Designation: D7296 – 12

Standard Practice for Collection of Settled Dust Samples Using Dry Wipe Sampling Methods for Subsequent Determination of Beryllium and Compounds[1]

This standard is issued under the fixed designation D7296; 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 practice covers the collection of settled dust containing beryllium and/or beryllium compounds on surfaces using the dry wipe sampling method. These samples are collected in a manner that will permit subsequent extraction and determination of beryllium and compounds in the wipes using laboratory analysis techniques such as atomic spectrometry or fluorescence detection.

1.2 This practice is limited in its scope to applications where wetted wipe sampling (using Practice D6966) or vacuum sampling (using Practice D7144) is not physically feasible (for example, if the surface to be wiped would be compromised by use of wetted wipes).

1.3 This practice does not address the sampling design criteria (that is, sampling plan which includes the number and location of samples) that are used for clearance, hazard evaluation, risk assessment, and other purposes. To provide for valid conclusions, sufficient numbers of samples should be obtained as directed by a sampling plan. Additional guidance is provided in Guide D7659.

1.4 This practice contains notes that are explanatory and are not part of the mandatory requirements of this practice.

1.5 The values stated in SI units are to be regarded as standard.

1.6 *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]

D1356 Terminology Relating to Sampling and Analysis of Atmospheres

D4840 Guide for Sample Chain-of-Custody Procedures

D6966 Practice for Collection of Settled Dust Samples Using Wipe Sampling Methods for Subsequent Determination of Metals

D7144 Practice for Collection of Surface Dust by Micro-vacuum Sampling for Subsequent Metals Determination

D7659 Guide for Strategies for Surface Sampling of Metals and Metalloids for Worker Protection

D7707 Specification for Wipe Sampling Materials for Beryllium in Surface Dust

3. Terminology

3.1 For definitions of terms not listed here, see Terminology D1356.

3.2 *Definitions:*

3.2.1 *batch, n*—a group of field or quality control (QC) samples that are collected or processed together at the same time using the same reagents and equipment.

3.2.2 *sampling location, n*—a specific area within a sampling site that is subjected to sample collection. **D6966**

3.2.2.1 *Discussion*—Multiple sampling locations are commonly designated for a single sampling site (see 3.2.3).

3.2.3 *sampling site, n*—a local geographic area that contains the sampling locations (see 3.2.2). **D6966**

3.2.3.1 *Discussion*—A sampling site is generally limited to an area that is easily covered by walking.

3.2.4 *dry wipe, n*—a suitable non-wetted wiping medium.

[1] This practice is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.04 on Workplace Air Quality.

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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.

3.2.4.1 *Discussion*—These are to be distinguished from wipes as defined in Practice D6966 and Specification D7707, which are wet wipes.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *field blank, n*—a dry wipe (see 3.2.4) that is exposed to the same handling as field samples except that no sample is collected (no surface is actually wiped).

3.3.1.1 *Discussion*—Analysis results from field blanks provide information on the analyte background level in the dry wipe, combined with the potential contamination experienced by samples collected within the batch (see 3.2.1) resulting from handling.

4. Summary of Practice

4.1 Wipe samples of settled dust are collected on surfaces from areas of known dimensions with dry wipes satisfying certain requirements, using a specified pattern of wiping.

4.2 The collected dry wipes are then ready for subsequent sample preparation and analysis for the measurement of beryllium and compounds.

5. Significance and Use

5.1 This practice is intended for the collection of settled dust samples for the subsequent measurement of beryllium and compounds. The practice is meant for use in the collection of settled dust samples that are of interest in clearance, hazard evaluation, risk assessment, and other purposes.

5.2 This practice is intended solely for the collection of settled dust samples from hard, relatively smooth nonporous surfaces that may be compromised by water or other wetting agents and that are therefore not suitable for wet wipe sampling using Practice D6966 or micro-vacuum sampling using Practice D7144. Use of this practice for any purpose other than the intended purpose is discouraged due to the limited collection efficiency and high variability of dry wipe sampling as compared to wetted wipe or micro-vacuum sampling.[3]

5.3 This practice is less effective for collecting settled dust samples from surfaces with substantial texture such as rough concrete, brickwork, textured ceilings, and soft fibrous surfaces such as upholstery and carpeting. Micro-vacuum sampling using Practice D7144 may be more suitable for these surfaces.

