PPMS/ VSM QUICK LAB GUIDE

PURPOSE

Use this guide for routine magnetic moment measurements versus temperature M(T), ZFC/FC, and magnetic field M(H).

It is a bench guide for mounting, sample insertion, centering, running, monitoring, and closing an experiment. It does not replace the full PPMS/VSM SOP.

If anything looks, sounds, or behaves abnormally: STOP, record what happened, and ask the trainer.

Safety — before touching the PPMS

ESSENTIAL SAFETY

- **Only trained/approved users operate the PPMS/VSM.**
- **Keep unnecessary metal, keys, phones, tools, and watches away from the magnet area.**
- **Wear clean gloves; use non-magnetic/non-metallic tools where appropriate.**
- **Never force a rod, holder, puck, connector, VSM head, or chamber hardware.**
- **Do not open the chamber cold or at a significant magnetic field.**
- **Do not perform maintenance, calibration, cylinder changes, or internal VSM disassembly unless specifically trained.**

REQUIRED MATERIALS

- ☐ **Sample and correct VSM sample holder**
- ☐ **Cryogenic varnish if required**
- ☐ **Clean gloves and non-magnetic/non-metallic tweezers**
- ☐ **Isopropanol and Kimwipes**
- ☐ **Camera/phone for mounting photo**
- ☐ **Paper PPMS/VSM log notebook**
- ☐ **PPMS Lab Logging Software**

1. Before Every Experiment

Complete BOTH the Lab Logging Software and the paper notebook before you start.

A. Pre-Experiment Log

	CHECK	WHAT TO VERIFY / RECORD
☐	**Lab Logging Software**	**Sign in → Pre-Experiment → sample ID → experiment type → planned T/H range → helium → water readings → confirm paper notebook.**
☐	**Paper PPMS/VSM Notebook**	**Date/time • user • sample ID • experiment • planned temperature/field range • initial system condition.**
☐	**Primary Water**	**Record P_in • P_out • Flow**
☐	**Secondary Water**	**Record P_in • P_out • Flow.**
☐	**MultiVu / VSM**	**Correct MultiVu (not Simulation Mode); no unresolved warnings/errors; VSM/system status normal.**

B. System Readiness

CHECK BEFORE STARTING

- ☐ **Helium supply is sufficient.**
- ☐ **Koolant Kooler water level is within its marked limits.**
- ☐ **Cooling-water readings are normal.**
- ☐ **No unresolved system or VSM faults.**
- ☐ **VSM hardware is already installed for routine sample insertion.**

HELIUM REMINDER

≥ 400 psi before routine measurements

≥ 500 psi preferred for extended work below 20 K

If helium is near ~300 psi, contact the trainer before starting a long run.

C. Know Your Experiment Before You Mount

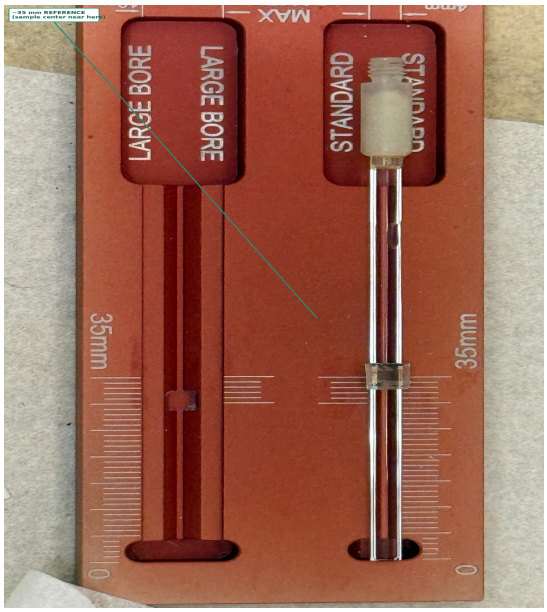
WHAT?	RANGE?	GEOMETRY?
M(T), ZFC/FC, M(H), or both?	Temperature range and field/range?	IP or OOP?
FILES?	**TIME?**	**PLAN?**
What filename(s) will you use?	Approximate run duration?	What should happen first, next, and last?

DO NOT START IF...

Helium/water condition is unacceptable • MultiVu shows an unresolved alarm/error • the sample is loose or poorly mounted • you do not understand the sequence you are about to run.

