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Standard Guide for Use of Test Kits to Measure Inorganic Constituents in Water¹

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1. Scope

1.1 This guide covers general considerations for the use of test kits for quantitative determination of analytes in water and wastewater. Test kits are available from various manufacturers for the determination of a wide variety of analytes in drinking water, surface or ground waters, domestic and industrial feedwaters and wastes, and water used in power generation and steam raising. See Table 1 for a listing of some of the types of kits that are available for various inorganic analytes in water.²

1.2 Ranges, detection limits, sensitivity, accuracy, and susceptibility to interferences vary from kit to kit, depending on the methodology selected by the manufacturer. In some cases, kits are designed to replicate exactly an official test method of a standard-setting organization such as the Association of Official Analytical Chemists (AOAC), American Public Health Association (APHA), ASTM, or the U.S. Environmental Protection Agency (USEPA). In other cases, minor modifications of official test methods are made for various reasons, such as to improve performance, operator convenience, or ease of use. Adjustments may be made to sample size, reagent volumes and concentrations, timing, and details of the analytical finish. In yet other cases, major changes may be made to the official test method, such as the omission of analytical steps, change of the analytical finish, omission of reagents, or substitution of one reagent for another. Reagents in test kits are often combined to obtain a fewer number and make the test easier to use. Additives may also be used to minimize interferences and to make the reagent more stable with time. A kit test method may be based on a completely different technology, not approved by any official or standard-setting organization. Combinations of test kits—multi-parameter test kits—may be packaged to satisfy the requirements of a particular application conveniently. The test kits in such combination products may be used to make dozens of determinations of several parameters.

1.3 Test kit reagent refills are commonly available from manufacturers. Refills permit cost savings through reuse of the

TABLE 1 Availability and Types of Test Kits

Analyte	Kit Methodology ^A
Acidity	T
Alkalinity	C, P, T
Aluminum	C, P
Ammonia	C, P
Boron	C, P
Bromine	C, P, T
Cadmium	C
Calcium	P, T
Carbon dioxide	T
Chloride	A, C, P, T
Chlorine	C, P, T
Chlorine dioxide	C, P, T
Chromium (III)	C
Chromium (VI)	C, P, T
Cobalt	C
Copper	C, P, T
Cyanide	C, P, T
Fluoride	P
Hardness	C, GNG, P, T
Hydrazine	C, P
Hydrogen peroxide	C, P, T
Iodine	C, P, T
Iron	C, P
Lead	C, P
Manganese	C, P
Magnesium	C, T
Molybdate	C, P, T
Nickel	C, P
Nitrate	C, P
Nitrite	C, P, T
Oxygen (dissolved)	C, P, T
Ozone	C, P
Permanganate	C, T
pH	C, P
Phosphate	C, P
Silica	C, P
Silver	P
Sulfate	A, C, P, T
Sulfide	C, P, T
Sulfite	C, P, T
Thiocyanate	C
Tin	C
Vanadium	C
Zinc	C, P, T

^A Kit Methodology: A = appearance/turbidity, C = visual colorimetric, GNG = go no go, P = photometric, and T = titrimetric.

major test kit components.

1.4 Because of the wide differences among kits and methodologies for different analytes, universal instructions cannot be provided. Instead, the user should follow the instructions provided by the manufacturer of a particular kit.

1.5 A test kit or kit component should not be used after the manufacturer's expiration date; it is the user's responsibility to

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² Test kits for determining inorganic analytes in water are available from various United States and foreign manufacturers, as well as from laboratory supply companies.

determine that the performance is satisfactory.

1.6 *This standard does not purport to address all of the safety problems, 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 specific precautionary statements, see Section 10.

