INTERNATIONAL STANDARD

ISO 14122-3

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Safety of machinery — Permanent means of access to machinery —

Part 3: Stairs, stepladders and guard-rails

Sécurité des machines — Moyens d'accès permanents aux machines —

Partie 3: Escaliers, échelles à marches et garde-corps

Reference number
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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 14122 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14122-3 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 199, *Safety of machinery*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, 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.

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Foreword

The text of EN ISO 14122-3:2001 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of an identical text or by endorsement, at the latest by October 2001, and conflicting national standards shall be withdrawn at the latest by October 2001.

This European Standard 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).

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

Introduction

It is the third part of this document "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, step ladders and guard-rails

Part 4: Fixed ladders.

This document is a type B standard as stated in EN 1070.

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 6.2.4 "Provision for safe access to machinery" of EN 292-2:1991.

The provisions of this document may 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 take precedence over the provisions of this type B standard.

The purpose of this standard is to define the general requirements for safe access to machines mentioned in EN 292-2. Part 1 of EN ISO 14122 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.

The dimensions specified are consistent with established ergonomic data given in EN 547-3 "Safety of machinery - Human body dimensions – Part 3 : Anthropometric data".

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.

This standard contains a Bibliography.

1 Scope

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

This standard applies to stairs, step ladders and guard-rails which are a part of a machine.

This standard may also apply to stairs, step ladders and guard-rails 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 stairs, step ladders and guard-rails specific to the machine which are not permanently fixed to the machine and which may be removed or moved to the side 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.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 14122. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 14122 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

EN 292—1 (ISO/TR 12100-1), *Safety of machinery — Basic concepts, general principles for design — Part 1 : Basic terminology, methodology*

EN 292-2:1991 + A1 (ISO/TR 12100-2), *Safety of machinery — Basic concepts, general principles for design — Part 2 : Technical principles and specifications*

EN 1070, *Safety of machinery — Terminology*

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

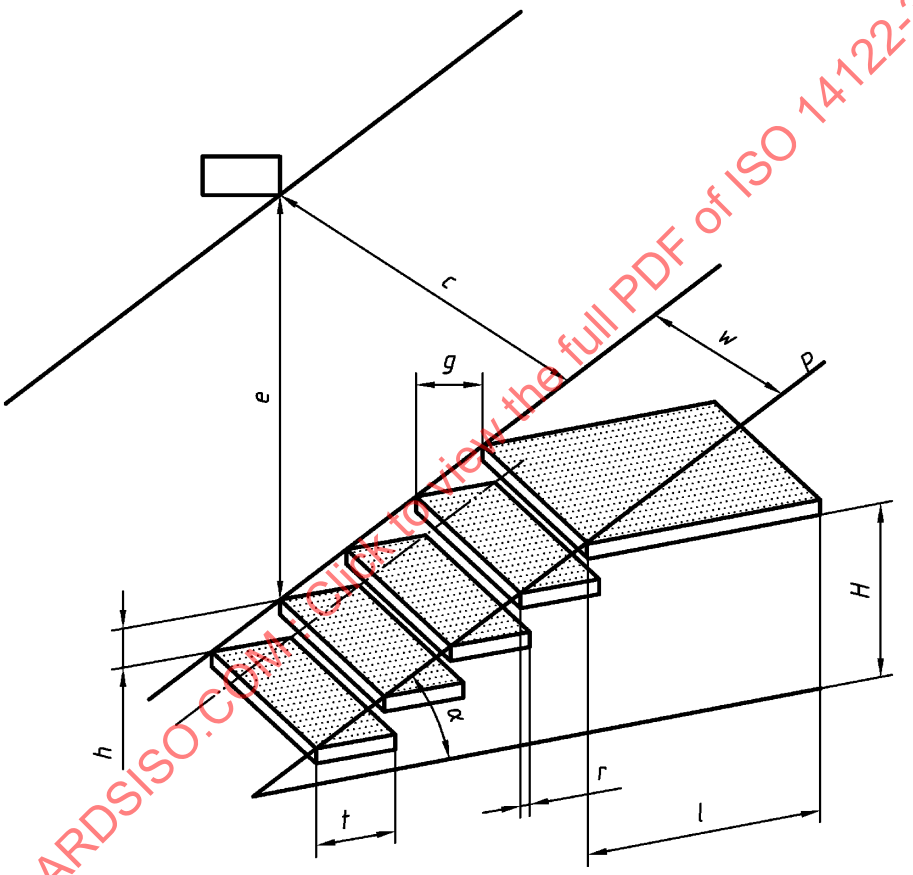
3 Terms and definitions

For the purposes of this part of EN ISO 14122, the terms and definitions stated in EN 1070 "Safety of machinery - Terminology" and of EN ISO 14122-1 apply.

