EQUILIBAR®
PRECISION FLUID CONTROL

EVR Series

¼" - 4" Precision Vacuum Regulating Valves

MANUAL AND ELECTRONIC CONTROL OPTIONS

How It Works

The Equilibar® vacuum regulator (EVR) works in a completely different way than traditional regulators and valves.

Instead of a single large valve seat the Equilibar vacuum regulator uses multiple orifices sealed by a flexible diaphragm. The Equilibar is dome-loaded by vacuum pressure on top of the diaphragm and controls the inlet vacuum pressure to closely equal this pilot vacuum pressure. As flow requirements change, the diaphragm moves a few millimeters to open and close over some or all of the orifices, providing instantaneous and frictionless control.

The pilot (reference) vacuum pressure may be set with a manual or electronic pilot pressure regulator (Fig. 1). The pilot regulator is a small, sensitive vacuum regulator which generates a precise setpoint pressure that is equal to the desired process vacuum. This small regulator is energized by the vacuum supply at the outlet port of the EVR. It allows a very small amount of air to be drawn into it to allow for reductions in vacuum setpoint.

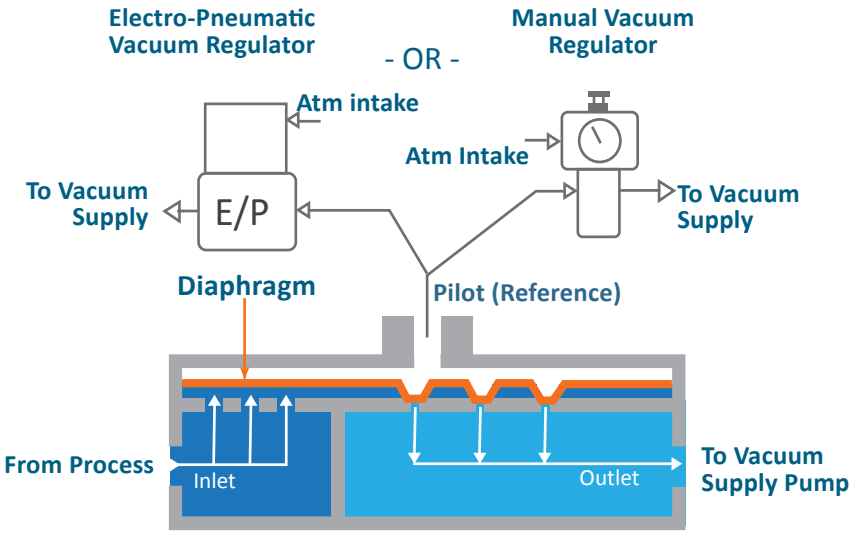


Fig. 1: Vacuum pilot regulator supplying a reference vacuum pressure to the flexible diaphragm in the unique EVR design

The EVR is a non-relieving[1] vacuum regulator that throttles flow between the vacuum supply pump and the process in order to precisely control the process vacuum (Fig. 2) to a specific setpoint.

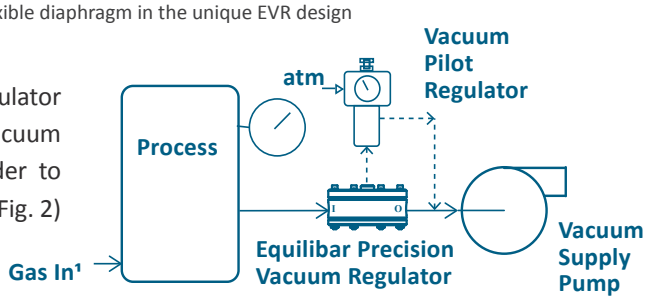
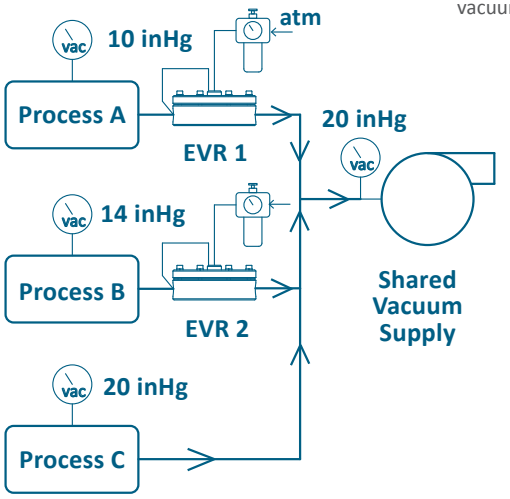


Fig. 2: EVR used to throttle flow between the process and vacuum supply pump

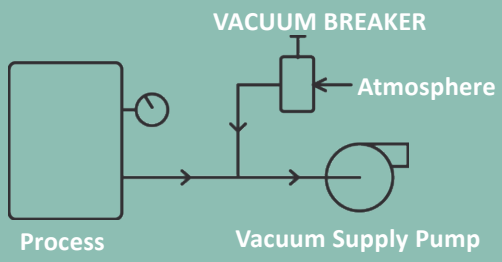


Certain applications require the use of a **vacuum regulator** because vacuum breakers will not work in those cases. For instance, in a central vacuum distribution system where several processes are sharing one vacuum supply, a vacuum regulator is essential. There are also certain types of vacuum pumps that work more effectively when controlled by a vacuum regulator instead of a vacuum breaker.

