BS EN 16228-7:2014

BSI Standards Publication

Drilling and foundation equipment — Safety

Part 7: Interchangeable auxiliary equipment

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National foreword

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BS EN 16228-5:2014 and BS EN 16228-6:2014, it supersedes BS EN 791:1995+A1:2009 and BS EN 996:1995+A3:2009, which are withdrawn.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

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Foreword

This document (EN 16228-7:2014) has been prepared by Technical Committee CEN/TC 151 “Construction equipment and building material machines - Safety”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2014 and conflicting national standards shall be withdrawn at the latest by November 2014.

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

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

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

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

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

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

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 interchangeable auxiliary equipment when they are used as intended and under the conditions of misuse which are reasonably foreseeable by the manufacturer associated with the whole life time of the machine (see Clause 4).

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

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

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

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

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

2 Normative references

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

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

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

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

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

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

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

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

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

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

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

3 Terms and definitions

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

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

3.1
rotary percussion hammers
equipment to drill holes into the ground, where the rotary drive has an additional impact hammer

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

3.2
down the hole hammers (DTH-hammers)
device in which the percussion mechanism is located directly behind the drill bit

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

3.3
impact hammer
leader-guided or free-riding equipment to drive pile-elements by high-force striking action into the ground

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

3.4
static pile pushing/pulling device
equipment to push or pull piles, mostly sheet piles, into or out of the ground or vice versa, by static pushing pulling forces, which are commonly actuated by hydraulic energy

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

3.5
sonic drilling device
equipment which superposes rotary drilling with vibrations at a high frequency

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

3.6
casing oscillator/rotator
equipment to drive in or push out casings with great diameters by low-speed rotation and high push/pull force

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

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

3.7
rotary drilling drives
equipment to actuate the rotating drilling stem, which is normally mounted at a leader or mast

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

3.8
deep vibrator
equipment to densify the soil by using a vertical into the ground driven lance, which is driven by an unbalanced mass at the bottom part of the lance

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

3.9
vibrators
equipment to install or extract piling elements by high-frequency oscillation into or out of the ground

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

3.10
connection of parts
installation of interchangeable equipment onto drilling and foundation equipment, earth-moving or agricultural equipment

4 List of additional significant hazards

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

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

Hazards generally occur under the following conditions:

a) in transportation to and from the work site;

b) in rigging and dismantling on the work site;

c) in service on the work site;

d) when moving between pile positions on the work site;

e) out of service on the work site;

f) in storage at the plant depot or on the work site;

g) maintenance.

Table 1 — List of additional significant hazards and associated requirements

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

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

5 Safety requirements and/or protective measures

5.1 General

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

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

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

5.2 Additional protective measures for interchangeable auxiliary equipment

5.2.1 Impact hammers

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

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

5.2.2 Casing oscillators/rotators

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

5.2.3 Vibrators

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

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

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

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

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

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

The clamping force for static pile pushing or pulling devices shall be at least 2 times the maximum pulling force.

The pressure developed in the hydraulic system shall provide at least the required minimum clamping force, and a device shall be included in the system for maintaining automatically the hydraulic pressure at the minimum required value as long as the clamp is closed.

All clamp systems shall have a protective device which prevents clamps from being unintentionally opened during operation.

Clamps shall have a safety device (e.g. check valve) maintaining them in the closed position even in case of total loss of pressure in the hydraulic lines.

The clamp hydraulic cylinder pressure shall be indicated on a pressure gauge or an indication device.

For all dynamic extractors used as vibrators with hydraulically or mechanically actuated clamps, unless part of a cast *in situ* system, the pile shall be secured to the extractor by means of a safety rope or sling of equal capacity to the load held in the clamp or similar equipment.

