EVR-IC Series Precision Vacuum Regulator

REGULATOR USE AND STARTUP

WARNING:

Be sure you have read and understand these directions before using, installing, or maintaining the Equilibar vacuum regulator. Take steps to ensure this instruction manual reaches the operator of this regulator and is accessible throughout its lifetime. The use, installation, operation, and maintenance of all pressurized products including this regulator must be performed by personnel who are properly trained and qualified through experience or specific training.

Failure to properly observe the instructions contained in this document may result in, but is not limited to:

- Serious personal injury or death
- Unconstrained release of the pressurized media
- Permanent damage to the pressure regulator and/or permanent damage to connected equipment

BACKGROUND

Background: The Equilibar® Vacuum Regulator (EVR) Series is a family of precision vacuum pressure regulators that directly control vacuum pressure at the inlet "I" port. The Equilibar EVR controls this vacuum by allowing flow from the system to vent through the regulator outlet "O" port. A vacuum supply source is connected to the outlet "O" port. The flow direction is from inlet to outlet. The EVR is pilot operated, so the vacuum pressure setpoint is determined by the pilot vacuum pressure applied to the Reference port (**Fig.1**). The EVR vacuum regulator will control the vacuum pressure on its inlet port in a precise 1 to 1 relationship with the vacuum pressure applied to the reference port (also called pilot or dome). The pilot vacuum setpoint pressure can be applied with a mechanical knob-adjusted vacuum regulator or with an electro-pneumatic vacuum regulator, see **Fig. 1**.

The Equilibar EVR uses a flexible membrane diaphragm to both sense the vacuum pressure and to provide a direct seal against the orifices in the regulator body. The pilot vacuum pressure is applied to one side of the diaphragm. The Inlet "I" port vacuum pressure is sensed on the other side of the diaphragm. When the pilot vacuum is closer to atmospheric pressure than the vacuum on the Inlet port then the diaphragm is pushed firmly against the orifices to form a seal and the regulator is effectively closed. When the inlet vacuum pressure just equals the pilot pressure, the closing forces are removed from the diaphragm and media can begin to pass from the Inlet to the Outlet port. When sufficient media has passed through the regulator, the Inlet vacuum will be reduced slightly, and the diaphragm is allowed to seal against the orifices again. In normal practice, equilibrium is achieved and the diaphragm modulates into a position where just enough flow is allowed out of the regulator in order to maintain a steady controlled vacuum on the inlet port, see **Fig 2**.

Example Circuit: In **Fig. 3** an EVR-IC vacuum regulator is in closed loop control with a vacuum table to maintain precise vacuum in sensitive applications such as when thin membranes or silicon wafers are being placed on and off the table. Flow rate fluctuates rapidly as the number of open holes in the table vary as membranes or wafers are placed on and off the table during processing. An EVR-IC vacuum regulator is quick to respond to rapid system changes and capable of providing stable pressure across the table even when the flow rate varies by 100:1 ratio

NOTE: Equilibar trained engineers work with you to suggest a vacuum regulator design, including wetted materials and pilot regulator for your specific application. These are recommendations only and are dependent on complete and accurate information from the end-user about the application. **It is the ultimate responsibility** of the end-user to determine the compatibility of the media with the materials of construction of the vacuum regulator and the pilot regulator.

The diaphragm installed in the vacuum regulator is a careful balance between the pressure, temperature, media compatibility, and flow rate requirements. Sometimes performance in one area must be sacrificed to obtain acceptable performance in another. Contact us if the EVR is not performing as expected so we can help troubleshoot.

