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**Earth-moving machinery — Trainer  
seat — Deflection limiting volume, space  
envelope and performance requirements**

*Engins de terrassement — Siège de l'instructeur — Volume limite de  
déformation, espace enveloppe et exigences de performance*



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## Foreword

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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 13459 was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 2, *Safety, ergonomics and general requirements*.

This second edition cancels and replaces the first edition (ISO 13459:1997), which has been technically revised.



# Earth-moving machinery — Trainer seat — Deflection limiting volume, space envelope and performance requirements

## 1 Scope

This International Standard specifies the trainer-seat deflection limiting volume (DLV), space envelope and performance requirements, and dimensions, for use in laboratory evaluations of protective structures on earth-moving machinery as defined in ISO 6165.

The effects of vibration are not considered a significant risk for short-term or temporary seats and are therefore outside the scope of this International Standard.

## 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 2867, *Earth-moving machinery — Access systems*

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

ISO 3449, *Earth-moving machinery — Falling-object protective structures — Laboratory tests and performance requirements*

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

ISO 5006, *Earth-moving machinery — Operator's field of view — Test method and performance criteria*

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

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

ISO 6683, *Earth-moving machinery — Seat belts and seat belt anchorages — Performance requirements and tests*

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

ISO 10262, *Earth-moving machinery — Hydraulic excavators — Laboratory tests and performance requirements for operator protective guards*

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*

ISO 20474-1, *Earth-moving machinery — Safety — Part 1: General requirements*

### 3 Terms and definitions

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

#### 3.1

##### **locating axis**

##### **LA**

horizontal axis for positioning the **DLV** (3.2) with respect to the seat index point (SIP)

#### 3.2

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

##### **DLV**

orthogonal approximation of a large, seated operator, as defined in ISO 3411, wearing normal clothing and a protective helmet

NOTE 1 Adapted from ISO 3164:1995, definition 3.1.

NOTE 2 The DLV applies to the operator, whereas the **trainer DLV** (3.7) applies to the trainer and trainer seat.

#### 3.3

##### **operator space**

space around the operator

#### 3.4

##### **orthogonal top head plane**

upper 270 mm × 330 mm rectangular horizontal surface of the **DLV** (3.2) for FOPS testing

See Figure A.1.

#### 3.5

##### **trainer seat**

seat installed in the operator's compartment, adjacent to or behind the operator's seat, for short-term or temporary usage for the primary purpose of training an operator

#### 3.6

##### **trainer space envelope**

envelope in which the trainer performs job tasks

See Figure 1.

#### 3.7

##### **trainer DLV**

approximation of a large, seated trainer wearing normal clothing and a protective helmet

See Figure A.1.

NOTE Adapted from ISO 3164:1995, definition 3.1. (The trainer is assumed to be the same size as the large operator in that definition and in definition 3.2).

#### 3.8

##### **handhold**

device which the trainer can hold onto, providing support and preventing body movement

## 4 Requirements

### 4.1 Seat dimensions

Trainer seats shall have dimensions in accordance with Table 1, unless a deviation is justified based on unusual ergonomic considerations. All dimensions shall be referenced to the seat index point (SIP), determined in accordance with ISO 5353. The trainer seat may consist of independent cushions, provided they conform to the required dimensions.

### 4.2 Trainer seat location

**4.2.1** The trainer seat shall be installed within the operator's station.

**4.2.2** No portion of the trainer seat shall be located in the sector of vision A, as defined in ISO 5006. The trainer seat shall be positioned so as to provide adequate visibility for observing the operator and the work environment. The location of the trainer seat shall not interfere with the safe operation of the machine by the operator.

### 4.3 Trainer space envelope dimensions/adjustment/suspension

The trainer space envelope shall have the dimensions given in Figure 1. Seat adjustment and suspension is not required for a trainer seat.

### 4.4 FOPS or top-guard requirements for trainer seats

The FOPS (falling-object protective structure) requirements of ISO 3449 or top-guard requirements of ISO 10262 apply to the trainer seat using the trainer DLV, in accordance with Annex A. Results from FOPS or top-guard testing for the operator may be used to evaluate and verify compliance with this International Standard if the cab structure is shown through analysis to be stronger above the trainer.

### 4.5 ROPS requirements for trainer seats

#### 4.5.1 General

The ROPS (roll-over protective structure) requirements given in ISO 3471 or ISO 12117-2, together with the provisions of 4.5.2 and 4.5.3, apply to trainer seats. Results from ROPS testing in accordance with ISO 3471 or ISO 12117-2 for the operator may also be used to evaluate and verify compliance with 4.5.3.

