
Wheelchairs —

Part 16:

**Resistance to ignition of postural
support devices**

Fauteuils roulants —

Partie 16: Résistance à l'inflammation des dispositifs de soutien postural



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Foreword

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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 7176-16 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 7176-16:1997), which has 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 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 postural support devices*
- *Part 19: Wheeled mobility devices for use as seats in motor vehicles*

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- *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*

A technical report (ISO/TR 13570-1) is also available giving a simplified explanation of these parts of ISO 7176.

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Introduction

The ignition and subsequent burning of wheelchairs is very rare, but can occur as a result of:

- being close to a burning object such as a fire beside the wheelchair;
- overheating of any electrical or electronic device on the wheelchair;
- fire sources (such as cigarettes or matches) falling onto the wheelchair.

Wheelchair occupants are at particular risk of injury or death from these fires and resulting fumes because they may not have the ability to move away from the wheelchair.

Wheelchairs can be considered to be comprised of the following components:

- a) structural components such as the frame, wheels, etc., which are essential to the mechanical integrity of the wheelchair;
- b) postural support devices, such as sling seats, sling backs, arm supports, foot supports, etc., which are attached to the wheelchair and/or its seating system and are primarily intended to give postural support to the wheelchair occupant;
- c) components to manage tissue integrity, such as seat or back support cushions, which are intended to have primarily a clinical function to minimize the risks of skin damage (these may also be intended to control posture);
- d) power-related components such as motors, energy sources, controllers, etc., which are required for the functioning of powered wheelchairs.

Each of the above components has a different severity of risk associated with their likelihood of igniting and of their resulting harm to the wheelchair occupant. ISO standards have been published or are in preparation to specify requirements and test methods for the above categories of components in order to help manufacturers and purchasers of wheelchairs to design and procure wheelchairs and their components which are appropriate for the risk of ignition balanced against the requirements of the wheelchair occupant. The aim of these ISO standards is to provide appropriate alternatives to using furniture-based standards, to reflect the uses and purposes of wheelchairs and their accessories.

The development of an ISO standard on the resistance to ignition of structural components [see list item a) above] has not yet commenced. The most likely sources of ignition are proximity to a heat source such as an electric radiator or domestic fire or a heat source such as a lighted match or cigarette falling onto the structure.

The tissue integrity components [see c)] are the subject of a draft ISO standard (ISO 16840-10), and permit a less stringent resistance to ignition based upon their priority for their clinical function which can override the need for a high resistance to ignitability.

The power related components [see d)] are the subject of ISO 7176-14 which specifies requirements to prevent overheating in electrical components that could lead to a fire.

This part of ISO 7176 is primarily concerned with the resistance to ignition of postural support devices [see b)] of a wheelchair. These typically include arm supports, sling seats, sling backs, lower leg supports, foot supports, lateral supports, head supports, etc. The most likely source of ignition is an open flame source falling onto the component's surface or into gaps between surfaces. Consequently, this part of ISO 7176 is written around resistance to an ignition source equivalent to a lighted match in contact with a test sample of an assembly of the upholstered part's composite materials in both a vertical and horizontal orientation. This part of ISO 7176 replaces ISO 7176-16:1997 since the latter only related to upholstered parts of a wheelchair and was originally based on furniture test methods and requirements, and therefore was not appropriate for clinically oriented components on a wheelchair.

The requirements of this part of ISO 7176 have been set at a basic minimum level and are less severe than mandatory requirements in some countries. Good practice is also to use materials which minimize

the risk of release of toxic substances as a result of ignition. Materials chosen shall also comply with biocompatibility requirements.

The day-to-day usage of a wheelchair can affect its materials' resistance to ignition through cyclic loading, movement of materials, washing, cleaning, etc. Manufacturers will often take these effects into account as part of their risk assessment when selecting materials for their products, to minimize the effects of this normal use. However, although this part of ISO 7176 can be used on parts that have been used, etc., the test samples specify new or unused parts.

