INTERNATIONAL STANDARD

ISO 8082-2

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Self-propelled machinery for forestry — Laboratory tests and performance requirements for roll-over protective structures —

Part 2: Machines having a rotating platform with a cab and boom on the platform

Machines forestières automotrices — Essais de laboratoire et exigences de performance pour les structures de protection au retournement —

Partie 2: Machines ayant une tourelle d'orientation avec une cabine et une flèche sur la tourelle

Reference number
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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.

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 8082-2 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 15, *Machinery for forestry*.

ISO 8082 consists of the following parts, under the general title *Self-propelled machinery for forestry — Laboratory tests and performance requirements for roll-over protective structures*:

— *Part 1: General machines*

— *Part 2: Machines having a rotating platform with a cab and boom on the platform*

Introduction

Earth-moving excavators used in cross-over applications involving sites with trees, but excluding forestry applications, are covered by ISO 12117-2. Because of the similarity between excavators and forestry machines having a rotating platform with a cab, a fixed cab riser and a boom on a platform, this part of ISO 8082 specifies test methods and procedures similar to those of ISO 12117-2 and ISO 3471.

Self-propelled machinery for forestry — Laboratory tests and performance requirements for roll-over protective structures —

Part 2: Machines having a rotating platform with a cab and boom on the platform

1 Scope

This part of ISO 8082 establishes a consistent and reproducible means of evaluating the load-carrying characteristics of roll-over protective structures (ROPS) on self-propelled forestry machines under static loading, and gives performance requirements for a representative specimen under such loading. It is applicable to machines configured as forestry machines or defined as such in ISO 6814, having a rotating platform with a cab — with or without a fixed cab riser — and boom on the same or a separate platform, intended to be operated by an operator wearing a seat-belt.

It is not applicable to forestry machines with elevating cabs.[1)]

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.

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread*

ISO 898-2, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread*

ISO 3164, *Earth-moving machinery — Laboratory evaluations of protective structures — Specifications for deflection-limiting volume*

ISO 3411, *Earth-moving machinery — Physical dimensions of operators and minimum operator space envelope*

ISO 5353, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point*

ISO 6814, *Machinery for forestry — Mobile and self-propelled machinery — Terms, definitions and classification*

1) The roll-over behaviour of such machines needs more study.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
bedplate
substantially rigid part of the test fixtures to which the machine frame is attached for the purpose of the test

[ISO 12117-2]

3.2
boundary plane
BP
plane defined as the vertical projected planes of the back, side and knee area of the DLV

NOTE The boundary plane is used to determine the load application zone.

[ISO 12117-2]

3.3
deflection-limiting volume
DLV
orthogonal approximation of a large, seated, male operator as defined in ISO 3411 wearing normal clothing and a protective helmet

[ISO 8082-1]

3.4
deflection of ROPS
movement of the ROPS, mounting system and frame section as measured at the load application point, excluding the effect of any movement of the test fixture(s)

[ISO 12117-2]

3.5
elevating cab
additional means for raising and lowering the cab relative to the rotating platform

3.6
fixed cab riser
additional structure that changes the height position of the cab relative to the rotating platform and which is considered a ROPS structural member

3.7
lateral simulated ground plane
LSGP
for a machine coming to rest on its side, the plane 15° away from the DLV about the horizontal axis within the plane established in the vertical plane passing through the outermost point of the ROPS

See Figure 1.

NOTE 1 The LSGP is established on an unloaded ROPS and moves with the member to which the load is applied while maintaining its 15° angle with respect to the vertical.

NOTE 2 Adapted from ISO 8082-1:2009, definition 3.5.1.

3.8
locating axis
LA
horizontal axis for positioning the DLV with respect to the seat index point (SIP)

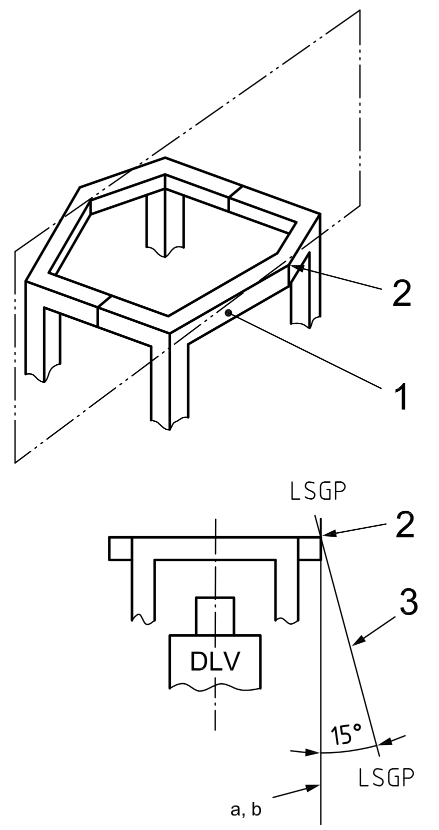
[ISO 3164]

3.9
load application point
LAP
point on the ROPS structure where the test load force (F) is applied

[ISO 12117-2]

3.10
load distribution device
LDD
device used to prevent localized penetration of the ROPS members at the load application point

[ISO 12117-2]



Key

1 upper ROPS member to which the lateral load is applied

2 outermost point from the end view of ROPS member (1)

3 lateral simulated ground plane (LSGP)

a vertical line passing through the point (2)

b vertical plane parallel to the machine longitudinal centreline through line a

Figure 1 — Determination of lateral simulated ground plane (LSGP)

3.11
machine mass
m
maximum mass declared by the manufacturer, including attachments in the operating condition and with tools, ROPS and all reservoirs filled, but excluding towed equipment (e.g. chippers, planters, discs) and any load that could be carried on the machine

[ISO 8082-1]

3.12
operator protective structure
OPS
system of structural members arranged in such a way as to minimize the possibility of operator injury from penetrating objects (such as whipping saplings, branches and broken winch lines)

[ISO 8082-1]

3.13
representative specimen
ROPS, mounting hardware and machine/rotating platform (complete or partial and including elements connecting the ROPS to the frame) used for test purposes that is within the range of material and manufacturing variances designated by the manufacturer's production specifications

NOTE 1 The intent is that all ROPS manufactured to these specifications are capable of meeting or exceeding the stated levels of performance.

