



**SLOVENSKI STANDARD**  
**SIST-TP CEN/TR 614-3:2011**  
**01-januar-2011**

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**Varnost strojev - 3. del: Ergonomska načela za načrtovanje mobilnih strojev**

Safety of machinery - Part 3: Ergonomic principles for the design of mobile machinery

Sicherheit von Maschinen - Teil 3: Ergonomische Grundsätze für die Gestaltung von mobilen Maschinen

Sécurité des machines - Partie 3: Principes ergonomiques pour la conception de machines mobiles

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**Ta slovenski standard je istoveten z: CEN/TR 614-3:2010**  
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**ICS:**

13.110	Varnost strojev	Safety of machinery
13.180	Ergonomija	Ergonomics

**SIST-TP CEN/TR 614-3:2011**                      **en,fr,de**

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TECHNICAL REPORT  
RAPPORT TECHNIQUE  
TECHNISCHER BERICHT

**CEN/TR 614-3**

November 2010

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ICS 13.110

English Version

## Safety of machinery - Part 3: Ergonomic principles for the design of mobile machinery

Sécurité des machines - Partie 3: Principes ergonomiques  
pour la conception de machines mobiles

Sicherheit von Maschinen - Teil 3: Ergonomische  
Grundsätze für die Gestaltung von mobilen Maschinen

This Technical Report was approved by CEN on 23 August 2010. It has been drawn up by the Technical Committee CEN/TC 122.

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COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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**CEN/TR 614-3:2010 (E)****Foreword**

This document (CEN/TR 614-3:2010) has been prepared by Technical Committee CEN/TC 122 “Ergonomics”, the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

During the development of this document the Technical Committee has referred to the recommendations made within CEN/CENELEC Guide 6 to address the specific needs of older persons and persons with disabilities.

CEN/TR 614-3:2010 contains the following annexes:

- Annex A (informative) – Method for assessing the level of visibility
- Annex B (informative) – Method for assessing vibration

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## Introduction

Mobile machinery considering ergonomic design principles enhances safety, effectiveness and efficiency, improve human working conditions, and counteract adverse effects on human health and performance. Good ergonomic design therefore exerts a favourable influence on the whole work system, and on the reliability of the human being within it.

In this Technical Report the term 'ergonomics' refers to a multidisciplinary field of science and its application. Applying ergonomics to the design of operator's station and/or workplaces considering the elements of the work system ensures that human capabilities, skills, limitations and needs are taken into account.

This Technical Report deals with common aspects for the ergonomics design principles of mobile machinery.

This Technical Report contains different types of information to be considered and used when designing the ergonomics aspects of a mobile machinery. Some clauses provide general guidance to be considered in the design of mobile machinery. Other clauses include more specific design guidance and requirements relevant to current technology.

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**CEN/TR 614-3:2010 (E)****1 Scope**

This Technical Report establishes the ergonomic principles to be followed during the design process of mobile machinery with special emphasis on the aspects in which mobile machinery differs from static machinery.

The ergonomic design principles given in this Technical Report apply to either or both seated and standing positions.

This Technical Report is applicable for the design of mobile (self-propelled and towable) machines in order to ensure ergonomic working conditions for the operator.

This Technical Report applies only to driving and operating mobile machinery and not to performing other tasks (e.g. sorters on a potato harvesting machine). Pedestrian-controlled and handheld machinery are not included. This Technical Report also applies to vehicle-mounted machinery when observing their functional properties e.g. mobile cranes.

Installing, cleaning, and repairing of mobile machinery is not included.

Basic concepts and general ergonomic principles for the design of machinery are dealt with in prEN ISO 12100 and EN 614-1 and EN 614-2.

NOTE 1 EN 614-1 provides a framework for incorporating ergonomics principles in the design process. This framework helps designers to perform ergonomics analyses and design actions at the appropriate stages of the design process.

NOTE 2 EN 614-2 provides principles of the design of the work tasks in interaction with machinery design. This framework helps designers to focus on the work task design and on the optimal allocation of work tasks between the operator and the machine.

