
Wheelchairs —

Part 23:

**Requirements and test methods for
attendant-operated stair-climbing devices**

Fauteuils roulants —
STANDARD PREVIEW
*Partie 23: Exigences et méthodes d'essai pour les monte-escalier
manipulés par une tierce personne*

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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 7176-23 was prepared by Technical Committee ISO/TC 173, *Technical systems and aids for disabled or handicapped persons*, Subcommittee SC 1, *Wheelchairs*.

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 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 19: Wheeled mobility devices for use in motor vehicles

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- *Part 22: Set-up procedures*
- *Part 23: Requirements and test methods for attendant-operated stair-climbing devices*

The following parts are also on the programme of work:

- *Part 20: Determination of the performance of stand-up wheelchairs*
- *Part 21: Electromagnetic compatibility of electrically powered wheelchairs and motorized scooters — Requirements and test methods*
- *Part 24: Requirements and test methods for user-operated stair-climbing devices*
- *Part 25: Requirements and test methods for batteries and their chargers for powered wheelchairs and motorized scooters*
- *Part 26: Vocabulary*

Annexes A to D of this part of ISO 7176 are for information only.

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Introduction

The goal of this part of ISO 7176 is to create a common understanding, and to develop a means of qualifying and quantifying the various conditions and environments encountered in stair-climbing operations, and stair-climbing device performance. If the stair-climbing device can be used as a wheelchair, it shall also meet all ISO requirements for wheelchairs. This will allow the users and manufacturers to evaluate and communicate the pertinent safety and utility issues.

These tests are used to gather comparison information about factors relating to the performance of the stair-climbing device whilst in stair-climbing mode on stairs and on level ground. They include identification of suitable operating environments for each device and indications of various performance criteria in stair-climbing mode for on-stair operations and on level ground.

NOTE 1 When ascending stairs, present known attendant-operated stair-climbing devices are driven backwards, which means that the attendant goes backwards up the stairs with the occupant facing downstairs. Descending stairs is performed forwards with the occupant facing downstairs.

NOTE 2 Elements of this part of ISO 7176 may be used as a basis for developing requirements and test methods for stair-climbing devices not covered by this part of ISO 7176.

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 the manufacturer or test house from legal obligations relating to health and safety at any stage.

NOTE 3 The attendant should be familiar with the operation of the stair-climbing device and not apply forces other than those minimally necessary to operate the device.

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Some stair-climbing devices may have adjustable components and/or alternative parts. Where there is an obligation to ensure that all variations conform to this part of ISO 7176, it is for those commissioning the tests to decide, which configurations should be tested.

It is anticipated that this part of ISO 7176 will continue to be developed and future revisions may include the results of ongoing work in the following areas:

- fatigue-strength test for joystick;
- determination of static stability on winding stairs;
- development of the fatigue-strength test for stair-climbing devices in informative annex B to a normative test method;
- development of the edge stop test in annex C to a normative test method;
- development of the configuration and position of the stair-climbing device for stability tests in annex D to a normative test method.

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Wheelchairs —

Part 23:

Requirements and test methods for attendant-operated stair-climbing devices

1 Scope

This part of ISO 7176 specifies requirements and test methods for electrically propelled stair-climbing devices and stair-climbing wheelchair carriers operated by an attendant. It also includes ergonomic, safety labelling and disclosure requirements.

This part of ISO 7176 is applicable to stair-climbing devices for which the attendant walks directly behind the device and where the device is driven backwards when ascending stairs.

NOTE This means that when ascending stairs the attendant walks backwards up the stairs, with the occupant facing downstairs. Descending stairs is performed forwards with the occupant facing downstairs.

2 Normative references

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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 3880-1, *Building construction — Stairs — Part 1: Vocabulary.*

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

ISO 7176-1, *Wheelchairs — Part 1: Determination of static stability.*

ISO 7176-3, *Wheelchairs — Part 3: Determination of efficiency 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 7176-8:1998, *Wheelchairs — Part 8: Requirements and test methods for static, impact and fatigue strengths.*

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

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

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

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ISO 7176-14, *Wheelchairs — Part 14: Power and control systems for electric wheelchairs — Requirements and test methods.*

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

ISO 7176-16:1997, *Wheelchairs — Part 16: Resistance to ignition of upholstered parts — Requirements and test methods.*

ISO 7176-19, *Wheelchairs — Part 19: Wheeled mobility devices for use in motor vehicles.*

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

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

ISO 7193, *Wheelchairs — Maximum overall dimensions.*

3 Terms and definitions

For the purposes of this part of ISO 7176, the terms and definitions given in ISO 3880-1, ISO 6440, ISO 7176-15 and the following apply.

