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Standard Guide for Field Preservation of Groundwater–Ground Water Samples¹

This standard is issued under the fixed designation D6517; 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.

^{ε1} NOTE—Editorial changes were made throughout in May 2012.

1. Scope–Scope*

1.1 This guide covers methods for field preservation of ~~groundwater samples~~ ground water samples from the point of sampling through receipt at the laboratory. Laboratory preservation methods are not described in this guide. Purging and sampling techniques are not addressed in this standard but are addressed in Guides D6564/D6564M, D6634/D6634M, D7929, and Practice D6771.

1.2 Ground water samples are subject to chemical, physical, and biological change relative to in situ conditions at the ground surfaces due to exposure to ambient conditions during sample collection. Physical and chemical preservation of samples minimize further changes in sample chemistry that can occur from the moment the ground water sample is retrieved, to the time it is removed from the sample container for extraction or analysis.

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

1.4 This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.

1.5 This standard may involve hazardous materials, operations, and equipment. 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 ~~health~~ environmental practices and determine the applicability of regulatory limitations prior to use.

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1.6 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:²

[D653 Terminology Relating to Soil, Rock, and Contained Fluids](#)

[D3694 Practices for Preparation of Sample Containers and for Preservation of Organic Constituents](#)

[D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction](#)

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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.

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

[D4840 Guide for Sample Chain-of-Custody Procedures](#)

[D5903 Guide for Planning and Preparing for a Groundwater Sampling Event](#)

[D6089 Guide for Documenting a Groundwater Sampling Event](#)

[D6564/D6564M Guide for Field Filtration of Groundwater Samples](#)

[D6634/D6634M Guide for Selection of Purging and Sampling Devices for Groundwater Monitoring Wells](#)

[D6771 Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations](#)

[D7929 Guide for Selection of Passive Techniques for Sampling Groundwater Monitoring Wells](#)

2.2 *Other Documents:*

Standard Methods for the Examination of Water and Wastewater, 20th ed., 1999³

*International Air Transport Association Dangerous Goods Regulations*⁴

U.S. EPA, Office of Solid Waste, SW-846, 3rd ed. [\(with updates\)](#)

U.S. EPA, Title 40, Code of Federal Regulations, Part 136 [with updates](#)

U.S. DOT, Title 49, Code of Federal Regulations, Part 172 [with updates](#)

3. Terminology

3.1 *Definitions*—For definitions of common technical terms in this standard, refer to Terminology [D653](#).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *chemical preservation*—*preservation, n—in ground water sampling*, the addition of acidic, alkaline or biologically toxic compounds, or combination thereof, to a ~~groundwater~~ ground water sample to prevent changes in chemical properties of the sample that may occur after collection.

3.2.2 *holding time*—*time, n—in ground water sampling*, the maximum amount of time that may transpire from the moment a sample container is filled to the time the sample is extracted or analyzed. Holding times are parameter-specific, variable in length, and defined by laboratory analytical methods.

3.2.3 *physical preservation*—methods that are implemented to protect the physical integrity of a ~~groundwater~~ ground water sample from the ~~time the sample is collected until the sample is analyzed~~.

3.2.3 *temperature blank*—*blank, n—in ground water sampling*, a quality control sample that is transported with samples and is used by the laboratory performing sample analyses to verify that temperature-sensitive samples have been adequately cooled to 4°C for shipment to and arrival at the laboratory (see laboratory, [Note 1](#)).

NOTE 1—Forms of temperature blank include: (1) using a commercially prepared, fluid-filled bottle containing a permanently fixed National Institute of Standards and Technology (NIST)-certified (or NIST-traceable) thermometer, the temperature of which is read directly by the laboratory; (2) submission of a designated sample container filled with water (for example, groundwater, distilled water, or deionized water) that is opened by the laboratory and immediately measured for temperature of the water using a National Institute of Standards and Technology-certified (or NIST-traceable) thermometer; or (3) submission of a designated container filled with water (for example, groundwater, distilled water, or deionized water) on which the laboratory uses a remote infrared temperature sensor to measure the temperature. Regardless of the method used, all measured temperatures are compared against the required temperature for each sample (for example, 4°C) in conjunction with a previously defined window of acceptable variance from this required temperature as documented in the sampling and analysis plan.

