Designation: D7822 – 13

Standard Practice for Dermal Wipe Sampling for the Subsequent Determination of Metals and Metalloids[1]

This standard is issued under the fixed designation D7822; 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 describes a procedure for the wet wiping of potentially exposed skin of workers for the subsequent determination of metals and metalloids.

NOTE 1—For guidance on collection of wipe samples on surfaces other than skin, refer to Guide D7659.

1.2 This practice does not address the sampling design criteria that are used for hazard evaluation, risk assessment, or other purposes.

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

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

1.5 This practice offers a set of instructions for performing one or more specific operations. This practice cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This practice 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 practice be applied without consideration of a project's many unique aspects. The word "Standard" in the title means only that the practice has been approved through the ASTM consensus process.

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 Microvacuum 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

E1792 Specification for Wipe Sampling Materials for Lead in Surface Dust

2.2 *ISO and European Standards:*

ISO 14294 Workplace atmospheres—Measurement of dermal exposure—Principles and methods[3]

EN 689 Workplace Atmospheres—Guidance for the Assessment of Exposure by Inhalation to Chemical Agents for Comparison with Limit Values and Measurement Strategy[4]

EN 1540 Workplace exposure—Terminology[4]

3. Terminology

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

3.2 *Definitions:*

3.2.1 *agent*—any chemical or biological entity on its own or admixed as it occurs in the natural state or as produced by any work activity, whether or not produced intentionally and whether or not placed on the market. **EN 689**

[1] This test method 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] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, http://www.cen.eu.

3.2.2 *dermal exposure*—process of contact between an agent and human skin at an exposure surface over an exposure period. **ISO 14294**

3.2.2.1 *Discussion*—Dermal exposure can originate from contact with surfaces or from airborne contaminants. The exposure period may or may not be known.

3.2.3 *dermal exposure loading*—dermal exposure mass divided by the dermal exposure surface area. **ISO 14294**

3.2.3.1 *Discussion*—For practical reasons dermal exposure loading can be expressed as the mass divided by area-averaged skin contaminant layer surface area in mg/cm^2.

3.2.4 *dermal exposure mass*—mass of agent present in the dermal contact volume. **ISO 14294**

3.2.4.1 *Discussion*—For practical reasons, dermal exposure mass is defined by the amount of agent present in the skin contaminant layer. The outcome of the process of dermal exposure (that is, the contact) can be expressed by different parameters of exposure, such as mg/cm^2, or mg/hand, though ascertaining the exact area of the exposure is preferred.

3.2.5 *dermal exposure surface*—the skin surface area where an agent is present. **ISO 14294**

3.2.5.1 *Discussion*—For practical reasons this may be determined from a two dimensional representation, such as a tracing of the hand for the skin contaminant layer in cm^2. It may also be represented by specifying the part of the body with a description of the anatomical limits of the sampling area (for example, the hand as far as the wrist).

3.2.6 *skin contaminant layer*—compartment on top of the stratum corneum of the human skin formed by sebum lipids, sweat and additional water from transepidermal water loss, also including products from cornification and unshed corneocytes. **ISO 14294**

3.2.7 *workplace*—the defined area or areas in which the work activities are carried out. **EN 1540**

4. Summary of Practice

4.1 Wipe samples of workers' skin are collected from estimated dermal surface areas with wetted wipes using a specified wiping procedure.

4.2 The collected wipes are then ready for subsequent determination of the metals and metalloids of interest by using spectrometry or other laboratory analysis techniques such as atomic or mass spectrometry.

5. Significance and Use

5.1 This practice is intended for the collection of samples of skin contamination to be used for the estimation of dermal exposure to metals and metalloids. The practice is meant for use in the collection of dermal samples that are of interest in hazard evaluation, risk assessment, or other purposes. This practice is meant to provide a standardized means for estimating exposures to body parts that are potentially exposed via dermal contact with airborne or surface contaminants, or both.

5.2 The techniques described in this practice may not accurately reflect the transferability or bioavailability of metal or metalloid residues by way of dermal contact.

5.3 Additional information on the principles and methods for the measurement of dermal exposure can be found in ISO 14294.

6. Materials

6.1 *Wipes,* for collection of metals samples from skin surfaces. The background metal(s) content of the wipes should be as low as possible. At a maximum, the background level of target metal(s) shall be no more than one-tenth the target concentration the metal(s) to be measured. Wipes shall be fully wetted prior to use. Wipes may be wetted on site in the field by the person collecting the samples, or may be purchased pre-wetted.

NOTE 2—Wipes meeting the requirements of Specification E1792 or D7707, or both, may be suitable.

6.2 *Sample Containers,* sealable, disposable, clean rigid-walled, of sufficient volume for the wiping material to be used.

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

6.3 *Measuring Tool,* tape or ruler, capable of measuring to ±0.1 cm.

