BRITISH STANDARD

BS EN ISO
14122-4:2004

Safety of machinery — Permanent means of access to machinery —

Part 4: Fixed ladders

The European Standard EN ISO 14122-4:2004 has the status of a British Standard

ICS 13.110

BSI
British Standards

National foreword

This British Standard is the official English language version of EN ISO 14122-4:2004. It is identical with ISO 14122-4:2004. It partially supersedes BS 5395-3:1985, and BS 4592-1 to -5, which have been amended to address the requirements of this standard.

The UK participation in the preparation of EN ISO 14122-4 was entrusted by Technical Committee B/208, Stairs and walkways, to Subcommittee B/208/1, Stairs and walkways — Industrial stairs, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Examples of the trapdoors defined in **3.12** and specified in **4.7.3.3** are given in national annex NA.

Recommendations on the design aspects of industrial type stairs, walkways, platforms, fixed ladders and companion way ladders not addressed by this standard can be found in BS 5395-3. Requirements for industrial type metal flooring, walkways and stair treads that are not addressed by this standard can be found in BS 4592-0 to -5, which covers the following:

— Part 0: *Common requirements* (in preparation);
— Part 1: *Specification for open bar gratings*;
— Part 2: *Specification for expanded metal grating panels*;
— Part 3: *Specification for cold formed planks*;
— Part 4: *Specification for glass reinforced plastics open bar gratings*;
— Part 5: *Specification for solid plates in steel, aluminium and glass reinforced plastics*.

Summary of pages

This document comprises a front cover, an inside front cover, page i, a blank page, the EN ISO title page, the EN ISO foreword page, the ISO title page, pages ii to v, a blank page, pages 1 to 32, an inside back cover and a back cover.

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The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 14122-4

March 2004

ICS 13.110

English version

Safety of machinery - Permanent means of access to machinery - Part 4: Fixed ladders (ISO 14122-4:2004)

Sécurité des machines - Moyens d'accès permanents aux machines - Partie 4: Echelles fixes (ISO 14122-4:2004)

Sicherheit von Maschinen - Ortsfeste Zugänge zu maschinellen Anlagen - Teil 4: Ortsfeste Steigleiter (ISO 14122-4:2004

This European Standard was approved by CEN on 18 March 2003.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN ISO 14122-4:2004: E

Foreword

This document (EN ISO 14122-4:2004) has been prepared by Technical Committee CEN/TC 114 “Safety of machinery”, the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 199 “Safety of machinery”.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2004 , and conflicting national standards shall be withdrawn at the latest by August 2004 .

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this document.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EN ISO 14122-4:2004

INTERNATIONAL STANDARD

ISO 14122-4

First edition
2004-12-15

Safety of machinery — Permanent means of access to machinery —

Part 4: Fixed ladders

Reference number
ISO 14122-4:2004(E)

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Contents

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 14122-4 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 199, *Safety of machinery*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

ISO 14122 consists of the following parts, under the general title *Safety of machinery — Permanent means of access to machinery*:

— *Part 1: Choice of fixed means of access between two levels*

— *Part 2: Working platforms and walkways*

— *Part 3: Stairs, stepladders and guard-rails*

— *Part 4: Fixed ladders*

For the purposes of this part of ISO 14122, the CEN annex regarding fulfilment of European Council Directives has been removed.

Introduction

This is the fourth part of the standard "Safety of machinery — Permanent means of access to machinery". The parts of the standard are:

Part 1: Choice of a fixed means of access between two levels

Part 2: Working platforms and walkways

Part 3: Stairs, stepladders and guard-rails

Part 4: Fixed ladders.

This European standard is a type B standard as stated in EN ISO 12100.

This standard is to be read in conjunction with Clause 1.6.2 "Access to operating position and servicing points" and 1.5.15 "Risk of slipping, tripping or falling" of the essential safety requirements expressed in Annex A of EN 292-2:1991/A1:1995. See also 5.5.6 "Measures for safe access to machinery" of EN ISO 12100-2:2003 which supersedes EN 292-2.

The provisions of this document can be supplemented or modified by a type C standard.

NOTE 1 For machines which are covered by the scope of a type C standard and which have been designed and built according to the provisions of that standard, the provisions of that type C standard will take precedence over the provisions of this type B standard.

NOTE 2 The use of materials other than metals (composite materials, so-called "advanced" materials, etc.) does not alter the application of the present standard.

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1 Scope

This standard applies to all machinery (stationary and mobile) where fixed means of access are necessary.

The purpose of this standard is to define the general requirements for safe access to machines mentioned in EN ISO 12100-2. EN ISO 14122-1 gives advice about the correct choice of access means when the necessary access to the machine is not possible directly from the ground level or from a floor.

This standard applies to fixed ladders, which are a part of a machine.

This standard may also be applied to fixed ladders to that part of the building where the machine is installed, providing the main function of that part of the building is to provide a means of access to the machine.

NOTE This standard may be used also for means of access which are outside the scope of this standard. In those cases the possible relevant national or other regulations should be taken into account.

This standard applies also to ladders which are not permanently fixed to the machine and which may be removed, moved to the side or pivoted (swivel-mounted) for some operations of the machine (e. g. changing tools in a large press).

For the significant hazards covered by this standard, see Clause 4 of EN ISO 14122-1.

This standard is not applicable to machinery which are manufactured before the date of publication of this standard by CEN.

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.

EN 131-2:1993, *Ladders — Requirements, tests, markings.*

EN 353-1, *Personal protective equipment against falls from a height — Part 1: Guided type fall arresters including a rigid anchorage line.*

EN 363, *Personal protective equipment against falls from a height — Fall arrest systems.*

EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles (ISO 12100-2:2003).*

EN ISO 14122-1, *Safety of machinery — Permanents means of access to machinery — Part 1: Choice of a fixed means of access between two levels (ISO 14122-1:2001).*

EN ISO 14122-2, *Safety of machinery — Permanents means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2:2001).*

EN ISO 14122-3, *Safety of machinery — Permanents means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2001).*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN ISO 12100-1:2003, EN ISO 14122-1:2001 and the following apply.

The main terms used in the present standard are given as an example in Figures 1, 2, 3 and 4.

3.1
fixed ladder with two stiles
ladder, according to 3.1 of EN ISO 14122-1, which is stationary and where the rungs are arranged between and attached to the stiles. The stiles carry the load (see Figure 2)

3.2
fixed ladder with one stile
ladder, according to 3.1 of EN ISO 14122-1, which is stationary and where the rungs are attached to both sides of the stile. The stile carries the load alone (see Figure 3)

3.3
ladder flight
continuous part of the fixed ladder (see Figure 1):

— between arrival and departure area, in the case of ladders without platforms; or

— between the arrival area respectively departure area and the nearest platform; or

— between rest platforms following each other

3.4
climbing height *H* of a fixed ladder
total vertical distance between the walking surface of the arrival area at the top of the ladder(s) and the walking surface of the departure area at the base of the ladder(s) (see Figure 1)

3.5
height *h* of the ladder flight
vertical distance between the level at the beginning and the level at the end of each flight (see Figure 1)

3.6
fall protection
technical measure to prevent or reduce the risk of people falling from fixed ladders

NOTE Commonly used fall protection devices are defined in 3.6.1 and 3.6.2.

3.6.1
safety cage
assembly which serves to limit the risk of people falling from the ladder (see Figure 2)

3.6.2
guided type fall arrester on a rigid anchorage line
fall arrester
protective equipment fixed to ladder used in combination with personal protective equipment that everyone has available before being allowed to use the ladder. (See also definition in EN 353-1 and EN 363)

In the following text the abbreviation "fall arrester" will also be used for this type of fall protection device.

3.7
arrival level
upper level of the surroundings or of the intermediate platform to which, the person steps after the ascent (see Figure 1)

3.8
departure level
lower level of the surroundings or of the intermediate platform from which the person starts to climb the fixed ladder (see Figure 1)

3.9
intermediate platform
horizontal structure (platform) between two consecutive flights of a ladder (used with ladders having staggered flights) (see Figure 1 and 4b)

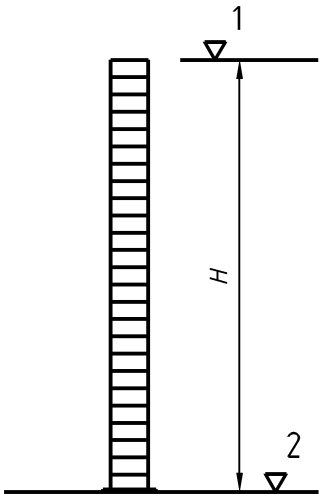
3.10
rest platform
area equipped with the required protective means designed so that the user of the ladder can have a physical rest (See Figures 1b, 10, 11 and 12)

3.11
access platform
horizontal structure at the arrival or departure area used by a person for means of access

3.12
trap door
normally closed device which can be opened to give access through a platform or through other similar horizontal structures

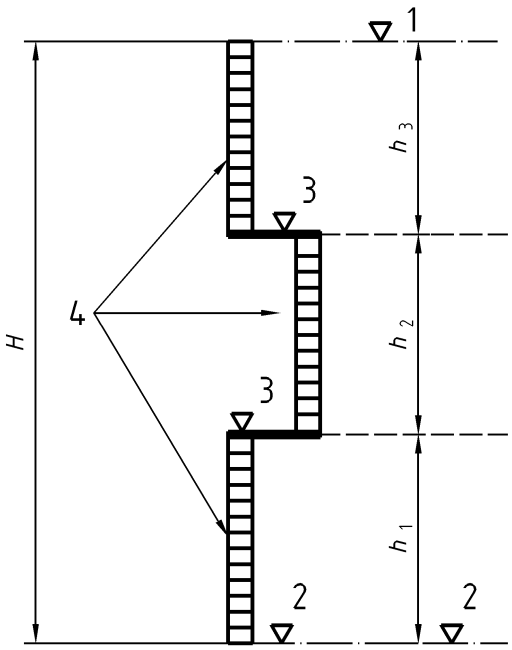
Position of the rest platforms

Dimensions in millimetres



H_{max} = 10000 mm

Figure 1.a : Ladder without rest platform (single flight)



