BS EN 16228-3:2014

BSI Standards Publication

Drilling and foundation equipment — Safety

Part 3: Horizontal directional drilling equipment (HDD)

bsi.

...making excellence a habit.™

National foreword

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BS EN 16228-6:2014 and BS EN 16228-7:2014, it supersedes BS EN 791:1995+A1:2009 and BS EN 996:1995+A3:2009, which are withdrawn.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

Published by BSI Standards Limited 2014

ISBN 978 0 580 73266 9
ICS 91.220; 93.020

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 August 2014.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16228-3

May 2014

ICS 93.020

English Version

Drilling and foundation equipment - Safety - Part 3: Horizontal directional drilling equipment (HDD)

Machines de forage et de fondation - Sécurité - Partie 3: Appareils de forage horizontal dirigé (HDD)

Geräte für Bohr- und Gründungsarbeiten - Sicherheit - Teil 3: Geräte für das gerichtete Horizontalbohrverfahren

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

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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 United Kingdom.

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

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

Contents

Page

Foreword

This document (EN 16228-3:2014) 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.

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, hazardous situations and events are covered are indicated in the scope of this document.

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

1 Scope

This European Standard, together with part 1, deals with all significant hazards for horizontal directional drilling equipment (HDD) 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 horizontal directional drills.

A machine is considered a horizontal directional drill if it is designed to drill in a shallow arc for the installation of pipes, conduits, and cables and typically has a drill string entry angle of less than 45° relative to the operating surface of the earth.

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 474-1:2006+A4:2013, *Earth-moving machinery — Safety — Part 1: General requirements*

EN 12999:2011+A1:2012, *Cranes — Loader cranes*

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

EN ISO 2867:2011, *Earth-moving machinery — Access systems (ISO 2867:2011)*

EN ISO 3411:2007, *Earth-moving machinery — Physical dimensions of operators and minimum operator space envelope (ISO 3411:2007)*

EN ISO 3449:2008, *Earth-moving machinery — Falling-object protective structures — Laboratory tests and performance requirements (ISO 3449:2005)*

EN ISO 3471:2008, *Earth-moving machinery — Roll-over protective structures — Laboratory tests and performance requirements (ISO 3471:2008)*

EN ISO 5353:1998, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point (ISO 5353:1995)*

EN ISO 6682:2008, *Earth-moving machinery — Zones of comfort and reach for controls (ISO 6682:1986, including Amd 1:1989)*

EN ISO 7731:2008, *Ergonomics — Danger signals for public and work areas — Auditory danger signals (ISO 7731:2003)*

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

ISO 9244:2008, *Earth-moving machinery — Machine safety labels — General principles*

ISO 9533:2010, *Earth-moving machinery — Machine-mounted audible travel alarms and forward horns — Test methods and performance criteria*

ISO 11112:1995[1], *Earth-moving machinery — Operator's seat — Dimensions and requirements*)

ISO/DIS 15818:2013, *Earth-moving machinery — Lifting and tying-down attachment points — Performance requirements*

ISO 16754:2008, *Earth-moving machinery — Determination of average ground contact pressure for crawler machines*

ISO 17063:2003, *Earth-moving machinery — Braking systems of pedestrian-controlled machines — Performance requirements and test procedures*

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 Terminology for horizontal directional drills is specified in ISO 21467.

3.1
horizontal directional drill
machine that uses a steerable cutting head attached to the end of a drill string for creating a bore through the earth in a horizontal direction

Note 1 to entry: Drilling can include fluid injection through the drill string to the cutting head, tracking of the bore by use of sensors or a transponder near the cutting head and subsequent enlargement of the bore by back-reaming.

3.2
drill string for HDD
length of rods joined together which transmit forces from the drill frame to the cutting head or back-reamer that cuts the earth and which is also used to rotate the cutting head to position it for steering

Note 1 to entry: This terms is herafter referred to as "drill string".

3.3
drill frame
structure on the horizontal directional drill that transmits rotational and linear forces to the drill string

3.4
ground fixation device
device by which the horizontal directional drill is secured to the ground

3.5
exit side
location remote from the base machine where the drill string exits the ground

3.6
back-reaming
process of enlarging the bore by pulling back a tool of larger diameter than that previously used to form the bore

3.7
back-reamer
tool of larger diameter than that previously used to form the bore

