EXT turbomolecular pumps and EXC controllers

Our range of EXT turbomolecular and compound molecular pumps and EXC Controllers uses state-of-the-art technology to provide reliable, high and ultra high vacuum.

Key performance factors

A turbomolecular pump (TMP) is a multi-stage axial-flow turbine in which high speed rotating blades provide compression by increasing the probability of gas molecules moving in the pumping direction. The turbomolecular pump is optimized for molecular flow conditions and requires a suitably sized two stage rotary vane pump or an oil free scroll pump to exhaust to atmosphere.

A compound molecular pump (CMP) is based on the concept of combining bladed turbomolecular stages with molecular drag stages on the same rotor. This design allows:

- High critical foreline pressures (typically up to 10 mbar)
- Options to use smaller backing pumps or dry diaphragm backing pumps

Pumping speed (volume flow rate) is determined by the rotor diameter, inlet flange size and rotational speed. The pumping speed reduces at high inlet pressures to a value determined by the size of the backing pump.

As the inlet pressure rises, the motor power dissipation and pump temperature increase. **Maximum continuous inlet pressure** sets the maximum throughput limit for steady state pumping and depends on the cooling method used. Above this pressure, the rotational speed of the pump reduces as temperature sensors limit the pump power. With a water-cooled pump, the actual **maximum throughput** depends on the size of the backing pump.

Quiescent electrical power is the nominal power dissipated by a pump operating normally at full rotational speed and with low gas throughput (inlet pressure below the 10^{-3} mbar range). During the run-up time, or when operating at high gas throughput or above the critical backing pressure, the pump power dissipation will rise and approach the maximum power output for the EXC Controller used. Critical backing pressure for conventional turbomolecular pumps is approximately 0.1 to 0.2 mbar.

Compression ratio is determined by the rotational speed, the number of pump stages and the molecular weight of the pumped gas. It is higher for heavier gases which explains why the suppression of hydrocarbon backstreaming is so effective and why the ratio for hydrogen is important for ultra high vacuum applications.

Ultimate pressure measured according to Pneurop standards, is the lowest pressure achieved in the test system, 48 hours after bakeout. The system is backed only by a two-stage rotary vane pump. Fluoroelastomer inlet seals are used with ISO-flanged pumps and metal seals are used with CF-flanged pump models.

Bearing and suspension technologies

We use two basic technologies: magnetic bearings and mechanical ceramic ball bearings.

Ceramic bearings, which are lubricated for life by either grease or oil, have replaced conventional steel bearings. The silicon nitride ceramic balls are lighter, harder and smoother than steel equivalents, leading to longer life and lower vibration characteristics. Reliability is increased because the ball and race materials are different, which prevents micro pitting.

Magnetic bearings further increase reliability. Our EXT turbomolecular pumps up to 540 $l\,s^{-1}$ use a hybrid bearing arrangement with a permanent magnet upper bearing and an oil lubricated ceramic lower bearing.

Rotor technologies

We use two basic technologies:

- conventional full stack turbomolecular (typically 12 stages)
- compound molecular (combining turbomolecular and drag stages)

In addition, EXT pumps up to 540 $l\,s^{-1}$ use monobloc rotors machined from solid bar by computer controlled high speed milling machines. This technology produces stable, rigid rotors and allows virtually unlimited design flexibility for optimum vacuum performance.

Motor technology

EXT pumps use brushless d.c. motors and are available in 24 and 80 volt variants. For the 24 volt pumps the TIC line of controllers are available with the added benefit of integrated instrument controllers. For the 80 volt pumps you can choose from our EXC line of controllers to optimize the performance and cost options for your application.

The Controllers incorporate a regenerative back-up supply which provides power in the event of electrical supply failure to keep the vent-valve closed for several minutes.

