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Soil quality — Sampling —

Part 4: Guidance on the procedure for investigation of natural, near-natural and cultivated sites

Qualité du sol — Échantillonnage —

Partie 4: Lignes directrices pour les procédures d'investigation des sites naturels, quasi naturels et cultivés

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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 10381-4 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 6: Guidance on the collection, handling and storage of soil for the assessment of aerobic microbial processes in the laboratory*

The following parts are under preparation:

— *Part 5: Guidance on investigation of soil contamination of urban and industrial sites*

— *Part 7: Guidance on the investigation and sampling of soil gas*

— *Part 8: Guidance on the sampling of stockpiles*

Introduction

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

The general terminology used is in accordance with that established in ISO/TC 190 and, more particularly, with the terminology on sampling given in ISO 11074-2.

Soil quality — Sampling —

Part 4: Guidance on the procedure for investigation of natural, near-natural and cultivated sites

1 Scope

This part of ISO 10381 describes the sampling of soils of

— natural and near-natural sites,

— areas used for agriculture (arable and pasture sites),

— areas used for horticulture (including domestic gardens, allotments),

— areas used for special crop-cultivation, arboreal, vineyard, etc.,

— forest areas and woods.

It is applicable to

— soil investigations and evaluations in the field,

— chemical, geochemical, physical, biological and radiological characterization of soil and soil materials in the laboratory after sampling.

This part of ISO 10381, sets out appropriate strategies for the design of sampling programmes, field procedures and subsequent treatment of samples for transport and storage prior to sample pretreatment (e.g. drying, milling).

NOTE This part of ISO 10381 is intended to be used in conjunction with the other parts of ISO 10381 when appropriate.

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 10381-1, *Soil quality — Sampling — Part 1: Guidance on the design of sampling programmes*

ISO 10381-2, *Soil quality — Sampling — Part 2: Guidance on sampling techniques*

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

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 11074-1:1996, *Soil quality — Vocabulary — Part 1: Terms and definitions relating to the protection and pollution of the soil*

ISO 11074-2:1998, *Soil quality — Vocabulary — Part 2: Terms and definitions relating to sampling*

ISO 11277, *Soil quality — Determination of particle size distribution in mineral soil material — Method by sieving and sedimentation*

ISO 11464, *Soil quality — Pretreatment of samples for physico-chemical analyses*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11074-1 and ISO 11074-2 apply.

4 Objectives of sampling

The sampling strategy is mainly affected by

— the objective of the investigation,

— current and previous soil/land use.

The objective of investigations may be

— collection of information on general soil quality with regard to preservation and improvement of ecological soil functions,

— collection of information for evaluation of soil quality and nutrient supply or nutrient demand with regard to preservation and improvement of productivity of soils,

— collection of information for soil mapping, classification and taxation,

— collection of information for establishment and maintenance of soil monitoring areas,

— collection of information for replicate samples used for soil specimen banks or environmental specimen banks.

Table 1 gives information on different objectives and strategies for the sampling of soils.

More information about the objectives for soil sampling is given in ISO 10381-1.

Table 1 — Objectives of soil sampling

No.	Objectives	Land use	Average concentration	Spatial variability		Time change	ISO 10381 reference to Part
				horizontal	vertical		
1	Mapping	all	−	+	+	−	1, 2, 3
2	Classification	all	+	−	+	−	1, 2, 3
3	Monitoring	agricultural	+	−	+/−	+	1, 2, 3
		forestry	+/−	+	+	+	1, 2, 3
		natural	+/−	+	+	+	1, 2, 3
4	Taxation	all	+/−	+	+/−	plot	1, 2, 3
5	Improving soil function	all	+	−	−	+/−	1, 2, 3, 5
6	Maximum[a] loading	agricultural	+	−	+/−	+	1, 2, 3, 5

− not important
+/− not too important
+ important

[a] Nutrient supply/residues of pesticides and organic substances, metals in traces

5 General principles, requirements and considerations of soil sampling

5.1 This clause summarizes general principles, requirements and considerations of soil sampling which should be taken into account for natural, near-natural and cultivated sites. ISO 10381-1 gives further information to be used in conjunction with this part of ISO 10381.

The aspects in 5.2 to 5.19 should be considered when developing a sampling strategy.

5.2 Selection of sampling locations should take into consideration uniformity of soil quality, land use and type of cultivation (the sampling locations should be representative of the total area to be sampled).

5.3 A field sampling pattern may be adopted to provide either single samples or incremental samples to be mixed, to provide a composite sample.

5.4 Selection of sampling points (e.g. for borings) for sampling the area or systematic (patternlike) point sampling.

5.5 Sampling patterns may be based on statistical models, numerical random distributions or systematic patterns.

5.6 Avoidance of locations such as dead patches, field margins, damp areas and other areas which obviously deviate from the average.

5.7 Types of sample, including

— disturbed samples (mass-proportional sampling, samples obtained without any attempt to preserve the soil structure);

— undisturbed samples (volume-proportional sampling, samples obtained using a method designed to preserve the soil structure).

