
Wheelchairs —

Part 32:

**Test method for wheelchair castor
assembly durability**

Fauteuils roulants —

*Partie 32: Méthode d'essai pour la durabilité des roues pivotantes des
fauteuils roulants*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 173, *Assistive products*, Subcommittee SC 1, *Wheelchairs*.

A list of all parts in the ISO 7176 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document has been developed to address the need for evaluation of wheelchair castor assembly quality. Wheelchair castor assemblies come in different sizes and designs. Most castor assembly designs are known to fail within three months to two years of use due to impacts, fatigue, and wear caused by adverse outdoor conditions^[3]. Castor assembly quality issues have been identified. Only a subset of field castor assembly failures is covered in the ISO 7176-8, which include static, impact and fatigue tests^[2]. Failures caused by environmental factors (corrosion, dust, dirt, abrasion on rough surfaces) and heavy impacts while travelling on rocky terrains and transporting wheelchairs are not represented. To reproduce accurately field failures and to predict castor assembly quality in the laboratory, it is recommended to conduct castor assembly testing based on outdoor environmental and use conditions. This document introduces a new wheelchair castor assembly durability testing standard that is developed based on field evidence.

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Wheelchairs —

Part 32: Test method for wheelchair castor assembly durability

1 Scope

This document specifies strength requirements and test methods for wheelchair castor assemblies. The test methods include corrosion, abrasion and fatigue conditions. This document also specifies requirements for disclosure of test results.

It is applicable to castor assemblies of or developed for use in occupant and to assistant-propelled manual wheelchairs and electrically powered wheelchairs.

The test requirements are also applicable to wheelchair castor assemblies not necessarily associated or supplied with a wheelchair.

Castor assemblies including those with anti-tip castor wheels that do not touch the ground during wheelchair travel are outside the scope of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 — Part 11: Test dummies*

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

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

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 22877, *Castors and wheels — Vocabulary, symbols and multilingual terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7176-26, ISO 22877 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

castor assembly test load

weight supported by the castor

**3.2
tyre failure**

separation of a tyre from the castor wheel or castor wheel axle (in case, the tyre is mounted directly on the axle) or rupture of the inner tube of a pneumatic tyre, where any of these conditions can lead to a loss of function

**3.3
castor stem assembly**

components in a castor stem housing, which includes the castor stem, nuts, washers, stem bearings, or spacers

**3.4
test cycle**

one revolution of the turntable

Note 1 to entry: The fatigue testing machine specified in this document includes a turntable.

4 Castor assembly classification

Castor assemblies are classified into three types based on the castor wheel diameter as listed in [Table 1](#).

Table 1 — Castor assembly classification by size

Castor Assembly Type	Castor wheel diameter
Type 1	Less than 75,0 mm
Type 2	Greater than or equal to 75,0 mm and less than 150,0 mm
Type 3	Greater than or equal to 150,0 mm

NOTE Based on their wheel sizes, castors experience fatigue differently. Accordingly, the testing methods in this document are based on the castor wheel diameter.

5 Strength requirements

When tested in accordance with [Clause 8](#), a single castor assembly shall meet all of the following requirements at the conclusion of the tests.

- a) No component shall show evidence of failure caused by visible crack, fracture, and/or detachment of a part that could lead to a loss of function.
- b) No component or assembly of parts shall exhibit permanent deformation, free play or loss of adjustment that could lead to a loss of function.
- c) No tyre failure shall occur.

6 Test apparatus

6.1 Corrosion testing machine

A corrosion testing machine shall be as specified in ISO 9227 for the neutral salt spray method. Provision shall be made for specimens to be oriented such that their wheel bearing faces are horizontal.

6.2 Fatigue testing machine

6.2.1 Testing machine description

A fatigue testing machine shall be used to evaluate the castor assembly specimens against shocks from obstacles and surface abrasion. An example fatigue test machine is shown in [Figures A.1](#) and [A.2](#). The testing machine shall have a horizontal turntable capable of rotating in both directions. Castor assembly test specimens shall roll on the turntable against obstacles. The support arm setup shall be as specified in [Figure 3](#) including a hinged support that allows the castor wheel to bounce in an arc trajectory after an obstacle hit. The castor stem assembly shall be installed in a castor stem assembly holder that accommodates the castor stem assembly design.

The mass, stiffness, durability, corrosion resistance and securement of the testing machine (and its components) shall be sufficient that they do not affect the validity of testing under this document.