2 SET-POINT OPTIONS

Fig. 1

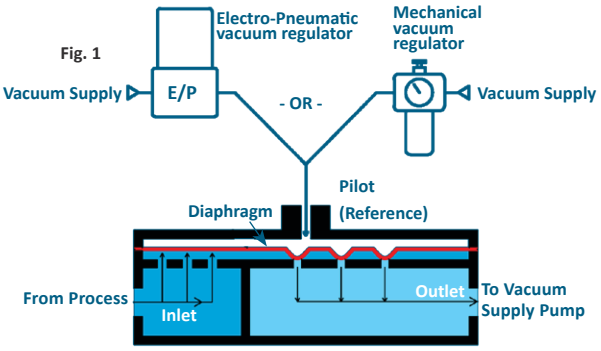


Fig. 2

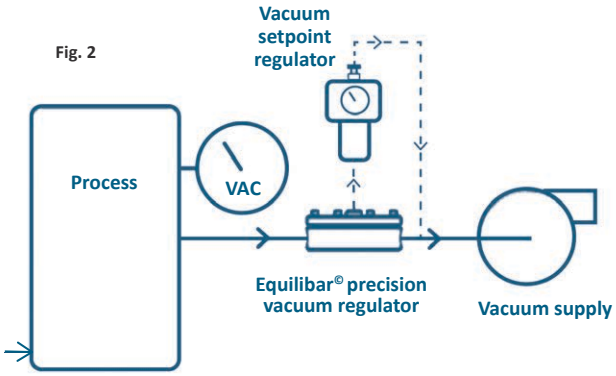
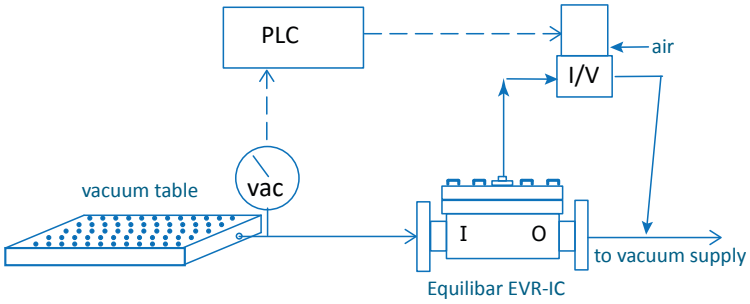


Fig. 3



EVR-IC Series Precision Vacuum Regulator

PREPARING FOR INSTALLATION

Equilibar vacuum regulators (EVR) arrive assembled, cleaned and ready to install.

Equilibar vacuum pilot regulators (EVPs) and fittings are not compatible with corrosive chemicals. If the process fluid contains corrosive gases, we recommend installing a check valve in the line from the EVP to the vacuum supply pump as described on the safety page of our website.

The EVR is intended for processes where at least a **very small gas flow** is present at all times. If your process is gas-tight, an Equilibar application engineer can discuss easy methods of providing a small gas bleed in the process.