Ceramic ball bearings

Corrosive applications

For maximum life and reliability in the exacting process conditions encountered in semiconductor wafer processing applications, we recommend that you use turbomolecular pumps from our Edwards STP-C and STPH-C series (see page 2-33). These Maglev pumps have magnetic bearings and are ideal for these harsh duty applications.

Purge port

The EXT pumps all have purge-ports which can be used to purge the motor and bearing cavity with an inert gas (such as nitrogen). We recommend that you purge the pump when you pump corrosive and abrasive gas mixtures or those with an oxygen content over 20%. You can use our PRX10 purge-restrictor to set the purge gas flow rate. This typically adds up to 25 sccm to the total gas load and the backing pump must be sized accordingly.

Venting

To maintain the cleanliness of your vacuum system, we recommend that you vent a turbomolecular pump at or above half rotational speed, when the rotor is still spinning fast enough to suppress any backstreaming of hydrocarbons from the backing line.

The vent port on the EXT pump is part way up the rotor stack to ensure maximum cleanliness even with fluoroelastomer sealed vent-valves. Each pump is supplied with a manual vent-valve. If you use this manual valve care must be taken not to open it too quickly, especially if the system volume is small (typically less than the approximate volume of the turbomolecular pump), because if the rate of pressure rise is too high, the pump bearing life may be reduced.

In a small volume system, the rate of pressure rise will be greater than in a large volume for a given vent flow rate, and it may be necessary to restrict the vent gas flow. We offer the VRX range of vent restrictors which you can fit to your EXT pump, (see page 2-29).

Since the rate of pressure rise cannot be accurately controlled by the manual vent-valve, we recommend that, unless you fit a suitable VRX restrictor to the vent port, you must wait until the turbomolecular pump has slowed down to 50% speed, as indicated by the controller, before you open the manual vent-valve.

The maximum rate of pressure rise varies by pump model, and the Instruction Manual supplied with an EXT pump gives further guidance on this, and the size of vent restrictor needed to meet the fastest pressure rise allowed.

Control of the rate of venting is particularly important with pumps using fully magnetic bearings, otherwise the safety bearings may be damaged.

The manual vent-valve can be replaced with a TAV solenoid valve driven by the EXC Controller to allow venting after a 2 second delay on shut-off, or delaying vent until the rotational speed has dropped to 50%. The EXC Controller can also control the TAV vent-valve in the event of power or pump failure.

You can choose from two solenoid vent-valve options; the TAV5 which covers most auto-venting applications, and the TAV6 which has a higher conductance than the TAV5 and is designed either for use on larger chambers (typically with a volume greater than 10 liters), or when you want to use a two-stage venting procedure for the fastest possible vent times.

For two-stage venting you need two TAV valves. By using the appropriately restricted flow for the first stage vent-valve you can start venting when the EXT pump is still at full rotational speed. Once the pump has slowed to half rotational speed you can then introduce higher flow rates from the second stage vent-valve.

Inlet-screen

An inlet-screen is fitted as standard to all EXT pumps. The inlet-screen prevents debris from falling into the pump-inlet. In addition, the inlet-screen prevents you from coming into contact with the blades of the pump when it is disconnected from your vacuum system.

Cooling

For most applications, we recommend that you use forced-air cooling with the appropriate ACX air-cooler connected to your EXT pump.
NB: high gas load, high backing pressure and rapid cycling require more cooling.

However, if the ambient temperature is above 35 °C you must water-cool the EXT. The barbed connectors on the water-cooler are suitable for 6 mm internal diameter hose.

Water cooling reduces the running temperature of the pump motor and bearings and is particularly recommended when you operate the EXT with a continuous high throughput (that is, inlet pressure above 1×10^{-3} mbar) or when you bake the EXT pump to above 70 °C (measured at the inlet flange).

Scope of supply

For end users desiring front panel controls and indications when using an 80 volt pump a minimum operating system requires you to order an EXT pump, an EXC controller and a pump to controller cable. For a 24 volt pump a minimum operating system requires you to order an EXT pump, a TIC controller and an EXDC controller. (The EXDC controller is not required when using an EXT75DX or EXT255DX).

