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Indian Standard

DRINKING WATER - SPECIFICATION

(Second Revision of IS 10500)

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Price Group

FOREWORD

(Formal clauses will be added later.)

This standard was originally published in 1983. A report prepared by the World Health Organization in cooperation with the World Bank showed that in 1975, some 1 230 million people were without safe water supplies. These appalling facts were central to the United Nations decision to declare an International Drinking Water Supply and Sanitation decade, beginning in 1981. Further, the VI Five-Year Plan of India had made a special provision for availability of safe drinking water for the masses. Therefore, the standard was prepared with the objective of assessing the quality of water resources, and to check the effectiveness of water treatment and supply by the concerned authorities.

While preparing the standard, Committee took due note of the limited testing facilities available in the country. The standard therefore categorized various characteristics as essential or desirable.

During VII Five-Year Plan, 55 mini mission districts were identified with a view to meet *supply of* water to all the problem villages. The VIII Five-Year Plan intended to provide safe drinking water to the rural masses. It also proposed to ensure supply of desired quality and required quantity of drinking water.

The first revision was undertaken to take into account the uptodate information available about the nature and effect of various contaminants as also the new techniques for identifying and determining their concentration. Based on experience gained additional requirements for alkalinity, aluminium and boron were incorporated and the permissible limits for dissolved solids, nitrate and pesticides residues modified.

In the formulation of the first revision, assistance was derived from the following publications:

a) International Standards for Drinking Water issued by World Health Organization, 1984 Geneva;

b) Manual of Standards of Quality for Drinking Water Supplies. Indian Council of Medical Research, 1971, New Delhi; and

c) Manual on Water Supply and Treatment (third *revision),* Ministry of Urban Development,1989, New Delhi

The tenth five year Plan document of India (2002-2007) has emphasized protection of the environment and safeguarding of health through the integrated management of water resources and liquid and solid waste.

Need was felt to upgrade the requirements of the standard and align with the internationally available specifications on Drinking water. The second revision was undertaken for this purpose. In the second revision the following were considered:

i) EU Directives relating to the quality of water intended for human consumption (80/778/EEC) and Council Directive 98/83/EC.
ii) USEPA standard – National primary drinking water standard. EPA 816-F-02-013 dated July, 2002
iii) WHO Guidelines for Drinking Water Quality. 2nd Edition Vol. 2 Health Criteria and other supporting information.
iv) Manual on Water supply and treatment, third edition – revised and updated May 1999, Ministry of Urban Development, New Delhi

The standard mentions the desirable limit and indicates its background. It is recommended that the Desirable limit is to be implemented. Values in excess of those mentioned under Desirable render the water not acceptable, but still may be tolerated in the absence of an alternative source but upto the limits indicated under. permissible limit in the absence of alternate source in col (5) Table 1 to 4 of the Specification, above which the sources will have to be rejected.

Pesticide residues limits and test methods given in Table 5 of the standard are based on consumption pattern, persistence and available manufacturing data. The limits have been specified based on WHO Guidelines wherever available. In cases where WHO Guidelines are not available the data available from standards of other countries has been examined and incorporated taking in view the Indian conditions.

In the second revision test method for virological examination has been given in specification.

Routine surveillance of drinking water supplies must be carried out by the relevant authorities to understand the risk of specific pathogens and to define proper control procedures. Precautions/ care should be taken to prevent contamination of drinking water from chlorine resistant parasites such as cryptosporidium species and giardia.

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1 SCOPE

The standard prescribes the requirements, test methods and sampling procedure for ascertaining the suitability of water for drinking purpose.

2 REFERENCES

The Indian Standards listed in Annex A contain provisions which through reference in this text , constitute provisions of this Indian Standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the Standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard the following definition shall apply.

3.1 Drinking water

Drinking water is water intended for human consumption for drinking and cooking purposes from any source. It includes water supplied by pipes or any other means for human consumption by any supplier.

4 REQUIREMENTS

Drinking water shall comply with the requirements given in Table 1, Table 2, Table 3 and Table 4. The analysis of Pesticide residues given in Table 3 shall be conducted by a recognized laboratory using internationally established test method meeting the residue limits as given in Table 5.

