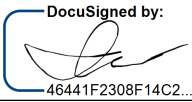
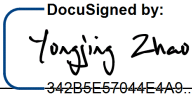



UCD IMPROVE Technical Information #226E

Leak Check

*Interagency Monitoring of Protected Visual Environments
Air Quality Research Center
University of California, Davis*

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DOCUMENT HISTORY

Date Modified	Initials	Section/s Modified	Brief Description of Modifications
05/13/21	SRS	All	Separated TI: A-H doc into individual TIs
5/17/21	IVP	4,5,6,7,10,11	Added missing sections
07/15/22	SRS	All	Annual formatting, no procedural changes

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1. PURPOSE AND APPLICABILITY

The purpose of this technical information (TI) is to describe the procedure used to check the modules at IMPROVE sites for any vacuum leaks.

2. SUMMARY OF THE METHOD

Vacuum readings are taken from each pump and its corresponding module to ensure that the readings from each pump and module pair are similar to each other. Pump and module differences should not be greater than 2.0" Hg. If differences are too large, troubleshooting procedures are performed to determine where the leak is coming from.

3. DEFINITIONS

- Hg: mercury
- TI: technical information

4. HEALTH AND SAFETY WARNINGS

At some sites, modules are not mounted at an ergonomic height for taking measurements. Make sure you have solid footing on proper step stool before taking any sampler measurements.

5. CAUTIONS

After zeroing the vacuum gauge, make sure to close the switch on the gauge. If the tab is left open, glycerin will leak out.

The Vacuum in the sampler can cause filter tearing if suddenly released by suddenly removing the leak probe. You should always remove the small vacuum gauge plug first before pulling out the full problem.

6. INTERFERENCES

Not applicable.

7. PERSONNEL QUALIFICATIONS

Leak checks should be performed by trained field technicians who have experience with the procedure and have a good understanding of the fundamentals of sampler operation. In extraordinary circumstances, a local operator might be asked to perform this check with the remote assistance of a field technician, while closely following printed instructions and/or and instructional video.

8. EQUIPMENT AND SUPPLIES

Supplies for the vacuum kit:

- Adapter
- Probe
- Coupler
- Manifold plug
- Vacuum grease
- Vacuum gauge

Supplies for the maintenance spare parts kit:

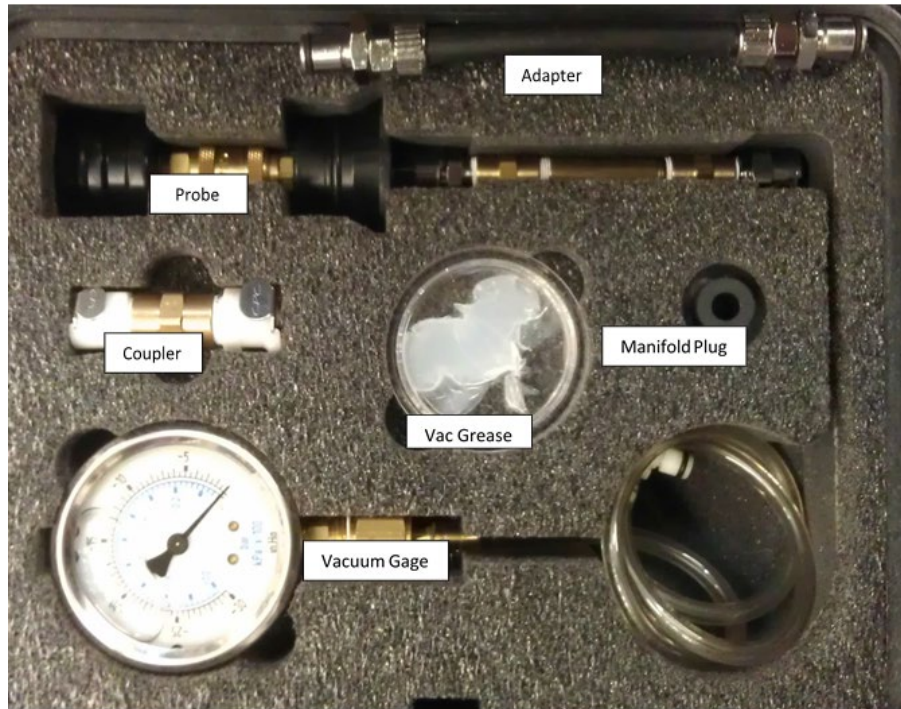
- Spare O-rings
- Cyclone
- Manifold
- Braided hose
- Valve

9. PROCEDURAL STEPS

9.1 Leak Check at the Pump Hose

- 1) Take the vacuum gauge out of the vacuum kit. Zero the gauge by briefly lifting the yellow tab at the top to the “Open” position. After a few seconds, return the tab to the “closed” position to ensure that glycerin does not leak from the gauge.
- 2) Detach the pump hose from underneath the module and attach it to the large opening of the coupler. Attach the white plastic end of the vacuum gauge to the smaller end of the coupler.
- 3) From the Home Screen of the controller, press the **Menu** button, then **Advanced Menu** button, enter **9051**, press the **More** button, then **Flow Adjustment**.
- 4) Press the **Pump: Off** button to turn on the pump.
- 5) The needle on the pressure gauge will rise once the pump it is connected to is activated. Record this value in cell B20 of the flow check/calibration sheet or under “Pump (“Hg)” on the Leak Check form, whichever is being used. If the pump has trouble starting under vacuum, disconnect the coupler and reattach once the pump has started.
- 6) Press **Pump: On** to turn off the pump.
- 7) Disconnect the vacuum gauge, coupler, and pump hose. Restore the original configuration of the system.

