
Soil quality — Sampling —

Part 1:

**Guidance on the design of sampling
programmes**

Qualité du sol — Échantillonnage —

*Partie 1: Lignes directrices pour l'établissement des programmes
d'échantillonnage*

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

ISO 10381-1:2002

<https://standards.iteh.ai/catalog/standards/sist/5ab789ec-ea28-4791-99b3-99824ca25b61/iso-10381-1-2002>



Reference number
ISO 10381-1:2002(E)

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)

ISO 10381-1:2002

<https://standards.iteh.ai/catalog/standards/sist/5ab789ec-ea28-4791-99b3-99824ca25b61/iso-10381-1-2002>

© ISO 2002

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from 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

Published in Switzerland

Contents

Page

Foreword.....	v
Introduction	vi
1 Scope.....	1
2 Normative references	1
3 Terms and definitions.....	1
4 Planning the sampling programme.....	2
4.1 General.....	2
4.2 Defining the objective.....	2
4.3 Preliminary information.....	3
4.4 Strategy.....	3
4.5 Sampling.....	3
4.6 Safety.....	3
4.7 Sampling report.....	4
5 Objectives of sampling.....	4
5.1 General.....	4
5.2 Specific objectives.....	5
5.3 Sampling of other material in connection with soil investigation	7
6 Special considerations for the sampling of soils	7
6.1 General.....	7
6.2 Preliminary survey.....	8
7 Requirements for sampling personnel.....	9
7.1 General.....	9
7.2 Experience.....	9
7.3 Coordination of sampling and analysis.....	10
8 Safety precautions	10
9 Samples and sampling points	10
9.1 General.....	10
9.2 Sampling patterns.....	10
9.3 Identifying the sampling location.....	12
9.4 Preparation of the sampling site	13
9.5 Barriers to sampling	13
9.6 Choice of appropriate equipment to obtain samples.....	14
9.7 Depth of sampling.....	14
9.8 Timing of investigation.....	15
9.9 Sample quantity	15
9.10 Single samples vs. composite samples	15
9.11 Laboratory preservation, handling and containerization, labelling and transport of soil samples.....	15
10 Sampling report.....	19
10.1 General.....	19
10.2 Title data.....	19
10.3 Site data	19
10.4 Sampling procedure	19
10.5 Transportation and storage	20
10.6 Sample, profile and site description	20
10.7 Sample and profile description	20
10.8 Site description	20

11	Quality control, quality assurance and operation and testing of laboratories	20
Annex A (informative)	Sources of additional information	21
Annex B (informative)	Determination of a sampling plan.....	23
Annex C (informative)	Examples of different sampling patterns used in soil sampling programmes.....	24
Bibliography.....		33

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 10381-1:2002](https://standards.iteh.ai/catalog/standards/sist/5ab789ec-ea28-4791-99b3-99824ca25b61/iso-10381-1-2002)

<https://standards.iteh.ai/catalog/standards/sist/5ab789ec-ea28-4791-99b3-99824ca25b61/iso-10381-1-2002>

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 10381-1 was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 2, *Sampling*.

ISO 10381 consists of the following parts, under the general title *Soil quality — Sampling*:

- *Part 1: Guidance on the design of sampling programmes*
- *Part 2: Guidance on sampling techniques*
- *Part 3: Guidance on safety*
- *Part 4: Guidance on the procedure for investigation of natural, near-natural and cultivated sites*
- *Part 5: Guidance on investigation of soil contamination of urban and industrial sites*
- *Part 6: Guidance on the collection, handling and storage of soil for the assessment of aerobic microbial processes in the laboratory*

Introduction

This part of ISO 10381 is one of a set of International Standards intended to be used in conjunction with each other as appropriate and necessary. ISO 10381 (all parts) deals with sampling procedures for the various purposes of soil investigation.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 10381-1:2002](https://standards.iteh.ai/catalog/standards/sist/5ab789ec-ea28-4791-99b3-99824ca25b61/iso-10381-1-2002)

<https://standards.iteh.ai/catalog/standards/sist/5ab789ec-ea28-4791-99b3-99824ca25b61/iso-10381-1-2002>

Soil quality — Sampling —

Part 1: Guidance on the design of sampling programmes

1 Scope

This part of ISO 10381 sets out the general principles to be applied in the design of sampling programmes for the purpose of characterizing and controlling soil quality and identifying sources and effects of contamination of soil and related material, with emphasis on

- procedures required to locate points from which samples may be taken for examination or at which instruments may be installed for *in situ* measurement including statistical implications,
- procedures for determining how much sample to collect and whether to combine samples,
- methods of collecting samples,
- methods for containing, storing and transporting samples to prevent deterioration/contamination.