- Every Equilibar regulator is individually hand tested at the factory for operation and external leakage. Leak testing is performed at 1.5X the MAWP. Typically this is 1.5 X standard atmospheric pressure, or 1.5 Bar gauge pressure.
- Equilibar regulators are cleaned internally and externally at the factory using aqueous based cleaners in an ultrasonic cleaner and manual wipe down with denatured alcohol.
- A small amount of DuPont Krytox™ lubricant is occasionally used on the internal non-wetted O-ring.
- Inspect the EVR for any damage. Consult Equilibar before proceeding if you find any damage.
- Verify that the part number on the EVR product label matches what you had requested
- Verify that the rating on the EVR label for maximum allowable working pressure (MAWP) and maximum allowable working temperature (MAWT) will not be exceeded when the EVR is used.
- Verify the system process fluid will not exceed the MAWP and MAWT of the pilot regulator.
- Many Equilibar diaphragms are manufactured with a small tab of protruding material. This is nonfunctional and is included only to allow easy inspection of the diaphragm material and thickness without the need to disassemble the regulator.
- Call or e-mail Equilibar if you have any questions, concerns, or need a new copy of these instructions. Be sure to include the full part number and serial number of the EVR you are inquiring about. (Phone +1-828-650-6590 or email info@equilibar.com)
- The Equilibar EVR is not a “Safety Accessory” as defined by the Pressure Equipment Directive 2014/68/EU. Be sure to install appropriate over and/or under pressure protection devices such as safety relief valves, vacuum relief valves, or rupture discs to protect the system and the EVR from exceeding the maximum allowable working pressures and to protect the system from excessive vacuum that could collapse tanks, vessels, or plumbing. These safety devices must meet applicable law, codes, regulations, and standards for your jurisdiction. All EVR regulators are rated to withstand full vacuum without damage.
- The EVR is designed, manufactured, and tested in accordance with sound engineering practices and the European Community Pressure Equipment Directive 2014/68/EU (the PED). Because the EVR series is used only at pressures less than 0.5 Bar gauge (above atmosphere) the PED does not apply and no specific PED Declaration of Conformity is issued for the EVR Series.
- Take precautions to prevent injury to personnel in the event of a diaphragm failure or external leak. Sensitive fluid controls can experience internal or external leaks. See standard terms and conditions for important limitations of liability notes.
- Diaphragms may fail in the open or closed position. Proper safety precautions should be taken for either failure mode.
- Inlet ports are stamped with an “I” and outlet ports are stamped with an “O”.
- The inlet “I” port is connected to the point in the system where it is desirable to maintain or control the pressure. The best pressure control will be seen if the plumbing to the EVR inlet port is as short and as large as practical to minimize the amount of pressure drop in the plumbing.
- Install a strainer or filter upstream of the EVR where necessary to prevent plugging of the orifices. Recommended 100 micron/100 mesh or better.
- System media will be vented out the EVR outlet “O” vent port, also called an exhaust port. Be sure that the media is vented to a safe environment, away from employees, and in accordance with applicable laws in your jurisdiction.
- Even inert gasses can cause suffocation through oxygen displacement. Take care to ensure that adequate ventilation and oxygen levels will be maintained.
- Provide adequate exhaust line capacity. Short or oversized exhaust lines are recommended.
- The EVR is not orientation sensitive and may be mounted in any plane and maintain good vacuum control. Media draining or other considerations may need to be taken in to account by your specific application requirements.
- Tapered pipe thread inlet/outlet port connections will require the addition of a sealant. PTFE tape may be used if it is compatible with your process and media. Take care not to let the PTFE tape extend past the first two male threads to prevent the PTFE tape from being ingested by the regulator. Tape or other debris can prevent the EVR from closing tightly and therefore not able to maintain the vacuum pressure at low flow rates. PTFE based pipe dope or an anaerobic “Loctite” product may also be used. Confirm the thread sealant used is compatible with your process, temperature, and media.
- Any bolt, screw, or connector that is threaded into a stainless steel body should have some small amount of lubricant to prevent thread galling. Threads galling together is usually permanent and causes the regulator to be scrapped. The Equilibar factory applies engineering-approved lubricant to all bolt and screw thread connections that are not wetted by the process fluid.

PREPARING THE VACUUM PILOT REGULATOR

- The flow through the Equilibar vacuum pilot regulator (EVP) is from atmosphere to the vacuum pump, so no process gases are entering the EVP in normal operation. (There is always a slight bleed through the EVP). If the process fluid contains corrosive gases, we recommend installing a check valve in the line from the EVP to the vacuum supply pump to prevent corrosion in the pilot. Note, the check valve will limit the control range of the EVR due to the dP across it to open. Selecting a check valve with minimal opening dP will minimize this effect. For more information, visit https://www.equilibar.com/equilibar-safety-information/
- Exercise caution when adjusting the pilot pressure. The EVR will attempt to adjust the inlet vacuum pressure at the same rate that the pilot vacuum pressure is being adjusted. This can result in extremely rapid release of media through the outlet (O) port of the regulator. Adjust the pilot pressure as slowly as practical.
- The EVR is designed to have maximum pilot pressure applied even when there is no pressurized media at the inlet (I) port. No damage will result.

