PACKAGED DRINKING WATER (OTHER THAN PACKAGED NATURAL MINERAL WATER)
ACCORDING TO IS 14543: 2016

Major test equipments essentially required to test as per requirements of Indian Standard

LIST OF TEST FACILITIES

A- ORGANOLEPTIC AND PHYSICAL REQUIREMENTS

Sl. No. (1)	Tests (2)	Clause Ref. of IS 14543:2016 or IS 13428:2005 (3)	Referred Method of Test & Limit of Detection (4)	Test Equipment/Apparatus (5)	Chemicals/Reagents (6)
1.	Colour	5.3, Sl No. i) of Table 1	IS 3025 (P 4) i) Platinum cobalt (Visual comparison method) ii) Spectrophoto- metric method	• Nessler cylinders,50 ml • Centrifuge or filter assembly, functional pore size 0.45µm • Spectrophotometer,400-700 nm with 10 mm absorption cell • Filtration system consisting of filtration flask with side tubes • crucible holder • Micrometallic filter crucible, pore 40 µm • Calcined filter aid (celite 505 or equivalent • Vacuum system • Refrigerator (recommended) • pH meter • Centrifuge	• Potassium chloroplatinate • Cobaltous chloride, crystalline • Conc. Hydrochloric acid • Distilled water • Conc. Sulphuric acid • Sodium hydroxide
2	**Odour**	5.3, Sl No. ii) of Table 1	IS 3025 (P 5)	• Wide mouth glass stoppered bottles (approx. 1 lit. capacity)	• Odour free distilled water (or distilled water and column of granulated activated carbon) • Hydrochloric acid
3.	**Taste**	5.3, Sl No. iii) of Table 1	IS 3025 (P 8)	• Beaker (50 ml) • Water bath • Thermometer	• Taste and Odour free water • 2000 mg/l solution of sodium chloride
4.	**Turbidity**	5.3, Sl No. iv)	IS 3025 (P 10)	• Sample tubes	• Distilled water

		of Table 1		• Turbidimeter • Volumetric flasks (100 ml) • Membrane filter with pore size not more than 0.45 µm	• Hexamethylene Tetramine • Hydrazine sulphate
5.	**Total dissolved solids**	5.3, Sl No. v) of Table 1	IS 3025 (P 16)	• Filter: any one of the following may be used: *glass fibre filter disc (2.1 to 5.5. cm dia, pore size 1.2 µm / Acid washed, ashless hard filter finish paper (Pore size 2-2.5 µm) / Gooch crucible - 30 ml capacity with 2.1 or 2.4 cm diameter glass fibre filter disc / Sintered disc - G-5 or its equivalent with pore size 1 to 2 µm / Membrane filter – 0.45 µm membrane* • Filtering Assembly (suitable for type of filter selected) • Drying oven (180 ± 2˚C) • Desiccator • Analytical balance (200 g capacity, l.c. 0.1 mg) • Pipettes • Evaporating dish • Magnetic stirrer, recommended	

	6 **pH**	5.3,Sl No. vi) of Table 1	IS 3025 (P 11) i) Electrometric method ii) Colorimetric Method	• pH meter – with glass and reference electrode (saturated calomel) l.c 0.1 Magnetic stirrer with polytetrafluoro ethylene coated stirring bar • Thermometer (l.c. 0.5°C) • Beakers • Hard glass tubes	Standard pH Buffer solutions/tablets (Minimum two different values) **OR** • Distilled water • Borax (for Borax buffer) • Potassium dihydrogen phosphate, Sodium hydrogen phosphate and oven (for phosphate buffer) • Potassium hydrogen tartarate (for Tartarate buffer) • Potassium hydrogen phthalate (for Phthalate buffer) • Potassium tetraoxalate dihydrate (for Calcium hydroxide buffer) • Calcium Carbonate Platinum dish, Muffle furnace, Hot Plate, Fritted glass filter of medium porosity, polyethylene bottle, Suction pump & fritted glass funnel (for Tetra oxalate buffer) • Methyl orange, methyl red, bromothymol blue, phenolphthalein and alcohol (66%) (for universal indicator) • Thymol blue indicator (acid range) • Bromophenol blue indicator • Bromocresol green indicator • Methyl red indicator • Bromocresol purple indicator • Bromothymol blue indicator • Phenol Red indicator • Cresol Red indicator • Thymol Blue (alkali range) indicator • Thymolphthalein indicator • Thymol violet indicator • Different buffer solutions of known pH

B - CHEMICAL REQUIREMENTS

Sl. No.	Tests	Clause Ref. of IS 14543:2016 or IS 13428:2005	Referred Method of Test & Limit of Detection	Test Equipment/Apparatus*	Chemicals/Reagents
(1)	(2)	(3)	(4)	(5)	(6)
1.	**Barium**	5.3, Sl. No i) of Table 2	i) Annex F of IS 13428	• Filter paper and filtration assembly • Hot plate/gas burner	• Ammonium Dichromate • Ammonium Acetate • Ammonium Hydroxide • Potassium Iodide • Sodium Thiosulphate(0.1N) • Hydrochloric Acid • Ammonium Chloride • Starch indicator
			ii) IS 15302	• Atomic Absorption Spectrophotometer and Associated equipment (Burner, Readout mechanism, lamp for Barium, Pressure Reducing valves and vents) • Nitrous oxide burner head • T-junction valve or other switching valve Air Acetylene Gas Nitrous oxide gas	• Metal free water • Hydrochloric Acid • Nitric Acid • Sulphuric Acid • Hydroflouric Acid • Potassium Chloride • Standard barium solution 100µg/ml (Barium chloride, oven, hydrochloric acid)

			iii) IS 3025 (P 2)	• Induction Coupled Plasma-Atomic Emission Spectrometer • Sample Bottles • Glasswares • Acid Dispensers • Membrane Filtration Equipment and Filters (0.45µ) • Hot Plate • Argon Gas	Nitric Acid • Hydrogen Peroxide • Sulphuric Acid • Hydrochloric acid • Ammonium Sulfate • Stock Solution of Barium
2.	**Copper**	5.3, Sl No. ii) of Table 2	i) IS 3025 (P 42) a) Neocuproine Method **Detection range 0.05 to 5.0mg/l** b) Atomic Absorption Method (Direct) **Detection range 0.02 to 5.0mg/l**	• Spectrophotometer & 1cm cell Hot plate • Separating funnels (125 ml) • Conical flasks • Atomic Absorption Spectro- photometer With air-acetylene flame & Copper Hollow Cathode lamp	• Ammonium Hydroxide • Chloroform, AR Grade • Hydrochloric acid, Conc. • Hydroxylamine Hydrochloride • Isopropyl Alcohol • Neocuproine • Double Distilled water • Nitric Acid, Conc. • Sulphuric Acid, Conc. • Hydrated Sodium Citrate • Stock copper (II) solution 200µg/ml (Pure Copper Metal, hot plate) • Hydrogen Peroxide • Hydrochloric Acid, Conc. • Nitric Acid, Conc. • Dilute Sulphuric Acid • Stock copper (II) solution – 1.0mg/ml (Pure Copper metal & hot plate)

			c) Atomic Absorption Method (Chelation Extraction) **Detection range 0.002 to 0.5 mg/l**	• Atomic Absorption Spectrophotometer with Air-acetyleneflame • Copper Hollow Cathode Lamp • Separating Funnel • Volumetric Flasks • Distillation Assembly	• Hydrochloric Acid, Conc. • Nitric Acid, Conc. • Pyrrolidine • Dithiocarbamic acid • Methyl Isobutyl Ketone, AR grade Carbon Disulphide • Sodium Hydroxide • Distilled water • Water Standard MIBK • Bromophenol Blue • Ethanol or Isopropanol • Stock copper (II) solution – 1.0mg/ml (Pure Copper metal & hot plate)
			d) Differential Pulse Anodic Stripping Voltametry **Detection range 0.01 to 0.1mg/l**	• Polarograph capable of Performing differential pulse work • Hanging Mercury Drop electrode • Platinum Counter Electrode • Saturated Calomel Reference Electrode • Magnetic Stirrer Control unit with Stirring Bar • Scrubber Assembly • Whatman Filter Paper No. 40 • Nitrogen Gas	• Hydrochloric Acid Conc. (Spectro Grade) • Nitric Acid-Conc. (Spectro Grade) • Sulphuric Acid Conc. • Pure Copper Metal • Granular Zinc • Mercury
			ii) IS 3025 (P 2)	• Induction Coupled Plasma-Atomic Emission Spectrometer • Sample Bottles • Glasswares • Acid Dispensers • Membrane Filtration Equipment and Filters (0.45µ) • Hot Plate • Argon Gas	• Nitric Acid • Hydrogen Peroxide • Sulphuric Acid • Hydrochloric acid • Ammonium Sulfate • Stock Solution of Copper