NOTE 2 Adapted from ISO 12117-2:2008, definition 3.17.

3.14
roll-over protective structure
ROPS
system of structural members whose primary purpose is to reduce the possibility of a seat-belted operator being crushed should the machine roll-over

[ISO 8082-1]

NOTE These structural members include any sub-frame, bracket, mounting, socket, bolt, pin, suspension or flexible shock absorber used to secure the system to the machine rotating platform.

3.15
ROPS structural member
member designed to withstand applied force and/or absorb energy

NOTE 1 This may include components such as sub-frame, bracket, fixed cab riser, mounting, socket, bolt, pin, suspension or flexible shock absorber.

NOTE 2 Adapted from ISO 12117-2:2008, definition 3.20.

3.16
socket
S
test component that allows unrestricted point loading of the load distribution device (LDD)

[ISO 3471]

3.17
rotating platform
structural member(s) of the machine to which the ROPS is permanently attached during normal operation

NOTE For the purposes of this part of ISO 8082, all bolt-on and normally detachable components may be removed from the rotating platform. It is necessary only that this frame constitute a replication of the rotating platform as it attaches to the top of the rotating bearing.

3.18
vertical projection of DLV
cross-sectional area of the column formed by vertically projecting the outside corners of the deflection-limiting volume (DLV), excluding the foot section

NOTE Adapted from ISO 12117-2:2008, definition 3.25.

4 Symbols

U energy absorbed by the structure, related to the manufacturer's declared machine mass (m), expressed in joules (J)

F load force, expressed in newtons (N)

m machine mass, expressed in kilograms (kg)

L length of the ROPS, expressed in millimetres (mm):

- For ROPS with cantilevered load-carrying structural members, L is the longitudinal distance from the outer surface of the ROPS post(s) to the outer surface of the furthest cantilevered load-carrying members, if applicable, at the top of the ROPS. See Figures 2 and 7.
- For ROPS without cantilevered load-carrying structural members, L is the distance between the front and rear surface of the ROPS post. It is not necessary for the ROPS structural members to cover the complete vertical projection of the DLV.
- For multiple-post ROPS, L is the greatest longitudinal distance from the outer surface of the front to the outer surface of the rear posts. See Figure 2.
- For ROPS with curved structural members, L is defined by the intersection of plane A with the outer surface of the vertical member at Y. Plane A is the bisector of the angle formed by the intersection of planes B and C. B is the tangent line at the outer surface parallel to plane D. Plane D is the plane intersecting the intersections of the curved ROPS members with the adjacent members. Plane C is the projection of the top surface of the upper ROPS structural member. See Figure 3.

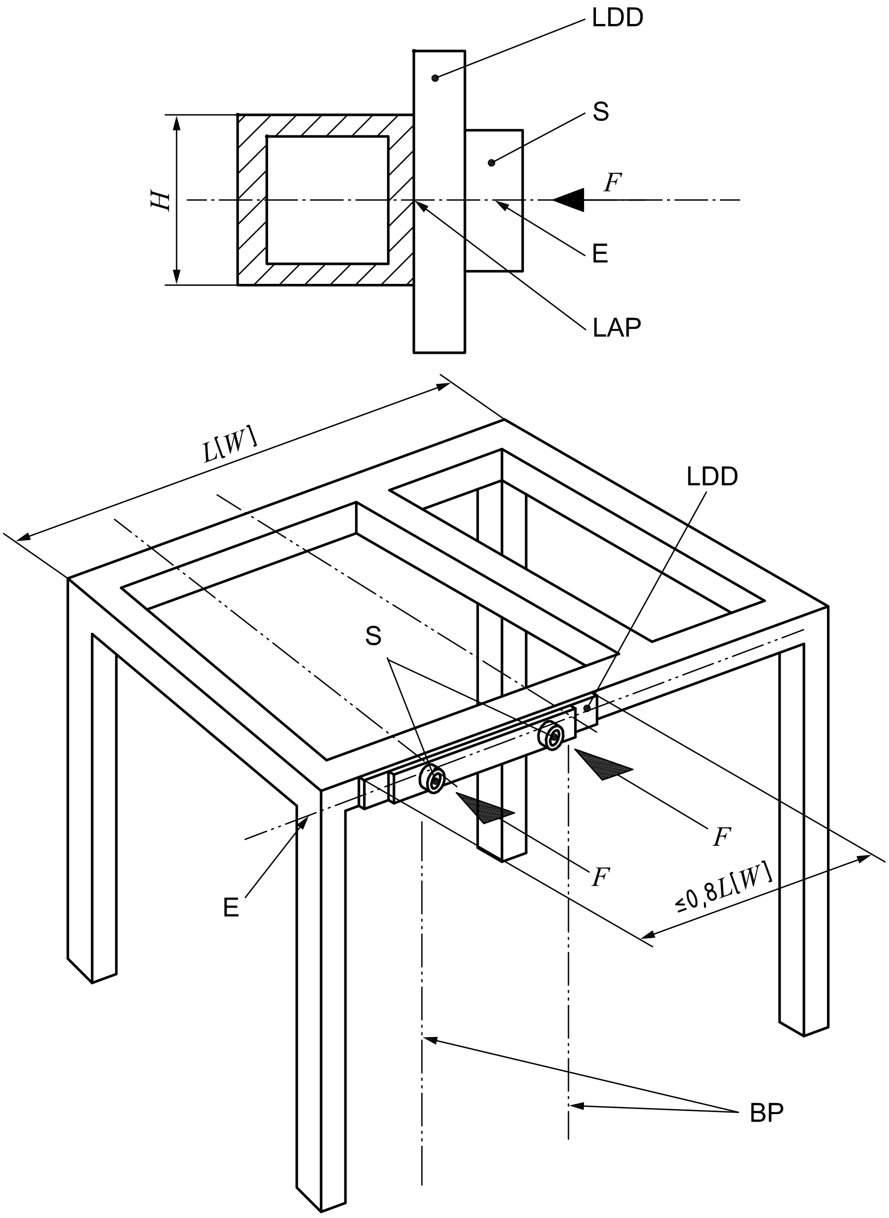
W width of ROPS, expressed in millimetres:

