



# SLOVENSKI STANDARD

## SIST EN 16228-7:2014

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SIST EN 791:2000+A1:2009

SIST EN 996:2000+A3:2009

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**Oprema za vrtanje in temeljenje - Varnost - 7. del: Zamenljiva pomožna oprema**

Drilling and foundation equipment - Safety - Part 7: Interchangeable auxiliary equipment

Geräte für Bohr- und Gründungsarbeiten - Sicherheit - Teil 7: Auswechselbare Zusatzausrüstungen

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Machines de forage et de fondation - Sécurité - Partie 7: Equipements interchangeables

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EUROPEAN STANDARD  
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**EN 16228-7**

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Supersedes EN 791:1995+A1:2009, EN  
996:1995+A3:2009

English Version

## Drilling and foundation equipment - Safety - Part 7: Interchangeable auxiliary equipment

Machines de forage et de fondation - Sécurité - Partie 7:  
Equipements complémentaires interchangeables

Geräte für Bohr- und Gründungsarbeiten - Sicherheit - Teil  
7: Auswechselbare Zusatzausrüstungen

This European Standard was approved by CEN on 6 March 2014.

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

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

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## Foreword

This document (EN 16228-7:2014) has been prepared 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of an identical text or by endorsement, at the latest by November 2014 and conflicting national standards shall be withdrawn at the latest by November 2014.

This document supersedes EN 791:1995+A1:2009 and EN 996:1995+A3:2009.

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 EU Directive(s).

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

This European Standard is divided into several parts and covers drilling and foundation equipment.

Part 1 contains requirements that are/may be common to all drilling and foundation equipment. Other parts contain additional requirements for specific machines that supplement or modify the requirements of part 1. Compliance with the clauses of part 1 together with those of a relevant specific part of this standard giving requirements for a particular machine provides one means of conforming with the essential health and safety requirements of the Directive concerned.

When a relevant specific part does not exist, part 1 can help to establish the requirements for the machine, but will not by itself provide a means of conforming to the relevant essential health and safety requirements of the Directive.

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This European Standard, EN 16228, *Drilling and foundation equipment - Safety*, consists of the following parts:

- *Part 1: Common requirements*
- *Part 2: Mobile drill rigs for civil and geotechnical engineering, quarrying and mining*
- *Part 3: Horizontal directional drilling equipment (HDD)*
- *Part 4: Foundation equipment*
- *Part 5: Diaphragm walling equipment*
- *Part 6: Jetting, grouting and injection equipment*
- *Part 7: Interchangeable auxiliary equipment*

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

**EN 16228-7:2014 (E)****Introduction**

This European Standard is a type C standard as stated in EN ISO 12100.

The machinery concerned and the extent to which hazards are covered are indicated in the scope of this standard.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for drilling and foundation equipment that have been designed and built according to the provisions of this type C standard.

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## 1 Scope

This European Standard, together with part 1, deals with all significant hazards for interchangeable auxiliary equipment when they are used as intended and under the conditions of misuse which are reasonably foreseeable by the manufacturer associated with the whole life time of the machine (see Clause 4).

The requirements of this part are complementary to the common requirements formulated in EN 16228-1:2014.

This document does not repeat the requirements from EN 16228-1, but adds or replaces the requirements for application for interchangeable auxiliary equipment.

This document specifies the specific safety requirements for interchangeable auxiliary equipment to be used in drilling and foundation operations, connected with drilling and foundation equipment, agricultural equipment and/or earth moving machinery when they are used as intended and under the conditions of misuse which are reasonably foreseeable by the manufacturer.

Interchangeable auxiliary equipment includes pile installation and extraction equipment, impact hammers, extractors, vibrators, deep vibrators, static pile pushing/pulling devices, rotary percussion hammers, rotary drilling drives, drill mast equipment such as leaders equipped with a drill stem and gears attached to the boom of an excavator and casing oscillators/rotators.

Diaphragm wall cutting tools are dealt with in EN 16228-5.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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EN 16228-1:2014, *Drilling and foundation equipment — Safety — Part 1: General requirements*

EN 16228-2:2014, *Drilling and foundation equipment — Safety — Part 2: Mobile drill rigs for civil and geotechnical engineering, quarrying and mining*

EN 16228-3:2014, *Drilling and foundation equipment — Safety — Part 3: Horizontal directional drilling equipment (HDD)*

EN 16228-4:2014, *Drilling and foundation equipment — Safety — Part 4: Foundation equipment*

EN 16228-5:2014, *Drilling and foundation equipment — Safety — Part 5: Diaphragm walling equipment*

EN 16228-6:2014, *Drilling and foundation equipment — Safety — Part 6: Jetting, grouting and injection equipment*

EN ISO 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane (ISO 3744:2010)*

EN ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201:2010)*

EN ISO 11203:2009, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level (ISO 11203:1995)*

**EN 16228-7:2014 (E)**

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

**3 Terms and definitions**

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010, EN 16228-1:2014 and the following apply.

