
Oprema za vrtanje in temeljenje - Varnost - 5. del: Oprema za izdelavo membranskih sten (vključno z dopolnilom A1)

Drilling and foundation equipment - Safety - Part 5: Diaphragm walling equipment

Geräte für Bohr- und Gründungsarbeiten - Sicherheit - Teil 5: Geräte für Schlitzwandarbeiten

Machines de forage et de fondation - Sécurité - Partie 5 : Machines pour parois moulées

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**Drilling and foundation equipment - Safety - Part 5:
Diaphragm walling equipment**

Machines de forage et de fondation - Sécurité - Partie 5:
Machines pour parois moulées

Geräte für Bohr- und Gründungsarbeiten - Sicherheit -
Teil 5: Geräte für Schlitzwandaarbeiten

This European Standard was approved by CEN on 6 March 2014 and includes Amendment 1 approved by CEN on 22 November 2021.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 16228-5:2014+A1:2021) 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of an identical text or by endorsement, at the latest by June 2022 and conflicting national standards shall be withdrawn at the latest by June 2022.

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

This document supersedes A1 EN 16228-5:2014 A1.

This document includes Amendment 1 approved by CEN on 22 November 2021.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

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

For relationship with EU Directive(s) / Regulation(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.

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

- *Part 1: Common requirements*
- A1 *Part 2: Mobile drill rigs for civil and geotechnical engineering in soil or soil and rock mixture* A1
- *Part 3: Horizontal directional drilling equipment (HDD)*
- *Part 4: Foundation equipment*
- *Part 5: Diaphragm walling equipment*
- *Part 6: Jetting, grouting and injection equipment*

EN 16228-5:2014+A1:2021 (E)*— Part 7: Interchangeable auxiliary equipment*

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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

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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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EN 16228-5:2014+A1:2021 (E)

1 Scope

This European Standard, together with part 1, deals with all significant hazards for diaphragm walling 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+A1:2021](#).

This document does not repeat the requirements from [EN 16228-1:2014+A1:2021](#), but adds or replaces the requirements for application for diaphragm walling equipment.

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.

EN 474-5:2006+A3:2013, *Earth-moving machinery — Safety — Part 5: Requirements for hydraulic excavators*

EN 474-12:2006+A1:2008, *Earth-moving machinery — Safety — Part 12: Requirements for cable excavators*

[EN 16228-1:2014+A1:2021](#), *Drilling and foundation equipment — Safety — Part 1: Common requirements*

[EN 16228-4:2014+A1:2021](#), *Drilling and foundation equipment — Safety — Part 4: Foundation equipment*

EN 13000:2010+A1:2014, *Cranes — Mobile cranes*

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

ISO 6395:2008, *Earth-moving machinery — Determination of sound power level — Dynamic test conditions*

ISO 6396:2008, *Earth-moving machinery — Determination of emission sound pressure level at operator's position — Dynamic test conditions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010, [EN 16228-1:2014+A1:2021](#) and the following apply.

3.1 diaphragm wall

structural retaining wall or cut-off wall, both of which can be impermeable and constructed in-situ in the ground as a series of contiguous panels

Note 1 to entry: Panels are typically narrow but deep and are cut between surface guide walls and can depend on a slurry or mud suspension for temporary ground support. Structural walls are typically of reinforced concrete with the concrete placed from the bottom of the panel upwards to displace the slurry or mud suspension.

Note 2 to entry: There are other diaphragm wall techniques, for example continuous trenchers; these techniques use machines and cutting tools such as digging chain or wheel disc, which are covered by EN 474-10.

3.2**diaphragm walling equipment**

equipment for cutting panels for diaphragm walls

3.3**▣^{A1} diaphragm walling rig**

carrier machine equipped with diaphragm wall cutting tool

Note 1 to entry: The diaphragm walling rig is either:

- a complete machine satisfying this document, or
- a carrier machine able to withstand dynamic loads as specified in 5.2 with interchangeable equipment in the form of diaphragm wall cutting tools, which can be provided by different suppliers or manufacturers.

Note 2 to entry: The carrier machine is, e.g.:

- foundation equipment as defined in EN 16228-4:2014+A1:2021; or
- a crane as defined in EN 13000:2010+A1:2014; or
- a cable excavator as defined in EN 474-12:2006+A1:2008; or
- a hydraulic excavator as defined in EN 474-5:2006+A3:2013. ^{A1}

3.4**diaphragm wall cutting tool**

tool for cutting panels for diaphragm walls

Note 1 to entry: Diaphragm wall cutting tools can either be:

- diaphragm wall grab, see definition 3.5;
- diaphragm wall cutter, see definition 3.6.