- For ROPS with cantilevered load-carrying structural members, W is that portion of the cantilevered load-carrying members that covers at least the vertical projection of the width of the DLV, as measured at the top of the ROPS from the outside faces of the cantilevered load-carrying members. See Figures 2 and 8.
- For all other ROPS, W is the greatest total width between the outside of the left and right ROPS posts, as measured at the top of the ROPS from the outside faces of the load-carrying members. See Figure 2.
- For ROPS with curved structural members, W is defined by the intersection of plane A with the outer surface of the vertical member at Y. Plane A is the bisector of the angle formed by the intersection of planes B and C. B is the tangent line at the outer surface parallel to plane D. Plane D is the plane intersecting the intersections of the curved ROPS members with the adjacent members. Plane C is the projection of the top surface of the upper ROPS structural member. See Figure 3.

Δ deflection of the ROPS, expressed in millimetres

H height of the load application zone, expressed in millimetres:

- For a straight member, *H* is the distance from the top to the bottom of the ROPS structural member, as shown in Figure 2.
- For a curved member, *H* is the vertical distance from the top of the member to the vertical plane at the end of *L* where it intersects the inner surface of the curved member at Y, as shown in Figure 3 a).
- For a ROPS configuration consisting of separate upper structural members as shown in Figure 4, each structure shall fulfil the material requirements of Clause 7. Height *H* may include both upper structural members, by spanning both with an LDD and with the LAP applied halfway between the outer extremes of the upper structural members.



Key

BP boundary planes of DLV

E vertical midpoint of upper ROPS structural member

F load force

LAP load application point

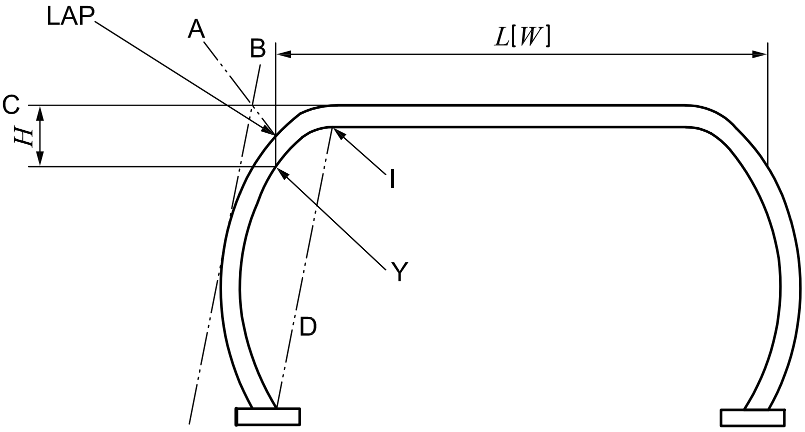
LDD load distribution device

S socket

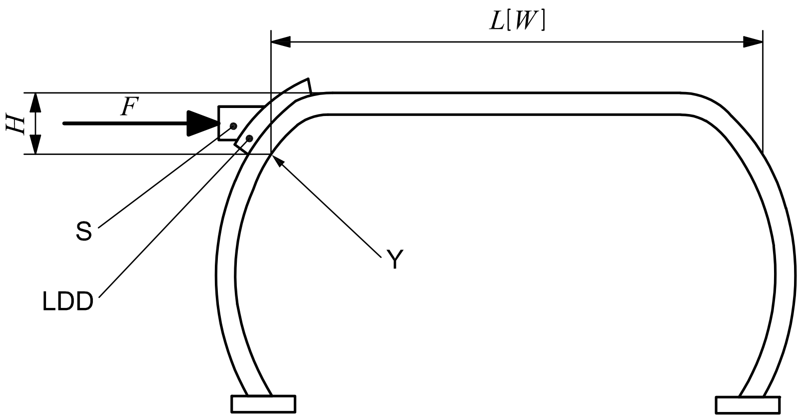
L [*W*] length or width of ROPS

NOTE Two sockets are shown in this example to illustrate that more than one socket may be used simultaneously to apply the required force.

Figure 2 — Four-post ROPS lateral load application point



a) Example of curved structural member (curved post) showing *L* or *W* and *H* dimensioning



b) Example of curved structural member (curved post) showing load application

Key

A angle bisector of two tangent lines (B and C)

B tangent line parallel to D on outer surface of curved ROPS structural member

C projection of top surface of upper ROPS structural member

D straight line intersecting ends of curved ROPS structural member with mating members

F load force

I intersection of curved surface with flat surface

H height of load application zone

LDD load distribution device

L [*W*] length [width] on ROPS for LAP determination

S socket

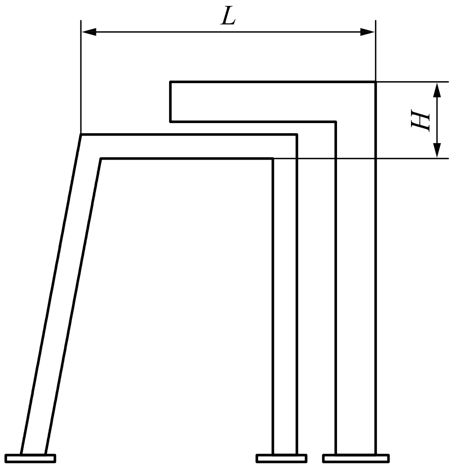
LAP load application point

Y intersection of a vertical line from LAP to inner surface of vertical member

NOTE 1 The angle between A and B is equal to the angle between B and C.