---

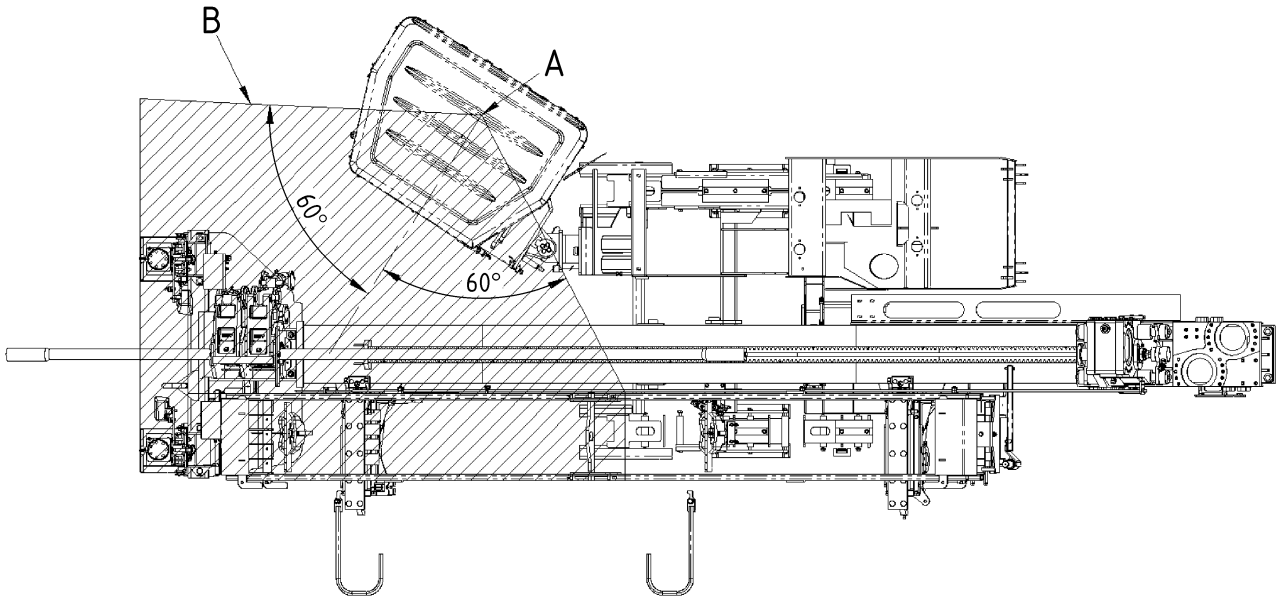
[1]) This document is impacted by Amendment 1 published in 2001.

3.8
hose track
carrier that protects, guides, and maintains proper bend radius of hydraulic hoses, electrical cables, and air hoses during movement between the stationary and moving portion of the horizontal directional drill

3.9
drill rod/pipe receiver
structure or a method that supports the drill rod/pipe on horizontal directional drills that are not equipped with mechanical drill rod/pipe loaders

3.10
operator zone of control
visible length of the drill pipe when seated in the operator's seat with a profile of 60° each side based on the nasal binocular field of vision assuming a fixed head and fixed eyes measured from the central position with respect to the head but the length extends only to the inside edge of the drill rod/pipe storage magazine and not beyond

Note 1 to entry: See Figure 1.



Key

A seat index point

B operator zone of control

Figure 1 — Operator zone of control

4 List of additional significant hazards

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

Table 1 of EN 16228-1:2014 and Table 1 of this document contain all hazards, hazardous situations and events, identified by risk assessments as significant for horizontal directional drilling 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 tramming between working positions on the job site;

e) out of service on the work site;

f) maintenance;

g) in storage at the plant depot or on the work site.

Table 1 — List of additional significant hazards and associated requirements

No.	Hazard	Relevant clause(s) in this standard
1	Mechanical Hazards	5.10.3
1.1	Drawing in or trapping	5.3
1.2	Entanglement	5.10.3, 5.12.3, 5.13
1.3	Crushing due to machine operation	5.6, 5.7, 5.9, 5.10.2
1.4	Crushing due to product movement	5.6
1.5	Crushing during rod/pipe connection operation	5.12.8, 5.12.9.1
1.6	Crushing during manual drill rod handling	5.12.9
2	Hazardous events due to unexpected movement	5.3
2.1	Movement of drill string/tooling at Exit side	5.13
2.2	Movement of product connected to drill string at exit side	5.13
2.3	Movement of machine from anchored position	5.2
2.4	Movement of machine (tramming) while in drilling position	5.6, 5.8
3	Hazards due to electrical contact	5.11
4	Hazards generated by noise, resulting in:	
4.1	Hearing losses and physiological disorders	Annex B
4.2	Accidents due to interference with speech communication and warning signals	Annex B
5	Visibility of work area	5.6.2.2, 5.11.2, 5.12.5

5 Safety requirements and/or protective measures

5.1 General

Horizontal directional drills shall comply with the requirements of EN 16228-1:2014, as far as not modified or replaced by the requirements of this part.

5.2 Stability

5.2.1 General

Subclause 5.2.3 of EN 16228-1:2014 applies with the following modification(s).

The stability angle shall not be less than 10° in any direction when tramming and not less than 5° under any other conditions. This shall be achieved by having a sufficiently heavy machine and/or by the use of ground fixation devices. Stability shall be determined by calculation or by physical test.

5.2.2 Ground pressure

Subclause 5.2.3.7 of EN 16228-1:2014 applies with following modification.

For crawler mounted horizontal directional drills, the ground pressure while tramming shall be calculated according to Annex F of EN 16228-1:2014 or ISO 16754:2008.

5.3 Brakes

5.3.1 Brakes for travelling

Subclause 5.7.1 of EN 16228-1:2014 applies with the following addition.

Brake systems of pedestrian controlled horizontal directional drills shall meet the requirements of ISO 17063:2003.

5.3.2 Brakes for slewing

Subclause 5.7.2 of EN 16228-1:2014 applies with the following modification.

Only horizontal directional drills equipped with a slewing mechanism shall comply.

5.4 Winches, draw-works and ropes

5.4.1 General

Subclause 5.8 of EN 16228-1:2014 does not apply.

NOTE Horizontal directional drills do not have winches used for the purpose of lifting.

5.4.2 Roller and leaf chains

Subclause 5.8.5 of EN 16228-1:2014 applies with the following exception:

Roller and leaf chains used on horizontal directional drills for linear feeding of the drill string with a force of 200 kN or less may be selected with a safety factor of at least 1,5.

5.5 Indicating devices for inclination

Subclause 5.10 of EN 16228-1:2014 does not apply.

NOTE Horizontal directional drill stability is not affected by the position of the drill frame.