Drinking water shall also comply with Bacteriological requirements (4.1) Virological requirements (4.2) and Biological requirements (4.3)

4.1 Bacteriological Requirements

4.1.1 *Water in Distribution System*

Ideally, all samples taken from the distribution system including consumers' premises, should be free from coliform organisms and the following Bacteriological quality of Drinking water collected in the distribution system, as given in Table 6 is therefore recommended when tested in accordance with IS 1622.

4.1.1.1 If any coliform organisms are found the minimum action required is immediate resampling and examination. Measures should at once be taken to discover the source of contamination and remove the source of the pollution.

Table 1 Organoleptic and Physical parameters (clause 4)

Sl. No	Substance or Characteristic	Requirement (Desirable Limit)	Undesirable Effect Outside the Desirable Limit	Permissible Limit in the Absence of Alternate Source	Methods of Test (Ref to IS)	Remarks
i)	Colour, Hazen units, *Max*	5	Above 5,consumer Acceptance decreases	25	3025(Part 4)	Extended to 25 only if toxic substances are not suspected, in absence of alternate sources
ii)	Odour	Agreeable	-	Agreeable	3025 (Part 5)	a) Test cold and when heated b) Test at several dilutions
iii)	Taste	Agreeable	-	Agreeable	3025 (Parts 7 and 8)	Test to be conducted only after safety has been established

iv)	Turbidity, NTU, Max	5	Above 5, consumer acceptance decreases	10	3025 (Part 10)	-
v)	Dissolved solids mg/l, *Max*	500	Beyond this palatability decreases and may cause gastro intestinal irritation	2 000	3025 (Part 16)	-
vi)	*p*H value	6.5 to 8.5	Beyond this range the water will affect the mucous membrane and/ or water supply system	No relaxation	3025 (Part 11)	-
vii)	Total hardness (as $CaCO_3$) mg/l *Max*	300	Encrustation in water supply structure and adverse effects on domestic use	600	3025 (Part 21)	-

Table 2 General Parameters concerning substances undesirable in excessive amounts
(clause 4)

Sl. No	Substance or Characteristic	Requi re-ment (Desir a-ble Limit)	Undesirable Effect Outside the Desirable Limit	Permis sible Limit in the Absen ce of Alterna te Source	Methods of Test (Ref to IS)	Remarks
i)	Copper (as Cu) mg/l, *Max*	0.05	Astringent taste, discoloration and corrosion of pipes, fitting and utensils will be caused beyond this	1.5	3025 (Part 42)	-

ii)	Iron (as Fe) mg/l, *Max*	0.3	Beyond this limit taste/ appearance are affected, has adverse effect on domestic uses and water supply structures,and promotes iron bacteria	1.0	3025 (Part 53)	-
iii)	Manganese (as Mn) mg/l, Max	0.1	Beyond this limit taste/ appearance are affected has adverse effect on domestic uses and water supply structures	0.3	35 of 3025	-
iv)	Nitrate (as NO_3) mg/l, *Max.*	45	Beyond this methaemog-lobinemia takes place/ may be indicative of pollution	No relaxati on	3025 (Part 34)	-
v)	Fluoride (as F) mg/l, *Max*	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	23 of 3025	-
vi)	Zinc (as Zn) mg/l, *Max*	5	Beyond this limit it can cause as-tringent taste and an opalescence in water	15	3025 (Part 49)	-
vii)	Aluminlum (as Al), mg/l, *Max*	0.03	Cumulative effect is reported to cause dementia	0.2	3025 (Part 55)	-
viii)	Chlorides (as Cl) mg/l, *Max*	250	Beyond this limit, taste, corrosion	1 000	3025 (Part 32)	-