3.1

stair-climbing device

electrically propelled stair-climbing wheelchair or wheelchair carrier

3.2

attendant-operated stair-climbing wheelchair

wheelchair, operated by an attendant, intended by the manufacturer to be powered up and down on stairs with a seated occupant

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3.3

attendant-operated stair-climbing wheelchair carriers

portable device, operated by an attendant, intended by the manufacturer to be attached to a wheelchair in order to power it up and down on stairs with a seated occupant

3.4

climbing

ascent or descent of stairs

3.5

winding stairs

stairs built in a curved construction

NOTE Normally the steps on winding stairs are wider on one side and narrower on the other side (see Figure 2).

3.6

attendant

person operating the stair-climbing device, not sitting on the device

3.7

occupant

person being transported by the stair-climbing device

3.8

U-shaped stairs

two flights of stairs at an angle of 180° to each other and connected by an intermediate landing

3.9**skew angle**

angle of deviation between the pitch line of the stair and the axes of movement of the stair-climbing device

3.10**edge stop**

device to stop forward movement of a balancing stair-climbing device when approaching the nosing of a downward step

NOTE See annex C.

4 Test apparatus and conditions**4.1 Test apparatus**

In addition to the test apparatus specified below, further test apparatus described in the normative references are also required.

4.1.1 Standard test stairs with eight steps having a rise of $180 \text{ mm} \pm 5 \text{ mm}$ and an overall pitch of 35° with a tolerance of $+1^\circ$ (see Figure 1). A riser shall close the front face of each step. All nosing shall fall within a region contained between two imaginary parallel planes 10 mm apart and inclined at the overall pitch angle of the stairs.

The nosing shall be of a rigid material, smooth and rounded to a radius of $8 \text{ mm} \pm 1 \text{ mm}$. Each step shall be level and shall have a coefficient of friction that complies with ISO 7176-13. The width of the stairs shall be at least 500 mm wider than the stair-climbing devices under test, including the attendant. A fixed barrier shall limit the stair width on one side and sideways adjustable barriers on each step shall limit the stair width on the other side. The height of the barriers shall be $1\,800 \text{ mm} \pm 100 \text{ mm}$ above the stairs. The test stairs shall be capable of being connected to the landing platform (see 4.1.3). Provision for a handrail to be mounted if required shall be incorporated on both sides.

4.1.2 Winding test stairs with eight steps having a rise of $180 \text{ mm} \pm 5 \text{ mm}$. The winding angle shall be $19^\circ \pm 0,5^\circ$ per step. The stair nosing shall have a tangentiality to the central axis of the stair of $75 \text{ mm} \pm 20 \text{ mm}$. The going/run of each step shall be $257 \text{ mm} \pm 10 \text{ mm}$ at a point which is $760 \text{ mm} \pm 10 \text{ mm}$ apart from the central axis of the stair when measured parallel to the stair nosing. The inner radius of the stair shall be $310 \text{ mm} \pm 10 \text{ mm}$. A riser shall close the front face of each step (see Figure 2).

