SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J185

REAF. MAY2003

Issued 1970-07
Reaffirmed 2003-05

Superseding J185 JUN1988

Access Systems for Off-Road Machines

***Foreword*—**This reaffirmed document has been changed only to reflect the new SAE Technical Standards Board Format. Scope is Section 1. Purpose is 1.1. References were added as Section 2.

ISO Equivalence—This SAE Recommended Practice conforms in all significant detail with ISO 2867-1980. This recommended practice provides more criteria than provided in ISO 2867-1980 primarily addressing the needs of larger machines. The ISO standard is in process of being revised which, if adopted, will make both documents technically equivalent.

1. Scope

1.1 Minimum criteria are provided for steps, stairways, ladders, walkways, platforms, handrails, handholds, guardrails, and entrance openings which permit ingress to and egress from operator, inspection, maintenance or service platforms on off-road work machines parked in accordance with the manufacturer's instructions.

1.2 This SAE Recommended Practice pertains to off-road self-propelled work machines used in construction, general purpose industrial, agricultural (agricultural tractors only), forestry and specialized mining machinery categories as defined in SAE J1116 JUN86. It also pertains to specialized off-road machines used in mining such as shovels, draglines, and drills not identified in SAE J1116 JUN86.

1.3 The minimum criteria established herein is based on one unladen person using the access system at any one time.

1.4 Purpose—This document establishes criteria for access systems primarily to aid in minimizing accidents and injury to personnel getting on, off, or moving about while servicing or preparing to operate off-road machines.

2. References

2.1 Applicable Publications——The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1116—Categories of Off-Road Self-Propelled Work Machines
SAE J/ISO 3411—Earth-moving machinery — Human physical dimensions of operators and minimum operator space envelope

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2.1.2 ANSI PUBLICATIONS—Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ANSI A10.4-1984
ANSI A10.4-1981

3. Definitions

3.1 Access System—System provided on a machine for ingress to and egress from an operator, inspection, maintenance or service platform from and to the ground.

3.1.1 PRIMARY ACCESS SYSTEM—Access system normally used.

3.1.2 ALTERNATE EGRESS SYSTEM—Egress system for use during anticipatable emergency situations when the primary access system is not usable.

3.2 Boom Walkway—An inclined walkway used mainly on long booms such as on draglines for inclined angles up to 50 degrees from the horizontal.

3.3 Controlled Descent Device—A device which can automatically lower a person without power at a fixed rate of speed as part of an alternate egress system.

3.4 Enclosure Opening—Opening in an enclosure for an access system.

3.4.1 PRIMARY OPENING—Opening normally used for access.

3.4.2 ALTERNATE OPENING—Opening for use during emergencies when the primary opening is not usable.

3.4.3 SERVICE OPENING—Opening for use during maintenance, service or inspection.

3.5 Foot Barrier—A device to prevent a person's foot from slipping off the edge of a platform or walkway.

3.6 Guardrail—A device around the open sides of walkways or platforms to protect a person from falling.

3.7 Handrail and Handhold—Devices that may be grasped by the hand for body support.

3.7.1 HANDRAIL—A device which permits hand movement to a different location without removing the hand from the device.

3.7.2 HANDHOLD—A device for single hand placement.

3.8 Ladder—An access system or part of an access system whose inclined angle from the horizontal is greater than 50 degrees but not more than 90 degrees consisting of a series of equally spaced steps that accommodate one or both feet.

3.8.1 VERTICAL LADDER—A ladder whose inclined angle from the horizontal is greater than 75 degrees.

3.8.2 INCLINED LADDER—A ladder whose inclined angle from the horizontal is greater than 50 degrees but not more than 75 degrees.

3.9 Ladder Fall Limiting Device—Any device which minimizes or limits the length of fall from a ladder system.

3.10 Operator's Platform—Area from which an operator controls the machine's travel and work functions.

3.11 Passageway—Walkway with confining barriers on both sides that extend more than 1200 mm vertically above the walking surface for erect walking or 300 mm for crawling.

3.12 Platform—A horizontal surface from which machine operation, servicing, inspection, or maintenance is performed.

3.13 Ramp—An inclined plane of 20 degrees or less from horizontal without steps but may have cleats or other surface treatments for the purpose of traction.

