

**ANNEX – A**

**1. LIST OF TEST EQUIPMENTS AND GLASSWARES REQUIRED FOR TESTING OF PACKAGED DRINKING WATER AS PER IS 14543:2004**

Sl. No.	Tests	Referred Method of Test/Refer to IS	Test Equipment/Apparatus*
1.	Colour	IS 3025 (part 4) i) Platinum cobalt (Visual comparison) method	Nessler cylinders (50 ml); and Centrifuge or filter assembly (functional pore size 0.45µm) OR
		ii) Spectrophotometric Method	Spectrophotometer (400 to 700 (nm) with 10 mm absorption cell; Filtration system consisting of filtration flask with side tubes; crucible holder; Micrometallic filter; Crucible (pore size 40 µm; Calcined filter aid (Celite 505 or equivalent); Vacuum system; Refrigerator (recommended), pH meter and Centrifuge
2.	Odour	IS 3025 (Pt 5)	Wide mouth glass stoppered bottles (approx. 1 lit. capacity)
3.	Taste	IS 3025 (Pt 8)	Breaker (50 ml); Water bath; and Thermometer
4.	Turbidity	IS 3025 (Pt 10)	Sample tubes; Turbidity meter; Volumetric flasks (100 ml); and Membrane filter with pore size not more than 0.45 µm
5.	Total dissolved solids	IS 3025 (Pt 16)	Filter; Glass fibre filter Disc (whatman GF/C or equivalent) 2.1 to 5.5 cm in diameter, pore size 1.2 µm or Ashless Filter Paper- pore size 2 to 2.5 µm equivalent to whatman filter No. 542 or Gooch crucible or Sintered Disc (G-5 or equivalent) Pore size 1 to 2 µm or 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 and l.c. 0.1 mg); Pipettes; Evaporating dish; and Magnetic stirrer (recommended)
6.	pH	IS 3025 (Part 11) 1. Electrometric 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); and Beakers OR
		2. Colorimetric Method	Hard glass tubes
7.	Barium	i) Annex F of IS 13428	Filter paper and filtration assembly; and Hot plate/gas burner OR
		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 (compressor or commercially bottled gas); Acetylene Gas

			standard commercial grade; and Nitrous oxide gas
8.	Copper	IS 3025 (Part 42) i) Neocuproine Method	Spectrophotometer & 1cm cell; Hot plate; Separating funnels (125 ml); Conical flasks OR
		ii) Atomic Absorption Method (Direct)	Atomic Absorption Spectrophotometer with air-acetylene flame; Copper Hollow Cathode lamp OR
		iii) Atomic Absorption Method (Chelation (Extraction))	Atomic Absorption Spectrophotometer with air-acetylene flame; Copper Hollow Cathode Lamp; Separating Funnel; Volumetric Flasks and Distillation Assembly OR
		iv) Differential Pulse Anodic Stripping Voltametry	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; Whatman Filter Paper No. 40 & Purified Nitrogen Gas.
9.	Iron	IS 3025 (Pt. 53) i) 1,10 Phenanthroline Method	Spectrophotometer; Std. volumetric Glass wares; Hot Plate; Beakers; Volumetric Flasks; Pipettes Conical flasks; Separating Funnel; Fuming Hood & 0.45µ m Membrane Filter with Filtration Assembly OR
		ii) Atomic Absorption Method (DIRECT)	Atomic Absorption Spectrophotometer; Air Acetylene Flame; Iron Hollow Cathode Lamp or Electrodeless discharge lamp for use at 248.3nm; Volumetric Flasks OR
		iii) Electrothermal Atomic Absorption Spectrometric Method	Atomic Absorption Spectrometer; Hollow Cathode lamp for Iron; Graphite Furnace; Readout Mechanism; Sample Dispenser; Vent for fumes; Cooling device & Membrane Filter Apparatus (0.45µm)
10.	Manganese	Cl. 35 of IS 3025	Nessler's Tubes; Beakers; Hot Plate; Volumetric flask; Pipettes; Conical Flasks & Burette
11.	Nitrate (as NO <sub>3</sub> )	IS 3025 (Part 34) i) Cadmium Reduction Method	Reduction Column; Colorimeter Spectrophotometer or Filter photometer; Glass wool; 0.45 µ m pore diameter membrane filter & Refrigerator OR

		ii) Chromotropic Acid Method	Spectrophotometer OR Photometer; Pipettes & Volumetric flasks
		iii) Devarda's Alloy Reduction Method	Distillation Assembly (Kjeldahl Assembly); Measuring Scoop; Spectrophotometer or Photometer; Volumetric Flasks
12.	Nitrite	IS 3025(Part 34)	Spectrophotometer / Photometer or Nessler's cylinders method - Nessler's Tubes; 0.45 µm Membrane Filter; Distillation Assembly (borosilicate)
13.	Flouride	Clause 23 of IS 3025	Nessler Tubes (100ml), Distillation Apparatus, Refrigerator (Recommended) and Heating mantle
14.	Zinc	IS 3025 (Part 49) i) Zincon Method	Spectrophotometer (620 nm) with 1cm cells OR
		ii) Atomic Absorption Method (Direct)	Atomic Absorption Spectrophotometer with Air-Acetylene Flame, Hollow Cathode Lamp Or Electrodeless discharge lamp OR
		iii) Atomic Absorption Method (Chelation – Extraction)	Atomic Absorption Spectrophotometer with Air-Acetylene Flame and Hollow Cathode Lamp OR
		iv) Differential Pulse Anodic Stripping Voltammetry (DPASV) Method	Polarographic Instrumentation Capable of Performing Differential Pulse Work, Hanging Mercury Drop Electrode, Platinum Counter Electrode, Saturated Calomel Reference Electrode and Magnetic Stirrer
15	Silver	Annex J of IS 13428	Atomic Absorption Spectrophotometer with Oxidizing Air Acetylene Flame