3.	**Iron**	5.3, Sl. No. iii) of Table 2	i) IS 3025 (P 53) a) 1, 10 Phenanthroline Method i) Detection range 0.075 to 0.5mg/1 ii) This requirement is not applicable for Packaged Natural Mineral Water	• Spectrophotometer • Std. volumetric glass wares • Hot Plate • Fuming Hood • 0.45µ m Membrane Filter with Filtration Assembly	• Amalgamated Zinc (Granular Zinc and Mercury) • Ammonium Meta Vanadate • Distilled water • Hydrochloric Acid-Conc. (Containing less than 0.00005% iron) • Hydroxylamine Hydrochloride Ammonium Acetate Glacial Acetic Acid • Sodium Acetate • 1,10 Phenanthroline Monohydrate Stock Iron Solution 1ml=200µg of Fe (Conc. Sulphuric Acid, Ferrous Ammonium Sulphate, Potasssium Permanganate) • Std. Iron Solution (1.0 ml=1.0µg of Iron) Di-isopropyl Ether
			b) Atomic Absorption Method (DIRECT) **Detection range 0.1 to 10 mg/l**	• Atomic Absorption Spectrophotometer Air Acetylene Flame • Iron Hollow Cathode Lamp or Electrodeless discharge lamp for use at • 248.3nm • Volumetric Flasks	• Distilled water • Hydrochloric Acid, Conc. • Nitric Acid, Conc. • Sulphuric Acid, Conc. • Calcium Chloride Solution (Calcium Carbonate, Hydrochloric acid) • Stock Iron Solution (1.0 ml=100µg of Fe) (Pure iron wire, Hydrochloric acid Nitric Acid)

			ii) IS 15303 Electrothermal Atomic Absorption Spectrometric Method **Minimum detection limit 0.001mg/l**	• Atomic Absorption Spectrometer • Hollow Cathode lamp for Iron • Graphite Furnace • Readout Mechanism • Sample Dispenser • Vent for fumes • Cooling device • Membrane Filter, 0.45µm	• Metal free water • Hydrochloric Acid, Conc. • Nitric Acid, Conc. • Matrix Modifier stock solutions • (Magnesium Nitrate, Nickel Nitrate, • Phosphoric Acid, Palladium Nitrate & Citric Acid) • Stock iron Solution – 100µg/ml (Iron wire) • Sodium hydroxide 10N • Chelating resin
			iii) IS 3025 (P 2)	• Induction Coupled Plasma-Atomic Emission Spectrometer • Sample Bottles • Glasswares • Acid Dispensers • Membrane Filtration Equipment and Filters (0.45µ) • Hot Plate • Argon Gas	• Nitric Acid • Hydrogen Peroxide • Sulphuric Acid • Hydrochloric acid • Ammonium Sulfate • Stock Solution of Iron
4.	**Manganese**	5.3, Sl. No. iv), Table 2	i) IS 3025(Part 59) a) Periodate Colorimetric Method **Detection limit up to 0.2mg/l**	• Nessler's Tubes • Beakers • Hot Plate • Volumetric flask • Pipettes • Conical Flasks • Burette	• Sulphuric Acid • Hydrogen Peroxide (30%) • Nitric Acid, Conc. • Stabilized Distilled Water OR • Distillation Assembly, OR Distilled water, • Potassium Permanganate and • Dil Sulphuric Acid • Phosphoric Acid (sp. Gr. 1.75) • Potassium Periodate • Std. Manganese Solution (1ml=0.02 mg of

					Mn) (Standard 0.1 N Potassium Permanganate solution, saturated solution of sulphur dioxide)
			b) Formaldoxime Spectrometric Method **Detection limit between 0.01mg/l to 5 mg/l**	• Spectrophotometer • Glass Bottle • Autoclave	• Fluoride Free Water • Potassium Peroxodisulphate or Sodium Peroxodisulphate • EDTA Tetrasodium Salt, Solution, c(EDTA) • Sodium Hydroxide • Hydroxylammonium Chloride • Formalde hyde • Ammonia Solution • Ammonium Iron (II) Sulphate Hexahydrate Solution • Sulphuric Acid, conc. • Manganese Monohydrate (for Standard Mn Solution)
			ii) IS 3025 (P 2)	• Induction Coupled Plasma-Atomic Emission • Spectrometer • Sample Bottles • Glasswares • Acid Dispensers • Membrane Filtration Equipment and Filters (0.45µ) • Hot Plate • Argon Gas	• Nitric Acid • Hydrogen Peroxide • Sulphuric Acid • Hydrochloric acid • Ammonium Sulfate • Stock Solution of Iron
5.	**Nitrate (as NO_3)**	5.3, Sl. No. v) of Table 2	IS 3025 (Part 34) i) Cadmium Reduction Method	• Reduction Column • Colorimeter OR • Spectrophotometer OR • Filter photometer • Glass wool • 0.45 µ m pore diameter membrane filter • Refrigerator	• Distilled water • Nitrate free water • Cadmium granules (40 – 60 mesh) • Hydrochloric Acid (6N) • Copper Sulphate Solution • Sulphanilamide • Conc. Hydrochloric Acid • N-(1-napthyl))-Ethylenediamine

			Detection Limit maximum 0.1 mg/l		dihydrochloride (NED) Dihydrochloride) • Ammonium Chloride Disodium Ethylene diamine tetra acetate Ammonia Solution • Copper sulphate Solution – 2% • Stock nitrate solution – 100µg/ml (Potassium Nitrate & Chloroform) • Chloroform • Stock nitrite solution - 100µg/ml (Potassium Nitrite & Chloroform) • Nitrite free water
			ii) Chromotropic Acid Method **Detection range 0.1 to 5.0mg/l**	• Spectrophotometer • Standard laboratory glasswares	• Nitrate free water • Stock Nitrate Solution - 100µg/ml • (Potassium Nitrate, Chloroform) • Standard Nitrate solution – 10.0µg/ml Sulphite Urea Reagent (Urea & Anhydrous sodium Sulphite) • Antimony reagent (Antimony metal, Conc. Sulphuric acid) • Chromotropic Acid Reagent (Purified chromotropic Acid crystals, Conc. Sulphuric Acid) • Sulphuric Acid, Conc. Nitrate free
			iii) Devarda's Alloy Reduction Method **Detection limit minimum 2 mg/l**	• Distillation Assembly (Kjeldahl • Assembly) • Measuring Scoop • Spectrophotometer	• Ammonia Free Water • Borate Buffer Solution (0.1N Sodium Hydroxide, 0.025M Sodium Tetraborate) • Sodium Hydroxide – 6 N • Devarda's Alloy – 20 mesh with less than

					• 0.005 percent Nitrogen • Mixed indicator Solution (Methyl Red indicator, Ethyl alcohol/Isopropyl alcohol, Methylene Blue) • Indicating Boric Acid Solution • (Hydroboric Acid, mixed indicator solution) • Std. Sulphuric Acid Titrant - 0.02 N • Nessler's Reagent (Mercuric Iodide, Potassium Iodine. Sodium Hydroxide) • Stock Ammonia Solution -1.22mg ammonia/ ml (Anhydrous Ammonium Chloride) • Standard Ammonia Solution
6.	**Nitrite**	5.3, Sl. No. vi) of Table 2	IS 3025(P 34)	• Spectrophotometer / Photometer OR • Nessler's cylinders method • Nessler's Tubes • 0.45 µm Membrane Filter • Distillation Assembly (borosilicate)	• Nitrite Free water (Distilled water, Potassium Permanganate, Barium Hydroxide/Calcium Hydroxide Conc. Sulphuric Acid, Manganese Sulphate) • Sulphanilamide Reagent • NED Dihydrochloride • Hydrochloric Acid • Sodium Oxalate – 0.05 N. Ferrous Ammonium Sulphate – 0.05N (Ferrous Ammonium Sulphate, Conc. • Sulphuric Acid, Std. Dichromate solution) • Stock Nitrite Solution - 250µg of nitrogen/ml (Sodium Nitrite, Chloroform, Sodium Oxalate, Std., Potassium Permanganate solution) • Intermediate Nitrite Solution – 50.0µg/ml Standard Nitrite Solution – 0.500µg/ml

7.	Flouride	5.3, Sl. No. vii) of Table 2	IS 3025(Part 60) i) Zirconium alizarin Method Detection range 0.05 to 1.0 mg/l	• Nessler Tubes (100ml) • Distillation Apparatus • Refrigerator (Recommended) • Heating mantle	• Sodium Thiosulphate Solution (0.1 N) • Standard Sodium Fluoride Solution (1ml =0.01 mg F) • Zirconium Oxychloride OR Zirconium Oxynitrate • Alizarin Sodium Monosulphonate (Alizarin S) • Conc. Hydrochloric Acid • Conc. Sulphuric Acid • Silver Sulphate • Perchloric Acid • Phenolphthalein Indicator • Sodium Hydroxide Solution
			ii) Electro Chemical Probe Method Detection range 0.2mg to 2.0 g/l 0.2mg to 2.0 g/l 0.2mg to 2.0 g/l	• Millivolt Meter • Fluoride Ion – Selective Electrode • Reference Electrode – Either a calomel electrode, filled with saturated Potassium Chloride (KCl) Solution or a Silver / Silver Chloride Electrode • Measuring Cells – 100ml(Polypropylene fitted with thermostated jacket) • Water Bath • Magnetic Stirrer with a polytetrafluoroethylene(PTFE) • Polyethylene Beaker • pH meter • Standard Volumetric Glasswares • Desiccator • Screw Capped Polyethylene Container • Plastic Bottle	• Sodium Hydroxide- 5 M • Total Ionic Strength Adjustment Buffer (TISAB)-[Sodium Chloride, Glacial Acetic Acid, Sodium Hydroxide, CDTA(trans -1,2-diaminocyclohexane – N,N,N',N' tetra acetic acid)] • Fluoride, Stock Solution, 1000mg/1 (Sodium Fluoride) Note: Purity of the reagent – Unless specified otherwise, only pure chemicals & Fluoride free distilled water shall be used in tests.