			and palatibility are affected -			
ix)	Selenium (as Se), mg/l, *Max*	0.01	Beyond this, the water becomes toxic	No relaxa-tion	3025 (Part 56) or IS 15303*	
x)	Sulphate (as SO_4) mg/l, *Max*	200	Beyond this causes Gastro intestinal Irritation when Magnesium or Sodium are present	400 (see col 7)	3025 (Part 24)	May be extended up to 400 provided that Mg does not exceed 30
xi)	Alkalinity as Calcium carbonate mg/l, *Max*	200	Beyond this limit taste becomes unpleasant	600	3025 (Part 23)	-
xii)	Calcium (as Ca) mg/l, *Max*	75	Encrustation in water supply structure and adverse effects on domestic use	200	3025 (Part 40)	-
xiii)	Magnesium (as Mg), mg/l, *Max*	30	Encrustation in water supply structure and adverse effects on domestic use	100	3025 (Part 46)	-
xiv)	Residual, free chlorine, mg/l, Min	0.2	-	1	3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral

						infection is required, it should be Min 0.5 mg/l.
xv)	Phenolic com-pounds (as C_6H_5OH) mg/l, *Max*	0.001	Beyond this, it may cause objectionable taste and odour	0.002	3025 (Part 43)	-
xvi)	Mineral oil mg/l, *Max*	0.01	Beyond this limit undesirable taste and odour after chlorination take place	0.03	APHA 5520C and IS 3025 (Part 39) infrared partition method	
xvii)	Anionic detergents (as MBAS) mg/l, *Max*	0.2	Beyond this limit it can cause a light froth in water	1.0	Annex K IS 13428	
xviii)	Boron (as B), mg/l Max	0.3	-	1.5	29 of 3025	-
xix)	Barium (as Ba) *mg/l Max*	0.7	May lead to cardiovascular problem	No relaxati on	Annex F IS 13428*/ IS15302	
xx)	Molybdenum (as Mo) mg/l, *Max*	0.07	Beyond this it may cause osteoporosis/bon e disorders	No relaxati on	3025 (Part 2;2002)/ ISO 11885:1996	
xxi)	Sulphide (as H_2S) mg/l, Max.	0.05	Beyond this it may cause objectionable taste and odour	No relaxati on	IS 3025 (Part 29)	

Note – In case of dispute, the method indicated by `*' shall be the referee method

Table 3 Parameters concerning toxic substances (clause 4)

Sl. No	Substance or Characteristic	Requirement (Desirable Limit)	Undesirable Effect Outside the Desirable Limit	Permissible Limit in the Absence of Alternate Source	Methods of Test (Ref to IS)	Remarks
i)	Mercury (as Hg) mg/l, *Max*	0.001	Beyond this, the water becomes toxic	No Relax-ation	3025 (Part 48)/ Mercury analyser	
ii)	Cadmium (as Cd), mg/l, *Max*	0.003	Beyond this, the water becomes toxic	No Relax-ation	3025 (Part 41)	
iii)	Arsenic (as As), mg/l, *Max*	0.01	Beyond this the water becomes toxic	0.05	3025 (Part 37)	
iv)	Cyanide (as CN), mg/l, *Max*	0.05	Beyond this, limit the water becomes toxic	No Relax-ation	3025 (Part 27)	
v)	Lead (as Pb), mg/l, *Max*	0.01	Beyond this, the water becomes toxic	No Relax-ation	3025 (Part 47)/	
vi)	Chromium (as Cr^{6+}) mg/l, Max	0.05	May be carcinogenic above this limit	No relaxation	3025 (Part 52)	
vii)	Polynuclear Aromatic Hydrocarbons (as PAH)mg/l, *Max*	0.0001	May be Carcinogenic	No Relaxatio n	APHA 6440	-
viii)	Pesticides mg/l Max	Table 5	Toxic	No Relaxatio	Table 5	-

				n		
ix)	Nickel (as Ni) mg/l Max	0.02	Beyond this it may cause allergic reaction	No Relaxatio n	3025 (Part 54)	
x)	Polyclorinated biphenyls mg/l, Max	0.0005	may be carcinogenic	No relaxation	ASTM 5175/ APHA 6630	
xi)	Trihalomethan es					
a)	Bromoform mg/l Max	0.1	May be carcinogenic above this limit	No relaxation	ASTM D 3973-85/APHA	
b)	Dibromochloro methane mg/l Max	0.1	--do	--do—	--do—	
c)	Bromodichloro Methane mg/l Max	0.06	--do—	--do—	--do—	
d)	Chloroform mg/l, Max	0.2	--do--	--do--	--do--	