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**2 Terms and definitions**

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For the purposes of this Technical Report, the definitions given in EN 614-1, prEN ISO 12100 and the following apply.

**2.1****access**

process of getting to or out of:

- operator's station or workplace(s);
- maintenance and service areas

NOTE Getting out of or off a machine is also called "egress".

**2.2****access system**

system provided on a machine for access

NOTE This definition is compatible with the definition for earth-moving machines in EN ISO 2867:2008, 3.1.

**2.3****cabin**

enclosure around the operator's station or operator's workplace(s)



**2.4****handrail  
handhold**

top element designed to be grasped by the hand for body support which can be used individually or as the upper part of a guard-rail

[EN ISO 14122-3:2001, 3.2.1]

**2.5****operator's station  
workplace of the operator**

location on the mobile machine where the operator controls some or all of his tasks

**2.6****seat index point  
SIP**

point on the central vertical plane of the seat

NOTE 1 SIP is determined by the device shown in Figure 1 of EN ISO 5353:1998, when installed in the seat as specified in EN ISO 5353:1998, 5.3.

NOTE 2 The SIP is fixed with respect to the machine and does not move with the seat through its adjustment and/or oscillation range.

NOTE 3 The SIP as established and defined by this International Standard may be considered, for operator work-place design purposes, to be equivalent to the intersection on the central vertical plane through the seat centerline of the theoretical pivot axis between a human torso and thighs.

[EN ISO 5353:1998, 3.1]

**2.7****stair**

fixed means of access with an angle of pitch from more than 20° up to 45°, whose horizontal elements are steps (see Figure 1)

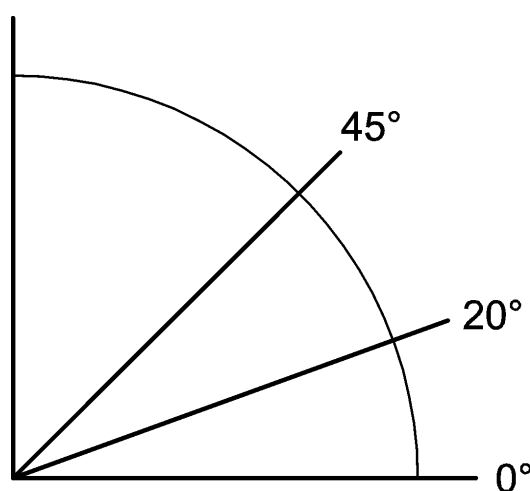


Figure 1 —  $20^\circ < \text{angle of pitch} \leq 45^\circ$

[EN ISO 14122-1:2001, 3.3]

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**2.8 three point support**  
feature of an access system that enables a person to use simultaneously two hands and one foot or two feet and one hand while ascending, descending or moving about on the machine

[EN ISO 2867:2008]

**3 General design principles****3.1 General**

The general ergonomics design principles set out in EN ISO 6385 and EN 614-1 apply also for mobile machinery.

**3.2 Ergonomic design principles concerning anthropometry and biomechanics**

Special consideration needs to be given to:

- dimensioning of the operator's work station;
- safety distances;
- dimensions for access;
- manual handling of component parts during assembly and disassembly (e.g. by marking the mass of the main parts).

Information on anthropometrical aspects of the European population is given in EN 547-1 to EN 547-3 and EN ISO 14738. Biomechanical aspects are covered by EN 1005-1 to EN 1005-5. For safety distances, consider EN ISO 13857.

**3.3 Ergonomic design principles concerning work tasks**

The general ergonomics principles for work task design set out in EN 614-2 apply also for mobile machinery.

**3.4 Accessible design for people with special requirements**

Where it is required, the designer should take account of people with special requirements and apply ergonomic principles to accessible design and assistive technology in order to enable the use of machinery by people with special requirements.

**NOTE** Special needs includes sensory abilities like vision, tactile and acoustic input, physical abilities like dexterity, manipulation, movement, voice, strength and endurance, cognitive abilities like intellect, memory, language and literacy and allergies like contact allergy and respiratory allergy. For further information see CEN/CENELEC Guide 6 and ISO/TR 22411.

