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Geotehnično preiskovanje in preskušanje - Preskušanje na terenu - 5. del: Preskus tlakomera pred vrtanjem (ISO/DIS 22476-5:2022)

Geotechnical investigation and testing - Field testing - Part 5: Prebored pressuremeter test (ISO/DIS 22476-5:2022)

Geotechnische Erkundung und Untersuchung – Felduntersuchungen – Teil 5: Vorgebohrter Pressiometerversuch (ISO/DIS 22476-5:2022)

Reconnaissance et essais géotechniques - Essais en place - Partie 5: Essai au pressiomètre en préforage (ISO/DIS 22476-5:2022)

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Geotechnical investigation and testing — Field testing —

Part 5:
Prebored pressuremeter test

Reconnaissance et essais géotechniques — Essais en place —

Partie 5: Essai au pressiomètre en préforage

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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.

This second edition cancels and replaces the first edition (ISO 22476-5:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

— Title of the document: title of ISO 22476-5 edition 1 was flexible dilatometer. The title of the Edition 2 is different from Edition 1 and ISO 22476-2 includes now provisions for all kinds of prebored pressuremeters tests.

— A reference loading programme with cyclic loading has been added.

— Calibration procedures have been developed.

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 5: Prebored pressuremeter test

1 Scope

This Part of ISO 22476 is applicable to pressuremeter tests using cylindrical flexible probes placed in pre-existent boreholes using testing procedures other than the Menard procedure.

For pressuremeter tests following the Menard procedure refer to ISO 22476-4.

NOTE A high pressure flexible pressuremeter probe which contains transducers for the measurement of radial displacements is also known as flexible dilatometer or high-pressure dilatometer

This standard applies to tests performed in any kind of grounds, starting from soils, treated or untreated fills, hard soils and soft rocks, up to hard and very hard rocks, either on land or offshore.

The parameters derived from this test may include stiffness, strength, initial in-situ stress state and consolidation properties.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including amendments) applies.

Guide to the expression of uncertainty in measurement (GUM), BIPM/IEC/IFCC/ISO/IUPAC/ IUPAP/ OIML, 1995 (published 1993 Corrected and reprinted, 1995).

EN 1997 (all parts), *Eurocode 7: Geotechnical design*

EN 16228-1, *Drilling and foundation equipment - safety. Common requirements*

EN 16228-2, *Drilling and foundation equipment - safety. Mobile drill rigs for civil and geotechnical engineering, quarrying and mining*

ENV 13005:1999, *Guide to the expression of uncertainty in measurement*

ISO 10012, *Measurement management systems — Requirements for measurement processes and measuring equipment*

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

ISO 14689-1, *Geotechnical investigation and testing – Identification and classification of rock - Part 1: Identification and description*

ISO 22475-1, *Geotechnical investigation and testing — Sampling methods and groundwater measurements — Part 1: Technical principles for the sampling of soil, rock and groundwater*

ISO 22476-4, *Geotechnical investigation and testing — Field testing — Part 4: Prebored pressuremeter test by Ménard procedure*

ISO 22476-6, *Geotechnical investigation and testing — Field testing — Part 6: Self-boring pressuremeter test*

ISO 22476-8, *Geotechnical investigation and testing — Field testing — Part 8: Full displacement pressuremeter test*

ISO 22476-15, *Geotechnical investigation and testing — Field testing — Part 15: Measuring while drilling*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1
pressuremeter probe
cylindrical flexible probe which can be expanded by the application of hydraulic pressure and/or pressurised gas

Note 1 to entry: Note to entry: Pressuremeter probes contains means of measurement of its radial displacements or volume. A high pressure flexible pressuremeter probe which contains transducers for the measurement of radial displacements is also known as flexible dilatometer or high pressure dilatometer

3.1.2
flexible dilatometer/high pressure dilatometer
High pressure flexible pressuremeter probe which contains transducers for the measurement of radial displacements

3.1.3
pressuremeter control unit-
set of suitable devices capable of supplying fluid and/or gas pressure to the probe, to control and take readings of the probe's pressure, radial displacements or volume of the measuring cell.