Equilibar EVR is NOT a vacuum breaker

Equilibar vacuum regulators are **NOT** vacuum breakers, which let a large volume of air into the system to relieve pressure.

Note: While the EVR pilot regulator lets in air, similar to a breaker, the amount of air is less than if you were to use a breaker to control vacuum within the whole system.



[1] 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 Equlibar application engineer can discuss easy methods of providing a small gas bleed in the process.

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Key Performance Advantages

EASE OF USE

Simply connect the vacuum pump or house vacuum utility to the outlet port of the EVR. Connect the process to be controlled to the inlet port. Add the vacuum pilot regulator and adjust vacuum pilot setting to achieve the desired vacuum level.

EXCELLENT STABILITY

As flow increases through any vacuum regulator, the vacuum pressure decreases due to friction in the regulator. Because of its unique design, the EVR delivers less vacuum loss with increasing flow than do traditional spring-operated regulators. The orange curve in Fig. 3 illustrates the vacuum stability of the 1" EVR across a range of flow rates. For those processes requiring further vacuum stability over a wide range of flow rates, Equilibar offers closed loop control configurations. That stability is illustrated in the green curve in Fig. 3 and is discussed further on pages 6-9.

The Equilibar EVR also holds vacuum pressure stable across varying supply pressures. Traditional vacuum regulators are often sensitive to vacuum supply pressure, whereas Equilibar vacuum regulators effectively isolate upstream pressure from varying supply. (See Fig. 4)

SMOOTH COMPUTER AUTOMATION

Equilibar vacuum regulators respond instantaneously to changes in vacuum supply or setpoint pressure. An electro-pneumatic vacuum pilot regulator can be combined with the EVR for smooth automated computer control.

LIGHTNING FAST CONTROL

Unlike vacuum control valves using PID controllers, the EVR vacuum regulator responds within milliseconds to flow and pressure changes.

Fig. 3 Vacuum Flow Stability Curve 1" EVR-GSD8

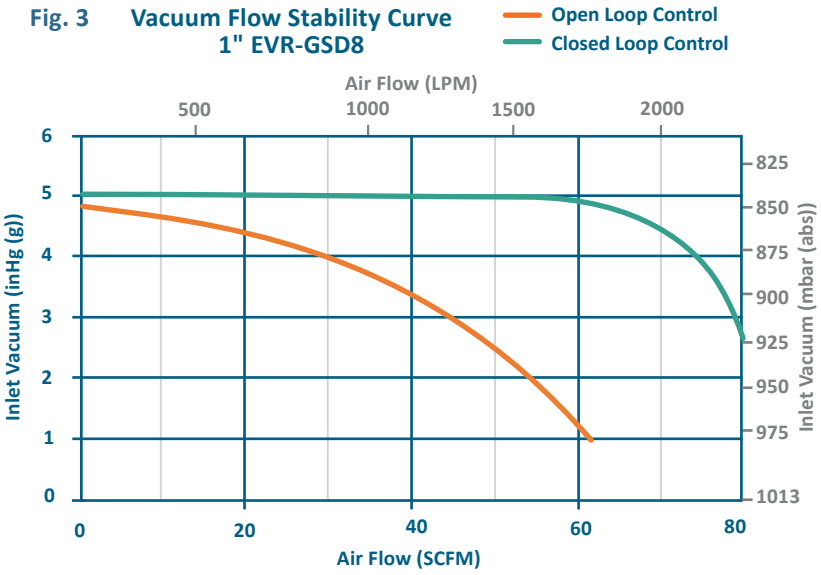
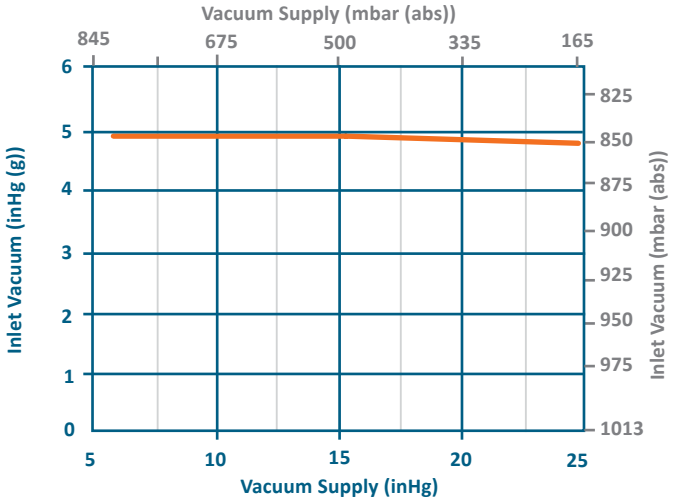


Fig. 4 Vacuum Stability with Varying Vacuum Supply 1" EVR-GSD8



CHEMICAL AND TEMPERATURE COMPATIBILITY

Equilibar vacuum regulators are available in 316SS, anodized aluminum or PVC, with O-rings and diaphragm materials to meet the needs of the most challenging vacuum environments. Certain designs can withstand process applications with ultrapure and aggressive chemical fumes and moisture. Options are also available for high temperature performance.

