
Wheelchairs

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

Fauteuils roulants —

*Partie 28: Exigences et méthodes d'essai pour les dispositifs monte-
escalier*



This document is a preview generated by EVS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2012

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

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

Published in Switzerland

Contents

Page

Foreword	vi
Introduction	viii
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Application of reference standards	13
4.1 Use of a stair-climbing device in driving mode	13
4.2 Use of a stair-climbing device in other operational modes	14
5 Requirements	14
5.1 General	14
5.2 Skew angle	14
5.3 Effectiveness of brakes	15
5.4 Static stability	15
5.5 Dynamic stability	16
5.6 Direct operating forces	16
5.7 Step transition safety	16
5.8 Static, impact and fatigue strength	16
5.9 Climatic tests	17
5.10 Flammability	17
5.11 Electromagnetic compatibility	17
5.12 Safe operation as the battery becomes depleted	17
5.13 Safety equipment	17
5.14 Ergonomic aspects	18
6 Test apparatus	18
7 Preparation of the stair-climbing device for testing	22
7.1 General	22
7.2 Equipment	23
7.3 Adjustments	23
7.4 Batteries	23
7.5 Tyre inflation	23
7.6 Power switch	23
7.7 Speed setting	23
7.8 Loading of stair-climbing devices	24
7.9 Adaptation of the body support system	25
7.10 Exaggerated test set-up	25
8 Test conditions	25
9 Skew angle	25
9.1 Principle	25
9.2 Test method	25
9.3 Evaluation of results	26
9.4 Test report	27
10 Effectiveness of brakes	27
10.1 Principle	27
10.2 Test method	28
10.3 Test report	29
11 Static stability	30
11.1 Principle	30
11.2 Test methods	30
11.3 Test report	32
12 Dynamic stability	33

12.1	Principle	33
12.2	Test methods	33
12.3	Test report	36
13	Direct operating forces	36
13.1	Principle	36
13.2	Preparation	36
13.3	Test methods for assistant-operated stair-climbing devices	37
13.4	Test methods for occupant-operated stair-climbing devices	41
13.5	Test evaluation	42
13.6	Test report	42
14	Step transition safety	43
14.1	Principle	43
14.2	General	43
14.3	Test method	43
14.4	Evaluation of results	45
14.5	Test report	46
15	Static, impact and fatigue strength	47
15.1	Principle	47
15.2	General	47
15.3	Additional static strength tests	47
15.4	Fatigue strength — climbing	53
15.5	Test evaluation	54
15.6	Test report	54
16	Climatic tests	55
16.1	Principle	55
16.2	Test methods	55
16.3	Test report	56
17	Electromagnetic compatibility	56
17.1	Principle	56
17.2	Test method	56
17.3	Test report	57
18	Safe operation as the battery becomes depleted	58
18.1	General	58
18.2	Test method	58
18.3	Test report	58
19	Safety equipment	58
19.1	Principle	58
19.2	Test methods	59
19.3	Test report	61
20	Test report	61
21	Labelling and documentation	62
21.1	General	62
21.2	Labels	62
21.3	Specification sheets	62
21.4	Instructions for use	63
Annex A	(normative) Types of stair-climbing devices with typical representations	64
Annex B	(normative) Space of easy reach of the operator	67
Annex C	(normative) Recommended safety equipment	69
Annex D	(normative) Surrogate wheelchair	70
Annex E	(normative) Least stable configuration and least stable position	71
Annex F	(informative) Fatigue tests with test machine	80

Annex G (informative) Compensation factor	84
Annex H (normative) Determination of maximum speed	85
Annex I (normative) Determination of theoretical energy consumption	86
Annex J (normative) Determination of occupied dimensions and manoeuvring space	89
Annex K (normative) Distinction between small and large clusters	97

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 7176-28 was prepared by Technical Committee ISO/TC 173, *Assistive products for persons with disability*, Subcommittee SC 1, *Wheelchairs*.

