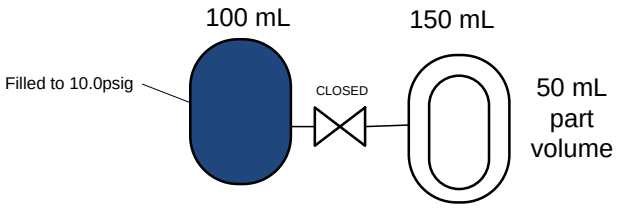
Chamber Test – Testing Theory

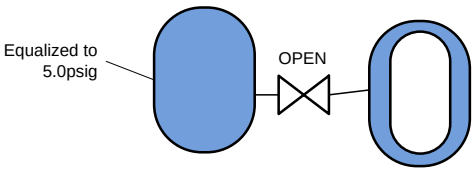
A chamber test is used to find leaks in sealed packaging or sealed devices without an opening to use for filling. To test the part, a technique called metered-volume fill must be employed. The test works by filling a reference volume to a set pressure. After pneumatic isolation, the pressurized volume is then introduced to the test chamber through an equalization valve. With a known good part in the chamber, the resulting pressure will equalize to the desired test pressure. This same procedure done with a gross leaking part will not reach this same value due to an increase in total volume. This difference between the test pressures will be used to set the pressure tolerance. A part that doesn't fill to the test pressure within the pressure tolerance is a gross leak and will fail the test. If the part passes this gross test, the testing will continue with typical pressure decay test steps.

For example:

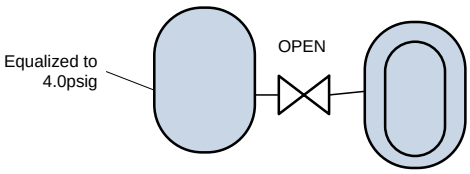
A reference volume of 100 ml (filled to 10.0psi), and test chamber with a volume of 150 ml, and a part with a volume of 50 ml isolated by a valve. The chamber volume with the part installed is 100 ml.



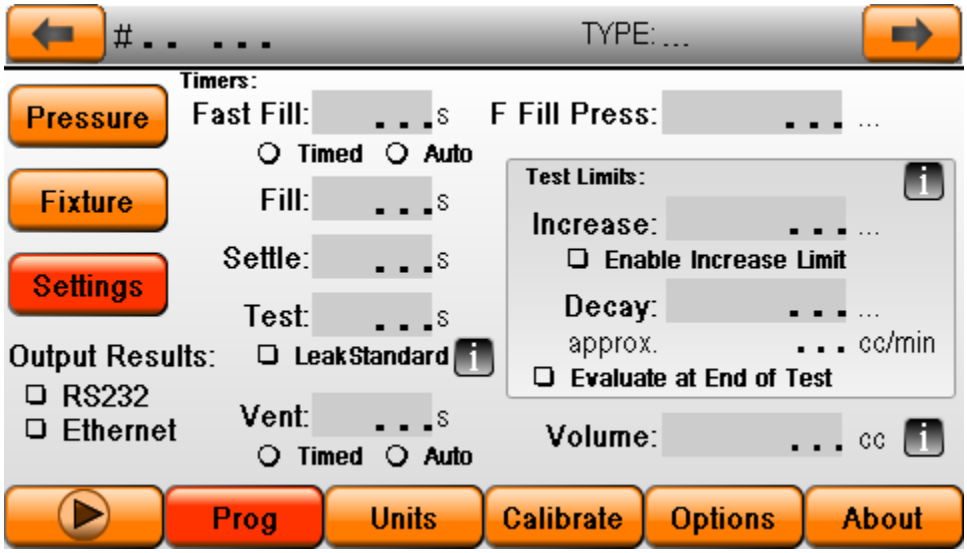
The valve separating the two chambers opens. With a good part in the test chamber, both chambers equalize to 5psig.



With a gross leaking part in the test chamber and the equalization valve open, both chambers equalize to a lower pressure due to the change in volume.



