Technical Overview

Agilent
Trusted Answers

How to Select the Proper Ion Pump

Introduction

Ion pumps are commonly used to create ultrahigh vacuum (UHV) and extreme high vacuum (XHV) due to their cleanliness, ability to pump different gases, and maintenance and vibration-free operation. Long operating life and ability to read pressure are also important features of ion pumps. The Vaclon Plus family has been designed to enhance all of these characteristics, and offers the most advanced and valuable solution to any ion pumping requirement.

What size ion pump?

In ultrahigh vacuum (UHV), the available flange size on the chamber should match the flange size on the ion pump when possible. In order to minimize conductance losses, the ion pump should also be installed directly into the chamber. To gain the most pumping speed, select the largest pump available with the flange you have on your system. A pump with a larger flange than what is on your system does not gain you any extra performance because the effective pumping speed is reduced due to conductance losses.

Table 1. Agilent Vaclon Plus pump flange sizes.

Flange Size	Vaclon Plus Pump Size
3/8 inch OD Tube	Vaclon Miniature, 2 L/s pumps
3/4 inch OD Tube	Vaclon 2 L/s pumps
DN 16 CF-F (1.33 in CFF)	Vaclon 2 L/s pumps
DN 40 CF-F (2.75 in CFF)	Vaclon 2, 10, 20, 40 L/s pumps
DN 63 CF-F (4.5 in CFF)	Vaclon 55 L/s pumps
DN 100 CF-F (6 in CFF)	Vaclon 75, 150 L/s pumps
DN 160 CF-F (8 in CFF)	Vaclon 200, 300, 500, 800 L/s pumps
DN 200 CF-F (10 in CFF)	Vaclon 800 L/s pumps
DN 250 CF-F (12 in CFF)	Vaclon 1,000 L/s pumps

Which element? Diode, StarCell, or Noble Diode?

Agilent ion pumps are available in three different element types: Diode, StarCell and Noble Diode. Element selection should be based on how the pump will be installed and used.

Diode

Diode pumps have the highest pumping speed among all ion pumps for getterable gases such as hydrogen (H_2). As a trade-off, they have less pumping speed for noble gases such as argon (Ar), which is naturally present in trace amounts in ambient air. This makes the diode pump a good choice for devices that are pumped down and stay under vacuum, and are not intended to be vented to atmosphere. Permanently installed appendage pumps such as the Agilent Miniature Vaclon pump and Agilent Vaclon 2 and 10 L/s pumps use diode elements for this reason. For systems that are frequently vented to atmosphere or are prone to leaks, diode elements are not the best choice. Diode elements excel when left alone under UHV.

Noble Diode

The Noble Diode element uses a different cathode material than the Diode element, which increases noble gas pumping speed while sacrificing some hydrogen or getterable gas pumping speed. Noble Diode elements should be selected when the pump is under constant UHV pressure and there are consistent pressure levels.

StarCell

When pumping down from atmosphere you will have residual noble gases that are present at trace amounts in ambient air. The StarCell is an excellent all-around element choice. It has a star-shaped element, from which its name is derived, and is an improved version of the triode element. Given its design, it can handle the greatest amount of noble gases (more than Noble Diode) while still offering comparable hydrogen pumping speeds compared to the diode element. This makes it an all-around excellent choice for an ion pump. It performs well pumping both getterable gases and noble gases.

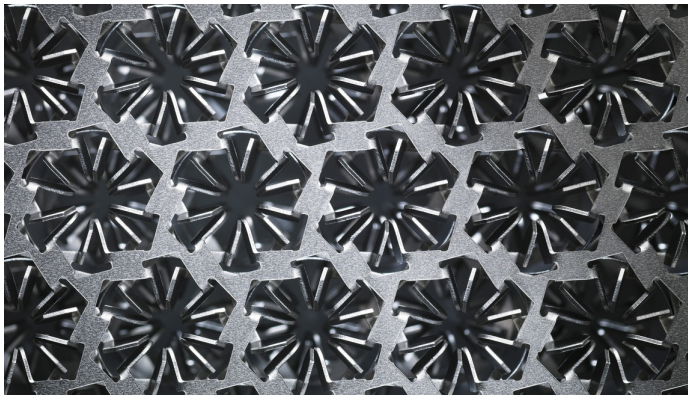

Figure 1. Agilent StarCell pumping element.