MULTIPLE PORT SIZES

EVR models are available in port sizes from ¼" to 4" and in a variety of fittings including NPT, BSPP and 150# Flange.

Centralized Vacuum Distribution

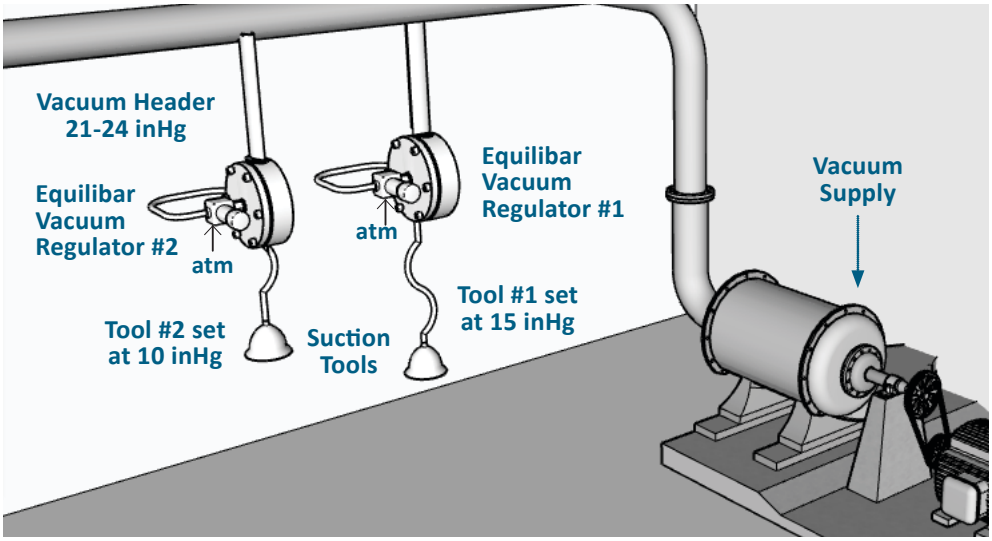


Fig. 5: Multiple Equilibar vacuum regulators that share a common vacuum supply

In industrial settings, it is common for a single vacuum utility header to supply several diverse processes, each with separate vacuum pressure requirements. For example, one piece of equipment might function best with 10 inHg vacuum, while another process requires 15 inHg vacuum.

For this application, a vacuum regulating valve is needed on each process line requiring lower vacuum than the supply vacuum. While vacuum breaking regulators (VBR) are commonly used on vacuum pumps that supply a single pressure, these VBRs are not suitable in the case of multiple users because the VBR sets the system vacuum for the entire header.

In the illustration above, Tool #1 requires a higher vacuum level than Tool #2. In order to use a shared vacuum supply pump, vacuum regulators are required on the Tool process lines to reduce the vacuum to the required level.

EVR Series vacuum regulators work by restricting the flow from the supply pump to the process and do not let any significant amount of air into the process.

Remote Sense Vacuum Pilot for Improved Control

In many vacuum applications a filter or long run of piping exists between the vacuum regulator and the vacuum process to be controlled. In these situations, it is difficult to achieve accurate vacuum control with a standard vacuum regulator because the regulator cannot compensate for these significant pressure losses. For these applications, a “Remote Sense” at the process is needed to help the vacuum control valve control the process directly to the desired pressure.

The Equilibar Remote Sense Vacuum (RSV) pilot is a highly sensitive mechanical vacuum pilot with remote sense capability designed specifically to provide closed loop control of an EVR. The RSV actively adjusts the pilot reference vacuum level to maintain an extremely steady vacuum setpoint despite large variations in flow and process pressure drop.

In this schematic a tube runs between the remote sense port in the RSV and a line near the process to be controlled. The RSV works by using this remote sense input to carefully adjust the vacuum force that is applied to the pilot reference port of the Equilibar vacuum regulator. See page 8 for more details.

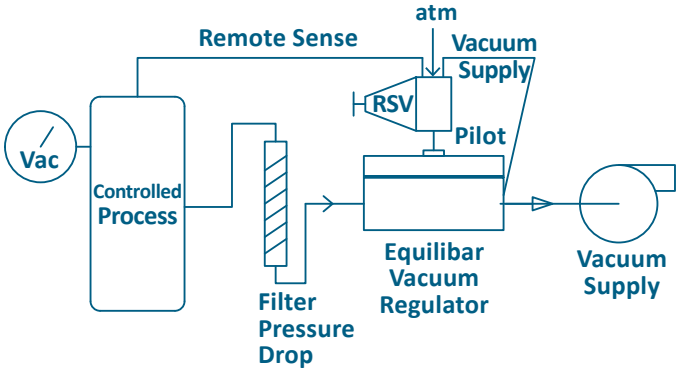


Fig. 6: EVR with RSV pIlot for precision remote sense control

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Extrusion Control with Vacuum Sizing Box

Many tubular polymer extrusions, such as PVC pipe, are made using vacuum sizing boxes to shape the extruded plastic against a sizing tool before cooling. Vacuum stability is critical in this process to create and maintain consistent shape and surface finish of the plastic product. The Equilibar vacuum regulator delivers improved product quality in this application by tightly controlling vacuum in the sizing box.

