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## Drinking (potable) water — Specification

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## **Foreword**

Uganda National Bureau of Standards (UNBS) is a parastatal under the Ministry of Tourism, Trade and Industry established under Cap 327, of the Laws of Uganda. UNBS is mandated to co-ordinate the elaboration of standards and is

- (a) a member of International Organisation for Standardisation (ISO) and
- (b) a contact point for the WHO/FAO Codex Alimentarius Commission on Food Standards, and
- (c) the National Enquiry Point on TBT/SPS Agreements of the World Trade Organisation (WTO).

The work of preparing Uganda Standards is carried out through Technical Committees. A Technical Committee is established to deliberate on standards in a given field or area and consists of representatives of consumers, traders, academicians, manufacturers, government and other stakeholders.

Draft Uganda Standards adopted by the Technical Committee are widely circulated to stakeholders and the general public for comments. The committee reviews the comments before recommending the draft standards for approval and declaration as Uganda Standards by the National Standards Council.

This Uganda Standard (US 201) was first declared a national standard in 1994 and it has now been technically revised to update it in accordance with developments in the sector. This is in line with new guidelines of the World Health Organisation (WHO) and other market requirements. The standards also takes into consideration the various types of potable water available in Uganda including the water which is conventionally treated and water made available for rural water consumers through boreholes, protected springs, shallow wells, gravity flow schemes and harvested rain water which may be used for consumption in accordance with the guidelines provided by the Directorate of Water Development (DWD).

The standard has also undergone a structural change in editorial style.

Annex A is for information only.

### **Committee membership<sup>1)</sup>**

The following organisations were represented on the Technical Committee on Food and agriculture standards, UNBS/TC 2, in the development of this standard:

- Blue wave Beverages Limited
- Consumer Education Trust (CONSENT)
- Directorate of Water Development
- Government Analytical Laboratories
- House of Eden Limited
- Ministry of Agriculture Animal Industry and Fisheries (Fisheries Department)
- Ministry of Health
- Mukwano Industries Limited
- NC Beverages Limited
- Rwenzori Beverages Limited
- Uganda National Bureau of Standards

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<sup>1)</sup> Does not include of members who were responsible for the development of First edition of 1994

# Drinking (potable) water — Specification

## 1 Scope

**1.1** This Uganda Standard prescribes the quality and safety requirements for drinking (potable) water. It also lays down the factors required during surveillance of water sources to ensure that the quality and safety of water is maintained.

**1.2** It describes two classes of drinking water:

- a) Class I potable water available from conventional treatment processes such as chlorination, filtration, and ozonation; and used in food establishments or distributed through the water distribution systems. This water is comparable to current international standards for water quality. This water is considered to be acceptable for lifetime consumption, and is the recommended compliance limit.
- b) Class II (untreated water) potable water available for water consumers through boreholes, protected springs, shallow wells, gravity flow schemes and harvested rain water which may be used for consumption in accordance with the guidelines provided by the Directorate of Water Development (DWD). This class specifies a water quality range that poses an increasing risk to consumers depending on the concentration of the determinant within the specified range and the possibility of monitoring its quality. It is considered to represent drinking water for consumption for a limited period.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

US ISO 5664, *Water quality — Determination of ammonium — Distillation and titration method*

US ISO 5666, *Water quality — Determination of mercury*

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

US ISO 5667-2, *Water quality — Sampling — Part 2: Guidance on sampling techniques*

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

US ISO 5667-4, *Water quality – Sampling – Part 4: Guidance on sampling from lakes, natural and man-made.*

US ISO 5667-5, *Water quality — Sampling — Part 5: Guidance on sampling of drinking water from treatment works and piped distribution systems*

US ISO 5667-6, *Water quality — Sampling — Part 6: Guidance on sampling of rivers and streams*

US ISO 5667-11, *Water quality — Sampling — Part 11: Guidance on sampling of groundwaters*

US ISO 5961, *Water quality — Determination of cadmium by atomic absorption spectrometry*

US ISO 6058, *Water quality — Determination of calcium content — EDTA titrimetric method*

