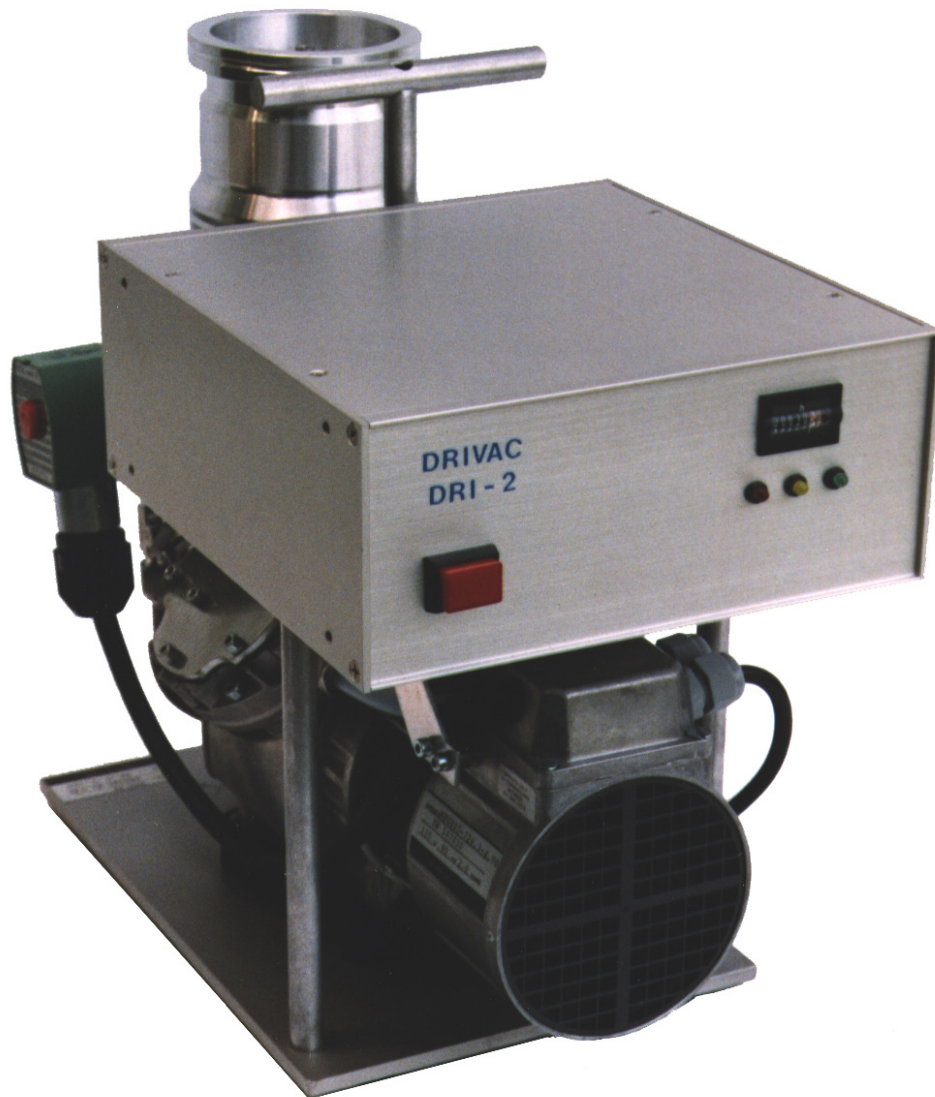


OPERATING INSTRUCTIONS

MODEL BH2-60HD



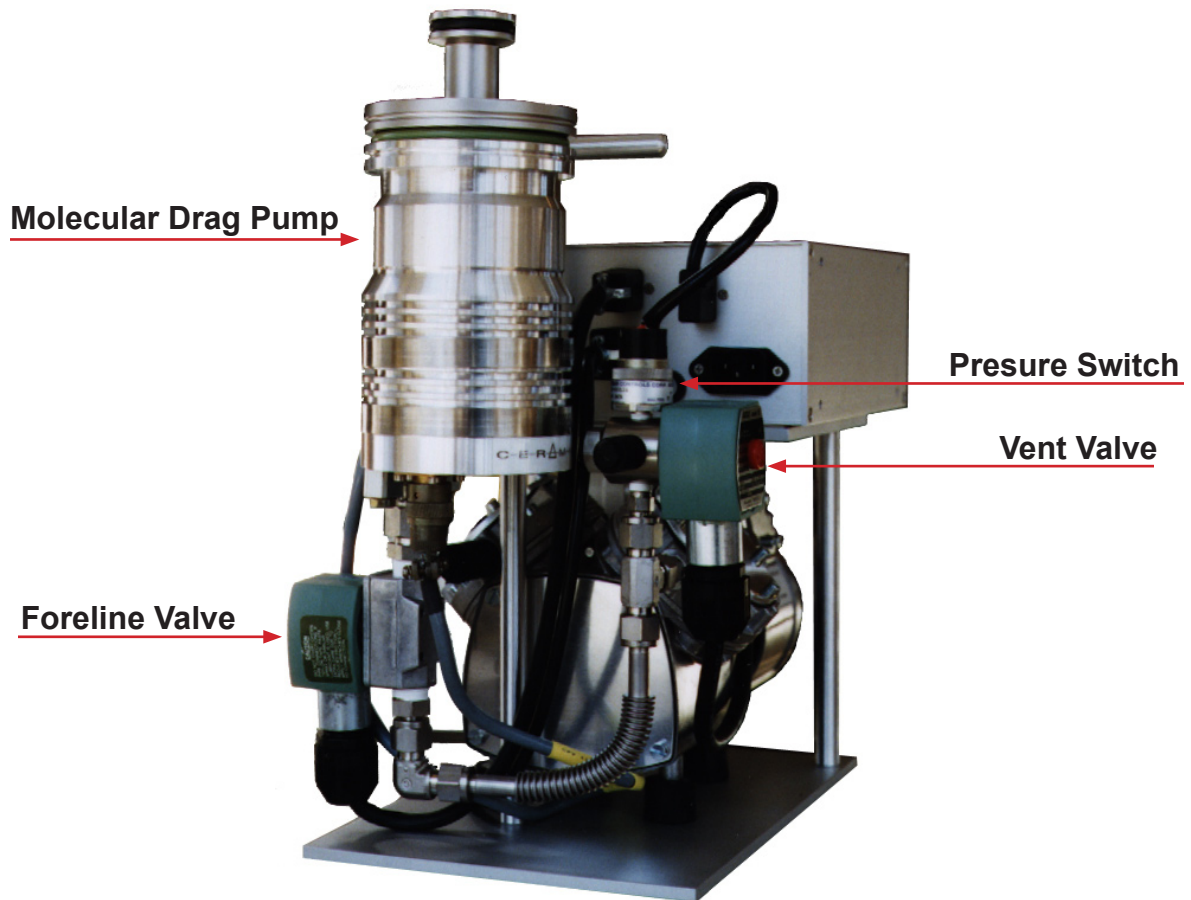
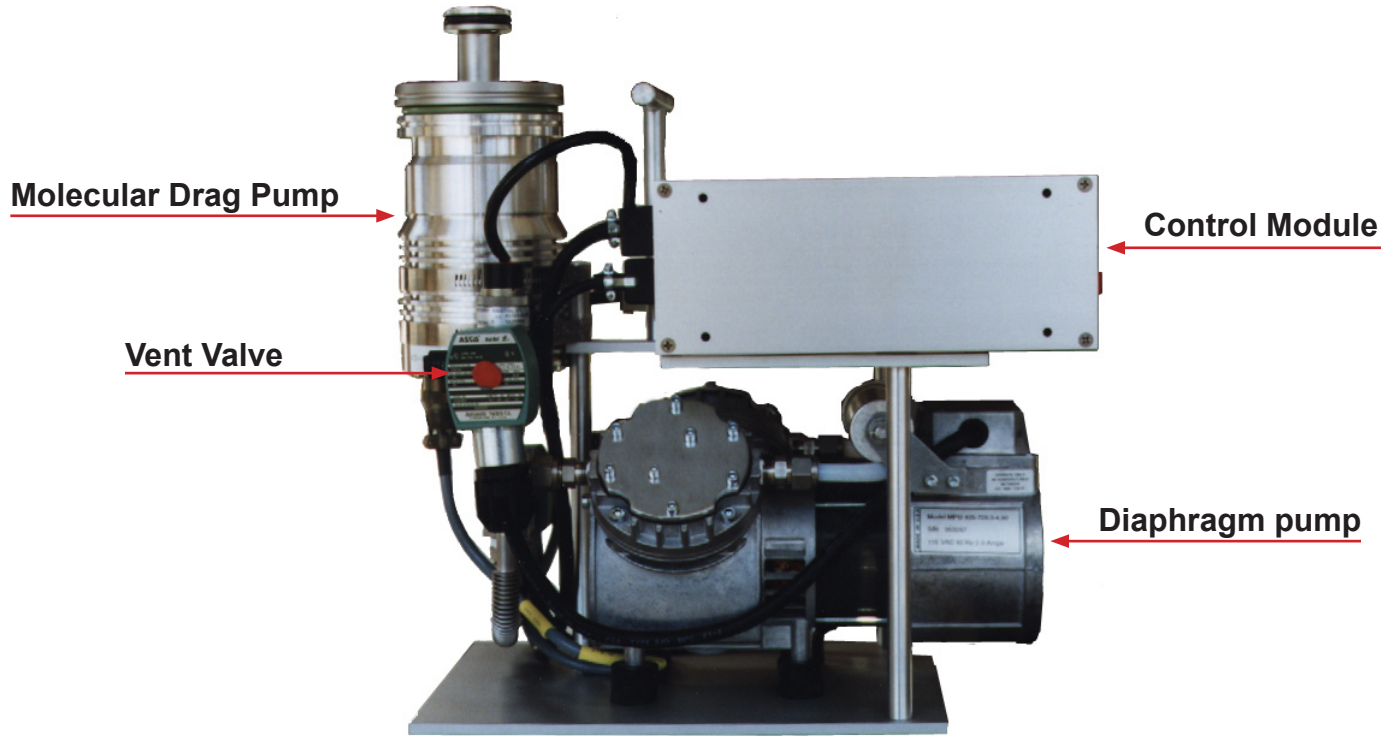
- **INSTALLATION**
- **BACK PANEL CONNECTIONS**
- **IS YOUR PUMP PACKAGE IDIOT PROOF?**
- **FRONT PANEL - INDICATORS**
- **OPERATING SEQUENCE**
- **INTERLOCKS**
- **PREVENTATIVE MAINTENANCE**
- **QUICK TROUBLE SHOOTING**
- **IN-DEPTH TROUBLE SHOOTING**
- **COMPONENTS**

FOR SERVICE ASSISTANCE
During working hours, 8:00 AM TO 5:00 PM

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DRIVAC, INC.
1466 Sugar Bottom Road, Furlong, Pa 18925
FAX: 215-345-7045
www.drivac.com

MAJOR COMPONENTS OF BH2-60 PUMP PACKAGE



INSTALLATION

Utilities required

The only utility required for the BH2-60HD package is 115V, 5 amps.