3.14 Rest Platform—Platform used in conjunction with a ladder system for person to rest while standing without requiring use of hands.

3.15 Riser Height—Height between two consecutive steps or rungs measured from the tread surface of one to tread surface of the next step or rung.

3.16 Rung—Device for foot placement that may be used only on vertical ladders.

3.17 Stairway—An access system or part of an access system whose inclined angle from the horizontal is greater than 20 degrees but not more than 50 degrees and consisting of four or more steps.

3.18 Step—Device for foot placement on a ladder, stairway, or as individual placements.

3.19 Stride Distance—Horizontal distance from the leading edge of one step to the leading edge of the next step.

3.20 Three Point Support—Features of an access system which permit 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.

3.21 Tread Depth—Distance from the leading edge to back of step.

3.22 Walkway—Part of an access system that permits walking or crawling between locations on a machine.

4. General Criteria

4.1 Access systems' walking and standing surfaces shall comply without visible permanent deformation from a force perpendicular to the surface with the following minimum criteria:

a. 4500 N uniformly distributed force per square meter of surface area or fraction thereof if less than 1 m^2.
b. 2000 N concentrated force applied at any location through a 125 mm diameter disc.

4.2 Openings in walkways and platform surfaces shall not permit the passage of a 40 mm or larger diameter spherical object through it. If the floor surface is above a surface where persons will be walking, standing, or working, the opening size shall not permit the passage of a 20 mm or larger diameter spherical object through it. Solid surfaces shall be used when necessary to prevent material from going through the surface 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 can be increased up to twice the above recommended values.

4.3 Handrails, handholds, and guardrails shall be capable of withstanding a minimum force of 1000 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 Machinery enclosure roofs, such as cab and canopy roofs, used only for inspection purposes may comply only with 4.1(b).

4.5 Access systems shall:

a. Minimize probability 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.
b. Minimize protrusions that could trip or increase severity of injury in case of a fall.
c. Provide smooth hand grasp surfaces.
d. Minimize probability of user contact with potential hazards such as extreme differentials in hot or cold, moving parts, electrical hazards, and sharp corners.
e. Accommodate dimensionally a 95th percentile male through a 5th percentile female as defined in SAE SAE J/ISO 3411.
f. Be obvious as to proper usage without special training.
g. Permit and, by proper placement of components, promote achievement of three point support while ascending or descending the access system when more than one meter above the ground.
h. Permit rescue if a person becomes incapacitated while using the access system.

4.6 An alternate egress system shall be provided if the operator's platform is 3 m or higher from ground level; preferably if 2 m or higher from the ground.

4.7 Step, walkway, and platform surfaces (including any machine or tool structural component used as part of an access system) as a minimum shall be slip resistant at the foot contact areas.

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 and in the stored position.

4.9 Machines with an access system entrance located so that a person approaching it cannot readily establish visual contact and acknowledgment with the machine's operator shall have instructions posted at the entrance to the access system describing the method to secure permission to board.

4.10 Alternate egress system entrance and travel route shall be clearly indicated if not obvious to the user.

5. Steps

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

5.2 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.

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

5.4 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.

