



SLOVENSKI STANDARD

SIST EN 996:2000

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Oprema za vrtanje lukenj za zabijanje pilotov - Varnostne zahteve

Piling equipment - Safety requirements

Rammausrüstung - Sicherheitsanforderungen

Matériel de battage - Prescriptions de sécurité

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53.100	Stroji za zemeljska dela	Earth-moving machinery
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EUROPEAN STANDARD

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Piling equipment - Safety requirements

Matériel de battage - Prescriptions de sécurité

Rammausrüstung - Sicherheitsanforderungen

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CEN

European Committee for Standardization
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Contents

	Page
Foreword	4
0 Introduction	5
1 Scope	5
2 Normative references	6
3 Definitions	8
3.1 Piling equipment	8
3.2 Piling rig	8
3.3 Pile elements	8
3.4 Carrier machine	8
3.5 Leader	8
3.6 Pile installation and extracting equipment	9
4 Safety measures and/or provisions	9
4.1 Stability	9
4.2 Ergonomics	9
4.3 Hot and cold surfaces and sharp edges	9
4.4 Hydraulic and pneumatic hoses or pipes	9
4.5 Isolation of energy sources	10
4.6 Pulleys, drums and wire ropes	10
4.7 Winches	11
4.8 Devices for transport and mounting	11
4.9 Operator's position	12
4.10 Visibility	12
4.11 Illumination	12
4.12 Starting	13
4.13 Controls	13
4.14 Guards to prevent falling	14
4.15 Personnel lift or platform	14
4.16 Suspension device of vibrators	15
4.17 Clamping devices	15
4.18 Inclination measuring system	16
4.19 Electrical installation	16
4.20 Control over output energy	16
4.21 Piling equipment - Auxiliary equipment	16
4.22 Emergency stop	17
4.23 Brakes of the carrier machine	17
4.24 Protection against moving parts	17
4.25 Hydraulic installations	18
4.26 Fire protection	18
4.27 Noise	19
4.28 Vibrations	20
4.29 Data plate	20
4.30 Warning devices and signs	20
4.31 Maintenance	20

		Page
5	Information for use	21
5.1	General	21
5.2	Operator's manual	21
5.3	Examinations or inspections	23
5.4	Spare parts list	23
5.5	Maintenance and service manual	23
6	Verification of safety requirements/measures	24
Annex A (normative)	List of significant hazards	25
Annex B (normative)	Calculation of piling equipment stability and ground pressure	29
Annex C (normative)	Diaphragm walling rig - Safety requirements	40
Annex D (normative)	Wire rope grips for drop hammers - Selection and fitting	43
Annex E (informative)	Grouting and injection equipment - Safety	45
Annex F (informative)	Bibliography	47

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Foreword

This European Standard has been prepared by CEN/TC 151 "Construction equipment and building material machines - Safety" of which the secretariat is held by DIN.

This European Standard 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).

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 1996, and conflicting national standards shall be withdrawn at the latest by June 1996.

The Annex A is normative and contains "List of significant hazards", the Annex B is normative and contains "Calculation of piling equipment stability and ground pressure", the Annex C is normative and contains "Diaphragm walling equipment - Safety requirements", the Annex D is normative and contains "Wire rope grips for drop hammers - Selection and fitting", the Annex E is informative and contains "Grouting and injection equipment - Safety" and the Annex F is informative and contains a "Bibliography".

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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0 Introduction

This European Standard is a Type C-standard as defined in EN 292-1:1991.

The machinery concerned and the extent to which hazards are covered is indicated in the scope of this standard.

1 Scope

1.1 This standard specifies safety requirements for piling equipment suitable for the following purposes:

- a) construction of foundations, slurry walls or retaining walls, using piles or other longitudinal elements;
- b) removal of piles;
- c) installation of drain- or injection elements.

The pile material can be timber, concrete (precast or cast in situ) or steel (tubes or rolled sections). Additionally piles may have an interlocking feature to enable adjacent piles to be joined together.