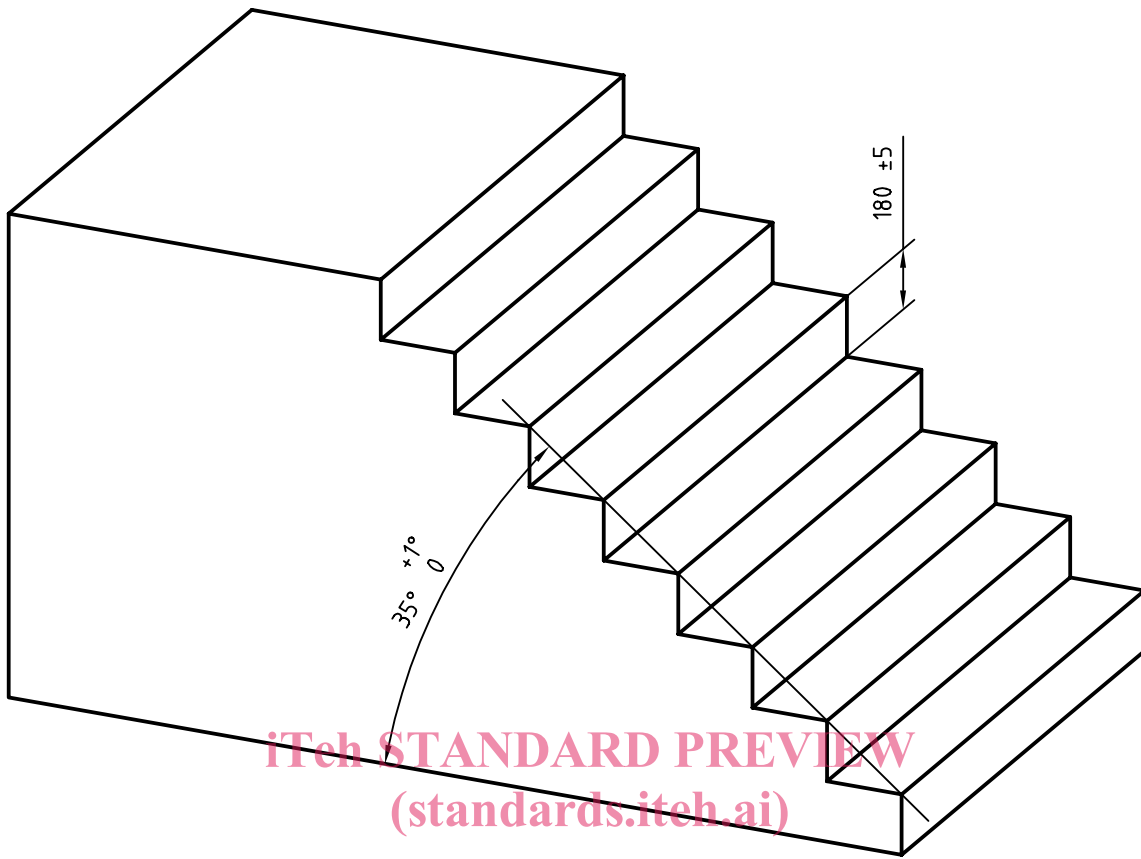
The nosing shall be of a rigid material, smooth and rounded to a radius of $8 \text{ mm} \pm 1 \text{ mm}$. Each step shall be level and shall have a coefficient of friction that complies with ISO 7176-13. The width of the stairs shall be at least 500 mm wider than the stair-climbing devices under test, including the attendant. Movable barriers shall limit the stair width on each step on the outer side and a fixed barrier shall limit the stair width on the inner side. The height of the barriers shall be $1\,800 \text{ mm} \pm 100 \text{ mm}$ above the stairs. The test stairs shall be capable of being connected to the landing platform (see 4.1.3). Provision for a handrail to be mounted if required shall be incorporated on both sides.

4.1.3 Landing platform with a height equal to the height of the top step in 4.1.1 and 4.1.2 with a tolerance of $\pm 5 \text{ mm}$. The top of the platform shall be covered with a material whose coefficient of friction complies with ISO 7176-13. On one side the platform shall be capable of being rigidly connected to the test stairs. On the other sides the platform shall be equipped with movable barriers with a height of $1\,800 \text{ mm} \pm 100 \text{ mm}$.

Recommended area of the platform is $2 \text{ m} \times 4 \text{ m}$.

NOTE If convenient, the test equipment in 4.1.1, 4.1.2 and 4.1.3 can be built in one piece.

Dimensions in millimetres



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Figure 1 — Standard test stair with landing (see 4.1.1)
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Dimensions in millimetres

