UTILITY SOLUTIONS GROUP

Model 243-RPC Pilot Operated Regulator

Installation & Maintenance Manual

Contents

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Regulator Introduction

The 243-RPC is a genuine pilot operated regulator (relay principle of operation) at an economical price.

The relay principle provides exceptionally precise pressure control. Accuracy is largely unaffected by changes in the inlet pressure.

Although particularly applicable to pressure factor measurement and fixed factoring, the 243-RPC makes an excellent choice elsewhere. Use it on commercial or industrial applications where pilot operation is specified, as on gas burners of various kinds and gas engines. Use it also on smaller distribution loads such as district regulator stations. While most applications involve natural gas, the 243-RPC performs equally well on other non-corrosive gases such as air, dry carbon dioxide (CO_2), liquid propane gas (LPG), nitrogen (N_2), and others.

Outlet Pressure Ranges

Outlet Pressure Range	Pilot Spring	
	Spring Color	Spring Part Number
3 ½" to 6 ½" w.c.	Red	143-08-021-00
5" to 8 ½" w.c.	Blue	143-08-021-01
6" to 14" w.c.	Green	143-08-021-02
12" to 28" w.c.	Orange	143-08-021-03
1 to 2 psi	Black	143-08-021-06
1 to 5 psi	White	138-18-021-01
3.5 to 5 psi	Aluminum	138-18-021-05
3 to 15 psi	Gray	138-18-021-04
10 to 35 psi	Brown	138-18-021-03

Maximum Inlet Pressures

Pipe Size	Orifice Sizes	Maximum Inlet Pressure
1 ½" and 2" NPT* 2" ANSI 125 FF** Flanged	¼", ⅜", ½"	150 psi
	¾"	125 psi
	1"	60 psi
	1 ¼"	30 psi
1 ¼" NPT*	¼", ⅜", ½"	150 psi
	¾"	125 psi

* National Pipe Thread (NPT)

** Flat-Faced (FF)

Installation

1. Thoroughly purge the inlet piping to remove dirt and debris that could damage the regulator or impair its operation. If the installation is in a location where continual dirt problems are encountered, a filter or strainer should be installed upstream of the regulator.

NOTE: Inlet and outlet shutoff valves are recommended. Use of a by-pass is recommended where it will may assist in repair or replacement of the regulator.

2. Remove Shipping covers or screens from the inlet, outlet, and control line connections. Ensure the regulator is free of foreign matter and debris.

CAUTION

It is the user's responsibility to ensure the 243-RPC being installed matches the specified application required for installation. Ensure the installation complies with all applicable standards and codes.

3. Install the regulator. Ensure the inlet and outlet are piped correctly, and the body flow arrow is in the correct direction. High-pressure connects to the inlet side. Apply pipe joint compound to male pipe threads only. On flanged connections, ensure the inlet and outlet flanges are properly aligned before installing the regulator. Tighten the flanges evenly and firmly.

NOTE: The preferred mounting position is with the diaphragm oriented horizontal, (see Typical Installation illustrations on Page 2). Inverting the regulator will change the set-point slightly and adjustment may be required, (see Set-Point Adjustment section on Page 5).

4. Install regulator vent tubing.

CAUTION

It is the user's responsibility to ensure that each regulator is individually vented and that common vent lines are not used. Regulators installed indoors should be vented to a safe place outside. The vent line should be as short as possible with minimum bends or elbows. Avoid moisture pockets. The vent line outlet must be protected against entry of water or other foreign matter, but must allow unobstructed venting. Route the vent in a safe place to avoid ignition source hazards in the event any combustable gases are discharged.

CAUTION

Models 243-RPC and 243-RPC-A require a control line (note the instruction tag affixed to the control connection at the pilot). Model 243-RPC-B has an internal control and therefore does not require a control line. (See Typical Installations illustration on page 4.)

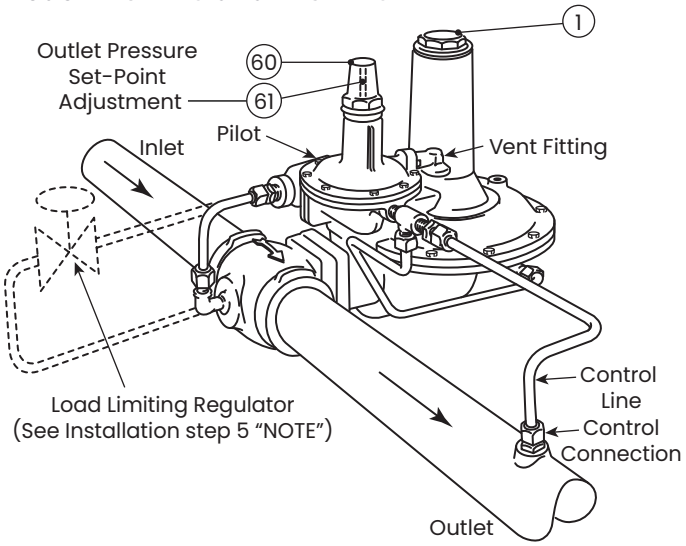
5. Run the control line at least five pipe diameters downstream of the regulator. The control connection in the outlet piping should be clean and smooth on the inside. It should be located in straight pipe clear of valves and fittings to avoid excess turbulence. Keep the control line clean on the inside and protect it from corrosion. Pitch it away from the regulator to avoid moisture pockets. Control line tubing or piping should not be less than ¼-inch in size and be adequately protected against breakage (regulators open fully if the control line is broken).

