ENVIRONMENTAL STANDARDS, 2020

National Environment Commission

Royal Government of Bhutan

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List of Abbreviations:

TSS: Total Suspended Solids
TDS: Total Dissolved Solids
DO: Dissolved Oxygen
BOD: Biochemical Oxygen Demand
COD: Chemical Oxygen Demand
TKN: Total Kjeldahl Nitrogen
PAH: Polycyclic Aromatic Hydrocarbon
PCB: Polychlorinated Biphenyl
SAR: Sodium Absorption Rate
TSPM: Total Suspended Particulate Matter
RSPM: Respirable Suspended Particulate Matter

Units and Measurements:
mg/l: Milligrams per liter
µS/cm: Microsiemens Per Centimeter
µg/m³: Microgram per cubic meter
mg/Nm³: Milligram per cubic meter
ppm: Parts per million
dB(A): A-weighted decibels

1. Ambient Water Quality Criteria

S.No.	Parameter	Unit	A	B	C
1.	**pH**	**pH scale**	6.5-8.5	6.0-9.0	6.0-9.0
2.	**Colour,**	**Hz**	5	50	-
3.	**TSS**	**mg/l**	25	100	-
4.	**Conductivity**	**µS/cm**	800	1000	2000
5.	**Odour**		Unobjectionable	Unobjectionable	-
6.	**Mineral oil**		No film	No film	-
7.	**Nitrate**	**mg/l**	10	50	-
8.	**Fluoride**	**mg/l**	1	2.0	-
9.	**Sulphates**	**mg/l**	25	100	-
10.	**Chloride**	**mg/l**	50	200	-
11.	**Surfactants**	**mg/l**	0.1	0.2	-
12.	**Phosphates**	**mg/l**	0.5	<0.1	-
13.	**DO**	**mg/l**	6	4	-
14.	**BOD**	**mg/l**	2	5	50
15.	**TKN**	**mg/l**	0.5	2.0	-
16.	**Ammonia**	**mg/l**	0.05	0.5	-
17.	**T. coliform***	**CFU/100ml**	50	5000	10,000
18.	**F. coliform***	**CFU/100ml**	20	2000	5000
19.	**F. Streptocoppi**	**CFU/100ml**	20	1000	1000
20.	**Dissolved Iron**	**mg/l**	0.2	0.5	-
21.	**Copper**	**mg/l**	0.05	0.1	-
22.	**Zinc**	**mg/l**	0.2	0.5	-
23.	**Arsenic**	**mg/l**	0.01	0.05	-
24.	**Cadmium**	**mg/l**	0.003	0.003	-
25.	**Total chromium**	**mg/l**	0.05	0.05	-
26.	**Lead**	**mg/l**	0.02	0.02	-
27.	**Selenium**	**mg/l**	0.01	0.01	-
28.	**Mercury**	**mg/l**	0.0005	0.0005	-
29.	**Phenols**	**mg/l**	0.001	0.002	-
30.	**Cyanides**		0.05	0.05	-
31.	**PAH**	**mg/l**	0.0002	0.0002	0.001
32.	**Total pesticides**	**mg/l**	0.0005	0.0005	0.001
33.	**PCB**	**mg/l**	0.0002	0.0002	-
34.	**SAR**		-	-	26
35.	**Boron**	**mg/l**	-	-	1
36.	**Floating materials-wood, plastic, rubber etc.**		Absent	Absent	-
37.	**Anionic Detergents[1]**	**mg/l**	0.2	1	-
38.	**Manganese**	**mg/l**	0.4	-	-
39.	**Sodium (Absorption ratio)[2]**	**Max**	-	-	26

[1]Annex K of IS 13428

[2]American Public Health Association (APHA)

40.	**TDS[3]**	**mg/l**	500	1500	2100
41.	**Calcium hardness[4]**	**mg/l**	200	-	-
42.	**Magnesium hardness[5]**	**mg/l**	200	-	-
43.	**Barium[6]**	**mg/l**	0.7	-	-
44.	**Turbidity**	**NTU**	5	-	-
45.	**COD*[7]**	**mg/l**	5		

*Applicable only to Surface water quality

NOTE:

A: (Very good)
Drinking water source without conventional treatment, but after disinfection whenever necessary

B: (Good)
Drinking water source with conventional treatment

C: (Moderate)
Used for irrigation, industrial cooling, etc.

