INTERNATIONAL STANDARD

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Water quality — Sampling —

Part 11: Guidance on sampling of groundwaters

Qualité de l'eau — Échantillonnage —

Partie 11: Lignes directrices pour l'échantillonnage des eaux souterraines

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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 5667-11 was prepared by Technical Committee ISO/TC 147, *Water quality*, Subcommittee SC 6, *Sampling (general methods)*.

This second edition cancels and replaces the first edition (ISO 5667-11:1993) and ISO 5667-18:2001, which have been technically revised.

ISO 5667 consists of the following parts, under the general title *Water quality — Sampling*:

— *Part 1: Guidance on the design of sampling programmes and sampling techniques*

— *Part 3: Guidance on the preservation and handling of water samples*

— *Part 4: Guidance on sampling from lakes, natural and man-made*

— *Part 5: Guidance on sampling of drinking water from treatment works and piped distribution systems*

— *Part 6: Guidance on sampling of rivers and streams*

— *Part 7: Guidance on sampling of water and steam in boiler plants*

— *Part 8: Guidance on the sampling of wet deposition*

— *Part 9: Guidance on sampling from marine waters*

— *Part 10: Guidance on sampling of waste waters*

— *Part 11: Guidance on sampling of groundwaters*

— *Part 12: Guidance on sampling of bottom sediments*

— *Part 13: Guidance on sampling of sludges from sewage and water treatment works*

— *Part 14: Guidance on quality assurance of environmental water sampling and handling*

— *Part 15: Guidance on preservation and handling of sludge and sediment samples*

— *Part 16: Guidance on biotesting of samples*

— *Part 17: Guidance on sampling of suspended sediments*

— *Part 19: Guidance on sampling of marine sediments*

— *Part 20: Guidance on the use of sampling data for decision making — Compliance with thresholds and classification systems*

— *Part 21: Guidance on sampling of drinking water distributed by tankers or means other than distribution pipes*

— *Part 22: Guidance on design and installation of groundwater sample points*

— *Part 23: Determination of significant pollutants in surface waters using passive sampling*

This part of ISO 5667 should be read in conjunction with other parts, in particular ISO 5667-1 and ISO 5667-3.

Introduction

This part of ISO 5667 is a revision of both ISO 5667-11:1993, *Guidance on sampling of groundwaters* and ISO 5667-18:2001, *Guidance on sampling of groundwater at contaminated sites*.

The guidance in this part of ISO 5667 can be used in parallel with other guidance on water quality sampling and/or investigation of contaminated or potentially contaminated sites, as any groundwater sampling from such sites is likely to form part of a much wider investigation programme.

Development of a groundwater sampling programme depends on the purposes of the investigation. A definition of the purpose of groundwater sampling is an essential prerequisite for identifying the principles to be applied to a particular sampling problem.

The principles set out in this part of ISO 5667 can be used to satisfy the following more detailed objectives:

a) to determine the suitability of groundwater as a source of drinking water or industrial/agricultural water;

b) to identify, at an early stage, contamination of aquifers caused by potentially hazardous surface or sub-surface activities (e.g. the operation of waste disposal sites, land contamination, industrial developments, mineral exploitation, agricultural practices, changes in land use) and its potential to impact on surface waters and other potential receptors in the vicinity of the site;

c) to establish whether migration of contaminants is occurring in order to assess the impact on groundwater quality and to calibrate and validate suitable groundwater quality models;

d) to develop an understanding of groundwater quality and flow variations, including those caused by deliberate actions (e.g. variations in groundwater pumping regimes, groundwater recharge caused by effluent, surface clean-up activities arising from contaminated sites), in order to achieve optimal resource management, provide data for undertaking risk assessment and to enable enforcement of pollution-control law;

e) to assist in the selection of remedial measures and remediation process design, and monitor the performance and effectiveness of these measures or facility design;

f) to demonstrate compliance with licence conditions, or collect evidence for regulatory purposes;

g) to identify and characterise discrete aquifer water bodies.

Examples of situations where this guidance can be used include:

— general surveys of groundwater quality for chemical and microbiological assessment;

— investigation of present or former industrial sites with a history of potentially contaminatory activities;

— groundwater investigation and monitoring of waste disposal (landfill) sites;

— investigation of sites where natural and/or artificial processes have led to potential land and groundwater contamination;

— investigation of sites where products have been spilled or released as a result of accidents or other unforeseen events, e.g. transportation accidents.

The guidance contained in this part of ISO 5667 covers selection of sampling points, selection of sampling installations and devices, groundwater parameter selection and sampling frequency.

Prescriptive guidance on methods and applications is not possible. Therefore, this guidance provides information on the most commonly applied, and available, techniques and lists their advantages, disadvantages and limitations of use where these are known. When considering design of sampling strategies, the properties of the groundwater (aquifer) system, monitoring point design, contaminant source(s), pathways for migration and the receptors need to be considered.

Water quality — Sampling —

Part 11: Guidance on sampling of groundwaters

1 Scope

This part of ISO 5667 provides guidance on the sampling of groundwaters. It informs the user of the necessary considerations when planning and undertaking groundwater sampling to survey the quality of groundwater supply, to detect and assess groundwater contamination and to assist in groundwater resource management, protection and remediation. This part of ISO 5667 does not apply to sampling related to the day-to-day operational control of groundwater abstractions for potable purposes. The guidance includes sampling of groundwater from both the saturated (below water table) zone and the unsaturated (above the water table) zone.

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 772, *Hydrometry — Vocabulary and symbols*

ISO 5667-1:2006, *Water quality — Sampling — Part 1: Guidance on the design of sampling programmes and sampling techniques*

ISO 5667-3, *Water quality — Sampling — Part 3: Guidance on the preservation and handling of water samples*

ISO 5667-14, *Water quality — Sampling — Part 14: Guidance on quality assurance of environmental water sampling and handling*

ISO 6107-2, *Water quality — Vocabulary — Part 2*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6107-2, ISO 772 and the following apply.