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 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					1
5.2	Additional protective measures for interchangeable auxiliary equipment						
5.2.1	Impact hammers	x		x			
5.2.2	Casing oscillators/rotators	x		x			
5.2.3	Vibrators	x		x		x	
5.2.4	Clamping devices for connection of pile elements to the driving tool	x			x	x	
7	Information for use						
7.1	Marking of interchangeable auxiliary equipment	x		x			1
7.1.2	Down the hole hammers (DTH-hammers)			x			
7.1.3	Impact hammers			x			
7.1.4	Static pile pushing/pulling device			x			
7.1.5	Casing oscillators/rotators			x			
7.1.6	Rotary drilling drives			x			
7.1.7	Deep vibrators			x			
7.1.8	Vibrators			x			
7.2	Instruction books for interchangeable auxiliary equipment						
7.2.1	General			x			1
7.2.2	Down the hole hammers (DTH-hammers)	x	x				1
7.2.3	Impact hammers			x			1
7.2.4	Static pile pushing/pulling device	x		x			1
7.2.5	Casing oscillators/rotators	x				x	1
7.2.6	Vibrators			x			1
1 Verification by reference to standard which is mentioned in the corresponding clause.							

7 Information for use

7.1 Marking of interchangeable auxiliary equipment

7.1.1 General

Clause 7.1 of EN 16228-1:2014 applies with following additions.

Data plates shall be provided for all interchangeable auxiliary equipment, except down the hole hammers.

Hydraulic and pneumatic interchangeable auxiliary equipment shall be marked with the maximum allowable pressure, where applicable.

7.1.2 Down the hole hammers (DTH-hammers)

DTH-hammers shall be marked by engraving.

7.1.3 Impact hammers

— maximum impact energy per impact;

— maximum drop height for free fall hammers.

7.1.4 Static pile pushing/pulling device

— maximum clamp pressure;

— maximum pushing/pulling force on suspension system.

7.1.5 Casing oscillators/rotators

— maximum pressures;

— maximum torque.

7.1.6 Rotary drilling drives

— maximum pressure;

— maximum torque;

— maximum pushing/pulling force.

7.1.7 Deep vibrators

— maximum pulling force.

7.1.8 Vibrators

— maximum clamp pressure;

— maximum pulling force on suspension system.

7.2 Instruction books for interchangeable auxiliary equipment

7.2.1 General

To comply with 7.3.2 of EN 16228-1:2014, the manufacturer of interchangeable auxiliary equipment shall specify in the instruction books the machinery with which it can be safely assembled either by all technical information required or by reference to specific models.

The manufacturer of interchangeable auxiliary equipment shall also provide the necessary instructions for safe assembly and use of the interchangeable equipment.

The manufacturer of interchangeable auxiliary equipment shall provide all the technical data including dimensions, masses and position of centre of gravity to allow calculations for stability of drilling and foundation equipment to be carried out according to the instructions for use.

The person or company that assembles the combination shall check to ensure that this equipment fulfils all relevant requirements as specified in the instructions for the interchangeable auxiliary equipment.

The manufacturer of the interchangeable auxiliary equipment shall place a warning in the instructions that the person or company which is assembling the interchangeable auxiliary equipment with drilling and foundation equipment according to EN 16228 parts 1 to 6, earth-moving machinery, agricultural equipment, etc. and changing the original shape or functions of the equipment which departs from the manufacturer's instructions will be fully responsible for the final assembled machine.

7.2.2 Down the hole hammers (DTH-hammers)

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

— maximum air/liquid pressure;

— maximum flow;

— maximum allowable torque and feeding force for the hammer and/or the threads of the drill stem.

7.2.3 Impact hammers

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

— specification of the fuel used in diesel hammers.

7.2.4 Static pile pushing/pulling device

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

— pushing/pulling device not to be used for lifting operations;

— pushing/pulling force shall only be activated, if the reaction clamps are closed.

If the static pushing/pulling device is mounted on a leader or mast, the operator shall be informed about the hazard of damaging the leader of the piling rig, in case the reaction clamps are not able to withstand the pushing/pulling forces.

7.2.5 Casing oscillators/rotators

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

The casing clamp shall always be equipped with a casing or shall be in the lowest possible position to prevent unintended movement.

