

**SLOVENSKI
PREDSTANDARD**

oSIST prEN ISO 22476-1:2005

marec 2005

Geotechnical investigation and testing - Field testing - Part 1: Electrical cone and piezocone penetration tests (ISO/DIS 22476-1:2005)

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[oSIST prEN ISO 22476-1:2005](https://standards.iteh.ai/catalog/standards/sist/f26d4a33-5382-4fd1-a04c-abf432cb305f/osist-pren-iso-22476-1-2005)
<https://standards.iteh.ai/catalog/standards/sist/f26d4a33-5382-4fd1-a04c-abf432cb305f/osist-pren-iso-22476-1-2005>

ICS 93.020

Referenčna številka
oSIST prEN ISO 22476-1:2005(en)

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[oSIST prEN ISO 22476-1:2005](https://standards.iteh.ai/catalog/standards/sist/f26d4a33-5382-4fd1-a04c-abf432cb305f/osist-pren-iso-22476-1-2005)

<https://standards.iteh.ai/catalog/standards/sist/f26d4a33-5382-4fd1-a04c-abf432cb305f/osist-pren-iso-22476-1-2005>

January 2005

ICS

English version

**Geotechnical investigation and testing - Field testing - Part 1:
Electrical cone and piezocone penetration tests (ISO/DIS
22476-1:2005)**

Reconnaissance et essais géotechniques - Essais en place
- Partie 1: Essais électriques de pénétration au cône et au
piézocone (ISO/DIS 22476-1:2005)

This draft European Standard is submitted to CEN members for parallel enquiry. It has been drawn up by the Technical Committee CEN/TC 341.

If this draft becomes a European Standard, 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.

This draft European Standard was established by CEN 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Foreword

This document (prEN ISO 22476-1:2005) has been prepared by Technical Committee CEN/TC 341 "Geotechnical Investigation and Testing", the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 182 "Geotechnics".

This document is currently submitted to the parallel Enquiry.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[oSIST prEN ISO 22476-1:2005](https://standards.iteh.ai/catalog/standards/sist/f26d4a33-5382-4fd1-a04c-abf432cb305f/osist-pren-iso-22476-1-2005)

<https://standards.iteh.ai/catalog/standards/sist/f26d4a33-5382-4fd1-a04c-abf432cb305f/osist-pren-iso-22476-1-2005>



Geotechnical investigation and testing — Field testing —

Part 1: Electrical cone and piezocone penetration tests

Reconnaissance et essais géotechniques — Essais en place —

Partie 1: Essais électriques de pénétration au cône et au piézocône

ICS 93.020

iTeh STANDARD PREVIEW (standards.iteh.ai)

oSIST prEN ISO 22476-1:2005

<https://standards.iteh.ai/en/standards/iso/22476-1-2005-4014>
ab9322476-1-2005-4014

ISO/CEN PARALLEL ENQUIRY

This draft International Standard is a draft standard developed within the European Committee for Standardization (CEN) and processed under the CEN-lead mode of collaboration as defined in the Vienna Agreement. The document has been transmitted by CEN to ISO for circulation for ISO member body voting in parallel with CEN enquiry. Comments received from ISO member bodies, including those from non-CEN members, will be considered by the appropriate CEN technical body. Should this DIS be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month FDIS vote in ISO and formal vote in CEN.

In accordance with the provisions of Council Resolution 15/1993 this document is circulated in the English language only.

Conformément aux dispositions de la Résolution du Conseil 15/1993, ce document est distribué en version anglaise seulement.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

THIS DOCUMENT IS A DRAFT CIRCULATED FOR COMMENT AND APPROVAL. IT IS THEREFORE SUBJECT TO CHANGE AND MAY NOT BE REFERRED TO AS AN INTERNATIONAL STANDARD UNTIL PUBLISHED AS SUCH.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

**iTeh STANDARD PREVIEW
(standards.iteh.ai)**

[oSIST prEN ISO 22476-1:2005](https://standards.iteh.ai/catalog/standards/sist/f26d4a33-5382-4f1f-a04c-abf432cb305f/osist-pren-iso-22476-1-2005)

<https://standards.iteh.ai/catalog/standards/sist/f26d4a33-5382-4f1f-a04c-abf432cb305f/osist-pren-iso-22476-1-2005>

Copyright notice

This ISO document is a Draft International Standard and is copyright-protected by ISO. Except as permitted under the applicable laws of the user's country, neither this ISO draft nor any extract from it may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, photocopying, recording or otherwise, without prior written permission being secured.

Requests for permission to reproduce should be addressed to either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Reproduction may be subject to royalty payments or a licensing agreement.

Violators may be prosecuted.