3.1
piezometer
device consisting of a tube or pipe with a porous element or perforated section (surrounded by a filter) on the lower part (piezometer tip), which is installed and sealed into the ground at an appropriate level within the saturated zone for the purposes of water level measurement, hydraulic pressure measurement and/or groundwater sampling

NOTE Adapted from ISO 6107-2:2006.

3.2
nested piezometers
bundled piezometer installation

group of piezometers installed to different depths within a single larger diameter borehole

NOTE 1 In general, each piezometer should be designed to allow sampling over a specific depth interval within the aquifer. Piezometer tips are isolated from each other by installing a permanent impermeable seal between them.

NOTE 2 Adapted from ISO 6107-2:2006.

3.3
multiple boreholes
group of individual boreholes or piezometers installed to different depths separately, but in close proximity, to form a monitoring network adequate for the purposes of an investigation

NOTE Adapted from ISO 6107-2:2006.

3.4
multi-level sampler
single installation for sampling groundwater from discrete depths or depth intervals within the sub-surface

NOTE 1 The device can be installed directly into the ground or into a pre-existing, or purpose-drilled, borehole. When installed into a borehole, integral packers (or similar sealing devices) are used to isolate the individual horizons within the groundwater system that are to be sampled.

NOTE 2 Adapted from ISO 6107-2:2006.

3.5
aquifer
geological water-bearing formation (bed or stratum) of permeable rock, or unconsolidated material (e.g. sand and gravels) capable of yielding significant quantities of water

NOTE Adapted from ISO 6107-3:1993[4].

3.6
consolidated aquifer
aquifer comprising material which is compact due to cementation or compression

3.7
saturated zone
part of an aquifer in which the pore spaces of the formation are completely filled with water

[ISO 6107-2:2006]

3.8
unsaturated zone
part of an aquifer in which the pore spaces of the formation are not totally filled with water

[ISO 6107-2:2006]

3.9
groundwater
water in the saturated zone and/or unsaturated zone of an underground geological formation or artificial deposit such as made ground, e.g. fill material

3.10
perched groundwater
isolated body of groundwater, which is limited in lateral and vertical extent, located within the unsaturated zone overlying a much more extensive groundwater body and isolated above by a discontinuous poorly permeable surface (discontinuous aquitard)

NOTE Adapted from ISO 6107-2:2006, “perched water table”.

3.11
receptor
entity (human, animal, water, vegetation, building services, etc.) that is vulnerable to the adverse effect(s) of a hazardous substance or agent

NOTE Adapted from ISO 6107-2:2006.

3.12
packer
device or material that inflates or expands for temporarily isolating specified vertical sections within boreholes to allow groundwater sampling from discrete zones or locations within the borehole or aquifer

NOTE Adapted from ISO 6107-2:2006.

3.13
field capacity
maximum amount of water that a soil or rock can retain after gravitational water has drained away

NOTE Adapted from ISO 6107-2:2006.

3.14
dense non-aqueous phase liquids
DNAPLs
organic compounds that have very low water solubility and a density greater than that of water

EXAMPLE Chlorinated hydrocarbons such as trichloroethane.

NOTE 1 Adapted from ISO 6107-2:2006.

NOTE 2 When present in sufficient quantities, DNAPLs form a separate phase from the water.

3.15
light non-aqueous phase liquids
LNAPLs
organic compounds that have very low water solubility and a density less than that of water

EXAMPLE Petroleum products.

NOTE 1 Adapted from ISO 6107-2:2006.

NOTE 2 When present in sufficient quantities, LNAPLs form a separate phase from the water.

3.16
well
borehole
⟨groundwater sampling⟩ hole sunk into the ground, either by drilling (boring) or digging, to obtain groundwater or for observation purposes

NOTE This definition differs from the one given in both ISO 772:— and ISO 6707-1:2004[3].

3.17
spring
groundwater emerging naturally through the surface of the land

[ISO 6107-3:1993[4]]

3.18
pore water
water that fills the pores or cavities within a body of rock or soil

3.19
casing
tubular retaining structure, which is installed in a drilled borehole or excavated well, to maintain the borehole opening

[ISO 772:—]

NOTE In the context of groundwater sampling, “maintain the borehole opening” means the prevention of the ingress of solid aquifer material into the borehole or control of groundwater entry to the borehole at specific depths via a (well) screen. The structure can be temporary or permanent.

4 Sampling strategy and programme design

4.1 General

Groundwater sampling can be carried out as a single exercise, as part of a larger site or environmental investigation, or as part of a regional/national programme. Regardless of the purpose, a rational approach should be taken that clearly defines the objectives, determines the level of information needed, and identifies the various stages of the investigation. Consideration should also be given to practical constraints such as site access, infrastructure, and the distance between the site and analytical laboratories.

It should be noted that, normally, groundwater sampling from the saturated zone alone cannot fully assess the level of contamination in the subsurface in situations where an unsaturated zone of considerable thickness exists. The potential consequence of ignoring the unsaturated zone is that the unsaturated zone and groundwater system could become extensively contaminated before any tangible evidence of leakage or contamination is evident in samples collected from below the water table.

4.2 Selection of sampling point location

4.2.1 General

The location of monitoring installations, the design of the network, and the selection of monitoring points for investigating groundwater quality should take account of:

a) the hydrogeological setting of the investigation site;

b) the past and future use(s) of the site;

c) the purpose of the exercise;

d) the anticipated or known groundwater quality;

e) the nature and extent of any likely contamination.