NOTE Examples are given in Annex A of EN 16228-1:2014.

**3.1****rotary percussion hammers**

equipment to drill holes into the ground, where the rotary drive has an additional impact hammer

Note 1 to entry: The rotary percussion hammer can be mounted at the end of the drill stem outside the hole on the leader of the drilling and foundation equipment. The range of the impact frequencies is usually between 20 Hz and 60 Hz.

**3.2****down the hole hammers (DTH-hammers)**

device in which the percussion mechanism is located directly behind the drill bit

Note 1 to entry: The drill pipes transmit the necessary feed force and rotation to hammer and bit plus compressed air or fluids for the hammer and flushing of cuttings. The drill pipes are added to the drill string successively behind the hammer as the hole gets deeper. The hammer piston strikes the impact surface of the bit directly, while the hammer casing gives straight and stable guidance of the drill bit. This means that the impact energy does not have to pass through any joints at all. The impact energy therefore is not lost in joints allowing for much deeper percussion drilling.

**3.3****impact hammer**

leader-guided or free-riding equipment to drive pile-elements by high-force striking action into the ground

Note 1 to entry: The equipment can be actuated by hydraulic or pneumatic energy, or by internal combustion, e.g. diesel hammer or a free falling weight lifted by a winch.

**3.4****static pile pushing/pulling device**

equipment to push or pull piles, mostly sheet piles, into or out of the ground or vice versa, by static pushing/pulling forces, which are commonly actuated by hydraulic energy

Note 1 to entry: The equipment is fastened via clamps to more than one pile and is pushing/pulling one pile with the actuator and using the other clamps as thrust bearing. This equipment can be mounted on a leader of a drilling and foundation equipment or can be self-riding on top of the piles.

**3.5****sonic drilling device**

equipment which superposes rotary drilling with vibrations at a high frequency

Note 1 to entry: The vibrations are mostly generated within the drill head and can be controlled by the operator to suit the specific conditions of the soil/rock geology. Resonance magnifies the amplitude of the drill bit, which fluidizes the soil particles at the bit face, generating a fast and easy penetration through most geological formations. The frequencies used with this method are normally between 50 Hz and 120 Hz. This equipment can be connected at the leader of a drilling and foundation equipment.

**3.6****casing oscillator/rotator**

equipment to drive in or push out casings with great diameters by low-speed rotation and high push/pull force

Note 1 to entry: This equipment can be connected to the undercarriage of the drilling and foundation equipment. Some types of casing oscillator/rotator can be used as standalone equipment, controlled from the operator's position of the



drilling and foundation equipment, or by an extra operator at the casing oscillator/rotator. In case of combination with the undercarriage, the drilling and foundation equipment has to be able to resist the reaction forces coming from the torque and the pushing/pulling forces of the casing oscillator/rotator. The movement of the clamp system holding the casing can be intermittent, changing the moving direction after each movement interval or can be a more or less turning movement in one direction.

### 3.7

#### rotary drilling drives

equipment to actuate the rotating drilling stem, which is normally mounted at a leader or mast

Note 1 to entry: Rotary drilling drives are rotating the drill stem continuously in one direction.

### 3.8

#### deep vibrator

equipment to densify the soil by using a vertical into the ground driven lance, which is driven by an unbalanced mass at the bottom part of the lance

Note 1 to entry: The hole which is generated by densifying the ground is filled with soil improving material such as gravel. This material can be fed by a special material tube alongside the deep vibrator or by filling the emerging hole with gravel by loaders. The apparatus can be rope suspended or guided on a leader or mast. The vibrations are normally generated by hydraulic or electric power and have a usual range between 25 Hz and 60 Hz.

### 3.9

#### vibrators

equipment to install or extract piling elements by high-frequency oscillation into or out of the ground

Note 1 to entry: The force is generated by vibrations, which have a usual range between 20 Hz and 50 Hz. These vibrations will soften the ground; the weight or pull down or pulling force will move the elements. The vibrations are generated by unbalanced weights, which are driven by hydraulic or electric power. Vibrators can be mounted at the leader of a piling rig or can be free riding at top of the element, suspended by a rope or connected to a cardan/universal joint to the carrier machine.

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### 3.10

#### connection of parts

installation of interchangeable equipment onto drilling and foundation equipment, earth-moving or agricultural equipment

## 4 List of additional significant hazards

Clause 4 of EN 16228-1:2014 applies with the following additional Table 1.

