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Potable water — Specification



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National foreword

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This Uganda Standard, US EAS 12: 2014, *Potable water — Specification*, is identical with and has been reproduced from an East African Standard, EAS 12: 2014, *Potable water — Specification*, and adopted as a Uganda Standard.

This standard cancels and replaces US 201:2008, *Drinking (potable) water – Specification*, which has been technically revised.

Wherever the words, "East African Standard" appear, they should be replaced by "Uganda Standard."



EAS 12: 2014

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EAST AFRICAN STANDARD

Potable water — Specification

EAST AFRICAN COMMUNITY

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Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in the East African Community. It is envisaged that through harmonized standardization, trade barriers that are encountered when goods and services are exchanged within the Community will be removed.

In order to achieve this objective, the Community established an East African Standards Committee mandated to develop and issue East African Standards.

The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

FDEAS 12 was prepared by Technical Committee EASC/TC 075, *Environment, Health and Safety*.

This second edition cancels and replaces the first edition (EAS 12:2000), which has been technically revised.

Introduction

The provision of safe and quality drinking-water is high priority for human health.

The appearance, taste and odour of drinking-water should be acceptable to the consumer. This will build the confidence of consumers, avoid complaints and, more importantly, prevent consumers from the use of water from sources that may be unsafe.

Safety of water is affected by several factors including environmental, the nature of the source, the human activities undertaken on or around the sources and the water harvesting, handling and treatment that may be undertaken. Thus, water may be exposed to physical, chemical and microbiological contamination that may make water unsafe for human consumption.

A few chemical contaminants have been shown to cause adverse health effects in humans as a consequence of prolonged exposure through drinking-water however; some inorganic elements are also recognized to be essential elements in human nutrition.

Infectious diseases caused by pathogenic bacteria, viruses and parasites (e.g. protozoa and helminths) are the most common and widespread health risk associated with drinking-water. The greatest risk to public health from microbes in water is associated with consumption of drinking-water that is contaminated with human and animal excreta, although other sources and routes of exposure may also be significant.

Consumers have no means of judging the safety of their drinking-water themselves. Water producers have a challenge of ensuring the quality and safety of water they provide. Regulators are required to establish health-based targets that must be met by water operators.

This standard sets minimum requirements for physical, chemicals and microbiological characteristics that affect safety and quality of drinking water. The use of this standard is expected to ensure provision of safe and quality drinking water for human consumption.

Potable water — Specification

1 Scope

This Final Draft East African Standard specifies requirements and methods of sampling and test for potable water (treated potable water and natural potable water).

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.

ASTM D 5907, *Standard test methods for filterable matter (total dissolved solids) and non-filterable matter (total suspended solids) in water*

EAS 39, *Hygiene in the food and drink manufacturing industry — Code of practice*

ISO 10359, *Water quality -- Determination of fluoride*

ISO 10523, *Water quality -- Determination of pH*

ISO 11423, *Water quality -- Determination of benzene and some derivatives*

ISO 11732, *Water quality -- Determination of ammonium nitrogen -- Method by flow analysis (CFA and FIA) and spectrometric detection*

ISO 11885, *Water quality -- Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES)*

ISO 11923, *Water quality -- Determination of suspended solids by filtration through glass-fibre filters*

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

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

ISO 12846, *Water quality -- Determination of mercury -- Method using atomic absorption spectrometry (AAS) with and without enrichment*

ISO 13877, *Soil quality -- Determination of polynuclear aromatic hydrocarbons -- Method using high - performance liquid chromatography*

ISO 14402, *Water quality -- Determination of phenol index by flow analysis (FIA and CFA)*

ISO 14911, *Water quality -- Determination of dissolved Li+, Na+, NH4+, K+, Mn2+, Ca2+, Mg2+, Sr2+ and Ba2+ using ion chromatography -- Method for water and waste water*

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

ISO 15089, *Water quality -- Guidelines for selective immunoassays for the determination of plant treatment and pesticide agents*

ISO 15681, *Water quality -- Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA)*

ISO 16265, *Water quality -- Determination of the methylene blue active substances (MBAS) index -- Method using continuous flow analysis (CFA)*

ISO 16266, *Water quality -- Detection and enumeration of Pseudomonas aeruginosa —Method by membrane filtration*

ISO 21567, *Microbiology of food and animal feeding stuffs —Horizontal method for the detection of Shigella spp.*