Test Setup



Screen shown from 'PROG' Menu –Parameters Button

Step Definitions:

Fast Fill – This timer sets the duration of the initial pre-charge of the reference volume. The 'Timed' radio button should be selected

F Fill Pressure – Not used in this application. Should be set to 0.00

Fill – This is the amount of time allowed to equalize the reference volume to the test chamber. If the test pressure is not met within the tolerance a 'hi or low' pressure error will occur.

Settle – This is the time allowed to let the pressure and part to settle from any compliance or thermodynamic effects on the part. If the pressure drops greater than the minus tolerance the tester will indicate the failure by ending the test and giving the failure type (Gross).

Test – This is the time allowed to watch for a decay of the pressure on the test port. This decay will be compared against the 'Decay' value to determine pass/fail status.

Vent – The vent step has no impact on the pass fail status, it is mostly employed as a safety step to safely vent any pressure out of the part before the operator removes it from the test fixture. The step runs as a standard vent step.

Enable Increase Limit – This check box enables a second set of limits to be used. If this box is checked the 'Evaluate at End of Test' box should also be checked.

Increase – A secondary limit for pass/fail status. Used as the top limit for a min/max condition

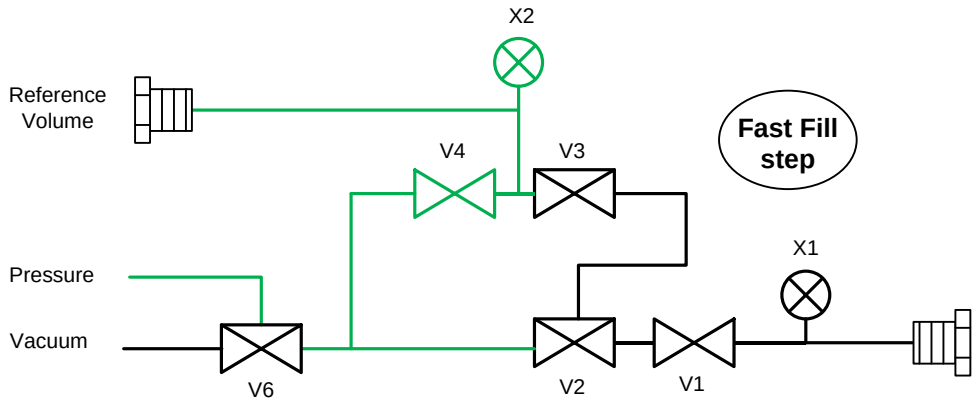
Decay - This value is the amount of pressure drop during the 'Test' step time that will cause a reject condition.

Evaluate at End of Test – This check box will allow the test step to run completely to the end of the timer before evaluating the decay for pass/fail status. Leaving the box unchecked will cause the tester to short cycle when the decay value is reached prior to the timer expiring.

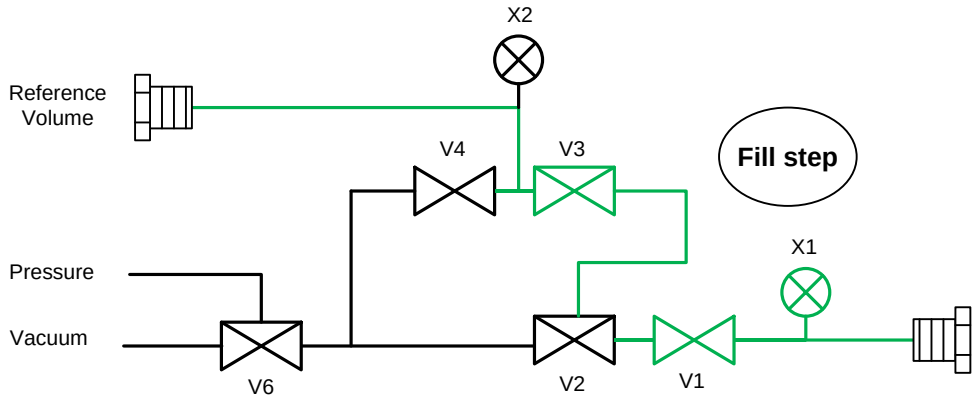
Pneumatic Sequence

This example is for pressure chamber test (Chamber). Valve 6 (V6) is activated in the Vacuum Chamber test type (VChamb)

