

VRP-SB-PID Controller provides ZERO steady state bleed pressure control, specifically designed for power plant type pressure control and double-stage pressure cuts

Description:

The Becker Model VRP-SB-PID is a three mode, proportional-integral-derivative, controller providing pressure control when utilized with a single-acting actuated control valve or in tandem with a pneumatic positioner. The VRP-SB-PID measures process sensing pressure adjusting the signal to the positioner or actuator to maintain the pressure setpoint. The VRP-SB-PID Controller is ideal for short pressure control applications such as power plant regulation and double-stage pressure cuts with setpoints ranging from inches WC to 1300 psig. An output feedback module is added to the VRP-SB-CH design allowing the controller to respond in quickly and avoid cycling of the pressure system. The VRP-SB-PID features zero steady state bleed and is capable of receiving a back-pressure.



Figure 1.0 - Becker Model VRP-600-SB-PID pressure control system. Direct-Acting configuration shown.



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| VRP-SB-PID Applications | |
|-----------------------------------|--|
| Pressure Control | |
| Flow Control | |
| Power Plant Type Pressure Control | |
| Power Plant Type Flow Control | |
| Surge Control | |
| Compatible Actuators | |
| RPDA Series (Small Volume Models) | |
| RPDA Series (Large Volume Models) | |
| RPSR Series | |
| LPDA Series (Small Volume Models) | |
| LPDA Series (Large Volume Models) | |
| LPSR Series | |
| LD Series | |

Guidelines for Usage (Restrictions):

Short systems:

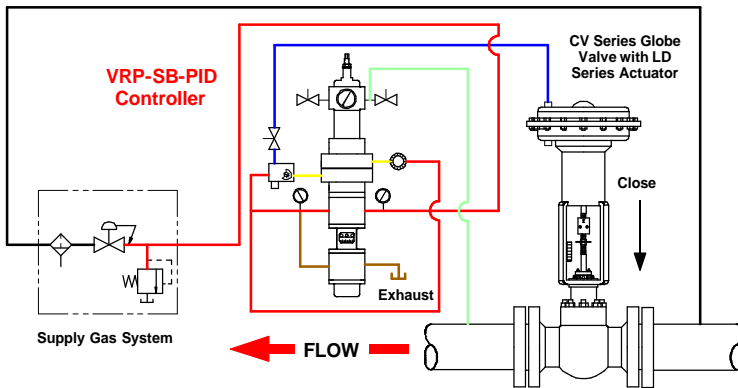
The VRP-SB-PID controller is designed for use on short systems that require a quick response. VRP-SB-PID is not recommended for large, slow systems. For systems not requiring a quick response, the VRP-SB-CH pilot should be used.

Supply pressure to spring & diaphragm actuators:

The VRP-SB-PID controller cannot be used with spring & diaphragm actuators requiring actuating pressures higher than 40 psig. The maximum supply pressure going through the VRP-SB-PID controller must be 40 psig or lower.

RPSR Actuators:

Becker VRP-SB-PID Series Controllers can only be used with RPSR actuators when the setpoint is above 70 psig. If the setpoint for a VRP-SB-PID is lower than 70 psig, an HPP series positioner must be used in conjunction with the VRP-SB-PID on RPSR actuators.



Schematic Legend:

- Sensing Pressure (P2)
- Upstream Pressure (P1)
- Exhaust (Discharge)
- Supply Gas (Regulated)
- Intermediate Pressure (Loading)
- Feedback Pressure (Derivative, Reset)

Improve Performance and Minimize Bleed Gas Emissions!

Optimum performance is achieved by pairing the VRP-SB-PID with genuine Becker control valve actuators and HPP series positioners. If you already have existing control valve actuators and positioners in service, the addition of a VRP-SB-PID can improve performance and minimize bleed gas emissions. Becker VRP-SB-PID Pilots are compatible for retrofit with most manufacturer's single-acting style actuators and positioners. Consult Becker Precision Equipment for more information.



