
Features

- ❖ Windowless HV to UHV vacuum isolation
- ❖ Five orders ($10^{-5} \rightarrow 10^{-10}$) Pressure Isolation
- ❖ Clear through aperture to 10 mm H x 28 mm W.
- ❖ Standard form only 34" long overall
- ❖ Custom versions too.
- ❖ **NEW!** Line of sight pumping available.

Description

The XIA Models DP-0X differential pumps provide a cost effective means of providing a windowless, direct, line-of-sight transition between an ultra-high vacuum (UHV) region ($< 1 \times 10^{-9}$ Torr) and a high vacuum (HV) region ($< 1 \times 10^{-4}$ Torr). Differential pumps traditionally consist of a series of pumps separated from each other and from the UHV region by flow restricting throttles. The DP-01 adheres to this arrangement, consisting of a pair of throttles separated by an active pumping region. An adapter nipple on one end facilitates connection to HV, while an adapter cross on the other end makes the connection to the UHV system as well as providing ports for pressure monitoring, viewing, and attaching the user supplied secondary pump which completes the system.

Innovative in design, the DP series is able to provide quite large through apertures while keeping the overall pump length short by placing distributed pumping close to the line of sight through the differential pump. This enhances effective pumping speed by up to 10 compared to conventional ion pumps of similar dimension. For most applications only a single DP-01 stage and a 30-60 l/sec exit pump will be required.

DPs are easy to configure to specific applications, allowing their owners to optimize the tradeoff between through aperture dimensions and the amount of isolation provided. This is accomplished by adjusting the dimensions of the two throttles and by selecting the pumping speed of the user supplied exit pump. Throttle aperture dimensions are specified at time of order, but can easily be removed and altered later. Further details

are provided below in the section on performance.

New: molecule "Line of Sight Pumping".

Models DP-03 and higher contain an XIA patented innovation which passes the line of sight directly through the active pumping region of a Penning style ion pump. The Penning electrons trapped by the magnetic field in the ion pump's active pumping region have a substantial cross section for "straight through" molecules and are able to remove the vast majority of them. Tests on a "Line of Sight Pumping" DP, using an RGA sensitive to 10^{-14} Torr, were unable to detect any straight through N_2 beam on the UHV side when the HV side was at 10^{-5} Torr. Further, the new design also offers better pumping speed, so that the model Eqn. 1 should be regarded as a upper limit on performance.

Applications

X-ray Lithography & Microscopy

Simplifies the design of alignment and exposure equipment and allows window free expose of resist materials at 10^{-6} Torr.

Thin Window Elimination

Removes the operating complexities associated with fragile windows while transmitting full intensity in the soft x-ray range. Also a possible solution in situations where high power loading on thin windows is a problem.

UHV Incompatible Materials

Now surface science or soft x-ray experiments can be carried out on materials whose vapor pressures exceed 10^{-9} torr. With an additional stage of pumping the direct study of sputtering and low pressure CVD are possible.

Faster Sample Chamber Cycling

If UHV conditions are not actually a necessity for your experiment, install a DP-01 and operate your sample chamber at 10^{-6} torr. The need for bakeouts will be eliminated and cycle times will drop from days to minutes.

Remove Unwanted UHV Restrictions

Complex precision mechanical devices such as monochromators may be an order of magnitude more expensive at 10^{-9} torr than they are at 10^{-6} torr. In many cases it will be cost effective to isolate such devices from both the storage ring and the experiment, using two DP-01s in order to employ 10^{-6} fabrication technology.

Performance

Extensive measurements have established that, for many common applications, the DP design is so efficient that only a single stage is needed when combined with a user supplied exit pump of conventional design (ion or turbomolecular). In this configuration the output pressure P_3 for N_2 gas is well described within a factor of 2 over 5 orders of magnitude in input pressure P_1 (10^{-10} - 10^{-5} Torr) by

$$P_3 = 5.0 \times 10^{-5} \left(\frac{C_{12} \times C_{23}}{S_3} \right)^{0.5} P_1^{0.78} + P_{30} \quad (1)$$

where P_{30} is the output pressure for negligible input pressure P_1 . S_3 is the pumping speed in l/sec of the exit pump (seen through the 400 l/sec connecting cross conductance) and the throttle conductances may be computed for N_2 from the molecular flow formula

$$C_{N_2} = \frac{29 h^2 w^2}{(h + w) L} \quad (2)$$

in l/sec, where h and w are the height and width (in cm) of the throttle cross section and L is its length in cm (15 is standard). If two Model DP-01s' are connected in series without an exit pump between them, Eqn 1 does not apply. Contact XIA for further details.

Figure 1 presents acceptance test data from an installed system, plotting outlet P vs inlet P for a DP-01 pump having 4 mm H by 15 mm W throttles and a 30 l/sec

exit pump. The experimental data are compared to an Eqn. 1 calculation assuming a 50 l/sec exit pumping.

