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Earth-moving machinery — Access systems

Engins de terrassement — Moyens d'accès

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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 approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 2867 was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*.

This fourth edition cancels and replaces the third edition (ISO 2867 : 1980), of which it constitutes a technical revision.

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Earth-moving machinery — Access systems

1 Scope

This International Standard specifies the 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.

2 Normative references

The following standards contains 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 2860 : 1983, *Earth-moving machinery — Minimum access dimensions*.

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

3.1.1 primary access : Access route normally used on the machine, for ingress into and egress from operating, inspection or maintenance areas, to and from the ground.

3.1.2 alternative access : Access route for use during emergency situations or when the primary access system is not usable.

3.2 Enclosure opening

3.2.1 primary opening : Opening in an enclosure normally used for access.

3.2.2 alternative opening : Opening in an enclosure for use during emergencies when the primary opening is not usable.

3.2.3 service opening : Opening in an enclosure for use during inspection, service or maintenance.

3.3 Stairway, ladder, step

3.3.1 stairway : Access system where the inclined angle from the horizontal is greater than 20° but not more than 50°, consisting of four or more steps.

3.3.2 ladder : Access system where the inclined angle from the horizontal is greater than 50° but not more than 90°, consisting of a series of steps or rungs that accommodate one or both feet.

3.3.3 step : Device for foot placement on a ladder or stairway, or as individual placements.

3.3.3.1 rung : Device for foot placement to be used only on ladders.

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

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

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

3.4 Walkway, platform, ramp

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

3.4.1.1 boom walkway : Inclined walkway used mainly on long booms for inclined angles of up to 40° to the horizontal.

3.4.2 platform : Part of the access system from which machine operation, servicing, inspection or maintenance is performed.

3.4.3 ramp : Part of an access system that contains an inclined plane of 20° or less from the horizontal without steps; it may have cleats or other surface treatment for the purpose of traction.

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

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

3.5 Guardrail, handrail, handhold

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

3.5.2 handrail, handhold : Devices that may be grasped by the hand for body support.

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

3.5.2.2 handhold : Device for single hand placement.

3.6 slip-resistant surface : Aspects of the access system surface that improve the traction obtained by the foot.

4 Access systems — Performance criteria

4.1 A surface of an access system on which personnel may stand shall withstand without visible permanent deformation

- a force of 2 000 N applied through a 125 mm diameter disc at any location on the surface; and
- a uniformly distributed force of 4 500 N per square metre.

These forces shall be applied consecutively, but not at the same time.

4.2 Openings in the walkway and platform grating or open-type flooring shall not permit the passage of a 40 mm or larger diameter spherical object. If the floor surface is above a surface where personnel will be walking, standing or working, the opening shall not permit the passage of a 20 mm or larger diameter spherical object.

4.3 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 more than 80 mm from their normal undeflected position with the test load applied.

4.4 All surfaces of the access system (including any machine or equipment structural component used as part of an access system) shall have a slip-resistant surface.

5 Access systems — General criteria

5.1 An alternative access system shall be provided if the operator's platform is 3 m or higher from ground level.

5.2 The possibility of a user being inadvertently restrained by devices such as protrusions, controls, steps or handles catching or holding body appendages or user's wearing apparel shall be minimized.

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

5.4 Hand grasp surfaces shall be free of roughness, such as sharp corners or protrusions.

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

5.6 Access systems shall accommodate dimensionally a 5th percentile female through a 95th percentile male as defined in ISO 3411.

5.7 Correct use shall be self-evident without special training.

5.8 Proper placement of components shall permit and encourage a person to use two hands and one foot or two feet and one hand simultaneously while ascending or descending the access system, when more than 1 m above the ground.

6 Access systems — Component criteria

6.1 Steps

6.1.1 Steps shall conform with the recommended dimensions in figure 1. It is preferred that all steps be wide enough to accommodate both feet.

6.1.2 Where lateral body movement is necessary from the top or bottom step of a ladder to the next stepping surface, the vertical distance from the step to that surface shall be no more than 300 mm.

6.1.3 The steps of ladders, boom walkways and individual placement steps shall be spaced such that twice the riser height plus the stride distance shall not exceed 800 mm, and preferably not exceed 600 mm; i.e. $2B + G < 800$ mm; $2B + G < 600$ mm preferably (see figure 1).

