



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L105

Using Drying Ovens

Standard Operating Procedure

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1. Purpose

This procedure describes the safe operation of gravity convection and forced-air drying ovens used in the EA Program laboratory. Drying ovens are used to determine gravimetric moisture content of soil, sediment, and plant tissue samples (see [SOP-L400 Soil Moisture](#)), to pre-dry samples before loss on ignition (see [SOP-L406 Loss on Ignition](#)), to dry glassware, and to regenerate desiccants. Consistent oven operation ensures accurate and reproducible mass-loss measurements across the laboratory (Gardner, 1986; Robertson et al., 1999).

2. Scope

- **Applies to:** All gravity convection and forced-air drying ovens in the EA Program laboratory, operated at temperatures up to 250 C
- **Does not apply to:** Muffle furnaces (550+ C; see SOP-L50), vacuum ovens, microwave drying, or autoclaves
- **Location:** EA Program laboratory, SGM 133

3. Definitions

- **Desiccator:** An airtight container holding a hygroscopic drying agent (typically silica gel or Drierite) used to cool crucibles or dried samples to room temperature without re-absorbing atmospheric moisture.
- **Forced-air oven (mechanical convection):** A drying oven with a fan that circulates hot air to produce uniform temperature and faster drying; preferred when rapid or even drying is required.
- **Gravity convection oven:** A drying oven without a fan; relies on natural convection. Slightly less temperature-uniform than forced-air but adequate for most soil and sediment drying.
- **Gravimetric moisture content:** The mass of water lost on drying expressed as a proportion of the dry mass: $\theta_g = (M_{wet} - M_{dry})/M_{dry}$; expressed as g g⁻¹ or as a percentage.
- **Oven-dry basis:** The convention of expressing soil or sediment concentrations relative to the mass of material dried at 105 °C to constant mass; the standard reference state for soil analysis.
- **Set point:** The target temperature programmed into the oven controller; the actual chamber temperature should be verified with a calibrated thermometer and may differ from the set point by a few degrees.
- **Tare mass:** The mass of an empty, pre-dried container (crucible, tin, or pan) recorded before adding sample; subtracted from the gross mass to obtain sample mass.

4. Responsibilities

Role	Responsibility
Lab PI	Approve SOP, ensure training compliance
Lab Manager	Maintain ovens, schedule annual calibration checks
Trained Personnel	Operate ovens following this SOP, report malfunctions
New Students	Complete training before independent use

5. Safety and Hazards

Hazards

- **Physical:** Oven surfaces and contents reach temperatures up to 250 C. Severe burns can result from touching hot surfaces, shelves, or sample containers without proper PPE. Steam may escape when opening the door if drying wet samples.
- **Chemical:** Do not dry samples containing volatile organic solvents, flammable materials, or corrosive chemicals in these ovens. Drying ovens are not explosion-proof. Volatile fumes can accumulate inside the oven chamber and pose fire or explosion risks.
- **Electrical:** Do not operate ovens with damaged power cords or plugs. Ensure the oven is properly grounded.

5.1. Required PPE

- ☐ Heat-resistant gloves or oven mitts (required when loading/unloading)
- ☐ Safety glasses
- ☐ Lab coat
- ☐ Closed-toed shoes

5.2. Emergency Procedures

For burns, cool the affected area under cool running water for at least 10 minutes. Seek medical attention for burns with blistering. If smoke or unusual odors are detected, turn off the oven, unplug it, and ventilate the area. Refer to [SOP-L002 Laboratory Safety](#).

6. Equipment and Materials

6.1. Equipment

Item	Location	Notes
Drying oven	Lab bench, SGM 133	<i>TBD – confirm manufacturer and model number</i>
Calibrated thermometer or thermocouple	Inside oven	For independent temperature verification

Item	Location	Notes
Desiccator with indicating desiccant	Lab bench	For cooling samples after removal from oven
Metal tongs or oven mitts	Near oven	For handling hot containers

6.2. Consumables

Item	Notes
Aluminum weighing tins	Pre-labeled or numbered
Ceramic crucibles	For higher-temperature applications
Indicating desiccant (silica gel or Drierite)	Replace or regenerate when color changes

7. Procedure

7.1. Pre-Use Checks

1. Verify the oven is clean and free of residue from previous use
2. Check that the oven vent is unobstructed (gravity convection ovens rely on passive airflow; blocked vents cause uneven heating)
3. Confirm the temperature setpoint using the oven's built-in display or controller
4. Verify the temperature against an independent thermometer or thermocouple placed inside the oven. The reading should agree within ± 2 C of the setpoint. If it does not, contact the lab manager.

7.2. Setting the Temperature

Common drying temperatures used in the EA Program laboratory:

Application	Temperature	Duration	Reference SOP
Gravimetric soil moisture	105 C	24+ hours	SOP-L41
Pre-drying soil for LOI	105 C	24+ hours	SOP-L50
Drying glassware	105 C	2–4 hours	–
Drying plant tissue	65–70 C	48–72 hours	–
Regenerating Drierite desiccant	210 C	1–2 hours	–
Acid-treated soil (IC removal)	105 C	Until dry	SOP-L51

1. Set the temperature using the oven controller dial or digital display
2. Allow the oven to reach the target temperature and stabilize before loading samples (typically 30–60 minutes)
3. Record the setpoint and actual temperature in your lab notebook

7.3. Loading Samples

1. Arrange samples on oven shelves with adequate spacing to allow air circulation. Do not stack containers or block vents.
2. Place containers with the lids removed or loosely resting to allow moisture to escape
3. For large batches, distribute samples evenly across shelves to minimize temperature gradients
4. Close the oven door promptly after loading

Tip

Place a small label or sign on the oven door indicating: your name, the setpoint temperature, the date and time samples were loaded, and the expected removal time. This prevents others from accidentally changing the temperature or disturbing your samples.

7.4. Monitoring

1. Check the oven temperature at the start and end of each drying cycle using the independent thermometer
2. Do not open the oven door unnecessarily during drying, as this introduces cool air and extends drying time
3. For multi-day drying, check the oven temperature at least once daily

7.5. Removing Samples

1. Wear heat-resistant gloves or oven mitts
2. Use metal tongs for small containers (aluminum tins, crucibles)
3. Transfer hot containers directly into a desiccator to cool to room temperature. Do not weigh hot samples; thermal convection currents around hot objects cause unstable balance readings (Harris & Lucy, 2020).
4. Allow samples to cool in the desiccator for 20–30 minutes before weighing
5. Close the oven door after removing samples

7.6. Verifying Dryness (Constant Mass)

For analytical applications (soil moisture, LOI), drying is complete only when the sample reaches constant mass:

1. After the initial drying period, remove the sample, cool in the desiccator, and weigh
2. Return the sample to the oven for an additional 2–4 hours
3. Cool and re-weigh
4. If the mass has changed by less than 0.01 g between successive weighings, constant mass has been achieved
5. If the mass has decreased by more than 0.01 g, return to the oven and repeat until constant mass is reached

7.7. Shutdown

1. If the oven will not be used for several days, turn it off using the power switch or controller
2. Leave the door slightly ajar to prevent moisture buildup and odors inside the chamber
3. Ensure no samples remain in the oven before shutting down

8. Quality Control and Acceptance Criteria

- Verify oven temperature against an independent thermometer at least monthly; record in the oven calibration log
- Acceptable temperature accuracy: ± 2 C of setpoint at 105 C
- If the oven temperature drifts beyond ± 5 C, remove the oven from service and contact the lab manager
- Ensure the desiccator contains active (indicating) desiccant; regenerate or replace when the indicator changes color
- For analytical drying, always confirm constant mass (Section 6.6) rather than relying on a fixed drying time alone

8.1. Interferences

- Overcrowding the oven can create temperature gradients and uneven drying, leading to inconsistent results
- Opening the oven door frequently extends drying time and introduces moisture
- Drying samples containing volatile compounds at 105 C will cause mass loss beyond water content, biasing moisture determinations

9. Waste Disposal

Waste Type	Disposal Method
Dried soil samples	Standard trash or return to field site
Aluminum tins	Clean and reuse, or recycle
Spent desiccant	Regenerate at 210 C or dispose as non-hazardous solid waste

10. References

- Gardner, W. H. (1986). Water content. In A. Klute (Ed.), *Methods of soil analysis, part 1: Physical and mineralogical methods* (2nd ed., pp. 493–544). Soil Science Society of America.
- Harris, D. C., & Lucy, C. A. (2020). *Quantitative chemical analysis* (10th ed.). W. H. Freeman.
- Robertson, G. P., Coleman, D. C., Bledsoe, C. S., & Sollins, P. (1999). *Standard soil methods for long-term ecological research*. Oxford University Press.

11. Training Record

Before using the drying oven independently, personnel must:

1. Read this SOP and [SOP-L002 Laboratory Safety](#) in full
2. Demonstrate proper use of heat-resistant gloves and tongs
3. Demonstrate setting the oven temperature and verifying it with an independent thermometer
4. Demonstrate loading and unloading samples, including transfer to the desiccator
5. Be signed off by the PI or lab manager

12. Appendix A: Troubleshooting

Symptom	Probable Cause	Corrective Action
Oven does not heat	Power switch off, unplugged, or blown fuse	Check power connections; replace fuse if needed
Temperature overshoots setpoint	Faulty thermostat or controller	Remove from service; contact lab manager
Uneven drying across samples	Overcrowded shelves or blocked vent	Redistribute samples; check vent is clear
Samples not reaching constant mass after 48 hours	Very wet or clay-rich samples; temperature too low	Verify setpoint is 105 C; extend drying time; check oven seal
Unusual odor during drying	Contaminated samples or residue from previous use	Turn off oven; ventilate; clean interior