NOTE 2 Typical, but not required, layout.

Figure 3 — Examples of curved structural member



Key

H full height of uppermost ROPS structural member(s) referenced to determine height of LDD

L length of ROPS for LAP determination

Figure 4 — Height of load application zone of ROPS with separate upper structural members

5 Test method and facilities

CAUTION — Some of the tests specified in this International Standard involve the use of processes which could lead to a hazardous situation.

5.1 General

The test requirements are force resistance in the lateral and vertical directions, as well as energy absorption in the lateral and then longitudinal directions. There are limitations on deflections under lateral, longitudinal and vertical loading. The force and energy resistance plus the limitations on deflection are intended to ensure that the ROPS will not compromise the DLV as defined in ISO 3164 as a result of impacts during a roll-over.

5.2 Instrumentation

The test apparatus shall be equipped with instruments for measuring the force applied to the protective structure and the deflection (deformation) of the structure. The instrument accuracy shall be in accordance with Table 1.

Table 1 — Instrument accuracy requirements

Measurement	Accuracy[a]
Deflection of ROPS	±5 % of maximum deflection measured
Force applied to ROPS	±5 % of maximum force measured

[a] The percentages are nominal ratings of the accuracy of the instrumentation and shall not be taken to indicate that a compensating overtest is required.

5.3 Test facilities

Facilities shall be provided for securing the representative specimen to a bedplate and for applying the required lateral, longitudinal and vertical loads, as specified by the formulae given in Table 3.

5.4 ROPS/rotating platform assembly and attachment to bedplate

5.4.1 The ROPS shall be attached to the machine/rotating platform or body as it would be on an operating machine. A complete machine or rotating platform is not required for the evaluation. Nevertheless, the machine/rotating platform or body and mounted ROPS test specimen shall represent the structural configuration of an operating installation. In cases of multiple rotating structural elements, the lowest rotating means shall be included in the test. All normally detachable windows, panels, doors and other non-structural elements shall be removed so that they neither contribute to, nor detract from, the structural evaluation.

The ROPS/rotating platform assembly shall be secured to the bedplate so that the members connecting the assembly and bedplate experience minimal deflection during testing.

Non-ROPS elements (polycarbonate windows, OPS, etc.) with structural attributes that contribute to the performance of the ROPS structure may be included.

5.4.2 The assembly shall be secured or modified, or both, so that any machine element that might be considered as suspension (rubber, gas, gas-oil or mechanical spring) shall be effectively eliminated as an energy absorber. The ROPS structural members may, however, include suspension or flexible shock absorbers, which shall not be altered.

5.4.3 During lateral loading, the representative specimen shall not receive any support from the bedplate, other than that due to the initial attachment.

5.4.4 The test shall be conducted with any machine/ground suspension elements blocked externally so that they do not contribute to the load-deflection behaviour of the test specimen. Elements used to attach the ROPS to the machine/rotating platform acting as a load path shall be in place and considered part of the ROPS structural member.

5.4.5 If equipped with a cab tilt feature, for load testing the cab shall be positioned in the normal operating position for forestry operations. If the tilt mechanism is designed to transfer, it shall be considered part of the representative specimen. Tilt mechanisms used to connect the ROPS to the structure during normal working operation shall be considered part of the representative specimen. Tilt mechanisms used for service access or transport and which are fixed into position during working operation do not require their rotating mechanism to be included as part of the representative specimen.

6 Test loading procedure

6.1 General

6.1.1 The test loading sequence shall be

a) lateral load energy and force,

b) vertical load force, and

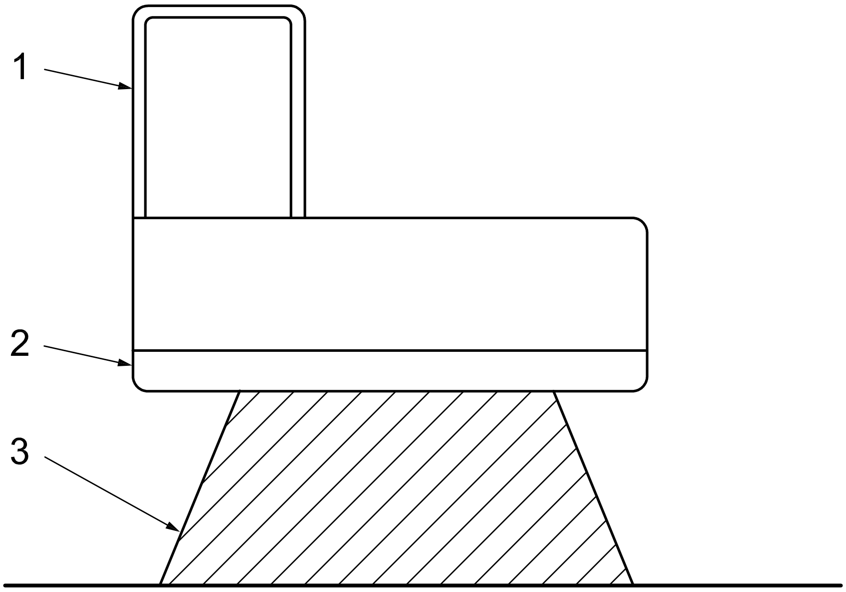
c) longitudinal load energy.