Installing EVR-IC Series Vacuum Regulator

INSTALLATION OF EVR WITH MANUAL PILOT SETPOINT REGULATOR

1. The Equilibar EVR-IC and pilot regulator arrive ready to use (**Fig. 5**)
2. Attach the manual vacuum pilot regulator to the reference port on the top of the EVR:
   - Connect the port labelled SET to the reference port of the EVR. A short length of tubing between the EVR and the pilot regulator may improve performance.
   - Connect the tubing from the port labelled VAC to the vacuum supply port on the side of the EVR-IC. **See Fig. 6**
3. Attach the inlet "I" of the EVR-IC to the point in the system process where the vacuum needs to be regulated. (**Fig. 7**)
4. Attach the outlet "O" of the EVR to your vacuum supply.
5. Adjust the vacuum pressure on the manual setpoint regulator to set the desired vacuum setpoint of the EVR.
6. Equilibar recommends an initial "diaphragm setting" of polymer and rubber diaphragms up to 1.5X of application operating pressure. This is achieved by applying pressure to the reference port. This 'setting of the diaphragm' can help the diaphragm perform at lower flow rates. For metal diaphragms, Equilibar recommends applying a set pressure of ***only 1X*** of operating pressure for best performance. The unit is designed to withstand full differential pressure of rated pressure from reference/pilot to process pressure.

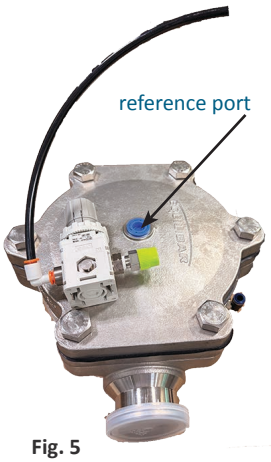


Fig. 5
EVR-IC is shipped without pilot regulator connected.

Fig. 7
Location of Inlet "I" stamp on EVR-IC

Fig. 6
EVR-IC with manual pilot regulator connected

INSTALLATION OF EVR WITH AN ELECTRONIC PILOT SETPOINT REGULATOR

The EVR comes standard with a manual vacuum pilot regulator. If you wish to automate the process, an electronic vacuum pilot regulator can be ordered separately. The manual pilot can be used for initial setup and troubleshooting of your vacuum process, then the electronic pilot regulator can be installed knowing that the system is working properly. Contact Equilibar with questions or to discuss options.

The following instructions apply to installation of an Equilibar EPC or QPV electronic vacuum pilot regulator.

you may refer to our YouTube video for instructions

1. There are separate Installation Manuals for Equilibar electronic vacuum pilot regulators. Follow those instructions for complete information. The instructions below are a brief summary.
2. Attach the port labelled OUT on the QPV or EPC vacuum pilot regulator to the reference port on the top of the EVR-IC as shown in **Fig. 8.** For best stability, the tubing between the pilot regulator and the reference port requires a minimum volume of 2 cubic inches.
3. Attach a line from the "E" exhaust port of the EPC or QPV to the vacuum supply port on the side of the EVR-IC (**Fig. 6**).
4. Attach the inlet "I" of the EVR-IC to the point in the system process where the vacuum needs to be regulated. (**Fig. 7**)
5. Attach the outlet "O" of the EVR to your vacuum supply.
6. Leave the port labelled IN on the EPC or QPV open to atmosphere. A 40 micron sintered filter is pre-installed in the inlet port. Do not remove this filter.
7. Connect the leads from the power cord to the correct terminals in your PLC per the installation manual for your specific electronic vacuum pilot regulator.
8. Connect the power cord to the electronic pressure regulator.
9. Adjust the pressure on the electronic pilot regulator using a 0-10V or 4-20 mA signal (depending on your unit) to set desired vacuum setpoint for the EVR-IC.
10. Perform initial diaphragm setting as described in STEP 6 above.

Fig. 8
EVR-IC with QPV Electronic pilot Regulator*

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MAINTENANCE NOTES

- Maintain strainer or filter upstream of device.
- Annual inspection of diaphragm integrity is recommended, especially for applications where there is strong or regular pulsing.
- It is expected that O-rings and diaphragms will need to be replaced on a regular basis, the timing of which is dependent on the application.
- It is recommended to order spare parts prior to performing maintenance. The following replacement part kits are available for order:
  - RBK – Rebuild Kits – replacement parts for O-rings AND diaphragms
  - DI – Diaphragm Kit – replacement parts for diaphragms only
  - OR – O-ring Kit – replacement parts for the O-rings only
- Visit our maintenance website or contact us for more information.