Compact BH2-60HD

If you ordered the compact unit as shown in the data sheet on the previous page, your system has arrived fully assembled and ready to operate. Merely attach an inlet adapter to the ISO-63 inlet flange if required, and plug in the power cord at the rear of the control module. Your unit is now ready for operation.

BH2-60HD with CG 760 convection gauge option

The convection gage receives its' power from the "ON-OFF" pushbutton of the pump package. To complete the installation of this option, merely plug in the sensor cable to the rear of the control module, and install the sensor onto your system.

BH2-60HD with remote control module

If you ordered this version, your unit will arrive with the control module mounted on the top plate of the pump package and the extension cables packed separately. To complete the installation of your package, you need to do the following:

- A. Remove the four screws from the top cover of the control module and remove the top cover.
- B. Find the three screws (black heads) holding the bottom plate of the control module to the top plate of the pump package and remove those screws. The control module can now be removed from the top plate. Reinstall the top cover of the control module.
- C. Attach the rack mounting brackets to the control module and attach the extension cables.

Plug in the power cord at the rear of the control module. Your unit is now ready for operation.

BH2-60HD for direct mounting of the molecular drag pump to your system flange

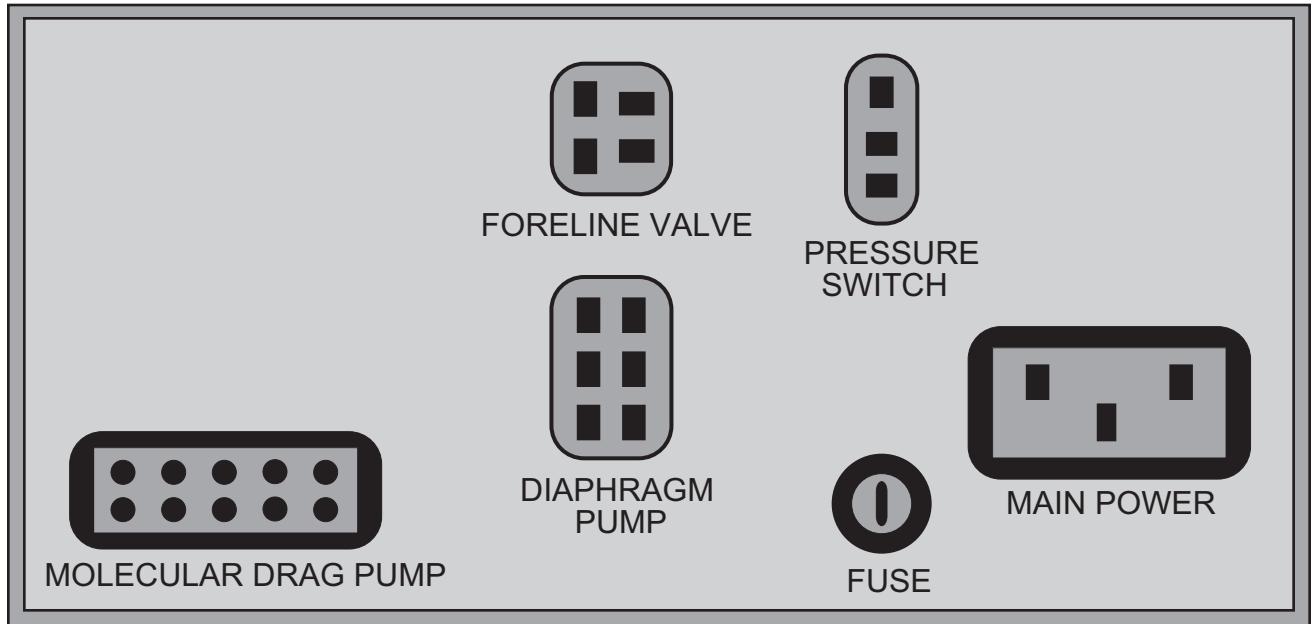
If you ordered this version, your unit will arrive without the flexible connector installed between the drag pump and the diaphragm pump. To complete the installation, you need to do the following:

- A. Demount the drag pump by removing the two stainless steel clamps leaving the foreline valve connected to the drag pump.
- B. Attach the drag pump to your system flange using an adapter if required for the ISO-63 flange of the drag pump.
- C. Install the flexible foreline connector.
- D. If you ordered the extended cable set, see above.

