INTERNATIONAL STANDARD

ISO 18400-201

First edition
2017-01

Soil quality — Sampling —

Part 201: Physical pretreatment in the field

Qualité du sol — Échantillonnage —

Partie 201: Prétraitement physique sur le terrain

Reference number
ISO 18400-201:2017(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html

This document was prepared by Technical Committee ISO/TC 190, *Soil Quality*, Subcommittee SC 2, *Sampling*.

A list of all parts in the ISO 18400 series can be found on the ISO website.

Introduction

Pretreatment of samples is usually required before they are tested to determine chemical or other properties, although there are some situations when any pretreatment would be unacceptable because it would affect the results.

Sample pretreatment is to preferably take place in the laboratory, as sample integrity can be best controlled under laboratory conditions. However, under some circumstances, pretreatment may be started in the field directly after sampling, to obtain a representative laboratory sample from the material extracted from the ground, or to prepare a composite laboratory sample.

The representativeness of a sample depends on factors like sample size, particle size, particle shape, contaminant type and concentration, consistence of soil materials and sampling strategy (see ISO 18400-104[1]).

When volatiles are present, the procedures described in ISO 22155 are to be used as appropriate if possible. No further pretreatment is allowed. Other specified pretreatment methods will result in a significant loss of volatiles.

Pretreatment comprises one or a combination of the following:

— homogenization;

— sample division: obtaining subsamples of smaller size than the original sample without reducing the particle size of the individual particles;

— particle size reduction: grinding and crushing the sample in order to reduce the particle size of the sample without reducing the sample size (mass);

— separation of fractions on the basis of particle sizes (sieving or screening) if only a separate size fraction of soil is of interest for investigation or on the basis of the physical nature of the materials (e.g. appearance);

— preparation of composite sample(s).

Several cycles of a number of these activities could be required to derive the test sample (e.g. analytical sample) from the material extracted from the ground. Except as noted above when pretreatment would affect the results of subsequent testing or analysis, subsampling is normally required in the laboratory because the amount of material in the laboratory sample (i.e. that sent from the field to the laboratory) is almost always larger than the amount of material necessary for the test or analysis.

There might be occasions when it is considered desirable to combine soil material in the field from, for example different locations into a composite sample. A suitable procedure for doing this is described in this document.

For reasons explained in Clause 4, only some of the pretreatment measures listed above can be carried out in the field.

This document is part of a series of sampling standards for soil. The role/position of the International Standards within the total investigation programme is shown in Figure 1.

NOTE This document is intended to complement ISO 23909 and ISO 22155.

1) Under preparation.

