

# SVENSK STANDARD

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### **Anläggningsmaskiner - ROPS-skydd (skyddshytter) – Provning och hållfasthets- och prestandakrav (ISO 3471:2008)**

### **Earth-moving machinery – Roll-over protective structures – Laboratory tests and performance requirements (ISO 3471:2008)**

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Denna standard ersätter SS-EN 13510, utgåva 1.

The European Standard EN ISO 3471:2008 has the status of a Swedish Standard. This document contains the official English version of EN ISO 3471:2008.

This standard supersedes the Swedish Standard SS-EN 13510, edition 1.

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN ISO 3471**

August 2008

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English Version

**Earth-moving machinery - Roll-over protective structures -  
Laboratory tests and performance requirements (ISO  
3471:2008)**

Engins de terrassement - Structures de protection au  
retournement - Essais de laboratoire et exigences de  
performance (ISO 3471:2008)

Erdbaumaschinen - Überrollschutzaufbauten -  
Laborprüfungen und Leistungsanforderungen (ISO  
3471:2008)

This European Standard was approved by CEN on 8 May 2008.

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## **Foreword**

This document (EN ISO 3471:2008) has been prepared by Technical Committee ISO/TC 127 "Earth-moving machinery" in collaboration with 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of an identical text or by endorsement, at the latest by February 2009, and conflicting national standards shall be withdrawn at the latest by February 2009.

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

For relationship with EC Directive(s), see informative Annexes ZA and ZB, which are integral parts of this document.

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### **Endorsement notice**

The text of ISO 3471:2008 has been approved by CEN as a EN ISO 3471:2008 without any modification.

## SS-EN ISO 3471:2008 (E)

### Introduction

A review of the initial work on the criteria for roll-over protective structures (ROPS) indicated that these criteria were based on requirements for machines now identified as mid-range size machines. Since the ROPS criteria were established, both smaller and larger machines have become common within the size range of earth-moving machines.

The criteria are a combination of linear 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.

The longitudinal force criteria were added as new data became available. Situations could arise where ROPS designs would meet the lateral and vertical loading requirements, but yet be considered as lacking sufficient performance capability in the longitudinal load direction. For this reason, this International Standard incorporates a ROPS longitudinal force criterion. The longitudinal force criterion has been established at 80 % of the lateral force requirement.

The evaluation procedure will not necessarily duplicate structural deformations due to a given actual roll. However, specific requirements are derived from investigations on ROPS that have performed the intended function in a variety of actual roll-overs, as well as analytical considerations based upon the compatibility of ROPS and the machine frame to which it is attached.



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

## 1 Scope

This International Standard specifies performance requirements for metallic roll-over protective structures (ROPS) for earth-moving machinery, as well as a consistent and reproducible means of evaluating the compliance with these requirements by laboratory testing using static loading on a representative specimen.

NOTE 1 The structure can also provide FOPS (falling-object protective structure) protection.

This International Standard is applicable to ROPS intended for the following mobile machines with seated operator as defined in ISO 6165 and with a mass greater than or equal to 700 kg:

- dozer;
- loader;
- backhoe loader;
- dumper;
- pipelayer;
- tractor section (prime mover) of a combination machine (e.g. tractor scraper, articulated frame dumper);
- grader;
- landfill compactor;
- roller;
- trencher.

This International Standard is not applicable to training seats or additional seats for operation of an attachment.

NOTE 2 It is expected that reasonable crush protection for a seat-belted operator will be provided under at least the conditions of an initial forward velocity of 0 km/h to 16 km/h on a hard clay surface of 30° maximum slope in the direction of roll, and 360° of roll about the longitudinal axis of the machine without loss of contact with the slope.

NOTE 3 This International Standard can be used to provide guidance to the manufacturers of roll-over protective structures should it be decided to provide such protection for these or other machines for a particular application.

## 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 148-1:2006, *Metallic materials — Charpy pendulum impact test (V-notch) — Part 1: Test method*

ISO 898-1:1999, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs*

## SS-EN ISO 3471:2008 (E)

ISO 898-2:1992, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread*

ISO 3164:1995, *Earth-moving machinery — Laboratory evaluations of protective structures — Specifications for deflection-limiting volume*

ISO 5353:1995, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point*

ISO 6165:2006, *Earth-moving machinery — Basic types — Identification and terms and definitions*

ISO 9248:1992, *Earth-moving machinery — Units for dimensions, performance and capacities, and their measurement accuracies*

### 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 fixture to which the machine frame is attached to conduct the test

#### 3.2

##### **boundary plane**

##### **BP**

plane defined as the vertical projected plane of the back, side, or knee area of the DLV

NOTE The boundary planes are used to determine the load application point.

#### 3.3

##### **deflection-limiting volume**

##### **DLV**

orthogonal approximation of a large, seated, male operator wearing normal clothing and a protective helmet

NOTE Adapted from ISO 3164:1995.

#### 3.4

##### **deflection of ROPS**

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

#### 3.5

##### **falling-object protective structure**

##### **FOPS**

system of structural members arranged in such a way as to provide operators with reasonable protection from falling objects (e.g. trees, rocks, small concrete blocks, tools)

#### 3.6

##### **head portion of DLV**

upper 270 mm by 330 mm rectangular section of the DLV, whose dimensions are in accordance with ISO 3164

#### 3.7

##### **lateral simulated ground plane**

##### **LSGP**

plane defined as where the machine comes to rest on its side, where the plane is 15° away from the DLV.

NOTE It is created by rotating a vertical plane parallel to the machine's longitudinal centreline about a horizontal line through the outermost point of the upper ROPS member, to which the lateral load is applied (see Figure 6). 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.

### 3.8

#### load distribution device

##### LDD

device used to prevent localized penetration of the ROPS members at the load application point (LAP)

### 3.9

#### load application point

##### LAP

point (or a point within a defined range) on the ROPS structure at which the test load force ( $F$ ) is applied

### 3.10

#### machine frame

metallic main chassis or main metallic load-bearing member(s) of the machine that extend(s) over a major section of the machine and upon which the ROPS is directly mounted

### 3.11

#### mounting system

all brackets, weldments, fasteners or other devices whose function is to attach the ROPS to the machine frame

### 3.12

#### representative specimen

ROPS, mounting system and machine frame (complete or partial) used for test purposes that is within the range of material and manufacturing variances designated by the manufacturer's production specifications

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

### 3.13

#### roll-over protective structure

##### ROPS

system of structural members whose primary purpose is to reduce the possibility of a seat-belted operator being crushed in the event of a machine roll-over

NOTE 1 See Figures 1 to 5 and ISO 6683.

NOTE 2 It can include components such as sub-frame, bracket, mount, bolt, pin, suspension or flexible shock absorber.

NOTE 3 Non-load-carrying members (posts) are not considered.

#### 3.13.1

##### rollbar ROPS

ROPS having one or two posts, formed or fabricated, and having no cantilevered structural member(s)

#### 3.13.2

##### one-post [two-post] ROPS

ROPS having one or two posts, formed or fabricated, and having one or more cantilevered load-carrying structural members

#### 3.13.3

##### multiple-post ROPS

ROPS having more than two posts, formed or fabricated, and joining load-carrying structural members

NOTE It can have cantilevered load-carrying structural members.

### 3.14

#### ROPS structural member

metallic member designed to withstand an applied force or absorb energy