5.6 Operating position(s)

5.6.1 General

Subclause 5.14.1 of EN 16228-1:2014 does not apply.

Where there is a risk of horizontally ejected objects, an appropriate protection shall be provided.

Required space, leg space etc. shall be in accordance with EN ISO 3411:2007 and EN ISO 6682:2008.

5.6.2 Cab/Cabin

5.6.2.1 Horizontal directional drills with a mass less than 8 000 kg

Horizontal directional drills with an operating mass less than 8 000 kg are not required to have a cab.

5.6.2.2 Horizontal drills with a mass greater than 8 000 kg

Horizontal directional drills with an operating mass greater than or equal to 8 000 kg shall be equipped with a cab/cabin. The cab shall meet the requirements of 5.3.2, 5.20.1 and 5.22.5 of EN 474-1:2006+A4:2013.

Horizontal directional drills supplied with an enclosed cab shall have a minimum of a windscreen cleaning device on the forward facing window. The dimensions for operator envelope shall meet the requirements of EN ISO 3411:2007.

5.6.3 Driving, tramming and operating(s) position

Horizontal directional drills that allow the operator to ride the machine during tramming, shall be provided with a seat and a roll-over protective structure (ROPS) in accordance with EN ISO 3471:2008.

Horizontal directional drills that allow the operator to realign the machine from a seated operator's position during the drilling operation that are not equipped with a ROPS structure shall have a maximum tramming operation time of 10 s. The 10 s tramming limitation shall be provided by a hold to run switch.

Horizontal directional drills (excluding types designed to work from a pit, or to be controlled remotely) shall be fitted with a seat from which the operator can comfortably operate the machine controls during operation of the machine. The seat dimensions and horizontal adjustment ranges shall be in accordance with ISO 11112:1995.

5.6.4 Falling Object Protection (FOPS)

Horizontal directional drills shall be fitted with falling object protective structure (FOPS) level II of EN ISO 3449:2008 if they are equipped with lifting devices where there is a capability to lift drill rod or tooling over the operator station.

5.7 Access to operating positions, intervention and servicing points

Subclause 5.12 of EN 16228-1:2014 applies with the following addition:

Required access to the drive chuck and breakout clamps for wire-line connections shall comply with EN ISO 2867:2011.

5.8 Retrieval, transportation, lifting and towing of horizontal directional drills and their parts

Subclause 5.19 of EN 16228-1:2014 applies with the following addition.

Horizontal directional drills shall be equipped with tying down points. If equipped with lifting points, ISO/DIS 15818:2013 can be used as a guideline.

When a removable drill rod box/magazine is provided, the weight of the full rod box/magazine and its lifting points shall be marked on it.

5.9 Travel speed

The forward speed of pedestrian controlled horizontal directional drills shall not be capable of exceeding 6 km/h by design.

The speed for travelling towards the operator (i.e. reversing) shall not be capable of exceeding 2,5 km/h by design. Where the horizontal direction drill is controlled while tramming via a tethered or wireless remote control, the forward and reverse speed shall not exceed 6 km/h by design.

5.10 Control devices

5.10.1 General

Subclause 5.16 of EN 16228-1:2014 applies with the following addition:

Horizontal directional drill specific control device pictograms are given in Annex A.

5.10.2 Pedestrian controlled horizontal directional drills

The travel function of pedestrian controlled horizontal directional drills shall be controlled by means of a hold-to-run device which when released, causes the machine to stop.

5.10.3 Protective measures for stopping of rotation and feed

Subclause 5.16.1, paragraph 3 of EN 16228-1:2014 does not apply to horizontal directional drills.

The primary controls for rotation and feed shall be hold-to-run and shall stop drill movement if released. If it is possible to select a control mode whereby rotation and feed can be set to continuous operation, any subsequent manipulation of drill rotation or feed control(s) shall immediately cause rotation and feed to stop.

An interlock shall be provided to ensure that drill pipe rotation and feed functions can only be engaged when the operator is properly positioned at the operator's station. If the operator leaves the designated operator's position, drill pipe rotation and feed shall automatically stop.

5.10.4 Restricted operating mode

Subclause 5.23.2.2.4 of EN 16228-1:2014 applies with the following modification.

The restricted operating mode for horizontal directional drills shall be engaged with the following specifications: a feed speed of not more than 20 m/min.

5.11Equipment for information and warning

5.11.1 General

Horizontal directional drills shall be equipped with devices to warn the operator if the machine becomes electrically energized as a result of contact with buried electrical cables. For example, such devices can be a strike detector or strike alarm system.

A horizontal directional drill designed for use where buried services could be present shall have a means to track the end of the drill string.

5.11.2 Warning devices

Subclause 5.30, paragraph 1 of EN 16228-1:2014 does not apply.

Subclause 5.30, paragraph 2 of EN 16228-1:2014 does not apply.

Ride-on horizontal directional drills with an obstructed view to the rear shall have an automatically activated reversing alarm complying with ISO 9533:2010.

5.12 Guards and protective devices

5.12.1 General

Subclause 5.23.2 of EN 16228-1:2014 does not apply with the exception of 5.23.2.2.4.

Fixed and movable guards shall comply with EN 953.

5.12.2 Design

The machine shall be designed to prevent access to rotating drill rods or moving parts within the rod handling system that are outside of the operator zone of control.

Within the operator zone of control, between the operator station and the ground fixation device, guarding of the rotating drill rod is not required.

The horizontal directional drill shall be designed so that while the drill rod/pipe is rotating, a person is not required to handle drill rod/pipe or enter drill rod/pipe path.

