



SLOVENSKI STANDARD
SIST EN 13531:2002

01-januar-2002

Earth-moving machinery - Tip-over protection structure (TOPS) for compact excavators - Laboratory tests and performance requirements (ISO 12117:1997 modified)

Earth-moving machinery - Tip-over protection structure (TOPS) for compact excavators - Laboratory tests and performance requirements (ISO 12117:1997 modified)

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Erdbaumaschinen - Umsturzschutzvorrichtung (TOPS) für Kompaktbagger Prüfungen und Anforderungen (ISO 12117:1997 modifiziert)

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Engins de terrassement - Structure de protection au basculement (TOPS) pour mini-pelles - Essais de laboratoires et exigences de performance (ISO 12117:1997 modifiée)

Ta slovenski standard je istoveten z: EN 13531:2001

ICS:

53.100 Stroji za zemeljska dela Earth-moving machinery

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EUROPEAN STANDARD

EN 13531

NORME EUROPÉENNE

EUROPÄISCHE NORM

August 2001

ICS 53.100

English version

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Engins de terrassement - Structure de protection au
basculement (TOPS) pour mini-pelles - Essais de
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Kompaktbagger - Prüfungen und Anforderungen (ISO
12117:1997, modifiziert)

This European Standard was approved by CEN on 11 June 2001.

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 Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

EN 13531:2001 (E)**Foreword**

The text of the International Standard 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 February 2002, and conflicting national standards shall be withdrawn at the latest by February 2002.

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.

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Endorsement notice
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The text of the International Standard ISO 12117:1997 has been approved by CEN as a European Standard with agreed common modifications as given below.

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The informative clause 6.1.4 and the informative Annex B of ISO 12117:1997 dealing with a longitudinal loading test of TOPS have not been taken over in the European Standard.

0 Introduction

This European Standard is a type C-standard as stated in EN 292.

1 Scope

This European Standard establishes a consistent and reproducible means of evaluating the load-carrying characteristics of tip-over protective structures (TOPS) under static loading, and prescribes performance requirements of a representative specimen under such loading.

It applies to TOPS of compact excavators (as defined in [EN ISO 6165](#)) with swing type boom, having an operating mass [\(see 3.14\)](#) of 1 000 kg to 6 000 kg.

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 (including amendments).

EN 292-1:1991	Safety of machinery - Basic concepts, general principles for design – Part 1: Basic terminology, methodology
EN 292-2:1991	Safety of machinery – Basic concepts, general principles for design – Part 2 : Technical principles and specifications
EN ISO 898-1:1999	Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, screws, and studs (ISO 898-1:1999)
EN 20898-2:1993	Mechanical properties of fasteners - Part 2: Nuts with specified proof load values - Coarse thread (ISO 898-2:1992)
ISO 148	Steel - Charpy impact test (V-notch)
EN ISO 3164:1995	Earth-moving machinery - Laboratory evaluations of protective structures - Specifications for deflection-limiting volume
EN ISO 6683:1984	Earth-moving machinery - Seat belts and seat belt anchorages
ISO 7135:1993	Earth-moving machinery - Hydraulic excavators - Terminology and commercial specifications
ISO 9248:1992	Earth-moving machinery - Units for dimensions, performance and capacities, and their measurement accuracies
ISO 10262:1998	Earth-moving machinery - Hydraulic excavators - Laboratory tests and performance requirements for falling-object guards

EN 13531:2001 (E)

3 Terms and definitions

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

3.1**tip-over protective structure (TOPS)**

system of structural members whose primary purpose is to reduce the possibility of an operator, held by a seat belt system (3.5), being crushed should a machine tip-over.

NOTE: Structural members include any subframe, bracket, mounting, socket, bolt, pin, suspension, flexible shock absorber used to secure the system to the swing frame, but excludes mounting provisions that are integral with the swing frame.

3.1.1**cabin type TOPS**

TOPS for machines with a cabin.

3.1.2**canopy type TOPS**

TOPS for machines having an open canopy.

NOTE: Both of these types of TOPS are designed to be integrated with the main members of the TOPS for the evaluation test, whether they are separated from the load carrying members or not.

3.2**falling object guard (FOG)**

system of top guard and front guard for the protection of the excavator operator's station. (See ISO 10262.)

