INTERNATIONAL STANDARD

ISO 7176-9

Third edition
2009-11-15

Wheelchairs —

Part 9: Climatic tests for electric wheelchairs

Fauteuils roulants —

Partie 9: Essais climatiques pour 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 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 7176-9 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 7176-9:2001), all clauses of which have been technically revised.

Significant technical changes from the second edition are that the climatic tests are carried out in a specified sequence, the cold operating conditions test is repeated (to cause a build-up of condensation within enclosures) and inspection is carried out following the water spray test to confirm that creepage and clearance distances will remain acceptable. In addition, the effects of dust are now included in the scope of this International Standard, although requirements are under consideration.

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 electrically powered 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 scooters, and battery chargers*

— *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*

— *Part 28: Requirements and test methods for stair-climbing devices*

Introduction

Wheelchairs can be used or stored in adverse environmental conditions which could severely affect their functioning, sometimes to the extent of being dangerous. The tests specified in this part of ISO 7176 have been developed to determine whether, and to what extent, wheelchairs are vulnerable to environmental conditions. Operation is tested in conditions which simulate use in some of the wider climatic variations experienced around the world.

The wheelchair electrical system might be exposed to liquids, including salt water. Since the effects of salt water contamination are difficult to evaluate, the immunity of the system is assessed on the basis of exposure to a fresh water spray.

Wheelchairs —

Part 9:
Climatic tests for electric wheelchairs

1 Scope

This part of ISO 7176 specifies requirements and test methods to determine the effects of rain, dust, condensation and the effects of changes of temperature on the basic functioning of electrically powered wheelchairs, including scooters, intended to carry one person, with a maximum speed not exceeding 15 km/h.

This part of ISO 7176 does not include requirements for resistance to corrosion.

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 — Test dummies*

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

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

ISO 7176-26, *Wheelchairs — 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*

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
standard ambient conditions
environmental conditions of 20 °C ± 5 °C and relative humidity of 60 % ± 20 %

3.2
enclosure
housing affording the type and degree of protection suitable for the intended application

[IEV 195-02-35]

4 Principle

The functioning of the wheelchair is tested after it has been exposed to environmental conditions that are expected in normal use, storage and transportation.

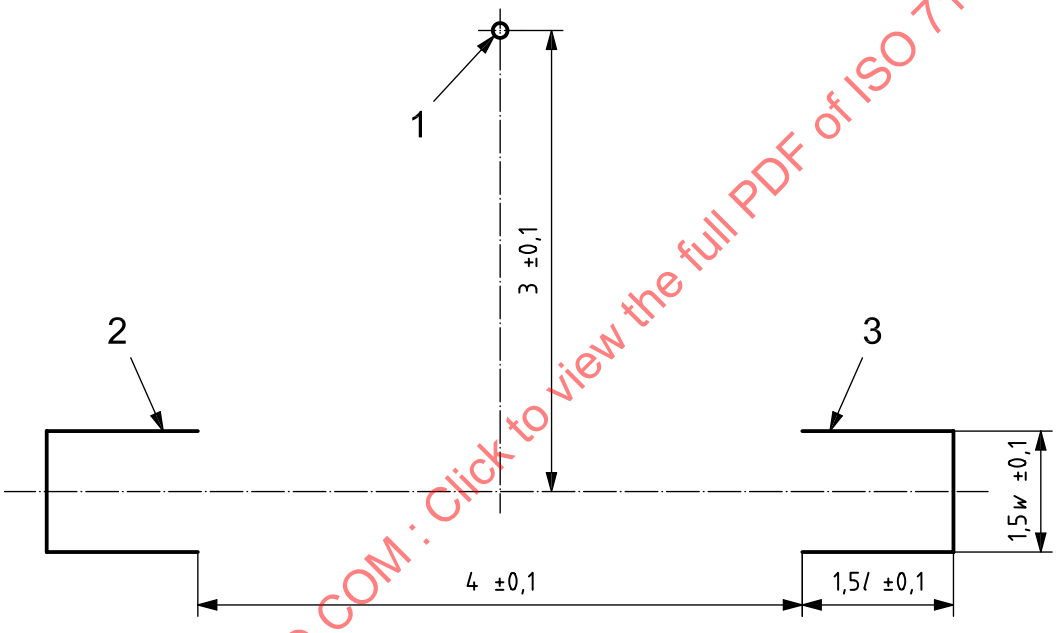
NOTE Conditions expected in normal use include extremes of temperature, and rain.