1.2 This European standard deals with all significant hazards pertinent to piling equipment, when they are used as intended and under the conditions foreseen by the manufacturer (see annex A) associated with the following:

- transport of equipment;
- rigging and dismantling of equipment;
- equipment in service and out of service;
- moving of equipment between pile positions;
- storage of equipment.

This European Standard specifies the appropriate technical measures to eliminate or reduce risks arising from the significant hazards.

1.3 Piling equipment includes:

- a) piling rig consisting of carrier machine (crawler, wheel or rail mounted, floating), leader attachment, leader or other guiding systems, e. g. direct mounted, boom supported, swinging, guide cage or free riding;
- b) pile installation and extraction equipment, e. g. impact hammers, extractors, vibrators or static pile pushing/pulling devices;
- c) accessories, e. g. pile caps, helmets, plates, followers, clamping devices, pile handling devices, pile guides, acoustic shrouds and shock/vibration absorbing devices, power packs/generators and personnel lifts or platforms.

1.4 In addition, this standard applies to diaphragm walling rigs. Additionally the particular requirements which apply to diaphragm walling equipment are given in normative annex C.

1.5 If the carrier machine of a piling rig consists of an excavator, crane etc. the carrier shall be covered by its own standards to the extent the requirements of this standard are not applicable.

If piling equipment operates with attachments other than those for piling according to this standard, e. g. drilling, the safety standards applying to such machines shall also be complied with.

1.6 When operating in explosive atmosphere, additional requirements are needed which are not contained in this standard.

1.7 Informative Annex E is provided for the information and guidance for manufacturers of grouting and injection equipment for use in the foundation industry in the absence of a European Standard for this equipment. It is not a normative part of this standard and does not contain sufficient guidance on safety requirements and measures to achieve conformity with the essential safety requirements of any EC Directive.

1.8 This European Standard applies primarily to machines which are manufactured after the date of approval by CEN of the standard.

2 Normative references

This European Standard incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to, applies.

EN 3	Portable fire extinguishers
EN 292-1	Safety of machinery - Basic concepts - General principles for design - Part 1: Basic terminology, methodology
EN 292-2:1991	Safety of machinery - Basic concepts - General principles for design - Part 2: Technical principles and specifications
EN 418	Safety of machinery - Emergency stop equipment, functional aspects - Principles for design
EN 474-1:1994	Earth-moving machinery - Safety - Part 1: General requirements
EN 791	Drill rigs - Safety
prEN 809	Pumps and pump-units for liquids - Safety requirements
prEN 853	Rubber hoses and hose assemblies - Wire braid reinforced hydraulic type - Specification
prEN 854	Rubber hoses and hose assemblies - Textile reinforced hydraulic type - Specification

prEN 855	Plastic hoses and hose assemblies - Thermoplastics textile reinforced hydraulic type - Specification
prEN 856	Rubber hoses and hose assemblies - Spiral wire reinforced hydraulic type - Specification
prEN 857	Rubber hoses and hose assemblies - Wire braid reinforced compact type for hydraulic applications - Specification
prEN 953	Safety of machinery - General requirements for the design and construction of guards (fixed, movable)
prEN 954-1	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design
prEN 982	Safety requirements for fluid power systems and components - Hydraulics
prEN 983	Safety requirements for fluid power systems and components - Pneumatics
prEN 1037	Safety of machinery - Isolation and energy dissipation - Prevention of unexpected start-up
prEN 12151	Machinery and plant for the preparation of concrete and mortar - Safety requirements
ENV 1070	Safety of machinery - Terminology
EN ISO 3457:1995	Earth-moving machinery - Guards and shields - Definitions and specifications
EN ISO 6682	Earth-moving machinery - Zones of comfort and reach for controls
EN 22860	Earth-moving machinery - Minimum access dimensions
EN 23411	Earth-moving machinery - Human physical dimensions of operators and minimum operator space envelope
EN 60204-1:1992	Safety of machinery - Electrical equipment of industrial machines - Part 1: General requirements
ISO 2631-1:1985	Evaluation of human exposure to whole-body vibration - Part 1: General requirements
ISO 2631-3:1985	Evaluation of human exposure to whole-body vibration - Part 3: Evaluation of exposure to whole-body z-axis vertical vibration in the frequency range 0,1 to 0,63 Hz
ISO 2867:1994	Earth-moving machinery - Access systems
ISO 3449:1992	Earth-moving machinery - Falling object protective structures (FOPS) - Laboratory tests and performance requirements
ISO 3795:1989	Road vehicles and tractors and machinery for agriculture and forestry - Determination of burning behaviour of interior materials
ISO 3864:1984	Safety colours and safety signs

