BS EN 16228-6:2014

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Drilling and foundation equipment — Safety

Part 6: Jetting, grouting and injection equipment

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Foreword

This document (EN 16228-6:2014) 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of an identical text or by endorsement, at the latest by November 2014 and conflicting national standards shall be withdrawn at the latest by November 2014.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, 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.

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 document 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 jetting, grouting and injection 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 jetting, grouting and injection equipment.

Rigs for drilling, vibrating, pile driving, to be used for preparing holes for these applications are covered by EN 16228-2:2014 and/or EN 16228-4:2014.

Jetting, grouting and injection equipment is used in the preparation, transfer and application of grouting materials used for either:

— the improvement of ground condition; or

— the filling of voids e.g. around piles or ground anchors.

Jetting, grouting and injection equipment are constituted by all equipment and installations, operated by hand or electrically, pneumatically, mechanically or hydraulically powered, necessary for the following:

— mixing, storing, measuring and pumping of substances (cement suspension, mortar or chemical liquids/mixtures);

— jetting, grouting and injection processes (of/into subsoil) with low, medium or high pressure or vacuum systems;

— all types of pressure and wear resistant grout hoses, fittings, quick release coupling with thread or hose connection, ball valves and flexible pipes;

— all control systems, electrical or mechanical pressure and flow recorders, for monitoring the grouting;

— all jetting, grouting and injection accessories, such as: special tools, lances, rods, sockets, packers, retention clamps and swivel hooks.

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 809:1998+A1:2009, *Pumps and pump units for liquids — Common safety requirements*

prEN 853:2013, *Rubber hoses and hose assemblies — Wire braid reinforced hydraulic type — Specification*

prEN 854:2013, *Rubber hoses and hose assemblies — Textile reinforced hydraulic type — Specification*

prEN 855:2011, *Plastics hoses and hose assemblies — Thermoplastics textile reinforced hydraulic type — Specification*

prEN 856:2011, *Rubber hoses and hose assemblies — Rubber-covered spiral wire reinforced hydraulic type — Specification*

prEN 857:2013, *Rubber hoses and hose assemblies — Wire braid reinforced compact type for hydraulic applications — Specification*

EN 12001:2012, *Conveying, spraying and placing machines for concrete and mortar — Safety requirements*

EN 12151:2007, *Machinery and plants for the preparation of concrete and mortar — Safety requirements*

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

EN ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components (ISO 4413:2010)*

EN ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components (ISO 4414:2010)*

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
grouting
method for filling boreholes voids

Note 1 to entry: The pressure of the grout pump is up to 0,3 Mpa.

3.2
injection
method for grouting liquid mixtures or resins into voids/pores or for injecting of ground anchors or micro piles

Note 1 to entry: Two different methods can be distinguished: the injection of solid matter in a liquid mixture, like cement or bentonite and the injection of chemicals, like water glass and hardener.

Note 2 to entry: The pressure of the injection pump is up to 11 Mpa.

3.3
jetting or jet-grouting
method for producing concrete part in soil, which is normally used for the underpinning of foundations of existing buildings, to produce a dense pit or to densify the pit floor, to stabilize the soil while tunnelling or to erect a dense screen for dams

Note 1 to entry: The pressure of the jetting or high pressure pump is up to 60 MPa, which creates an exit velocity of the jet from the nozzle of more than 100 m/s.

3.4
safety burst hose
special hose with a lower burst strength than the normally used hoses, which is intended to burst first, when exceptional load cases or pressure peaks occur

Note 1 to entry: By using this special hose, the bursting of this hose should prevent the other hoses in the line being damaged and to dissipate the unintended overpressure.

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 jetting, grouting and injection 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;

g) during remote control of the pump, especially if the pump is out of sight of the drill rig operator;

h) during maintenance.

Table 1 — List of additional significant hazards and associated requirements

No.	Hazard	Relevant clause(s) in this standard
1	Mechanical hazards	
1.1	Fluids under pressure	5.2.1, 5.2.2, 5.2.5, 5.2.7, 5.2.8, 5.2.9, 7.1
1.2	High pressure fluid injection or ejection hazard	5.2.2, 5.2.6, 5.2.9, 7.1
2	Hazards generated by noise, resulting in:	
2.1	Hearing losses and physiological disorders	Annex A
2.2	Accidents due to interference with speech communication and warning signals	Annex A
3	Processed materials and substances, used materials, fuels	
3.1	Hazards from contact with harmful fluids, gases, mists, fumes and dusts	5.2.3, 5.3

5 Safety requirements and/or protective measures

5.1 General

Jetting, grouting and injection equipment shall comply with the requirements of EN 16228-1:2014 except as modified or replaced by the requirements of this document.

