VRG Controls, LLC
RP Series Regulator Pilot
Instruction Manual

Applicable Models:

This Instruction Manual applies to the following VRG – RP Series Regulator Pilots. To confirm suitability for additional models and/or components, please contact VRG Controls or view us online at www.vrgcontrols.com.

RP-225-SN-CS

RP-700-SN-OS

RP-700-SN-CS

RP-1500-SN-CS

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RP Series Regulator Pilot Instruction Manual Table of Contents

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Scope of Manual:

This Instruction Manual provides instructions for installation, maintenance, adjustment and troubleshooting of VRG Controls **RP Series Regulator Pilots**. This product is typically utilized in conjunction with pilot-operated regulators and a variety of other ancillary devices and accessories. For information on products other than those manufactured by VRG Controls, please consult the appropriate manufacturer.

Warning:

RP Series Regulator Pilots utilize high pressure flammable natural gas or other pneumatic supply as part of their standard operation. Improper installation, operation, maintenance and adjustment of these devices can result in property damage, personal injury or death. Only those qualified through training should install, operate, maintain or adjust this product. Contact your local VRG Controls sales representative or VRG Controls direct for additional information or assistance.

Technical Assistance:

For technical assistance with VRG products, please contact your local VRG Controls sales representative or VRG Controls direct. In order to facilitate technical assistance, we strongly recommend that obtain the MODEL NUMBER and SERIAL NUMBER of the product for which you require assistance prior to contact us. MODEL NUMBER and SERIAL NUMBER may be found on the PRODUCT ID LABEL located on the front of the VPC product on the center face of lower portion of the unit.

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We recommend that you record the MODEL NUMBER and SERIAL NUMBER of all VRG Products installed at each application location in the table below for future reference.

Installed Product Identification Log

Item	Tag	Model Number	Serial Number
1			
2			
3			
4			
5			
6			
Example	Run 1 Monitor Regulator	RP-700-SN-CS	0912123R

Product ID Label

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RP-225-SN-CS	RP-700-SN-OS	RP-1500-SN-CS
	RP-700-SN-CS	

Description:

RP Series Regulator Pilots are reversible pressure control regulator devices designed for use in conjunction with pilot-operated regulators bodies manufactured by others. They can be used for pressure reducing, backpressure or relief type applications. The RP Series Regulator Pilots are designed for Gas applications and provide a higher performance than other "standard-issue regulator pilots.

RP Series Regulator Pilots are available with three (3) differently sized sensing diaphragms that are suited for different applications based upon the maximum sensing pressure applied and the desired setpoint pressure to be achieved. See Table 3.0 for additional information.

RP Series Regulator Pilots utilize an internal seat & nozzle internal loading configuration as noted by the characters "SN" in the model number derivation. Internal nozzles are available in 3/32 in dia. and 1/8 in dia. sizes. The internal nozzles may be interchanged to achieve required performance based upon application criteria. Standard issue internal nozzle is 3/32 in dia which is suitable for typical "pipeline applications." For "close-coupled" applications such as power plant fuel gas feed and 2-stage pressure cut, a 1/8 in dia. internal nozzle should be installed. When utilizing a 1/8 in internal nozzle a "L" Adjustable Orifice is required.

RP Series Regulator Pilots are available with two (2) different sensing chamber configurations. The "CS" closed spring sensing chamber design features a design that minimizes forces applied to the pilot internal mechanism and exhibits the optimum control accuracy, sensitivity and stability. Furthermore the "CS" closed spring sensing chamber encapsulates the control spring within the process media eliminating exposure to the local atmosphere and protecting it from corrosive environments. The "OS" open spring sensing chamber provides high performance control accuracy at a reduced price with fewer parts.

RP Series Pilots parts are interchangeable across model numbers and even across some product series in the VRG products lines. This interchangeability facilitates understanding of maintenance and operation and may benefit operators in the field in the event that parts may be needed on an immediate basis for conversion of models and/or repair. All RP Series Pilots feature body construction with VRG Military Grade Aluminum Alloy with "Stealth System" Corrosion Protection materials and 316 Stainless Steel to ensure durability and long life in even the most corrosive environments.

The RP Series Regulator Pilot features a manifolded integral Adjustable Orifice installed on the INLET side of the device. Three (3) different sizes of Adjustable Orifices are available (S, M, and L) to adapt to different operating scenarios and ensure optimal performance. For "close-coupled" applications such as power plant fuel gas feed and 2-stage pressure cut, a 1/8 in dia. internal nozzle should be installed. When utilizing a 1/8 in internal nozzle a "L" Adjustable Orifice is required.

RP Pilots are available in two (2) different Actions: Normally Open (NO) & Normally Closed (NC). Normally Open (NO) is the standard issue product from VRG Controls and is commonly utilized for Pressure Reduction and Monitor Overpressure applications. Reference the "RP Model Number Identification Label" on the body of the RP Regulator Pilot to confirm the Action of the pilot. Note that all RP Regulator Pilots may be field-converted from Normally Open (NO) to Normally Closed (NC) and vice-versa without the need for any additional parts. If an RP unit action is changed, we recommend that you obtain a new "RP Model Number Identification Label" in order to display the proper action.

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Installation:

ATTENTION:

Personal injury, damage, or explosion due to leakage of accumulated gas, or rupture of pressurized components could result if this pilot is overpressured or is installed where operating parameters could exceed the design limits as indicated in this manual, or where parameters exceed the ratings of the regulator body, adjacent piping or piping components & fittings. Verify the pressure limitations of pilot and the regulator on which it is installed to ensure neither device is overpressured. To avoid injury or damage to property, incorporate relief valves or pressure limiting devices to prevent operating parameters from exceeding required limits. Reference U.S. code of Federal Regulations, by the National Fire Codes of the National Fire Protection Association, or by other applicable codes or codes mandated by the operating company as needed.