8.	**Zinc**	5.3, Sl. No. viii) of Table 2	(I) IS 3025 (Part 49) i) Zincon Method **Detection range 0.02 to 5 mg/l**	• Spectrophotometer (620 nm with 1cm cells)	• Sodium Hydroxide • Potassium Cyanide • Cyclohexanone • Distt. Water • Zincon • Methanol • Sodium Ascorbate • Borate Buffer Solution (Sodium • Hydroxide, Potassium Chloride, Boric Acid) • Hydrochloric Acid, Conc. • Zinc Sulphate
			ii) Atomic Absorption Method (Direct) **Detection range 0.01 to 2.0mg/l**	• Atomic Absorption Spectrophotometer with Air-Acetylene Flame • Hollow Cathode Lamp Or Electrodeless discharge lamp	• Hydrochloric Acid, Conc. • Nitric Acid, conc. • Stock Zinc Solution – 1.0mg/ml (Zinc Granules/Zinc Oxide)
			iii)Atomic Absorption Method (Chelation – Extraction) **Detection range 0.001 to 0.2mg/l**	• Atomic Absorption Spectrophotometer with Air-Acetylene Flame • Hollow Cathode Lamp	• Hydrochloric Acid, Conc. • Nitric Acid, Conc. • Pyrrolidine Dithio Carbamic Acid - Chloroform Reagent (Pyrrolidine, Chloroform, Carbon disulphide) • Sodium Hydroxide • Chloroform

			iv) Differential Pulse Anodic Stripping Voltammetry (DPASV)Method **Detection range 0.001 to 0.1mg/l** **(II) IS 3025 (P 2)**	• Polarographic Instrumentation Capable of Performing Differential Pulse Work • Hanging Mercury Drop Electrode • Platinum Counter Electrode • Saturated Calomel Reference • Electrode • Magnetic Stirrer	• Bromophenol Blue Indicator (Bromophenol Blue, Ethanol or Isopropanol) • Stock Zinc (II) Solution- 1.0 mg/ml (Zinc Granules or Zinc Oxide, Nitric Acid) • Hydrochloric Acid, Conc. • Nitric Acid, Conc • Stock Zinc Solution -1.0mg/ml • Amalgamated Zinc (Granular Zinc, Conc. • Hydrochloric Acid, Mercury) • Purified Nitrogen (Ammonium Meta Vanadate, Scrubber, Amalgamated Zinc, Nitrogen Gas)
9.	**Silver**	5.3, Sl. No. ix) of Table 2	Annex J of IS 13428	Atomic Absorption Spectrophotometer with Oxidizing Air Acetylene Flame	• Deionised Distilled Water (Ion Exchange Column & Distilled Water) • Nitric Acid – Redistilled • Hydrochloric Acid – Redistilled • Silver Std. Solution (Silver Nitrate) • Lanthanum Chloride • Lanthanum Stock Solution (Lanthanum Oxide, Hydrochloric Acid) • Ammonium Pyrrolidine Dithiocarbamate solution) • Methyl isobutyl ketone

10.	**Aluminium**	5.3, Sl. No. x) of Table 2	i) IS 3025(P 55)		
			a) Eriochrome Cyanine R Method **i) Detection range 0.02 to 0.3mg/l;**	• Spectrophotometer (535 nm with 1cm Cells) • pH Meter • Standard Volumetric Glasswares	• Sulphuric Acid – 0.02 N and 6 N • Ascorbic Acid Solution • Buffer Solution (Sodium Acetate & 1 N Acetic Acid) • Acetic Acid Solution – 1:1 and 1 N • Sodium Hydroxide Solution – 0.1 N and 1N • Stock Eriochrome Cyanine R Dye Solution Stock Aluminium Solution – 500 µg/l (Aluminium Potassium Sulphate) • Methyl Orange Indicator Solution
			b) Atomic Absorption Method (Direct) **Detection range 5 to 100mg/l**	• Atomic Absorption Spectrophotometer with Nitrous Oxide – Acetylene Flame and Hollow-Cathode Lamp • Standard Volumetric Glasswares	• Hydrochloric Acid, Conc. • Nitric Acid, Conc. • Potassium Chloride Solution • Stock Aluminium Solution - 500 µg/l (Aluminium Potassium Sulphate)
			ii) IS 15302:2003 Direct Nitrous Oxide – Acetylene Flame Atomic Absorption Spectrometry **Detection limit 0.1mg/l**	• Atomic Absorption Spectrometer • Burner • Read Out Mechanism • Lamp (Hollow Cathode or EDL) • Pressure Reducing Valves • Vent • Nitrous Oxide Burner Head • T-Junction Valve or Other Switching Valve • Air (Compressor or Bottled Gas) • Acetylene, Standard Commercial Grade • Nitrous Oxide Gas	• Metal Free Meter • Hydrochloric Acid – 1 N • Nitric Acid, Conc. • Sulphuric Acid • Hydrofluoric Acid – 1 N • Potassium Chloride • Aluminium Nitrate • Standard Aluminium Solution - 100 µg/l (Aluminium Metal)

11.	**Chloride**	5.3, Sl. No xi) of Table 2	IS 3025 (P 32)		
			i) Argentometric Method	• Erlenmeyer Flask (250ml) • Burette	• Potassium Chromate Indicator Solution (Potassium Chromate, Silver Nitrate) • Standard Silver Nitrate Solution – 0.01 N (silver nitrate, sodium chloride) • Standard Sodium Chloride Solution – 0.01 N (Sodium Chloride) • Aluminium Hydroxide Suspension (Aluminium Potassium Sulphate or Aluminium Ammonium Sulphate, Conc Ammonium Hydroxide) • Phenolphthalein Indicator Solution • Sodium Hydroxide – 1N • Sulphuric Acid – 1N • Hydrogen Peroxide – 30%
			ii) Mercuric Nitrate Method	• Erlenmeyer Flask (250 ml) • Microburette (5 ml with l.c. 0.01ml) • Refrigerator • pH meter	• Standard Sodium Chloride Solution, • 0.01N • Nitric Acid, 0.1N • Sodium Hydroxide, 0.1N • Indicator – Acidifier Reagent (S-Diphenyl-carbazone, Conc. Nitric Acid, Xylene Cyanol FF, Ethyl Alcohol or Isopropyl Alcohol) • Standard Mercuric Nitrate Solution, 0.01N (Mercuric Nitrate, Conc. Nitric Acid, Sodium Bicarbonate, Std. Sodium Chloride Solution) • Mixed Indicator Reagent (Diphenylcarbazone, Bromo Phenol Blue, Ethyl Alcohol or Isopropyl Alcohol) • Standard Mercuric Nitrate Solution – 0.1N
			iii) Potentiometric Method	• Glass and Silver- Silver Chloride Electrodes • Electronic Voltmeter • Mechanical Stirrer	• Standard Sodium Chloride Solution (0.01N) • Nitric Acid-Conc