In addition, the 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 Components

5.2.1 Fluid pumps, hoses and mixers

The following components of jetting, grouting and injection equipment shall conform to the requirements stated in the following standards where applicable:

— fluid pumps: EN 809:1998+A1:2009;

— hoses: prEN 853:2013, prEN 854:2013, prEN 855:2011, prEN 856:2011, prEN 857:2013, EN ISO 4413:2010, EN ISO 4414:2010;

— mixers: EN 12151:2007.

5.2.2 Working conditions

All components in the process pressure system shall be designed and constructed so that they are able to work safely under all unfavourable conditions.

These components, excluding hoses, shall have a safety factor against bursting of twice the operating pressure or a value of 50 % above the maximum possible pressure, or alternatively a minimum value of 50 % above the maximum possible pressure of the pump system.

5.2.3 Additional requirements for hazardous gases

When a jetting, grouting or injection unit is intended to use products that generate toxic gases, the manufacturer shall provide a forced ventilation system and an atmosphere control device with an acoustic or flashlight warning signal, where applicable.

5.2.4 Remote control

The reset of the power supply shall be done locally for devices that are controlled remotely.

5.2.5 Additional requirements for hoses used for jet-grouting

If hoses or hose lines have a working pressure more than 400 bar, a safety burst hose has to be implemented in the hose line. The safety burst hose shall be enclosed by an appropriate shielding, to prevent injuries.

The bursting pressure of the safety burst hose shall not exceed twice the working pressure.

5.2.6 Emergency stops for jet-grouting

In addition to subclause 5.15.4.2 of EN 16228-1:2014 for jet-grouting applications both the drill rig and the high pressure pump shall have an emergency stop at the operator's positions to stop the pump.

5.2.7 Hose fastening for jet-grouting

Hoses and hose lines on the equipment used for jet-grouting shall be secured against pulsation or vibrating of the hoses.

5.2.8 Burst safety factors for jet-grouting hoses

Hoses used for jet-grouting shall have the quadruple bursting pressure compared to the working pressure. The bursting pressure of the safety burst hose is only twice the working pressure.

5.2.9 Conditions for testing the high pressure jet of jet-grouting drill rigs

For testing the high pressure jet of jet-grouting drill rigs, the nozzle orifice shall be secured by a surrounding casing, fixed in clamps of the equipment.

5.3 Dust

Clause 5.28.2 of EN 16228-1:2014 applies with the following modifications:

Manually fed mixers shall be exempted from having a dust suppression system or dust filters.

Manually fed mixers shall carry a warning sign indicating dust health hazards.

6 Verification of the safety requirements and/or protective measures

6.1 General

Safety requirements and/or protective measures of Clauses 5 and 7 of this European Standard shall be verified according to Table 2 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 2 — Verification of safety requirements and/or protective measures

Clause	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 measures						
5.1	General	x					2
5.2	Components						
5.2.1	Fluid pumps, hoses and mixers	x					1, 2
5.2.2	Working conditions	x					1
5.2.3	Additional requirements for hazardous gases	x				x	
5.2.4	Remote control	x				x	
5.2.5	Additional requirements for hoses used for jet-grouting	x					1
5.2.6	Emergency stops for jet-grouting	x					2
5.2.7	Hose fastening for jet-grouting	x		x			
5.2.8	Burst safety factors for jet-grouting hoses	x					1
5.2.9	Conditions for testing the high pressure jet of jet-grouting drill rigs	x		x			
5.3	Dust			x			2
7	Information for use						
7.1	Operator's manual			x			2
7.2	Maintenance instructions			x			2

1 Verification by reference to hose manufacturers documents.
2 Verification by reference to standard which is mentioned in the corresponding clause.

6.2 Functional test

All motions of the drilling and foundation equipment for jetting, grouting and injection shall be operated throughout their range of movements, without load, up to their maximum operating speeds. Motion limiters and buffer positions shall initially be approached and contact made at slow speed prior to contact being made at maximum operational speed.

7 Information for use

7.1 Operator's manual

Subclause 7.3.2.2 of EN 16228-1:2014 applies with the following additions:

— instructions to install and assembly the equipment for jetting, grouting and injection;

— instructions for testing the high pressure jet of jet-grouting equipment;

— instructions for handling the high pressure pump in case the emergency stop was activated by the operator or driver;

— instructions for handling the high pressure hoses on job site.

7.2 Maintenance instructions

Subclause 7.3.3 of EN 16228-1:2014 applies with the following additions:

— instructions to supervise the wear and tear of all pressure hoses;

— instructions to supervise the fastening points of high pressure hoses at the equipment.

Annex A
(normative)

Noise test code

Annex B of EN 16228-1:2014 does not apply.

Noise measurements shall be carried out according to EN 12001:2012.

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 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.

Bibliography

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

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

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