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Part 14: Borehole dynamic probing

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Partie 14: Sondage dynamique au carrottier

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 182, *Geotechnics*.

A list of all parts in the ISO 22476 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Geotechnical investigation and testing — Field testing —

Part 14:
Borehole dynamic probing

1 Scope

This document specifies the equipment requirements, execution of and reporting on borehole dynamic probing.

NOTE This document fulfills the requirements for borehole dynamic probing as part of the geotechnical investigation and testing according to EN 1997-1 and EN 1997-2.

The document specifies technical requirements in respect to equipment and implementation, in order to extensively prevent incorrect appraisals of the subsoil conditions and to limit scatter in the probing results due to equipment and implementation.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10025-2, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

ISO 14688-1, *Geotechnical investigation and testing — Identification and classification of soil — Part 1: Identification and description*

ISO 22475-1, *Geotechnical investigation and testing — Sampling methods and groundwater measurements — Part 1: Technical principles for execution*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
probing
indirect subsoil exploration method in soils normally by driving a cone vertically while measuring the *penetration resistance* (3.4) to derive geotechnical parameters

3.2
borehole dynamic probing
probing (3.1) in the borehole, which is carried out by driving by impact from the borehole base over a defined penetration depth

Note 1 to entry: Here the impact device is directly above the probe in the borehole.

3.3
number of blows N_{30}
blows required for the probe to penetrate by 30 cm, in relation to the depth ranges of 15 cm to 45 cm of the probe depth

3.4
penetration resistance
sum of the tip resistance and negligible skin friction recorded by the *number of blows N30* (3.3)

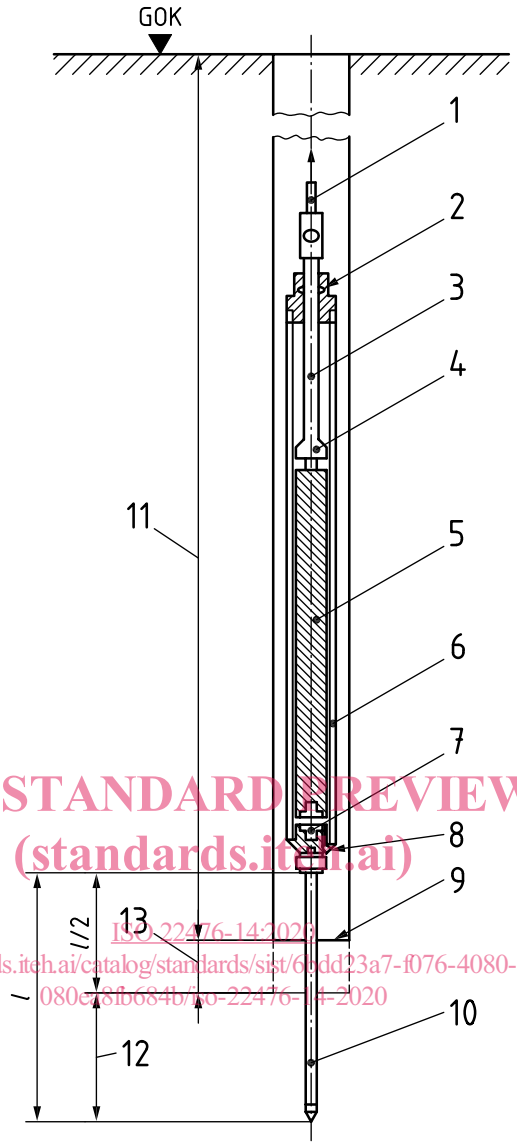
3.5
derived value
value of a geotechnical parameter determined by theory, correlation or empirically

Note 1 to entry: The derived values are used as an initial basis for determining characteristic values according to EN 1997-1:2010, 2.4.3.

4 Equipment

The device for the borehole dynamic probing is shown in Figure 1. The technical data are shown in Table 1.

The device is lowered into the borehole with an encased impact device on the rope and the probe is driven in from there without a rod.