7.2.6 Vibrators

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

The following information shall be included:

— vibrator/clamps not to be used for lifting operations;

— prohibited to leave an element suspended in the clamp of a vibrator, which is free hanging and out of operation;

— prohibited to leave vibrators without the support of a carrier when not in operation clamped on an element installed in the ground, except for the situation where a pile, which is sufficiently embedded, will be used to support the equipment, clamped on that pile for stability;

— extraction pulling force not to be exceeded;

— pile to be secured to the service winch by means of a safety rope or sling of equal capacity to the load held in the clamp unless part of a cast *in situ* system;

— prohibited to use vibrator as an impact hammer, by hammering with open clamps.

Annex A
(normative)

Noise test code for interchangeable auxiliary equipment

A.1 General

Annex B of EN 16228-1:2014 applies with the following exceptions:

— for down the hole hammers: Annex A of EN 16228-2:2014 Percussive drill rigs shall be used;

— for rotary percussion hammers: Annex A of EN 16228-2:2014 Percussive drill rigs shall be used;

— for casing oscillators/rotators: Annex A of EN 16228-2:2014 Non-Percussive drill rigs shall be used;

— for sonic drilling devices: Annex A of EN 16228-2:2014 Non-Percussive drill rigs shall be used;

— for rotary drilling drives: Annex A of EN 16228-2:2014 Non-Percussive drill rigs shall be used;

— for pile installation and extracting equipment: A.2 to A.7 of this annex shall be used.

For interchangeable auxiliary equipment that is not mentioned above and is not dealt with in Annex A of this standard, Annex B of EN 16228-1:2014 applies.

NOTE An amendment to EN 16228–1 for “Development of noise test code for cabin noise and interchangeable equipment” is planned to be started after publication of EN 16228 series.

A.2 Pile installation and extracting equipment

Clauses A.3 to A.7 give the noise test codes for pile installation and extracting equipment with the following specifications. This noise test code is applicable for impact hammers and extractors up to a maximum striking energy of 250 kNm and to vibrators and static pile pushing/pulling devices up to a power of 1 000 kW of its power source.

For equipment above these limits this noise test code may have to be adapted to accommodate the practical problems associated with the testing of large equipment. In such cases the details of adaptation shall be recorded and reported (see also A.6).

NOTE This noise test code is not intended for an exact comparison of noise levels generated by different types of equipment (i.e. impact hammers versus vibrators).

A.3 Installation and operation of source under test

A.3.1 Test-pile or test-stand

The equipment shall be operated mounted on a test-pile or on a test-stand. The test-pile, if any, shall be a steel pipe pile.

The test-stand shall allow a normal operation of the equipment according to the manufacturers' specifications.

As far as practicable, the effect of background noise from the environment including that from any power source shall be minimized and subsequently corrected by calculation.

The height of force transfer h_F is recommended to be between 0 m and 2 m above ground level.

NOTE For impact hammers *h* is in general 2 m maximum because the sound source is very close to the level of the force transfer.

This height of the force transfer level is defined as follows:

— for impact hammers: contact level with top of pile or bottom of pile cap, helmet or anvil respectively;

— for vibrators: top of pile;

— for static pile pushing/pulling device: top of (highest) pile.

A.3.2 Operating conditions for the equipment

The equipment shall be operated under rated conditions, according to the manufacturers' specifications. This includes the following:

— operation under normal working temperature;

— equipment shall operate at minimum at 90 % of its maximum specified rating. This is defined as follows:

  — for impact hammers: striking energy, which can be defined as impact energy (kNm);

  — for vibrators: eccentric moment (kgm);

  — for static pile pushing/pulling devices: pushing force (kN).

— blow-rate or frequency or velocity shall be at a percentage of the manufacturers' specified maximum values at specified rating defined above;

  — for impact hammers: 90 % blow-rate (blows/min);

  — for vibrators: 95 % frequency (s^{-1} or min^{-1});

  — for static pile pushing/pulling devices: 90 % velocity (m/min).

A.3.3 Specific requirements for the various types of interchangeable auxiliary equipment

A.3.3.1 Impact hammers

A.3.3.1.1 Cushion assembly

A hammer cushion assembly as specified by the manufacturer shall be used during noise measurement.

