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2024 Soil Comparison Proficiency Test
FTS-24-SOIL Summary Report

The Submission Deadline for this test was November 22, 2024

The test was manufactured by FTS at the FTS Laboratory Facility (127 W. Grand River Avenue, Williamston, MI 48895) and all activities were coordinated by Rebecca Smith (rsmith@forsci.com), Proficiency Test Program Manager. Ms. Smith is also authorizing the release of this report. The preparation of proficiency test samples was subcontracted to a qualified forensic geologist. This is the summary report issued on 12/9/24. FTS considers all reports confidential and does not release information regarding participant's results without authorization from that participant.

Summary

Test results were received in 6 of 9 tests distributed (67% response rate). Of the 6 respondents:

Comparison of Item 1 and Item 3

5 of 6 (83%) reported the questioned soil from Item 3 could have originated from the same source as the known soil in Item 1.
1 of 6 (17%) reported the questioned soil from Item 3 could not have originated from the same source as the known soil in Item 1.

Comparison of Item 2 and Item 3

5 of 6 (83%) reported the questioned soil from Item 3 could not have originated from the same source as the known soil in Item 2.
1 of 6 (17%) reported the questioned soil from Item 3 could have originated from the same source as the known soil in Item 2.

Assigned Value

Proficiency tests under ISO 17043:2023 are assessed via comparison of the participant result to the assigned value of a proficiency test item or items. For quantitative tests, FTS determines the assigned value based on statistical methods described in ISO 13528:2022. For qualitative tests, the FTS study coordinator determines the assigned value based on a number of factors, including product source information, internal and/or external pre-distribution laboratory analysis, and consensus of responses (consensus value).

Quality systems and laboratory reporting guidelines vary greatly from laboratory to laboratory, therefore participating laboratories and their accrediting bodies are responsible for the assessment of whether a reported result is an outlying result. For the convenience of subscribers FTS has highlighted, in yellow, any result that in the opinion of the FTS study coordinator may be inconsistent with the assigned value in the summary report.

For this proficiency test, the following assigned values are based on source information which was then confirmed by laboratory analysis:

Item 1: Yes, the questioned soil from Item 3 could have originated from the same source as the known soil in Item 1.
Item 2: No, the questioned soil from Item 3 could not have originated from the same source as the known soil in Item 2.

Manufacturer's Information

Sandy soil samples were collected from different locations on Cape Cod, Massachusetts.

The soil sample selected for Item 1 was taken from the larger mass of bulk sample from coordinates N 41° 49' 15.1", W 70° 00' 17.82". Approximately 6g of soil was weighed for each sample in Item 1 and packaged in a labeled Vivaplex® 2 oz. clear glass jar (X001BZ3PQ5).

The soil sample selected for Item 2 was taken from the larger mass of bulk sample from coordinates N 41° 39' 01.69", W 70° 10' 44.74". Approximately 6g of soil was weighed for each sample in Item 2 and packaged in a labeled Vivaplex® 2 oz. clear glass jar (X001BZ3PQ5).

The soil sample selected for Item 3 was taken from the same larger mass of bulk sample from Item 1, with coordinates N 41° 49' 15.1", W 70° 00' 17.82". Approximately 2g of soil was weighed for each sample in Item 3 and packaged in a labeled Vivaplex® 2 oz. clear glass jar (X001BZ3PQ5).

The Item 1/3 samples were collected and examined by a forensic geologist and could be distinguished from the Item 2 sample by **color (macro), grain size, sorting, minerology and lithics %.**

All items with matching UTICs were packaged in a cardboard box, sealed and labeled per FTS guidelines.

Statement Regarding Test Design

Soils are characteristically heterogeneous over numerous spatial scales. In many cases, investigators employ a sampling strategy to collect multiple known in situ soil samples in order to provide an adequate representation of an area of interest. Multiple known samples can aid comparisons and help compensate for the complexities of soil heterogeneity and transfer. However, the additional analytical and statistical demands for such a scenario are not practical for a proficiency examination.

Please examine the submitted items to determine if the questioned soil samples could have originated from the same source as the known soil sample.