WARNING

Regulator Pilots and Pilot Operated Regulators installed in enclosed or confined spaces should be provided with adequate ventilation to prevent the potential of gas accumulation from leakage or venting. Leakage and vent gas can accumulate causing property damage, severe injury or death. Atmospheric vent ports should be vented to a safe area away from air intakes, or any hazardous location.

PERSONNEL: Installation of RP Series Regulator Pilots and other manufacture's Pilot Operated Regulator Bodies should be performed by qualified personnel that are familiar with high pressure natural gas piping and regulator technologies.

INSPECTION: Inspect the RP Series Pilot for damage that might have occurred in shipping and handling. Do NOT use any product that has any remote semblance of damage. Care should also be taken to ensure that no damage exists on previously installed products that may have been installed at previous locations. If the origin or operational capability of any product is suspect or unknown, we recommend confirmation of fitness for service by a qualified technician or by VRG Controls.

ACTION: Inspect the RP Model Number Identification Label AND the Body of the RP Series Pilot to ensure that the unit has the appropriate ACTION for the desired application. Figures XX and Table XX provide necessary information to confirm RP Series Pilot Action.

INSTALLATION ORIENTATION: RP Series Regulator Pilots may be installed in any orientation. However, for optimum results and ease of maintenance, it is typically receommended to install RP Series Pilots in a vertical orientation with the RP Series Setpoint Adjustment Screw pointing upward.

PILOT MOUNTING: The RP Series Pilot may be installed utilizing a convenient mounting bracket available from VRG Controls. The RP Pilot may be wall mounted or 2.0 in pipe mounted.

PIPING: Appropriate pipe thread seal tape should be applied to all fittings installed on the RP Pilot. Use of pipe dope is also encouraged to minimize potential for galling or damage to threaded connections. All threaded connection on the RP Pilot are ¼ in FNPT.

PILOT SUPPLY LINES: $^3/_8$ in stainless steel tubing or ¼ in diameter threaded, non-restricted connections should be utilized to make connections to the RP Series Pilot. The INLET connection should be made with restrictions in the piping components. In the event that an isolation valve is installed in the INLET connection, it should be a full-opening type without restriction.

FILTRATION: Most gas pipeline applications do not require a filter on the INLET connection. If the application may exhibit dirty gas, an appropriate filter should be applied upstream of the INLET connection to prevent clogging of the ADJUSTABLE ORIFICE. The filter should be application appropriate with adequate capacity with filtration to 10µ.

PILOT DISCHARGE (OUT): $^3/_8$ in stainless steel tubing or ¼ in diameter threaded, non-restricted connections should be utilized to make connections to the RP Series Pilot. The OUT connection should be made with restrictions in the piping components. In the event that an isolation valve is installed in the OUT connection, it should be a full-opening type without restriction.

PILOT GAS PRE-HEATERS: Pilot INLET gas may be heated to prevent excessive refrigeration effects and potential formation of ice or hydrates in the system. Pilot INLET gas heaters should be connected after the pilot filter upstream of

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the INLET port. Note that Pilot pre-heaters are NOT REQUIRED and may be considered per application when large pressure drops result in severe refrigeration effects.

SENSING LINES: Sensing Lines should be run from the Sensing Port of the RP Series Regulator Pilot to a point roughly 10 pipe diameters from the outlet of the pilot-operated regulator body. See table below for recommended piping configurations for Sensing Lines. Reduce as necessary to connect to the ¼ in FNPT ports on the RP Series Regulator Pilot. The Sensing Line connection should be avoid turbulent areas (valves, reducers, and elbows) and should have a full bore opening to the pipe. Isolation valves are typically recommended on the Sensing Line(s) and should be non-restricted, full opening type.

Table 1.0 – Recommended Sensing Line Configuration for RP Series Pilots

Desired Setpoint Pressure		
in. WC ≤ SETPOINT < 2.0 psig	2.0 psig ≤ SETPOINT < 5.0 psig	5.0 psig ≤ SETPOINT
½ in Pipe (Min.)	½ in Seamless SS Tubing	3/8 in Seamless SS Tubing

Maintenance

Regulator and control device parts utilized in gas regulation applications are subject to normal wear and should be inspected and replaced as necessary. The frequency of inspection and replacement of parts depends on severity of service conditions and/or the requirements of local, state, federal regulations. You should consult your company standards and regulations to determine protocol for maintenance on your equipment. It is critical to ensure that the RP Model Number Identification Labels, RP Spring Control Range Labels, and other applicable labels are updated and maintained to ensure legibility and accurately reflect the operation limitations of the device.

WARNING

Before removal, disassembly, or initiating maintenance ensure that the RP Series Regulator Pilot and the Pilot-Operated Regulator on which it is installed have been isolated from the process. All pressurized gas must be safely vented from the RP and Regulator System. Failure to relieve all pressure from the system may result in property damage, severe injury or death.

Applications:

The RP Series Regulator Pilot is designed to provide self-contained pressure control when incorporated with pilot-operated regulators. The system utilizes pressurized natural gas or from the pipeline to operate and can address a number of common pipeline pressure control applications. Contact VRG Controls for assistance with your application.