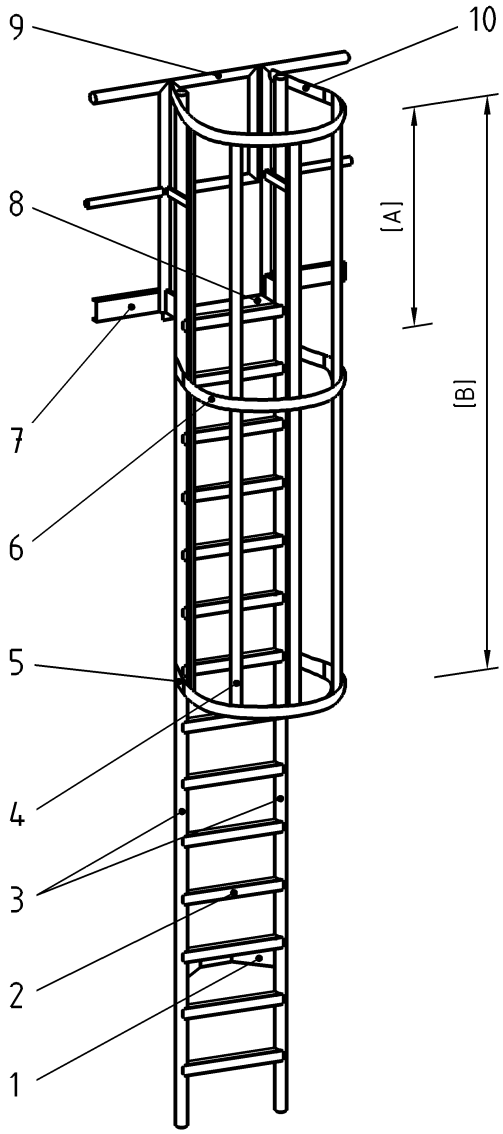
h_{max} = 6000 mm

Figure 1.b : Ladder with staggered flights

Key

1 Arrival area
2 Departure area
3 Intermediate platform or rest platform
4 Ladder flight

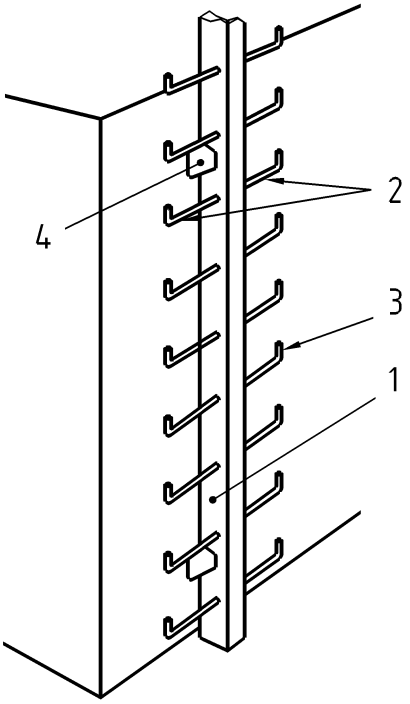
Figure 1 — Height of flights and location of platforms



Key

1 Anchor bracket
2 Rung
3 Ladder stile
4 Safety cage vertical members
5 Lowest hoop
6 Intermediate hoop
7 Toe plate
8 Platform step
9 Gate
10 Upper hoop
[A] Exit section
[B] Safety cage

Figure 2 — Terminology



Key

1 Stile
2 Rung
3 Protective device against slipping-off
4 Anchor point

Figure 3 — Example of a ladder less than 3000 mm with one stile

4 Safety requirements

4.1 General requirements

The materials, dimensions of constituent elements and construction mode used shall meet the safety objectives of this standard.

Ladders shall be designed to meet the same installation requirements as the machine, taking into consideration where necessary, conditions such as harsh environment, vibrations, etc.

As far as possible, fixed ladders should be designed with two stiles. In exceptional circumstances (e. g. a continuous ladder with a varying angle of pitch or insufficient space to provide two stiles), fixed ladders may be provided with only one stile.

All parts likely to be in contact with users shall be designed so as not to catch, hurt or hinder i. e. sharp corners, welds with burrs, or rough edges, etc. should be avoided. Opening or closing the mobile parts (gate) shall not cause further hazards (e. g. shearing or accidental falling) for persons using the ladder and those in the vicinity.

Fittings, hinges, anchor points, supports and mounting points shall hold the assembly sufficiently rigid and stable to ensure the safety of users under normal conditions of use.

4.2 Strength of fixed ladders

4.2.1 General requirements

A ladder, platform and safety cage (when installed) shall meet the following design requirements:

4.2.1.1 Ladder element

The ladder elements are considered to fulfil the requirements mentioned in 4.2.1 when they meet the requirements of EN 131-2. The maximum deflection as indicated in 5.1 shall not exceed 50 mm.

In case of fixed ladders with one stile instead of the lateral bending test (see 4.4 of EN 131-2:1993) a torsion test shall be made by application of two test loads each 400 N. The deflection of the ladder shall not exceed 20 mm (see 5.4.3 and Figure 16). For the rungs, the load is applied on a length of 100 mm close to the lateral devices against slipping off. The residual deflection of the rungs shall be not more than 0,3 % related to the length of the rung (see 5.4.2, and Figure 15).

4.2.1.2 Safety cage

The safety cage is considered to meet these requirements if the permanent deformation as the result of a vertical load of 1000 N is not more than 10 mm and as the result of a horizontal load of 500 N is not more than 10 mm. (see 5.3 and Figure 13).

4.2.1.3 Fixed ladders equipped with a fall arrester

In addition to the requirements of 4.2.1.1, the combination of fall arrester and ladder shall be capable of stopping the user from falling (see Clause 5).

4.2.2 Fixing elements

4.2.2.1 General

Fixing elements such as fittings, anchorage points, hinges, supports and mountings shall hold the assembly sufficiently rigid and stable to ensure the safety of user under normal conditions of use (see verification in 5.5).

In case of fixed ladders equipped with a fall arrester the connecting elements shall withstand the stresses caused by the fall arrester catching the person who falls down.

4.2.2.2 Anchoring points of fixed ladders

The anchoring points and connections to them shall be capable of supporting 3000 N per stile. Up to four anchorages may be considered to contribute to this support. See 5.5 for the test method.

4.2.3 Platforms

All platforms shall comply with the requirements of EN ISO 14122-2.

