



# Standard Guide for Collection of Soils and Other Geological Evidence for Criminal Forensic Applications<sup>1</sup>

This standard is issued under the fixed designation E3272; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This standard provides guidance to instruct crime scene professionals in good practices for the documentation, collection, and preservation of soil and other geological evidence for use in criminal investigations. Sampling for environmental geology is outside of its scope. It is designed as a resource for professionals whose job responsibilities include the collection and preservation of soil evidence and for forensic scientists to enable them to advise crime scene investigators.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.3 This standard is intended for use by competent forensic science practitioners with the requisite formal education, discipline-specific training (see Practice E2917), and demonstrated proficiency to perform forensic casework.

1.4 *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 environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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:*<sup>2</sup>

D6966 Practice for Collection of Settled Dust Samples

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.11 on Interdisciplinary Forensic Science Standards.

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<sup>2</sup> 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.

Using Wipe Sampling Methods for Subsequent Determination of Metals

D7296 Practice for Collection of Settled Dust Samples Using Dry Wipe Sampling Methods for Subsequent Determination of Beryllium and Compounds

D7144 Practice for Collection of Surface Dust by Microvacuum Sampling for Subsequent Determination of Metals and Metalloids

D5755 Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading (Withdrawn 2023)<sup>3</sup>

D5756 Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Mass Surface Loading (Withdrawn 2017)<sup>3</sup>

E1188 Practice for Collection and Preservation of Information and Physical Items by a Technical Investigator

E1459 Guide for Physical Evidence Labeling and Related Documentation

E1732 Terminology Relating to Forensic Science

E2917 Practice for Forensic Science Practitioner Training, Continuing Education, and Professional Development Programs

## 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *aggregate(s) [clump(s)]*, *n*—a group of soil particles that cohere to each other more strongly than to other surrounding particles.

(1)<sup>4</sup>

3.1.1.1 *Discussion*—Soil aggregates can be natural (a *ped*) or formed by human activities (a *clod*). Often the genesis of evidentiary soil aggregates is unknown, so aggregate is often a preferred term in descriptions of soil evidence.

3.1.2 *alibi location(s)*, *n*—a known location suggested or linked to a subject (for example, a subject's home) that is distinct from the crime scene.

<sup>3</sup> The last approved version of this historical standard is referenced on www.astm.org.

<sup>4</sup> The boldface numbers in parentheses refer to a list of references at the end of this standard.

3.1.2.1 *Discussion*—The term alibi or alibi location can be perceived negatively, but comparisons of geological materials from alibi locations can be exonerating. Alibi location is used in this document to be succinct, however use of this term in documentation of evidence, evidence examination reports, or courtroom testimony is discouraged.

3.1.3 *known, adj*—of established origin associated with the matter under investigation. **E1732**

3.1.3.1 *Discussion*—*Known soil samples* are intentionally collected, typically from crime scene or alibi locations, for comparison to a questioned soil sample. Soils are heterogeneous mixtures of organic matter and minerals that vary with depth and across the landscape. Typically, more known samples are needed to represent the range of variation in soils than are required for manufactured materials. “Reference sample” is used synonymously in Ref (2).

3.1.4 *provenance, n*—a place or origin; specifically, the area from which the constituent materials of a sedimentary rock or facies are derived, also, the rocks of which this area is composed.

**adapted from Ref (3)**

3.1.4.1 *Discussion*—In the context of forensic provenance examination, geological material is analyzed and interpreted to estimate or limit the geographic or environmental conditions of the source of this material to provide an investigative lead. For example, soil on a shovel can be examined to aid in the search for a clandestine grave, typically by comparison of observations to reference data. “Geographic attribution” is an alternative term for provenance.

3.1.5 *questioned sample, n*—material collected as or from items of evidence which have a known location but an unknown originating source. **(4)**

3.1.5.1 *Discussion*—Soil evidence of unknown origin, or questioned soil sample, typically consists of: debris adhering to an evidentiary object or exhibit (3) (for example, tire, wheel well, garment, shoe, digging tool); foreign soil left at a crime scene (for example, transferred from a shoe/tire, or adhering to a re-buried body/object); or debris recovered from on or within a body (for example, nasal, stomach, or lung contents).