*To achieve the drinking quality standard, disinfection/boiling of the water is recommended. The total coliform may be high due to their contribution from natural sources like soil, litter etc, which does not relate to pathogen. If MPN of total coliform is noticed to be more than the limit suggested, then regular tests should be carried out. The criteria would be satisfies if during a period not more than 5% samples show greater than prescribed limit.

Acronyms:

SAR: Sodium Absorption Ratio
PAH: Poly Aromatic Hydrocarbon
CFU: Colony Forming Unit
PCB: Poly Chlorinated Biphenyl
BOD: Biochemical Oxygen Demand
DO: Dissolved Oxygen
COD: Chemical Oxygen Demand
NTU: Nephelometric Turbidity Unit

[3]IS: 3025 (Part 16)
[4]IS 3025 (Part 21)
[5]IS 3025 (Part 46)
[6]Annex F of IS 13428* or IS 15302
[7]American Public Health Association (APHA)

2. Industrial Effluent Discharge Standard

S.No.	Parameters	Unit	Generic	Food	Mining	Metal Ind. (Electric Arc. Furnace)	Chemicals (Textiles and carpets)	Wood	Pharmaceutical Industries
1.	Ammoniacal Nitrogen (NH_3-N)	mg/l	10	10			8	8	
2.	Arsenic	mg/l	0.1		0.1	0.1			
3.	BOD	mg/l	30	30	30	30	30	100	100
4.	Boron	mg/l	1						
5.	Cadmium total	mg/l	0.05						
6.	COD	mg/l	150	150				200	
7.	Chloride	mg/l	500						
8.	Chromium total	mg/l	0.5						0.1
9.	Chromium Hexavalent	mg/l	0.1						
10.	Copper total	mg/l	0.1		0.5	0.5			
11.	Cyanide	mg/l	0.1						
12.	Fluoride	mg/l	2						
13.	Phosphate	mg/l	3						5
14.	Nitrate	mg/l	10						
15.	Iron total	mg/l	2						
16.	Lead total	mg/l	0.1		0.1	0.1			0.1
17.	Manganese	mg/l	0.5						
18.	Mercury	mg/l	0.001		0.001	0.001			0.01
19.	Nickel	mg/l	0.1		0.5	0.5			

S.No.	Parameters	Unit	Generic	Food	Mining	Metal Ind. (Electric Arc. Furnace)	Chemicals (Textiles and carpets)	Wood	Pharmaceutical Industries
20.	**Oil and grease**	**mg/l**	5						10
21.	**pH**		6.5-8.5	6.5-8.5					6 to 9
22.	**Phenolic compounds**	**mg/l**	0.5				0.5	0.5	1
23.	**Selenium**	**mg/l**	0.05						
24.	**Sulphate (SO4)**	**mg/l**	500						
25.	**Sulphide (S)**	**mg/l**	1.0				0.2		2
26.	**TDS**	**mg/l**	1500						
27.	**TSS**	**mg/l**	80	80	50	50			100
28.	**Temperature****	**mg/l**	<3						
29.	**TKN**	**mg/l**	20						
30.	**Total residual chlorine**	**mg/l**	0.5						
31.	**Zinc total**	**mg/l**	3		2	2			
32.	**Free Ammonia[8]**	**mg/l**	5						
33.	**Color and Odor*[9]**		Absent						

Note:

The generic standards will apply unless otherwise stated.

All units are mg/l unless otherwise stated

*For color and odor, it is recommended that as far as practicable color and unpleasant odor should be absent in the samples.

[8]American Public Health Association (APHA)

[9]Colour: American Public Health Association (APHA); Odour: IS 3025 (Part 5)

3. Sewage Treatment Plant (STP) Discharge Standards

Parameter	Unit	Standards
BOD	**mg/l**	30
TSS	**mg/l**	100
Fecal coliform	**CFU/100ml**	1000
pH[10]	**pH scale**	6.5-9
COD[11]	**mg/l**	125

[10]American Public Health Association (APHA)
[11]American Public Health Association (APHA)

4. Ambient Air Quality Criteria

Parameter		Unit	Industrial area	Mixed Area*	Sensitive area**
Total Suspended Particulate Matter	**24-hour average**	**µg/m³**	500	200	100
	Yearly average	**µg/m³**	360	140	70
PM 2.5[12]	**24-hour average**	**µg/m³**	60	60	60
	Yearly average	**µg/m³**	40	40	40
PM 10	**24-hour average**	**µg/m³**	200	100	75
	Yearly average	**µg/m³**	120	60	50
Sulfur Dioxide (SO2)	**24-hour average**	**µg/m³**	120	80	30
	Yearly average	**µg/m³**	80	60	15
Nitrogen Oxides (NOx)	**24-hour average**	**µg/m³**	120	80	30
	Yearly average	**µg/m³**	80	60	15
Carbon Monoxide	**8-hour average**	**µg/m³**	5,000	2,000	1,000
	1-hour average	**µg/m³**	10,000	4,000	2,000
Ozone[13]	**8-hour average**	**µg/m³**	100	100	100
	1-hour average	**µg/m³**	180	180	180