PREPARING FOR MAINTENANCE OR TROUBLESHOOTING

- When shutting the system down for maintenance or troubleshooting, turn the process fluid off before removing pilot pressure supply to the pilot port. This step will prevent a sudden release of system media pressure through the BPR.
- Release the pilot pressure and remove the pilot port piping to clear the BPR for maintenance. Equilibar BPR's can be serviced 'inline' and do not need to be removed from the system piping.
- Loosen the bolts in the cap of the BPR and disassemble wearing proper protective equipment. See exploded view on page 4.
- Inspect diaphragm and O-rings for integrity to determine if they need to be replaced. Check for scratched O-ring sealing surfaces.
- Clean all wetted surfaces to remove any residual process fluid and particulates.
- Reassemble the clean parts with new diaphragm and O-rings following the instructions on page 5.

TROUBLESHOOTING

PROBLEM	POSSIBLE SOLUTIONS
Maximum flow is reduced	**The internal orifices may be blocked with debris. Inspect and remove as required. Maintain an upstream filter.**
Excessive vacuum is on the controlled port	**Many EVR diaphragm types cannot seal tightly and require a constant flow rate.** • Add a small bleed of suitable gas and continuously add gas to the EVR inlet port. • Ask an Equilibar engineer if a different diaphragm might be more suitable **Debris may be preventing the diaphragm from making an effective seal.** • Make sure all the outlet orifices under the diaphragm are clear and in good repair **The vacuum on the pilot port may be different than expected** • Install a vacuum pressure gauge in the line feeding the EVR pilot reference port. Make sure the pilot pressure regulator is functioning correctly.
Too little vacuum is on the controlled port	**Inadequate supply vacuum** • Install a vacuum pressure gauge in the vacuum supply line as near to the EVR as possible. The supply line for the pilot regulator is a good spot. • Verify that the supply vacuum is greater than the desired vacuum control pressure **EVR may be undersized** • Compare the pilot vacuum pressure (using a vacuum gauge) to the controlled vacuum pressure as near the EVR inlet port as possible • A large difference indicates an undersized EVR regulator • Confirm this by reducing the amount of system flow to the EVR. The EVR should resume normal operation with reduced flows.
No control over vacuum level	• Diaphragm may have ruptured; check and replace if necessary. This can be done by applying a small amount of positive pressure to the pilot port (less than 1 Bar/15 psig), trapping it, and observing any leak down rate. • Pilot regulator inlet and outlet might be reversed. Verify using the pilot connection procedure in this manual • Using a vacuum gauge as near the EVR outlet port as possible, verify that adequate supply vacuum is present • Using a vacuum pressure gauge, verify that the pilot vacuum pressure applied to the EVR pilot port is at the correct level

RATED PRESSURE NOTE

Equilibar regulator bodies have a Shell pressure rating based on the body and bolt strength using principles of the ASME B31.3 and confirmed using hydrostatic testing. These Shell pressure ratings are the maximum rating for each design as listed in the technical brochures. For example, BD16 in SS316L (BD16S) is listed with a maximum pressure rating of 70 psig.

Equilibar configures individual regulators to the specific customer application which may involve fitting the valve with a thinner diaphragm to meet precision or low-flow requirements. The diaphragm selection, operating temperature, chemical composition or other factors cause pressure derating. Therefore, the MAWP printed on an Equilibar BPR label reflects that of the selected diaphragm and application conditions but will not exceed the Shell pressure rating of the body design. For EVR models, the MAWP is expressed in vacuum units.

The maximum pressure rating for the shell is always based on the body and bolt strength and is not printed on the product label. Customers may contact Equilibar engineers if they desire to increase unit MAWP by upgrading diaphragm thickness.

REFERENCE PRESSURE AND PRESSURE TESTING

Equilibar recommends that reference pressure always be applied when pressurizing the process (inlet and outlet) ports of the Equilibar, such as in the case of pressure testing a system that has an Equilibar BPR installed. This helps prevent the diaphragm from lifting and deforming into the cap which can have a negative impact on performance of the diaphragm.