Dimensions in millimetres

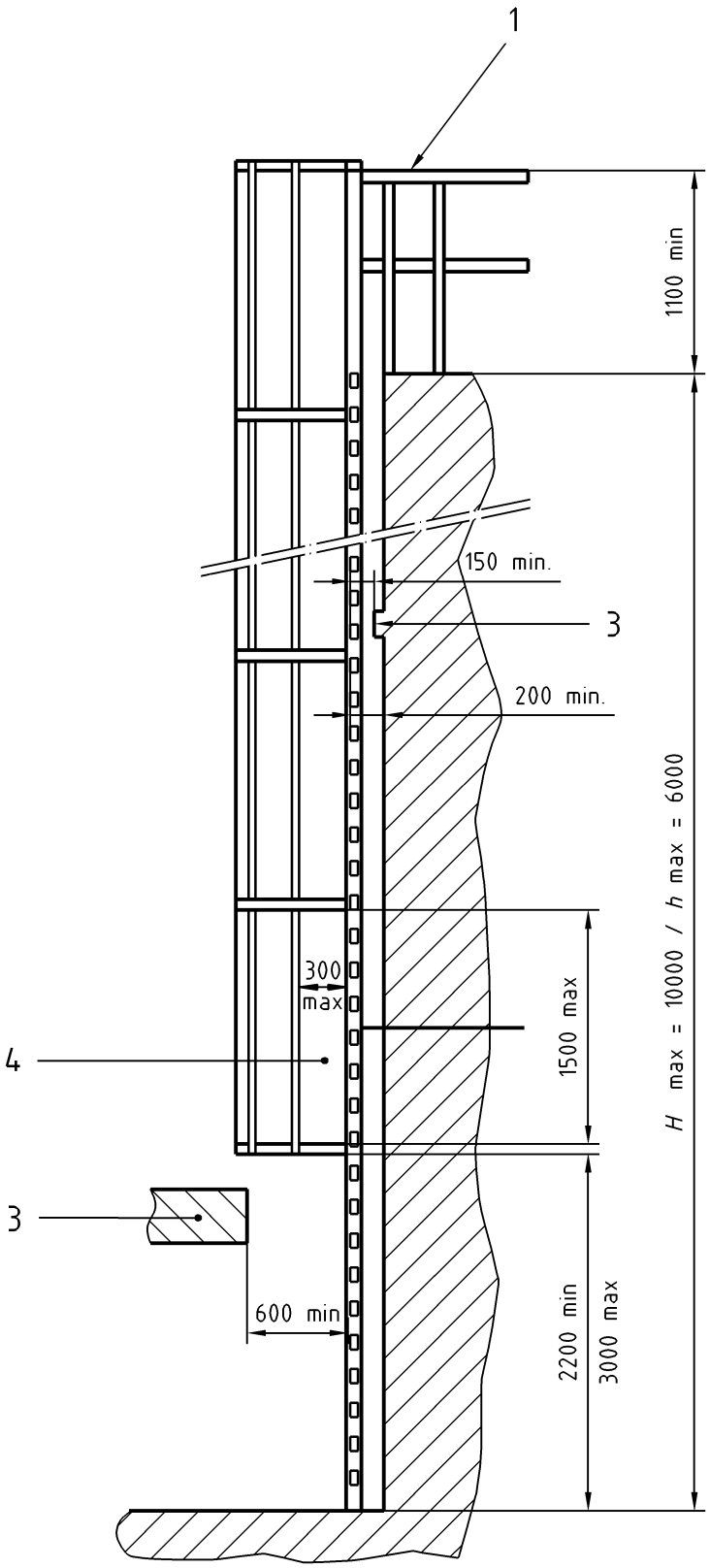


Figure 4a — Side elevation on ladder with a safety cage

Dimension in millimetres

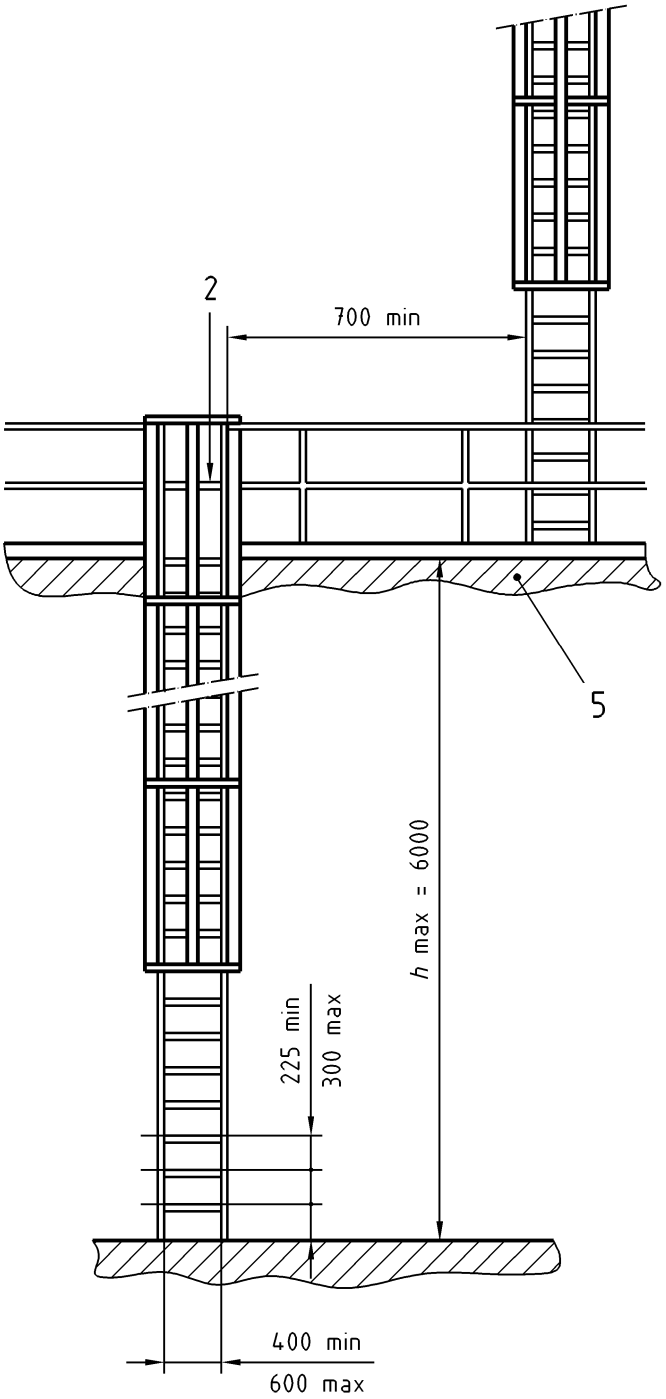


Figure 4b — Front elevation on ladder with safety cage

Dimensions in millimetres

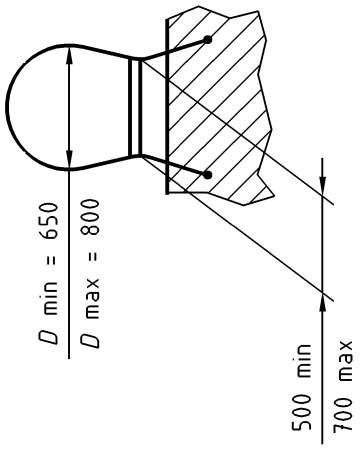


Figure 4.c – Plan view of a ladder with a safety cage

Dimensions in millimetres

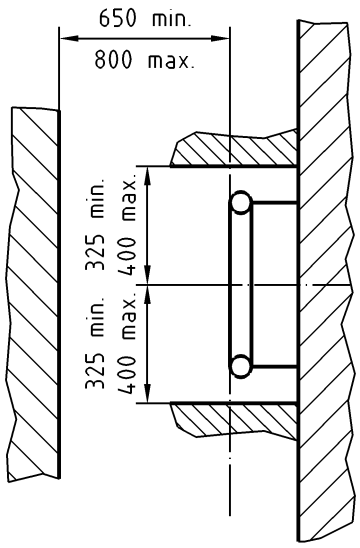


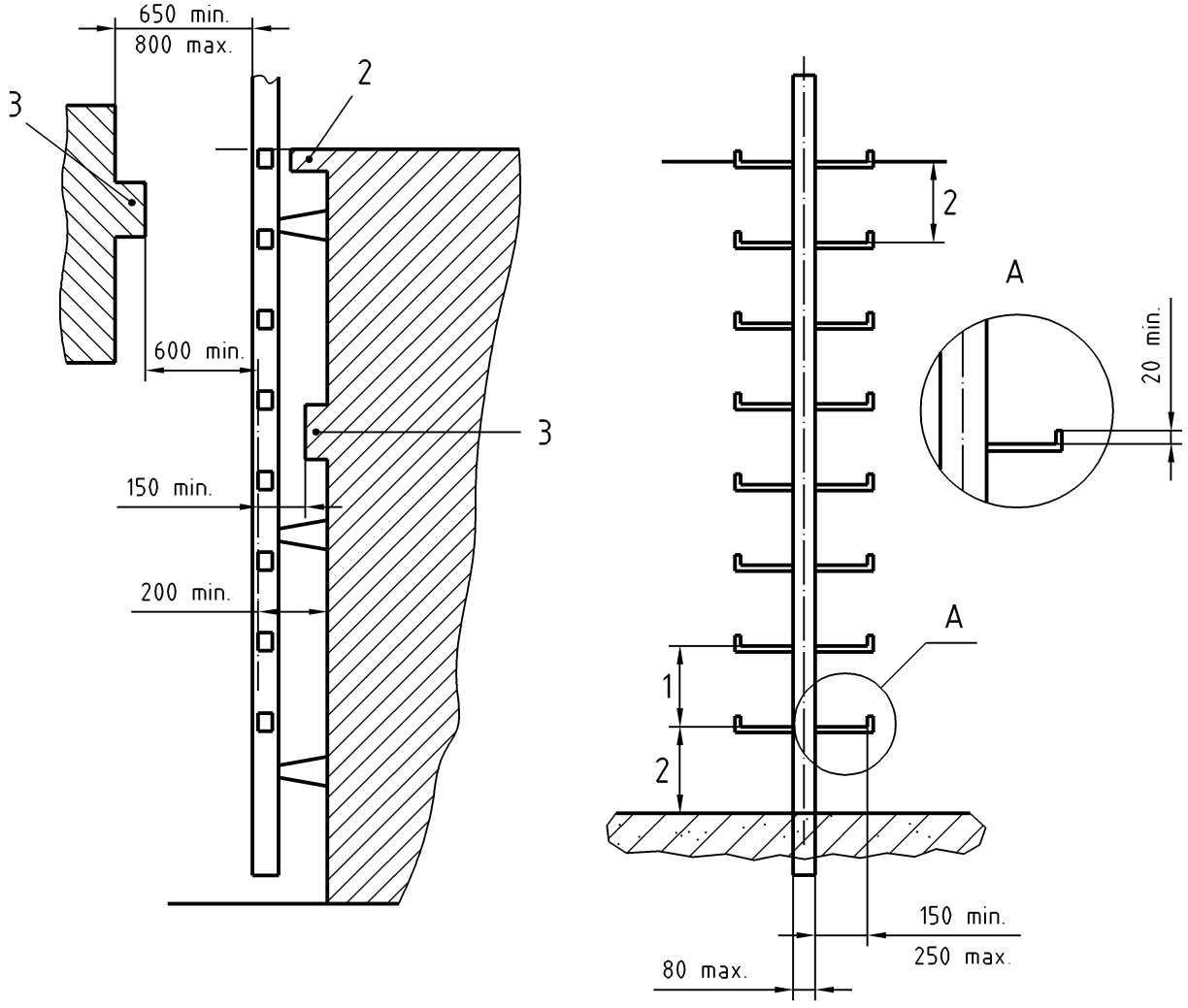
Figure 4.d – Plan view of a ladder without safety cage

Key

1 Connection element
2 Gate
3 Discontinuous obstacle
4 To suit maximum open area ≤ 0,4 m²
5 Intermediate platform

Figure 4 — Principal dimensions of ladders and safety cages

Dimensions in millimetres



Key

1 See 4.4.1.1
2 See 4.4.1.2 and Figure 6.a
3 Discontinuous obstacle

Figure 5 — Principal dimensions of a fixed ladder with one stile

4.3 Conditions for installation of an fall protection device

4.3.1 Conditions requiring the installation of an fall protection device

The ladder shall be fitted with a fall protection device when:

a) height of the ladder flight is more than 3000 mm;

b) height of the ladder is 3000 mm or less, but at the departure area there is the risk of falling an additional distance. In this case, the total distance of fall from the upper level of the ladder could be more than 3000 mm.

NOTE Risk of falling is considered to exist when the distance from the centre of the ladder to the unprotected side of a platform (or similar structure) is less than 3000 mm.