6.1.2 All tests prescribed in Table 3 shall be conducted on the same representative specimen. If the load must be stopped and re-applied for any reason, then only the additional energy summed after reaching the maximum deflection of the first loading shall be added to the sum.

6.1.3 The DLV and its location shall be in accordance with ISO 3164. The DLV shall be fixed firmly to the same part of the machine to which the operator's seat is normally secured, and shall remain there during the entire formal test period. For machines with a reversible operator's position, the DLV is considered to be the combined clearance zones for the two positions.

6.1.4 All LAPs shall be identified and marked on the structure before any loading is applied. No repair or straightening of any ROPS/machine member shall be carried out during or between loading phases. An LDD may be used to prevent localized penetration. The LDD shall not impede rotation of the ROPS.

NOTE The figures referenced in the following subclauses are illustrative and it is not intended that they restrict the design of loading devices.



Key

1 ROPS

2 rotating platform

3 bedplate

Figure 5 — Anchorage of rotating platform

6.1.5 For ROPS having more than two posts, the LDD shall not distribute the load over a distance greater than 80 % of the length, L. Figure 3 provide guidance on L for curved surfaces.

6.1.6 The height of the LDD shall be as determined from Figures 2, 3 and 4 for the upper ROPS structural member(s). The LDD may be formed so that it comes into contact with the contour of the load application section(s) of the ROPS.

6.1.7 For all one- or two-post ROPS, the initial loading shall be dictated by the length, L, and the vertical projections of the front and rear boundary planes of the DLV. The LAP shall not be within $L/3$ of the ROPS structure. Should the $L/3$ point be between the vertical projection of the DLV and the ROPS structure, the LAP shall be moved away from the structure until it enters the vertical projection of the DLV (see Figure 2).

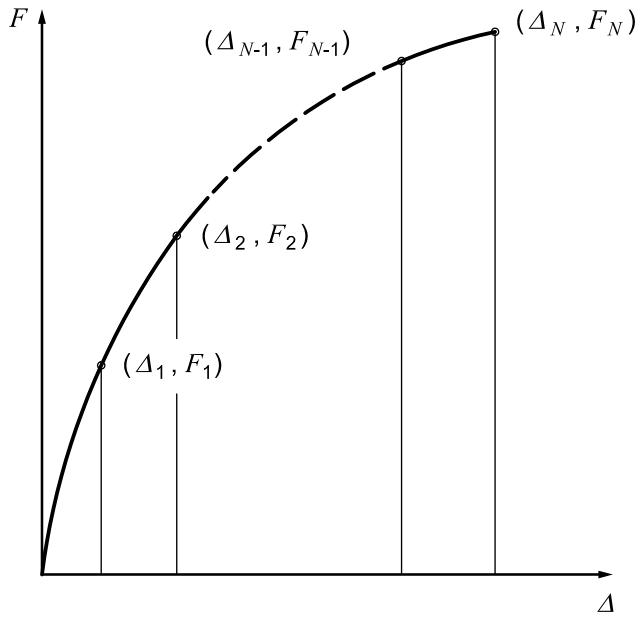
6.1.8 For ROPS with more than two posts, the LAP shall be located between vertical projections of the front and rear boundary planes of the DLV. See Figure 2.

6.1.9 If the operator's seat is off the machine's or rotating platform's longitudinal centreline, the loading shall be against the outermost side nearest the seat. If mounting of the ROPS is such that different force-deflection relations are obtained from loading from left or right, the side loaded shall be that which will place the most severe requirements on the representative specimen.

6.1.10 For on-centreline seats, if mounting of the ROPS is such that different force-deflection relations are obtained from loading from left or right, the side loaded shall be that which will place the most severe requirements on the ROPS/machine assembly.

6.1.11 The initial direction of the loading shall be horizontal and perpendicular to a vertical plane through the machine's or rotating platform's longitudinal centreline. As loading continues, ROPS/machine/rotating platform deformations may cause the direction of loading to change; this is permissible.

6.1.12 The rate of application of deflection (load) shall be such that the loading may be considered static, i.e. a speed of <5 mm/s. At deflection increments of no greater than 15 mm at the point of application of the resultant load, the force and deflection shall be recorded and plotted. The loading shall be continued until the ROPS has achieved both the force and energy requirements. The area under the resulting force-deflection curve equals the energy. See Figure 6. The deflection or deflections used in calculating the energy shall be that of the ROPS along the line(s) of action of the force(s). Any deflection of members used to support the LAP(s) shall not be included in the deflection measurements used for the calculation of energy.



Key

F force

Δ deflection

U energy: $U = \frac{\Delta_1 F_1}{2} + (\Delta_2 - \Delta_1)\frac{F_1 + F_2}{2} + \ldots + (\Delta_N - \Delta_{N-1})\frac{F_{N-1} + F_N}{2}$

Figure 6 — Force-deflection curve for lateral loading

6.2 Lateral loading

6.2.1 The lateral load shall be applied to the upper ROPS structural member(s) to determine the force-deflection characteristics.

6.2.2 If the ROPS is off the machine/rotating platform's longitudinal centreline, the lateral load shall be against the outermost side which is the furthest in distance from the equipment and attachment of the machine/rotating platform. If this requirement is in conflict with those of 6.1.9, then the most severe requirements shall be used to evaluate operator protection, i.e. it shall not compromise the DLV.

6.3 Vertical loading

6.3.1 After completion of lateral loading, a vertical load shall be applied to the top of the ROPS using a 250 mm wide beam.

6.3.2 For all ROPS, the centre of the vertical load shall be applied in the same vertical plane, perpendicular to the longitudinal centreline of the ROPS, (see 6.1.7 and 6.1.8), as for the lateral load, defined on the structure before deformation.

6.3.3 The load on the ROPS may be applied without limitation on the manner of distribution, provided it is applied symmetrically with the longitudinal centreline of the deformed ROPS structure. Figure 7 shows an example of the vertical load application.