See also Annex B.

#### 4.5.2 ROPS test procedure

Test the ROPS structure in accordance with ISO 3471 or ISO 12117-2, using the trainer DLV provisions given in Annexes A and B.

#### 4.5.3 ROPS acceptance criteria

The acceptance criteria of ISO 3471 or ISO 12117-2, together with those of Annex B, apply.

### 4.6 Trainer seat ROPS/FOPS or top-guard labelling

If the acceptance criteria given in Annex B have been met, a reference to this International Standard shall be added to the ROPS/FOPS or top-guard label.

**4.7 Materials**

Materials used for the trainer seat and its fittings shall be flame-retardant and in accordance with ISO 20474-1.

**4.8 Handhold**

A handhold meeting the dimensional requirements for handholds given in ISO 2867 shall be placed within arm's reach of the person seated in the trainer seat. The handhold may be the same one as that used to push to open or pull to close the door. The door latch mechanism for latching and unlatching the door shall not be used as a handhold.

**4.9 Storage**

The trainer seat may be stored or removed when not in use.

**4.10 Restraint system**

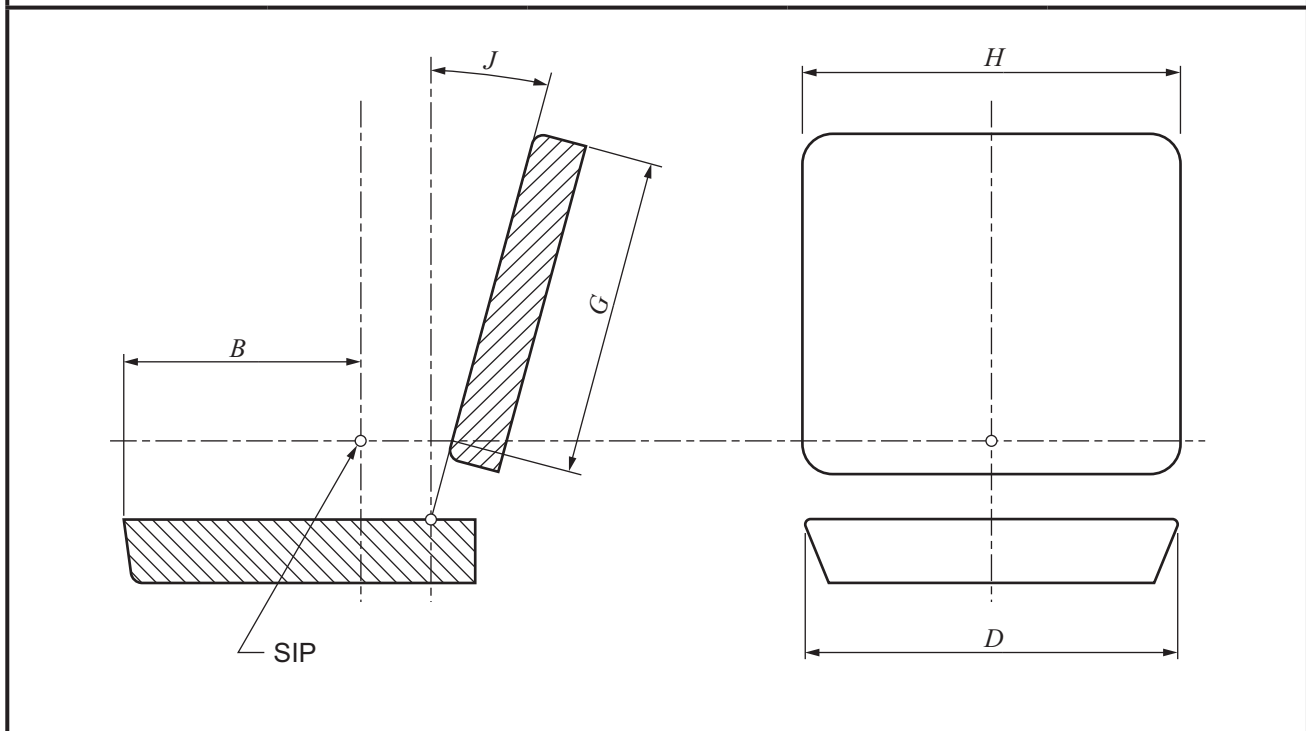
The trainer seat shall have a restraint system (e.g. seat belt and seat belt anchorage) in accordance with ISO 6683.

