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Soil quality — Sampling —

Part 104: Strategies

Qualité du sol — Échantillonnage —
Partie 104: Stratégies

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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 of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 190, *Soil quality*, Subcommittee SC 2, *Sampling*.

This first edition of ISO 18400-104, together with ISO 18400-101, ISO 18400-102, ISO 18400-105, ISO 18400-107, ISO 18400-202, ISO 18400-203 and ISO 18400-206, cancels and replaces the first editions of ISO 10381-1:2002, ISO 10381-4:2003, ISO 10381-5:2005, ISO 10381-6:2009 and ISO 10381-8:2006, which have been structurally and technically revised.

The new ISO 18400 series is based on a modular structure and cannot be compared to the ISO 10381 series clause by clause.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is part of a series of sampling standards for soil (the role/position of the individual standards within the total investigation programme is shown in Figure 1). It provides guidance on the development of site investigation strategies in general (more specific guidance is given in other standards) and of sampling strategies [e.g. what to sample, where to sample (locations and depths) and the types of samples to take] taking into account the need to obtain representative samples and to have regard to relevant statistical principles.

Soils (and other soil materials) are composed of a mixture of mineral particles, organic matter, water, air (soil gas) and living organisms. In the case of some contaminated soils, a non-aqueous liquid phase might also be present. The solid matrix (phase), consists of particles of different size, shape and physical and chemical properties. The aim when carrying out soil sampling is usually to obtain sufficiently representative samples that can be used to characterize the properties of the whole soil entity (e.g. *in situ* soil in the form of a volume or horizon, or surface deposit such as a stockpile) or the portion considered relevant to the objectives of the investigation (e.g. <0,1 mm fraction for exposure assessment via hand-to-mouth activity). The properties of discrete entities such as individual soil particles are not addressed. As the soil as a whole cannot be analysed, soil samples are taken instead. The assumption that the results of these investigations on samples represent the total soil volume of interest is always an approximation, the reliability of which depends on additional information about the soil, the site and use of an appropriate sampling strategy. In other words, the sampling strategy should guarantee that, together with additional information (on-site observations, background information, previous investigation results, etc.), the results for the samples analysed allow a model to be developed of relevant properties of the soil volume of interest to a sufficiently reliable degree, in accordance with the investigation objectives.

Whatever the purpose of the investigation, a sound conceptual site model is required. Every property of a soil or soil material is a result of their dynamic development influenced by natural and human-induced processes such as weathering, leaching, dislocation, contamination, and many others. Without considering this, the results of any investigation of samples cannot be interpreted and evaluated properly. When spatial variability of soil properties (including contamination) is of particular interest, the conceptual site model includes what is known, or believed to be known, about the processes that led to the anticipated spatial distribution of properties.

The sampling strategy, especially when average properties are of interest, is preferably based on statistical methods, as far as practical and appropriate.

Having first defined key elements such as involved parties, objectives, properties of interest, phase of the investigation, background and site information, as well as health and safety aspects, a sampling strategy is developed that can form the basis of a sampling plan in accordance with ISO 18400-101 (the sampling plan covers a number of practical issues as well as the sampling strategy).

The appropriate sampling strategy in any particular case depends on

— the objectives of the investigation,

— the special situation and characteristics of the material to be sampled,

— the properties of interest, and

— the required degree of precision and reliability of the results.

Many other factors can also influence the design of the sampling strategy including:

— accessibility of the site as well as the sampled material;