- **Primary Pressure Control (Active)**
- **Overpressure Protection (Monitor)**
- **Overpressure Protection (Relief)**
- **Underpressure Protection (Standby)**
- **Backpressure Control**
- **Two-Stage Pressure Control**
- **Power Plant Fuel Gas Feed**

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Table 2.0 – RP Series Regulator Pilot Technical Specifications

		
RP Series	**RP-SN-CS**	**RP-SN-OS**
Type	Regulator Pilot	Regulator Pilot
Internal Valve Logic	Seat & Nozzle	Seat & Nozzle
Spring Chamber Type	Closed Spring (CS)	Open Spring (OS)
Outputs	Single, Variable	Single, Variable
Available Action	Normally Open (NO)[1] Normally Closed (NC)[1]	Normally Open (NO)[1] Normally Closed (NC)[1]
Setpoint Range	1.25 - 1500 psig (9.0 - 10,342 kPa)	9 - 700 psig (62 – 4,826 kPa)
Temperature Range	-20°F to +160°F (-29°C to +71°C)	
Pneumatic		
Supply Gas Quality	Dry, Filtered @ 10µ Natural Gas	
Max Inlet Pressure	1500 psig (10,342 kPa)	1500 psig (10,342 kPa)
Max Differential Pressure	700 psid (4,826 kPad) – “225” 700 psid (4,826 kPad) – “700” 1500 psid (10,342 kPad) – “1500”	700 psid (4,826 kPad) – “700”
Connections	All Ports ¼ FNPT	
Construction		
External Parts	VRG Military Grade Aluminum Alloy with “Stealth System” Corrosion Protection 304 SS – Optional Construction	
Internal Parts	All Internal Parts 316 SS	
Diaphragms	High Performance Nylon Reinforced Buna-N, VITON (Optional)	
O-Rings	Buna-N, VITON (Optional)	
Control Springs	Painted Alloy Steel	
Gauges	2.5 in. Liquid-Filled SS Case & Body (Optional)	
Weight (Approx.)	11 lbs. (5.0 kg)	10 lbs. (4.5 kg)
Dimensions (Approx.)	12 in X 7.5 in X 4.0 in (305 mm X 191 mm X 102 mm)	13.5 in X 7.5 in X 4.0 in (343 mm X 191 mm X 102 mm)
Application Guide		
Pressure Reducing/Monitor	Optimum (NO)	Very Good (NO)
Relief/Backpressure	Optimum (NC)	Very Good (NC)
Boiler Power Plant	Optimum	--
Asphalt Plants	Optimum	--
Duct Burner Control	Optimum	--
Liquid Pressure Control	Optimum	Very Good
Performance Guide		
Sulfur Formation Problems	Sulfur Resistant	Sulfur Resistant
Flow Capacity	High Capacity	High Capacity
Control Accuracy	Ultimate Accuracy	Very Good Accuracy
Control Stability	Ultimate Stability	Very Good Stability
Droop Performance	Low Droop	Low Droop

Notes:

1. Normally Open (NO) and Normally Closed (NC) may be converted without additional parts.

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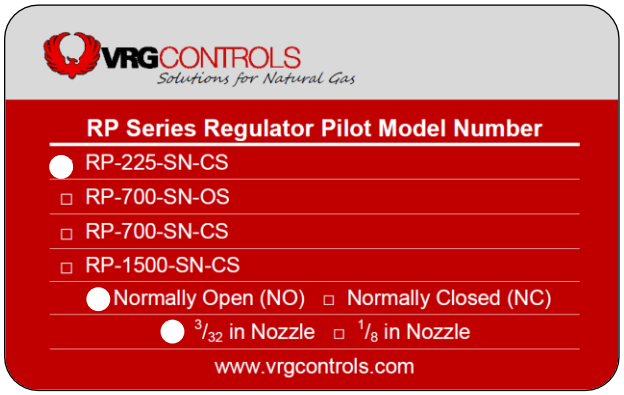
Table 2.0 - Model Number Explanation:

Base Model		Pressure Series		Internal Valve Logic		Spring Chamber Type	
RP	Pilot Regulator	225	225 psig Max Sensing	SN	Seat & Nozzle	OS	Open Spring Chamber
		700	700 psig Max Sensing			CS	Closed Spring Chamber
		1500	1500 psig Max Sensing				

Example: Model RP-700-SN-CS
Regulator Pilot, 700 psig Max Sensing, Seat & nozzle Internal Valve, Close Spring Chamber Design

RP Model Number Identification Label:



RP Spring Control Range Label:

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Table 3.0 – RP Series Available Control Spring Configurations