The manufacturer is not responsible for guarding the drill string beyond the breakout clamps. The area ahead of the breakout clamps of the machine that has exposed drill rod/pipe should be job site controlled.

5.12.3 Foot barrier

When a cab is not fitted and if the rotating drill rod/pipe is within 1 050 mm of the seat index point as defined in EN ISO 5353:1998 at the operator's position, a foot barrier shall be provided to prevent inadvertent foot placement on the drill rod/pipe at the operator control position. All exposed drill rod/pipe within a 1 050 mm radius of the SIP shall be protected by a foot barrier if not protected by another machine structure (e.g. engine enclosure, operator’s console, etc.). The foot barrier shall extend to a height equal to the top of the drill rod/pipe or 350 mm, whichever is greater.

5.12.4 Danger zones at rear of machine

At the rear of the machine when in operational mode, access to the drill rods and drill rotating head shall be prevented. Guards shall be used to limit access that is not provided by other machine structure (e.g. engine enclosure).

The guard shall provide protection from the top surface of the feed beam (upon which the drive head slides) to 2,5 m above the ground, measured with the feed beam placed in the operating position.

Where the hose track extends beyond the edge of the directional drill frame (feed beam) at the rear of the machine at a height between 1,2 m and 2 m above the ground, there shall be a means of preventing personnel entering that danger zone behind the machine or the hose track speed shall be reduced to less than 0,6 m/s in the danger zone.

5.12.5 Elevating drill frame

Where the directional drill frame (feed beam) can be raised independently of the machine and access is possible below the frame, the operator shall have direct visibility of the area below the frame when lowering it. Where the operator does not have direct visibility, an audible alarm complying with EN ISO 7731:2008 shall sound for 3 s before the frame can be lowered or the frame lowering speed shall be limited to 0,2 m/s measured at the rear of the drill frame.

5.12.6 Breakout clamps

Where the movement of the breakout clamp system, except the jaws of the clamp, creates a crushing hazard, guards or a protective device shall be installed to prevent access.

5.12.7 Ground fixation device

Ground fixation devices comprising full length augers shall be protected by a fixed guard. Fixed guards are not required if the flights do not extend above the base guide and the operator has direct visibility of the ground fixation device and hold to run controls.

5.12.8 Horizontal directional drills with a drill rod/pipe storage magazine

5.12.8.1 General

On the side of the horizontal directional drill on which the drill rod/pipe storage magazine is located, guarding shall be provided to prevent access to the stored rods and through the storage magazine to the rotating drill rod.

Access to the rotating drill rod/pipe below the drill rod/pipe storage magazine on crawler drills shall be considered adequately prevented if the lower edge of the guarding method is not higher than 1 m above ground level.

A means of adding additional drill rod/pipe to the storage magazine may be provided at the manufacturer's discretion.

Instructions for adding additional drill rod/pipe to the storage magazine shall be included in the operator's manual.

Instructions for drill rod operation/loading shall be included in the operator's manual.

5.12.8.2 Drills equipped with mechanical drill rod/pipe handling system

Access to the moving parts of the mechanical drill rod/pipe handling system shall be prevented by guards.

Where access to the drill rod/pipe is required at the breakout clamps and/or drive head (e.g. for wire-line connection), a switch shall be provided at the access point that will activate a restricted operating mode as specified in 5.10.4.

5.12.9 Horizontal directional drills without a mechanical drill/pipe handling system

5.12.9.1 Drills with a drill rod/pipe of more than 25 kg

The horizontal directional drill shall be designed so that drill pipes/rods can be loaded by a crane or separate lifting device.

Where the horizontal directional drill is equipped with a loading crane, the crane shall comply with EN 12999:2011+A1:2012.

When the horizontal directional drill does not have an on-board crane, the separate lifting device for handling drill rod/pipes should be provided by the user.

Drill rod/pipe receivers shall be provided to support both ends of drill rod/pipe for connection/threading without the use of hands.

Where access to the drill rod/pipe is required at the breakout clamps and/or drive chuck (e.g. for wireline connections), a switch shall be provided at the access point that will enable a restricted operating mode as specified in 5.10.4.

5.12.9.2 Drills with a drill rod/pipe of 25 kg or less

On horizontal directional drills designed to use a drill rod/pipe of 25 kg or less, rods may be hand loaded by the operator.

Where rods are hand loaded drill rod/pipe receivers shall be provided to support both ends of drill rod/pipe. It shall be possible to connect or thread rods without the use of hands.

Continuous operation modes for drill rotation and feed control(s) as described in 5.10.3 shall not be permitted on hand loaded drills.

5.13 Immobilisation system

Horizontal directional drilling equipment shall be provided with a wireless control system between the machine and personnel working at the exit side.

The system shall comprise a machine mounted base station at the operator's station and a portable control station. It shall allow someone distant from the machine to stop and then immobilize both rotation and feed of the drill string. Once the drill string has been immobilized, the system shall prevent further drill string movement until the portable control station has enabled a run condition at the machine mounted base station and the machine operator restarts drill string operation.

The remote immobilization station shall not replace an emergency stop for the base machine.

The status of drill rotation and feed immobilization shall be indicated at the portable control station and at the operator's station.

NOTE The immobilization system does not replace voice communication between the machine operator and exit side personnel.

5.14 Drill frame extensions

Horizontal directional drilling equipment with bolt on extensions to lengthen or shorten the drill frame shall be designed per 5.2.1 of EN 16228-1:2014 for strength. The drill frame extension pieces shall be equipped with lifting points in accordance to ISO/DIS 15818:2013.