3.3**swing frame**

main chassis or main load bearing structural member(s) of the revolving upper frame of the mini-excavator upon which the TOPS is directly mounted.

3.4**swing-type boom**

boom pivoted horizontally at the boom base. (See ISO 7135:1993, figure 18.)

3.5**seat belt restrain system**

seat belt assembly with anchorages. (EN ISO 6683:1984/99, definition 4.3).

3.6**bedplate**

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

3.7**deflection-limiting volume (DLV)**

orthogonal approximation of a large, seated, male operator wearing normal clothing and a protective helmet. (See [EN ISO 3164:1995](#), figure 1). [[EN ISO 3164:1995](#), definition 3.1]

3.8**representative specimen**

TOPS, mounting hardware and machine frame (complete or partial) for test purposes that is within the manufacturer's specifications.

3.9**load distribution device**

device used to prevent localized penetration of the TOPS members at the load application point.

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3.10**load application point**

point on the TOPS structure where the test load is applied to the TOPS structure.

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3.11**deflection of TOPS**

movement of the TOPS structure caused by the application of the load and measured at the load application point.

3.12**simulated ground plane (SGP)**

flat surface on which a machine, after tipping over, is assumed to come to rest.

3.13**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 1). This establishes the LSGP. The LSGP is established on an unloaded TOPS and moves with the member to which load is applied while maintaining its 15° angle with respect to the vertical.

3.14**operating mass**

mass of the base machine, with equipment and attachments as specified by the manufacturer, operator (75 kg), full fuel tank, and all fluid systems at the levels specified by the manufacturer.

EN 13531:2001 (E)

NOTE: 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 Symbols

The following symbols are used in this European Standard.

4.1 U : Energy, expressed in joules (**J**), absorbed by the structure, related to the machine mass (m).

4.2 F : Force, expressed in newtons (N).

4.3 m : Manufacturer's maximum recommended machine mass, expressed in kilograms (**kg**). The manufacturer's maximum recommended machine mass includes attachments in operating condition with all reservoirs full to capacity, tools and TOPS.

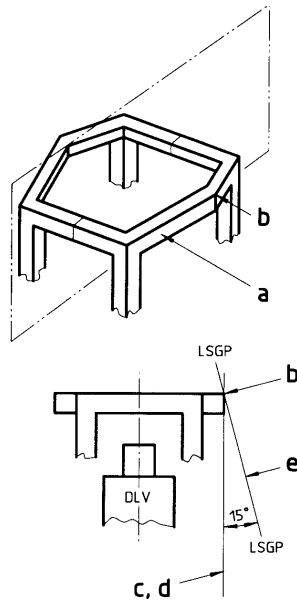
4.4 L : Length of the TOPS, expressed in millimetres, defined as below.

- a) For a one- or two-post TOPS with a FOG-falling object (top and front) guard for the operator's station 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 TOPS, from the extreme face of the TOPS post(s) to the far end of the cantilevered load-carrying members (see Figure 2).
- b) For all other TOPS, the length, L , is the greatest total longitudinal distance between the outsides of the front and rear posts (see Figure 3).