					• Standard Silver Nitrate Solution (0.01N) • Pretreatment Reagent (Sulphuric Acid, Hydrogen Peroxide, Sodium Hydroxide – 1N)
			iv) Automated Ferricyanide Method	• Automated Analytical Equipment • Filters (480nm)	• Stock Mercuric Thiocyanate Solution (Mercuric Thiocynate, Methanol) • Stock Ferric Nitrate Solution (Ferric Nitrate, Conc. Nitric Acid) • Colour Reagent (Poly oxy Ethylene 23 Lauryl Ether) • Sodium Chloride
12	**Selenium**	5.3, Sl. No. xii) of Table 2	i) IS 3025 (P56): 2003		
			a)Spectrophotometric Method (Diamino naphthalene method) **Detection limit minimum 0.01mg/l**	• Spectrophotometer (480nm,light path of 1 cm • Volumetric Glasswares • Separating Funnel (250ml) Preferably Flourocarbon Stopcock • Water Bath – Thermostatically Controlled • pH Meter • Centrifuge • Centrifuge Bottles with Flourocarbon Screw Cap	• Stock Selenium Solution – 1.0mg/ml (Sodium Selenite, Hydrochloric Acid) • Hydrochloric Acid – 0.1N • Ammonium Hydroxide,1:1Cyclohexane • 2,3 – Diaminonaphthalene (DAN) • Hydroxylamine Hydrochloride • Sodium Salt of EDTA • Amberlite XAD -8 or Equivalent Resin • Hydrochloric Acid, Conc • Potassium Hydroxide
			b) Atomic Absorption Spectrometric Method (Hydride Technique)	• Atomic Absorption Spectrometer (196.0 nm) Fitted with Hydride System and Hollow Cathode Lamp/Electrodeless Discharge Lamp • Gas (Argon or Nitrogen) • Glasswares Decomposition Apparatus (Round Bottom Flask, Reflux Condenser, Condensate Reservoir)	• Nitric Acid • Sulphuric Acid • Hydrochloric Acid • Hydrogen Peroxide • Sodium Hydroxide • Sodium Tetrahydro borate • Selenium Stock Solution (1mg/ml) (Selenium Dioxide)

			ii) IS **15303:2003** Electrothermal Atomic Absorption Spectrometric Method **Detection limit minimum 0.002mg/l**	• Atomic Absorption Spectrometer • monochromator or filter and ○ adjustable slit • Hollow Cathode Lamp or Electrode less • Discharge Lamp • Graphite Furnace • Photoelectric Detector • Readout Mechanism • Sample Dispenser • Vent for Fumes • Cooling Device • Membrane Filter Apparatus (0.45 µ) • Argon Gas	• Metal Free Water • Hydrochloric Acid, Conc • Nitric Acid, Conc • Matrix modifier Stock Solutions • (Magnesium Nitrate, Nickel Nitrate, • Phosphoric Acid, Palladium Nitrate, Citric Acid) • Stock Metal Solution – 1mg/ml (Sodium • Selenite) • Chelating Resin – 100 to 200 mesh
13	**Sulphate**	5.3, Sl. No. xiii) of Table 2	IS 3025 (P24): 1986 i)Gravimetric Method **Detection limit more than 10mg/l**	• Steam Bath • Drying Oven (thermostatically controlled) • Muffle Furnace • Desiccator • Analytical Balance (l.c.0.1mg) • Filter Paper (Preferably Whatman No.42) • Silica or Porcelain Crucible (max pore size of 5 microns) • Ion Exchange Column • Filter (0.45 µ m) • Platinum Dish	• Methyl Red Indicator • Hydrochloric Acid • Barium Chloride • Silver Nitrate • Nitric Acid • Ion Exchange Resin (Amberlite IR-120 or • Equivalent)
			ii) Thorin Method **Detection range 5 to 150mg/l**	• White Porcelain Basin • Burette • Ion Exchange Column • Filter – 0.45µm	• Ethyl Alcohol • Ammonium Hydroxide (Ammonia-Conc and Distilled Water) • Hydrochloric Acid • Thorin (2,2 – Hydroxy – 3,6 – Disulpho – 1 – Naphthylazo Benzene Arsenic Acid)

					• Ion Exchange Resin (Amberlite IR-120 or Equivalent) • Stock Sulphate Solution – 100 mg/l (Anhydrous Sodium Sulphate)
			iii)Turbidity Method **Detection limit 1 to 40mg/l**	• Turbidity Meter or Spectrophotometer`(420 nm) • Glass Apparatus • Hot Plate • Refrigerator (recommended) • Filter – 0.45µm	• Barium Chloride – Standard Solution (Barium chloride in hydrochloric acid ammonia) • Barium Chloride • Gelatin Powder • Glycerol • Hydrochloric Acid, Conc • Sodium Chloride • Ethyl or Isopropyl Alcohol • Anhydrous Sodium Sulphate • Stock sulphate solution – 100mg/l
14	**Alkalinity**	5.3, Sl. No. xiv) of Table 2	IS 3025 (P 23): 1986 with Amendment 1& 2 i) Indicator Method **Detection range 0.5 to 500mg/l**	• pH Meter • Burette • Magnetic Stirrer Assembly • Beaker	• Distilled Water • Sulphuric Acid, Conc • Sulphuric Acid, 0.02 N • Phenolphthalein Indicator • Mixed Indicator Solution (Methyl Red, • Bromocresol Green, Ethyl or Isoprophyl Alcohol)
			ii)Potentiometric Method **Detection range 0.5 to 500mg/l**	• Potentiometer • Glasswares	• Standard Sulphuric Acid – 0.02N

15	**Calcium**	5.3, Sl. No. xv) of Table 2	i) IS 3025 (P40): 1991 with Amendment 1 a)EDTA Titrimetric Method	• Hot Plate • Glasswares • Polyethylene Bottle	• Sodium Hydroxide Solution – 1N • Hydrochloric Acid – 0.1N • Indicator Solution:Murexide (Ammonium Purpurate) Indicator, Absolute Ethylene Glycol Sodium Chloride **OR** Patton and Reeder's Indicator (Eriochrome Blue Black R, Sodium Sulphate/Potassium Sulphate) • Standard EDTA Solution – 0.01M (Disodium Ethylene Diamine Tetra – Acetate, Standard Zinc Solution, (Or Standard Calcium Solution) Buffer Solution, Eriochrome Black T Indicator Solution • Stock Calcium Solution (Calcium Carbonate, Hydrochloric Acid – 0.1N) • Nitric Acid, Conc
			b)Atomic Absorption Spectrometric Method **Detection limit maximum 50mg/l**	Atomic Absorption Spectrometer (422.7 nm) with Air/Acetylene or Nitrous Oxide/Acetylene Flame and Hollow Cathode Lamp (Calcium)	• Hydrochloric Acid – 1N and 0.1N • Lanthanum Chloride • Cesium Chloride • Standard Calcium Solution
			c) Permanganate Titration Method	• Beakers, Cover Glass, and Glass Rod • Filtration Set up (Gooch Crucible with Suction) • Hot plate	• Hydrochloric Acid – 1N • Methyl Red Indicator Solution • Ammonium Oxalate Solution Urea • Dilute Sulphuric Acid – 1N • Sodium Oxalate • Standard Potassium Permanganate Solution (Potassium permanganate, sodium oxalate)

			ii)IS 3025(Part 2) Inductively Coupled Plasma Atomic Emission Spectroscopy (a e s) **Detection limit** **0.1 mg/l**	• ICP AES (315.887 nm) including - • • computer controlled a e s with background • correction • • radio frequency generator • • argon gas supply (welding grade or better) Sample bottles Glassware (beakers, filter funnels, volumetric flasks, pipettes) acid dispensers Membrane filtration equipment Filter of pore size 0.45 microns	• Nitric Acid • Hydrogen Peroxide • Sulphuric Acid • Hydrochloric Acid • Ammonium Sulphate • Distilled Water • Calcium Stock solution (10 mg/l)
16	**Magnesium**	5.3, Sl No. xvi) of Table 2	i) IS 3025 (P 46): 1994 with Amendment 1 & 2 a)Gravimetric Method **Detection limit more than 1 mg/l**	• Vacuum Pump • Filter Flasks • Filter Crucibles (medium porosity, 30 ml) • Muffle Furnace	• Methyl Red Indicator • Hydrochloric Acid • Ammonium Oxalate • Ammonium Hydroxide • Nitric Acid, Conc • Diammonium Hydrogen Phosphate • Urea

			b) Volumetric Method (EDTA)	• Hot plate • Volumetric Flasks • Glass wares	• Indicator Solutions i) Patton and Reeder Reagent, Sodium Chloride/Potassium Chloride ii)Murexide (Ammonium Purpurate), Absolute Ethylene Glycol, Sodium Chloride iii)Eriochrome Black T Indicator (EBT Indicator), Hydroxylamine Hydrochloride, Ethanol/Methanol • Standard Zinc Solution – 0.01M (Pure Zinc Dust/Granules – 99.9% Pure; Hydrochloric Acid) • Buffer Solution (Ammonium Chloride, Ammonia, Sodium Hydroxide-1N) • Standard Ethylene Diamine Tetra Acetic Acid (EDTA) Solution – 0.001M (Disodium Ethylene Diamine Tetra Acetate Dihydrate, Standard Zinc Solution) • Triethanolamine Solution – 10% • Potassium Cyanide • Hydroxlamine Hydrochloride
			c)Atomic Absorption Spectrophotometric Method **Detection limit max 5 mg/l**	Atomic Absorption Spectrophotometer (285.2 nm) with Air-Acetylene Flame or Nitrous Oxide-Acetylene Flame and Hollow Cathode Lamp (Magnesium) Polyethylene Bottles	• Hydrochloric Acid – 1N and 0.1N • Lanhanum Chloride (Lathanum Oxide, Hydrochloric Acid, Conc) • Cesium Chloride • Standard Magnesium Solution (1000mg/l) (Magnesium Oxide, Hydrochloric Acid)

