Standing Committee of Analysts

The Determination of Taste and Odour in Drinking Water (2014)

Methods for the Examination of Waters and Associated Materials

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This booklet contains methods for the qualitative and quantitative determination of taste and odour in drinking waters. An on-site method is also described for continuous odour monitoring.

No performance data are available for the methods described in this booklet.

This bluebook updates and complements the earlier version published in 2010 and may be read in conjunction with “The assessment of taste, odour and related aesthetic problems in drinking waters 1998”, “The Microbiology of Drinking Water (2004) - Part 11 - Taste, odour and related aesthetic problems” and “The Microbiology of Drinking Water (2004) - Part 12 - Methods for the isolation and enumeration of micro-organisms associated with taste, odour and related aesthetic problems”.

Whilst specific commercial products may be referred to in this document, this does not constitute an endorsement of these products but serves only as illustrative examples of the types of products available. Equivalent products may be available and it should be understood that the performance of the method might differ when other materials are used and all should be confirmed by validation of the method.

Contents

About this series

Introduction

This booklet is part of a series intended to provide authoritative guidance on recommended methods of sampling and analysis for determining the quality of drinking water, ground water, river water and sea water, waste water and effluents as well as sewage sludges, sediments, soils (including contaminated land) and biota. In addition, short reviews of the most important analytical techniques of interest to the water and sewage industries are included.

Performance of methods

Ideally, all methods should be fully evaluated with results from performance tests. These methods should be capable of establishing, within specified or pre-determined and acceptable limits of deviation and detection, whether or not any sample contains concentrations of parameters above those of interest.

For a method to be considered fully evaluated, individual results from at least three laboratories should be reported. The specifications of performance generally relate to maximum tolerable values for total error (random and systematic errors) systematic error (bias) total standard deviation and limit of detection. Often, full evaluation is not possible and only limited performance data may be available.

In addition, good laboratory practice and analytical quality control are essential if satisfactory results are to be achieved.

Standing Committee of Analysts

The preparation of booklets within the series "Methods for the Examination of Waters and Associated Materials" and their continuing revision is the responsibility of the Standing Committee of Analysts. This committee was established in 1972 by the Department of the Environment and is now managed by the Standing Committee of Analysts. At present, there are eight working groups, each responsible for one section or aspect of water quality analysis. They are

1 General principles of sampling and accuracy of results
2 Microbiological methods
3 Empirical, inorganic and physical methods
4 Metals and metalloids
5 General non-metallic substances
6 Organic impurities
7 Biological, biodegradability and inhibition methods
8 Radiochemical methods

The actual methods and reviews are produced by smaller panels of experts in the appropriate field, in co-operation with the working group and strategic committee. The names of those members principally associated with these methods are listed at the back of this booklet.

Publication of new or revised methods will be notified to the technical press. If users wish to receive copies or advanced notice of forthcoming publications or obtain details of the index of methods then contact the Secretary on the SCA web-page (http://www.gov.uk/environment-agency) or by post.

Every effort is made to avoid errors appearing in the published text. If, however, any are found, please notify the Secretary. Users should ensure they are aware of the most recent version they seek.

Mark Gale
Secretary
May 2014

Warning to users

The analytical procedures described in this booklet should only be carried out under the proper supervision of competent, trained analysts in properly equipped laboratories.

All possible safety precautions should be followed and appropriate regulatory requirements complied with. This should include compliance with the Health and Safety at Work etc Act 1974 and all regulations made under the Act, and the Control of Substances Hazardous to Health Regulations 2002 (SI 2002/2677). Where particular or exceptional hazards exist in carrying out the procedures described in this booklet, then specific attention is noted.

Numerous publications are available giving practical details on first aid and laboratory safety. These should be consulted and be readily accessible to all analysts. Amongst such resources are; HSE website HSE: Information about health and safety at work ; RSC website http://www.rsc.org/learn-chemistry/collections/health-and-safety ,"Safe Practices in Chemical Laboratories" and "Hazards in the Chemical Laboratory", 1992, produced by the Royal Society of Chemistry; "Guidelines for Microbiological Safety", 1986, Portland Press, Colchester, produced by Member Societies of the Microbiological Consultative Committee; and "Safety Precautions, Notes for Guidance" produced by the Public Health Laboratory Service. Another useful publication is "Good Laboratory Practice" produced by the Department of Health.

A Taste and odour in drinking waters

Introduction

The determination of taste and/or odour in water using the methods set out in this booklet relies on the subjective judgement of a limited number of individuals. Four methods are included in this booklet.

Method A1 describes a simple, entirely qualitative, procedure whereby an undiluted sample is smelled and tasted at ambient temperature by an individual to make an immediate judgement as to whether the water has an odour or taste and if present identify its nature and intensity. This procedure is intended to provide a basis for such assessments made by trained individuals in the field, for example when sampling, or in the laboratory.

Method A2 describes procedures whereby a de-chlorinated, undiluted sample is smelled and tasted by a group of people in a controlled environment as the screening step preceding quantitative assessment, if required. A description of any taste and/or odour in the sample, if present, is provided. In addition, an indication of the intensity of the taste/odour is recorded. If the assessment of the original undiluted sample is that the sample is deemed taste- and odour-free, then no further action is required. The sample is assigned a taste/odour threshold number of one, i.e. a taste/odour dilution number of zero, and the sample is deemed to be acceptable to consumers.

Method A3 describes techniques whereby, if any taste and/or odour is detected in the de-chlorinated, undiluted sample using the procedures described in method A2, a quantitative determination of the taste/odour threshold number is undertaken on a portion of the sample diluted with blank water. The intensity of the taste/odour in this diluted sample is determined by a group of people, and a single numerical value, expressed as a taste/odour threshold number is determined from the geometric mean of the taste/odour threshold number results obtained by the group. Once the taste/odour threshold number is known, a taste/odour dilution number is calculated, and a further assessment should be undertaken to ascertain whether the sample is deemed to be acceptable to consumers and whether abnormal changes have occurred in the sample over a period of time.

Method A4 describes techniques where a continuous on-line odour monitor is used in water treatment works for monitoring odours in waters. The intensity of the odour is amplified by raising the temperature of the sample when the determination is carried out.

Methods A2 - A3 are primarily directed towards assessing compliance with the taste and odour requirements of new UK legislation. (Appendix 1, Figure 1). The requirements are based on the acceptability of any taste and/or odour present in drinking water to consumers, and whether the taste and/or odour results from an abnormal change. Although comparable data to that previously required for drinking water compliance purposes can be obtained, additional work outside the laboratory environment is now required. Investigations should be carried out, in order to ascertain whether a taste and/or odour detected is acceptable to consumers, and whether the taste and/or odour results from an abnormal change, rather than rely on the use of a prescribed statutory limit for taste and odour.

When water possesses an odour it may possess a taste. However, a distinct taste may arise from a sample that possesses no odour. Several dissolved metal ions, such as iron, manganese, potassium, sodium and zinc can be detected by taste whilst not giving rise to any perceptible odour.

Many complaints received from consumers are specifically concerned with poor taste, and the rapid identification of such tastes often assists in the elucidation of the cause. Several tastes can be correlated with specific water treatment problems and a person who has a particularly sensitive palate may be able to assess a sample to provide an early indication of the presence of a taste in a raw or treated water before it comes to the notice of consumers. (These people should however not be used for the routine assessment of taste and odour in drinking water). As a consequence, remedial measures may be applied at the treatment works in order to prevent, or reduce, problems associated with taste (and odour) occurring in the distribution system.

Taste tests should only be performed on samples known to be safe. In methods A2 and A3, the panellist should, as a precaution, be instructed not to swallow any of the sample. Consideration should be given to the potential hazards that panellists may face when carrying out the assessments of taste and odour.

Appendix 1, Table 1 lists a number of compounds capable of causing odours (and possibly tastes) in water, together (in some cases) with typically reported odour threshold concentrations. The actual odour threshold concentration may vary for different people, depending on their differing olfactory sensitivities. These variations may range between up to 2 - 3 orders of magnitude, and the values quoted are given solely to indicate their relative odour-causing potentials.

Threshold numbers

The taste/odour threshold number (T/O TN) of a sample is that dilution of the sample with blank (reference) water where no taste or odour is detected.

Expressed mathematically, the taste/odour threshold number (T/O TN) is given by

$$\text{T/O TN} = (A+B) / A$$

Where A = volume of sample, and
B = volume of blank (reference) water used to dilute the sample.

The T/O TN of each panellist used in the test procedure is used to calculate a geometric mean T/O TN. At the final stage of the assessment, this geometric mean T/O TN is converted to a taste/odour dilution number (T/O DN).