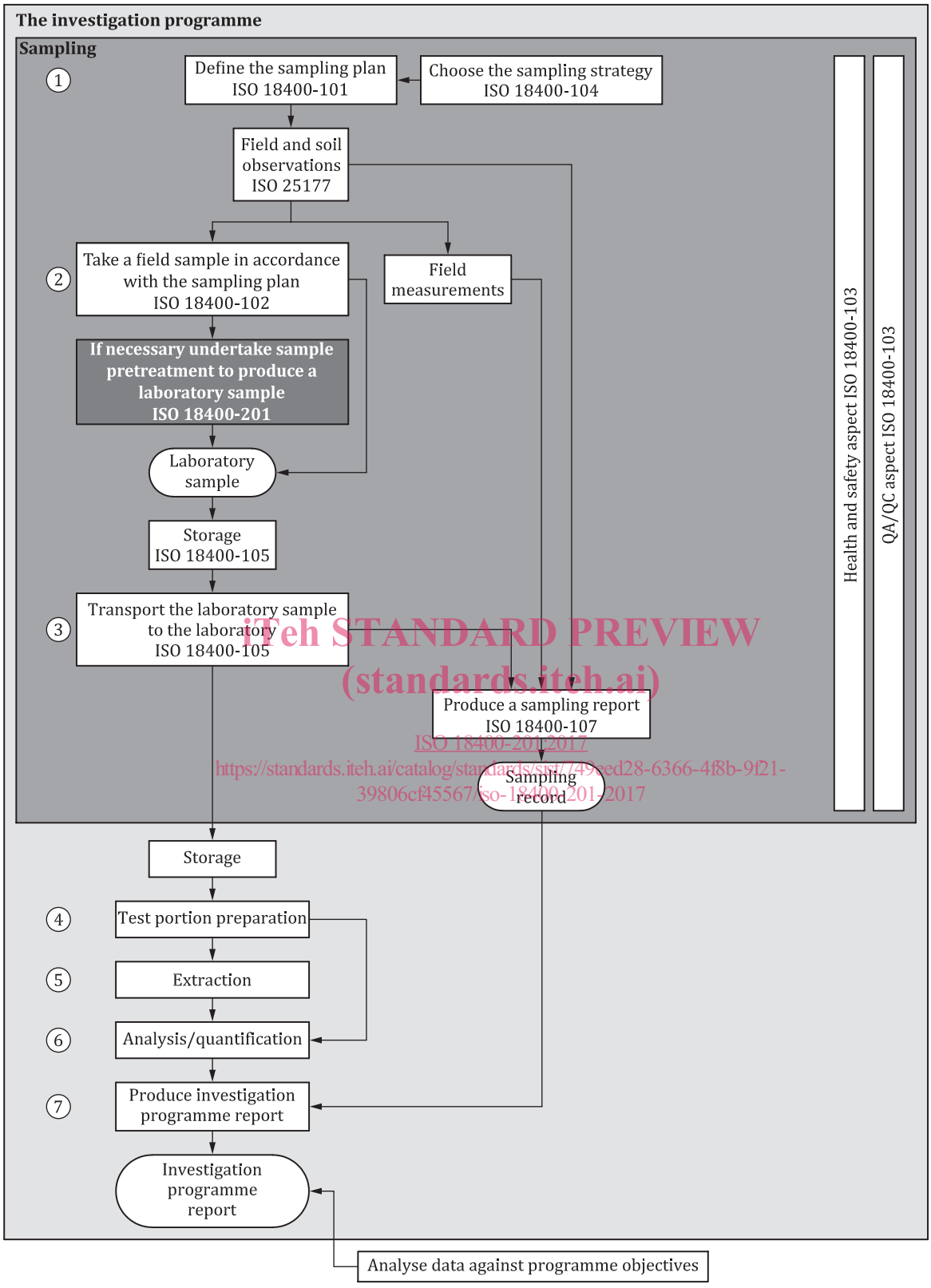

Figure 1 — Links between the essential elements of an investigation programme

NOTE 1 Numbers in circles define the key elements and steps of the investigation programme.

NOTE 2 Figure 1 displays a generic process which can be amended when necessary.

Soil quality — Sampling —

Part 201: **Physical pretreatment in the field**

1 Scope

This document specifies methods for the pretreatment of samples that can be applied "in the field" directly after sampling. Pretreatment methods in this document are limited to:

— sample division methods aimed at reducing the size/volume of the sample;

— the production of composite samples;

— the selection of a specific fraction of the sampled material.

This document

— does not apply to samples required for biological or microbiological examination,

— does not apply to soil materials sampled for the content of volatile components, and

NOTE 1 These soil materials are intended to be sampled according to ISO 22155.

— does not give instructions for particle size reduction.

NOTE 2 Guidance for particle size reduction is given in ISO 11464, ISO 14507 and ISO 23909.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

ISO 11074, *Soil quality — Vocabulary*

ISO 18400-101:2017, *Soil quality — Sampling — Framework for the preparation and application of a sampling plan*

ISO 18400-104[2)], *Soil quality — Sampling — Strategies*

ISO 18400-105, *Soil quality — Sampling — Packaging, transport, storage and preservation of samples*

ISO 18400-107, *Soil quality — Sampling — Recording and reporting*

ISO 22155, *Soil quality — Gas chromatographic determination of volatile aromatic and halogenated hydrocarbons and selected ethers — Static headspace method*

DIN 19747, *Investigation of solids — Pre-treatment, preparation and processing of samples for chemical, biological and physical investigations*

2) Under preparation. Stage at the time of publication: ISO/DIS 18400-104:2016.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
analytical sample
portion of material, resulting from the original sample or composite sample by means of an appropriate method of sample pretreatment and having the size (volume/mass) necessary for the desired testing or analysis

[SOURCE: ISO 11074:2015, 4.1.3]

3.2
laboratory sample
sample intended for laboratory inspection or testing

Note 1 to entry: When the laboratory sample is further prepared (reduced) by subdividing, mixing, grinding, or by combinations of these operations, the result is the test sample. When no preparation of the laboratory sample is required, the laboratory sample is the test sample. A test portion is removed from the test sample for the performance of the test or for analysis.

Note 2 to entry: The laboratory sample is the final sample from the point of view of sample collection but it is the initial sample from the point of view of the laboratory.

Note 3 to entry: Several laboratory samples can be prepared and sent to different laboratories or to the same laboratory for different purposes.

[SOURCE: ISO 11074:2015, 4.3.7]

3.3
sample division
(bulk material) activity in sample preparation whereby a sample of bulk material is divided by such means as riffling, mechanical division, or quartering into separate parts, one or more of which is retained

[SOURCE: ISO 3534-2:2006, 5.3.8]

3.4
subsample
selected part of a sample

Note 1 to entry: The subsample can be selected by the same method as was used in selecting the original sample, but need not be so.

