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Water quality — Sampling —

Part 5:
Guidance on sampling of drinking water and water used for food and beverage processing

Qualité de l'eau — Échantillonnage —

Partie 5: Guide pour l'échantillonnage de l'eau potable et de l'eau utilisée dans l'industrie alimentaire et des boissons

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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.

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.

International Standard ISO 5667-5 was prepared by Technical Committee ISO/TC 147, *Water quality*.

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

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

— *Part 2: Guidance on sampling techniques*

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

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

— *Part 5: Guidance on sampling of drinking water and water used for food and beverage processing*

— *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 wastewaters*

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— *Part 11: Guidance on sampling of groundwaters*

— *Part 12: Guidance on sampling of industrial cooling water*

— *Part 13: Guidance on sampling of sludges and sediments*

Annex A forms an integral part of this part of ISO 5667. Annex B is for information only.

Introduction

This part of ISO 5667 is one of a group of standards dealing with the general aspects of sampling (parts 1 to 3) and the sampling of specific types of water (from part 4 onwards). It should be read in conjunction with ISO 5667-1, ISO 5667-2 and ISO 5667-3.

The general terminology used is in accordance with the various parts of ISO 6107.

Water quality — Sampling —

Part 5:
Guidance on sampling of drinking water and water used for food and beverage processing

1 Scope

This part of ISO 5667 establishes detailed principles to be applied to the design of sampling programmes, to sampling techniques and to the handling and preservation of samples of drinking water and water used for food and beverage processing (hereafter abbreviated for convenience to drinking water). It includes the processing of water in a treatment plant (including the analysis of the raw water), the supervision of the treatment plant and the distribution system, and the search for defects in the system.

This part of ISO 5667 does not include the sampling of sources such as ground water, wells and natural and man-made lakes, the water from which may be used as raw water for a treatment plant. If it is necessary to take samples at these locations, for instance to find a source of contamination of the raw water, sample according to the relevant part of ISO 5667.

Sampling is a vital part of the monitoring programme for drinking water. It is important that the sampling purpose be defined as accurately as possible and that the measurements provide the required information in the most efficient and statistically representative manner. It is worthwhile expending appreciable time and effort on the planning and design of sampling programmes; careful planning will normally be well rewarded.

Examples of sampling purposes are

— determination of the efficiency of the drinking water treatment plant or parts of it (oxidation, disinfection);

— quality monitoring of the water leaving the treatment plant;

— quality monitoring of the water in the distribution system;

— search for the cause of pollution of the distribution system (customer's complaints);

— Monitoring of the corrosive potential of drinking water in domestic plumbing;

— assessment of the effects of materials in contact with water on the water quality;

— monitoring of the influent water and the various processing stages in a food and beverage processing plant, including necessary treatment steps.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 5667. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 5667 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2859-1:1989, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

ISO 5667-1:1980, *Water quality — Sampling — Part 1: Guidance on the design of sampling programmes.*

ISO 5667-2:—[1] , *Water quality — Sampling — Part 2: Guidance on sampling techniques.*

ISO 5667-3:1985, *Water quality — Sampling — Part 3: Guidance on the preservation and handling of samples.*

ISO 8199:1988, *Water quality — General guide to the enumeration of micro-organisms by culture.*

3 Sampling equipment

Reference should be made to ISO 5667-2 for sampling equipment and requirements for materials in contact with the sample, and to ISO 5667-3 for cleaning of sample containers.

4 Sampling procedure

4.1 Sampling location

Detailed guidance, including statistical consideration, is given in ISO 5667-1.

The sampling location and local safety regulations (see clause 6) influence the method of sample collection. Before collection of the sample, it should be decided whether some of the analyses are to be performed on site. On-site analysis is recommended particularly for such determinands as odour, taste, pH, chlorine, ozone, dissolved oxygen, acid (base) capacity, carbon dioxide, electrical conductivity, and for the assessment of the temperature of the water and the ambient air and the visual inspection of the sample. Cognizance should also be taken of any national regulations requiring on-site analysis.

Before transporting the sample to the laboratory, the appropriate preservation technique has to be applied; reference should be made to the guidance given in ISO 5667-3 and the relevant analytical International Standards.