5.5 Step design shall minimize foot slipping laterally off the step.

5.6 Step tread surface shall not be intended to be used as a handhold.

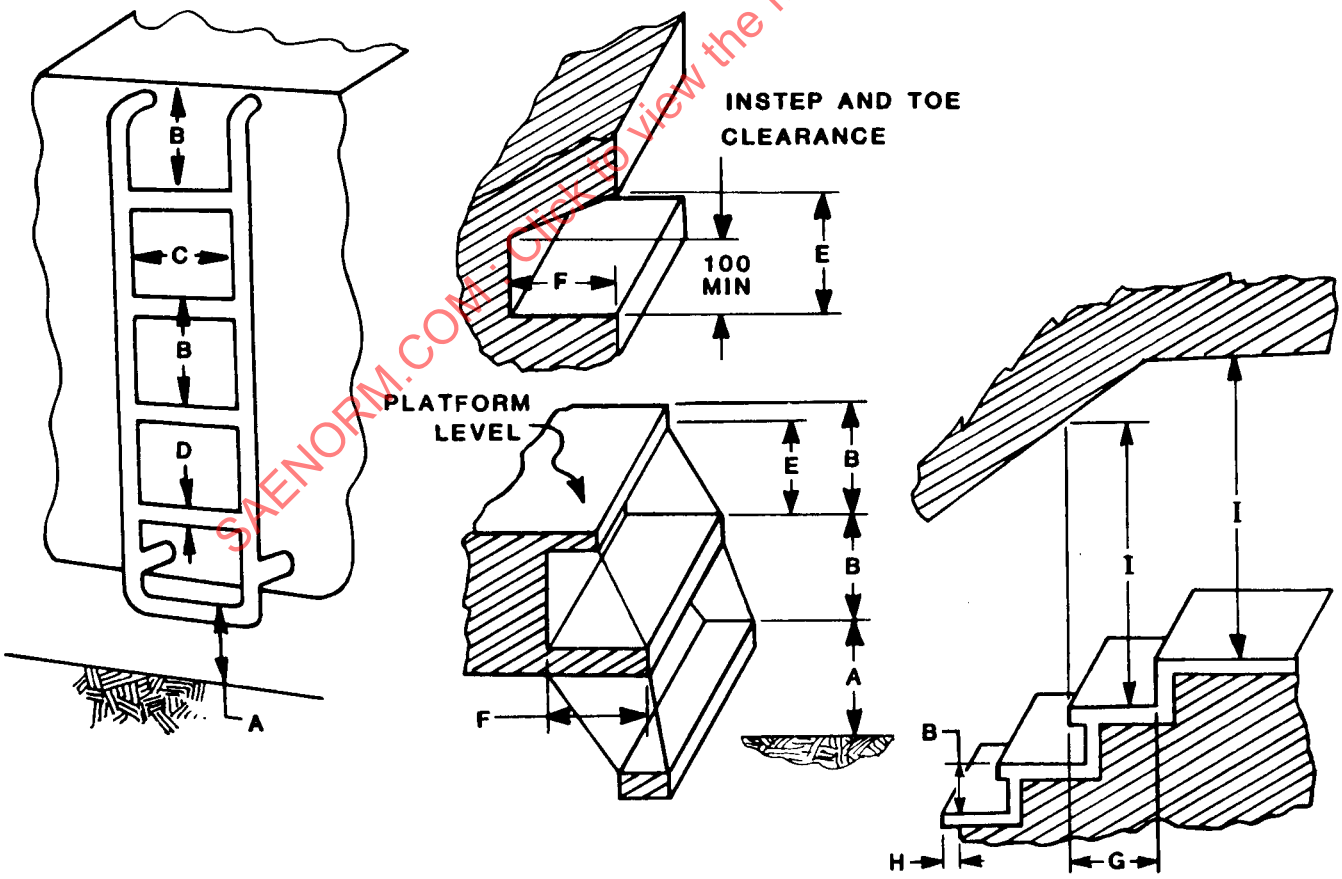
5.7 Step design shall minimize accumulation of debris and aid in the cleaning of mud and debris from the shoe sole.

5.8 Step design shall provide natural foot placement while descending or the step shall be clearly visible while descending.

TABLE 1—LADDER STEPS AND STAIRWAYS

Dimension	Minimum mm	Maximum mm	Preferred mm
A. Height of first step above ground or platform	—	700	400
B. Riser height - see 5.10 and 6.5			
(1) Steps or ladders	230[1]	400	300
(2) Stairways	—	250	180
C. Step width			
(1) One foot	160	—	200
(2) Both feet	320	—	400
D. Rung tread - dia. or width	19	—	60
E. Instep clearance	150	—	190
F. Toe clearance	150	—	200
G. Tread depth			
(1) Steps and ladders	130	—	200
(2) Stairways and boom walks	240	400	300
H. Tread projection from riser	—	25	—
I. Head clearance above step leading to walkway	2000	—	—

1. 150 mm from top step of ladder to platform.



5.9 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 1000 N is applied centered onto 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.

5.10 Step placement shall be such that two times the riser height plus the stride distance shall not exceed 800 mm; preferably not exceeding 600 mm.

6. Ladders

6.1 Ladder steps shall meet the criteria specified in Section 5.

6.2 Ladders which extend more than six meters vertically above ground level shall be equipped with a ladder fall limiting device. Such a device shall not require continual manipulation for the user to ascend or descend the ladder.

