



**International
Standard**

ISO 11671

**Fibre reinforced plastics —
Telescopic ladder — Requirements
and test methods**

*Plastiques renforcés de fibres de verre — Échelle télescopique —
Exigences et méthodes d'essai*

**First edition
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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 61, *Plastics*, Subcommittee SC 11, *Products*.

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 relates only to telescopic ladders made of fibre-reinforced plastic materials. Therefore, the test methods and technical requirements for the aging performance of the ladders are increased.

This document is applicable to different countries and regions in the world, considering the weight difference between people in different countries and regions, and also in order to reduce the weight of the ladder and more convenient to carry, so the maximum total weight of the ladder is divided into two grades: 100 kg and 150 kg.

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Fibre reinforced plastics — Telescopic ladder — Requirements and test methods

1 Scope

This document specifies the terms and definitions, technical requirements, test methods and inspection rules for telescopic ladders made of fibre-reinforced plastics.

This document applies to the manufacture, selection, inspection and use of telescopic ladders made of fibre-reinforced plastics.

NOTE 1 [Annex A](#) provides guidance for inspection rules of the telescopic ladders.

NOTE 2 [Annex B](#) classifies all the tests covered in this document into 8 test blocks and specifies the sequence of tests within the same test block.

It does not apply to ladders with a length over 5 m.

NOTE 2 Ladders with a length over 5 m can use this document as a reference.

The scope of this document does not relate to the “live working” and “explosive atmospheres”.

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 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test*

ISO 4892-2:2013, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 7599, *Anodizing of aluminium and its alloys — Method for specifying decorative and protective anodic oxidation coatings on aluminium*

ISO 14125, *Fibre-reinforced plastic composites — Determination of flexural properties*

ISO 14644-1, *Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness by particle concentration*

ISO 14713-2, *Zinc coatings — Guidelines and recommendations for the protection against corrosion of iron and steel in structures — Part 2: Hot dip galvanizing*

ISO 16293-2, *Glass in building — Basic soda lime silicate glass products — Part 2: Float glass*

IEC 62321-3-1, *Determination of certain substances in electrotechnical products — Part 3-1: Screening test methods — Screening of electrotechnical products for lead, mercury, cadmium, total chromium and total bromine using X-ray fluorescence spectrometry*

IEC 62321-4, *Determination of certain substances in electrotechnical products — Part 4: Determination of mercury in polymers, metals and electronics by CV-AAS, CV-AFS, ICP-OES and ICP-MS*

EN 59, *Glass reinforced plastics — Determination of indentation hardness by means of a Barcol hardness tester*

EN 131-3, *Ladders — Part 3: Marking and user instructions*

EN 10088-2, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

3 Terms and definitions

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

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

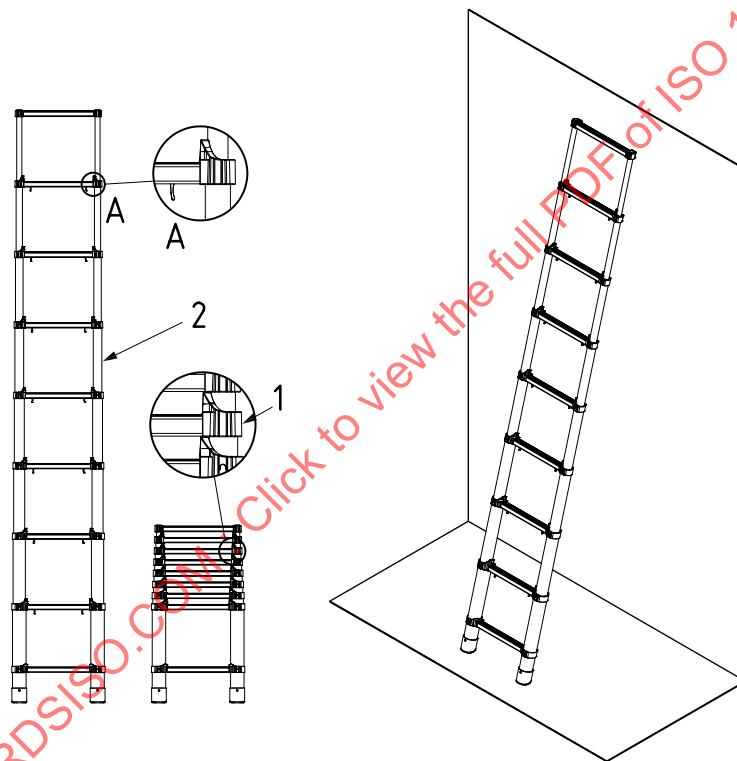
- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

telescopic ladder

ladder consisting of three or more rung/step sections with telescopic stiles

Note 1 to entry: See [Figure 1](#).



Key

- 1 bracket
- 2 stile
- A rung/step section locking mechanism

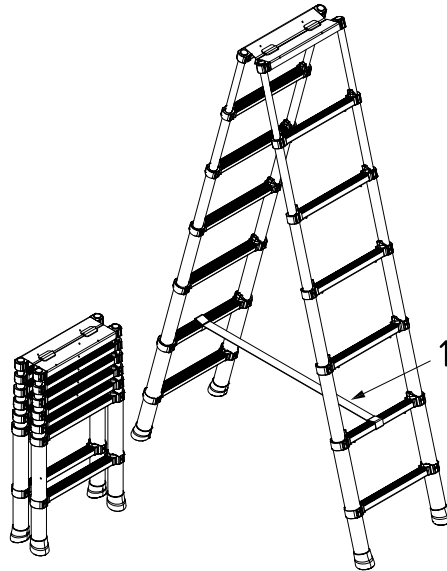
Figure 1 — Example of structure of a telescopic ladder

3.2

free-standing telescopic ladder

ladder (with rungs or steps) which has its own support with opening restraints

Note 1 to entry: See [Figure 2](#).



Key

1 one of the opening restraints

Figure 2 — Example of structure of free-standing telescopic ladder

3.3

rung/step section

section of ladder that consists of one rung/step connected to two telescopic stiles

3.4

bracket

part that attaches the rung/step to the stile

Note 1 to entry: See [Figure 1](#).

3.5

locking indicator

mechanism or part that indicates that one rung/step section or part of one rung/step section is locked/unlocked

3.6

rung/step section locking mechanism

mechanism that locks a rung/step section

Note 1 to entry: See [Figure 1](#).