US ISO 6059, *Water quality — Determination of the sum of calcium and magnesium — EDTA titrimetric method*

US ISO 6222, *Water quality — Enumeration of culturable micro-organisms — Colony count by inoculation in a nutrient agar culture medium*

US ISO 6332, *Water quality — Determination of iron — Spectrometric method using 1,10-phenanthroline*

US ISO 6333, *Water quality — Determination of manganese — Formaldoxime spectrometric method*

US ISO 6703-1, *Water quality — Determination of cyanide — Part 1: Determination of total cyanide*

US ISO 6703-3, *Water quality — Determination of cyanide — Part 3: Determination of cyanogen chloride*

US ISO 6777, *Water quality — Determination of nitrite — Molecular absorption spectrometric method*

US ISO 7027, *Water quality — Determination of turbidity*

US ISO 7393-1, *Water quality — Determination of free chlorine and total chlorine — Part 1: Titrimetric method using N,N-diethyl-1,4-phenylenediamine*

US ISO 7887, *Water quality — Examination and determination of colour*

US ISO 7888, *Water quality — Determination of electrical conductivity*

US ISO 7890-3, *Water quality — Determination of nitrate — Part 3: Spectrometric method using sulfosalicylic acid*

US ISO 7980, *Water quality — Determination of calcium and magnesium — Atomic absorption spectrometric method*

US ISO 8199, *Water quality — General guidance on the enumeration of micro-organisms by culture*

US ISO 8288, *Water quality — Determination of cobalt, nickel, copper, zinc, cadmium and lead — Flame atomic absorption spectrometric methods*

US ISO 9174, *Water quality — Determination of chromium — Atomic absorption spectrometric methods*

US ISO 9308-2, *Water quality — Detection and enumeration of coliform organisms, thermotolerant coliform organisms and presumptive Escherichia coli — Part 2: Multiple tube (most probable number) method*

US ISO 9390, *Water quality — Determination of borate — Spectrometric method using azomethine-H*

US ISO 9964-1, *Water quality — Determination of sodium and potassium — Part 1: Determination of sodium by atomic absorption spectrometry*

US ISO 9965, *Water quality — Determination of selenium — Atomic absorption spectrometric method (hydride technique)*

US ISO 10304-1, *Water quality — Determination of dissolved fluoride, chloride, nitrite, orthophosphate, bromide, nitrate and sulfate ions, using liquid chromatography of ions — Part 1: Method for water with low contamination*

US ISO 10359-2, *Water quality — Determination of fluoride — Part 2: Determination of inorganically bound total fluoride after digestion and distillation*

US ISO 10523, *Water quality — Determination of pH*

US ISO 10566, *Water quality — Determination of aluminium — Spectrometric method using pyrocatechol violet*

US ISO 10705-2, *Water quality — Detection and enumeration of bacteriophages — Part 2: Enumeration of somatic coliphages*

US ISO 11423-1, *Water quality — Determination of benzene and some derivatives — Part 1: Head-space gas chromatographic method*

US ISO 11423-2, *Water quality — Determination of benzene and some derivatives — Part 2: Method using extraction and gas chromatography*

US ISO 11885, *Water quality — Determination of 33 elements by inductively coupled plasma atomic emission spectroscopy*

US ISO 11969, *Water quality — Determination of arsenic — Atomic absorption spectrometric method (hydride technique)*

US ISO 12020, *Water quality — Determination of aluminium — Atomic absorption spectrometric methods*

US ISO 14403, *Water quality — Determination of total cyanide and free cyanide by continuous flow analysis*

US ISO 15061, *Water quality — Determination of dissolved bromate — Method by liquid chromatography of ions*

US ISO 15553, *Water quality — Isolation and identification of Cryptosporidium oocysts and Giardia cysts from water*

US ISO 16590, *Water quality — Determination of mercury — Methods involving enrichment by amalgamation*

### 3 Terms and definitions

For the purposes of this standard, the following terms and definitions shall apply.