			ii) IS 3025(Part 2) Inductively Coupled Plasma Atomic Emission Spectroscopy **Detection limit** **0.03 mg/l**	ICP AES (279.079nm) including - computer controlled aes with background correction radio frequency generator argon gas supply (welding grade or better) Sample bottles Glassware (beakers, filter funnels, volumetric flasks, pipettes) acid dispensers Membrane filtration equipment	• Nitric Acid • Hydrogen Peroxide • Sulphuric Acid • Hydrochloric Acid • Ammonium Sulphate • Distilled Water • Magnesium Stock solution (10 mg/l)
17	**Sodium**	5.3, Sl No. xvii) of Table 2	i) IS 3025 (P45): 1993 with Amendment 1 a)Flame Emission Photometric Method anyone of the following applicable detection range:(0 to 1)mg/lit(1 to 10)mg/lit (0 to 100)mg/lit b)Atomic Absorption Spectrometry Method **Detection range 0.20 to 4.0mg/l**	• Flame Photometer (Direct Reading OR Internal Standard Type) **OR** Atomic Absorption Spectrophotometer (In Flame Emission Mode) • Glasswares • pH meter • Weighing balance Atomic Absorption Spectrophotometer with Air-Acetylene Flame and Hollow Cathode Lamp (Sodium)	• Deionized Distilled Water • Stock Sodium Solution – 1mg/ml (Sodium Chloride) • Standard Lithium Solution – 1mg/ml • Sodium Chloride • Potassium Chloride • Stock Sodium Solution – 1mg/ml • Stock Potassium Solution – 1mg/ml

			c)Gravimetric Method ii) IS 3025(Part 2):2004	• Glassware • Beakers (20ml, Borosilicate) • Fritted Glass Crucible or Porous Porcelain • Crucibles • Vacuum Pump or Aspirator • Filter paper • Pyrex bottle • Stirring rod • Oven • Membrane filtration equipment and filters(0.45µm) • Inductively coupled plasma atomic emission spectrometer; Computer controlled AAS with background correction, Radiofrequency Generator, Argon Gas supply(welding grade or better) • pH meter • PTFE container • PTFE sample bottles(250 ml or 500ml) • Acid dispensers, Variables	• Zinc Uranyl Acetate Reagent (Glacial Conc. Acetic Acid, Uranyl Acetate Dihydrate, Zinc Acetate Dihydrate, Sodium Chloride) • Ethyl Alcohol Wash Solution (Ethyl Alcohol, Pure Sodium Zinc Uranyl Acetate, Sodium Chloride, Acetic Acid, Diethyl Ether) • Nitric acid • Hydrogen peroxide • Sulphuric acid • Hydrochloric acid • Ammonium sulphate • Sodium Stock solution
18	**Residual Free Chlorine**	5.3, Sl No. xviii) of Table 2	IS 3025 (P 26): 1986 Stabilized Neutral Ortho-Toluidine Method **Detection range 0.005 to 0.01mg/l**	• Spectrophotometer (wit h light pa t h of 1c m c ell or longer f or ≤ 1 mg/ l) • Magnetic Stirrer Assembly • Refrigerator (Recommended)	Distilled Water – Chlorine Demand Free (Distilled Water, Chlorine) Neutral Ortho-Toluidine Reagent (Hydrochloric Acid – Conc, Mercuric Chloride, Disodium Salt of EDTA –

				• pH meter • Brown Glass Stoppered Bottles	Dehydrated, Ortho-Toluidine Dihydrochloride Buffer Stabilizer Reagent (Dipotassium Hydrogen Phosphate, Potassium Dihydrogen Phosphate, Di (2-Ethyl Hexyl) Sulphosuccinate, Diethylene Glycol Monobutyl ether Potassium Iodide Solution (Potassium Iodide Sulphuric Acid Conc. Sodium Carbonate Sodium Arsenite Standard Chlorine Solution (Chlorine Gas & Distilled Water OR Hypochlorite Solution) Sodium Thiosulphate Solution – 0.025N)
20	**Mineral Oil**	5.3, Sl No .xx) of Table 2	IS 3025 (P 39): 1991 with Amendment 1 Partition Infra-Red Method **Detection limit 0.5 to 100 mg/l**	• Separating Funnel (1lit) with Teflon or Equivalent Stopcock • Infra-Red Spectrophotometer – Double Beam, Recording type • Cells – Infra-Red, Silica • Filter Paper – Whatman No.40 or Equivalent, 11cm Diameter • Analytical Balance	• Hydrochloric Acid • Hexane • Sodium Sulphate, Anhydrous • Reference Oil (Iso-Octane, Hexadecane, Benzene) • Trichlorotrifluoroethane

21	**Anionic Surface Active Agents (as MBAS)**	5.3, Sl No. xxi) of Table 2	Annex K of IS 13428:2005 **Detection limit about** **0.05 mg/l**	• pH Meter • Spectrophotometer (650 nm) 10mm & 50mm cells • Gas Stripping Apparatus (1 lit Capacity) • Nitrogen Air (20 ltr/hr to 50 ltr/hr) • Reflux Condenser • Fume hood • Water bath	• Sodium Chloride • Ethyl Acetate • Al_2O_3 • Chloroform • Ethanol • Methanol • Sulphuric Acid • Ethanolic Sodium Hydroxide-0.1 • mol/lit (Sodium Hydroxide, Ethanol) • Methylene Blue, Neutral Solution • Methylene Blue, Acidic Solution • Bufer Solution, pH 10 (Sodium CHydrogen Carbonate, Anhydrous Sodium Carbonate) • Phenolphthalein Indicator, Ethanol • Dodecyl Benzene Sulphonic Acid Methyl Ester (Tetrapropylene Type), Stock Standard Solution
22	**Sulphide**	5.3, Sl. No. xxii) of Table 2	IS 3025 (P 29): 1986 i) Iodometric Method **Detection limit above 1 mg/l** ii) Methylene blue method D**etection limit upto 20 mg/l**	• Glass Fibre Filter Paper. • Reaction Flask (1 lit capacity with 2 holestopper fitted with gas-diffusion tube. • Absorption flasks (250ml Capacity) (2 No's) • Nitrogen/Carbon dioxide gas cylinder Or Carbon dioxide gas generator • Spectrophotometer (664 nm) or filterphotometer (600 nm). • Matched test tubes	• Zinc acetate solution – 2N • Sulphuric Acid, Conc. • Standard Iodine solution – 0.025 N • (Potassium Iodide, Iodine) • Hydrochloric Acid, Conc. • Standard Thiosulphate Solution - 0.025 N (Sodium thiosulphate, Sodium Hydroxide/Chloroform) • Starch indicator solution (Starch, salicylic acid, toluene) • Aluminium Chloride solution – 6N • Sodium hydroxide – 6N • N, N-dimethyl-p-Phenylene Diamine oxalate • Sulphuric Acid, Conc. & 1:1 solution

				• Droppers • Dark glass bottle.	• Ferric Chloride • Diammonium Hydrogen Phosphate • Methylene Blue • Standard Sulphide Solution • Zinc acetate
23	**Antimony**	5.3 Sl. No. xxiii) of Table 2	i) Annex G of IS 13428:2005 Spectrophoto-metric Method	• Spectrophotometer (565 nm) • Erlenmeyer Flask (125ml) • Seperating Funnels (125 ml) with Teflon • Stopcocks • Refrigerator • Ice Bath • Test Tubes • Pipettes	• Hydrochloric Acid – 6 N • Phosphoric Acid – 3N • Rhodamine B • Antimony Standard Solution (100 µg/ml and 1 ug/ml (pure antimony, sulphuric acid) • Benzene • Sulphuric Acid • Perchloric Acid
			ii) IS 15303:2003 Electrothermal Atomic Absorption Spectrometric Method	Atomic Absorption Spectrometer with • Hollow Cathode Lamp **OR** • Electrodeless discharge lamp (EDL). • Graphic Furnace • Readout Mechanism • Microlitre Pipettes-5 to 100 µl. **OR** • Automatic sampling device designed for the specific instrument. • Vent for Fumes • Cooling Device • Membrance Filter Apparatus (0.45µm) or smaller pore diameter membrane filters.	• Metal free Water • Hydrochloric Acid, Conc. • Nitric Acid, Conc. • Matrix Modifier Stock Solutions (Magnesium Nitrate, Nickel Phosphoric Acid, Palladium Nitrate, Citric Acid) • Stock Metal Solution • Antimony Solutions (100 µg/m Sb) • Iron-100µg Fe • Selenam-1.00 mg Sb • Chelating Resin • Sodium hydroxide -10 N