**Table 1 — Trainer seat dimensions**

Dimensions in millimetres

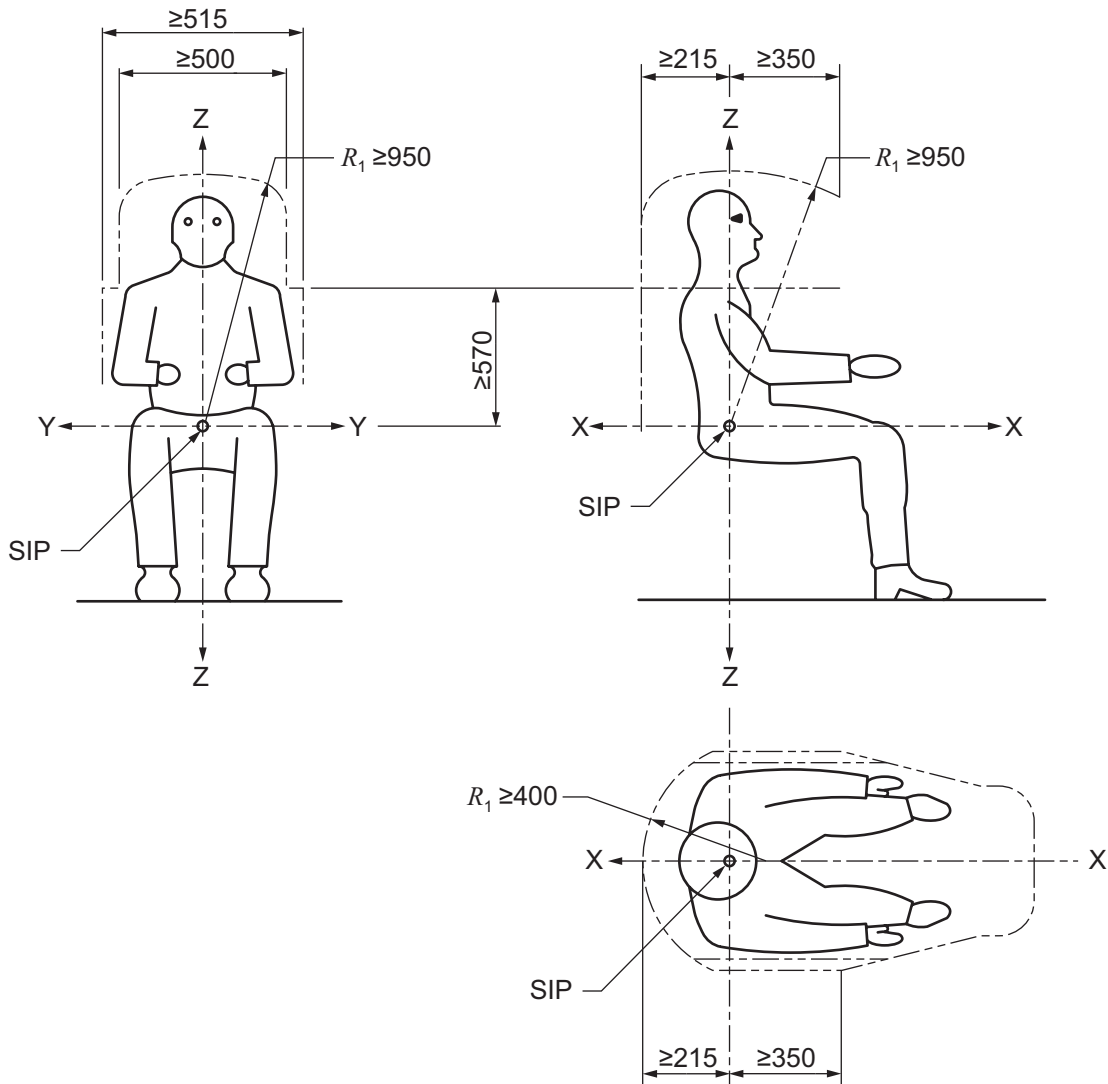
Dimension	Description	Maximum	Basic	Minimum
<i>B</i>	Seat cushion length	320	300	215
<i>D</i>	Seat cushion width	—	360	300
<i>G</i>	Back cushion height	—	400	150
<i>H</i>	Back cushion width	—	360	300
<i>J</i>	Back cushion angle	15°	10°	0°

For the SIP, see ISO 5353.





