



Standard Practice for Collection of Surface Dust by Air Sampling Pump Vacuum Technique for Subsequent Lead Determination¹

This standard is issued under the fixed designation E 1973; 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 vacuum collection of surface dusts onto filters using portable air sampling pumps. Samples collected in this manner allow for the subsequent digestion and determination of lead content by using atomic spectrometric (or equivalent) methods. The primary intended application is sampling from soft surfaces.

1.2 This practice allows for the determination of lead on a loading basis (microgram of lead per area sampled). Lead may also be determined on a concentration basis (microgram of lead per gram of dust collected) where pre-weighed filters or filter cassettes are used.

1.3 *Limitations*—Due to a number of physical factors inherent in the vacuum sampling method, analytical results for vacuum dust samples are not likely to reflect the total dust contained within the sampling area prior to sample collection. This practice generally will have a collection bias toward smaller, less dense dust particles; however, the practice will generate leaded dust data that are consistent and comparable between operators performing vacuum collection using this practice at a variety of locales and sites.²

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 *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:

D 1356 Terminology Relating to Sampling and Analysis of Atmospheres³

¹ This practice is under the jurisdiction of ASTM Committee E-6 on Performance of Buildings and is the direct responsibility of Subcommittee E06.23 on Lead Paint Abatement.

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² Reynolds, S. J., et al., "Laboratory Comparison of Vacuum, OSHA," and "HUD Sampling Methods for Lead in Household Dust." Am. Ind. Hyg. Assoc., J. 58:439-446 (1997).

³ *Annual Book of ASTM Standards*, Vol 11.03.

D 3195 Practice for Rotameter Calibration³

E 1553 Practice for the Collection of Airborne Particulate Lead During Abatement and Construction Activities⁴

E 1728 Practice for Field Collection of Settled Dust Samples Using Wipe Sampling Methods for Lead Determination by Atomic Spectrometry Techniques^{4,5}

3. Terminology

3.1 *Definitions*—For definitions of terms relating to sampling and analysis of dust by means of the air sampling pump vacuum technique, refer to Terminology D 1356.

3.2 *Description of Terms Specific to This Standard:*

3.2.1 *air sampling pump, n*—a portable air pump that is used to draw air through a filter holder/nozzle assembly for vacuum collection of surface dust. An example would include a personal sampling pump.

3.2.2 *batch, n*—a group of field or quality control samples that are collected in a similar environment and are processed together using the same reagents and equipment.

3.2.3 *collection nozzle, n*—a piece of stainless steel or acrylic hard plastic tubing molded on one end (inlet) to form a narrow opening. The outlet end of the collection nozzle shall fit snugly to flexible tubing, which connects it to a filter holder. Alternatively, a collection nozzle may consist simply of a piece of flexible tubing that is cut at a 45° angle at the inlet end.

3.2.4 *field blank, n*—a sample that is handled in exactly the same way that field samples are collected, except that no air is drawn through it.

3.2.5 *filter holder, n*—a plastic holder that supports the filter medium upon which dust is collected. It is also often referred to as a filter cassette.

3.2.6 *sampling device (sampling assembly)*—a collection nozzle, filter holder, and air sampling pump assembly used to collect surface dust on a filter. The collection nozzle (with tubing connector, if applicable) is attached to the inlet end of the filter holder. The filter holder houses the filter, through which air is drawn by using the air sampling pump. The filter holder is attached to the pump by flexible tubing.

⁴ *Annual Book of ASTM Standards*, Vol 04.11.

⁵ *ASTM Standards on Lead-Based Paint Abatement in Buildings*, ASTM, Conshohocken, PA, 1994.

3.2.7 *surface dust, n*—settled particulate that has been transported to its present location by various means, such as transport through the air or tracking from other sources.

4. Summary of Practice

4.1 Samples of settled dust are collected from selected surface sampling locations onto cellulose ester or polyester filters by using a vacuum collection technique that employs a portable air sampling pump.⁶ Surface dust is collected by using a collection nozzle attached to a filter holder, through which air is drawn using an air sampling pump. The sample is then processed for shipment and ultimately for digestion and laboratory analysis.

