BECKER
PRECISION EQUIPMENT INC.

Instruction Manual for the VRP-B-CH Valve Regulator Pilot

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Introduction

The Becker VRP-B-CH series balanced seat design, Double acting pilot represents a breakthrough in valve control technology for the natural gas industry. Built to exacting specifications, this easily maintained unit offers highly accurate control characteristics over a wide range of operating environments. When in control, in a steady state, the VRP-B-CH series pilots have a very low gas consumption rate to minimize fugitive emissions. Furthermore, the VRP-B-CH pilots are designed to allow bleed gas to be routed to a lower pressure system, or downstream, for complete elimination of bleed gas. The elimination of this expensive bleed gas ultimately saves a significant amount of money for the operating company and reduces the environmental impact of atmospheric hydrocarbons and diminishing natural resources.

Description

The Becker Model VRP-B-CH Balance seat, Double-Acting Pilot provides pressure control when utilized with a double-acting piston actuated control valve. The VRP-B-CH measures downstream sensing pressure and positions the double-acting actuator to maintain the desired downstream pressure. The VRP-B-CH Pilot may be utilized for pressure control applications with setpoints ranging from 1 psig to 1300 psig. The –CH design pilot represents Becker's commitment to continuos development of new products and updating of existing products to maximize their performance while retaining simple operation and minimum maintenance.

Scope of Manual

This manual provides information on the installation, operation, adjustment, and maintenance of the VRP-B-CH double-acting pilot.

For information concerning actuators, valves, and accessories, refer to the instruction manuals provided with the specific product.

Note: *Only those qualified through training or experience should install, operate, or maintain Becker pilots. If there are any questions concerning these instructions, contact your Becker sales representative, sales office, or manufacturer before proceeding.*

Advantages of the Combination Chamber VRP-B-CH Pilots:

1. The Spring is protected against corrosion caused by exposure to the outside weather conditions and condensation.
2. Small net force will be transferred to the pilot body resulting in negligible dead band shift when changing setpoint.
3. The Need for a flat diaphragm for some pilot models is eliminated meaning…
   - Five pilot model numbers instead of 11
   - Less trouble-shooting during assembly
4. The VRP-B pilots will have only 3 diaphragms (as opposed to 5).
5. Larger measured variable chamber volume and surface area dampens control pressure signal, helping to compensate for vibration induced by poor location of sensing tap in area of flow pulsation and turbulence
6. Number of fittings and tubing is minimized with "manifold" body design.
7. Sensing gauge is brought up to eye level.
8. Control springs can be replaced without disturbing any diaphragms.
9. Springs are guided by the outside resulting in less likelihood of friction from poorly aligned spring.
10. The accuracy of pilots is guaranteed to be ±3/4 %.

Applications

- Primary Pressure Control
- Overpressure Protection (Monitor)
- Underpressure Protection (Standby)
- Relief Valve
- Backpressure Control
- When Unique "Bleed to Pressure System" **BPS**™ feature can be utilized
- Any large downstream systems (city gate stations, inter-system pressure limiting)
- Suction control to reciprocating compressors*

* (consult Becker for additional information)

Guidelines for Usage

Large downstream systems-
City gate stations, inter-system pressure limiting, overpressure protection for custody transfer stations, and mainline relief valve applications are all suited to this pilot.

No “Low” pressure available-
The low steady state consumption of the pilot makes it a first choice for any pressure control application covered above in which the downstream pressure exceeds 300 psig and there are no alternative pipeline systems nearby operating below 300 psig as well. Without a system to “dump” the pilot bleed gas, the VRP-B-CH makes an exceptional choice since it bleeds <10 scfh while in control at steady state.

The Becker BPS® Bleed to a pressure system may be utilized with the Becker VRP-B pilot. When adjusted to bleed to a pressure system, the VRP-B-CH sensitivity is set up to open the internal balance valves for further control accuracy. This adjustment places the gas consumption rate of the VRP-B-CH pilot equal to that of the VRP-CH pilot.

Compatible Actuators:

- Becker RPDA Actuators (Rotary Piston Double-Acting)
- Becker LPDA Actuators (Linear Piston Double-Acting)
- Other manufacturer’s double-acting piston actuators*
  *consult Becker for additional information

Retrofit Compatibility:
Optimum performance is achieved by pairing the VRP-B-CH with genuine Becker control valve actuators. Should you already have existing control valve actuator(s) in service, the addition of a Model VRP-B-CH can improve performance and minimize atmospheric bleed emissions.
Some Compatible Actuators:

- Bettis T-Series Piston Actuators
- Rotork Series XX Actuators
- Fisher Type 470 Piston Actuators
- Fisher Type 1061 Piston

Technical Assistance

Should you have any questions, contact your local Becker Precision sales representative or Becker Precision technical assistance at:

Becker Precision Equipment, Inc.
Attn: Technical Assistance
950 Pratt Boulevard
Elk Grove Village, IL 60007 USA
Toll Free: (800) 323-8844
Tel: (847) 437-5940
Fax: (847) 437-2549
E-mail: Becker@bpe950.com
Website: www.bpe950.com

Technical Specifications

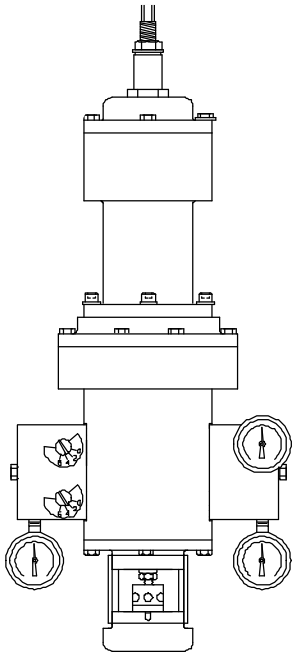
Steady State Gas Consumption	<10 scfh when bleeding to atmosphere When bleeding downstream, see con-
Supply Gas	dry, filtered (100 micron) gas
Maximum flow capacity	850 scfh (24 scmh)
Maximum Supply Pressure	400 psig (2758 kPa)
Maximum Supply-Discharge Differential	150 psig (1034 kPa)
Minimum Supply-Discharge Differential	50 psig (348 kPa)
Operative Ambient Temperature Range:	-20°F to 160°F (-68°C to 256°C)
Approximate Weight:	12 pounds (5.4 kg)
Minimum Deadband	0.2% instrument signal
Control Accuracy	**± 0.75% of setpoint**
Maximum Sensing Pressure	**1300 psig**
Setpoint Range	1 psig – 1300 psig 10 kPa – 8966 kPa
Housing	meets NEMA 3 Classification
Installation Orientation	vertical position recommended Custom bracket supplied with Becker Actuators 2" pipe mount provided for retrofit to other

Materials of Construction

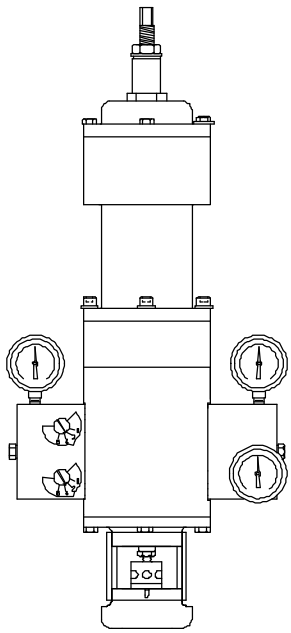
External Parts:	anodized AL 2024 316 SS available
Internal Parts:	316 Stainless Steel and 2024 Anodized Aluminum
Springs	plated steel
Diaphragms:	Buna-N with Nylon Reinforcement
Seats and O-Rings:	Buna-N
Tubing & Tubing Fittings:	316 Stainless Steel
Gauges:	2½ inch dial liquid filled brass connection w/ stainless steel case* (standard issue with units of psig-