4.5 W : Width of the TOPS, expressed in millimetres, defined as below.

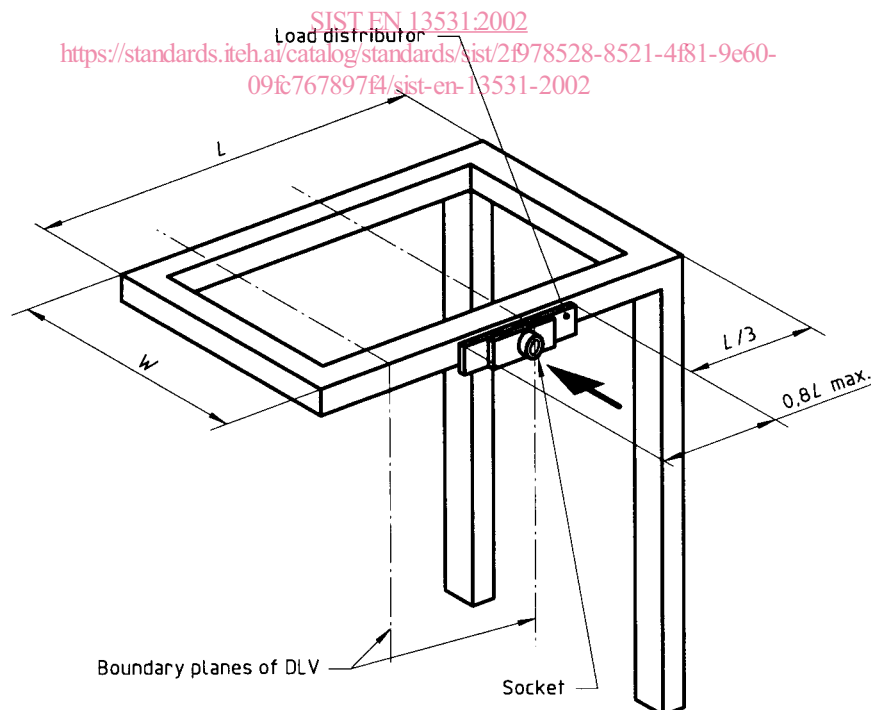
- a) For a one- or two-post TOPS with a FOG-falling object (top and front) guard for the operator's station and/or cantilevered load-carrying structural members, the width, W , is that portion of the cantilevered load-carrying members which covers at least the vertical projection of the width of the DLV. It is measured at the top of the TOPS, members from the extreme face of the TOPS left and right post to the far end of the cantilevered load-carrying members (see Figure 2).
- b) For all other TOPS, the width, W , is the greatest total width between the outsides of the left and right TOPS posts (see Figure 3).

4.6 Δ : Deformation of the TOPS, expressed in millimetres.

**Key**

- a Upper TOPS member to which the lateral load is applied
- b Outermost point from the end view of member a
- c Vertical line through point b
- d Vertical plane parallel to the machine longitudinal centreline through line c
- e Lateral simulated ground plane (LSGP)

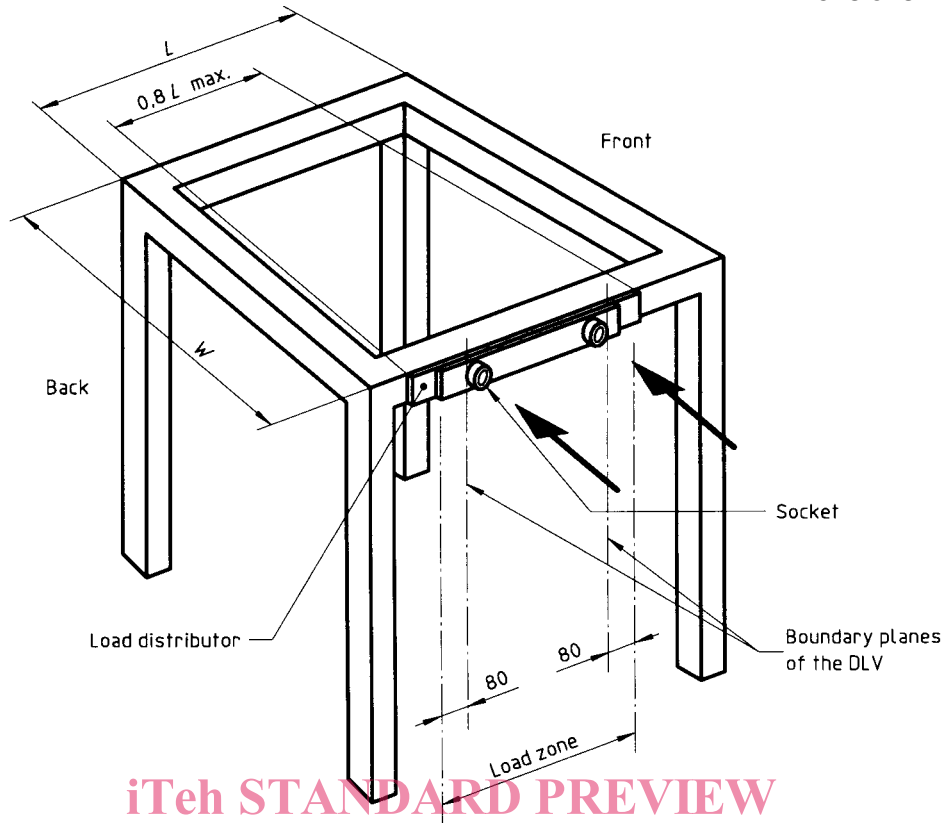
Figure 1 - Determination of lateral simulated ground plane (LSGP)



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

Figure 2 - Two-post TOPS lateral load application point

Dimensions in millimetres



NOTE 1: Load distributor and socket are used to prevent local penetration and to hold the end of the load-generating device.