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Figure 2.0 - VRP-SB-PID Series Controller configured for downstream pressure control

The VRP-SB-PID may be utilized directly on a spring & diaphragm actuator and globe valve combination to achieve downstream pressure control for power plants and double-stage pressure cuts. Shown here with Becker CV Series globe valve and LD Series linear actuator. The VRP-SB-PID controller is direct-acting (valve will fail open).

Benefits of the VRP-SB-PID Controller:

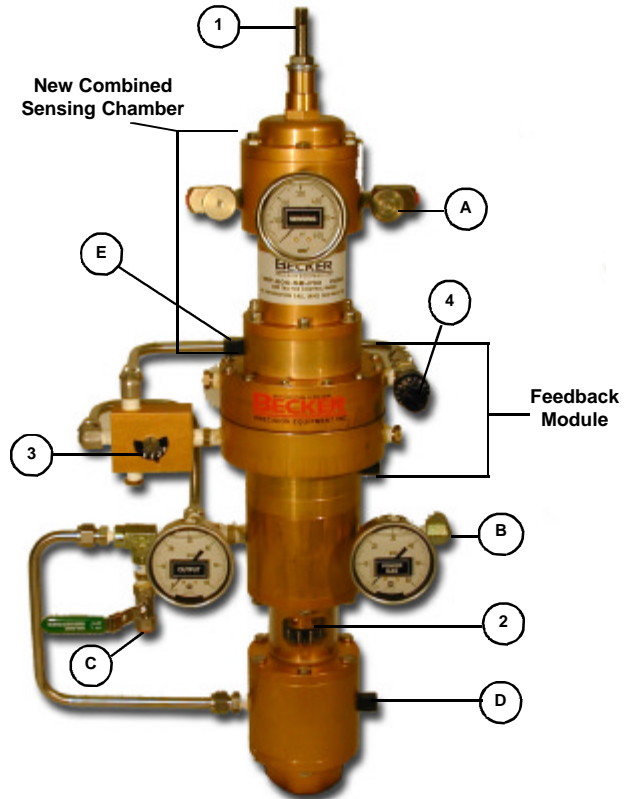
- Zero atmospheric bleed when the control valve is in steady state, full open, and full closed positions.
- Ideally suited for power plant pressure control.
- Becker's unique Bleed to Pressure System™ feature allows for complete elimination of atmospheric bleed gas by maintaining exhaust gas within the process piping.
- Sensing pressure up to 1300 psig.
- VRP-SB-PID Pilot sensitivity is $\pm 0.75\%$.
- The VRP-SB-PID has a fixed gain that is the same throughout the entire stroke of the actuator.
- Two adjustments, derivative and reset, allow for accurate and stable control of any short system.
- The VRP-SB-PID includes the combination chamber where the sensing pressure and the control spring are combined in the same chamber so that only the "net force" is transmitted to the VRP-SB-PID Body allowing greater sensitivity of the controller.
- The VRP-SB-PID control spring is totally enclosed and protected from potentially corrosive effects of the atmosphere.
- The VRP-SB-PID has a large flow capacity to directly feed large actuators eliminating the need of a positioner to act as an amplifier. The VRP-SB-PID is field configurable to a PD controller.
- Vibration resistant design will perform in the most demanding applications and maintain calibration. No annual adjustments required.
- Anodized AL 2024 Aluminum and Stainless Steel construction provide rugged durability for a long service life.
- Ideally suited for different two-stage pressure cut regulation.

Improve Performance and Minimize Bleed Gas Emissions!

Optimum performance is achieved by pairing the VRP-SB-PID with genuine Becker control valve actuators and HPP series positioners. If you already have existing control valve actuators and positioners in service, the addition of a VRP-SB-PID can improve performance and minimize bleed gas emissions. Becker VRP-SB-PID Pilots are compatible for retrofit with most manufacturer's single-acting style actuators and positioners. Consult Becker Precision Equipment for more information.



