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Earth-moving machinery — Access systems

Engins de terrassement — Moyens d'accès
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Reference number
ISO 2867:1994(E)

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.

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.

International Standard ISO 2867 was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 2, *Safety requirements and human factors*.

[ISO 2867:1994](#)

This fifth edition cancels and replaces the fourth edition (ISO 2867:1989), which has been technically revised.

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Earth-moving machinery — Access systems

1 Scope

This International Standard specifies criteria for access systems — steps, ladders, walkways, platforms, grab rails (handrails), grab handles, guardrails and enclosure entrance and exit openings — as they relate to aiding the operator and servicemen in performing their functions on the machinery.

It applies to access systems to the operator's station and to service points on earth-moving machinery as defined in ISO 6165 while the machinery is parked in accordance with manufacturer's instructions.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3411:1982, *Earth-moving machinery — Human physical dimensions of operators and minimum operator space envelope*.

ISO 6165:1987, *Earth-moving machinery — Basic types — Vocabulary*.

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 access system: System provided on a machine for entrance to and exit from an operator, inspection or maintenance platform from and to the ground.

The primary access system is the access system normally used, while the alternative access system is the access route used during anticipated emergency situations when the primary access system cannot be used.

3.2 basic dimension: Dimensional value which takes into account human factors criteria. The actual value may vary within the specified range.

3.3 enclosure opening: Opening leading to or from an access system and large enough for a person to pass through.

3.3.1 primary opening: Opening normally used for access.

3.3.2 alternative opening: Opening for use during emergencies when the primary opening is not usable.

3.3.3 service opening: Opening for use during maintenance, service or inspection.

3.4 guardrail: Device along the open sides of walkways or platforms to protect a person from falling.

3.5 handrail and handhold: Parts of an access system that may be grasped by the hand as an aid to body support and balance.

3.5.1 handrail: Device which permits hand movement to a different location without removing the hand from the device.

3.5.2 handhold: Device for single hand placement.

3.6 slip-resistant surface: Access system surface having qualities which improve the traction obtained by the foot.

3.7 ladder

3.7.1 inclined ladder: Ladder whose angle of inclination from the horizontal is greater than 50° but not more than 75°.

3.7.2 vertical ladder: Ladder whose angle of inclination from the horizontal is greater than 75°, but not more than 90°.

3.7.3 ladder fall-limiting device: Any device which minimizes or limits the length of fall from a ladder system.

3.8 stairway: Access system or part of an access system inclined from the horizontal at an angle greater than 20° but not more than 50° and consisting of four or more steps.

3.9 step: Device for placement of one or both feet, either as part of a ladder or stairway, or installed (placed) individually.

3.10 rung: Device on which one or both feet may be placed, generally installed on ladders or similar devices.

3.11 riser height: Height between two consecutive steps or rungs, measured from the tread surface of one step or rung to the tread surface of the next.

3.12 tread depth: Distance from the leading edge to the back of the step.

3.13 stride distance: Horizontal distance from the leading edge of one step to the leading edge of the next step.

3.14 walkway: Part of an access system that permits walking or crawling between locations on the machine.

3.14.1 boom walkway: Walkway used mainly on long booms inclined at angle of up to 20° from the horizontal.

3.14.2 passageway: Walkway with confining barriers on both sides that extend vertically above the walking surface to a height of at least 1 200 mm for erect walking or 300 mm for crawling.

3.15 platform: Horizontal surface for the support of persons engaged in operation, maintenance, inspection or repair work.

3.15.1 operator's platform: Area from which an operator controls the travel and work functions of the machine.

3.15.2 rest platform: Platform used in conjunction with a ladder system for a person to rest on while standing.

3.16 foot barrier: Device to prevent a person's foot from slipping off the edge of a platform or walkway.

3.17 ramp: Plane inclined at an angle of 20° or less from the horizontal, without steps, but with cleats or other surface treatment for the purpose of traction.

3.18 cleat: Device added to a walkway or ramp surface to improve traction.