6. Apparatus

6.1 *Sampling Templates*—One or more of the following: 10 cm by 10 cm (minimum dimensions) reusable or disposable aluminum or plastic template(s), or disposable cardboard templates, (full-square, rectangular, square "U-shaped," rectangular "U-shaped," or "L-shaped," or both); or templates of alternative areas having accurately known dimensions (see Note 1). Templates shall be capable of lying flat on a surface.

NOTE 1—For most surfaces, it is recommended to collect settled dust from a minimum surface area of 100 cm^2 to provide sufficient material for subsequent laboratory analysis. However, larger areas (for example, 30 cm by 30 cm) may be appropriate for surfaces having little or no visible settled dust, while a smaller sampling area (for example, 10 cm by 10 cm) may be appropriate for surfaces with high levels of visible settled dust. It is recommended to have a suite of templates with various sampling dimensions.

6.2 *Dry Wipes,* for collection of settled dust samples from surfaces. The background metal(s) content of the dry wipes should be as low as possible. At a maximum, the background level of beryllium shall be no more than one-tenth the target concentration to be measured. Variability of background levels of beryllium shall not exceed ten times the standard deviation of the mean background level. Dry wipe materials shall be compatible with the anticipated sample preparation and analysis methods.

NOTE 2—Characteristics of dry wipe materials, such as hardness, porosity, and thickness, may affect collection efficiency. Quantitative laboratory filter paper, or wipe media with demonstrated equivalent or superior performance, should be used. Consistent use of a single material is recommended because use of multiple materials may produce widely varying results.[3] For analysis by ICP-AES or ICP-MS, dry wipes should be either wholly soluble or wholly insoluble when using the selected sample preparation method. This is because partially dissolved wipes can make subsequent handling of sample solutions difficult, or they can cause analytical errors due to matrix mismatches between sample solutions and calibration solutions, or both. Partially dissolved wipes may be acceptable as long as the undissolved remnant leaves an intact skeleton (that is, of woven fabric) that does not adversely affect the sample solution. If the sample preparation method selected involves quantitative transfer of the sample solution to volumetric glassware prior to analysis, the wipes used for sampling should be completely soluble when using the chosen sample preparation method.

6.3 *Sample Containers,* sealable, rigid-walled, 15-mL minimum volume.

NOTE 3—Screw-top plastic centrifuge tubes are an example of a suitable rigid-walled sample container.

NOTE 4—Use of sealable plastic bags for holding and transporting the settled dust wipe samples is not recommended due to the potential loss of collected dust within the plastic bags during transportation and laboratory handling. Quantitative removal and processing of the settled dust wipe sample by the laboratory is significantly improved through the use of sealable rigid-walled containers.

6.4 *Measuring Tool,* tape or ruler, capable of measuring to the nearest ±0.1 cm.

6.5 *Plastic Gloves,* powderless.

6.6 *Cleaning Cloths,* for cleaning of templates and other equipment.

NOTE 5—Wet wipes that comply with Specification D7707 may be used for cleaning templates and other sampling equipment as long as they are allowed to dry thoroughly before use. Other cleaning cloths or wipes not meeting those requirements may also be suitable for this purpose.

6.7 *Adhesive Tape,* suitable for securing the template(s) to the surface(s) to be sampled, and for demarcating sampling areas if templates are not used.

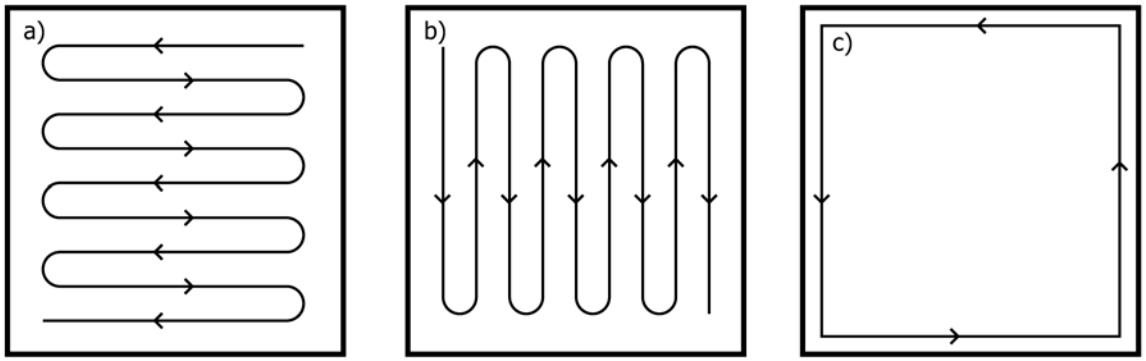
NOTE 6—Masking tape, for example, functions well for these purposes.