The VRP-SB-PID is ideal for power plant pressure control and double-stage pressure cuts utilizing ZERO Bleed Technology.



| VRP-SB-PID Port Definitions | Port Size | Item |
|-----------------------------|-----------|------|
| Sensing Input | 1/4" FNPT | A |
| Power Gas Supply (Input) | 1/4" FNPT | B |
| Loading (Output) | 1/4" FNPT | C |
| Exhaust (Discharge) | 1/4" FNPT | D |
| Breather Vent | 1/4" FNPT | E |

| VRP-SB-PID Adjustments | Item |
|------------------------|------|
| Setpoint Adjustment | 1 |
| Deadband (Sensitivity) | 2 |
| Derivative Adjustment | 3 |
| Reset Adjustment | 4 |

Figure 3.0- Becker Model VRP-600-SB-PID-40 pressure control system

The VRP-SB-PID is specifically designed for use in natural gas short system pressure regulation and provides a more reliable alternative to conventional controllers.

VRP-SB-PID Series Natural Gas Controller

How it Works: (Downstream Pressure Control)

VRP-SB-PID configuration shown is direct acting - VRP-SB-PID output increases on increasing sensing pressure and the control valve will be a "Fail Open" valve. If the VRP-SB-PID is signaling an HPP Series Positioner, the positioner will close the valve on increasing output pressure from the VRP-SB-PID. The energy to operate the control valve is obtained from the differential between supply gas pressure and discharge gas pressure. When the measured variable (sensing) is at setpoint the controller output remains in steady state with zero bleed. From a steady state position, an increase in the sensing pressure causes a downward net force on the sensing diaphragm. The internal pistons move down and load pressure to the actuator or positioner, closing the valve. The measured variable (sensing) returns to setpoint, and the pilot pistons center in the steady state position trapping the pressure in the actuator holding the control valve steady. If the measured variable falls below setpoint, the opposite reaction takes place, opening the valve.

In order to control how much gas passes through the balanced valve, the output pressure is fed back to the bottom side of a diaphragm within the feedback module. The feedback module incorporates derivative and reset adjustments. As the output pressure increases, the feedback pressure closes the supply valve. As the output pressure decreases, the feedback pressure

decreases, closing the exhaust valve. The feedback force is such that the output pressure will change proportionally with the deviation of the sensing pressure from setpoint, which gives the VRP-SB-PID a proportional response. By restricting the flow of the output pressure to the feedback diaphragm, a derivative function is introduced, and the feedback force is delayed. This delay allows the output to change quickly in response to quick change in the system. Slow changes in the system; however, are less affected by the derivative orifice because the output pressure has time to equalize on both sides of the orifice. If the restriction is too great, the feedback delay will be too long and the system will become unstable.

Because the change in output pressure is proportional to the deviance of the sensing pressure from setpoint, a sensing pressure that is not at the setpoint is required to maintain a particular change in output pressure. The difference between the setpoint and the maintained pressure at a particular output pressure is the "offset". This offset can be eliminated over time by introducing a reset function on the top side of the feedback diaphragm to slowly equalize with the bottom side. If the reset function causes the top side of the diaphragm to equalize with the bottom side too quickly, the feedback function providing proportionality is cancelled out and control will become unstable.