24	**Borates**	5.3, Sl. No. xxiv) of Table 2	Annex H of IS 13428:2005	• Spectrometer (410 – 420nm) • Lab Apparatus made of Polypropylene/Polyethylene/Polytetrafluoro Ethylene • Refrigerator	• Azomethine – H, Sodium Salt • L + - Ascorbic Acid • Buffer Solution (pH 5.9) [Ammonium Acetate, Sulphuric Acid, Phosphoric Acid, Citric Acid, Disodium Ethylene diamine – Tetraacetic Acid Dihydrate] • Borate Stock Solution - (1mg/ml) (Boric Acid) • Boron Standard Solution - 10µg/ml • Calcium Hydroxide

C - REQUIREMENTS FOR TOXIC SUBSTANCES

1	**MERCURY**	5.2, Sl. No. i) Of Table 3	IS 3025 (P 48): 1994 with Amendment 1 i) Cold Vapour Atomic Absorption Spectrophotometry **Detection limit 0.0002 mg/l, Min**	• Atomic Absorption Spectrometer and Associated Equipment (Cold Vapour Technique) • Mercury Vapour Generation Assembly • Mercury Hollow Cathode Lamp • Recorder/Printer/Display Meter • BOD bottle, 300 ml • Water bath • Equipment assembly as per Fig 1	• Sulphuric acid,conc. • Nitric acid,Conc. • Stannous chloride • Hydrochloric acid, Conc. • Sodium chloride • Hydroxylamine sulphate • Potassium permanganate • Potassium persulphate • Mercuric chloride • Mercury free distilled water
			ii) Colorimetric Dithizone Method **Detection limit 0.002 mg/l, Min**	• Spectrophotometer • Separating Funnels (250 and 1000ml with PTFE stopcocks) • Glass wares • Whatman Filter No. 42	• Redistilled or Deionised Distilled Water (Mercury free) • Mercuric chloride • Nitric acid, Conc. • Potassium permanganate • Potassium persulphate • Hydroxylamine hydrochloride • Dithiozone solution, 6 µg/ml • Sulphuric acid –0.25 N • Potassium bromide • Chloroform • Disodium hydrogen phosphate • Anhydrous potassium carbonate • Sodium sulphate, Anhydrous • Hydrochloricacid (1:1) • Ammonium hydroxide

2	**CADMIUM**	5.2, Sl. No. ii) of Table 3	IS 3025 (P 41): 1992 i) Atomic Absorption Method (Direct) **Detection range 0.05 to 2mg/l**	• Atomic Absorption spectrophotometer with Air-Acetylene Flame • Cadmium Hollow Cathode Lamp or Multi Element Hollow Cathode Lamp for Use at 228.8 nm	• Hydrochloric acid, Conc. • Nitric acid, Conc. • Nitric acid, dilute – 1:499 • Pure Cadmium Metal
			ii) Atomic Absorption Method (Chelation and Extraction) **Detection range 0.005 to 0.2mg/l**	• Atomic Absorption spectrophotometer with Air-Acetylene Flame • Cadmium Hollow Cathode Lamp or Multi Element Hollow Cathode Lamp for Use at 228.8 nm • Separating funnel • pH meter • pH paper	• Hydrochloric acid, Conc. • Hydrochloric acid – 1:49 • Nitric acid, Conc. • Nitric acid, dilute – 1:499 • Pure Cadmium Metal • Sodium hydroxide • Methyl Isobutyl Ketone (MIBK) • Bromophenol Blue • Ethanol or Isopropanol • Pyrrolidine dithiocarbamic acid • Carbon Disulphide
			iii) Differential Pulse Anodic Stripping Voltametry **Detection range 0.0001 to 0.1mg/l**	• Polarograph – Capable of Differential Pulse Work • Hanging MercuryDrop Electrode • Platinum Counter Electrode • Saturated calomel Reference Electrode • Magnetic Stirrer Control Unit with Stirring Bar • Nitrogen Gas (Cylinder) • Scrubber assembly for nitrogen purification • Voltametric Cell assembly	• Hydrochloric Acid, Conc., spectrograde • Nitric Acid, Conc., spectrograde • Nitric Acid, dil – 1:1 • Hydroxylamine Hydrochloride • L-Ascorbic Acid • Pure Cadmium Metal • Granular Zinc • Mercury • Ammonium Meta Vanadate
3	**ARSENIC**	5.2, Sl. No. iii) of Table 3	IS 3025(P 37): 1988 i) Atomic absorp tion method **Detection limit 0.001 mg/l**	• Atomic absorption spectrometer equipped with gas flow meter for Argon or Nitrogen and Hydrogen and with arsenic electrode less discharge lamp • Atomizer • Reaction cell for producing arsenic hydride • Eye dropper or syringe • Refrigerator	• Argon or Nitrogen and Hydrogen • Sodium borohydride • Sodium hydroxide • Sodium Iodide • Sulphuric acid-18N & 2.5 N • Potassium persulphate • Nitric acid, conc

					Hydrochloric acid, conc • Perchloric acid, conc. • Arsenic trioxide • Arsenic pentaoxide • Dimethyl arsenic acid/cacodylic acid • Calcium chloride
			ii) Silver diethyl dithiocarbamate method	Arsine generator & absorption assembly (Fig 2 of IS 3025 Pt 37) Spectrophotometer, 535 nm with 1 cm cells	• Hydrochoric acid , Conc • Potassium Iodide • Stannous chloride, arsenic free

			(Refree method) **Detection limit** **0.001 mg/l**		• Ephedrine • Pyridine • Chloroform • Silver diethyl dithiocarbamate • Zinc – 20 to 30 mesh, arsenic free • Arsenic trioxide • Sodium hydroxide
			iii) Mercuric bromide stain method **Detection limit** **0.001mg /l**	Arsine generator glass assembly (Fig 3 of IS 3025 Pt 37)	• Sulphuric acid (1:1) • Nitric acid, conc • Roll cotton • Lead acetate • Arsenic papers • Mercuric bromide • Ethyl alcohol/isopropanol • Potassium iodide • Arsenic free stannous chloride • Zinc-20 to 30 Mesh, arsenic free • Arsenic trioxide • Sodium hydroxide
4	**CYANIDE**	5.2, Sl. No. iv) of Table 3	IS 3025(P.27): 1986 with Amendment 1 i) Total cyanide after distillation method	• Distillation apparatus consisting of boiling flask, 1l, thistle tube, Allihn water cooled condenser, gas dispersion tube, needle valve, suction flask and	Sodium hydroxide Lead carbonate-powdered Sulphamic acid

			Detection limit minimum 0.02 mg/l	suction pump (Fig 1 of IS 3025 Pt 27) Heating mantle Gas absorber Ground glass ST joints Spectrophotometer for use at 62 nm with 1-cm cell pH paper Thermometer – $0^{o}C$ – $110^{U}C$, l.c. $1^{o}C$	Magnesium chloride Sulphuric acid, conc Acetic acid, glacial Potassium cyanide Silver nitrate Chloramine - T Pyridine Pyrazolone BIS – pyrazolone
			ii) Selective electrode method **Detection range 0.05 to 10 mg/l**	Expanded – scale pH meter or specific Ion meter Cyanide Ion selective electrode Reference electrode, double junction Magnetic mixer with TFE coated stirring Bar	Potassium cyanide Silver nitrate Sodium hydroxide Potassium nitrate Potassium hydroxide
5	**LEAD**	5.2, Sl. No. v) of Table 3	IS 3025(P 47): 1994 with Amendment 1 & 2 i) Atomic absorption method (direct) **Detection range 1.0 to 10.0mg/l**	Atomic absorption spectrophotometer with air acetylene flame Hollow cathode lamp OR Electrodeless Discharge lamp for use at 283.3 nm	Hydrochloric acid, conc Nitric acid, conc. (Lead nitrate Nitric acid, dil (1:499)
			ii) Atomic absorption method (chelation – extraction) **Detection range 0.1 to 1.0 mg/l (with graphite system 0.001 mg/l)**	Atomic absorption spectrophotometer with air acetylene flame Hollow cathode lamp OR Electrode less Discharge lamp for use at 283.3 nm Separatory funnel 0.45µm membrane filter Acid washed filter paper pH meter	Hydrochloric acid, conc Hydrochloric acid, dil (1:2) Hydrochloric acid, dil (1:49) Nitric acid, conc. Pyrrolidine Chloroform Carbon disulphide Sodium hydroxide Bromophenol blue Lead nitrate

			iii) Differential pulse anodic stripping voltametry (DPASV) **Detection range 0.001 to 0.1mg/l**	Polarograph capable of performing differential pulse work Hanging mercury drop electrode Platinum counter electrode Saturated calomel reference electrode Magnetic stirrer control unit with stirring bar Scrubber assembly for nitrogen purification Nitrogen gas (cylinder) 0.45µm membrane filter	Lead nitrate Hydrochloric acid, conc. Nitric acid, conc. Nitric acid, dil (1:1) Granular zinc Mercury Ammonium metavandate
			iv) Dithizone method **Detection limit 0.1 mg/l**	Spectrophotometer for use at 510 nm with 1-cm cell pH meter TEF beakers, 100 ml Separating funnels, 250 ml, 500 ml	Lead free distilled water Lead nitrate Nitric acid, 95% (w/w) Nitric acid, dil 20% (w/w) Nitric acid, dil (1:1) Ammonium hydroxide Conc. (14 N) Ammonium hydroxide, dil. 10% (v/v) Ammonium hydroxide, dil. 1% v/v) Anhydrous Ammonium Citrate Anhydrous Sodium Sulphite Hydroxylamine hydrochloride Potassium cyanide Dithizone Chloroform Hydrochloric acid (1:1)
6	**CHROMIUM**	5.2, Sl. No. vi) of Table 3	Annex J of IS 13428:2005	Atomic absorption spectrophotometer with reducing Air – acetylene flame 0.45µm membrane filter pH meter Centrifuge	Deionised distilled water, Ammonia free Nitric acid, redistilled – 1:1 (v/v) Hydrochloric acid, redistilled – 1:1 (v/v) Chromium oxide Lanthanum chloride Lanthanum oxide , 99.9%, w/w Ammonium pyrrolidine dithocarbamate