Logging rule: If it is not in BOTH the software and the paper notebooks, it did not happen. Record errors/events immediately while details are fresh.

2. Prepare and Mount the Sample

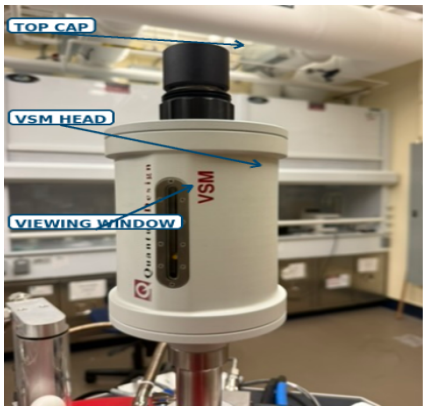


SAMPLE MOUNTING

- Wear fresh gloves. Clean holder and tweezers with isopropanol/Kimwipes.
- Use the holder/orientation specified by the trainer for the required IP/OOP geometry.
- For thin films, use only enough cryogenic varnish to hold the sample securely.
- Keep the sample flat and avoid excessive overhang or contact with surrounding hardware.
- Place the sample center near the 35 mm reference on the mounting station.
- Allow varnish to cure ~15 minutes before insertion.
- Take a clear overhead mounting photograph with the reference scale visible.
- If a sample is remounted, remeasure/reconfirm its position — never assume the old value.

Routine Sample Insertion A — VSM hardware already installed

1. Verify field ≈ 0 Oe and the chamber is at ~300 K; after cold operation, keep it at 300 K for 1 hour before opening.
2. In MultiVu, open the VSM Install/Remove Sample wizard and follow the prompts.
3. When prompted, open/vent the chamber and wait for the load position.
4. Lift the VSM top cap straight upward — do not twist it.
5. Attach the sample holder to the insertion rod and lower it slowly/vertically without touching the chamber wall.
6. Replace the cap; complete purge/seal. Verify the chamber reaches its normal low-pressure state (target <~10 Torr before low-T work).



IF VSM HARDWARE / COILSET IS NOT INSTALLED

STOP. Trainees do not install/remove the heavy VSM linear motor transport, coilset puck, or associated electrical connections without direct trainer supervision.

Routine Sample Insertion B — VSM hardware not installed

1. Verify field ≈ 0 Oe and the chamber is at ~300 K; after cold operation, keep it at 300K for 1 hour before opening.
2. Install the VSM pickup coilset by attaching the VSM coilset puck to the puck-extraction tool and lock it securely. Carefully lower the coil set straight into the chamber. Gently rotate/position the puck until you feel it drop and seat correctly. **DO NOT FORCE IT!** Unlock and withdraw the puck extractor, making sure the coilset remains inside the chamber.

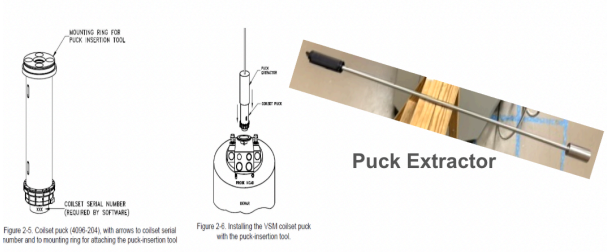


Figure 2-5. Coilset puck (4096-204), with arrows to coilset serial number and to mounting ring for attaching the puck-insertion tool

Figure 2-6. Installing the VSM coilset puck with the puck-insertion tool.

3. Insert the VSM sample-tube/stabilizer assembly carefully into the chamber above the installed pickup coilset.

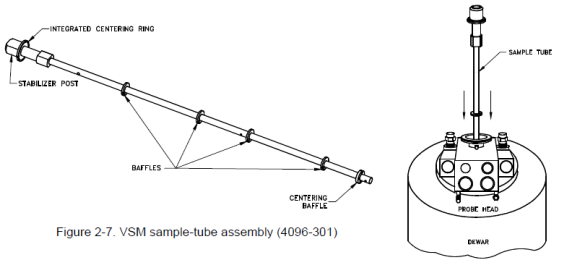
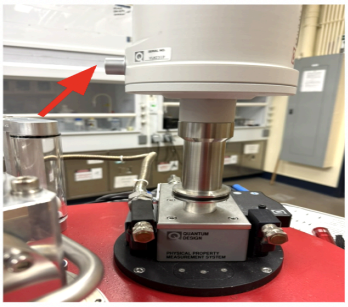