RP Model	Control Range	Spring Color	Setpoint Change / Rev.	Control Spring
Models: **RP-225-SN-CS**[2]	3.0 - 14 psig (20.6 - 97 kPa)	Black	0.8 psig (5.5 kPa)	CS-0100
	5 - 53 psig (55 - 365 kPa)	Brown	3.1 psig (21.4 kPa)	CS-0110
	16 - 100 psig (110 - 689 kPa)	Grey	8 psig (55 kPa)	CS-0120
	40 - 170 psig (276 - 1172 kPa)	Orange	20.2 psig (139 kPa)	CS-0130
	65 - 205 psig (448 - 1413 kPa)	White	32.2 psig (222 kPa)	CS-0135
	100 - 225 psig (689 - 1551 kPa)	Purple	44.2 psig (305 kPa)	CS-0140
Models: **RP-700-SN-CS**[2] **RP-700-SN-OS**[1]	9 - 45 psig *(62 - 310 kPa)*	Black	2.4 psig (17 kPa)	CS-0100
	30 - 160 psig (241 - 1103 kPa)	Brown	9.6 psig (73 kPa)	CS-0110
	75 - 310 psig (517 - 2137 kPa)	Grey	24.5 psig (175 kPa)	CS-0120
	150 - 520 psig (1034 - 3585 kPa)	Orange	62.1 psig (423 kPa)	CS-0130
	240 - 635 psig (1655 - 4378 kPa)	White	98.9 psig (687 kPa)	CS-0135
	350 - 700 psig (2413 - 4826 kPa)	Purple	135.9 psig (926 kPa)	CS-0140
Models: **RP-1500-SN-CS**[2]	30 - 90 psig (207 - 620 kPa	Black	5.0 psig (34 kPa)	CS-0100
	50 - 335 psig (345 - 2309 kPa)	Brown	19.7 psig (149 kPa)	CS-0110
	100 - 640 psig (689 - 4412 kPa)	Grey	50.4 psig (361 kPa)	CS-0120
	265 - 1070 psig (1827 - 7377 kPa)	Orange	127.6 psig (870 kPa)	CS-0130
	400 - 1300 psig (2758 – 8962 kPa)	White	203.2 psig (870 kPa)	CS-0135
	625 - 1500 psig (4309 – 10341 kPa)	Purple	279.3 psig (1904 kPa)	CS-0140

Notes:

1. "Open Spring" spring cartridge available for economical standard applications
2. "Closed Spring" spring cartridge available for high performance applications.

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Flow Calculations

Critical Flow Equation:

$$Q_c = 312.9 \times (P_1 + 14.7) \times C_V \times \sqrt{\frac{1}{G \times (T + 460)}}$$

Where:

Variable	Description	Unit
Q_c	Critical Flow Across Inlet Orifice	Scfh
P_1	Supply Pressure	Psig
C_v	Flow Factor	--
G	Specific Gravity of Gas	--
T	Gas Temperature	°F

Flow Coefficient Tables (Cv)

Table 4.0 – Adjustable Orifice Flow Coefficients

	Adjustable Orifice Setting							
Installed Orifice	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Standard	0.006	0.009	0.018	0.044	0.069	0.096	0.111	0.126
Medium (M)	0.042	0.045	0.062	0.089	.134	0.172	0.211	0.249
Large (L)	0.042	0.063	0.172	0.328	0.461	0.578	0.634	0.675

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Table 5.0 RP Series Regulator Pilot Assembly Configuration Summary

Component	RP-225-SN-CS	RP-225-SN-CS	RP-700-SN-CS	RP-700-SN-CS	RP-700-SN-OS	RP-700-SN-OS	RP-1500-SN-CS	RP-1500-SN-CS
Output	Normally Open	Normally Closed	Normally Open	Normally Closed	Normally Open	Normally Closed	Normally Open	Normally Closed
Sensing Cartridge Type	Closed Spring	Closed Spring	Closed Spring	Closed Spring	Open Spring	Open Spring	Closed Spring	Closed Spring
Internal Valve Logic	SN	SN	SN	SN	SN	SN	SN	SN
Cartridge Top Flange	1	1	1	1	1	1	1	1
Spring Cartridge	2	2	2	2	2	2	2	2
Sensing Adapter	3	3	3	3	3	3	3A	3A
Sensing Spacer	3A	3A	--	--	--	--	3B	3B
Block Spacer	--	--	--	--	--	--	▼	▼
Pilot Block (TOP)	▲	●	▲	●	●	▲	▲	●
Pilot Block (BOTTOM)	●	■	●	■	■	●	●	■
Block Spacer	--	--	--	--	--	--	▲	▲
Pilot Bottom Flange	7	7	7	7	7	7	7	7
Left Hand Manifold	ORIFICE BLOCK	ORIFICE BLOCK	ORIFICE BLOCK	ORIFICE BLOCK	ORIFICE BLOCK	ORIFICE BLOCK	ORIFICE BLOCK	ORIFICE BLOCK
Right Hand Manifold	NPT OUTPUT	NPT OUTPUT	NPT OUTPUT	NPT OUTPUT	NPT OUTPUT	NPT OUTPUT	NPT OUTPUT	NPT OUTPUT

Notes:

1. Normally Open configuration utilized for PRESSURE REDUCING application and is most common configuration.
2. Normally Open configuration utilized for BACKPRESSURE and RELIEF VALVE applications.

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Table 6.0 – RP Series Regulator Pilot Available Models

RP-225-SN-CS (Normally Open) PA-0190	RP-225-SN-CS (Normally Closed) PA-0191
	

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Table 6.0 – RP Series Regulator Pilot Available Models (Cont'd.)

RP-700-SN-CS (Normally Open) PA-0200	RP-700-SN-CS (Normally Closed) PA-0201
	

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Table 6.0 – RP Series Regulator Pilot Available Models (Cont'd.)