This part of ISO 7176 becomes applicable as of the date of publication. It replaces ISO 7176-23 and ISO 7176-24. However, ISO 7176-23 and ISO 7176-24 remain valid for a transitional period of two years, to enable manufacturers and test houses to adapt their production lines and procedures for measuring and testing.

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 25: Batteries and chargers for powered wheelchairs — Requirements and test methods*
- *Part 26: Vocabulary*
- *Part 28: Requirements and test methods for stair-climbing devices*

The following two Technical Reports are also available:

- *ISO/TR 13570-1, Wheelchairs — Part 1: Guidelines for the application of the ISO 7176 series on wheelchairs*
- *ISO/TR 13570-2, Wheelchairs — Part 2: Typical values and recommended limits of dimensions, mass and manoeuvring space as determined in ISO 7176-5¹⁾*

1) Under preparation.

Introduction

This part of ISO 7176 was written in response to the need for common terminology in the field of stair-climbing devices, to give a means of evaluating important safety features, and to establish a means of qualifying and quantifying the performance of stair-climbing devices under the various conditions and environments encountered in their operation. It allows occupants and manufacturers to compare the pertinent safety and utility issues of all functions and features of a given stair-climbing device.

The tests specified in this part of ISO 7176 are used to gather comparative information about factors relating to the safety and performance of a stair-climbing device while in climbing mode on stairs and in climbing mode or crawling mode on landings, as well as in driving mode. They include identification of suitable operating environments for each stair-climbing device and indications of various performance criteria in climbing mode for operations on stairs and on driving surfaces.

This part of ISO 7176 specifies tests for the “reference configuration” of the stair-climbing device. Since some stair-climbing devices have adjustable components and/or alternative parts, testing in different configurations may be needed to determine whether a given variation conforms to this part of ISO 7176.

Other parts of ISO 7176 might be applicable to stair-climbing devices that can also be used as wheelchairs. All technical aspects which are relevant for wheelchairs and covered in ISO 7176 are adapted, modified and/or extended for the various needs of the different operational modes of a stair-climbing device.

Wheelchairs —

Part 28:

Requirements and test methods for stair-climbing devices

1 Scope

This part of ISO 7176 is applicable to stair-climbing chairs and stair-climbing wheelchair carriers where the stair-climbing device climbs backwards up the stairs, with the occupant facing downstairs, and climbs forwards down the stairs with the occupant also facing downstairs.

This part of ISO 7176 is applicable to stair-climbing devices which are intended for the transport of adults and those intended for the transport of children. It is not applicable to stair-climbing devices which are intended to be operated by children as operating occupants or assistants.

This part of ISO 7176 specifies requirements and test methods for electrically powered stair-climbing devices. It is not applicable to manually powered stair-climbing devices.

NOTE 1 Some clauses in this part of ISO 7176 might be useful for testing manually powered stair-climbing devices.

This part of ISO 7176 specifies tests to demonstrate the stair-climbing device's ability to perform safely on stairs with a pitch of 35°, or higher if declared by the manufacturer. It also includes ergonomic, labelling and disclosure requirements.

NOTE 2 When the stair-climbing device is tested in driving mode as specified this part of ISO 7176, the device need not be tested a second time for the same aspects as a wheelchair.

NOTE 3 Some requirements apply only for a specified range of rated loads.

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 3880-1, *Building construction — Stairs — Vocabulary*

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

ISO 7176-2, *Wheelchairs — Part 2: Determination of dynamic stability of electric wheelchairs*

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 7176-5, *Wheelchairs — Part 5: Determination of dimensions, mass and manoeuvring space*

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

ISO 7176-7, *Wheelchairs — Part 7: Measurement of seating and wheel dimensions*

ISO 7176-8, *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 7176-10, *Wheelchairs — Part 10: Determination of obstacle-climbing ability of electrically powered wheelchairs*

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

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

ISO 7176-14, *Wheelchairs — Part 14: Power and control systems for electrically powered wheelchairs and scooters – Requirements and test methods*

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

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

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

ISO 7176-21:2009, *Wheelchairs — Part 21: Requirements and test methods for electromagnetic compatibility of electrically powered wheelchairs and scooters, and battery chargers*

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

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

ISO 14971, *Medical devices — Application of risk management to medical devices*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3880-1, ISO 7176-5, ISO 7176-7, ISO 7176-15, ISO 7176-26 and the following apply.