7	**NICKEL**	5.2, Sl. No. vii) of Table 3	Annex L of IS 13428:2005	Atomic absorption spectrophotometer with nebulizer – burner having air- acetylene flame Centrifuge Nickel hollow cathode lamp/electrode less discharge lamp Separating funnel, 250-ml with PTFE taps pH meter	Nitric acid, conc. – 1.4 g/ml Pure nickel metal Sodium hydroxide Hydrochloric acid, conc. – 1.19 g/ml Methyl isobutyleketone (MIBK) Ammonium 1 – pyrrolidino carbodithioate Bromophenol blue Ethanol
8	**POLY CHLORINATED BIPHENYLE (PCB)**	5.2, Sl. No. viii) of Table 3	Annex M of IS 13428:2005	Gas chromatograph with EC detector & coupled with printer-plotter-cum- integrator Glass chromatographic column, 300 mm long, 8 mm ID with ground glass socket at the upper end and a stop cock at low end. Kuderna-Danish type, evaporator Snyder columns Syringe (5 µl) Heating oven Desiccator	Silica gel, 60 – 100 mesh N-hexane-redistilled Potassium hydroxide pellets Sodium hydroxide solution – 5N Diethyl ether, chromatography grade Cotton wool, extracted with hexane and diethyl ether Acetic acid, glacial, redistilled Chromium trioxide, re-crystallized Apiezon L grease Epikote Resin 1001 – 0.15 % Chromosorb G (acid washed) DMCS treated, 60 – 80 mesh Silicone gum GE-S-SI – 1.3 %
9	**POLYNUCLEAR AROMATIC HYDROCARBON**	5.2, Sl. No. ix) of Table 3 APHA 6440	i) High Performance Liquid Chromatography (HPLC) Method ii) Gas chromatographic (GC) Method	High Performance Liquid Chromatograph (HPLC) complete with gradient pumping system, reverse phase column and detectors (UV and fluorescence) Gas Chromatograph (GC) complete with column and flame ionization detector. Separating funnel (2 l) Evaporative flask Three Ball Synder column Kuderna- Danish Apparatus	Reagent Water Sodium thiosulphate, granular Cyclohexane Methanol Acetone, Methylene chloride Pentane – Pesticide quality or equivalent. Acetonitrile – HPLC quality Sodium sulphate, granular, anhydrous Silica Gel – 100/200 mesh

				Water bath (60-65˚C)	Stock standard solution Std. PAHs Solutions – (a) 100 µg/ml of naphthalene, acenaphthylene, fluorine, phneanthrene and anthracene. (b) 5µg/ml Benzo (k) fluoranthene

*Note: Besides listed Equipments/Apparatus/Chemicals, following accessories are essential part of a chemical lab:

i) General glass wares like Pipettes Burette, Conical flasks, Beakers, Measuring cylinders, Volumetric flasks, (of different volumes)

ii) Provision for distilled/double distilled water

iii) Fuming Hood and sink with tap in the lab

The list does not cover the requirements of Pesticide Residues and Radio Active Residues as these requirements are got to be tested from outside approved lab.

D - MICROBIOLOGICAL REQUIREMENTS

General microbiological lab equipments **

- Hot air oven (capable of 180 ºC).
- Autoclave (capable of 15 psi/ 121 ºC) of suitable size as per need.
- Weighing Balance with least count 0.01 g (least count 0.001 g, if Tergitol-7 agar medium or Crystal violet neutral red bile lactose (VRBL) agar is being prepared in house).
- *p*H meter with least count 0.1 *p*H unit.
- Laminar air flow chamber OR inoculation room/cabinet fitted with U.V. tube light.
- Hot plate for media preparation.
- Membrane filtration assembly (including sterilized membrane filters of 47 mm to 50 mm diameter with 0.45 µm pore size, vacuum pump (for applying vacuum of about 70 kPa) and forceps with rounded tips).
- Inoculation loop/needle.
- Bunsen burner with LPG cylinder.
- Thermostatically controlled water bath.
- Air conditioner (recommended)
- Refrigerator
- Colony counting equipment (recommended)
- General glasswares including, petri dishes (made of glass or plastic), volumetric pipettes (of capacity 1 ml and 10 ml), flasks, test tubes, culture bottles, funnels, glass rod, measuring cylinders.
- Thermometer with least count 1 °C
- Filter paper
- Cotton

Sl No.	Parameter	Clause Ref.	Referred Method of Test	Test Equipment/Apparatus **	Chemicals/Media/Reagents **
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	Escherichia coli (or thermotolerant bacteria)		ii) IS 15185 : 2002 a) Standard Test	General microbiological lab equipments (as listed above) Water bath and/or incubator thermostatically controlled (36 ± 2 °C and 44.0 ± 0.5 °C Membrane filter of 0.2 µm pore size (*for sterilizing TTC solution during preparation*	Distilled water Lactose TTC agar with sodium heptadecylsulphate – (Lactose, Peptone, Yeast extract, Meat extract, Bromothymol blue, Agar; 2,3,5 Triphenyltetrazolium chloride (TTC), Sodium heptadecylsulphate (Tergitol-7)) Tryptone soy agar (TSA) – (Tryptic digest of casein,

				of Lactose TTC agar)	Soy peptone, Sodium chloride, Agar) Tryptone broth – (Tryptic digest of casein, L-tryptophan, Sodium chloride) Oxidase reagent – (Tetramethyl-p-phenylene diamine hydrochloride) Kovac's Reagent – (p-Dimethylaminobenzaldehyde, Amyl or butyl alcohol , Concentrated hydrochloric acid)
			b) Rapid test **(Optional)**	General microbiological lab equipments (as listed above) Ultra violet lamp, wavelength 254 nm (low pressure mercury lamp) Filter pads, with a diameter of at least 47 mm. Water bath and/or incubator thermostatically controlled (36 ± 2 °C and 44.0 ± 0.5 °C	Distilled water Tryptone soy agar (TSA) – (Tryptic digest of casein, Soy peptone, Sodium chloride, Agar) Tryptone bile agar (TBA) – (Tryptone, Bile salts, Agar) Indole reagent – (p-Dimethylaminobenzaldehyde, Concentrated hydrochloric acid)

2	Coliform Bacteria	**5.1.2** of IS 14543 : 2004 **6.1.2** of IS 13428 : 2005	i) **Reference method** IS 5401 (Pt. 1) : 2012	General microbiological lab equipments (as listed above) Incubator capable of operating at 30 ºC ± 1 ºC or 37 ºC ± 1 ºC @ Test tubes of dimensions approximately 16 mm x 160 mm @ Durham tubes of dimensions appropriate for use with the test tubes	Distilled water Crystal violet neutral red bile lactose (VRBL) agar – (Enzymatic digest of animal tissues, Yeast extract, Lactose, Sodium chloride, Bile salts, Neutral red, Crystal violet, Agar) @ Brilliant green lactose bile broth – (Enzymatic digest of casein, Lactose, Dehydrated ox bile, Brilliant green)
			ii) IS 15185 :	General microbiological lab equipments	Distilled water

	2002	(as listed above)	Lactose TTC agar with sodium heptadecylsulphate – **(**Lactose, Peptone, Yeast extract, Meat extract, Bromothymol blue, Agar; 2,3,5 Triphenyltetrazolium chloride (TTC), Sodium heptadecylsulphate (Tergitol-7))
	Standard Test	Water bath and/or incubator thermostatically controlled (36 ± 2 °C and 44.0 ± 0.5 °C	Tryptone soy agar (TSA) – (Tryptic digest of casein, Soy peptone, Sodium chloride, Agar)
		Membrane filter of 0.2 µm pore size (*for sterilizing TTC solution during preparation of Lactose TTC agar*)	Tryptone broth – (Tryptic digest of casein, L-tryptophan, Sodium chloride)
			Oxidase reagent – (Tetramethyl-p-phenylene diamine hydrochloride)
			Kovac's Reagent – (p-Dimethylaminobenzaldehyde, Amyl or butyl alcohol , Concentrated hydrochloric acid)