Items Submitted

Item 1: Known soil sample collected from the shoreline of West Dennis Beach, Dennis, MA (Coordinates 41° 49' 15.1" N, 70° 00' 17.82" W).

Item 2: Known soil sample collected from the ridge of First Encounter Beach, Eastham, MA (Coordinates 41° 39' 01.69" N, 70° 10' 44.74" W).
Item 3: Questioned soil sample.

3) What type of microscope was utilized for the examination (stereomicroscope, compound microscope, etc) and what magnification levels were used?:

UTIC	Webcode	What type of microscope was utilized for the examination (stereomicroscope, compound microscope, etc) and what magnification levels were used?
p2024702	W061	Leica M205C stereomicroscope 7.8-160x mag
p2024703	W193	Stereomicroscope and digital microscope (20X to 50X magnification)
p2024704	W181	Stereomicroscope Leica Stemi 2000C 6,5x50x
p2024705	W006	Stereobinocular 10-64X Petrographic microscope from 40-400X
p2024706	W006	Stereomicroscope from 10-64X, Compound petrographic microscope from 40-400X.
p2024708	W031	stereomicroscopy PLM comparison microscope 20-40X

4) Indicate all methods used for analysis (select all that apply):

A) ○ Macro/Microscopic Examinations

B) ○ PLM

C) ○ Fluorescence Microscopy

D) ○ XRF

E) ○ XRD

F) ○ SEM-EDS

G) ○ SEM-EDX

H) ○ ICP-OES

I) ○ Alternate Light Source

UTIC	Webcode	Could the questioned soil from Item 1 have originated from the same source as the known soil in Item 3?
p2024702	W061	Macro/Microscopic Examinations
p2024703	W193	Macro/Microscopic Examinations

UTIC	Webcode	Could the questioned soil from Item 1 have originated from the same source as the known soil in Item 3?
p2024704	W181	Macro/Microscopic Examinations
p2024705	W006	Macro/Microscopic Examinations
p2024706	W006	Macro/Microscopic Examinations
p2024708	W031	PLM

5) Other methods used (if none, please enter "N/A"):

UTIC	Webcode	Other methods used (if none, please enter "N/A")
p2024702	W061	Analysis undertaken using Macro/Microscopic examinations and SEM-EDS. XRD currently out of operation but would routinely have been used.
p2024703	W193	i) Color ii) Particle size iii) Density gradient iv) Elemental composition
p2024704	W181	SEM-EDX
p2024705	W006	The radial buttons in Question 4 do not allow me to select more than one item. Item 4 should be: A, B Color designation was conducted using a light box set to daylight + UV.
p2024706	W006	Color by Munsell, PLM. Question 4 wouldn't allow me to select multiple methods.
p2024708	W031	sieve fractions

6) Could the questioned soil from Item 3 have originated from the same source as the known soil in Item 1?

A) ○ Yes

B) ○ No

C) ○ Inconclusive

7) If you eliminated the questioned soil in Item 3 as coming from the same source as the known soil in Item 1, which class characteristic(s) did you use to make the elimination? If you did not make an elimination, please respond "N/A".

UTIC	Webcode	Could the questioned soil from Item 3 have originated from the same source as the known soil in Item 1?	If you eliminated the questioned soil in Item 3 as coming from the same source as the known soil in Item 1, which class characteristic(s) did you use to make the elimination? If you did not make an elimination, please respond "N/A".
p2024702	W061	Yes	N/A
p2024703	W193	Yes	N/A
p2024704	W181	Yes	N/A
p2024705	W006	No	Compositional differences via PLM examination include: Lack of carbonate/shell fragments in 125-250 micrometer fraction in Item 3 Lack of opaques in Item 3 Lack of amphibole, zircon in Item 3 *Note: these phases were not present in Item 1 125-250 micrometer fraction, only <125 micrometer fraction.* Micro-textural differences include: Lack of **any** particles <125 micrometers in Item 3 Fewer particles in 125-250 micrometer range in Item 3 versus Item 1 Larger mean particle area in Item 3 verusus Item 1
p2024706	W006	Yes	N/A
p2024708	W031	Yes	N/A

8) Could the questioned soil from Item 3 have originated from the same source as the known soil in Item 2?