6.2.1 Passive ladder fall limiting devices are preferred.

6.2.2 Lower end of a ladder cage or other similar device, if used, shall be a minimum of 2.1 m and a maximum of 2.5 m above ground or platform level.

6.2.3 Ladder cage's internal surface on a vertical ladder shall not extend more than 760 mm from the steps nor shall its internal width be more than 760 mm.

6.2.4 Inclined ladder cage shall be sized as required to provide equivalent performance as required in 6.2.3 for vertical ladders.

6.3 A rest platform shall be provided for at least every 15 m of vertical climb; preferably at least every 10 m of vertical climb.

6.4 Winding or spiral ladders shall not exceed 3 m in vertical height without open-side guardrails; preferably not exceed 2 m in vertical height.

6.5 Inclined ladder steps or rungs shall be spaced such that two times the riser height plus the stride distance shall not exceed the values specified in Table 1.

7. Stairways

7.1 Stairway steps shall meet the criteria specified in Section 5.

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

7.3 Stairways shall be provided with at least one handrail.

7.4 Guardrails shall be provided on the open side or sides of stairways if a vertical drop from the stairway exceeds 3 m; preferably if the vertical drop exceeds 2 m.

8. Handrails and Handholds

8.1 Handrails and handholds shall conform with the recommended dimensions in Table 2.

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

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

8.4 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.

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

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

9. Platform, Passageways, Walkways, and Guardrails

9.1 Platforms, passageways, walkways, guardrails, and foot barriers shall conform with the recommended dimensions in Table 3. A rail shall be spaced midway between the top rail of a guardrail and the walkway or platform.

9.2 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's surface exceeds 3 m; preferably if the vertical drop exceeds 2 m.

9.3 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.

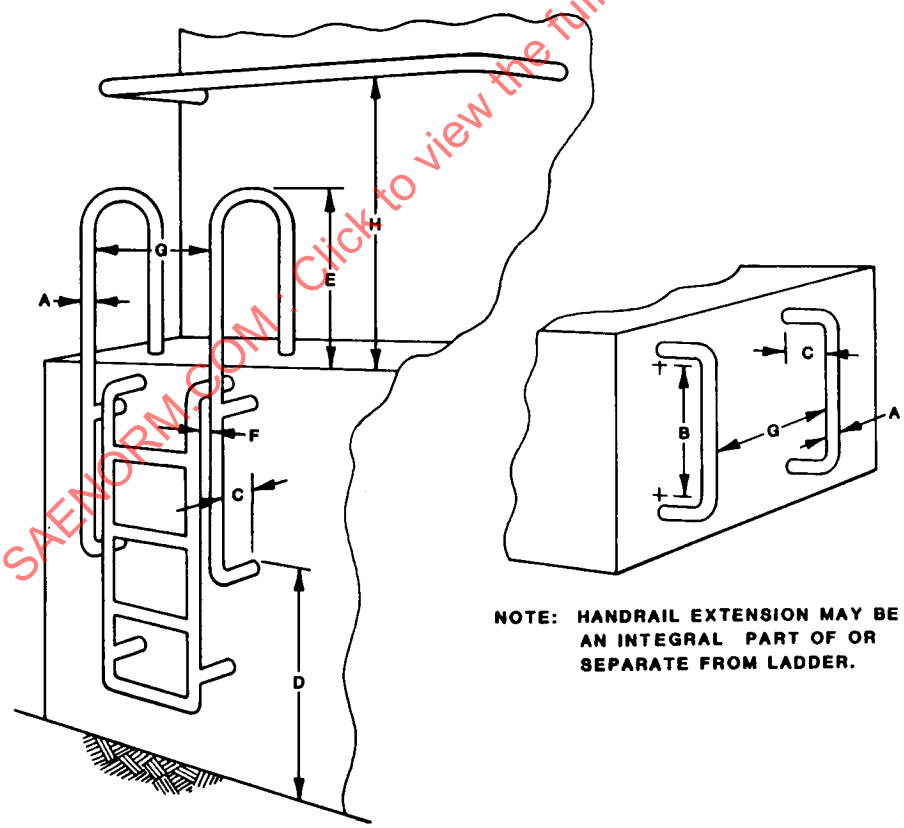
9.4 Where an opening has been provided in a guardrail, other than to provide access to a ladder or to steps, a device shall be provided across the opening that meets the requirements specified in 4.3.