Key

1	rope	8	drain plug
2	packing box	9	borehole base
3	lifting rod	10	cone
4	automatic releasing device	11	borehole depth
5	hammer	12	test range
6	hollow cylinder, water tight	13	penetration under the weight of the device
7	anvil	l	probe length

Figure 1 — Device for borehole dynamic probing

Table 1 — Technical data

Technical data	Symbol	Unit	Value
Tip cross-section area	A_c	cm^2	20
[a] Production tolerances.			
[b] These are the parts (hollow cylinder, anvil and probe) without the moving parts for lifting and releasing the hammer.			
[c] There is no need to indicate production tolerances here.			

Table 1 *(continued)*

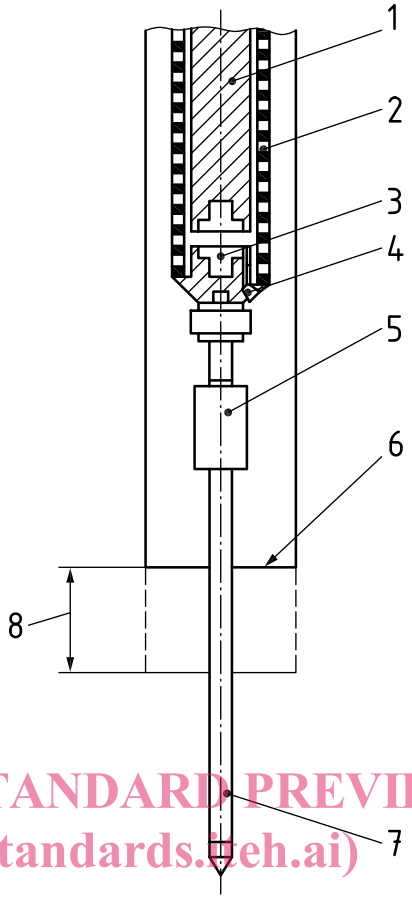
Technical data	Symbol	Unit	Value
Tip diameter	d	mm	50,5 ± 0,5[a]
Wear limit	d_{min}		49
Mass of hammer	m	kg	63,5 ± 0,5[a]
Height of fall	h	m	0,76 ± 0,01[a]
Diameter of the lifting rod	D_h	mm	45[c]
External diameter of the cone	d	mm	120[c]
Mass of the drive-in device[b] without additional weight	m_1	kg	91 ± 2[c]
Cone length	l	m	0,9[c]
Test depth from borehole base	t	m	0,45

[a] Production tolerances.

[b] These are the parts (hollow cylinder, anvil and probe) without the moving parts for lifting and releasing the hammer.

[c] There is no need to indicate production tolerances here.

The hammer shall be located in a watertight hollow cylinder. In case of application depths of more than 20 m under water, additional weights shall be used between the cone and hollow cylinder (see Figure 2).

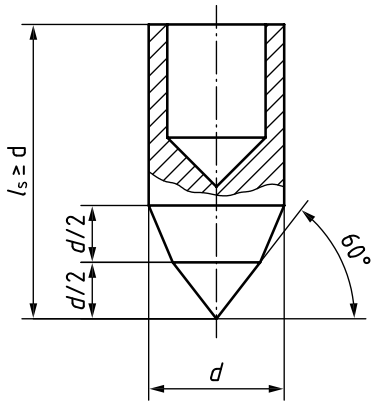


Key

1 hammer
2 hollow cylinder
3 anvil
4 drain plug
5 additional weight
6 borehole base
7 cone
8 penetration under the weight of the device

Figure 2 — Location of the additional weight

The dimensions of the cone tip are given in Table 1 and Figure 3. The material shall correspond to a steel quality S 235 JR minimum according to EN 10025-2.



Key

d tip diameter

l_s tip length

Figure 3 — Cone dimensions

5 Test procedure

5.1 General

The initial depths for the borehole dynamic probing in a borehole shall be specified.

The probing device defined in this document may be used to explore the subsoil — depending on its state and the boring device used — down to depths of ≈60 m.