A) ◯ Yes

B) ◯ No

C) ◯ Inconclusive

9) If you eliminated the questioned soil in Item 3 as coming from the same source as the known soil in Item 2, which class characteristic(s) did you use to make the elimination? If you did not make an elimination, please respond "N/A".

UTIC	Webcode	Could the questioned soil from Item 3 have originated from the same source as the known soil in Item 2?	If you eliminated the questioned soil in Item 3 as coming from the same source as the known soil in Item 2, which class characteristic(s) did you use to make the elimination? If you did not make an elimination, please respond "N/A".
p2024702	W061	No	Overall texture and compositional differences, specifically grain sizing and presence of mica.
p2024703	W193	No	N/A
p2024704	W181	Yes	N/A
p2024705	W006	No	Color, texture, compositon. Note: while color was conducted using Munsell Soil Color Charts, the elimination decision was based on color differences when viewing Items 1 and 2 side-by-side. The application of a designated color to unconsolidated sediments of this type is not recommended
p2024706	W006	No	Texture and composition.
p2024708	W031	No	visual compostition sieve fraction amounts stereomicroscopic gran examination

10) How would you state your findings in a report? (Use the same wording as you would to submit a report to the lead investigator and/or court). In order to maintain confidentiality, please refrain from including identifying information specific to your laboratory.

UTIC	Webcode	How would you state your findings in a report? (Use the same wording as you would to submit a report to the lead investigator and/or court).
p2024702	W061	Item #1 comprised approximately 6g of pale, predominantly coarse sand. Contributions of marine origin were noted within the predominantly sub-angular to rounded, quartz-based sand. Item #2 comprised approximately 6g of pale, fine to medium sand. Small amounts of tentatively identified mica were noted within the predominantly sub-angular - sub rounded, quartz-based sand. Item #3 comprised approximately 2g of predominantly coarse, pale sand. Contributions of marine origin were noted within the predominantly sub-angular to rounded, quartz-based sand. Item #3 cannot be excluded as having originated from the same source as that represented by Item #1. Differences to Item #2 were noted in texture and composition. These results do not support the proposition that item #3 originated from the same source as that represented by Item #2.
p2024703	W193	On analysis, I found: a) The questioned soil sample (Item 3) is to be similar with the known soil sample (Item 1). b) The questioned soil sample (Item 3) is to be dissimilar with the known soil sample (Item 2). Thus, I am of the opinion that: a) The questioned soil sample (Item 3) and the known soil sample (Item 1) could have come from the same source. b) The questioned soil sample (Item 3) did not come from the same source as the known soil sample (Item 2).
p2024704	W181	Class characteristic used to make the elimination are as follow: 1) examination the samples with stereomicroscope 2) the elemental analysis by scanning electron microscopy (SEM-EDX) was made with 0,5-2 mm fraction

UTIC	Webcode	How would you state your findings in a report? (Use the same wording as you would to submit a report to the lead investigator and/or court).
p2024705	W006	The questioned debris (Item 3) is different from the known sample collected from the shoreline of West Dennis Beach, Dennis, MA (Item 1) and the known sample collected from the ridge of First Encounter Beach, Eastham, MA (Item 2). Accordingly, the possibility that the questioned debris (Item 3) originated from the shoreline of West Dennis Beach as represented by Item 1 or the ridge of First Encounter Beach as represented by Item 2 is eliminated. See "Exclusion" in the Interpretation Section, below. It should be noted that unconsolidated beach sediments such as Items 1 and 2 are heterogeneous by nature and are not likely representative of the source locations. Multiple known exemplars would be required to conduct an appropriate comparison. See the Limitations Section, below). Interpretation: Color, texture, and composition are used as comparison criteria when a sufficient quantity of geologically derived material for reliable and reproducible results is present. There are four possible conclusions when comparing geologically derived materials: • Fracture Fit: The geologically derived materials were once part of the same broken object. This conclusion can only be reached when two or more geologically derived materials physically fit together. • Inclusion: The possibility that the geologically derived item(s) originated from the same source as the geologically derived material collected from a known location (exemplar) cannot be eliminated. Additional geologically derived material(s) that are indistinguishable in all assessed characteristics could also be potential sources. This conclusion is reached when the material(s) cannot be differentiated from the exemplar using all observed or measured characteristics, there is sufficient quantity of material for reliable and reproducible results, and no inseparable mixing or deleterious change is indicated. • Inconclusive: No conclusion can be reached on whether or not the geologically derived material(s) could have originated from the same source. This conclusion can be reached for several reasons, including insufficient quantity for either the compared item or exemplar, when there is inseparable mixing with other sources of geologic materials, or when there has been deleterious change of the item(s) or exemplar. • Exclusion: The possibility that the item(s) originated from the same source as the exemplar is eliminated.