Thus

$$\text{T/O DN} = \text{T/O TN} - 1$$

For the original (undiluted) sample, where the taste/odour is deemed taste- and odour-free,

$$\text{T/O TN} = 1 \quad \text{and}$$

T/O DN = 0

In the UK, the assessment of tastes and odours is undertaken for samples taken for statutory drinking water compliance purposes. Where any tastes or odours have been detected in the de-chlorinated, undiluted sample (method A2) it is required that these be expressed in units of taste/odour dilution numbers, T/O DN, for assessments carried out at 25 °C (method A3).

In method A3, the diluted sample is subjected to an ascending/descending triangle test to evaluate the T/O TN. Using these procedures enables a measure of the taste/odour intensity to be determined in a diluted sample at 25 °C.

Sampling and sample preservation

Collect the sample (with no headspace) in an appropriate clean sample bottle (for details see individual methods). The sample should be kept cool 5°C, (normally with an achievable tolerance of ±3 where referred to in the text), and tested as soon as possible after collection. Do not store the sample for more than 72 hours post sample collection, before commencement of analysis. The sample should not be de-chlorinated at the time of collection.

The following sections refer specifically to methods A2 and A3:

Panellists

The number of panellists within the group should consist of an odd number. This number should ensure a confirmed decision can be made with regard to the presence or absence of taste/odour in the sample.

The pool of panellists capable of undertaking the test should consist of as many people as possible. These panellists may or may not be laboratory staff. At least three panellists should be available to perform the assessment of taste and odour. Increasing the number of appropriate persons in the panel carrying out the assessment of taste and odour will enhance the precision of the assessment and hence the reliability of the results reported.

Due to the subjectivity of the method there is a need to incorporate a satisfactory protocol to select and ‘understand’ the sensitivity of panellists and to monitor their performance.

Procedures should exist for the assessment of potential panellists in order to ascertain the suitability of those persons considered for panel membership as persons with high or low taste/odour sensitivities may cause bias in the recorded results.

This initial assessment should consist of screening with defined pass/fail criteria and may also be followed by further assessment / training. On-going assessment of each panellist should form part of the routine monitoring of method performance.(see Appendix 2). Panellists should be free from colds or allergies that affect taste/odour response, should not eat or smoke for a minimum period (for example up to 1 hour) prior to the test. Ideally, on the day of the assessment, panellists should avoid the use of perfumes or cosmetic preparations, including scented soap for hand washing.

A panellist should not assess the taste and odour of more than ten samples, together with associated positive and negative controls, in any one session without a short break. If any of the samples has a pronounced taste or odour, a short rest period or break may be required before continuing with the tests. It has been found that ingesting a plain tasting biscuit and/or drinking a dilute sucrose solution, followed by a short break can speed recovery of the panelists' ability to continue.

In addition to the panellists, a person (sometimes referred to as a coordinator or panel leader) is required to prepare the samples, to offer them to the panellists and to record and collate the results. It is essential that this person carries out the manipulations with respect to samples and blank waters without revealing to the panellists the identities of the samples and blank waters. This person should not be used as one of the taste/odour assessors for the batches of samples he or she has prepared for the panellists.

Accommodation

The room in which the determinations are carried out should be free from interferences that may affect the taste/odour determinations (for example odours caused by cooking, or the use of chemicals, paints, polishes, air fresheners, room de-odorizers, etc) and other factors (such as drafts, noise, the presence of on-lookers, etc) that may cause a distraction to the testing panel.

Apparatus

General. Glassware should be reserved solely for taste and odour determinations and, when not in use, should be stored in a clean condition so that accidental contamination is avoided.

Cleaning of apparatus. Sample bottles should be cleaned before use by soaking them thoroughly overnight in a dilute solution of a strong detergent and then rinsing thoroughly with water. Detergents containing phosphates should not be used. Alternatively, an automatic dishwasher supplied with water at a temperature of not less than 60 °C and a detergent (for example as described above) may be suitable.

Water bath or incubator capable of maintaining a temperature of 25 °C normally with an achievable tolerance of ±1 where referred to in the text.

Sample bottles. Wide-mouthed glass-stoppered bottles or food grade polyethyleneterephthalate (PET) bottles of at least 500 ml capacity should be used. If non-glass bottles are used then these should be thoroughly tested before use to ensure that no taste or odour is imparted to, or removed from, the sample under investigation.

Testing vessels e.g. typical wine glasses, where the opening or mouth of the glass is smaller in diameter than the bulb or convex part of the glass. The glasses are so designed to restrict volatile components from escaping. Alternative containers for sub-sampling may also be suitable, e.g. glass stoppered bottles. These should be thoroughly tested before use to ensure they do not reduce or increase the intensity of the taste/odour of the sample or blank water, or remove from or impart to the sample or blank water a taste/odour .

UK legislation

The Water Supply (Water Quality) Regulations 2000 (Statutory Instrument 2000:3184) as amended in The Water Supply (Water Quality) Regulations 2000 (Amendment) Regulations 2007, Statutory Instrument 2007:2734 and associated Guidance documents.

See also The Water Supply Regulations 2010, Statutory Instrument 2010:991 and The Water Supply (Miscellaneous Amendments) (England and Wales) Regulations 2010, Statutory Instrument 2010:996.

Similar legislation applies to Wales: The Water Supply (Water Quality) Regulations 2001 (Statutory Instrument 2001:3911) as amended in The Water Supply (Water Quality) Regulations 2001 (Amendment) Regulations 2007 (Statutory Instrument 2007:3374) (W299). See also The Water Supply (Water Quality) Regulations 2010, Statutory Instrument 2010:994 (W.99).

Similar legislation applies to Scotland : The Water Supply (Water Quality) (Scotland) Regulations 2001, Scottish Statutory Instrument 2001:207. At the time of publication of this booklet, the requirements of these regulations include the statutory limit for taste and odour of 3 DN. (See the 1994 booklet in this series).

Similar legislation applies to Northern Ireland: The Water Supply (Water Quality) Regulations (Northern Ireland) 2007, Statutory Instrument 2007:147. The Water Supply (Water Quality) Amendment Regulations (Northern Ireland) 2009, Statutory Instrument 2009:246.

A1 Qualitative method for the determination of odour and taste

A1.1 Principle

This method is primarily directed at providing guidance for trained individuals making simple assessments on potable water samples. These assessments will usually be undertaken either for routine operational reasons or to provide additional interpretation or verification. They may be performed by a sampling officer on site at a sampling location or an analyst in the laboratory.

The sample is first smelled at ambient temperature and any odour is assessed in terms of its intensity and nature. As a separate assessment, the sample is then tasted at ambient temperature and any taste is assessed in terms of intensity and nature.

A1.2 Field of application and interferences

In treated waters which have been chlorinated, the chlorinous odour may mask or enhance the presence of other smells or tastes. The method is only applicable to treated waters known to be safe for ingestion (see section A1.3).
It is important wherever these assessments are performed that the environment is, as far as possible, free from other smells that might interfere with the assessors perception.

A1.3 Hazards

Taste tests should only be performed on samples known to be safe for ingestion. Samples that are known or suspected of being contaminated with bacteria, viruses, parasites or any hazardous chemicals should not be tasted. Samples should always be smelled before tasting.

Depending on the type of sample to be tasted and the nature of any odour detected it may be appropriate, as a precaution, for the taster not to swallow any of the test sample, but to discharge it without swallowing. This taster should make this assessment at the time.

A1.4 Apparatus

A1.4.1 General

While odour may be assessed direct from a sample bottle it is recommended that cups or beakers used for taste determinations are reserved solely for this purpose. When not in use bottles, cups and beakers should be stored in a clean condition so that accidental contamination is avoided.

A1.4.2 Cleaning of Apparatus

Clean sample bottles should be used. If using non-glass bottles these should be brand new and have been stored in a clean environment.

Glass bottles can be cleaned by soaking thoroughly overnight in a dilute solution of a strong detergent and then rinsing thoroughly with odour and taste free water. Detergents containing phosphates should not be used. Alternatively an automatic dishwasher supplied with water at not less than 60 °C and a detergent described above may be suitable. If required glass sample bottles may be sterilised by autoclaving before use.

A1.4.3 Sample Bottles

Wide mouthed glass-stoppered bottles or food grade polyethyleneterephthalate (PET) bottles of at least 500 ml capacity are recommended. If non-glass bottles are used then these should be thoroughly tested before use to ensure that no odour or taste is imparted to, or removed from, the sample.