#### 3.1

##### **approved water supply**

source of water that has been inspected and approved by the competent authority for the intended purpose

#### 3.2

##### **water distribution system**

public or private water systems providing consumers with tap water suitable for direct consumption

#### 3.3

##### **treated water**

water that is conventionally treated usually by coagulation, sedimentation, filtration, and disinfection and distributed through a water distribution system

#### 3.4

##### **untreated/rural water**

water that is either mined or harvested from natural sources without any conventional treatment applied to it such as borehole water, spring water, shallow wells, or harvested rainwater

#### 3.5

##### **conventional treatment**

collection, storage and distribution of drinking water involving deliberate coagulation, sedimentation, filtration, and disinfection to improve the safety and quality of the finished drinking water for consumers

3.6

**potable**

water which is suitable for human consumption

**4 Requirements**

**4.1 Factors affecting organoleptic and physical characteristics**

Drinking water shall conform to the requirements for factors affecting organoleptic and physical characteristics corresponding to a given class indicated in Table 1.

**Table 1 — Requirements for factors affecting organoleptic and physical characteristics**

Characteristic	Requirement levels		Method of test
	Class I	Class II	
Colour	15 true colour units (TCU)	15 true colour units (TCU)	US ISO 7887
Taste	Acceptable to consumers and no abnormal changes	Acceptable to consumers and no abnormal changes	-
Odour	Acceptable to consumers and no abnormal changes	Acceptable to consumers and no abnormal changes	Annex A
Electrical conductivity, at 25 °C	1500 µS/cm	2500 µS/cm	US ISO 7888
pH	5.5 – 8.5	6.5 – 8.5	US ISO 10523
Turbidity	5 Nephelometric Turbidity Units	10 Nephelometric Turbidity Units	US ISO 7027
Total dissolved solids (TDS)	500 mg/L	1 500 mg/L	Annex A
Iron	0.2 mg/L	1 mg/L	US ISO 6332,
Ammonia	0.5 mg/L	1.0 mg/L	US ISO 5664
Aluminium	0.2 mg/L	0.2 mg/L	US ISO 10566 US ISO 12020
Potassium as K, mg/l, max.	50	100	US ISO 9964-1
Sodium as Na, mg/l, max.	200 mg/L	400 mg/L	US ISO 9964-1
Chloride	250 mg/L	500 mg/L	US ISO 10304-1
Magnesium	100 mg/L	150 mg/L	US ISO 6058, US ISO 6059 US ISO 7980

**4.2 Chemical requirements**

Drinking water shall conform to the maximum limits for chemicals of health significance in drinking water as indicated in Table 2, Table 3, Table 4 and Table 5.

NOTE Safety factors indicated in Table 3, Table 4 and Table 5 apply to both Class I and Class II.



Table 2 — Requirements for naturally occurring chemicals

Chemical	Maximum limit, mg/L		Method of test
	Class I	Class II	
Arsenic	0.01 calculated as total As	0.05	FDUS ISO 11969
Barium	0.7	1.0	Annex A
Boron	1.0		US ISO 9390,
Chromium	0.05 calculated as total Cr.	0.05	US ISO 9174
Fluoride	1.0	1.5	US ISO 10359-2
Manganese	1.0	0.1	US ISO 6333
Molybdenum	0.07		Annex A
Selenium	0.01	0.01	US ISO 9965
Uranium	0.015	0.015	Annex A
Mercury	0.001	0.001	US ISO 16590

Table 3 — Requirements for chemicals used in water treatment<sup>2)</sup>

Chemical	Required limit, max, mg/L	Method of test
Acrylamide	0.0001	*
Antimony	0.005	Annex A
Benzo[a]pyrene	0.0001	*
Bromate	0.01	US ISO 15061
Bromodichloromethane	0.06	*
Bromoform	0.1	*
Chlorate	0.7	*
Chlorine	5	US ISO 7393-1
Chlorite	0.7	*
Chloroform	0.3	*
Copper	2	US ISO 8288
Cyanogen chloride	0.07	US ISO 6703-3
Dibromoacetonitrile	0.07	*
Dibromochloromethane	0.1	*
Dichloroacetate	0.05	*
Epichlorohydrin	0.0001	*
Lead	0.01	US ISO 8288
Monochloroacetate	0.02	*
Monochloroamine	3	*
Nickel	0.02	US ISO 8288
Trichloroacetate	0.2	*
Trichlorophenol, 2,4,6-	0.2	*
Trihalomethanes <sup>3)</sup> , total	0.1	*
Vinyl chloride	0.0003	*
* Methods of test of the ASTM or APHA may be used (see Annex A)		