6.1.4 Steps shall be coordinated with properly positioned handrails or handholds to encourage the use of the proper foot on the step.

6.1.5 Wherever a foot may contact a moving part by protruding through the step, a shield shall be provided between the step and the moving part.

6.1.6 Step construction shall minimize the risk of the foot slipping laterally off the step.

6.1.7 The step tread surface shall not be intended to be used as a handhold.

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

6.1.9 Step construction shall provide natural foot placement while descending or the step shall be clearly visible while descending.

6.1.10 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 onto the outer edge of the leading edge of the first non-swinging step from the ground. The first step from the ground may be free swinging.

6.2 Ladders

6.2.1 Ladder steps shall meet the criteria specified in 6.1.

6.2.2 Ladders shall conform with the recommended dimensions in figure 1.

6.3 Stairways

6.3.1 Stairway steps shall meet the criteria specified in 6.1.

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

6.3.3 Stairways shall be provided with at least one handrail.

6.3.4 Guardrails shall be provided on the open side or sides of stairways if a vertical drop from the stairway exceeds 3 m.

6.3.5 Stairways shall conform with the recommended dimensions in figure 1.

6.4 Handrails and handholds

6.4.1 Handrails and handholds shall conform with the recommended dimensions in figure 2.

6.4.2 Handrails shall be appropriately spaced to provide continuous support to a moving person and be within convenient reach.

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

6.4.4 Handrails and successive handholds shall be placed parallel to the path of motion of the user. Handholds may be oriented vertically or horizontally but shall be consistent within a given system.

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

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

6.5 Platforms, walkways, guardrails and foot barriers

6.5.1 Platforms, walkways, guardrails and foot barriers shall conform with the recommended dimensions in figure 3. A rail shall be spaced mid-way between the top rail of a guardrail and the walkway or platform.

6.5.2 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 platform or walkway surface exceeds 3 m.

6.5.3 Walkways used only for access to service and inspection platforms not more than 3 m above ground level may have a minimum width of 230 mm. Service and inspection may be performed from the walkway if it can be readily performed while maintaining three-point support.

6.5.4 Where an opening has been provided in a guardrail, other than to provide access to a ladder or to steps, a chain or rope, that meets that requirement specified in 4.3, shall be provided across the opening.

6.5.5 A foot barrier shall be provided whenever a person's foot could slip from a walkway or platform into moving machinery or equipment that could create a hazard.

7 Enclosure openings

7.1 Enclosure openings shall conform with the requirements of ISO 2860 and the recommended dimensions in figure 4.

7.2 If a rectangular enclosure opening is not possible, the minimum opening may be reduced to the minimum dimensions indicated in figure 4. As an alternative, the 460 mm maximum dimension of the minimum opening may be increased to 770 mm in conjunction with an increase in the 250 mm dimension to 300 mm.

7.3 The primary opening shall be accessible directly from the access steps or from a platform or walkway.

7.4 The enclosure opening door shall not sweep the area where the person must stand to open or close the door.

7.5 An alternative opening that is different from the primary opening shall be provided in an enclosure.

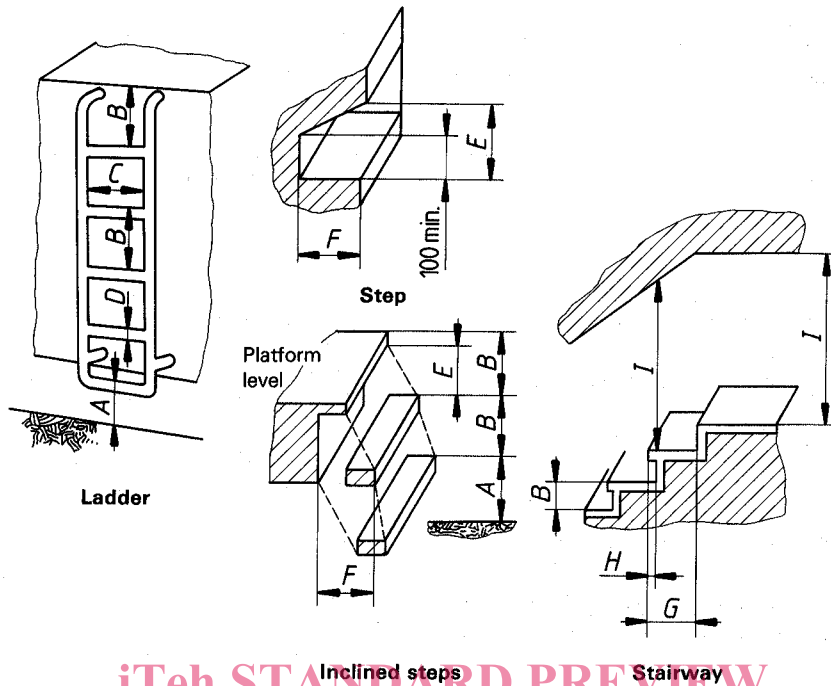
7.6 Force needed to open and close a hinged enclosure door or cover should not exceed 135 N.