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 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 measures						
5.1	General	x					1
5.2	Stability						
5.2.1	General	x	x			x	1
5.2.2	Ground pressure	x	x				1
5.3	Brakes						1
5.3.1	Brakes for travelling						1
5.3.2	Brakes for slewing	x				x	1
5.4	Winches, draw-works and ropes						1
5.4.2	Roller and leaf chains	x					1
5.5	Indicating devices for inclination						1
5.6	Operating position(s)						
5.6.1	General					x	
5.6.2	Cab/Cabin						1
5.6.2.1	Horizontal directional drills with a mass less than 8 000 kg			x	x		
5.6.2.2	Horizontal drills with a mass greater than 8 000 kg	x			x		1
5.6.3	Driving, tramming and operating(s) position	x					1
5.6.4	Falling Object Protection (FOPS)	x	x				1
5.7	Access to operating positions, intervention and servicing points						1
5.8	Retreival, transportation, lifting and towing horizontal directional drills and their parts			x			1
5.9	Travel speed	x			x	x	
5.10	Control devices						
5.10.1	General			x			1
5.10.2	Pedestrian controlled horizontal directional drills	x				x	
5.10.3	Protective measures for stopping of rotation and feed					x	1
5.10.4	Restricted operating mode	x				x	1

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)
5.11	Equipment for information and warning					x	1
5.11.2	Warning devices					x	1
5.12	Guards and protective devices						
5.12.1	General						1
5.12.2	Design	x			x		
5.12.3	Foot barrier	x			x		
5.12.4	Danger zones at rear of machine	x			x		
5.12.5	Elevating drill frame	x				x	1
5.12.6	Breakout clamps	x		x			
5.12.7	Ground fixation device	x		x			
5.12.8	Horizontal directional drills with a drill rod/pipe storage magazine						
5.12.8.1	General	x		x			
5.12.8.2	Drills equipped with mechanical drill rod/pipe handling system	x		x			
5.12.9	Horizontal directional drills without a mechanical drill rod /pipe handling system						
5.12.9.1	Drills with a drill rod/pipe of more than 25 kg	x				x	1
5.12.9.2	Drills with a rod/pipe of 25 kg or less	x		x			
5.13	Immobilisation system					x	
5.14	Drill frame extensions	x		x			1
7	Information for use						
7.2	Operator's manual			x			1
7.3	Warning signs			x			1
1 Verification by reference to standard which is mentioned in the corresponding clause.							

6.2 Fitness for purpose testing

Subclause 6.2.2.3 of EN 16228-1:2014 does not apply.

Horizontal directional drills shall be tested as specified in subclause 6.2.2.1 of EN 16228-1:2014.

7 Information for use

7.1 General

When a removable drill rod box/magazine is provided, the weight of the full rod box/magazine and its lifting points shall be marked on it, see 5.8 (final paragraph).

7.2 Operator's manual

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

Instructions on how to use safety equipment associated with horizontal directional drills shall be provided including the following:

— electrical strike detectors and alarm systems;

— equipotential grid system;

— exit side lockout systems;

— instructions for drill rod operation/loading;

— instructions to exclude all personnel from the horizontal directional drill during the drilling process;

— instructions for placement of the control cabin;

— instructions for the installation and removal of drill frame extensions if provided;

— instructions for suitable rod breaking and handling equipment at the exit side;

— instructions for remote control operation that the operator shall be able to observe the machine while operating;

— instructions fully describing what actions to take if a buried electrical cable is struck during drilling operations.

7.3 Warning signs

Subclause 7.3.2.2.2 of EN 16228-1:2014 applies with the following addition:

Warning signs and controls symbols specific to horizontal directional drills shall meet the requirements of ISO 9244:2008 and Annex A.

Annex A
(informative)

Symbols and signs

A.1 General

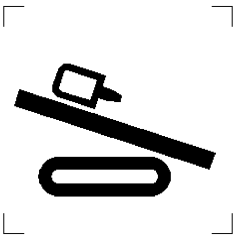
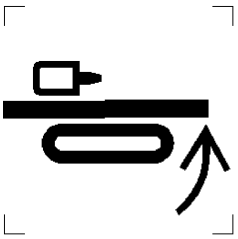
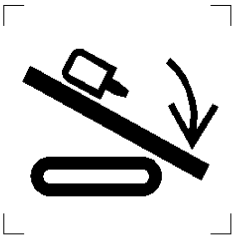
This annex gives a collection of symbols to be used to promote the safe use and operation of horizontal directional drills and are generally specific to horizontal directional drills. The symbols in this annex are to supplement those provided for in EN 16228-1:2014, Annex D.

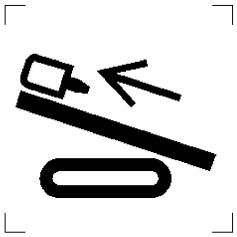
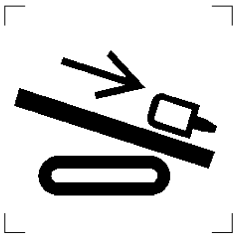
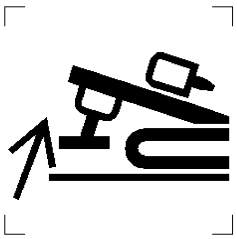
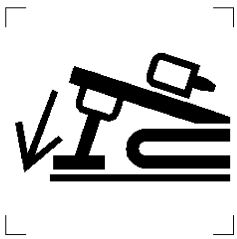
The symbols given are basic symbols for a single function but several symbols can be combined to symbolize a more complex function and some examples are given for such combinations that are common in operation of horizontal directional drill rigs.

