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**Tips for assistive products for walking —  
Requirements and test methods —**

**Part 2:  
Durability of tips for crutches**

*Embouts pour produits d'assistance à la marche — Exigences et  
méthodes d'essai —*

*Partie 2: Durabilité des embouts de béquilles*

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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 24415-2 was prepared by Technical Committee ISO/TC 173, *Assistive products for persons with disability*.

ISO 24415 consists of the following parts, under the general title *Tips for assistive products for walking — Requirements and test methods*:

- *Part 1: Friction of tips*
- *Part 2: Durability of tips for crutches*

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## Introduction

The characteristics of tips attached to the bottom of assistive products for walking are essential to ensuring user safety. The tips are continuously and repeatedly subjected to load and friction while walking; durability against this repeated load is important both for safety and for cost effectiveness.

Tips are used on many different assistive products for walking, including canes, walking sticks, crutches, walking frames, rollators, and walking tables. They are produced in many different sizes and are made of many different materials, depending on the sort of assistive products for walking to which they are applied. A variety of bottom shapes are available on the market for the many kinds of assistive products for walking.

Generally, durability of rubber is estimated based on a wearing resistance test using test pieces rather than finished goods. However, tips for assistive products for walking are used in several different ways, therefore it is favourable to perform the test on manufactured tips (not manufactured test pieces) to obtain realistic data. For example, tips for crutches can endure less abrasion, because the load on tips for crutches is higher than that on tips for other assistive products for walking.

This part of ISO 24415 specifies requirements and test methods for durability of tips for crutches to enable developers, manufacturers, distributors, and health care providers to determine whether tips have the necessary durability.

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# Tips for assistive products for walking — Requirements and test methods —

## Part 2: Durability of tips for crutches

### 1 Scope

This part of ISO 24415 specifies requirements and test methods for the durability of tips for crutches, and is not applicable to tips manufactured for special purposes. The requirements and test method are based on tips being used with an ordinary gait on dry and flat walking surfaces.

Crutches include elbow crutches, forearm support crutches, and axillary crutches, as described in ISO 9999.

NOTE Special purposes might include walking on ice and/or snow.

### 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 9999, *Assistive products for persons with disability — Classification and terminology*

EN 13036-4, *Road and airfield surface characteristics — Test methods — Part 4: Method for measurement of slip/skid resistance of a surface — The pendulum test*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

#### 3.1

##### **tip**

that part of the crutch which is in contact with ground

NOTE See Figure 1.

#### 3.2

##### **test track**

surface against which the tip is to be tested

#### 3.3

##### **actuator**

mechanism to produce the dynamic loading force

#### 3.4

##### **loading rod**

part onto which the tip is fixed and which transfers the loading force from the actuator to the tip

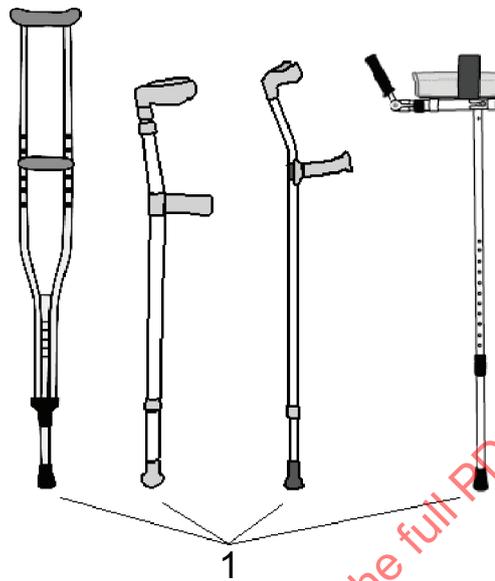
#### 3.5

##### **loading force**

force exerted on the tip along the longitudinal axis of the loading rod

**3.6 tilt angle**  
plane angle between the rod axis when tilted and the rod axis when perpendicular to the test track surface

**3.7 axis of relative rotation**  
axis about which the relative rotation between the tip and the test track takes place



**Key**  
1 tip

**Figure 1 — Tips**

## 4 Requirements

After having been tested, the condition of the tip shall be verified by inspection. No inner part shall be visible, no tear shall appear, and the tip shall be correctly fixed on the loading rod. All three tested samples shall fulfil the conditions mentioned above.

## 5 Apparatus

### 5.1 Test device

The test device consists of a test track, a motion control mechanism, a loading force mechanism and a load cell. Figure 2 shows a test track and a rod. A motion control mechanism and a loading force mechanism cooperate during the test. When the loading rod with the tip is in the upright position, perpendicular to the test track, the loading force is at its maximum. The whole test apparatus (including the load cell) shall be rigid.

### 5.2 Test track

The test track shall be a flat board, made of concrete. The test track shall be placed on a flat base during the test. Frictional characteristic of the surface on the test track is defined as “walkway surface traction” which shall be greater than 80 BPN when tested in accordance with EN 13036-4.

### 5.3 Motion control mechanism

The motion control mechanism shall apply the tilt angle.