A1.4.4 Taste cups/beakers

Tasting should be performed from a clean cup or beaker kept specifically for this purpose. These may be made of disposable food grade plastic or glass. If any other type is used these should be tested before use to ensure they do not reduce or increase the taste of the sample.

A1.5 Assessors

It is recommended that assessors carrying out this analysis should have been assessed for their sensory perception of odour and taste. They must possess sufficient sensitivity to a range of odours and tastes. They should receive training to ensure that they are able to differentiate a range of commonly encountered odours and tastes by reference to the lists in Appendix 1 Tables 2 & 3. Assessors should be aware of any environmental odours, such as cooking, chemicals, paints, polishes, air fresheners and room de-odorizers etc, which may influence the test.

A1.7 Analytical procedure

Step	Procedure	Notes
A1.7.1	Decant a portion of sample from the sample bottle so that there is a head-space.	
A1.7.2	Shake the bottle and contents, remove the stopper, smell the sample and, if an odour is detected, classify it according to its intensity and nature, see Appendix 1 Tables 2 & 3 for a typical list of odours and tastes, see note a.	(a) Solutions should be smelled by holding each bottle at the base and immediately applying the nose to the mouth of the bottle. The cap or stopper should be replaced as soon as the odour has been assessed.
A1.7.3	To assess taste decant a portion of the sample into a suitable clean cup or beaker, see section A1.4.4 and note b	(b) If the sample has been cooled it should first be brought to ambient temperature.
A1.7.4	The tester should taste the sample and, if a taste is found, classify it according to its intensity and nature (see Appendix 1, Tables 2 and 3 for a typical list of tastes) see notes c and d	(c) The sample may be tested directly from the sample bottle providing only one taster is carrying out the test, and the sample is not used for any other purpose.
		(d) Solutions should be tasted by taking into the mouth whatever volume of water is comfortable, holding it for several seconds and then, depending on the type of sample, either swallowing or discharging it without swallowing (see section A1.3).

A2 The quantitative determination of taste and odour – screening stage

All samples should be de-chlorinated prior to assessment (A2.2.1) then an assessment carried out to ascertain if any taste or odour is detectable.

A2.1 Reagents

Use analytical reagent grade chemicals unless otherwise indicated. Water for the preparation of reagents should be distilled, deionised or of similar grade quality.

A2.1.1 Blank (reference) water

The blank water is a critical reference point for the entire testing process. It is used in the panel screening and quantitative assessments and for diluting test water samples when performing quantitative assessments.

The testing laboratory should choose a blank water which is consistently judged by a group of people, from whom testing panels will be drawn, to possess no taste and odour at 25 °C. The blank water should be chosen for the long term with the consistency of its characteristics and availability in mind.

The blank water should be water appropriate to the area and, where possible, should be similar in composition to the type of water samples being tested. Ideally, each laboratory should choose only one blank (reference) water. However, where the water samples to be tested vary significantly by virtue of their chemical composition, hardness for example, it may be necessary to employ more than one.

It is prudent for laboratories to identify a continuity plan in the event that the chosen blank water becomes unavailable for a reason outside their control. It is also advisable that the blank water is subject to a programme of monitoring sufficient to verify its consistency with respect to absence of taste and odour and simple chemical characteristics. This information should be sufficient to provide the basis for investigation should there be any indication of a change in the performance of the blank water.

Blank water should be collected in clean glass-stoppered glass containers, or food grade polyethyleneterephthalate (PET) bottles, reserved solely for this purpose. Collected blank water should have a shelf-life no longer than 72 hours, the same as for test samples, after which unused water must be discarded and a fresh supply obtained. When not in use blank water should be kept cool (about 5°C).

If non-glass containers are used, they should be thoroughly tested before use to ensure no taste or odour is imparted to, or removed from, the blank water or water under investigation.

It may be necessary with some blank waters to condition them to achieve consistency or remove an undesirable taint. This may be achieved as follows. Pass the water at a flow rate not exceeding 10 litres per hour through a glass column (for example 20 mm in diameter and 200 mm in length) filled with fresh technical grade activated carbon (5 to 20 mesh). Collect the water in a suitable container. This water should be prepared on the day of use and judged independently by a testing panel to possess no taste and odour at 25 °C. It should be used or discarded within 12 hours of preparation. Activated carbon may act as a potential growth medium for bacteria. Unless changed frequently bacteria may collect in the activated carbon and may ultimately gain access to and contaminate the water so prepared.

A2.1.2 Rinse water

Water used for rinsing containers and glassware should be appropriate to the stage of the method. For each stage it should be evident that water used for rinsing has no impact on the assessment results. For example, fresh glassware may be rinsed with de-ionised or distilled water after washing and before drying. Blank water may be used for rinsing at various stages. Glassware used for neat test samples may be rinsed with the next sample between assessments.

A2.1.3 De-chlorinating agent.

A2.1.3.1 Sodium thiosulphate solution (approximately 0.0125M). Dissolve 3.5 g of sodium thiosulphate pentahydrate ($Na_2S_2O_3.5H_2O$) in water and make to 1000 ml with water. Mix well. This reagent may be stored in an amber glass bottle at a temperature about 5 °C for up to 7 days. The addition of 1 ml of this reagent will neutralise up to approximately 1 mg/l of residual chlorine in 500 ml of sample.

A2.1.3.2 Alternative example L-ascorbic acid (approximately 0.0284 M). Dissolve 5 g of L-ascorbic acid in water and make up to 1000 ml with water. Mix well. This reagent may be stored in an amber glass bottle at a temperature about 5 °C for up to 7 days. The addition of 1 ml of this reagent will neutralise up to approximately 1 mg/l of residual chlorine in 500 ml of sample. If ascorbic acid is used, add the acid solution to the water and allow the water to stand for approximately 5 minutes before the taste or odour is assessed.

In certain cases depending on the nature of the sample, sodium thiosulphate can give rise to sulphurous odours when used as a de-chlorinating agent. An alternative de-chlorinating agent, for example ascorbic acid may therefore need to be used. However, ascorbic acid may also cause interfering odours, for example where waters have been chloraminated. Other de-chlorinating agents may be used provided tastes/odours are not imparted to or removed from the sample.

A2.2 Analytical procedure

Step	Procedure	Notes
	Preparation of de-chlorinated sample	
A2.2.1	Either decant a portion of sample into a suitable vessel, or remove the stopper from the sample bottle and discard a small portion of sample. Add a volume of de-chlorinating agent (A2.1.3) to the container and mix to completely de-chlorinate the sample or portion of sample removed. See note a. Allow the contents of the container to reach 25 °C.	(a) A large excess of de-chlorinating agent should be avoided, to ensure the effect of the de-chlorinating agent itself is not assessed.
A2.2.2	Pour a portion of the de-chlorinated sample into a suitable vessel eg. wine glass and cover with a watch glass. Repeat this process for each panellist to be used in the assessment of taste and odour. See note b. Alternatively use the bottles prepared in A2.2.1	(b) Different panellists should not smell or taste from the same wine glass/taste vessel. Each panellist should be able to assess the taste and odour independently.
A2.2.3	Prepare up to ten undiluted de-chlorinated samples in a similar way as described in steps A2.2.1 and A2.2.2. In addition, in a similar way, prepare a minimum of at least two blank (reference) water samples (A2.1.1). See note c. Arrange the glasses/bottles in a random, but known order and assess immediately.	(c) The samples and blank waters should not be identifiable to individual panellists, either by means of appearance or wine glass/taste vessel. If samples are turbid or coloured, consideration should be given to covering all glasses/taste vessels with, for example aluminium foil before they are presented to individual panellists.
A2.2.4	For each prepared individual blank water and de-chlorinated portion, if prepared in bottles pour a small quantity into a wine glass/taste vessel. Gently, so as not to spill any of the contents, shake or swirl the wine glass/taste vessel and its contents, remove the watch glass (if applicable) (see note d). Classify the odour immediately according to its intensity and nature (see Appendix 1 Tables 2 and 3 respectively).	d) The contents should be smelled by holding each container at its base and immediately applying the nose to the mouth of the glass

A2.2.5 Remove the watch glass (if applicable). Gently, so as not to spill any of the contents, shake or swirl the glass/vessel and its contents again, and taste the contents (see note e). Classify the taste immediately according to its intensity and nature (see Appendix 1, tables 2 and 3 respectively)

(e) The contents should be tasted by taking into the mouth whatever volume of de-chlorinated sample or blank water is comfortable, holding the contents in the mouth for several seconds and then discharging the contents without swallowing any.