Dimensions in millimetres



$R_1 \geq 1\ 050$  (with protective helmet) or  $R_1 \geq 1\ 000$  (without protective helmet). For the SIP, see ISO 5353.

Figure 1 — Trainer space envelope

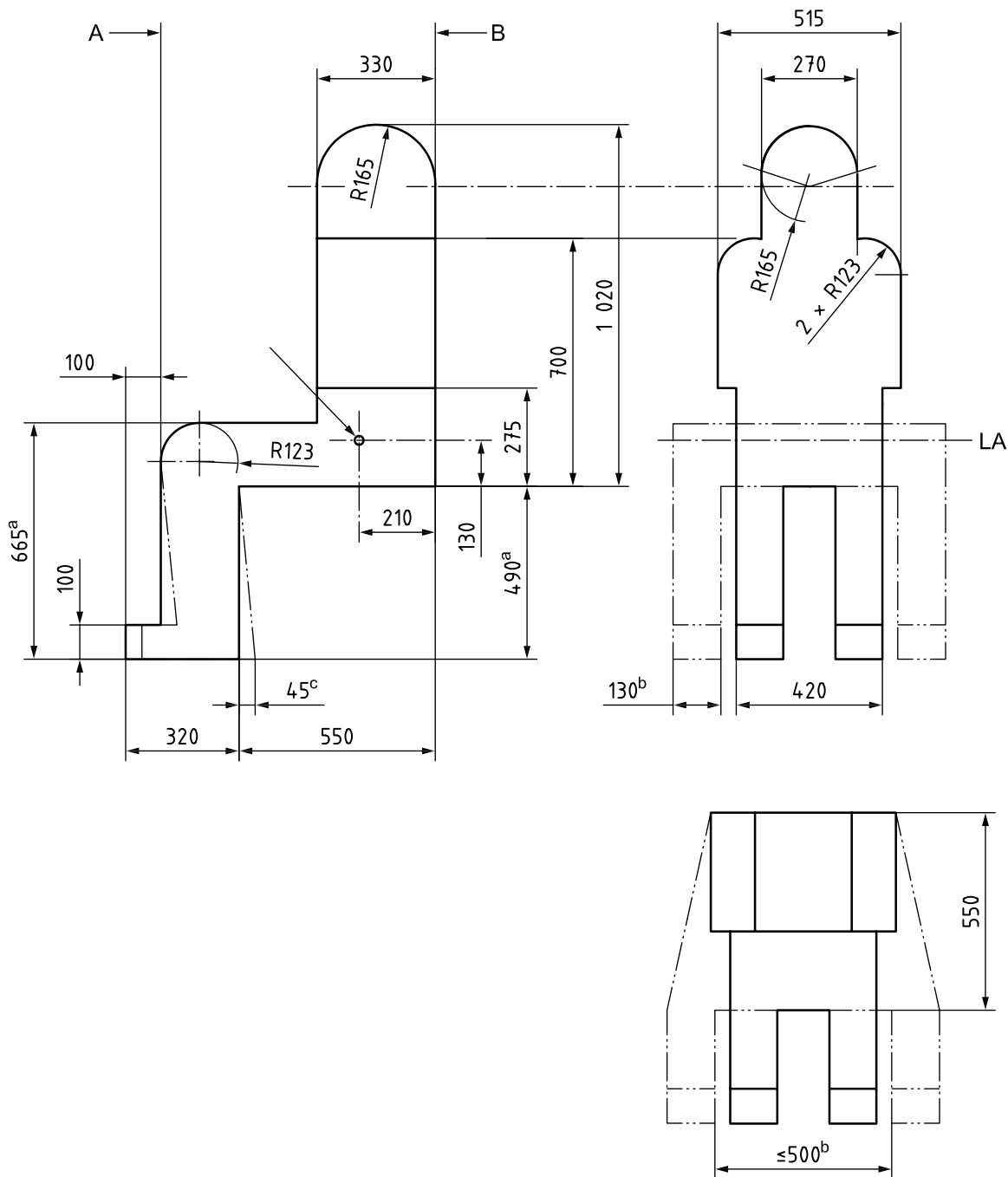
# Annex A (normative)

## Trainer DLV dimensions

The dimensions of the trainer DLV shall be as shown in Figure A.1.

NOTE Orthogonal top head plane for use with a rounded DLV for FOPS testing.

Dimensions in millimetres



A is the front boundary plane and B the rear boundary plane. For the SIP, see ISO 5353.