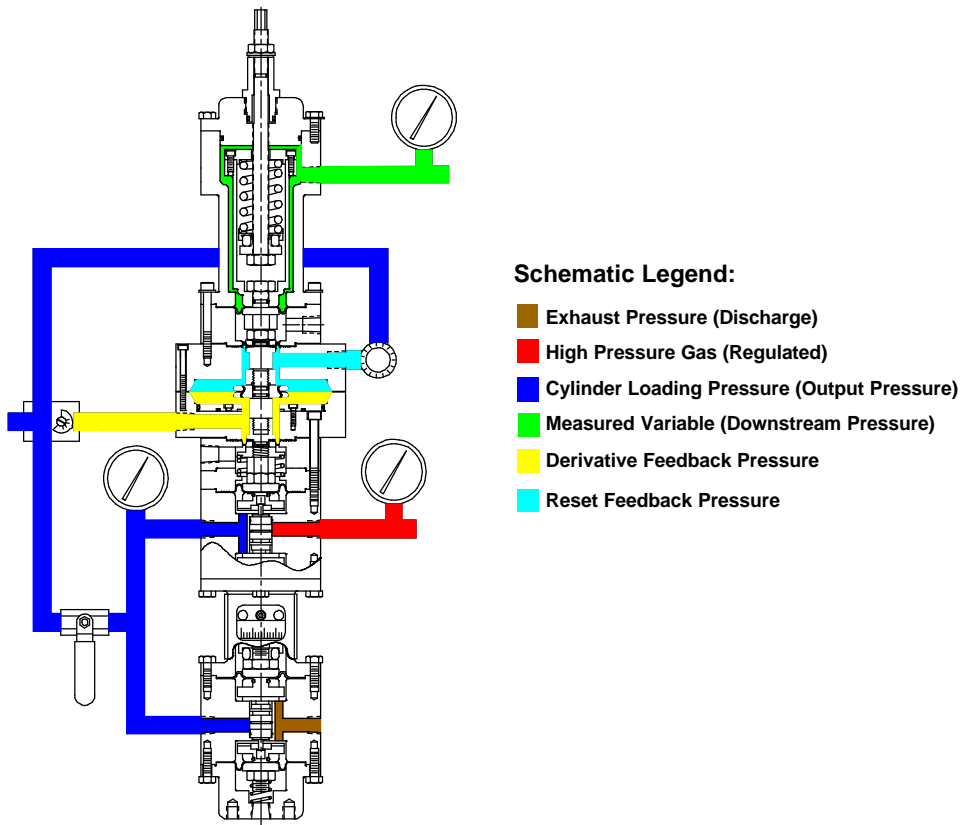


Figure 4.0 – Direct Acting VRP-SB-PID Controller

| Technical Specifications | |
|---|---|
| Steady State Gas Consumption | ZERO (see Table 2.0) |
| Supply Gas | dry, filtered (100 micron) gas |
| Maximum flow capacity | 2400 scfh (14 scmh) |
| Maximum Supply Pressure | Model specific * |
| Operative Ambient Temperature Range: | -20°F to 160°F (-29°C to 71°C) |
| Approximate Weight: | 25 pounds (9.1 kg) |
| Minimum Deadband | 0.2% instrument signal |
| Independent Linearity | ±1.0% positioning range |
| Resolution | 0.2% of setpoint |
| Control Accuracy | ± 0.75% of setpoint |
| Maximum Sensing Pressure | 1300 psig (8966 kPa) |
| Setpoint Range | 25 psig – 1300 psig (172 kPa – 8966 kPa) |
| Control Modes Available | PID & PD |
| Pressure Connections | 1/4 inch female NPT |
| Housing | meets NEMA 3 Classification |
| Installation Orientation | vertical position recommended Custom bracket supplied with Becker Actuators 2" pipe mount provided for retrofit to other manufacturer's actuators |
| Materials of Construction | |
| External Parts | anodized AL 2024 316 SS available (for marine environments) |
| Internal Parts | 316 SS and anodized AL 2024 |
| Springs | plated steel |
| Diaphragms | buna-n reinforced by nylon fabric |
| Seats and O-rings | buna-n |
| Tubing & Tubing Fittings | 316 SS |
| Gauges | 2½ inch dial liquid filled brass connection w/ stainless steel case* (standard issue with units of psig dual units of psig/kPa available) |
| Notes: 1 Direct Acting: increasing instrument signal causes control valve to open (fail closed upon loss of instrument signal) 2 Reverse Acting: decreasing instrument signal causes control valve to open (fail open upon loss of instrument signal) * Model Specific Maximum Supply Pressure: VRP-SB-PID-40 has 40 psig max. VRP-SB-PID-80 has 80 psig max. VRP-SB-PID-150 has 150 psig max. | |