A2.2.6 The assessment of any taste and odour should be made as quickly as possible after smelling and tasting the contents, and recorded immediately. See note f.

(f) To ensure panellists do not become de-sensitised, no more than ten de-chlorinated samples should be assessed by each panellist at any single occasion.

A2.2.7 At the same time that samples are assessed, the assessment of appropriate QC samples should also be undertaken. See Appendix 3.

Assessment of results

A2.2.8 The results of each batch of test results will be valid only if at least 60 % of the blank waters are identified as being taste- and odour-free (see Table 4 and note g).

(g) If blank waters are persistently identified by several panellists as not being taste- and odour-free, then the blank water may not be of adequate quality and a further quantity should be prepared.

A2.2.9 If a set of results is found to be invalid then additional de-chlorinated samples should be prepared for each additional panellist and steps A2.2.4 - A2.2.7 should be carried out using additional panellists (see notes b and h).

(h) If a single panellist persistently identifies the blank water as not being taste- and odour-free then consideration should be given to removing the panellist from the panel (see Appendix 2).

A2.2.10 If a de-chlorinated sample is identified as being taste- and odour-free by at least 60 % of panellists with valid results then no further action is required by panellists. See Appendix 1, Figure 1.

A2.2.11 If a de-chlorinated sample is identified as possessing any taste/odour by at least 60 % of those panellists with valid results, then the sample should be further tested using the quantitative procedures described in method A3.

A3 Quantitative method for the determination of taste/odour threshold number

This method should be used to quantify the result where the quantitative screen assessment described in method A2 indicates that the undiluted, de-chlorinated sample is deemed to possess a non-chlorinous taste or odour.

Where the taste/odour assessment on the undiluted, de-chlorinated sample has shown the sample to be taste- and odour-free in A2, i.e. is assigned a threshold number of 1 (a taste/odour dilution number of 0) this method may not need to be carried out.

A3.1 Performance characteristics of the method

A3.1.1	Determinand	Taste and odour.
A3.1.2	Type of sample	Drinking waters.
A3.1.3	Basis of method	A series of diluted samples is prepared with blank (reference) water (A3.2.1). These diluted samples are smelled and tasted at 25 °C and the dilution at which no taste or odour is detected is recorded.
A3.1.4	Range of application	A taste/odour threshold number (T/O TN) of 2 to 10, equivalent to taste/odour dilution number (T/O DN) 1 to 9, respectively. Higher taste/odour threshold numbers or dilution numbers can be determined using an alternative (more dilute) series of consecutive or geometric dilutions.
A3.1.5	Lower reporting limit	Taste/odour threshold number of 2, with corresponding taste/odour dilution number of 1.
A3.1.6	Sensitivity	Depends on the combined subjective sensitivities of the panellists.
A3.1.7	Bias	Depends on the combined subjective sensitivities of the panellists and the range of the diluted samples used in the test.
A3.1.8	Time required for analysis	For one sample; coordinator - 60 minutes, panellist - 10 minutes.
A3.1.9	Expression of results	The taste/odour threshold number is used throughout the procedure. This value is converted to a dilution number in the final stage of the determination.

A3.2 Reagents

Use analytical reagent grade chemicals unless otherwise indicated. Water for the preparation of reagents should be distilled, deionised or of similar grade quality.

A3.2.1 Blank (reference) water

The blank water is a critical reference point for the entire testing process. It is used in the panel screening and quantitative assessments and for diluting test water samples when performing quantitative assessments.

The testing laboratory should choose a blank water which is consistently judged by a group of people, from whom testing panels will be drawn, to possess no taste and odour at 25 °C. The blank water should be chosen for the long term with the consistency of its characteristics and availability in mind.

The blank water should be water appropriate to the area and, where possible, should be similar in composition to the type of water samples being tested. Ideally, each laboratory should choose only one blank (reference) water. However, where the water samples to be tested vary significantly by virtue of their chemical composition, hardness for example, it may be necessary to employ more than one.

It is prudent for laboratories to identify a continuity plan in the event that the chosen blank water becomes unavailable for a reason outside their control. It is also advisable that the blank water is subject to a programme of monitoring sufficient to verify its consistency with respect to absence of taste and odour and simple chemical characteristics. This information should be sufficient to provide the basis for investigation should there be any indication of a change in the performance of the blank water.

Blank water should be collected in clean glass-stoppered glass containers, or food grade polyethyleneterephthalate (PET) bottles, reserved solely for this purpose. Collected blank water should have a shelf-life no longer than 72 hours, the same as for test samples, after which unused water must be discarded and a fresh supply obtained. When not in use blank water should be kept cool (about 5°C).

If non-glass containers are used, they should be thoroughly tested before use to ensure no taste or odour is imparted to, or removed from, the blank water or water under investigation.

It may be necessary with some blank waters to condition them to achieve consistency or remove an undesirable taint. This may be achieved as follows. Pass the water at a flow rate not exceeding 10 litres per hour through a glass column (for example 20 mm in diameter and 200 mm in length) filled with fresh technical grade activated carbon (5 to 20 mesh). Collect the water in a suitable container. This water should be prepared on the day of use and judged independently by a testing panel to possess no taste and odour at 25 °C. It should be used or discarded within 12 hours of preparation. Activated carbon may act as a potential growth medium for bacteria. Unless changed frequently bacteria may collect in the activated carbon and may ultimately gain access to and contaminate the water so prepared.

A3.2.2 Rinse water

Water used for rinsing containers and glassware should be appropriate to the stage of the method. For each stage it should be evident that water used for rinsing has no impact on the assessment results. For example, fresh glassware may be rinsed with de-ionised or distilled

water after washing and before drying. Blank water may be used for rinsing at various stages. Glassware used for neat test samples may be rinsed with the next sample between assessments.

A3.3 Analytical procedure

Step	Procedure	Notes
	Ascending and descending triangle test	
A3.3.1	The de- chlorinated sample should be brought to 25 °C. Shake the sample bottle and remove the stopper. Quickly transfer suitable volumes (see Table 4) of sample to separate containers and replace the stopper. Immediately, add to the containers the appropriate volume of blank (reference) water (A3.2.1) at 25°C and seal or stopper the containers. Mix well. See note a.	(a) An alternative (more dilute) consecutive or geometric series may need to be prepared if the taste or odour of the sample is extremely intense. If the taste or odour of the sample is less intense, only a few (consecutive) dilutions may need to be prepared (for example solutions C to F in Table 4).
A3.3.2	For each panellist used in the assessment (see note b) place portions of each diluted sample prepared in step A3.3.1 into separate wine glasses/taste vessels. Cover each glass/vessel with a watch glass. For each wine glass/taste vessel of diluted sample prepare two wine glasses/taste vessels containing blank (reference) water only. Alternatively use the bottles prepared in A3.3.1 for the triangular test, making two additional bottles of blank water for each dilution.	(b) Different panellists should not smell or taste from the same wine glass/taste vessel. Each panellist should be able to assess the taste and odour independently.
A3.3.3	Present in random order (to each panellist) three samples containing respectively two blank (reference) waters (A3.2.1) and one diluted sample, for example solution E (see Appendix 1, Table 4 and Figure 2, and note c) and assess immediately.	(c) The diluted samples and blank waters should not be identifiable to individual panellists, either by means of appearance or glass. If diluted samples are turbid or coloured, consideration should be given to covering all glasses/bottles with, for example aluminium foil before they are presented to individual panelists
A3.3.4	If using bottles decant a small quantity from the bottle into a wine glass/taste vessel. For each of the blank waters and diluted sample, gently shake or swirl the glass/vessel and its contents, so as not	(d) The contents of the wine glasses/taste vessels should be smelled by holding the glass at its base and immediately applying the nose to the opening

to spill any of the contents. Remove the watch glass (if applicable) and request the panellist to smell the contents and replace the watch glass (if applicable) (note d). The panellist is to immediately record whether any of the three solutions possess an odour. If the panellist opines that any of the contents of the three samples possesses an odour, then those samples and their contents should be identified. Immediately, record the observations made.

A3.3.5 Remove the watch glass if applicable. Gently, so as not to spill any of the contents, shake or swirl the glass and its contents again, and taste the contents (see note e). The panellist is to immediately record whether any of the three solutions possess a taste. If the panellist opines that any of the contents of the three samples possesses a taste, then those glasses/vessels and their contents should be identified. Immediately, record the observations made.

A3.3.6 The assessment of any taste and odour should be made as quickly as possible after smelling and tasting the contents, and recorded immediately. See note f.