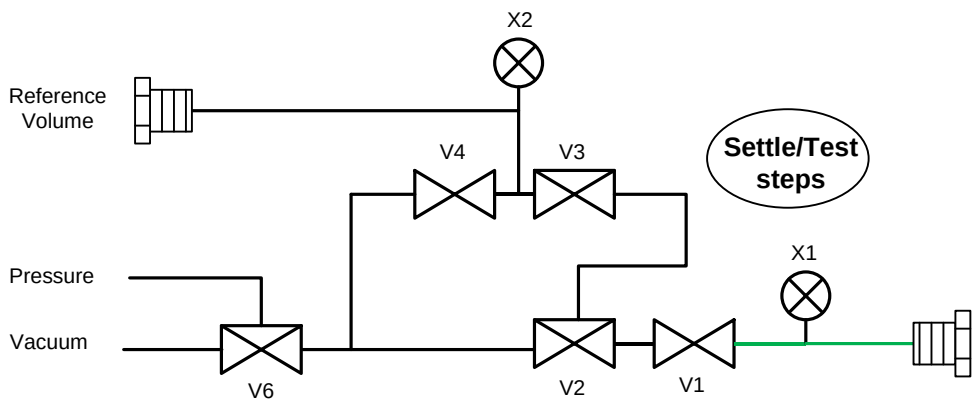
During the **fast fill** timer, valve 4 (V4) opens to allow pressure into the reference volume. The pressure is monitored by a reference sensor (X2). The pressure value is shown on the run screen in the lower right corner.



During the **fill** timer, the volume of pressurized air is sent to the test port. This pressure is monitored by (X1). The change in total volume will cause a pressure drop from the initial charge. With a good part in the test chamber, the target pressure will be achieved.



If the pressure in the test chamber meets the tolerance settings, all valves close and trap test pressure in the chamber with the pressure sensor (X1) monitoring the decay.



Setting Test Pressure

Place a known good part into the test chamber. During the 'Fast Fill' time the reference volume pressure will be displayed in the lower right corner of the run screen. Adjust the regulator on the back of the machine until the good part yields the test pressure set in the 'Pressure' screen (10.00). This might take a couple of tries to fine tune the process. Do not worry if the test fails at this point, we are setting up the fill parameters for now.

Depending on the size of the reference volume and the free space around the part, the required reference volume pressure could be around twice or three times the test pressure.

Once the pressure has been adjusted, replace the part in the test chamber with a gross leaking device. Running the test without adjusting the regulator or test times should yield a lower test pressure result.

For example, where as a good part gets to 10.0psi test pressure; a part with a gross leak might only get to 9.2psi due to the change of volume in the test chamber. This change of pressure will be used to set the +,- tolerance on the test pressure. In this example you could set the '-'tolerance to 0.7psi. Any part that doesn't reach 10.0psi ±0.7psi will fail the fill step and be considered a gross leaking failure.

A sampling of parts should be run to determine the ± tolerances.

With the fill step tolerances set, the settle and test step times and limits can be modified to reach the desired leak rate.

Reference Volume

The amount of capacity in the reference volume is critical to the success of the test. Using too large of a volume will not allow for a measurable pressure change due to the change in volume.

In the example above the 100 mL reference volume is filled to 10psi and a gross leaking part filled to 4.0psi. If the reference chamber volume is reduced the resulting drop of a bad part will be increased. There is more differential between a good part and bad part

For example:

Reference Volume reduced to : 50 cc
Test chamber: 100 cc
Part volume: 50 cc
Test pressure: 5.00psi
Reference pressure needed to reach test pressure: 15.0psi

A gross leaking part would fill to 3.75psi.

For test parts with smaller internal cavities the reference volume should be reduced and the reference pressure should increase. The test chamber part gap should be as small as possible. As with all leak testing, a smaller test volume will allow for more sensitivity to pressure changes and a faster cycle time.