In this annex the carrier part of the machine is symbolized by a triangle or a block which may be replaced in the actual case by a symbol picturing the carrier configuration.

A.2 Symbols for base machine and drilling rack

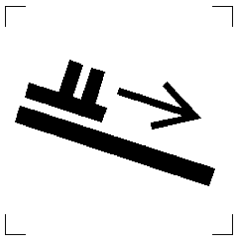
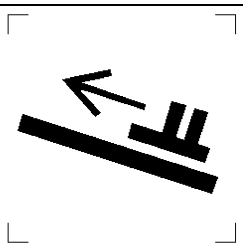
Table A.1 — Symbols for base machine and drilling rack

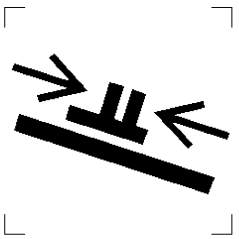
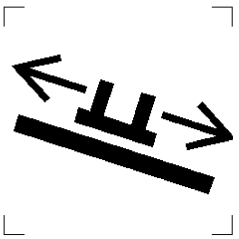
Symbol Number	Symbol Description/Application	Symbol Form/Shape
1	Machine/Basic symbol	
2	Machine rack/Frame angle – Up	
3	Machine rack/Frame angle – Down	

Symbol Number	Symbol Description/Application	Symbol Form/Shape
4	Carriage – Up/Retract	
5	Carriage – Down/Thrust	
6	Stabilizer – Up	
7	Stabilizer – Down	

A.3 Symbols for front vice

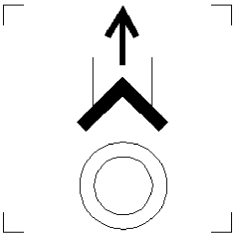
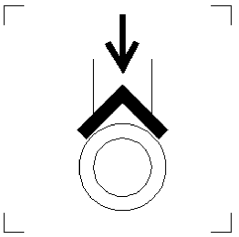
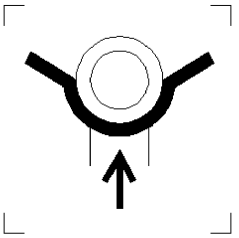
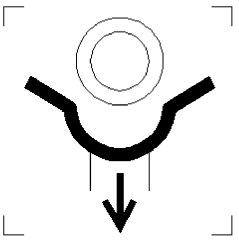
Table A.2 — Symbols for front vice

Symbol Number	Symbol Description/Application	Symbol Form/Shape
8	Vise assembly travel – Forward	
9	Vise assembly travel – Rearward	

Symbol Number	Symbol Description/Application	Symbol Form/Shape
10	Vise assembly – Close	
11	Vise assembly – Open	

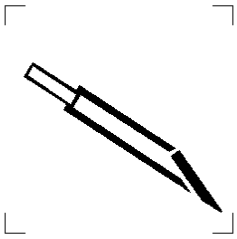
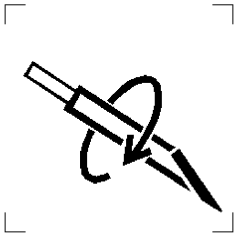
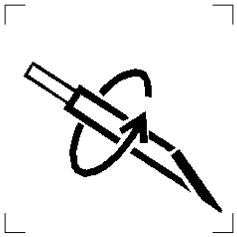
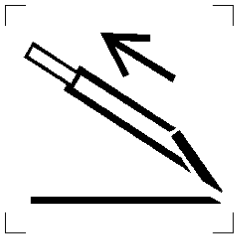
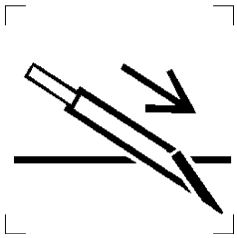
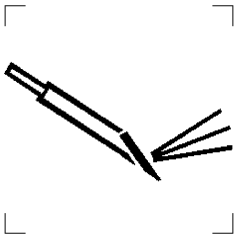
A.4 Symbols for rod cradle

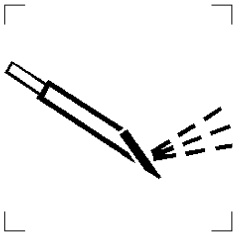
Table A.3 — Symbols for rod cradle

Symbol Number	Symbol Description/Application	Symbol Form/Shape
12	Rod joint alignment – Raise	
13	Rod joint alignment – Lower	
14	Rod cradle – Raise	
15	Rod cradle – Lower	

A.5 Symbols for drill head

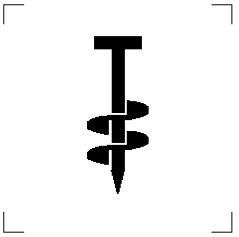
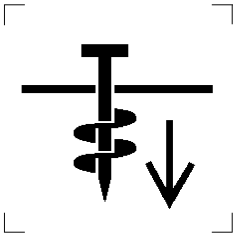
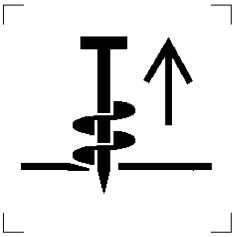
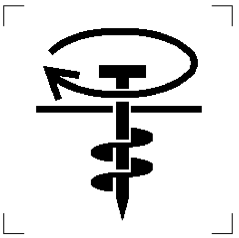
Table A.4 — Symbols for drill head