A3.3.7 The results are recorded as either

i. Taste/odour detected in the diluted sample - Proceed to step A3.3.8

ii. Diluted sample and the blank waters assessed as being taste- or odour-free. Proceed to step A3.3.10.

iii. Taste/odour detected in the blank water. - Repeat steps A3.3.3 - A3.3.5. If the blank water (A3.2.1) is still identified as possessing taste/odour (see notes g and h).

A3.3.8 Repeat steps A3.3.3 - A3.3.5 proceeding along the dilution series with the next more diluted sample. In

of the glass/vessel.

(e) The contents of the wine glasses/taste vessels should be tasted by holding the glass at its base and taking into the mouth whatever volume of diluted sample or blank (reference) water is comfortable, holding the contents in the mouth for several seconds and then discharging the contents to waste without swallowing any.

(f) To ensure panellists do not become de-sensitised, each panellist should be allowed to take a short break between assessments.

(g) If blank waters are persistently identified by several panellists as possessing a taste/odour, then the blank water (A3.2.1) may not be of adequate quality and a further quantity should be prepared.

(h) If a single panellist persistently identifies the blank water (A3.2.1) as possessing taste/odour then consideration should be given to removing that person from the panel (see Appendix 2).

the example given as described in step A3.3.3, the next dilution would be solution F (see Appendix 1, Table 4 and Figure 2).

A3.3.9 The process is repeated until the panellist records the diluted sample and blank waters as being taste - or odour-free. At this point, re-assess the next more concentrated sample to confirm the previous assessment of this solution (as possessing a taste and/or odour). If this re-assessment is confirmed, then the threshold number is the relevant calculation value of the more dilute diluted sample. See Table 4. If however, the re- assessment is not confirmed (and is now assessed as being taste- or odour-free) then go to section A3.3.10 and assess the next more concentrated sample. See also note i.

(i) If the end of the dilution series is reached and the diluted sample is still recorded as possessing taste/odour, then a further, more dilute consecutive or geometric series will need to be prepared.

A3.3.10 If the panellist records the diluted sample and blank waters as being taste- or odour-free, repeat steps A3.3.3 - A3.3.5 proceeding along the dilution series with the next more concentrated sample. In the example given as described in step A3.3.3, the next dilution would be solution D (see Appendix 1, Table 4 and Figure 2).

A3.3.11 This process is repeated until the panellist records a taste/odour in the diluted sample but that the blank waters are taste- or odour-free. At this point, re-assess the next more dilute sample to confirm the previous assessment of this solution (as being taste- or odour-free). If this re-assessment is confirmed, then the threshold number is the relevant calculation value of the diluted sample assessed as taste- and odour-free. See Table 4. If however, the re-assessment is not confirmed (and is now assessed as possessing a taste and/or odour) then go to section A3.3.8 and assess the next more diluted sample. See also note j.

(j) If the diluted sample at the most concentrated level, i.e. solution C, is assessed to be taste- or odour-free then the sample is deemed to possess a taste/odour threshold number of 2.

A3.3.12 This iterative procedure is undertaken to establish a confirmed threshold number for each individual panellist.

A3.3.13 At the same time that samples are assessed, the assessment of appropriate QC samples should also be undertaken. See Appendix 3.

A3.3.14 Repeat steps A3.3.3 - A3.3.13 for the original panellists who detected a taste or odour (where these are new panellists, at least three panellists are required).

Calculation of T/O DN

A3.3.15 The overall T/O TN for the sample is calculated as the geometric mean of the individual panellist's results. i.e.

T/O TNy = (T1 x T2 x T3 ..... x Ty)1/Y

where

T1 to Ty are the individual panellist's T/O TNs
Y is the number of panellists and T/O TNy is the T/O TN of the sample.

The result is rounded to the nearest whole number (see note k).

A3.3.16 Subtract one from the overall T/O TN (i.e.T/O TNy) to obtain the taste/odour dilution number, T/O DN for that (see note l).

(k) If the individual panellist's results for a given sample are 2, 3 and 4 respectively then the overall T/O TN for the sample would be (2 x 3 x 4)1/3 = 2.8845 which is rounded to 3 (see Table 7).

(l) The result should be quoted as a taste/odour dilution number.

A4 Determination of odour (on-site) by a continuous odour monitor

A4.1 Principle

The method describes a qualitative on-line procedure for determining odour, where the early detection of potential problems may be required. The method is applicable to raw, partially-treated and treated waters.

The water under test is heated to an elevated temperature, for example at 60 °C, for at least 30 seconds, after which, it is sprayed in a continuous stream into a bell-jar. Any odour thus collected and amplified in intensity is detected at the neck of the bell-jar and classified according to Tables 2 and 3. See also Table 1.

A4.2 Reagents

A4.2.1 De-chlorinating agent.

Sodium thiosulphate solution (approximately 0.0125M). Dissolve 3.5 g of sodium thiosulphate pentahydrate ($Na_2S_2O_3.5H_2O$) in water and make to 1000 ml with water. Mix well. This reagent may be stored in an amber glass bottle at a temperature about 5 °C for up to 7 days.

In certain cases depending on the nature of the sample, sodium thiosulphate can give rise to sulphurous odours when used as a de-chlorinating agent. An alternative de-chlorinating agent, for example ascorbic acid may therefore need to be used. However, ascorbic acid may also cause interfering odours, for example where waters have been chloraminated. Other de-chlorinating agents may be used provided odours are not imparted to or removed from the sample.

A4.3 Apparatus

The apparatus is described in Figure A4.1 and requires, for example a water pressure of 70 - 80 kPa (10 - 12 psi) and a 3 kw heater.

The apparatus should be constructed so that the constituent parts can easily be dismantled for cleaning purposes to prevent the build- up of pathogenic organisms in the system.

Glassware should be cleaned before use by soaking thoroughly overnight in a dilute solution of a strong detergent and then rinsing thoroughly with water.

Alternatively, an automatic dishwasher supplied with water at a temperature of not less than 60 °C and a detergent may be suitable.

A4.4 Installation and operation of continuous odour monitors (smell bells)

In order to minimise the possible risk of operators being exposed to pathogenic organisms etc, and potential problems caused by inadequate instrumentation the following should be considered.

(i) The use of short direct runs of pipe work from the water intake to the heater, and from the heater to the bell-jar.

(ii) Dead legs and over-sized pipe-work should be avoided.

(iii) Approved materials and fittings should be used.

(iv) The intake pipe work should be insulated in order to keep the water cold prior to heating if necessary.

(v) The water should be uniformly heated to an elevated temperature, for example 60 °C for not less than 30 seconds in a suitable unit which can easily be dismantled for cleaning.

(vi) The water temperature probe should be located near the outlet of the heater chamber, it should be periodically checked for accuracy.

(vii) The water should be sprayed onto the inner surface of the bell-jar as an unbroken stream, for example in a fan shape. Jets which produce fine mists should be avoided.

(viii) The smell bell water jet, bell-jar and base should be cleaned regularly, but the heater unit may require dismantling and cleaning less frequently.

(ix) If smell bells have not been used for a period exceeding 1 month, the apparatus and its associated pipe work should be disinfected and thoroughly flushed out prior to use.

(x) The use of an in-line ultra violet disinfection unit to allay concerns over the potential risks of inhaling aerosols of raw water.

(xi) The use of large bore pipe work for the supply of raw water, possibly through a by-pass system, in order to reduce potential problems caused by algae, weed and other debris, blocking the system.

(xii) The use of flow sensors for hard water monitoring, offering protection to heating elements where cessation of flow causes the element to burn out.

A4.5 Analytical procedure

Step	Procedure	Notes
A4.5.1	The "smell bell" should be plumbed into the system, the odour of which is required to be monitored (see section A4.4 and note a.	(a) If this method is to be applied to waterworks control, the influence of terminal chlorination on the odour

may be significant and a decision should be taken on whether the measurement is carried out on water supplied to the consumer. The chlorinous odour of treated water may mask other odours which may become apparent after distribution. The odour of de-chlorinated water may be assessed by de-chlorinating the water by in-line injection of de-chlorinating agent (A4.2.1).

A4.5.2 The thermostat should be set at an elevated temperature, for example at 60 °C, see note b, in order to maintain the temperature of the water for a minimum of 30 seconds.

(b) The intensity of volatile odours is increased as the temperature is raised.