3.1.4
connecting line
cable that connects the control unit to the probe, delivers fluid and/or gas pressure in the measuring and guard cells

3.1.6
pressuremeter test pocket
circular cylindrical cavity formed in the ground to receive a *pressuremeter probe* (3.1.1)

3.1.7
pressuremeter borehole
borehole in which pressuremeter pockets with circular cross sections are made in the ground, and into which the *pressuremeter probe* (3.1.1) is to be placed.

3.1.8
pressuremeter test
process of expanding the pressuremeter probe so as to pressurize the flexible membrane against the pocket wall and so measure pressure, radial displacements or volume as a function of time during the expansion test (see Figure 1).

3.1.9
pressuremeter sounding
the whole series of successive operations in a given borehole i.e. forming pressuremeter pockets and performing pressuremeter tests in them

3.1.10
seating pressure
pressure during the expansion of the pressuremeter at which the pressuremeter membrane contacts the pocket wall

3.1.11
nominal radius/diameter of the cavity
radius/diameter of the cavity at the time of first application of the seating pressure at the cavity walls

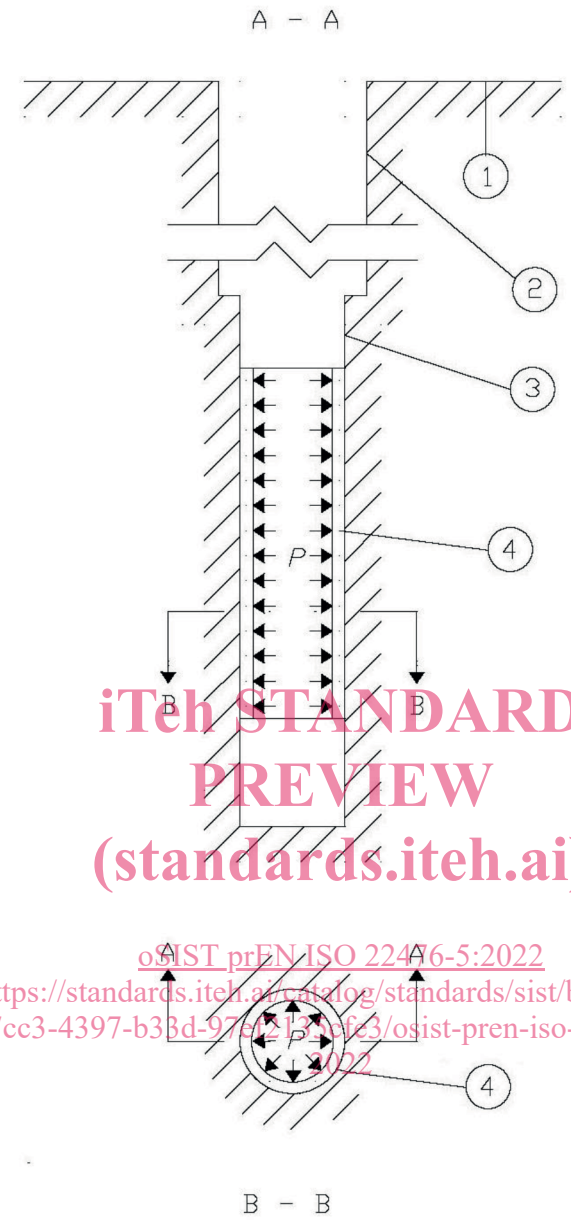
3.1.12
controlling parameter
variable (pressure, radius displacement or injected volume) used to define the loading programme of the test according to a pre-determined programme and recorded in the control unit

3.1.13
radial displacement/diameter increase or decrease
Change in pressuremeter probe radius/diameter or in cavity wall displacement

3.1.14
volume increase or decrease
Change in measuring cell volume

3.1.15
pressuremeter curve
graphical plot of pressure versus the associated pocket wall displacement or measuring cell volume

3.1.16
pressuremeter shear modulus (G_{PBP})
apparent pressuremeter shear modulus



Key

1	ground surface
2	borehole wall
3	pocket
4	expanding pressuremeter probe
p	applied pressure
A-A	axial section
B-B	cross section

Figure 1 — Example of a prebored pressuremeter test

3.1.17
depth of test
distance between the ground level and the centre of the expanding length of the pressuremeter probe measured along the borehole axis (see Figure 2).