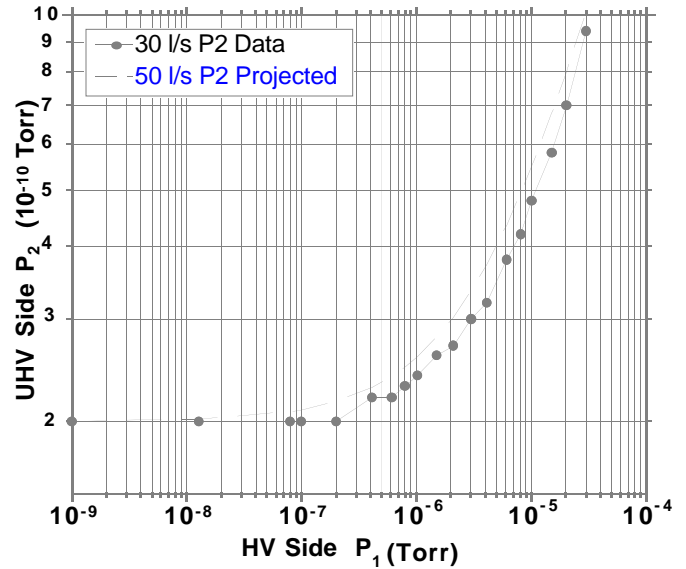


Fig. 1: Measured vs modeled output pressure curves from an installed DP-01.

Specifications

The following specifications are for **Standard DP Models only**. Performance specifications for custom models may vary and will be established on a quotation basis.

Performance specifications

Following an adequate bakeout cycle conducted according to generally agreed upon good vacuum practice and tested as described in the User's Manual, a DP will achieve the following:

BACKGROUND PRESSURE: 3×10^{-10} torr or better.

N_2 PRESSURE ISOLATION: within a factor of two of the values predicted by Equation 1 above.

Overall dimensions

Please see the pdf schematic diagram

Throttle dimensions

LENGTH: 6" (15 cm)

APERTURE: specified at time of order, up to 12 mm high by 28 mm wide.

High voltage connection

Varian 954-5143 or equivalent.

Materials:

BODY: Type 304 Stainless Steel

PUMP: Type 304 Stainless Steel

ADAPTER CROSS & NIPPLE: 304 Stainless Steel.

THROTTLE PLATE & TUBE: OFHC Copper.

THROTTLE TUBE INSERTS: 6061 Aluminum alloy.

MAGNET: Ferrite.

Connection flanges

ADAPTER NIPPLE TO HV: 4.5" CF.flange.

ADAPTER CROSS: 4.5" CF flange to UHV; two 4.5" CF flanges for pump connections and two 2.75" CF flanges for pressure gauges, viewports, etc.

Mounting

Varies by Model number:

DP-01, DP-02: 3 POINT KINEMATIC DESIGN: one socket for a 1 ³/₁₆" ball, 2 holes for 3/4-10 NC threaded shafts.

DP-03: 4 HOLE, NON-KINEMATIC DESIGN: 4 bolt holes to attach the pump to the mounting structure of the customer's design.

Alignment aids

TOOLING BALL SOCKETS: 0.250", 4 provided.

High voltage supply & cable

BOTH USER SUPPLIED: we recommend the Varian Midivac 929-6000 Negative HV Card supply and 929-0770 HV bakeable cable or equivalents.

Pump Life

35,000 HOURS MINIMUM with inlet $P_1 \leq 1 \times 10^{-6}$ Torr and increase as throttle conductances decrease.

Temperature Limits

PUMP: 375° C. MAGNET: 325°C.

Standard Designs

There are presently 4 "standard" designs available. Many simple design changes (e.g. flange dimensions) can be adjusted without requiring custom design. Please contact the factor with your requirements.

DP-01: Horizontal design, 34" overall length, 3-point kinematic mounting. Throttle dimensions up to 28 mm horizontal by 10 mm vertical.

DP-02: Vertical design, 34" overall length, 3-point kinematic mounting. Throttle dimensions up to 10 mm horizontal by 28 mm vertical.

DP-03: Horizontal design, 34" overall length, 4-point non-kinematic mounting. Includes patented XIA "Line of Sight Pumping". Throttle dimensions up to 28 mm horizontal by 10 mm vertical.

DP-04: Short 22.4" overall horizontal design, 4-point non-kinematic mounting. Includes patented XIA "Line of Sight Pumping". Throttle dimensions up to 28 mm horizontal by 10 mm vertical.

Custom Designs

XIA differential pumps can be customized in many ways to accommodate the specific requirements of different applications. For example, pumps with magnetic shields have been built to accommodate operation in close proximity to electron spectrometers. Customers are encouraged to contact XIA with their needs. The basic DP-01 design is intended for laboratory sources or bending magnet beam lines. Details concerning its connecting flanges, mounting geometry, additional ports, etc are simple and not expensive to modify. For wiggler or undulator applications the throttles will require modification to avoid direct beam strike and introduce cooling. XIA can either contract to design these modifications or work with your engineers to develop an acceptable design. Even more extreme modifications can be considered for applications we have not yet imagined. We look forward to hearing your ideas.

Ordering Information

Warranty: One year

Delivery:

STANDARD MODEL DP-01/2/ or 3: 12 weeks ARO.

CUSTOM DESIGNS: As per quotation.

Shipping: FOB Menlo Park, CA.

Direct Sales Prices: Per Current Price Sheet