Technical Overview

Calibration for Precision Leak Testing

Introduction

This document makes reference to an earlier generation Agilent product, the VS Series leak detector. However, the content is still relevant to the current Agilent helium mass spectrometer leak detector, the HLD. Note that the step-by-step calibration procedure described on page 2, formerly a manual process, is now an automated procedure in the HLD's High Sensitivity application setup. Refer to section 5.1.3.7 of the HLD Operation Manual (p/n G8610-90002).

For most leak testing applications, an internal calibration gives the desired result, namely that the leak detector is properly tuned to helium and will accurately report the leak it sees. However, accuracy is dependent on numerous factors, most of which are outside the control and influence of the leak detector and are not taken into account by an internal calibration. Remember that during the calibration process the detector is isolated from the user's test fixture or chamber. The effect these factors have is usually viewed as inconsequential as most users are interested in finding a leak and not necessarily measuring it with a high degree of precision. However, for any quantitative analysis an external calibration process should be performed. This includes proper zeroing of the fixture background signals.

Calibration procedure

Some applications may have rigid set point objectives or are performing high sensitivity testing and want to read a leak value as accurately as possible. Additionally, the user may have the leak detector connected to a volume that presents a significantly different test environment (in terms of surface conditions, gas entrapment, material outgassing conditions, etc.) than the leak detector itself. These characteristics all contribute to the helium signal that the leak detector sees and for accuracy must be considered. The only way to take these factors into account is to calibrate to a helium source that is a part of the users system. In these applications the following external calibration procedure, written for the Agilent VS Leak Detector, should be followed. General knowledge of the features and operation of the VS is assumed. If more detail is needed refer to the Operation Manual.

External calibration procedure

1. Power on the VS and wait for it to complete the normal start up routine. Allow proper warm up time for the test sensitivity required. Do not put the VS in **TEST**.
2. On the Calibration set up screen verify that Internal and Full calibration modes are selected.
3. Press **TEST**. Once the VS is in test initiate an internal calibration.
4. After calibration is complete, set the range stop to the desired range.
    a. –7 or above, set the VS in High Pressure Test.
    b. –8 or lower, make sure High Pressure Test is not selected.
5. Turn off the Auto 0<0 function.
6. Zero the VS.
7. Connect the VS to the test system and follow a or b below, whichever matches the application:
    a. If there is a calibrated leak with shutoff valve installed on the outside of the chamber, system or part:
        i. With the calibrated leak valve closed, press **TEST** and pump down the system.
        ii. Wait for the pressure and leak rate readings to stabilize.
        iii. Zero the VS.
        iv. Press **VENT**.
        v. Open the calibrated leak, press **TEST** and again pump down the system.
        vi. Wait for the leak rate reading to stabilize.
        vii. Perform External calibration.
            1. Set the VS for fast external calibration.
            2. Enter the value of the calibrated leak.
            3. Return to the home screen.
            4. Initiate external calibration.
        viii. When calibration is complete, close the leak and wait for the signal to clean up and stabilize.
        ix. Verify the zero value. If it has drifted substantially the above procedure must be repeated as insufficient time was given to the initial stabilization process.
    b. If a calibrated leak is placed inside the chamber or system. This is common in applications where dummy parts with either no leak, or fitted with a calibrated leak are used to represent good and bad parts respectively:
        i. Place a “good” part in the system and press **TEST**.
        ii. Wait for the pressure and leak rate readings to stabilize.
        iii. Zero the VS.
        iv. Press **VENT** and replace the “good” part with a “bad” part. Press **TEST**.
        v. Wait for the pressure and leak rate readings to stabilize.
        vi. Perform the External calibration.
            1. Set the VS for fast external calibration.
            2. Enter the value of the “bad part” calibrated leak.
            3. Return to the home screen.
            4. Initiate external calibration.
        vii. When calibration is complete, press **VENT** and replace the “bad” part with the “good” part. Press **TEST**.
        viii. Wait for the pressure and leak rate readings to stabilize.
        ix. Verify the zero value. If it has drifted substantially the above procedure must be repeated as insufficient time was given to the initial stabilization process.

Variables

Note that even when following the above procedure exactly, there can still be uncontrolled variables in the calibration process such as:

- The accuracy of the leak itself. It is not unusual for a leak's stated accuracy to vary 10 to 20% during the time period for which it is certified (usually this is one year).
- Storing the leak with the valve closed. This can saturate the leak element which will temporarily cause a higher than normal reading.
- Not properly compensating the calibrated leak value for the ambient temperature, as well as variations in ambient temperature that may go unnoticed.

  For example, while reading a –10 calibrated leak in the test port, grab the leak with your hand and hold it for 30 to 60 seconds. The leak rate will increase as a result of the temperature change.
- The extent to which the user allows the leak detector to establish stable operating conditions as mentioned in the steps above. The amount of time this takes can vary widely depending on the system design and on background helium, discussed in the next point.
- Variations in background helium can cause considerable instability making accurate readings in the –10 and –11 atm·cc/sec ranges impossible. To prevent this any number of preventative measures may be required such as nitrogen purging and improved ventilation.

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