2. Referenced Documents

2.1 ASTM Standards:

- D 1129 Terminology Relating to Water³
- D 1192 Specification for Equipment for Sampling Water and Steam in Closed Conduits³
- D 1193 Specification for Reagent Water³
- D 3370 Practices for Sampling Water from Closed Conduits³
- D 4453 Practice for Handling of Ultra-Pure Water Samples³
- D 4691 Practice for Measuring Elements in Water by Flame Atomic Absorption Spectrophotometry³
- E 178 Practice for Dealing with Outlying Observations⁴
- E 275 Practice for Describing and Measuring Performance of Ultraviolet, Visible, and Near Infrared Spectrophotometers⁵
- E 958 Practice for Measuring Practical Spectral Bandwidth of Ultraviolet-Visible Spectrophotometers⁵

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminology D 1129 and Practice D 4691.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *analyte*—the chemical or constituent being determined.

3.2.2 *carryover*—the contamination of a subsequent sample by a previous sample, typically due to incomplete cleaning of a reused test kit component.

3.2.3 *expiration date*—a date applied by the manufacturer after which an accurate result is not ensured by the manufacturer.

3.2.4 *finish (usually analytical finish)*—the analytical methodology used for the measuring step of the analysis.

3.2.5 *kit (or test kit)*—a commercially packaged collection of components that is intended to simplify the analytical testing function.

3.2.6 *interference*—an effect of a matrix component that might cause an analytical bias or that might prevent a successful analysis.

3.2.7 *material safety data sheet*—a federally-mandated, safety-related document that must be made available to kit chemistry users.

3.2.8 *matrix*—sample contents other than the target analyte.

3.2.9 *official method*—an analytical test method officially approved by an industry consensus organization such as

ASTM, AOAC, or APHA or by a government entity such as the USEPA.⁶

3.2.10 *refill*—a replacement package of test kit components used in testing.

3.2.11 *spike*—a small volume, high relative concentration aliquot of analyte added quantitatively to a split sample as a quality check.

3.2.12 *split sample*—a sample that is split into sub-samples that are intended to have the same composition as the original sample.

4. Summary of Guide

4.1 Analytical test kits simplify the operational procedures necessary to perform an analysis. This guide includes general considerations relating to the procedures to be followed in order to ensure an accurate determination. This guide also describes, in general terms, the characteristics of some kit types and kit components and includes some comments on their capabilities, benefits and, where appropriate, their limitations.

5. Significance and Use

5.1 Inorganic constituents in water and wastewater must be identified and measured to support effective water quality monitoring and control programs. Currently, one of the simplest, most practical and cost effective means of accomplishing this is through the use of chemical test kits and refills. A more detailed discussion is presented in ASTM STP 1102.⁷

5.2 Test kits have been accepted for many applications, including routine monitoring, compliance reporting, rapid screening, trouble investigation, and tracking contaminant source.

5.3 Test kits offer time-saving advantages to the user. They are particularly appropriate for field use and usually are easy to use. Users do not need to have a high level of technical expertise. Relatively unskilled staff can be trained to make accurate determinations using kits that include a premixed liquid reagent, premeasured reagent (tablets, powders, or glass ampoules), and premeasured sample (evacuated glass ampoules).

6. General Considerations

6.1 *Personnel*—The selection of a test kit and determination that the test kit analysis is appropriate should be conducted by a responsible chemist. The development of suitable protocols and conditions for safe use should be conducted by the responsible chemist with the assistance of an industrial hygienist. The kit user may be a relatively unskilled staff person but must be trained to an appropriate level of proficiency.

6.2 *Completeness of Kits*—The kit's components may or may not be complete for the required determination. The user

⁶ Other documents: *Official Methods of Analysis of the Association of Official Analytical Chemists*, 15th Ed., AOAC, Arlington, VA, 1990. Changes are published in annual supplements. *Standard Methods for the Examination of Water and Wastewater*, 17th Ed., APHA, AWWA, and WPCF, Washington, DC, 1989. *Methods for the Chemical Analysis of Water and Wastes*, USEPA, Cincinnati, OH, March 1983.

⁷ Spokes, G. Neil, and Bradley, Julie A., "Performance Testing of Selected Test Kits for Analysis of Water Samples," *ASTM STP 1102*, ASTM, Philadelphia, PA, 1991.

³ *Annual Book of ASTM Standards*, Vol 11.01.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

⁵ *Annual Book of ASTM Standards*, Vol 03.06.