9.5 A foot barrier shall be provided whenever a person's foot may slip from a walkway or platform into moving machinery or equipment that could create a hazard. The barrier also may be utilized to prevent material from sliding off the platform or walkway.

TABLE 2—HANDRAILS AND HANDHOLDS

Dimension	Minimum mm	Maximum mm	Preferred mm
A. Width - diameter or across flats			
(1) Ladder, step, walkway	16[1]	38	25
(2) 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	—	—
D. Distance above standing surface	900	1600	—
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	—	600	400[2]
(2) Stairway and ramp	460	—	—
H. Distance above walkway, passageway, step, or stairway step	850	1400	900

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

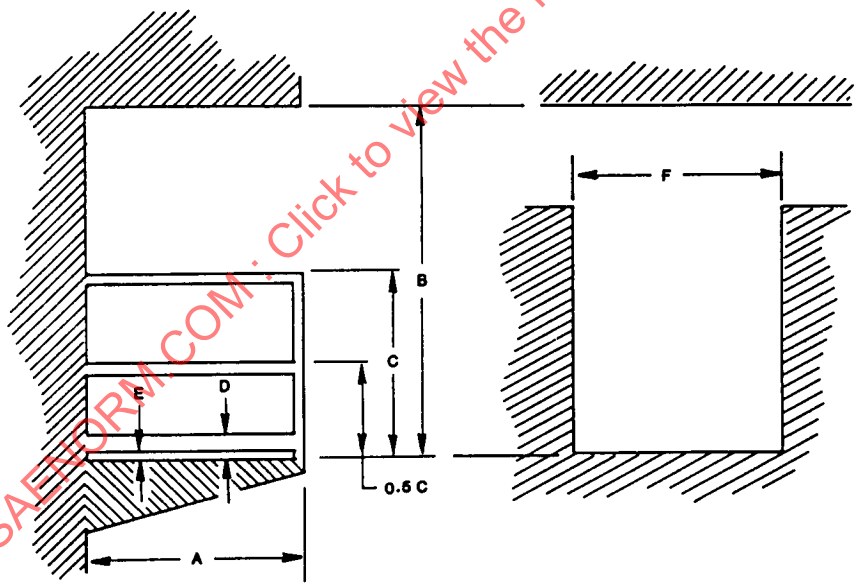


NOTE: HANDRAIL EXTENSION MAY BE AN INTEGRAL PART OF OR SEPARATE FROM LADDER.

TABLE 3—PLATFORMS, PASSAGEWAY, WALKWAYS AND GUARDRAILS

Dimension	Minimum mm	Maximum mm	Preferred mm
A. Width			
(1) Platform	300	—	600
(2) Walkway	300	—	600
B. Head Clearance			
(1) Standing	2000	—	—
(2) Kneeling[1]	1500	—	—
(3) Crawling[1]	1000	—	—
C. Guardrail height	1000	1100	1100
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	—	1300

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



10. Enclosure Openings

10.1 Enclosure openings shall conform with the recommended dimensions in Table 4.

10.2 If a rectangular enclosure opening is not possible, the minimum opening area may be reduced to the minimum dimensions indicated in Figure 4 in Table 4. As an alternate for the lower area, the minimum opening's height from the floor can be increased from 460 to 770 mm maximum in conjunction with an increase in the minimum width from 250 mm dimension to 300 mm.

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

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

10.5 An alternate opening shall be provided in an enclosure surface different from the surface of the primary opening.

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

10.7 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.

10.8 Hinged egress doors shall normally open outward. Sliding doors shall be designed to minimize door movements due to inertia force caused by machine operations.

10.9 A minimum of 80 mm hand clearance shall be provided:

a. between the outer vertical edge of a hinged door and any fixed object other than its door frame.
b. where required for hand clearance while opening or removing other types of enclosure opening doors or covers.

10.10 Removable enclosure opening covers held in place by gravity, such as manhole covers, shall be designed to prevent the possibility of falling through the opening.

10.11 A removable enclosure opening cover shall not exceed 40 Kg in weight if required to be lifted vertically up to 300 mm; with a weight decrease of at least 5 Kg for each additional 300 mm increment or fraction thereof in lift height.