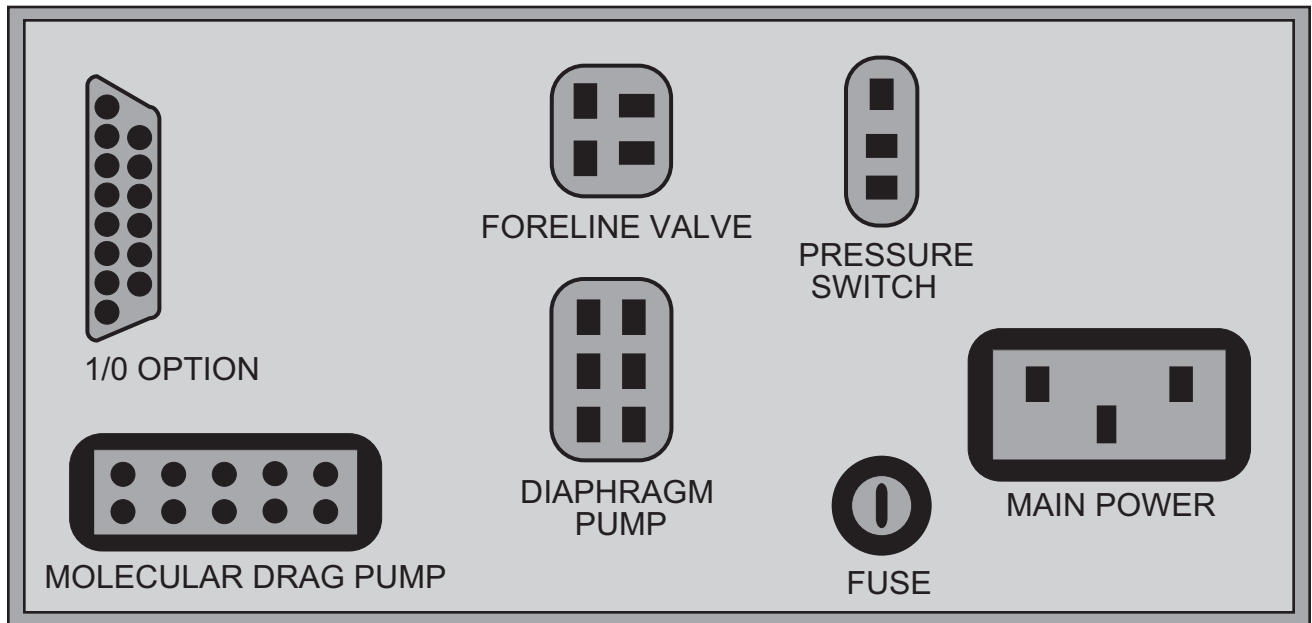
Plug in the power cord at the rear of the control module. Your unit is now ready for operation.

BACK PANEL

Standard unit



1/0 remote signal option



Cable connections

The plug connections on the back panel of the control module are shown above. The interconnecting cables have plugs which mate with the connectors on the back panel. Each cable has a different plug connection ensuring proper cable hook-up

Fuse

5 amp, 1.25" x .25"

IS YOUR DRI-2 PACKAGE IDIOT-PROOF?

Your pump package includes more interlocks and protective circuits than any other oil-free pump package now available. We designed the BH2-60HD to be virtually “bulletproof” to operator mistakes, power failures, and changing pressure conditions in your vacuum system.

There are, however, some things you should avoid in respect to the use of your pump package.

Plasma Etch, Rie, Plasma Deposition, CVD

These packages are not designed to handle large amounts of reactive process gases such as chlorine, boron trichloride, silane, etc. used in applications such as plasma etching, plasma deposition, and CVD. Even though the wetted surfaces of the pump package are stainless steel, teflon, and aluminum – we do not recommend these packages for continuous operation as process gas pumps in these applications.

While we recommend against using the BH2-60HD as a process gas pump, these packages do tolerate small amounts of reactive gases very well in RGA sampling system applications for the above processes. There are several pump packages installed on RGA sampling systems in chlorine-based etching applications with no adverse affects reported on the pump package after several years of operation.

In summary, the small amounts of reactive gases encountered in RGA sampling system applications appear to present no problem for these pump packages. On the other hand, we do not recommend these packages as process gas pumps in reactive gas applications.

Rapid ON-OFF application of power to the pump package

The motor of the diaphragm pump will overload if the diaphragm pump is started with vacuum at its' inlet. For that reason, the small volume at the inlet of the diaphragm pump is automatically vented when power goes off to the pump package. The dual valve (one vent valve and one isolation valve) design of the pump package keeps your vacuum system under vacuum when the power goes off and also keeps the foreline volume to be vented as small as possible.

The time required for the automatic vent valve to raise the small volume at the inlet of the diaphragm pump to atmospheric pressure is approximately two seconds. The user should wait at least two seconds after turning off the pump package prior to restarting the pump package.

In summary, avoid restarting the BH2-60HD less than two seconds after it was turned off.

FRONT PANEL - INDICATORS

The BH2-60HD pump packages are fully automatic and interlocked. The only visual indicators required to monitor routine operation of the pump packages are on the front panel.



The **hourmeter** logs run time.

The green LED

This LED indicates the MDP is operating at full rotational speed.

The yellow LED

This LED indicates the MDP is rotating, but that it is not at full rotational speed. The yellow LED will light as the pump is powered up.

The red LED

This LED is a fault indicator for the MDP. If the MDP operates at high pressure for an extended time period, an over-temperature sensor and control circuit will automatically turn off the MDP if it overheats. In this event, the **red LED** will come on. When the MDP cools down to a safe temperature, it will automatically restart.

The red LED will also come on if the cable from the control module to the MDP is disconnected. In this event, turn the main power off, then connect the MDP cable, then restart the pump package.

There are also some **audible indicators** involved in monitoring system operation. Both the vent valve and the foreline valve are solenoid-driven valves. A “click” can be heard when these valves open. The foreline valve opens five seconds after power is supplied. The vent valve opens immediately upon power-off.