16	Aluminium	i) IS 3025(Part 55) a) Eriochrome Cyanine R Method	Spectrophotometer (535 nm with 1cm Cells), pH Meter and Standard Volumetric Glasswares OR
		b) Atomic Absorption Method (Direct)	Atomic Absorption Spectrophotometer with Nitrous Oxide – Acetylene Flame and Hollow-Cathode Lamp and Standard Volumetric Glasswares OR
		ii) IS 15302:2003 Direct Nitrous Oxide – Acetylene Flame Atomic Absorption Spectrometry	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 and Nitrous Oxide Gas
17.	Chloride	IS 3025 (Part 32)	
		i) Argentometric Method	Erlenmeyer Flask (250ml), Burette OR
		ii) Mercuric Nitrate Method	Erlenmeyer Flask (250 ml), Microburette (5 ml with l.c. 0.01ml, Refrigerator pH meter OR
		iii) Potentiometric Method	Glass & Silver- Silver Chloride Electrodes, Electronic Voltmeter and Mechanical Stirrer OR
	iv) Automated Ferricyanide Method	Automated Analytical Equipment, Filters (480nm)	
18.	Selenium	IS 3025 (Part 56) a) Spectrophotometric Method	Spectrophotometer, Volumetric glass wares, separating funnel (fluorocarbon stop cock), Water bath- thermostatically controlled, pH meter, centrifuge, centrifuge bottles with fluorocarbon screw caps OR

		b) Atomic Absorption Spectrometric Method (Hydride Technique)	Atomic Absorption Spectrometer 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) OR
		c) Electrothermal Atomic Absorption Spectrometric Method	Atomic Absorption Spectrometer,Hollow Cathode Lamp,Electrodeless Discharge, Lamp Graphite Furnace,Readout Mechanism,Sample Dispenser, Vent for Fumes, Cooling Device, Membrane Filter Apparatus (0.45 $\mu$ m)
19.	Sulphate	IS 3025 (Part 24)	
		i)Gravimetric Method	Steam Bath,Drying Oven, Muffle Furnace, Desiccator, Analytical Balance (l.c.0.1mg), Filter Paper (Preferably Whatman No.42), Silica or Porcelain Crucible, Ion Exchange Column Filter (0.45 $\mu$ m), Platinum Dish OR
		ii) Thorin Method	White Porcelain Basin, Burette, Ion Exchange Column OR
		iii)Turbidity Method	Filter – 0.45 $\mu$ m, Turbidity Meter or Spectrophotometer, Glass Apparatus, Hot Plate Refrigerator (recommended), Filter – 0.45 $\mu$ m
20.	Alkalinity	IS 3025 (Part 23)	
		i) Indicator Method	pH meter, burette & magnetic stirrer assembly OR
		ii)Potentiometric Method	Potentiometer and Glasswares
21.	Calcium	IS 3025 (Part 40)	
		i)EDTA Titrimetric Method	Hot Plate, Glasswares & Polyethylene bottles OR
		ii)Atomic Absorption Spectrometric Method	Atomic Absorption Spectrometer with Air/Acetylene or Nitrous Oxide/Acetylene Flame Hollow Cathode Lamp (Calcium) OR
		iii) Permanganate Titration Method	Beakers, Cover Glass, Glass Rod, Filtration Set up (Gooch Crucible with Suction), Hot plate

22.	Magnesium	IS 3025 (Part 46) i) Gravimetric Method	Vacuum Pump, Filter Flasks, Filter Crucibles, Muffle Furnace OR
		ii) Volumetric Method (EDTA)	Hot Plate, Volumetric Flasks and Glasswares OR
		iii) Atomic Absorption Spectrophotometric Method	Atomic Absorption Spectrophotometer with Air-Acetylene flame or Nitrous Oxide- Acetylene flame and Hollow Cathode lamp (Magnesium) & Polyethylene bottles
23.	Sodium	IS 3025 (Part 45) i) Flame Emission Photometric Method	Flame Photometer (Direct Reading or Internal Standard Type) or Atomic Absorption Spectrophotometer (In Flame Emission Mode), Glasswares OR
		ii) Atomic Absorption Spectrometry Method	Atomic Absorption Spectrophotometer with Air-Acetylene Flame and Hollow Cathode Lamp for Sodium, Glasswares OR
		iii) Gravimetric Method	Beakers (20ml, Borosilicate), Fritted Glass Crucible or Porous Porcelain Crucibles and Vacuum Pump or Aspirator
24.	Residual Free Chlorine	IS 3025 (Part 26) i) Iodometric Method	Glasswares OR
		ii) Stabilized Neutral Ortho-Toluidine Method	Spectrophotometer, Magnetic Stirrer Assembly, Brown Glass Stoppered Bottles and Refrigerator (Recommended)
25.	Phenolic Compounds	IS 3025 (Part 43) i) 4-Aminoantipyrine Method without Chloroform Extraction	Spectrophotometer, pH meter, Distillation assembly (All Borosilicate with Graham Condenser OR