<sup>2)</sup> Includes disinfectants, disinfections by products, contaminants from treatment chemicals and contaminants from pipes and fittings

<sup>3)</sup> Trihalomethanes (bromoform, bromodichloromethane, dibromochloromethane, chloroform) are formed in drinking-water primarily as a result of chlorination of organic matter present naturally in raw water supplies.

Table 4 — Requirements for residues of agricultural chemicals

Chemical	Maximum limit, mg/L, Max.	Remarks
Alachlor	0.02	a)
Aldicarb	0.01	Applies to aldicarb sulfoxide and aldicarb sulfone
Aldrin and dieldrin	0.00003	For combined aldrin plus dieldrin
Atrazine	0.002	a)
Chlordane	0.0002	Currently 0.0003
Chlorpyrifos <sup>b)</sup>	0.03	a)
Chlorotoluron	0.03	a)
2,4-D (2,4-dichlorophenoxyacetic)	0.03	Applies to free acid acid)
2,4-DB	0.09	a)
DDT and metabolites <sup>b)</sup>	0.001	a)
Dichlorprop	0.1	a)
Dimethoate	0.006	a)
Endrin	0.0006	a)
Fenoprop	0.009	a)
Isoproturon	0.009	a)
Lindane	0.002	a)
MCPA	0.002	a)
Mecoprop	0.01	a)
Methoxychlor	0.02	a)
Metolachlor	0.01	a)
Molinate	0.006	a)
Nitrate (as NO <sub>3</sub> )	50	Short-term exposure
Nitrite (as NO <sub>2</sub> )	3	Short-term exposure
	0.2	Long-term exposure
Permethrin <sup>b)</sup>	0.3	Only when used as a larvicide for public health purposes
Pyriproxyfen <sup>b)</sup>	0.3	a)
Simazine	0.002	a)
2,4,5-T	0.009	a)
Terbutylazine	0.007	a)
Trifluralin	0.02	a)
<p>a) Methods of test of the ASTM or APHA may be used (see Annex A)</p> <p>b) Chemicals used in water for public health purposes such as treatment of mosquito nets and larvicidal effects on water surfaces</p>		

**Table 5 — Requirements for chemicals from industrial sources**

Chemical	Maximum limit, mg/L, Max.	Remarks
Benzene	0.001	US ISO 11423-1 US ISO 11423-2
Cadmium	0.003	US ISO 5961 US ISO 8288
Carbon tetrachloride	0.004	*
Cyanide	0.07	US ISO 14403
Di(2-ethylhexyl)phthalate	0.008	*
Dichlorobenzene, 1,2-	1	*
Dichlorobenzene, 1,4-	0.3	*
Dichloroethane, 1,2-	0.03	*
Dichloroethene, 1,2-	0.05	*
Dichloromethane	0.02	*
Dioxane, 1,4-	0.05	*
Edetic acid (EDTA)	0.6	Applies to the free acid
Ethylbenzene	0.3	*
Hexachlorobutadiene	0.0006	*
Nitrilotriacetic acid (NTA)	0.2	*
Pentachlorophenol	0.009	*
Styrene	0.02	*
Tetrachloroethene	0.04	*
Toluene	0.7	*
Trichloroethene	0.02	*
Xylenes	0.5	*
* Methods of test of the ASTM or APHA may be used (see Annex A)		

**Table 6 — Requirements of radioactive matter in drinking water**

Total radioactivity present in the form of	Maximum limit
Total beta activity (except K <sup>40</sup> and H <sup>3</sup> ) *	1 Bq/L
Total alpha activity	0.5 Bq/L
* The contribution of potassium-40 to beta activity shall be calculated using beta activity of 27.6 Bq/g of stable potassium and subtracted from total beta activity. If beta activity levels are higher than 1 Bq/LI after adjusting for potassium-40 beta activity due to tritium shall be determined and shall not exceed 100 Bq/L..	