The following additional definitions particularly required for this standard apply :

3.1
stairs and step ladders
the definitions stated in 3.2 and 3.3 of EN ISO 14122-1:2001 are completed by:

Succession of horizontal levels (steps or landings) allowing passage on foot from one level to another composed of the following elements, shown in figure 1 and explained from 3.1.1 to 3.1.16.



Key

H	Climbing height
g	Going
e	Headroom
h	Rise
l	Length of landing
r	Overlap
α	Angle of pitch
w	Width
p	Pitch line
t	Depth of step
c	Clearance

Figure 1 — Parts of stairs and step ladders

3.1.1
climbing height
vertical distance between the reference level and the landing (*H* in figure 1)

3.1.2
flight
uninterrupted sequence of steps between two landings

3.1.3
going
horizontal distance between the step nosing of two consecutive steps (*g* in figure 1)

3.1.4
headroom
minimum vertical distance, clear of all obstacles (such as beams, ducts, etc.) above the pitch line (*e* in figure 1)

3.1.5
landing
horizontal resting area situated at the end of a flight (*l* in figure 1).

3.1.6
walking line
theoretical line indicating the average path of the users of the stair or the step ladder

3.1.7
overlap
difference between the depth of the step and the going (*r* in figure 1)

3.1.8
pitch line
a notional line connecting the leading edge of the nosing of successive steps taken on the walking line and which extends down to the landing at the bottom of the flight from the nosing on the landing at the top of the flight (*p* in figure 1)

3.1.9
angle of pitch of the stair or step ladder
angle between the pitch line and its projection on the horizontal level (α in figure 1)

3.1.10
rise
height between two consecutive steps measured from the tread surface of one to the tread surface of the next (*h* in figure 1)

3.1.11
step
horizontal surface on which one places the foot to go up or down the stair or step ladder

3.1.12
nosing
top edge at the front of the step or landing

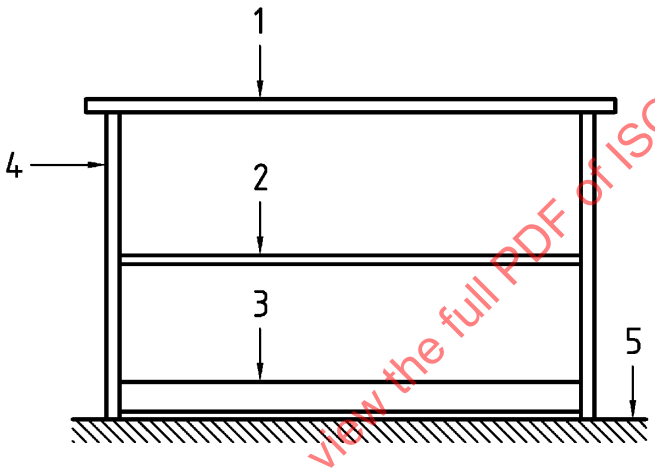
3.1.13
string
flanking framework element supporting the steps

3.1.14
width
clear distance over the outside faces of the step (*w* in figure 1)

3.1.15
depth of step
clear distance from the leading edge or the nosing to the rear of the step (*t* in figure 1)

3.1.16
clearance
absolute minimum clear distance between any obstacle and the pitch line (*c* in figure 1) measured at an angle of 90° from the pitch line

3.2
guard-rail
device for protection against accidental fall or accidental access to a hazardous area, with which stairs, step ladders or landings, platforms and walkways may be equipped. Typical parts of a guard-rail are shown in figure 2 and defined in 3.2.1 to 3.2.5



Key

1 Handrail
2 Kneerail
3 Toe plate
4 Stanchion
5 Walking level

Figure 2 — Example of the parts of a typical structure of a guard-rail

3.2.1
handrail
top element designed to be grasped by the hand for body support which can be used individually or as the upper part of a guard-rail (1 in figure 2)

3.2.2
kneerail
element of the guard-rail placed parallel with the handrail, giving extra protection against the passage of a body (2 in figure 2)

3.2.3
stanchion
vertical structural element of the guard-rail to anchor the guard-rail to the platform or stair. (4 in figure 2)

3.2.4
toe-plate
solid lower part of a guard-rail or upstand on a landing to prevent the fall of objects from a floor level (3 in figure 2)

NOTE A toe-plate also reduces the free space between the floor and kneerail to prevent the passage of a body.