4.3.2 Choice of the type of fall protection device

Two main alternatives for protection of the users of fixed ladders against falls from a height are safety cages or fall arresters:

— The cage shall be the required choice, as it is a means which is always present and the actual safety function is independent of the operator's actions,

— Where it is not possible to use a cage, individual protective equipment shall be provided. The fall arrester is only effective if the user chooses to use it. If a harness with an incompatible sliding system is used with a guided type fall arrester, there will be a risk (requirements for information for use see Clause 6).

A fall arrester shall be designed only for low frequency and specialised access (e. g. maintenance).

NOTE An appropriate individual fall protection device is able to arrest a fall better than a cage.

4.4 Ladder

The principal dimensions of the ladder shall be determined in accordance with 4.4.1 to 4.4.4 (See also Figures 4 and 5).

4.4.1 Position of the rungs

4.4.1.1 Spacing between the rungs

The spacing between successive rungs shall be constant and shall be between 225 mm and 300 mm.

4.4.1.2 Spacing between rungs and the departure and arrival area

The distance between the walking surface of the departure area and the first rung shall not exceed the spacing between two consecutive rungs.

NOTE In case of mobile machinery to be used on uneven ground, the distance between the walking surface of the departure area and the first rung may be 400 mm max..

The top rung shall be positioned at the same level as the walking surface of the arrival area (see Figure 6a). If the gap between the walking surface and the ladder is greater than 75 mm, a floor extension shall be provided at the arrival area to reduce this gap.

4.4.1.3 Position of rungs of fixed ladders with one stile

The rungs at one side of the stile shall be on the same level as the respective rung at the opposite side of the stile (see Figure 5).

Dimension in millimetres

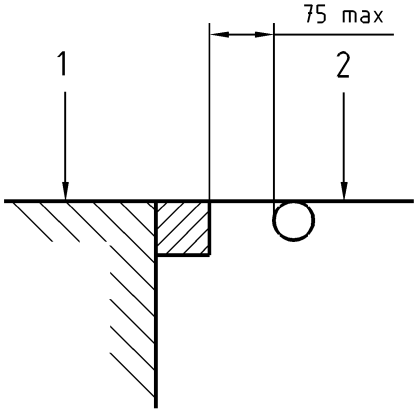


Figure 6.a — Position of top rung

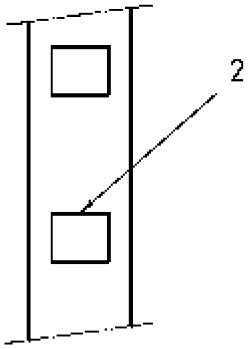


Figure 6.b — Design of polygonal rungs – Recommended mounting

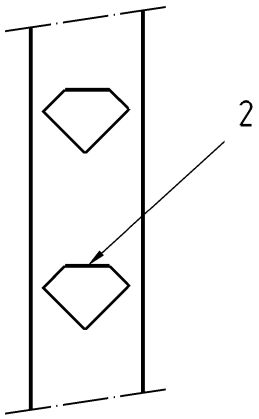


Figure 6.c — Design of polygonal rungs — Mounting for special use only

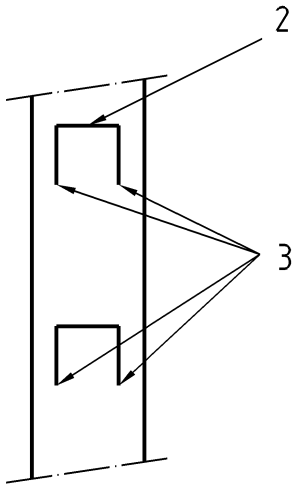


Figure 6.d — Design of U-shaped profile rungs

Key

1 Walking surface of the arrival area
2 Rung/tread surface
3 No sharp edges

Figure 6 — Position of rungs

4.4.2 Rungs

4.4.2.1 Position of polygonal and U-shaped rungs

Polygonal and U-shaped rungs shall be positioned so that the tread walking surface is horizontal (see Figure 6.b, 6.c and 6.d).

4.4.2.2 Length of the rungs

a) Length of rungs of fixed ladders with two stiles

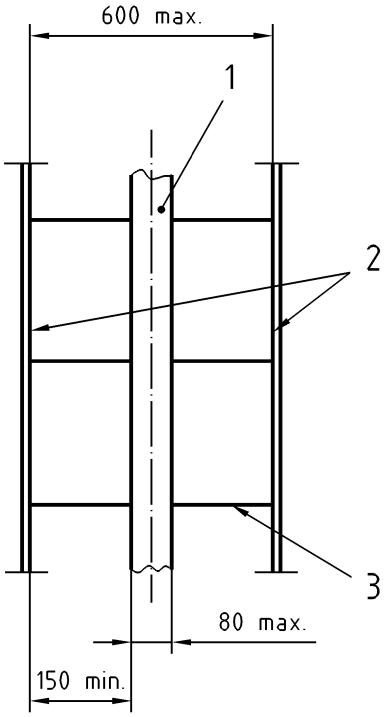
The clear width between the two stiles shall be between 400 mm and 600 mm (see Figure 4). However, a shorter length between 300 mm and 400 mm is permissible, in cases where the immediate environment makes it

impossible to use 400 mm. Before a shorter length is considered a check should be carried out to see if it is possible to find a more favourable position for the ladder allowing a clear width of 400 mm or more.

b) Length of rungs of fixed ladders with two stiles and a fall arrester.

The clear width between the stiles and the rigid anchorage line for a guided type fall arrester shall be at least 150 mm and the thickness of the anchorage line shall not be more than 80 mm (see Figure 7).

Dimension in millimetres



Key

1 Rigid anchorage line
2 Stile
3 Rung

Figure 7 — Length of the rungs of a fixed ladder with two stiles and a rigid anchorage line for a guided type fall arrester

c) Rungs of fixed ladders with one stile

The clear width between the stile and the protective device against slipping-off shall be between 150 mm and 250 mm and the thickness of the stile shall not be more than 80 mm (see Figure 5).

4.4.2.3 Cross-section of the rungs

The diameter of the rungs shall be at least 20 mm, or the walking surface of the tread of polygonal or U-shaped rungs shall have a depth of at least 20 mm.

The cross-section of the rungs shall not be given dimensions difficult to grasp by hand. The diameter of the rung shall not be more than 35 mm.

4.4.2.4 Surface of the rungs

The surface of the rungs shall not cause injuries, notably to hands, e. g. no sharp edges (see Figure 6.d).

The surface of the rung shall have a slip resistant walking surface. Special measures to prevent slipping may be necessary when the risk of slipping is increased due to environmental conditions (oil, ice, etc.).

4.4.3 Devices against slipping-off

The ends of the rungs of fixed ladders with one stile shall be fitted with protective devices against slipping-off laterally from the rungs. These protective devices against slipping-off shall have a height of at least 20 mm (see detail A of Figure 5).

4.4.4 Spacing between the ladder and any permanent obstruction

The space between the ladder and any permanent obstruction or obstacles shall be:

— in front of the ladder:

  at least 650 mm and 600 mm in case of a discontinuous obstacle;

— behind the front side of the rungs:

  at least 200 mm and 150 mm in case of a discontinuous obstacle.

See Figures 4 and 5.

4.5 Safety cage

The lowest part of safety cage, e. g. the lowest hoop shall start at a height of between 2200 mm and 3000 mm above the departure area. Below the cage on the chosen access side, the safety cage shall not have elements likely to obstruct the access to the area situated in front of the ladder. At the arrival area the safety cage shall be extended up to the height of the guard-rail of the arrival area (see Figure 4).

The clear distances within the hoop of the safety cage shall be between 650 mm and 800 mm (see Figure 4.c). This applies equally to non-circular as well as circular safety cages. The distance from the rung to the safety cage shall be between 650 mm and 800 mm (see Figure 4.d). With regard to the ladder axis, the distance from the surrounding structure in the absence of a safety cage shall be between 325 mm and 400 mm (see Figure 4.d).

The clearance within the cage at the arrival area, measured along the transverse axis of the ladder rungs between the inside face of the cage shall be between 500 mm and 700 mm (see Figure 4.c).

The distance between two hoops shall not exceed 1500 mm and the distance between two uprights on the cage shall not exceed 300 mm. The hoops shall be placed at right angles to the uprights on the cage. The safety cage uprights shall be fixed to the inside of the hoop and be equally spaced.

The spacing of safety cage components shall be designed so that the empty spaces are in any case not more than 0,40 m^2.

A cage is not necessary if surrounding structures (walls, parts of machines, etc.) in front of and on the sides of the ladder provide a similar safety function (e. g. by providing similar dimensions).

4.6 Guided type fall arrester on a rigid anchorage line

Fall arresters shall meet the relevant requirements of EN 353-1.

4.7 Departure and arrival areas - Platforms

Departure and arrival areas as well as intermediate platforms shall meet the relevant requirements of EN ISO 14122-2.

When required, guard-rails as protective devices against the risk of falling from a height at departure and arrival areas as well as at intermediate platforms shall meet the relevant requirements for guard-rails according to EN ISO 14122-3.

4.7.1 Departure areas

If the walking surface of the departure area has been raised by more than 500 mm above the surroundings or the departure area borders on areas which are not able to take a load, e. g. area made of glass or synthetic material, the departure area shall have guard-rails or equivalent means that are able to protect persons against falling from a height.

4.7.1.1 Access platforms

If the departure area on the structure of a machine, a building, etc. cannot be considered as an area which meets the relevant requirements of EN ISO 14122, an access platform shall be provided.

4.7.1.2 Fixed ladders with a safety cage

If the horizontal distance from a fixed ladder, equipped with a safety cage, to the guard-rail of the raised departure area is not more than 1500 mm, the guard-rail shall be fitted with an extension or the structure of the cage shall be extended down to the guard-rail (see Figure 8).