Conclusion for elements

StarCell: The best all-around ion pump element choice for the combination of getterable gas pumping and noble gases.

Diode: The best choice for systems or parts that are pumped down and stay at UHV, where the highest hydrogen or getterable gas pumping speed is desired. Diode is not desirable if your system is vented to atmosphere.

Noble Diode: An improvement of the diode for noble gas pumping speed at the cost of reducing some of the getterable gas pumping speed.

Which controller: IPCMini versus 4UHV?

Agilent offers both the Agilent IPCMini Ion Pump Controller, a single-channel controller capable of operating one ion pump, or the Agilent 4UHV Ion Pump Controller, which can operate one to four pumps simultaneously depending on the configuration.

Figure 2. Agilent 4UHV Ion Pump Controller and Agilent IPCMini Ion Pump Controller.

The IPCMini is a good choice for ion pumps up to 500 L/s in size and has excellent current resolution (< 1 nA), which enables the controller to act as a gauge and accurately read pressures at UHV. It is available with either the standard Fischer connector or the Kings (SHV) connector. Ethernet communication is an option that can be selected at time of order.

The 4UHV is capable of delivering more power than the IPCMini and can be used for all pump sizes, although that extra power is not always needed for smaller pumps. It is a good choice for multiple ion pumps being operated from one controller, or for larger ion pumps requiring more power. It is available with the standard Fischer connector and can be ordered with options for Ethernet or Profibus communication.

Positive or negative voltage?

When selecting the controller, the proper voltage must be selected depending on the type of element on the ion pump (Table 2).

Table 2. Controller voltage requirement.

Element Type	Voltage
Diode, Noble Diode	Positive
StarCell	Negative

Which connector to select?

The standard high-voltage feedthrough option on an ion pump controller is the Fischer feedthrough, which has a built-in safety interlock and automatically cuts off voltage if accidentally unplugged while the current is live. This is the standard connector on the 4UHV. The IPCMini is available with either the standard Fischer connector or Kings (SHV) connector.

The Fischer feedthrough is recommended unless the controller is replacing a legacy ion pump controller that came with a Kings (SHV) and the cable will be re-used or will be used to operate a miniature ion pump.

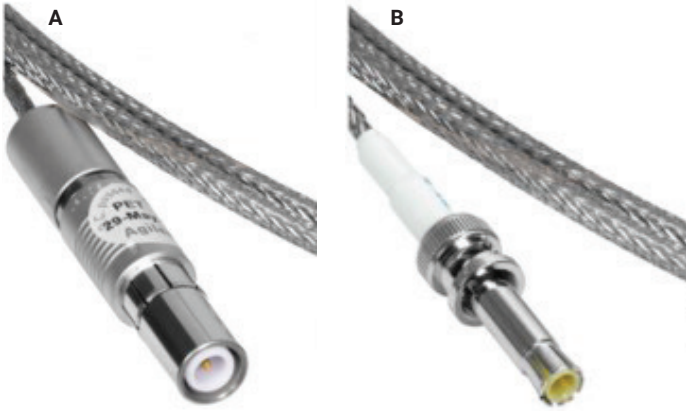

Figure 3. Fischer connector (A) and Kings 10 kV (SHV) connector (B) controller side connector. **Note**: Power cords for the IPCMini and 4UHV must be ordered separately.

Now that the connector on the controller has been selected as Fischer or Kings (SHV), the pump side of the cable needs to be identified. Most Agilent ion pumps come with Fischer feedthrough. This makes a Fischer-to-Fischer the most popular cable configuration.

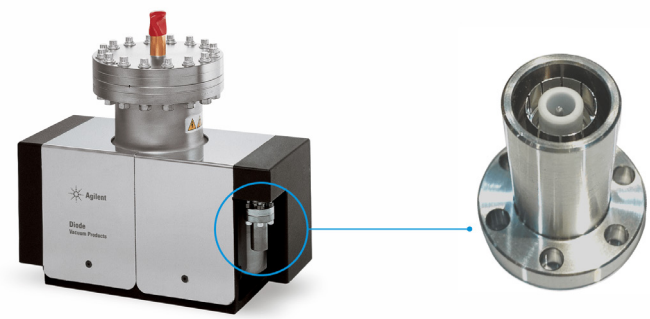

Figure 4. Agilent Vaclon 75 pump with Fischer feedthrough.