		ii) 4-Aminoantipyrine Method with Chloroform Extraction	Spectrophotometer, Filter funnel (Buchner type with fritted disc) or Filter paper (Whatman No. 40), pH Meter, Separating Funnel, Distillation Assembly (All Borosilicate Glass) with Graham Condenser.
26.	Mineral Oil	IS 3025 (Part 39) i) Partition Gravimetric Method	Separating Funnel (1 lit) with Teflon or Equivalent Stop cock, Distillation flask, Water bath, Filter Paper No. 40, Desiccator, & Analytical Balance OR
		ii) Partition Infra-Red Method	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 OR
		iii) Soxhlet Extraction Method	Soxhlet Apparatus, Vacuum Pump', Buchner Funnel (12cm Diameter), Electric Heating Device, Paper Extraction Thimble, Filter Paper-Whatman No.40 or Equivalent, 11cm Diameter, Muslin Cloth Discs – 11 cm Diameter, Oven, Water Bath, Desiccator and Analytical Balance
27.	Anionic Surface Active Agents (as MBAS)	Annex K of IS 13428	pH Meter, Spectrometer, Gas Stripping Apparatus (1 lit Capacity), Nitrogen or Air, and Reflux Condenser
28	Sulphide	IS 3025 (Part 29) i) Iodometric Method	Reaction Flask (1 lit capacity), Absorption flasks (250ml Capacity), Nitrogen/Carbon dioxide gas cylinder or Carbon dioxide gas generator OR
		ii) Methylene blue method	Spectrophotometer (664 nm) or filter photometer, and Matched test tubes, Droppers
29.	Antimony	Annex G of IS 13428  i) Spectrophotometric Method	Spectrophotometer, Erlenmeyer Flask, Separating funnels (125 ml) with Teflon stopcocks, Refrigerator, Ice bath & Test tubes OR
		ii) IS 15303 Electrothermal Atomic Absorption Spectrometric Method	Atomic Absorption Spectrometer with Hollow Cathode Lamp or Electrodeless discharge lamp Graphite Furnace and Readout Mechanism, Sample Dispenser, Vent for Fumes, Cooling Device and Membrane Filter Apparatus (0.45µm)

30.	Borates	Annex H of IS 13428	Spectrometer (410 – 420nm) and Lab Apparatus made of Polypropylene/Polyethylene/Polytetrafluoro Ethylene
31.	Mercury	IS 3025 (Part 48) i) Cold Vapour Atomic Absorption Spectrophotometric Method	Atomic Absorption Spectrometer and Associated Equipment (Cold Vapour Technique), Mercury Vapour Generation Assembly , Mercury Hollow Cathode Lamp, Recorder/Printer/Display Meter OR
		ii) Colorimetric Dithizone Method	Spectrophotometer, Separating funnels (250 and 1000ml with PTFE Stopcock), Glass Wares Whatman Filter No. 42.
32.	Cadmium	IS 3025 (Part 41) i) Atomic Absorption Method (Direct)	Atomic Absorption Spectrophotometer with Air-Acetylene Flame , Cadmium Hollow Cathode Lamp or Multi Element Hollow Cathode Lamp for Use at 228.8nm OR
		ii) Atomic Absorption Method (Chelation and Extraction)	Atomic Absorption Spectrophotometer with Air-Acetylene Flame , Cadmium Hollow Cathode Lamp or Multi Element Hollow Cathode Lamp for Use at 228.8nm and Separating funnel OR
		iii) Differential Pulse Anodic Stripping Voltametry	Polarograph (capable of differential pulse work), Hanging mercury drop electrode, Platinum Counter Electrode, Saturated Calomel Reference Electrode, Magnetic Stirrer Control Unit with stirring bar, Nitrogen Gas Cylinder & Scrubber Assembly for Nitrogen Purification
33.	Arsenic	IS 3025(Part 37) i) Atomic absorption method	Atomic absorption spectrometer with arsenic electrode less discharge lamp, Atomizer, Hydride generation system, Reaction cell for producing arsenic hydride, Eye dropper or syringe, Refrigerator, Argon or nitrogen OR
		ii) Silver diethyl dithiocarbamate method	Arsine generator and absorption assembly and Spectrophotometer (535 nm with 1 cm. cells) OR
		iii) Mercuric Bromide stain Method	Arsine generator, glass assembly
34.	Cyanide	IS 3025(Pt.27) i) Total cyanide after distillation method	Distillation apparatus consisting of boiling flask (1lit.), thistle tube, Allihn water cooled condenser, gas dispersion tube, needle valve, suction flask and suction pump, Heating mantle

			Gas absorber, Ground glass st joints, Spectrophotometer OR
		ii) Selective electrode method	Expanded – scale pH meter or specific Ion meter, Cyanide Ion selective electrode, Reference electrode, double junction and Magnetic mixer with TFE coated stirring Bar
35.	Lead	IS 3025(Pt.47) i) Atomic absorption method (direct)	Atomic absorption spectrophotometer with air acetylene flame, Hollow cathode lamp or Electrodeless Discharge lamp for use at 283.3 nm OR
		ii) Atomic absorption method (chelation-extraction)	Atomic absorption spectrophotometer with air acetylene flame & Hollow cathode lamp or Electrodeless Discharge lamp for use at 283.3 nm OR
		iii) Differential pulse anodic stripping voltammetry (DPASV)	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)
36.	Chromium	Annex J of IS 13428	Atomic absorption spectrophotometer with reducing Air – acetylene flame
37.	Nickel	Annex. L of IS 13428	Atomic absorption spectrophotometer with nebulizer – burner having air-acetylene flame & Nickel hollow cathode lamp/electrodeless discharge lamp
38	Poly chlorinated biphenyle (PCB)	Annex. M of IS13428	Gas chromatograph with EC detector, coupled with printer-plotter-cum-integrator, Glass chromatographic colum., Kuderna-Danish type, evaporator, Snyder columns, Syringe (5 µl), Heating oven & Desiccator
39.	Polynuclear Aromatic Hydrocarbon	APHA 6440 i) High Performance Liquid Chromatographic (HPLC) Method	High Performance Liquid Chromatograph (HPLC) complete with gradient pumping system, reverse phase column and detectors (UV and fluorescence) OR
		ii) Gas Chromatographic (GC) Method	Gas Chromatograph (GC) complete with column and flame ionization detector., Separating funnel (2 lit) Evaporative flask, Three Ball Snyder column, K-D Apparatus & Water bath (60-65°C)

