INTERNATIONAL STANDARD

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Geotechnical investigation and testing — Sampling methods and groundwater measurements —

Part 1: Technical principles for execution

Reconnaissance et essais géotechniques — Méthodes de prélèvement et mesurages piézométriques —
Partie 1: Principes techniques des travaux

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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.

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 22475-1 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 341, *Geotechnical investigation and testing*, in collaboration with Technical Committee ISO/TC 182, *Geotechnics*, Subcommittee SC 1, *Geotechnical investigation and testing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 22475-1 consists of the following parts, under the general title *Geotechnical investigation and testing — Sampling methods and groundwater measurements*:

— *Part 1: Technical principles for execution*

— *Part 2: Qualification criteria for enterprises and personnel*

— *Part 3: Conformity assessment of enterprises and personnel by third party*

Introduction

ISO 22475-1 specifies the technical principles for the execution of sampling and groundwater measurements for geotechnical purposes.

The quality of these services can be proven by:

a) a declaration of conformity by a contractor (first party control);

b) a declaration of conformity by a client (second party control);

c) a declaration of conformity by a conformity assessment body (third party control).

Every enterprise or individual may decide, if and how they will prove the fulfilment of the technically related criteria: by first, second or third party control because no part of ISO 22475 requires such a declaration.

ISO/TS 22475-2 specifies the qualification criteria for enterprises and personnel that perform sampling and groundwater measurements according to ISO 22475-1.

The conformity assessment by third party control can be made according to the technical principles for execution of sampling and groundwater measurements specified in ISO 22475-1, as indicated in ISO/TS 22475-2, and in the conformity assessment procedure given in ISO/TS 22475-3.

Geotechnical investigation and testing — Sampling methods and groundwater measurements —

Part 1: Technical principles for execution

1 Scope

This part of ISO 22475 deals with the technical principles of sampling of soil, rock and groundwater, and with groundwater measurements, in the context of geotechnical investigation and testing, as described in EN 1997-1 and EN 1997-2.

The aims of such ground investigations are:

a) to recover soil and rock samples of a quality sufficient to assess the general suitability of a site for geotechnical engineering purposes and to determine the required soil and rock characteristics in the laboratory;

b) to obtain information on the sequence, thickness and orientation of strata and joint system and faults;

c) to establish the type, composition and condition of strata;

d) to obtain information on groundwater conditions and recover water samples for assessment of the interaction of groundwater, soil, rock and construction material.

The quality of a sample is influenced by the geological and hydrogeological conditions, the choice and execution of the drilling and/or the sampling method, handling, transport and storage of the samples.

This part of ISO 22475 does not cover soil sampling for the purposes of agricultural and environmental soil investigation.

NOTE 1 Soil sampling for these purposes is to be found in ISO 10381.

Water sampling for the purposes of quality control, quality characterisation, and identification of sources of pollution of water, including bottom deposits and sludges is not covered.

NOTE 2 Water sampling for these purposes is to be found in ISO 5667.

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.

EN 791, *Drill rigs — Safety*

EN 996, *Piling equipment — Safety requirement*

EN 1997-1, *Eurocode 7: Geotechnical design — Part 1: General rules*

EN 1997-2, *Eurocode 7: Geotechnical design — Part 2: Design assisted by laboratory testing*

ISO 22476-3, *Geotechnical investigation and testing — Field testing — Part 3: Standard penetration test*

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 3551-1, *Rotary core diamond drilling equipment — System A — Part 1: Metric units*

ISO 3552-1, *Rotary core diamond drilling equipment — System B — Part 1: Metric units*

GUM: Guide to the expression of uncertainty in measurement, BIPM/IEC/IFCC/ISO/OIML/IUPAC/IUPAP

ISO 10097-1, *Wireline diamond core drilling equipment — System A — Part 1: Metric units*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1997-1, EN 1997-2, ISO 14688-1 and ISO 14689-1 and the following apply.

NOTE Additional terms and definitions can be found in the books and literature listed in the Bibliography.

3.1 Site investigation methods

3.1.1
trial pit
open excavation constructed to examine the ground conditions *in situ*, recover samples or carry out field testing

3.1.2
shaft
open vertical or steeply inclined excavation, typically more than 5 m deep, constructed to examine the ground conditions *in situ*, recover samples or carry out field testing

3.1.3
heading
adit
small tunnel driven horizontally or with a slight inclination from a shaft or into sloping ground to examine the ground conditions *in situ*, recover samples and carry out field testing

3.1.4
borehole
hole of any predetermined diameter and length formed in any geological formation or man-made material by drilling

NOTE Investigations carried out in such a hole can be to recover rock, soil or water samples from a specified depth or to carry out *in situ* tests and measurements.