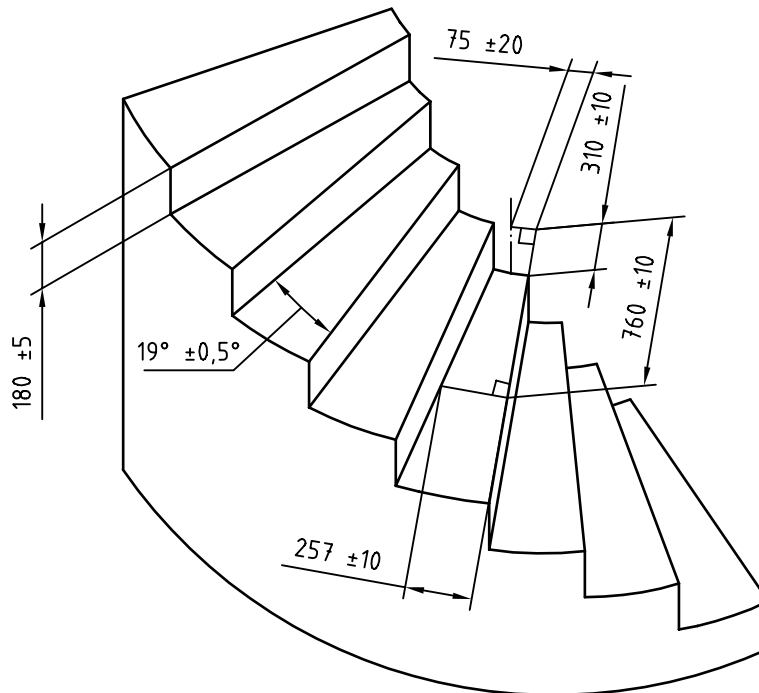


Figure 2 — Winding test stair (see 4.1.2)

4.1.4 Rigid horizontal test plane of sufficient size to accommodate the stair-climbing device during testing, such that the whole surface is contained between two imaginary parallel planes 5 mm apart. The surface of the plane shall have a coefficient of friction as defined in ISO 7176-13.

NOTE The imaginary planes are intended to provide a measure of control on the flatness of the test plane.

4.1.5 Test wheelchair recommended by the manufacturer of the stair-climbing device. If the manufacturer recommends several wheelchairs, priority shall be given to those conforming with ISO 7193. If no wheelchair is recommended, a wheelchair that conforms with ISO 7193 shall be used, or a surrogate wheelchair in accordance with specifications given in annex A.

4.1.6 Standard test dummy in accordance with ISO 7176-11, modified as follows:

Replace the lower leg portions of the 100 kg, 75 kg and 50 kg dummies with two footpieces with a shape that permits ready attachment to the footrests and which have the following properties:

- a) mass 3,5 kg \pm 0,5 kg;
- b) height of centre of gravity 20 mm \pm 2 mm above footplate surface.

NOTE 1 Two steel blocks each having dimensions 75 mm \times 150 mm \times 40 mm are suitable as footpieces.

NOTE 2 A human test occupant with the same mass may be used instead of the test dummy.

4.1.7 Energy consumption instrumentation, a device capable of measuring the ampere-hours used by the stair-climbing device which does not itself use more than 0,5 % of the ampere-hours used by the stair-climbing device.

4.1.8 Device for measuring time with an accuracy of 0,1 s.

4.1.9 Lifting gear for lifting the standard test stairs relative to the horizontal for the purposes of the test specified in 9.3.2.

4.1.10 Device for measuring linear dimensions up to 2 m with an accuracy of \pm 1 mm.

4.1.11 Rectangular attendant-space gauge to simulate the space an attendant occupies when operating the stair-climbing device (see Figure 3), with a horizontal length of 640 mm \pm 10 mm and horizontal width of 560 mm \pm 10 mm or the distance between the midpoint of the handgrips of the tested stair-climbing device plus 200 mm \pm 10 mm, whichever is larger. Both rear corners shall be rounded with a radius of 200 mm \pm 10 mm. It shall be possible to attach the gauge to the midpoint of the handgrips of the tested stair-climbing device.

NOTE A frame made of wood or steel wire is suitable.

4.1.12 Rectangular foot-space gauge to simulate the area the feet of the occupant occupies when sitting on the stair-climbing device or the test wheelchair (see Figure 4), with a horizontal length of 300 mm \pm 10 mm and a horizontal width of 300 mm \pm 10 mm. Both front corners shall be rounded with a radius of 100 mm \pm 10 mm. It shall be possible to attach the gauge to the footrest of the stair-climbing device so that it is in line with it and in line with the stair-climbing device.

NOTE A frame made of wood or steel wire is suitable.

4.2 Test conditions

4.2.1 The test equipment specified in 4.1.1 to 4.1.4 shall remain immobile during the test.

4.2.2 The ambient temperature shall be (20 \pm 5) °C.