There are a few notable exceptions regarding the pump feedthrough:

- Miniature ion pumps come with a miniature style feedthrough. These cables have an SHV connector on the controller side, so part number 9240122 or a different length version should be ordered.
- VacIon 10 L/s pumps have a Varian Diode feedthrough on the pump. A cable with Varian Diode connector on the pump side needs to be selected.

Note that Varian StarCell is a legacy type of feedthrough and is no longer sold on new StarCell pumps.

A comprehensive list of Agilent ion pump cables is available on the Agilent website with filters to help narrow down the proper connector types on the pump and controller sides: Agilent ion pump cables.

Do I need a titanium sublimation pump (TSP)?

Titanium sublimation pumps offer improved pumping performance for creating ultra and extreme high vacuum. Each Agilent titanium sublimation pump (TSP) cartridge contains three titanium molybdenum filaments which, when activated by a TSP controller, sublimate titanium. This creates a fresh coating of reactive titanium, which has a very high pumping speed for getterable gases.

Figure 5. Agilent titanium sublimation pump (TSP) cartridge.

A TSP cartridge can be paired directly with either a cryopanel or ambient shield and directly installed in a vacuum chamber. Both options provide a surface for the freshly sublimated titanium to coat. The cryopanel is typically cooled with liquid nitrogen or water cooling. When cooled with liquid nitrogen, the cryopanel provides very high water pumping speeds. An alternative is the ambient shield, which is designed to increase surface area for sublimated titanium in applications where cooling is not possible, not practical, or simply not desired.

Figure 6. (A) Agilent Cryopanel and (B) Agilent TSP Ambient Shield.

A TSP cartridge and accompanying cryopanel or ambient shield can also be combined with an Agilent VacIon Plus pump. The combination of the TSP and ion pump is an excellent match for faster pumpdowns or increased pumping speed. The TSP contributes high pumping speeds for getterable gases, while the ion pump offers high pumping speeds for non-getterable gases, such as argon and methane. Agilent offers VacIon Plus CombiTSP pumps from VacIon 150 to 500 in both side-mount and bottom-mounted configurations.

Figure 7. Agilent VacIon Plus CombiTSP pump shown with side-mount TSP cryopanel configuration.

Do I need a nonevaporable getter (NEG)?

An alternative technology to a titanium sublimation pump is a nonevaporable getter, or NEG pump. These pumps have no moving parts and offer exceptional pumping speeds at UHV and XHV for getterable gases. NEG pumps consist of sintered metal alloys that are formed into disks to provide increased surface area for gas capture. For the pump to function, it first needs to be activated by supplying current from a NEG controller to heat the NEG cartridge. After activation, a NEG cartridge does not need to be activated again for years when at pressures below 10^{-10} mbar unless vented. This makes a NEG pump an excellent addition to an ion pump whenever the system or chamber is left under vacuum for an extended amount of time.

When systems are vented more often, it is optimal to pair a TSP with an ion pump instead of using a NEG pump.

Agilent has partnered with SAES Getters to make a combination pump using the Agilent StarCell ion pump and a NEG cartridge from SAES. For further information regarding pairing an ion pump with a NEG or TSP cartridge, please contact Agilent.

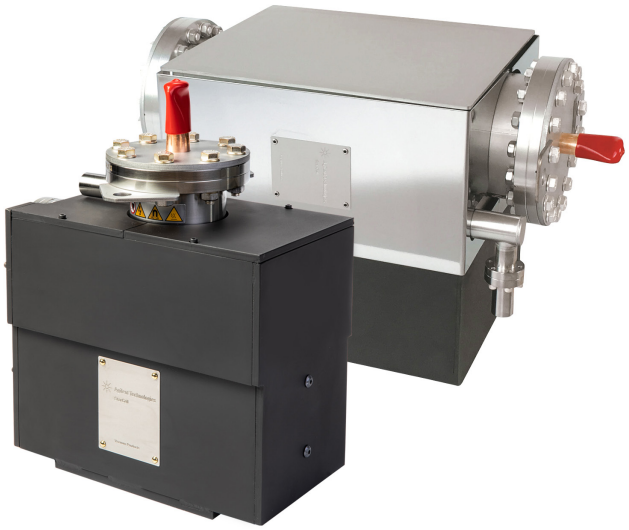

Figure 8. Agilent CombiNEG 40-400 and 150-2000 pumps.

Learn more

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