Contents

Page

Foreword.....	v
Introduction.....	vi
1 Scope	1
2 Normative references	2
3 Terms and definitions	2
4 Symbols and abbreviations	8
5 Equipment	9
5.1 Geometry of the cone penetrometer	9
5.2 Cone	10
5.3 Friction sleeve	11
5.4 Filter element	12
5.4.1 General filter location	12
5.4.2 Pore pressure u_1	13
5.4.3 Pore pressure u_2	13
5.4.4 Pore pressure u_3	13
5.5 Gaps and soil seals	14
5.6 Push rods	14
5.7 Measuring system	14
5.7.1 Accuracy	14
5.7.2 Sensors for cone resistance and sleeve friction	14
5.7.3 Sensor for pore pressure	14
5.7.4 Sensor for inclination	15
5.7.5 Measuring system for penetration length	15
5.8 Thrust machine	15
6 Test procedures	15
6.1 Selection of cone penetrometer	15
6.2 Selection of equipment and procedures according to required Application Class	15
6.3 Position and level of thrust machine	17
6.4 Preparation of the cone penetrometer	18
6.5 Pushing of the cone penetrometer	18
6.6 Use of friction reducer	18
6.7 Frequency of logging parameters	19
6.8 Registration of penetration length	19
6.9 Dissipation test	19
6.10 Test completion	20
6.11 Equipment checks and calibrations	20
7 Test results	20
7.1 Measured parameters	20
7.2 Correction of measurements	20
8 Reporting	22
8.1 General	22
8.2 General reporting of test results	23
8.2.1 General information	23
8.2.2 Location of the test	23
8.2.3 Test equipment	23
8.2.4 Test procedure	23
8.2.5 Measured parameters	23
8.3 Choice of axis scaling	24

8.4	Presentation of test results	24
Annex A	(normative) Maintenance, checks and calibration	26
A.1	Maintenance and checks	26
A.1.1	Linearity of push rods	26
A.1.2	Wear of the cone	26
A.1.3	Gaps and seals	26
A.1.4	Pore pressure measuring system	26
A.1.5	Maintenance procedures	27
A.2	Calibration	27
A.2.1	General procedures	27
A.2.2	Calibration of cone resistance and sleeve friction	28
A.2.3	Calibration of pore pressure and net area ratio	28
A.2.4	Calibration of ambient temperature effects	29
A.2.5	Calibration of penetration length sensor	29
A.2.6	Calibration of the inclinometer	29
Annex B	(normative) Calculation of penetration depth	30
Annex C	(informative) Correction of sleeve friction for water pressure	31
Annex D	(informative) Preparation of the piezocone	32
D.1	Saturation	32
D.2	Slot filter	32
Annex E	(informative) Uncertainties in cone penetrometer testing	33
Bibliography	35

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Figures

Figure 1	— Cross section of an example of a cone penetrometer	3
Figure 2	— Locations of measured pore pressures	5
Figure 3	— Penetration length and penetration depth	7
Figure 4	— Tolerance requirements for use of cone penetrometer (in mm)	11
Figure 5	— Geometry and tolerances of friction sleeve (in mm)	12
Figure 6	— Correction of cone resistance and sleeve friction due to the unequal end area effect	22
Figure A.1	— Pressure chamber for determination of the end area ratios a and b	29

Tables

Table 1	— Types of cone penetration tests	15
Table 2	— Application Classes	17
Table A.1	— Control scheme for maintenance routines	27

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 22476-1 was prepared by Technical Committee ISO/TC 182, *Geotechnics*, Subcommittee SC 1, *Geotechnical investigation and testing*.

ISO 22476 consists of the following parts, under the general title *Geotechnical investigation and testing — Field testing*:

- Part 1: *Electrical cone and piezocone penetration tests*
- Part 2: *Dynamic probing*
- Part 3: *Standard penetration test*
- Part 4: *Menard pressuremeter test*
- Part 5: *Flexible dilatometer test*
- Part 6: *Self-boring pressuremeter test*
- Part 7: *Borehole jack test*
- Part 8: *Full displacement pressuremeter test*
- Part 9: *Field vane test*
- Part 10: *Weight sounding test (TS)¹⁾*
- Part 11: *Flat dilatometer test (TS)¹⁾*
- Part 12: *Mechanical cone penetration test*
- Part 13: *Plate loading test.*

1) TS Technical Specification.

Introduction

The electrical cone penetration test (CPT/CPTU) consists of pushing a cone penetrometer using a series of push rods into the soil at a constant rate of penetration. During penetration, measurements of cone resistance and sleeve friction can be recorded. The piezocone penetration test (CPTU) also includes the measurement of pore pressures at or close to the cone. The test results may be used for interpretation of stratification, classification of soil type and evaluation of engineering soil parameters. This standard is split in two parts: Part 1 describes CPT and CPTU practice using electronic transducers. EN ISO 22476-13 describes CPT practice using mechanical measuring systems.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[oSIST prEN ISO 22476-1:2005](https://standards.iteh.ai/catalog/standards/sist/126d4a33-5382-4fd1-a04c-abf432cb305f/sist-pren-iso-22476-1-2005)

<https://standards.iteh.ai/catalog/standards/sist/126d4a33-5382-4fd1-a04c-abf432cb305f/sist-pren-iso-22476-1-2005>

Geotechnical investigation and testing — Field testing — Part 1: Electrical cone and piezocone penetration tests

1 Scope

This document deals with equipment requirements, the execution of and reporting on electrical cone and piezocone penetration tests as part of geotechnical investigation and testing according to EN 1997-1 and EN 1997-2.