The top of the extension shall at least meet the following requirements:

— no dimension between the cage and the extension shall exceed 400 mm, or

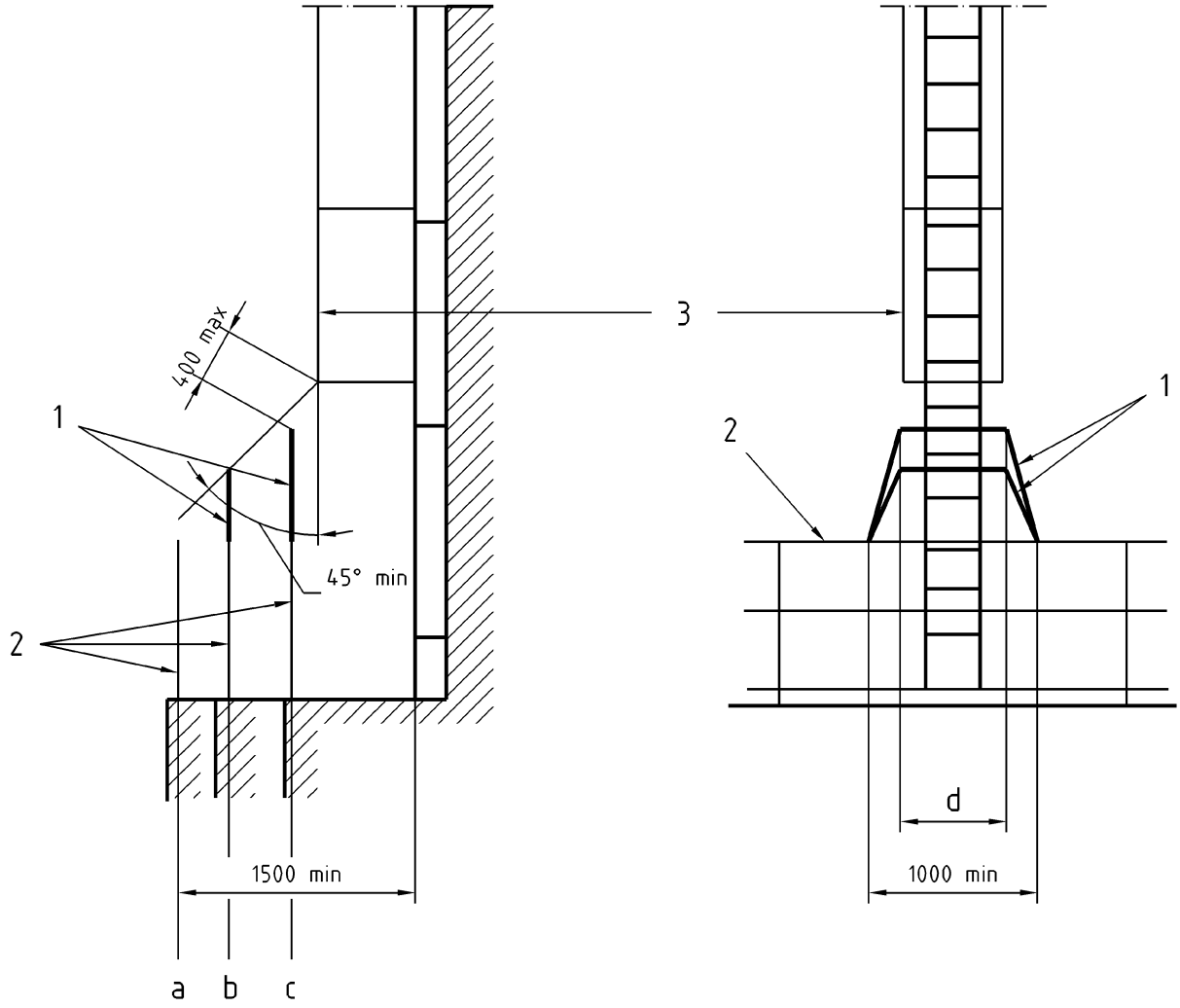
— it shall have an angle, formed by the vertical and a straight line linking the upper section of the extension to the nearest part of the safety cage of 45 degrees or more.

The components shall be positioned so that:

— horizontal width of any space is not more than 300 mm and,

— area of a free space is $\leq 0{,}4\ m^2$.

Dimension in millimetres



Key

1 Extension
2 Guard-rail
3 Safety cage

a guard-rail without an extension
b height of the extension determined by an angle 45° minimum
c height of the extension determined by a distance 400 mm maximum
d diameter of the safety cage

Figure 8 — Extension completing the protective function of guard-rails at the departure area

4.7.2 Arrival areas

4.7.2.1 Access platform

If the arrival area on the structure of a machine, a building, etc. cannot be considered as an area which meets the relevant requirements of EN ISO 14122, an access platform shall be provided.

4.7.2.2 Falling from a height

Suitable means to prevent persons falling from a height, e. g. guard-rails, shall be provided at drop edges of arrival areas, over a length of at least 1500 mm on both sides of the vertical axis of the ladder or over the entire length of the edge, if this is less than 3000 mm. This is independent of any fall protection device fitted beyond this length.

4.7.3 Access openings

4.7.3.1 Front or side exit

Ladders may have a front or side exit to the arrival area.

The width of the access opening shall be between 500 mm and 700 mm.

4.7.3.2 Gates

To prevent falling through the access opening at arrival areas the opening shall be provided with a gate.

The gates shall meet the following requirements:

a) opening direction of this gate shall not be towards the edge of the drop (outwards);

b) gate shall be designed so, that it can be opened easily;

c) gate shall close automatically, e. g. by means of springs or the effects of gravity;

d) gate shall have at least a handrail and a kneerail according to relevant requirements of EN ISO 14122-3.

4.7.3.3 Access through platforms by means of trap doors

When it is necessary for technical reasons, a platform may have an opening to permit access to (and exit from) a ladder below the platform.

Protection against the risk of falling through such an opening shall be provided by a trap door or by guard-rails in combination with a gate. The guard-rail shall meet the requirements of EN ISO 14122-3 and the gate shall be according to 4.7.3.2 of this standard.

The trap door shall be designed so that:

a) The opening shall be at least equal to the required size of the ladder cage (see 4.5).

b) The trap door shall not open downwards. It shall move upwards or horizontally.

c) Opening the trap door shall be manual and easy.

d) The trap door shall allow the safe passage of the operator whilst in the open position.

e) Closing of the trap door shall be done following safe passage without much strain of the operator for example, springs, hydraulic means.

4.7.4 Climbing off and getting on to a fixed ladder safely

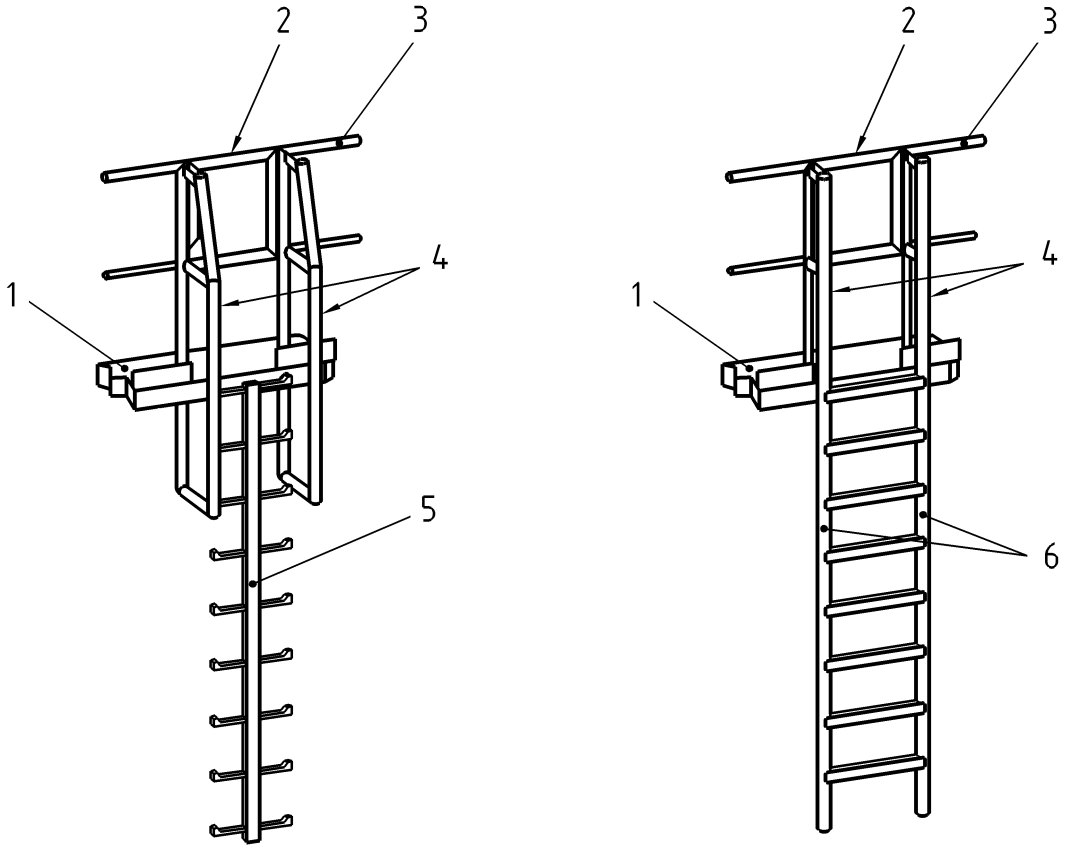
4.7.4.1 Ladder with two stiles and without a fall arrester (3000 mm max)

Handrails shall be fitted connecting the ladder stiles to the handrail of the guard-rail. Those handrails shall be fixed to the guard-rail at the arrival area (see Figure 9).

See also 4.7.3.1 and Figure 4.c.

4.7.4.2 Ladder with one stile and without a fall arrester (3000 mm max)

Handrails shall be fitted on both sides of the ladder beginning at the level of the rung before the last rung, extending up the level of and connected to the handrail of the guard-rail at the arrival area (see Figure 9).



