



Designation: D4192 – 15

Standard Test Method for Potassium in Water by Atomic Absorption Spectrophotometry¹

This standard is issued under the fixed designation D4192; 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.

1. Scope*

1.1 This test method covers the determination of low amounts of potassium in waters² having low solids content. The applicable range of this test method is 0.20 to 4.0 mg/L when using the 766.5-nm resonance line. The range may be extended upward by dilution of an appropriate aliquot of sample or by using the less-sensitive 404.4-nm resonance line. Many workers have found that this test method is reliable for potassium levels to 0.02 mg/L, but use of this test method at this low level is dependent on the configuration of the aspirator and nebulizer systems available in the atomic absorption spectrophotometer as well as the skill of the analyst. The precision and bias data presented are insufficient to justify use of this test method in the 0.02-mg/L range.

1.2 This test method has been used successfully with spiked reagent water. It is the analyst's responsibility to ensure the validity of this test method to other low dissolved solids matrices.

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

1.4 *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.* For a specific precautionary statement, see 8.6.

¹ This test method is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.05 on Inorganic Constituents in Water.

Current edition approved Feb. 1, 2015. Published March 2015. Originally approved in 1982. Last previous edition approved in 2008 as D4192 – 08. DOI: 10.1520/D4192-15.

² Platte, J. A., and Marcy, V. M., "A New Tool for the Water Chemist," *Industrial Water Engineering*, May 1965.

2. Referenced Documents

- 2.1 *ASTM Standards*:³
- D1066 Practice for Sampling Steam
 - D1129 Terminology Relating to Water
 - D1193 Specification for Reagent Water
 - D2777 Practice for Determination of Precision and Bias of Applicable Test Methods of Committee D19 on Water
 - D3370 Practices for Sampling Water from Closed Conduits
 - D4841 Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents
 - D5810 Guide for Spiking into Aqueous Samples
 - D5847 Practice for Writing Quality Control Specifications for Standard Test Methods for Water Analysis

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this test method, refer to Terminology D1129.

4. Summary of Test Method

4.1 Potassium is determined by flame atomic absorption spectrophotometry. The potassium content is determined by aspirating the low solids sample directly with no sample pretreatment.

5. Significance and Use

5.1 Potassium occurs in rocks in a form that is not easily solubilized; therefore, the potassium content of natural waters is usually low. Most natural waters contain less than 20 mg/L of potassium, but waters containing several hundred milligrams per litre are occasionally found. Potassium is essential to animal nutrition, but a concentration of 1000 to 2000 mg/L in stock water is regarded as the extreme limit permissible.

³ 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.

*A Summary of Changes section appears at the end of this standard

6. Interferences

6.1 In the analysis of low-solids water, interferences are usually negligible.

7. Apparatus

7.1 *Atomic Absorption Spectrophotometer* for use at 766.5 nm.

NOTE 1—The manufacturer's instructions should be followed for all instrumental parameters. Wavelengths other than 766.5 nm may be used only if they have been determined to be equally suitable.

7.2 *Potassium Hollow-Cathode Lamps*—Multielement hollow cathode lamps are available and also have been found satisfactory.

7.3 *Pressure-Reducing Valves*—The supplies of fuel and oxidant shall be maintained at pressures somewhat higher than the operating pressure of the instrument by using suitable valves.

8. Reagents and Materials

8.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.⁴ Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

8.2 *Purity of Water*—Unless otherwise indicated, reference to water shall be understood to mean reagent water conforming to Specification D1193, Type I. Other reagent water types may be used provided it is first ascertained that the water is of sufficiently high purity to permit its use without adversely affecting the bias and precision of the test method. Type II water was specified at the time of round robin testing of this test method.

8.3 *Potassium Solution, Stock* (1.0 mL = 1.0 mg K)—Dry potassium chloride to constant weight at 105°C. Dissolve 1.907 g of the dry potassium chloride (KCl) in water and dilute to 1 L with water.

NOTE 2—Certified potassium stock solutions of appropriate known purity are commercially available through chemical supply vendors.

8.4 *Potassium Solution, Standard* (1.00 mL = 0.1 mg K)—Dilute 100.0 mL of potassium stock solution to 1 L with water.

8.5 *Oxidant: Air*, which has been passed through a suitable filter to remove oil, water, and other foreign substances is the usual oxidant.

8.6 *Fuel: Acetylene*—Standard, commercially available acetylene is the usual fuel. Acetone, always present in acetylene cylinders can affect analytical results. The cylinder should be replaced at 345 kPa (50 psig) to avoid acetone carry over.

⁴ *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For Suggestions on the testing of reagents not listed by the American Chemical Society, see *Annual Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

(Warning—"Purified" grade acetylene containing a special proprietary solvent rather than acetone should not be used with poly(vinyl chloride) tubing as weakening of the tubing walls can cause a potentially hazardous situation.)

9. Sampling

9.1 Collect the samples in accordance with the applicable ASTM standard as follows: Practices D3370 and Practice D1066.

10. Standardization

10.1 Prepare 100 mL each of a blank and at least four standard solutions to bracket the expected potassium concentration range of the samples to be analyzed by diluting the standard potassium solution 8.4 with water. Prepare the standards each time the test is to be performed or as determined by Practice D4841. Select the standards to give zero, median, and maximum points for an analytical curve.

10.2 Analyze at least four working standards containing concentrations of potassium that bracket the expected sample concentration, prior to analysis of samples, to calibrate the instrument. Aspirate the blank and the standards and record the instrument readings. Aspirate water between standards.

10.3 Read directly in concentration if this capability is provided with the instrument or prepare a linear analytical curve by plotting the absorbance versus concentration for each standard on linear graph paper.

11. Procedure

11.1 Aspirate each sample and determine its absorbance or concentration. Aspirate water between samples.

12. Calculation

12.1 Calculate the concentrations of potassium in the samples, in milligrams per litre, by either reading directly in concentration if the capability is provided with the instrument or referring the absorbance obtained for each sample to a prepared analytical curve (see 10.3).

12.2 If an aliquot of diluted sample was analyzed, multiply the concentration of potassium, in milligrams per litre, by the appropriate dilution factor.

13. Precision and Bias⁵

13.1 The overall and single-operator precision of this test method for eight laboratories, which included a total of twelve

⁵ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D19-1081. Contact ASTM Customer Service at service@astm.org.

TABLE 1 Determination of Bias for Potassium in Reagent Water by Atomic Absorption

Amount Added, mg/L	Amount Found, mg/L	S_r	S_o	Bias %
0.15	0.164	0.037	0.014	+ 9.33
1.50	1.62	0.085	0.044	+ 8.00
3.00	3.03	0.179	0.062	+ 1.13