40	ESCHERICH IA COLI	i) IS 5887(Pt.1)	Hot air oven (capable of 180° C), Autoclave (capable of 15 psi/121° C) of suitable size depending on need, Balance for media preparation (l.c. 0.01 g), pH meter (l.c.0.1), Laminar air flow chamber or inoculation room/cabinet fitted with U.V. tube light, U.V. cabinet fitted with U.V. lamp, Hot plate for media preparation, Membrane filtration assembly (including 0.45µm pore dia with 47-50 mm diameter sterilized filters, vacuum pump and forceps with rounded tips), Inoculating loop, Bunsen burner with LPG cylinder, Hot plate for media preparation, Water bath thermostatically controlled, Microscope, Air conditioner (recommended), Refrigerator, Colony counting equipment (recommended), general glasswares including Petri dishes, pipettes, flasks slides, Durham's tubes, test tubes, both side open glass tubes, culture bottles, Incubator capable of maintaining 37 ±1° C and Incubator capable of maintaining 44° C @ OR
		ii) IS 15185 Standard Test	General microbiological lab equipments as listed above and Water bath and/or incubator thermostatically controlled (36 ±2° C and 44.0±0.5° C)
		iii) Rapid Test	General microbiological lab equipments as listed above, Water bath and/or incubator thermostatically controlled (36 ±2° C and 44.0±0.5° C), Ultra violet lamp wave length 254 nm (Low pressure mercury lamp) and Filter pad, dia (min.) 47mm
41	Coliform	i) IS 5401(Pt 1)	General microbiological lab equipments as listed above and Incubator (37 ± 1° C) OR
		ii) IS 15185 Standard Test	General microbiological lab equipments as listed above and Water bath and/or incubator thermostatically controlled (36 ±2° C and 44.0±0.5° C)
42	Sulphite reducing anaerobes	Annex C of IS 13428	General microbiological lab equipments as listed above, Volumetric pipettes – 10 ml and 1 ml, Iron wire, Incubator (37 ± 1° C), Screw cap-bottles/vials and stoppers of boron silicate glass of capacities 200, 100 and 25 ml & Anaerobic Jar assembly (Recommended)
43	Pseudomonas aeruginosa	Annex D of IS 13428	General microbiological Lab equipments as listed above, Screw capped bottles, Incubator (37 ± 1° C) and Incubator (42 ± 0.5° C) @
44	Aerobic microbial count	IS 5402	General microbiological lab equipments as listed above, Incubators (21 ± I° C) and 37 ± I° C) and Colony counting equipment
45	Yeast and mould	IS 5403	General microbiological lab equipments as listed above and Incubator (25 ± I° C)

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 for specific requirements 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 apparatus may be accepted as an alternative to re-usable glassware.

Note 5 – For details of test equipment, chemicals and glasswares, please refer respective test methods.

Note 6 – Equipments of higher accuracy and detection limit than the specified in the specification can be used.

Note 7 – Equipments shall have valid calibration certificate as per the manual of the instrument or as decided by the user, in case manual is not supplied with the instrument.

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

\*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.

The requirements having frequency of testing as once a month or more may be got tested from outside lab like Fluoride, Silver Selenium, Sodium, Phenolic Compounds, Mineral Oil, Antimony, Borate, Mercury, Cadmium, Arsenic, Cyanide, Lead, Chromium, Nickel, Poly-nuclear aromatic hydrocarbon (PAH), poly chlorinated bi-phenyl (PCB)

Note : 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

## **1. LIST OF CHEMICALS REQUIRED FOR TESTING OF PACKAGED DRINKING WATER AS PER IS 14543:2004**

Sl. No.	Tests	Referred Method of Test/ Refer to IS	Chemicals
1.	Colour	IS 3025 (part 4) i) Platinum cobalt (Visual comparison) method	Potassium Chloroplatinate, Cobaltous Chloride Crystalline, Conc. Hydrochloric acid and Distt. Water OR
		ii) Spectrophotometric Method	Conc. Sulphuric acid and Sodium hydroxide
2.	Odour	IS 3025 (Pt 5)	Odour free distilled water and Hydrochloric acid
3.	Taste	IS 3025 (Pt 8)	Taste and Odour free water and 2000 mg/l solution of sodium chloride
4.	Turbidity	IS 3025 (Pt 10)	Distilled water, Hexamethylene Tetramine, Hydrazine sulphate
5.	Total dissolved solids	IS 3025 (Pt 16)	None
6.	pH	IS 3025 (Part 11)  1. Electrometric method	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 tartrate (for Tartrate buffer), Potassium hydrogen phthalate (for Phthalate buffer) Potassium tetraoxalate dihydrate (for Tetraoxalate 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) OR
		2. Colorimetric Method	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 and Different buffer solutions of known pH
7.	Barium	i) Annex F of IS 13428	Ammonium Dichromate, Ammonium Acetate, Ammonium Hydroxide, Potassium Iodide, Sodium Thiosulphate(0.1N), Hydrochloric Acid, Ammonium Chloride & Starch indicator OR
		ii) IS 15302	Metal free water, Hydrochloric Acid, Nitric Acid, Sulphuric Acid, Hydrofluoric Acid Potassium Chloride, Aluminium Nitrate & Standard barium solution 100µg/ml (Barium chloride, oven and hydrochloric acid)
8.	Copper	IS 3025 (Part 42) i) Neocuproine Method	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 OR
		ii) Atomic Absorption Method (Direct)	Hydrochloric Acid, Conc., Nitric Acid, Con, Dilute Sulphuric Acid and Stock copper (II) solution – 1.0mg/ml (Pure Copper metal & hot plate) OR
		iii) Atomic Absorption Method (Chelation (Extraction))	Hydrochloric Acid, Conc, Nitric Acid, Conc., Pyrrolidine , Methyl Isobutyl Ketone - Reagent grade (MIBK), 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) Sulphuric Acid OR
		iv) Differential Pulse Anodic Stripping Voltametry	Hydrochloric Acid Conc. (Spectro Grade), Nitric Acid-Conc. (Spectro Grade), Sulphuric Acid Conc., Stock copper (II) solution – 1.0mg/ml (Pure Copper metal & hot plate) , Amalgamated Zinc (Granular Zinc and Mercury), Ammonium Meta Vanadate