6.3.4 The rate of deflection shall be such that the loading may be considered static (see 6.1.12). The loading shall be continued until the applicable force level specified in Table 3 has been reached. The structure shall support this load for a period of 5 min or until any deformation has ceased, whichever is the briefer.

Dimensions in millimetres

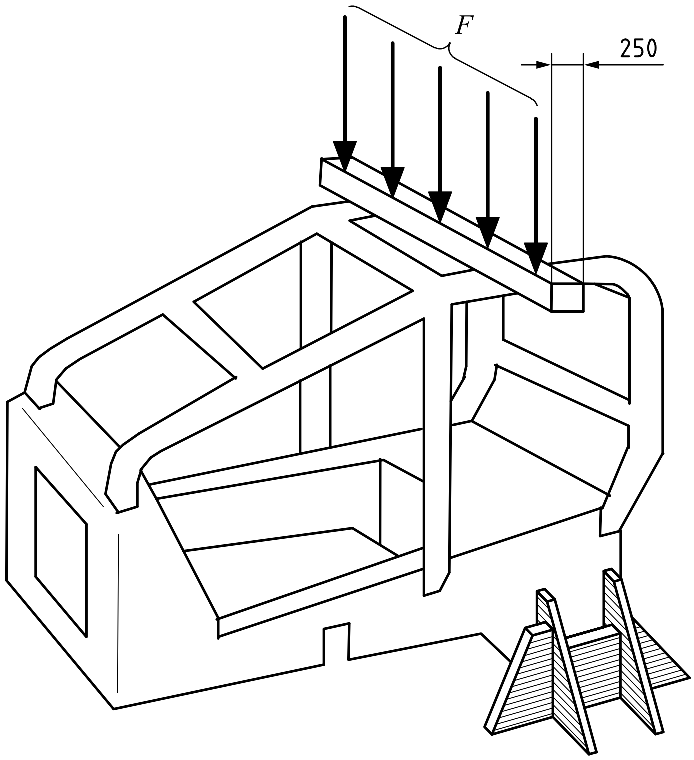


Figure 7 — Vertical loading

6.4 Longitudinal loading

6.4.1 After removal of the vertical loading, a longitudinal load shall be applied to the upper ROPS structural member along the longitudinal centreline of the ROPS. This longitudinal load shall be applied at the deformed location of the originally established point, since the lateral and vertical loading of the ROPS is likely to result in permanent deformation of the structure. The originally established point shall be determined by the location of the load distributor and socket prior to any test being performed on the structure.

6.4.2 The longitudinal load shall be applied at a location consistent with the lateral loading shown in Figure 2, established prior to the lateral loading. The LDD may span the width in cases where no rear (or front) cross-member exists. In all other cases, the LDD shall not distribute the load over a length greater than 80 % of the width, W, of the ROPS. See Figure 9. No ROPS, straight or curved, should have its strength affected by the load distributor.

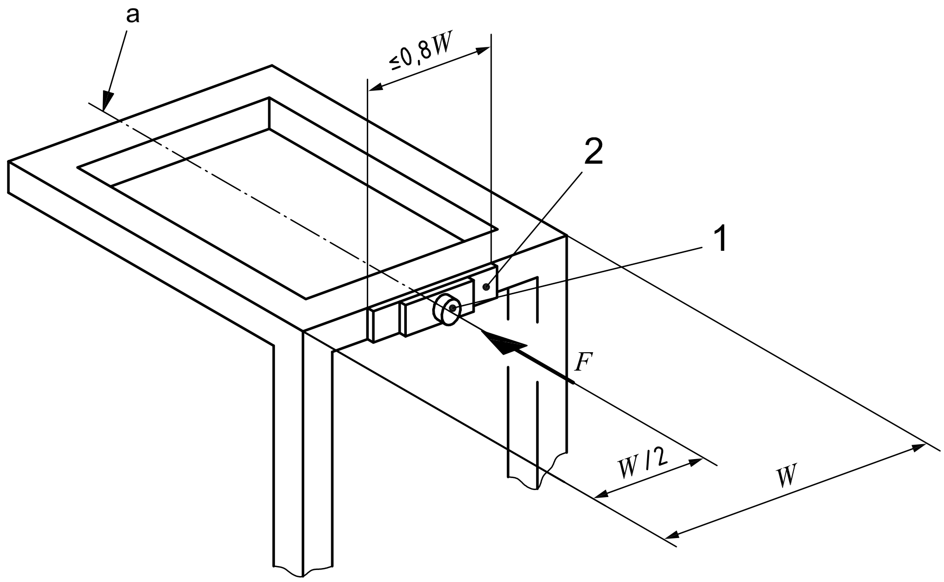
6.4.3 The direction of loading (fore or aft) shall be selected so as to place the most severe requirements on the representative specimen. The initial direction of loading shall be horizontal, parallel to the original longitudinal centreline of the machine. Additional factors to be considered when deciding in which direction to apply the longitudinal load are the following:

a) the location of the ROPS relative to the DLV and the effect that longitudinal deflection of the ROPS would have on providing crush protection for the operator;

b) the machine characteristics that can limit the direction of the longitudinal component of loading on the ROPS (e.g. other structural members of the machine that could resist longitudinal deflection of the ROPS);

c) experience which may indicate the possibility of longitudinal tipping or the tendency of a particular classification of machine to skew as it rotates about a longitudinal axis during an actual roll-over.

6.4.4 The rate of deflection shall be such that the loading may be considered static, see 6.1.12. This loading is to continue until the ROPS has achieved the longitudinal energy requirement.



Key

1 socket, load application point

2 load distribution device

W width of ROPS

a Parallel to the longitudinal centreline of the machine.

