment are exposed to one or more hazard(s)

[IEC 60601-1]

3.13
hazard
potential source of harm

[IEC 60601-1]

3.14
harm
physical injury or damage to the health of people or animals, or damage to property or the environment

[IEC 60601-1]

3.15
enclosure
part providing protection of equipment against certain external influences and, in any direction, protection against contact

NOTE 1 Enclosures provide protection of equipment against harmful effects of mechanical impacts.

NOTE 2 Barriers, shapes of openings or any other means – whether attached to the enclosure or formed by the enclosed equipment – suitable to prevent or limit the penetration of the specified test probes, are considered as a part of the enclosure, except when they can be removed without the use of a key or tool.

3.16
capacity
⟨for cells or batteries⟩ electric charge which a cell or battery can deliver under specified discharge conditions

NOTE The SI unit for electric charge, or quantity of electricity, is the coulomb, C [1 C = 1 As (ampere second)] but in practice, capacity is usually expressed in ampere hours (Ah).

[IEV 482-03-14]

3.17
rated capacity
capacity value of a battery determined under specified conditions and declared by the manufacturer

[IEV 482-03-15]

3.18
discharge rate
electric current at which a battery is discharged

NOTE The discharge rate is calculated as the rated capacity divided by the corresponding discharge time, which results in an electric current.

[IEV 482-03-25]

3.19
charge rate

⟨relating to secondary cells and batteries⟩ electric current at which a secondary cell or battery is charged

NOTE The charge rate is expressed as the reference current $I_t = C_r/n$ where C_r is the rated capacity declared by the manufacturer and n is the time base in hours for which the rated capacity is declared.

[IEV 482-05-45]

3.20
theoretical state of charge
electric charge added to a fully discharged battery by charging at a known charge rate for a known time, or estimated to remain in a battery that has been fully charged and then discharged at a known discharge rate for a known time, and expressed as a percentage of the rated capacity

3.21
terminal
conductive part of a device, electric circuit or electric network, provided for connecting that device, electric circuit or electric network to one or more external conductors

[IEV 151-12-12]

NOTE Removable bolts, screws and fasteners are not considered part of a terminal.

3.22
analogue signal
signal in which the characteristic quantity representing information may at any instant assume any value within a continuous interval

NOTE For instance, an analogue signal may follow continuously the values of another physical quantity representing information.

[IEV 702-04-02]

3.23
leakage current
electric current in an unwanted conductive path other than a short circuit

[IEV 151-15-49]

4 Apparatus

4.1 Inclined test plane, with a surface of sufficient friction (as specified in ISO 7176-13) to cause minimal wheel slippage, of sufficient size to enable the applicable tests specified in this part of ISO 7176 to be performed and with a marker from which wheelchair stopping distance can be measured.

The inclined test plane shall be fixed at 3° or 6° to the horizontal. The steeper gradient shall be used unless the loaded wheelchair (see 5.2) is unable to climb it at a speed greater than 0,5 km/h.

NOTE An inclined test plane of size 6,0 m × 1,5 m will usually be suitable for testing a wheelchair with a maximum speed of 6 km/h.

4.2 Horizontal test plane, with the same high-friction surface as the inclined test plane (4.1), and of sufficient size to enable the applicable tests specified in this part of ISO 7176 to be performed.

NOTE A horizontal test plane of size 6,0 m × 1,5 m will usually be suitable for testing a wheelchair with a maximum speed of 6 km/h.

4.3 Acoustic test area, marked on a horizontal plane in a room with an ambient noise level not exceeding 55 dB(A-weighted) and of sufficient length for the wheelchair to attain its maximum speed before reaching the test area specified in 10.6 and to stop safely beyond the test area.

4.4 Speedometer, or other means for measuring the speed of a wheelchair within a range of 0 km/h to 20 km/h, to an accuracy of ± 0,5 km/h.

4.5 Means of measuring stopping distance of a wheelchair, to an accuracy of ± 100 mm.

NOTE It is important that the means for measuring the speed (4.4) and stopping distance give the required accuracy. Suitable methods include:

a) a photocell-operated interrupting switch capable of detecting reflective tape or a light source on the test plane;

b) a “fifth wheel” capable of recording the distance travelled where the recording device can be started by the interrupting switch.

4.6 Voltage source, with a voltage adjustable in the range 0,25 U_B to 1,5 U_B, where U_B is the nominal voltage of the battery set, expressed in volts.

