

CES 58

# Compulsory Ethiopian Standard

First Edition  
2013

## Drinking water - Specifications.



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## Foreword

This Ethiopian Standard has been prepared under the direction of the Technical Committee for Water Quality (TC 78) and published by the Ethiopian Standards Agency (ESA).

This Compulsory Ethiopian Standard cancels and replaces ES 261:2001.

Application of this standard is **COMPULSORY** with respect to clauses 4.1, 4.2.2 (Table 3), and 4.4 (Table 4).

A Compulsory Ethiopian Standard shall have the same meaning, interpretation and application of a "Technical Regulation" as implied in the WTO-TBT Agreement.

Implementation of this standard shall be effective as of 01 October 2013.

## Drinking water — Specifications

### 1 Scope

This Ethiopian Standard specifies the physical, chemical and bacteriological requirements of water for drinking and domestic purpose.

### 2 Normative references

The following referenced documents are indispensable for the application of this Ethiopian standard. Only the latest edition of the documents (including any amendments) shall be applicable.

ES 605, *Water quality - Determination of odour and taste.*

ES ISO 606, *Water quality – Determination of barium by atomic absorption spectrometry.*

ES ISO 607, *Water quality – Determination of total hardness.*

ES ISO 609, *Water quality – Determination of total solids and dissolved solids.*

ES ISO 4833, *Microbiology – General guidance for the enumeration of micro – organisms – Colony count technique at 30°C.*

ES ISO 5566-3, *Water quality – Determination of total mercury by flameless atomic absorption spectrometry – Method after digestion with bromine.*

ES ISO 5667-1, *Water quality – Sampling- Part 1: Guidance on the design of sampling programs.*

ES ISO 5667-2, *Water quality – Sampling – Part 2: Guidance on sampling techniques.*

ES ISO 5667-3, *Water quality – Sampling –Part 3: Guidance of the preservation and handling of samples.*

ES ISO 5667-5, *Water quality – Sampling – Part 5: Guidance on sampling of drinking water and water used for food and beverage processing.*

ES ISO 5961, *Water quality – Determination of cadmium by atomic absorption spectrometer.*

ES ISO 6107, *Water quality – Vocabulary.*

ES ISO 6332, *Water quality – Determination of iron spectrometric method using 1,10-phenanthroline.*

ES ISO 6333, *Water quality – Determination of manganese Formaldoxime spectrometric method.*

ES ISO 6468, *Water quality – Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes – Gas chromatographic method after liquid – liquid extraction.*

ES ISO 6595, *Water quality – Determination of total arsenic – Silver diethyl dithiocarbonate spectrophotometric method.*

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- ES ISO 6703-1, *Water quality – Determination of cyanide – Part 1: Determination of total cyanide.*
- ES ISO 6777, *Water quality – Determination of nitrite – molecular absorption spectrometric method.*
- ES ISO 7027, *Water quality – Determination of turbidity.*
- ES ISO 7150-2, *Water quality – Determination of ammonium – Part 2: Automated spectrometric method.*
- ES ISO 7393, *Water quality – Determination of free chlorine and total chlorine.*
- ES ISO 7875-1, *Water quality – Determination of surfactant – Part 1: Determination of anionic surfactants by measurement of the methylene blue index (MBAS).*
- ES ISO 7887, *Water quality – Examination and determination of colour.*
- ES ISO 7890-3, *Water quality – Determination of nitrate - Part 3: Spectrometric method using sulfosalicylic acid.*
- ES ISO 7899-1, *Water quality – Detection and enumeration of intestinal enterococci in surface and waste water – Part 1: Miniaturized method (Most Probable Number) by in occultation in liquid medium.*
- ES ISO 7899-2, *Water quality – Detection and enumeration of fecal streptococci – Part 2: Method by membrane filtration*
- ES ISO 7980, *Water quality – Determination of calcium and magnesium – Atomic absorption spectrometric method.*
- ES ISO 8165-1, *Water quality – Determination of selected monovalent phenols – Part 1: Gas chromatographic method after enrichment by extraction.*
- ES ISO 8288, *Water quality – Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric method.*
- ES ISO 9280, *Water quality – Determination of sulfate – Gravimetric method.*
- ES ISO 9297, *Water quality – Determination of chloride – Silver nitrate titration with chromate indicator (mohr's method).*
- ES ISO 9308-1, *Water quality – Determination and enumeration of coliform organisms, thermotolerant coliform organisms and presumptive escherichia coli – Part 1: Membrane filtration method.*
- ES ISO 9308-2, *Water quality – Determination and enumeration of coliform organisms, thermotolerant coliform organisms and presumptive escherichia coli – Part 2: Multiple tube (most probable number) method.*
- ES ISO 9390, *Water quality – Determination of borate – Spectrometric method using azomethine –H.*
- ES ISO 9696, *Water quality – Measurement of gross alpha activity in non-saline water – Thick source method.*
- ES ISO 9697, *Water quality – Measurement of gross beta activity in non-saline water.*
- ES ISO 9963-1, *Water quality – Determination of alkalinity Part 1: Determination of total and composite alkalinity.*
- ES ISO 9964-1, *Water quality – Determination of sodium and potassium – Part 1: Determination of sodium by atomic absorption spectroscopy.*
- ES ISO 9964-2, *Water quality – Determination of sodium and potassium – Part 2: Determination of potassium by atomic absorption spectroscopy.*

## 4.2 Chemical requirements

### 4.2.1 Palatability properties

Characteristics that affect the palatability of water shall conform to the levels specified in Table 2.