Table 1.0– Specifications for Model VRP-SB-PID Controller

VRP-SB-PID 0300

| | VRP-CH Pilot | VRP-B-CH Pilot | VRP-SB-CH Pilot | VRP-SB-PID Pilot | HPP-4 Positioner | HPP-5 Positioner | HPP-SB Positioner | EFP Positioner |
|---|----------------|----------------|-----------------|------------------|------------------|------------------|-------------------|----------------|
| Bleed Rates (Consumption) | | | | | | | | |
| Steady State Bleed* | ~100 | <10 | zero | zero | ~100 | <10 | zero | zero |
| Non-Bleed Full-Open/Full Closed | Y ¹ | Y ² | Y | Y | Y ¹ | Y ² | Y | Y |
| Bleed to Pressure System (BPS™)† | Y | Y | Y | Y | Y | Y | Y | Y |
| Notes: *Bleed rates are estimated utilizing Supply Gas Pressure=100 psig (690 kPa) and are reliant upon process activity. All bleed rates are reported in standard cubic feet per hour (scfh). 1-Requires Model PS-2 or NBV Non-Bleed Device to eliminate bleed when control valve is in full-open or full-closed position 2-Requires Model DPS-2 or NBV Non-Bleed Device to eliminate bleed when control valve is in full-open or full-closed position †Bleed to Pressure System (BPS™) eliminates all atmospheric bleed emission by containing bleed gas within piping system. | | | | | | | | |

Table 2.0 - Bleed Rates (consumption) for Becker Control Instrumentation
Becker control instrumentation features low bleed and zero bleed technologies to minimize fugitive natural gas emissions and environmental impact.

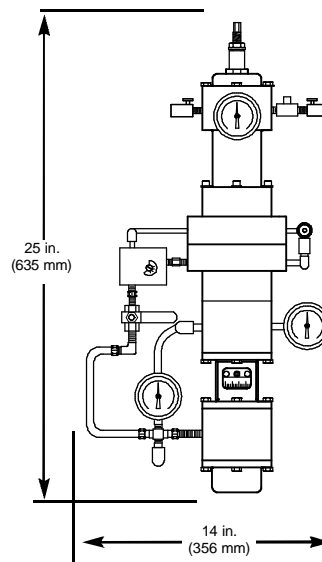


Figure 5.0 - Overall dimensions of Becker Model VRP-600-SB-PID-40 Controller (Direct Acting)

VRP-SB-PID Series Natural Gas Controller

Table 3.0-
Selection Chart for VRP-SB-PID-40 Series Natural Gas Controller

| VRP-SB-PID Model Number | Control Range (psig/kPa) | Spring Color | Part Number | Controller Coefficient, K | | | Proportional band with 3-15 psig output | | |
|-------------------------|------------------------------------|--------------|-------------|---------------------------|-----------------------|-----------------------|---|-------------------|-------------------|
| | | | | | | | | | |
| VRP-600-SB-PID-40 | 25 – 60 psig 172 – 414 kPa | Gold | 25-8236 | 0.234 psi 1.61 kPa | 0.334 psi 2.30 kPa | 0.523 psi 3.61 kPa | 51 psi 352 kPa | 36 psi 248 kPa | 23 psi 159 kPa |
| | 45 – 160 psig 310 – 1103 kPa | Beige | 25-8238 | | | | | | |
| | 70 – 195 psig 483 – 1345 kPa | Burgundy | 25-8239 | | | | | | |
| | 155 – 320 psig 1069 – 2206 kPa | Pink | 25-8240 | | | | | | |
| | 295 – 600 psig 2034 – 4137 kPa | Yellow | 25-1306 | | | | | | |
| VRP-1000-SB-PID-40 | 115-330 psig 793 – 2275 kPa | Burgundy | 25-8239 | 0.138 psi 0.952 kPa | 0.197 psi 1.36 kPa | 0.308 psi 2.12 kPa | 87 psi 600 kPa | 61 psi 421 kPa | 39 psi 269 kPa |
| | 260-540 psig 1793 – 3723 kPa | Pink | 25-8240 | | | | | | |
| | 550 – 1000 3792 – 6895 kPa | Yellow | 25-1306 | | | | | | |
| VRP-1300-SB-PID-40 | 820 – 1300 psig 5654 – 8964 kPa | Gray | 25-1562 | 0.138 psi 0.952 kPa | 0.197 psi 1.36 kPa | 0.308 psi 2.12 kPa | 87 psi 600 kPa | 61 psi 421 kPa | 39 psi 269 kPa |