Model Number Explanation

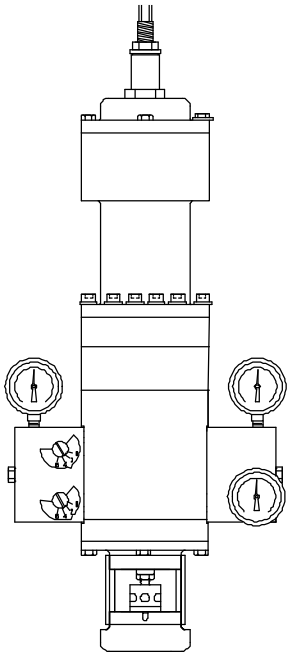
- *The VRP-B-CH pilot is available in four different models to cover sensing pressures from 1 psig to 1300 psig.*
- *The number expressed in the VRP model designation is the maximum sensing pressure (for example, a VRP -B-600-CH has a maximum sensing pressure of 600 psig).*



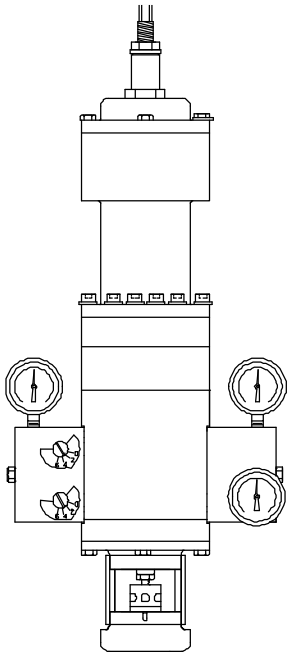
VRP-B-175-CH



VRP-B-600-CH



VRP-B-1000-CH



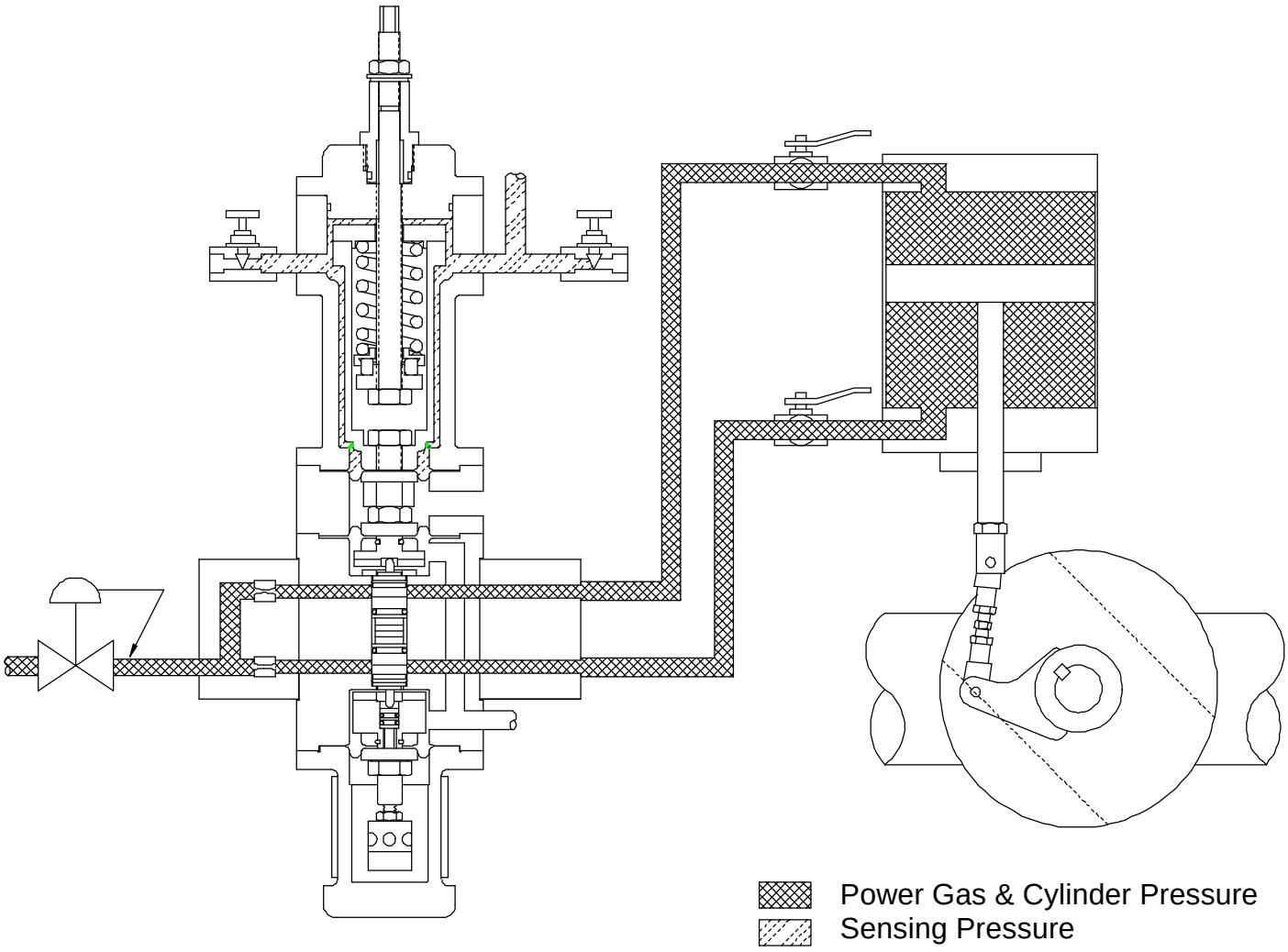
VRP-B-1300-CH

VRP-B-CH Model Number	Control Range (psig/kPa)	Spring Color	Part Number	Setpoint change per revolution of setpoint screw	Repair Kit Part Number	Setpoint Range Discreet remote control (SM-1100)	Setpoint Range Analog (4-20MA) remotel (SM-1000)
VRP-B-175-CH*	1 – 10 psig 6.9 – 69 kPa	Gold	25-8236	0.57 psig 3.9 kPa	30-9102	3.1 psig 21 kPa	9 psig 62.1 kPa
	7 – 30 psig 48 – 207 kPa	Beige	25-8238	2.0 psig 13.7 kPa	30-9102	11 psig 75.8 kPa	23 psig 159 kPa
	15 – 50 psig 103 – 345 kPa	Burgundy	25-8239	3.0 psig 21 kPa	30-9102	16.5 psig 114 kPa	35 psig 241 kPa
	20 – 85 psig 138 – 596 kPa	Pink	25-8240	6.4 psig 44 kPa	30-9102	35.2 psig 243 kPa	65 psig 448 kPa
	50 – 175 psig 345 – 1207 kPa	Yellow	25-1306	23 psig 157 kPa	30-9102	125 psig 862 kPa	125 psig 862 kPa
VRP-B-600-CH	5– 40 psig 34 – 276 kPa	Gold	25-8236	2.1 psig 14.6 kPa	30-9104	11.5 psig 79 kPA	35 psig 241 kPa
	25 – 140 psig 172 – 965 kPa	Beige	25-8238	7.4 psig 51 kPa	30-9104	41 psig 283 kPa	115 psig 793 kPa
	50 – 175 psig 345 – 1207 kPa	Burgundy	25-8239	11.3 psig 78 kPa	30-9104	62 psig 427 kPA	125 psig 862 kPa
	135 – 300 psig 931 – 2069 kPa	Pink	25-8240	24 psig 164 kPa	30-9104	132 psig 910 kPA	165 psig 1138 kPa
	275 – 600 psig 1896 – 4137 kPa	Yellow	25-1306	85 psig 586 kPa	30-9104	425 psig 2930 kPa	425 psig 2930 kPa
VRP-B-1000-CH	550 – 1000psig 3792 – 6895 kPa	Yellow	25-1306	143 psig 990 kPa	30-9105	700 psig 4826 kPA	700 psig 4826 kPa
VRP-B-1300-CH	800 – 1300 psig 5516 – 8964 kPa	Gray	25-1562	227 psig 1565 kPa	30-9105	900 psig 6205 kPa	900 psig 6205 kPa

*These models should only be used for applications that require high gain. Consult Becker prior to selecting these models

Remote Setpoint Change Options

- The SM-1000 series motors accept a 24 VDC or 120 VAC input. The SM-1100 series motors accept a 4-20 MA signal and require a separate 24 VDC or 120 VAC power connection.
- The total motor rotation is adjustable. The maximum number of motor rotations possible coupled with the spring rate determines the total setpoint range.