4.1.1 Service reservoir

Samples should be collected from the inlet and outlet pipes, as close as possible to the service reservoir. Generally, 2 min or 3 min of free flow should be allowed to flush out any stale water within the sampling line before taking a sample. If this is insufficient, calculate the volume of water that needs to be displaced from the pipe, estimate the flushing time required at an appropriate flushing rate, and then apply a flushing time of five times that value. Alternatively, when the reservoir is below ground, monitoring of the water temperature from the flushing may be useful in indicating when water from the reservoir is being withdrawn.

Sometimes, for example when a reservoir has been out of service or cleaned, or when there is no sampling valve on the outlet pipe, it may be necessary to take dip samples from service reservoirs, although this means of sampling should be avoided wherever possible. If it is essential to take dip samples, special care should be taken to ensure that the sampling operation does not introduce debris into the water and that equipment is sterilized before sampling, to avoid contamination of the water in the reservoir.

4.1.2 Water treatment plant

Samples should be collected from the inlet and outlet pipes as close as possible to the treatment plant. For monitoring of the different stages of water treatment, sampling should take place before and after the respective stage being monitored, for example sedimentation and filtration. If there is a disinfection and/or an oxidation plant, refer to 4.1.3.

For monitoring of water treatment plants continuous time-proportional sampling and continuous analysis (e.g. for pH value, turbidity, oxygen content) are often used. The sampling equipment should be used according to the manufacturer's instructions; reference should also be made to ISO 5667-2 for further guidance.

4.1.3 Disinfection plant

Samples from the influent to the disinfection/oxidation plant should be collected as close as possible to the plant. Samples of the effluent should be collected after allowing for the appropriate contact period between water and disinfectant/oxidant. In some installations this contact period may depend upon utilization of part of the distribution systems (however, this is prohibited in some countries). In these situations samples taken to test the efficiency of the disinfection/oxidation stage should be taken at an appropriate point within the distribution system; alternatively, a sample line with an appropriate residence time may be used for sampling within the treatment plant, although this is not generally recommended.

4.1.4 Distribution system

Samples should be collected at different locations in the distribution system and in particular from the ends of distribution systems, for example from predetermined sampling taps or hydrants, which are located before any further treatment stages. Sam-

1) To be published. (Revision of ISO 5667-2:1982)

pling from hydrants should be avoided wherever possible; if this is unavoidable special disinfection precautions are required, namely all surfaces of the hydrant that come into contact with the water should be clean and free from debris, and disinfected by, for example, contact with a 5 % (*m*/*m*) to 10 % (*m*/*m*) available chlorine solution. The chlorine solution should be run to waste completely before sampling.

The supply line to any sampling tap should be as short as possible. For microbiological purposes, sampling taps should be sterilized by flame or alternative methods of equivalent efficacy, for example soaking in a chlorine solution (see previous paragraph), and should be maintained in good order. The water discharged by flushing should be able to run off freely.

Samples should be taken in the turbulent zone of a pipe if possible. A suitable sample location may be available in piping immediately downstream from a valve or fitting that is causing turbulent flow. The sampling line should not protrude inside the pipe wall. Water in a mains spur should not be considered as a representative sample (however, see the second last paragraph of this subclause).

A need may arise to sample water where there is a very low flow. When taking the sample care should be taken that disturbance of sedimentary material does not occur. If this cannot be avoided, a sufficient volume of water should be flushed or a sufficient time allowed for a steady state to occur after the sampling valve has been opened or the flow disturbed.

The sampling site should be investigated to find the correct sampling location for the chosen sampling purpose. For example, a hydrant may be more practical than a consumers' tap when repeated sampling is required for monitoring of the dosing efficiency of, for example, the addition of silicate for the suppression of iron precipitation.

When collecting a sample from the distribution system the flushing time should be in accordance with the sampling purpose, 2 min to 3 min being generally sufficient. Sometimes it may be necessary to allow the water to flow freely for as long as 30 min before collecting the sample, for example when sampling a mains spur in which there may be settled sediment that needs flushing out before sampling.

If dissolution of materials from the pipework, or growth of micro-organisms within the pipework are being investigated, samples should be taken from the initial draw-off.