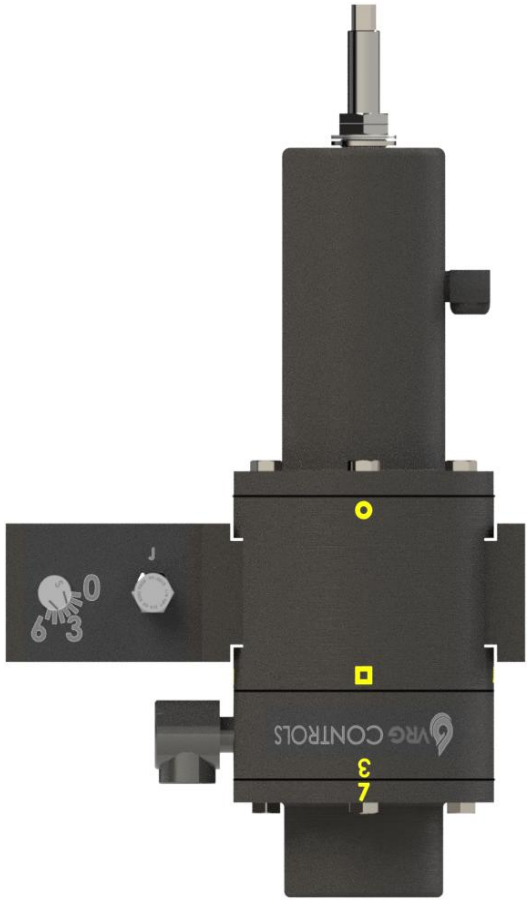
RP-700-SN-OS (Normally Open) PA-0300	RP-700-SN-OS (Normally Closed) PA-0301
	

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Table 6.0 – RP Series Regulator Pilot Available Models (Cont'd.)

RP-1500-SN-CS (Normally Open) PA-0210	RP-1500-SN-CS (Normally Closed) PA-0215
	

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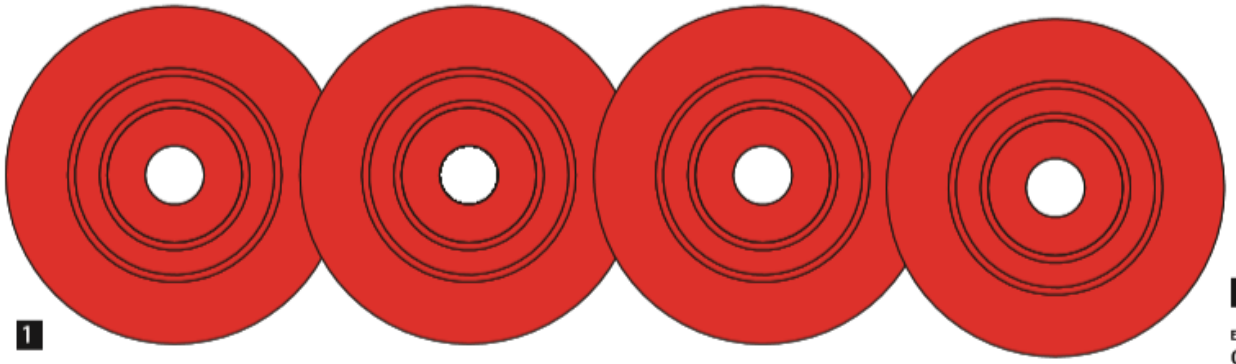
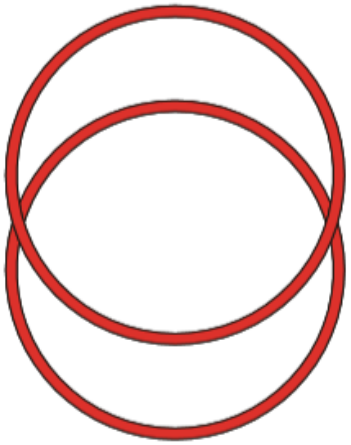
VRG CONTROLS SP/BP/RP-SN-RK-0400-VER1-12721 REPAIR KIT VISUAL BOM - Part No. RK-0400



1 EL-0010 Diaphragm w/hole -700 psig, Buna QTY 4

2 EL-0020 Diaphragm w/hole -1500 psig, Buna QTY 1



10 EL-0240 O-Ring,-147, Buna, 2-7/8 x 2-11/16 x 3/32 QTY 2

3 EL-0030 Diaphragm w/Hole-225 psig, Buna QTY 1

4 EL-0200 O-Ring, -010, Buna, 3/8 x ¼ x 1/16 QTY 3

17 EL-0300 1/2 Thread Seal-Steel QTY 1

5 EL-0210 O-Ring,-012, Buna, ½ x 3/8 x 1/16 QTY 3

8 EL-0235 O-Ring,-112, Buna, 11/16 x ½ x 3/32 QTY 2

11 EL-0100 Buna-N Seat QTY 1

6 EL-0220 O-Ring,-014, Buna, 5/8 x ½ x1/16 QTY 3

12 Mobilith SHC 220 Standard VRG Lubricant

7 EL-0230 O-Ring,-109, Buna, ½ x 5/16 x 3/32 QTY 1

9 EL-0237 O-Ring,-116, Buna, 15/16 x ¾ x 3/32 QTY 1

16 FN-0100-1 W 8-32 X 1/2 SHCS AL. Ctd. Alloy QTY 8

SP_BP_RP-SN-RK-0400-VER1--2121

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Table 8.0 – Factory Quality Checklist RP Series Regulator Pilot

Date:			
VRG Invoice Number:			
Personnel:			
Model Number:			
Serial Number:			
Customer:			
Customer Tag:			
Supply Pressure			
Discharge Pressure			
Orifice Setting	_____		
Procedure		Verified	Notes
Apply Maximum Sensing Pressure 30 min.		□ VERIFY	
Adjust RP to Setpoint		□ VERIFY	
Friction Test		□ VERIFY	
Gage Check (if applicable)		□ VERIFY	
Valve Leak Check		□ VERIFY	
Assembly Leak Check		□ VERIFY	
Seat Check		□ VERIFY	
Sensitivity Check		□ VERIFY	
Label Check		□ VERIFY	
Notes:			

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Table 9.0 - RP-SN Series Regulator Pilots Application Schematics - Table of Contents