3.2.5
self closing gate
part of the guard-rail which is intended to be opened easily. When the gate is released, it will close automatically using e.g. the effect of gravity or a spring

4 General safety requirements concerning materials and dimensions

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

4.2 The materials used shall be, themselves, by their nature or by a complementary treatment, able to resist corrosion provoked by the surrounding atmosphere.

4.3 Any parts liable to be in contact with the users shall be designed so as not to hurt or hinder (sharp corners, welds with burrs, rough edges, etc.).

4.4 Steps and landings shall offer satisfactory slip resistance to avoid any risk of slipping.

4.5 Opening or closing of moving parts (gates) shall not cause further hazards (for example by shearing or by falling) to users and other persons in the vicinity.

4.6 Fittings, hinges, anchorage points, supports and mountings shall provide sufficient rigidity and stability to the assembly to ensure safety.

4.7 The structure and the steps shall be designed to satisfactorily resist the intended imposed loads.

4.7.1 For the structure the unfactored loads used in the industrial field, may vary from 1,5 kN/m^2 for low density pedestrian traffic without load, up to 5 kN/m^2 for low density pedestrian traffic with load or for high density pedestrian traffic.

4.7.2 Steps shall resist the following unfactored loadings:

— if the width w < 1200 mm, then 1,5 kN shall be distributed over an area of 100 mm x 100 mm where one boundary is the leading edge of the nosing applied at the middle of the stair width;

— if the width $w \geq 1200$ mm, then respectively 1,5 kN shall be distributed simultaneously over each of the 100 mm x 100 mm areas applied at the most unfavourable points spaced at intervals of 600 mm where one boundary is the leading edge of the nosing.

The deflection between the structure and the steps under an unfactored load shall not exceed 1/300th of the span or 6 mm whichever is the lesser.

5 Safety requirements applicable to stairs

5.1 Going, g, and rise, h, shall meet the formula (1):

$$600 \leq g + 2h \leq 660 \qquad \text{(dimensions in mm)} \qquad (1)$$

5.2 The overlap, r, of the step shall be ≥ 10 mm and shall apply equally to landings and floors.

5.3 On the same flight, the rise shall be constant wherever possible. In the case where it is not possible to maintain the height of the rise between the level of departure and the lower step, it may be reduced by a maximum of 15 %. If it is justified, it may be increased, for example in the case of certain mobile machines.

5.4 The uppermost step shall be level with the landing (see figure 3).

NOTE The principle of maintaining the going at the top of the stair is important and a change of going at the landing which is the last step is a significant cause of accidents.

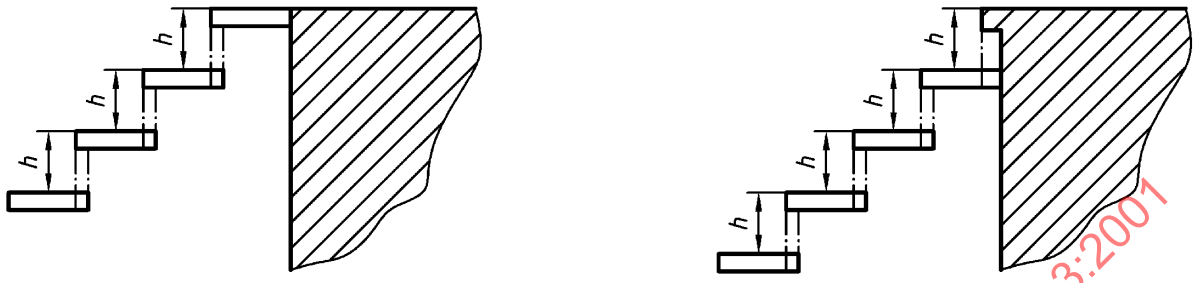


Figure 3 — Positioning of the uppermost step

5.5 Headroom, *e*, shall be 2300 mm minimum.

5.6 Clearance, *c*, shall be 1900 mm minimum.

5.7 Unless there are exceptional circumstances, the clear width of a stair shall be a minimum of 600 mm but preferably 800 mm. When the stairway is usually subject to the passage or crossing of several persons simultaneously, the width shall be increased to 1000 mm. The width of the stair, when designated as an escape way shall meet the requirements of appropriate regulations.