3.19 three-point support: Feature of an access system that enables a person to use simultaneously two hands and one foot or two feet and one hand while ascending, descending or moving about on the machine.

4 General criteria

4.1 An alternative exit is required if the operator's platform is ≥ 3 m above ground level, and should preferably be provided if ≥ 2 m above ground level.

4.2 The probability of a user being inadvertently restrained by protruding devices such as controls, steps or handles catching or holding body appendages or wearing apparel shall be minimized.

4.3 Protrusions that could trip the user or increase the severity of injury in case of a fall shall be minimized.

4.4 The probability of user contact with potential hazards such as extreme differences in heat or cold, electrical hazards, moving parts and sharp corners shall be minimized.

4.5 Access systems shall accommodate the 5th percentile through the 95th percentile operator dimensions as defined in ISO 3411.

4.6 Correct use of the access system shall be self-evident without special training.

4.7 Proper placement of components shall permit and encourage a person to use three-point support while ascending, descending or moving about the access system when more than 1 m above the ground.

4.8 Primary access system devices may be portable for convenient storage on the machine but shall be capable of being positively secured when in use or in the stored position.

4.9 An alternative exit and travel route shall be provided and shall be clearly indicated if not obvious.

5 Performance criteria

5.1 The walking and standing surfaces of access systems shall withstand without visible permanent deformation the following minimum forces applied perpendicular to the surface.

- a) 2 000 N concentrated through a 125 mm diameter disc applied at any location on the surface;
- b) 4 500 N uniformly distributed per square metre of surface area or fraction thereof if less than a square metre.

The forces shall be applied consecutively, but not simultaneously.

5.2 Openings in walkways and platform surfaces shall not permit the passage of a spherical object of diameter ≥ 40 mm. If the floor surface is above a surface where persons will be walking, standing or working, the opening shall not permit the passage of a spherical object of diameter ≥ 20 mm. Solid surfaces shall be used when necessary to prevent the passage of material that could result in personal injury to a person above or below the surface. For boom walkways and other similar areas that are used only for inspection or maintenance, the standing or stepping surface openings may be increased to twice the above values.

5.3 Handrails, handholds and guardrails shall be capable of withstanding a minimum force of 1 000 N applied at any point from any direction without visible permanent deformation. Flexible devices shall not deflect under the applied test load more than 80 mm from their normal undeflected position.

5.4 Machinery enclosure roofs used only for support of personnel during inspection, such as cab and canopy roofs, may comply only with 5.1 a).

5.5 All surfaces of the access system for e.g. walking, stepping or crawling (including any device or structural component thereof used as part of an access system) shall be slip-resistant.

Track shoe and track pad surfaces can be used as access steps if three-point support is provided.

5.6 Hand-grasp surfaces shall be free of roughness, sharp corners or protrusions which could cause injury to the hand.

6 Steps

6.1 Steps shall conform to the dimensions given in figure 1 and table 1. All steps should preferably be wide enough to accommodate both feet.

6.2 Where lateral body movement is necessary from the top or bottom step of a ladder to the next stepping surface, the distance between the rung and the nearest edge of the bearing surface shall be within a spherical radius R of 300 mm max. (see figure 1).

6.3 Steps shall be coordinated with properly positioned handrails and handholds.

6.4 Wherever a foot can protrude through the step and contact a moving part, a shield shall be provided between the step and the moving part.

6.5 Step design shall minimize the risk of the foot slipping laterally off the step.

6.6 The step tread surface shall not be intended for use as a handhold.

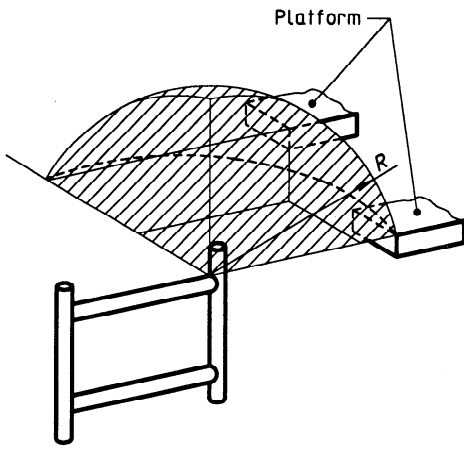
6.7 Step design shall minimize accumulation of debris and aid in the cleaning of mud and debris from the shoe sole.