The results from a cone penetration test are used to evaluate:

- stratification;
- soil type;
- soil density and in situ stress conditions;
- mechanical soil properties:
 - shear strength parameters;
 - deformation and consolidation characteristics.

Within the electrical cone and piezocone penetration test, two subcategories of the cone penetration test are considered:

- The electrical cone penetration test (CPT) that includes measurement of cone resistance and sleeve friction;
- The piezocone test (CPTU) that is a cone penetration test with the additional measurement of pore pressure.

The CPTU is performed like a CPT with the measurement of the pore pressure at one or several locations on the penetrometer surface.

NOTE CPT or CPTU are also used without measurement of sleeve friction.

This document specifies the following features:

- a) the type of cone penetration test, according to Table 1;
- b) the Application Class, according to Table 2;
- c) the achievable penetration length or penetration depth;
- d) the elevation of the ground surface or the underwater ground surface at the location of the cone penetration test with reference to a datum;
- e) the location of the cone penetration test relative to a reproducible fixed location reference point;

- f) if applicable, the method of back filling of the hole in the soil resulting from the cone penetration test;
- g) if applicable, the depths and duration of the pore pressure dissipation tests.

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 any amendments) applies.

ISO 8503, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-clean steel substrates.*

ISO 10012-1, *Quality Assurance Requirements for Measuring Equipment — Part 1: Metrological confirmation system for measuring equipment.*

EN ISO 14688-2, *Geotechnical investigation and testing — Identification and classification of soil — Part 2: Principles of a soil classification.*

3 Terms and definitions

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

3.1 average surface roughness

R_a
average deviation between the real surface of the probe and a medium reference plane placed along the surface of the probe

3.2 cone

conical shaped bottom part of the cone penetrometer. When pushing the penetrometer into the ground, the cone resistance is transferred through the cone to the load sensor

NOTE This document assumes that the cone is rigid, so when loaded its deformation is very small relative to the deformation of other parts of the cone penetrometer.

3.3 cone penetration test CPT

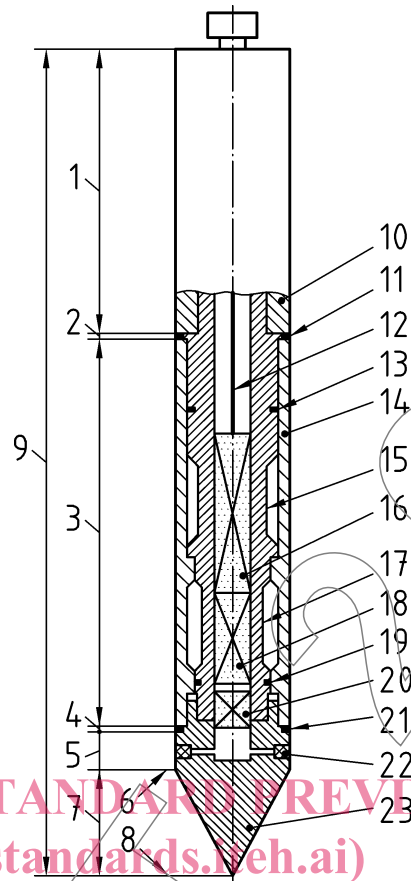
pushing of a cone penetrometer at the end of a series of cylindrical push rods into the ground at a constant rate of penetration

3.4 electrical cone penetration test

CPT where forces are measured electrically in the cone penetrometer

3.5 piezocone penetration test CPTU

electrical CPT with measurement of the pore pressures at or close to the cone



iTeh STANDARD PREVIEW
(standards.iteh.ai)

Key

- | | |
|---|---------------------------|
| 1 shaft | 13 friction sleeve |
| 2 gap between friction sleeve and shaft | 14 friction sleeve sensor |
| 3 friction sleeve | 15 amplifier unit |
| 4 gap between friction sleeve and cone | 16 core sensor |
| 5 cylindrical extension above base of cone | 17 inclinometer |
| 6 base of cone | 18 water seal |
| 7 face of cone | 19 pressure sensor |
| 8 apex of cone | 20 soil seal |
| 9 push rod connector | 21 filter |
| 10 soil seal | 22 cone |
| 11 electrical cable for signal transmission | 23 penetrometer tip |
| 12 water seal | |

Figure 1 — Cross section of an example of a cone penetrometer

3.6 cone penetrometer

assembly containing the cone, friction sleeve, any other sensors and measuring systems as well as the connection to the push rods.

NOTE An example of a cone penetrometer is shown in Figure 1; for other filter locations see Figure 2.