NOTE When justified by the risk assessment and restrictions due to the machinery or environment, the free width may be reduced to no less than 500 mm' if :

— the working platform or stair is used only occasionally, and ;

— the reduction is made only for a short distance.

5.8 The climbing height *H* of individual flights shall not exceed 3000 mm, otherwise a landing is deemed necessary before continuing on to another flight. The length of the landing, *l*, shall be at least 800 mm and in any case equal to or greater than the width of the stair. Only in the case of a single flight (see 3.1.2) shall the climbing height not exceed 4000 mm.

5.9 For requirements related to guard-rails for stairs, see 7.2.

6 Safety requirements applicable to step ladders

6.1 The minimum step depth, *t*, shall be 80 mm.

6.2 The maximum rise, *h,* shall be 250 mm.

6.3 The overlap, *r*, of the step or the landing shall be ≥ 10 mm.

6.4 The clear width between stringers or guard-rails shall be within the range of 450 mm to 800 mm but preferably 600 mm, .

6.5 On the single flight, the rise shall be constant wherever possible. In the case where it is not possible to maintain the height of the rise between the level of departure and the first step, it may be reduced by a maximum of 15 %. If it is justified, it may be increased, for example in the case of certain mobile machines.

6.6 Headroom, *e*, shall be 2300 mm minimum.

6.7 Clearance, *c*, shall be 850 mm minimum.

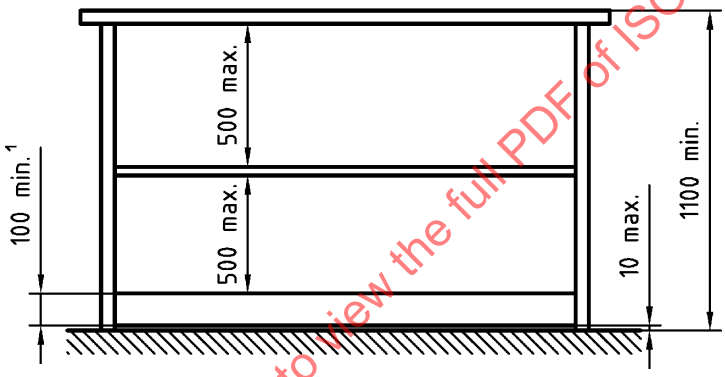
6.8 The climbing height, *H*, of a single flight shall not exceed 3000 mm.

NOTE For multi-flights, additional safety measures should be considered.

7 Safety requirements applicable to guard-rails

7.1 Horizontal guard-rails

Dimensions in millimetres



1 Upstand

Figure 4 — Example of a horizontal guard-rail

7.1.1 A guard-rail shall be installed near to the dangerous areas where there is a risk of sinking or of passage through (for example, walkway accesses to an extractor on a roof).

7.1.2 When the height of the possible fall exceeds 500 mm, a guard-rail shall be installed.

7.1.3 A guard-rail shall be provided when the gap between a platform and the structure of a machine or wall is greater than 200 mm or if the protection of the structure is not equivalent to a guard-rail. However, a toe plate shall be provided when the gap between the platform and adjoining structure is greater than 30 mm.

7.1.4 The minimum height of the guard-rail shall be 1100 mm.

7.1.5 The guard-rail shall include at least one intermediate kneerail or any other equivalent protection. The clear space between the handrail and the kneerail, as well as between the kneerail and the toe plate, shall not exceed 500 mm.

7.1.6 When vertical uprights are used instead of a kneerail the clear horizontal distance between those uprights shall be 180 mm maximum.

7.1.7 A toe-plate with a minimum upstand of 100 mm shall be placed 10 mm maximum from the walking level and the edge of the platform (see figure 4).

7.1.8 The distance between the axes of the stanchions is preferred to be limited to 1500 mm. But, if this distance is exceeded, specific attention shall be paid to the stanchion anchoring strength and the fixing devices.