Notes:

1. Contact VRG Controls for additional schematics that do not appear in this manual.

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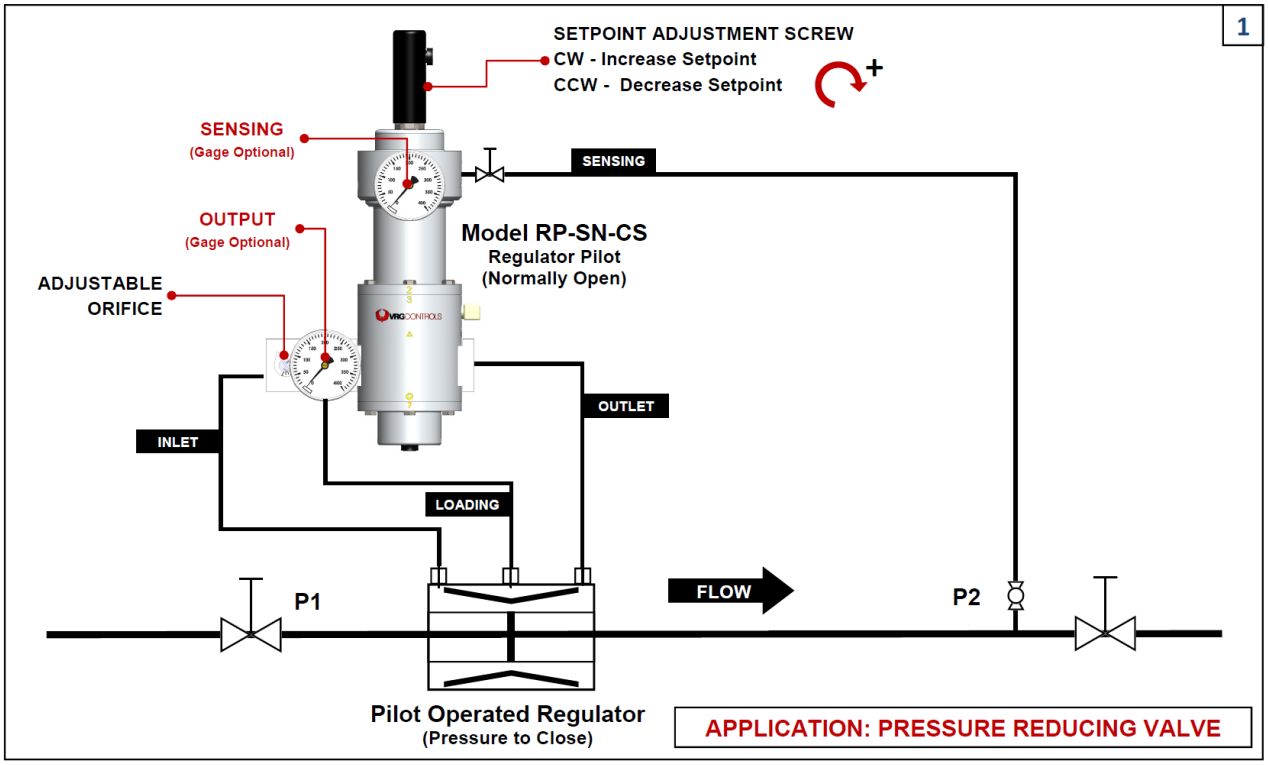