9.	Iron	IS 3025 (Pt. 53) (1) 1,10 Phenanthroline Method	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, Potassium Permanganate), Std. Iron Solution (1.0 ml=1.0µg of Iron) & Di-isopropyl Ether OR
		(2) Atomic Absorption Method (DIRECT)	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) OR
		IS 15303 3. Electrothermal Atomic Absorption Spectrometric Method	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
10.	Manganese	Clause 35 of IS 3025	Sulphuric Acid, Hydrogen Peroxide (30%), Nitric Acid, Conc. Stabilized Distilled Water OR Distillation Assembly, 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)
11.	Nitrate (as NO <sub>3</sub> )	i) Cadmium Reduction Method	Distilled water, Nitrate free water, Cadmium granules (40 – 60 mesh), Hydrochloric Acid (6N), Copper Sulphate Solution, Sulphanilamide, Conc. Hydrochloric Acid, N-(1-naphthyl)-Ethylenediamine 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 OR
		ii) Chromotropic Acid Method	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 OR

		iii) Devarda's Alloy Reduction Method	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
12.	Nitrite	IS 3025(Part 34)	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
13.	Flouride	Clause 23 of IS 3025	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
14.	Zinc	IS 3025 (Part 49)	
		i) Zincon Method	Sodium Hydroxide, Potassium Cyanide, Chlorohexanone, Distt. Water, Zincon, Methanol, Sodium Ascorbate, Borate Buffer Solution (Sodium Hydroxide, Potassium Chloride, Boric Acid), Hydrochloric Acid, Conc. & Zinc Sulphate OR
		ii) Atomic Absorption Method (Direct)	Hydrochloric Acid, Conc., Nitric Acid, conc. & Stock Zinc Solution – 1.0mg/ml (Zinc Granules/Zinc Oxide) OR

		iii) Atomic Absorption Method (Chelation – Extraction)	Hydrochloric Acid, Conc., Nitric Acid, Conc, Pyrrolidine Dithio Carbamic Acid - Chloroform Reagent (Pyrrolidine, Chloroform, Carbon disulphide), Sodium Hydroxide, Chloroform, Bromophenol Blue Indicator (Bromophenol Blue, Ethanol or Isopropanol), Stock Zinc (II) Solution- 1.0 mg/ml (Zinc Granules or Zinc Oxide & Nitric Acid) OR
		iv) Differential Pulse Anodic Stripping Voltammetry (DPASV) Method	Hydrichloric 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)
15.	Silver	Annex J of IS 13428	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
16.	Aluminium	i) IS 3025(Part 55) a) Eriochrome Cyanine R Method	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 OR
		b) Atomic Absorption Method (Direct)	Hydrochloric Acid, Conc., Nitric Acid, Conc., Potassium Chloride Solution & Stock Aluminium Solution - 500 µg/l (Aluminium Potassium Sulphate) OR
		ii) IS 15302 Direct Nitrous Oxide – Acetylene Flame Atomic Absorption Spectrometry	Metal Free Metal, 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)
17.	Chloride	IS 3025 (Part 32) i) Argentometric Method	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% OR

		ii) Mercuric Nitrate Method	Standard Sodium Chloride Solution – 0.01N (sodium chloride), Nitric Acid – 0.1N, Sodium Hydroxide – 0.1N, Indicator – Acidifier Reagent (S-Diphenylcarbazone, 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 – 0.1 OR
		iii) Potentiometric Method	Standard Sodium Chloride Solution (0.01N), Nitric Acid-Conc, Standard Silver Nitrate Solution (0.01N) & Pretreatment Reagent (Sulphuric Acid, Hydrogen Peroxide, Sodium Hydroxide – 1N) OR
		iv) Automated Ferricyanide Method	Stock Mercuri, Thiocyanate Solution (Mercuric Thiocynate, Methanol), Stock Ferric Nitrate Solution (Ferric Nitrate, Conc. Nitric Acid), Colour Reagent (Poly oxy Ethylene 23 Lauryl Ether) & Sodium Chloride
18.	Selenium	i) IS 3025 (Part 56)	
		a) Spectrophotometric Method	Stock Selenium Solution – 1.0mg/ml (Sodium Selenite, Hydrochloric Acid), Hydrochloric Acid – 0.1N, Ammonium Hydroxide, Cyclohexane, 2,3 – Diaminonaphthalene (DAN), Hydroxylamine Hydrochloride, Sodium Salt of EDTA Amberlite XAD -8 or Equivalent Resin, Hydrochloric Acid, Conc & Potassium Hydroxide OR
		b) Atomic Absorption Spectrometric Method (Hydride Technique)	Nitric Acid, Sulphuric Acid, Hydrochloric Acid, Hydrogen Peroxide, Sodium Hydroxide, Sodium Tetrahydro borate & Selenium Stock Solution (1mg/ml) (Selenium Dioxide) OR
		ii) IS 15303 Electrothermal Atomic Absorption Spectrometric Method	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