UTIC	Webcode	How would you state your findings in a report? (Use the same wording as you would to submit a report to the lead investigator and/or court).
p2024705 (Cont.)	W006	This conclusion is reached when the item(s) can be differentiated from the exemplar, there is sufficient quantity of material for reliable and reproducible results, and no inseparable mixing or deleterious change is indicated. Soil properties vary both across the land and below the land surface as a function of parent material, climate, biological activity, geography, and time, yielding soil which is distinct from location to location and with depth below the surface. These changes can occur abruptly or gradually. Therefore, the exemplar soils from a specific site must be interpreted to represent only that site, and may not be representative of all soils in the area or soil that may have been present in the past. Limitations: A geologically derived materials analysis is typically a comparison of two or more geologically derived materials in an attempt to determine if they originated from different sources. These analyses require the determination of class characteristics that may associate objects within a group of similar objects such as a particular variety of wallboard from a specific manufacturer, but never to a single object except for a fracture fit. Only when two or more broken fragments of geologically derived materials physically fit together can it be said that they were once part of the same object. Due to the possible variations in soil, the boundaries of a homogeneous soil cannot be predicted with absolute certainty. Soil and geologic studies and maps of an area may assist in defining the approximate extent of a homogeneous soil. When debris from an item is eliminated as originating from an exemplar location through a soil comparison, no inference can be made as to whether or not the item was present at that location. A number of factors can produce this results, including: • The material did not originate from the location in question. • No material was transferred from the location to the item. • Material which may have transferred from the location to the item was not preserved. • Additional material may have transferred at some other time which mixed into the material on the item(s). • The exemplars from the location in question do not adequately represent that location.

UTIC	Webcode	How would you state your findings in a report? (Use the same wording as you would to submit a report to the lead investigator and/or court).
p2024706	W006	The questioned soil (Item 3) cannot be differentiated from the known soil from West Dennis Beach as represented by Item 1 by color, texture, and composition. Consequently, the known soil from West Dennis Beach as represented by Item 1 cannot be eliminated as a possible source of the questioned soil (Item 3). The questioned soil (Item 3) is different from the known soil from First Encounter Beach as represented by Item 2. Consequently, the known soil from First Encounter Beach as represented by Item 2 is eliminated as a possible source of the questioned soil (Item 3).
p2024708	W031	ITEMS: 1 a sealed cardboard box identified as "FTS FORENSIC TESTING SERVICES FTS-24-SOIL p2024708" containing: 1-1 a closed glass jar identified as "FTS-24-SOIL Item 1 p2024708" containing sand 1-2 a closed glass jar identified as "FTS-24-SOIL Item 2 p2024708" containing sand 1-3 a closed glass jar identified as "FTS-24-SOIL Item 3 p2024708" containing sand RESULTS: The sand samples in items #1-1, #1-2, and #1-3 were examined and compared utilizing visual examinations, stereomicroscopy, grain fractions, and polarized light microscopy. The questioned sand, item #1-3, corresponded to the known sand, item #1-1, in overall visual composition, stereomicroscopic grain composition, relative grain fraction amounts, and microscopic grain composition. The questioned sand, item #1-3, did not correspond to the known sand, item #1-2, in overall visual composition, stereomicroscopic grain composition, or relative grain fraction amounts. OPINION: The questioned sand in item #1-3 could have originated from the known sand in item #1-1 or any other sand with similar visual and microscopic properties. This is a Type III Association. See Association Key below. The questioned sand in item #1-3 could not have originated from the known sand in item #1-2. This is an Elimination. See Association Key below.

