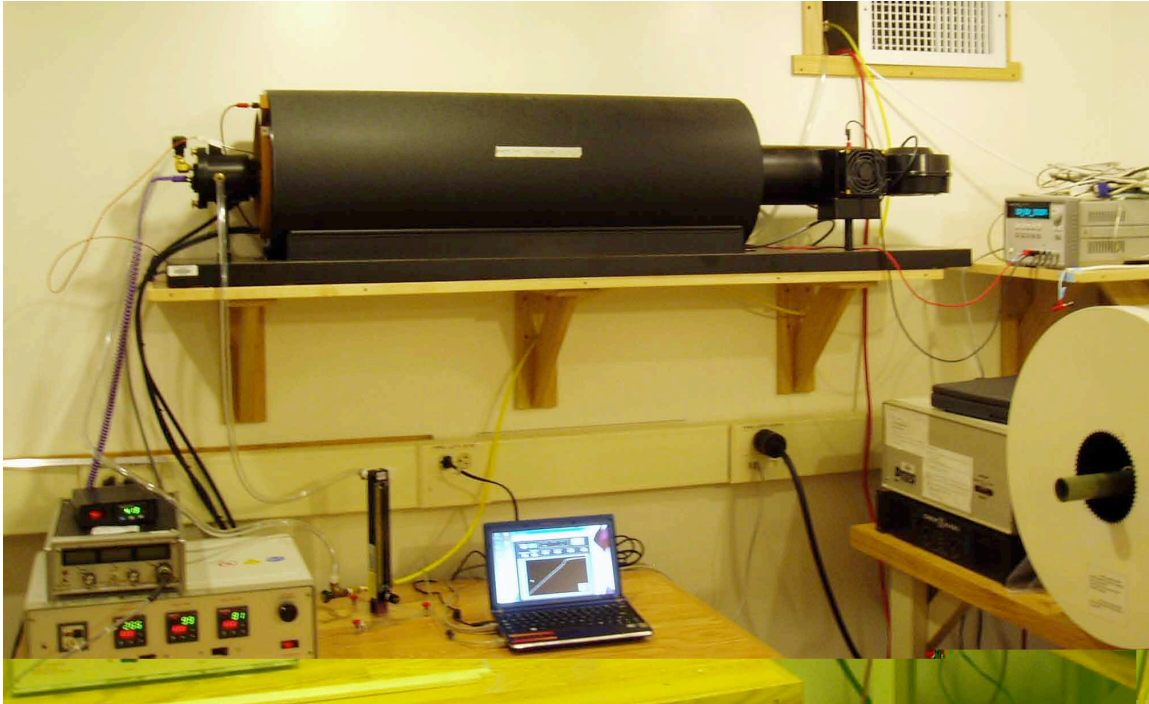


Institute for Rock Magnetism
Paleointensity Furnace Operation



Furnace: ASC Model TD-48SC Thermal Demagnetizer with TRM field coil
Power supply to field coil: Agilent E3632A DC Power Supply

The furnace can be operated either in air or with an inert atmosphere (usually Ar). The latter uses a special sealed quartz insert which can be left in place for air operation, but the system behaves better with it removed.

Furnace Use

1) Air

- a. Load samples in boat and insert boat into furnace with socket for thermocouple facing out. End of sample boat should be inset about 0.5 cm from end of oven.
- b. Plug white thermocouple lead into end of sample boat, taking care to match wide and narrow parts of plug.
- c. Turn on power to furnace (Fig. 2A) and computer; launch “ASC_Thermal” program
- d. Enter user information (Fig. 4)
 - i. User name and BatchID (if available)
 - ii. Field information (this is currently for notation purposes only; field must be controlled manually at power supply – see below)
 - iii. Temperature setpoint (SP) – enter desired maximum temperature (note that computer will first send the SP – 20°C to avoid overshoot, and will then gradually approach the actual SP)
 - iv. Select controlled temperature ramp rate if desired. If NOT selected, temperature can increase rapidly (20-80°C min⁻¹) to SP-20°C. If the first heating of samples is to high temperature (>400°C ?), a controlled heating rate (5-10°C min⁻¹) may be desired to prevent sample explosion from rapid water loss.
 - v. Select desired soak time at high temperature. When time is up, computer will e-mail or text you a notification if “E-mail me when done” option is selected. You must then manually turn off the oven.
 - vi. When all options are set, click “Continue”
- e. You will be prompted to turn on oven switch (Fig. 2B) and fan switch (Fig. 2C), and to reset timer. Use pinwheel dials (Fig. 2D) to set time to a high value (e.g. 900 min), and press small black reset button (Fig. 2E).
- f. **WHEN TIME IS UP, YOU MUST MANUALLY TURN ON FAN.** Click the “Stop” button on computer. Then dial down time to zero using pinwheels (Fig. 2D). You should hear the fan turn on. Power to furnace windings will also be automatically cut off.