### 5.4 Loading force mechanism

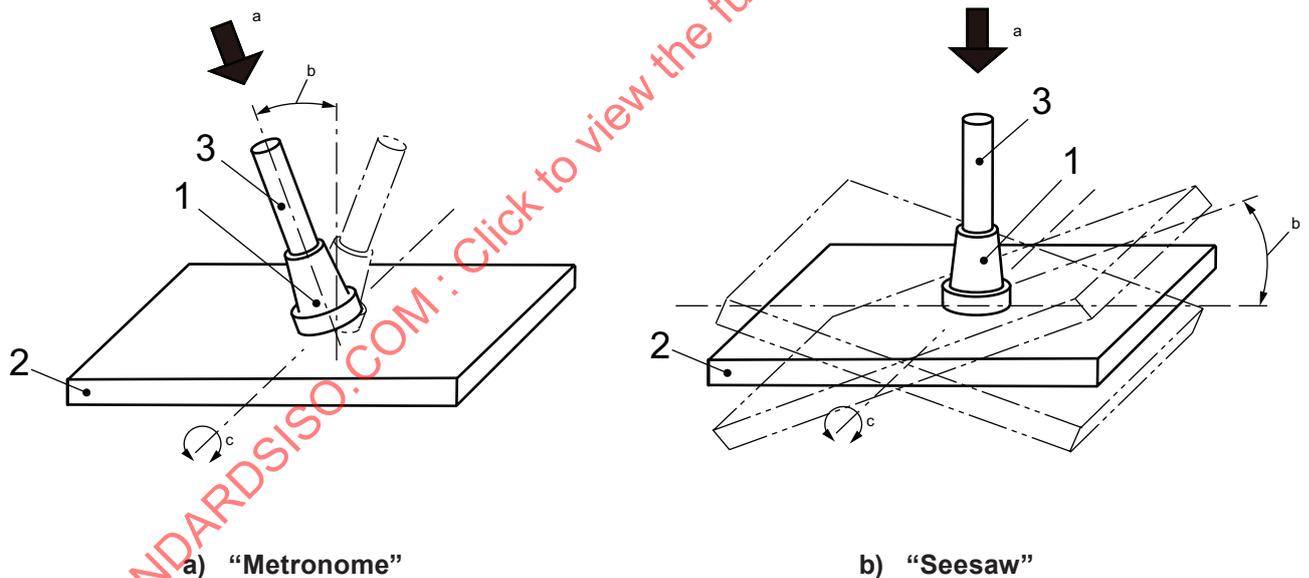
The loading force mechanism shall exert a loading force on the tip as observed in actual gait. The load shall alternate from 0 N at the beginning and end of the test cycle, to  $\left(500^{+20}_{-0}\right)$  N when the loading rod is perpendicular to the test track.

A loading force mechanism may consist of a pneumatic actuator and a loading rod. The actuator generates pushing and pulling motions that allow an axial loading force via the loading rod onto the tip to be tested (two possible conceptual schemes are shown in Figure 2).

The longitudinal axis of the loading rod shall intersect with the axis of relative rotation between the tip and the test track. The axis of relative rotation shall be on the top surface of the test track.

### 5.5 Load cell

A load cell that has been calibrated to an accuracy of  $\pm 2\%$  shall measure the axial load. It is recommended that the capacity of the load cell be up to 1 000 N and that the load cell be connected with a waveform-viewing device (oscilloscope, etc.) or a data-recording system.



#### Key

- 1 tip
- 2 test track
- 3 loading rod
- a Loading force.
- b Tilt angle.
- c Axis of relative rotation.

Figure 2 — Two examples of test apparatus

## 6 Test method

### 6.1 Preparation

If not otherwise specified, wash the tip with neutral detergent, rinse with water and store the tip for at least 3 h in the test environment, in accordance with 6.2.

Three test samples shall be prepared and tested.

### 6.2 Testing environment

The test shall be carried out at a temperature of  $(23 \pm 2)$  °C.

### 6.3 Test procedure

The test procedure shall be conducted as follows.

- a) Fix the tip sample to the loading rod. During the test the tip sample shall not be turned.
- b) Position the loading rod so that the tip just touches the test track at a tilt angle of  $-20$  °C.
- c) Load the tip to  $(100 \pm 20)$  N.
- d) Start to activate smoothly both the loading force mechanism and the motion control mechanism.
- e) Exert the loading force smoothly to the maximum axial load of  $(500^{+20}_{-0})$  N when the loading rod is perpendicular to the test surface.
- f) Release the loading force smoothly to 0 N as the rod is tilted to a tilt angle of  $+20$  °C.
- g) Lift the tip up from the test track and return the loading rod to the start position, as described in b).
- h) Repeat the procedure from b) to g) 500 000 times with a frequency less than 0,8 Hz.
- i) After 500 000 cycles, check the tip as described in Clause 4.
- j) Three samples shall be tested and the results recorded.

## 7 Test report

The test report shall contain but not be limited to the following information:

- a) name and address of the manufacturer;
- b) name and address of the supplier of the product for testing;
- c) name and address of the testing institution;
- d) classification code and name in accordance with ISO 9999;
- e) manufacturer's product type and model identification name and/or number;
- f) supplier's product type and model identification name and/or number;
- g) tip photographs (side shape, bottom shape) before and after the test;
- h) inner diameter, bottom diameter, height, bottom thickness and weight of the tip before the test;
- i) test temperature, type and model identification name and/or number or specification of the test device;