19.	Sulphate	IS 3025 (Part 24)	
		i) Gravimetric Method	Methyl Red Indicator, Hydrochloric Acid, Barium Chloride, Silver Nitrate, Nitric Acid & Ion Exchange Resin (Amberlite IR-120 or Equivalent) OR
		ii) Thorin Method	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) & Barium Chloride – Standard Solution (Barium chloride m hydrochloric acid ammonia) OR
		iii) Turbidity Method	Barium Chloride, Gelatin Powder, Glycerol, Hydrochloric Acid, Conc, Sodium Chloride, Ethyl or Isopropyl Alcohol, Anhydrous Sodium Sulphate & Stock sulphate solution – 100mg/l
20.	Alkalinity	IS 3025 (Part 23)	
		i) Indicator Method	Distilled Water, Sulphuric Acid, Conc, Standard Solution of Sulphuric Acid – 0.02 N, Phenolphthalein Indicator, Mixed Indicator Solution (Methyl Red, Bromocresol Green & Ethyl or Isopropyl Alcohol) OR
		ii) Potentiometric Method	Standard Sulphuric Acid – 0.02N
21.	Calcium	IS 3025 (Part 40)	
		i) EDTA Titrimetric Method	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, Cone OR
		ii) Atomic Absorption Spectrometric Method	Hydrochloric Acid – 1N and 0.1N, Lanthanum Chloride, Cesium Chloride & Standard Calcium Solution OR

		iii) Permanganate Titration Method	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)
22.	Magnesium	IS 3025 (Part 46):1994 i) Gravimetric Method	Methyl Red Indicator, Hydrochloric Acid, Ammonium Oxalate, Ammonium Hydroxide, Nitric Acid, Conc, Diammonium Hydrogen Phosphate & Urea OR
		ii) Volumetric Method (EDTA)	Indicator Solutions, Patton and Reeder Reagent, Sodium Chloride/Potassium Chloride, Murexide (Ammonium Purpurate), Absolute Ethylene Glycol, Sodium Chloride, 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, Hydroxylamine Hydrochloride OR
		iii) Atomic Absorption Spectrophotometric Method	Hydrochloric Acid – 1N and 0.1N, Lanthanum Chloride (Lanthanum Oxide, Hydrochloric Acid, Conc), Cesium Chloride & Standard Magnesium Solution (1000mg/l) (Magnesium Oxide, Hydrochloric Acid)
23.	Sodium	IS 3025 (Part 45) i) Flame Emission Photometric Method	Deionized Distilled Water, Stock Sodium Solution – 1mg/ml (Sodium Chloride) & Standard Lithium Solution – 1mg/ml OR
		ii) Atomic Absorption Spectrometry Method	Sodium Chloride, Potassium Chloride, Stock Sodium Solution – 1mg/ml & Stock Potassium Solution – 1mg/ml OR
		iii) Gravimetric Method	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)

24.	Residual Free Chlorine	IS 3025 (Part 26) i) Iodometric Method	Acetic Acid, Glacial, Potassium Iodide – Crystals, Standard Sodium Thiosulphate – 0.01N, Standard Potassium Dichromate – 0.1N & Starch Indicator Solution OR
		ii) Stabilized Neutral Ortho-Toluidine Method	Distilled Water – Chlorine Demand Free (Distilled Water, Chlorine), Neutral Ortho-Toluidine Reagent (Hydrochloric Acid – Conc, Mercuric Chloride, Disodium Salt of EDTA – 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)
25.	Phenolic Compounds	IS 3025 (Part 43) i) 4-Aminoantipyrine Method without Chloroform Extraction	Stock Phenol Solution (Phenol, Bromate – Bromide Solution – 0.1N, Hydrochloric Acid (Conc), Potassium Iodide, Sodium Thiosulphate – 0.025N, Starch Indicator), Standard Phenol Solution (1µg/ml), Ammonium Hydroxide-0.5N, Phosphate Buffer Solution (Potassium Hydrogen Phosphate, Potassium Dihydrogen Phosphate), 4 – Aminoantipyrine, Potassium Ferricyanide, Sodium Sulphate, Anhydrous & Phosphoric Acid OR
		ii) 4-Aminoantipyrine Method with Chloroform Extraction	Phenol Stock Solution(Phenol), Standard Phenol Solution (1µg/ml), Ammonium Hydroxide – 0.5N, Phosphate Buffer Solution (Potassium Hydrogen Phosphate, Potassium Dihydrogen Phosphate), 4-Aminoantipyrine, Potassium Ferricyanide, Chloroform & Sodium Sulphate Anhydrous
26.	Mineral Oil	IS 3025 (Part 39) i) Partition Gravimetric Method	Hydrochloric Acid, TrichlorotrifluoroEthane & Sodium Sulphate, Anhydrous OR
		ii) Partition Infra-Red Method	Hydrochloric Acid, Trichloro Trifluoroethane, Sodium Sulphate, Anhydrous & Reference Oil (Iso-Octane, Hexadecane, Benzene) OR
		iii) Soxhlet Extraction Method	Hydrochloric Acid, Trichloro Trifluoroethane & Diatomaceous Silica Filter Aid Suspension (10g/l)