6.8 Step design shall provide the user with natural foot placement, or the steps shall be clearly visible to the user.

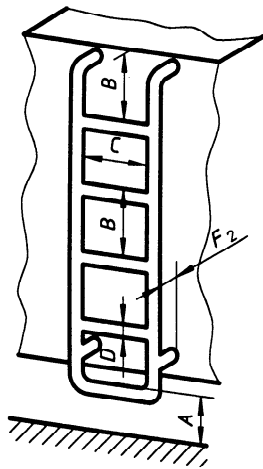
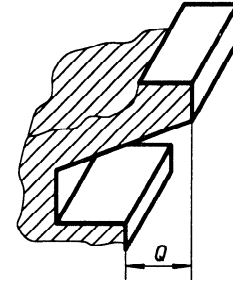
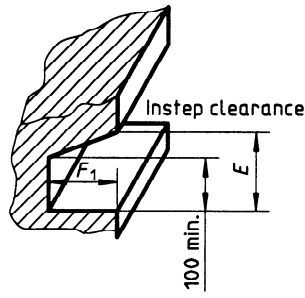
6.9 Flexibly-mounted series of steps should be avoided. If used, the steps shall not move more than 80 mm elastically in any plane when a horizontal force of 1 000 N is applied, centred on the outer edge of the leading edge of the first nonswinging step from the ground. The first step from the ground may be free-swinging.

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Dimensions in millimetres



R = spherical radius



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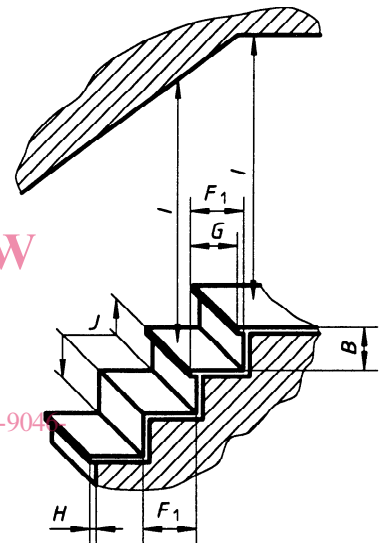
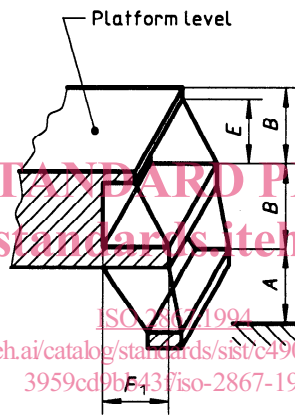


Figure 1 — Steps, ladders and stairways

Table 1 — Dimensions of steps, ladders and stairways

Dimensions in millimetres

Symbol	Description	Dimension		
		min.	max.	basic
<i>A</i>	Height of first step above ground or platform	—	700	400
<i>B</i>	Riser height			
	Steps or ladders	230 ¹⁾	400 ²⁾	300
	Stairways	—	250	180
<i>C</i>	Step width			
	for one foot	160	—	200
	for both feet	320	—	400
<i>D</i>	Rung tread — diameter or width	19	—	60
<i>E</i>	Instep clearance	150	—	190
<i>F</i> ₁	Tread depth:			
	Steps and ladders	130 ³⁾	—	200
	Stairways and boom walkways	240	400	300
<i>F</i> ₂	Toe clearance (free space behind rungs)	150	—	200
<i>G</i>	Stride distance	130	—	—
<i>H</i>	Tread projection from riser	—	25	0
<i>I</i>	Head clearance above step leading to walkway	2 000	—	> 2 000
<i>J</i>	Step placement ⁴⁾	—	800	600
<i>Q</i>	Maximum retraction of 1 step/stair	—	10 ⁵⁾	—
<i>R</i>	Step placement from ladder	—	300	0

1) 150 mm from top step of ladder to platform.
2) On track/wheel systems, 500 mm max. from track/step to platform top.
3) 19 mm diameter if width of step is likely subject to impact damage and/or accumulation of debris and/or mud.
4) See 6.10 or 7.5 for calculation formula.
5) 30 mm for steps which are an integral part of the track frame.