4.1.5 Consumer's taps

When sampling at consumer's taps, the flushing time depends upon the sampling purpose; if the effects of materials on water quality are being investigated then the initial draw-off should be sampled. For most other purposes a flushing time of 2 min to 3 min is sufficient to establish equilibrium conditions. For microbiological sampling, metal taps should be flamed and plastics taps should be disinfected using an available chlorine solution (see 4.1.4). All fittings should be removed from the taps prior to flushing and sampling.

4.1.6 Sampling of bottled drinking water and water in tanks and containers for bulk storage on trains, aircraft and ships

For sampling of bottled water, an appropriate number of bottles should be selected from the stock, sufficient to give a representative sample of the batch by, for example, choosing a sufficient number of samples such that the determinand can be sampled within an acceptable quality level. The number chosen usually depends on the variability of the determinand in question. For instance, dissolved oxygen in particular can vary from bottle to bottle. Further guidance on the number of bottles to be analyzed can be obtained from ISO 2859-1. The minimum sample volume requirements for some determinands, which may require a sample volume greater than the volume of a single bottle, should be taken into account; in this case the contents of a number of bottles sufficient to obtain the required volume should be mixed together and then considered as one "bottle" for the purposes of deciding how many "bottles" are sampled. The contents of these bottles should then be analysed as for tap water, if the water is not under gas pressure. For water under gas pressure, special techniques are required and reference is necessary to the relevant national regulations/standards and to the laboratory undertaking the analyses.

For water in tanks and containers, sampling should proceed as for service reservoirs (see 4.1.1), but account should be taken of the special risks of contamination during filling, venting and storage.

Special care is necessary if dip samples have to be taken (see 4.1.1).

4.1.7 Sampling of water used in food and beverage processing

Food and beverage processing plants may include one or several of the treatment plants mentioned so far. Also some special requirements of the industry (e.g. softened water) may require extra sampling before and after the different stages. The procedures will be analogous to the other stages described in 4.1.

4.2 Frequency and timing of sampling

Detailed guidance, including statistical considerations, is given in ISO 5667-1.

According to the purpose of sampling, the frequency may have to be different. The sampling frequency depends, among other factors, on

- the number of consumers served;
- the volume of water distributed;
- the quality of the raw water;
- the variation in the quality of the raw water;
- the health hazard involved;
- the complexity and characteristics of the specific distribution system involved;
- the purpose of sampling (e.g. general monitoring, monitoring for the effects of materials on water quality etc.);
- the specific parameters.

Minimum frequencies for different parameters need not be the same.

National and/or regional legislation, such as WHO recommendations[1] or EEC recommendations, whichever has precedence, should be followed.

then it should be handled as described in this subclause.

Reference should be made either to ISO 5667-3 or the "Sampling and preservation of samples" clause of the respective analytical International Standard for detailed instructions concerning the handling of samples after sampling.

Sampling for particulate matter is not normally performed on a routine basis. To obtain a representative sample it is necessary to

- sample at a location where particulate matter is uniformly distributed in the pipe, by sampling from systems with turbulent flow as far away as practicable from any obstructions such as bends or valves and sampling from a straight length of pipe;
- withdraw a representative sample from the bulk fluid by, for example, sampling isokinetically via a sampling probe protruding into the pipe and facing into the direction of flow;
- transport the sample to the point of collection without producing changes, for example by avoiding long horizontal sections of the sampling line and using small bore pipework for the sampling line, to ensure turbulent conditions.

If sampling for particulate matter is carried out, the sampling operation should be described in detail in the sampling report.

5 Sampling technique

Before collecting the sample, the water should normally be allowed to flow freely for the time required by the sampling purpose (see also clause 4 and 5.3).

5.1 Sampling for physical, chemical and radiological analysis

When sampling from taps, usually of the distribution system or the service reservoir, the water should be allowed to flow slowly into the sampling container and to overflow. Samples that are to be preserved, and microbiological samples should not be filled to overflowing (see also 5.3).

Then the completely filled container should be stoppered tightly and checked for the absence of air bubbles.

For the determination of oxygen or dissolved gases it is necessary to use a hose, attached to the tap or pump outlet, that reaches the bottom of the sample container. The water should be allowed to flow slowly into the sampling container through the hose,

5.2 Sampling for biological analysis

Macro-invertebrate animals and their associated detritus in distribution systems may be sampled directly or by flushing known volumes of water from the system through nets.