3.2.3.1 *Discussion*—

Forms of temperature blank include: (1) using a commercially prepared, fluid-filled bottle containing a permanently fixed, calibrated, and certified thermometer, the temperature of which is read directly by the laboratory; (2) submission of a designated sample container filled with water (for example, ground water, distilled water, or deionized water) that is opened by the laboratory and immediately measured for temperature of the water using a calibrated and certified thermometer; or (3) submission of a designated container filled with water (for example, ground water, distilled water, or deionized water) on which the laboratory uses a remote infrared temperature sensor to measure the temperature. Regardless of the method used, the measured temperatures are compared against the required temperature for each sample in conjunction with a previously defined window of acceptable variance from this required temperature as documented in the sampling and analysis plan.

4. Significance and Use

4.1 ~~Groundwater~~ Ground water samples are subject to chemical, physical, and biological change relative to in-situ conditions at the ground surfaces as a result of exposure to ambient conditions during sample collection (for example, pressure, temperature, ultraviolet radiation, atmospheric oxygen, and contaminants) **(1) (2)**.⁵ Physical and chemical preservation of samples minimize

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

⁵ The boldface numbers in parentheses refer to the list of references at the end of this standard.

further changes in sample chemistry that can occur from the moment the ~~groundwater~~ ground water sample is retrieved, to the time it is removed from the sample container for extraction or analysis, or both. Measures also ~~must~~should be taken to preserve the physical integrity of the sample container.

4.2 The need for sample preservation for specific analytes should be defined prior to the sampling event and documented in the site-specific sampling and analysis plan in accordance with Guide **D5903**. The decision to preserve a sample should be made on a parameter-specific basis as defined by individual analytical methods.

4.3 This guide includes examples from government documents in the United States. When work is in other countries or regions, the local governing or regulating agencies should be consulted.

NOTE 1—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice **D3740** are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice **D3740** does not in itself assure reliable results. Reliable results depend on many factors; Practice **D3740** provides a means of evaluating some of those factors.

5. Timing and Purpose of ~~Groundwater~~Ground Water Sample Preservation

5.1 ~~Groundwater~~Ground water samples should be preserved in the field at the time of sample collection using physical means to prevent sample container breakage or temperature increases, and chemical means to minimize changes in ~~groundwater~~ground water sample chemistry prior to laboratory analysis.

6. ~~Groundwater~~Ground Water Sample Preservation Procedures

6.1 ~~Groundwater~~Ground water sample preservation procedures are grouped into two general categories: (1) physical preservation and (2) chemical preservation. Preservation procedures should address the following details on a parameter-specific basis: sample container design and construction, protection from ultraviolet light, temperature control, chemical addition, and pH control measures (2).

6.1.1 *Physical Preservation of ~~Groundwater~~Ground Water Samples*—Physical ~~groundwater~~ground water sample preservation methods include: (1) use of appropriate sample collection containers for each parameter being analyzed, (2) use of appropriate packing of sample containers for shipment to prevent sample container breakage and potential cross-contamination of samples during shipment, and (3) temperature control.

6.1.1.1 *Sample Container Selection*—Selection—Proper selection of containers for ~~groundwater~~ground water sample collection is an important means of protecting the integrity of the sample. Specifications on container design, including shape, volume, gas tightness, materials of construction, and use of cap liners, are defined for specific parameters or suites of parameters (for example, amber glass containers protect photosensitive analytes such as (PCBs) from chemical alteration). Specifications for sample container selection are documented in parameter-specific analytical methods (for example, ASTM, U.S. EPA SW846, AWWA Standard Methods) as well as in Federal (40 CFR Part 136), ~~state~~, ~~state~~ and local regulatory guidelines on ~~groundwater~~ground water sample collection and preservation. The type of sample containers to be used in a sampling event should be determined during sampling event planning in accordance with Guide **D5903** and documented in the sampling and analysis plan as described in **8.1** of this guide and Guide **D6089**.

