

PSL ChargePoint Helium Test

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Many of today's pharmaceutical and chemical processes are faced with the requirements of operating under minimum oxygen and vacuum-sealed environments. Achieving these conditions can be quite challenging and generally the ability to sustain a satisfactory environment is limited to the manufacturing systems and interface equipment being used. This compromise can at worst be catastrophic resulting in uncontrolled reactions or reduced productivity where achieving the satisfactory conditions can be very time consuming.

In a typical reactor or vessel charging application, the product being transferred would originate either from a hopper, container or a pre-stage process unit. In order to reach the required vacuum state and inert atmosphere within the processing environment, an isolation / containment transfer valve is used. These isolation devices need to be suitably validated to verify their vacuum and leak rate capabilities.

A commonly applied test used for detecting leaks within an enclosure is the vacuum helium detection method.

Helium is an excellent trace gas because it is the lightest of the inert gases and as a consequence readily penetrates small leaks. In addition, its presence in the atmosphere is minute (typically 5ppm) and is therefore easily detected by a simple mass spectrometer.

The evacuated void within the ChargePoint is isolated from the external atmosphere, which allows the accurate detection and measurement of increased helium levels.

The purpose of generating the vacuum within the void, is to support the operation of the analysing spectrometer tube. Helium molecules entering through a potential leak individually reach the spectrometer tube in a few milliseconds. Helium molecules as well as molecules of other gases are continuously removed by the vacuum system. If helium is applied to a leak point, the concentration in the spectrometer tube will rise sharply at first, then reach equilibrium when it is being pumped out at the same rate as it is entering. When helium is completely removed from the leak, the input will drop to zero while the residual helium is pumped out of the system. Thus a leak is indicated by a rise in the output signal of the spectrometer tube.

1. Test Equipment

Vacuum and Helium sensor – Varian 979 Helium Leak detector



Containment split butterfly valve – 100mm, Pressure rated, 316 stainless steel
ChargePoint with 100mm Triclamp interface
Stainless steel vacuum/pressure plug
Helium source

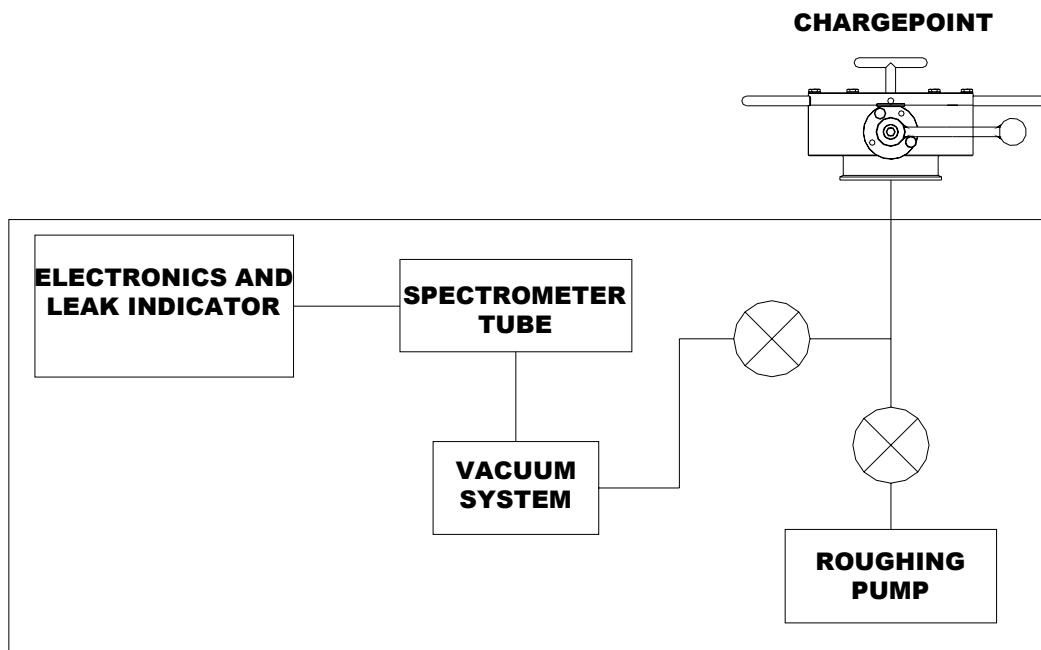
2. Test Procedure

The ChargePoint valve is fitted with a stainless steel, 6 Bar/vacuum rated pressure plug. The plug seal is achieved via an oring, located in a perimeter groove on the plug and interfaces between the inner bore of the Active body and the plug itself.