Flushing should be carried out using flows of sufficient velocity to release debris. A polyamide net, of mesh aperture about 150 µm, should be used to collect the sample. The net should be connected to the water outlet via a flow gauge. Efficiency of flushing can be increased by using a foam swab followed by flushing to release the animals.

To investigate biotic infestation of distribution systems, similar techniques and equipment should be employed but at possible points of ingress. Stainless steel filters of mesh aperture typically 0,5 mm may be used in conjunction with flow meters and/or pumps.

NOTE 1 Core samplers should be used for sampling filter beds. Insects, as potential contaminants, can be sampled in enclosed systems using commercially available UV-electric attractor traps. Direct observation at obvious locations should always be carried out.

Samples for biological analysis should be preserved in accordance with ISO 5667-3.

5.3 Sampling for microbiological analysis

When collecting the sample from a sampling line or tap, it may be necessary to flush any part of the system that has been stagnant for 2 h or more to remove stagnant water, except when investigating the microbiological quality of the water within the local pipework. The water should be allowed to flow freely from the tap or the outlet. The sampling container should be filled directly.

To avoid secondary contamination of the sample the sampling outlet should, if necessary, be sterilized by flame or other methods of comparable efficacy (for example see 4.1.5) to inactivate any micro-organisms present. After sampling, the sampling container should be closed tightly. Contamination of the stopper should be avoided; further information is given in ISO 5667-2.

Wide-mouth sample containers of at least 300 ml capacity with ground glass stoppers or screw caps should be used. The sample containers should be sterilized for 20 min at 120 °C and 200 kPa above ambient pressure in a wet autoclave, or an equivalent dry or chemical sterilization technique used. See, for example, ISO 5667-3. Disposable material which is supplied sterile may also be used; see also ISO 8199.

During sterilization and sample storage, the materials should not produce or release chemicals which inhibit or increase microbiological viability (see also ISO 5667-2).

5.4 Sampling for virological analysis

The collection of samples of water for the detection of viruses is similar in many respects to collecting for microbiological analysis. The main difference is in the volume of the sample required for virological analyses. Large volumes may be needed, particularly of drinking water. It is therefore often better to concentrate rather than to transfer large volumes of water to the laboratory. Also see ISO 5667-2 for large volume sampling.

It should be realised, however, that even the most current methods for concentrating viruses from water are still being researched and continue to be modified and improved. The efficiency of a virus concentration method may vary widely depending on the quality of the water.

6 Safety precautions

It is essential that personnel responsible for the design of sampling programmes and for carrying out sampling operations ensure that the requirements of relevant national safety regulations are taken into account and complied with and that the sampling personnel are informed of the necessary precautions to be taken in sampling operations.

For further information reference should be made to ISO 5667-1.

7 Volume of sample, handling of samples

7.1 Volume of sample

The volume of the sample to be collected depends on the number and types of analyses to be performed. If very small concentrations are to be determined, the volume of the sample may have to be large. Reference should be made to the relevant International Standards for the analytical methods for the volumes needed for each determination.

The taking of large volume samples may mask changes in the water quality during the sampling period but the sample volume may be an overriding factor in the requirements of the analysis.

When sampling for certain pathogens, for example , *Giardia Lamda*, large composite samples can be used. Composite samples are generally not recommended for the analysis of drinking water unless monitoring of parameters over long periods is required.

7.2 Handling of samples

As different analytical methods may require different methods of preservation, distribution of the sample into several containers may be required. To minimize changes in the samples during collection, storage and transport, these operations should be carried out in as short a time period, and as soon after sampling as possible; reference should also be made to ISO 5667-3 for further detailed information.

If contact of the sample with air has to be avoided, the sample container should be filled completely and then immediately stoppered.

If samples require vigorous mixing before taking portions for analyses, the sample container should not be filled completely or, if air has to be avoided a few pieces of clean sterile inert solids, for example solid beads or a magnetic stirrer, should be placed in the sampling container before collection of the sample.

If filtration is necessary, for example to separate two forms of a determinand, the sample should be filtered during or immediately after collection, to minimize any changes that may occur in the sample. Simple techniques for filtering samples through membrane or glass fibre filters may be adequate but