Jefferson Lab

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TITLE: Standard Vacuum Leak Check Requirements

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Standard Vacuum Leak Check Requirements

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– Purpose and Scope

The purpose of this procedure is to outline generic methods for helium mass spec leak testing.

This procedure will outline the requirement for equipment used, equipment calibration, and the test report.

In addition basic methods for testing will be outlined.

Vendors may suggest their own test procedures to JLab SOTR's. If the suggested procedure is proven to meet designed leak test requirements it may be approved for use.

For the purpose of this procedure the leak test sensitivity requirement is: **1.0 x 10-9 Atm. CC/Sec. of Helium**

– References

– Terms and Definitions

1. **MDL**– Minimal detectable leak
2. **Calibrated Leak** – A device consisting of a reservoir of **helium** gas contained within a metal, typically nickel-plated carbon steel or aluminum cylinder with a hollow pyrex-glass tube through its center and an isolation valve. A fixed/ known volume of helium leaks out to calibrate test equipment.
3. **M.S.L.D** – Mass Spectrometer Leak Detector

– Process Details

Test Equipment:

- A properly calibrated Mass Spectrometer Leak Detector (M.S.L.D.) to have a MDL at a rate of 1.0 x 10-9 Atm. Cc/Sec. of helium or better.
    - The M.S.L.D. should be routinely calibrated as per the manufactures instruction, or per a recognized standard. A record of the performed calibration should be kept as part of an established Quality Assurance program.
- A calibrated helium leak sized appropriately to prove equipment sensitivity. A calibrated leak sized at the leak specification or smaller is required.
- Method for documenting the leak test to provide JLab test reports.

Test setup:

Various test components will require different test setups. Some components may require several test setups. The following will outline general setups but for complicated items it will be the responsibility of the vendor to outline appropriate test methods.

- For a standard chamber it should be pumped down and the M.S.L.D. tied in to solely pump on the system. If the chamber is large and the system allows it is preferred to have a calibrated leak at the far end of the test system so it can be opened to prove sensitivity of the equipment with the volume being pumped.
- For small items, or where practical, it is preferred to bag the device to be leak tested. Bag the entire part with a plastic bag or sheeting. Vinyl tape can be used to seal the bag to hold helium in and concentrate helium around joints to be tested.
- When setting up to pump on a volume, it's common that many vacuum ports will need to be sealed to establish a vacuum. Several methods can be used to seal such ports. In some cases a welded cap may be preferred that can be cut off after testing. Other cases may involve the bolting of temporary flanges with leak tight seals such as copper or rubber gaskets. It is also acceptable to use steel plates with Apiezon or rubber seals. Depending on the method used, the part may need to be thoroughly cleaned to remove any contaminates after testing.

Test Procedure:

1. Evacuate the volume to be leak tested. Ensure any calibrated leaks on the system are open to ensure they are under vacuum. They can be closed preferably after the M.S.L.D is solely pumping on the system to ensure reduced wait time during sensitivity testing.
2. Tie in the M.S.L.D into the pumping system. It is preferred to isolate any rough pumps so the M.S.L.D is the only item pumping on the test volume. For some items additional pumping may be required to attain the required background pressure. This is allowed as long as it can be shown that the M.S.L.D still can achieve the

required sensitivity with this configuration. After the M.S.L.D is established on the test volume, the sensitivity of the machine must be proven. Allow the M.S.L.D to establish a stable trace. Typically 5-15 minutes is allowed to ensure a stable leak detector and establish a base helium background.

Open the calibrated leak to allow the M.S.L.D to indicate it can see helium. Allow the helium background to stabilize. The time for stabilization will vary depending on many factors but usually this will only take a few minutes. Record the helium partial pressure when stable with the helium calibrated leak open.

Close the Calibrated leak and allow the helium background to stabilize. Record the helium partial pressure when stable with the helium calibrated leak closed.

The differential of the helium partial pressure will indicate proof of the leak detector sensitivity. Direct readout leak detectors will calibrate the machine so the helium partial pressure will be true to the sensitivity of the machine. In other words the helium calibrated leak size should match that of the helium partial pressure indicated on the M.S.L.D when the leak is open. When the leak is closed the helium partial pressure should be lower.

A non-direct readout M.S.L.D will need to be calculated manually to determine the sensitivity. This is a simple calculation, refer to your leak detector manual. Also for a non-direct readout M.S.L.D the MDL will need to be calculated. This is just the machine sensitivity per scale division times the number of scale division rise you see from a leak. Depending on the test conditions, temperature compensation may also be required.

3. Once the M.S.L.D is verified to be sensitive to the correct value leak testing can take place.
    a. Rough leak test: Flood all external welds with helium to verify no leaks. Continue to monitor the test item for 5 to 10 minutes after the last weld has been sprayed with helium.
    b. If the part has been bagged for leak checking, fill the bag generously with helium and monitor the M.S.L.D to ensure a stable partial pressure to indicate no leaks present. Typical hold time for a helium filled bag is 10 minutes before declaring leak tight. In some cases a generous spraying of helium around joints to be tested will be adequate but bagging is preferred.
    c. Any leaks found above specification will need to be located and repaired.
4. Final sensitivity verification: When helium saturation is complete and the appropriate wait time is over, the calibrated leak should again be open to show the M.S.L.D can see helium. After the M.S.L.D helium partial pressure is stable with the calibrated leak open to prove sensitivity below the 1.0 x 10-9 Atm. Cc/Sec. of helium the test is complete.

Test Reports/ Results:

JLab will require documented test results. Electronic version of the documented test results will be provided with product shipment.

- The following needs to be part of the documentation package.
  - Part name, drawing number and serial number (If applicable)
  - Test date and time
  - Helium partial pressure or scale units before helium probing
  - Helium partial pressure or scale units at the end of helium saturation test
  - M.D.L of the M.S.L.D
- Most leak detectors allow electronic files to be exported. This should be provided with an explanation of the time line of the test. The time line should indicate where the calibrated leak was open, closed and helium testing took place.
- When exported files are not available other methods can be used such as an analog chart recorder of the helium partial pressure. A photo of the leak detector chart can also be used with written indicators of the test time-line.