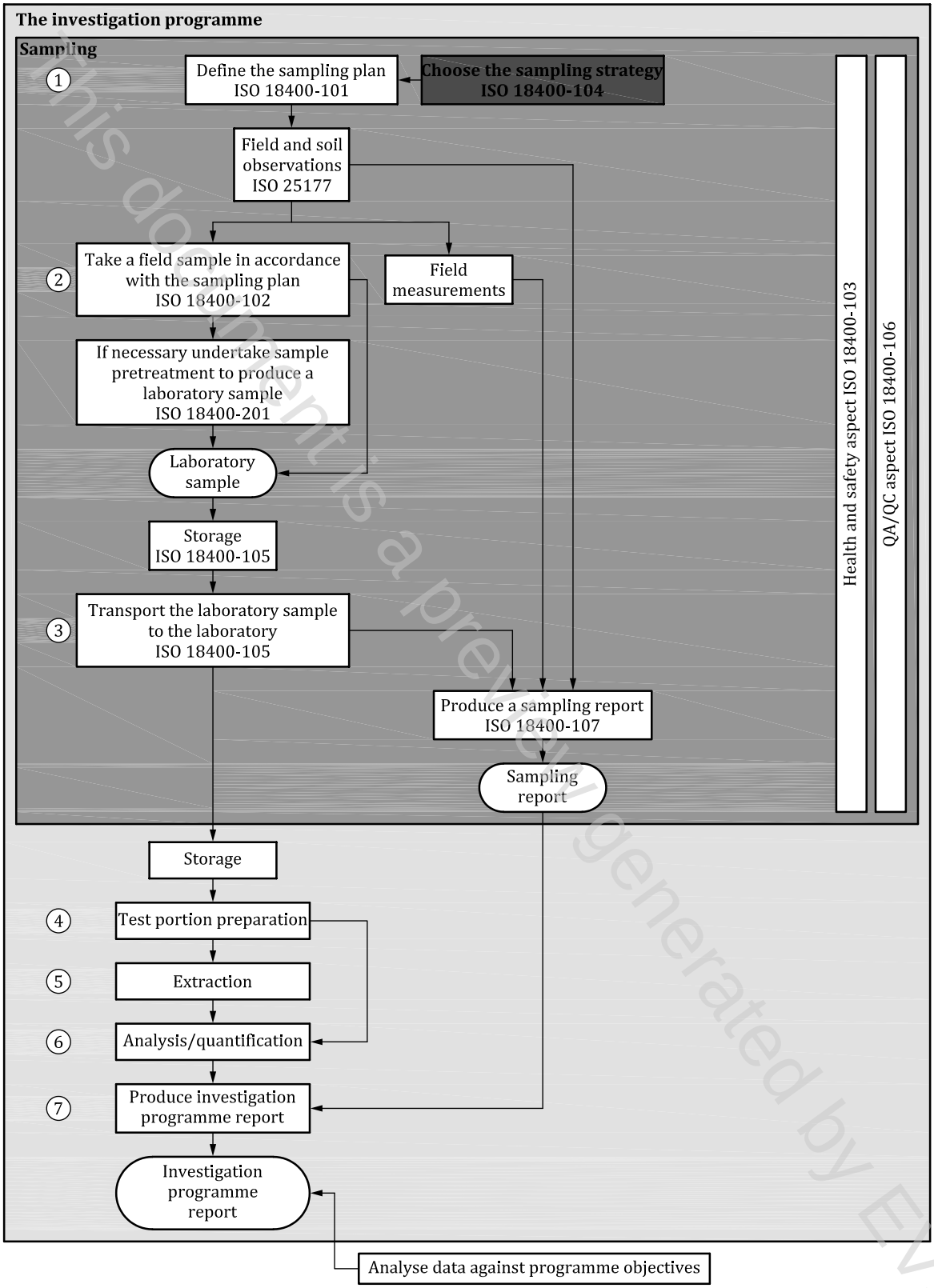
— financial, personnel, and technical resources;

— weather conditions;

— the time schedule/frame;

— legal/environmental restrictions.

Following the definition of the sampling approach, the appropriate sampling techniques are selected following the guidance in ISO 18400-102 with regard to health and safety (ISO 18400-103) and various practical considerations. The decisions made regarding sampling techniques form part of the sampling plan.



NOTE 1 The numbers in circles in Figure 1 define the key elements (1 to 7) of the investigation programme.

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

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

Soil quality — Sampling —

Part 104: Strategies

1 Scope

This document gives general guidance on the development of site investigation strategies and detailed guidance on the development of sampling strategies, when collecting information on

— the average properties of soil,

— the variability of soil properties, and

— the spatial distribution of soil properties.

It is applicable to soil samples intended for chemical testing and determination of a variety of other properties (e.g. physical).

Although the main focus of this document is the collection of material (field samples) for transfer to a laboratory for testing, it is also applicable when measurements are made directly in the field.

NOTE 1 This document also provides information on the statistical principles underlying the development of appropriate sampling strategies and statistical methodologies.

NOTE 2 Guidance on other forms of related sampling activities are given in other International Standards [for soil gas (ISO 18400-204) and for biological testing purposes (ISO 18400-206)]. Guidance on sampling groundwater is provided in ISO 5667-11 and ISO 5667-22 and on sampling methods and groundwater measurements in geotechnical investigations in ISO 22475-1.

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 11074, *Soil quality — Vocabulary*

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

ISO 18400-201, *Soil quality — Sampling — Part 201: Physical pretreatment in the field*

ISO 18400-202, *Soil quality — Sampling — Part 202: Preliminary investigations*

3 Terms and definitions

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

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

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

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

NOTE The hierarchical approach and terms used in this document as well as the relationships between the sampling approaches and sampling patterns employed in this document are shown in Table 1.