Figure 8 — Longitudinal load distribution device

7 Temperature and material requirements

7.1 In addition to the loading requirements, there are material and temperature requirements for ensuring that the ROPS will have resistance to brittle fracture. One of the following two alternative requirements shall be met in order to comply with the material and temperature requirements. The requirement may be met by applying the lateral, vertical and longitudinal loadings with the representative specimen at or below −18 °C. Alternatively, the requirement may be met by applying the loadings at higher temperatures if the representative specimen meets the mechanical requirements of 7.2 to 7.4, as applicable.

7.2 Bolts and nuts used to attach the ROPS to the machine/rotating platform and to connect structural parts of the ROPS shall be

— property class 8.8, 9.8 or 10.9 for bolts in accordance with ISO 898-1,

— property class 8, 9 or 10 for nuts in accordance with ISO 898-2.

NOTE 1 In those countries using the inch system, it is important that the bolts and nuts used be of an equivalent grade.

NOTE 2 Use of beyond 10.9 property class bolts or property class 10 nuts can require better quality control to avoid brittle and delayed failure.

7.3 Structural member specimens are to be "longitudinal" and taken from flat stock, tubular or structural sections before forming or welding for use in the ROPS. Specimens from tubular or structural sections shall be taken from the middle of the side of greatest dimension and shall not include welds (see ISO 148-1).

7.4 Thin steel shall be considered as having met the Charpy requirement given in Table 2 provided the steel meets the following specifications:

a) steel less than 2,5 mm in thickness having a maximum carbon content of 0,20 %;

b) fully killed fine-grained steel of 2,5 to 4,0 mm thickness having a maximum carbon content of 0,20 %.

Table 2 — Minimum Charpy V-notch impact strengths

Specimen size	**Energy**	
	− 30 °C	− 20 °C
mm	J	J[b]
10 × 10[a]	11	27,5
10 × 9	10	25
10 × 8	9,5	24
10 × 7,5[a]	9,5	24
10 × 7	9	22,5
10 × 6,7	8,5	21
10 × 6	8	20
10 × 5[a]	7,5	19
10 × 4	7	17,5
10 × 3,3	6	15
10 × 3	6	15
10 × 2,5[a]	5,5	14

[a] Indicates preferred size. Specimen size shall be no less than the largest preferred size that the material will permit.

[b] The energy requirement at the temperature of − 20 °C is 2,5 times the value specified for − 30 °C. Other factors affecting impact energy strength, i.e. direction of rolling, yield strength, grain orientation and welding shall be considered when selecting and using a steel.

8 Performance requirements

8.1 The specific lateral energy and force, vertical load force and longitudinal load energy requirements shall be achieved or exceeded in the testing of single representative specimens. The requirements for determining the performance to be achieved for machines with or without fixed cab risers are given in Table 3.

The force and energy requirements under lateral loading need not be attained simultaneously. One may be significantly exceeded before the other is attained. If the force is attained before the energy, the force may decrease, but shall again attain the required force level when the lateral energy requirement is achieved or exceeded.

Table 3 — Requirements for determining energy and force performance

Performance requirement	Energy/force
Lateral load energy, U_s (J)	13 000 $(m/10\ 000)^{1,25}$
Lateral load force, F_s (N)	50 000 $(m/10\ 000)^{1,2}$
Vertical load force, F_v (N)	19,61m
Longitudinal load energy, U_f (J)	4 300 $(m/10\ 000)^{1,25}$

8.2 The limitations on the deflections are absolute; no part of the ROPS shall enter the DLV's upper portion above the locating axis (LA) at any time during the lateral, vertical or longitudinal test of the representative specimen. The DLV inclination is allowed as described below for lateral and longitudinal loading.

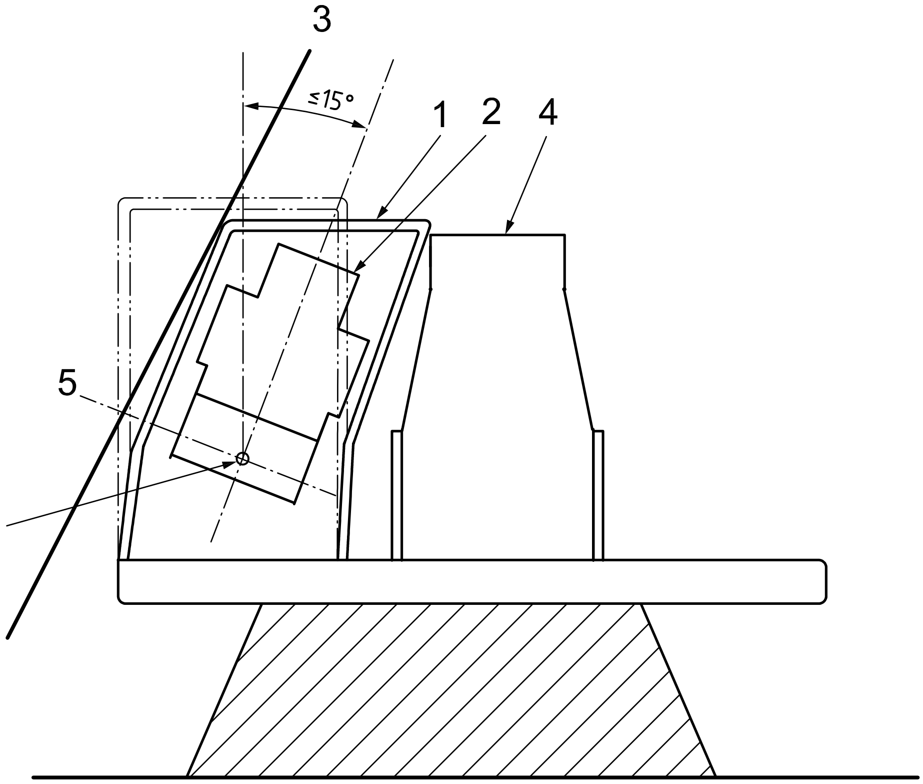
8.3 During lateral loading, it is permissible for the upper portion of the DLV to be rotated sideways up to 15° about the SIP (seat index point) as defined in ISO 5353. Sideways rotation of the DLV shall be limited to less than 15° if there is interference between the DLV and any machine component or control at a lesser angle. See Figure 9. Additional rotation of the DLV's upper portion due to deformation of the floor on which the DLV is mounted is allowed.