NOTE 1—**Caution:** Collection efficacy using this practice is low, so it is important to use the device in a consistent manner.

5. Significance and Use

5.1 Human exposure by ingestion of lead in surface dust may result in an excess of lead in the bloodstream, tissues, and bone and may lead to physiological disorders associated with lead poisoning. Methods for the collection, preparation, and analysis of lead in surface dust samples are needed to determine the potential for human, especially children's, exposure.

5.2 This practice is intended to be used for the collection of settled dust samples in and around buildings and related structures for the subsequent determination of lead. This practice allows for the subsequent determination of collected lead concentration on an area or mass percent basis, or both.

5.3 This practice involves the use of personal sampling pumps to collect surface samples of dust that may contain lead and is intended for use by qualified technical professionals.

5.4 This practice is suitable for the collection of samples of settled dust on either soft, porous surfaces such as carpet or hard, nonporous surfaces such as tile. A companion sampling technique that may be used for hard surfaces is wipe sampling (Practice E 1728).⁷

5.5 Procedures presented in this practice are intended to provide a method for dust collection from surfaces that cannot be sampled using wipe collection methods. In addition, the procedures described use equipment that is readily available and in common use for other environmental sampling applications.

6. Apparatus

6.1 *Dust Sampling Equipment*—The sampling assembly for the vacuum collection of surface dust lead samples has the following components:

6.1.1 *Sample Filters:*

6.1.1.1 Cellulose ester, 0.8- μ m pore size, 37-mm diameter (lead-free).

6.1.1.2 Alternatively, polyester filters (0.8 μ m, 37 mm) may be obtained pre-weighed (to the nearest 0.1 mg).

NOTE 2—Pre-weighed polytetrafluoroethylene (PTFE) filters are also available, but they have not been evaluated for use with this matrix and are therefore not recommended. Measured lead content in filters must be below the method detection level.

6.1.1.3 Filters and filter holders are not to be handled with bare or gloved hands; clean tweezers shall be used to handle filters.

6.1.2 *Filter Holders*, for 37-mm diameter filters, three piece (lead-free).

6.1.2.1 If desired, filter holders can be weighed, without inlet and outlet caps, to the nearest 0.1 mg. If pre-weighed filters and filter holders are used, it will be necessary to tare the filter holders (plus backup pads) prior to use. The procedure to be used for accurate weighing of filter cassettes is described in the *NIOSH Manual of Analytical Methods*.⁷ Pre-weighed filter cassettes shall be pre-labeled prior to their being weighed.

6.1.2.2 Tared filter holders are not to be handled with bare hands; powderless plastic gloves shall be worn during the handling of tared filter holders.

6.1.3 *Backup Pads*, cellulose or stainless steel screen.

NOTE 3—If pre-weighed filters are used, it is not necessary to know the mass of the backup pads. However, if pre-weighed filter holders, as well as pre-weighed filters, are used, it will be necessary to know the influence of the mass of the backup pads on the overall mass of the entire filter cassette assembly (to the nearest 0.1 mg).⁷

6.1.3.1 Backup pads are not to be handled with bare or gloved hands; clean tweezers shall be used for the handling of backup pads.

6.1.4 *Portable Air Sampling Pump*, capable of 1 to 5 L/min flow rate; an example may include a "personal" sampling pump (see Practice E 1553). The pump shall be calibrated with a representative filter plus collection nozzle unit in line so that the volume of air sampled can be measured to an accuracy of $\pm 5\%$.

6.1.5 *Collection Nozzle*, stainless steel or acrylic plastic; inlet orifice dimensions of 0.9 ± 0.4 cm by 0.3 ± 0.2 cm; the outlet fits snugly to flexible tubing used to connect the nozzle to the filter cassette. Alternatively, the collection nozzle may consist of a piece of flexible tubing of 0.60 ± 0.05 -cm inside diameter, cut at a 45° angle.

6.1.6 *Tubing*, flexible, for connecting the collection nozzle and filter holder to the air sampling pump. The length of the tubing connecting the collection nozzle to the inlet of the filter holder shall be no less than 5 cm and no more than 10 cm. The tubing connecting the outlet of the filter holder to the sampling pump shall be a maximum length of 1 m.