Table 4 Parameters concerning radioactive subtances
(Clause 4)

Sl. No	**Substance or Characteristic**	**Requirement (Desirable Limit)**	**Undesirable Effect Outside the Desirable Limit**	**Permissible Limit in the Absence of Alternate Source**	**Methods of Test (Ref to IS)**	**Remarks**
i)	Radioactive Materials:					

	a) Alpha emitters Bq/l, *Max*	0.1	may be carcinogenic above this limit	0.1	IS 14194 (Pt 2)	-
	b) Beta emitters Bq/l, *Max*	1.0	-	1	IS 14194 (Pt 1)	-

Table 5 Pesticide residues limits and test method

Sl.No.	Pesticide	Limit µg/l	Test method USEPA AOAC/ISO
i)	DDT (o,p and p,p-Isomers of DDT, DDE and DDD)	1	508 AOAC 990.06
ii)	Gamma-HCH (Lindane)	2	508 AOAC 990.06
iii	2,4 D	3	515.1
iv)	Isoproturon	9	532
v)	Alachor	20	525.2, 507
vi)	Atrazine	2	525.2, 8141A
vii)	Aldrin/ Dieldrin	0.03	508
viii)	alpha HCH	0.01	508
ix)	beta HCH	0.04	508
x)	delta HCH	0.04	508
xi)	Endosulfan (alpha, beta and sulphate)	0.4 l	508 AOAC 990.06
xii)	Monocrotophos	1	8141 A
xiii)	Ethion	3	1657 A
xiv)	Chlorpyriphos	30	525.2, 8141A
xv)	Phorate	2	8141A
xvi)	Butachlor	125	525.2, 8141A
xvii)	Methyl parathion	0.3	8141A ISO 10695
xviii)	Malathion	190	8141A

Table 6 Bacteriological quality of drinking water [a]
(clause 4.1)

Organisms	Guidelines
All water intended for drinking E.coli or thermotolerant coliform	Must not be detectable in any 100-ml

bacteria [b,c]	sample
Treated water entering the distribution system E.coli or thermotolerant coliform Bacteria [b] Total coliform bacteria	 Must not be detectable in any 100-ml sample Must not be detectable in any 100-ml sample
Treated water in the distribution system E.coli or thermotolerant coliform Bacteria Total coliform bacteria[d]	 Must not be detectable in any 100-ml sample Must not be detectable in any 100-ml sample. In the case of large supplies, where sufficient samples are examined, must not be present in 95% of samples taken throughout any 12-month period.

a) Immediate investigative action must be taken if either E.coli or total coliform bacteria are detected. The minimum action in the case of total coliform bacteria is repeat sampling; if these bacteria are detected in the repeat sample, the cause must be determined by immediate further investigation.

b) Although E.coli is the more precise indicator of faecal pollution, the count of thermotolerant coliform bacteria is an acceptable alternative. If necessary, proper confirmatory tests must be carried out. Total coliform bacteria are not acceptable indicators of the sanitary quality of rural water supplies, particularly in tropical areas where many bacteria of no sanitary significance occur in almost all untreated supplies.

c) It is recognised that, in the great majority of rural water supplies in developing countries, faecal contamination is widespread. Under these conditions, the national surveillance agency should set medium-term targets for progressive improvement of water supplies.

d) In the remaining five percent sample total coliform bacteria should not exceed ten per hundred ml.

4.2 Virological Examination

4.2.1 Ideally all samples taken from the distribution system including consumers premises, should be free from virus. It is theoretically possible that virus disease can be transmitted by water free from coliform organisms, but conclusive evidence, that this has occurred, is lacking.

4.2.2 None of the generally accepted sewage treatment methods yield virus-free effluent. Although a number of investigators have found activated sludge treatment to

be superior to trickling filters from this point of view, it seems possible that chemical precipitation methods will prove to be the most effective.