EVR-IC Series Precision Vacuum Regulator

ASSEMBLY INSTRUCTIONS (IC SERIES)

1. Prepare the work surface to minimize any particulate or debris entering the valve during assembly.
2. Clean all parts prior to installation. Equilibar recommends a final wipe down using a solvent and lint free cloth.
3. Install bolts(1) into reference cap(2). Flip reference cap and bolts upside down on a clean, flat surface.
4. Carefully place reference cap O-ring(3) inside the groove of the reference cap(2).
5. Inspect diaphragm for any damage. Replace if any question about condition.
6. Lay diaphragm(4) centered onto reference cap(2), aligning bolts and holes.
7. Insert upper seat plate O-ring(5) into the top groove of the seat plate(6). If O-ring rests on inner groove wall, then slightly stretch the O-ring so it rests on the outer wall of the groove.
8. Invert seat plate(6) with O-ring onto diaphragm, aligning bolts with holes and taking care not to allow O-ring to fall out.
9. Insert seat plate bottom O-rings(7a & 7b) into bottom grooves of the seat plate(6).
10. Carefully align the body(8) inlet, outlet and bolt holes up with the seat plate(6) and cap(2) subassembly built in steps 1-7 and lay on top.
11. Holding the parts together flip the assembly.
12. Tighten all bolts one at a time in a star pattern (see torque pattern shown in **Fig. 10**). Torque the bolts using the recommended torque wrench settings referenced in the table below.
13. If your rebuild kit contains a new label, be sure to apply it to the EVR-IC; the wetted materials or operating parameters may have changed.

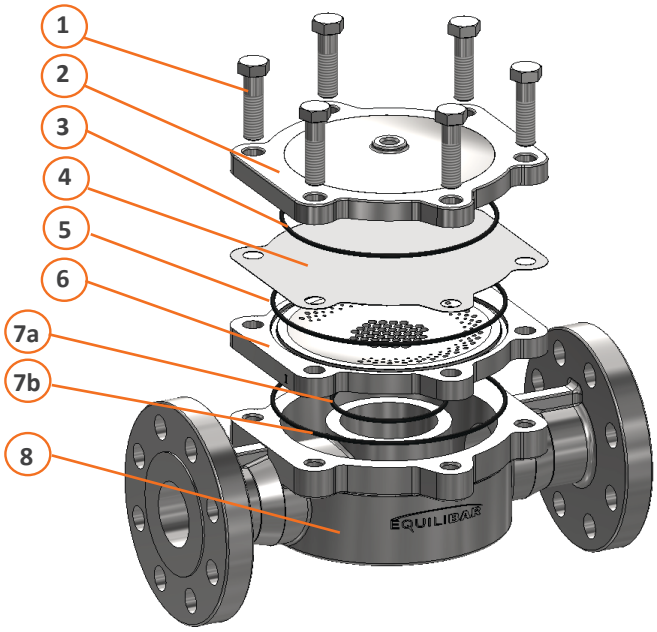

Fig. 9
Exploded view of Equilibar IC Series

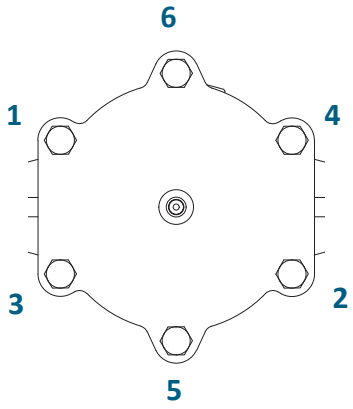

Fig. 10
Sample Torque Pattern for IC Series.
Number of bolts will vary by size

Recommended torque wrench settings:

Model Size	BOLT	RECOMMENDED TORQUE
IC12	9/16-12	65 ft-lbf / 88 N-m
IC16	9/16-12	65 ft-lbf / 88 N-m
IC24	1/2-13	46 ft-lbs / 62 N-m

EVR-IC Series Precision Vacuum Regulator

SYSTEM HAZARD ANALYSIS

Both normal operation as well as possible failure modes and foreseeable misuse must be accounted for in the design of the system which interacts with and connects to the Equilibar back pressure regulator (BPR). It is the responsibility of the end user to account for these hazards. **Please read all of the following safety and hazard precautions before installing or operating any equipment.**

A. The EVR is not certified as or marketed as a pressure vessel safety relief valve. The EVR is a precision control valve. Guarding against overpressure or underpressure must be achieved with devices designed and marketed as such.

