International Standard

ISO 11334-4

Second edition
2024-10

Assistive products for walking, manipulated by one arm — Requirements and test methods —

Part 4: Walking sticks with three or more legs

Produits d'assistance à la marche manipulés avec un bras — Exigences et méthodes d'essai —

Partie 4: Cannes à trois pieds ou plus

Reference number
ISO 11334-4:2024(en)

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Published in Switzerland

Contents

Page

Foreword

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 173, *Assistive products*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 293, *Assistive products and accessibility,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 11334-4:1999), which has been technically revised.

The main changes are as follows:

— the minimum requirements for stability have been removed and are replaced by requirements on disclosure of the stability performance level for the specified direction;

— the static strength test for the legs and separation part was added;

— Clause 6 on general requirements for assistive products for walking was added.

A list of all parts in the ISO 11334 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

A walking stick with three or more legs can be used when a person needs assistance for walking. It provides more stability when walking and standing compared with other types of sticks and canes manipulated by one arm and can thus reduce the risk of falling.

Assistive products for walking, manipulated by one arm — Requirements and test methods —

Part 4: Walking sticks with three or more legs

1 Scope

This document specifies requirements and test methods of walking sticks with three or more legs used as assistive products for walking, manipulated by one arm, without accessories, unless specified in the particular test procedure. This document also gives requirements related to safety, ergonomics, performance and information supplied by the manufacturer, including marking and labelling.

The requirements and tests are based on every-day use of walking sticks with three or more legs as assistive products for walking for a maximum user mass as specified by the manufacturer. This document is for walking sticks with three or more legs specified for a user mass of no less than 35 kg.

This document is not applicable to walking sticks with three or more legs with underarm or forearm support or with moving parts such as a universal joint.

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 7000, *Graphical symbols for use on equipment — Registered symbols*

ISO 10993-1, *Biological evaluation of medical devices — Part 1: Evaluation and testing within a risk management process*

ISO 10993-5, *Biological evaluation of medical devices — Part 5: Tests for in vitro cytotoxicity*

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

ISO 15223-1, *Medical devices — Symbols to be used with information to be supplied by the manufacturer — Part 1: General requirements*

ISO 20417, *Medical devices — Information to be supplied by the manufacturer*

ISO 24415-1, *Tips for assistive products for walking — Requirements and test methods — Part 1: Friction of tips*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
anatomic handgrip
handgrip (3.2) that is shaped in a way to match the shape of the hand

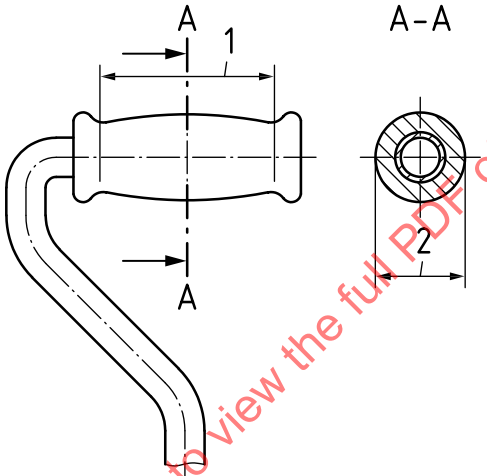
Note 1 to entry: Anatomic handgrips exist in right-hand and left-hand types.

3.2
handgrip
part of the walking stick which is normally held in the hand when the walking stick is in use

3.3
handgrip length
dimension of the *handgrip* (3.2) measured longitudinally where the hand rests

Note 1 to entry: See Figure 1, key 1.

Note 2 to entry: Where the front end or the rear end of the handgrip is not clear, the full length of the handgrip that can support the weight of the user is defined as the handgrip length.



Key

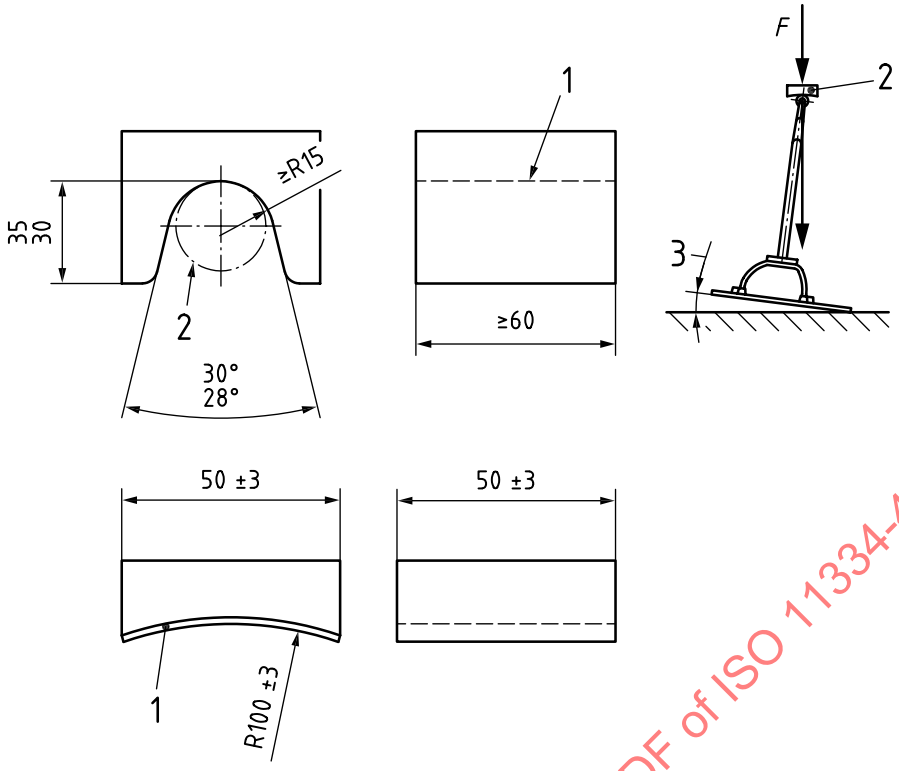
1 handgrip length
2 handgrip width

Figure 1 — Detail of handle and handgrip

3.4
handgrip loading pad
device capable of applying the test force to the *handgrip* (3.2)

Note 1 to entry: See Figure 2, key 2.

Note 2 to entry: For some anatomically shaped handgrips, it can be necessary to design a custom loading pad.



Key

F	force	2	handgrip loading pad
1	loading surface	3	tilt angle

Figure 2 — Handgrip loading pad

3.5
handgrip reference point
crossing point of vertical line through centre of *shaft* (3.11) and *handgrip* (3.2)

3.6
handgrip width
dimension of the *handgrip* (3.2) measured length cross-sectionally to longitudinal direction where the hand rests

Note 1 to entry: See Figure 1, key 2.

3.7
handle
part of walking stick to which the *handgrip* (3.2) is attached

Note 1 to entry: On most devices, the handgrip and the handle are part of the same piece.

3.8
leg
frame or rod separated from the *shaft* (3.11), which contacts the ground

3.9
locking device
part of a walking stick that provides locking of the height and/or other adjustment mechanisms

Note 1 to entry: See Figure 4, key 7.

3.10
separation part
part of a *shaft* (3.11) to which separated *legs* (3.8) are attached

Note 1 to entry: See Figure 9, key 1.

3.11
shaft
prop section of the walking stick

Note 1 to entry: In most types of walking sticks, the shaft is made of two telescopic tubes used for height adjustment.

3.12
tip
part of a walking stick *leg(s)* (3.8) which contacts the ground

Note 1 to entry: see Figure 4, key 10.

3.13
maximum user mass
greatest permissible mass of the person using the product

Note 1 to entry: It is measured in kilograms (kg).

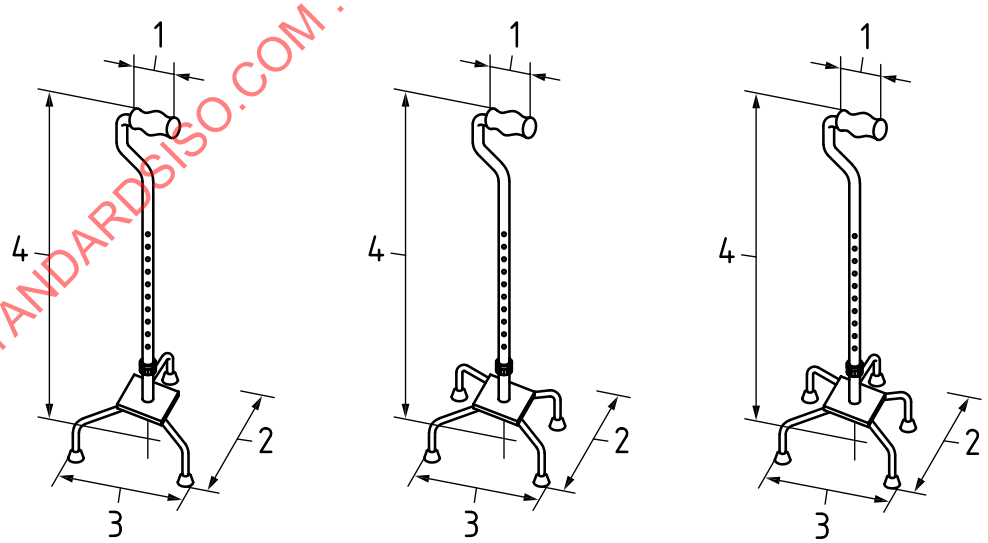
[SOURCE: ISO 21856:2022, 3.16.1]

3.14
walking-stick height
vertical distance from the highest point on the *handgrip* (3.2) to the ground where the *tips* (3.12) of the walking stick rest

Note 1 to entry: See Figure 3, key 4.

3.15
walking-stick depth
maximum outside dimension of a walking stick measured horizontally in the direction of movement

Note 1 to entry: See Figure 3, key 3.



Key

1	handgrip length	3	walking-stick depth
2	walking-stick width	4	walking-stick height

Figure 3 — Measurements of a walking sticks with three or more legs

3.16
height adjustment device
device for adjusting the height of the walking stick

EXAMPLE Button type, plug-in clips.

Note 1 to entry: See Figure 4, key 5.

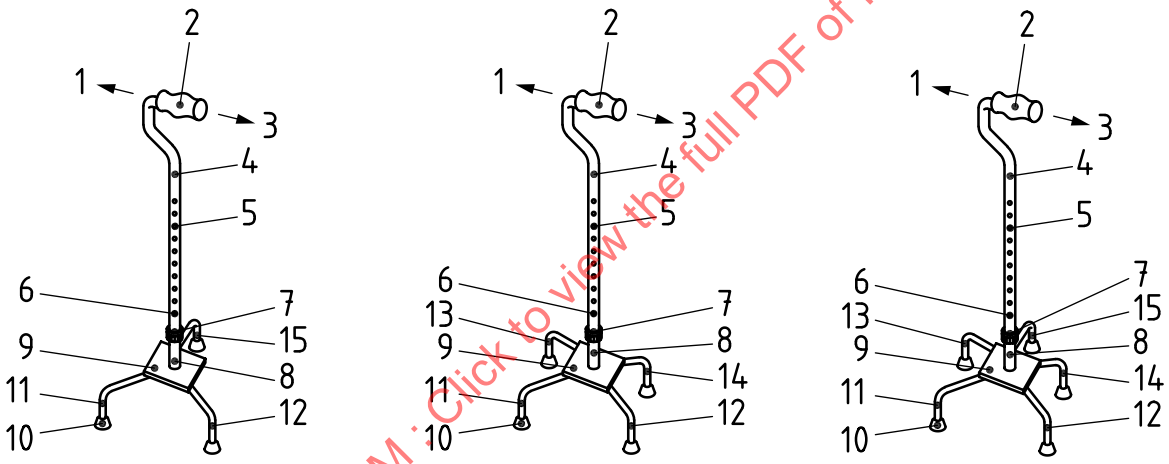
3.17
walking-stick width
maximum outside dimension of a walking stick measured horizontally at right angles to the direction of movement

Note 1 to entry: See Figure 3, key 2.

3.18
walking stick with three or more legs
walking device providing support and balance which has a *handgrip* (3.2), *shaft* (3.11) and three or more *legs* (3.8) with *tips* (3.12)

Note 1 to entry: Throughout this document the term walking stick refers to a walking stick with three or more legs.

[SOURCE: ISO 9999:2022, 5.3, 12 03 16]



Key

1	forward direction	9	base
2	handgrip	10	tip
3	rearward direction	11	inside front leg
4	shaft (upper)	12	inside rear leg
5	height adjustment device	13	outside front leg
6	height adjustment hole	14	outside rear leg
7	locking device	15	outside leg
8	shaft (lower)		

Figure 4 — Identification of parts of walking sticks with three or more legs

4 Apparatus

4.1 Means to apply a force with an accuracy of ±5 % and with a rate of application less than 1 N/s.

4.2 Means to measure force with an accuracy of ±5 % in increments of 1 N.

4.3 Means to measure distance in the range of 0 m to 3 m with an accuracy of ±5 mm or ±2 %, whichever is greater.

4.4 Means to measure grade of the test plane to an accuracy of ±0,5°.

4.5 A test plane of sufficient size and stiffness to support the walking stick during testing, such that the whole surface is contained between two imaginary parallel planes 5 mm a part.

The test plane shall have a stopper and shall be able to be tilted from the horizontal with the centreline of the hinges paralleled to the line joining the axis of the two legs being tested.

NOTE A wooden or steel frame with a plywood surface can be used.

4.6 Stoppers, devices of sufficient height to prevent the walking stick from moving during testing, without interfering with the test or the walking stick.

5 Test conditions

The following conditions shall be applied:

a) The tests shall be performed at an ambient temperature of 21 °C ± 5 °C.

b) Adjustable parts of the walking stick shall be adjusted to the most adverse position according to manufacturer's instruction unless otherwise specified in the test procedure. The most adverse condition includes that the height of the handgrip shall be set at maximum.

c) All abnormalities such as breakage or permanent deformation in each test shall be recorded and be distinguished from the abnormalities in the subsequent tests.

d) During the stability tests, the walking stick shall be prevented from sliding before tilting occurs. The results of the tests shall not be influenced by the means used.

e) If the device has alternative handle fittings as accessory equipment, all alternatives shall be taken into consideration to define the least favourable configuration (e.g. extended handles).

f) Before testing, the walking stick shall be inspected. Any apparent defects shall be documented so that they shall not later be recorded as having been caused by the tests.

g) One walking stick shall be tested in the following sequence:

   — measurements;

   — stability;

   — static strength of the walking stick;

   — static strength of the legs and separation part;

   — durability;

   — adjustment mechanism and locking devices.

   The static strength test of the legs and separation part shall be performed without the leg tip. The spare leg tip shall be installed on the leg for the durability test.

6 General requirements and test methods

6.1 Risk analysis

The safety of a walking stick shall be assessed by the manufacturer by identifying hazards and estimating the risks associated with them using the procedures specified in ISO 14971. If relevant, ISO 12100 can be used additionally.

When a walking stick is intended by the manufacturer to be used in combination with other devices, the risks shall be assessed by the manufacturer.

NOTE In the case of certain disabilities, there can be a need for higher levels of safety for equipment used to offset the mobility effects of that disability.

6.2 Maximum user mass/load limits

The maximum user mass shall be declared by the manufacturer.

6.3 Structural requirements

6.3.1 Handgrip

The handgrip width shall be not less than 20 mm and not more than 50 mm. This shall be checked by measurement. The handgrip shall be securely fixed to the handle of the walking stick. This requirement is not applicable to anatomic handgrips.

6.3.2 Adjustment mechanisms and locking devices

Any adjustment mechanism shall remain fixed during the intended use.

The maximum extension of the height adjustment mechanism shall be clearly marked or excessive extension shall be prevented by the design.

Adjustment mechanism and locking devices shall be assessed by visual inspection.

6.3.3 Leg section and tips

When the walking stick is used as intended by the manufacturer, the leg section shall not pierce the tips.