*__Mixed Area__ means area where residential, commercial or both activities take place

**__Sensitive Area__ means area where sensitive targets are in place like hospitals, schools, sensitive ecosystems

[12]Gravimetric/ Tapered element oscillating micro balance (ToEM)/Beta Attenuation

[13]UV Photometric/Chemiluminescence/Chemical Method

5. Industry Emission Standards (Maximum Limit for Pollutants)

Industrial type by technology	Maximum Limit for Pollutants				
	SPM	SO2	NOx	CO	Total Fluoride[14]
Unit	(mg/Nm³)	(mg/Nm³)	(mg/Nm³)	(mg/Nm³)	(mg/Nm³)
Lime Kilns	150	100	100	50	-
Arc furnace, induction furnace	150	100	100	50	-
Tapping fume stack	150	-	-	-	-
Coal fired, oil fired, wood fired boiler	150	100	100	50	-
Horizontal/rotary kiln, vertical shaft kiln and other kilns	150	100	100	50	-
Other technologies	150	100	100	50	25

[14]Specific Ion Electrode Method (EPA Method)

6. Industrial Emission Standards for Aluminum Smelting Unit[15]

Parameter	Unit	Standard	
Raw material handling			
PM	**mg/Nm3**	150	
Precipitation Area			
PM		Calcination	250
CO	**%**	Calcination	1%
Stack Height	**m**	Calcination	H=14(Q)0.3 where Q is emission rate of SO2 in kg/hr and H is stack height in m
Smelter Plant			
PM	**mg/Nm3**	Green Anode Shop	150
	mg/Nm3	Anode Bake Oven	50
	mg/Nm3	Pot Room	150
Total Fluoride	**mg/Nm3**	Anode Bake Oven	0.8
	mg/Nm3	Pre-Baked Technology	0.8
Polyfluorinated Hydrocarbons	**mg/Nm3**	0.1 (All types of smelting of Al)	

[15]Specific Ion Electrode Method (EPA Method)

7. Workplace Emission Standards

Parameter		Unit	Standards
TSPM	**8-hour average**	**mg/m³**	10
RSPM (PM10)	**8-hour average**	**mg/m³**	5
PM 2.5[16]	**24-hour average**	**mg/m³**	25
	1-year average	**mg/m³**	10
Sulfur dioxides	**8-hour average**	**mg/m³**	1
Nitrogen oxides	**8-hour average**	**mg/m³**	1
Carbon monoxide	**8-hour average**	**mg/m³**	5
Pb[17]	**1-hour average**	**mg/m³**	0.0005
Ozone[18]	**8-hour average**	**ppm**	0.08

[16]Gravimetric/light-scattering/ beta attenuation-based instruments
[17]National Institute of Occupational Safety and Health (NIOSH) Method 7303
[18]UV Photometric/ Chemiluminescence/ Chemical method

8. Vehicular Emission and Noise Limit Standards

Vehicle Emission standards

Fuel Type	Vehicles registered prior 01/2005	Vehicles registered after 01/2005	Vehicles registered prior 01/2021	Vehicles registered after 01/2021 [Approval type: Euro 6/BS VI]
Petrol/ Gasoline (%CO)	4.5 %	4.0 %	4.0 %	0.5%
Diesel (%HSU)	75%	70%	70%	50%

Vehicular Noise Level Limits

	Vehicular Noise Level Limits	
S. No.	**Type of Vehicle**	**Noise Limits dB(A)[19]**
Two wheeler		
1.1	Displacement upto 80 cc	75
1.2	Displacement more than 80 cc but upto 175 cc	77
1.3	Displacement more than 175 cc	80
2	Vehicles used for carriage of passengers and capable of having not more than nine seats, including the driver's seat	74
Vehicles used for carriage of passengers having more than nine seats, including the driver's seat, and a maximum gross Vehicle Weight (GVW) of more than 3.5 tonnes		
3.1	With an engine power less than150 KW	78
3.2	With an engine power of 150 KW or above	80
Vehicles used for carriage of passengers having more than nine seats, including the driver's seat: Vehicles used for carriage goods		