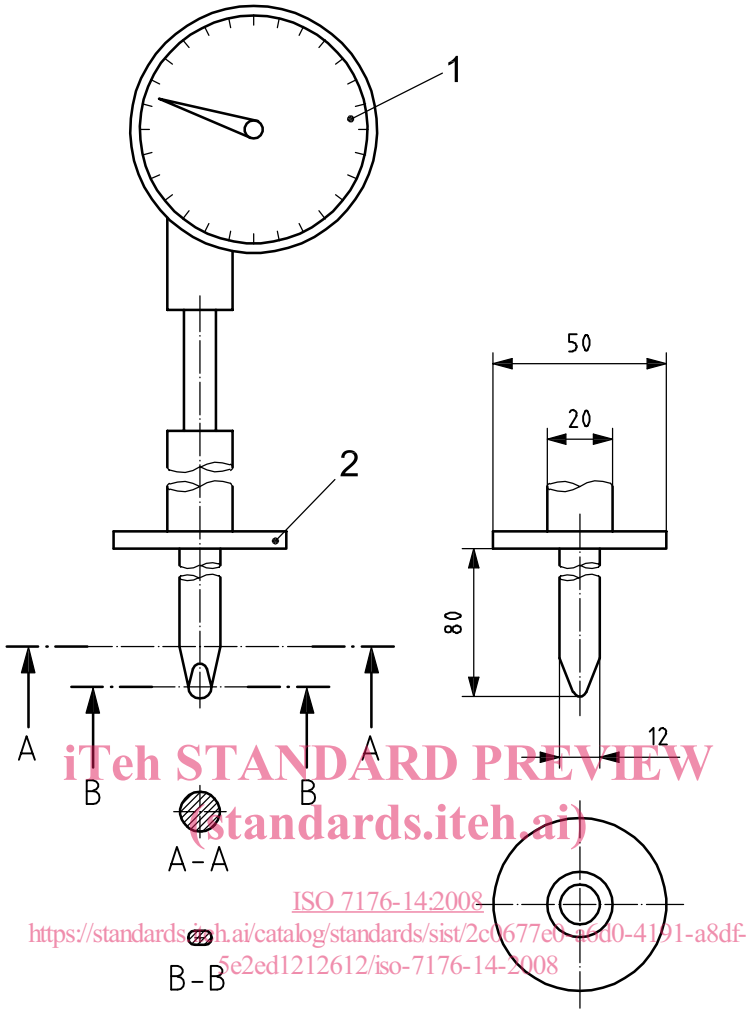
The voltage source shall be capable of supplying the peak current drawn from the battery set during wheelchair operation and shall be capable of sinking the peak current returned to the battery during wheelchair operation. Any change in the voltage shall be no greater than 5 % of U_B while the current is within this range.

4.7 Test probe B, as specified in IEC 61032.

4.8 Test probe 18, as specified in IEC 61032.

4.9 Test probe 11, as specified in IEC 61032, capable of attachment to a force measuring instrument (4.11). See Figure 1.

Dimensions in millimetres



Key

1 force measuring instrument
2 stop plate

Figure 1 — Test probe 11 (informative)

4.10 Small unjointed test probe, constructed as specified for test probe 18 (4.8), but without joints, and capable of attachment to a force measuring instrument (4.11) both with and without the handle extension.

4.11 Force measuring instrument, capable of measuring forces in the range of 0 N to 150 N in increments of 1 N with an accuracy of ± 1 N.

4.12 Force measuring instrument for control devices, capable of measuring forces in a range of 0 N to 10 N in 0,1 N increments with an accuracy of ± 0,1 N, and that can be fitted with a rigid spherical tip of radius 5,0 mm ± 0,2 mm.

4.13 Positive differential air pressure measuring device, capable of measuring positive differential air pressure, relative to local atmospheric pressure, in a range of 0 kPa to 20 kPa in 200 Pa increments with an accuracy of ± 200 Pa.

4.14 Negative differential air pressure measuring device, capable of measuring negative differential air pressure, relative to local atmospheric pressure, in a range of 0 kPa to −20 kPa in 200 Pa increments with an accuracy of ± 200 Pa.

4.15 Test circuit, that can be arranged as shown in Figure 2 and Figure 3, comprising the following:

a) direct current ammeter, capable of measuring current in the range 0 mA to 10 mA in 1 mA increments with an accuracy of ± 1 mA, and capable of withstanding a current of 100 mA;

b) a resistor of resistance R ± 5 %, where R (in ohms) is calculated from the following expression:

$$R = \frac{U_B}{0{,}1}$$

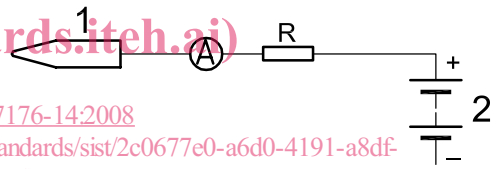
where U_B is the nominal voltage of the battery set.

EXAMPLE At 12 V, R is 120 Ω; at 24 V, R is 240 Ω.

The minimum power rating P (in watts) of the resistor is calculated from the following expression:

$$P = 0{,}1 \times U_B$$

c) test probe 11 (4.9).



Key

1 test probe
2 wheelchair battery set

Figure 2 — Test circuit in positive configuration

Key

1 test probe
2 wheelchair battery set

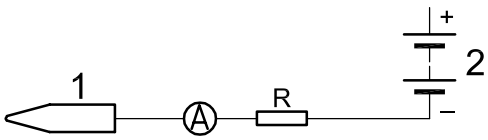


Figure 3 — Test circuit in negative configuration

4.16 Circuit breaker, manually operated, capable of interrupting the maximum possible current obtainable from the battery set or batteries, such that the voltage drop across the circuit breaker and its associated wiring at that current does not exceed 10 % of the nominal voltage of the battery set.

NOTE Typical wheelchair batteries have maximum short-circuit currents of several hundred amperes.

4.17 Means for supporting the wheelchair, such that it is upright and secure, with all wheels lifted off the ground and free to revolve.

4.18 Means for measuring sound pressure level, to an accuracy of ± 3 dB(A-weighted).

4.19 Fine wire thermocouples, with suitable means for indicating temperature to an accuracy of ± 2 °C.