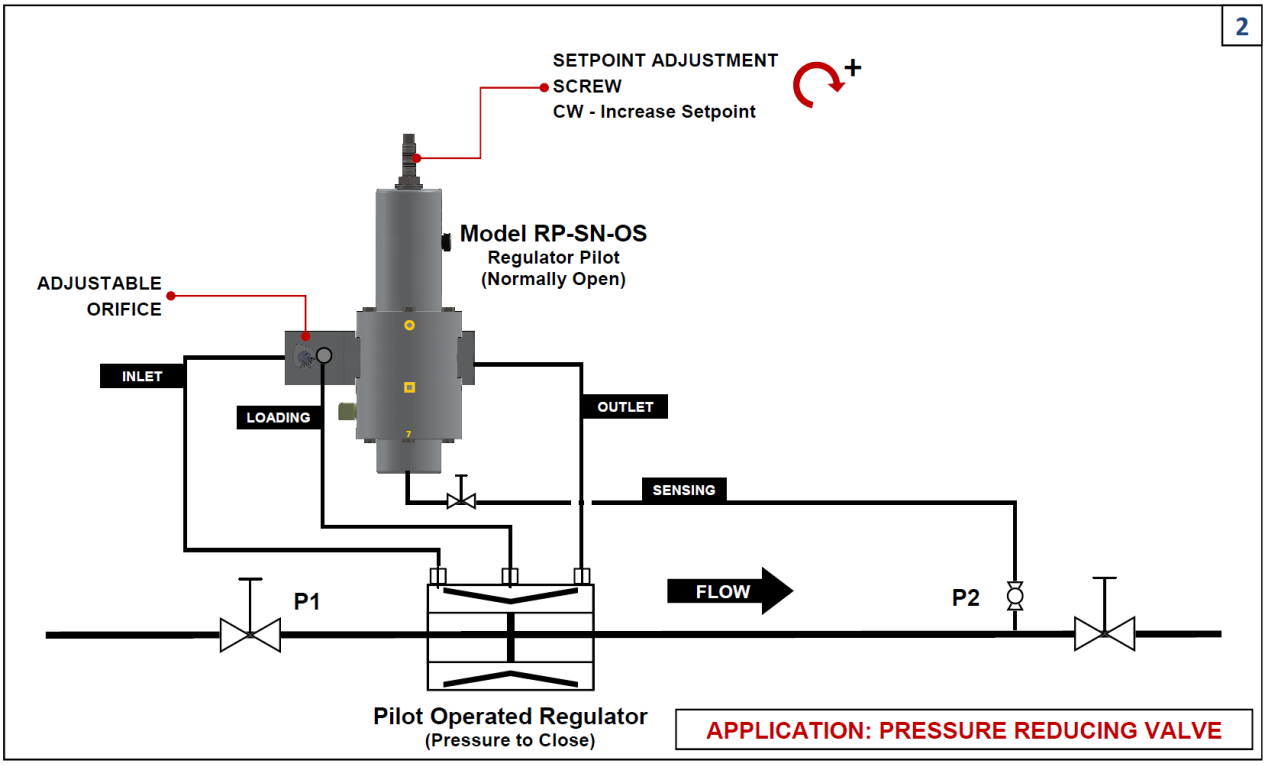

APPLICATION DRAWING

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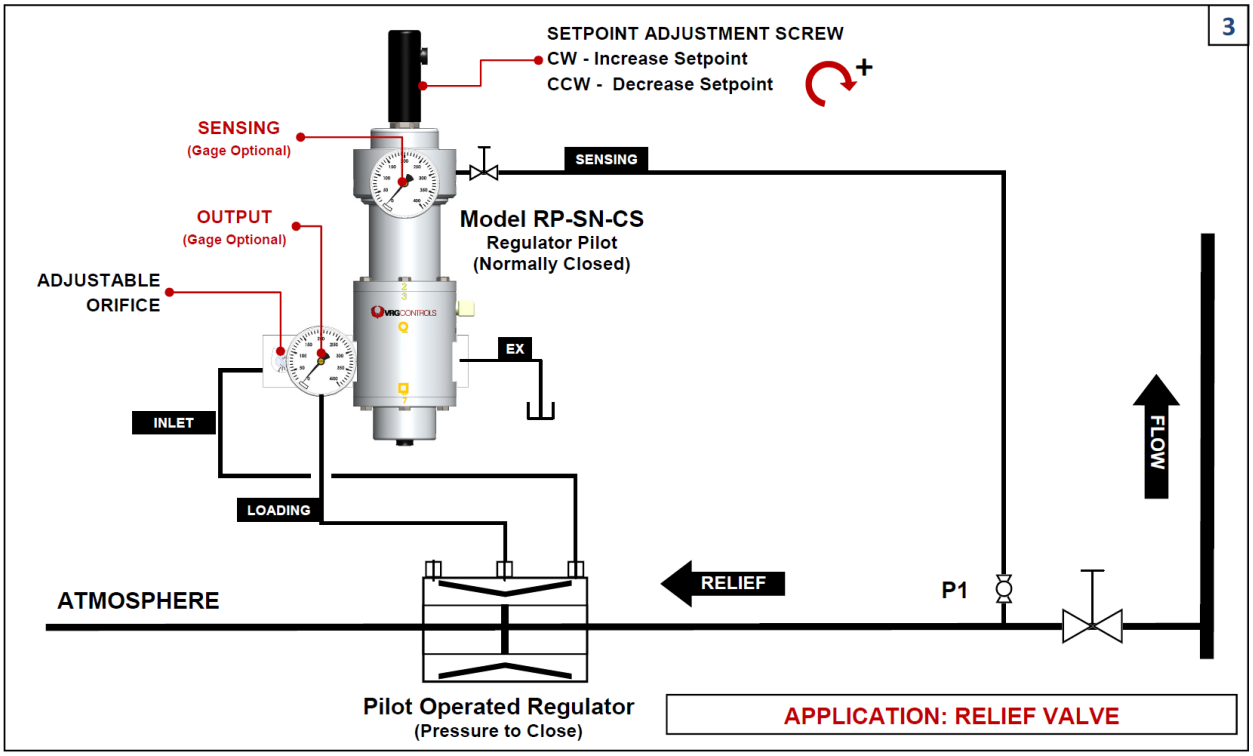