6.4 *Disposable Gloves,* powder-free, to avoid the possibility of contamination and to protect hands from contact with toxic and corrosive substances. PVC or nitrile gloves are suitable.

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

6.6 *Digital camera or graph paper,* if necessary for assistance in estimating the surface area of the skin surface sampled.

6.7 *Timer,* when necessary to measure the sampling time period.

6.8 *Sampling Templates,* one or more of the following: 25 cm^2 (for example, 5 cm by 5 cm minimum dimensions); reusable or disposable flexible plastic template(s) (for example, full-square, rectangular, ovals, circles and triangles); or templates of alternative areas having accurately known dimensions (see Practice D6966). Templates shall be flexible or otherwise capable of being adjusted (that is, flexible) to conform to the skin surface. To minimize the risk of cross-contamination, the use of disposable templates is generally preferred. Reusable templates shall be cleaned prior to each use.

6.9 *Marker,* permanent or semi-permanent (metal-free ink) may be used in place of the template (see 6.8) to mark the area of skin to be wiped.

NOTE 4—Caution should be exercised to avoid disturbing or touching the area to be sampled when marking the sampling area.

6.10 *Medical Tape (adhesive tape)* may be used instead of a sampling template (see 6.8) to mark an area of skin to be wiped or to immobilize the sampling template on the skin.

NOTE 5—Caution should be exercised to avoid disturbing or touching the area to be sampled when marking the sampling area.

7. Procedure

7.1 *Sampling:*

7.1.1 *Sampling Efficiency*—It is recommended to conduct sampling efficiency studies prior to field sampling, under conditions that are similar to conditions of exposure regarding exposure process, levels of skin loading, and time of residence of the compound on the skin before collecting field samples. **(1), (2)**[5]

NOTE 6—Based on the results of sampling efficiency studies, it may be desirable to use more than one wipe for a specific sampling event. The number of wipes to be used should be specified prior to performing the sampling.

7.1.2 *Wipe Method:*

7.1.2.1 *Hand Sample Collection:*

(1) The person collecting the sample opens a wipe packet and without touching the wipe, offers it to the subject whose exposure is to be evaluated **(3)**.

(2) The subject is instructed to remove the wipe from the packet, and unfold it.

(3) The subject is instructed to wipe the palms first, then the top surfaces of both sides of the subject's hands, including the fingers (using normal hand washing pressure).

(4) The subject is instructed to wipe the hands for a period of not less than 30 seconds.

(5) After wiping is finished, the subject is instructed to place the wipe into a clean, labeled sampling container.

NOTE 7—If the palms of the hands are dirtier than the back of the hands, it is recommended to wipe the back of the hands before the palms (that is, begin on the cleaner side and move to the dirtier side).

7.1.2.2 *Sample Collection for Skin Other than Hands:*

(1) An area of skin, with the minimum 25 cm^2 area to be wiped, is demarcated by the person collecting or assisting in collecting the sample.

(2) A template (see 6.8) is placed on the surface of the skin of the exposed person and held in place (manually or with tape) while the sample is collected. Alternatively, the area of skin to be wiped is marked using a ruler and marker (see 6.9) or medical tape.

(3) Where the surface area of the body part cannot easily be measured (for example, ears or nose), or circumstances do not permit measurement of the body part, a description of the anatomical limits of the body part being wiped should be noted and those limits adhered to for all similar samples.

(4) The person collecting the sample thoroughly wipes the exposed skin surface. If applicable, sample collection shall be conducted using the patterns starting from the perimeter and working towards the interior of the area to be wiped (see Fig. 1).

(5) After sample collection, the wipe used for sampling is transferred to a clean, labeled sample container.

7.1.3 *Labeling*—After the wipe sample has been placed in the sample container, label the container with sufficient information to uniquely and indelibly identify the sample, and record the dimensions (in cm^2, if applicable) of the selected sampling area (that is, the internal dimensions defined by the template, the taped area or the estimation of the hand surface area, if applicable).

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

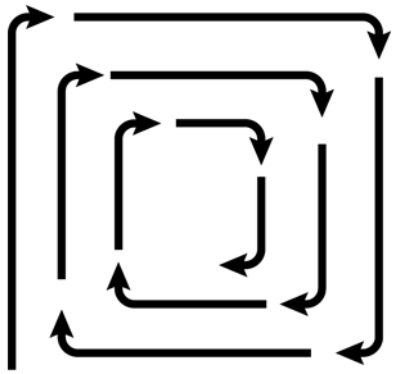

FIG. 1 Wiping Pattern Starting from Perimeter and Working Towards the Interior of the Sampling Area

7.1.4 *Sample Transport*—Collected samples shall be transported to a laboratory for analysis following appropriate chain-of-custody procedures (see Guide D4840).

7.1.5 *Estimation of Exposed Skin Surface Area of the Hand*—If desired, the exposed area of the wiped hand can be estimated using one of the following techniques:

7.1.5.1 Place the wiped hand on a piece of graph paper subdivided in cm^2, and trace the hand with a pen to include the entire area that was wiped, as shown in Fig. 2. Estimate the surface area as described in 7.1.5.3.