6.10 Step placement shall be such that two times the riser height plus the stride distance shall conform to the dimensions specified for *J* in table 1.

7 Ladders

7.1 Ladder steps shall meet the criteria specified in clause 6.

7.2 Ladders which extend more than 5 m vertically above ground level shall be equipped with a ladder fall-limiting device, preferably of the passive type. Such a device shall not require continual manipulation for the user to ascend or descend the ladder.

7.2.1 The lower end of a vertical ladder cage or other similar device, if used, shall be a maximum of 3 m above ground or platform level.

7.2.2 The internal surface of a ladder cage on a vertical ladder shall not extend more than 700 mm from the steps nor shall its internal width be more than 700 mm.

7.3 A rest platform shall be provided at least every 15 m of vertical climb, and preferably at least every 10 m of vertical climb.

7.4 Winding or spiral ladders of vertical height > 3 m (and preferably those of vertical height > 2 m) shall be provided with open-side guardrails.

7.5 Step placement shall be such that two times the riser height plus the stride distance shall conform to the dimensions specified for *J* in table 1.

8 Stairways

8.1 Stairway steps shall meet the criteria specified in clause 6.

8.2 Step tread depth on stairways shall be equal to or greater than the riser height. Successive riser heights and successive step tread depths shall be uniform.

8.3 Stairways shall be provided with at least one handrail.

8.4 Stairways with a vertical drop > 3 m (and preferably those with vertical drop > 2 m) shall be provided with guardrails on the open side or sides.

9 Handrails and handholds

9.1 Handrails and handholds shall conform with the dimensions specified in figure 2 and table 2.

9.2 Handrails and handholds shall be appropriately placed along the access system to provide continuous support to a moving person and to enable users to maintain their balance.

9.3 The preferred cross-section of a handrail and handhold is circular. A square or rectangular cross-section with rounded corners is permissible.

9.4 Any handrail or handhold on which the handgrasp surface extends beyond the support shall have a change of shape at the end of the handgrasp surface to help prevent the hand from slipping off the end.