NOTE: A load limiting regulator should be used where outlet pressure is below 1 psi and inlet pressure exceeds 40 psi, (see Typical Installations illustrations below). Adjust set-point 3 to 5 psi above the 243-RPC set-point, (see Set-Point Adjustment on Page 5).

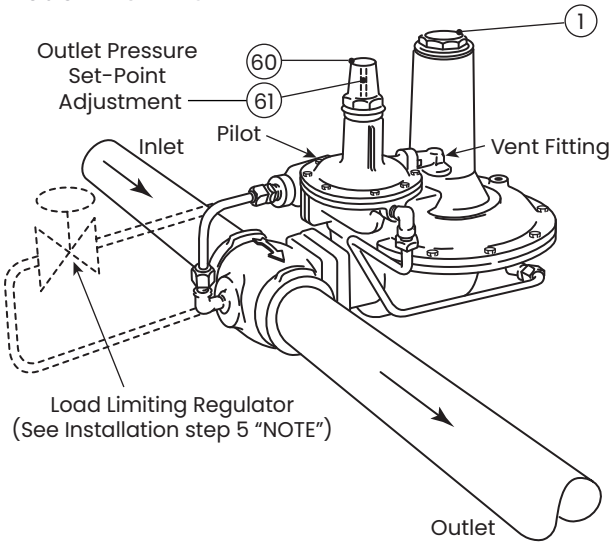
6. Ensure regulator is connected correctly, and pipe joints are tight.

Typical Installations

Model 243-RPC and 243-RPC-A



Model 243-RPC-B



Start-Up

1. Make notation of the regulators current set-point (set-point is the outlet pressure that the regulator is adjusted to deliver). The regulator is factory adjusted to the set-point specified on the order.
2. Close both the inlet and outlet valves. If used, the by-pass should also be closed.
3. Slowly and carefully open the inlet valve just enough to allow inlet pressure to build up until the regulator is fully pressurized.

CAUTION

With a pressure gauge, carefully watch the outlet pressure of the regulator. While inlet pressure builds up, outlet pressure must not exceed set-point by more than 1 psi. If regulator outlet pressure begins to exceed set-point by more than 1 psi, close the inlet valve. This indicates that the regulator is not closing properly. Check and make necessary corrections before proceeding with the start-up. If the regulator outlet pressure exceeds the set-point by more than 5 psi, (see section Maximum Emergency Pressures on Page 7).

4. Check installation for leaks before proceeding.
5. Slowly open the outlet valve to allow flow (approximately 250 standard cubic feet per hour (SCFH)). Safely dispose of this gas to the atmosphere.
6. With gas flowing, check for correct inlet and outlet pressures. It may be necessary to open the inlet valve more to maintain full inlet pressure. If a change in the outlet pressure is needed, adjust set-point, (see Set-Point Adjustment on Page 5).

NOTE: For the regulator to be fully operable, inlet pressure must be at least 1 ½ psi greater than the outlet pressure.

7. Check for tight shutoff (lock-up). To do this, reduce flow to zero by slowly closing outlet valve. Outlet pressure should not exceed set-point by more than 1 ½-inches w.c. (for set-points below 1 psi), ¼ psi (for set-points of 1 to 5 psi), and 1 psi (for set-points over 5 psi).
8. Slowly and carefully open both inlet and outlet valves fully. Watch pressure gauges.
9. Inspect fully operational regulator and its connections to ensure there are no leaks.

Set-Point Adjustment

(See illustration on Page 6 for component locations.)

The 243-RPC is factory adjusted as specified on the order. To change the set-point:

1. Remove pilot seal cap (**60**) and loosed lock-nut (**62**).

NOTE: Do not remove main cover cap (**1**). It is sealed and pressurized. It does not contribute to set-point adjustment.