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 10381-3, *Soil quality — Sampling — Part 3: Guidance on safety*

ISO 10381-4, *Soil quality — Sampling — Part 4: Guidance on the procedure for investigation of natural, near-natural and cultivated sites*

ISO 10381-5, *Soil quality — Sampling — Part 5: Guidance on investigation of soil contamination of urban and industrial sites*

ISO 10381-6, *Soil quality — Sampling — Part 6: Guidance on the collection, handling and storage of soil for the assessment of aerobic microbial processes in the laboratory*

ISO 11074-2, *Soil quality — Vocabulary — Part 2: Terms and definitions relating to sampling*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11074-2 apply.

4 Planning the sampling programme

4.1 General

Samples are collected and examined primarily to determine their physical, chemical, biological and radiological properties. This clause outlines the more important factors which should be considered when devising a sampling programme for soil and related material. More detailed information is given in subsequent clauses.

Whenever a volume of soil is to be characterized, it is generally not possible to examine the whole and it is therefore necessary to take samples. The samples collected should be as representative as possible of the whole to be characterized, and all precautions should be taken to ensure that, as far as possible, the samples do not undergo any changes in the interval between sampling and examination. The sampling of multiphase systems, such as soils containing water or other liquids, gases, biological material, radionuclides or other solids not naturally belonging to soil (e.g. waste materials), can present special problems. In addition, examination for some physical soil parameters may require so-called undisturbed soil samples for correct execution of the relevant measurement.

Before any sampling programme is devised, it is important that the objectives be first established since they are the major determining factors, e.g. the position and density of sampling points, time of sampling, sampling procedures, subsequent treatment of samples and analytical requirements. The details of a sampling programme depend on whether the information needed is the average value, the distribution or the variability of given soil parameters.

Some consideration should also be given to the degree of detail and precision required and also to the manner in which the results are to be expressed and presented, for example concentrations of chemical substances, maximum and minimum values, arithmetic means, median values, etc. Additionally, a list of parameters of interest should be compiled and the relevant analytical procedures consulted, since these will usually give guidance on precautions to be observed during sampling and subsequent handling of soil samples.

It may often be necessary to carry out an exploratory sampling and analysis programme before the final objectives can be defined. It is important to take into account all relevant data from previous programmes at the same or similar locations and other information on local conditions. Previous personal experience can also be very valuable. Time and money allocated to the design of a proper sampling programme is usually well justified because it ensures that the required information is obtained efficiently and economically.

It is emphasized that whether soil investigations completely achieve their objectives depends mainly on the design and execution of an appropriate sampling programme.

The main points about which decisions shall be made in the design of a sampling programme are listed below in 4.2 to 4.7. The relevant references are indicated.

4.2 Defining the objective

The following should be considered when defining the objective:

- a) delineation of area(s) to be investigated;
- b) setting of objectives for the whole investigation;
- c) listing of parameters to be determined;
- d) listing of other information required to enable interpretation of results;
- e) content of sample report;
- f) decisions regarding contractual arrangements for sampling;
- g) management arrangements;
- h) estimation of costs.

4.3 Preliminary information

The following questions may help in the choice of preliminary information:

- a) What is already known?
- b) What can be made easily available?
- c) Who is to be contacted for certain (historical) sources?
- d) Are there any legal problems, e.g. entering the site?
- e) What should be observed on first visit to the site?

For details see Clause 6 and ISO 10381-4, ISO 10381-5 and ISO 10381-6.

4.4 Strategy

Decisions regarding the following factors are usually involved in a sampling strategy:

- a) sampling patterns;
- b) sampling points;
- c) depth of sampling;
- d) type of samples to be obtained;
- e) sampling methods to be employed, e.g. borings, drillings, trial pits, etc.

For details see Clause 10 and ISO 10381-4, ISO 10381-5 and ISO 10381-6.

4.5 Sampling

The following procedures are involved in planning the sampling:

- a) coordination with personnel responsible for the sample preparation and analysis;
- b) choice of suitable sampling tools;
- c) choice of suitable storage;
- d) choice of suitable preservation measures;
- e) choice of suitable labelling and transportation;
- f) field tests to be carried out, if specified.

For details see Clauses 7, 8, 10 and ISO 10381-2, ISO 10381-4, ISO 10381-5 and ISO 10381-6.

4.6 Safety

The following safety aspects need to be considered:

- a) all necessary safety precautions at the site;
- b) informing landowners, construction authorities, local authorities;

- c) data protection efforts;
- d) requirements for disposal of surplus soil or test material.

For details see Clause 9 and ISO 10381-2, ISO 10381-3, ISO 10381-4, ISO 10381-5 and ISO 10381-6.