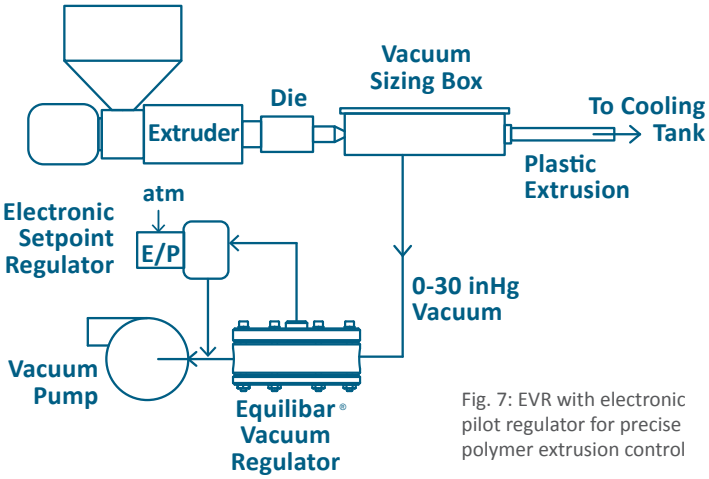


Fig. 7: EVR with electronic pilot regulator for precise polymer extrusion control

In a typical vacuum sizing application, the EVR is installed between the vacuum pump and the sizing box (Fig. 7). Because the EVR is extremely stable over widely varying flow rates, the pressure in the vacuum box is maintained in a tight range even during process fluctuations.

To enable sizing box process automation, the vacuum pilot setpoint signal can be provided by an electronic pressure regulator as shown in Fig. 7. A manual regulator would also work as an EVR pilot setpoint in this case.

Control for Precision Vacuum Distillation

Vacuum distillation is used to reduce the pressure above a liquid to less than its vapor pressure, allowing the most volatile liquids to be selectively boiled off and distilled. This is particularly useful if the temperatures required for a fluid to boil at atmospheric pressures would be hot enough to damage sensitive molecules.

Precisely controlling the vacuum pressure is often critical because the mixture being distilled may contain several liquids with close boiling points. Accurately controlling the vacuum allows for much higher selectivity in the distillation process.

Many vacuum regulators simply do not offer the accuracy required to selectively distill fluids with close boiling points. Those regulators that are sensitive enough are so fragile that they cannot stand up to the corrosive chemistries or elevated temperatures often encountered in vacuum distilleries.

Equilibar vacuum regulators are designed to meet the stringent accuracy and durability requirements of this process. The EVR controls vacuum pressure very accurately to a required setpoint regardless of fluctuations in the system flow rate or variations in the supply vacuum pressure.

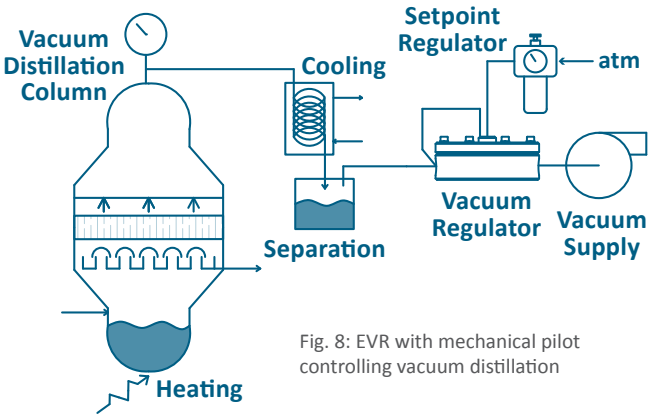


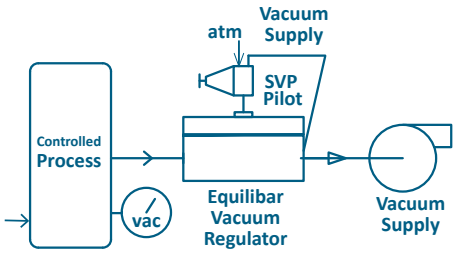
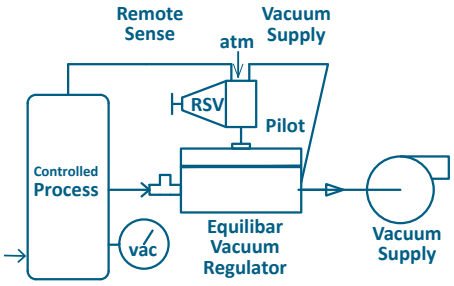
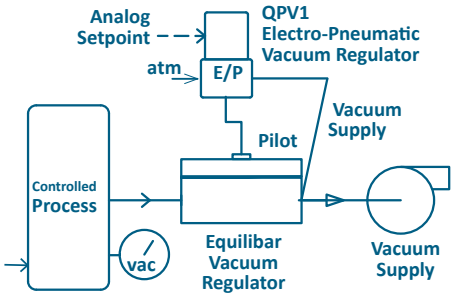
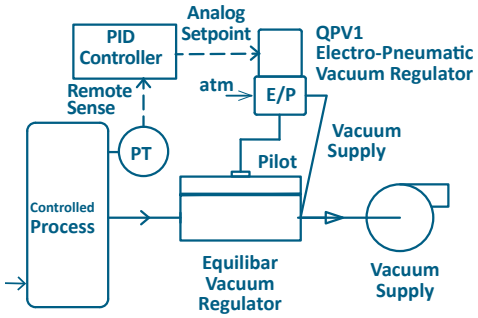
Fig. 8: EVR with mechanical pilot controlling vacuum distillation