Principles of Operation

The Becker VRP-B-CH pilot and double-acting cylinder actuator can be used in conjunction with varying valve types to provide a complete package for stable, accurate pressure control over a wide range of applications. The energy for control valve operation comes from the pressure differential between the pilot supply and discharge pressures.

The power gas channels through two adjustable orifices which feed the top and the bottom portion of the cylinder independently.

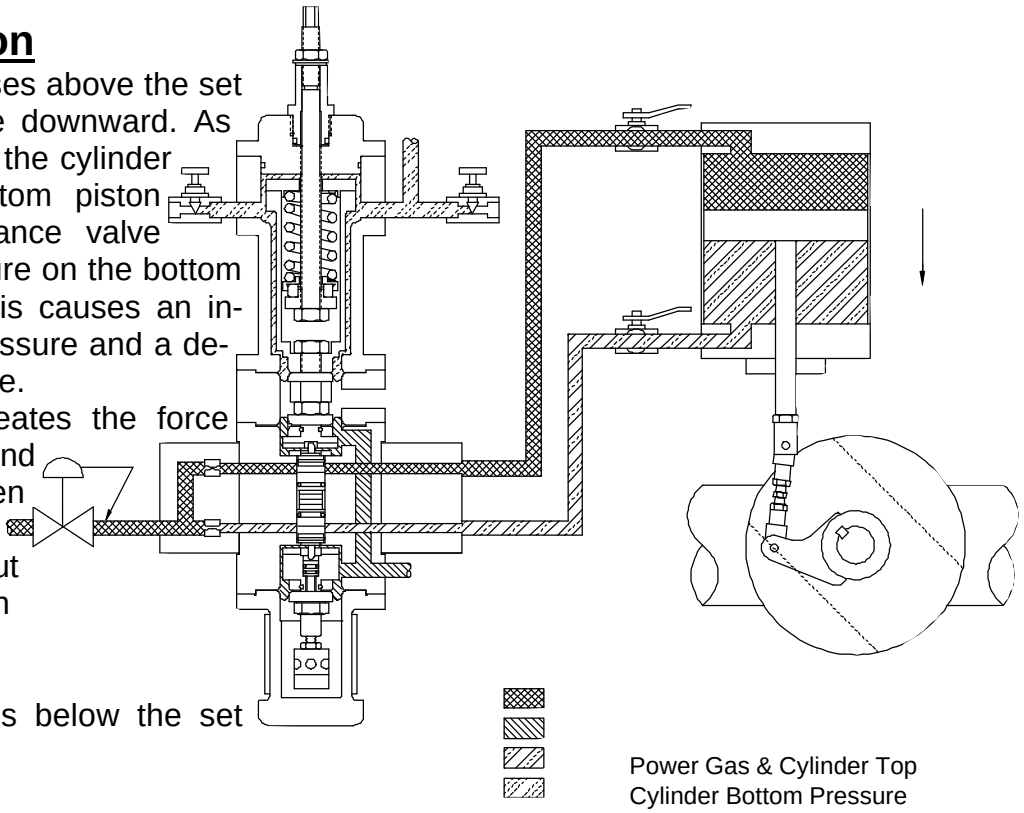
Both sides of the actuating cylinder are under full power gas pressure at steady state since both balanced valves are closed.

When the sensing pressure resides within the pilot deadband region, bleed gas is virtually eliminated. The pilot therefore operates on the design concept of a deadband within which a non-bleeding, forces balanced state is achieved. Deadband can be defined as the amount of change necessary in the sensing pressure to the pilot to create a change in the output pressure to the cylinder.

Principles of Operation

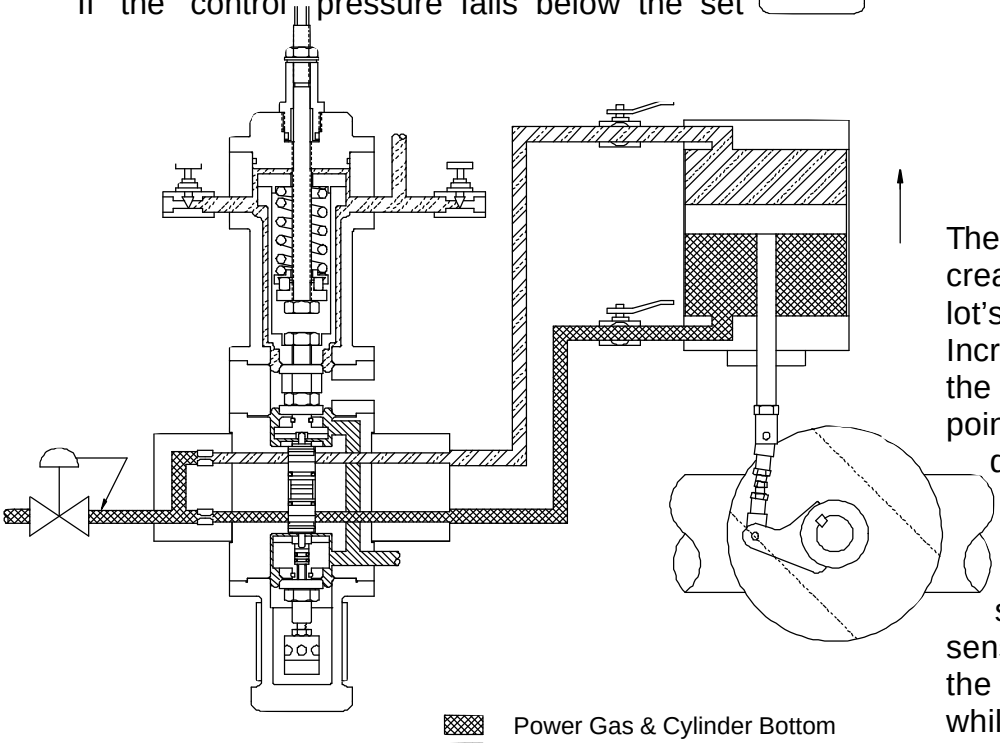
When the control pressure rises above the set point, the pilot pistons move downward. As the top inside piston unloads the cylinder top balance valve, the bottom piston moves away from the balance valve plunger and maintains pressure on the bottom of the actuator cylinder. This causes an increase in cylinder bottom pressure and a decrease in cylinder top pressure.

The pressure differential creates the force needed to close the valve and lessen the flow of gas. When the control pressure returns to the set point, the pilot output pressures automatically return to power gas at the new valve position.



Power Gas & Cylinder Top
Cylinder Bottom Pressure
Exhaust

If the control pressure falls below the set



Power Gas & Cylinder Bottom
Cylinder Top Pressure
Exhaust

The deadband region can be increased and decreased with the pilot's sensitivity adjustment drum. Increasing the deadband increases the pilot's error in controlling setpoint. Decreasing the deadband reduces the error, with the tradeoff of increasing bleed gas. Therefore, deadband is adjusted to produce an adequate pilot response to a small change in sensing pressure, while producing the minimum amount of bleed gas while the pilot is in a steady state.

The variable orifices provide tuning of the stroking speed of the actuator. Increasing the variable orifice number increases the stroking speed. The two separate orifices allow tuning in both directions to match the pilot response to a wide variety of valves and operating systems.