Symbol Number	Symbol Description/Application	Symbol Form/Shape
16	Drill head – Basic symbol	
17	Drill head – Forward rotate	
18	Drill head – Reverse rotate	
19	Drill head – Retract	
20	Drill head – Thrust	
21	Drill head fluid – Full flow	

Symbol Number	Symbol Description/Application	Symbol Form/Shape
22	Drill head fluid – Reduced flow	

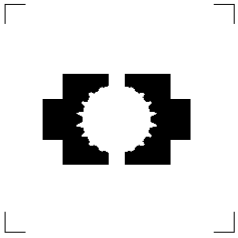
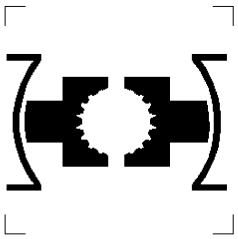
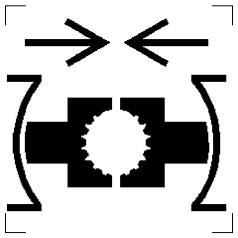
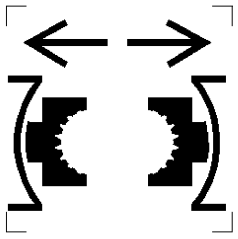
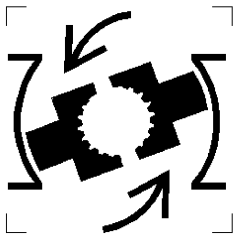
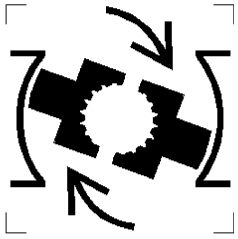
A.6 Symbols for earth anchor

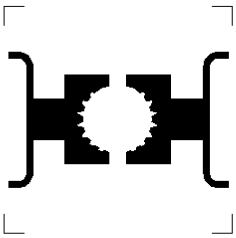
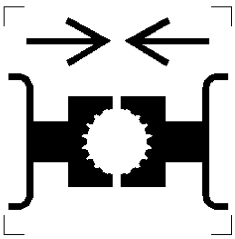
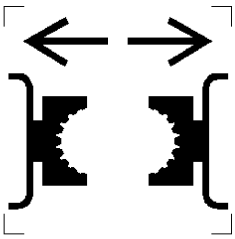
Table A.5 — Symbols for earth anchor

Symbol Number	Symbol Description/Application	Symbol Form/Shape
23	Earth anchor – Basic symbol	
24	Earth anchor – In/Down	
25	Earth anchor – Out/Up	
26	Earth anchor – Rotate in	
27	Earth anchor – Rotate out	

A.7 Symbols for rod clamp

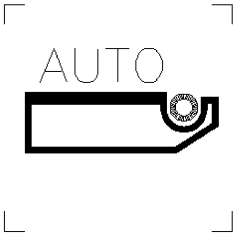
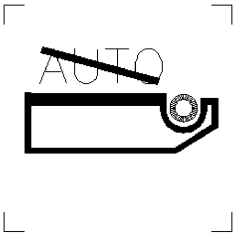
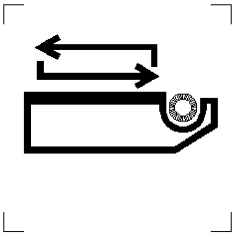
Table A.6 — Symbols for rod clamp

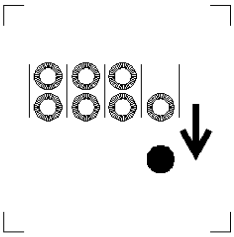
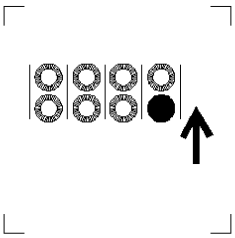
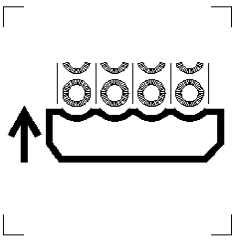
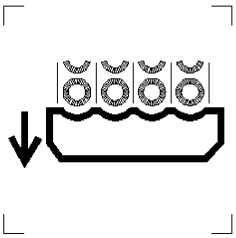
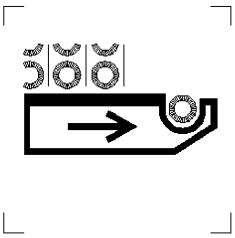
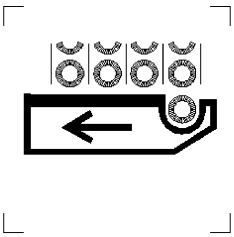
Symbol Number	Symbol Description/Application	Symbol Form/Shape
28	Clamp – Basic symbol	
29	Rotating clamp – Basic symbol	
30	Rotating clamp – Close	
31	Rotating clamp – Open	
32	Rotating clamp – Rotate counter-clockwise (Break lower joint)	
33	Rotating clamp – Rotate Clockwise (Break upper joint)	

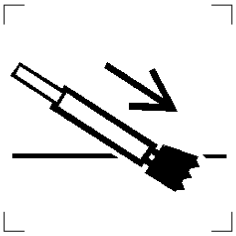
Symbol Number	Symbol Description/Application	Symbol Form/Shape
34	Stationary clamp – Basic symbol	
35	Stationary clamp – Close	
36	Stationary clamp – Open	