			Rapid test **(Optional)**	General microbiological lab equipments (as listed above) Ultra violet lamp, wavelength 254 nm (low pressure mercury lamp) Filter pads, with a diameter of at least 47 mm. Water bath and/or incubator thermostatically controlled (36 ± 2 °C and 44.0 ± 0.5 °C	Distilled water Tryptone soy agar (TSA) – (Tryptic digest of casein, Soy peptone, Sodium chloride, Agar) Tryptone bile agar (TBA) – (Tryptone, Bile salts, Agar) Indole reagent – (p-Dimethylaminobenzaldehyde, Concentrated hydrochloric acid)
3	Sulphite reducing anaerobes	**5.1.4** of IS 14543 : 2004 **6.1.4** of IS 13428 : 2005	Annex C of IS 13428 : 2005	General microbiological lab equipments (as listed above) Screw cap bottles or vials and stoppers of boron silicate glass of capacities 200, 100 and 25 ml Test tubes - 150 mm x 13 mm Iron wire Incubator (37 ºC ± 1 ºC) Anaerobic jar assembly (recommended)	Distilled water Differential reinforced clostridial medium (DRCM) – (Peptone tryptic digest of meat , Meat extract, Yeast extract, Starch, Hydrated sodium acetate, Glucose, L-cysteine-hydrochloride, Sodium hydroxide) Sodium sulphite Iron (III) citrate
4	*Pseudomonas aeruginosa*	**5.1.5** of IS 14543 : 2004 **6.1.5** of IS 13428 : 2005	Annex D of IS 13428 : 2005	General microbiological lab equipments (as listed above) Screw capped bottles Incubator (37 ± 1° C)	Distilled water Medium for determination of presumed ***Pseudomonas aeruginosa*** – (DL asparagine, L proline, Anhydrous dipotassium hydrogen phosphate, Magnesium sulphate heptahydrate, Anhydrous potassium sulphate, Ethanol) @ Confirmatory medium (Milk agar medium) – [Skim

				UV cabinet fitted with UV lamp emitting light of wavelength 360 ± 20 nm Magnetic stirrer (recommended) Cellulose acetate or nitrate membrane of pore size 0.22 µm (for alternate sterilization of ethanol) @ Incubator, capable of being maintained at 42 ± 0.5° C	milk powder, Bacteriological yeast extract, Peptone, Sodium chloride, Agar hexadecyltrimethyl ammonium bromide (centrimide)] @ Clause D-10 (NOTE) of IS 13428 : 2005 specifies confirmation of non-pigmented strains as a further step, if required. Annex 2D of IS 13428 : 2005 specifies biochemical characteristics to be tested for this purpose. No specific apparatus, media and reagents have been specified for the same. It is specified that commercially available identification kits may be used for this.
5	Aerobic Microbial Count	**5.1.6** of IS 14543 : 2004	IS 5402 : 2012	General microbiological lab equipments (as listed above) Incubators 21 ºC ± 1 ºC and 37 ºC Colony counting equipment	Distilled water Plate count agar (PCA) – (Enzymatic digestion of casein, Yeast extract, Glucose anhydrous, Agar) Overlay medium (if necessary) – Agar
6	Yeast and Mould	**5.1.7** of IS 14543 : 2004 **6.1.6** of IS 13428 : 2005	IS 5403 : 1999	General microbiological lab equipments (as listed above) Incubator (25 ± 1 ºC)	Distilled water Yeast extract-dextrose-chloramphenicol-agar medium – (Yeast extract, Dextrose, Chloramphenicol or Oxytetracycline hydrochloride, Agar)

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NOTES

Note 1 – The list does not cover the following requirements, as these parameters are got to be tested from outside approved lab:

i) *Faecal streptococci* and *Staphylococcus aureus*.

ii) *Salmonella* and *Shigella*.

iii) *Vibrio cholera* and *V. parahaemolyticus*.

Note 2 – General Microbiological Lab Equipments as listed are common for various microbiological tests. Other additional equipments required for specific test methods are indicated against each parameter.

Note 3 – For preparation of culture media and reagents ingredients of uniform quality and chemicals of analytical reagent grade should be used. Alternatively, commercially available media and reagents may be used provided their composition comply with those given in Indian Standards.

Note 4 – Disposable glassware may be accepted as an alternative to re-usable glassware.

Note 5 – All efforts have been made to compile the list as per the respective standards exhaustively covering all the required test equipments, apparatus and chemicals. However, in case any omission or incorrectness is noticed while referring, the same may be conveyed to CMD immediately for suitable actions.

@The marked equipments/ chemicals and media are required for confirmatory tests of respective microorganisms. The confirmatory test may be dispensed with/omitted, provided the licensee undertakes to start corrective actions based on presumptive presence of microorganisms.

TEST EQUIPEMENTS FOR BOTTLES/CONTAINERS FOR PACKAGED WATER

Sl. No.	Clause No. of IS 15410:2003	Specified Requirement	Test Facility Requirement	Range and Accuracy/ Least Count (If and as Applicable)	Method of Test/ Remarks (If any)
1	4.1	Material	---	----	Raw Material conformity to ISs is indicated
2	4.2 4.2.1	Design, Shape and Dimensions	Visual	-----	
3	4.3 4.3.1 4.3.2	Manufacture, Workmanship, Finish and Appearance	 Visual	 ----- -----	 To adhere GMP --
4	4.4	Capacity	Weighing Balance or Measuring Cylinder	Suitable range with , LC 0.1 g for Balance or 1 ml for Cylinder	Cl 5 of IS 2798
5	4.5	Wall Thickness	Micrometer	Suitable Range with LC 0.02 mm	Cl 4.5 of IS 2798
6	4.6.2	Transparency	Transparency/ Haze Meter	Range upto 100 %, LC 1%	Annex A of IS 15410
7	4.6.3	Leakage Test	Vibration Leakage Tester as per Cl. 6.2.1 of IS 2798 Reservoir Air Pressure Leakage Tester	-	Cl 6 of IS 2798
8	4.6.4	Drop Test	Drop Tester with height of 0.5 m		Cl 8 of IS 2798
9	4.6.5	Migration Test	Oven/Water Bath Hot Plate Analytical Balance SS Evaporating Dish Dessicator Glass Beaker, pyrex, 1000 ml Pouch Sealing Machine	Capable of maintaining 40±2° C	IS 9845
10	4.6.6	Water Potability Test	Conditioning Chamber	Capable of maintaining 38±2° C	Annex B of IS 15410

F- REQUIREMENTS FOR POLYETHYLENE FLEXIBLE POUCHES FOR PACKAGED WATER

Sl. No.	Clause No.	Specified Requirement	Test Facility Requirement	Range and Accuracy/ Least Count (If and as Applicable)	Method of Test/ Remarks (If any)
Clause 6.1 Requirements for Films					
1	6.1.1	Description	Visual	----------	
2	6.1.2	Film Form	Visual	----------	
3	6.1.3	Winding of Film	Visual	----------	
4	6.1.4	Odour	Olfactory	----------	
5	6.1.5	Thickness	Dead Weight Dial Micrometer	Suitable Range with LC 1 µ	A-2 of IS 2508
6	6.1.6	Width (in mm)	Scale	Suitable Range, LC 1 mm	
7	6.1.7	Overall Migration	Oven/Water Bath Hot Plate Analytical Balance SS Evaporating Dish Dessicator, Glass Beaker, pyrex, 1000 ml Pouch Sealing Machine	Capable of maintaining $40 \pm 2^{\circ}$ C	IS 9845
8	6.1.8	Tensile Strength	Tensile Testing Machine of suitable range	LC 0.01 kN	A-4 of IS 9845
9.	6.1.9	Elongation at break	Tensile Testing Machine of suitable range	LC 0.01 kN	A-4 of IS 9845
10.	6.1.10	Dart Impact Resistance	Dart Impact Tester with Drop Height of 66 cm	Set of weights (Min. Impact failure load : 2.20 N)	A-6 of IS 9845

Clause 7 Requirements for Pouches

11.	7.2	Water Potability Test	Oven/Heating Arrangement Pouch Sealing Machine	Capable of maintaining 38 ± 2^{o} C	Annex E of IS 15609
12.	7.3	Stack Load Test	Flat Wooden Plank Temp. - Ambient or 27 ± 2^{o} C in case of dispute	Set of weights for 20 N to 200 N	Annex F of IS 15609
13.	7.4	Drop Test	Arrangement for flat drop from 1.2 m height	----------	Annex G of IS 15609
14.	7.5	Ink Adhesion Test for Printed Pouch	Pressure Sensitive Tapes or Cello- Tape	25 mm wide tape Arrangement for pulling tape at 10 mm/s at about 90^{o}	Annex H of IS 15609
15.	7.6	Product Resistance Test for Printed Pouch	Paper Tissue	----------	Annex J of IS 15609
Clause 8 Construction					
16.	8	Construction	Visual	----------	