ISO 22743, *Water quality -- Determination of sulfates -- Method by continuous flow analysis (CFA)*

ISO 4832, *Microbiology of food and animal feeding stuffs —Horizontal method for the enumeration of coliforms —Colony-count technique*

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

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

ISO 6222, *Water quality -- Enumeration of culturable microorganisms — Colony count by inoculation in nutrient agar culture media*

ISO 6332, *Water quality -- Determination of the chemical oxygen demand*

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

ISO 6461, *Water quality -- Detection and enumeration of the spores of sulphite-reducing anaerobes (clostridia) —Method by membrane filtration*

ISO 6703, *Water quality -- Determination of cyanide*

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

ISO 6785, *Milk and milk products -- Detection of Salmonella spp.*

ISO 6888, *Microbiology of food and animal feeding stuffs —Horizontal method for the enumeration of coagulase-positive staphylococci (Staphylococcus aureus and other species)*

ISO 7027 *Water quality -- Determination of turbidity*

ISO 7393, *Water quality -- Determination of free chlorine and total chlorine*

ISO 7887, *Water quality -- Determination of colour*

ISO 7888, *Water quality -- Determination of electrical conductivity*

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

ISO 7899, *Water quality -- Detection and enumeration of intestinal anteroococci*

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

ISO 8165, *Water quality -- Determination of selected monovalent phenols*

ISO 8245, *Water quality -- Guidelines for the determination of total organic carbon (TOC) and dissolved organic carbon (DOC)*

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

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

ISO 9297, *Water quality -- Determination of chloride —Silver nitrate titration with chromate indicator (Mohr's method)*

ISO 9308, *Water quality -- Detection and enumeration of Escherichia coli and coliform bacteria*

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

ISO 9696, *Water quality -- Measurement of gross alpha activity in non-saline water -- Thick source method*

ISO 9697, *Water quality -- Measurement of gross beta activity in non-saline water -- Thick source method*

ISO 9964, *Water quality -- Determination of sodium and potassium*

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

3 Terms and definitions

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

3.1

potable water

water that is safe and suitable for human consumption

3.2

drinking water

potable water intended for human consumption

3.3

treated water

water that has undergone through processes such as flocculation, coagulation, sedimentation, filtration and disinfection

3.4

natural potable water

water that is from natural sources that is fit for human consumption without undergoing any form of treatment which will alter its original chemical composition and bacteriological purity

3.5

conventional treatment

process involving deliberate coagulation, flocculation sedimentation, filtration, and disinfection to improve the safety and quality of the finished drinking water to consumers

3.6

water quality

the chemical, physical and biological characteristics of water in respect to suitability for human consumption

**3.7
safe water**
water that is free from physical, chemical and/or biological substances in concentrations which could cause illness or injury to consumers

**3.8
surveillance**
an independent continuous, specific measurement, observation and reporting for the purpose of water quality management and operational activities

**3.9
disinfection**
reduction by means of chemical agents and/or physical methods, of the number of micro-organism to a level that does not compromise public health

**3.10
potable water distribution system**
public or private water systems providing consumers with tap water suitable for direct consumption

**3.11
approved water supply**
source of water that has been inspected and approved by the competent authority for human consumption

4 Requirements for potable water

4.1 General requirements

4.1.1 Potable water shall be free from organisms and chemical substances that are hazardous and injurious to human health and shall comply with requirements in Table 1, 2, 3, 4, 5, and 6.

4.1.2 The location, construction, operation and supervision of water supply source, its reservoirs and its distribution system shall be such that they exclude any possible pollution of the water in compliance with relevant national regulations.

4.1.3 Potable water shall be handled under hygienic conditions as stipulated in EAS 39.

4.2 Specific quality requirements

4.2.1 Physical characteristics

Potable water shall conform to the physical characteristics in Table 1.

Table 1— Physical requirements for potable water

Sl. No.	Characteristic	Treated potable water	Natural potable water	Method of test
i)	Colour (TCU ^a max)	15	50	ISO 7887
ii)	Turbidity (NTU max)	5	25	ISO 7027
iii)	pH	6.5 – 8.5	5.5-9.5	ISO 10523
iv)	Taste	Not objectionable	Not objectionable	-
v)	Odour	Odourless	Odourless	-
vi)	Conductivity (µS/cm)max	1500	2500	ISO 7888
vii)	Suspended matter	Not detectable	Not detectable	ISO 11923

^{a)} True colour units (TCU) mean 15 hazen units after filtration.

