



## Standard Specification for Reagent Water<sup>1</sup>

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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. 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 manual, Form and Style for ASTM Standards. 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 specification 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 specification.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

- 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
- 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 Guide for On-Line Monitoring of Total Organic Carbon in Water by Oxidation and Detection of Resulting Carbon Dioxide

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

**TABLE 1 Processes for Reagent Water Production**

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

<sup>A</sup> 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.*

<sup>B</sup> 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.*

<sup>C</sup> 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.*

<sup>D</sup> 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.*

<sup>E</sup> Electrical conductivity at 25°C.

<sup>F</sup> Electrical resistivity at 25°C.

<sup>G</sup> pH at 25°C, not applicable to higher resistivity waters.

<sup>H</sup> Total organic carbon.

<sup>I</sup> Sodium.

<sup>J</sup> Chloride ion.

<sup>K</sup> Heterotrophic bacteria count.

<sup>L</sup> Endotoxin in endotoxin units per mL.