7.7 An enclosure opening door that will be left open during machine operation shall be provided with a means to secure it in the open position.

7.8 Hinged egress doors shall normally open outward. Sliding doors shall be designed to open when moved in the direction opposite to the machine's primary direction of travel.

7.9 A minimum of 80 mm hand clearance shall be provided between the outer vertical edge of a hinged door and any fixed object other than its door frame.

Dimensions in millimetres



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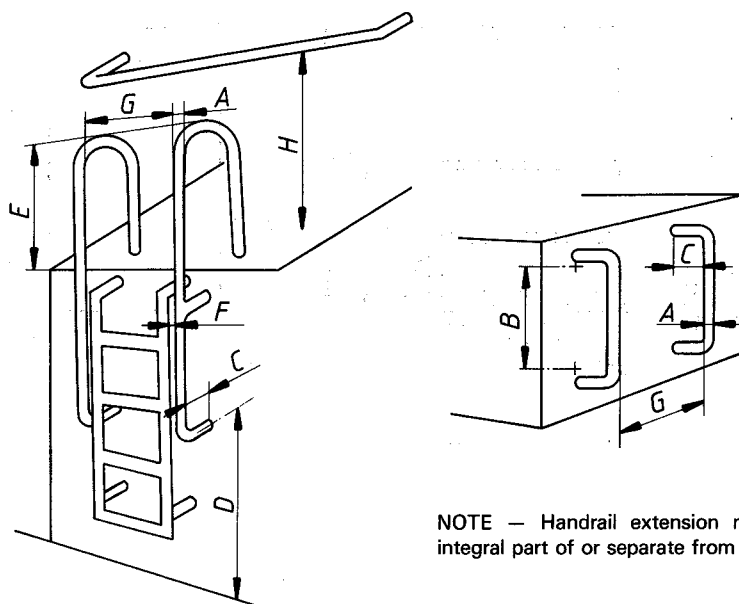
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Dimension code	Description	Dimension		
		min.	max.	preferred
A	Height of first step above ground or platform	—	700	400
B	Riser height : 1) steps or ladders 2) stairways	230 ¹⁾ —	400 250	300 180
C	Step width : 1) one foot 2) both feet	160 320	— —	200 400
D	Rung tread — diameter or width	19	—	60
E	Instep clearance	150	—	190
F	Toe clearance	150	—	200
G	Tread depth : 1) steps and ladders 2) stairways	130 240	— 400	200 300
H	Tread projection from riser	—	25	—
I	Head clearance above step leading to walkway	2 000	—	—

1) 150 from top step of ladder to platform.

Figure 1 — Steps, ladders and stairways

Dimensions in millimetres



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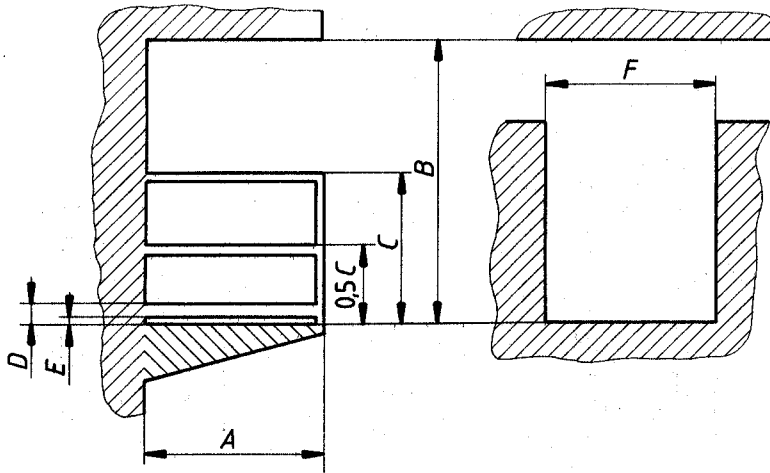
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Dimension code	Description	Dimension		
		min.	max.	preferred
A	Width — diameter or across flats : 1) ladder, step or walkway 2) stairway and ramp handrails	16 ¹⁾ 16	38 80	25 50
B	Length between bend radii for support legs of handholds	150	—	250
C	Hand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