6.8 *Disposable Shoe Covers,* optional.

7. Procedure

7.1 Use one of the following two procedures for collecting settled dust samples from each sampling location. For wide, flat locations, it is recommended to use the template-assisted

[3] Dufay, S. K., and Archuleta, M.,, "Comparison of Collection Efficiency of Sampling Methods for Removable Beryllium Surface Contamination," *J. Environ. Monit.*, Vol 8, No. 6, 2006, pp. 630–633; DOI 10.1039/b601526n.



NOTE 1—Only the center of the wiping path is shown, not the entire wiping width. a) shows the first "S" wiping pattern over the surface area to be sampled; b) demonstrates the second "S" wiping course over the surface; and c) shows the final wiping which is targeted toward edges and corners.

FIG. 1 Schematic of a Side-to-Side Overlapping "S" Wiping Pattern

sampling procedure (see 7.1.1.2(1)). For small locations (for example, window sill, section of a piece of equipment, or portion of a vehicle interior), it will ordinarily be necessary to use the confined-area sampling procedure (see 7.1.1.2(2)).

NOTE 7—Metal contamination problems during field sampling can be severe and may affect subsequent wipe sample analysis results. Contamination can be minimized through frequent changing of gloves, use of shoe covers (see 6.8), and regular cleaning of sampling equipment with cleaning cloths (see 6.6). Use of disposable shoe covers between different locations, and removal of them prior to leaving the sampling site or entering vehicles, can be helpful in minimizing inadvertent transfer of contaminated dust from one location to another.

7.1.1 *Sampling Procedure:*

7.1.1.1 Don a pair of clean, powderless, plastic gloves (see 6.5 and Note 7).

7.1.1.2 Use one of the following three procedures, (1), (2), or (3):

(1) Carefully place a clean template on the surface to be sampled in a manner that minimizes disturbance of settled dust at the sampling location. Tape the outside edge of the template to prevent the template from moving during sample collection.

(2) Alternatively, mark the defined area to be sampled with adhesive tape (see 6.7) being careful not to disturb the settled dust, and measure the area to be sampled using the measuring tool (see 6.4).

(3) When templates or tape cannot be used or are impractical, the sampling area may be visually defined based on the size, shape, geometry, and/or visible landmarks on the surface being sampled or adjacent areas. Templates or rulers used in a non-contact manner can aid in collecting the sample or measuring the area sampled.

7.1.1.3 Obtain a dry wipe (see 6.2) and, if there is a possibility for the package containing the wipe to be contaminated with dust, clean the outside of the package with a cleaning cloth (see 6.6).

7.1.1.4 Remove the dry wipe from its package, and inspect the dry wipe to ensure that it is dry and not contaminated with dust or other material. Discard the dry wipe if it is found to be damp or contaminated, or both.

7.1.1.5 Using an open flat hand with the fingers together, place the dry wipe on the surface to be sampled. Wipe the selected surface area, side to side, in an overlapping "S" or "Z" pattern while applying pressure to the fingertips (refer to Figs. 1 and 2). Wipe the surface so that the entire selected surface area is covered. Perform the wiping procedure using the fingers and not the palm of the hand.

7.1.1.6 Repeat 7.1.1.5 using a different type of dry wipe material (after selecting a different sampling location) if the dry wipe originally used significantly changes shape (for example, rolls up by curling) or tears during the wiping process.

NOTE 8—Some surfaces (for example, rough surfaces) may cause certain wipes to curl up or otherwise significantly change shape during the wiping process. A type of wipe that maintains its integrity should be selected for each surface sampled.

7.1.1.7 Fold the dry wipe in half with the collected dust side folded inward and repeat the preceding wiping procedure (see 7.1.1.5) within the selected sampling area using an up and down overlapping "S" or "Z" pattern at right angles to the first wiping (see Fig. 1, Fig. 2, and Note 9).

NOTE 9—Dry wipes are folded to envelop the collected dust within the wipe, to avoid loss of the collected dust, and to expose a clean wipe surface for further dust collection from the sampling location. For sample areas containing large amounts of settled dust, care must be taken during wiping to capture all of the dust present within the dry wipe.