Key

1 Walking surface of the arrival area
2 Gate
3 Guard-rail
4 Handrail
5 Ladder with one stile and without a fall arrester
6 Ladder with two stiles and without a fall arrester

Figure 9 — Connected handrail at the arrival area

4.7.4.3 Arrangement for getting on and off ladders with a guided-type fall arrester

Suitable safeguards shall be provided, e. g. a locked device, to ensure that only authorised, trained and fully equipped operators (see also 4.3.2), can use the ladder.

NOTE A written warning or audible signal are not adequate safeguards.

In addition, the fall arrester and its surroundings shall be designed so that the operator has to connect or disconnect in a safe position, e. g. by providing a continuous line or an automatically closing extendable platform.

4.7.5 Platforms

4.7.5.1 Cases where the installation of platforms are required

Generally, if the climbing height *H* of fixed ladders is more than 6000 mm the ladders shall be equipped with one or more platform(s).

Where there are several flights, the height *h* of a ladder flight between the departure area and the nearest platform or between consecutive rest platforms shall be no more than 6000 mm.

But in the case of a single flight only (no rest platform), the height *h* between departure area and the arrival area (see Figures 1.a and 1.b) can be extended to no more than 10000 mm.

4.7.5.2 Intermediate platforms

The length of the intermediate platform shall be at least 700 mm installed between the two flights of the ladder (see Figure 4.b). In this case the requirement of 4.7.1 and 4.7.2 apply.

These platforms shall be equipped with a gate with dimensions to suit emergency situations.

4.7.5.3 Rest platforms

The width of a rest platform shall be at least 700 mm (see Figure 12).

4.7.5.4 Movable rest platforms

For ladders with one stile or guided type fall arresters the movable rest platforms shall be at least 400 mm wide and 300 mm long (see Figure 10) or consist of 2 parts at least 130 mm wide and 300 mm long (see Figure 11).

Dimensions in millimetres

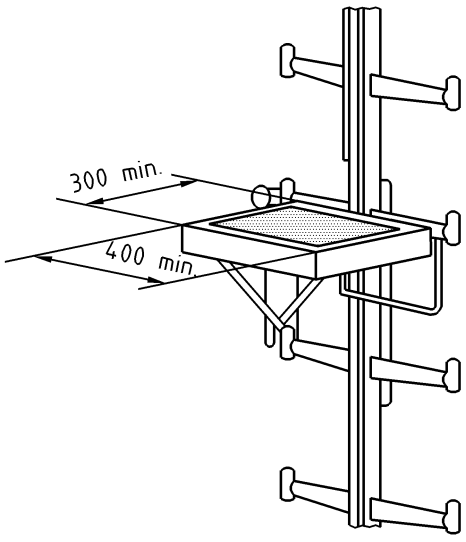


Figure 10 — Example of a movable rest platform (one part)

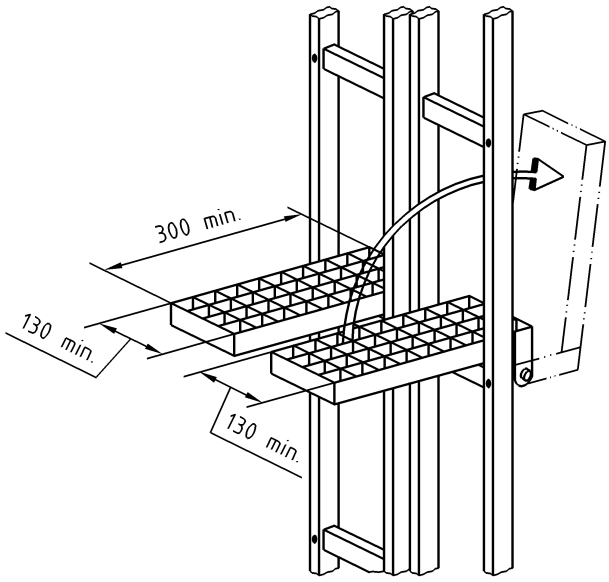


Figure 11 — Example of a movable rest platform (two parts)

4.7.5.5 Staggered ladder flights

If the layout of the machine or its environment make it unavoidable to do otherwise, two successive ladder flights may be adjacent, without a separate platform. In this case the lower flight of the ladder shall be extended to where the highest rung is at least 1 680 mm above the platform to provide good handholds for the user of the ladder. The height of the guarding above the platform shall be at least 1 600 mm (see Figure 12).

The clear height for the passage between the platform and the lowest complete hoop of the safety cage on the upper ladder shall be between 2 200 mm and 2 300 mm.

Dimensions in millimetres

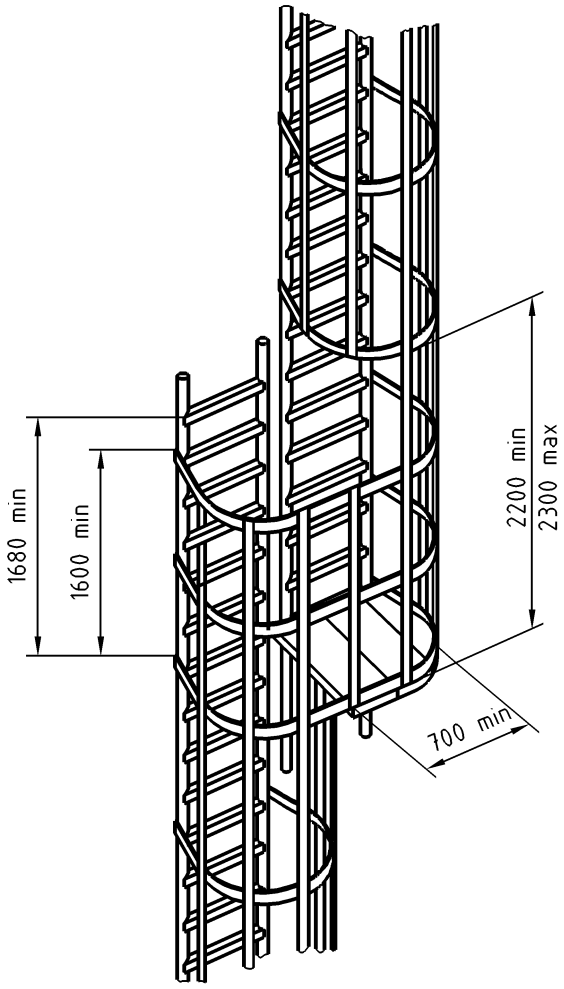


Figure 12 — Example of adjacent staggered ladder flights including a rest platform

5 Verification of safety requirements

5.1 General

The stipulated safety requirements and/or measures may be assessed by measurement, inspection, calculation and/or testing. When testing is used it shall be according to the testing procedure described in this Clause.

5.2 Tests of fixed ladders with two stiles

— The ladder element shall satisfy the following tests:

— strength test of the ladder (see 4.2 of EN 131-2:1993);

— bend test of ladder (see 4.3 of EN 131-2:1993);

— lateral bending test of ladder (see 4.4 of EN 131-2:1993);

— bend test of rungs (see 4.6 of EN 131-2:1993);

— torsion test of rungs (see 4.7 of EN 131-2:1993).

These tests are carried out on a ladder according to the requirements of 4.1 of EN 131-2:1993 in the order indicated above.

The distance L to be taken into account for the strength, bend and lateral bending tests, is the distance in mm between two consecutive anchor points of the ladder, see point 4 in Figure 16.

Acceptance criterion of the bending test (see 4.3 of EN 131-2:1993) is modified as follows: The maximum deflection admissible under load shall be no more than $5 \times L^2 \times 10^{-6}$ in mm without exceeding 50 mm.

5.3 Testing of the safety cage

5.3.1 The test is carried out under the same conditions as those likely to exist at the place where it would be used. The safety cage is fixed to the ladder. The two tests take place in accordance with Figures 13 and 14.

5.3.2 For the safety cage hoop, a preload (F_{PL}) of 200 N is applied vertically at the most unfavourable point (see Figure 13). The preload may be distributed over three horizontal safety cage hoops for one minute providing the connections between the uprights of the cage and the safety cage hoops are tension proof. The position of the lowest safety cage hoop after removing the preload is taken into account as a reference position for the test to be carried out for a test load (F_T) of 1000 N. The permissible permanent deformation which is measured at the point of application of the load is no more than 10 mm.