Different environments commonly encountered by some wheelchair occupants can also affect the flammability of materials. For example, home oxygen systems, delivery systems for drugs carried in an inflammable medium, etc., can turn an inert material into a flammable one. Dust and other materials accumulated within the chair have also been found to be a source of readily ignitable material. Wheelchair manufacturers and occupants should be aware of these risks, and design and use wheelchairs accordingly, as covered by ISO 14971.

This part of ISO 7176 describes testing an assembly of the composite of materials as used in the wheelchair component, because the resistance to ignition of these materials individually may be quite different from those when assembled as a composite. Hence the results of testing to this part of ISO 7176 do not give any indication of the resistance to ignition of any of the separate individual materials of the postural support device.

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Wheelchairs —

Part 16:

Resistance to ignition of postural support devices

1 Scope

This part of ISO 7176 specifies requirements and test methods to assess the resistance to ignition by match flame equivalent of all postural support devices that are supplied to be part of a wheelchair or its seating system.

This part of ISO 7176 only determines the resistance to ignition of the devices tested and not the ignitability of the complete wheelchair.

This part of ISO 7176 does not apply to the resistance to ignition of other parts of a wheelchair, e.g. wheels, framework.

This part of ISO 7176 does not take into consideration changes in resistance to ignition as a result of washing or use.

This part of ISO 7176 allows for the separate testing of inferior/superior supports (e.g. arm supports), which are usually used in the horizontal plane, and anterior/posterior/lateral/medial supports (e.g. thoracic harnesses, calf panels), which are usually used in the vertical plane.

Until such time as a flammability standard is available for the testing of other components or accessories of the wheelchair, it is advisable that any structural components considered to be at risk are tested at least to the ignitability levels of this part of ISO 7176.

NOTE 1 The requirements of this part of ISO 7176 have been set at a basic minimum level and are less severe than mandatory requirements in some countries.

Where practical, it is advisable that manufacturers use materials with superior resistance to ignition.

NOTE 2 Requirements for the control of risks from sources of fire created by electrical and electronic components are included in ISO 7176-14.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8191-2:1988, *Furniture — Assessment of ignitability of upholstered furniture — Part 2: Ignition source: match flame equivalent*

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

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

ISO 554, *Standard atmospheres for conditioning and/or testing — Specifications*

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
progressive smouldering
exothermic oxidation, not accompanied by flaming, that is self-propagating, i.e. independent of the ignition source. It may or may not be accompanied by incandescence

[ISO 8191-2:1988, definition 3.1]

3.2
flaming
undergoing combustion in the gaseous phase with the emission of light

[ISO 8191-2:1988, definition 3.2]

4 Principle

Test materials as used in any postural support devices are assembled in either horizontal or vertical samples and subjected to an ignition source which is equivalent to a match flame. The resulting effects on the test materials are observed and measured.

5 Health and safety of test personnel

5.1 General

WARNING — The following test methods call for the use of procedures that may be injurious to health if adequate precautions are not taken.

These precautions are drawn from ISO 8191-2:1988, Clause 6.

5.2 Enclosure

For safety, the tests should be conducted in a non-combustible fume cupboard. If such a cupboard is not available, a test enclosure should be constructed (see 6.2) so that the operator is protected from the fumes.

5.3 Extinguishers

Adequate means of extinguishing the assembly should be provided, bearing in mind that some combinations may produce severe flaming during the test. A hand and/or a fixed water spray which can be directed over the burning area can be useful. Other means such as fire extinguishers (water and halogenated hydrocarbons), fire blankets and a bucket of water will assist. In some cases smouldering may be difficult to extinguish completely and complete immersion in water may be necessary.

6 Apparatus

6.1 Test rig

Use a test rig as specified in ISO 8191-2 or use the wheelchair on which the postural support is to be used (or an equivalent subassembly/frame), provided that the assembly being tested is positioned in a horizontal or vertical plane.

NOTE 1 The frame of the test rig described as the back frame with a width of $450 \text{ mm} \pm 2 \text{ mm}$, but with a height of $450 \text{ mm} \pm 2 \text{ mm}$, can be used for both the horizontal and vertical tests.