11) How long did it take to complete this test (in hours)? Please report actual analytical hours only.

12) Did you find this test to be a fair test of the process of soil comparison?

A) ◯ Yes

B) ◯ No

UTIC	Webcode	How long did it take to complete this test (in hours)? Please report actual analytical hours only.	Did you find this test to be a fair test of the process of soil comparison?
p2024702	W061	6	Yes
p2024703	W193	60 hour	Yes
p2024704	W181	15	Yes
p2024705	W006	12	No
p2024706	W006	12	No
p2024708	W031	12	Yes

13) How would you change the aspects of the test (i.e. scenario, test samples, question sections, report format) to improve a future version of this test? Comments and suggestions are welcome.

Additionally, this question is a means to provide you with an opportunity to explain or include information about your findings or interpretation, as needed. In order to maintain confidentiality, please refrain from including identifying information specific to your laboratory.

UTIC	Webcode	How would you change aspects of this test (i.e. scenario, test samples, question sections, report format) to improve a future version of this test?	FTS Response
p2024705	W006	This is an inappropriate soil test. Unconsolidated sediments derived from glacial morraines, such as the reported sources of Items 1 and 2, are heterogeneous by nature. This means that obtaining a representative or pseudo-representative sample of the known sources is very difficult. In an actual case, this limitation can potentially be overcome by taking multiple samples of a source area in an attempt to capture the variability. Even so, the possibility that the source area is not adequately represented by the knowns remains higher than in other geographic areas, leading to a potentially higher rate of false exclusions.The disclaimer above indicates that FTS is aware of the potential issue of not having appropriate knowns. If FTS is only going to supply one known to represent an area, it is incumbent upon them to make sure that the known is representative. This should be done by both choosing better souces and making sure the tests are checked by subject matter experts such as geologists or soil scientists before distribution. Given that I analyzed one test and conducted a review of another test, and the results were different between tests, FTS did not accomplish this. Geologists have many ways to ensure adequate particle size distribution and compositional homogeneity between samples. These include but are not limited to: sieving, optical point counting, laser particle size analysis, 2D automated image analysis, and X-ray Computed Tomography. It is clear that FTS did not employ any such tecniques.	The samples in this proficiency test are glacially-derived beach sands, composed of unconsolidated sediment. Sand is a textural class, and therefore a subset of materials colloquially referred to as soils, which may reasonably be expected to be submitted for forensic soil examination. The samples were selected and examined by a forensic geologist. By definition, sands, like all soils, are heterogeneous. However, the geological processes of weathering and sorting in shoreline environments often produces more homogenous volumes of sand, and therefore, samples with fewer class characteristics for comparison. In such cases, it may be appropriate to broaden the assessment criteria for comparison to avoid false exclusions.

UTIC	Webcode	How would you change aspects of this test (i.e. scenario, test samples, question sections, report format) to improve a future version of this test?	FTS Response
p2024706	W006	The samples selected by FTS could potentially lead to false inclusions and/or false exclusions depending on the results, even if the Examiner performed all analyses correctly. First, these samples are not soil. They are unconsolidated sand. While soil Examiners would typically analyze sand, using it in a proficiency test is not appropriate. This is because it is virtually impossible to subdivide an unconsolidated coarse sand without unacceptable levels of fractionation between the finer and coarser components. This means that samples provided to Examiners that are intended by FTS to be indistinguishable, will quite possibly be different. For example, if a questioned sand is much coarser than a known sample, an Examiner would likely determine that they came from different sources, even if they are indistiguishable in all other properties. If FTS has not verified that every sample that is "supposed" to be the same, actually is, then I expect some Examiners to misclassify these samples through no fault of their own. When soils contain more clay, it is much easier to subdivide samples while avoiding fractionation. Second, selecting samples from Cape Cod, which is a glacial morraine and also subject to longshore transport of sediment, means that there is also the possibility that samples selected from different locations might be included by Examiners as having come from the same source, because that source is quite large. In fact, I would expect based on the geology and the longshore currents that sands collected several miles away from West Dennis Beach are likely to be very similar if not indistiguishable.	Please see FTS Response for p2024706.