Dimensions in millimetres

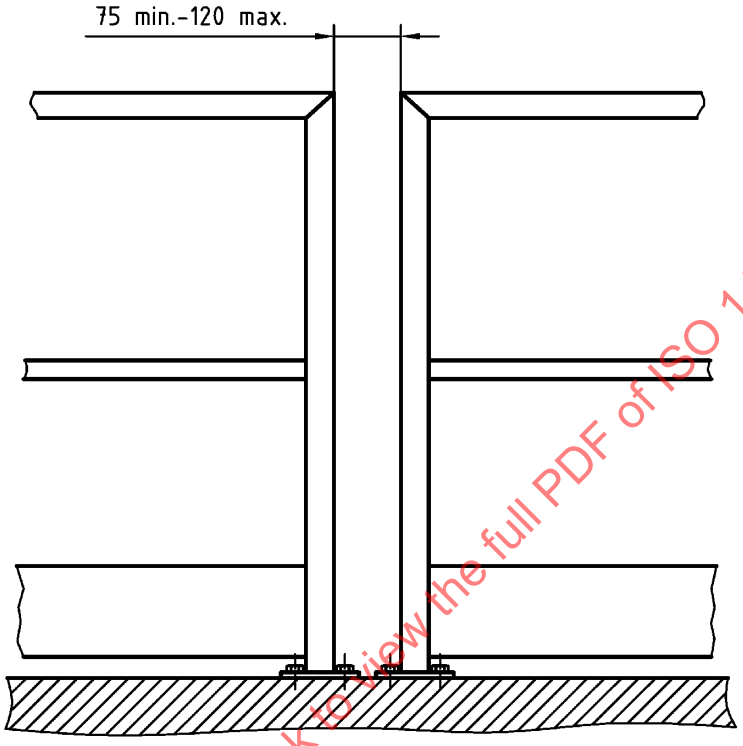


Figure 5 — Clear space between two gard rail segments

7.1.9 In the case of an interrupted handrail, to prevent hand traps the clear space between the two segments should not be less than 75 mm and not greater than 120 mm (see figure 5). If there is a larger opening, a self closing gate shall be used.

7.1.10 Where access through the guard rail is required, a self-closing gate shall be used. A gate shall have the handrail and kneerail positioned at the same level as that of the guard-rail that it extends to (for exit section of the ladder, see prEN ISO 14122-4:1996).

Any gates shall be self-closing and shall be designed to open onto the platform or floor and to close against a firm stop to prevent users pushing against them and falling through the opening. Gates shall be subject to the same loading criteria as guard-rails.

7.1.11 The ends of the handrail shall be designed in such a manner as to eliminate any risk of harm caused by sharp edges of the product or by catching of the user's clothing.

7.2 Guard-rails of stairs and step ladders

Dimensions in millimetres

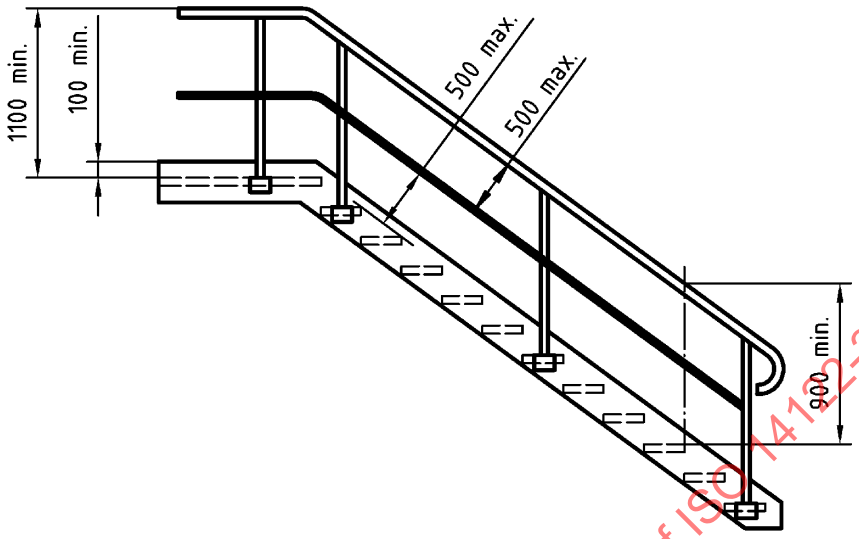


Figure 6 — Example of a stair guard-rail and its continuation to the horizontal guard-rail

7.2.1 A stair shall have at least one handrail. If the stair width is greater or equal to 1200 mm, there shall be two handrails. Step ladders shall always have two handrails.

7.2.2 A guard-rail shall be fitted whenever the height to climb exceeds 500 mm, and when there is a lateral space adjacent to the string which is greater than 200 mm, in order to provide protection on the side of the stair where this gap exists.