[19]Sound pressure level (SPL)

4.1	With maximum GVW not exceeding 2 tonnes	76
4.2	With maximum GVW greater than 3 tonnes but not exceeding 3.5 tonnes	77
Vehicles used for transport of goods with a maximum GVW exceeding 3.5 tonnes		
5.1	With an engine power less than 75 KW	77
5.2	With an engine power of 75 KW or above but less than 150 KW	78

9. Noise Level Limits

Parameter	Unit	Day	Night
Industrial area	**dB (A)**	75	65
Mixed area	**dB (A)**	65	55
Sensitive area	**dB (A)**	55	45

All the Values are Maximum Value

*Day time is from 6:00 hours to 22:00 hours (human activities)

**Night time is from 22:00 hours to 6:00 hours (limited human activities)

Maximum value allowed in workplace at any point of time is 75 dB(A)

10. Incineration Emission Standards

Parameter [20]	Unit	Solid waste*		Bio-medical waste		Hazardous waste	
		Value	Sampling duration (minutes, unless otherwise stated)	Value	Sampling duration (minutes, unless otherwise stated)	Value	Sampling duration (minutes, unless otherwise stated)
Particulates	**mg/Nm³**	50	Half hourly average value	50	30 or 1NM³ of sample volume,which ever is more	50	30
HCl	**mg/Nm³**	50	Half hourly average value	50	30 or 1NM³ of sample volume, whichever is more	50	30
SO_2	**mg/Nm³**	200	Half hourly average value			200	30
CO	**mg/Nm³**	100	Half hourly average value			100	30
	mg/Nm³	50	Half hourly average value			50	24 hours
Total Organic Carbon	**mg/Nm³**	20	Half hourly average value			20	30
HF	**mg/Nm³**	4	Half hourly average value			4	30
NO_x(NO and NO_2 expressed as NO_2)	**mg/Nm³**	400	Half hourly average value	400	30 for online sampling or grab sample	400	30
Total dioxins and furans	**ng TEQ/N m³**	0.1	6-8 hours	0.1	8 hours or 5NM³ of sample volume, whichever is more	0.1	8 hours
Cd + Th + their compounds	**mg/Nm³**	0.05	Anywhere between 30 minutes and 8 hours.			0.05	2 hours
Hg and its compounds	**mg/Nm³**	0.05	Anywhere between 30 minutes and 8 hours.	0.05	2 hours or 1NM³ of sample volume, whichever is more	0.05	2 hours

[20]Test Methods

Particulates	EPA	HF	EPA
HCl	EPA	NO_x(NO and NO_2 expressedas NO_2)	EPA
SO_2	EPA	Total dioxins and furans	EPA
CO	IS:10270-1992	Cd + Th + their compounds	EPA
Total Organic Carbon	EPA	Hg and its compounds	EPA
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V +their compounds	EPA		

Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V + their compounds	**mg/Nm³**	0.5	Anywhere between 30 minutes and 8 hours.			0.50	2 hours

Note:

*Solid Waste refers to all types of inert' waste that is not bio-degradable, recyclable or reusable in any form or solid waste generated in geographic regions where there is no facility for recycling and reusing the waste.

11. Waste Incinerator ash disposal/utilization standards[21]

Substance	Limit values for element leaching	
	Cat. 2 (mg/kg)	Cat. 3 (mg/kg)
Chloride	300	6000
Sulphate	500	8000
Sodium	200	3000
Arsenic	0.016	0.1
Barium	0.6	8
Lead	0.02	0.2
Cadmium	0.004	0.08
Chromium total	0.02	1
Copper	0.09	4
Mercury	0.0002	0.002
Manganese	0.3	2
Nickel	0.02	0.14
Zinc	0.2	3

Note:

- Cat 2: Utilization in Roads, Paths, Cable graves, Floors and foundations, Noise banks Ramps, pads etc.
- Cat 3: Utilization in Roads, Paths, Cable graves
- If the value of parameter exceeds cat 3, the residual is to be landfilled

The use is constrained by the following additional requirements:

- All applications must be paved (watertight pavement is required if category 3)
- The distance to the nearest drinking water well must be 30 m or more
- The residues must be placed above the highest ground water table
- The maximum average thickness of the ash/residue layer is 1 m (paths: 0.3 m; ramps: 4 m; noise banks: 5 m).

[21]CEN pr EN 12457-part3