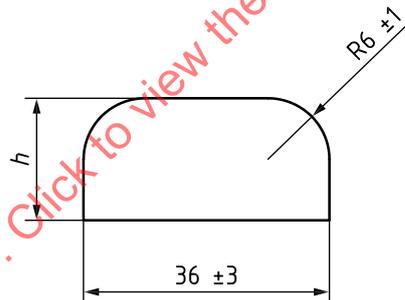
6.2.2 Abrasion surface

An abrasive sheet made with aluminium oxide of grain size 36, at least covering the top surface of the turntable, 1 mm average thickness and having a fully adhesive-back shall be attached to the turntable.

6.2.3 Obstacle profile

The obstacle shown in [Figure 1](#) is placed over the abrasive sheet and clamped to the turntable. The obstacle length shall be greater than twice the castor wheel diameter.

Dimensions in millimetres



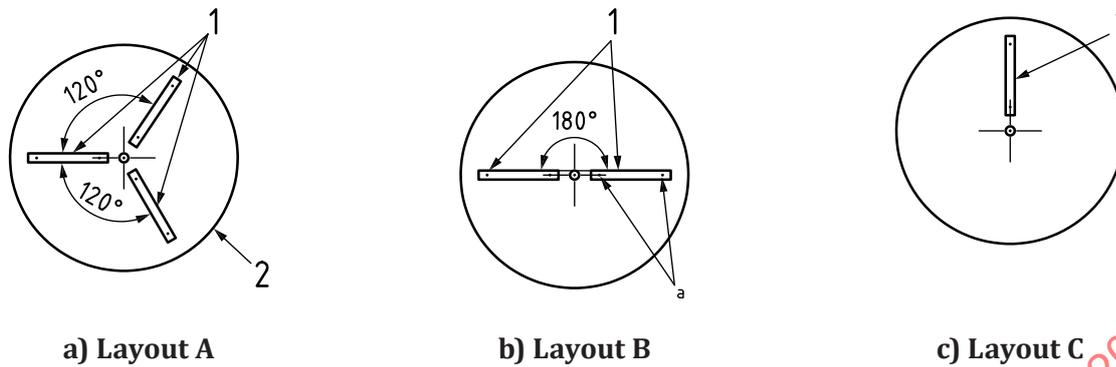
Key

h height of the obstacle depends on castor assembly type
See [Table 3](#) for different obstacle heights. Tolerance $\pm 8\%$.

Figure 1 — Sectional view of the obstacle

6.2.4 Obstacle placement

Three obstacle layouts shown in [Figure 2](#) are used for testing. The angle of the obstacles relative to the tyre rolling direction is $90^\circ \pm 10^\circ$.



Key

- 1 obstacle
- 2 turntable
- a Obstacle mounting holes outside of the castor running track.

Figure 2 — Obstacle layouts

6.2.5 Castor assembly loading

Weights shall be used for castor assembly loading. A pull-type hanging spring gauge with suitable load range and accuracy can be connected to the castor stem to measure the castor assembly load on the wheelchair and test load on the fatigue test machine.

7 Test preparation

7.1 Preparation of the castor stem assembly holder and support arm

During installation of the castor stem assembly in the holder, the assembly shall be tightened to a torque of 2,0 Nm to 5,0 Nm or as specified by the manufacturer. The castor stem assembly holder shall be attached to the support arm at the point such that the castor wheel axle axis coincides with the turntable coordinate axis as specified in [Figure 3](#). The support arm shall be horizontally parallel within $\pm 2^\circ$ with the turntable plane. A bubble level can be used for this purpose.

7.2 Setup of the turntable

Adjust the angular speed of the turntable so that the speed at impact of the castor wheel with obstacles is $1,0 \text{ m/s} \pm 0,1 \text{ m/s}$.

7.3 Abrasion surface

The abrasive sheet shall be discarded following completion of the test sequence in [Table 2](#).

7.4 Environmental conditions

The ambient temperature during fatigue testing shall be $22 \text{ }^\circ\text{C} \pm 12 \text{ }^\circ\text{C}$. The test specimen shall not be artificially cooled during testing.