5 Apparatus

5.1 Test track, marked as shown in Figure 1 and consisting of a flat, horizontal plane at standard ambient conditions.

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

Dimensions in metres



Key
1 marker M
2 rectangle A
3 rectangle B

Figure 1 — Test track

The markings consist of the following:

— a single marker M with no horizontal dimensions greater than 200 mm;

— two open rectangles, A and B, with

  — length L = 1,5l ± 100 mm;

  — width W = 1,5w ± 100 mm;

where

l is the full overall length of the wheelchair;

w is the overall width of the wheelchair.

5.2 Test dummy, as specified in ISO 7176-11, selected as specified in ISO 7176-22, or a human test occupant with supplementary weights added to give a mass distribution equivalent to the applicable dummy.

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.

5.3 Means to drive the wheelchair, which may be a remote controller or the human test occupant, if used.

5.4 Thermometer, to measure ambient air temperature to an accuracy of ±1 °C.

5.5 Stopwatch, to measure time to an accuracy of ±1 s.

5.6 Hygrometer, to measure relative humidity to an accuracy of ±2 %.

5.7 Cold test environment, to subject a wheelchair to ambient conditions of (–40 ± 5) °C and ($-25\ ^{+2}_{-5}$) °C.

5.8 Hot test environment, to subject a wheelchair to ambient conditions of ($50\ ^{+5}_{-2}$) °C and (65 ± 5) °C.

5.9 Ambient test environment, to subject a wheelchair to **standard ambient conditions** (3.1).

5.10 Water spray, spray water as specified in IEC 60529 for second characteristic numeral 4.

5.11 Means to support the wheelchair, as specified in 8.6.

6 Preparation of test wheelchair

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

NOTE The dummy or human test occupant is placed in the wheelchair only during the functional testing specified in Clause 9.

6.2 Make provision to detect any movement of driven parts of the wheelchair during the tests.

EXAMPLE Making marks on the driven wheels, seat raising mechanism and back support reclining mechanism.

6.3 Ensure the batteries are fully charged before commencing each test.

6.4 If practicable, ensure that any facilities that cause the wheelchair to deactivate automatically, or to switch off after being unused for a period of time, are disabled.

EXAMPLE Sleep mode.

NOTE Where such features cannot be disabled it will be necessary to reactivate the wheelchair during exposure to some test conditions. See 8.1.

7 Requirements

The wheelchair shall continue to function according to the manufacturer's specifications after being subjected to each of the tests specified in Clause 8.

At the end of testing, there shall be no evidence of water that could result in reduction of clearances and creepage distances below the applicable values specified in IEC 60601-1 for degree of pollution 3.

NOTE This applies only to creepage and clearance distances between conductors that are equal to, or less than, those specified in IEC 60601-1 for degree of pollution 3, that would carry a continuous current of more than 5 A when leakage occurs, and that are in enclosures where water ingress has occurred during the test specified in 8.6.

When the wheelchair is tested as specified in Clause 8:

— it shall meet the requirements of the functional check specified in Clause 9;

— no driven part shall exhibit unintended movement during exposure to the specified test conditions.

8 Test methods

8.1 General

Conduct the tests specified in 8.2 to 8.6 in the following sequence:

a) Cold operating conditions and resistance to condensation (8.2);

b) Hot operating conditions (8.3);

c) Cold storage conditions (8.4);

d) Hot storage conditions (8.5);

e) Protection against ingress of liquids (8.6).

If features that cause the wheelchair to deactivate automatically or to switch off after being unused for a period of time cannot be disabled (see 6.4), ensure that the wheelchair is reactivated promptly whenever such features operate during the tests specified in 8.2 to 8.6.

Do not change the set-up of the wheelchair except as specified for a test.

EXAMPLE Removal and replacement of the test dummy or human test occupant; removal and replacement of batteries; operational check of non-drive control functions.

8.2 Cold operating conditions and resistance to condensation

CAUTION — During this test the wheelchair will become very cold. It is essential that appropriate safety precautions be taken to protect test personnel.

a) Store the wheelchair for not less than 20 h in standard ambient conditions with the wheelchair switched off.

b) Carry out the functional check specified in Clause 9.

c) Leaving the wheelchair switched on, subject it to a temperature of $(-25\ ^{+2}_{-5})$ °C for not less than 3 h.

d) Inspect the wheelchair for evidence that any driven part has moved.

e) Conduct the functional check specified in Clause 9 commencing within 5 min of completion of c) and continue testing until all visible parts of the control system have warmed such that no frost remains.

f) Leave the wheelchair switched on for 1 h ± 5 min in standard ambient conditions.

g) Inspect the wheelchair for evidence that any driven part has moved.

h) Conduct the functional check specified in Clause 9 commencing within 5 min of completion of f).

i) Repeat c) to h) for a total of two times, commencing as soon as practicable, and within 5 min, after completing the functional test in h).