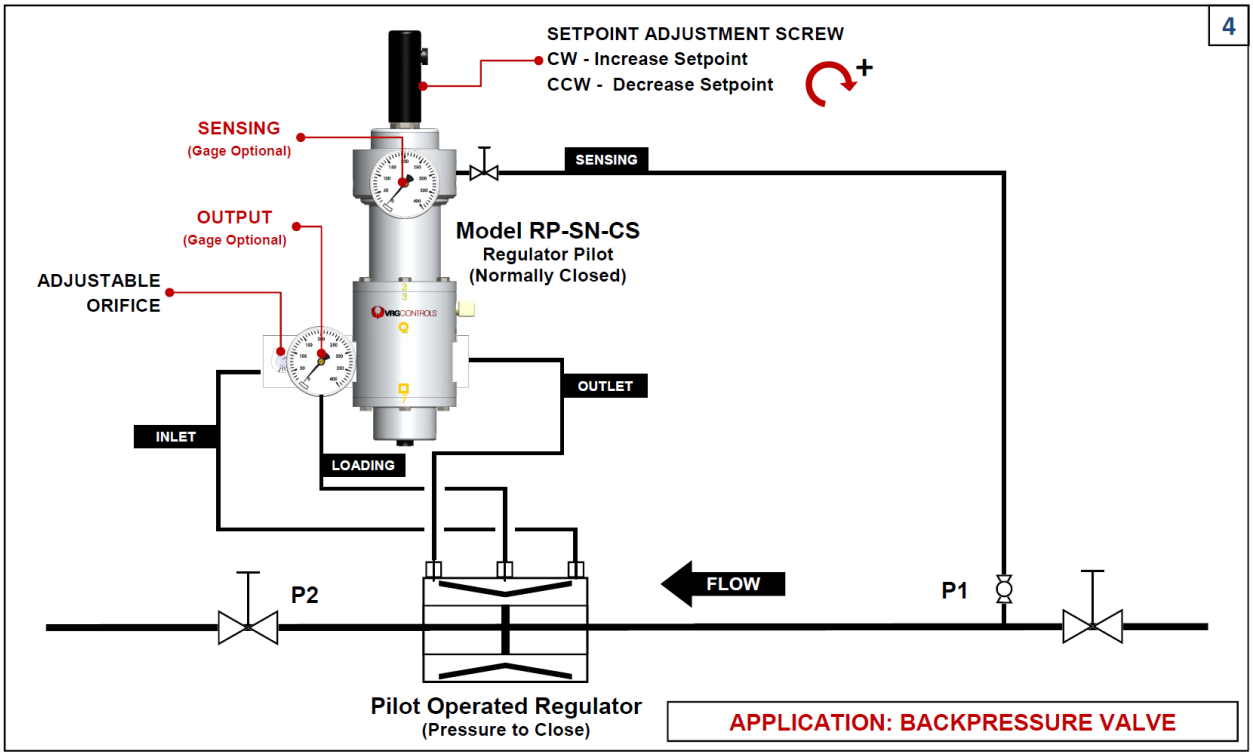

VRG CONTROLS Solutions for Natural Gas

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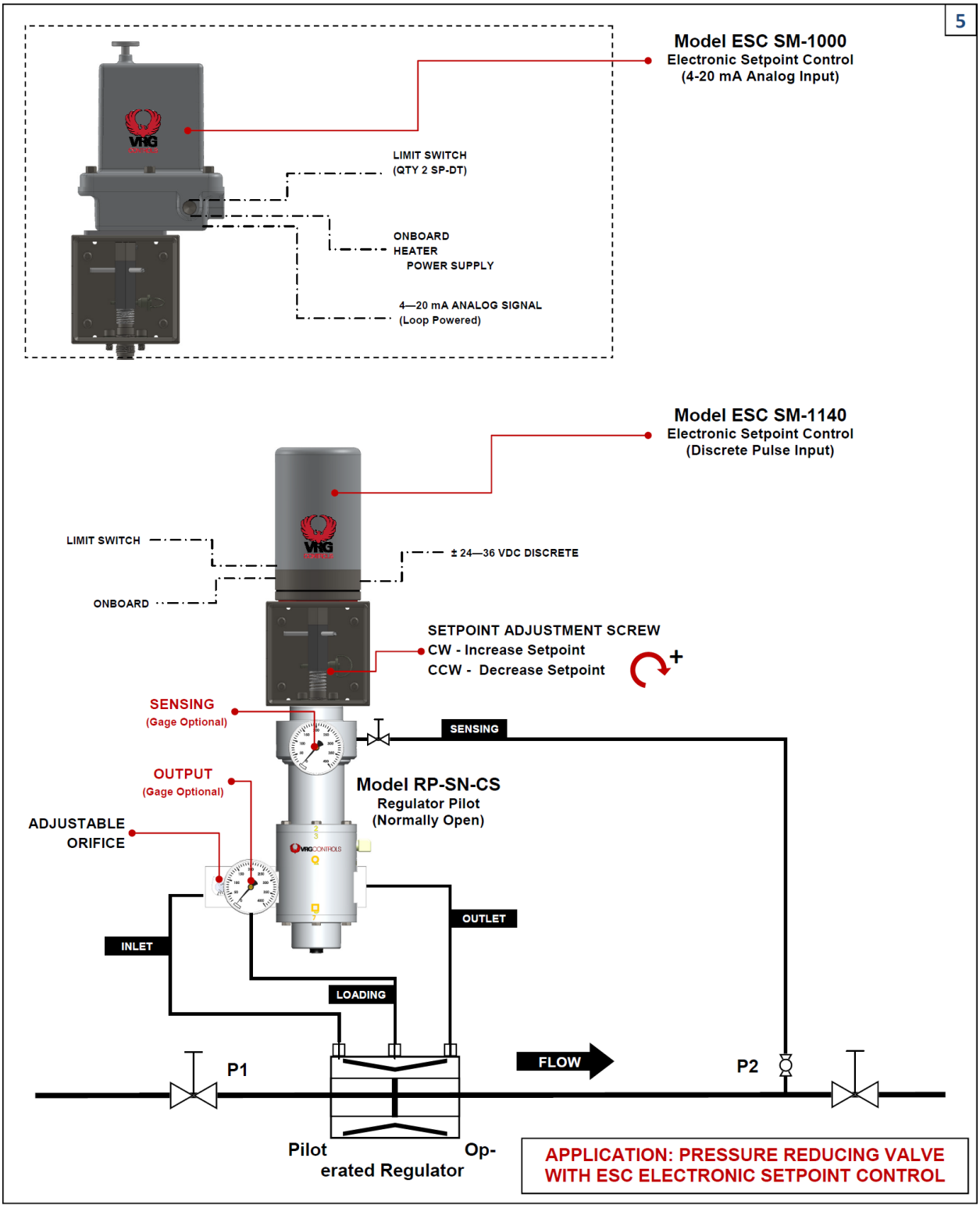

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Notes:

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