A.8 Symbols for rod loader

Table A.7 — Symbols for rod loader

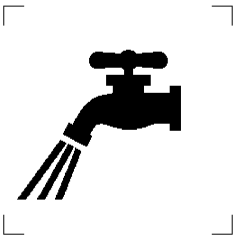
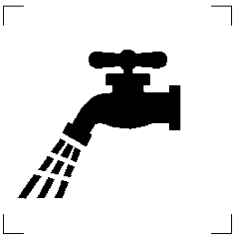
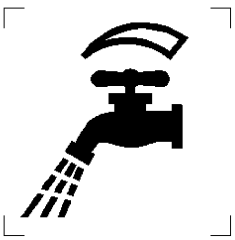
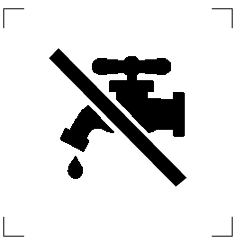
Symbol Number	Symbol Description/Application	Symbol Form/Shape
37	Rod loader – Auto cycle on	
38	Rod loader – Auto cycle off	
39	Rod loader – Auto cycle	

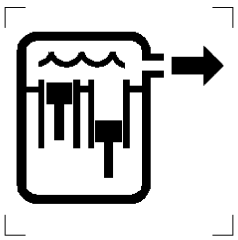
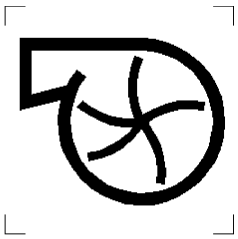
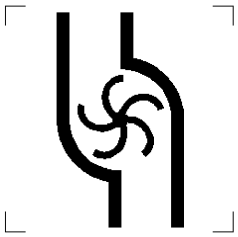
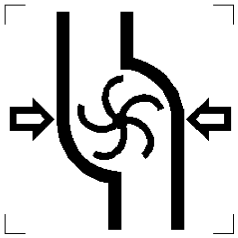
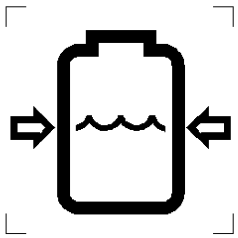
Symbol Number	Symbol Description/Application	Symbol Form/Shape
40	Rod loader – Rod out	
41	Rod loader – Rod in	
42	Rod loader – Rod lift	
43	Rod loader – Rod lower	
44	Rod loader – Rod extend	
45	Rod loader – Rod retract	

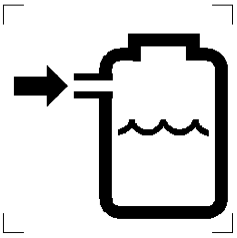
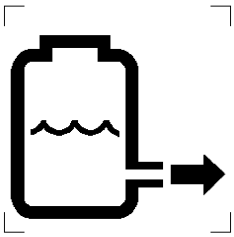
Symbol Number	Symbol Description/Application	Symbol Form/Shape
46	Drill head – Impact hammer	

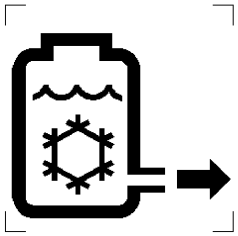
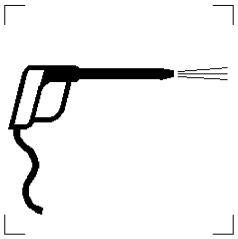
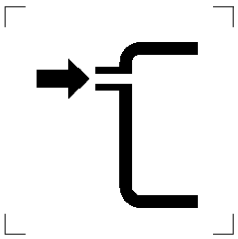
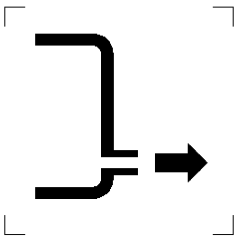
A.9 Symbols for Drilling Fluid Supply

Table A.8 — Symbols for drilling fluid supply

Symbol Number	Symbol Description/Application	Symbol Form/Shape
47	Fluid supply/Source – Basic	
48	Fluid supply/Source – Full flow	
49	Fluid supply/Source – Partial flow	
50	Fluid supply/Source – Variable flow	
51	Fluid supply/Source – Off	

Symbol Number	Symbol Description/Application	Symbol Form/Shape
52	Water pump – High pressure	
53	Pump – Centrifugal	
54	Fluid pump – Basic symbol	
55	Fluid pump pressure	
56	Fluid tank – Basic symbol	
57	Fluid tank pressure	

Symbol Number	Symbol Description/Application	Symbol Form/Shape
58	Fluid tank – Inlet	
59	Fluid tank – Outlet	
60	Fluid mixing tank – Basic symbol	
61	Fluid mixing tank – Inlet	
62	Fluid mixing tank – Outlet	
63	Antifreeze tank – Basic symbol	

Symbol Number	Symbol Description/Application	Symbol Form/Shape
64	Antifreeze tank – Outlet	
65	Water/Washing wand	
66	Inlet/Pressure/Supply	
67	Outlet/Return	

Annex B
(normative)

Noise test code

B.1 General

Annex B of EN 16228-1:2014 applies with following additions.

B.2 Operating conditions

For horizontal directional drill rigs the influence of the process is eliminated by allowing the drill rig to work at full speed, but without the drilling tool engaged.

During the noise emission tests the rotary drill rig shall be operated under no load in a normal operational cycle.

Subclause B.2.4 of EN 16228-1:2014 does not apply for integral drilling fluid pumps and air compressors.

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.

Bibliography

[1] ISO 21467:2004, *Earth-moving machinery — Horizontal directional drills — Terminology and specifications*

[2] ISO 15817:2012, *Earth-moving machinery — Safety requirements for remote operator control systems*

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™