7.1.5.2 Photograph the wiped hand, including a vertical and horizontal scale in cm such that the length and circumference of the hand (see Fig. 2) can be determined. Estimate the surface area as described in 7.1.5.3.

7.1.5.3 An estimate of the hand surface area can be calculated using a method described by Li, et al. **(4)**. This estimation is performed as follows:

(1) The hand length, in cm, is measured from the center of the wrist, at the metacarpal phalangeal joint, to the tip of the middle finger, as shown in Fig. 2, using a flexible ruler.

(2) The hand circumference, in cm, is measured at the metacarpal phalangeal joint, as shown in Fig. 2, using a flexible ruler.

(3) The estimated hand surface area, HSA, is calculated using the equation:

$$HSA = 1.219 \times HL \times HC \quad (1)$$

where:

HSA = calculated estimate of hand surface area, in cm^2
HL = hand length, in cm
HC = hand circumference, in cm

7.2 *Field Blanks*—At least one field blank for every 20 samples, or five percent of the total number of samples, whichever is greater, shall be set aside from the sample materials. At least three blanks are required per analytical batch. Field blanks shall take into account the material (template, marker, or medical tape) used for demarcation of the area being wiped, to correct for any metal contamination that may be caused by the material used. Field blanks shall be placed in sample containers that are labeled in the same fashion as the collected dermal samples (see 7.1.4) prior to being transported to a laboratory for subsequent analysis.

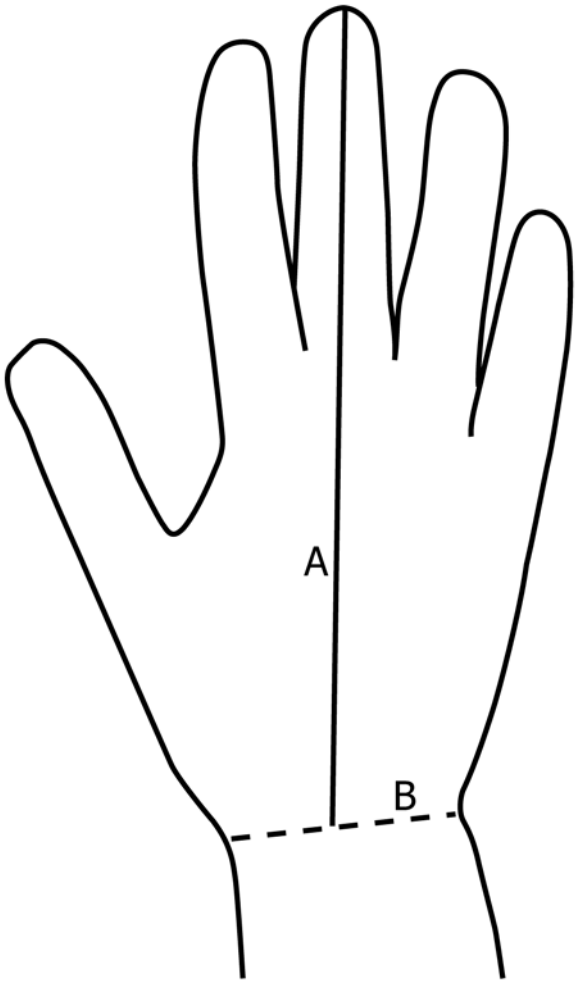

FIG. 2 Drawing of the Hand Illustrating Where the Hand Length (A) And Circumference (B) are Measured to the Nearest Centimetre

7.3 *Chain of Custody*—Follow sampling chain of custody procedures to ensure sample traceability. Ensure that the documentation which accompanies the samples is suitable for a chain of custody to be established in accordance with Guide D4840.

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 8). 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 9). The correct entry shall be annotated next to the error.

NOTE 8—Field notebooks are useful for recording field data even when preprinted sample data forms are used.

NOTE 9—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 ensure the integrity of the data recorded, including prevention of falsification or other unauthorized changes, and to allow regular backup of data.

8.3 At a minimum, the following information shall be documented and available for reporting:

8.3.1 Project or client name, address, and city/state/country location.

8.3.2 General sampling site description.

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

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

8.3.5 Information on quality control (QC) samples: that is, which QC samples are associated with what group of field blanks.

8.3.6 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.

8.3.7 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 centimeters), if applicable.

8.3.8 For each sample collected: name of person collecting the sample, and specific sampling location information for which the person worked from whom the sample was collected.

8.3.9 A description of the body part sampled including the area of the body part sampled if obtained and the anatomical features of the limit of the area sampled (for example, hand, as far as the wrist; outside of forearm).

8.3.10 A listing of protective clothing used by the worker, if any.

9. Keywords

9.1 dermal; exposure assessment; hand sampling; metals; skin; surface wipe

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