3.1.6 *soil, n*—sediments or other unconsolidated accumulations of solid particles (for example, minerals and organic matter) that are produced by the physical, chemical, and biological disintegration of parent material, or which has the ability to support rooted plants in a natural environment, or both; and which can include manufactured materials.

**adapted from Ref (1)**

3.1.6.1 *Discussion*—Within this document, “soil” includes native soil, as well as unconsolidated material emplaced by human activities.

3.1.7 *soil horizon, n*—a layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics such as color, structure, texture, consistency, kinds and numbers of organisms present, degree of acidity or alkalinity, etc. **(1)**

3.1.8 *soil core sampler [soil corer; soil probe], n*—a device used to collect virtually undisturbed sub-surface soil samples for documenting a soil profile.

3.1.9 *soil profile, n*—a vertical section of soil exposed from the ground surface to a depth of interest. A soil profile can be observed in a freshly dug pit, along a road bank, or in many other places.

**adapted from Ref (1)**

## 4. Significance and Use

4.1 This guide describes good practices for the collection (5), packaging, and preservation (8.3) of soils in criminal forensic investigations. Some of the information in this guide is demonstrated in its companion video, which is available on-line and is intended as a complementary resource to this guide (6).

4.2 Individual agencies can use this guide to develop agency-specific procedures regarding the collection of soils for forensic applications.

## 5. Collection Tools

### 5.1 Collection Tool Materials:

5.1.1 Tools for forensic soil collection should either be new, disposable items (for example, plastic spoons, swabs, wipes, filters) or non-porous tools, cleaned prior to each use (see 5.2) to prevent contamination from either the tool itself or a previously collected sample.

5.1.2 Tools for collection of softer materials (for example, unconsolidated sand) can be made of plastic, but for collection of harder materials, tools made of steel are recommended.

5.1.3 Examples of some non-disposable tools are shown in Fig. 1 (see 8.3 for soil evidence packaging materials and recommendations).

### 5.2 Cleaning Tools:

5.2.1 In most circumstances, non-disposable tools can be cleaned by rinsing with clean water (deionized or distilled are recommended) or with a pre-moistened wipe and dried (preferably with a lint free material). Pre-moistened wipes are convenient for cleaning tools during field collections.

5.2.2 Alcohol, bleach, or other suitable disinfectant solutions can be used to help with the decontamination of tools used to collect samples with biological components.

5.2.3 Do not re-use tools that cannot be cleaned.

5.2.4 An item is considered sufficiently clean when no particles are seen on a clean cloth used to wipe the tool.

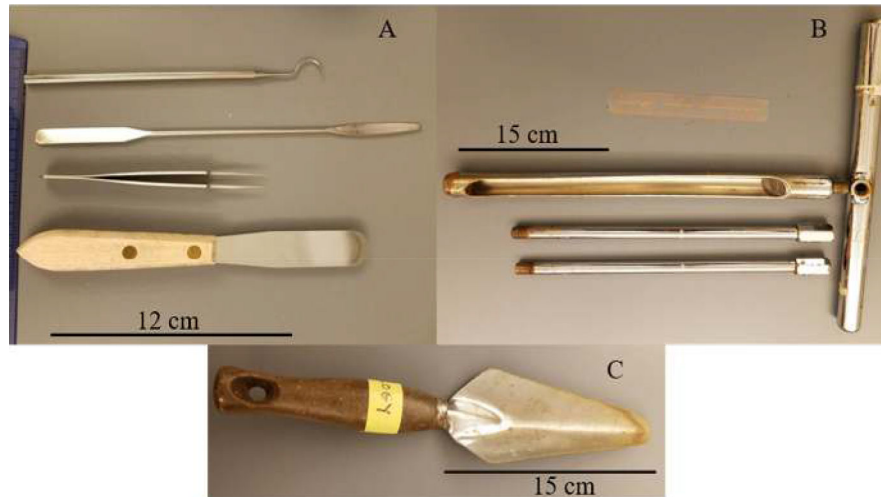
NOTE 1—More rigorous tool cleaning methods are required to achieve DNA-free tools.

### 5.3 Tools for Collection of Questioned Soils:

#### 5.3.1 For Small Quantities of Questioned Soils (Fig. 1A):

NOTE 2—These tools can also be used to collect a non-native soil aggregate from a crime scene.