Pilot Options

FOR USE WITH EVR SERIES VACUUM REGULATORS

The EVR Series vacuum regulators can be operated with a mechanical or an electronic pilot regulator in open loop or closed loop control schemes for precise vacuum control. The choice depends on the setup and performance requirements of the specific process. Contact an Equilibar application engineer with questions or for help determining the best design for your vacuum control process.

The table below shows the benefits of the various options.

	OPEN LOOP CONTROL	CLOSED LOOP CONTROL
OPTION BENEFITS	• Simple and robust • Lower cost • Best where flow is relatively stable • Regulator is near process	• Higher accuracy • Higher capacity • Better where flows are varying widely • Remote sensing capability
MECHANICAL CONTROLLER APPROACH		
ELECTRONIC CONTROLLER APPROACH		

SVP1 pilot for ¼"-1" EVR

Customers can use the standard SVP as a pilot regulator, or request an upgrade to the QPV or RSV pilot regulator described on the following pages.

SVP2 pilot for 1 ½" - 4" EVR

Note: Equilibar vacuum pilot regulators and fittings are not compatible with corrosive chemicals. The flow from the pilot regulator is from atmosphere to the vacuum pump, so no process gases are entering the pilot in normal operation. If the process fluid contains corrosive gases, we recommend installing a check valve in the line from the pilot to the vacuum supply pump. Contact Equilibar for more details.

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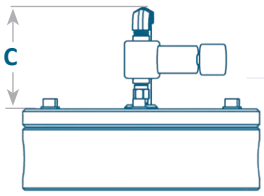
Pilot Options

Vacuum pilot open loop and closed loop options are tabulated below. Each vacuum pilot regulator has a different air intake rate from atmosphere. See table for more information



	SVP 1	SVP 2	RSV	QPV
CONTROL TYPE	Open Loop Mechanical Control		Closed Loop Mechanical Control	Open Loop or Closed Loop Electronic Control
EVR PORT SIZES	¼" - 1"	1 ½" - 4"	ALL SIZES	
DIM C[1]	3 ¾"	3 ¾"	5 ¼"	3 ¾"
ATM. INTAKE	<260 CC/MIN @ 30 INHG	600 CC/MIN MAXIMUM	1166 CC/MIN MAXIMUM	117 CC/MIN @30 INHG

[1]DIM C is approximate

QPV ELECTRONIC PILOT REGULATOR

For precise electronic control, using an Equilibar QPV electronic pilot regulator is an excellent option. It can be mounted near the process control system for easy process integration or mounted directly to the EVR. This pilot can be used in open loop or closed loop configuration depending on process requirements.

To upgrade to electronic vacuum control, it is easy to remove the mechanical standard vacuum pilot and replace it with a QPV electronic vacuum regulator from the chart below. Watch our YouTube video for detailed installation instructions, or contact an application engineer for assistance.

QPV with optional digital display

QPV SPECIFICATIONS AND ORDERING INFORMATION

PART NUMBER	TYPE	MANIFOLD MATERIAL	THREAD TYPE	INPUT SIGNAL RANGE	MONITOR SIGNAL RANGE	PRESSURE RANGE	BLEED ORIFICE	DIGITAL DISPLAY?	TYPICALLY IN STOCK?
QPV1MANEEZN30IHGXCL	Single Loop	Aluminum	NPT	0 to 10 VDC	0 to 10 VDC	0-30 inHg (g)	Include Bleed Orifice	N	Y
QPV1MANISZN30IHGXCL	Single Loop	Aluminum	NPT	4 to 20 mADC	4 to 20 mADC (Sourcing)	0-30 inHg (g)	Include Bleed Orifice	N	Y
QPV1MANEEZP760TRACXL	Single Loop	Aluminum	NPT	0 to 10 VDC	0 to 10 VDC	0-760 torr (absolute)	Include Bleed Orifice	N	Y
QPV1MANEEZN30IHGXCL-DD	Single Loop	Aluminum	NPT	0 to 10 VDC	0 to 10 VDC	0-30 inHg (g)	Include Bleed Orifice	Y	N
QPV1MANISZN30IHGXCL-DD	Single Loop	Aluminum	NPT	4 to 20 mADC	4 to 20 mADC (Sourcing)	0-30 inHg (g)	Include Bleed Orifice	Y	N
QPV1MANEEZP760TRACXL-DD	Single Loop	Aluminum	NPT	0 to 10 VDC	0 to 10 VDC	0-760 torr (absolute)	Include Bleed Orifice	Y	N