6.1.1.2 *Sample Container Packing and Shipping*—Field personnel should package and ship samples in compliance with ~~all applicable regulations including the Department of Transportation (for example, Title 49 Code of Federal Regulations, Part 172) and the International Air Transportation Association (IATA).~~ applicable regional and national regulations. Sample containers should be shipped in a manner that will ~~ensure~~make sure the samples are received intact by the laboratory, at the appropriate temperature, and as soon as ~~possible~~practicable to allow sufficient time for the laboratory to perform the requested analyses within the holding time defined by the applicable laboratory analytical method for each parameter.

NOTE 2—If chain of custody is required by the sampling and analysis plan, the process should be initiated as the samples are taken in the field and maintained throughout the process of shipping. See Guide **D4840** for additional guidance.

6.1.1.3 *Temperature Control*—Samples analyzed for some parameters (for example, nitrite) require temperature control. The temperature of these samples should be lowered to ~~4°C~~4°C immediately ~~immediately~~ as practicable after performing ~~any~~field analyses ~~required~~needed (for example, temperature or pH) and chemical preservation (3). When necessary, temperature should be lowered as soon as ~~possible~~practicable and maintained at ~~4°C~~4°C until the sample is analyzed. Sample temperatures can be lowered most efficiently using on-site refrigeration or wet ice. Wet ice may need to be replenished prior to shipping to maintain ~~sample temperatures~~ at 4°C. ~~If required~~specified sample temperatures. If needed by regulation, dry ice may be used to cool samples, however, care should be taken to prevent sample freezing. Samples should not be frozen at any time. Reuseable ice packs may be used to lower sample temperature, however, they often do not have the capacity to adequately lower or maintain temperatures, or both; consequently, their use is not recommended (4). A temperature blank should be used with each shipping container of samples to determine actual sample temperatures at the time the sample shipment is received by the laboratory.

NOTE 3—Temperature control for the preservation of samples for each parameter or analyses should be established in the sampling and analyses plan. The appropriate equipment and supplies to measure and lower and maintain the sample temperatures from the time of collection through receipt at the laboratory should be available prior to the start of sampling. Sample temperature preservation is typically 4°C, however other regional or national agencies

may allow other temperatures (for example, 6°C). Thermometers used should be calibrated and accurate to 0.1°C.

6.1.2 ~~Chemical Preservation of Groundwater~~ Ground Water Samples:

6.1.2.1 Chemical preservation of ~~groundwater~~ ground water samples involves the addition of one or more chemicals (reagent-grade or better) on a parameter-specific basis to protect sample integrity. **Appendix XI** provides examples of common analyte-specific chemical preservation methods.

6.1.2.2 Chemical preservation is specified in numerous analytical methods as well as in various regulatory guidance documents. Chemicals can be used to adjust sample pH or inhibit microbial activity to prevent chemical alteration of samples. Initial pH of samples should be determined prior to chemical preservation so appropriate chemical adjustment can be made.

6.1.2.3 ~~Groundwater~~ Ground water samples can be chemically preserved in one of several ways: (1) titration of pH-adjusting compounds (for example, nitric acid) while monitoring pH change with a pH meter ~~or narrow-range litmus paper, capable of measuring to .1 pH units~~ (2) addition of a premeasured volume of liquid preservative (for example, sulfuric acid) contained in glass vials or ampules to the sample container (**Note 23**); (3) addition of pelletized preservative (for example, sodium hydroxide) to the sample container; and (4) addition of preservative to empty sample containers prior to shipment of the empty containers to the field (that is, prepreserved sample containers) **Note 34**. After the sample container is filled and preserved, it should be securely capped and gently inverted to ensure provide uniform distribution of the preservative throughout the sample (see **Note 45**).