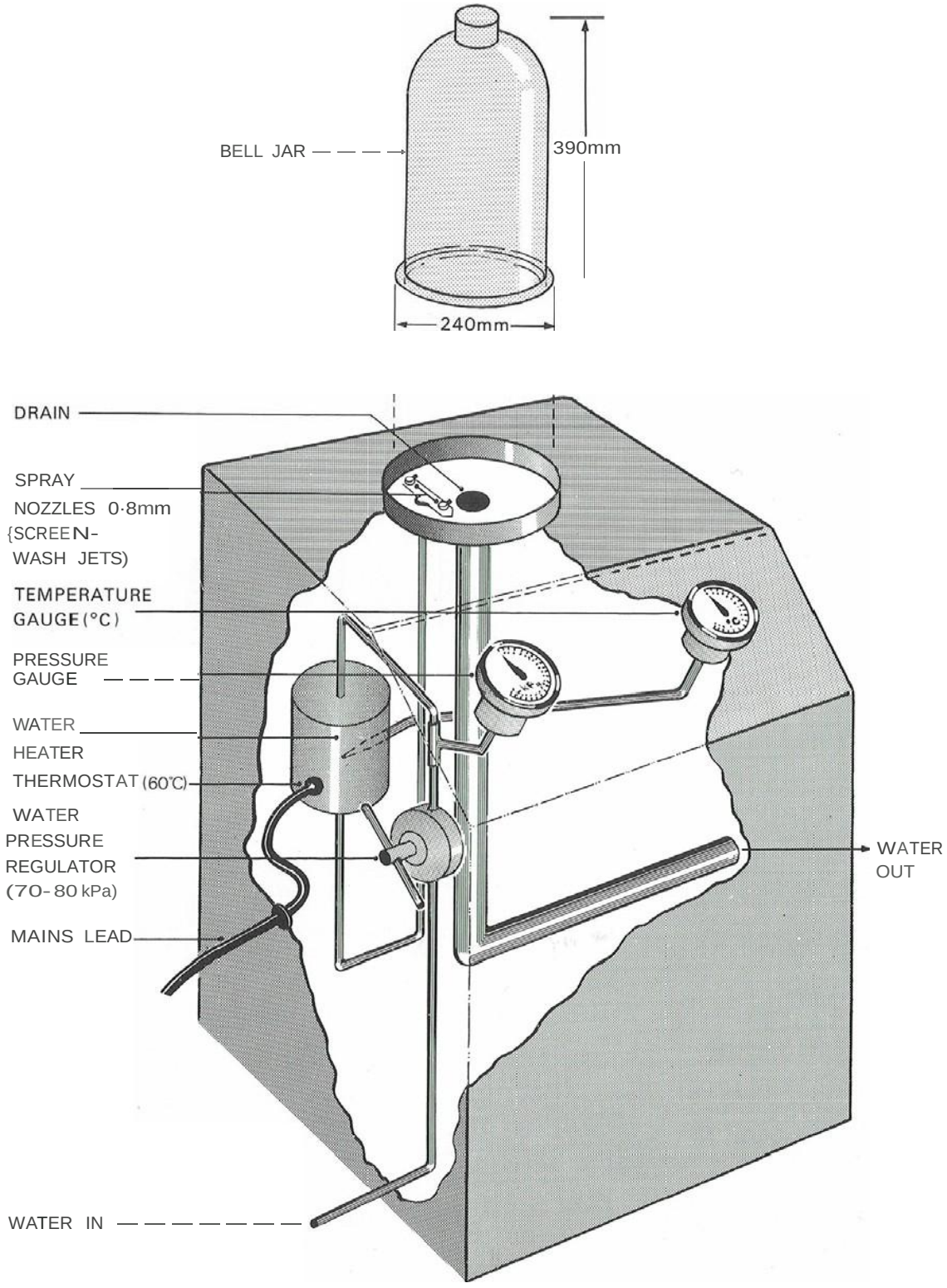
A4.5.3 Any odour present in the water should be detected by removing the seal from the mouth of the bell-jar and smelling the contents of the jar. An immediate subjective assessment of the odour should be recorded.

A4.5.4 At the same time that samples are assessed, the assessment of appropriate QC samples can also be undertaken. See Appendix 3.

A4.5.5 The result should be expressed as an intensity and description according to Appendix 1 Tables 2 and 3 respectively. See also Table 1.

Figure A4.1 Typical apparatus for the assessment of odour - smell-bell

Figure A4.2 Cutaway view of an apparatus for the assessment of odour- smell-bell



Appendix 1 Tables and Figures for use with methods A1 - A4

Table 1 Odour- (and possibly taste-) causing compounds

Compound	Odour description	Approximate odour threshold concentration (µg/l)	Possible sources
ammonia	sharp / pungent	40	fertilizers and sewage
pentylethanoate	pear drops	5	industrial waste
2-ethyl-5,5-dimethyl-1,3-dioxane	musty / nutty / sweet	0.01	industrial waste
2 ethyl 4 methyl 1,3 dioxolane	musty / nutty / sweet	0.01	industrial waste
phenol	carbolic	300	decomposition of vegetation or industrial waste
2-methylisoborneol	musty / camphor	0.02	Actinomycetes, cyanobacteria, micro-fungi
4-methylphenol	creosote	45	disinfectant and solvent
3-methylphenol	creosote	330	disinfectant and solvent
2-methylphenol	creosote	70	disinfectant and solvent
menthol	camphorus / minty	2	
linalool	woody / aromatic	60	Cleaning agents
geosmin	musty / earthy	0.015	Actinomycetes, cyanobacteria, micro-fungi
dimethyl sulphide	rotting vegetables	10	*Pseudomonas* species
diethyl sulphide	garlic	0.25	
butanoic acid	sweaty	50	
2,4,6-trichlorophenol	medicinal	0.1	chlorination of phenol during water treatment
2,6-dichlorophenol	medicinal	3**	chlorination of phenol during water treatment
2,4-dichlorophenol	medicinal	2**	chlorination of phenol during water treatment
4-chlorophenol	phenolic	250**	chlorination of phenol during water treatment
2-chlorophenol	phenolic	2**	chlorination of phenol during water treatment
chlorine	chlorinous	100 - 500*	disinfection of water
biphenyl	musty	0.5	industrial waste
benzothiazole	rubber	80	industrial waste
benzaldehyde	sharp / almonds	35	industrial waste
acetophenone	sweet / almonds	65	industrial waste
2-isopropyl-3-methoxypyrazine	mouldy / musty	-	Actinomycetes
cadin-4-ene-1-ol	woody, earthy	-	Actinomycetes
cis-3-hexen1-ol	grassy	-	green algae
diphenyl ether, trichloramine	geranium-like	-	diatoms
trans-2- and cis-6-nonadienal	cucumber	-	green algae
aldehydes (C_7 and above)	fruity, fragrant	-	ozonation
hydrocarbons; 1,3-pentadiene	solvent-like	-	permeation of petrol, diesel etc through plastic pipes
n-hexanal; n-heptanal	fishy	-	green algae, diatoms
decadienal	cod liver oil	-	green algae
hepta- and deca-dienals	fishy	-	*Dinobryon* (algae)
mercaptan	malodourous sulphur	-	decomposing cyanobacteria
hydrogen sulphide	rotten eggs	-	sulphate-reducing bacteria, clostridia
aldehydes of low molecular weight	swampy, swimming pool	-	chlorination of amino acids
iodinated trihalomethanes	medicinal		chloramination
phenolic anti-oxidants	plastic, burnt plastic		plastic, burnt plastic
ozone (in solution)	ozonous		disinfection of water
dichloramine	swimming pool		disinfection of water
2-tert-butyl-5-methyl-1,4 benzoquinone	pencil, graphite	0.005	black alkathene pipe

* Dependent on pH.