27.	Anionic Surface Active Agents (as MBAS)	Annex K of IS 13428	Sodium Chloride, Ethyl Acetate, Chloroform, Ethanol, Methanol, Sulphuric Acid, Ethanolic Sodium Hydroxide-0.1mol/lit (Sodium Hydroxide, Ethanol), Methylene Blue, Neutral Solution, Methylene Blue, Acidic Solution, Bufer Solution, pH 10 (Sodium Hydrogen Carbonate, Anhydrous Sodium Carbonate), Phenolphthalein Indicator, Ethanol & Dodecyl Benzene Sulphonic Acid Methyl Ester (Tetrapropylene Type), Stock Standard Solution
28.	Sulphide	i) Iodometric Method	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 OR
		ii) Methylene blue method	N, N – dimethyl – p- Phenylene Diamine oxalate, Sulphuric Acid, Conc. & 1:1 solution, Ferric Chloride, Diammonium Hydrogen Phosphate, Methylene Blue & Standard Sulphide Solution
29.	Antimony	i) Annex G of IS 13428 Spectrophotometric Method	Hydrochloric Acid – 6 N, Phosphoric Acid – 3N, Rhodamine B, Antimony Standard Solution (100 µg/ml and 1µg/ml (pure antimony, sulphuric acid), Benzene, Sulphuric Acid & Perchloric Acid OR
		ii) IS 15303 Electrothermal Atomic Absorption Spectrometric Method	Metal free Water, Hydrochloric Acid, Conc., Nitric Acid, Conc., Matrix Modifier Stock Solutions (Magnesium Nitrate, Nickel Nitrate, Phosphoric Acid, Palladium Nitrate, Citric Acid), Stock Antimony Solution (100 µg/ml), Chelating Resin & Sodium hydroxide -10 N
30.	Borates	Annex H of IS 13428	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
31.	Mercury	IS 3025 (Part 48) i) Cold Vapour Atomic Absorption Spectrophotometric Method	Sulphuric Acid, conc., Nitric Acid, Conc., Stannous Chloride, Hydrochloric Acid, Conc., Sodium Chloride, Hydroxylaminesulphate, Potassium Permanganate, Potassium Persulphate, Stock Mercury Solution (1mg/ml) & Mercuric Chloride OR

		ii) Colorimetric Dithizone Method	Redistilled or Deionised Distilled Water, Stock Mercury Solution – 100 µg/ml (Mercuric Chloride, Nitric Acid – Conc.), Potassium Permanganate, Potassium Persulphate, Hydroxylamine Hydrochloride, Dithiozone Solution – 6 µg/ml (Dithiozone Chloroform, Hydrochloric Acid, Ammonium Hydroxide), Sulphuric Acid – 0.25 N, Potassium Bromide, Chloroform, Disodium Hydrogen Phosphate, Anhydrous Potassium Carbonate & Sodium Sulphate, Anhydrous
32.	Cadmium	IS 3025 (Part 41) i) Atomic Absorption Method (Direct)	Hydrochloric Acid, Conc., Nitric Acid, Conc. & Stock Cadmium Solution – 1mg/ml (Pure Cadmium Metal) OR
		ii) Atomic Absorption Method (Chelation and Extraction)	Hydrochloric Acid, Conc., Nitric Acid, Conc., Stock Cadmium Solution - 0.5 µg/ml, Sodium Hydroxide, Methyl Isobutyl Ketone (MIBK), Bromophenol Blue Indicator, Ethanol or Isopropanol, Pyrrolidine & Carbon Disulphide OR
		iii) Differential Pulse Anodic Stripping Voltammetry	Hydrochloric Acid, Conc., Nitric Acid, Conc., Hydroxylamine Hydrochloride, L-Ascorbic Acid, Standard Cadmium Solution - 10 µg/ml (Pure Cadmium Metal), Granular Zinc, Mercury & Ammonium Meta Vanadate
33.	Arsenic	IS 3025(Part 37) i) Atomic absorption method	Sodium boro hydride, Sodium hydroxide, Sodium Iodide, Sulphuric acid-18N & 2.5 N, Potassium persulphate, Nitric acid, conc, Perchloric acid, conc, Hydrochloric acid, Conc, Standard arsenic (III) solution 0.1 µg/ml. (Arsenic trioxide), Standard arsenic (V) solution 0.1 µg/ml. (Arsenic pentaoxide) & Standard organic arsenic solution – 0.1 µg/ml. (Dimethyl arsenic acid/cacodylic acid) OR
		ii) Silver diethyl dithiocarbamate method	Hydrochoric acid, conc, Potassium Iodide, Stannous chloride, arsenic free, Lead acetate, Ephedrine, Chloroform, Silver diethyl dithiocarbamate, Zinc – 20 to 30 mesh, arsenic free & Standard arsenic solution – 1 µg/ml (Arsenic trioxide, Sodium Hydroxide) OR
		iii) Mercuric bromide stain method	Sulphuric acid, 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 & Standard arsenic solution - 1 µg/ml (Arsenic trioxide, sodium hydroxide)
34.	Cyanide	IS 3025(Pt.27) i) Total cyanide after distillation method	Sodium hydroxide, Lead carbonate-powdered, Sulphamic acid, Magnesium chloride, Sulphuric acid, conc, Acetic acid, glacial, Standard cyanide solution – 1 µg/ml (potassium cyanide, silver nitrate), Chloramine – T, Pyridine, Pyrazolone, BIS – pyrazolone & Standard silver nitrate solution – 1 ml = 1 mg CN (silver nitrate) OR