NOTE 4—Care should be taken not to add too large a volume of chemical preservative to prevent sample dilution. A generally accepted limit is 0.5 % maximum dilution.

NOTE 5—The use of prepreserved containers should be evaluated on a parameter-specific basis.

NOTE 6—Pelletized preservatives may take longer to dissolve and mix with the sample.

6.1.2.4 The end point of chemical preservation, designed to adjust pH to specific final pH levels, (for example, <2.0 or >12.0) should be verified in the field using ~~narrow-range litmus paper (pH paper)~~ a properly a correctly and currently calibrated pH meter. A small amount of sample can either be decanted into a separate container or a parallel sample can be collected for pH verification (for example, for samples containing light non-aqueous phases), rather than introducing foreign materials into the sample container being submitted for analysis. When collecting samples in prepreserved containers, care ~~must~~ should be taken not to prerinse the container with the sample and to avoid overfilling the container to prevent loss of chemical preservative.

NOTE 7—Samples containing a light non-aqueous phase should not be chemically preserved with strong acid or base.

6.1.2.5 When using premeasured volume preservatives such as vials, ampules, or prepreserved containers, additional preservative should be provided by the laboratory and be available in the field to add to a sample if necessary to reach the ~~required final-needed~~ pH. The additional preservative should be the same type, grade, and concentration as that used initially to preserve the sample (see **Note 68**, **Note 79**, and **Note 810**).

NOTE 8—The use of acid and other chemicals used to chemically preserve samples can potentially expose personnel. Sampling personnel should have appropriate protective equipment in accordance with the sampling and health and safety plans when working with these materials.

7. ~~Timing of Groundwater~~ Ground Water Sample Preservation

7.1 ~~Groundwater~~ Ground water samples should be preserved immediately upon collection to minimize the time for chemical alteration of sample chemistry to occur (**3**). An exception is those samples requiring field filtration, which should be field-filtered first, then chemically preserved.

NOTE 9—When using ampules, care should be taken to avoid introducing glass shards or painted ampule surfaces into the sample container which could impact sample integrity (**5**).

NOTE 10—Even when following recommended chemical preservation methods, chemical reactions may occur (**2**). For example, water containing high concentrations of calcium carbonate may effervesce when acidified. In these cases, modifications of sample preservation methods may be necessary, such as collecting an unpreserved sample or using alternate chemical preservatives. ~~Any modifications must~~ Modifications of preservation methods are to be pre-approved by regulatory agencies and laboratories involved, and allowed by the sampling and analysis plan. Many environmental agencies publish approved sample container and preservatives and should be consulted.

NOTE 11—It may be necessary to establish site-specific protocol to address acceptable periods for storage and storage conditions for prepreserved sample containers due to the potential for chemical reactions to occur between the chemical preservative and the empty sample container.

8. ~~Report~~ Report: Test Data Sheet(s)/Form(s)

8.1 Records should be kept for ~~all the~~ forms of sample preservation used for ~~groundwater~~ ground water samples. Report the following in accordance with Guide **D6089**; and record as a minimum, the following general information (data).

8.1.1 Type of sample container(s) used for each parameter being analyzed (volume, materials of construction, type of cap, and so forth);

8.1.2 Number of each type of sample container actually filled;

8.1.3 Packaging method(s) used to prevent sample bottle breakage during sample storage and shipment;

8.1.4 Temperature and pH of ~~groundwater~~ ground water samples at the time of sample collection;

8.1.5 How ~~groundwater~~ ground water samples were cooled to 4°C, if required cooled, if needed for physical preservation;

8.1.6 Sample temperature at the time of sample shipment;

8.1.7 Chemical preservative(s) used on a parameter-specific basis: