



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F401

Soil Texture Determination by Feel (Ribbon Method)

Standard Operating Procedure

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1. Purpose

This SOP describes the field determination of soil texture using the texture-by-feel (ribbon) method. This rapid, equipment-free technique classifies soil into one of 12 USDA textural classes based on how a moistened soil sample behaves when formed into a ball, extruded into a ribbon, and rubbed between the fingers (Soil Survey Division Staff, 2017; Thien, 1979). Field texturing provides an immediate estimate of sand, silt, and clay content without laboratory analysis.

2. Scope

- **Applies to:** Field characterization of mineral soils at all EA Program sites; preliminary texture assessment for soil sampling campaigns
- **Does not apply to:** Soils with very high organic matter content (>20%, e.g., peat); quantitative particle size analysis (use the hydrometer method, SOP-L401); soils with large gravel or rock fragment content (assess the fine fraction only)
- **Location:** All EA Program field sites; can also be performed on samples brought back to the lab

3. Responsibilities

Role	Responsibility
Lab PI	Approve protocol, ensure training compliance
Field Lead	Coordinate sampling, verify observer calibration
Trained Personnel	Perform texture assessments, record results
New Students	Complete training and calibration exercise before independent use

4. Definitions

- **Clay:** The finest soil particle size class, with equivalent spherical diameter less than 0.002 mm; imparts stickiness, plasticity, and cohesion to the moist soil; forms a long, flexible ribbon when extruded between thumb and forefinger.
- **Loam:** A textural class with roughly balanced proportions of sand, silt, and clay; exhibits moderate ribbon length (25–50 mm), moderate grittiness, and moderate stickiness; the most common agricultural soil texture.
- **Plasticity:** The ability of moist soil to be molded and deformed without cracking or crumbling; highest in clay-rich soils; assessed by rolling soil into a thread between the palms.

- **Ribbon:** The flat, continuous strip extruded when moist soil is pushed between the thumb and forefinger; ribbon length is the primary diagnostic criterion in the field texture-by-feel method; longer ribbons indicate higher clay content.
- **Sand:** Soil mineral particles with equivalent spherical diameter 0.05–2.0 mm; feels gritty between the fingers; does not form a ribbon; individual grains are visible to the naked eye.
- **Silt:** Soil mineral particles with equivalent spherical diameter 0.002–0.05 mm; feels smooth and floury when dry; slippery and slightly plastic when moist; imparts a silky texture to the soil.
- **Texture class:** A USDA classification category (e.g., sandy loam, silt clay loam, clay) based on the relative percentages of sand, silt, and clay; determined from the USDA textural triangle and confirmed by laboratory hydrometer analysis (see [SOP-L401](#)).
- **Water content (field):** The moisture status of the soil at the time of testing; texture-by-feel must be performed on soil adjusted to a defined moist or wet state to produce consistent results across operators.

5. Safety and Hazards

Hazards

- **Biological:** Soil-borne pathogens; wash hands thoroughly after handling soil
- **Chemical:** At contaminated sites, soil may contain heavy metals or other hazardous materials; wear gloves
- **Physical:** Standard field hazards (ticks, snakes, heat exposure)

5.1. Required PPE

- ☐ Closed-toed shoes or field boots
- ☐ Nitrile gloves (recommended, especially at unknown or contaminated sites)
- ☐ Sun protection (hat, sunscreen)
- ☐ Hand sanitizer or soap and water for post-handling cleanup

5.2. Required Training

- [SOP-F001 Field Safety](#)

6. Background

6.1. Soil Particle Size Fractions

Soil texture is defined by the relative proportions of three mineral particle size fractions (Soil Survey Division Staff, 2017):

Fraction	Diameter	Feel
Sand	2.0–0.05 mm	Gritty; individual grains visible and felt between fingers
Silt	0.05–0.002 mm	Smooth, floury, or silky; like rubbing flour or talc
Clay	< 0.002 mm	Sticky when wet; plastic and moldable; stains fingers

6.2. The USDA Textural Triangle

The 12 USDA textural classes are defined by the percentages of sand, silt, and clay. The texture-by-feel method estimates which class a soil belongs to without measuring exact percentages.

