

Earth-moving machinery — Roll-over protective structures — Laboratory tests and performance requirements —

The European Standard EN 13510:2000 has the status of a
British Standard

ICS 53.100

National foreword

This British Standard is the official English language version of EN 13510:2000. It supersedes BS 6912-14:1995 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee B/513, Construction machinery and plant, and site safety, to Subcommittee B/513/1, Earth-moving machinery (international), which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 27 and a back cover.

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English version

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Laboratory tests and performance requirements
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Engins de terrassement - Structures de protection au
retournement - Essais de laboratoire et critère de
performance (ISO 3471:1994, Amendement 1:1997 modifié
inclus)

Erdbaumaschinen - Überrollschutzaufbauten - Prüfungen
und Anforderungen (ISO 3471:1994, einschließlich
Änderung 1:1997 modifiziert)

This European Standard was approved by CEN on 12 November 1999.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

The text of the International Standard ISO 3471:1994 + Amendment 1:1997 from Technical Committee ISO/TC 127 "Earth-moving machinery" of the International Organization for Standardization (ISO) has been taken over with modifications as a European Standard by Technical Committee CEN/TC 151 "Construction equipment and building material machines - Safety", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2000, and conflicting national standards shall be withdrawn at the latest by July 2000.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

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

Endorsement notice

The text of the International Standard ISO 3471:1994 and Amendment 1:1997 has been approved by CEN as a European Standard with agreed common modifications as given below:

- scope is modified;
- normative references are updated;
- based on the revised scope the technical content of some clauses was modified;
- annex A is amended to include some further means of verification.

Introduction

A review of the initial work on the ROPS criteria indicated that the criteria were based on requirements for machines now identified as mid-range size machines. Over a period of 20 years, since the ROPS criteria were established, both smaller and larger machines have become common within the size range of earth-moving machines. Thus it was necessary to change the criteria for the lower and upper mass machines.

The criteria are a combination of linear, with respect to mass, and exponential, with respect to mass. For small machines, the exponential criterion has been changed to a linear function with respect to machine mass. For larger machines, the exponential criterion was excessive at very large machine masses, and thus was changed to become a linear function with respect to machine mass.

A second criterion of longitudinal force was added as a new generation of ROPS designers became active, some of the early expertise that was developed through the process of establishing the criteria being lost. Situations could arise where ROPS designs would meet the lateral and vertical loading requirements, but yet be considered to lack sufficient performance capability in the longitudinal load direction. For this reason this European Standard now incorporates a ROPS longitudinal force criterion. The longitudinal force criterion was established at 80 % of the lateral force requirement.

1 Scope

This European Standard establishes a consistent and reproducible means of evaluating the load-carrying characteristics of Roll-Over Protective Structures (ROPS) under static loading, and prescribes performance requirements for a representative specimen under such loading.

It applies to the following seated design operator-controlled machines as defined in ISO 6165:

- dozers (crawler and wheeled);
- graders;
- loaders (crawler and wheeled);
- earth- and landfill compactors;
- skid-steer loaders and backhoe loaders;
- tractor portion (prime mover) of scrapers and articulated steer dumpers;
- rollers;
- rigid frame dumpers.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 20898-1:1991	Mechanical properties of fasteners - Part 1: Bolts, screws and studs
EN 20898-2:1993	Mechanical properties of fasteners - Part 2: Nuts with specified proof load values - Coarse thread
ISO 148:1983	Steel - Charpy impact test (V-notch)
ISO 3164:1995	Earth-moving machinery - Laboratory evaluations of roll-over and falling-object protective structures - Specifications for deflection-limiting volume
ISO 6165:1997	Earth-moving machinery - Basic types - Vocabulary
ISO 9248:1992	Earth-moving machinery - Units for dimensions, performance and capacities, and their measurement accuracies

3 Definitions

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

3.1 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. Structural members include any subframe, bracket, mounting, socket, bolt, pin, suspension or flexible shock absorber used to secure the system to the machine frame, but exclude mounting provisions that are integral with the machine frame.

3.2 Machine frame: Main chassis or main load-bearing member(s) of the machine which extend(s) over a major portion of the machine and upon which the ROPS is directly mounted.

3.3 Rollbar ROPS: One- or two-post ROPS without FOPS or any cantilevered load-carrying structural members.

3.4 Bedplate: Substantially rigid part of the test fixtures to which the machine frame is attached for the purpose of the test.

3.5 Deflection-limiting volume (DLV): Orthogonal approximation of a large, seated, male operator wearing normal clothing and a hard hat. (See ISO 3164:1992, figure 1.)

3.6 Representative specimen: ROPS, mounting hardware and machine frame (complete or partial) for test purposes that is within the manufacturer's specifications.

3.7 Load distribution device: Device used to prevent localized penetration of the ROPS members at the load application point.

3.8 Load application point: Point on the ROPS structure where the test load is applied to the ROPS structure.

3.9 Deflection of ROPS: Movement of the ROPS structure caused by the application of the load and measured at the load application point.

3.10 Falling-object protective structure (FOPS): System of structural members arranged in such a way as to provide operators with reasonable protection from failing objects (for example, trees, rocks, small concrete blocks, tools).