4.7 Sampling report

The sampling report should meet the basic content as specified in this part of ISO 10381. Additional information required should be clearly specified by the client and laid down in a written contract. Any later deviation should be justified to avoid deficiencies with regard to evaluation of the investigation and to avoid conflicts between business partners.

For details see Clauses 11, 12, 13 and ISO 10381-4, ISO 10381-5 and ISO 10381-6.

5 Objectives of sampling

5.1 General

5.1.1 Principal objectives

The four principal objectives of sampling of soil may be distinguished as follows:

- sampling for determination of general soil quality;
- sampling for characterization purposes in preparation of soil maps;
- sampling to support legal or regulatory action; [ISO 10381-1:2002](https://standards.iteh.ai/catalog/standards/sist/5ab789ec-ea28-4791-99b3-09874ca25b61/iso-10381-1-2002)
- sampling as part of a hazard or risk assessment.

These four principal objectives are discussed further below.

The utilization of the soil and site is of varying importance depending on the primary objective of an investigation. For example, while consideration of past, present and future site use is particularly relevant to sampling for risk assessment, it is less important to soil mapping where the focus is on description rather than evaluation of a soil. Objectives such as soil quality assessment, land appraisal and soil monitoring take utilization into account to varying degrees.

The results obtained from sampling campaigns to assess soil quality for mapping may indicate a need for further investigation, for example if contamination is detected which indicates a need for identification and assessment of potential hazards and risks.

5.1.2 Sampling for determination of general soil quality

Such sampling is typically carried out at (irregular) time intervals to determine the quality of the soil for a particular purpose e.g. for agriculture. As such, it tends to concentrate on factors such as nutrient status, pH, organic matter content, trace element concentrations and physical factors, which provide a measure of current quality and which are amenable to manipulation. Such sampling is usually carried out within the main rooting zone and also at greater depths but sometimes without exact distinction of horizons or layers.

The guidance given in ISO 10381-4 is particularly relevant.

5.1.3 Sampling for preparation of soil maps

Soil maps may be used in soil description, land appraisal (taxation), and for soil monitoring sites to establish the basic information on the genesis and distribution of naturally occurring or man-made soils, their chemical, mineralogical, biological composition, and their physical properties at selected locations. The preparation of soil maps involves installation of trial pits or core sampling with detailed consideration of soil layers and horizons. Special strategies are required to preserve samples in their original physical and chemical condition. Sampling is nearly always a one-off procedure.

The guidance given in ISO 10381-4 is particularly relevant.

5.1.4 Sampling to support legal or regulatory action

Sampling may be required to establish baseline conditions prior to an activity which might affect the composition or quality of soil, or it may be required following an anthropogenic effect such as the input of an undesirable material which may be from a point or a diffuse source.

Sampling strategies need to be developed on a site-specific basis.

To adequately support legal or regulatory action, particular attention should be paid to all aspects of quality assurance including for example "chain-of-custody procedures".

The guidance given in ISO 10381-5 is particularly relevant. That in ISO 10381-4 may also be relevant.

5.1.5 Sampling for hazard and risk assessment

When land is contaminated with chemicals and other substances that are potentially harmful to human health and safety or to the environment, it may be necessary to carry out an investigation as a part of a hazard and/or risk assessment, i.e. to determine the nature and extent of contamination, to identify hazards associated with the contamination, to identify potential targets and routes of exposure, and to evaluate the risks relating to current and future use of the site and neighbouring land. A sampling programme for risk assessment (in this context: phase I, phase II, phase III and phase IV investigation) may have to comply with legal or regulatory requirements (see 5.1.3), and careful attention to sample integrity is recommended. Sampling strategies should be developed on a site-specific basis.

The guidance given in ISO 10381-5 is particularly relevant. That in ISO 10381-4 may also be relevant.

5.2 Specific objectives

5.2.1 General

Depending on the principal objective(s), it is usually necessary to determine, for the body of soil or part thereof:

- the nature, concentrations and distribution of naturally occurring substances,
- the nature, concentrations and distribution of contaminants (extraneous substances),
- the physical properties and variations,
- the presence and distribution of biological species of interest.

It is often necessary to take into account changes in the above parameters with time, caused by migration, atmospheric conditions and land/soil use.

Some detailed objectives are suggested in the subclauses below. The list is not exhaustive.

5.2.2 Sampling for the determination of soil chemical parameters

There are many reasons for chemical investigation of soil and related material and only a few are mentioned here. It is important that each sampling routine be tailored to fit the soil and the situation.