### 4.2.2 Content of toxic and/or disease causing substances

- a) When tested, the characteristics that affect the safety of drinking water shall conform to the levels specified in Table 3.
- b) If nitrates (expressed as N) are present in concentrations in excess of 10 mg/l, the water may be unsuitable for use by infants under one year of age, and an alternative source of supply must be found for such infants use or the water from the same source should be corrected in case of lack of other sources.

Table 2 – Characteristics that affect the palatability of drinking water

Substance or characteristic	Maximum permissible level	Test method
Total hardness (as CaCO <sub>3</sub> )	300	ES 607
Total dissolved solids mg/l, Max	1000	ES 609
Total Iron (as Fe) mg/l, Max	0.3	ES ISO 6332
Manganese (as Mn) mg/l, Max	0.5	ES ISO 6333
Ammonia (NH <sub>3</sub> +NH <sub>4</sub> <sup>+</sup> )* mg/l, Max	1.5	ES ISO 7150-2
Residual, free chlorine mg/l, max	0.5	ES ISO 7393
Anionic surfactants, as mass concentration of MBAS mg/l, Max	1.0	ES ISO 7875-1
Magnesium (as Mg) mg/l, Max	50	ES ISO 7980
Calcium (as Ca), mg/l, Max	75	ES ISO 7980
Copper (as Cu) mg/l, Max	2	ES ISO 8288
Zinc (as Zn) mg/l, Max	5	ES ISO 8288
Sulfate (as SO <sub>4</sub> ) mg/l, max.	250	ES ISO 9280
Chloride (as Cl), mg/l, Max	250	ES ISO 9297
Total alkalinity (as CaCO <sub>3</sub> ) mg/l, Max	200	ES ISO 9963-1
Sodium (as Na), mg/l, Max	200	ES ISO 9964-1
Potassium (as K), mg/l, max	1.5	ES ISO 9964-2
pH value, units	6.5 to 8.5	ES ISO 10523
Aluminium (as Al) mg/l, Max	0.2	ES ISO 12020

\* The term ammonia includes the non-ionized (NH<sub>3</sub>) and ionized (NH<sub>4</sub><sup>+</sup>) species.

NOTE 1 - Several of the inorganic elements for which maximum permissible levels has been settled are recognized to be essential elements in human nutrition. No attempt has been made here to define a minimum desirable concentration of such substances in drinking water.

Table 3 – Content of toxic and/or disease causing substances of drinking water

Substance or characteristic	Maximum permissible level	Test method
Barium (as Ba) mg/l, Max	0.7	ES 606
Total mercury (as Hg) mg/l, Max	0.001	ES ISO 5666-3
Cadmium (as Cd) mg/l, Max	0.003	ES ISO 5961
Arsenic (as As) mg/l, Max	0.01	ES ISO 6595
Cyanide(as CN) mg/l, Max	0.07	ES ISO 6703-1
Nitrite (as NO <sub>2</sub> ), Mg/l, Max	3	ES ISO 6777
Nitrate as NO <sub>3</sub> Mg/l, Max	50	ES ISO 7890-3
Phenolic compound as phenols , mg/l, Max.	0.002	ES ISO 8165-1
Lead (as Pb) mg/l, Max	0.01	ES ISO 8288
Boron (as B) mg/l, Max	0.3	ES ISO 9390
Selenium (as Se) mg/l, Max	0.01	ES ISO 9965
Fluoride (as F) Max	1.5	ES ISO 10359-1
Chromium (as Cr) mg/l, Max	0.05	ES ISO 11083
Pesticides and Organic constituents, Mg/l, Max		
a) DDT	2	ES ISO 6468
b) Heptachlor and heptachlor epoxide	0.03	
c) Hexachlorobenzene	1	
d) Lindane (Gamma – BHC)	2	
e) Methoxychlor	20	
f) Aldrin/Dieldrine	0.03	
g) 1,2 Dichloro ethane	30	ES ISO 10301
h) 1,1,1- Trichloro ethane	2001	
i) – Trichloro ethene	70	
j) Trichlorobenzenes (total)	20	
k) Hexachlorobutadiene	0.6	

NOTE - 2 Because of the possibility of simultaneous occurrence of nitrite and in drinking water, the sum of the ratios of the concentration of each to its standard value should not exceed 1, i.e.  $\frac{C_{\text{nitrite}}}{SV_{\text{nitrite}}} + \frac{C_{\text{nitrate}}}{SV_{\text{nitrate}}} \leq 1$ ,

Where, C is concentration and SV is standard value.