Adjustment Procedure

Your VRP-B-CH pilot will come factory adjusted for your particular application. The use of the adjustment procedures will be necessary upon installation of a rubber goods replacement kit or any other disassembly or reassembly of the pilot.

The sensitivity adjustment drum in the center of the pilot determines the sensitivity of the unit.

The set point adjustment screw determines the set point at which the pilot operates.

The variable orifices determine the response speed of the pilot.

Initial Adjustment

1. Adjust the supply regulator:

Adjust the supply regulator to the desired Power Gas pressure. Refer to the original invoice paperwork supplied with the product for the appropriate Power Gas pressure setting. It is imperative that adequate supply gas pressure be supplied to the VRP-B-CH in order to ensure proper

2. Adjust the adjustable orifices:

The adjustable orifices are utilized to control the volume of gas that is supplied to the VRP-B-CH. The stroking speed of the system is proportional to the numerical value of the adjustable orifice. Adjustable orifice settings are typically equal for both orifices. However, a few applications may require unequal settings for each adjustable orifice. Set both orifices according to the table A below if pilot bleeds to atmosphere and Table B is pilot bleeds to pressure system

Notes:

- To determine the cylinder bore, look at the model number stamped on the stainless steel tag on the top of the cylinder. The cylinder bore will be the first number following the first capital letter “H”. This one or two digit number following the first “H” will be the diameter in inches and will be followed by another letter (For example, a unit with the model number 6H8F6FG-PCH has an 8" bore).
- If equipped with a DPS sensor and/or AB-control, see page 20

Table A – Exhaust vented to Atmosphere

SUPPLY PRESSURE (psig)	CYLINDER BORE (IN.)						
	4	5	6	8	10	12	14
	VARIABLE ORIFICE NUMBER						
Up to 50	3	3	3	4	4	5	6
51-200	2	2	3	3	4	5	5
201-600	2	2	2	3	3	4	5

Table B – Exhaust vented to Pressure System

SUPPLY PRESSURE (psig)	CYLINDER BORE (IN.)						
	4	5	6	8	10	12	14
	VARIABLE ORIFICE NUMBER						
Up to 50	3	3	3	4	4	5	6
51-200	4	4	4	5	5	6	6
201-600	2	2	2	3	3	4	5

3. Disable DPS-2 Series Non Bleed Sensor (if equipped):
The DPS-2 Non Bleed Sensor should be disabled prior to commencing initial adjustment procedures. Failure to disable the DPS Non Bleed Sensor may prevent initial adjustments from being completed properly. To disable the DPS-2 Series Non Bleed Sensor(s) rotate the adjustment screw of the DPS-2 until it extends approximately 1.75" from the top surface of the DPS-2 spring cartridge.

4. Disable AB Series Atmospheric Bleed Control (if equipped):
The AB Series Atmospheric Bleed Control should be disabled prior to commencing initial adjustment procedures. Failure to disable the AB Control may prevent initial adjustments from being completed properly. To disable the AB Control rotate the adjustment screw of the AB Control until it disengages. Then, tighten the nut on the AB Sensor adjustment screw to seal threads on the cap

5. Close cylinder block valves:
Closing the cylinder block valves will isolate the VRP-B-CH from the control valve actuator. This prevents unintended stroking of the control valve and simplifies setting the VRP-B-CH.

6. Close the valve on the sensing line:
It is imperative that a full-sealing valve be installed as close to the sensing port of the VRP-B-CH as possible. The volume of gas between the VRP-B-CH sensing port and the block valve on the sensing line should be minimized. It is also imperative that the fittings between the VRP-B-CH Sensing port and the Sensing line block valve be bubble tight in order to facilitate adjustment. It is recommended that a quarter-turn (locking) ball valve be utilized to isolate the VRP-B-CH Sensing line.

Confirm that the VRP-B-CH Exhaust (discharge) line is open. The discharge line is connected to the port marked "EX". Should flow from the Exhaust port be blocked, adjustment of the VRP-B-CH will not be possible.

7. Initialize the Sensitivity Adjustment:
Turn the sensitivity adjustment drum to the left (increasing numbers on the scale) as far as it will turn. Then turn it one (1) complete rotation to the right (decreasing numbers on the scale).

8. Apply a "False Signal" to the Sensing port of the VRP-B-CH:
The "False Signal" pressure should be equivalent to the desired setpoint pressure. Refer to the original invoice paperwork supplied with the product for the appropriate Setpoint pressure setting. If the adequate gas pressure is not available from the pipeline, A nitrogen bottle with regulator may be utilized to introduce the proper "False Signal" pressure. Additionally, an SP Series Setpoint Adjustment Pump may be utilized to provide a false signal pressure above the available pipeline gas pressure.

Note: It is recommended that a calibrated pressure gage be utilized to ensure accuracy of the "False Signal" pressure.

9. Adjust the Setpoint Adjustment Screw:
Turn the Setpoint Adjustment screw on top of the VRP-B-CH unit until Cylinder Top and Cylinder Bottom pressure gauges show equal pressure. Clockwise rotation decreases Cylinder Bottom pressure. Turn Setpoint Adjustment only when pressures are not equal.

Note: For pilots venting to atmosphere in control, continue, otherwise, skip forward to the adjustment section for pilots bleeding to a pressure system.

10. **Final Sensitivity Drum Adjustment**
Turn the Sensitivity Adjustment to set the Cylinder Top and Cylinder Bottom equal to power gas pressure. When equal, the exhaust port should stop bleeding gas. If not, turn the sensitivity adjustment drum to the left (increasing numbers) until the exhaust port just stops bleeding.

11. To check the deadband, turn the setpoint adjustment screw clockwise until the cylinder bottom pressure just drops off. Than turn the setpoint adjustment screw counterclockwise until the cylinder top pressure just drops off. Keep track of the total rotation of the screw. Now place the setpoint adjustment screw in the middle of this rotation.

Turn the sensitivity adjustment drum to the right (decreasing numbers) until the exhaust port just starts bleeding gas. Check the total deadband again and repeat this process until the deadband is eliminated and the following criteria is met:

With a 3/4 percent change in the sensing pressure (above and below setpoint), the cylinder top and cylinder bottom pressure should develop a pressure differential equivalent to 20% of power gas.

The following is an example…
Power gas = 100 psig
Orifice #3 top, #3 bottom
Setpoint = 400 psig
With a change of the sensing pressure to 403 psig, the cylinder top pressure should drop at least 20 psig.
With a change of the sensing pressure to 397 psig, the cylinder bottom pressure should drop at least 20 psig.

If the Pilot sensitivity is greater than this, bleed gas may further be reduced by turning the ing the sensitivity again to insure the pilot meets the minimum criteria.

For VRP-B-CH pilots bleeding to a pressure system
10. Leave the pilot vent port attached to the system it normally discharges to and insure this discharge line is open. The Pilot is properly adjusted when both gauges are equal at the pilots desired setpoint, the cylinder pressure are set at 90% of the power gas, and any movement to the adjustment drum causes an immediate response from the pilot output gauges. Skip to 12 below.

12. Verify "False Signal":
Upon achieving setpoint, inspect the gage which measures the "False Signal." If the "False Signal" has deviated, readjust it to attain proper pressure. Remember that the "False Signal" applied to the VRP-B-CH Sensing port should be equivalent to the desired pressure setpoint of the pilot. Upon readjustment of the "False Signal" repeat step 11 until setpoint is achieved.

13. Remove "False Signal" Pressure from Sensing port of VRP-B-CH.

14. Open valve on sensing line.

15. Open cylinder block valves:
Opening the cylinder block valves will reestablish communication between the VRP-B-CH and the control valve actuator and put the system back into service. Exercise caution when putting the VRP-B-CH into service to prevent unintended closure/opening of the valve.