[SOURCE: ISO 3534-2:2006, 1.2.19]

3.5
selective subsampling
separation of part of a sample on the basis of grading (i.e. above or below a defined particle size), appearance or some other attribute

3.6
volatile organic compound
VOC
organic compound that is a gas under normal environmental/atmospheric conditions, although it can be found in the ground in the solid, liquid and dissolved phase form as well as in the gaseous phase

Note 1 to entry: The US Environmental Protection Agency uses a variety of definitions for VOCs in different contexts but the one most appropriate here is "an organic compound which has a boiling point below that of water and which can easily vaporize or volatilize".

Note 2 to entry: Examples include single-ring aromatic hydrocarbons and other low boiling halogenated hydrocarbons, which are used as solvents or fuels, and some degradation products.

4 Preliminary considerations

The intention when sampling in the field is almost always to obtain a sufficiently representative sample of the desired size that can be placed directly in a container for transport to the laboratory. However, under some circumstances, as described in this document, some pretreatment can be done in the field to reduce the size of a large field sample to a more manageable size for sending to the laboratory or to select a particular fraction to form the laboratory sample.

The direct selection of the material to form the laboratory sample from the material extracted from the ground when this forms an integral part of the sampling process is described in ISO 18400-102 on the selection and application of sampling techniques.

When the laboratory sample is received, pretreatment is usually required before testing to determine chemical or other properties, although there are some situations when any pretreatment would be unacceptable because it would affect the results (e.g. when volatile organic compounds are present). Pretreatment is normally required in the laboratory because the amount of material in the laboratory sample (i.e. that sent from the field to the laboratory) is almost always larger than the amount of material necessary for the test or analysis.

Pretreatment comprises one or a combination of the following:

— homogenization;

— preparation of a composite sample;

— sample division: obtaining subsamples of smaller size than the original sample without reducing the particle size of the individual particles;

— particle size reduction: grinding and crushing the sample in order to reduce the particle size of the sample without reducing the sample size (mass);

— selection of a fraction of a sample on the basis of particle sizes, appearance, or other physical characteristic.

Several cycles of a number of these activities could be required to derive the test sample (e.g. analytical sample) from the laboratory sample.

The International Standards on pretreatment (ISO 11464, ISO 14507 and ISO 16720) describe laboratory procedures for mixing (homogenization), dividing and particle size reduction, in order to provide a representative sample (e.g. analytical sample) assuming a laboratory sample (i.e. the material received in the laboratory for inspection or testing) of approximately 1 kg. When the sample received at the laboratory is larger than about 1 kg, the size of the sample can be reduced following the procedures described in ISO 23909 (this assumes a sample of about 25 kg is to be reduced in size but the procedures described are applicable to much larger samples).

ISO 11464, ISO 14507, ISO 16720 and ISO 23909 shall only be used for pretreatment of materials within their respective scopes and having regard to the need to preserve sample integrity. Inappropriate use

of these International Standards, including ISO 14507, will result in unacceptable loss of volatile organic compounds (VOCs) (3.6) and other volatiles.

When volatiles are present, the procedures described in DIN 19747 and ISO 22155 shall be used as appropriate.

NOTE DIN 19747 covers chemical, physical and biological investigations.

Uncertainty about whether a compound should be regarded as volatile or not should trigger a specific quality scheme to ensure that sample preparation does not introduce bias, cross contamination or other forms of unacceptable errors. Guidance on quality control is given in ISO 18400-106.

Sample pretreatment should preferably take place in the laboratory, as sample integrity can be best controlled under laboratory conditions. Among other things, the laboratory should have a range of equipment available that can be selected on the basis of the size and nature of the sample to be processed. However, under some circumstances, pretreatment of the material extracted from the ground may be started in the field directly after sampling. For example, the size of sampling equipment might be such that more soil material is extracted from the ground than needed. Sample pretreatment "in the field" is then necessary in order to limit the amount of material to be transported to the laboratory.

The procedures described can be used in the field to limit the amount of material to be transported to the laboratory. They can be used to produce a laboratory sample of about 1 kg (or larger if required) which can then be subjected as appropriate to the pretreatment procedures described in ISO 11464, ISO 14507, ISO 16720 or DIN 19747 or produce a larger sample that can then be subjected in the laboratory to the procedures described in ISO 23909 to further reduce the size of the sample.

Size reduction, other than the manual crushing of clods and/or macro-aggregates as described in 9.4, is seldom practical in the field because it requires powered equipment and appropriate laboratory conditions. Particle size reduction involves a substantial risk of (cross) contamination, loss of components and loss of soil material. These risks can be properly controlled under laboratory conditions. Particle size reduction should therefore only be carried out under laboratory conditions.