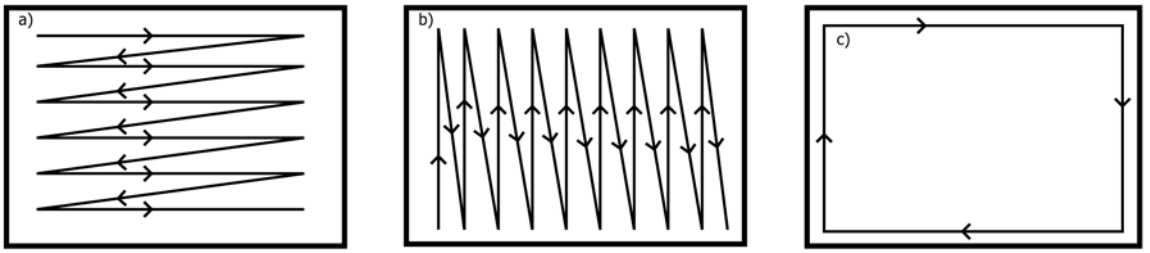
7.1.1.8 Fold the dry wipe in half again with the collected dust side folded inward and repeat the wiping procedure one more time, concentrating on collecting settled dust from edges and corners within the selected surface area (see Fig. 1, Fig. 2, and Note 9).

7.1.1.9 Fold the dry wipe again with the collected dust side folded inward and insert the wipe into a sample container (see 6.3).

7.1.1.10 Label the sample container with sufficient information to uniquely and indelibly identify the sample, and record the dimensions (in square centimetres) of the selected sampling area (that is, the internal dimensions defined by the template or the taped area). Discard the gloves.

7.2 Collect field blanks at a minimum frequency of 5 % (at least one field blank for every 20 wipe samples collected). The minimum number of field blanks to collect for each batch of dry wipe material used shall be three. Place field blanks in sample containers and label these samples in the same fashion as the collected surface dust samples (see 7.1.1.10).

7.3 Follow sampling chain of custody procedures to ensure sample traceability. Ensure that the documentation which



NOTE 1—Only the center of the wiping path is shown, not the entire wiping width. a) shows the first "Z" wiping pattern over the surface area to be sampled; b) demonstrates the second "Z" wiping course over the surface; and c) shows the final wiping which is targeted toward edges and corners.

FIG. 2 Schematic of a Side-to-Side Overlapping "Z" Wiping Pattern

accompanies the samples is suitable for a chain of custody to be established in accordance with Guide D4840.

7.4 Recovery efficiency from the surface may be enhanced by repeating wipes over the same area and pooling results.[4] Recovery efficiency from the surface area may be checked by repeated wiping over the same area and comparison of results.

8. Records

8.1 *Log Forms and Notebooks*—Field data related to sample collection shall be documented in a sample log form or field notebook (see Note 10). If field notebooks are used, then they shall be bound with pre-numbered pages. All entries on sample data forms and field notebooks shall be made using ink, with the signature and date of entry. Any entry errors shall be corrected by using only a single line through the incorrect entry (no scratch outs), accompanied by the initials of the person making the correction, and the date of the correction (see Note 11). The correct entry shall be annotated next to the error.

NOTE 10—Field notebooks are useful for recording field data even when preprinted sample data forms are used.

NOTE 11—These procedures are important to properly document and trace field data.

8.2 *Electronic Laboratory Notebooks*—If electronic laboratory notebooks, or ELNs, are used in lieu of a field notebook or sample log, procedures shall be implemented to assure the integrity of the data recorded, including prevention of falsification or other unauthorized changes, and regular backup of data.

8.3 *Sampling Information*—At a minimum, the following information shall be documented:

8.3.1 A statement to indicate the confidentiality of the information supplied, if appropriate.

8.3.2 Project and client name(s), and client postal address.

8.3.3 General sampling site description and address (if applicable).

8.3.4 Information as to the specific collection protocol used (for example, template-assisted; "Z"-wiping pattern, etc.).

8.3.5 Information as to the specific type, brand, or both, of dry wipes used, including manufacturer and lot number.

8.3.6 Information on quality control (QC) samples, such as which samples are associated with what group of field blanks.

8.3.7 For each sample collected (including field blanks): an individual and unique sample identifier and date of collection. This information shall be recorded on the sample container in addition to the field documentation.

8.3.8 For field samples (not including field blanks), record in field documentation (field notebook or sample log form) the dimensions of each area sampled (in square centimetres).

8.3.9 For each sample collected: name of person collecting the sample, and specific sampling location information from which the sample was removed.

9. Keywords

9.1 beryllium; dry wipe; sample collection; settled dust; surfaces

[4] Wheeler, J. P, and Stancliffe, J. D., "Comparison of methods for measuring solid particulate surface contamination in the workplace," *Ann. Occ. Hyg.*, Vol 42, 1998, pp. 477–488.