3.7

locking pin

part that locks each rung/step section and that is engaged when the locking mechanism is locked

3.8

protection system against squeezing

mechanism or part that minimizes the risk of squeezing when the ladder is shortened

3.9

release function

function which releases the locking mechanism

3.10

ascendable side

part of the ascending leg consisting only of fully extended rung/step sections

3.11**storage position**

position where none of the rung/step sections are extended

3.1.12**acceptance test**

contractual test to prove to the customer that the item meets certain conditions of its specification

3.1.13**type test**

conformity test made on one or more items representative of the production

4 Technical requirement**4.1 Functional dimension**

The size mark of the telescopic ladder is shown in [Figure 3](#), and the numerical relationship between dimensions is shown in [Table 1](#). It shall meet the requirements in [Table 1](#).

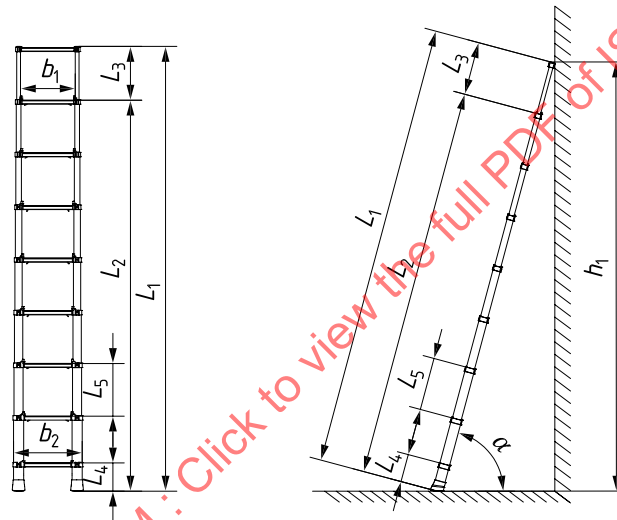


Figure 3 — Dimension of telescopic ladder

Table 1 — Functional sizes

Dimensions in millimetres

	b_1	b_2 where $L_1 < 3\,000$	b_2 Where $L_1 > 3\,000$	L_3 and L_4	L_5	α
min.	280	340	$b_1 + 0,1 \times L_1$	$0,5 L_5$	250	65°
max.	—	— ^a	— ^a	$L_5 + 15$	300	75°

^a The dimension b_2 for leaning ladders may be limited to a maximum of 1 200 mm at the discretion of the manufacturer.

4.2 Total load

The telescopic ladder is divided into two grades: I and II. The maximum total load that telescopic ladders can bear are shown in [Table 2](#).

Table 2 — Maximum total load table

Grade	m ^a (kg)
I	100
II	150
^a Total weight of the operator and its load.	

NOTE 1 It takes into account differences in height and weight in different parts of the world. The maximum total load is equal to the sum of the weight of the personnel and the weight of the tools carried.

NOTE 2 Ladders are intended to be used by one person at a time, however this excludes any person footing (stabilizing) the ladder.

4.3 Materials

The main part of the ladder (stiles, rung/step) should be made of fibre-reinforced engineering plastics. It shall be protected against penetration of water and dirt. The surface shall be smooth. The fibre shall be embedded. The Barcol hardness shall be at least 35 in accordance with EN 59.

The content of heavy metals such as lead, cadmium, mercury and hexavalent chromium in non-metallic material parts shall meet the requirements of IEC 62321-4 and IEC 62321-3-1.

4.4 Protection

Screws and nuts shall be secured against loosening.

It shall be impossible to separate rung/step sections without using an adapted tool.

The unlocking and sliding in of the ladder shall be possible in a safe way. Squeezing between the rung/steps is avoided when the ladder is used in accordance to the user instructions.

If only the stopper is used to protect against squeezing between the steps, the distance between the block and the position where the user's hand is placed when the telescopic ladder is recovered as recommended by the manufacturer shall not be less than 80 mm.

4.5 Surface finish

In order to avoid injuries, accessible edges, corners, and protruding parts shall be free of burrs, for example chamfered or rounded.

The metal parts of the ladder shall be smooth and flat, with chamfered edges and no sharp corners.

At least the following anti-corrosion treatment shall be carried out:

- surface anodization for aluminium alloy, which meets the requirements of ISO 7599;
- galvanization for ferrous metal which meets the requirements of ISO 14713-2.

Rotating elements shall be made of stainless steel.

4.6 Hinges (turning points)

The joints shall reliability connect the planes of the double rung/step ladders.

The hinge pin shall be secured against unintentional loosening. Pins shall have at least the same.

Strength as M 6 (5,3 mm) pins of steel 8,8. If the pin has several shearing points (piano hinge) there is no restriction as to the hinge pin diameter.

The hinges shall satisfy the tests according to [5.4.10](#).

4.7 Opening restraints

The legs of the standing ladders shall be prevented from opening beyond the normal use configuration by means of opening restraints. If chains are used, all chain links with the exception of the first and the last one shall be free to move.

The opening restraints shall satisfy the tests according to [5.4.10](#).

4.8 Rung/steps

Rung/steps shall have a textured surface on the working face to reduce slipping.

Rung/steps shall be firmly and permanently connected to the stiles. The width of rung/steps shall be less than 80 mm and at least 20 mm. The top surface of flat standing surfaces shall have an angle less than or equal to 25° to the horizontal. For leaning ladders, the angle related to the stile shall be 65° to 90° for rung/steps.

Rung/steps shall satisfy the tests according to [5.4.7](#) and [5.4.9](#).

4.9 Ladder feet

Bottom ends of the ladder shall be slip resistant.

The ladder feet shall satisfy the tests described in [5.4.14](#).

4.10 Top of leaning ladders

The top of the ladder shall be in a way that a 2-point area of contact between the top of the ladder and a vertical plane can be ensured.

4.11 Locking of the rung/step sections

All extended rung/step sections are locked when the ladder is in the position of use.

Every rung/step section shall have a locking mechanism for each stile. With ladder in position of use it shall be clearly visible to the user that all of the locking mechanisms are locked or unlocked.

NOTE Visible indication can, for example, be a coloured area of a visible locking pin.

5 Testing methods

5.1 Appearance check

With the naked eye, check whether the appearance of the test product has defects, such as exposed fibres, cracks, mechanical damage or electric burns.

5.2 Dimension check

Measure the dimensions of each part with a tape or vernier caliper.

5.3 Marking durability test

The durability shall be checked by inspection and by rubbing the marking/user instruction lightly:

- first for 15 s with a cloth soaked in water;
- then for 15 s with a cloth soaked in petroleum spirit, e.g. n-hexane.

There shall be no reduction of legibility at the conclusion of the test. Adhesive labels, where used, shall not have worked loose or become curled at the edges.

5.4 Mechanical performance test

5.4.1 General requirements

The tests shall conform with the following tolerances unless specified otherwise:

- a) ± 1 mm for the length measurement;
- b) ± 5 mm for the measurement of the distance between the supports and the overhanging length
- c) $\pm 1^\circ$ for angle measurement;
- d) ± 1 % for static force;
- e) ± 1 % for torque.

Tests shall be performed at a temperature between 15 °C and 25 °C.

Where the ascendable side cannot be determined by the construction of the product, the ladder shall be tested twice according to [5.4.3](#) and [5.4.4](#); conduct strength test and bending test on one side then rotate the ladder 180° about the longitudinal axis and repeat [5.4.3](#) and [5.4.4](#). The second test can be carried out on a new ladder.

Inspect the ladder before testing to confirm condition and operation of all rails by fully extending the ladder.

5.4.2 Drop test

Place the extended ladder in vertical position. Let the ladder fall in the direction of use from vertical to horizontal position on a flat concrete floor by its own weight. Repeat the test with ladder rotated 180° about the longitudinal axis.

Bring the ladder back to storage position.

After drop test, the following requirement shall be met:

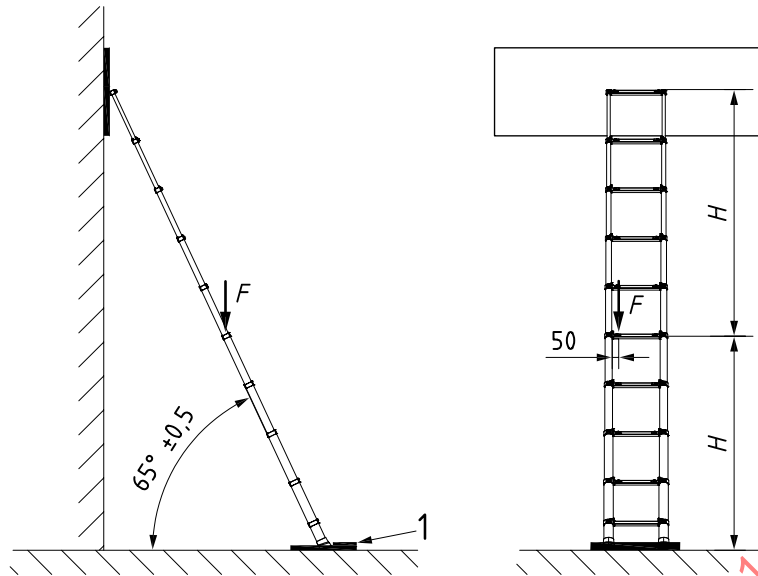
- no rupturing of parts shall be observed;
- the release function and/or locking indicator shall work correctly;
- the locking mechanism shall work correctly;
- there shall be no relative movement between the connectors and the rung/steps;
- permanent deformation is only acceptable providing the ladder remains fully functional and it does not impair the fitness for use, or safety, of the ladder;
- the complete ladder shall be fit for use;
- the protection system against squeezing or entrapment shall be fully functional.

As for the test block A in [Annex B](#), the state after the drop test in [5.2](#) is used as the preset condition for the test ladder.

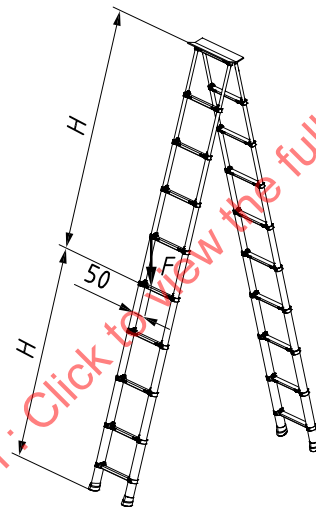
5.4.3 Strength test of stiles

The test shall be carried out on the complete ladder. The test shall be carried out on the maximum extended ladder according to the manufacturer's instruction.

Where the ascendable side cannot be determined by the construction of the product the ladder shall be tested twice. For the second test the ladder shall be rotated 180° about the longitudinal axis. The second test can be carried out on a new ladder.



a) Whole ladder strength test diagram of the reclining ladder



b) Whole ladder strength test diagram of the standing ladder

Key

- F test load
 1 restraint
 H the distance between the rung nearest the centre of the ladder and the end of the ladder

Figure 4 — Strength test of stiles

Erect the ladder in its position of use at the maximum extension.

Ladders shall be erected at 65° with the top resting against a smooth vertical surface and with the base of the ladder blocked to prevent it slipping [see [Figure 4 a\)](#)].

The test load F according to [Table 2](#) shall be applied to the rung/step or tread nearest to the centre of the ladder and at a point 50 mm from the inside of one stile and distributed over a 100 mm of the length of the rung/step or tread for a period of 1 min [see [Figure 4 b\)](#)]. Care should be taken to apply the load smoothly.

The test load F according to [Table 3](#) shall then be moved and applied to the highest rung/step where it's allowed to stand on according to the manufacturer's instruction and at a point 50 mm from the inside of one

stile and distributed over a 100 mm of the length of the rung/step or tread for a period of 1 min. Care should be taken to apply the load smoothly.

Where the test ladder includes a base stabilizer bar then clearance under both stiles of the ladder of a minimum 10 mm shall be maintained throughout the test.

Upon completion of the test, remove the load and inspect the ladder. The following requirements shall be met:

- no rupturing of parts shall be observed;
- the release function and/or locking indicator shall work correctly;
- the locking mechanism shall work correctly;
- there shall be no relative movement between the brackets and the rung/steps;
- permanent deformation is only acceptable providing the ladder remains fully functional and it does not impair the fitness for use, or safety, of the ladder.

Table 3 — Ladders strength test load F

Grade	Total weight of the operator and its load		Ladder class	Strength test load F (N)
	m(kg)	G(N)		
I	100	1 000	Professional	$100 \times 10 \times 1,8 = 1\,800$
II	150	1 500	Professional	$150 \times 10 \times 1,8 = 2\,700$
NOTE 1 $g=9,81 \approx 10$ N/kg,				
NOTE 2 safety factor is 1,8.				