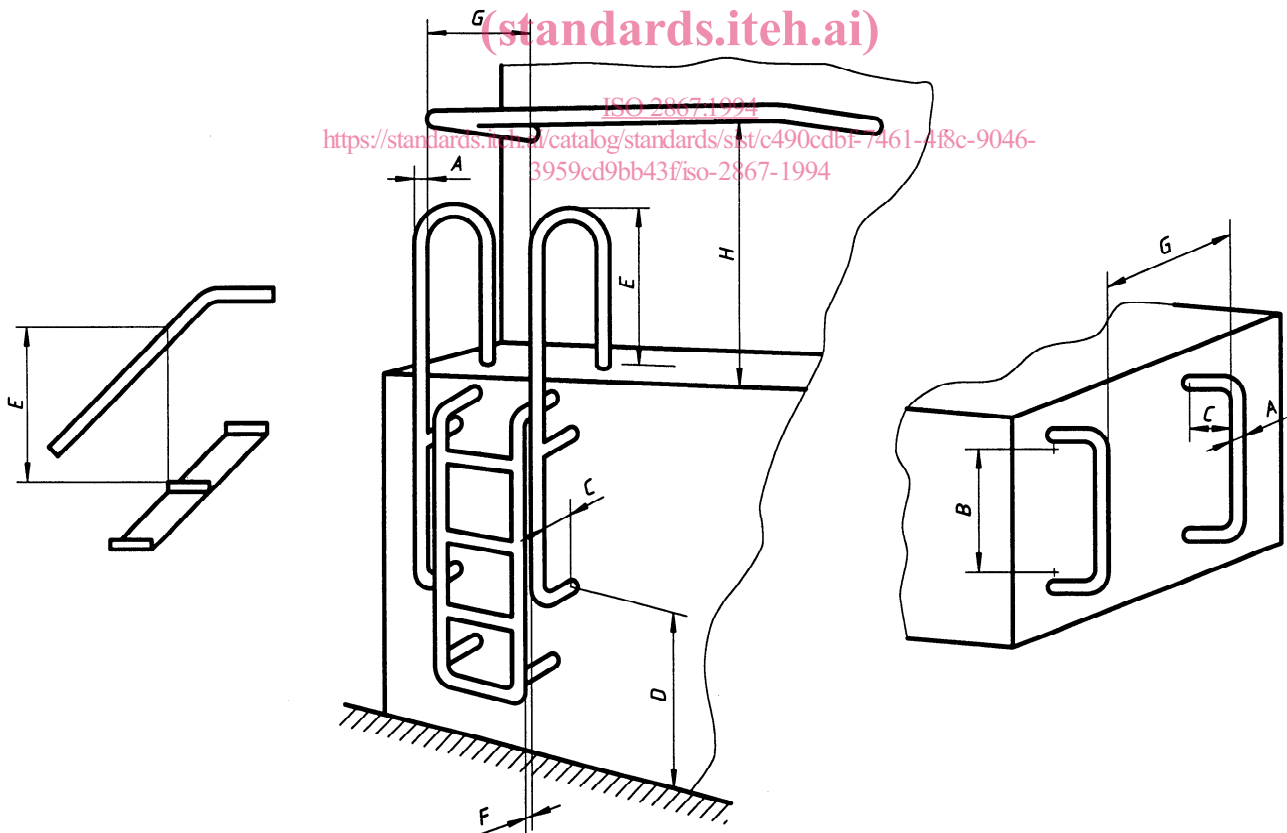
9.5 The use of handrails on a ladder system is preferred to handholds. Where handholds are used, their spacing shall correspond to the step spacing.

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NOTE — Handrail extension may be an integral part of or separate from ladder.

Figure 2 — Handrails and handholds

Table 2 — Dimensions of handrails and handholds

Dimensions in millimetres

Symbol	Description	Dimension		
		min.	max.	basic
A	Width (diameter or across flats)			
	Ladder, step or walkway	16 ¹⁾	38	25
	Stairway and ramp handrails	16	80	50
B	Length between bend radii for support legs of handholds	150	—	250
C	Hand clearance to mounting surface	75	—	75
D	Distance above standing surface	—	1 600	900
E	Vertical distance of handrail continuation above step, platform, stairway or ramp	850	960	900
F	Offset distance of handrail or handhold from edge of step	75	200	150
G	Width between parallel handrails			
	Ladder	—	600 ²⁾	400 ³⁾
	Stairway and ramp	460	—	700
H	Distance above walkway, passageway, step or stairway step	850	1 400	900

1) 19 mm if orientation is vertical.
2) Up to 800 mm maximum when the handrails/handholds are an integral part of a door opening.
3) 600 mm if hip clearance is required.

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10 Platforms, passageways, walkways, guardrails and foot barriers

platform or walkway surface is > 3 m (and preferably if the vertical drop is > 2 m).

10.1 Platforms, passageways, walkways, guardrails and foot barriers shall conform with dimensions specified in figure 3 and table 3.

10.2 A rail shall be placed mid-way between the top rail of a guardrail and the walkway or platform.

10.3 Platforms and walkways shall be provided with handholds, handrails or guardrails. Guardrails shall be provided if the vertical drop from the open side of a

10.4 Walkways used only for access to maintenance and inspection platforms \leq 3 m above ground level may have a minimum width of 230 mm. Maintenance and inspection may be performed from the walkway if this can be readily performed while maintaining three-point support.

10.5 Where an opening has been provided in a guardrail, other than to provide access to a ladder or to steps, a device that meets the requirements specified in 5.3 shall be provided across the opening.

10.6 Wherever a foot could slip from a walkway or platform, a foot barrier shall be provided.