A.3.3.1.2 Pile cap

A suitable pile cap for the test conditions as specified by the manufacturer shall be used during noise measurement.

A.3.3.2 Specifications for vibrators and extractors

If a clamping device for vibrators is needed to operate the machine during noise measurement, a standard clamping device as specified by the manufacturer shall be used.

The vibrator shall be operated at a test bench or freely suspended or directly connected to a support which may be part of the piling equipment.

The total mass of the dynamic part of the vibrator shall be increased at least by 40 % by adding extra mass (e.g. clamping device(s)).

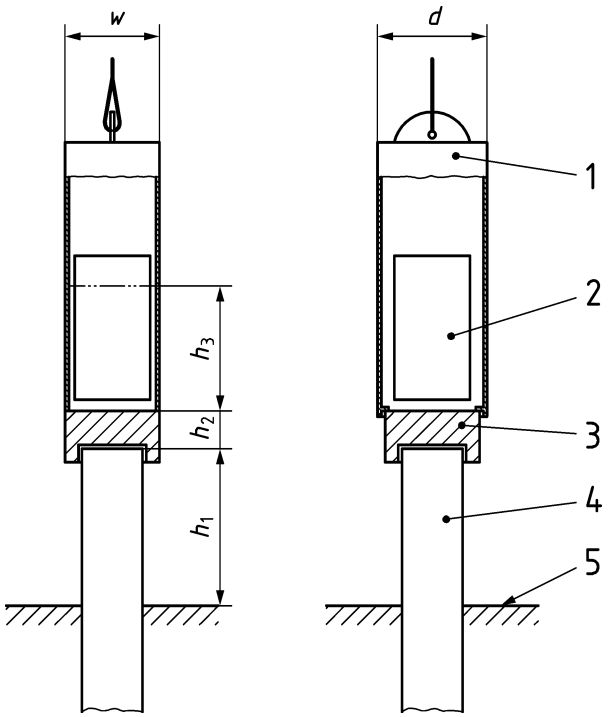
A.4 Determination of the sound power level emitted by the equipment

A.4.1 Hemispherical measurement surface (see EN ISO 3744:2010, 7.2)

The measurement surface shall be a hemisphere with a radius relating to the dimension of the noise source for the equipment.

Types of pile installation and extracting equipment and their characteristic dimensions:

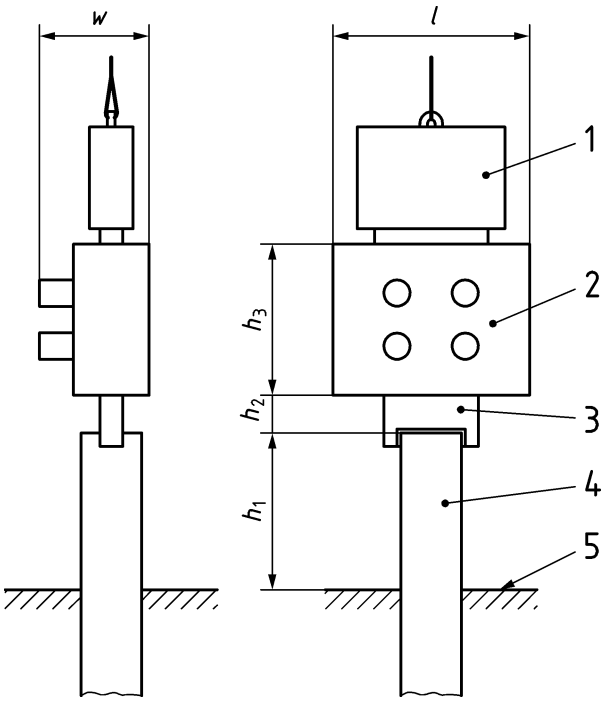
Examples of the dimensions of the hypothetical reference box (as defined in EN ISO 3744:2010, 7.1) are given in Figures A.1, A.2 and A.3: length = d, width = w and height = $h_1 + h_2 + h_3$.