Notes:
1 Refer to the VRP-SB-PID Instruction Manual for spring return ranges for the VRP-SB-PID-80 and the VRP-SB-PID-150.
2 Proportional Band= $\frac{\text{Output Range}}{K}$

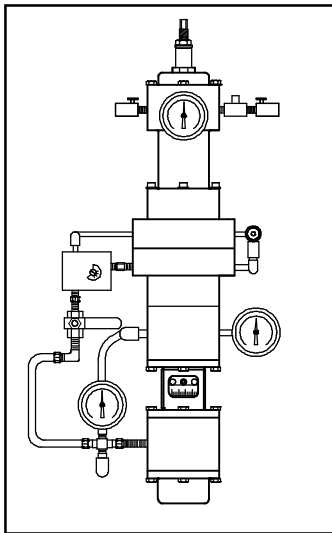


Figure 6.a
Model VRP-600-SB-PID-40
Direct Acting

Repair Kit Number 30-9306

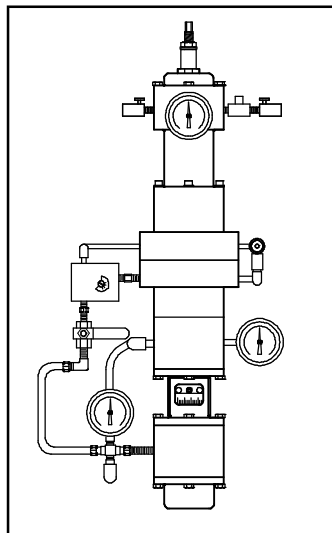


Figure 6.b
Model VRP-1000-SB-PID-40
Direct Acting

Repair Kit Number 30-9307

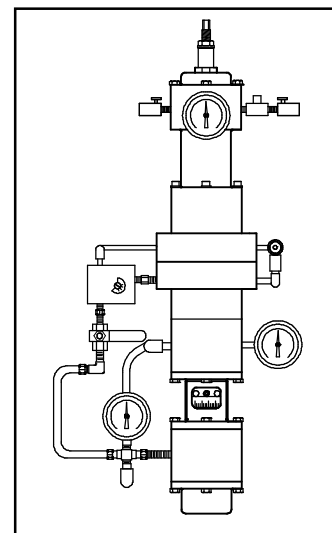


Figure 6.b
Model VRP-1300-SB-PID-40
Direct Acting

Repair Kit Number 30-9307

VRP-SB-PID Series Natural Gas Controller Accessories

Realize Optimum Performance of your VRP-SB-PID Series Controller with these popular instrumentation accessories!



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Bleed to Pressure System

All Becker control instrumentation feature the unique capability to discharge vent gas into the downstream pipeline or alternate low pressure gas system. This feature is exclusive to Becker and provides complete elimination of atmospheric bleed gas emissions.



SP Series Setpoint Pump:

Provides a simple and accurate method of applying false signal pressure during initial adjustment of the VRP-SB-PID controller. The pump can provide a false signal pressure of 20%-50% in excess of working pipeline pressure which eliminates the need for nitrogen bottles or electronic calibration devices. The SP Series Setpoint Pump is compatible with all models and series of Becker VRP-SB-PID Controllers.