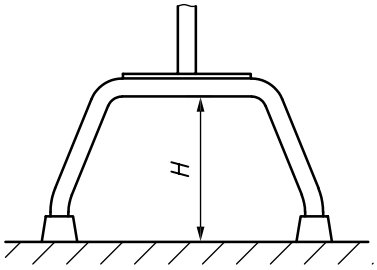
The tips shall be replaceable.

The tips shall be securely fixed to the leg of the walking stick.

The tips shall fulfil the requirements of ISO 24415-1.

6.3.4 Leg height from the ground of the walking stick for outside use

To ensure all tips touching the ground on irregular terrain, the base should have a minimum distance H = 120 mm from the ground (see Figure 5).



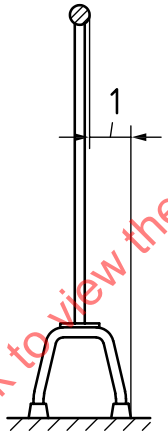
Key

H distance of the base of the leg from the ground

Figure 5 — Height of the base of the leg from the ground

6.3.5 Shaft distance from the user

In order to avoid risks of user stumbling on the lower part of the stick, the frame should be designed to minimize the distance of the handgrip from the tips in the area of the base near the feet of the user as shown in Figure 6. This distance is recommended to be not more than 40 mm.



Key

1 distance

Figure 6 — Shaft distance

7 Materials

7.1 General

The materials used to make a walking stick should not mark, e.g. cause discolouring of skin or clothing, or scratch.

Wherever possible materials should be used that can be recycled.

7.2 Biocompatibility and toxicity

Materials that come into direct contact with the human skin shall be assessed for biocompatibility in accordance with in ISO 10993-1. The handgrip shall at least be assessed for cytotoxicity in accordance with ISO 10993-5 (cytotoxicity).

Special attention shall be given to substances that are carcinogenic, mutagenic or toxic to reproduction and other substances of very high concern (SVHCs).

The result of the assessment shall be incorporated in the risk analysis (see 6.1).

7.3 Infection and microbiological contamination

7.3.1 General

Walking sticks and their auxiliary parts shall be designed to be accessible for cleaning to prevent cross infection.

7.3.2 Cleaning and disinfection

The method and suitable cleaning and/or disinfection materials shall be described in the information supplied by the manufacturer. A walking stick should be easy to clean and should not incorporate features which will retain dust, liquid and/or contaminated material.

A walking stick should be able to be disinfected repeatedly by readily available disinfectants without damage to the walking stick. If necessary, the instruction should indicate the type of disinfectant to be used to avoid damaging the materials of the stick.

7.4 Resistance to corrosion

The risk of corrosion affecting the safety of the user or an assistant (e.g. structural load carrying parts of the walking stick) shall be assessed in the risk analysis (see 6.1).

Assistive products for walking that are identified to be at risk of corrosion shall be sufficiently protected against corrosion.

These requirements are tested by the salt spray test according to ISO 9227 with a test duration of 72 h.

8 Temperatures of parts that come in contact with human skin

The risk analysis (see 6.1) shall identify hazards and evaluate the risks associated with the surface temperature of parts that can come into contact with human skin during the intended conditions of use.

9 Prevention of traps for parts of the human body

9.1 Holes and clearances

Holes in and clearances between stationary parts that are accessible to the user and/or assistant during the intended use of a walking stick shall be as specified in Table 1.

These measurements shall be done before and after any relevant strength and durability testing.

Table 1 — Safe distances between stationary parts

To avoid	Safe distances for adults	Safe distances for children[a]
Finger traps	Less than 8 mm or more than 25 mm	Less than 5 mm or more than 12 mm
[a] Also includes adults with a height of less than 146 cm, or a mass of less than 40 kg, or a body mass index (BMI) of less than 17.		

If the intended purpose of the walking stick cannot be met without a hazard caused by the size of holes and the clearance between stationary parts, a warning and instructions on how to operate the walking stick safely shall be provided in the instructions for use.

For stationary parts that can cause a trap, consideration of those parts of the body that are at risk shall be taken into account. The user/user group shall be specified, so that correct safety distances can be applied.