ISO 4302:1981	Cranes - Wind load assessment
ISO 4305:1991	Mobile cranes - Determination of stability
ISO 4309:1990	Cranes - Wire ropes - Code of practice for examination and discard
ISO 6394:1985	Acoustics - Measurement of airborne noise emitted by earth-moving machinery - Operator's position - Stationary test condition
ISO 6405-1:1991	Earth-moving machinery - Symbols for operator controls and other displays - Part 1: Common symbols
ISO 7095:1982	Earth-moving machinery - Crawler tractor and crawler loader - Operator's controls
ISO 12508:1994	Earth-moving machinery - Limits for potentially injury causing sharp edges

3 Definitions

For the purposes of this European Standard the definitions stated in ENV 1070:1993 apply.

Additional definitions specifically needed for this European Standard are added below:

3.1 Piling equipment

Assembly of machines and components used for installation or extraction of piles.

3.2 Piling rig

Carrier machine complete with leader attachment and leader but without pile installation and other equipment.

3.3 Pile elements

Pile elements consist of timber, concrete (precast or cast in situ) or steel (tubes or rolled sections). Piles may have an interlocking feature to enable adjacent piles to be joined together.

3.4 Carrier machine

Machine providing mobility for and supporting the weight of the piling equipment, together with the pile.

NOTE: A carrier machine may also accommodate the necessary power source and controls of the piling equipment. Apart from stationary carrier machines, wheel, crawler or rail mounted, together with fixed or movable floating carrier machines can be considered.

3.5 Leader

A structure mounted to the carrier machine guiding the installation and extracting equipment.

3.6 Pile installation and extracting equipment

Impact, vibration equipment and static devices that are used for driving and/or extracting of pile elements.

4 Safety measures and/or provisions

Machinery shall comply with the safety measures and/or technical provisions of this clause and in addition with EN 292-1:1991 and EN 292-2:1991 for hazards relevant but not significant which are not covered by this standard.

4.1 Stability

4.1.1 The stability shall be proven according to annex B. Stability criteria are:

- A minimum stability angle and the summation of suitably amplified moments.

The operator's manual shall state under which conditions the piling equipment can be stably used. The manufacturer/supplier of the piling equipment, as delivered, is responsible that the stability is verified by calculation.

4.1.2 Weights and positions of centres of gravity of the machine parts which are the basis for the stability calculation shall be obtained by calculation and/or weighing.

4.1.3 Each manufacturer of single parts of the machine shall supply all necessary data about these parts relevant to the overall stability calculation.

4.2 Ergonomics

The piling equipment shall be designed according to ergonomic principles to avoid fatigue and stress on the operator and other personnel. Consideration shall be given to the fact that operators may wear heavy gloves, footwear and other personal protection equipment. For guidance, see EN 23411 and EN ISO 6682.

4.3 Hot and cold surfaces and sharp edges

Where there is a risk of human contact with hot or cold surfaces, such surfaces shall be protected by guards or covers in accordance with 4.8 of EN ISO 3457:1995. Edges shall fulfil the requirements of ISO 12508:1994.

4.4 Hydraulic and pneumatic hoses or pipes

Hoses and pipes shall comply with prEN 982 and prEN 983.

Pipes, hoses and fittings shall be able to safely withstand the pressure. The hoses shall be marked with the rated working pressure.