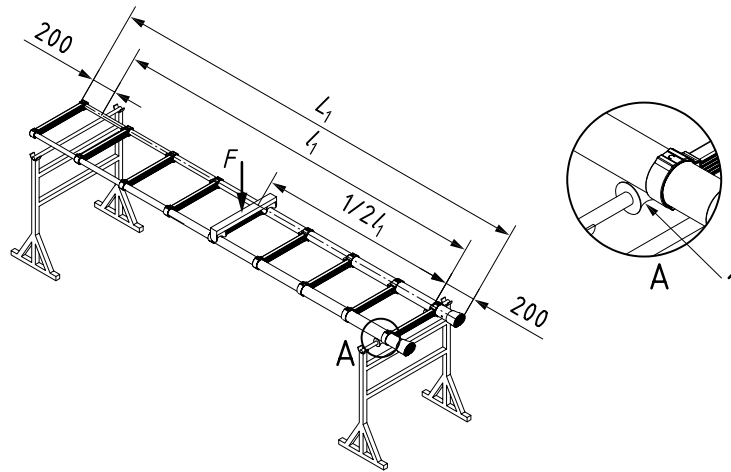
5.4.4 Bending test of stile

The test shall be carried out on the complete ladder. In the case of standing ladders, the test shall be carried out on the complete extended ladder. The test shall be carried out without supporting legs if not permanently fixed to the ladder. Where the ascendable side cannot be determined by the construction of the product, or where it is a multiple part combination ladder the ladder shall be tested twice. For the second test the ladder shall be rotated 180° about the longitudinal axis. The ladder shall be placed horizontally on supports situated 200 mm from each end of the ladder.

The supports shall be cylindrical with diameters between 25 mm and 100 mm and one shall be free to rotate the other shall be fixed. The test load shall be slowly placed in the middle of the ladder equally to both stiles over a width of 100 mm, while avoiding applying by jerks.

A pre-load of 100 N shall be applied for the duration of one minute. The position of the ladder after removal of the pre-load is the origin for the measurement." A test load $F=G/2$ (see [Figure 5](#)) shall be applied vertically on the centre of the ladder for a duration of at least 1 min. Thereby the maximum permissible deflection $f_{\max}$ as a function of the distance l_1 between the supports shall be:

$$f_{\max} = 5 \times l_1^2 \times 10^{-6} \text{ mm}$$

**Key**

1 free rotated support

Figure 5 — Diagram of strength and bending test of stiles**5.4.5 Lateral deflection test of the ladder**

This test shall be conducted on each ascendable side of the standing ladders.

The ladder shall be placed horizontally on supports situated 200 mm from each end of the ladder.

The supports shall be cylindrical with diameters between 25 mm and 100 mm and one shall be free to rotate the other shall be fixed.

The ladder shall be placed in the lateral position.

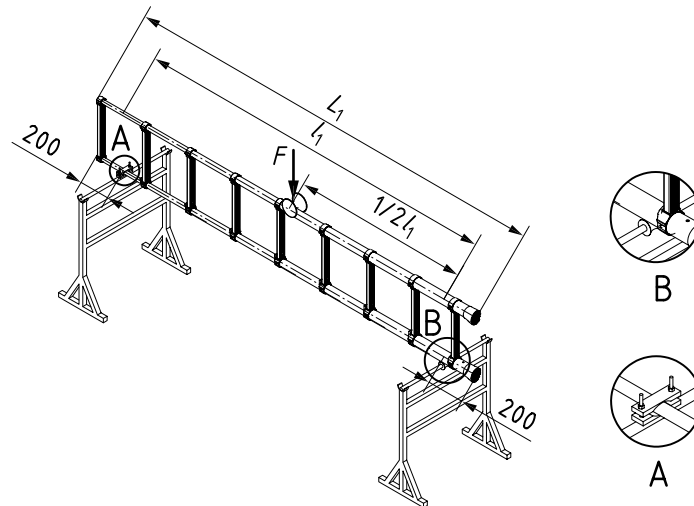
A pre-load of 100 N shall be applied for the duration of 1 min. The position of the ladder after removal of the pre-load is the origin for measurement.

A test load $F=G/6$ (see [Figure 6](#)) shall be applied to the lower stile equidistant from the supports.

The deflection is measured equidistant from the supports 1 min after loading.

Thereby the maximum permissible deflection $f_{\max}$ as a function of the distance l between the supports shall be:

$$f_{\max} = 000,5 l,$$

**Key**

1 the free rotated support

Figure 6 — Lateral deflection test

5.4.6 Bottom stile ends test

Place the ladder laterally, with the longitudinal axis of the ladder in the horizontal position. The lower stile is to be fixed to the support so that the stile ends overhang the supporting surface (see [Figure 10](#)). If the rung/steps are bolted, riveted, or similarly fixed to the stile the edge of the support shall be in line with the bottom lower edge of the assembling hole. If the rung/steps are fixed to the stile without the stile being penetrated the edge of the support shall be in line with the lower edge of the rung/step.

If the ladder has a bar type stabilizer, then this test is not carried out.

A rigid load block 50 mm wide is placed with its end up to and parallel with the end of the stile. The load block shall rest on the stile and shall effect the whole width of the stile. The lateral deflection f of the stile end is measured at the outer edge of the load block in the longitudinal axis.

To be able to obtain a good rest against the stile, it is permitted to cut off a part of a slip resistant material, if any.

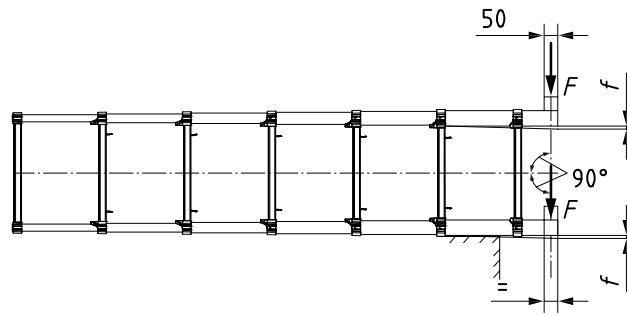
A vertical force F of 1 100 N (see [Figure 7](#)) is placed in the middle of the load block and is maintained for one min. The permanent deflection after removal of the test load together with any damages are noted.

The test is repeated on the lower stile without turning the ladder.

The permanent deflection f in each test shall not exceed 2 mm.

Neither fracture nor visible cracks are allowed.

This test shall also be performed on supporting legs.

**Key**

F test load on the rigid block

Figure 7 — Test method of the bottom stile ends

5.4.7 Vertical load on rung/steps

5.4.7.1 General

The ladder shall be erected in the position of use at the maximum angle allowed by the manufacturer's instructions. A pre-load F of 200 N shall be applied for the duration of 1 min. The position of the rung/step after removal of the pre-load is the origin for measurement. The ladders shall not be moved/replaced after this measurement.

5.4.7.2 Rung/steps — Locked position

In the position of use of the ladder, a test load F (see [Table 3](#)) shall be applied vertically on the mid-point of the weakest rung/step of any design evenly distributed over a width of 100 mm and a depth equal to the rung/step and for the duration of 1 min (see [Figure 8](#)).

The maximum permanent deformation after removal of the test-load shall be less than or equal to 0,5 % of the inner width of the longest rung/step of each type measured underneath the tested rung/step.

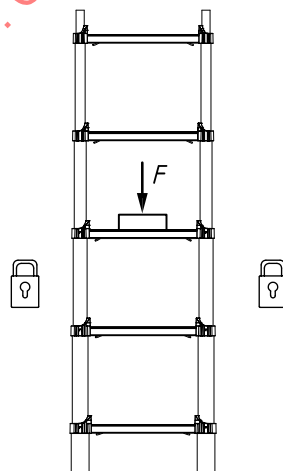


Figure 8 — Rung/steps strength test — Locked position

5.4.7.3 Rung/steps — Unlocked position

Set up the ladder in its position of use at the maximum extension. Ladders shall be positioned at 75° with the top resting against a smooth vertical surface and with the base of the ladder blocked to prevent it slipping.

Standing ladders shall be erected according to the manufacturer's instructions.

Rung/steps that can be used in two directions, e.g. hinge joint ladders, shall be tested in both directions. Standing ladders shall be tested on both sides. Ladders that can be used as standing or leaning ladders shall be tested in both configurations.

A vertical test load F (see Table 3) shall be applied for the duration of 1 min on the upper most rung/step section allowed to be used according to the user manual as close as possible to the stile over a width of 100 mm while it shall be taken care that an applying by jerks is avoided (see Figure 9).

Before applying the load, unlock the rung/step locking mechanism of this rung/step section on the same side where the load is applied.

After the load has been removed the ladder shall be put in storage position. Extend the ladder again. The following requirements shall be met:

- no rupturing of parts shall be observed;
- the release function and/or locking indicator shall work correctly;
- the locking mechanism shall work correctly;
- there shall be no relative movement between the brackets and the rung/steps;
- permanent deformation is only acceptable providing the ladder remains fully functional and it does not impair the fitness for use, or safety, of the ladder.

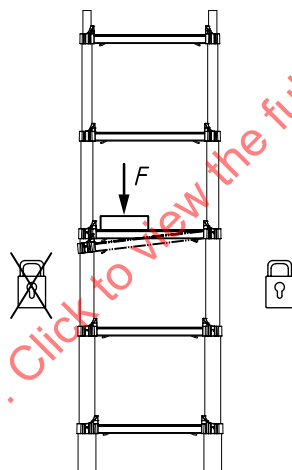


Figure 9 — Rung/steps strength test — Unlocked position

5.4.8 Torsion test of rung/steps

A torque M of 50 Nm (see Figure 10) shall be applied on the midpoint of the rung/step or step via a 100 mm wide clamping device. The torque shall be applied alternately 10 times in clockwise and 10 times in counter-clockwise direction for a period of 10 s each.

During testing there shall be no relative movement in the connection between stile and rung/step/step. After the test a permanent deformation shall be 1° at maximum with a tolerance of $\pm 0,2^\circ$.

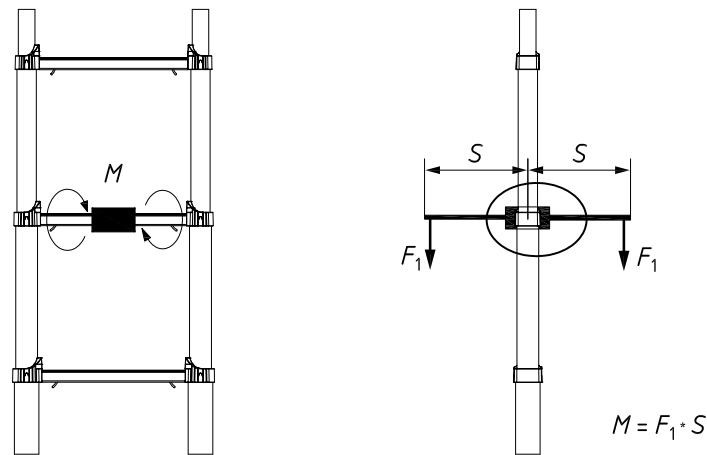


Figure 10 — Torsion test of rung/steps

5.4.9 Pull out test of rung/step

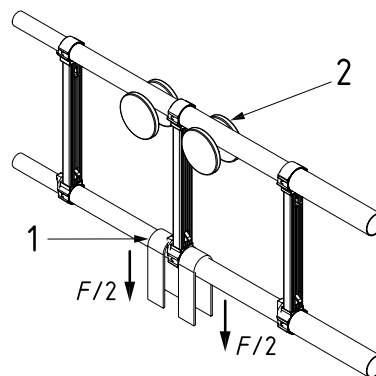
The fastening of three rung/steps shall be tested on a fully extended ladder. The test rung/steps shall be the one closest to the centre, one from the top third of the ladder and one from the bottom of the ladder. If more than one method of fixing the rung/steps to the connector has been used, at least one rung/step from each different fixing method shall be tested.

The test shall be executed in the longitudinal direction of the rung/step, and the pulling load F should gradually increase, at least reaching the corresponding level of load in [Table 3](#) (see [Figure 11](#)).

The load shall be applied on the stiles as close as possible to the rung/step, not more than 50 mm from the rung/step. The stile shall be supported on each side of the rung/step on pulley with grooves. The load F shall be applied on each side of the rung/step on the stiles on a surface of a maximum width of 50 mm. The load F shall be equally divided to both sides of that rung/step.

Grooved pulleys with a diameter between the diameter of the stile and a diameter 1,5 times the diameter of this stile are preferable.

After the test, the ladder and the locking mechanism shall function in all sections normally and in accordance with the manufacturer's instructions.



Key

- 1 weaving tape
- 2 pulley with grooves

Figure 11 — Pull out test of rung/step

5.4.10 Test of opening restraints and hinges of standing ladders

This test is for standing ladders or combination ladders used as standing ladders. For the purpose of this test, the working position for these ladders is two parts connected at the top and secured against sliding away from each other. Where a ladder is fitted with both automatic and manual restraint devices, only the automatic device shall be employed. The engagement of a ladders manual restraint device is only permitted where no automatic device is fitted.

NOTE 1 In some countries, the use of only manual restraint devices is not permitted.

NOTE 2 A locking hinge is considered an automatic restraint device.

Each leg of the ladder in the working position is placed on a platform provided with multidirectional rollers (see [Figure 15](#)). The effects of friction, from both the rollers and floor surface, shall be negligible. The test is to be conducted on a clean, smooth finish concrete floor.

The test shall be carried out on a fully extended ladder.

The test load F (see [Table 3](#)) is divided into two $F/2$, respectively acting on the force ring of two fabric belts (see [Figure 12](#)). The width of each fabric belt is 100 mm. Wrap symmetrically and vertically on the pedal surface, and the load should be applied on the top pedal. The fabric belt should be as close to the ladder frame as possible, and the load should last for 1 minute.

After removal of the test loads, no visible permanent deformation shall occur on the hinge joints, opening restraint devices and their attachments. The ladder shall not show any visible damages such as cracks, indentations, etc. Permanent deformation is acceptable only if it does not impair the fitness for use of the ladder.



Figure 12 — Test of opening restraint devices and hinges of free-standing telescopic ladder

5.4.11 Base slip test for leaning ladders

5.4.11.1 Ladders to be tested

All leaning ladders or ladders that may be used as a leaning ladder shall be tested. The whole ladder shall be tested, and it shall be fully extended when testing. Where the ascendable side cannot be determined, the test

shall be repeated. For the second test the ladder shall be rotated 180° about its longitudinal axis. Optionally, a second ladder may be used.

Where ladders have stabilizing devices, they should be deployed in this test the way the manufacturer designed.

In the case of combination ladders that may be used as a leaning ladder, they shall be tested as a leaning ladder.

The feet of the ladder shall be new.

The surface supporting the base of the ladder shall be a sheet of float glass conforming to the requirements of ISO 16293-2. The glass shall be of a suitable thickness to support the weight of the ladder.

The surface supporting the upper end of the ladder shall be firm and smooth stainless steel, smooth glass or smooth high-pressure laminate.

5.4.11.2 Pre-test procedures

Prior to carrying out the test, the float glass surface supporting the base of the ladder and the surface supporting the upper end of the ladder shall both be cleaned using pure industrial grade ethanol, and a clean-room dry hygiene wipe. After cleaning remove any remaining ethanol with another clean-room dry hygiene wipe.

Prior to carrying out the test, the feet of the ladder shall be cleaned with a low particulate, dry hygiene wipe suitable for use in an ISO class 5 clean room in accordance with ISO 14644-1.

The supporting surfaces shall be left to dry for 20 min before positioning the ladder.

5.4.11.3 Test procedure

The ladder shall be positioned at an angle of 75° or the maximum angle up to 75° permitted by the design. Its feet shall be on the float glass base and with the top of the ladder resting against the upper supporting surface (see [Figure 16](#)). Confirm the angle of the ladder is correct by measuring it with an inclinometer accurate to within $\pm 0,5^\circ$ positioned on the stiles and adjacent to the base of the ladder. The base of the ladder shall be restrained to prevent outward movement.

A datum shall be established at the base of the ladder as the origin of measurement for outward movement of the feet of the ladder.

The air temperature shall be measured within 100 mm measured horizontally from the ladder feet and at a height no greater than 10 mm from the float glass surface supporting the base of the ladder.

The surface temperature of the float glass supporting the base of the ladder, the ladder feet and the air temperature surrounding the feet shall be $(20 \pm 2)^\circ\text{C}$ before the testing and shall remain within this range during the testing.

A vertical downwards test load $F=G$ (see [Table 3](#)) shall be applied to the midpoint of the fourth rung/step down from the top of the ladder. The feet of the ladder shall be allowed to settle for a period of 2 min.

The restraint preventing outward movement of the base of the ladder shall then be removed.

After a period of 1 min the restraint preventing outward movement of the ladder shall be replaced.

Measure any outward movement of the ladder feet relative to datum established for the origin of measurement.

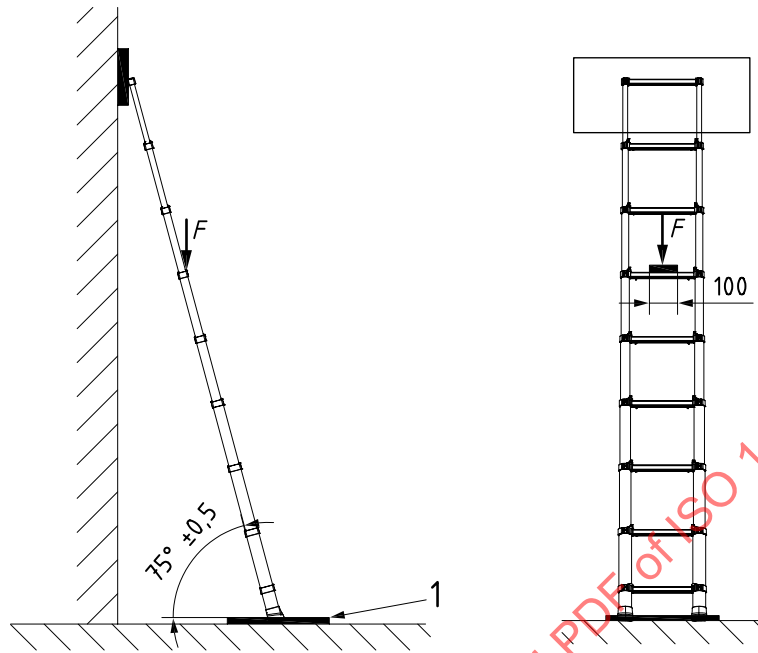
Repeat the test procedure 4 times.

NOTE It is not necessary to replace the feet of the ladder or repeat the cleaning process between tests.

5.4.11.4 Test requirement

The ladder feet shall not move outwards more than 40 mm with respect to the origin for measurement.

Dimensions in millimetres



Key

- F test load
1 restraint

Figure 13 — Base slip test for leaning ladders

5.4.12 Test of locking mechanism

5.4.12.1 Cyclic test of locking mechanism

Aim of the test is to check the functional reliability of the locking mechanism. Test shall be carried out vertically on the locking mechanisms of the bottom two extendable rung/step sections. The ladder shall stand upright in a fixture during the test.

The following test cycle shall be conducted:

- 1) unlock the rung/step (if needed);
- 2) pull out the bottom two rung/step sections as far as needed till both side locks are automatically and fully engaged;
- 3) apply a vertical load of $F=G/2$ N on each stile for the duration of 3 s to 5 s;
- 4) after removing the load, the release function shall be operated;
- 5) bring the ladder section in by its own weight. If not possible, it shall be forced down.