		ii) Selective electrode method	Standard cyanide solution – 10 µg/ml (Potassium cyanide, silver nitrate), Sodium Hydroxide, Potassium nitrate & Potassium hydroxide
35.	Lead	IS 3025(Pt.47) i) Atomic absorption method (direct)	Hydrochloric acid, conc, Nitric acid, conc. & Standard lead solution – 0.1 mg/ml (Lead nitrate) OR
		ii) Atomic absorption method (chelation-extraction)	Hydrochloric acid, conc , Nitric acid, conc., Pyrrolidine, Chloroform, Carbon Disulphide, Sodium hydroxide, Bromophenol blue, Ethanol or isopropanol & Standard lead solution – 0.1 mg/ml (lead nitrate) OR
		iii) Differential pulse anodic stripping voltammetry (DPASV)	Hydrochloric acid, conc., Nitric acid, conc., Standard lead solution – 0.2 µg/ml (Lead Nitrate)., Granular zinc, Mercury, Ammonium meta vandate
36.	Chromium	Annex J of IS 13428	Deionised distilled water, Nitric acid, redistilled, Hydrochloric acid, redistilled, Standard chromium solution (chromium oxide), Lanthanum chloride, Lanthanum oxide & Ammonium pyrrolidine ditho carbamate
37.	Nickel	Annex. L of IS 13428	Nitric acid, conc., Nickel standard solution-1mg/ml. (pure nickel metal), Sodium Hydroxide, Hydrochloric acid, conc., Methyl-isobutyleketone (MIBK), Ammonium 1 – pyrrolidine dithio carbamate (APDC), Bromophenol blue & Ethanol
38.	Poly chlorinated biphenyle (PCB)	Annex. M of IS13428	Silica gel, 60 – 100 mesh, N-hexane-redistilled, Potassium hydroxide pellets, Sodium hydroxide solution – 5N, Diethyl ether, chromatography grade, Cotton wool, Acetic acid, glacial, redistilled & Chromium trioxide, re-crystallized.
39.	Polynuclear Aromatic Hydrocarbon	APHA 6440 i) High Performance Liquid Chromatographic (HPLC) Method & ii) Gas Chromatographic (GC) Method	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, Stock standard solution & Std. PAHs Solutions – (a) 100 µg/ml of naphthalene, acenaphthylene, fluorine, phneanthrene and anthracene. (b) 5µg/ml Benzo (k) fluoranthene
40.	ESCHERICH IA COLI	i) IS 5887(Pt.1)	Distilled water, Nutrient broth @ (peptone, meat extract, sodium chloride), Nutrient Agar medium @ (Nutrient broth, Agar), Mac Conkey broth (Peptone, sodium taurocholate/Bile salts, sodium chloride, lactose, neutral red, ethanol), Mac Conkey

			Agar Medium (Mac Conkey Broth, Agar), Eosin methylene blue Lactose Agar medium (Peptone, Dipotassium hydrogen phosphate, Agar, lactose, Eosin methylene blue), Tergitol Agar medium (Proteose peptone, yeast extract, lactose, Agar, tergitol-7, Bromothymol blue), TSI medium for H <sub>2</sub> S test @ (Meat extract, yeast extract, peptone, glucose, lactose, sucrose, ferrous sulphate, sodium chloride, sodium thiosulphate, Agar, phenol red), Medium for urease test @ (Peptone, sodium chloride, Agar, potassium dihydrogen phosphate, phenol red, glucose, urea, Seitz filtration assembly), Medium for indole production@ (Peptone, sodium chloride, strain of Bacterium known to produce indole), Kovac's reagent @ (p-Dimethyl-aminobenzaldehyde, Amyl alcohol/Iso-amyl alcohol, conc. Hydrochloric acid), Medium for methyl red and Voges-Proskauer tests @ (Peptone, Dipotassium hydrogen phosphate, glucose) $\alpha$ -naphthol, ethanol, potassium hydroxide,@, Simmon's citrate Agar @ (Sodium chloride, magnesium sulphate, ammonium dihydrogen phosphate, Dipotassium hydrogen phosphate, sodium citrate, Agar, Bromothymol blue indicator), Peptone water medium for carbohydrate fermentation test @ (Peptone, sodium chloride, Andrade's indicator, sugar), Lactose@, Gram stain @ (Methyl violet/crystal violet; iodine; potassium iodide; neutral red, acetic acid, ethanol) OR
		ii) IS 15185 Standard Test	Distilled water, Lactose TTC Agar (Lactose; peptone; yeast extract; meat extract; Bromothymol blue; Agar; 2,3,5- Triphenyltetrazolium chloride (TTC); sodium heptadecylsulphate (Tergitol-7); membrane filter – 0.2 $\mu$ m pore size), Tryptone soy agar (TSA) (Tryptic digest of casein; 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-dimethyl aminobenzaldehyde, amyl or butyl alcohol, hydrochloric acid) OR
		• Rapid Test	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-Dimethylamino benzaldehyde, hydrochloric acid)
41.	Coliform	i) IS 5401(Pt 1)	Distilled water & Crystal violet neutral red bile lactose (VRBL) Agar (Peptone, yeast extract, lactose, sodium chloride, bile salts, neutral red, crystal violet, Agar) OR

		ii) IS 15185 Standard Test	Distilled water, Lactose TTC Agar (Lactose; peptone; yeast extract; meat extract; Bromothymol blue; Agar; 2,3,5- Triphenyltetrazolium chloride (TTC); sodium Heptadecylsulphate (Tergitol-7); membrane filter – 0.2 µm pore size), Tryptone soy agar (TSA) (Tryptic digest of casein; soy peptone; sodium chloride; Agar) & Oxidase reagent (Tetramethyl-p- phenylene diamine hydrochloride)
42.	Sulphite reducing anaerobes	Annex. C of IS 13428	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
43.	Pseudomonas aeruginosa	Annex D of IS 13428	Presumptive medium for pseudomonas aeruginosa [DL asparagine, L proline, anhydrous dipotassium hydrogen phosphate, magnesium sulphate heptahydrate, anhydrous potassium sulphate, ethanol and cellulose acetate or nitrate, membrane of pore size 0.22 µm - for alternate sterilization of ethanol], Confirmatory medium @ (Skim milk powder, yeast extract bacteriological, peptone, sodium chloride, Agar hexadecyltrimethyl ammonium bromide/ centrimide), Oxidase and catalase test medium @ Gelatin liquification test medium @, Acetamide @ & Starch hydrolysis test medium @
44.	Aerobic microbial count	IS 5402	Plate count medium (Tryptone, dehydrated yeast extract, anhydrous glucose, Agar)
45.	Yeast and mould	IS 5403	Yeast extract-dextrose -chloramphenicol Agar medium (Yeast extract, dextrose, chloramphenicol/ox tetracycline hydrochloride, Agar)

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

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

v) **Salmonella and Shigella.**

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

Note 2 – General Microbiological Lab Equipments as listed, are common for various microbiological tests. Other additional equipments for specific requirements 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 apparatus may be accepted as an alternative to re-usable glassware.

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

Note : 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