Regulator is now ready for service.
The Initial Adjustments are utilized to set the VRP-B-CH at a point approximating the desired setpoint. In order to achieve optimum accuracy of setpoint and sensitivity, the Fine

Fine Tuning Procedures

To Change the VRP-B-CH Setpoint only:
In the case where the VRP-B-CH only requires a change in setpoint only, the Setpoint Adjustment may be rotated to achieve a new setpoint while the VRP-B-CH is in service. No other adjustments need to be made. Becker recommends noting the Setpoint change per revolution of the Control Spring installed in the pilot. Setpoint change per revolution of the Control Spring can be found in the table on page 5 of this manual.

To change the VRP-B-CH Sensitivity:
In the event that the VRP-B-CH requires a change in to the Sensitivity Adjustment, the Setpoint Adjustment will also require adjustment. Any changes in the Sensitivity Adjustment affect the Setpoint Adjustment. A decrease (higher numbers) in the Sensitivity of the pilot, will require the Setpoint Adjustment to be decreased. An increase (lower numbers) in the Sensitivity of the pilot, will require the Setpoint Adjustment to be increased.

Once adjusted, the Becker VRP-B-CH pilot typically requires very little or no readjustment.

Troubleshooting

Control problems generally fall into one of the following three categories:

1. **Regulator is too sensitive:** Position of the regulator will change frequently while control pressure is stable.
2. **Regulator is not sensitive enough:** Control pressure fluctuates while position of the regulator does not change (or changes very little).
3. **Regulator is lagging behind changes in the control pressure:** The control pressure fluctuates while the regulator is constantly changing its position.

Case # 1 Regulator is too sensitive:
Turn the sensitivity adjustment drum to the left (Increasing numbers on the scale) by small increments. Typically good control is achieved within one or two divisions on the sensitivity adjustment drum.

WARNING: Do not turn the sensitivity adjustment drum to the left (Increasing numbers on the scale) more than one full turn (11 numbers) from the initial adjustment position. While certain VRP models will become insensitive on even minimal rotation, turning more than one full turn will guarantee excessive deadband on any VRP model.

Case # 2 Regulator is not sensitive enough:
The pilot should be able to meet the response criteria as described in the adjustment section (20% change in output differential with a 3/4% change in sensing pressure). If this adjustment does not produce satisfactory results, most likely the control valve torque has elevated. To further improve sensitivity, the control valve must be lubricated. See the Becker Ball valve regulator maintenance manual for information on how to service the Becker con-

Troubleshooting (Continued)

Case # 3 Regulator is lagging behind changes in the control pressure:
Increase both inlet orifice settings. This will cause the regulator to move faster. Turn the sensitivity adjustment drum to the left (Increasing numbers on the scale) in order to maintain the desired cylinder top and cylinder bottom pressures. Finally, turn the set point adjustment screw clockwise to increase the set point for the original desired pressure. Changing the set point will not change the sensitivity.

If the simultaneous increase of both adjustable orifices did not produce the desired result (i.e. the regulator is still unstable) it is necessary to set the adjustable orifices to open and close at different rates. This can be achieved by doing the following:

1) Open both adjustable orifices to #6 and note the total swing of the regulator. Leave the top adjustable orifice (controlling the opening speed of the regulator) at #6, and reduce the bottom adjustable orifice (controlling the closing speed of the regulator) to #3. If the swing has stopped, or at least reduced, the direction of speed adjustment is correct (the closing speed should be smaller than the opening speed). In order to find the optimum setting, try several combinations of adjustable orifice settings.
2) If the swing of the regulator has increased, change the direction of speed adjustment. Reduce the top adjustable orifice (controlling opening speed of the regulator) to # 3, and increase the bottom adjustable orifice to #6.
3) If stability of the unit cannot be achieved through different adjustable orifice setting combinations, the gain of the pilot is too high. Leave the adjustable orifices at the setting combination which generates the smallest swing. Turn the sensitivity adjust--ment drum to the left (decreasing numbers on the scale) by small increments until the stability is achieved.
4) Finally, turn the set point adjustment screw clockwise to increase the set point. Changing the set point will not change the ad-

Inspection Procedure

As with all precision equipment, it is necessary to periodically test the pilot to insure optimum performance. We recommend the following procedure once a year

1. Close the cylinder block valves in order to prevent the control valve from moving.
2. Close valve on the sensing line
3. Shut off supply pressure and bleed down at pilot. Note the settings of the adjustable orifices before removing them from the orifice assembly. Remove adjustable orifices and clean then thoroughly. Reinstall using new o-rings, being sure to install each orifice into the hole from which it was removed (the orifice and block have matching numbers for this purpose). Reset adjustable orifices to original settings
4. Turn on supply pressure.
5. Check the integrity of the pilot balance valve seats by changing the sensing pressure 3/4% above and below the pilot setpoint. One cylinder pressure gauge should drop to 20% less than power gas when the pressure is raised. At setpoint the bleed gas should be minimal. If the exhaust port does bleed gas, you should be able to stop the venting by turning the adjustment drum a couple of numbers to the left. If the venting gas will never shut off with both gauges balanced and reading full power gas pressure, the balance valve seats are worn. Failure to stop venting supply pressure is a sign of a worn pilot seat. Shut off Power gas supply, bleed off all remaining pressure , and rebuild pilot according to procedure in Assembly section.

Inspection Procedure (cont.)

6. Reinstate power gas and soap test around all diaphragms, vents and orifice assembly. Unless a leak is found, it is not necessary to disassemble the pilot. If any leaks are found around the diaphragms, all rubber goods must be replaced.
7. Apply a “False signal” pressure to the sensing chamber. Observe operation of the gauges. If any gauges are defective, replace them.
8. Perform the internal friction test
9. Readjust the VRP-B-CH pilot if necessary.

Internal Friction Test

Friction may occur if the diaphragms were not centered properly during installation or dirt has accumulated inside the pilot. To test for this friction...

1. Adjust the pilot using the initial adjustment procedure.
2. With both cylinder output gauges balanced, turn the adjusting screw slightly clockwise to decrease cylinder bottom pressure. Once the pressure reading on the gauge stops falling, turn the screw back in the opposite (counterclockwise) direction. The gauge arrow should immediately reverse.
3. Follow the reverse procedure on the cylinder top gauge.
4. If either of the gauge needles dip first before climbing, the pilot has friction and

VRP-B-CH Series Double-Acting Pilot Annual Maintenance Checklist

Refer to Inspection Procedure on page 13 of Operations Manual VRP-B-CH Series Double-Acting Pilot

1. _____ Clean and inspect Adjustable Orifice Assemblies. Refer to Number 3, Page 13

2. _____ Soap test all diaphragm mating surfaces and Adjustable Orifice Assembly to check for leaks. Refer to Number 6, Page 13

4. _____ Replace rubber goods utilizing Becker Model VRP-B-CH Pilot Seal Kit if necessary. See the Assembly Instruction Manual for the VRP-B-CH Series Double-Acting Pilot.

5. _____ Confirm Power Gas Supply Pressure is correct. Refer to original Becker invoice paperwork for proper power gas setting.

6. _____ Check sensitivity of VRP-B-CH Pilot. Confirm proper adjustment. Refer to Adjustment Procedure, Step 11, Page 10

7. _____ Observe operation of gages and replace if defective.

8. _____ Perform Internal Friction Test Refer to Internal Friction Test, Page 13

9. _____ Inspect and verify proper operation of all VRP-B-CH accessories. Refer to technical manual included with each specific instrumentation accessory for further instruction.

Note: It is not necessary to replace any rubber goods in Becker Precision Equipment instrumentation or instrumentation accessories on a regular basis. However, common practice suggests that replacement of rubber goods on a 5-year cycle basis provides adequate preventative maintenance.