4.2.2 Chemical characteristics

Potable water shall conform to the chemical characteristics affecting quality indicated in Table 2.

Table 2 — Quality requirements for potable water

Sl. No.	Substance or characteristic	Treated potable water (mg/L max.)	Natural potable water (mg/L max.)	Method of test
i)	Total dissolved solids	700	1500	ASTM D 5907
ii)	Total hardness, as CaCO ₃ ,	300	600	ISO 6059
iii)	Aluminium, as Al ⁺⁺⁺ ,	0.2	0.2	ISO 12020
iv)	Chloride, as Cl ⁻	250	250	ISO 9297
v)	Total Iron as Fe	0.3	0.3	ISO 6332
vi)	Sodium, as Na ⁺	200	200	ISO 9964-1
vii)	Sulphate SO ₄	400	400	ISO 22743

viii)	Zinc, as Zn ⁺⁺	5	5	ISO 8288
ix)	Magnesium, as Mg ⁺⁺	100	100	ISO 7980
x)	Calcium, as Ca ⁺⁺	150	150	ISO 7980

4.2.3 Chemical characteristics affecting the safety of potable water

4.2.3.1 Inorganic contaminants

Potable water shall conform to the limits of inorganic contaminants affecting safety indicated in Table 3.

Table 3 — Limits for inorganic contaminants in natural and treated potable water

Sl. No.	Substance	Treated potable water limit of concentration mg/L, max.	Natural potable water	Method of test
i)	Arsenic, as As	0.01	0.01	ISO 11969
ii)	Cadmium, as Cd	0.003	0.003	ISO 5961
iii)	Lead, as Pb	0.01	0.01	ISO 8288
iv)	Copper, as Cu	1.000	1.000	ISO 8288
v)	Mercury (total as Hg)	0.001	0.001	ISO 12846
vi)	Manganese, as Mn	0.1	0.1	ISO 6333
vii)	Selenium, as Se	0.01	0.01	ISO 9965
viii)	Ammonia (NH ₃)	0.5	0.5	ISO 11732
ix)	Chromium Total, as Cr	0.05	0.05	ISO 9174
x)	Nickel, as Ni	0.02	0.02	ISO 8288
xi)	Cyanide, as CN	0.01	0.01	ISO 6703
xii)	Barium, as Ba	0.7	0.7	ISO 14911
xiii)	Nitrate as NO ₃ ⁻	45	45	ISO 7890
xiv)	Boron, as Boric acid	2.4	2.4	ISO 9390
xv)	Fluoride, as F	1.5	1.5	ISO 10359
xvi)	Bromate, as BrO ₃ ⁻	0.01	0.01	ISO 15061
xvii)	Nitrite	0.003	0.003	ISO 6777
xviii)	Molybdenum	0.07	0.07	ISO 11885
xix)	Phosphates, as PO ₄ ³⁻	2.2	2.2	ISO 15681
xx)	Residual free Chlorine	0.2-0.5 ^a	Absent	ISO 7393

^a Under conditions of epidemic diseases, it may be necessary to increase the residual chlorine temporarily.

4.2.4 Organic contaminants

Potable water shall conform to the limits of organic contaminants affecting safety indicated in Table 4.

Table 4 — Limits for organic contaminants in treated and natural potable water

Sl. No.	Substance (Arrange alphabetical order)	Limit µg/L max.	Method of test
i)	<u>Aromatics</u>		-
	Benzene	10	ISO 11423
	Toluene	700	-
	Xylene	500	-
	Polynuclear aromatic hydrocarbon	0.7	ISO 13877
ii)	<u>Chlorinated Alkanes and Alkenes</u>		
	Carbon tetrachloride	2	-
	1,2-Dichloroethane	30	-
	1,1-Dichloroethylene	0.3	-
	1,1-Dichloroethene	30	-
	Tetrachloroethene	40	-
iii)	<u>Phenolic substances</u>		
	Phenols	2	ISO 8165
	2,4,6-Trichlorophenol	200	ISO 14402
iv)	<u>Trihalomethanes</u>		
	Chloroform	30	-
v)	<u>Pesticides</u>		
	Aldrin/Dieldrin	0.03	"ISO 15089
	Chlordane (total)	0.3	
	2,4- Dichlorophenoxyacetic acid	30	
	DDT (total)	1	
	Heptachlor and Heptachlor Epoxide	0.03	
	Hexachlorobenzene	1	
	Lindane BHC	2	
Methoxychlor	20		
vi)	Surfactants (reacting with methylene Blue)	200	ISO 16265
vii)	Mineral oil	0.01	-
viii)	Organic matter	3	-

4.2.5 Microbiological contaminants

Potable water shall conform to the microbial limits affecting safety as indicated in Table 5.