Table 1 of EN 16228-1:2014 and the additional Table 1 in this document contain all hazards, (hazardous situations and events), identified by risk assessments as significant for interchangeable auxiliary equipment and which require action to eliminate or reduce risk.

Hazards generally occur under the following conditions:

- a) in transportation to and from the work site;
- b) in rigging and dismantling on the work site;
- c) in service on the work site;
- d) when moving between pile positions on the work site;
- e) out of service on the work site;
- f) in storage at the plant depot or on the work site;

## EN 16228-7:2014 (E)

g) maintenance.

Table 1 — List of additional significant hazards and associated requirements

No.	Hazard	Relevant clause(s) in this standard
1	Mechanical hazards	
1.1	Generated by machine parts or work pieces, e.g. by:	
1.1.1	Mass and stability	5.2.1, 5.2.3, 5.2.4
1.1.2	Mass and velocity	5.2.1
1.1.3	Inadequacy of mechanical strength	5.2.1, 5.2.3, 5.2.4, 7.2.4
1.2	Accumulation of energy inside the machinery, e.g. by:	
1.2.1	Fluids under pressure	5.2.4
1.3	Elementary forms of mechanical hazards	
1.3.1	Crushing	5.2.3, 5.2.4, 7.2.6
1.3.2	Cutting or severing	5.2.2
1.3.3	Impact	5.2.1
2	Processed materials and substances, used materials, fuels	
2.1	Hazards from contact with harmful fluids, gases, mists, fumes and dusts	5.2.1
3	Unexpected start-up, unexpected overrun/overspeed (or any similar malfunction) from:	
3.1	Other external influences (gravity, wind, etc.)	5.2.1, 5.2.3, 5.2.4
4	Hazards generated by noise, resulting in:	
4.1	Hearing losses and physiological disorders	Annex A
4.2	Accidents due to interference with speech communication and warning signals	Annex A
5	Loss of stability/overturning of machinery	5.2.1
6	Relating to the travelling function	
6.1	Uncontrolled movement of machine when starting the engine	5.2.2, 7.2.5
6.2	Movement without an operator at the driving position	5.2.2
6.3	Excessive oscillations when moving	5.2.2
6.4	Insufficient ability of machinery to be slowed down, stopped and immobilized	5.2.2
7	Mechanical hazards at the work position — fall of objects, penetration by object; — contact of persons with machine parts or tools (pedestrian control).	5.2.1, 5.2.3, 5.2.4 5.2.2
8	Vibration at the driving position	5.2.3
9	Mechanical hazards and events	

No.	Hazard	Relevant clause(s) in this standard
9.1	From load falls, collision, machine tipping caused by:	
9.1.1	Lack of stability	5.2.1
9.1.2	Uncontrolled loading; overloading; overturning moment exceeded	5.2.1
9.1.3	Unexpected/unintended movement of loads	5.2.3, 5.2.4
9.1.4	Inadequate holding devices/accessories	5.2.3, 5.2.4
9.2	From insufficient mechanical strength of parts	5.2.1, 5.2.3, 5.2.4

## 5 Safety requirements and/or protective measures

### 5.1 General

The final combination of interchangeable auxiliary equipment with drilling and foundation equipment and/or earth-moving machinery shall fulfil the requirements of EN 16228-1 to EN 16228-6, where applicable.

Interchangeable auxiliary equipment of drilling and foundation equipment shall comply with the requirements of EN 16228-1, except as modified or replaced by the requirements of this part.

In addition, interchangeable auxiliary equipment shall be designed according to the principles of EN ISO 12100:2010 for relevant but not significant hazards, which are not dealt with by this document.

### 5.2 Additional protective measures for interchangeable auxiliary equipment

#### 5.2.1 Impact hammers

A device to control and limit the striking energy of impact type hammers/extractors shall be installed.

The exhaust channel for diesel hammers shall lead to upwards opening.

#### 5.2.2 Casing oscillators/rotators

The controls (including emergency stop) shall stay at the operator's position, or if there is a separate control station, there shall be an additional emergency stop at the operator's position.

#### 5.2.3 Vibrators

Suspension devices of vibrators shall isolate the transmission of vibrations to the carrier machine.

The maximum allowable pulling force shall be clearly marked on the vibrator.

In case of failure or breakage of the spring elements, a connection between vibrator and suspension device shall remain in order to prevent broken parts falling down.

#### 5.2.4 Clamping devices for connection of pile elements to the driving tool

The clamping force of the clamping device for vibrators shall be in any operating condition at least 1,2 times the actual vertical force.

This condition is deemed to be met when the clamping force is at least 1,2 times the theoretical maximum centrifugal force under no load.