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Federal Test Method
Standard No. 7916

Standard Specification for Reagent Water[1]

This standard is issued under the fixed designation D1193; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification describes the required characteristics of waters deemed suitable for use with the Standards under the jurisdiction of ASTM.

1.2 The alphanumeric characters ascribed to water types and grades are specified in the ASTM Format and Style Manual. These have been assigned in order of historical precedence and should not be taken as an indication of a progression in water purity.

1.3 Four types of waters have been specified, with three additional grades that can be applied to the four types. The grade specifications specifically address contaminants of microbiological origin.

1.4 All applicable ASTM Standards are expected to reference one or more of these reagent water types where reagent water is needed as a component of an analytical measurement process. Where a different water type or grade is needed for an ASTM Standard, it may be added to this Specification through the ASTM Standard revision process.

1.5 Although these water types and associated grades have been defined specifically for use with ASTM Standards, they may be appropriate for other applications. It is the responsibility of the users of this standard to ensure that the selected water types or grades are suitable for their intended use. Historically, reagent water Types I, II, III, and IV have been linked to specific processes for their production. Starting with this revision, these types of waters may be produced with alternate technologies as long as the appropriate constituent specifications are met *and that water so produced has been shown to be appropriate for the application where the use of such water is specified*. Therefore, the selection of an alternate technology in place of the technology specified in Table 1 should be made taking into account the potential impact of other contaminants such as microorganism and pyrogens. Such contaminants were not necessarily considered by the performance characteristics of the technology previously specified.

1.6 Guidance for applications, the preparation, use and monitoring, storage, handling, distribution, testing of these specified waters and validation of the water purification system is provided in Appendix X1 of this document.

1.7 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1125 Test Methods for Electrical Conductivity and Resistivity of Water

D1129 Terminology Relating to Water

D1293 Test Methods for pH of Water

D4453 Practice for Handling of High Purity Water Samples[3]

D4517 Test Method for Low-Level Total Silica in High-Purity Water by Flameless Atomic Absorption Spectroscopy

D5128 Test Method for On-Line pH Measurement of Water of Low Conductivity

D5173 Test Method for On-Line Monitoring of Carbon Compounds in Water by Chemical Oxidation, by UV Light Oxidation, by Both, or by High Temperature Combustion Followed by Gas Phase NDIR or by Electrolytic Conductivity

D5245 Practice for Cleaning Laboratory Glassware, Plasticware, and Equipment Used in Microbiological Analyses

D5391 Test Method for Electrical Conductivity and Resistivity of a Flowing High Purity Water Sample

D5542 Test Methods for Trace Anions in High Purity Water

[1] This specification is under the jurisdiction of ASTM Committee D19 on Water and is the responsibility of Subcommittee D19.02 on Quality Systems, Specification, and Statistics.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Determination of Trace Silica in Industrial Process Waters by Flameless Atomic Absorption Spectrometry, Judith Rawa and Earl Henn, *Analytical Chemistry* , Vol 51, No 3, March 1979.

TABLE 1 Processes for Reagent Water Production

Type	Grade	Production Process[A,B,C,D]	µS/cm[E] (max)	MΩ·cm[F] (min)	pH[G]	TOC µg/L[H] (max)	Sodium µg/L[I] (max)	Chloride µg/L[J] (max)	Total Silica µg/L (max)	HBC[K] cfu/mL (max)	Endotoxin, EU/mL[L] (max)
I		Purify to 20 µS/cm by dist. or equiv., followed by mixed bed DI, 0.2 µm filtration[A]	0.0555	18		50	1	1	3		
I	A	Purify to 20 µS/cm by dist. or equiv., followed by mixed bed DI, 0.2 µm filtration[A]	0.0555	18		50	1	1	3	10/1000	0.03
I	B	Purify to 20 µS/cm by dist. or equiv., followed by mixed bed DI, 0.2 µm filtration[A]	0.0555	18		50	1	1	3	10/100	0.25
I	C	Purify to 20 µS/cm by dist. or equiv., followed by mixed bed DI, 0.2 µm filtration[A]	0.0555	18		50	1	1	3	100/10	
II		Distillation[B]	1.0	1.0		50	5	5	3		
II	A	Distillation[B]	1.0	1.0		50	5	5	3	10/1000	0.03
II	B	Distillation[B]	1.0	1.0		50	5	5	3	10/100	0.25
II	C	Distillation[B]	1.0	1.0		50	5	5	3	100/10	
III		Distillation, DI, EDI, and/or RO, followed by 0.45 µm filtration.[C]	0.25	4.0		200	10	10	500		
III	A	Distillation, DI, EDI, and/or RO, followed by 0.45 µm filtration.[C]	0.25	4.0		200	10	10	500	10/1000	0.03
III	B	Distillation, DI, EDI, and/or RO, followed by 0.45 µm filtration.[C]	0.25	4.0		200	10	10	500	10/100	0.25
III	C	Distillation, DI, EDI, and/or RO, followed by 0.45 µm filtration.[C]	0.25	4.0		200	10	10	500	1000/100	
IV		Distillation, DI, EDI, and/or RO.[D]	5.0	0.2	5.0 to 8.0		50	50			
IV	A	Distillation, DI, EDI, and/or RO.[D]	5.0	0.2	5.0 to 8.0		50	50		10/1000	0.03
IV	B	Distillation, DI, EDI, and/or RO.[D]	5.0	0.2	5.0 to 8.0		50	50		10/100	0.25
IV	C	Distillation, DI, EDI, and/or RO.[D]	5.0	0.2	5.0 to 8.0		50	50		100/10	

[A] Type I grade of reagent water shall be prepared by distillation or other equal process, followed by polishing with a mixed bed of ion-exchange materials and a 0.2-µm membrane filter. Feed water to the final polishing step must have a maximum conductivity of 20 µS/cm at 298K (25°C). Type I reagent water may be produced with alternate technologies as long as the appropriate constituent specifications are met *and that water so produced has been shown to be appropriate for the application where the use of such water is specified*.

[B] Type II grade of reagent water shall be prepared by distillation using a still designed to produce a distillate having a conductivity of less than 1.0 µS/cm at 298 K (25°C). Ion exchange, distillation, or reverse osmosis and organic adsorption may be required prior to distillation, if the purity cannot be attained by single distillation. Type II reagent water may be produced with alternate technologies as long as the appropriate constituent specifications are met *and that water so produced has been shown to be appropriate for the application where the use of such water is specified*.

[C] Type III grade of reagent water shall be prepared by distillation, ion exchange, continuous electrodeionization, reverse osmosis, or a combination thereof, followed by polishing with a 0.45-µm membrane filter. Type III reagent water may be produced with alternate technologies as long as the appropriate constituent specifications are met *and that water so produced has been shown to be appropriate for the application where the use of such water is specified*.

[D] Type IV grade of reagent water may be prepared by distillation, ion exchange, continuous electrodeionization, reverse osmosis, electrodialysis, or a combination thereof. Type IV reagent water may be produced with alternate technologies as long as the appropriate constituent specifications are met *and that water so produced has been shown to be appropriate for the application where the use of such water is specified*.

[E] Electrical conductivity at 25°C.

[F] Electrical resistivity at 25°C.

[G] pH at 25°C, not applicable to higher resistivity waters.

[H] Total organic carbon.

[I] Sodium.

[J] Chloride ion.

[K] Heterotrophic bacteria count.

[L] Endotoxin in endotoxin units per mL.

by Ion Chromatography

D5997 Test Method for On-Line Monitoring of Total Carbon, Inorganic Carbon in Water by Ultraviolet, Persulfate Oxidation, and Membrane Conductivity Detection

D6071 Test Method for Low Level Sodium in High Purity Water by Graphite Furnace Atomic Absorption Spectroscopy

D6161 Terminology Used for Microfiltration, Ultrafiltration, Nanofiltration and Reverse Osmosis Membrane Processes

D6529 Test Method for Operating Performance of Continuous Electrodeionization Systems on Feeds from 50–1000 µS/cm[4]

F1094 Test Methods for Microbiological Monitoring of Water Used for Processing Electron and Microelectronic Devices by Direct Pressure Tap Sampling Valve and by the

[4] Withdrawn. The last approved version of this historical standard is referenced on www.astm.org.