6.2 *Ancillary Supplies:*

6.2.1 *Sampling Templates*, 10 by 10 cm or alternative measured inside dimensions (for example, 25 by 25 cm); reusable aluminum or plastic, or disposable plastic or cardboard.

6.2.2 *Powderless Plastic Gloves*.

6.2.3 *Tape Measure*.

6.2.4 *Tape*, masking or duct; and plastic (or shrinkable cellulose bands).

6.2.5 *Sealable Plastic Bags*, or other airtight containers.

⁶ Que Hee, S. S., Peace, B., Clark, C. S., Boyle, J. R., Bornsheim, R. L., and Hammond, P. B., "Evolution of Efficient Methods to Sample Lead Sources, Such as House Dust and Hand Dust, in the Homes of Children," *Environmental Research*, Vol 38, 1985, pp. 77–95.

⁷ Casinelli, M. E., and Eller, P. M., eds., *NIOSH Manual of Analytical Methods*, 4th Ed., Method Nos. 0500 and 0600, U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Cincinnati, OH, 1994.

6.2.6 *Tweezers*.

6.2.7 *Calibration Device*, for air sampling pumps; soap bubble meter or equivalent calibration device (see Practice D 3195).

6.2.8 *Rotameter*, calibrated (see Practice D 3195).

7. Procedure

7.1 *Assembly of Collection Device:*

7.1.1 Don a pair of powderless plastic gloves.

7.1.2 Assemble the filter in a two- or three-piece filter holder, with the filter supported on a stainless steel screen or cellulose backup pad. If pre-weighed filters are used, record their masses to the nearest constant 0.1 mg (see the *NIOSH Manual of Analytical Methods*⁷ for acceptance criteria). Close the filter holder cartridge firmly to prevent sample leakage around the filter. Seal the filter holder with plastic tape or a shrinkable cellulose band, and label the filter holder. To prevent contamination of the filter and filter holder, wear powderless gloves and handle the filter with tweezers during assembly.

NOTE 4—Loaded filter cassettes and cassettes with pre-weighed filters may be purchased already assembled from several manufacturers.

7.1.3 Attach the collection nozzle to the inlet end of the filter holder by means of a short piece (5 to 10 cm) of flexible tubing, and secure tightly. Alternatively (if a metal or hard plastic collection nozzle is not used), attach the uncut end of the collection tubing (5 to 10 cm long), cut at a 45° angle at the sampling end, to the inlet end of the filter holder, and secure tightly.

7.2 *Calibration of Air Sampling Pumps*—Using a soap bubble meter or an equivalent calibration device (for example, a calibrated rotameter; see Practice D 3195), set the flow rate (in litre per minute) of each air sampling pump with a filter cassette plus collection nozzle assembly in the line to 2.5 L/min, unless otherwise specified. Air sampling pumps shall be calibrated at least prior to and following use or suspected change in performance. Also, the pumps shall be charged sufficiently before they are used. Calibration records shall be kept in either a bound laboratory notebook or data sampling sheet for each pump that is used.

NOTE 5—Soap bubble meters may be used for the calibration of air sampling pumps or rotameters in the laboratory, while rotameters are used more easily for the calibration of pumps in the field.

7.3 *Sampling:*

7.3.1 Attach the sample collection device (collection nozzle plus filter holder assembly) to the calibrated air sampling pump with a piece of flexible tubing.

7.3.2 Place the template on the identified area of the surface to be sampled and secure the outside edges of the template with masking or duct tape. Alternatively, measure the area (in centimetre by centimetre) to be sampled with a tape measure and delineate the sampling area with masking or duct tape.

7.3.3 Turn the sampling pump on and allow for a suitable warm-up period. To ensure that the specified flow rate is obtained, sufficient pump warm-up shall be determined by using a rotameter.

NOTE 6—Warm-up times may differ for air sampling pumps of different manufacture and age. A 5 min warm-up period is usually sufficient,

although some pumps may require as long as a 30 min period.