3.1.18
operator
qualified person who carries out the test

3.1.19
phase
section of the loading or expansion program characterized by a controlling parameter, a loading rate and a loading direction

3.1.20
loop
sequence of the loading or expansion program including at least an unloading phase and a reloading phase, and possibly an intermediate hold phase

3.2 Symbols and abbreviations

For the purposes of this international standard the symbols of Table 1 apply.

Table 1 — Symbols

Symbol	Description	Unit
a	Corrected equipment radial displacement or volume loss coefficient, taking into account calibration cylinder self-deformability	mm.MPa^{-1} or cm^3.MPa^{-1}
a_r	Raw equipment radial displacement or volume loss coefficient	mm.MPa^{-1} or cm^3.MPa^{-1}
a_{cc}	Radial displacement or equivalent volume loss taking into account calibration cylinder self-deformability	mm.MPa^{-1} or cm^3.MPa^{-1}
d_{cc}	Calibration cylinder inside diameter	mm
d_c	Initial external diameter of the pressuremeter probe	mm
d_s	Nominal diameter	mm
E_{PBP}	A Young modulus derived from a prebored pressuremeter test	MPa
G	Shear modulus	MPa
G_{L1}	First loading pressuremeter shear modulus	MPa
G_{PBP}	Pressuremeter shear modulus	MPa
G_{Ri}	A reloading pressuremeter shear modulus	MPa
G_{sys}	Apparent shear modulus of the equipment or system during unloading-reloading loops	MPa
G_{Ui}	An unloading pressuremeter shear modulus	MPa
G_{URi}	An unloading/reloading pressuremeter shear modulus	MPa
k_f	Creep parameter in reference loading programme C	mm
L_{FD}	Length of the expanding part of the probe	mm
L_d	Length of the measuring segment of the probe	mm
L_g	Axial distance between transducer or LVDT section and membrane clamping ring	mm
p	Corrected pressure	MPa
$p_{1.1}$	Constant full relief pressure for loops in reference loading programme A	MPa
p_e	Pressure loss associated with membrane stiffness	

Table 1 *(continued)*

Symbol	Description	Unit
p_i	Corrected reversal pressure before loop *i*	MPa
p_{mean}	Average corrected pressure in reference loading programme D	MPa
p_{min}	Minimum corrected pressure in reference loading programme D	MPa
p_{max}	Maximum corrected pressure in reference loading programme D	MPa
p_r	Pressure as read at the measuring unit	MPa
p_s	Seating pressure	MPa
r	Corrected radius	mm
r_1	Corrected radius at time t_1 in reference loading programme C	mm
r_2	Corrected radius at time t_2 in reference loading programme C	mm
r_e	Radius correction	
r_s	Nominal cavity radius	mm
t	Time	min
T	Period in reference loading programme D	min
t_1	Time 1 in reference loading programme C	min
t_2	Time 2 in reference loading programme C	min
ΔV	Corrected injected volume	cm^3
ΔV_e	Injected volume correction	cm^3
ΔV_r	Injected volume, as read at the control unit	cm^3
V	Total volume	cm^3
z	Test depth	m
δ	Corrected radial displacement	mm
δ_e	Radial displacement correction	mm
δ_r	Radial displacement, as read at the control unit	mm
Δd_r	Increase of diameter, as read at the control unit	mm
Δd	Corrected diameter increase	mm
Δp_r	Pressure increment, as read at the control unit	MPa
Δp	Corrected pressure increment	MPa
ε_c	Cavity strain	-
ν	Poisson's ratio	-

4 Equipment

4.1 General

The test with the pressuremeter is performed by the expanding of a pressuremeter membrane placed in the ground (see Figure 1). The pressure and the associated expansion of the probe are measured and recorded so as to obtain a stress-displacement relationship for the ground as tested.