B. Sensitive diaphragms and external seals can leak. It is the responsibility of the end user to use this product in a way that prevents injury to personnel should leakage occur. See Standard Terms and Conditions for important Limitation of Liability notes.

C. If the internal diaphragm ruptures or leaks, the gas or fluid on the pilot port can be introduced into the process fluid. Make sure that the fluids are compatible and not hazardous when mixed.

D. If the internal diaphragm ruptures or leaks, process fluid can enter the pilot port plumbing.

i. Make sure that the process fluids and the pilot are compatible and not hazardous when mixed. Most auxiliary pressure regulators used to provide pilot pressure to the EVR are of the self-relieving design. Guard against the process fluid relieving out the vacuum pilot regulator if the EVR diaphragm fails. One method to accomplish this is to set the pilot pressure into a static volume chamber that is sealed with an ON/OFF valve after the vacuum pressure is set to the desired value. In order that the pilot pressure to the EVR can be reduced, most pilot regulators incorporate an internal bleed to atmosphere. This bleed port does introduce atmospheric air into the output "O" port and the vacuum supply line. If atmospheric air cannot be tolerated in the vacuum supply line please contact Equilibar® for alternate methods.

ii. If an electronic pressure regulator is used then special consideration must be made. In addition to reviewing the prospect of having the process media coming in contact with and venting out of the electronic vacuum pilot regulator, the possibility of ignition of the media by the electronic pressure regulator must be examined. It is the user's responsibility to determine if a hazardous area classification exists and to make sure that the electronic vacuum pilot regulator employed meets or exceeds the requirements of intrinsic safety for that area.

E. If the internal diaphragm ruptures or leaks the result is often that the EVR will fail into a closed position. This results in a blocked pipe with no path for the fluid to escape through the EVR. Over pressurization of the upstream can occur. Steps must be taken to ensure that the upstream piping is made sufficiently strong to withstand this or is guarded by an overpressure
relief device.

F. Make sure the process vacuum pressure to be controlled is connected to the EVR "I" Inlet port. Process fluid flow is from "I" Inlet to the "O" Outlet. If the EVR is connected in reverse it may still operate but it will give poor control and can result in excess pressures.

G. Observe the maximum temperature and pressure ratings on the EVR label. Take steps to ensure these values cannot be exceeded. Where necessary to protect equipment, a suitable type of safety overpressure and/or vacuum relief valve must be connected in parallel to the EVR. The overpressure relief valve must be rated to prevent the pressure or temperature from exceeding the EVR maximums as listed on the EVR label. In some installations a rupture disc may be substituted for the safety relief valve.

H. If the discharge piping on the EVR "O" Outlet port becomes blocked, the EVR will open and fill the discharge piping to the same pressure as the maximum pressure in the system. The discharge piping must be rated to contain this pressure or have a safety relief valve to limit this pressure at or below the safe pressure of the discharge piping.

I. Do not use the EVR as a structural member. All piping and plumbing connections to the EVR should be adequately supported. The EVR series is available with a mounting bracket to facilitate the installation.

J. Enriched oxygen media (>21%) should not be used in the EVR unless Equilibar® has specifically worked with you to provide a product rated and labelled for enriched oxygen. Standard products are not oxygen cleaned. Particle impact, adiabatic compression, and diaphragm motion can all cause ignition in an enriched oxygen media. This kindling chain can cause the entire EVR to oxidize extremely rapidly resulting in high temperatures, discharge of flames and molten metal, and unrestrained escape of process fluid.