NOTE 1 The test is repeated to provide a build-up of condensation.

NOTE 2 The batteries can be replaced with charged ones after g) if it is necessary for the repetition of the test.

8.3 Hot operating conditions

CAUTION — During this test the wheelchair will become very hot. It is essential that appropriate safety precautions be taken to protect test personnel.

a) Store the wheelchair for not less than 20 h and not more than 72 h in standard ambient conditions with the wheelchair switched off.

b) Carry out the functional check specified in Clause 9.

c) Leaving the wheelchair switched on, subject it to a temperature of $(50\ ^{+5}_{-2})$ °C for not less than 3 h.

d) Inspect the wheelchair for evidence that any driven part has moved.

e) Conduct the functional check specified in Clause 9 commencing within 5 min of completion of c).

f) Leave the wheelchair switched on for 1 h ± 5 min in standard ambient conditions.

g) Inspect the wheelchair for evidence that any driven part has moved.

h) Conduct the functional check specified in Clause 9 commencing within 5 min of completion of f).

8.4 Cold storage conditions

CAUTION — During this test the wheelchair will become very cold. It is essential that appropriate safety precautions be taken to protect test personnel.

a) Store the wheelchair for not less than 20 h and not more than 72 h in standard ambient conditions with the wheelchair switched off.

b) Carry out the functional check specified in Clause 9.

c) Remove the batteries from the wheelchair.

d) Subject the wheelchair to a temperature of (–40 ± 5) °C for not less than 5 h.

e) Store the wheelchair for 1 h ± 5 min in standard ambient conditions.

f) Replace the batteries removed in c).

g) Conduct the functional check specified in Clause 9 commencing within 5 min of completion of e).

8.5 Hot storage conditions

CAUTION — During this test the wheelchair will become very hot. It is essential that appropriate safety precautions be taken to protect test personnel.

a) Store the wheelchair for not less than 20 h and not more than 72 h in standard ambient conditions with the wheelchair switched off.

b) Carry out the functional check specified in Clause 9.

c) Switch off the wheelchair.

d) Subject the wheelchair to a temperature of (65 ± 5) °C for not less than 5 h.

e) Inspect the wheelchair for evidence that any driven part has moved.

NOTE 1 The wheelchair might have a fault that causes it to turn on and move during hot storage.

f) Store the wheelchair for 1 h ± 5 min in standard ambient conditions.

g) Inspect the wheelchair for evidence that any driven part has moved.

NOTE 2 The wheelchair might have a fault that causes it to turn on and move after hot storage.

h) Conduct the functional check specified in Clause 9 commencing within 5 min of completion of f).

8.6 Protection against ingress of liquids

a) Store the wheelchair for not less than 20 h and not more than 72 h in standard ambient conditions with the wheelchair switched off.

b) Carry out the functional check specified in Clause 9.

c) Support the wheelchair in such a manner that the water spray specified in 5.10 can be applied from beneath the wheelchair without obstruction by the support.

d) With the wheelchair switched on, apply the water spray (5.10) as specified in IEC 60529.

NOTE 1 Either the hoop or spray method can be used.

e) Determine whether any driven part of the wheelchair has moved during the test.

f) Conduct the functional check specified in Clause 9 commencing within 5 min of completion of d).

g) Leave the wheelchair switched on for 1 h ± 5 min in standard ambient conditions.

h) Inspect the wheelchair for evidence that any driven part has moved.

i) Conduct the functional check specified in Clause 9 commencing within 5 min of completion of g).

j) Inspect all enclosures containing electrical parts, and all electrical connectors to identify those places where water ingress has occurred.

NOTE 2 Carefully wipe enclosures to remove any surplus water before inspection. Take care when removing and opening enclosures to avoid displacing any water inside them.

k) Determine whether the wheelchair meets the requirements stated in Clause 7.

9 Functional check

9.1 General

The following test is used to determine whether the wheelchair performs acceptably before and after being subjected to the environmental conditions specified in Clause 8.