3.1.5
drilling
process by which a borehole is produced in any geological formation by rotary, rotary percussive, percussive or thrust methods and in any predetermined direction in relation to the drill rig

3.1.6
small diameter drilling
drilling in the soil with a diameter greater than 30 mm but less than 80 mm

3.1.7
drilling method
technique employed to create and stabilise the borehole

3.2 Drilling rigs and equipment

3.2.1
drilling tool
device attached to, or forming an integral part of, the drill string, used as a cutting tool for penetrating the geological formation

3.2.2
drill bit
device attached to, or forming an integral part of, the drill string, used as a cutting tool to penetrate the formation being drilled by the drilling method employed

3.2.3
drill rig
device which carries out the drilling function

3.2.4
casing
tubing temporarily or permanently inserted into a borehole

NOTE Casing is used, e.g. to stabilise the borehole, to prevent the loss of flushing medium to the surrounding formation, or to prevent cross flow between different groundwater horizons

3.2.5
flushing medium
liquid or gaseous medium used to move cuttings and/or samples and to lubricate and cool the drilling tool from the borehole

3.2.6
flushing additive
substance added to the flushing medium in order to affect or change its properties to improve its functioning

3.2.7
core lifter
split, internally slotted or serrated conical spring steel ring, grooves, flexible spring fingers, hinged wedge-shaped fingers or hinged flaps mounted in a carrier ring, to retain the core sample whilst the corebarrel is being hoisted from the borehole

3.2.8
sample retainer
cylindrical retainer fitted with a split-ring core lifter; it is mounted at the lower end of the sampler tube and used to retain the sample in the tube as the sampler is being lifted from the ground

3.3 Sampling

3.3.1
sampling by drilling
continuous sampling
process by which samples are obtained by the drilling tools as the borehole proceeds

NOTE The drilling process is designed to obtain complete samples of the length of the borehole. The drilling tools are used as sampling tools.

3.3.2
sampling by using sampler
process by which samples are obtained by samplers from trial pits, headings, shafts or borehole bottom at selected positions

3.3.3
soil sampling by small diameter drilling
sampling by drilling in soils, using drilling tools with a diameter greater than 30 mm but less than 80 mm

3.3.4
sample
defined amount of rock, soil or groundwater recovered from recorded depth

3.3.5
core, core sample
cylindrical sample of soil or rock obtained from a borehole from recorded depth

3.3.6
block sample
sample of soil or rock cut out by special techniques

3.3.7
cuttings
particles of geological formations formed in the borehole by the cutting action of the drilling tool

3.3.8
suspended matter
abraded ground material in the flushing medium generated by drilling, in which the individual particle size cannot be recognised with the naked eye

3.3.9
core run
length of the core drilling between the start and the finish for the removal of the sample

3.3.10
core loss
difference between a core run and the length of the core recovered

3.3.11
area ratio
C_a
ratio of the area of soil displaced by the sampler tube in proportion to the area of the sample

$$C_a = \frac{D_2^2 - D_1^2}{D_1^2} \cdot 100$$

See Figure 1.

NOTE 1 The area ratio is expressed in per cent.

NOTE 2 One of the factors that determines the mechanical disturbance of the soil.