OPERATING SEQUENCE

Operating sequence (manual start or initial power-up)

All the following are performed automatically after the lighted pushbutton is pushed to the “ON” position.

- A. Diaphragm pump starts, vent valve closes.
- B. Five seconds later, the system foreline valve opens.
- C. When the pressure reaches the factory-set pressure of 250 TORR, (see below) the drag pump automatically turns on. Drag pump turn-on is indicated by the yellow LED.
NOTE: 250 TORR is the optimum setting for systems volumes of 50 liters or less. If your system volume changes, the setpoint can be adjusted. See the “PRESSURE SWITCH” section of this manual for changing the set point.
- D. Within eight minutes, the drag pump will achieve full rotational speed as indicated by the green LED.

Operating sequence – pump package running – system at atmospheric pressure – system roughing valve then opened.

- A. The vacuum switch will sense a pressure higher than 250 TORR and the drag pump will automatically turn off. The foreline valve remains open, and the vent valve remains closed.
- B. When the diaphragm pump reduces the pressure to 250 TORR, the drag pump will automatically start as indicated by the yellow LED.

Operating sequence - power failure, then power resumption.

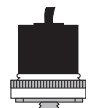
- A. The foreline valve closes (keeping your system under vacuum), and the vent valve opens, slowly venting the diaphragm pump.
- B. When power resumes, the diaphragm pump restarts, the vent valve closes, five seconds later the foreline valve opens, and when the system pressure reaches 250 TORR – the drag pump will restart.

INTERLOCKS



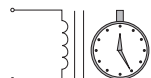
Temperature switch

The temperature switch turns off the molecular drag pump if it overheats. The red LED will light if the temperature switch turns off the MDP. When the MDP cools down, the molecular drag pump will automatically restart.



Pressure switch

The pressure switch automatically turns on the drag pump when the pressure falls to 250 TORR and turns off the drag pump if the pressure rises to 300 TORR.



Five-second time delay relay

The five-second time delay relay delays opening of the foreline valve until five-seconds after the diaphragm pump starts. This five-second time delay relay is to prevent the diaphragm pump from having to start under vacuum. If the diaphragm pump is started under vacuum, motor failure can occur. When power is off, the foreline valve closes (keeping your system under vacuum), and the vent valve opens (slowly venting the foreline and the diaphragm pump). The vent orifice is quite small, preventing a gas burst into your system as the foreline valve closes. When the power is resumed, the vent valve closes and five seconds later, the foreline valve opens. If the foreline valve opened simultaneously with the closing of the vent valve – the vacuum in your system would provide an instant “ballast vacuum” at the inlet of the diaphragm pump risking damage to the diaphragm pump as it tried to start. The five-second time delay relay permits the diaphragm pump to come to full rotational speed prior to encountering the “ballast vacuum” of your system. Another benefit is that your system is exposed to essentially no gas burst upon resumption of power in power-failure situations.

PREVENTIVE MAINTENANCE MODEL BH2-60HD PUMP PACKAGE

There is no preventative maintenance required or recommended for this heavy duty pump package.

QUICK TROUBLE SHOOTING THE PUMP PACKAGE

● The green LED

The green LED is an excellent “wellness indicator” for your pump package. If the green LED comes on (indicating full rotational speed of the MDP) and stays on – this is usually confirmation that no problem exists within the pump package.

If there were a problem with the MDP, foreline valve, vent valve, pressure switch, control module, or if there were a leak within the pump package – the green LED would not come on.

If the green LED stays on and your pumpdown performance is sluggish, it is almost certain that you have either a small leak, a larger-than-normal gas load in your system, or a diaphragm in the second stage of the diaphragm pump has failed

Eliminating your chamber as the cause of the problem

If the MDP does not come to full rotational speed as evidenced by the green LED – the problem could be caused by a large leak in your chamber. To eliminate your chamber as the cause of the problem, merely blank-off the pump package. When the pump package is blanked off, the green LED should come on within three to five minutes.

Assuming you are using an inlet adapter with either an NW-40, NW-25 or 2.75” Conflat flange, a quick blank off test can be performed as follows:

- A. Detach the pump package from your system at the NW-40/NW-25/2.75 Conflat connection.
- B. Place the palm of your hand firmly over the flange, pressing down to effect a seal, and turn on the pump package. The green LED should come on within three to five minutes. If the green LED comes on, this confirms there is no problem with the pump package.

When the pump package is blanked-off, if the green LED fails to come on within three to five minutes, there is probably a problem with the pump package.

See IN-DEPTH TROUBLE SHOOTING section.

IN-DEPTH TROUBLE SHOOTING THE PUMP PACKAGE “HOW SHOULD IT PERFORM?”

In order to effectively trouble shoot the pump package, it needs to be blanked off. Below is some information to help you trouble shoot the Drivac system.

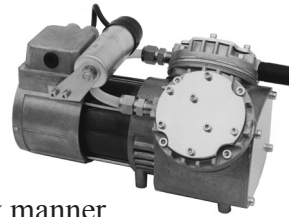
Real-world capability of the molecular drag pump

Alcatel correctly indicates that the ultimate vacuum capability of the molecular drag pump is low 10^{-6} Torr range. You should keep in mind that this is an ultimate vacuum capability under the most ideal conditions, i.e. your system is baked to 100C and you are prepared to wait several hours to attain that ultimate vacuum level. In an unbaked system, you will attain low 10^{-4} Torr vacuum very quickly, and unbaked ultimate vacuum of low 10^{-5} Torr range in about two hours.