IN STOCK ITEMS TYPICALLY SHIP WITHIN 2 DAYS, WHEREAS OTHERS TYPICALLY SHIP IN 8-10 WEEKS

Pilot Options

RSV CLOSED LOOP PILOT REGULATOR

The Equilibar Remote Sense Vacuum (RSV) pilot is a highly sensitive mechanical vacuum pilot regulator designed specifically to provide closed loop control of any Equilibar vacuum regulator (EVR). The RSV has a remote sense port that can be connected to a line near the controlled process or to the inlet of the EVR. The RSV works by using this remote sense input to carefully adjust the vacuum force applied to the pilot reference port of the EVR.

During high flow conditions, the RSV increases the vacuum force applied to the pilot reference port to open the vacuum regulator more fully. The opposite occurs during low flow conditions. This active pilot adjustment coupled with the instantaneous response of the Equilibar EVR keeps the pressure stable from the lowest flow rates to the maximum capacity of the EVR. The RSV can be integrated with any Equilibar vacuum regulator to provide improved vacuum control at a wider flow range. A remote sense pilot is useful in processes where flow rates are varying widely.

RSV SPECIFICATIONS

PORTING OPTIONS	
Vacuum Supply	¼" NPT
Remote Sense	¼" NPT
Pilot Output	¼" NPT
Automatic Bleed (in)	¼" (through filter provided)

SPECIFICATIONS	
Vacuum Supply Range	0 - 30 inHg (g)
Preferred Supply Differential	1 inHg (Supply Control)
Air Bleed	Through 0.015" orifice (2.5 SCFH or 70 liters/hour at higher setpoints)

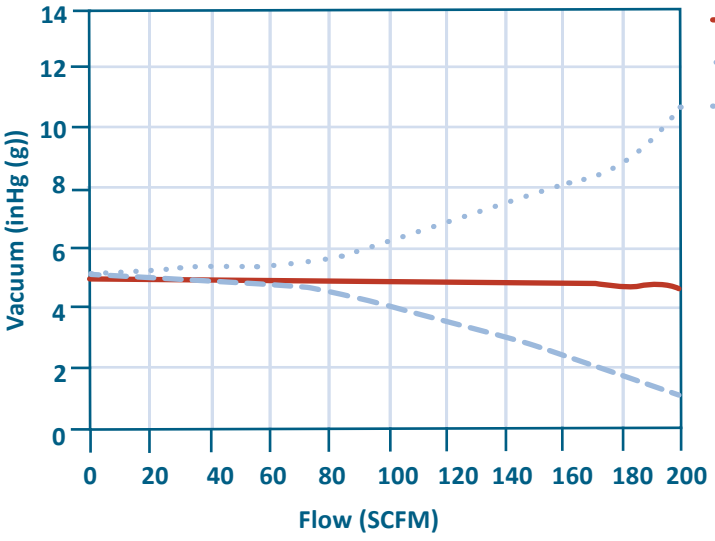
MATERIALS OF CONSTRUCTION[1]	
Body	Aluminum
Trim	PTFE, Stainless, Buna Nitrile
Springs	Steel

RSV ORDERING INFORMATION

MODEL	VACUUM CONTROL RANGE	
RSV-2-10	0.5 - 10 inHg(g)	1000 - 675 mbar(abs)
RSV-2-25	1 - 25 inHg(g)	980 - 165 mbar(abs)
Custom	Contact an application engineer	

[1] The materials of construction for the RSV are not corrosion resistant. These regulators are for use with inert, non-corrosive gases.

PERFORMANCE OF REMOTE SENSE RSV PILOT COMPARED TO STANDARD SVP PILOT



EVR-GSD4S with RSV pilot

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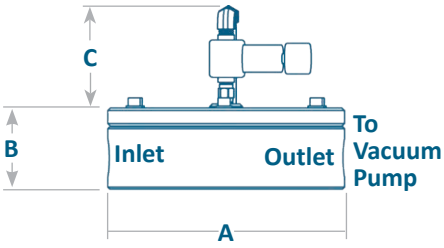
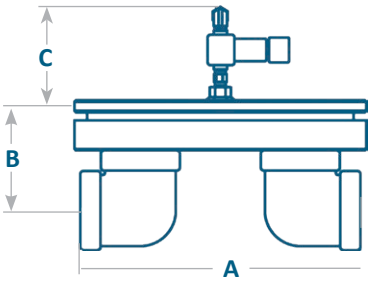
EVR Series Specifications



Ref Fig. 1: Dimensional Drawing for Regulators with Line Size ¼" to 1"



