
High Temperature Hall System Guide

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Installation

1. Loosen the four cap screws that secure the room temperature probe to the magnet using a 3/16" allen wrench.
2. Bring the pole pieces out to make room for the high temperature probe. Lift the levers and then move the pieces back. Lower the levers to lock the pole pieces into place when you're done.
3. Slide in the oven housing, with the metal plate on top of the magnet probe support structure. Secure with two 3/16" screws.
4. Attach the vacuum hose the oven housing and turn on the pumping station. The pressure should reach 10^{-4} Torr within a few minutes; if it doesn't, check the connections and make sure the vent valve on the pumping station is closed.
5. Connect the wrapped red cable to the oven housing. This provides power to the main heater and also measures the temperature.
6. Connect the other two cables to the blue break out box.
7. Attach the Argon line to the oven housing.
8. Insert the Hall probe between the oven housing and one of the pole pieces.

Operation

1. Evaporate contacts onto your film. There are four point masks that are made to work with the 8.5 and 5 mm shadow masks. If you're using a non-standard size, aluminum foil and double sided tape can be used to prepare a mask. Aim for 1 μm thickness, otherwise the pins may poke through. Aluminum usually works well, but you probably need to use two boats in the evaporator to get enough thickness.
2. Place the film on the copper block and line up the pins with the metal pads on your film. Gently tighten the screws to secure the pins, being sure that neither the pins nor the ring terminals will touch the oven housing when inserted.
3. Check the resistance between each pin and the breakout box. The resistance should be less than 5 Ω .
4. Wipe the probe down with acetone/alcohol.
5. Gently insert the probe into the oven housing and secure the bayonet mount.
6. Open the Argon cylinder and set the pressure to 80 - 100 psi. Make a note of the Argon pressure in the log book. Verify that there is enough Argon in the tank for you to complete your measurement (replace the tank at ~ 500 psi).
7. Press the button on the pump to evacuate the oven and fill it with Argon. The pressure should get to -20 mmHg or lower.
8. Repeat step 7 three times.
9. When setting up a measurement, make sure that the last step is to shut down the oven. If you don't do this, the oven will stay at its final set point after the measurement finishes.
10. Before you start the measurement, verify that the pressure in the oven housing is sufficiently low ($< 10^{-4}$ Torr). The vacuum is necessary to keep the outside of the oven cool and to allow the system to get up to temperature.

Shutdown

1. Verify that the heaters are off (check the output power on the temperature controller) and that the system is at or close to room temperature.
2. Close the argon cylinder. Note the final pressure in the log book. If the tank is getting low, order a new one from Airgas.
3. Turn off the pumping station. Wait for the turbo pump to spin down, then open the vent valve.
4. Once the system is at atmosphere, you can disconnect the hose and cables, and reinstall the room temperature insert.

Troubleshooting

High Resistance Between Contacts and Breakout Box

If the resistance between the contacts and the breakout box is more than a few ohms, try tightening the screws more, being careful not to break the ceramic insulators. If the problem persists, it may be necessary to clean the contact hardware. Clean the screws, washers, and nuts in a 1:1 mix of HCl and deionized water, followed by fifteen minutes in methanol in the ultrasonic bath. If the resistance is still too high, try polishing the washers and nuts with very fine sand paper (e.g. 2000 grit).

Current Leaks

Small current leaks of order 1% are normal when operating with excitation currents in the nanoamp range. If current leaks are observed at higher excitation currents, it may be necessary to check the ceramic insulators and the alignment of the oven housing and rotation stage.

Check the insulators by running IV curves with the insert out of the oven and no sample. If you can measure something, the ceramic might need to be cleaned.

The oven housing and rotation stage are joined by a KF flange. However, the groove in the rotation stage is too large and allows for a great deal of play in the exact positioning of the stage. Loosen the KF connection and recenter the stage. As you tighten it back down, do so slowly and make adjustments to the positioning of the stage, as it tends to move during tightening.

Very Low Resistance Across Sample

If you measure very low resistance across the sample with the insert out of the oven housing, check that the ring terminals are not touching. Be very careful when doing this, as the stainless steel wires can easily become disconnected from the ring terminals.

If you measure very low resistance across the sample when the probe is inserted, check the ring terminals and pins to make sure they do not touch the oven housing.

Non-Ohmic Contacts

If the IV curves are not linear, check that the pins are actually touching the contacts on the sample, and not the film itself.

If you measure non-Ohmic behavior even with the pins on the contacts, you may need to evaporate more metal. You should aim for 1 μm thickness, although 500 nm is usually sufficient. If it still doesn't work, reconsider your choice of metal.

Pressure is Too High

If the pressure is too high ($> 10^{-5}$ Torr), check all the vacuum connections, particularly the attachment of the hose to the oven housing. Also check the vent valve on the turbo pump; there is an o-ring that has a tendency to fall out of place, causing the pressure on the turbo exhaust to be too high. The ultimate pressure should be in the 10^{-6} Torr range, but it may take a day or so to reach this pressure, depending on the cleanliness of the vacuum system and how frequently the high temperature system has been used.