RSM Series Remote Setpoint Module:

The Remote Set Point Module provides remote adjustment of VRP-SB-PID Pilot set point via an electrical input signal. All Remote Setpoint Motors are equipped with internal limit switches to prevent over-travel of setpoint. 4-20 mA feedback of Remote Setpoint Module motor is available as an option. All Becker RSM Series Remote Setpoint Modules are rated Explosion Proof Class 1, Div. 1 for use in hazardous locations. Standard RSM input signals are:

Digital Pulse Input

- 24 VDC
- 120 VAC

Analog Current Input

- 4-20 mA command signal/24 VDC Supply Power
- 4-20 mA command signal/120 VAC Supply Power



Panel Mounting

Custom panel mounting is available to suit the specific needs of your application. All panels come fully assembled, tested and adjusted per your requirements. Panel mounting simplifies retrofit of Becker instrumentation to existing equipment and ensures satisfactory performance and fit. A variety of configurations and options are available.



Stainless Steel Option

All Becker Precision Control instrumentation is manufactured from high-strength anodized aircraft aluminum alloy (AL2024). The standard aluminum construction typically will provide adequate durability in most installation environments. In applications where the installation environment is unusually harsh, the instrumentation may be specially ordered in a stainless steel option. The stainless steel option is typically utilized in the following areas:

- Marine environments
- Offshore platforms
- Chemical plants
- Coastal regions



VB Series Volume Boosters

VB Series Volume Boosters are utilized in conjunction with Becker control instrumentation to provide adequate instrumentation flow volume for larger volume piston actuators. Volume Boosters are typically only required for Ball Valve Regulators model 12T and larger. Additionally, Volume Boosters may be utilized to provide increased actuator stroking speed when applications require, such as power plant and other short system applications. As with all Becker instrumentation, Volume Boosters may be discharged into a lower pressure system to eliminate atmospheric bleed. Volume Boosters are compatible with the VRP-SB-PID Natural Gas Controller.

VRP-SB-PID Natural Gas Controller



Figure 7.a - Before—Power plant regulator with typical controller installed on a globe valve with spring & diaphragm actuator. Constant cycling of control valve and constant bleed to atmosphere. The system required a valve positioner.

Retrofit Compatibility:

Optimum performance is achieved by pairing the VRP-SB-PID with genuine Becker control valve actuators and positioners. If you already have existing control valve actuators in service, the addition of a Model VRP-SB-PID can improve performance and minimize atmospheric bleed emissions. Becker VRP-SB-PID Pilots are compatible for retrofit with most manufacturer's single-acting spring & diaphragm or spring & piston type actuators and positioners. Consult Becker Precision Equipment for assistance.

- Fisher Type 1051/1052™ Rotary spring & diaphragm type actuators
- Fisher Type 657/667™ Linear spring & diaphragm type actuators
- Welker Jet® Control Valves
- Compatible with other manufacturer's system, consult Becker for assistance
- Most manufacturer's spring & diaphragm or spring & piston style valve actuators



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Figure 7.b - After—Power plant regulator retrofit with Becker VRP-SB-PID Controller on same control valve and actuator. Stable pressure control to power plant with ZERO atmospheric bleed in steady state. The need for a valve positioner was eliminated.

Repair or Rebuild?

Becker Instrumentation rebuild kits are available from stock for regular maintenance or emergency needs. To order repair kits for your Becker products call us at (800) 323-8844, or contact your local Becker sales Representative.