Each EXT pump is supplied with an inlet-screen, elastomer inlet seal or copper gasket (as appropriate), manual vent valve and water-cooler. EXT75DX, EXT255DX and EXT556H require a water-cooler accessory in addition (if required).

Each EXC/TIC controller is supplied with a 2 m unterminated electrical supply cable.

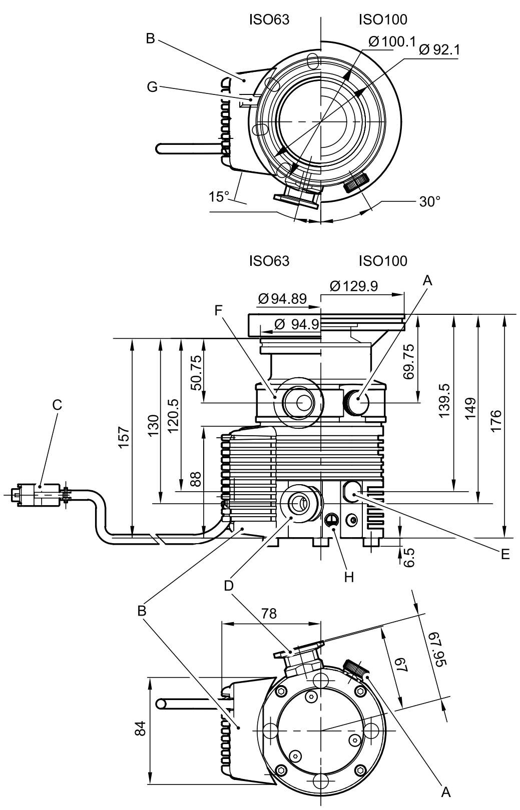
EXT75DX compound turbomolecular pump

Our range of EXT turbomolecular and compound molecular pumps and EXC Controllers uses state-of-the-art technology to provide reliable, high and ultra high vacuum.

Features & benefits

- Compatible with TIC Turbo and Instrument Controller
- Multiple communication modes available
  - Parallel mode allows traditional control signal interface
  - Serial mode allows RS-232 interface
- Numerous user configurable parameters via RS-232 interface
  - Vent valve control settings
  - Normal speed indication
  - Stand-by running speed
  - Programmable power settings
  - Power consumption
  - Pump temperature
- Enhanced monitoring capability including pump speed, power and temperature

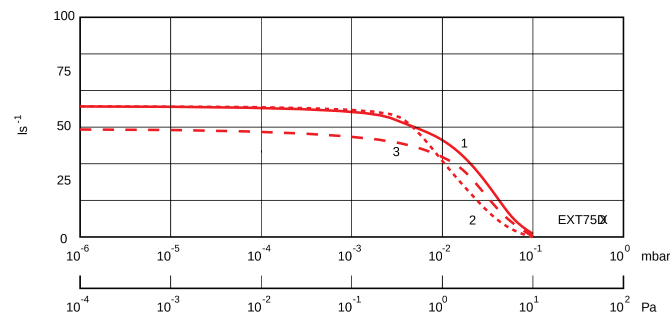
Dimensions



A	Manual vent valve in vent port	E	Purge Port (blanked off)
B	Podule	F	Interstage port (EXT75iDX only)
C	Logic interface connector	G	Podule connector socket
D	Backing Port	H	Earth Connection