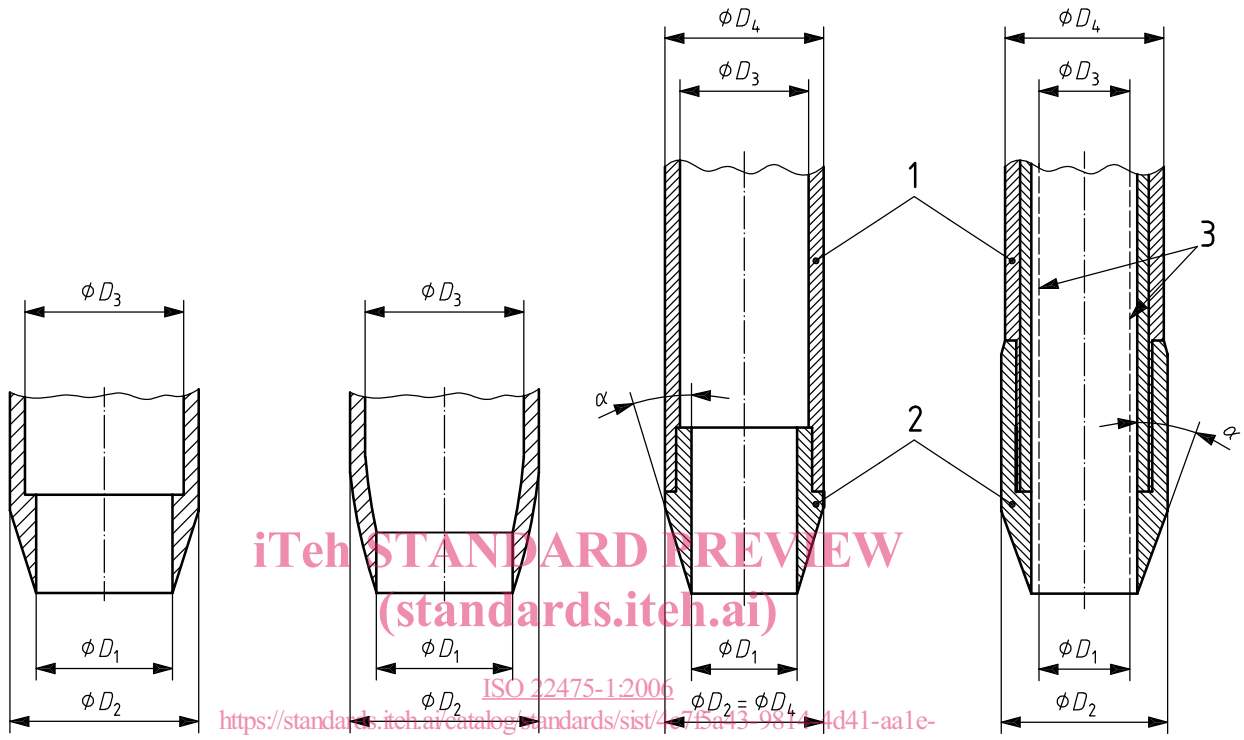
3.3.12
inside clearance ratio
C_i

$$C_i = \frac{D_3 - D_1}{D_1} \cdot 100$$

See Figure 1.

NOTE 1 The inside clearance ratio is expressed in percent.

NOTE 2 One of the factors that determines the mechanical disturbance of the sample caused by the friction on the inside wall of sample tube or of the liner.



Key

D_1	inside diameter of the cutting shoe	α	taper angle
D_2	greatest outside diameter of the cutting shoe	1	sample tube
D_3	inside diameter of the sample tube or liner	2	cutting shoe
D_4	outside diameter of the sample tube	3	liner (optional)

Figure 1 — Definitions of the diameters D_1, D_2, D_3 and D_4

3.3.13
outside clearance ratio
C_o

$$C_o = \frac{D_2 - D_4}{D_4} \cdot 100$$

See Figure 1.

NOTE The outside clearance ratio is expressed in percent.

3.3.14 Fracture state terms

3.3.14.1
total core recovery in rock
TCR
total length of core sample recovered (solid and non-intact), expressed as a percentage of the length of the core run

See Figure 2.

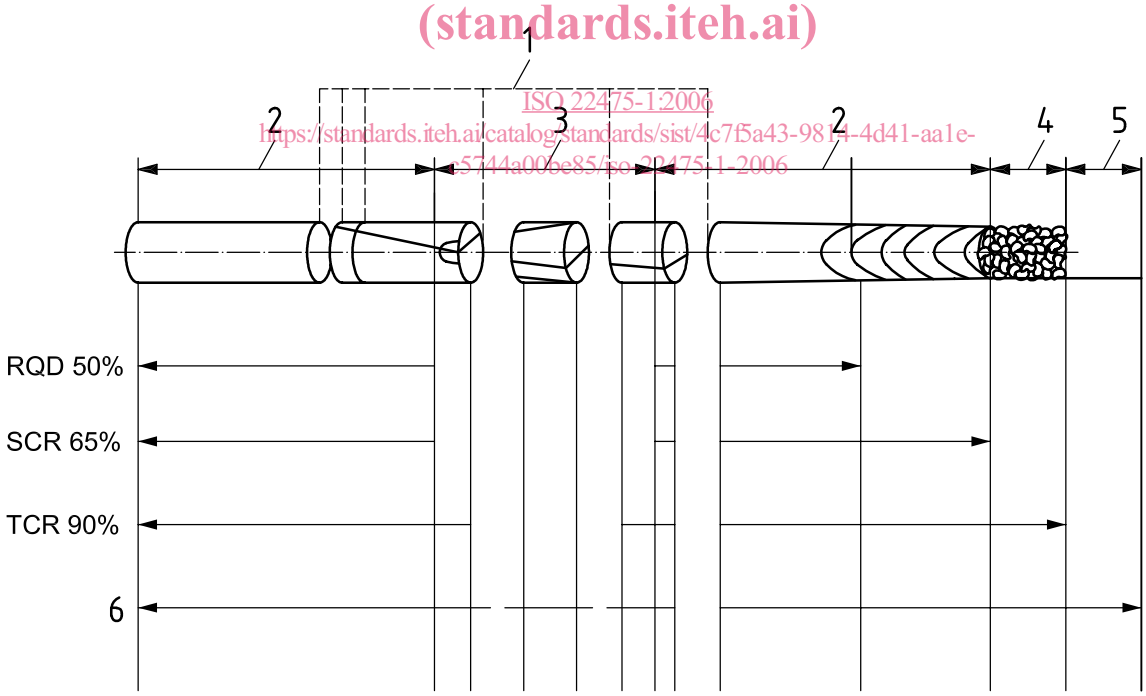
3.3.14.2
rock quality designation
RQD
sum length of all core pieces with at least one full diameter that are 100 mm or longer between natural fractures, measured along the centre line of the core, expressed as a percentage of the length of the core run

See Figure 2.