2. Turn set-point adjustment (**61**) clockwise to increase or counterclockwise to decrease the outlet pressure.

NOTE: There should be gas flow through the regulator during adjustment, preferably small (approximately 250 SCFH). Do not adjust set-point when there is no flow.

3. When the desired set-point is achieved, retighten lock-nut (**62**) and install seal cap (**60**). Ensure tetraseal (**63**) is not damaged.

Shutdown

1. To take the regulator out of service, fully close the inlet valve.

NOTE: If the regulator feeds into piping that remains pressurized, fully close the outlet valve. Close valves slowly and carefully.

2. Ensure the regulator is entirely depressurized before servicing or removal. Safely dispose of any gas released to the atmosphere.

Servicing

(See illustrations on Page 7 for component locations.)

1. Follow shutdown procedure before disassembling, servicing, or removing regulator, (see Shutdown section above).
2. Make note of the location and position of all disassembled parts to ensure correct reassembly. Inspect each part and replace those that are worn, damaged, or otherwise unsatisfactory.
3. For access to valve (**21**) and orifice (**24**) loosen union bolts (**16**) and remove the diaphragm case assembly from the body. To remove valve (**21**), first remove hair cotter pin (**20b**). Orifice (**24**) unscrews from the body.
4. Upon completion of servicing, ensure the regulator and connections free of leaks.

CAUTION

Regulators are pressure control devices with numerous moving parts subject to wear that is independent upon particular operating conditions. To ensure continuous satisfactory operation, a periodic inspection schedule must be adhered with the frequency of inspection determined by the severity of service and applicable laws and regulations.

Changing Pilot Spring

(See illustration on Page 7 for component locations.)

The outlet pressure range of the 243-RPC is determined by the pilot spring (see Outlet Pressure Ranges table on Page 1).

1. Take regulator out of service, (see Shutdown on the left).

NOTE: Do not change main spring (**4**). It does not contribute to set-point adjustment.

2. Remove pilot seal cap (**60**), loosen lock-nut (**62**), and turn set-point adjustment (**61**) counterclockwise until spring compression is released.
3. Remove top cap (**64**), ferrule (**66**) and spring (**68**). Be careful not to lose ball (**67**).
4. Install new spring. During reassembly, Ensure the spring is seated correctly at both ends.
5. Adjust to the desired set-point, (see previous section, Set-Point Adjustment).

Servicing Main Valve and Orifice

(See illustrations on Page 7 for component locations.)

1. Take regulator out of service, (see Shutdown on the left).
2. For access to valve (**21**) and orifice (**24**), disconnect pilot tubing (**46**).

NOTE: On Models 243-RPC and 243-RPC-A disconnect control line.

3. Carefully loosen and remove four union bolts (**16**) and entire main diaphragm case assembly from body (**25**).
4. Remove hair cotter pin (**20**) and valve (**21**).
5. Use 1 ⅝-inch socket (thin-wall type) to unscrew orifice (**24**) from body.

NOTE: When replacing orifice (**24**) use moderate amount of pipe joint compound to orifice threads to ensure proper seal.

6. To replace o-ring (**19**), remove throat block (**18**) by first loosening two small Allen setscrews that lock it into place (use 1/16-inch Allen wrench).
7. To reinstall throat block (**18**), lubricate o-rings (**19**) and (**18a**) with moderate amount of Parker O-Lube or equivalent. Ensure it is pushed fully inwards into position. Then tighten the small Allen setscrews (use 1/16-inch Allen wrench).

NOTE: Refer to instructions, (see Throat Block section on Page 6), for Models 243-RPC-A and 243-RPC-B.

8. Ensure Tetraseal (**17**) is correctly positioned before tightening union bolts (**16**).

Servicing Main Diaphragm

(See illustration on Page 7 for component locations.)

1. Take regulator out of service, (see Shutdown section Page 5).
2. To replace main diaphragm (**11a**), remove cap (**1**), nuts (**50**), spacer (**51**), spring ferrule (**52**), spring (**4**) and rim bolts (**8**). Then disconnect the pilot tubing connections and remove top case. Unscrew threaded stem (**53**) and disassemble diaphragm assembly.

NOTE: When loosening and tightening threaded stem (**53**). Be careful to avoid distorting coupling-lever-stem assembly (**13**).

3. Coupling-lever-stem assembly (**13**) can be removed by first removing valve (**21**), (see steps 1 and 2 of previous section, Service Main Valve and Orifice).
4. Make certain reassembled parts are in their correct locations and rim bolts (**8**) are tightened evenly.

NOTE: Rim bolts (**8**) must be tight enough to prevent leakage yet not so tight that the diaphragm is crushed or damaged. The diaphragm must lay flat in the rim joint and must not be twisted or pinched. Care must also be taken while inserting rim bolts (**8**) to avoid damaging the diaphragm. To prevent tearing diaphragm material, tighten bolts by rotating nuts onto bolts. Do not rotate bolts.