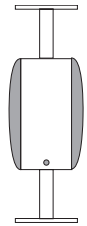
Real-world capability of the Diaphragm pump

When new, the diaphragm pump will attain 5 Torr blanked off. The pump package will operate to its' full capacity as long as the blank-off pressure of the diaphragm pump is 15 Torr or better. As long as the diaphragm pump produces pressure of 15 Torr or lower, it is performing in a satisfactory manner.



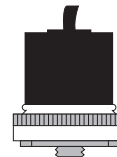
Real-world capability of the foreline valve

The Asco valve used as a foreline valve in the pump systems is remarkably effective in holding a good vacuum level in your system in power-off/power-failure situations. This solenoid valve, however, maintains a leak-tight seal across the seat only when atmospheric pressure is on the diaphragm pump side and vacuum is on the drag pump/system side. In trouble-shooting, you may have a condition wherein you have atmospheric pressure in the drag pump and vacuum in the foreline (just the opposite of normal operating conditions). In this case, you will notice considerable leakage across the valve seat. If you notice this, you should not be concerned, and this is not an indication of a defective valve.



Real-world capability of the pressure switch

The standard nominal factory setting of this switch is 250 Torr. Over time, the setpoint may change slightly. As long as the setpoint remains in the range of 175 to 300 Torr, normal system operation will take place.



IN-DEPTH TROUBLE SHOOTING THE PUMP PACKAGE SYMPTOMS AND CAUSES

This section assumes the BH2-60HD is operating blanked off.

Symptom ● ● ● **no LED'S lighting**

The most likely cause of no LED's coming on is a jammed molecular drag pump (MDP). Every pump package has an inlet screen at the MDP inlet, however, this is a coarse screen. A small particle can pass through this screen and cause jamming of the MDP. Usually no damage occurs to the MDP from these small particles.

To check for a jammed MDP, remove the inlet adapter, and inlet screen from the MDP. Grasp the nut at the center of the drag pump wheel with your fingers and attempt to turn the wheel clockwise. If it is jammed and does not turn clockwise, attempt to turn it counter-clockwise. Do not use a wrench. Small particles are usually dislodged with finger-pressure rotating the wheel. When the wheel turns, it will usually then turn very freely. When the wheel turns, give it another spin with your fingers to confirm free-spinning of the wheel. If free-spinning is achieved, the particle has fallen into the bottom of the drag pump (where it will remain harmlessly "forever"). Reinstall the inlet screen and inlet adapter, and re-start the pump package. If finger-pressure is not sufficient to dislodge the particle, the MDP will need to be disassembled. In that event see, the Alcatel manual.

Symptom ● ● ● **no LED'S lighting**

If the MDP is not jammed and no LED's are lighted, a diaphragm failure in the two-stage diaphragm pump could be the cause. A failure of the inlet diaphragm is easy to diagnose as follows (assuming your inlet adapter has an NW-40 or NW-25 or 2.75" Conflat flange):

Remove the blank-off flange and press the palm of your hand firmly over the NW-40/NW-25/2.75" Conflat flange to effect a seal. Turn on the DRI-2. If the suction is very weak, this is an indication of failure of the inlet-stage diaphragm.

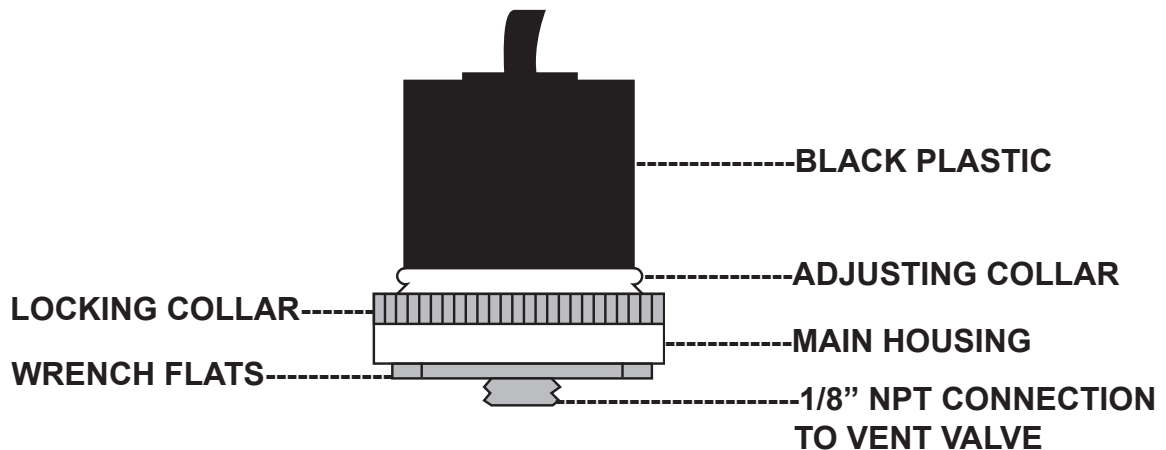
Symptom **Diaphragm pump won't start**

Diaphragm failure could be the cause. Remove the diaphragm pump from the stand. Then remove both heads of the diaphragm pump and inspect the diaphragms. See "Replacing Diaphragms" for instructions on removing the heads of the diaphragm pump.

