BS EN 16228-4:2014

BSI Standards Publication

Drilling and foundation equipment — Safety

Part 4: Foundation equipment

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National foreword

This British Standard is the UK implementation of EN 16228-4:2014. Together with BS EN 16228-1:2014, BS EN 16228-2:2014, BS EN 16228-3:2014, BS EN 16228-5:2014, BS EN 16228-6:2014 and BS EN 16228-7:2014, it supersedes BS EN 791:1995+A1:2009 and BS EN 996:1995+A3:2009, which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/513, Construction equipment and plant and site safety.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Foreword

This document (EN 16228-4:2014) 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of an identical text or by endorsement, at the latest by November 2014 and conflicting national standards shall be withdrawn at the latest by November 2014.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 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, *Drillling 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.

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.

1 Scope

This European Standard, together with part 1, deals with all significant hazards for foundation 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 16228-1:2014 but adds or replaces the requirements for application for foundation equipment.

In this document the general term “foundation equipment” covers several different types of machines used for installation and/or extracting by drilling (machines with a rotary torque greater than 35 kNm), driving, vibrating, pushing, pulling or a combination of techniques, or any other way, of:

— longitudinal foundation elements;

— soil improvement by vibrating and soil mixing techniques;

— vertical drainage.

NOTE Some foundation equipment may have an additional rotary head with a torque less than 35 kNm for pre-drilling applications; this equipment is covered by this standard.

Machines with one or more of the following characteristics are not covered by this standard, but are covered by EN 16228-2:

— machines that have a main rotary head torque of less than 35 kNm;

— machines that have multi-directional drilling capability;

— machines for which adding and removing rods or digging and drilling tools etc. is usually required during the installation/extraction process.

Typically the process of foundation techniques involves the installation of longitudinal elements such as concrete piles, steel beams, tubes and sheet piles, injection elements as tubes and hoses and casings for cast *in situ*.

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 13000:2010, *Cranes — Mobile cranes*

EN 13001 (all parts), *Cranes — General design*

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

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

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.

3.1
foundation equipment
equipment fitted with a carrier machine in order to perform piling and foundation operations

3.1.1
impact piling rig
carrier machine fitted with a mast or leader on which a hammer is mounted

Note 1 to entry: Hammers can be powered or free-fall drop weights.

3.1.2
rotary piling rig
carrier machine fitted with a mast or leader to which a rotary drive is attached

Note 1 to entry: Drilling or digging tools such as an auger or bucket are connected to the rotary drive by a coupling. Couplings between the rotary drive and tools and between sections of tools are non-threaded.

3.1.3
vibration piling rig
carrier machine fitted with a mast or leader, on which a vibrating tool is attached

Note 1 to entry: A range of vibrating tools are available for purposes such as pile driving, sheet piling or ground improvement.

Note 2 to entry: There are other piling and foundation engineering techniques such as band drains, mechanical mixing, rotary soil displacement and jet grouting. The machines and tools used in these techniques are sufficiently similar to the machines and tools defined above that separate categories are not required.

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 foundation 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 tramming between working positions on the work site;

— when travelling on work site;

— out of service on the work site;

— in storage at the plant depot or on the work site;

— during maintenance.

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	Overturning	5.2, 5.3, 5.5, 6, 7
1.2	Inadequacy of mechanical strength	5.3
2	Elementary forms of mechanical hazards	
2.1	Drawing–in/trapping from rotating parts	5.4, 7
3	Combination of hazards	5.3
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 Safety requirements and/or protective measures

5.1 General

Foundation equipment shall comply with the requirements of EN 16228-1:2014 except as modified or replaced by the requirements of this part of the standard.

When the carrier machine of a piling rig is a:

— crane it shall also comply with EN 13000:2010 and EN 13001 series of standards; or

— cable excavator it shall also comply with EN 474-12: 2006+A1:2008; or

— hydraulic excavator it shall also comply with EN 474-5:2006+A3:2013.

The requirements of EN 16228 shall take precedence over the standards for the carrier machine.

A crane shall not be used as the carrier machine for freely suspended vibration tools or a free fall drop weight.

5.2 Rigid body stability

Subclause 5.2.3 of EN 16228-1:2014 applies with the following additions:

The required stability angle shall be as stated in Table 2 below:

Table 2 — Required stability angle, dynamic influences included

	Stability class NC (normal conditions)	**Stability class SC (special conditions)**
Travelling	8 degrees	5 degrees + β (see below)
Operating and tramming	5 degrees	1,5 degrees + β (see below) [a]
[a] A static stability angle of 5 degrees + β (see c) below) calculated without dynamic accelerations and wind loads is also required.		

NC and SC are the stability classes (see explanations below).

The manufacturer shall provide a capacity table class NC in any case.

Tipping angle of stability class NC is applicable to all types of foundation equipment.