Effective homogenization can be difficult in the field because it often requires powered equipment and appropriate laboratory conditions, but can be done provided proper care and equipment is used (see Clause 8).

Depending on the objective of the investigation programme, it might be that there is only an interest in part of the soil or soil-like material. For example when "non-soil materials" are present (e.g. bricks, stones). This might imply that it is desirable to obtain only a specific size fraction of the material, either through removing the large elements from the sample, or, the other way around, through specifically selecting the larger parts that are of interest. Sometimes both fractions could be of interest.

Selective subsampling of materials of a particular grading (e.g. below a defined particle size) could be possible in the field if the material sampled is suitably dry (see 9.6). Sieving or screening is regularly practised in horticulture and when old mineral waste deposits are being processed on a small-scale to recover previously discarded materials of value. However, it might not be desirable in a particular case as it will usually be necessary to record the type and amount of both over-sized particles and under-sized particles to provide a full characterization of the material being sampled, and it could be difficult to avoid losses, especially fine materials, while processing the sample. Such processes are best carried out under laboratory conditions where a range of manual and powered equipment should be available.

As described in this standard (see 9.6.3), a fraction of the field sample may also be formed in the field (or the laboratory) by "hand-picking" of material from the bulk sample on the basis of particle size, appearance (e.g. colour), or nature (e.g. wood fragments, coal, organic/vegetable material, asbestos cement materials). As for sieving, the mass of the material removed should be weighed and recorded as should the mass of the bulk sample from which it is removed.

The preparation of composite samples is usually an integral part of the sampling process (see ISO 18400-102), e.g. in cluster sampling numerous small incremental samples roughly equal in size taken from a small area are placed in the sample container to form the laboratory sample which is then homogenized in the laboratory as part of the pretreatment process.

In spatial (i.e. area-wide) composite sampling, incremental samples roughly equal in size taken on a defined sampling pattern across the area of interest (e.g. a field) are placed in the (largish) sample container to form the laboratory sample which is then homogenized and subsampled in the laboratory as part of the pretreatment process.

However, there could be occasions when it is considered desirable to combine soil material in the field from, for example, different locations, into a composite sample. A suitable procedure for doing this is described in this standard (see Clause 8).

5 Incorporation in the sampling plan

The pretreatment method(s) to be used in the field (if pretreatment is necessary) and the necessary equipment shall be prescribed in the sampling plan according to ISO 18400-101.

When the circumstances in the field deviate too much from the assumed situation in the sampling plan, the requirements concerning pretreatment in the plan should be changed. In general, minor changes that have no effects on the test results may be made in the field by the sampler. If effects on the test results are to be expected or when in doubt, the sampler shall consult the project manager. This includes seeking advice on how to proceed if circumstances in the field or weather conditions deviate too much from the assumed situation in the sampling plan.

The project manager should always be consulted (see Note 1), when

— there is a change in the necessity for pretreatment,

— there is a change in the practicality of pretreatment.

Any changes made to the sampling plan should, like the original requirements in the plan, be in conformance with this document. The guidance in ISO 18400-101:2017, Clause 6 on the procedure when changes to the sampling plan are needed during sampling should be followed.

NOTE 1 ISO 18400-101:2017, Clause 6 distinguishes between changes that will not affect the achievement of the objective of the investigation and those which might affect the achievement of the objective of the investigation.

NOTE 2 The necessity of pretreatment might change for example when pretreatment was not planned, but appears to be necessary in light of the coarse soil material to be sampled (the particle size distribution of the soil material was not adequately identified by the project manager when defining the sampling plan).

NOTE 3 The practicality of pretreatment might change for example due the absence of a clean and unused surface at the sampling site or due to weather conditions that do not allow sample pretreatment of sufficient quality.

NOTE 4 As the potential effect of changes in the sample pretreatment will depend on the nature of the necessary changes, the specific sampling situation and the test to be performed, no further guidance to these changes is provided in this document.

6 General requirements

There are potential disadvantages in carrying out pretreatment in the field (see Note 1). Before deciding to do this, the sampling plan should be reviewed to determine whether the necessity to do so can be avoided by changing the sampling techniques to be employed, e.g. to select techniques that will provide samples suitable in size for direct transport to the laboratory without pretreatment.

Whatever sample pretreatment is carried out, the defined objectives of the sampling exercise and the need for samples to be “representative” to avoid bias (or to acknowledge unavoidable or designed bias) should govern what is done.

When it is considered that pretreatment in the field is unavoidable, consideration should be given to the establishment of a temporary on-site pretreatment laboratory. This may be a specially constructed facility or an area within in an existing building adapted for the purpose.