3.11 Simulated ground plane (SGP): Flat surface on which a machine, after rolling over, is assumed to come to rest.

3.11.1 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 (see figure 4). This establishes the LSGP. The LSGP is established on an unloaded ROPS and moves with the member to which load is applied while maintaining its 15° angle with respect to the vertical.

3.11.2 Vertical simulated ground plane (VSGP): For a machine coming to rest in an upside-down position, the plane is defined by the top cross-member of the ROPS and that front (rear) part of the machine likely to come in contact with flat ground at the same time as the ROPS and capable of supporting the upside-down machine. The VSGP moves with the deformed ROPS (see figure 5).

NOTE: The VSGP applies only to rollbar ROPS.

4 Symbols

The following symbols and abbreviations are used in this European Standard.

4.1 *U*: Energy absorbed by the structure, related to the machine mass as specified in 4.3, expressed in joules.

4.2 *F*: Force, expressed in newtons.

4.3 *M*: Manufacturer's maximum recommended mass, expressed in kilograms.

4.3.1 The manufacturer's maximum recommended mass includes attachments in operating condition with all reservoirs full to capacity, tools and ROPS; it excludes towed equipment such as rollers and drawn scrapers.

4.3.2 For the tractor scraper and articulated steer dumper, it is the manufacturer's maximum recommended mass of the tractor portion (prime mover) only. In most cases it is the tractor portion, but it should be the ROPS-bearing member or ROPS-carrying part. Kingpins, hitches and articulated-steering components that attach to hitches or towed units are excluded from the mass of these machines.

4.3.3 For rigid frame dumpers, M excludes the mass of the dump body and the payload when the "ROPS only" criteria are selected. When the "body only" criteria are selected, M includes the mass of the dump body but excludes the mass of the payload.

4.3.4 For rollers, loosely contained ballast is also to be excluded from M . Soil, mud, rocks, branches, debris, etc. that commonly adhere to or lie on machines in use are not considered as part of the mass of any machine. Material dug, carried or handled in any manner is not considered part of the machine mass in determining test requirements.

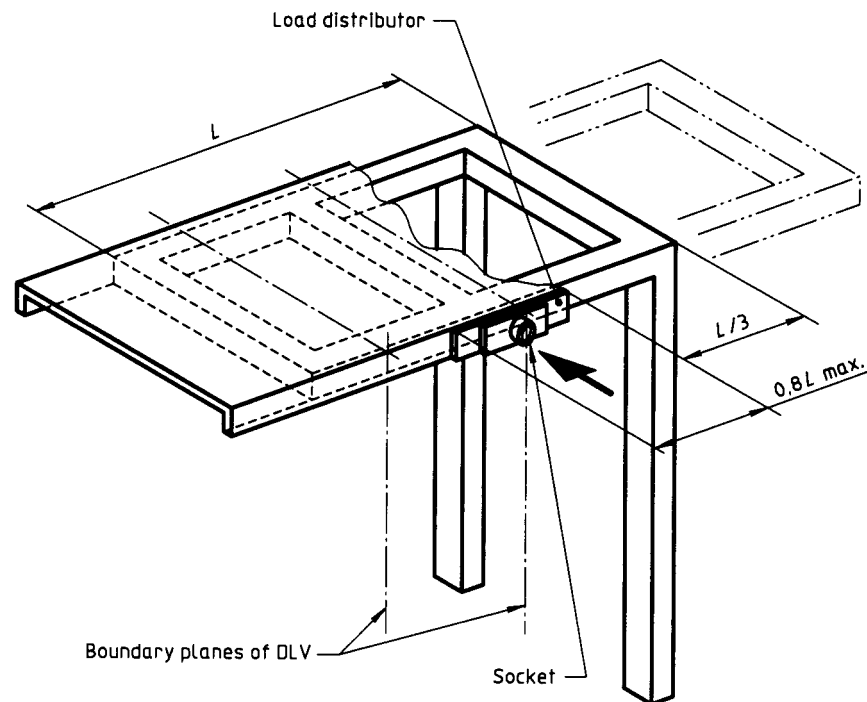
4.4 L : Length of the ROPS in millimetres as expressed below.

- a) For a one- or two-post ROPS with a FOPS and/or cantilevered load-carrying structural members, the length, L , is that portion of the cantilevered load-carrying members which covers at least the vertical projection of the length of the DLV of the operator. It is measured at the top of the ROPS, from the extreme face of the ROPS post(s) to the far end of the cantilevered load-carrying members (see figure 1).
- b) For all other ROPS, the length, L , is the greatest total longitudinal distance between the outsides of the front and rear posts (see figure 2).

4.5 W : Width of the ROPS in millimetres as expressed below.

- a) For a one- or two-post ROPS with a FOPS and/or cantilevered load-carrying structural members, the width, W , is that portion of the cantilevered load-carrying members which covers at least the vertical projection of the width of the DLV. It is measured at the top of the ROPS, from the extreme face of the ROPS structure left and right post to the far side of the cantilevered load-carrying members.
- b) For all other ROPS, the width, W , is the greatest total width between the outsides of the left and right ROPS posts (see figure 3).

4.6 Δ : Deflection of the ROPS, expressed in millimetres.



NOTE: Load distributor and socket are to prevent local penetration and to hold end of load-generating device.

Figure 1: Two-post ROPS with FOPS lateral load application point