Water Quality Standards

Technical standards on water quality have been established by a number of organizations including the American Society for Testing and Materials (ASTM), International Organization for Standardization (ISO), United States Pharmacopoeia (USP) and the Clinical and Laboratory Standards Institute(CLSI) - previously known as the US National Committee for Clinical Laboratory Standards (NCCLS). CLSI outlines Clinical Laboratory Reagent Water (CLRW) guidelines.

ASTM Standards for Laboratory Reagent Water (ASTM D1193-91)

ASTM: American Society for Testing and Materials

Measurement (Unit)	Type I	Type II	Type III	Type IV
Resistivity (MΩ-cm)	> 18	> 1	> 4	> 0.2 (200KΩ)
Conductivity (µS/cm)	< 0.056	< 1	< 0.25	< 5.0
pH at 25˚C	N/A	N/A	N/A	5.0 – 8.0
Total Organic Carbon (TOC) ppb or µg/L	<50	<50	<200	N/A
Sodium (ppb or µg/L)	< 1	< 5	< 10	< 50
Chloride (ppb or µg/L)	< 1	< 5	< 10	< 50
Silica (ppb or µg/L)	< 3	< 3	< 500	N/A

The ASTM standards are further subdivided into A, B and C that can be used in conjunction with the type I, II, III or IV water above when bacteria levels need to be controlled.

Additional ASTM Sub-Standards for Laboratory Reagent Water

Measurement (Unit)	A	B	C
Heterotrophic Bacteria Count (CFU/ml)	< 1	< 10	< 1000
Endotoxin (units per ml)	< 0.03	< 0.25	N/A

ISO 3696 Standard

ISO: International Organization for Standardization

Parameter	Grade 1	Grade 2	Grade 3
Conductivity µS/cm (temp corrected)	< 0.1	< 1.0	< 5.0
pH at 25˚C	N/A	N/A	5.0 – 7.0
Oxidizable matter Oxygen (02) content mg/L	N/A	< 0.08	< 0.4
Absorbance at 254 nm and 1 cm optical path length, absorbance units	< 0.001	< 0.01	N/A
Residue after evaporation on heating at 110˚C mg/kg	N/A	< 1	< 2
Silica (Si02) mg/L	< 0.01	< 0.02	N/A

CLSI[1]-CLRW Guidelines

CLSI-CLRW: Clinical and Laboratory Standards Institute– Clinical Laboratory Reagent Water

[1] CLSI was formerly known as NCCLS (US National Committee for Clinical Laboratory Standards)

Contaminant	Parameter and Unit	Type 3	Type 2	Type 1	CLRW
Ions	Resistivity (MΩ-cm)	> 0.05 (50 KΩ)	> 1	> 18	> 10
Organics	Total Organic Carbon (TOC) ppb	< 200	< 50	< 10	< 500
Pyrogens	(Eu/ML)	N/A	N/A	< 0.03	---
Particles	Particles > 0.2 µm (units/mL)	N/A	N/A	< 1 (0.22 µ filtration required)	Include 0.22 µ filtration
Colloids	Silica (ppb)	< 1000	< 100	< 10	----
Bacteria	Bacteria (cfu/mL)	< 1000	< 100	< 1	< 10

These values are best used as guidelines, as many applications require further treatment based on other factors. For example, many molecular biology applications require Type 1 water that is free of DNase and RNase and simple washing of instruments (usually Type 3) might require water that is pyrogen free for critical applications (Type 1).

Laboratory Water Purity Specifications '*Consolidated*' Guidelines

Contaminant	Parameter and Unit	Type 1	Type 2	Type 3
Ions	Resistivity (MΩ-cm)	> 18.0	> 1.0	> 0.05 (50 KΩ)
	Silica (ppb)	< 10	< 100	< 1000
Organics	Total Organic Carbon (TOC) ppb	< 20	< 50	< 200
Particles	Particles > 0.2 µm (#/ml)	< 1	N/A	N/A
Bacteria	Bacteria (cfu/ml)	< 1	< 100	< 1000
	Endotoxin (Eu/ML)	< 0.001	N/A	N/A

Typical uses for each type are outlined below:

Type 1	Required for critical laboratory applications such as HPLC, Mobile Phase Preparation, blanks and sample dilution for analytical techniques such as GC, HPLC, AA, ICP-MS, etc. Preparation of buffers and media for mammalian cell culture and IVF. Production of reagents for molecular biology applications (DNA sequencing, PCR). Preparation of solutions for electrophoresis and blotting.
Type 2	Used in buffers, pH solutions and microbiological culture media preparation and for preparation of reagents for chemical analysis. Used in clinical analyzers, cell culture incubators and weatherometers, etc. Also used as feed water to Type 1 systems.
Type 3	Used for glassware rinsing, filling autoclaves and heating baths and humidifiers. Also used as feed water to Type 1 systems.

Source: www.millipore.com

USP Standards

USP: United States Pharmacopoeia

Properties	USP 'Purified Water'	USP 'Water for Injection' & 'Highly Purified Water'
Conductivity (µS/cm @ 25˚C)	< 1.3	< 1.3
Total Organic Carbon (TOC) ppb or µg/L	< 500*	< 500*
Bacteria (guideline)	< 100 cfu/ml	< 10 cfu/100ml
Endotoxin (EU/ml)	N/A	< 0.25 EU/ml

*Or pass oxidisable substance test