Pumping speed

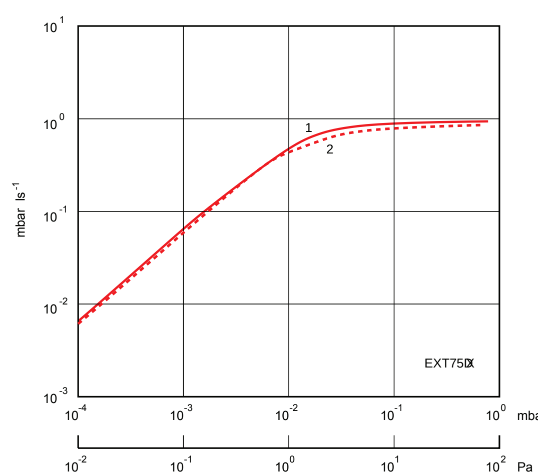
Pumping speed vs inlet pressure



1 Nitrogen **2** Helium **3** Hydrogen

Throughput

Throughput vs inlet pressure



1 Nitrogen **2** Helium

Technical data

Inlet flange	DN63ISO-K, DN63CF or DN40NW
Compression ratio	
N_2	$>1 \times 10^{11}$
He	1×10^{6}
H_2	5×10^{4}
Outlet flange	DN16NW
Interstage port (Hi variants)	DN25NW
Recommended backing pump*	E2M0.7
Vent port	⅛ inch BSP
Purge port	⅛ inch BSP
Maximum continuous inlet pressure (light gas pumping) †	
water cooling (water at 15 °C, ambient temp at 40 °C)	2×10^{-2} mbar
forced air cooled, 35 °C ambient	1×10^{-2} mbar
Nominal rotational speed	90000 rpm
Standby rotational speed	Variable from 49500 to 90000 rpm (63000 rpm default)
Start time 90% speed‡	110 s
Cooling method	Forced air / water
Ambient air temperature for forced air cooling	5-35 °C
Minimum cooling water flow rate (water 15 °C)	$15\ l\ h^{-1}$
Water temperature range	10-20 °C
Maximum inlet flange temperature	100 °C
Operating attitude	Vertical and upright, through to horizontal
Noise level at 1 metre	<50 dB(A)
Maximum magnetic field	5 mT
Recommended controller	TIC100 turbo or turbo and instrument controlled
Quiescent electrical power	10 W
Interstage pumping speed (Hi variants)	$4\ l\ s^{-1}$

Inlet flange	ISO63	63CF	DN40NW	ISO100
Pumping speed ($l\ s^{-1}$)‡				
N_2	61	61	42	66
He	57	57	49	59
H_2	53	53	48	54
Ultimate pressure (mbar)				
With rotary vane backing pump***	$<5 \times 10^{-9}$	$<5 \times 10^{-10}$	$<5 \times 10^{-9}$	$<5 \times 10^{-9}$
With diaphragm backing pump****	$<5 \times 10^{-8}$	$<5 \times 10^{-9}$	$<5 \times 10^{-8}$	$<5 \times 10^{-8}$
Weight (kg)	3.0	4.9	2.9	3.2

* A larger backing pump may be required for maximum throughput. A suitable diaphragm pump with ultimate <5 mbar may also be used.

† Above this inlet pressure, rotational speed drops to below nominal.

‡ Power limit set to 80 W.

*** Ultimate pressure 48 hours after bakeout with 2 stage rotary vane backing pump.

**** Ultimate pressure 48 hours after bakeout with P_b <5 mbar (500 Pa)

Ordering information

Product description		Order No.
Pump	**Inlet flange**	
EXT75DX ISO63	DN63ISO	B72241000
EXT75DX CF63	DN63CF	B72242000
EXT75DX NW40	DN40NW	B72243000
EXT75DX ISO100	DN100ISO	B72245000
EXT75iDX ISO63	DN63ISO (main) DN16NW (interstage)	B72237000
EXT75iDX ISO63	DN63ISO (main) DN25NW (interstage)	B72238000
EXT75iDX NW40	DN40NW (main) DN16NW (interstage)	B72235000
EXT75DX ISO100	DN25NW (backing)	B72246000

Accessories	Order No.
ACX75 air cooling accessory	B58053075
WCX250 water cooling accessory	B73600121