Parts Ordering

The following is provided to allow the ordering of replacement parts. Please specify the Becker instrument serial number when ordering parts (this can be found on the Stainless Steel tab attached to the pilot by the 7/16 hex head cap screws. If the instrument was supplied as a complete valve regulator package, the Stainless tag attached to the actuator piston can also provide the serial number. See Drawing #30-0110

Key	Description	Part No.
1	1/2-20 Jam Nut	98-3056
2	Seat Cover	35-1519
3	Orifice Assembly	35-1015
4	1/4-20 x 2-1/2 HHCS	98-3180
5	Inside Piston	30-7004
6	¼-28 Jam Nut	98-3214
7	Adjusting Drum	35-1520
8	Lexan Cover	25-1034
9	Outside Piston	35-1506
10	10-32 x 3/8 FHMS	98-2684
11	3/16-1/2 Roll Pin	98-3089
12	O-Ring -012	95-2615
13	Gauge Manifold	35-1013
14	Valve Adjusting Screw	35-1517
15	Washer	25-1016
16	Pilot Base	30-7005
17	8-32 x ½ SHCS	98-2614
18	Pilot Post	35-1521
19	Spacer	35-1526
20	8-32 x 1” SHCS	98-3144
21	1/4-20 x 3/4 HHCS S.S.	98-3137
22	Diaphragm w/ Convolute	25-1027
23	5-40 x 1/4 SHCS	98-2629
24	Double Pilot Body	35-1504
25	Seat Assembly	01-7082
26	Balance Valve assembly	35-1510
27	O-Ring -010	95-2609
28	#10 Lockwasher	98-3178
29	Strainer for Balance valve	35-1559

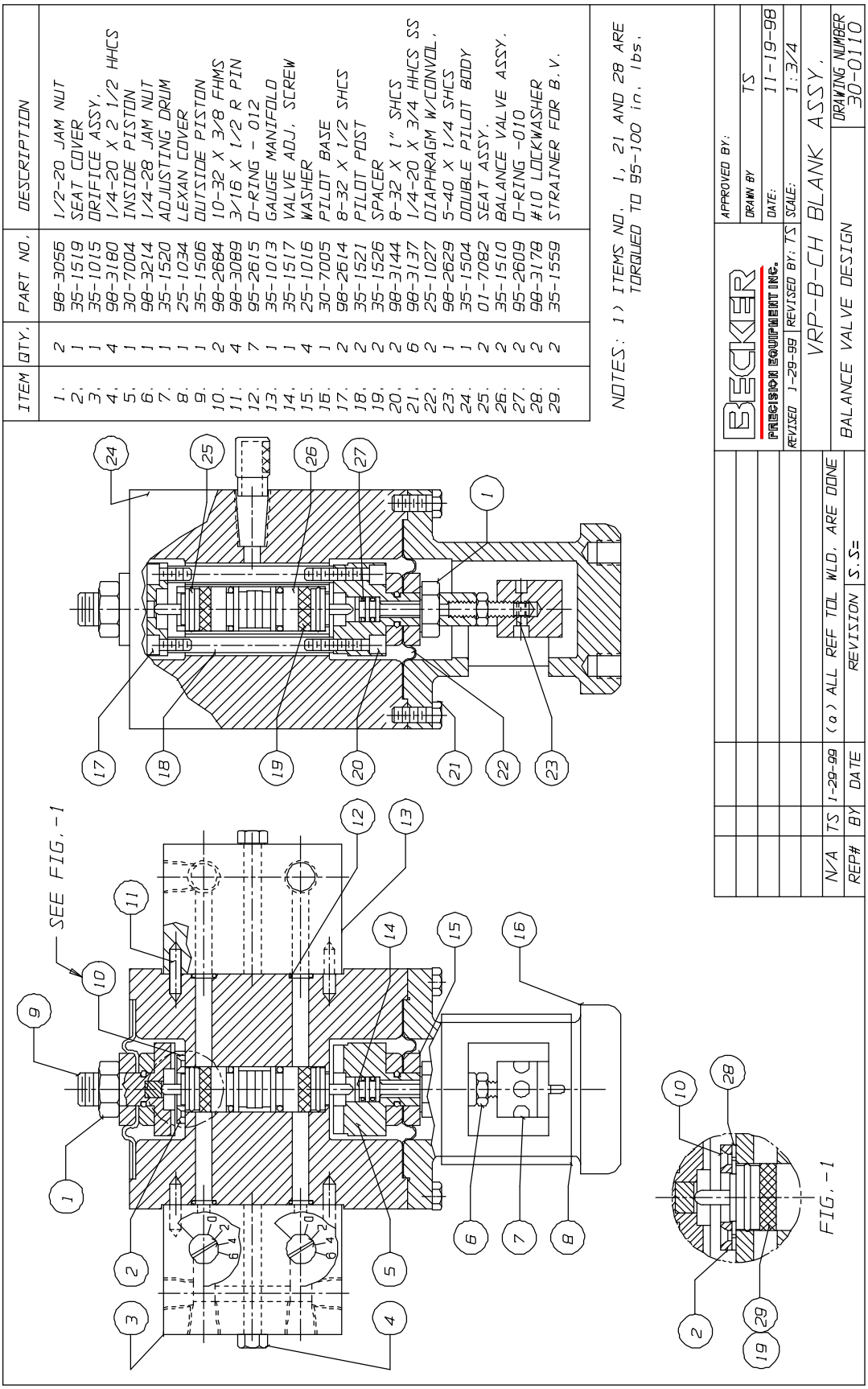
Seal Kit

A seal kit containing diaphragms, o-rings, seats, and balance valve assemblies for the VRP-B-CH pilot is available directly from Becker. Simply contact Becker Precision Equipment and refer to the following part number:

VRP-B-CH Pilot Model	Repair Kit
VRP-B-175-CH	30-9102
VRP-B-600-CH	30-9104
VRP-B-1000/1300-CH	30-9105

ITEM	QTY.	PART NO.	DESCRIPTION
1.	2	98-3056	1/2-20 JAM NUT
2.	1	35-1519	SEAT COVER
3.	1	35-1015	ORIFICE ASSY.
4.	4	98-3180	1/4-20 X 2 1/2 HHCS
5.	1	30-7004	INSIDE PISTON
6.	1	98-3214	1/4-28 JAM NUT
7.	1	35-1520	ADJUSTING DRUM
8.	1	25-1034	LEXAN COVER
9.	1	35-1506	OUTSIDE PISTON
10.	2	98-2684	10-32 X 3/8 FHMS
11.	4	98-3089	3/16 X 1/2 R PIN
12.	7	95-2615	O-RING - 012
13.	1	35-1013	GAUGE MANIFOLD
14.	1	35-1517	VALVE ADJ. SCREW
15.	4	25-1016	WASHER
16.	1	30-7005	PILOT BASE
17.	2	98-2614	8-32 X 1/2 SHCS
18.	2	35-1521	PILOT POST
19.	2	35-1526	SPACER
20.	2	98-3144	8-32 X 1" SHCS
21.	6	98-3137	1/4-20 X 3/4 HHCS SS
22.	2	25-1027	DIAPHRAGM W/CONVOL.
23.	1	98-2629	5-40 X 1/4 SHCS
24.	1	35-1504	DOUBLE PILOT BODY
25.	2	01-7082	SEAT ASSY.
26.	2	35-1510	BALANCE VALVE ASSY.
27.	2	95-2609	O-RING -010
28.	2	98-3178	#10 LOCKWASHER
29.	2	35-1559	STRAINER FOR B.V.