1) 19 if vertical orientation.
2) 600 if hip clearance is required.

Figure 2 — Handrails and handholds

Dimensions in millimetres

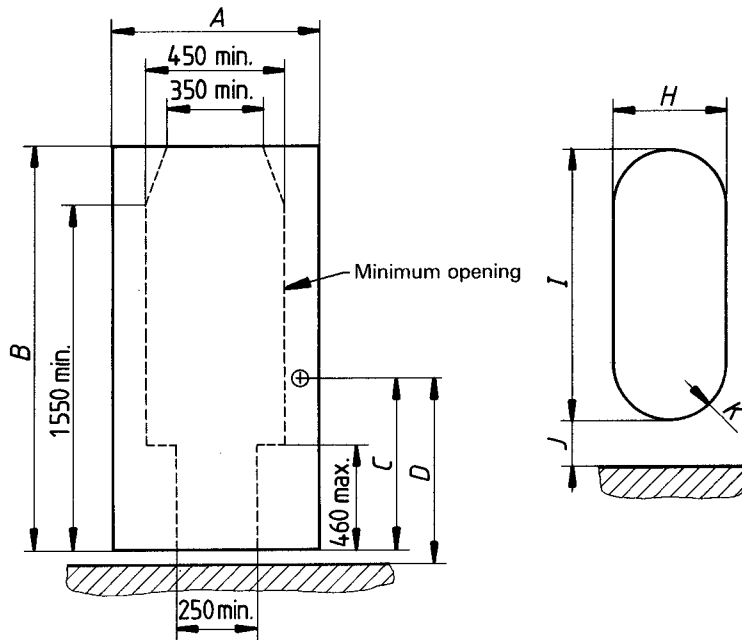


Dimension code	Description	Dimension		
		min.	max.	preferred
A	Width :			
	1) platform	300	—	600
	2) walkway	300	—	600
B	Head clearance :			
	1) standing	2 000	—	—
	2) kneeling ¹⁾	1 500	—	—
	3) crawling ¹⁾	1 000	—	—
C	Guardrail height	1 000	1 100	1 100
D	Foot barrier height	50	—	100
E	Foot barrier to floor clearance	0	10	—
F	Passageway ²⁾ :			
	1) forward-facing	550	—	650
	2) sideways	330	—	450
	3) passing others	900	—	1 300

1) For inspection and maintenance only.
2) Use preferred dimension as minimum for crawling.

Figure 3 — Platforms, walkways and guardrails.

Dimensions in millimetres



a) Primary opening b) Service openings
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NOTES

- 1 Shape changes of the minimum opening do not need to be symmetrical to each other.
- 2 Taper for head permitted on stand-up cabs only.

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Dimension code	Description	Dimension		
		min.	max.	preferred
	Primary opening			
A	Width	450	—	680
B	Height :			
	1) sit-down cab	1 300	—	—
	2) stand-up cab	1 800	—	—
C	Height of internal door handle from floor :			
	1) sit-down cab	500	850	—
	2) stand-up cab	800	1 000	—
D	Height of external door handle above standing surface	500	1 500 ¹⁾	900
	Alternative opening (preferred to be same size as primary opening)			
	round — diameter	650	—	—
	square	600 × 600	—	—
	rectangular	470 × 650	—	—
	Service openings			
H	Width	450	—	680
I	Height	760	—	1 100
J	Bottom edge to floor	—	500	250
K	Corner radius	—	0,5 H	150

1) 1 700 if from the ground.

Figure 4 — Enclosure openings