Formula used : $P_1 * V_1 = P_2 * V_2$

P_1 = Initial reference pressure charge

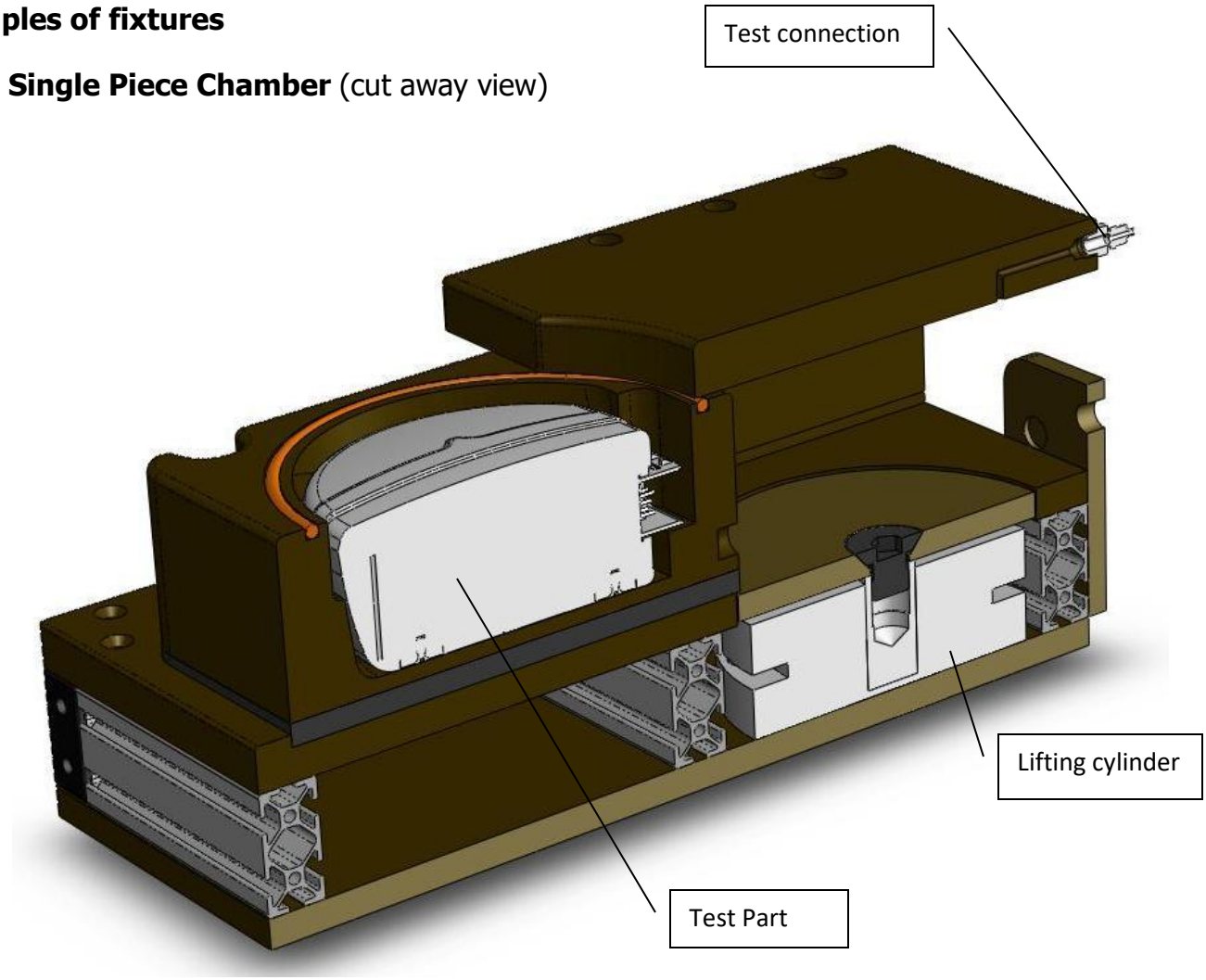
V_1 = Total reference volume

V_2 = Total volume of reference and test volume

P_2 will be the resulting pressure during the normal fill step.

Examples of fixtures

Single Piece Chamber (cut away view)



The part is loaded into the nest and slid into the test position. The lifting cylinder seals the test chamber against the top plate.

(801)264-1000

2442 South 2570 West

Salt Lake City, UT 84119

www.zaxisinc.com