- 5.3.1.1 Tweezers,
- 5.3.1.2 Forceps,
- 5.3.1.3 Dental picks,
- 5.3.1.4 Spoons,
- 5.3.1.5 Spatulas, and
- 5.3.1.6 Palette knives.



NOTE 1—(A, top to bottom) dental pick, micro-spatula, forceps, and spatula; (B) soil corer (with T-handle and two extension rods); (C) trowel. (Photographs courtesy of Dr. Libby Stern.)

**FIG. 1 Some Common Tools Used to Collect Soil Evidence**

5.3.2 For Collection of Thin Deposits of Questioned Soil:

- 5.3.2.1 Spatulas;
- 5.3.2.2 Ice scrapers;
- 5.3.2.3 Clean/new razor blades;
- 5.3.2.4 Other flat tools suitable for prying or scraping the soil deposit loose; and

5.3.2.5 Trays, dust pan, cardboard, or paper plates to recover dislodged soil.

5.4 Tools for Collection of Known Soils:

NOTE 3—In most cases, known soils are collected to represent the range of soil properties present at a location. As a result, known soil samples tend to be larger than questioned soil samples, requiring larger tools. A soil corer can be used to collect a surface to near-surface soil profile. Smaller tools, such as pallet knives or tweezers, should be used to collect soils from within impressions. A spade or pickaxe are recommended to access soils from sub-surface, but smaller, like 5.4.1 – 5.4.4 tools are typically used for collection of known soil specimens.

- 5.4.1 Garden trowels (Fig. 1C);
- 5.4.2 Soil corers (Fig. 1B);
- 5.4.3 Pointed (archaeologist’s/masonry) trowels;
- 5.4.4 Spoons;
- 5.4.5 Spades;
- 5.4.6 Mining picks (maddocks, pickaxes, hoepicks); and
- 5.4.7 Trays, dustpan, cardboard or paper plates to collect recovered soil, particularly for subsurface soil collections.

5.5 Tools for Collection of Dust:

5.5.1 Particulate filtration cassettes similar to those described in Test Methods D5755 and D5756 and Practice D7144;

NOTE 4—Do not use “evidence vacuum filters” because the convoluted filter material prevents recovery of dust and geological materials.

5.5.2 Low-tack tapes (similar to 3M Post-it<sup>5</sup> notes);

NOTE 5—Do not use high tack tapes or those used to lift fingerprints

because their strong adhesives prevent soil recovery and analysis (5).

- 5.5.3 Wipes (Practices D6966, D7296); and
- 5.5.4 Swabs (polyurethane is preferable).

**6. Collection of Questioned Soils**

6.1 Thoroughly document all questioned soil samples prior to collection. This includes any depositional (structure or layer) characteristics (7, 8).

6.2 Refer to 8.3 for methods of packaging and preserving soil evidence.

6.3 Collection of Questioned Soil on Object of Interest:

6.3.1 Objects that have soil evidence adhering to them (for example, shoes, tires, garments) should be documented and then collected intact and submitted to the forensic laboratory whenever possible. (See 8.3.4 for packaging of soil adhering to objects.)

6.3.2 If the object cannot be submitted to the forensic laboratory, then careful documentation of the soil on the object should be done prior to the soil removal.

6.4 Removal of Questioned Soil from Non-Porous Objects When Object Cannot be Submitted Intact:

NOTE 6—Evidentiary soil can occur on the surfaces and in crevices of objects that cannot be delivered to the laboratory.

6.4.1 Soil dried on a large hard surface, such as a vehicle, should be documented in place and then pried or scraped off with a flat tool (5.3.2) onto a clean piece of paper, or onto a clean collection pan, while trying to preserve intact aggregates which can have layering (7, 8).

6.5 Removal of Questioned Soil from Porous Objects When Object Cannot be Submitted Intact:

6.5.1 Remove soil from porous surfaces, such as upholstery, by gentle scraping with a spatula or similar tool, taking care to preserve intact soil aggregates.

6.5.2 Alternatively, low tack adhesive materials can be used to collect debris loosely attached to the substrate.

<sup>5</sup> A trademark of 3M Company in St. Paul, MN.