During movement the rung/step section locking mechanism and/or release function shall not be operated or operated as little as practicable.

This cycle shall be repeated 4 000 times. The frequency of the cycles shall be selected in a way that dynamic forces and frictional heating during the cycle of the test sample are minimized.

The following requirements shall be met:

- the rung/step locking mechanism shall work in a proper way during and after the test;
- if there is visible damage on a rung/step after the cyclic test, test [5.4.7.2](#) (rung/steps strength test - locked position) shall be performed again on that rung/step.

No lubricants shall be added before, or during, the test.

5.4.12.2 Static test of locking mechanism

The ladder shall be extended to its complete length and placed completely vertical.

A test load F of 3 500 N (see [Figure 14](#)) shall be applied at the upper part of one stile of the ladder, in the direction of the length of the ladder for the duration of 1 min.

After removal of the test load, permanent deformation is only acceptable providing the ladder remains fully functional and it does not impair the fitness for use, or safety, of the ladder.

Repeat for the other stile.

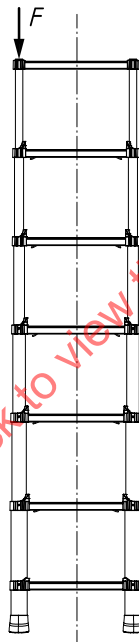


Figure 14 — Locking device test

5.4.13 Cyclic test of hinge joints

These tests are conducted on all hinge joints types with an automatic locking device.

To test their operation, hinge joints (lateral and longitudinal hinge joint ladders) shall withstand the cyclic tests. A pair of hinge joints comprising the maximum number of positions shall be subjected to a series of 4 000 cycles from the closed position to the fully open position. The hinge joint shall be locked and unlocked in each of its positions during the course of each cycle at the normal utilization speed. No oil shall be added to the hinge joints during the tests.

Automatic locking function shall operate with no manual intervention for a duration of 4 000 cycles.

After the test the following requirements shall be fulfilled:

- no rupturing of parts shall be observed;
- the release function and/or locking indicator shall work correctly;

- the locking mechanism shall work;
- there shall be no relative movement between the brackets and the rungs/steps.

Permanent deformation or wear is only acceptable providing the ladder remains fully functional and it does not impair the fitness for use, or safety, of the ladder.

5.4.14 Feet pull test

5.4.14.1 For ladder feet made of one part

Fix the ladder. Attach a fixing to the centre of a ladder foot. The force is to be applied in a direction most likely to separate the foot from the stile.

A load of 150 N shall be applied for 1 min.

After the test, the foot shall remain functional and show a separation from the stile of less than or equal to 4 mm.

5.4.14.2 For feet made of one part on stabilizer bars supplied by the ladder manufacturer

Prevent the ladder from moving by placing stops around one pair of feet. Apply the force to a free foot in the position and direction most likely to separate the foot from the stabilizer bar.

A load of 150 N shall be applied for 1 min.

After the test, the foot shall remain functional and show a movement from its original position of less than or equal to 4 mm.

5.4.14.3 For ladder feet and feet of stabilizer bars made of more than one part

The relevant test in [5.4.14.1](#) or [5.4.14.2](#) shall be performed. Additionally, the section of the foot that generates resistance to movement relative to the ground shall have a load of 150 N applied for 1 min in a location and direction that is likely to be the most critical, as determined by the tester. After the test, there shall be no indication of separation between the different parts of the foot.

5.4.15 Asymmetrical bending test

5.4.15.1 General

The test shall be carried out on the complete ladder. In the case of extending ladders and combination ladders, the test shall be carried out on the complete extended ladder. Sectional ladders shall be tested at full length with all permitted pieces.

Where the ascendable side of the ladder cannot be determined by construction of the product it shall be tested twice. For the test on the second side a new ladder shall be used. Prior to carrying out the test on the second side of the new ladder, it shall be subjected to all of the preceding tests in the test sequence given in [Table B.1](#) in [Annex B](#). The ladder shall be placed horizontally with the climbing face uppermost on supports situated 200 mm from each end of the ladder. The supports shall be cylindrical with diameters between 25 mm and 100 mm and one shall be free to rotate about its longitudinal axis and the other shall be fixed (see [Figure 15](#)). Measure the clear span between the supports. This is regarded as the test span for the purpose of this test. Apply a preload as given in [Table 4](#), vertically, at the middle of the ladder, distributed over 50 mm for a duration of 30 s, so that the stiles are loaded equally. Remove this load and establish a datum. Then apply a test load as given in [Table 4](#), to the centre point of one stile distributed over 50 mm. After a period of not less than 30 s from the application of the full test load, by any convenient means, measure the vertical deflection at the centre of the effective span of both stiles from the established datum.