3.3.14.3
solid core recovery
SCR
length of core recovered as solid cylinders, expressed as a percentage of the length of the core run

See Figure 2.

NOTE A solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference, and is commonly measured along the core axis or other scan line.



NOTE All features shown are natural discontinuities unless stated otherwise.

Key
1 drilling-induced fractures
2 at least one full diameter
3 no single full diameter
4 non-intact
5 no recovery
6 core run

Description of fracture state of rock cores:
RQD rock quality designation
SCR solid core recovery
TCR total core recovery

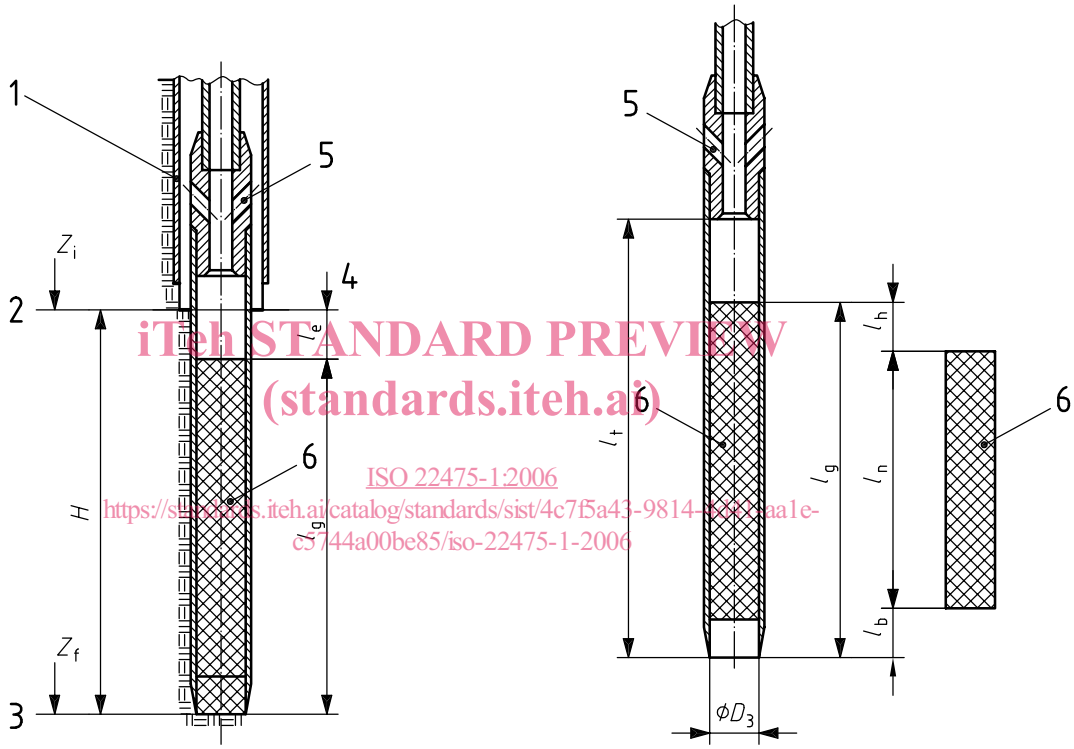
Figure 2 — Application of fracture state terms for rock cores

3.3.15
sample recovery ratio in soil
TC
ratio of the length of the sample, l_g, to the length of the sample run, H

See Figure 3.

3.3.16
net sample recovery ratio
IC
ratio of the net length of the sample, l_n, to the length of the sample run, H

See Figure 3



a) Before withdrawal of sampler **b) After withdrawal of sampler**

Key

1 casing
2 beginning of coring
3 end of coring
4 bottom of predrilled borehole
5 vent-hole
6 sample
D_3 inside diameter of the sample tube or liner
H length of the sample run
Z_f depth, under the natural ground level, of the lower end of the sampler after sampling and before withdrawing the sampler
Z_i depth, under the natural ground level, of the borehole bottom before sampling, and before the beginning of the following core run
l_b length of the lower part of the sample, which was remoulded or lost
l_e difference between the sample run and the actual length of the sample
l_g total length of the sample after withdrawal of the sampler, measured from the top of the sample to the cutter edge, including the remoulded or lost parts at both ends of the sample
l_h length of the remoulded or polluted upper part of the sample
l_n net length of the sample, before its conditioning
l_t effective (useful) length of the sampling tube

Figure 3 — Lengths of core run and sample