NOTE – 3 The limit value for fluoride should consider climatic conditions, volume of water consumed and intake from other sources provided the limit specified in the above table is satisfied.

### 4.3 Other constituents

4.3.1 Radioactivity if present shall not exceed the following levels, when determined according to ES ISO 9696 and ES ISO 9697 respectively :

- a) gross alpha activity 0.1 Bq/l max.
- b) gross beta activity 1Bq/l max.

NOTE – 4 If a screening value is exceeded, more detailed radionuclide analysis is necessary. Higher values do not necessarily imply that the water is unsuitable for human consumption.

### 4.4 Bacteriological requirements

4.4.1 When tested with the corresponding test methods, the bacteriological requirements of treated drinking water shall not exceed the levels shown in Table 4.

4.4.2 If any coliform organisms are found in a sample, a second sample shall be taken immediately after the tests on the first sample have been completed and shall be free from coliform organisms.

4.4.3 Not more than 2 percent of the total number of water samples from any one distribution system tested per year may contain coliform organisms.

4.4.4 Any treated water shall not contain faecal and coliform organisms when tested with the corresponding test methods.

4.4.5 Any treated water shall not contain any faecal streptococci when tested according to ES ISO 7899-1 or ES ISO 7899-2.

Table 4 – Bacteriological levels

Organism	Maximum permissible level	Test method
Total viable organisms, colonies per ml	must not be detectable	ES ISO 4833
Faecal streptococci per 100ml	must not be detectable	ES ISO 7899-1 ES ISO 7899-2
Coliform organisms, number per 100 ml	must not be detectable	ES ISO 9308-1
E. Coli, number per 100 ml	must not be detectable	ES ISO 9308-1 ES ISO 9308-2

## 5 Sampling

### 5.1 Sampling for bacteriological examination.

#### 5.1.1 Frequency of sampling

Sampling should be regular (see the guide given in Table 5) and its frequency will mainly depend on the following factors:

- a) quality of the water harnessed;
- b) type of treatment for drinking worthiness;
- c) risks of contamination;
- d) background of public water supply network; and
- e) number of people served.

Table 5 — Minimum sampling frequencies for drinking water in the distribution system

Population served	Samples to be taken monthly
Less than 5,000	1 sample
5,000 - 100,000	1 sample per 5,000 population
More than 100,000	1 sample per 10,000 population plus 10 additional samples

5.1.2 Collection, transportation and storage for samples shall be in accordance with ES ISO 5667-5.

### 5.2 Sampling for physical and chemical examination

#### 5.2.1 Frequency of sampling

Sampling frequency for the examination of physical and chemical characteristics shall be carried out at least twice per year; one is in the rain season and the other one is in the dry season the frequency of this examination shall be increased when toxic substances are known to be present at sub-tolerance levels in the source of supply, or in

certain special circumstances as, for example, when new industries that may be discharging toxic wastes are established in the area and the danger of epidemic arising.

5.2.2 Collection, transportation and storage of samples shall be in accordance with ES ISO 5667-5.



## Organization and Objectives

The Ethiopian Standards Agency (ESA) is the national standards body of Ethiopia established in 2010 based on regulation No. 193/2010. ESA is established due to the restructuring of Quality and Standards Authority of Ethiopia (QSAE) which was established in 1998.

ESA's objectives are:-

- ❖ Develop Ethiopian standards and establish a system that enable to check whether goods and services are in compliance with the required standards,
- ❖ Facilitate the country's technology transfer through the use of standards,
- ❖ Develop national standards for local products and services so as to make them competitive in the international market.

## Ethiopian Standards

The Ethiopian Standards are developed by national technical committees which are composed of different stakeholders consisting of educational Institutions, research institutes, government organizations, certification, inspection, and testing organizations, regulatory bodies, consumer association etc. The requirements and/or recommendations contained in Ethiopian Standards are consensus based that reflects the interest of the TC representatives and also of comments received from the public and other sources. Ethiopian Standards are approved by the National Standardization Council and are kept under continuous review after publication and updated regularly to take account of latest scientific and technological changes. Orders for all Ethiopian Standards, International Standards and ASTM standards, including electronic versions, should be addressed to the Documentation and Publication Team at the Head office and Branch (Liaisons) offices. A catalogue of Ethiopian Standards is also available freely and can be accessed in from our website.

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### International Involvement

ESA, representing Ethiopia, is a member of the International Organization for Standardization (ISO), and Codex Alimentarius Commission (CODEX). It also maintains close working relations with the international Electro-technical Commission (IEC) and American Society for Testing and Materials (ASTM). It is a founding member of the African Regional Organization for Standardization (ARSO).



### More Information?

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