Table 4 — Loads for torsion test

Preload	Test load
491 N	638 N

5.4.15.2 Test requirement

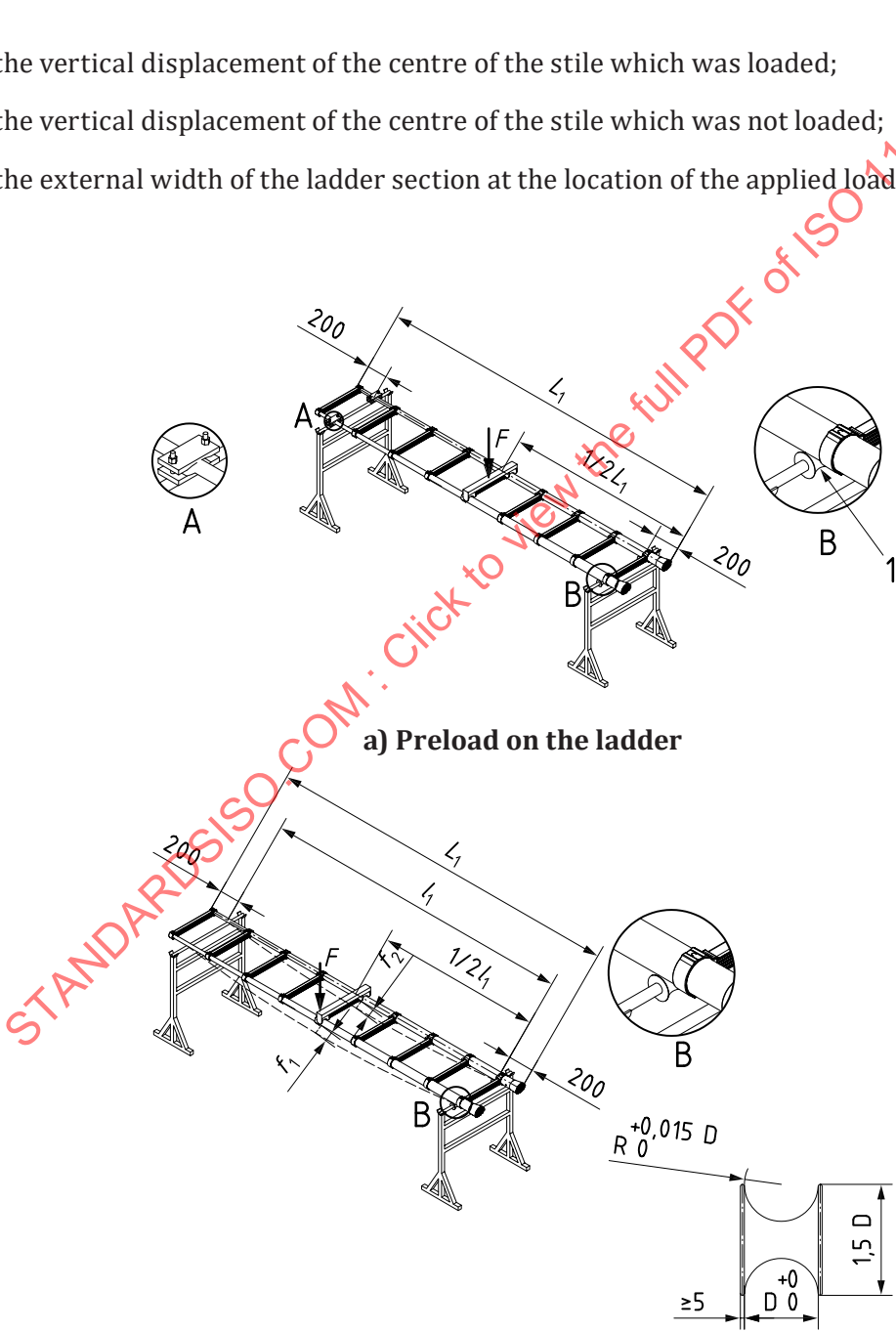
When tested in accordance with 5.4.15.1, the difference between the deflections of the two stiles shall meet Formula (1):

$f_1 - f_2 \leq 0,07 \, b_u$ (1)

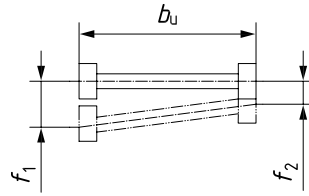
where

- f_1 is the vertical displacement of the centre of the stile which was loaded;
- f_2 is the vertical displacement of the centre of the stile which was not loaded;
- b_u is the external width of the ladder section at the location of the applied load [see Figure 15 c)].

Dimensions in millimetres



b) Test load on the ladder



c) Deformation after the load

Key

- A fixed support
- 1 free rotated support

Figure 15 — Leaning ladder torsion test

5.4.16 Durability test for standing ladders

5.4.16.1 General

This test is for standing ladders or any ladder that can be used as a standing ladder.

The test has criteria of 10 000 cycles for non-professional class and 50 000 cycles for professional class and this test to be a conditioning test before the test of opening restraints and hinges of standing ladders.

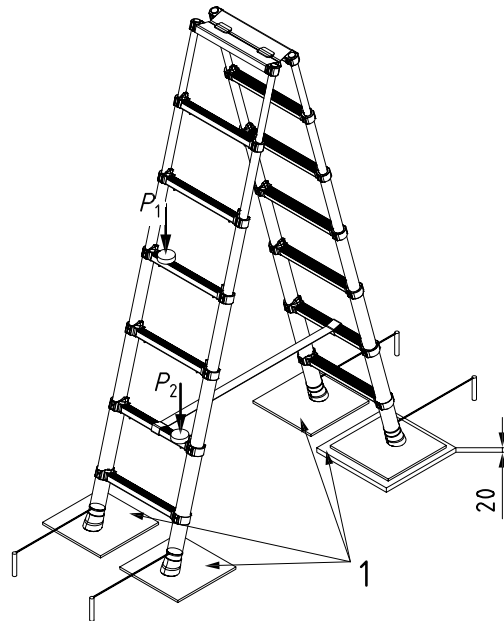
5.4.16.2 Principle

The standing ladder is placed in position of use on the testing surface with the 4 standing ladder stiles constrained to a fixed part by elastic rope/tape to prevent excessive progressive movement of the standing ladder (see [Figure 16](#)).

Two equal loads P1 and P2 are applied to the standing ladder by testing apparatus following a well-defined load versus time law of cycles: one load is applied to the topmost rung/step and the other one is applied to the rung/step in the middle of the ascending leg.

The load application shall continue until the defined load value is no longer maintained by the thrust device or until to the collapse of standing ladder or until the defined number of cycles for each class has been achieved.

The maximum number of cycles is registered.

**Key**

- 1 stainless steel
 P_1 and P_2 equal loads

Figure 16 — Scheme of principle of the durability test for standing ladder

5.4.16.3 Thrust surface/pad

The two loads shall be applied to the rung/step by a cylindrical rubber pad as thrust surface. Pad dimension shall be the following: 60 mm of diameter and a height of 25 mm. Pad shore hardness shall be in the following range: (60 ± 5) SHA.

5.4.16.4 Testing surface

Stainless steel plate such as number 1,430 1, type 2B (cold rolled ground) conforming to EN 10088-2 shall be used as testing surface. The plates shall be cleaned before testing.

For cleaning use pure industrial grade ethanol, and a low particulate, dry hygiene wipe suitable for use in an ISO class 5 clean room according to ISO 14644-1. After cleaning remove any remaining ethanol with another clean-room dry hygiene wipe.

Prior to carrying out the test, the feet of the ladder shall be cleaned with a dry hygiene wipe suitable for use in an ISO class 5 clean room according to ISO 14644-1.

The supporting surfaces shall be left to dry for 20 min before positioning the ladder.

5.4.16.5 Elastic ropes/tapes

The four elastic ropes/tapes shall be installed in order to maintain the ladder position during the test in an average position respect to the initial position. The characteristics of the ropes/tapes shall not produce measurable changes in the constraint of simple support between the base of the uprights and the test surface.

5.4.16.6 Test condition — Ambient condition

The ambient temperature shall be (20 ± 5) °C before testing and remain within this temperature range during the test.