** Produced during water treatment chlorination when phenol is present in the water.

Table 2 Intensity of tastes/odours

no taste/odour
very slight
slight
strong
very strong

Table 3 Description of tastes/odours

Odours	**Tastes**
no odour	no taste
ammoniacal	astringent
bad eggs (sulphide)	bitter
chlorine (bleach)	bituminous
diesel	chemical
earthy	chlorinous
farm like	chlorophenol
fruity	cucumber
fuel	decayed vegetable
medicinal (for example “TCP”)	diesel
milky	earthy
musty	fishy flat
oily	fuel
organic solvent	geranium
pencil	inky
petrol	metallic
phenolic	mouldy
soapy	musty
sweet	oily
yeasty	pencil
other (this should be specified)	petrol
	rubber
	saline
	sharp
	sour
	spirit
	sweet
	weedy
	other (this should be specified)

Table 4 Sample dilution series

Solution	Relevant calculation value	Volume of sample (ml)	Volume of blank water (ml)	Total volume (ml)
A	-	-	200	200
B	1	200	0	200
C	2	100	100	200
D	3	70	140	210
E	4	50	150	200
F	5	40	160	200
G	6	35	175	210
H	7	30	180	210
I	8	25	175	200
J	9	20	160	180
K	10	20	180	200

Solution B is the de-chlorinated undiluted sample

Table 5 Rounding off geometric mean values

Value of overall T/O TN	Reported T/O TN
1.415 - 2.449	2
2.450 - 3.464	3
3.465 - 4.472	4
4.473 - 5.477	5
5.478 - 6.481	6
6.482 - 7.483	7
7.484 - 8.485	8
8.486 - 9.487	9
9.488 - 10.488	10

Figure 1 Flowchart indicating actions for screening (Method A2) and quantitative assessment (Method A3) of taste and odour

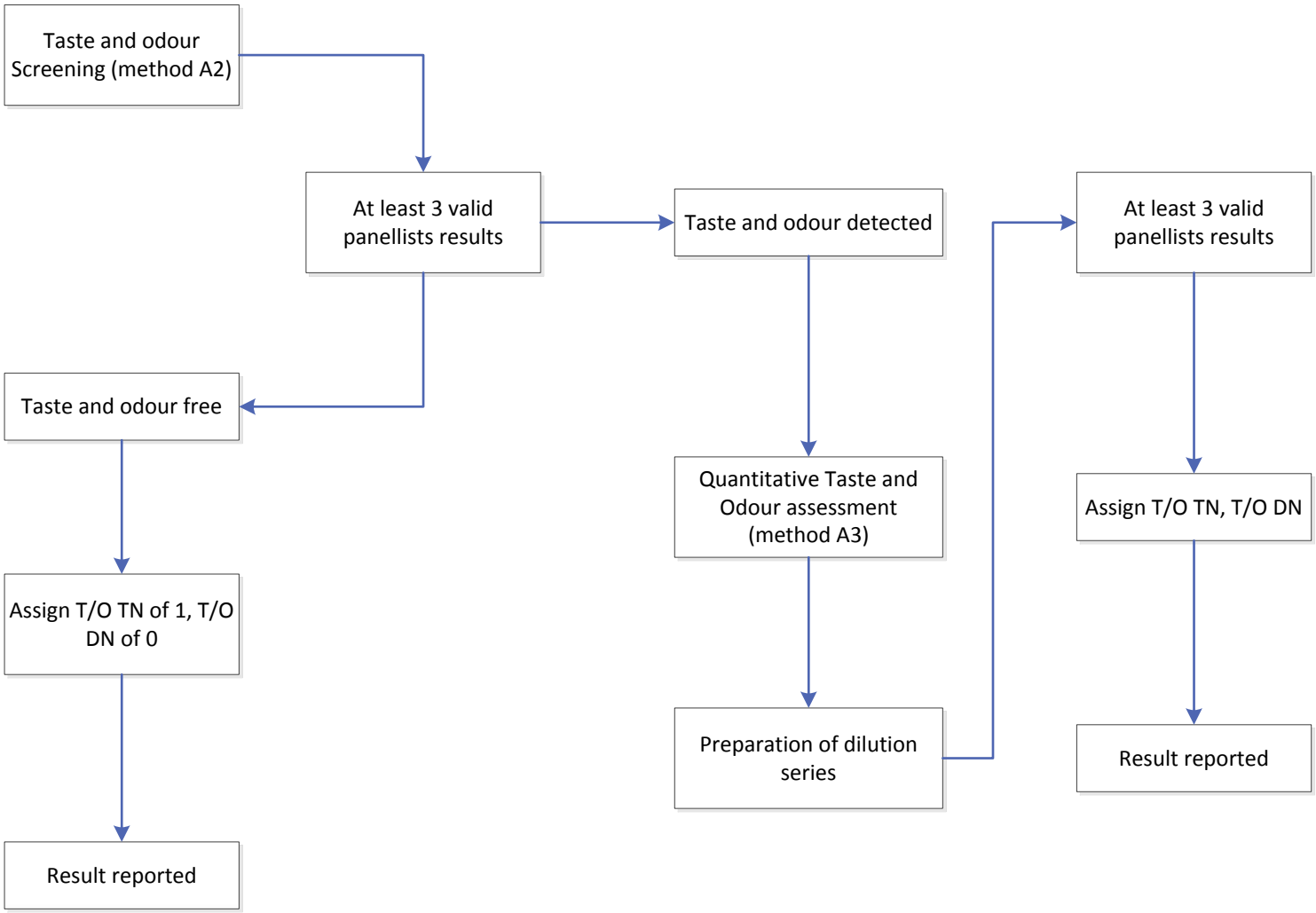
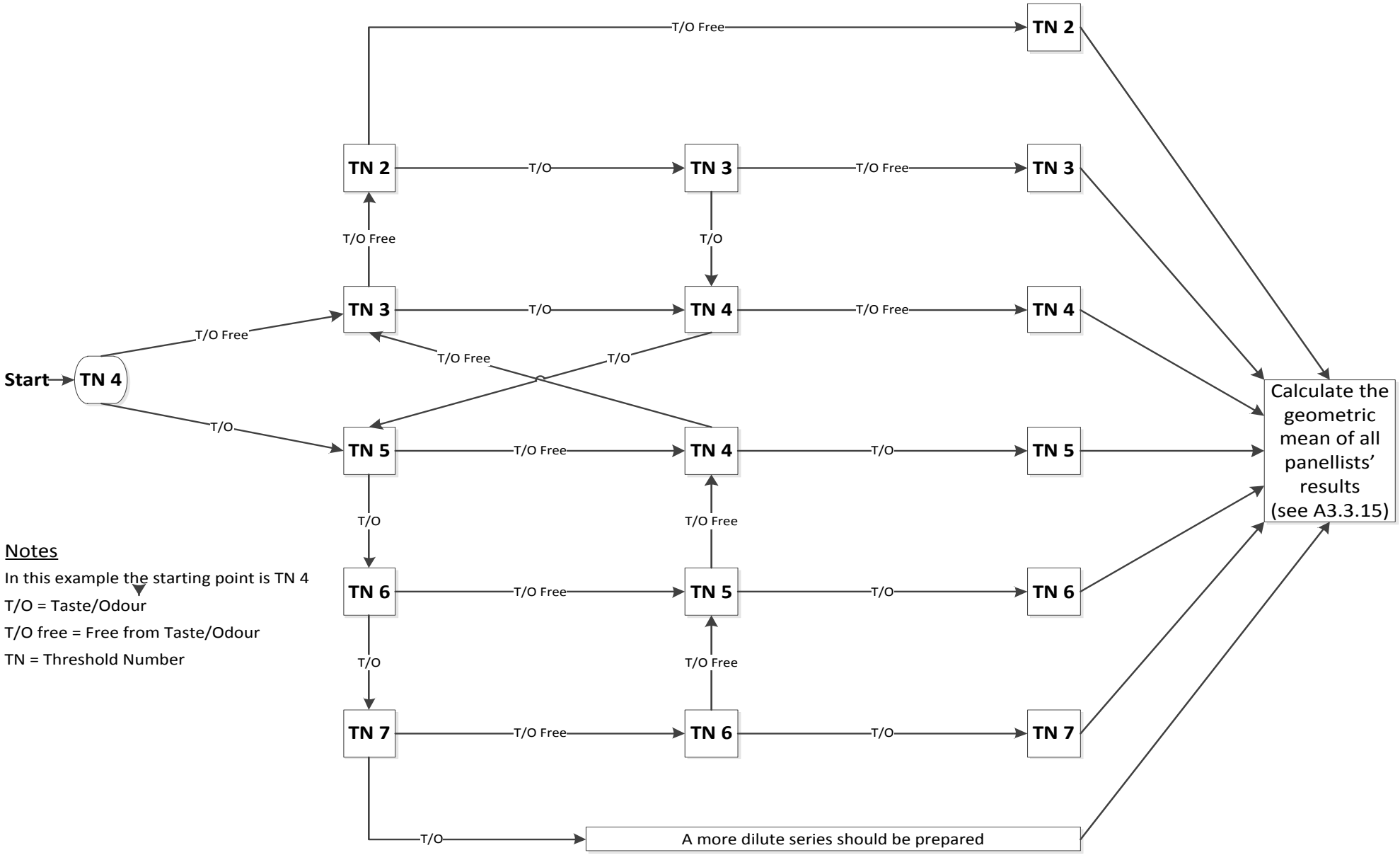


Figure 2 Example of an assessment of T/O TN by an individual panellist using method A3



Appendix 2 Selection and On-going Performance of panellists for taste and odour evaluation

1 Introduction

Procedures should be defined in order to select candidates considered suitable as panellists for taste and odour evaluations. The selection process may consist of different stages and examples are outlined below. In addition to this a system should be developed for monitoring the on-going performance of panellists, for example using positive controls and/or real samples and comparing the results obtained from individual panellists.