**4 Design of workplaces****4.1 General**

It is advisable that the operator's station or workplace is designed, constructed and/or equipped to ensure that the operator has good operating conditions and is protected against foreseeable ergonomics hazards (for instance: temperature, air flow and humidity, noise and vibration, inadequate visibility, mental overload).

For most mobile machinery the sitting working position is the preferred work position for the operator during operation as it is the most stable working position. For some mobile machines a standing work position may be required for work tasks, e.g. when the operator has to leave the machine frequently.

## 4.2 Workspace

### 4.2.1 General

Consideration of the operator's body dimensions (including clothing and helmet where appropriate) and task demands is a precondition in designing the operator's workspace. Sufficient space for movements of the head, trunk, arms and legs is necessary in order to control the mobile machinery. Make sure that the operator is able from either a sitting or standing position to move his arms freely and to turn the upper body in an obstacle free space.

For minimum operator space envelope in earth moving machines, see EN ISO 3411:2007, Clause 5.

### 4.2.2 Leg space

The following requirements concerning leg space are essential:

- foot and leg space for the operating position;
- foot and leg space to access the operating position.

NOTE The preferable location for foot-operated controls for a seated operator of earth moving machines within the "zone of comfort" is given in EN ISO 6682.

### 4.2.3 Work space height considerations for seated positions

The minimum distance between the SIP (see 2.6) and the head guard or cabin roof can be defined according to EN ISO 3411:2007, Clause 5.

### 4.2.4 Work space height considerations for standing positions

When operating a mobile machine in standing position it is important that the work space height ensures enough space between the roof and the operator and that the space is suitable for tasks requiring good visibility.

NOTE The minimum space envelope for a standing operator can be determined according to EN ISO 3411:2007, 5.1.

### 4.2.5 Arm space and reach envelopes

The minimum space and reach envelope for the arms (to meet the "zone of comfort") are given in EN ISO 6682.

When reversing mobile machinery with a non-turning seat provide sufficient space for placing the non-steering arm behind the backrest.

### 4.2.6 Field of vision to displays and control actuators

While designing horizontal monitoring area take into account the field of vision and the necessary movements of eye, head and body.

The information about optimal and necessary horizontal and vertical fields of vision can be found in EN 894-2. See also Clause 8 of this Technical Report.

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For maximum field of vision, see EN ISO 14738.

### 4.3 Seated operator

#### 4.3.1 Seat design and adjustment

Seats need to be designed with due regard to the nature of operation of the machinery. To minimize whole body vibration a seat suspension on mobile machinery is recommended. For the operator's posture, see 8.6.2.1.

It is recommended that seats:

- are easily adjustable (for/aft height) in order to suit operators of different sizes (from the 5<sup>th</sup> to the 95<sup>th</sup> percentile of the intended working population);
- incorporate an adjustable backrest to give a firm support to the lumbar spine without restricting necessary twisting of the torso, e. g. when reversing;
- have a seat-depth that does not impose pressure on the back of the knees/lower part of thighs of the operator;
- have a seat cushion that is wide enough for the 95<sup>th</sup> percentile operator to sit comfortable and allow him/her to move on the cushion;
- allow movements and change of posture while sitting in them;
- prevent harmful exposure of vibration and shocks;
- have a cushion of heat insulating material, which permits ventilation and which provides enough friction to prevent sliding off;
- have a proper maintenance program in the instructions for use.

Where appropriate, it is recommended that seats:

- are designed to compensate for prolonged work facing different directions; e.g. be tiltable backwards when work requires looking upwards, rotate sideways when working sideways and be possible to lock in that position;
- are provided with properly arranged height adjustable armrests that do not obstruct arm movements;
- if equipped with a safety belt, allow the operator to perform all tasks
- have a heating arrangement in the seat and backrest;
- are possible to swivel to assist easy access and egress.

If a seat is equipped with a suspension, a weight adjustment independent of the vertical adjustment is essential.

All seat adjustments are recommended to be:

- intuitive with clear and easily understood instructions;
- easily accessible when the operator is seated;
- convenient to use with no great effort required;