4.2.3 Virus can be isolated from raw water and from springs. Enterovirus, reovirus, and adenovirus have been found in water, the first named being the most resistant to chlorination. If enterovirus are absent from chlorinated water, it can be assumed that the water is safe to drink. Some uncertainty still remains about the virus of infectious hepatitis, since it has not so far been isolated but in view of the morphology and resistance of enterovirus it is likely that, if they have been inactivated hepatitis virus will have been inactivated also.

4.2.4 An exponential relationship exists between the rate of virus inactivation and the redox potential. A redox potential of 650 mV (measured between platinum and calomel electrodes) will cause almost instantaneous inactivation of even high concentrations of virus. Such a potential can be obtained with even a low concentration of free chlorine, but only with an extremely high concentration of combined chlorine. This oxidative inactivation may be achieved with a number of other oxidants also, for example, iodine, ozone and potassium permanganate, but the effect of the oxidants will always be counteracted if reducing components, which are mainly organic, are present. As a consequence, the sensitivity of virus towards disinfectants will depend on the *milieu* just as much as on the particular disinfectant used.

4.2.5 Thus, in a water in which free chlorine is present, active virus will generally be absent if coliform organisms are absent. In contrast, because the difference between the resistance of coliform organisms and of virus to disinfection by oxidants increases with increasing concentration of reducing components, for example, organic matter, it cannot be assumed that the absence of available coliform organisms implies freedom from active virus under circumstances where a free chlorine residual cannot be maintained. Sedimentation and slow sand filtration in themselves may contribute to the removal of virus from water.

4.2.6 In practice, **2-3 mg/l** of free chlorine for one hour is sufficient to inactivate virus, even in water that was originally polluted.

4.2.7 Virological examination shall be done by the PCR test method for virological examination at **Annex B**. USEPA Method in Manual of Method for Virology, Chapter 16, June, 2001 shall be alternate method.

4.3 Biological Examination

4.3.1 Ideally all samples taken including consumers premises should be free from biological organisms. Biological examination is of value in determining the causes of objectionable tastes and odours in water and controlling remedial treatments, in helping to interpret the results of various chemical analysis, and in explaining the causes of clogging in distribution pipes and filters. In some instances, it may be of use in demonstrating that water from one source has been mixed with that from another.

4.3.2 The biological qualities of a water are of greater importance when the supply has not undergone the conventional flocculation and filtration processes, since increased growth of methane-utilizing bacteria on biological slimes in pipes may then be expected, and the development of bryozoal growths such as *Plumatella* may cause operational difficulties

4.3.3 Some of the animalcules found in water mains may be free-living in the water, but others such as *Dreissena* and *Asellus* are more or less firmly attached to the inside of the mains. Although these animalcules are not themselves pathogenic, they may harbour pathogenic organisms or virus in their intestines, thus protecting these pathogens from destruction by chlorine.

4.3.4 Chlorination, at the dosages normally employed in waterworks, is ineffective against certain parasites, including amoebic cysts; they can be excluded only by effective filtration or by higher chlorine doses than can be tolerated without subsequent dechlorination. *Amoebiasis* can be conveyed by water completely free from enteric bacteria; microscopic examination after concentration is, therefore, the only safe method of identification.

4.3.5 Strict precautions against back-syphonage and cross-connections are required if amoebic cysts are found in a distribution system containing tested water.

4.3.6 The *cercariae of schistosomiasis* can be detected by similar microscopic examination, but there is, in any case, no evidence to suggest that this disease is normally spread through piped water supplies.

4.3.7 The cyclops vector of the embryos of *Dracunculus medinensis* which causes dracontiasis or Guinea-worm disease can be found in open wells in a number of tropical areas. They are identifiable by microscopic examination. Such well supplies are frequently used untreated, but the parasite can be relatively easily excluded by simple physical improvements in the form of curbs, drainage, and apron surrounds and other measures which prevent physical contact with the water source.

4.3.8 The drinking water shall be free from microscopic organisms such as algae, zooplanktons, flagillates, parasites and toxin-producing organisms. An illustrative (and not exhaustive) list is given in **Annex C** for guidance.

5 SAMPLING

Representative samples of water shall be drawn as prescribed in IS 1622 : 1981 and IS 3025 (Part 1) : 1987.