K. The metal cap and body of the EVR are excellent conductors of heat.

i. Assume the external temperature of the EVR will rise or fall to match the temperature of the process media flowing through it. In addition to thermal hazards posed to humans by directly touching the EVR exterior, it is the duty of the end user to verify that the temperatures of the process media do not exceed the ignition temperatures of any combustible gases or dust (or mixture) that may be present local to the EVR.

ii. Assume the internal temperature of the EVR will rise or fall to match the temperature of the ambient environment. Ensure that the process media flowing through the EVR cannot be damaged or ignited by the maximum and minimum ambient environment temperatures. Low ambient temperatures can cause the media within the regulator to freeze. Expansion cooling in certain gasses can also cause freezing. Freezing can block the EVR and cause excess pressures to build on the "I", Inlet, port. Expansion of water due to freezing can damage the regulator. Ice formation from freezing can perforate metallic foil diaphragms.

L. The EVR has been carefully designed by skilled engineers to provide proper safety ratios and adequate pressure regulation. Do not attempt to modify the EVR in any way, including adding or enlarging orifices or ports or replacing machine screws or bolts. Only replace the internal O-rings or diaphragms with Equilibar® factory provided repair parts.

M. Never perform maintenance or inspections on a system when pressurized fluids are present. De pressurize the system before performing this work. De-pressurize inlet pressure before the reference pressure, otherwise a quick drop in reference pressure can lead to a violent exhaust of the upstream pressure through the regulator.

N. The assembly is not intended to resist loads due to traffic, wind, earthquakes, attachments, decomposition of unstable contents, and piping moments (refer to point **I**.).

SYSTEM HAZARD ANALYSIS (CONTINUED)

Both normal operation as well as possible failure modes and foreseeable misuse must be accounted for in the design of the system which interacts with and connects to the Equilibar back pressure regulator (BPR). It is the responsibility of the end user to account for these hazards. **Please read all of the following safety and hazard precautions before installing or operating any equipment.**

O. The assembly has been analyzed and designed for normal operation under the following criteria frequency of start up, conditions of use, in-service supervision, in-service inspection, complexity of equipment, working life and fire. The design meets End users should review potential contributors to failure in their system prior to approval of installation of the Equilibar regulator. Equilibar standard engineering practice of regulator design. Please contact Equilibar with any questions.

P. The assembly has been analyzed for the consequences of possible failures to the following: public risk, operating personnel risk, energy released, explosion risk, toxicity, flammability, economic, and effect on adjacent equipment. End users should review the risk of operating the Equilibar regulator in their system prior to approval of installation of the Equilibar regulator. The design meets Equilibar standard engineering practice of regulator design. Please contact Equilibar with any questions.

Q. The valve assembly has been analyzed for possible failure modes due to lamellar tearing, aging, brittle fracture, corrosion, erosion, chemical attack, hydrogen induced cracking, fatigue, overheating, plastic instability, stress corrosion cracking, creep, overload. End users should analyze their system where the Equilibar valve will be used to verify compatibility with any of these possible failure modes prior to the approval of installation of the Equilibar regulator. This design meets Equilibar standard engineering practice of regulator design. Please contact Equilibar with any questions.

TRANSPORTATION AND STORAGE

The assembly should be secured by sufficient packaging to withstand transport. Insufficient packaging can result in injury, damage and other risk. Padding that can be compressed and allow movement should not be used. Single layer boxing is not recommended. Recommended to secure safely to prevent movement and anchored to a crate or pallet for transport.

The assembly does not require boxing for storage. Similar risk of injury and damage may occur if the product is not securely anchored during storage.

The assembly can be transported or stored in any orientation without negative impact to the assembly.

REMOVING FROM SERVICE

To remove the assembly from service, refer to the section ‘preparing for installation and maintenance’.

Equilibar recommends that the parts be disassembled by a trained technician and cleaned in accordance with local regulations for decontamination of the user’s media.

Once cleaned, the consumable parts such as the o-rings and diaphragm can be disposed. The metal parts should be recycled with your local metal recycling service in accordance with any local regulations.

PATENT INFORMATION

www.equilibar.com/support/patents/

Equilibar’s quality system is **ISO 9001:2015** certified.