The design of parts that confine a hole or clearance shall take into consideration the forces that can be applied in normal use.

NOTE A force might cause a hole/clearance to widen. This can then cause a failure, as specified in Table 1.

9.2 V-shape openings

On holes with the shape of a keyhole or V-shaped openings, the lower limit shall not apply. When inspecting the walking stick for traps for body parts, any flexibility/elasticity of adjacent parts shall be considered.

10 Surfaces, corners and edges

There shall be no burrs, sharp edges, or protrusions on the parts of walking stick that can blemish clothes or injure the users or the assistant.

11 Static stability

11.1 Requirements for static stability

11.1.1 Inward direction static stability

The walking stick shall not tilt when tested according to 11.2.1.

11.1.2 Outward direction, forward direction and backward direction static stability

The forward direction, backward direction and outward direction (if applicable) stability shall be tested and recorded according to the stability test described in 11.2.2.

The outward direction stability angle shall be declared by the manufacturer.

In the case of a walking stick with three legs, the lower tilt angle either for forward direction or backward direction shall be disclosed.

In the case of the walking stick with five or more legs, the lowest outward direction tilt angle shall be disclosed.

11.2 Test methods for static stability

11.2.1 Inward direction static stability test

The inward direction static stability test shall be performed as follows:

a) The walking stick shall be placed with its tips on the horizontal test plane.

b) A static force of 250 N ± 5 N shall be applied vertically to the walking stick using the handgrip loading pad. The loading line shall remain vertical and pass through the handgrip reference point during the test. The loading method shall not constrain the walking stick to bend in any direction.

11.2.2 Outward direction, forward direction and backward direction static stability test

Outward direction, forward direction and backward direction static stability test shall be performed as follows:

a) The walking stick shall be placed with its tips on the test plane, placing the tips of the adjacent two legs including at least one outside leg to the stopper [see Figure 7 a)].

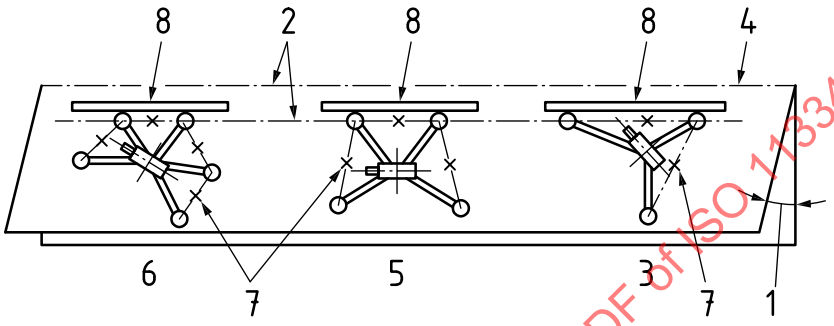
b) The loading force shall be applied vertically. The loading line shall remain vertical and pass through the handgrip reference point during the test [see Figure 7 b)]. The loading method shall not constrain the walking stick to bend in any direction.

NOTE Suspending the loading force allows the force to remain vertical during the test.

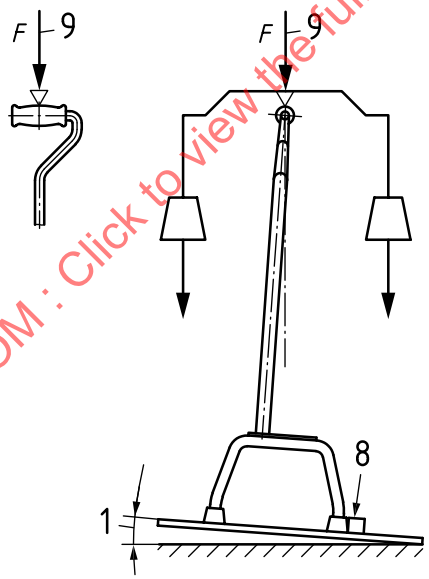
c) A static force of 250 N ± 5 N shall be applied. The test plane is tilted in the direction shown in Figure 7 b) and the minimum angle of the test plane at the point of the walking stick tilting, rounded down to the nearest 0,5°, shall be recorded.

d) Repeat this procedure for all outward directions, forward direction, and backward direction as indicated in Figure 7 a) and Figure 7 b).

e) Record the test results for each direction.



a) Setup



b) Loading geometry

Key

1	tilt angle	6	walking stick with five legs
2	parallel	7	adjacent two legs to be tested
3	walking stick with three legs	8	stopper
4	centreline of hinges	9	applied force by mass
5	walking stick with four legs	*F*	force

Figure 7 — Static stability test

12 Static strength

12.1 Static strength of walking sticks

12.1.1 Requirements for static strength of walking sticks

After testing according to 12.1.2, no part of the walking stick shall crack, break or show any permanent deformation that can constitute a hazard.

The legs shall not pierce through the tips when tested according to 12.1.2.

12.1.2 Test method for static strength of walking sticks

The walking stick shall be tested in the most adverse condition as described in Clause 5.

The static strength test for walking stick shall be performed as follows:

a) The walking stick shall be placed with its tips on the test plane with the outside of the device facing downhill on the test plane. The test plane is tilted as Figure 8 a).

b) The loading force is set to 1 000 N ± 20 N. If the maximum user weight specified for the walking stick deviates from the standard maximum user weight of 100 kg, a force of 10,0 N per kilogram of maximum user weight ±2 %, shall be applied. The load shall be not less than 350 N ± 7 N. When the walking stick tips over as a result of the loading force, reduce the test plane angle until tipping stops.

c) Apply the loading force through the handgrip loading pad gradually over a minimum of 5 s. Keep the loading vertical through the handgrip reference point during the test. Maintain the maximum force for at least 10 s. Record the angle of testing.

d) The loading method shall not prevent the walking stick from bending in any direction.

e) A fixture such as a stopper can be used to prevent the walking stick being tested from misaligning and/or rotating during testing.

f) Inspect the walking stick visually for cracks, breaks or permanent deformation.

12.1.3 Alternative test method for static strength of walking sticks

The following test method can be applied as the alternative.

a) The walking stick shall be placed with its tips on the horizontal test plane with a stopper, at right angles to the normal (forward) direction of movement when the walking stick is in use.

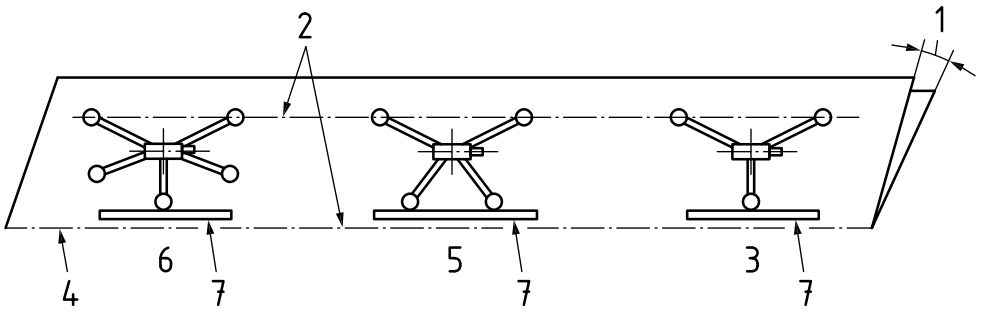
b) The loading force shall be 1 000 N ± 20 N. If the maximum user weight specified for the walking stick deviates from the standard maximum user weight of 100 kg, a force of 10,0 N per kilogram of maximum user weight ±2 %, shall be applied. The load shall be not less than 350 N ± 7 N.

c) The loading force shall be gradually applied with the angle of gradient to the walking stick over a minimum period of 5 s to maximum force through the handgrip loading pad. The angle of the loading force shall be the angle right before the walking stick tips up. In the case that the walking stick being tested tips up due to the test loading force, the angle of the loading force should be adjusted to the angle at which the walking stick being tested stands still. The loading line shall pass through the handgrip reference point. The maximum loading force shall be maintained for a minimum of 10 s. Record the angle of testing.