NOTE 2: Typical but not mandatory layout.
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Figure 3 - Four-post TOPS lateral load application point

5 Test method and facilities

5.1 General

The requirement for TOPS is energy absorption in the lateral direction. There are limitations on deflections under the lateral loading. The energy requirements and limitations on deflection (DLV) under lateral loading are intended to assure that the TOPS will not significantly deform while retaining significant capability to withstand impact in the tip.

The evaluation procedure will not necessarily duplicate structural deformations due to a given actual tip-over. However, it is expected that crush protection for a seat-belted operator will be assured under at least the following conditions:

- a flat hard soil surface;
- 90° of tip-over about the swing frame longitudinal axis without losing contact with the surface.

5.2 Instrumentation

Systems used to measure mass, force and deflection shall be capable of meeting the requirements of ISO 9248:1992.

5.3 Test facilities

Fixtures shall be adequate to secure the TOPS/swing frame assembly to a bedplate and to apply the required lateral load as determined by the formulae given in Table 1.

5.4 TOPS/swing frame assembly and attachment to bedplate

5.4.1 The TOPS shall be attached to the swing frame as it would be on an operating machine (see Figure 4). A complete swing frame is not required for the evaluation. However, the swing frame and mounted TOPS test specimen shall represent the structural configuration of an operating installation. All normally detachable windows, panels, doors, and other non-structural elements shall be removed so that they do not contribute to, nor detract from, the structural evaluation.

5.4.2 The TOPS/swing frame assembly shall be secured to the bedplate so that the members connecting the assembly and bedplate experience minimal deflection during testing. The TOPS/swing frame assembly shall not receive any support from the bedplate, other than that due to the initial attachment.

5.4.3 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. Suspension elements used to attach the TOPS to the machine frame and acting as a load path shall be in place and functioning at the start of the test.

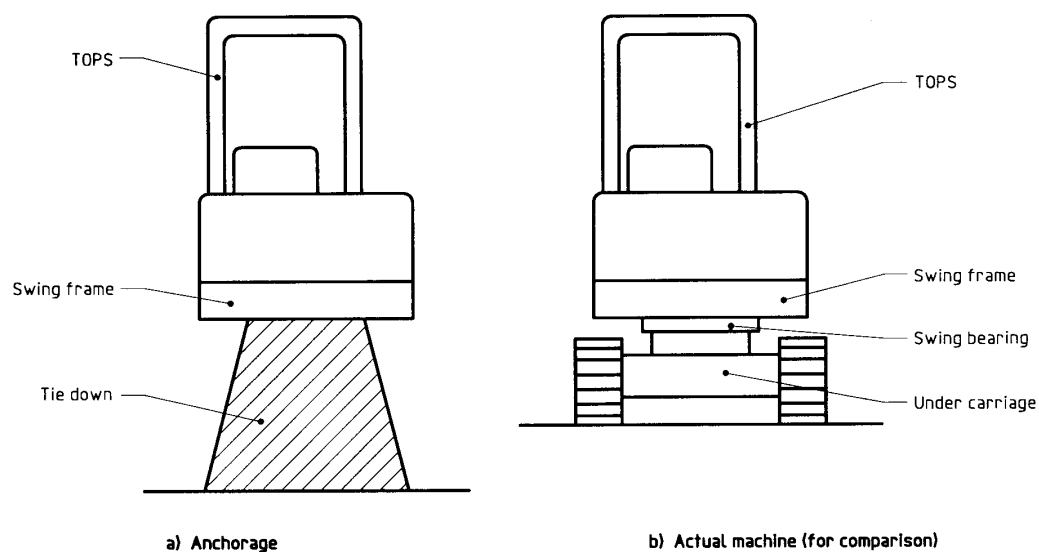


Figure 4 - Anchorage of swing frame