Figure 1. Vacuum kit.



9.2 Leak Check at the Module

- 1) Open the module that needs to be leak checked and confirm it has a complete filter cartridge. Remove the black plastic cap from the bottom of the module. Then, remove the plug from the Tee, which is the rectangular part of the module located right above the black cap.
- 2) Insert the white, CPC end of the gauge into the end of the probe.
- 3) Fully insert the probe into the Tee. If the probe does not go into the Tee easily, try applying a very small amount of vacuum grease on the circumference of the top end of the probe. It is important to get the probe fully inserted into the Tee, as the reading on the vacuum gauge will not be accurate otherwise.
- 4) From Flow Adjustment mode press **S2: Off** to turn on the second solenoid. The solenoid used is not important, but at least one solenoid should be open to measure the vacuum pressure through the module.
- 5) Use > or < to cycle through to the module being tested. For this particular procedure, it does not matter what position is running.
- 6) The needle on the vacuum gauge should rise. Record the value in cell B21 of the module specific flow check/flow adjustment sheet or under "Mod ("Hg)" on the Leak Check form, whichever document is being used.
- 7) The difference between the pump and module readings should be less than two inches mercury ("Hg). If the difference is two or less, the leak check test is complete. If the difference is greater than two, continue to the next section.

9.3 Leak Check at the Manifold

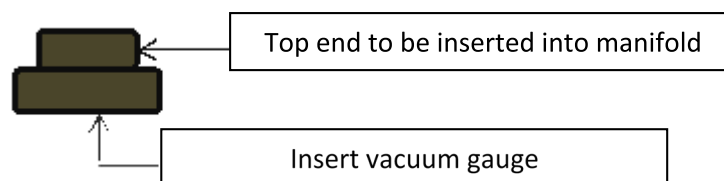
If the difference between the module and the pump is greater than two inches, this means that there may be a leak in one of five areas:

- Manifold
- Braided hose
- Valve
- Cyclone
- Cartridge

To narrow it down, perform the following test at the manifold:

1. Insert the end of the vacuum gauge (the white plastic barbed fitting) into the large circular end of the manifold plug (Figure 2):
2. Use the instructions listed in section 9.2 to go into **Flow Adjustment** mode. Use > and < to advance to the appropriate module being tested. Stay on position #1 for the module.
3. There are four holes on the underside of the manifold that normally encompass the tops of the filter cassettes. Insert the top end (smaller end) of the manifold plug into the bottom of the first hole, where the first filter cassette would normal sit.
4. The needle on the vacuum gauge should rise. Record this reading in the comments section of the flow check/flow adjustment sheet or under “Manifold Reading” on the Leak Check form, whichever is being used.
5. If the difference between the manifold and pump readings is less than two inches, the problem likely resides in the cyclone or the cartridge. Check to see if the cyclone is seated properly and that the connection between the cyclone and the Tee is straight. Check the cartridge to ensure that it is seated properly and that all of the cassettes have O-rings in the appropriate places. Remedy any issues and note the findings in the comments section on the flow check/calibration sheet or on the Leak Check form.
6. If the difference between the manifold and pump readings is more than two inches, a leak likely exists in the manifold, the braided hose, or the valve. To narrow it down even further, continue to the next section.

Figure 2. Manifold plug.



9.4 Leak Check at the Valve

To determine whether or not there is a leak in the valve, compare the vacuum from the top of the valve to the pump by performing the following procedure:

1. Find a short piece of pump hose (if included in the maintenance kit) or borrow a full pump hose from an alternate pump at the site.
2. Put the vacuum gauge in one end of the pump hose. Disconnect the braided hose from the valve and then connect the pump hose to the valve.
3. Use the instructions in section 9.2 to go into **Flow Adjustment** mode, open solenoid 1 by pressing **S1: Off** so that it reads "S1: On" on the appropriate module.
4. The needle on the vacuum gauge should rise. Record the value in the comments section of the flow check/calibration sheet or on the Leak Check form.
5. If the difference between the valve and pump readings is greater than 2" Hg, there is a leak from the valve. Replace the valve with a spare or remove and check fittings for integrity.
6. If the difference between the valve and pump readings is less than 2" Hg, the leak is likely coming from either the braided hose or the manifold. Replace them both with spare parts or determine faulty component and service it.

10. DATA AND RECORDS MANAGEMENT

The results of the leak check are stored on the same excel sheet as the flow check procedure. These files are to be stored indefinitely on the shared network drive.

11. QUALITY ASSURANCE AND QUALITY CONTROL

Excessive leaks can cause improper flow measurements and faulty sampling. If a leak is detected it should be fixed right away by replacing equipment until the leak falls below an empirical 2" Hg. After the leak is fixed the flow rate should be measured again. If the flow now falls outside of the 10% requirement, it should be reported to the data validation group for proper flagging.

12. REFERENCES

Not applicable.