Where there is a risk that a rupture of a hose or pipe at the operator's position could cause hazard to the operator the hoses and pipes shall be provided with protective guards in accordance with 4.9 of EN ISO 3457:1995.

4.5 Isolation of energy sources

4.5.1 Except as provided for in 4.5.3, piling equipment shall be fitted with a means to isolate them from all energy sources (see prEN 1037 and EN 60204-1). Such isolators shall be clearly identified. They shall be capable of being locked.

4.5.2 After the energy is shut off, it shall be possible to dissipate any energy remaining or stored in the circuits of piling equipment without risk to exposed persons.

4.5.3 Certain non-dangerous circuits may remain connected to their energy sources to hold parts, protect information, light interiors etc. In this case special steps shall be taken to ensure operator's safety.

4.6 Pulleys, drums and wire ropes

4.6.1 Pulley and drum diameters shall meet the following minimum requirements:

- Winch drum pitch diameter 14d;
- Pulley pitch diameter 16d;
- Compensation pulley pitch diameter 12,5d;
- Pulley part of pulling down system 12,5d.

Where d is the diameter of the wire rope.

4.6.2 There shall always remain at least three wraps of rope on the winch drum.

4.6.3 Flanges on drums shall be designed to extend at least two rope diameters beyond the outer wrap of rope in all operating conditions.

4.6.4 The side deviation angle of the wire rope between pulleys and/or drum shall not exceed 2,5° for non rotating or spin resistant type, and 4° for other wire ropes.

4.6.5 The breaking load of the wire rope shall be at least the following safety factor times, the maximum static load in the rope caused by equipment to be lifted, or the maximum line pull of the winch which ever is applicable.

Operating Condition	Safety factor
General hoisting and extracting	3,55
Free fall drop hammer	3,55
Boom and leader hoist	
Working	3,55
Erection	3,05
Stationary rope	
Working	3,0
Erection	2,73
Pulling down rope	3,0

4.6.6 Rope terminations with wire rope grips are only allowed for free fall drop hammers. They shall be used according to annex D.

4.7 Winches

4.7.1 General

Winches not intended for use lifting personnel and maintenance platforms, and which are integral part of the piling equipment and directly involved in the piling process shall fulfil the requirements stated in 4.7.2.

4.7.2 Safety requirements

The maximum line pull on the first rope layer of the winch shall be indicated on the dataplate of the winch.

Winches shall be equipped with:

- a service brake system;
- a parking brake system.

The parking brake system shall act automatically and prevent an unintentional running back of the load if the winch control levers are not actuated or in the case of failure of the energy supply.

NOTE: The brake systems may use common components. The load lowering valves of hydraulically powered winches or lowering devices are considered as the service brake.

Both brake systems shall hold a minimum of 1,3 times the maximum allowed line pull. The service brake shall enable the operator to retard and stop a descending load smoothly.

Winches for extraction having an influence on stability shall have a measuring system indicating the actual line pull of the rope of the hook load. Alternatively, there shall be a line pull limiter (e. g. a restriction of drive torque) to the winch. A capacity table visible to the operator shall show the allowed line pull or hook load.

Winches shall have a limiting device stopping the lifting movement by influencing the winch control, before the mechanical end position is reached. For winches with a capacity equal to or less than 20 kN a mechanical limit stopping device without influence on the winch control is sufficient.

Alternatively, they shall be fitted with an audible or visual warning system which operates an appropriate distance before the mechanical end position.

Activation of the free fall function of the winch shall only be possible by actuation of two independent controls simultaneously. Both controls shall be of the hold to run type.

To allow pile impact type equipment to follow and maintain contact with the pile either:

- the supporting winch shall be able to pay out the supporting cable freely, or
- the equipment shall be completely disconnected from its supporting cable.

When a winch is designed for several functions including a free fall function, a key operated control shall be additionally fitted which allows the free fall function to be operated.

4.8 Devices for transport and mounting

4.8.1 For safe removal, unloading and transport the pieces of equipment shall be equipped with slinging points, lugs, rings, provisions for eyebolts or other devices (see 5.2.4).