7.5 Castor assembly loading conditions

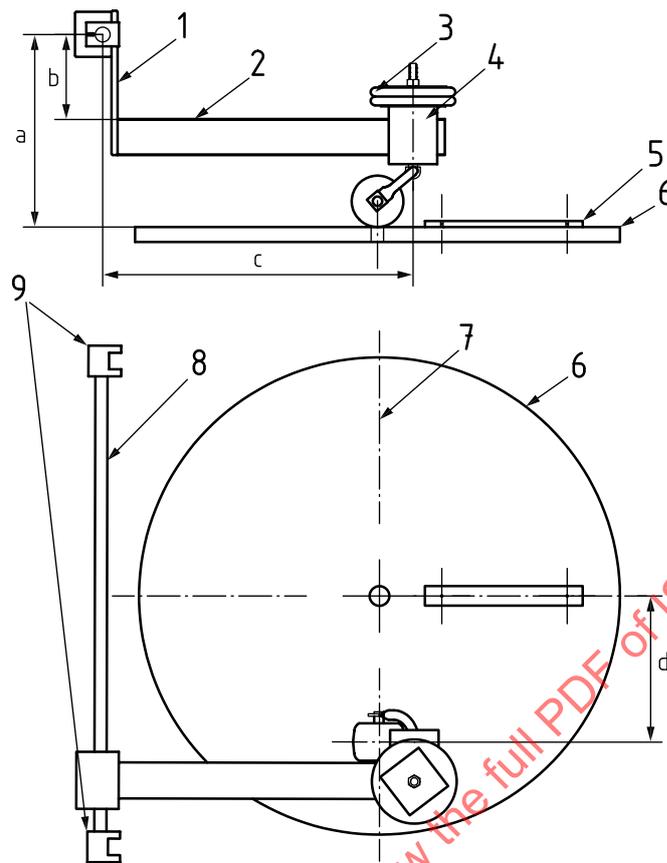
7.5.1 Where the castor assembly is specified for use in one or more wheelchairs, the castor assembly test load shall be the maximum weight supported by it +20 %, when mounted on the wheelchair(s) loaded with a test dummy in accordance with ISO 7176-11 and the wheelchair(s) set up in accordance with ISO 7176-22.

7.5.2 Where the castor assembly is not associated or supplied with any wheelchair, the castor assembly test load shall be the rated load declared by the castor manufacturer +20 %.

If a castor assembly is previously tested to meet the strength requirements in 5.1, the castor assembly loading conditions shall be recalculated according to [7.5](#).

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Dimensions in millimetres



Key

- 1 adjustable vertical support member of the support arm
- 2 support arm
- 3 castor assembly test load
- 4 castor stem assembly holder
- 5 obstacle
- 6 horizontal turntable
- 7 coordinate axes
- 8 circular rod
- 9 fixed supports for a rod that supports the hinging support arm
- a Maximum height of the wheelchair axle above the ground when the castor assembly is associated with one or more wheelchairs. Tolerance ± 30 mm.
- b 215 mm when the castor assembly is not associated with a wheelchair. Tolerance ± 30 mm.
- c 595 mm when the castor assembly is not associated with a wheelchair or maximum distance of the castor wheel axle from the wheelchair axle when the castor assembly is associated with one or more wheelchairs. Tolerance ± 30 mm.
- d 380 mm. Distances outside of this range may be used to avoid bouncing over or onto an obstacle. Tolerance ± 20 mm.

Figure 3 — Castor assembly testing setup

8 Test procedure

8.1 Test sequence

Testing shall be performed in the sequence listed in [Table 2](#) until either the number of test cycles listed in [8.2](#) and [8.3](#) are completed or the strength requirements as specified in 5.1 are violated. Re-tightening, readjusting or refitting of any castor assembly part is not allowed once testing has begun.

Table 2 — Test sequence

Test sequence	Test procedure subclause
Fatigue and abrasion testing	8.2
Corrosion testing	8.3
Fatigue and abrasion testing	8.2

If the manufacturer claims that the durability of a castor assembly exceeds this requirement, repeat the test sequence in [Table 2](#) until the claimed number of test cycles are completed.

8.2 Fatigue and abrasion test procedure

[Table 3](#) lists the test cycles for each castor assembly. The direction of turntable rotation shall be reversed for one cycle following completion of 99 test cycles.

Table 3 — Test Values

Castor assembly type	Obstacle layout	Total number of obstacles	Number of obstacles by size	Obstacle height	Number of test cycles
Type 1	A	3	3	6,4 mm	3 000
Type 2	A	3	2	6,4 mm	3 000
			1	12,7 mm	
Type 3	B ^a	2	2	12,7 mm	4 500
	C ^a	1	1	20,0 mm	1 500

^a For Type 3 castors, testing with layouts B and C shall be conducted separately in any order.