Key

1	impact hammer
2	ram weight
3	pile cap
4	pile
5	ground level
h_1	height of force transfer
h_2	height of cap device
h_3	stroke height
d	depth
w	width

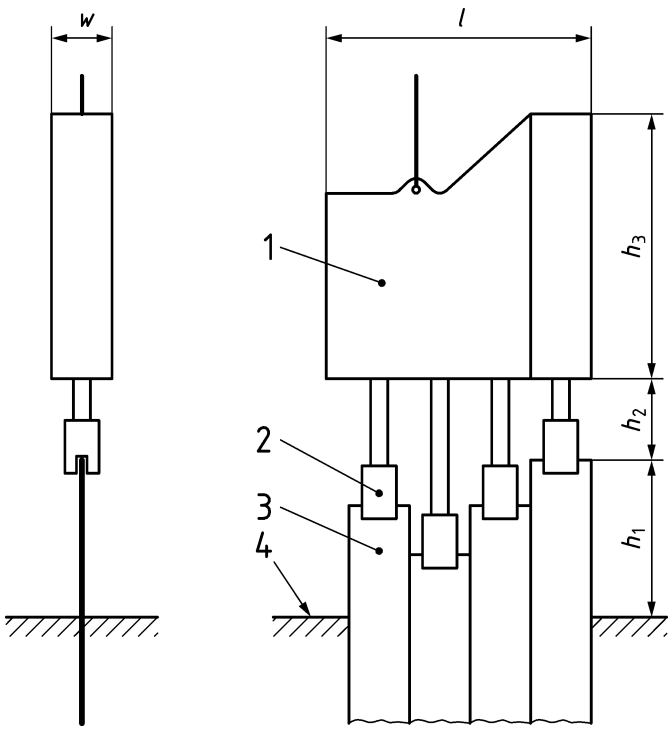
Figure A.1 — Impact hammer



Key

1	isolating device
2	vibrator
3	clamping device
4	pile
5	ground level
h_1	height of force transfer
h_2	height of clamping device
h_3	height of eccenter housing
l	length
w	width

Figure A.2 — Vibrator



Key

1	static pushing/pulling device
2	clamping device
3	piles
4	ground level
h_1	height of force transfer
h_2	height of clamping device
h_3	height of housing
l	length
w	width

Figure A.3 — Static pushing/pulling device

A.5 Noise at the operator's position

A.5.1 Determination of the A-weighted emission sound pressure level

The A-weighted emission sound pressure level at the operator's position(s) shall be measured according to EN ISO 11201:2010.

If no particular operator’s position(s) is specified by the manufacturer the emission sound pressure level at the operator's position(s) shall be determined from the sound power level according to EN ISO 11203:2009, using Q2 method. Values of emission sound pressure level at operator's position(s) shall be determined for the distances of 4 m from the pile installation and extracting equipment (e.g. for a distance of 4 m the following applies: Q2 = 20,0 dB, based on EN ISO 11203:2009).

A.5.2 Determination of the C-weighted peak emission sound pressure level

The C-weighted peak emission sound pressure level at the operator's position(s) shall be measured according to EN ISO 11201:2010.

A.6 Information to be recorded and to be reported

Clause B.6 of EN 16228-1:2014 applies with the following additions for test record and report:

— operating conditions as specified in A.3.2;

— for impact hammer: specification, including type, weight, dimensions, of anvil and/or pile cap and/or hammer cushion (including stiffness);

— mass of clamping device;

— description of further accessories used during measurement;

— test- pile dimensions and material or information on test-stand;

— length of test- pile above ground level;

— soil conditions;

— rate of penetration (for pile).

A.7 Noise declaration by the manufacturer

Clause B.7 of EN 16228-1:2013 applies with the following addition: for impact hammers the corresponding blow rate shall be indicated.

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 a means of conforming to Essential Requirements of the New Approach Directive 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 relevant Essential Requirements of that 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 11886:2002, *Building construction machinery and equipment — Pile driving and extracting equipment — Terminology and commercial specifications*

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