2 Screening / Training

a) Self Evaluation

A list of candidates for consideration as panellists can be completed and kept as a record, (for example see Form 1). Candidates are asked, for example whether they have any allergies or possess extreme sensitivity to taste or smell, and other similar questions to determine whether they can be considered suitable. Potential candidates who appear suitable are identified (which can be dated) and those unsuitable are declined. Candidates considered unsuitable should not be used as panellists.

Typical example of form 1

Name	Self evaluation	Date	Screened	Date

(i) Clearly identify in the "self evaluation" column if a candidate does not suffer from allergies and has not admitted lack of, or excessive, sensitivity to taste and odour (i.e. candidate is suitable, see 2 above).
(ii) If circumstances indicate that a person is unsuitable as a panellist, clearly identify this person in the relevant column and do not consider for use as a panellist.
(iii) In the "screened" column clearly identify if a candidate passed the screening procedure or failed the screening procedure (see 1 above).

b) Screening

Potential candidates may be screened further prior to acceptance as a panellist. Two examples are detailed below.

Example	Screen Procedure	Pass Criteria
1	Geosmin samples of 2.5 $ngl^{-1}$and 40 ngl^{-1} and 4 blanks are presented to each panellist	• An earthy or related descriptor must be detected for the 40 ngl^{-1}

	in a random order	Geosmin sample • A positive taste/odour must NOT be detected for the 2.5 ngl^{-1} Geosmin sample • A taste/odour must not be detected in >60% of the blanks
2	Samples of various solutions are presented to each panellist in a random order: Salt solution, Sugar Solution, Sour Solution, Bitter solution, Bottled water and Chlorinated Tap water (~0.6mgl^{-1}). Solutions are made from commercially available products and made up in bottled water(Aquapura or similar): Salt (Table Salt) – 1.25gl^{-1}; Sugar – 7.5gl^{-1}; Sour – Lemon Juice 1.25mls/l^{-1}; Bitter – Tonic water 2.5mls/l^{-1}	• A taste/odour should be detected in at least 2 out of 4 spiked solutions and a taste/odour detected in tap water • A taste/odour must not be detected in >60% of the blanks

c) Training

Potential candidates should undergo training once screened. Two examples are detailed below.

Example	Training Example
1	Present each panellist with the Geosmin (40 ngl^{-1}), Free chlorine (1mgl^{-1}), TCP (100 μgl^{-1}) and Naphthalene (10 μgl^{-1}) (odour only) solutions. Inform the potential panellist the correct taste and odour descriptor for each of the qualitative tests and the associated descriptor number. This is effectively a training run. After they have completed the training run, represent them with the solutions again (with the exception of naphthalene) and ask them to identify them and choose the correct descriptor. Failure to correctly identify the correct descriptors will have no bearing on the outcome of the candidate's success to become a panellist. This is a training exercise, not selection criteria.
2	Candidates considered suitable for the panel undertake further internal training using commercially available certified flavour standards. The flavour standards are typically equivalent to a threshold number (TN) of 3 for taste. The training will ensure the panellist is able: Identify at least 16 different off-flavours and taints in water, achieving >70% correct answers in blind tests Discriminate chlorinated and un-chlorinated water samples with >80% accuracy Find out which of the major water flavour problems which the panellist maybe blind to Scale the intensity of different flavour notes in water

d) Additional Assessment

Potential candidates may undergo further assessment once trained. An example is detailed below.

Example	Additional Assessment
1	The potential panellist shall complete 3 batches of analysis; these batches shall include positive control samples, sufficient blanks and a minimum of five samples that have previously been analysed by a trained panellist. The candidate shall record the descriptor and obtains TN for taste and odour for the positive controls analysed. In order to be deemed a suitable panellist the TN obtained for all positive controls must be similar the positive controls obtained from the routine panel. If the TN is outside this range then they will be deemed to be either under or over sensitive and unsuitable for being a routine panellist. The results obtained for the routine samples must compare with the original values obtained by the trained panellist. Blank results should show a minimum of 60% exhibiting no taste and odour. If these criteria are not met, the panellist will be deemed hypersensitive and not suitable for being a routine panellist.

3 Daily check

All candidates who are considered suitable as panellists on a long term basis should be further questioned on the day the tests are to be carried out, to determine whether they remain suitable on the day; for example whether any person considered is suffering from a cold, thus affecting their potential suitability.

A check-list, for example see Form 2 should be completed on the day the tests are to be carried out for any person proposed as a panellist. The person should be used only if the responses to the questions posed indicate that the candidate is suitable.

Typical example of form 2

Date	Enter “yes” or “no”			Comments
Name	Q1	Q2	Q3	

Prospective panellists should be asked, for example, the following questions.
(Q1) Do you have a cold or sore throat?
(Q2) Is there any other reason why you might be unsuitable for use in taste and odour evaluations?
(Q3) Just prior to testing, have you eaten, drunk (for example alcohol) or smoked in the last hour.

Other relevant questions may also be asked.

Any person confirming their unsuitability for the test should not be used as a panellist.

4 On-going Performance

Panellists shall be continually assessed based on their routine positive control and sample blank performance. Any significant change in individual panellist's performance may require retraining and/or reassessment to determine whether they are still suitable to remain as a panellist.

Appendix 3 Quality Control

Many labs employ standard taste and odour solutions as positive panellist control checks for the assessment of qualitative and quantitative taste and odours in drinking waters (See Appendix 2). The positive control is used routinely every time analysis is carried out, and is used to ensure that the panellist is suitable to carry out the sample assessments on the day of analysis. A separate taste daily check sample and odour daily check sample are used and should be presented so as not to interfere with the ability of the panellist to assess the samples.

In order to avoid a panellist becoming too familiar with the standards it is worth having a variety of tastes and odours at different concentrations (for example vanilla, geosmin, trichlorophenol, etc) which are presented on a rolling programme to the panellists. The concentrations of these standards should be chosen following the initial panel set up, so that they are relevant, for example they should be at a strength which confirms that the panellists sense of both taste and odour has not altered significantly from when they were screened (See Appendix 2).

Control checks should be carried out at both the screening stage (Method A.2) and the ascending/descending stage (Method A.3) of the analysis. If a panellist does not detect a positive taste or odour then consideration should be given to removing them from the panel, and they should be replaced on the day of analysis with another panellist.

Control solutions should be chosen from those used by the laboratory in their panellist selection and on-going performance protocol (See Appendix 2). Examples of positive control checks at both stages are described below:

a). Screening stage (Method A.2)

Example Odour positive control

Dissolve 0.100g of 2,4,6 trichlorophenol in 500ml of taste and odour free water, then make up to the mark in a 1litre volumetric using taste and odour free water. This solution is stable for seven days when stored in a fridge at approximately 5ºC.Dilute the standard to the relevant dilution based on initial panel results.

Example Taste positive control

Dissolve 14g of sugar in 500ml of taste and odour free water, then make up to the mark in a 1litre volumetric flask with taste and odour free water. This solution is stable for seven days when store in a fridge at approximately 5ºC.Dilute the standard to the relevant dilution based on initial panel results.

Present the diluted standards anonymously as per method with two blanks at the end of the batch of samples, and note the results as “presence/absence”

Note: It may also be worth presenting a sample in duplicate at the screening stage to help with validating the reproducibility of the panellists used.

b) Ascending/Descending triangle stage (Method A.3)

For each batch of samples that require ascending and descending triangle test, one sample should be selected and analysed in duplicate.

The sample should be presented in two series, A and B, each consisting of three clean wine glasses/vessels, covered with watch glasses containing two blanks and a diluted sample.

The panellist should be presented with series A and asked to identify which, if any of the solutions have a taste /odour. This is repeated with series B.

On calculation of the dilution number for both series A and B, a difference control chart can be obtained by subtracting the series B result from the series A result, and plotting on a relevant control chart.

NB Always subtract the second result from the first and plot the difference .

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Address for correspondence

However well procedures may be tested, there is always the possibility of discovering hitherto unknown problems. Analysts with such information are requested to contact the Secretary of the Standing Committee of Analysts at the address given below. In addition, if users wish to receive advance notice of forthcoming publications, please contact the Secretary.

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Standing Committee of Analysts

Members assisting with this method

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