**VRP-600-SB-PID Controller Rebuild Kit
Becker Part Number 30-9306**

**VRP-1000-SB-PID Controller Rebuild Kit
Becker Part Number 30-9307**

**VRP-1300-SB-PID Controller Rebuild Kit
Becker Part Number 30-9307**

Table 4.0-
Application Guidelines for
Becker Control Instrumentation*

| | VRP-CH Pilot | VRP-B-CH Pilot | VRP-SB-CH Pilot | VRP-SB-PID Pilot | HPP-4 Positioner | HPP-5 Positioner | HPP-SB Positioner | EFP Positioner | Notes |
|-------------------------------------|--------------|----------------|-----------------|------------------|------------------|------------------|-------------------|----------------|-------|
| Applications | | | | | | | | | |
| Pressure Control | • | • | • | • | • | • | • | • | 1,2 |
| Flow Control | | | | | • | • | • | • | 2 |
| Power Plant Type Pressure Control | • | | | • | • | | • | • | 3 |
| Power Plant Type Flow Control | | | | | • | • | • | • | 3 |
| Surge Control | | | | | • | | • | | |
| Compatible Actuators | | | | | | | | | |
| RPDA Series (Small Models) | • | • | | | • | • | | • | 4 |
| RPDA Series (Large Models) | • | | | | • | | | • | 5 |
| RPSR Series | | | • | • | | | • | • | |
| LPDA Series (Small Models) | • | • | | | • | • | | | 4 |
| LPDA Series (Large Models) | • | | | | • | | | • | 5 |
| LPSR Series | | | • | • | | | • | • | |
| LD Series | | | • | • | | | • | • | 6 |
| Instrumentation Options | | | | | | | | | |
| Bleed to Pressure System BPS™ | • | • | • | • | • | • | • | • | 7 |
| AB Series Atmospheric Bleed Control | • | • | • | • | • | • | • | • | |
| NBV Series No-Bleed Valve | • | • | | | • | • | | | 8 |
| DPS-2 Series Non-Bleed Sensor | | • | | | | • | | | 9 |
| PS-2 Series Non-Bleed Sensor | • | | | | • | | | | 9 |
| SP Series Setpoint Pump | • | • | • | • | | | | | |
| RSM Series Remote Setpoint Module | • | • | • | • | | | | | |
| Panel Mounting | • | • | • | • | | | | • | |
| Stainless Steel Option | • | • | • | • | • | • | • | | |
| VB Series Volume Booster | • | | • | • | • | | | | 10 |
| QEV Series Quick Exhaust Valve | | | | | • | • | • | | |
| I/P Transducer | | | | | • | • | • | | |
| SLV Series Signal Lock Valve | | | | | • | • | • | | |

- 1 Pressure Control applications include: pressure letdown, primary regulation, monitors, standby, overpressure protection. Underpressure protection and relief valves.
- 2 All Positioners require controller device to perform pressure control or flow control.
- 3 Power Plant Regulation includes all power plants and "fast-acting" short systems.
- 4 RPDA & LPDA Small Models are defined as actuator sizes 14L and smaller (<2000 in³/0.033m³)
- 5 RPDA & LPDA Large Models are defined as actuator sizes 12T and larger (≥2000 in³/0.033m³)
- 6 LD Series Actuators are limited to Becker CVE Series Globe Valves
- 7 BPS™ is limited to discharge pressure systems below 300 psig (2068 kPa). Consult Becker for application assistance.
- 8 NBV No-Bleed Valves may only be utilized when $P_{discharge} \leq 60$ psig (414 kPa) and/or $P_{supply} \leq 150$ psig (1034 kPa).
- 9 PS-2 & DPS-2 Non-Bleed Sensors must be utilized when $P_{discharge} > 60$ psig (414 kPa) and/or $P_{supply} > 150$ psig (1034 kPa).
- 10 VB Series Volume Boosters are necessary for Power Plant Regulation, Surge Control Applications, or when Large Model RPDA & LPDA Series Actuators are utilized.

***CAUTION:** This information is intended as a guideline for application of Becker Precision Equipment products. Becker strongly recommends consulting Becker Engineering prior to application of any product.



Figure 8.0– Becker VRP-SB-PID Controller on RPDA Series Actuator and HPP Series Positioner

The VRP-SB-PID and Ball Valve Regulator equipped with RPDA Double-Acting Actuator are ideal for pressure control in large volume, quick response applications such as this power plant pressure control regulator. The VRP-SB-PID will provide excellent performance in even the most demanding conditions.

Free Assistance!
(800) 323-8844

BECKER

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