NOTE 2 The wheelchair may need to be reoriented to achieve the horizontal or vertical position of the postural support.

6.2 Test enclosure

The test enclosure shall consist of either a room with a volume greater than 20 m³ (which contains adequate oxygen for testing) or a smaller enclosure with a through flow of air. Inlet and extraction systems providing air flow rates of 0,02 m/s to 0,2 m/s in the locality of the rig provide adequate oxygen without disturbing the burning behaviour.

NOTE This enclosure is the equivalent to that specified in ISO 8191-2:1988, 7.2.

6.3 Timer

A means of measuring time for a period of 5 s to 1 000 s with an accuracy of $\pm 0,1$ s.

6.4 Ignition source

A gas flame produced from a burner:

- consisting of a stainless steel tube with an outside diameter of 8 mm + 0,1 mm and internal diameter of 6,5 mm + 0,1 mm, and length of 200 mm + 5 mm;
- connected by a flexible tube 2,5 m to 3,0 m in length with an internal diameter of 7 mm + 1 mm via a flowmeter with an accuracy of + 0,5 ml/min;
- connected to a source of butane gas providing an outlet pressure of a nominal 2,8 kPa and at a flow rate of 45 ml/min $\pm$ 2 ml/min at 23 °C.

NOTE This source has been designed to give a calorific output approximating to that of a burning match.

6.5 Gas flow control

A means of controlling gas flow.

It is essential that the rate of supply of gas to the burner tube conforms to the flow rate specified. Some difficulties have been reported with the supply and measurement of the gas, particularly where the gas cylinder has, of necessity, to be stored in an environment cooler than the defined test conditions and/or at some distance from the test rig.

In these cases, and other situations where difficulties occur, it is important that there should be a sufficient length of tubing inside the controlled environment (10 °C to 30 °C) to ensure that the gas equilibrates to the required temperature before flow measurement. One way to assist this is to pass the gas (before flow measurement) through a metal tube immersed in water maintained at 20 °C (which is one of the temperatures specified for a stated flow of gas) so that flow corrections for temperature variations can be avoided.

Great care also needs to be exercised with the measurement and setting of the flow rate of the gas.

Direct reading flowmeters, even those obtained with a direct gas calibration, need to be checked when initially installed and also at regular intervals during testing by a method capable of accurately measuring the absolute gas flow at the burner tube. One way of doing this is to connect the burner tube with a short length of tubing (about 7 mm inside diameter) to a soap bubble flowmeter, such that the upward passage of a soap film meniscus in a glass tube of calibrated volume (e.g. a burette) over a known period of time gives an absolute measurement of the flow.

NOTE Subclause 6.5 is drawn from ISO 8191-2:1988, 7.5.

6.6 Conditioning environment

An environment with an atmosphere which can be maintained for up to 20 h at a temperature of 23 °C $\pm$ 2 °C and relative humidity of 50 % $\pm$ 5 % as specified in ISO 554.

6.7 Test environment

An environment in which the test procedure specified in Clause 7 can be conducted and which has an atmosphere with a temperature between 10 °C and 30 °C and a relative humidity between 15 % and 80 %.

6.8 Test sample

Test samples shall be in new or unused condition.

A manufactured part can be used for the test sample providing that it is no larger than the maximum dimensions specified below and no smaller than 30 mm × 150 mm.

Alternatively, a sample consisting of materials assembled as used in the relevant postural support device, and with dimensions comprising a minimum width of 150 mm and a maximum width of 450 mm, and a depth or length of a minimum of 150 mm and a maximum of 450 mm, and flat over at least 95 % of the surface projection.

NOTE Test samples representative of all postural support devices are required.

Spray-on flame retardant substances shall not be relied on unless the durability of their effectiveness for the life of the manufactured part is confirmed.