7.2.3 The vertical height of the handrail on a stair shall be between 900 mm and 1 000 mm above the nosing on the step of the flight and be a minimum of 1100 mm above the walking level on the landing. The shape of the handrail should have a diameter between 25 mm to 50 mm or an equivalent section, to provide a good grip for the hand.

7.2.4 The distance (dimension x) from the pitchline on a step ladder to the centreline of the handrail should be as shown in figure 7, with the handrail commencing from at least the distance of 1000 mm measured vertically from the bottom of the ladder. Table 1 gives indicative dimensions.

Dimensions in millimetres

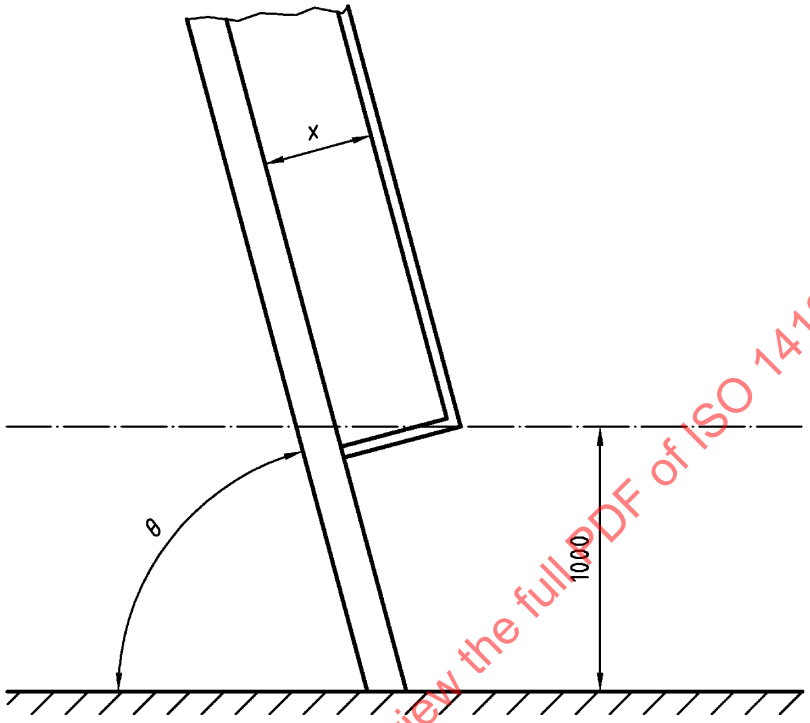


Figure 7 — Positioning of a handrail on a step ladder

Table 1 — Example of distances from the pitchline on a step ladder to the centerline of the handrail

θ (Degree)	x (mm)
60	250
65	200
70	150
75	100

7.2.5 The guard-rail on a stair shall include at least a kneerail or any equivalent device. The clear space between the handrail and the kneerail, as well as between the kneerail and the string, shall not exceed 500 mm (See figure 6).

Dimensions in millimetres

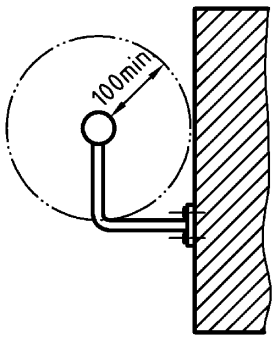


Figure 8 — Minimum gap between the handrail and any obstacle

7.2.6 The length of the handrail shall be clear of obstacles within a distance of 100 mm, except on the underside of the handrail, for the mounting of stanchion supports (see figure 8).

7.3 Structural requirements

The guard-rail shall support, without any perceivable permanent deformation, an unfactored horizontally applied point load equal to the service load, applied first to the top of the stanchion, then at the least favourable point along the handrail. In both cases, the maximum loaded deflection shall not exceed 30 mm.

The minimum service load F_{min} = 300 N/m x maximum distance, in meters, between the axes of two successive stanchions (L, in figure 9).

NOTE 1 F_{min} should be increased according to the conditions of use without exceeding the above required deflection value.

NOTE 2 It is essential to test the strength of the guard-rail under factored loads should it be required to verify the absence of any perceivable permanent deformation.

8 Verification of safety requirements

8.1 General

The safety requirements of this standard may be verified by measurements, inspection, calculation and/or testing. When testing is chosen, the testing procedure described in this clause shall be used.