Note 2 to entry: Diaphragm wall cutting tools can be rope suspended and guided by frames or kelly bars.

3.5**diaphragm wall grab**

clamshell grab within a guide device for cutting a diaphragm wall either hydraulically or rope operated

Note 1 to entry: See illustration A.2.24 of ^{A1} EN 16228-1:2014+A1:2021 ^{A1}.

3.6**diaphragm wall cutter**

assembly of counter-rotating cutting or milling wheels within a guide body used to break up soil or rock for cutting a diaphragm wall

Note 1 to entry: There are other non-mechanical diaphragm wall cutting tools used in the construction of a diaphragm wall such as a chisel and are not covered by this document.

Note 2 to entry: See illustration A.2.25 of ^{A1} EN 16228-1:2014+A1:2021 ^{A1}.

3.7**recovery**

extraction of a diaphragm wall cutting tool

EN 16228-5:2014+A1:2021 (E)

Note 1 to entry: For example, grab or cutter when it is stuck in the panel.

3.8

triggering of free fall

action (manual or automatic) that causes the starting of the free-fall

4 List of additional significant hazards

Clause 4 of EN 16228-1:2014+A1:2021 applies with the following additional Table 1.

Table 1 of EN 16228-1:2014+A1:2021 with the additional Table 1 in this document contain all hazards, (hazardous situations and events), identified by risk assessments as significant for diaphragm walling equipment and which require action to eliminate or reduce risk.

Hazards generally occur under the following conditions:

- in transportation to and from the work site;
- in rigging and dismantling on the work site;
- in service on the work site;
- when moving between working positions on the work site;
- out of service on the work site;
- in storage at the plant depot or on the work site;
- maintenance;
- changing diaphragm wall cutting tools and their components;
- changing ropes used to suspend diaphragm cutting wall tools.

Table 1 — List of additional significant hazards and associated requirements

No.	Hazard	Relevant clause(s) in this standard
1	Mechanical hazards and events	
1.1	Inadequacy of mechanical strength	5.2.2, 5.2.3
1.2	Overturning	5.2.3, 5.3, 5.4.4, 5.10, 5.11, 6, 7.1
1.3	From inadequate design of pulleys, drums	5.3
1.4	From inadequate selection of ropes	5.3
1.5	Ejection of teeth from milling cutters	7.1
1.6	Impact through excessive oscillation of tools when tramming	7.1
1.7	Uncontrolled release of lifted load	5.4.4, 5.9
2	Elementary forms of mechanical hazards	
2.1	Crushing/shearing between jaws of grabs	5.5, 7.1, 7.2
2.2	Drawing-in/trapping from teeth of milling cutters	5.4.2, 5.6, 7.1, 7.2

No.	Hazard	Relevant clause(s) in this standard
2.3	Crushing/entanglement/drawing-in/ abrasion when replacing ropes	5.4.3, 5.7, 7.1, 7.2
3	Fall of persons during access to (or at/from) the work position (including changing ropes)	7.1, 7.2
4	Hazards generated by noise, resulting in:	
4.1	Hearing losses and physiological disorders	5.12, Annex A
4.2	Accidents due to interference with speech communication and warning signals	5.12, Annex A
5	Inadequacy of the machine with the carrier	5.9

A1

5 Safety requirements and/or protective measures

5.1 General

Diaphragm walling equipment shall comply with the requirements of A1 EN 16228-1:2014+A1:2021 A1 except as modified or replaced by the requirements of this part of the standard.

A1 For the compatibility between the diaphragm walling equipment and the carrier machine, see 5.9. A1

5.2 Requirements for strength and stability

5.2.1 General

Subclause 5.2 of A1 EN 16228-1:2014+A1:2021 A1 applies with the following additions:

5.2.2 Loads from diaphragm wall cutting tools

When calculating stability in accordance with A1 EN 16228-1:2014+A1:2021 A1 the following shall be taken into account:

- weight of the diaphragm wall cutting tools (including any hose and cable handling system and their mounts);
- weight of the excavated material, slurry or suspension materials and any material adhering to the tool;
- loads applied to the tools during tool extraction;
- all loads induced by rope suspended components are acting at the point where the rope is leaving the upper pulley.

5.2.3 Stability of diaphragm walling rig

5.2.3.1 General

Diaphragm walling equipment can have diaphragm wall cutting tools either rope suspended or guided by frames or kelly bars rigidly connected to the carrier machine.

In both cases a general method for calculating stability shall be used, see 5.2.3.2 below.