### 4.3 Microbiological requirements

Drinking water shall conform to the maximum microbiological limits given in Table 7.

**Table 7 — Maximum microbiological limits of drinking water**

Microorganism	Allowable compliance limits and contribution of samples, % <sup>a)</sup>			Method of test
	Minimum 95%.	Maximum of 4% of samples,	Maximum of 1% of samples	
Heterotrophic plate count, count/mL	100	1 000	10 000	US ISO 6222
Total coliform bacteria count <sup>b)</sup> , count/100 mL	Not detected	10	100	US ISO 9308-2
<i>E. coli</i> , count <sup>b)</sup> ,/100 mL	Not detected	Not detected	1	
<i>Clostridium perfringens</i> (including viable spores), count/100 mL	Not detected	Not detected	Not detected	Annex A
Somatic coliphages count, count/10 mL	Not detected	1	10	US ISO 10705-2
Enteric viruses count, count/100 L	Not detected	1	10	Annex A
Protozoan parasites ( <i>Giardia/Cryptosporidium</i> ) count, count/ 10 L	Not detected	Not detected	1	US ISO 15553
<p><sup>a)</sup> , The allowable compliance contribution shall be at least 95 % of the samples to conform to the limits of 100 CFU/mL, and a maximum of 4 % and 1 % of samples, respectively, to conform to the limits of 1000 CFU/mL and 10 000 CFU/mL. The objective of disinfection should, nevertheless, be to attain 100 % compliance to the limit of 100 CFU/100mL.</p> <p><sup>b)</sup> , In most instances it will not be necessary to conduct both these tests; one or the other will normally suffice as the required indicator.</p>				

## 5 Water safety plans

**5.1** Drinking water systems operators shall develop, implement and maintain a water safety plan taking into consideration the potential risks to the safety of the water from the supply catchments to the consumer.

**5.2** A water safety plan shall consist of three key components:

- a) system assessment to determine whether the drinking-water supply chain (up to the point of consumption) as a whole can deliver water of a quality that meets health-based targets;
- b) identifying control measures in a drinking water system that will collectively control identified risks and ensure that the health-based targets are met; and
- c) management plans describing actions to be taken during normal operation or incident conditions and documenting the system assessment (including upgrade and improvement), monitoring and communication plans and supporting programmes.

**5.3** A water safety plan shall include:

- a) measures to protect the source of drinking water from risks of pollution;

- b) measures to ensure all installations intended for the production of drinking water exclude any possibility of contamination. For this purpose and in particular:
- the installation for collection, the pipes and the reservoirs shall be made from materials suited to the water and in such a way as to prevent the introduction of foreign substances in water;
  - the equipment and its use for production, especially installation for washing and packaging, shall meet hygienic requirements;
- c) measures to ensure an appropriate treatment such as pretreatment coagulation, flocculation, sedimentation, filtration and disinfection are undertaken to assure the safety of water for the consumers;
- d) appropriate operational monitoring system including monitoring parameters that can be measured and for which limits have been set to define the operational effectiveness of the activity; frequency of monitoring and procedures for corrective action that can be implemented in response to deviation from limits. If, during production it is found that the water is polluted, the producer shall stop all operations until the cause of pollution is eliminated; and
- e) a verification plan to ensure that individual components of a drinking-water system, and system as a whole is operating safely.

## **6 Surveillance**

### **6.1 General surveillance requirements**

Drinking-water suppliers shall ensure, at all times, the quality and safety of the water that they produce. Public health surveillance (that is, surveillance of health status and trends) contributes to verifying drinking-water safety.

Adequate infrastructure, proper monitoring and effective planning and management; and a system of independent surveillance are basic and essential requirements to ensure the safety of drinking-water.