7 Test procedure

7.1 Preparation

- a) Identify the parts of the wheelchair which need to be tested.
- b) When testing inferior/superior supports (e.g. arm supports) which are intended to be used only in the range of the horizontal plane $\pm 30^\circ$, use the horizontal test. For all other supports use the vertical test. If the part is intended for use in either plane, then use both tests.
- c) If using the test rig, attach the test sample(s) to the test rig(s).
- d) Place the assembly to be tested in the conditioning environment for a minimum of 16 h.
- e) Prepare the ignition source specified in 6.4 in the test environment by turning on the gas supply and igniting the gas emerging from the burner tube.
- f) Allow the flame to stabilize for at least 2 min while adjusting the gas flow to the required rate.

7.2 Horizontal test

- a) Set up the test sample mounted on the wheelchair or in the test rig in a horizontal orientation $\pm 3^\circ$ in the test environment.
- b) Select the surface which the manufacturer considers to be at risk from a fire source. Apply the ignition source specified in 6.4 to the test sample with the burner tube positioned at $45^\circ \pm 5^\circ$ to the surface of the sample from above, at its centroid and touching its surface.
- c) After a period of $20 \text{ s} \pm 1 \text{ s}$, remove the ignition source from the test sample.
- d) Observe the subsequent progress of combustion and record any evidence of progressive smouldering, or flaming in the interior and/or surface. Disregard any flames, afterglow, smoking or smouldering that cease within 120 s of the removal of the burner tube.
- e) Allow the sample to cool.
- f) Determine the burn damage area by multiplying the largest length of the damage by the largest dimension at right angles to the largest length as shown in Figure 2.

- g) Repeat 7.2 a) to f) once on a new test sample. The repeat test may be carried out on the first test sample providing there is a sufficient area of unaffected material to meet the dimensions specified in 6.8.
- h) Test separately each postural support device face that the manufacturer considers to be at risk from a fire source, but only if the different faces are constructed from different materials.