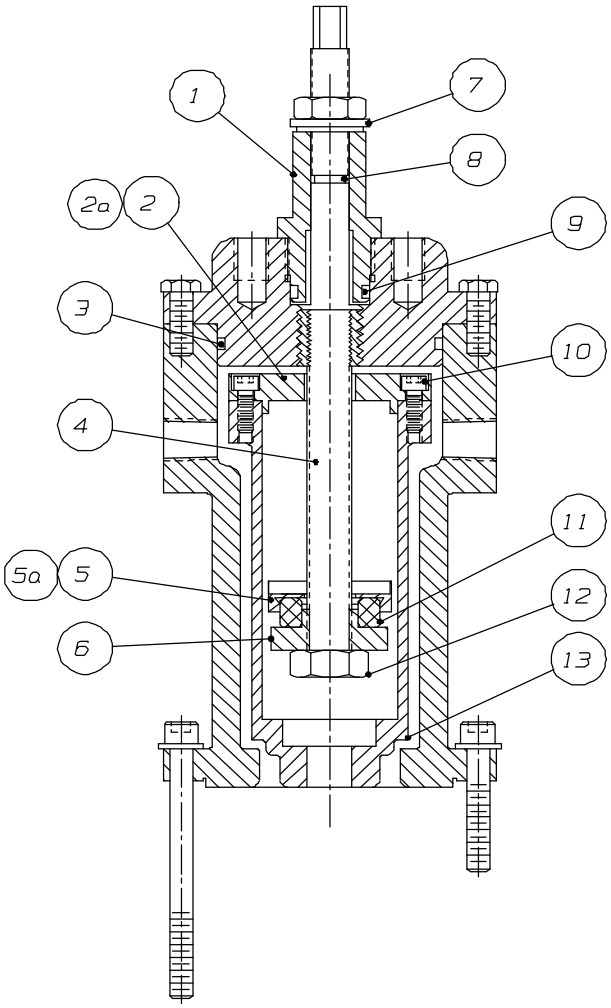
NOTES: 1) ITEMS NO. 1, 21 AND 28 ARE TORQUED TO 95-100 in. lbs.

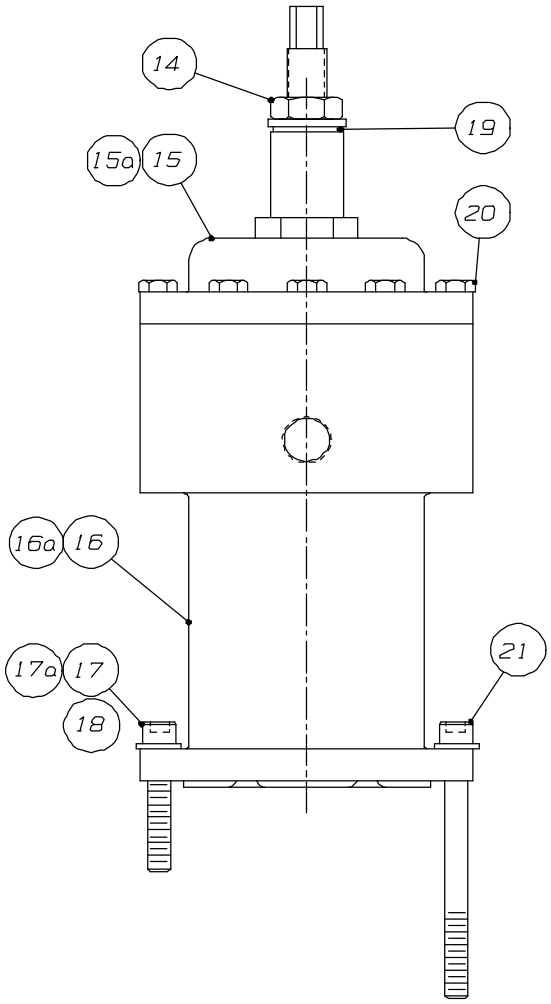


REVISED	1-29-99	REVISED BY: TS
DRAWN BY		TS
DATE:		11-19-98
SCALE:		1:3/4

VRP-B-CH BLANK ASSY.
BALANCE VALVE DESIGN
DRAWING NUMBER 30-0110

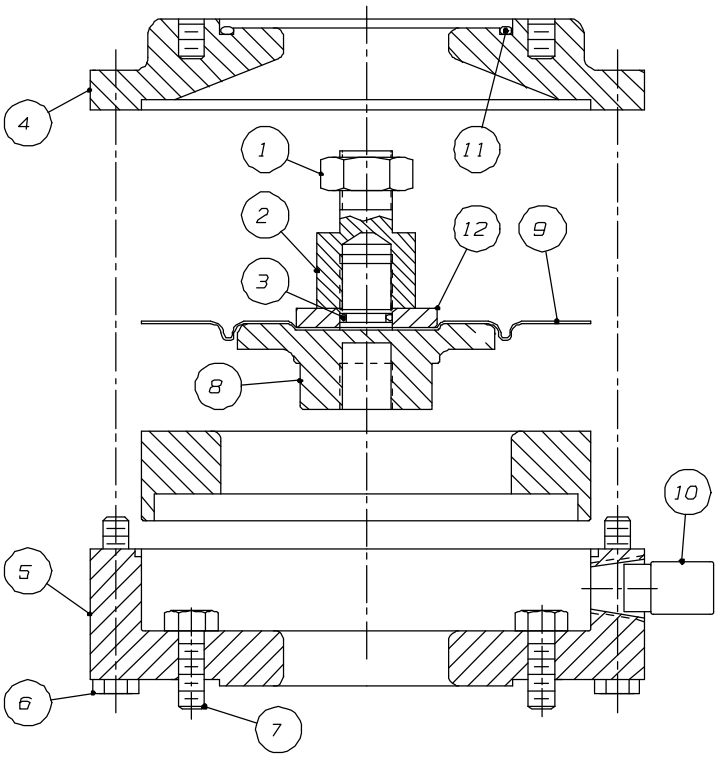
REP#	BY	DATE	REVISION
N/A	TS	1-29-99	(a) ALL REF TOL WLD. ARE DONE S.S=



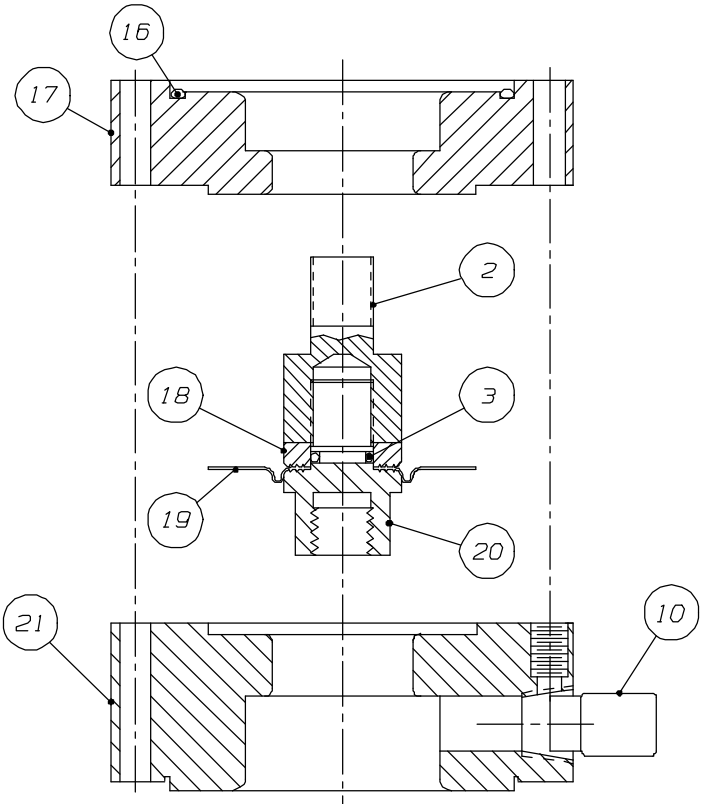


Key	Description	Part No.
1	Seal Neck	30-7009
2	Tube Cap	30-7007
2a	Tube Cap for 1300 CH	30-7026
3	O-Ring –141	95-2671
4	Adjusting Screw	30-7022
5	Bearing Case	30-7006
5a	Bearing Case for 1300 CH	30-7027
6	Bearing Nut	30-7001
7	7/16 Flat Washer S.S.	98-3181
8	O-Ring -108	95-2672
9	O-Ring -115	95-2670
10	8-32 x 1/2 SHCS	98-2614
11	Thrust Bearing	25-1062