- a May be reduced to avoid interference with floor plates.
- b Machine parts or controls can cause feet to be separated. As a minimum, the crush-proof volume for feet and legs in ISO 3411 shall be maintained on both sides.
- c Feet may move 45 mm rearward.

**Figure A.1 — Trainer DLV dimensions**

## Annex B (normative)

### Trainer DLV acceptance criteria

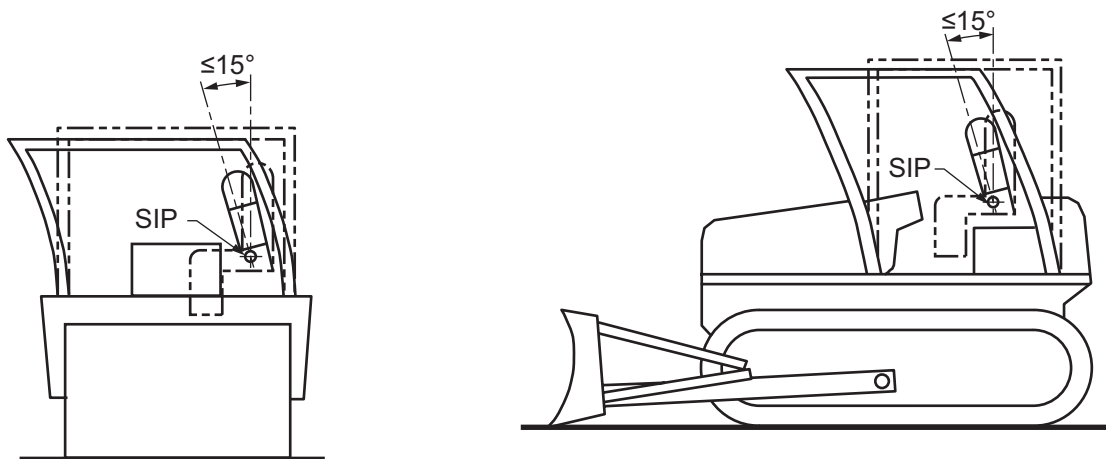
**B.1** The portion of the trainer DLV above the SIP shall be permitted to rotate (see Figure B.1) and translate as per the following.

- a) During lateral and longitudinal loading, it is permissible for the upper portion of the trainer DLV to be rotated sideways or forwards in the direction of ROPS deflection up to 15° around the locating axis (LA) line (see 3.1 and ISO 5353). The portion below the LA line of the DLV may be disregarded. The rotation of the trainer DLV shall be limited to  $\leq 15^\circ$ . If there is interference with any machine components or controls at a lesser angle, that angle shall be the limit of rotation. Upper-portion additional rotation due to deformation of the mounting surface on which the trainer DLV is mounted is allowed.
- b) The trainer DLV may be also be translated 50 mm laterally or longitudinally in the direction of ROPS loading, to allow for soft tissue deflection of a large trainer.

**B.2** When the trainer DLV is rotated up to a maximum of 16° in the direction of ROPS deflection, the operator space shall allow the operator DLV to rotate by up to a maximum of 15° to avoid interference between the two DLVs.

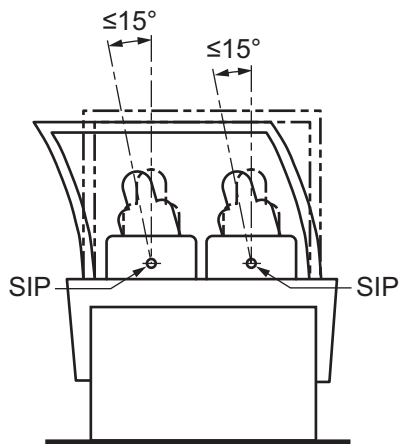
**B.3** For rigid-frame dumpers that have the operator seat closer to the edge of the machine than the trainer seat, or that have side-mounted operator stations and no appreciable lateral load on the trainer-seat side during a roll-over event, compliance with ISO 3471 meets the ROPS requirements for the trainer seat given in this International Standard (see 4.5).

**B.4** Measurement accuracy shall be in accordance with ISO 9248.



**a) Lateral load on roller with sideways-mounted seat**

**b) Longitudinal load on tractor-dozer**



**c) Lateral load on roller with forward-mounted seat**

**Figure B.1 — Allowable rotation of upper DLV about SIP**

## Bibliography

- [1] ISO 3164, *Earth-moving machinery — Laboratory evaluations of protective structures — Specifications for deflection-limiting volume*
- [2] ISO 11112, *Earth-moving machinery — Operator's seat — Dimensions and requirements*

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