The manufacturer may provide an additional capacity table class SC which is based on the assumption that all of the following conditions are fulfilled:

a) The ground shall support the machine and can reliably withstand the supporting forces, without significant unintended displacements or taking into account their affect on stability (support by e.g. timber plates, steel plates and/or improved ground surface may be required). This shall also be shown in the case, if supports (those not causing rigid body movement) become unloaded and thus cause maximum forces at other supports.

b) Masses of relevant parts of the machine shall be evaluated by weighing with an accuracy of ± 2,5 %.

c) When using tipping line 1 as defined Figure 1 of EN 16228-1:2014 then the required tipping angle shall be increased by β.

5.3 Winches and pulleys

Subclause 5.8.2 of EN 16228-1:2014 applies with the following addition:

To allow a suspended hammer to follow and maintain contact with the pile, the winch supporting the hammer shall be capable of paying out the supporting cable fast enough or the hammer shall be completely disconnected from the winch cable.

5.4 Moving parts involved in the process

Subclause 5.23.2 of EN 16228-1:2014 does not apply with the exception of 5.23.2.2.2.

Rotary piling rigs equipped with at least one of the following devices or components are exempted from the requirement of guards as in 5.23.2.2.2 of EN 16228-1:2014

— a kelly bar;

— rotating auger cleaners (see examples in Annex A of EN 16228-1:2014);

NOTE 1 Rotating auger cleaners can move up and down to release the spoil underneath the cleaning device.

— guides at the lower end of the leader to guide the auger, or rotating drill stem, which have a rotation speed of not greater than 30 rpm;

NOTE 2 Guides can be opened to allow the drilling head to move to ground level.

— casings or drill stem, having a rotation speed of not greater than 30 rpm.

NOTE 3 Casings usually have a plane surface and are moving with a low rotation speed.

All other rotary piling rigs shall be equipped with guards fulfilling the following requirements:

— the bottom edge of the guard shall be no more than 750 mm above ground level;

— the upper level of the guard shall not be less than 1 600 mm from ground level;

— moveable guards shall have a locking device.

The design of the guard shall ensure sufficient visibility on the working area.

5.5 Inclination of the carrier

Subclause 5.10.2 of EN 16228-1:2014 applies with the following addition:

Systems for measuring the inclination of the carrier shall be accurate within ± 0,2°.

6 Verification of the safety requirements and/or protective measures

Safety requirements and/or protective measures of Clauses 5 and 7 of this European Standard shall be verified according to Table 3 below. It includes the following types of verification:

a) design check: the result of which being to establish that the design documents comply with the requirements of this European Standard;

b) calculation: the results of which being to establish that the requirements of this European Standard have been met;

c) visual verification: the result of which only being to establish that something is present (e.g. a guard, a marking, a document);

d) measurement: the result of which shows that the required numerical values have been met (e.g. geometric dimensions, safety distances, resistance of insulation of the electric circuits, noise, vibrations);

e) functional tests: the result of which shows that the adequate signals intended to be forwarded to the main control system of the complete machine are available and comply with the requirements and with the technical documentation;

f) special verification: the procedure being given or in the referred clause.

Table 3 — Verification of safety requirements and/or protective measures

Clause number	Title	a) Design check	b) Calculation	c) Visual verification	d) Measurement	e) Functional test	f) Special verification (See at the end of this table)
5	Safety requirements and/or protective devices						
5.1	General	x					1
5.2	Rigid body stability	x	x				1
5.3	Winches and pulleys	X				x	1
5.4	Moving parts involved in the process	x			X		1
5.5	Inclination of the carrier	X			X		1
7	Information for use – operator's manual			x			1
1 Verification by reference to standard which is mentioned in the corresponding clause.							

7 Information for use – operator's manual

Subclause 7.3.2 of EN 16228-1:2014 applies with the following additions.

The following information shall be provided:

— illustrations showing the danger zones such as in front of the mast or leader and within the slew radius;

— information for opening/closing either the guides, auger cleaner and/or the guards;

— extraction pulling force not to be exceeded;

— capacity Table NC and if applicable SC;

— the capacity table for class SC only may be used if the requirement of 5.2 a) is tested and secured.

In case of a piling rig: information that the noise emission values of the piling rig were determined without pile installation equipment.

Annex A
(normative)

Noise test code

A.1 General

Annex B of EN 16228-1:2014 applies with the additions in Clauses A.2 and A.3.

A.2 Impact piling rig, vibration piling rig

A noise test of an impact piling rig or a vibration piling rig shall be carried out with equipment as defined in definition 3.7 of EN 16228-1:2014 and under conditions given in B.2.4 of EN 16228-1:2014

A.3 Rotary piling rig

A noise test of a rotary piling rig shall be carried out as described in Annex A of EN 16228-1:2014.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Directive Machinery 2006/42/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard and of part 1 of the series confers, within the limits of the scope of this standard, a presumption of conformity with the Essential Requirement of the Directive and associated EFTA regulations.

Warning: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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