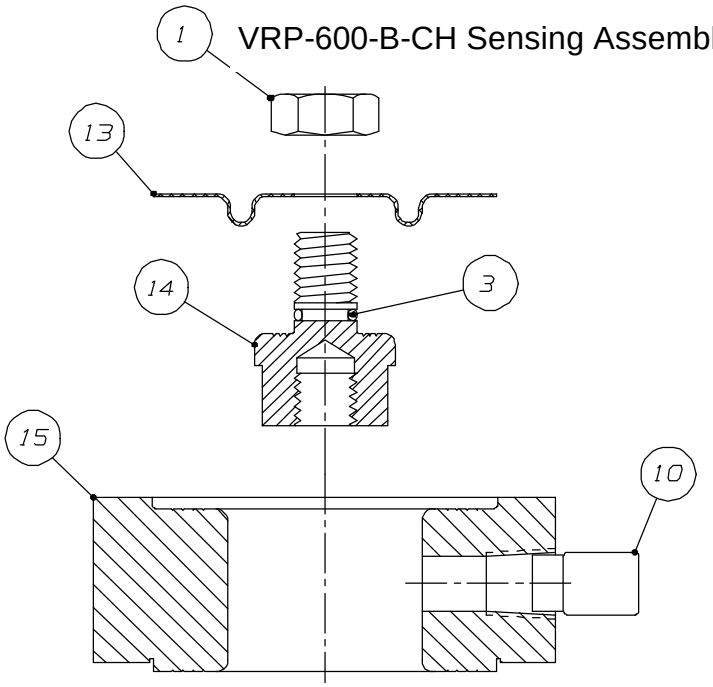
Key	Description	Part No.
12	LH 1/2-20 Jam Nut	98-3213
13	Inner Tube	30-7003
14	7/16-20 Jam Nut	98-2500
15	Cartridge Cap	30-7040
15a	Cartridge Cap for 175/600 CH	30-7008
16	Spring Cartridge	30-7023
16a	Spring Cartridge for 175/600 CH	30-7002
17	1/4-20 x 1-1/2” SHCS	98-3229
17a	1/4-20 x 2” SHCS for 175/600 CH	95-2609
18	1/4” Fiberglass Washer	98-3227
19	7/16 Thread Seal	30-7017
20	1/4-20 x 3/4” HHCS	98-3137
21	1/4-20 x 3” SHCS for 1000/1300	98-3231



VRP-B-175-CH Sensing Assembly



VRP-1000/1300-B-CH Sensing Assembly



VRP-600-B-CH Sensing Assembly

Key	Description	Part No.
1	1/2-20 Hex Jam Nut	98-3056
2	Thread Extension	30-7015
3	O-Ring –012	95-2615
4	Cartridge Spacer	30-7024
5	Bottom Flange	35-1548
6	1/4-20 x 1-1/2” HHCS	98-3153
7	1/4-20 x 3/4” HHCS	98-3137
8	Piston	30-7025
9	Diaphragm w/ Hole	30-7012
10	1/4” NPT Vent Elbow	01-2572
11	O-Ring –038	95-2656
12	Washer	30-7020
13	Diaphragm w/ Convolute	25-1027
14	Bottom Piston	25-1177
15	Bottom Spacer	25-1176
16	O-Ring –145	95-2665
17	Adapter Block	30-7016
18	Small Washer	30-7014
19	Diaphragm w/ Hole	30-7011
20	Bottom Piston	30-7010
21	Bottom Spacer	25-1568

Flow Calculations

Critical Flow

$$Q_C = 3128 x P_1 x C_V x \sqrt{\frac{1}{G x (T + 460)}}$$

Variables:
Q_c = critical flow across the inlet orifice in scfh
P_1 = supply pressure to the pilot in psig
C_v = $C_v = 0.00447 \times n^{1.656242}$
G = specific gravity of the gas
T = temperature of the gas in °F

Steady State Consumption for downstream bleed*

*(<10 scfh for bleed to atmosphere)

Q_{ssc} =steady state consumption
Q_{c1} = critical flow across the top orifice in scfh
Q_{c2} = critical flow across the bottom orifice in scfh
$C_v = 0.00447 \times n^{1.656242}$
n = number of the orifice setting on orifice block (1 through 6)

$Q_{ssc} = Q_{c1} + Q_{c2}$

Supply Regulator Capacity

$Q_{src} = 2Q_c$

Variables:
Q_{src} = supply regulator capacity
C_v = 0.0869 (calculated with n= 6)

Travel Time

Minimum travel time (the time the valve takes to move from one extreme position to another) is achieved when the signal deviates 5% or operation. The monitor or standby regulator pilot travel time is governed by the flow capability of the supply orifice. The control valve pilot travel time is governed by the exhaust capacity of the balanced valve. This is shown as t_2 below:

$$t_1 = 0.148 \times \frac{S \times D^2}{C_v} \times \sqrt{\frac{G}{T + 460}}$$

a). Monitor/Standby pilot bleeding to atmosphere or downstream:
Variables:
t = time in seconds
S = cylinder stroke in inches
D = cylinder diameter in inches
C_v = flow factor (for orifice or booster)

b). Working pilot time from 50% open to either extreme:

$$t = t_1 + 0.0003906 \times S \times D^2 \times P_2$$

Gas Consumption Table*

Supply Gas	Orifice number				
	2	3	4	5	6
100	29	56	90	130	176
150	41	80	130	187	253
200	54	105	169	244	330
250	66	129	210	301	407

Consumption (SCFH) For Monitor or Standby valve. For figure while in control, divide by 2.

*ONLY APPLIES TO VRP-B-CH WHEN BLEEDING TO A PRESSURE SYSTEM!

Accessories

The following Accessories are available to enhance the operation or provide additional features to your VRP-B-CH Series Double-Acting Pilot Control System. For additional informaiton regarding a specific VRP-B-CH accessory, contact Becker.

SP Series Set Point Change Pump:
provides a simple and accurate method of applying false signal pressure during initial adjustment of the VRP pilot. 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.

Remote Set Point Module:
provides remote adjustment of VRP-B-CH Pilot set point via an electrical signal. Standard input signals are 24 VDC pulse and 120 VAC pulse. A 4-20 mA input signal motor is optional. All motors provide 4-20 mA setpoint feedback.

AB Series Atmospheric Bleed Control:
maintains minimum pressure differential across the cylinder. AB Control is required to provide the necessary output to operate the control valve under all design conditions. **Note:** See Page 9 for adjustment information.

NBV Series No Bleed Valve:
achieves non-bleeding conditions at both full open and full closed positions without any adjustment. Selection based upon power gas pressure and discharge gas pressure

DPS-2 Series Sensor Adjustments

1. Turn the adjusting screw of the DPS-2 sensor clockwise until it extends about 1-3/4" from the top of the spring cartridge.
2. Adjust the VRP-B-CH according to the pilot adjustment procedures.

For a normally open regulator (Monitor):

3. Bleed off the sensing pressure.
4. Wait until the pressure reading on the cylinder bottom gauge is zero.

For normally closed (standby) regulator:

3. Increase the sensing pressure 5% above setpoint.
4. Wait until the pressure reading on the cylinder top gauge is equal to zero.

5. Turn the adjusting screw of the DPS-2 sensor counterclockwise until the exhaust port of the VRP-B-CH stops bleeding gas. Then turn the adjusting screw an additional half turn in the same direction.
6. The pressure sensor is now set for the existing supply pressure. If the supply pressure to the VRP-B-CH is changed, the sensor must be reset.

DPS Series Non-Bleed Sensor:
achieves non-bleeding conditions in either full open or full closed positions. Selection based upon power gas pressure and discharge gas pressure. **Note:** See Page 9 for initial pilot adjustment information.