Chemical investigations are carried out

- a) to identify immediate hazards to human health and safety and to the environment,
- b) to determine the suitability of a soil for an intended use, e.g. agricultural production, residential development,
- c) to study the effects of atmospheric pollutants including radioactive fallout on the quality of soil. This may also provide information on water quality and also indicate if problems are likely to arise in near-surface aquifers,
- d) to assess the effects of direct inputs to soil; there may be contributions from
 - naturally occurring substances which exceed local background values, e.g. certain mineral phases in metal deposits,
 - (un)expected contamination by application of agrochemicals
 - (un)expected contamination due to industrial processes,
- e) to assess the effect of the accumulation and release of substances by soils on other soil horizons or on other environmental compartments, e.g. the transfer of substances from a soil into a plant,
- f) to study the effect of waste disposal, including the disposal of sewage sludge on a soil (apart from contributing to the pollution load, such disposals may produce other chemical reactions such as the formation of persistent compounds, metabolites or the evolution of gases, such as methane),
- g) to identify and quantify products released by industrial processes and by accident (this is usually done by investigation of suspect sites or contaminated sites),
- h) to evaluate soil derived from construction works, with a view to possible or further utilization of such soils (see ISO 15176) or disposal as waste.

Commonly, sampling strategies are employed which require samples to be taken either from identifiable soil horizons, or from specified depths (below ground surface). It is best to avoid mixing the two approaches, particularly when sampling natural strata, as this can make it difficult to compare results. However, a coherent combination of the two approaches can sometimes be useful on old industrial sites where there is variation both in the nature of fill and of the depth of penetration of mobile contaminants into the ground, i.e. there are two independent reasons for changes in soil/fill properties.

Knowledge of the way in which particular chemical substances tend to be distributed between different environmental categories (air, soil, water, sediment and living organisms) is of advantage for the design of some sampling programmes. Similarly, knowledge of the behaviour of those living organisms affected by chemical substances or which affect the availability of substances due to microbiological procedures, is of advantage, too.

5.2.3 Sampling for the determination of soil physical parameters

The sampling of soil for the determination of certain physical properties requires special consideration, since the accuracy and extrapolation of measured data relies on obtaining a sample which retains its *in situ* structural characteristics.

In many circumstances it may be preferable to conduct measurements in the field, since the removal of even an undisturbed sample can change the continuity and characteristics of soil physical properties and lead to erroneous results.

However, certain measurements are not possible in the field. Others require specific field conditions, but the field situation can only be controlled to a very limited extent, e.g. it may be possible to modify the hydrological situation temporarily for measurement purposes by irrigation. The time and expense necessary for field measurements may not be affordable. Laboratory measurements of physical properties are therefore frequently necessary.

Differences and changes in soil structure affect the choice of sample size. Hence, a representative volume or minimum number of replicates shall be determined for each soil type to be studied.

The moisture status of the soil at sampling can influence physical measurements, e.g. hysteresis on rewetting can occur.

Many physical properties have vertical and horizontal components; this should be considered prior to sampling.

Where small undisturbed soil samples are required, manual excavation of cores, clods or soil aggregates can be applied. Sampling equipment should be designed such that minimal physical disturbance is caused to the soil. For larger samples, the use of hydraulic sampling equipment and cutting devices is preferable in order to obtain a sample with minimal disturbance. Care should be taken both in equipment design and manufacture to ensure that internal compression or compaction of the sample does not occur.

Where it is difficult to obtain an undisturbed sample for laboratory measurements, e.g. in stony or iron pan soils then *in situ* measurements may be the most appropriate approach.

5.2.4 Sampling for the assessment of soil biological parameters

Biological soil investigations address a number of different questions related to what is happening to or caused by life forms in and on the soil, including both fauna and flora in the micro and macro ranges. Ecotoxicological questions are usually given first priority, for example tests to verify the effects of chemicals added to the soil on life forms and also the possible effects of life forms in the soil on plants (e.g. high-value crops) and on the environment, especially on human health.

In some cases biological soil test procedures operate with fully artificial soils, but normally the major task of sampling is to choose a reliable soil or site to carry out the tests.

See ISO 10381-6 for information on sampling for the assessment of aerobic microbial processes.

5.3 Sampling of other material in connection with soil investigation

Soil investigation programmes, and particularly those carried out at contaminated sites, may also require samples other than soil to be taken. Reference should be made to International Standards for technical details, or to relevant national standards if no International Standards are available.

International Standards on the sampling of water, sludge and sediment which may be appropriate for use in soil quality investigations are listed in Annex A together with a brief description of their scopes.

6 Special considerations for the sampling of soils

6.1 General

This clause deals with matters which may influence the design of a sampling programme (e.g. pre-existing knowledge of the site) and a number of detailed aspects of the design and implementation (e.g. sampling patterns, sample handling).

Attention is drawn to the requirements for sampling personnel in Clause 7 and to the safety precautions necessary in various situations, briefly mentioned in Clause 8 but more fully described in ISO 10381-3.