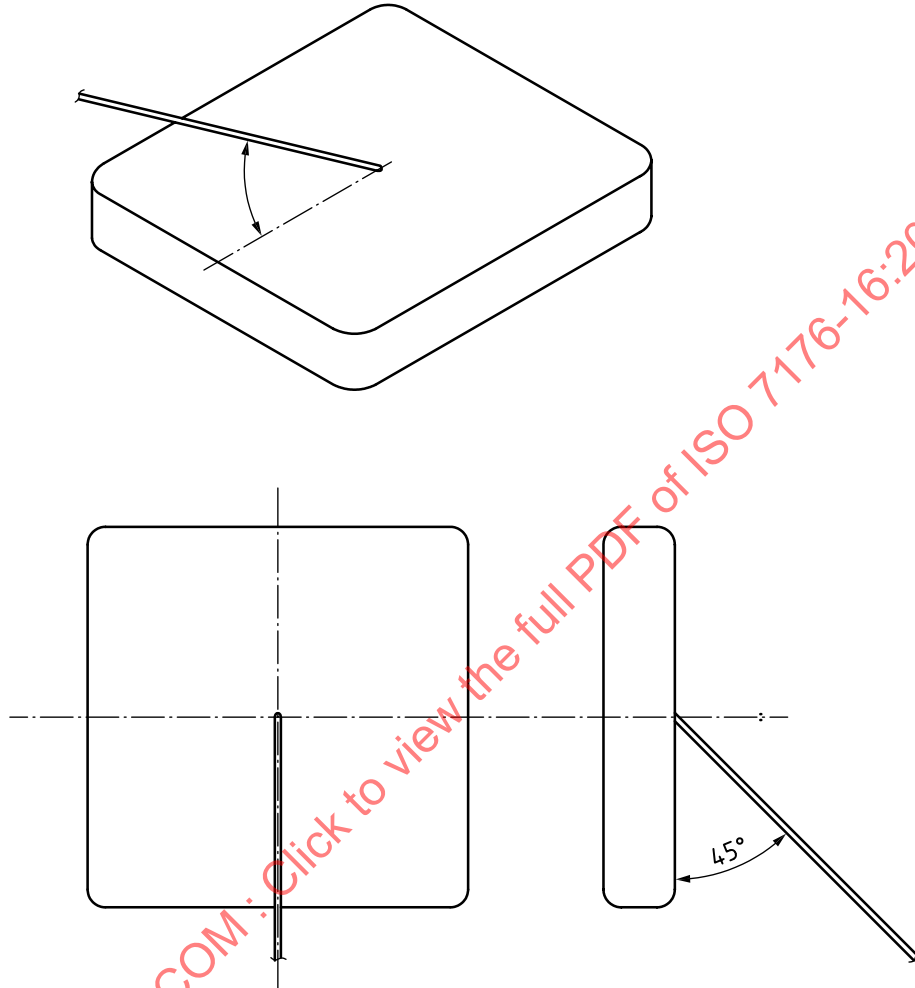
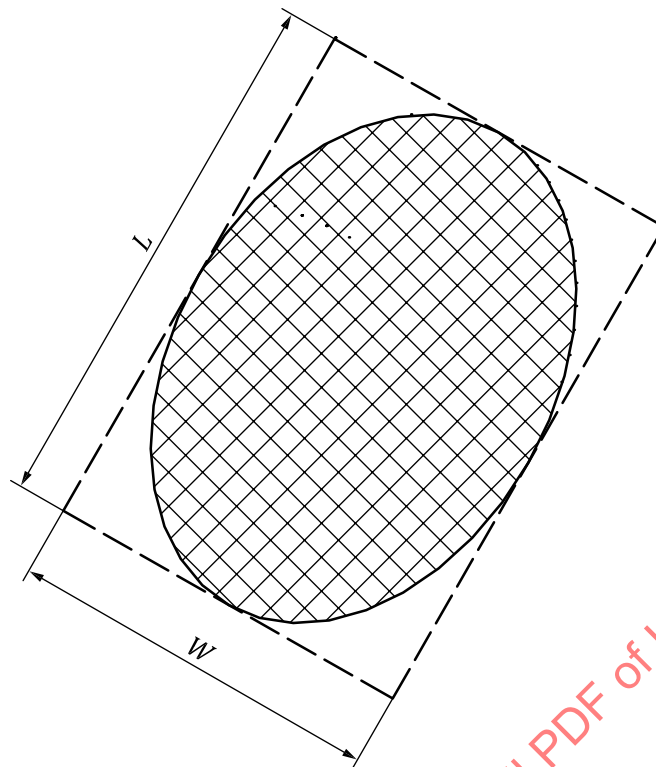


Figure 1 — Positioning of the burner tube for the horizontal test



Damage area = $L \times W$

Figure 2 — Determination of burn damage area

7.3 Vertical test

- a) Set up the test sample mounted on the wheelchair or in the test rig in a vertical orientation $\pm 3^\circ$ in the test environment.
- b) Apply the ignition source specified in 6.4 to the test sample with the burner tube positioned half way across the test sample and at a height of $(0,1 \pm 0,02) \times h$ above the bottom edge of the test sample, where h = total height of test sample.
- c) The burner tube shall lie in the horizontal plane $\pm 3^\circ$ and form an angle of $45^\circ \pm 5^\circ$ to the sample surface and just in contact with the surface.
- d) After a period of $20 \text{ s} \pm 1 \text{ s}$, remove the ignition source from the test sample.
- e) Observe the subsequent progress of combustion and record any evidence of progressive smouldering or flaming in the interior and/or surface. Disregard any flames, afterglow, smoking or smouldering that cease within 120 s of the removal of the burner tube.
- f) Allow the sample to cool.
- g) Determine the burn damage area by multiplying the largest length of the damage by the largest dimension at right angles to the largest length as shown in Figure 2.
- h) Repeat 7.3 a) to g) once on a new test sample. The repeat test may be carried out on the first test sample providing there is sufficient area of unaffected material to meet the dimensions specified in 6.8.
- i) Test separately each postural support device face that the manufacturer considers to be at risk from a fire source, but only if the different faces are constructed from different materials.