Table 5 — Microbiological limits for potable water

Sl. No.	Type of micro-organism	Potable water	Method of test
i)	Total viable counts at 22 °C, in mL, max. ^{a)}	100	ISO 6222
	Total viable counts at 37 °C, in mL, max. ^{a)}	50	
ii)	Total Coliforms ^{b)} in 100 mL	Absent	ISO 4832
iii)	<i>E. coli</i> ^{b)} in 100 mL	Absent	ISO 9308-1
iv)	<i>Staphylococcus aureus</i> in 100 mL	Absent	ISO 6888-1
v)	Sulphite reducing anaerobes in 100 mL	Absent	ISO 6461-2
vi)	<i>Pseudomonas aeruginosa</i> fluorescence in 100 mL	Absent	ISO 16266
vii)	<i>Streptococcus faecalis</i> in 100 mL	Absent	ISO 7899-2
viii)	<i>Shigella</i> in 100 mL	absent	ISO 21567
ix)	<i>Salmonella</i> in 100 mL	Absent	ISO 6785
^a This parameter is for monitoring the system at source. Total time before analysis should be not more than 6 h at 4 °C. Determination of total viable counts shall start within 12 h after collection of the potable water sample.			
^b During the bacteriological quality control for different types of water supply, refer to Annex A.			

4.2.6 Radioactive characteristics

Potable water shall conform to the limits for radioactive materials stipulated in Table 6.

Table 6 — Limits for radioactive materials in treated and natural potable water

Sl. No.	Radioactive material	Limits in Bq/L	Method of test
i)	Gross alpha activity	0.5	ISO 9696
ii)	Gross beta activity	1	ISO 9697

5 Sampling

5.1 Sampling requirements

Sampling shall be done as guided in Table 7 below.

Table 7 — Minimum frequency of sampling of water for surveillance

Population served (P)	Frequency * (minimum) of sampling
P >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
P <2 500	1 sample every month
* During the rainy season, sampling should be carried out more frequently.	

5.2 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 8 may be deemed acceptable for the purpose of indicating on going levels of operational efficiency in a water treatment plant. However, a relevant authority may require additional tests.

Table 8 — Physico-chemical and microbiological parameters required for minimum monitoring

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> ; Shigella spp Salmonella spp	See Table 5
Chemical: Fluoride as F ⁻ Nitrate Nitrite pH value Aluminum Iron(total) Ammonia Residual chlorine	See Table 3

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)

Bacteriological quality requirements for different types of water supplies

A summary of bacteriological quality requirements for different types of water supplies is given in Table A.1 below.

Table A.1— Bacteriological quality requirements for different types of water supplies

Type of supply	Number per 100 ml		Methods of test
Treated water entering the distribution system	E. coli	Absent	ISO 4832
	Coliform organisms	Absent	
Untreated water entering the distribution system	E. coli	Absent	
		3 coliform organisms in any one sample	
		Absent in any two consecutive samples	
		Absent in 98 % of yearly samples	
Water in distribution system	E. coli	Absent	
		3 coliform organisms in any one sample	
		Absent in any two consecutive samples	
		Absent in 95 % of yearly samples	
Unpipd supplies	E. coli	Absent	
	Coliform organisms	10	
Emergency supplies of water	E. coli	Absent	
	Coliform organisms	Absent	

Annex B (Normative)

Water safety plans

B.1 Drinking water systems operators should develop, implement and maintain a water safety plan taking into consideration the potential risks to the safety of the water from the supply catchment area to the consumer.

B.2 A water safety plan should 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.

B.3 A water safety plan should 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 should 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 should meet hygienic requirements;
- c) measures to ensure an appropriate treatment such as pre-treatment processes, 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.

B.4 Surveillance

B.4.1 General surveillance requirements

Drinking-water suppliers should 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 should 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 should be established and implemented. The sampling should be regular and its frequency should 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)

Bibliography

- [1] Guidelines for drinking water quality, fourth edition 2011, WHO.
- [2] Code of hygienic practice for bottled/packageged drinking waters (other than natural mineral waters)
CAC/RCP 48-2001