Surveillance shall cover the total supply network from the source of untreated water to the consumer delivery points.

A sampling programme that takes into consideration appropriate international recommendations shall be established and implemented. The sampling shall be regular and its frequency shall mainly depend on the following factors

- a) quality of water harnessed including effects on the water from climatic, human and industrial activities;
- b) type of treatment for drinking worthiness;
- c) volume of water processed;
- d) risks of contamination;
- e) background of public water supply network;
- f) population served; and
- g) capabilities of the analytical facility (both in terms of capacity and in terms of analytical performance).

## 6.2 Sampling requirements

The recommendations given in US ISO 5667-1 shall be used as the basis for the establishment of a sampling programme, and the recommendations given in US ISO 5667-2, US ISO 5667-3, US ISO 5667-4, US ISO 5667-5, US ISO 5667-6 and US ISO 5667-11 shall be used as the basis for implementing the sampling programme.

In the absence of a formally established sampling programme, the minimum sampling frequency given in Table 8 shall be used as an interim measure.

**Table 8 — Minimum frequency of sampling of water for surveillance**

Population served	Frequency <sup>*</sup> (minimum) of sampling
More than 100 000	10 samples every month per 100 000 of population served
25 001 – 100 000	10 samples every month
10 001 – 25 000	3 samples every month
2 500 – 10 000	2 samples every month
Less than 2 500	1 sample every month
* During the rainy season, sampling should be carried out more frequently	

## 6.3 Parameters required for minimum monitoring

It is recognized that, in many instances, the cost of performing a full analysis against Table 1, Table 2, Table 3, Table 4, Table 5, Table 6 and Table 7 can be prohibitive.

Analysis of the parameters in Table 9 may be deemed acceptable for the purpose of indicating ongoing levels of operational efficiency in a water treatment plant.

**Table 9 — Parameters for surveillance of drinking water safety**

Property	Methods of test
Physicochemical: Conductivity, or dissolved solids Colour Turbidity; Taste Odour	See Table 1
Microbiological Faecal coliform bacteria or <i>E. coli</i> ; <i>Clostridium perfringens</i> Heterotrophic plate count	See Table 7
Chemical Fluoride as F <sup>-</sup> (Nitrate and nitrite) as N pH value Aluminum  Iron Ammonia Appropriate residual treatment chemicals and disinfectants	See Table 2 DUS/ISO 10304-1 See Table 1 DUS/ISO 10566 DUS/ISO 12020 DUS/ISO 6332, DUS/ISO 5664

If abnormal results are encountered in any of these analyses, sampling frequency shall be increased and/or additional analyses carried out.

NOTE A consumer complaints register for the aesthetic qualities of the water should be maintained.



## **Annex A** (informative)

### **Recommended test methods**

#### **A.1 General**

The test methods listed in Tables 1 - 7 are recommended

#### **A.2 ASTM standard test methods**

All the determinants for which the requirements are listed in Tables 1-7 may be evaluated with the required accuracy, using ASTM test methods (see bibliography).

#### **A.3 APHA-AWWA-WPCF test methods**

All the determinants for which the requirements are listed in Tables 1 - 7 may be evaluated with the required accuracy, using the test methods given in the latest edition of *Standard methods for the examination of water and wastewater* (see bibliography).

## Bibliography

- [1] Annual book of ASTM standards 2003 – Section 11: *Water and Environmental Technology – Volume 11.01: Water* (I).
- [2] Annual book of ASTM standards 2003 – Section 11: *Water and Environmental Technology – Volume 11.02: Water* (II).
- [3] *Standards methods for the examination of water and wastewater*. 17th Ed., 1989, Washington, DC: American Public Health Association (APHA), American Water Works Association (AWWA), Water Pollution Control Federation (WPCF).
- [4] *Guidelines for Drinking-water Quality* [electronic resource]: incorporating first addendum. Vol. 1, Recommendations. – 3rd ed., 2006, World Health Organization
- [5] SANS 241:2001, *Drinking Water – Specification*. South African Bureau of Standard

## Certification marking

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