8.4 During vertical loading, no inclined or sideways rotation of the DLV is permitted. No part of the ROPS shall enter the DLV's upper portion above the LA at any time during the vertical test.

8.5 During longitudinal loading, it is permissible for the upper portion of the DLV to be inclined forward up to 15° about the SIP as defined in ISO 5353. Forward inclination of the DLV shall be limited to less than 15° if there is interference between the DLV and any machine component or control at a lesser angle. See Figure 10.

8.6 The ROPS shall not break away from the machine/rotating platform due to separation of the ROPS, its mounting system, or the machine/rotating platform. In the event of a partial separation, the ROPS shall demonstrate the capability of preventing total separation from the machine at the required force and energy levels of Table 3.

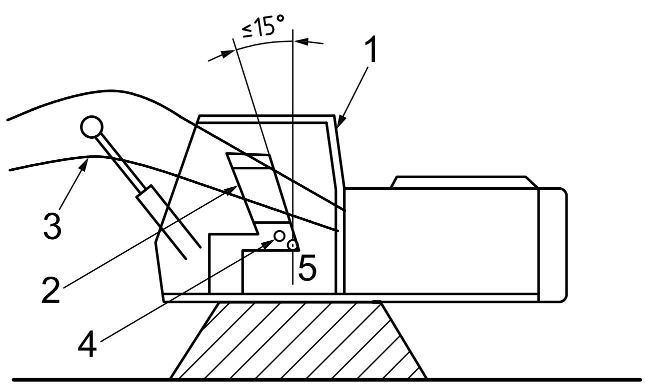
8.7 Machines with fixed cab risers that have a tilting feature, for example to lower overall machine transport height, shall be tested in the intended operating position for forestry operations.



Key

1 ROPS
2 DLV
3 LSGP
4 rigid structure
5 LA
6 SIP

Figure 9 — Inclination of upper portion of DLV under lateral loading



Key

1 ROPS
2 DLV
3 rigid structure
4 SIP
5 LA

Figure 10 — Forward inclination of DLV under rear longitudinal loading

9 Labelling of ROPS

9.1 General

ROPS meeting the requirements of this part of ISO 8082 shall be labelled in accordance with this clause.

9.2 Label specifications

The label shall be of a permanent type and shall be permanently attached to the ROPS structure. The label shall be located on the structure so that it can be easily read from the ground, the operator's seat or an access platform and be protected from weather defacing.

9.3 Label content

The label shall indicate the following:

a) the business name and address of the ROPS manufacturer and, where applicable, the ROPS manufacturer's authorized representative;

b) designation of the ROPS/type of machine for which the ROPS was intended;

c) mandatory marking as may be required for a specific regional requirement;

d) designation of series or type/model of machine for which the ROPS is intended;

e) serial number, if applicable;

f) machine mass, m, for which the ROPS structure meets all of the performance requirements of this part of ISO 8082;

g) International Standards for which the structure meets all of the performance requirements;

h) other such information as is deemed appropriate by the manufacturer (e.g. installation, repair or replacement information).

10 Reporting results

The results of the test shall be presented in a test report and shall include all applicable information specified in Annex A. The report's presentation and formatting may be different from that of Annex A.

Annex A
(normative)

Test report for ISO 8082-2

Machine identification

Type: ....

Manufacturer: ....

Model: ....

Serial number (if applicable): ....

Machine/rotating part number (if applicable): ....

Fixed riser height: .... mm

ROPS identification

Manufacturer (if different from machine manufacturer): ....

Type and model: ....

Serial number (if applicable): ....

ROPS part number (if applicable): ....

Manufacturer-supplied information

Maximum recommended mass of the ROPS' applicable members: .... kg

Location of DLV: ....

Criteria

Lateral load force: .... N

Lateral load energy: .... J

Vertical load force: .... N

Longitudinal load energy: .... J

Test results

The following force and energy levels were achieved or exceeded without penetration by the ROPS structural member into the upper portion of the DLV above the LA.

Lateral loading

Max. force attained after energy requirement achieved or exceeded: .... N

Absorbed energy attained: .... J

Vertical loading

Max. force attained: .... N

Longitudinal loading

Absorbed energy attained: .... J

Temperature and materials

Test performed with ROPS and machine members at (temperature): .... °C

The following is to be completed only if this temperature is above −18 °C.

The Charpy V-notch impact strength requirements for ROPS structural members were tested on a specimen of size ……… mm × ……… mm.

Absorbed energy: .... J

Nut property class: ....

Bolt property class: ....

Force-deflection curve for load testing

A force-deflection curve based on the actual test results shall be included in the test report. It is permissible for the manufacturer to treat this curve as proprietary information relative to disclosure.

Attestation

The minimum performance requirements of ISO 8082-2 were met in this test for a maximum machine mass of ……… kg.

....

....

....

Date of test: ....

Name and address of test facility: ....

....

Test engineer: ....

Identification or number of test report (if applicable): ....

Bibliography

[1] ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

[2] ISO 3471, *Earth-moving machinery — Roll-over protective structures — Laboratory tests and performance requirements*

[3] ISO 12117-2, *Earth-moving machinery — Laboratory tests and performance requirements for protective structures of excavators — Part 2: Roll-over protective structures (ROPS) for excavators of over 6 t*

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