NOTE This part of ISO 7176 makes use of some terms in ISO 3880-1 that are defined in relation to horizontal stairs. Since this part of ISO 7176 uses these terms for test stairs that can be tilted, the terms are redefined in this clause.

3.1
actuator
part of a climbing mechanism that is intended to transmit the load of the stair-climbing device to the stairs during climbing

NOTE An actuator can be a track, wheel, leg, finger or other part. In clusters, actuators are called cams.

3.2
angle of recline
rearward inclination of a manually stabilized stair-climbing device while it is climbing stairs

3.3
assistant
person operating the stair-climbing device but not being transported by the stair-climbing device

3.4
assistant-operated stair-climbing device
stair-climbing device intended to be operated by an **assistant** (3.3)

3.5
cam
actuator (3.1) of a **cluster** (3.8)

NOTE If the cam is a wheel, it can be freely rotating, have a unidirectional freewheel function, be temporarily braked or be driven. If the cam is eccentric, it usually has a curved or spiral shape of varying diameter. Some cams might consist of hinged posts or “shoes”.

3.6
climbing
ascending or descending stairs

3.7**climbing mechanism**

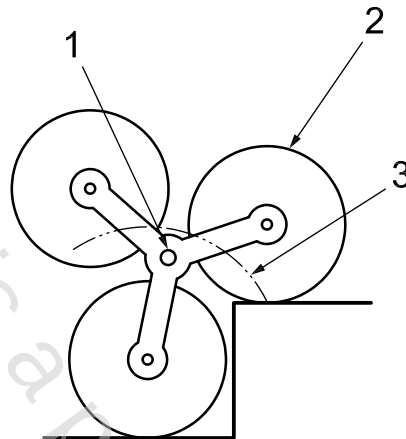
part of the stair-climbing device that provides the ability to climb stairs

3.8**cluster**

type of **stepwise climbing mechanism** (3.49) in which cams revolve around a common axis

NOTE 1 For details and examples, see Figures 1 and 2.

NOTE 2 The usual number of cams in a cluster ranges from 2 to 5. During climbing, each cam can perform the function of a lower actuator and an upper actuator as the cluster rotates.

**Key**

- 1 common axis
- 2 cam (wheel)
- 3 path of lowest points of cams relative to the common axis

Figure 1 — Cluster details

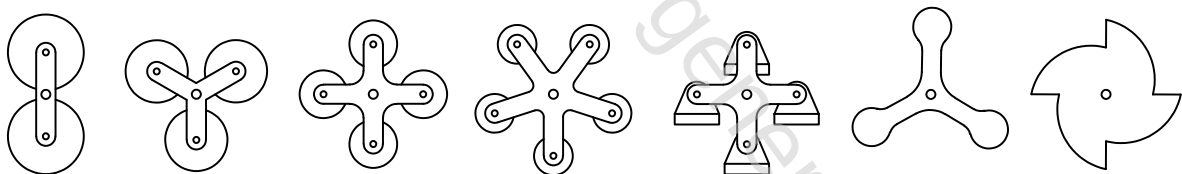


Figure 2 — Examples of clusters

3.9**continuous climbing mechanism**

type of climbing mechanism that extends over several steps and moves along their pitch line in a continuous fashion

EXAMPLE Climbing mechanisms which appear to have a nearly flat bottom when viewed from the side, such as tracks or stepping rails. Figure 3 shows the most common types.