8.3 Corrosion test procedure

The castor assembly specimen shall be exposed to corrosion for a duration of 200 h, using the corrosion testing machine specified in [6.1](#) with the specimen treated as non-organic coated, and with the following modifications:

- a) The results of the corrosion test are not evaluated;
- b) No test report is required;
- c) Following the salt spray method, dry the castor assembly specimen inside the testing machine as follows:
 1. Purge the chamber with fresh air until all visible moisture in the chamber has been removed;
 2. Discontinue the air purge and leave the specimen in the chamber for a total of 200 h, while maintaining an ambient temperature of $35\text{ °C} \pm 2\text{ °C}$ [5].

8.4 Evaluation of test results

After completing all the tests, examine if the castor assembly meets the requirements of 5.1. If any of the requirements is not met, the castor assembly does not meet the requirements of this document.

9 Disclosure requirements

Castor assembly manufacturers shall disclose the following in their specification sheets:

- a) the castor assembly model, size and description;
- b) the castor assembly load used in the test;
- c) whether the castor assembly meets the strength requirements of this document.

10 Test report

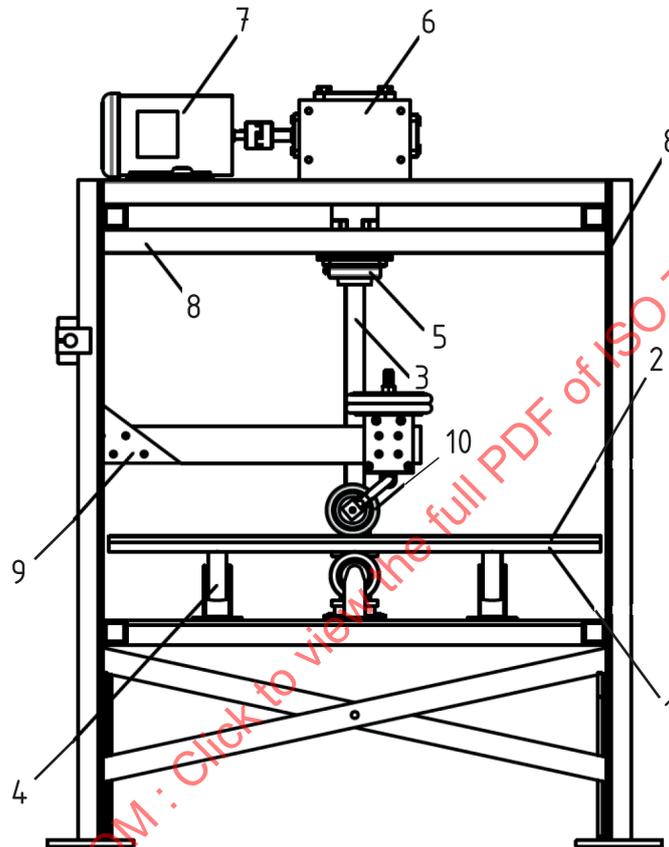
The test report as shown in [Annex B](#) may be used by manufacturers for documentation.

The test report shall contain the following:

- a) A reference to this document i.e. ISO 7176-32:2022;
- b) The name and address of the test institution and the accreditation status, if any;
- c) The name and address of the castor manufacturer.
- d) The date of issue of the test report.
- e) The castor assembly model, size, description, or if castor model is not known, specify the model of the wheelchair and/or any other information that can be used to identify the castor.
- f) Whether the castor assembly model meets the strength requirements specified in this document.
- g) If the castor assembly was tested beyond the strength requirements, report total number of test cycles.
- h) The castor assembly test load.
- i) If the castor assembly failed to meet the strength requirements, a summary of the failure modes.
- j) Photograph(s) of the testing setup and castor assembly following testing, and reference photographs showing the front and side views of the castor assembly.

Annex A (informative)

Castor assembly testing system example



Key

- 1 horizontal aluminium turntable
- 2 provision to attach slats and other surfaces on top of the turntable
- 3 centre shaft
- 4 support rollers
- 5 radial bearing at the top of centre shaft
- 6 gear reducer
- 7 motor
- 8 support frame made of steel angle iron and square tubing
- 9 support arm to support test castor assembly on the turntable
- 10 test castor assembly placed on one of the coordinate axes (see [Figure 1](#) for coordinate axes)

Figure A.1 — Front view of an example castor assembly testing system



Figure A.2 — Three-dimensional view of an example castor assembly testing system