5.8 Sampling of

— soil horizons (preferably for agricultural, forestry and natural land use);

— soil layers (e.g. artificial urban sites, mixed soils or forced by the objective).

5.9 Sampling procedure, e.g.

— probing,

— boring/augering,

— trial pit.

5.10 Sampling equipment.

Detailed guidance on the selection and application of suitable equipment is given in ISO 10381-2.

5.11 Depth of sampling in regard to the actual case and representativeness.

5.12 Time and frequency of sampling, depending on

— the objective of sampling,

— use of land (e.g. periodic sampling for soil fertility analysis),

— soil quality.

5.13 Sample quantity, depending on the type and extent of intended field and laboratory investigations and the need for bulk density determination. The following amounts are recommended:

— in the case of sandy, loamy and clay soils: up to 1 kg;

— in the case of peat soils and organic horizons from forest soils: up to 0,5 kg;

— in the case of soils with increasing fractions of gravel, cobbles and stones: greater masses are required (see ISO 11277).

Additional soil material is needed for preparation of replicate samples.

5.14 Sample containers:

— should have been shown not to contribute to the level of the determinant;

— should correspond to the objective of sampling;

— may require cooling in certain cases;

— should be suitable to avoid losses of volatile substances and water as well as losses by reaction with light (refined steel, fluorinated polymer compounds, aluminium, brown glass);

— should have suitable labels.

Bags can be used for collection of a number of smaller containers. Special bags are used for soil sample rings or drill cores.

5.15 Samples should be transported:

— as soon as possible and with cooling if necessary, e.g. for determination of mobile nitrogen in order to prevent losses caused by microbiological reactions;

— avoiding vibration as far as possible;

— avoiding loss of water by evaporation.

5.16 Storage, taking into account the following:

— in the case of short-term storage outside the laboratory and before the start of sample pretreatments in the laboratory, storage under appropriate conditions;

— in the case of recent preparation, storage of fresh sample(s) in a refrigerated room;

— in other cases, quick drying (40 °C)(see ISO 11464 for instructions).

5.17 Safety precautions: detailed instructions for safety aspects in relation to soil sampling are given in ISO 10381-3.

5.18 Quality control measures, conducted by technically qualified personnel with knowledge and experience in soil science, geological and hydrological aspects, including

— application of suitable sampling equipment to avoid cross-contamination, losses, etc.;

— application of reproducible sampling systems and procedures;

— off-site estimation of sampling variance.

5.19 Sampling report, to facilitate comparison of soil characteristics in soil inventories, land evaluation, etc., should

— include information on the site (location and utilization of the area, soil conditions, conditions of cultivation and climate, etc.);

— be supplemented by sketch maps of location, field maps, photographs, etc.

6 Special remarks

6.1 Number of samples in relation to agricultural objectives

In the case of uniform land use, soil quality and soil management, the number of samples taken should be as shown in Table 2.

Table 2 — Relationships between the number of samples and area to be sampled

Number of composite samples n	**Area** A ha
1	0 to 2
2	$>$ 2 to 5
3	$>$ 5 to 10
4	$>$ 10 to 15
5	$>$ 15 to 20
6	$>$ 20 to 30
For areas larger than those given, the following equation should be used to specify the number n of composite samples: $n = 1 + \sqrt{A}$	

6.2 Sampling for the determination of mobile nitrogen

The determination of mobile nitrogen is among the routine determinations in agricultural soil investigation, thus the procedures of sampling require special attention in order to obtain reliable results. Details are given in the following to address this special case.

The determination of the mobile (bioavailable and readily leachable) part of the total soil nitrogen provides important baseline data when making recommendations for nitrogen fertilization. In agriculture and horticulture, data on the nitrogen residuals after the vegetation period are also important in order to minimize leaching to groundwater.

Usually samples from three soil layers: 0 m to 0,3 m; 0,3 m to 0,6 m and 0,6 m to 0,9 m, are taken. There may be occasions when the specific needs of the investigation dictate that layers of incremental resolution greater than 0,3 m are required. Thus, the actual supply of mobile nitrogen can be determined and evaluated. Sampling can be carried out manually or by use of machinery. Up to 15 incremental samples, obtained with regard to site and layer, form a composite sample. To avoid losses of mobile nitrogen, the composite samples should be stored at 4 °C in a refrigerated box in darkness and transferred to the laboratory. It is strongly recommended that sampling, transport, pretreatment and analysis be carried out in as short a time as possible.

Consideration should be given to the maximum root depth of plants in order to increase or decrease the number of layers to be analysed.

6.3 Forest soils

For the investigation of forest soils, a special approach is required for the selection of sampling points. Within a forest unit of area, for example, at least 10 sampling circles should be selected in a pattern so that each of the circles encloses approximately the same number of trees. From these sampling circles, near-trunk zones (approximately 1 m distance from trunks), areas in between, and canopy areas are sampled. Incremental samples obtained in this way may be used to form horizon-related composite samples per unit area.