The outlet of the Active is coupled with a suitable vacuum rated hose, to the Varian vacuum unit with a standard stainless steel triclamp and EPDM gasket. All connections are checked and secured and all triclamp connections hand torqued.

The Varian unit is started and the vacuum system pulls down the void within the ChargePoint and connection lines to 1×10^{-4} Torr. The time taken to bring this vacuum level down, ranged from 5 - 10 minutes.



Mass spectrometer leak detection diagram

Once the vacuum level is reached, the Varian unit is set to zero and the helium source is introduced at the various potential leak points.

The images below indicate the specific locations where the helium is presented.

Location A – The interface between the perimeter of the plug and ChargePoint valve body.

Location B – The interface between the wrench handle PEEK bearing and valve body.

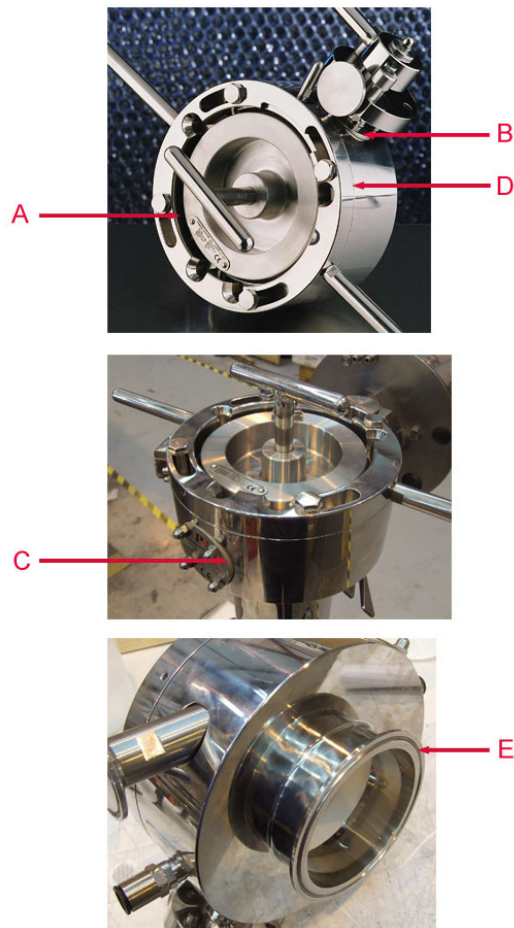
Location C – The interface between the rear shaft PEEK bearing and valve body.

Location D – The interface between the locking ring and valve body.

Location E – The triclamp seal interface between the valve body and vacuum flanged connection.

At each of these locations, a very small volume of helium is pulsed through a hand held trigger nozzle and then removed from the vicinity and sealed so as eliminate the risk of excessive gassing of the surrounding environment.

The Varian unit is allowed sufficient time to purge out the helium between each test and logging of readings.



3. Test Results

The readings taken from the Varian unit indicate a detected leak rate in cc/sec.

Location A – Plug interface
 8.6×10^{-9} cc/sec

Location B – Wrench handle bearing
1.1 x 10⁻⁹ cc/sec

Location C – Rear shaft bearing
1.2 x 10⁻⁹ cc/sec

Location D – Locking ring
1.0 x 10⁻⁹ cc/sec

Location E – Triclamp seal
8.3 x 10⁻⁹ cc/sec

4. Conclusions

The results show a very low level of helium detection. It is only possible to understand this leak rate level when comparing the results for vacuum rated compression fittings. Data obtained from web published material, indicates a maximum helium leak rate of 4.0 x 10⁻⁹ cc/sec, for a typical stainless steel vacuum compression fitting. This clearly shows that the ChargePoint split valve system when fitted with a pressure / vacuum plug, provides a suitably sealed environment comparable to that of a high specification compression fittings.