7.3.4 *Sample Collection:*

7.3.4.1 If a metal or hard plastic collection nozzle is used, hold the nozzle at a 45° angle adjacent to the surface being sampled, but apply no pressure.

7.3.4.2 Alternatively, if a piece of tubing (cut at a 45° angle) is used as the collection nozzle, hold it directly on the surface being sampled, but apply no pressure.

7.3.4.3 Move the nozzle from one side of the sampling area to the other. The rate of movement of the nozzle across the surface shall be approximately 10 to 20 cm/s. Repeat this sweeping motion in the same direction until the entire sampling area has been “vacuumed” with the collection attachment.

NOTE 7—The collection efficiency of this vacuum technique is unknown but is significantly lower than 100 %. Also, smaller dust particles will be sampled preferentially.⁵ If the nozzle becomes clogged during sampling, it may be unclogged by using a clean knife or other suitable tool.

7.3.4.4 Repeat the procedure described in 7.3.4.3 in a direction 90° from the initial direction. Be sure to cover the entire sampling area.

7.3.4.5 Repeat the procedure of 7.3.4.3 so that the delineated area is “vacuumed” a third time in the same direction as that used in 7.3.4.3 (and 90° to the direction used in 7.3.4.4).

7.3.4.6 Use a separate, clean (new or decontaminated) collection nozzle and collection nose, if used, for each sample.

NOTE 8—Decontamination may be accomplished by cleansing with soap and water, or more robust techniques.

7.3.5 Avoid excessive overloading of the filter. This problem can be identified by a >10 % drop in the measured flow rate. A subjective indicator of overloading is excessive darkening of the filter. Reduce the sampling area to prevent filter overloading if overloading of the filters becomes evident. Alternatively, use additional filter cassettes to sample the defined area and be sure to record this information.

7.3.6 Prepare field blanks at the same time that sample collection is conducted; these shall represent no less than 5 % of the total number of samples or at least one per batch at minimum. Field blanks shall be handled in the same fashion as the surface dust vacuum samples, but no air is drawn through the filters.

7.3.7 Following vacuum collection of a surface dust sample, disconnect the filter holder from the collection nozzle and personal sampling pump. Cap the inlet and outlet of the filter cassette with plugs after removing the connecting tubes, and label the sample.

NOTE 9—When disconnecting and capping the cassette, hold it upright to ensure that no loose dust comes out of the cassette. This is important to avoid loss of sample (dust which may be lead-containing) that could be measured to determine the mass-per-unit-area lead concentration (“loading”) of the sampled surface.

7.3.7.1 If pre-weighed cassettes are used, they shall be pre-labeled. If labeled manually, use gloved hands. Pre-labeling ensures that no error is introduced in weighing by the attachment of labels subsequent to taring of the filter cassettes.

7.3.8 Clean off the filter holder with a fresh laboratory dry wipe. This decontamination step aids in the prevention of sample contamination.

7.3.9 Place the filter holder in a container, such as a sealable plastic bag or sealable container.

7.3.10 Record pertinent sampling data for each sample, that is, the location of and site where the sample was taken, date, type of surface sampled, pump identifier, filter type, sampling area, and personal identifier. Record the type of air sampling pump used, as well as the initial and final flow rates (in litre per minute) for each pump. Also, if pre-weighed filters or cassettes are used, record the pre-sampling filter or cassette masses (to the nearest 0.1 mg).

7.4 *Sample Transport*—Samples are to be transported so that the filter holders and filters containing collected dust are neither disturbed nor contaminated. Samples are to be transported to a laboratory for sample preparation and analysis, and filters are not to be removed from the filter holders before or during transport.

8. Report

8.1 Report parameters such as flow rates, number of samples, number of field blanks, air sampling pumps used, pump settings, calibration data (before and after pump use), sampling areas, and so on. Report the type of collection nozzle used, as well as the date, site, and location where the samples are obtained and the identity of the individual who conducted the sampling. Record the sample identification numbers. If pre-weighed filters or filter cassettes are used, be sure to note this and record the pre-sampling filter or filter cassette masses. Record all of this information in a bound notebook (with numbered pages) or on data sampling forms, or both.

9. Keywords

9.1 lead; surface dust; vacuum sampling

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