Symptom ● **red LED'S lights**

If the red LED comes on as soon as the main power is applied to the pump package, the probable cause is a loose MDP cable. Check the MDP cable plugs to ensure they are properly seated.

PRESSURE SWITCH



Function of the pressure switch

This switch automatically initiates the turn-on of the molecular drag pump at a pressure of 250 TORR. That is the optimum setting for system volumes of 50 liters or less. This switch is set at the factory and should not require field adjustment, however the adjustment procedure is described below.

Adjustment of the pressure switch

A Granville-Phillips Convectron or other pirani-type gage which reads up to 760 TORR is required as a reference gage. If you do not have a reference gage – do not attempt to adjust the switch (it's possible to do, but very time consuming without a reference gage). Drivac stocks these switches with a wide range of set points. If you do have a reference gage, the adjustment procedure is described below.

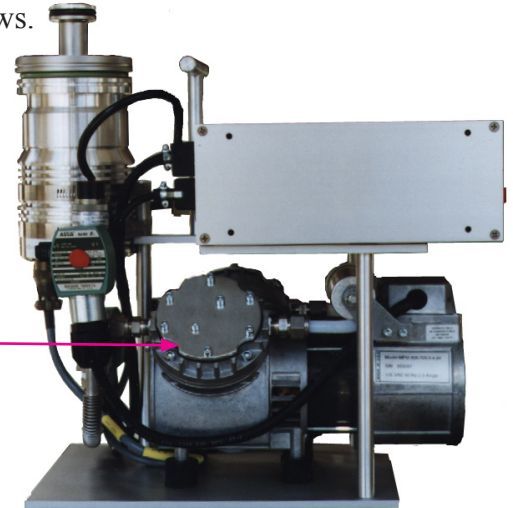
Loosen the LOCKING COLLAR. Looking down (from the cable-end) – turn the ADJUSTING COLLAR clockwise to lower the setpoint. **Small increments of rotation result in large changes to the setpoint.** When the desired pressure setting is achieved, firmly tighten the locking collar with a pliers while holding a wrench on the wrench flats.

REPLACING DIAPHRAGMS

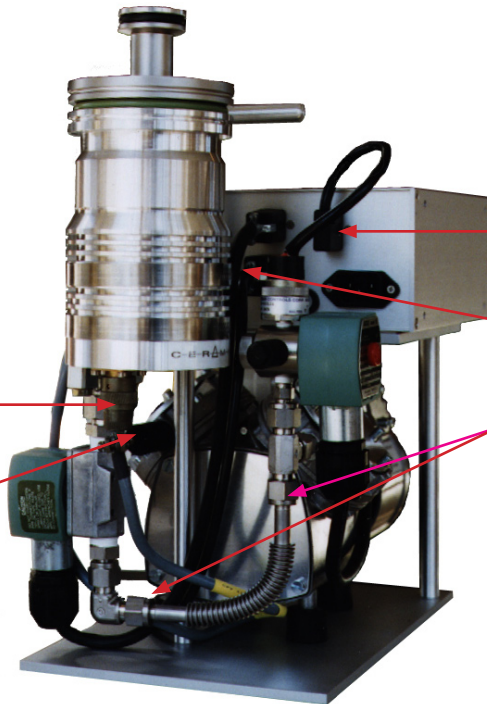
Removing the diaphragm pump from the pump stand

The diaphragm pump can be removed from the pump stand as follows.

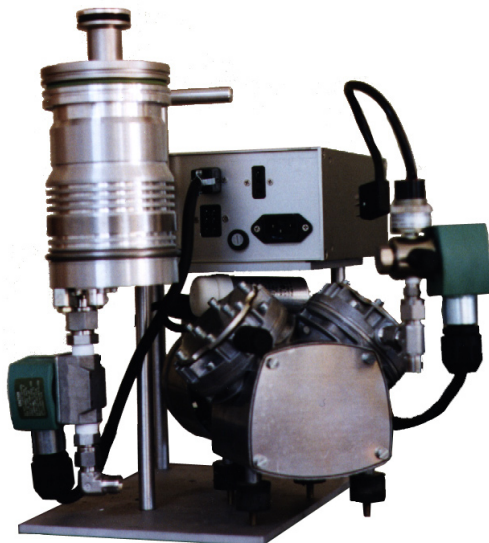
- Lay the package on its' side and remove the (4) locknuts from the pump mounting studs. Note the three scallops on the bottom side of the nuts. Return the pump package to its' normal upright position.
- Remove the two cap screws holding the capacitor to the diaphragm pump housing. Let the capacitor hang loosely.



- Disconnect the molecular drag pump cable and set aside
- Remove the pump muffler and set it aside



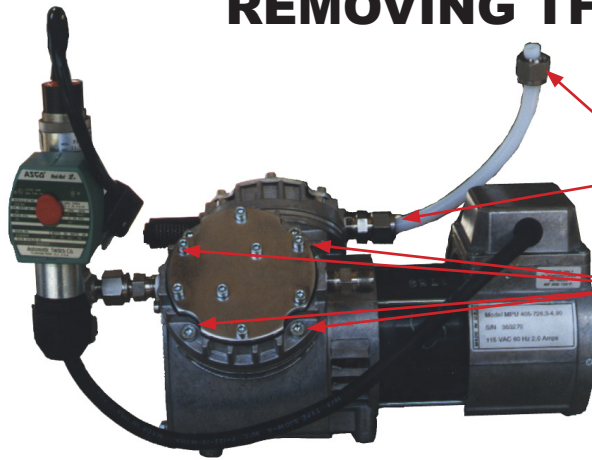
- Unplug the 3-pin pressure switch plug from the control module.
- Unplug the 6-pin diaphragm pump plug from the control module.
- Remove the flexible stainless steel foreline and set it aside.