The equipment to carry out pressuremeter tests shall consist of the components shown in Figure 2.

The following components are mandatory:

— Pressuremeter (No. 8 in Figure 2),

— Connecting line (No. 6 in Figure 2),

— Signal cable (No. 5 in Figure 2),

— Displacement or volume measuring unit (No. 2 in Figure 2),

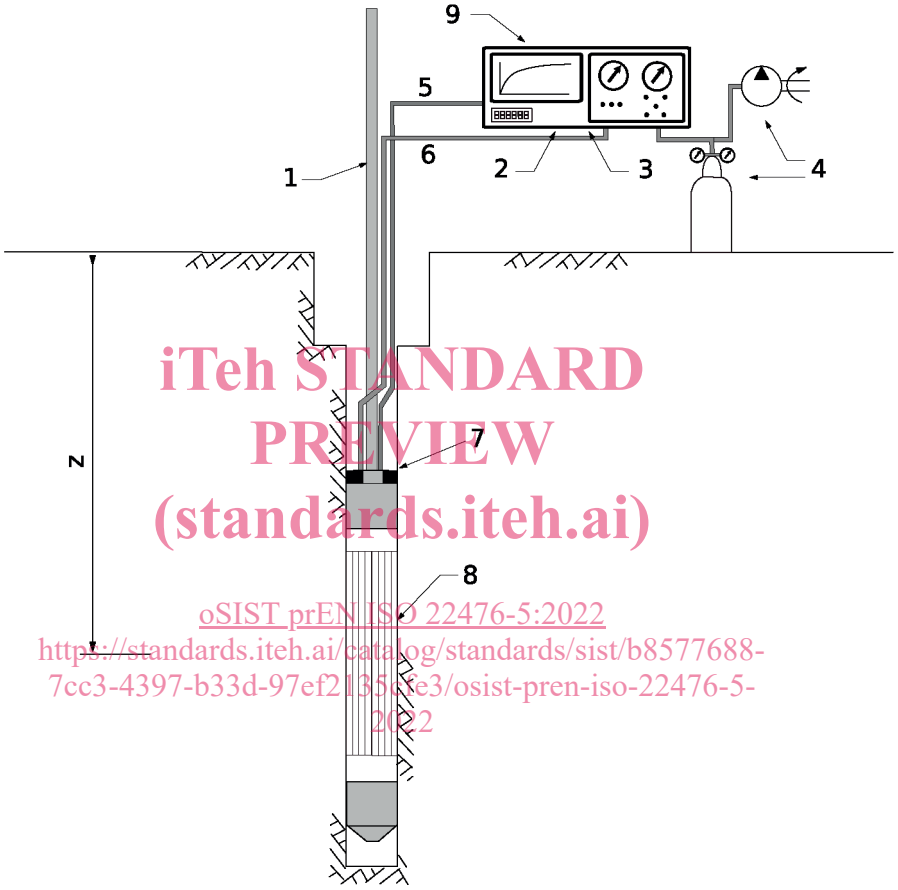
— Pressure control unit (No. 3 in Figure 2),

— Pressure source (No. 4 in Figure 2),

The following components may be added:

— Pore pressure measuring system,

— Accelerometer or geophones to perform shear wave velocity measurements.



Key

1	setting rods	6	connecting line
2	displacement or volume measuring unit	7	probe rode coupling Sediment collection tube
3	pressure control unit	8	pressuremeter probe
4	pressure source	9	optional data logger
5	signal cable	z	test depth

Figure 2 — Schematic diagram of pressuremeter equipment

The following components shall be used according to application class of the sounding:

— a control unit (No. 9 in Figure 2);

— sediment collection tube to protect from caving if applicable (No. 12 in Figure 3);

— setting rods (No.1 on Figure 2).