Ref Fig. 2: Dimensional Drawing for Regulators with Line Size 1 ½" to 4"

see page 7 for DIM C values

MODEL NUMBER	INLET / OUTLET PORT	STANDARD BODY MATERIALS	DIM A	DIM B	CV RANGE (PRECISION)	
			INCH (MM)		MIN[1]	MAX
	IN (DN)	REGULATORS WITH LINE SIZE ¼" TO 1" REFERENCE FIGURE 1				
EVR-GSD2A	¼" (8)	Anodized Aluminum	3 (76)	1.3 (33)	1E-03	1.2
EVR-GSD2S	¼" (8)	Stainless Steel 316	3 (76)	1.3 (33)	1E-03	1.2
EVR-GSD2P	¼" (8)	PVC	3.25 (83)	1.5 (38)	1E-03	1.2
EVR-GSD3A	⅜" (10)	Anodized Aluminum	3.5 (89)	1.4 (36)	1E-03	1.8
EVR-GSD3S	⅜" (10)	Stainless Steel 316	3.5 (89)	1.4 (36)	1E-03	1.8
EVR-GSD3P	⅜" (10)	PVC	3.75 (95)	1.6 (41)	1E-03	1.8
EVR-GSD4A	½" (15)	Anodized Aluminum	4.5 (114)	1.6 (41)	1E-03	3.2
EVR-GSD4S	½" (15)	Stainless Steel 316	4.5 (114)	1.6 (41)	1E-03	3.2
EVR-GSD4P	½" (15)	PVC	4.75 (121)	1.8 (46)	1E-03	3.2
EVR-GSD6A	¾" (20)	Anodized Aluminum	6 (152)	2 (51)	1E-02	5.5
EVR-GSD6S	¾" (20)	Stainless Steel 316	6 (152)	2 (51)	1E-02	5.5
EVR-GSD6P	¾" (20)	PVC	6.25 (159)	2.25 (57)	1E-02	5.5
EVR-GSD8A	1" (25)	Anodized Aluminum	7 (178)	2.6 (66)	1E-02	8.5
EVR-GSD8S	1" (25)	Stainless Steel 316	7 (178)	2.6 (66)	1E-02	8.5
EVR-GSD8P	1" (25)	PVC	7.25 (184)	2.9 (74)	1E-02	8.5
	IN (DN)	REGULATORS WITH LINE SIZE 1 ½" TO 4" REFERENCE FIGURE 2				
EVR-BD12A	1.5" (40)	Anodized Aluminum	9.5 (241)	3.9 (99)	1E-02	14.3
EVR-BD12S	1.5" (40)	Stainless Steel 316	7.6 (193)	3.7 (94)	1E-02	14.3
EVR-BD12P	1.5" (40)	PVC	9 (229)	4.3 (109)	1E-02	14.3
EVR-BD16A	2" (50)	Anodized Aluminum	9 (229)	4.3 (109)	3E-02	30.2
EVR-BD16S	2" (50)	Stainless Steel 316	11 (279)	4.1 (104)	3E-02	30.2
EVR-BD16P	2" (50)	PVC	11 (279)	5.1 (130)	3E-02	30.2
EVR-BD24A	3" (80)	Anodized Aluminum	12.5 (316)	5.9 (150)	6E-01	60
EVR-BD24S	3" (80)	Stainless Steel 316	13 (330)	5.3 (135)	6E-01	60
EVR-BD24P	3" (80)	PVC	15 (381)	8.8 (226)	6E-01	60
EVR-BD32A	4" (100)	Anodized Aluminum	20 (508)	8.1 (206)	1.5E-01	160
EVR-BD32S	4" (100)	Stainless Steel 316	20 (508)	8.1 (206)	1.5E-01	160
EVR-BD32P	4" (100)	PVC	20 (508)	9.6 (244)	1.5E-01	160

[1] Min Cv is dependent on diaphragm option. Contact an application engineer for specific details. Available in vacuum-only, absolute, and vacuum-to-positive options.

VACUUM RANGES
0 to 29.5 inHg (g) [1013 to 15 mbar (abs)]
0 - 10 inHg (g) [1013 to 675 mbar(abs)]
*Vacuum ranges as low as 0 to -2 in H_2O [0 to -5 mbar] Custom vacuum ranges available with electronic options. Consult an application engineer for assistance.

FITTINGS
NPT (Standard)
BSPP
SAE
150# Flange

DIAPHRAGM OPTIONS
Buna - N (Nitrile)
FKM
EPDM
PTFE (Glass Reinforced)
PTFE (Virgin)

O-RING OPTIONS
Buna - N (Nitrile)
Viton
FFKM (Kalrez or similar)
EPDM
PTFE

TEMPERATURE RATING
Polymer Units: 40°C
Metallic Units: 60°C
*High temperature models are available Consult an application engineer

Consult an application engineer for other available options.

EVR Part Number Key

This part number key explains our part numbering system and possible model options. All of our BPRs are custom-configured by our engineers based on the customer's specific application's parameters (process media, pressures, flow rates, temperature, etc.). Our engineers will request process operating parameters in order to build and quote a full part number for a suitable regulator. This chart is a reference to help understand the chosen part number.