4.8.2 For carrier machines with a slewing superstructure, a mechanical locking device or restraint shall be provided to prevent rotation of the superstructure on its undercarriage during transit, e. g. on highway, rail or sea.

4.9 Operator's position

Piling equipment shall be provided with a cab to protect the operator against noise, dust and adverse weather conditions. There may however be types of piling equipment or operating conditions where it would not be appropriate or possible to provide a cab.

Piling equipment shall be designed for and fitted with a falling object protective structure (FOPS) if specified for use in applications where there is a risk of rock fall. The FOPS shall comply with level II of ISO 3449:1992.

NOTE 1: Although the scope of ISO 3449:1992 specifically applies to earth-moving machinery it is equally relevant to piling equipment.

Piling equipment shall in all cases be fitted with a protective roof which shall meet the requirements of level I of ISO 3449:1992.

Consideration shall also be given to protection against horizontally ejected objects.

The cab shall provide the following:

- adequate ventilation where necessary and where applicable, heating and/or cooling;

NOTE 2: For this requirement no verification is given.

- protection against noise (see 4.27.1);
- isolation against vibration of the floor (see 4.28);
- a means of rapid escape from the cab;
- an emergency exit, e. g. in the form of knock-out windows or knock-out panels, on a different side of the cab from that where the normal exit is situated or provision of tools for breaking the window;
- a seat, unless the operator has to work in a standing position. The seat shall provide the operator with a comfortable and stable working position and shall be easily adaptable to operators of different weight and height. The seat shall be designed to reduce vibrations transmitted to the operator to the lowest level that can be reasonably achieved;
- a windscreen cleaning device.

Transparent panels of doors and windows shall be made of laminated safety glass or equivalent material. Cab interior upholstery shall be made of flame retardant material which has a linear velocity of flame propagation of maximum 250 mm/min when tested in accordance with ISO 3795:1989.

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4.10 Visibility

Visibility from the driver's and/or operator's position shall be such that when driving or operating the piling equipment the driver or operator can do this without causing danger to himself or other persons. Where necessary, optical aids or other means shall be provided.

4.11 Illumination

Piling equipment shall be equipped with lights causing a luminance of at least 100 lx at the working area near the piling point if they are required to work in the dark.

For moving in darkness mobile equipment shall be provided with lighting of at least 10 lx measured 7 m in front of the equipment in the direction of travelling.

4.12 Starting

Unauthorized starting shall be prevented by at least one of the following measures:

- lockable cab;
- lockable ignition;
- lockable battery switch.

4.13 Controls

4.13.1 For the design of safety related control systems see prEN 954-1.

Safe, quick and non-hazardous operation of controls shall be made possible in the following ways:

a) Controls of primary importance shall be within comfortable reach.

Controls of primary importance are for the main functions, e. g. raising and lowering

- the piling leader;
- the pile;
- the pile installation/extracting equipment;

changing position of the leader, inclining the leader, operations for slewing and travelling;

b) Controls of secondary importance shall be within normal reach. These are for other functions, e. g. engine speed, pile installation/extracting equipment.

4.13.2 For comfort and reach areas, see EN ISO 6682.

4.13.3 The forces required to operate the controls shall comply with table 2 of ISO 7095:1982.

4.13.4 Controls shall be designed, constructed and arranged so that

- their function is clearly identifiable;
- the movement to activate the controls corresponds as far as possible to the intended effect.

Controls which can cause a hazard shall be so arranged, deactivated or guarded that they cannot be activated inadvertently in particular when the operator enters or exits the operator's position.

When a control is designed and constructed to carry out several functions, e. g. keyboard control, the activated operation shall be clearly identified.

4.13.5 Controls shall be marked in accordance with relevant standards (e. g. ISO 6405-1: 1991) and positioned for safe, quick and comfortable operation.

4.13.6 All controls of primary importance (see 4.13.1.a)) shall automatically return after release to the neutral position.