2) Inert atmosphere

- a. Controlled atmosphere chamber (Fig. 1) should be installed by IRM staff.
- b. Load samples in boat and insert boat into furnace.
- c. Check o-ring?
- d. Tighten the two brass thumbscrews (Fig. 1) lightly by hand.
- e. Plug white and purple thermocouple leads into end of sample boat (Fig. 1), taking care to match colors, as well as wide and narrow parts of plug.
- f. Attach tygon tubing to purge valve barb (Fig. 1) at end of sample boat.
- g. Manage gas flow:
 - i. Turn on Ar (or other gas) at tank outside shielded room.
 - ii. Open bypass valve at flow meter (Fig. 3) and open purge valve (Fig. 1) on end of sample boat. Purge with gas for 5-10 min.
 - iii. Close purge valve (Fig. 3) and bypass valve (Fig. 1).
 - iv. Open flow meter (Fig. 3) and set to 150; this is the normal operating condition for gas flow during heating to avoid disrupting temperature uniformity inside the furnace.

- h. Follow steps 1c – 1f (above), BUT note that sample temperature is monitored by the auxiliary thermocouple (Fig. 2), which is not logged to the computer screen. The “Sample Zone” temperature on the main control box is connected to a thermocouple outside the controlled atmosphere chamber. **Actual sample temperature and time at temperature will need to be monitored in person.**
- i. Turn off Ar gas at tank when finished.

Field Control

1) Zero-field

- a. Unplug at least one of the electrical leads from power supply.
- b. Zero-field can be checked with fluxgate; Fluxgate X readout gives field along furnace axis. Keep in mind, however, that it is not uncommon for small calibration offsets in the fluxgate to bias the reading. Ask IRM staff for help in re-zeroing the fluxgate.
- c. If field is $> \sim 0.2$ mG (20 nT), oven may be AF demagnetized:
 - i. REMOVE ALL SAMPLES FROM OVEN
 - ii. Attach electrical leads to Variac.
 - iii. Turn on Variac (outside shielded room)
 - iv. Slowly turn knob to 8 V and then back to zero. Repeat once.
 - v. Turn off Variac
 - vi. Detach leads from Variac.
 - vii. Remeasure field.
- d. If a lower field (than 0.2 mG) is desired, you may try heating the oven up to 680°C and cooling back down to thermally demagnetize. Best case scenario is probably 0.02 to 0.04 mG (2-4 nT).

2) Non-zero field

- a. Connect electrical leads to power supply and turn on power.
- b. For 25, 50, or 100 μ T, select one of the pre-programmed power settings:
 - i. Push the “Recall” button.
 - ii. Use black knob to select 1 for 25 μ T, 2 for 50 μ T or 3 for 100 μ T.
 - iii. Push “Recall” button again.
- c. For other field values, set current appropriately:
 - i. Press “Output On/Off” button.
 - ii. Use “Voltage/Current” to toggle between voltage or current control. (You may need to increase voltage to reach your desired current.)
 - iii. Use left/right arrows to select control precision (digit will flash).
 - iv. Set current appropriately: 1 A = 100 μ T (1 G)
- d. Note that field may be checked with fluxgate, but calibration (i.e. 1 G/A) appears to be correct to within ~ 1 -2%. An improperly zeroed fluxgate (see 1b above) may lead to an improperly set field. If high accuracy in applied field is desired, see IRM staff for assistance in re-calibrating fluxgate. If good repeatability is desired (in a Thellier-type paleointensity experiment, for example), it is recommended that you rely on the current reading to set the field, NOT the fluxgate.