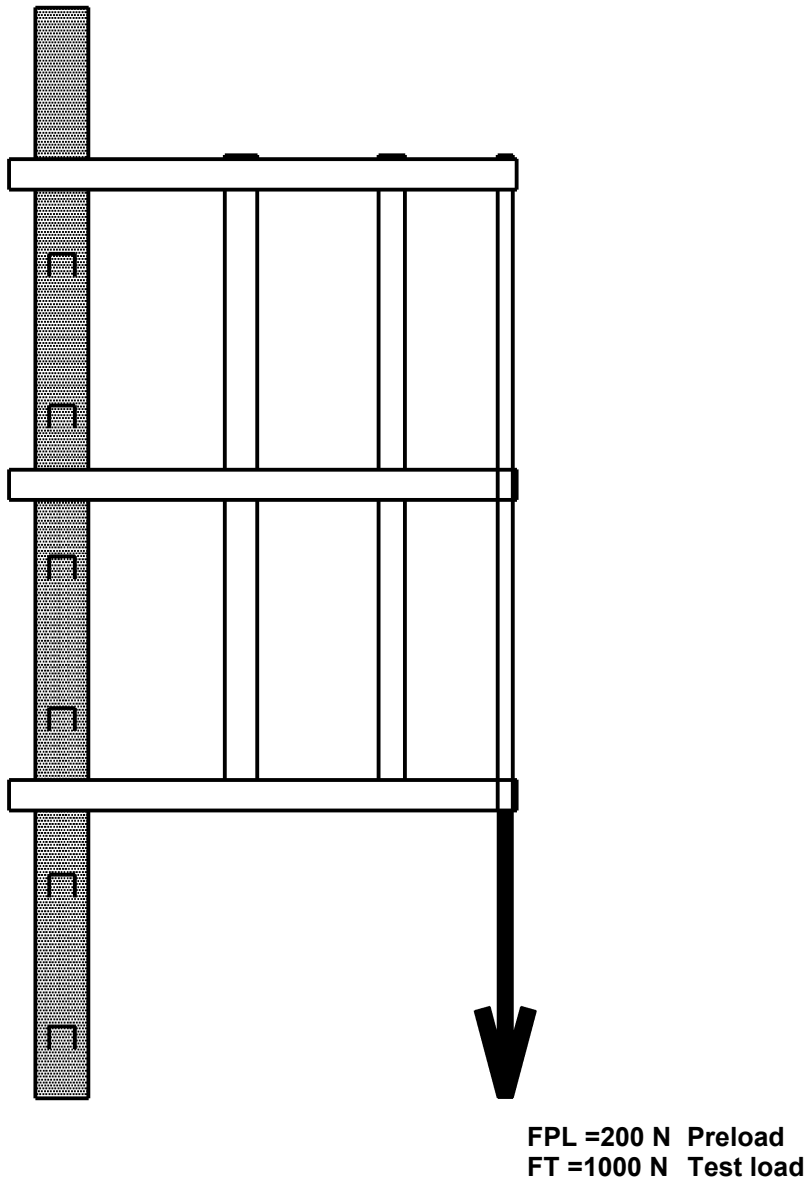


Figure 13 — Test of a safety cage (vertical)

5.3.3 For the uprights, a simulated load (F_H) of 500 N shall be horizontally applied at the most unfavourable point. The simulated load (F_H) may be distributed over three uprights (see Figure 14). The permissible permanent deformation measured at the point of application of the load is 10 mm maximum. Test cages recording any permanent deformation shall not be used in service.

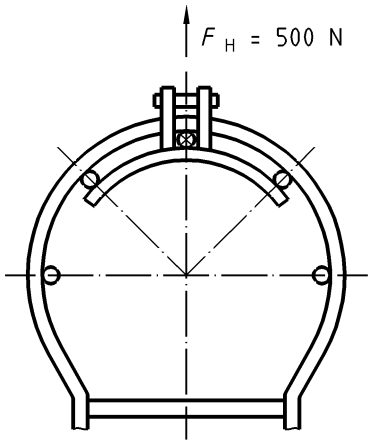


Figure 14 — Test of a safety cage (horizontal)

5.4 Tests of fixed ladders with one stile

5.4.1 Strength and bending of a ladder element; Torsion of the rungs

The ladder element shall satisfy the tests specified in the following of subclauses EN 131-2:1993:

— 4.2 Strength test;

— 4.3 Bending test;

— 4.7 Torsion test on the rungs.

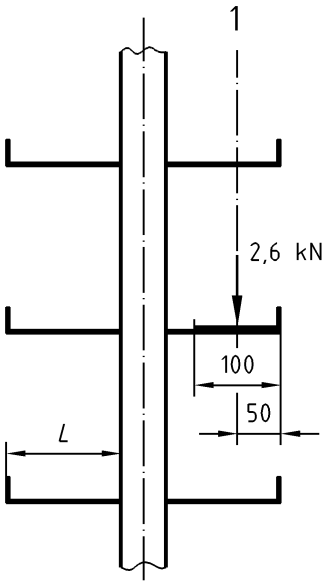
Whereby the distance *L* to be taken into account for strength and bending tests shall be the longest distance between two consecutive anchor points of the ladder, see point 4 in Figure 16.

Acceptance criteria of the bending test (see 4.3 of EN 131-2:1993) is modified as follows: The maximum admissible deflection under load shall be $\leq 5 \times L^2 \times 10^{-6}$ (mm) without exceeding 30 mm.

5.4.2 Strength of the rungs

The bending test of the rungs of ladders with one stile shall be carried out as shown in the Figure 15.

Dimensions in millimetres



Key

1 Line of application

Figure 15 — Test of the rungs of a ladder with one stile

A preload of 200 N perpendicular to the top of the rungs is applied for one minute. The position of the rung after moving the preload is taken into account as a reference position for the test carried out with the test load.

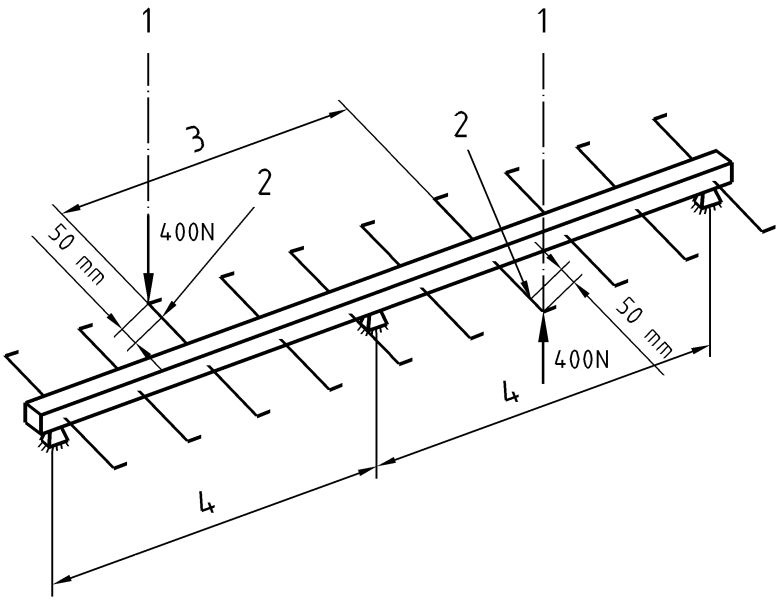
The direction of the preload and of the test load of 2,6 kN is perpendicular to the top of the rungs. The preload and test load are equally distributed on a length of 100 mm close to the lateral devices provided at the end of the rungs to prevent slipping.

After removing the test load, the residual deflection of the rungs shall be not more than 0,3 % related to the length *L* of the rung. Point of measuring is at a distance of 50 mm from the lateral protective device provided at the end of the rung to prevent slipping-off; the direction of measuring to be in the line of application of the test load. Measuring of the deflection of the rungs shall be carried out no less than one minute after removing the test load.

5.4.3 Strength of the stile

The ladder shall be stressed by two forces according to Figure 16.

Dimensions in millimetres



Key

Two test load each 400 N

1 Line of application
2 Measuring point
3 Distance between four sets of rungs
4 Distance between two consecutive anchor points

Figure 16 — Torsion test of a ladder with one stile

The direction of both test loads of 400 N is perpendicular to the face of the ladder. The length of the ladder is at least two distances between consecutive anchor points. The ladder shall be mounted at the anchor points on the ground.

The distance between the test loads corresponds to the distance between four sets of rungs of the ladder. The test loads are applied to the point considered as the most unfavourable.

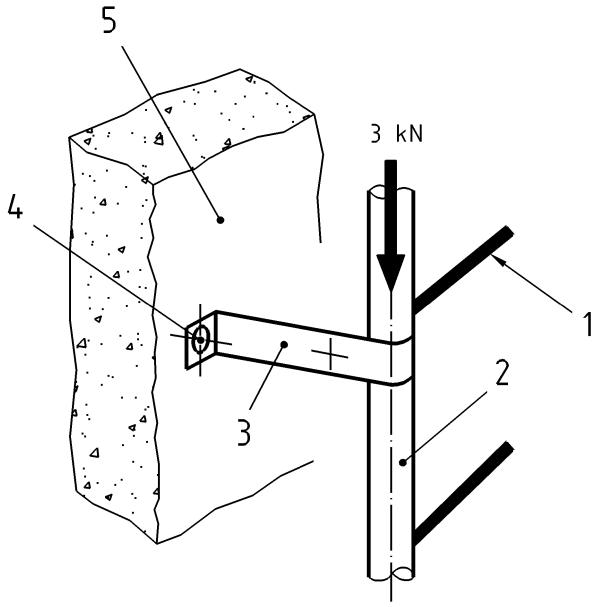
The deflection of the ladder shall not exceed 20 mm under the application of the test loads. Measuring points on the rungs stressed by the test loads shall be at a distance of 50 mm from the lateral protective devices used to prevent slipping-off. The direction of measuring shall be in the line of application of the test loads.

5.5 Test of the anchor points

5.5.1 Fixed ladders with two stiles without fall arrester

The strength of the anchor points of fixed ladders with two stiles shall be calculated taking into account a force of 3 kN for each stile, directed along the centre line of each stile (see Figure 17).

At each stile, no more than four anchor points shall be taken into account by which the forces will be transmitted to fixed parts of the surroundings (e. g. wall, enclosure of the machine, etc.).



Key

1 Rung
2 Stile
3 Mounting
4 Anchor point
5 Fixed part (e. g. wall)

Figure 17 — Arrangement for assessment of anchor points and connections of fixed ladders with two stiles

5.5.2 Fixed ladders with one stile

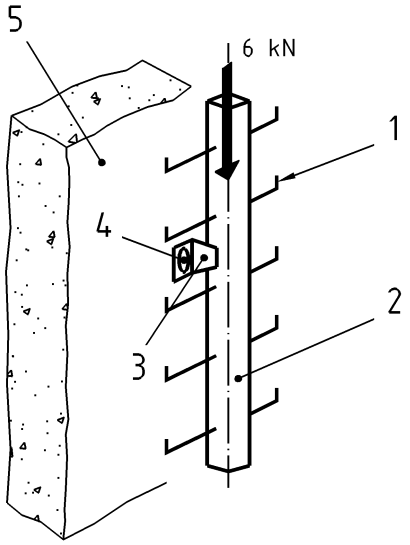
The strength of the anchor points of fixed ladders shall be calculated taking into account a force of 6 kN, directed along the center line of the stile. (see Figure 18).