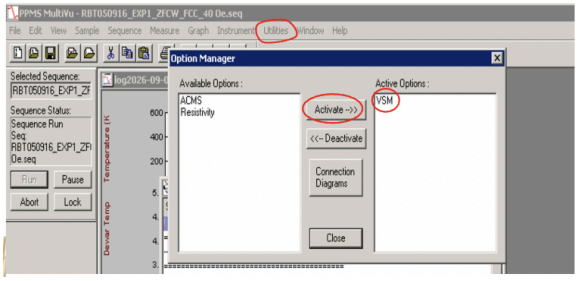
Figure 2-7. VSM sample-tube assembly (4096-301)

4. Instal the VSM head by carefully lifting the VSM linear motor transport/head and lower it vertically onto the sample-tube assembly. The VSM head is heavy; use a second person if necessary. Let the orientation be such that the viewing window faces the computer/operator side.

5. Clamp the VSM head once it is seated squarely. Install the flange clamp and secure the VSM head to the chamber flange.
6. Connect the VSM electrical connector carefully, making sure the connector is properly aligned before inserting it. **DO NOT FORCE ELECTRICAL CONNECTORS OR BEND CONNECTOR PINS!**

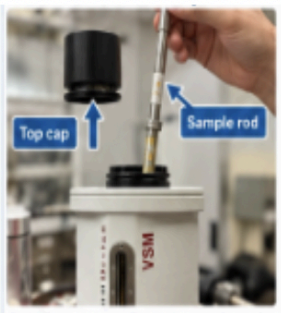


7. Activate the VSM option. In MultiVu, select: **Utilities —> Activate Option —-> VSM**



8. Install the sample by removing the black top cap from the VSM head by lifting it straight upward. Screw the mounted sample holder securely onto the sample insertion rod.

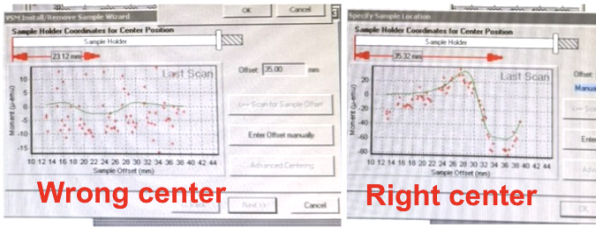
   Carefully lower the rod into the VSM, keeping it straight and avoiding contact between the sample and the chamber walls. Once the sample rod is fully inserted, replace the VSM top cap.



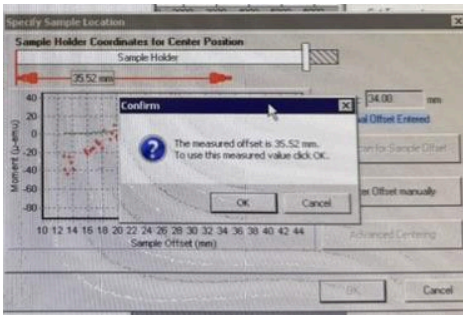
9. Complete the MutliVu wizard through the **VSM Install/ Remove Sample Wizard** and complete the remaining prompts. Allow the PPMS to purge and seal the chamber.Allow the system to return to approximately **300K** before beginning the experiment.
10. Select **Extended Purge and Close Chamber** to remove residual air from the VSM sample chamber. Ensure the chamber reaches approximately < 10 Torr; additional Purge/Seal cycles may occasionally be required.

3. Locate / Center the Sample

1. In MultiVu, run **Scan for Sample Offset** first at ~ 0 Oe. A good scan should show a clear, identifiable sample response. If the scan is only random scatter/ noise, the system has not located the sample reliably



2. If the sample cannot be found at zero field, either:
   - Apply a suitable magnetic field and repeat the scan, or
   - Estimate the position from the mounting photograph if the sample is field-sensitive.
3. When using the mounting photograph, compare the sample center with the **35 mm reference mark** and enter the estimated offset manually.
4. If MultiVu successfully determines the position, confirm the measured offset when prompted.



NB: The sample center should be as close as possible to **35 mm.** Even small positioning errors can affect the measured moment, especially its magnitude.