6.3. Why Field Texture Matters

- Determines water-holding capacity, drainage, and aeration
- Guides sampling strategy (e.g., different sample weights for carbon analysis; see SOP-L406)
- Informs the soil texture correction factor for nutrient extractions (see [SOP-L403](#))
- Rapid enough to characterize many points across a landscape in a single field day

7. Required Materials

Item	Notes
Water bottle with squeeze top	For wetting soil incrementally
Small ruler (cm)	For measuring ribbon length
Field data sheet	Printed from Appendix A
Clipboard and pencil	Mechanical pencil preferred
GPS unit or smartphone	For recording sample locations
Trowel or soil knife	For collecting subsurface samples
Sealable plastic bags	If bringing samples back for confirmation
Paper towels or rag	For cleaning hands between samples

No specialized laboratory equipment is required.

8. Estimated Time

Task	Time
Per sample (experienced observer)	2–5 minutes
Per sample (new observer)	5–10 minutes
Calibration exercise (training)	30–45 minutes with known-texture standards

9. Procedure

9.1. Collect the Sample

1. Select a representative location and record GPS coordinates
2. Clear surface litter and organic debris
3. Collect approximately a golf-ball-sized amount of mineral soil from the target depth (typically 0–15 cm)
4. Remove visible roots, gravel, and organic fragments

9.2. Moisten the Sample

1. Place the soil in your palm
2. Add water drop by drop from the squeeze bottle while kneading the soil
3. Continue adding water and kneading until the soil reaches the consistency of modeling clay or putty
4. The soil should be uniformly moist but not dripping wet
5. Crush all aggregates between your fingers during kneading

! Getting the Moisture Right

This is the most critical step. If the soil is too dry, it will crumble and you'll underestimate clay content. If too wet, it will be slippery and you'll overestimate clay. The target is a smooth, pliable consistency similar to play dough. This may take 2–3 minutes of kneading.

9.3. Test 1: Form a Ball

1. Try to form the moistened soil into a ball (bolus) by squeezing and rolling in your palm
2. **If the soil will not form a ball**, it is **Sand**. Record and move to the next sample.
3. If a ball forms, proceed to Test 2

9.4. Test 2: Ribbon Test

1. Place the ball between your thumb and forefinger
2. Gently push the soil forward with your thumb, squeezing it into a flat ribbon about 2 mm thick and 1 cm wide
3. Let the ribbon extend over your forefinger, unsupported, until it breaks from its own weight
4. Measure the ribbon length with a ruler before it breaks

- Repeat 3–5 times and use the longest consistent ribbon

Ribbon length determines clay content:

Ribbon Length	Clay Content	Category
No ribbon forms	< 10%	Low clay
< 2.5 cm (< 1 inch)	10–20%	Low-moderate clay
2.5–5 cm (1–2 inches)	20–35%	Moderate clay
> 5 cm (> 2 inches)	> 35%	High clay

9.5. Test 3: Feel Test (Grittiness and Smoothness)

- Take a pea-sized piece of the moistened soil
- Place it in your palm and add excess water to make a muddy slurry
- Rub the slurry between your thumb and forefinger using a circular motion
- Classify the dominant feel:

Feel	Sensation	Dominant Fraction
Gritty	Like rubbing sugar or fine sand between fingers; individual grains felt and possibly heard	Sand-dominated
Smooth	Like rubbing flour or talc; silky, no grains felt	Silt-dominated
Neither	Neither gritty nor silky dominates; sticky	Sand and silt balanced

9.6. Determine Textural Class

Combine the ribbon length and feel test results using the following decision matrix (Thien, 1979):

	Gritty Feel	Smooth Feel	Neither Gritty nor Smooth
No ribbon	Sand	Silt	Loam
< 2.5 cm	Sandy loam	Silt loam	Loam
2.5–5 cm	Sandy clay loam	Silty clay loam	Clay loam
> 5 cm	Sandy clay	Silty clay	Clay

Additional Clues

- Loamy sand** falls between sand and sandy loam: barely forms a ball, very gritty, ribbon <1 cm
- Silt** (pure): very smooth, almost soapy when wet, forms a weak ball but no ribbon

- When in doubt between two classes, record both (e.g., “sandy loam / loam”) and note the uncertainty

9.7. Record Results

Record the textural class, ribbon length, feel, and any notes on the field data sheet (Appendix A). Photograph the ribbon if possible for documentation.