The Diaphragm pump is now ready to be removed from the back (drag pump end) of the pump package.

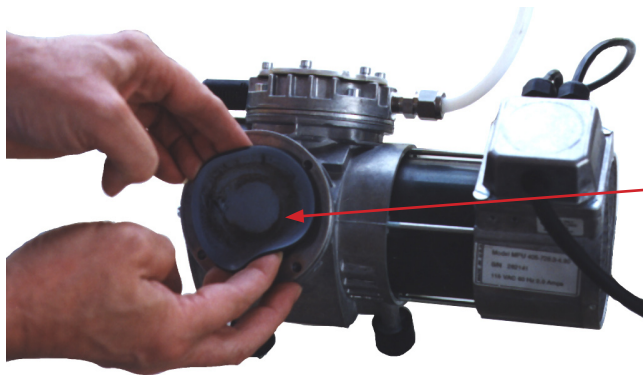
- Lift the diaphragm pump until the studs clear the baseplate, rotate it a few degrees, and pull it out past the drag pump from the rear end of the package.

REMOVING THE OLD DIAPHRAGM

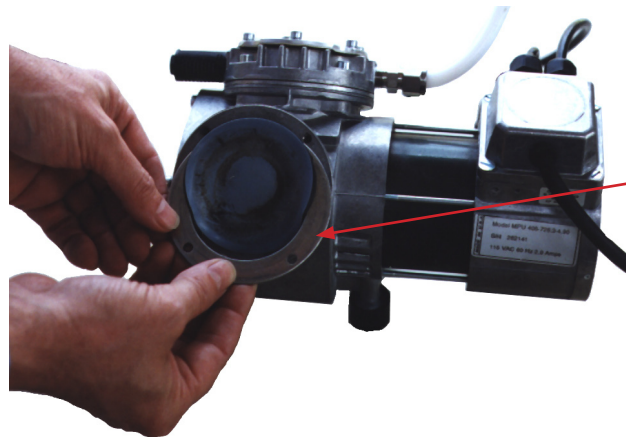


- Loosen the nuts at both ends of the teflon interstage line and rotate one end up.
- Locate the four (4) large Allen screws holding the head assembly, and remove those screws (do not remove the eight small Allen screws holding the head cover to the head).

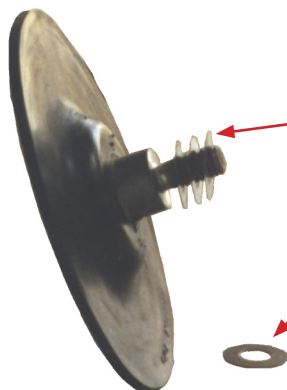
NOTE: Do not remove both heads at the same time. Complete the replacement of the first diaphragm and re-install the first head before removing the second head.



- Lift off the head and pull on the old diaphragm to raise it.



- Remove the sealing ring from the head. (Note that the rounded edge goes up).



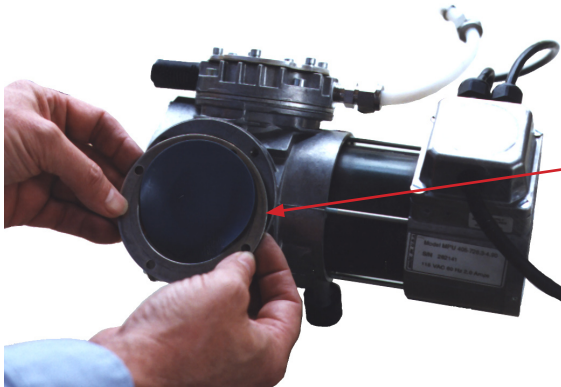
- Partially unscrew the diaphragm. Check for shims on the diaphragm stud. Some pumps have shims and some do not. If shims are present, make sure you install them on the new diaphragm stud.
- Remove the old diaphragm and install the new one using shims if applicable.

INSTALLING A NEW DIAPHRAGM

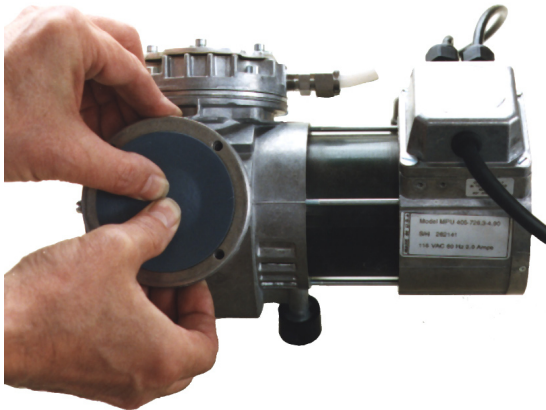


IMPORTANT NOTE!!!

Tighten the new diaphragm very snug. Use two hands (two thumbs) and twist hard for a very snug fit.



- Slide sealing ring over the new diaphragm (note rounded edge goes up).



- Push the diaphragm down until it is flush with the sealing ring, and align the screw holes.
- NOTE: Do not push the diaphragm down to its' lowest position. Push it down until it lightly touches the sealing ring.
- Re-install the head.

Repeat procedure on second head