At the stile, no more than four anchor points shall be taken into account by which the forces will be transmitted to fixed parts of the surroundings (e. g. wall, enclosure of the machine).

5.5.3 Fixed ladders with fall arrester

5.5.3.1 The fall arrester shall be tested according to the provisions of EN 353-1.

5.5.3.2 The stile and anchorage points of the ladder shall be tested taking into account a single force of 6 kN directed along the center line of the stile. The ladder shall support the load without fracture (see Figure 18).



Key

1 Rung
2 Stile
3 Mounting
4 Anchor point
5 Fixed part (e. g. wall)

Figure 18 — Arrangement for assessment of anchor points and connections of fixed ladders with one stile

6 Assembly and operating instructions

6.1 Assembly instructions

All information on the correct assembly shall be contained in the instructions, including the method of fixing and the assembly of the fall arrester, where applicable.

6.2 Operating instructions for ladders with fall arrester

The provisions of EN ISO 12100-2 as well as of EN 353-1 shall be considered in the operating instructions.

6.3 Marking at points of entry and exit

Ladders with fall arresters shall be permanently marked with the following information:

— type of guided type fall arrester and year of manufacture,

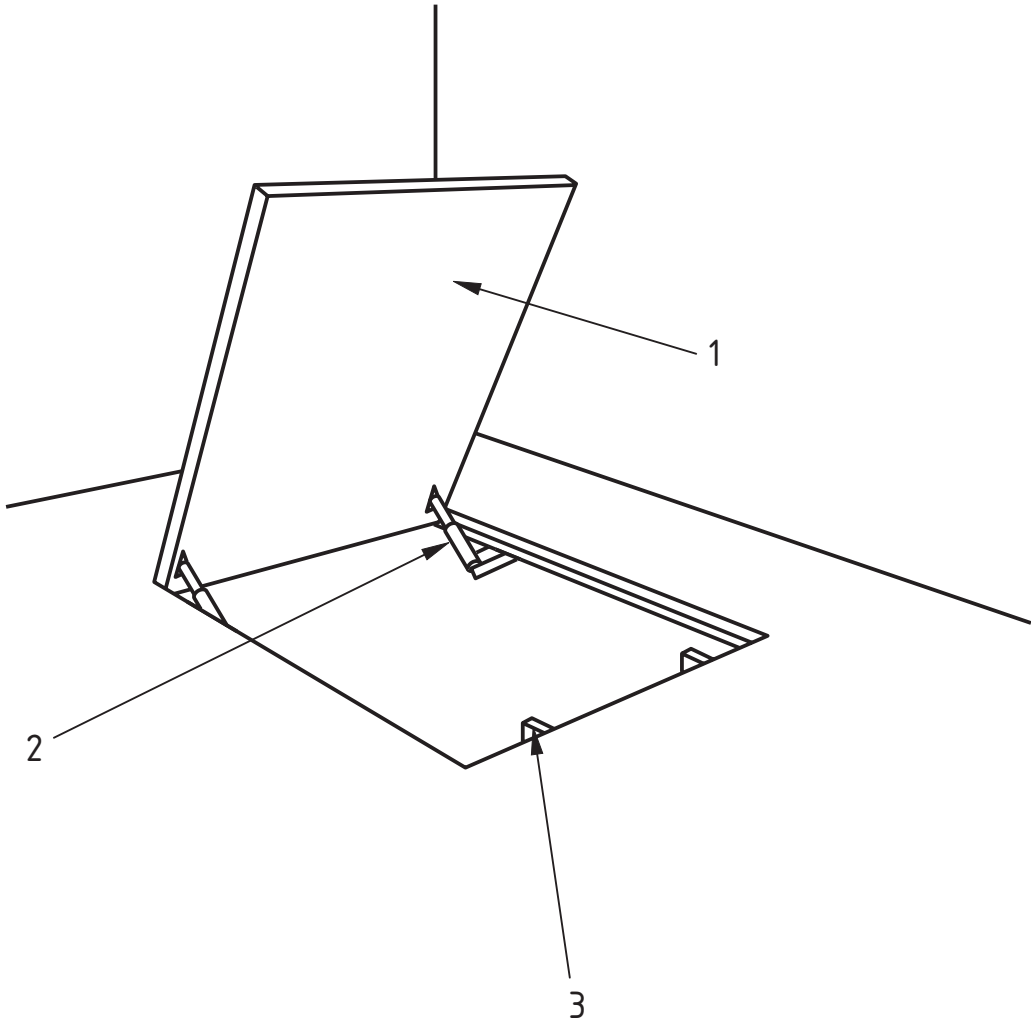
— notice: "Use of Personal Protective Equipment is mandatory”

The marking is only required to be applied to those points of entry and exit which are reachable via the respective ladders.

NOTE A marking, for example, by an embossed coating is considered permanent. The information of the marking should be mentioned in the operating instructions for ladders with fall arrester.

National Annex A (informative)
Examples of trap doors

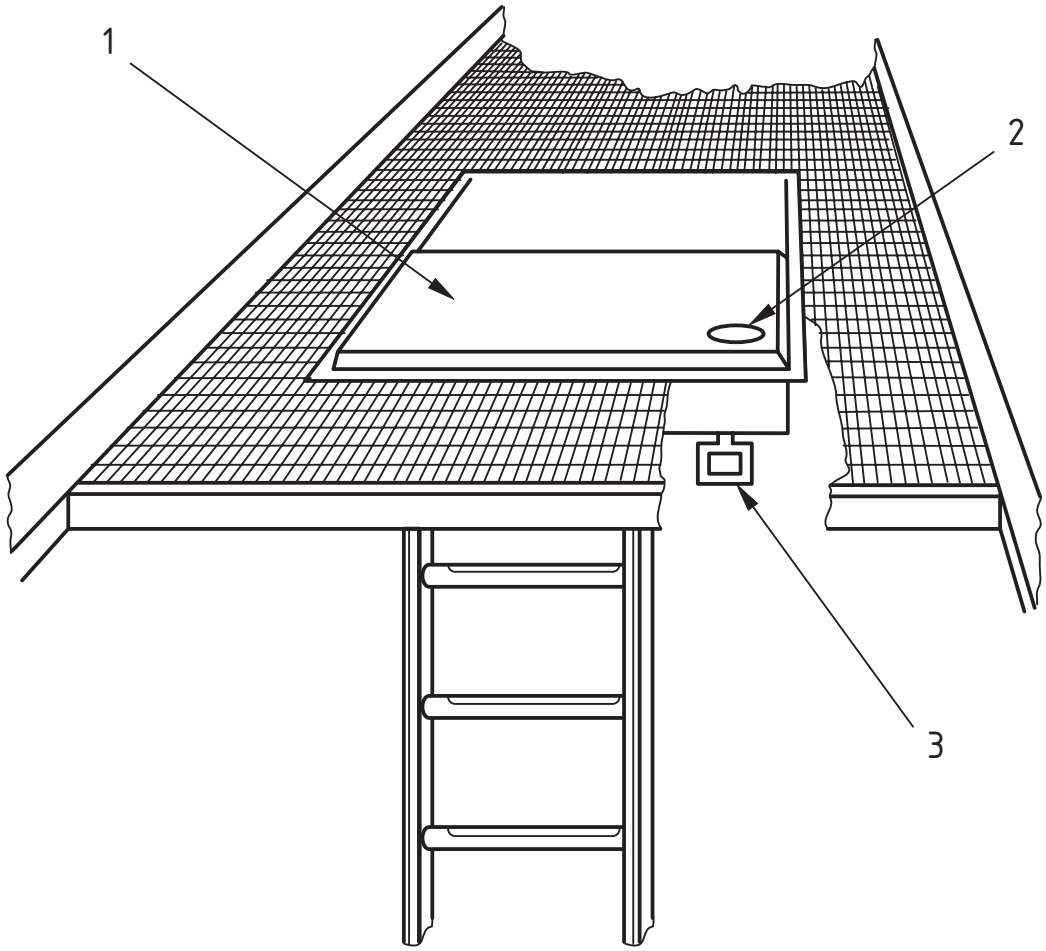
Figures NA.1 and NA.2 give examples of self-closing trap doors specified in **4.7.3.3**.



Key

1 Lifting hatch cover
2 Self-closing hydraulic rams
3 Top of ladder

Figure NA.1 — Lifting trap door



Key

1 Sliding hatch cover
2 Lock release pedal
3 Lock release handle

NOTE A hydraulic closing system (concealed) self-closes and locks the trap door after passage through it.

Figure NA.2 — Sliding trap door

Bibliography

[1] EN 294, *Safety of machinery — Safety distances to prevent danger zones being reached by the upper limbs.*

[2] EN 349, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body.*

[3] EN 364*, Personal protective equipment against falls from a height — Test methods.*

[4] EN 547-1, *Safety of machinery — Human body measurements — Part 1: Principles for determining the dimensions required for openings for whole body access into machinery.*

[5] EN 547-2, *Safety of machinery — Human body measurements — Part 2: Principles for determining the dimensions required for access openings.*

[6] EN 547-3, *Safety of machinery — Human body measurements — Part 3: Anthropometric data.*

[7] EN 811*, Safety of machinery — Safety distances to prevent danger zones being reached by the lower limbs.*

[8] EN 1050, *Safety of machinery — Principles for risk assessments*.

[9] ISO 13852, *Safety of machinery — Safety distances to prevent danger zones being reached by the upper limbs*

[10] ISO 13853, *Safety of machinery — Safety distances to prevent danger zones being reached by the lower limbs*

[11] ISO 13854, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

[12] ISO 14121, *Safety of machinery — Principles of risk assessment*

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive Machinery 98/37/EC, amended by Directive 98/79/EC

This European Standard has been prepared under a mandate given to CEN M by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the Directive Machinery 98/37/EC, amended by 98/79/EC.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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