9.2 Requirements

When the wheelchair is tested as specified in 9.3:

a) neither the wheelchair, nor any part of the wheelchair, shall make an unintended or abnormal movement;

b) the time taken to drive the wheelchair between the rectangles on the test path specified in Figure 2 shall not exceed 60 s;

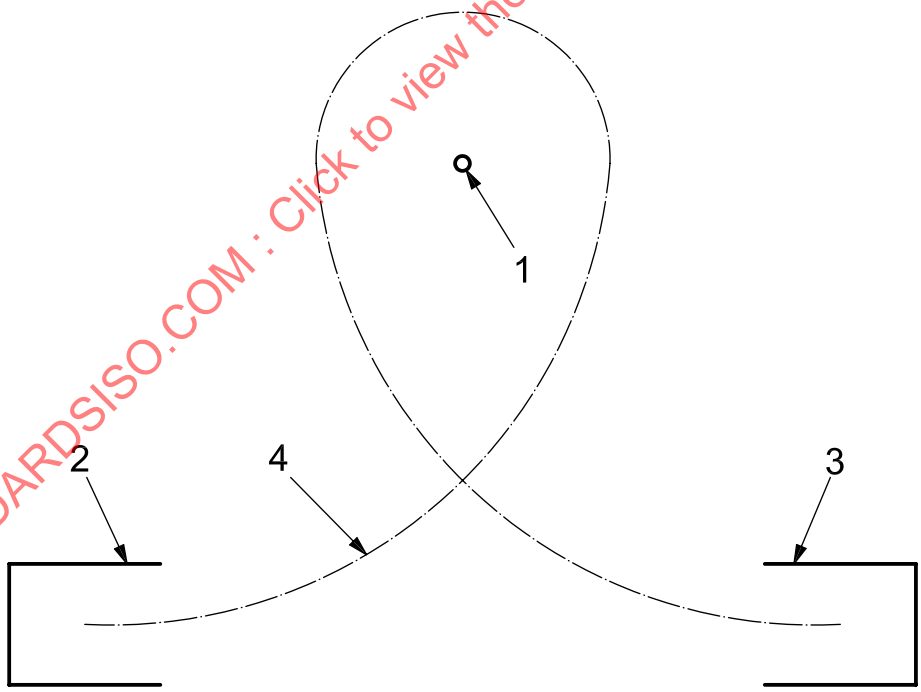
c) all non-drive control functions (e.g. actuators, lights, etc.) shall operate as intended by the manufacturer;

NOTE Some functions might be intended for use in a specified environment.

d) the wheelchair shall not fail to stop when commanded by the control device;

e) after being brought to a stop, the wheelchair shall remain stationary;

f) the means for switching the wheelchair on and off shall operate as intended.



Key

1 marker M
2 rectangle A
3 rectangle B
4 intended test path

Figure 2 — Test path

9.3 Test method

Complete the following procedure within 10 min.

CAUTION — This test can be hazardous. It is essential that appropriate safety precautions be taken to protect test personnel.

a) Place the wheelchair on the test track in rectangle A so that it faces rectangle B (see Figure 2).

b) Place the dummy or human test occupant in the wheelchair and set up the means to drive the wheelchair as specified in 5.3.

NOTE Precise positioning of the dummy is not critical to this test.

c) Switch on the wheelchair, then off and then on again.

d) Drive the wheelchair forwards around the marker and into the opposite rectangle as shown in Figure 2.

e) Stop the wheelchair by means of the control device and release the control device.

f) Observe and record whether the wheelchair fails to stop or exhibits any other abnormal response.

g) Record the time the wheelchair was in motion.

h) Observe the wheelchair for not less than 15 s and record whether the wheelchair fails to remain stationary.

i) Repeat the procedure specified in c) to h) driving the chair backwards from rectangle B around the marker and into rectangle A.

j) Turn the wheelchair on the test track so that it is placed within rectangle A and facing away from rectangle B.

k) Repeat the procedure specified in c) to h) but driving the wheelchair backwards.

l) Repeat the procedure specified in i) but driving the wheelchair forwards.

m) Operate any control functions other than the control device, and record any unintended or abnormal operation or movement.

EXAMPLE Electrically adjustable seat; wheelchair lights.

n) Ensure the wheelchair is restored to its set-up condition as specified in Clause 6.

o) Remove the test dummy or human test occupant from the wheelchair.

p) Record whether the wheelchair met the requirements specified in 9.2.

10 Test report

The test report shall contain the following information:

a) a reference to this part of ISO 7176, i.e. ISO 7176-9:2009;

b) the name and address of the test institution;

c) the name and address of the manufacturer of the wheelchair;