Deviations from this document and their effects on the result shall be substantiated and reported. The symbols are shown in Table 2.

Table 2 — Symbols

Symbol	Name	Unit
N_{30}	number of blows between 15 cm to 45 cm	—
$N_{0\text{-}15}$	number of blows between 0 cm to 15 cm	—
$N_{15\text{-}30}$	number of blows between 15 cm to 30 cm	—
$N_{30\text{-}45}$	number of blows between 30 cm to 45 cm	—
$N_{30,a}$	number of blows between 15 cm to 45 cm above ground water level	—
$N_{30,u}$	number of blows between 15 cm to 45 cm underground water level	—
σ'_{vz}	effective vertical stress in the depth z below the foundation base	MPa

5.2 Test preparation

The borehole dynamic probing is performed from the borehole base. ISO 22475-1 applies to the boring procedure. The borehole diameter shall not be more than 250 mm. If casing is used, this shall not extend below the borehole base. The test area shall be undisturbed.

The borehole base shall be cleaned to the lower edge of the casing in order to prevent the effects of boring sludge or caving in. When cleaning the borehole base negative pressure effects shall be avoided by slow withdrawal of the drilling equipment.

The water level in the borehole shall be kept above the ground water level. If confined ground water is expected, the borehole base shall be stabilised by excess water pressure.

5.3 Equipment checks and calibration

Besides the probe diameter and tip opening angle, the verticality of the probe and lifting rod shall also be checked before carrying out the borehole dynamic probing. The required height of fall shall be checked after every test. The automatic release device shall be checked in operation.

Water shall not penetrate into the hollow cylinder. The tightness shall be monitored via the water drain plug after every test.

The functionality of the device shall be checked after any damage, overloading and repair, but at least every 6 months, unless shorter periods are set by the manufacturer. The test report shall be kept with the probing device.

5.4 Probing procedure

Before lowering the probe, the actual height situation of the borehole base shall initially be measured, which then corresponds to the initial point of the probe tip. After this, the probe shall be lowered to this depth.

The degree of penetration under permanent weight in comparison to the borehole depth shall be measured to determine a disturbance zone at the borehole base. If the penetration depth is greater than 15 cm, the bore shall be sunk deeper and the borehole dynamic probing re-initiated.

After lowering the probe, the blows shall be counted three times each for 15 cm of penetration. The critical number of blows N_{30} is the number of blows between 15 cm to 45 cm. In soils of particularly low strength with a penetration by one blow above 15 cm, the penetration shall be indicated for one blow respectively. In soils of high strength with more than 50 blows per 15 cm of penetration, the penetration shall be indicated for 50 blows and then the probing shall be interrupted.

When using the borehole dynamic probing in water depths of more than 20 m, the buoyancy force of the lifting rod from the hollow cylinder is greater than the weight of the device under lifting force, owing to the water pressure onto the cross-section of the lifting rod. The lifting rod with the ram can then no longer be lifted out of the hollow cylinder, as the complete device is raised. Therefore, additional weights shall be attached between the hollow cylinder and the probe tip. Table 3 contains the masses of the additional weights for the probing device in relation to the water depth.

Table 3 — Masses of the additional weights for the probing device

Water depth in m	0 to 20	>20 to 30	>30 to 40	>40 to 50	>50 to 60	>60 to 70	>70 to 80
Additional weight in kg	0	15	33	52	70	89	≥107

5.5 Field records

The header sheet with measuring record according to Annex A shall be filled out for every borehole dynamic probing.

The borehole base, degree of penetration and upper edge of the test area shall be noted for every borehole dynamic probing carried out in the borehole. The number of impacts per 15 cm penetration shall also be entered in the layer directory according to ISO 14688-1 and ISO 22475-1.

The following shall also be recorded:

a) weather conditions;

b) probing interruptions with an indication of their duration;

c) unwanted processes during the test procedure (e.g. in the blow sequence and penetration, temporary obstructions, strained ground water level, cause of a premature termination etc.);