10. Supplementary Test: Jar Sedimentation

For a semi-quantitative confirmation of field texture, you can perform a jar test on the same soil:

1. Fill a clear, straight-sided jar (mason jar or pasta sauce jar) one-third full with soil
2. Fill the jar with water, leaving 2 cm of headspace
3. Add a pinch of non-foaming dish soap (dispersing agent)
4. Cap tightly and shake vigorously for 2 minutes
5. Set the jar on a level surface and do not disturb
6. After 1 minute, mark the settled layer on the jar (this is **sand**)
7. After 2 hours, mark the next layer (this is **silt**)
8. After 24–48 hours, the remaining suspended material has settled (this is **clay**); the water above may still be slightly turbid
9. Measure the thickness of each layer and calculate approximate percentages

i Note

The jar test provides a rough visual estimate only. For precise particle size distribution, use the hydrometer method (SOP-L401).

11. Quality Control

- **Calibration:** Before independent fieldwork, each observer must practice on at least 5 soils of known texture (confirmed by hydrometer analysis). Results should match the confirmed texture class for at least 4 of 5 samples.
- **Inter-observer agreement:** When multiple observers are surveying, have each observer independently classify at least 10% of the same samples. Agreement should be within one textural class. Inter-observer variability is a well-documented limitation of texture-by-feel; training and calibration reduce but do not eliminate systematic differences among observers (Salley et al., 2018).
- **Documentation:** Record ribbon length to the nearest 0.5 cm, not just the textural class, so results can be reviewed later.
- **Confirmation:** For critical projects, bring duplicate samples back to the lab for hydrometer analysis on at least 10% of field-textured samples.

When texture-by-feel results will inform quantitative analyses (e.g., pedotransfer functions for water-holding capacity), confirm at least 10% of field-textured samples with hydrometer analysis (SOP-L401). The accuracy of the feel method varies by textural class: sandy and clayey soils are identified most reliably, while loams and silt loams are misclassified more often (Salley et al., 2018).

12. Data Management

Enter results from field sheets into the project spreadsheet within 48 hours. Required fields:

- Date, site, plot ID, observer
- GPS coordinates
- Sample depth (cm)
- Ribbon length (cm)
- Feel (gritty, smooth, or neither)
- Textural class
- Notes (e.g., high gravel content, high organic matter, very dry)

13. References

- Salley, S. W., Herrick, J. E., Holmes, B. M., Karl, J. W., Levi, M. R., McCord, S. E., Waal, C. van der, & Edwards, B. R. P. (2018). A comparison of soil texture-by-feel estimates: Implications for the citizen scientist. *Soil Science Society of America Journal*, 82(6), 1526–1537. <https://doi.org/10.2136/sssaj2018.04.0137>
- Soil Survey Division Staff. (2017). *Soil survey manual*. Government Printing Office. <https://www.nrcs.usda.gov/resources/guides-and-instructions/soil-survey-manual>
- Thien, S. J. (1979). A flow diagram for teaching texture-by-feel analysis. *Journal of Agronomic Education*, 8, 54–55. <https://doi.org/10.2134/jae.1979.0054>

14. Training Record

Before performing field texture assessments independently, personnel must:

1. Read this SOP in full
2. Complete a calibration exercise on at least 5 soils of known texture
3. Demonstrate the moistening, ball, ribbon, and feel tests under supervision
4. Achieve agreement within one textural class on 4 of 5 known samples
5. Be signed off by the field lead or PI

15. Appendix A: Soil Texture Field Data Sheet

Print this sheet and use it in the field.

Site: _____ Date: _____

Observer: _____ **Project:** _____

Sample #	GPS / Location	Depth (cm)	Ball? (Y/N)	Ribbon (cm)	Feel (G/S/N)	Texture Class	Notes
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Feel key: G = Gritty, S = Smooth, N = Neither**Texture class options:** Sand, Loamy sand, Sandy loam, Loam, Silt loam, Silt, Sandy clay loam, Clay loam, Silty clay loam, Sandy clay, Silty clay, Clay