5. Create the Data File BEFORE Measuring. A descriptive filename can be: SampleID_Geometry_Measurement_Field-or-Temperatuure_Date. E.g. RBT050916_IP_ZFCW_20Oe_20to300K_09142026.
6. Write your sequence file based on the measurements you want to perform.

4. Common Routine Measurements

a. M(T) / ZFC -FC. Hold the field fixed while temperature changes. Use for ZFC/FC, magnetic transitions, and temperature dependence.

- Set the desired temperature range and steps (e.g., 10 K to 300 K, 20 K steps).
- Set the applied field (e.g., 1000 Oe or custom value).
- Choose the temperature stabilization mode (e.g., "Fast Settle" or "Stable Settle").
- Start the measurement and monitor the data collection.
- Once complete, save the data and verify for anomalies.

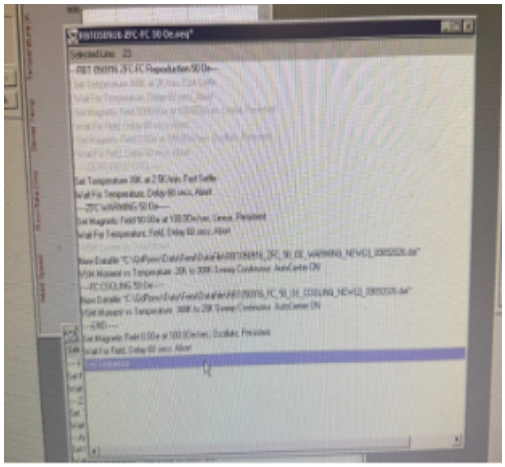
b. M(H) / Hysteresis. Hold temperature fixed while sweeping the field. Use for coercivity, remenance, saturation behavior, and loop shape.

- Load the sample and confirm alignment.
- Set the desired temperature (e.g., 10 K, 300 K).
- Define the field sweep parameters (e.g., -50 kOe to +50 kOe, with step size).
- Choose the field ramp rate and settle criteria.
- Start the measurement and monitor for any issues.
- Once complete, save and analyze the data.

There are lots of example sequence files you can run from the PPMS folder. You can check **FEMI, HOLCOMB, BENINGO** folder for sample sequence files. Go to **"C:\QdPpms\Data"** and select these folders. If you need to run a different sequence file, please talk to a trainer supervisor to assist you with it

5. Run and Monitor the Experiment

This is a typical sequence file running in the image below



Monitor During the Run

- **Temperature: follows target / reaches stable state**
- **Field: actual field matches intended field**
- **VSM status: ready/measuring; no motor faults**
- **Moment: signal remains physically reasonable**
- **Center/quality: watch Center Position, Std. Error, Quadrature when relevant**

NORMAL VS. CONCERN

A smooth thermal drift in Center Position can be normal.

A sudden large jump, repeated failed centering, disappearing moment, unusual noise, or a new fault is a reason to stop and investigate.

Once the experiment is up and running, you can remote access into the PPMS system to check how your measurements are coming up. You'll need to be trained properly and integrated into the remote access system by the trainer supervisor to use this feature.

5. Finishing the Experiment and Leaving the System Ready

1. Verify the data file exists and opens correctly
2. Return the field to 0 Oe
3. Put the system in **Shutdown mode**. This will keep the system at room temperature and conserve the Helium.
4. If you will be taking out your sample, please contact a supervisor for this. Else, leave the PPMS system at room temperature.
5. Complete the Post Experiment Logging

	ITEM	WHAT TO COMPLETE
☐	PPMS Lab Logging Software	Sample ID • experiment completed • final helium pressure • primary/secondary water readings • warnings/errors • unusual behavior • sample accounted for • data backed up • notebook completed.
☐	Paper Notebook	Date/time finished • measurements completed • T/H ranges • filenames • problems/observations • final PPMS state.
☐	Clean-up	Clean holder/tweezers • remove old varnish when appropriate • return rods/tools • discard gloves/Kimwipes • leave the area clean.

Before You Walk Away

☐ **Field ≈ 0 Oe / safe state**	☐ **Correct final temperature/mode**	☐ **Chamber closed & sealed**
☐ **Sample accounted for**	☐ **Data saved & backed up**	☐ **Software log complete**
☐ **Paper notebook complete**	☐ **Errors/problems reported**	☐ **Work area clean**