EXAMPLE																			
EVR	-	BD	12	S	N	G	X	-	N	S	X	P	30	T	100	V	X	VVVV	-
EVR	-																		
1		2	3	4	5	6	7	-	8	9	10		11		12	13	14	15	16

1	MODEL
EVR	Equilibar Vacuum Use Regulator

2	MODEL TYPE
GSD	¼" - 1" (DN 8-25)
BD	1 ½" - 4" (DN 40-100)

3	PORT SIZE - IN (DN)
2	¼" (8)
3	⅜" (10)
4	½" (15)
6	¾" (20)
8	1" (25)
12	1 ½" (40)
16	2" (50)
24	3" (80)
32	4" (100)

4	BODY MATERIAL
S	Stainless Steel 316/316L
P	PVC
A	Anodized Aluminum

Others available. Consult an application engineer for assistance.

5	PORT CONNECTION
N	NPT
B	BSPP
F	ANSI Class 150 Flange
D	DIN EN 1092-1 Flange
O	VCO® (for port sizes 1" and smaller)
R	VCR® (for port sizes 1" and smaller)
S	SAE (for port sizes 1" and smaller)

6	RECESS
	(Factory Selected)

7	MOD #
	(Factory Selected)

8	REFERENCE PORT THREADS
N	NPT
B	BSPP

9	CAP MATERIAL (NON WETTED)
S	Stainless Steel 316 / 316L
P	PVC
A	Anodized Aluminum

Items in blue typically in stock for fast shipment

10	BOLTS
	(Factory Selected)

11	PRESSURE RATING
30	30 inHg
10	10 inHg

12	TEMPERATURE RATING
40	40°C (Polymer Units)
60	60°C (Metallic Units)

Others available. Consult an application engineer for assistance.

13	DIAPHRAGM MATERIAL
G	PTFE (Glass Reinforced)
B	Buna-N (Nitrile)
V	FKM Fluoroelastomer
M	EPDM
E	Polyethylene
F	PTFE (Virgin)
I	Polyimide

14	DIAPHRAGM THICKNESS
	(Factory Selected)

15	15	O-RING MATERIAL OPTIONS
GSD	BD	(wetted)
VV	VVVV	Viton® Shore 75 (FKM)
KK	KKKK	FFKM (Kalrez® or similar)
ZZ	ZZZZ	Markez FFKM (Number varies by grade)
FF	FFFF	PTFE
EE	EEEE	EPDM
BB	BBBB	Buna-N (Nitrile)

GSD Series regulators have 2 O-rings and BD regulators have 4.

16	SPECIAL OPTIONS
B	Mounting Bracket (Port Size 2 & 3 Only)
O	Oxygen Cleaning

PATENTS

https://www.equilibar.com/support/patents/

EVR-GSD8P with SVP1 Pilot

EVR-BD24S with SVP2 Pilot

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About Equilibar

Equilibar provides innovative and robust pressure control technology for researchers and engineers worldwide. We are proud to design, manufacture and test our patented back pressure regulators in our factory overlooking the Blue Ridge Mountains near Asheville, NC, and we are equally proud to work with clients around the world each and every day.

APPLICATION ENGINEERING – WHAT SETS US APART

Unlike mass-market regulator distributors, we focus on working with you, the scientist or engineer with a complex pressure control scenario.

Our application engineers work collaboratively with clients to identify the optimal model, trim, and diaphragm for each application's unique challenges. No matter where you are on the globe, you can stay in close contact with your engineer by email, telephone, videoconferencing or fax.

After installation, your application engineer will support you with start-up information and fine-tuning as needed.

EQUILIBAR®
PRECISION PRESSURE CONTROL

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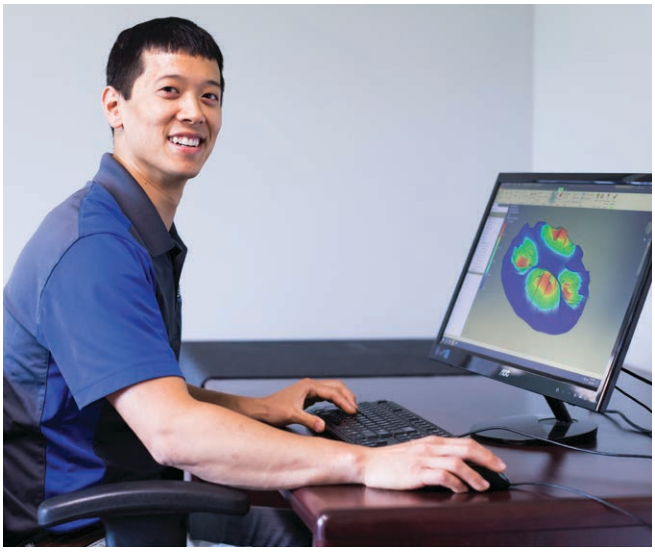
Each application is reviewed by our engineering team to ensure quality performance of our products.



Our engineers offer custom designed solutions for the most difficult pressure control challenges. Feel free to contact us to discuss your situation.

Made in the USA

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

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