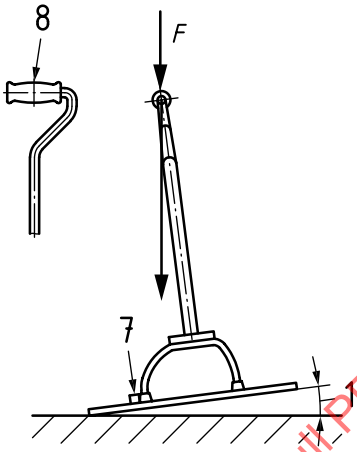
d) The loading method shall not hinder the walking stick from bending in any direction.

e) A fixture such as a stopper can be used to prevent the walking stick being tested from misaligning, rotating and/or slipping during testing.

f) Inspect the walking stick visually for cracks, breaks or permanent deformation.



a) Setup



a) Loading geometry

Key

1	tilt angle	6	walking stick with five legs
2	parallel	7	stopper
3	walking stick with three legs	8	point of force (handgrip reference point)
4	centreline of hinges	*F*	force
5	walking stick with four legs		

Figure 8 — Static strength test

12.2 Static strength for the legs and separation part

12.2.1 Requirements for static strength of the legs and separation part

After testing according to 12.2.2, no leg or separation part of the walking stick shall crack, break or show any permanent deformation that can constitute a hazard.

12.2.2 Test methods for static strength of the legs and separation part

The walking stick shall be tested in the most adverse condition as described in Clause 5.

The static strength test for legs and separation part shall be performed as follows:

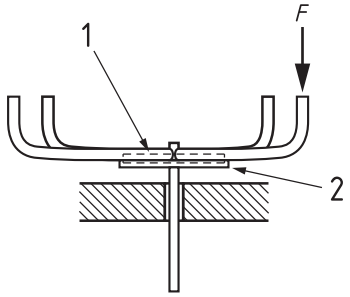
a) Tips shall be removed from the legs before testing. Turn the walking stick upside down and fix the part close to the junction/separation part of the walking stick firmly (see Figure 9).

b) The loading force is set to 350 N ± 7 N. If the maximum user weight specified for the walking stick deviates from the standard maximum user weight of 100 kg, a force of 3,5 N per kilogram of maximum user weight ±2 %, shall be applied. The load shall be not less than 122,5 N ± 2,45 N.

c) Apply the loading force vertically to each leg gradually over a minimum of 5 s at the centre of the leg end face. Maintain the maximum force for at least 10 s.

d) Repeat this procedure for all legs.

e) Inspect the legs and separation part of the walking stick visually for cracks, breaks or deformation.



Key

F force
1 junction/separation part
2 base

Figure 9 — Loading geometry for static strength test for the legs and separation part

13 Durability

13.1 Requirements for durability

After testing according to 13.2, no leg or separation part of the walking stick shall crack, break or show any permanent deformation that can constitute a hazard.

The legs shall not pierce through the tips when tested according to 13.2.

13.2 Test method for durability

The walking stick shall be tested in the most adverse condition as described in Clause 5.

The durability test for walking stick shall be performed as follows:

a) Place the walking stick and tilt the test plane as described in 12.1.2 a). A fixture such as a stopper can be used to prevent the walking stick being tested from misaligning and/or rotating during testing.

b) The loading force is set to 450 N ± 9 N. If the maximum user weight specified for the walking stick deviates from the standard maximum user weight of 100 kg, a force of 4,5 N per kilogram of maximum user weight ±2 %, shall be applied. The load shall be not less than 157,5 N ± 3,15 N. In the case that the walking stick being tested tips up due to the test loading force, the tilt angle of the test plane shall be adjusted to the angle at which the walking stick being tested stands still.

c) The loading method shall not prevent the walking stick from bending in any direction.

d) The loading force shall be applied vertically to the walking stick through the handgrip loading pad. The loading line shall remain vertical and pass through the handgrip reference point.

e) The frequency of the loading cycle shall not exceed 1 Hz. The full loading force shall be applied for at least 2 s each cycle.

f) The number of cycles shall be 200 000.