5. When reinserting spring (**4**), tighten lock nuts (**50**) to a height of 1 ¼-inches measured from the top of spring ferrule (**52**), (see illustration on page 7).

NOTE: Do this only when main diaphragm case assembly is in place and union bolts (**16**) are tight, (see step 5 of previous section, Service Main Valve and Orifice).

Servicing Pilot

1. Take regulator out of service, (see Shutdown section Page 5).
2. For access to pilot valve (**75**), stem assembly (**73**) and orifice (**76**), disconnect tubing connections (**46**) from pilot diaphragm case. Remove four bolts (**83**) and separate entire pilot diaphragm case assembly from body (**84**) to expose valve (**75**) and orifice (**76**).
3. Remove hair pin cotter (**74**) to remove valve (**75**).
4. Use a ¾-inch socket (thin-wall type) to unscrew orifice (**76**).

NOTE: When replacing orifice, use a small amount of pipe joint compound on threads to ensure proper seal.

5. To remove stem assembly (**73**) and o-ring (**72**), pilot top case (**80**), and the diaphragm assembly, (see next section, Service Pilot Diaphragm). Remove lever (**71**) to remove stem assembly (**73**).

Servicing Pilot Diaphragm

1. Take regulator out of service, (see Shutdown section Page 5).
2. To replace pilot diaphragm assembly (**70**), remove seal cap (**60**). Then loosen lock-nut (**62**), and turn adjustment (**61**) counterclockwise until spring compression is released.
3. Remove top cap (**64**), ferrule (**66**), and spring (**68**).

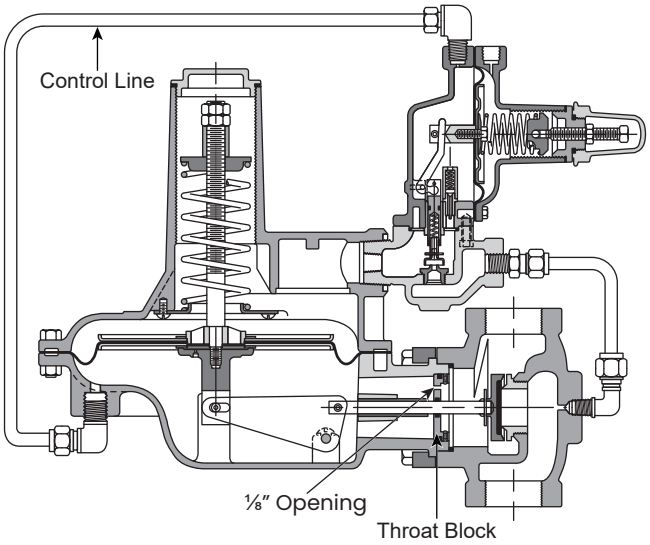
NOTE: Be careful not to lose ball (**67**).

4. Remove screws (**81**), top case (**80**), and diaphragm assembly by sliding it off the end of lever (**71**).
5. Reassembly is the reverse order of disassembly.

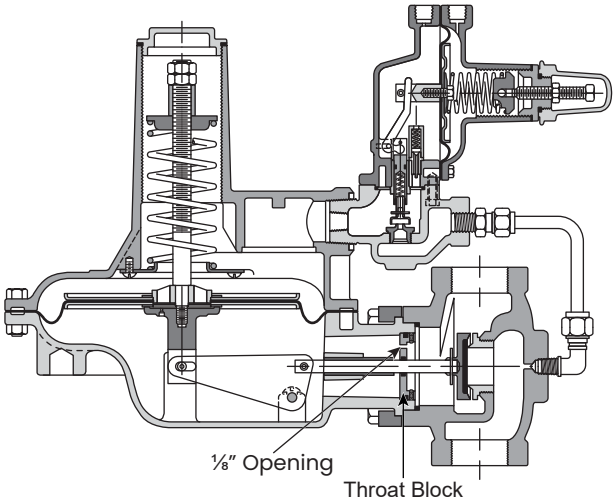
Throat Block

On Models 243-RPC-A and 243-RPC-B, throat block (18) must be positioned so that the ⅛-inch opening is aligned in the furthest downstream location to the body (25), (see illustrations below). For ½-inch and smaller orifices, use the 10° angled valve. For ¾-inch and larger orifices, use the 30° angled valve. Model 243-RPC does not have the ⅛-inch opening.

Model 243-RPC-A ⅛" Throat Block Opening (With Control Line)



Model 243-RPC-B ⅛" Throat Block Opening



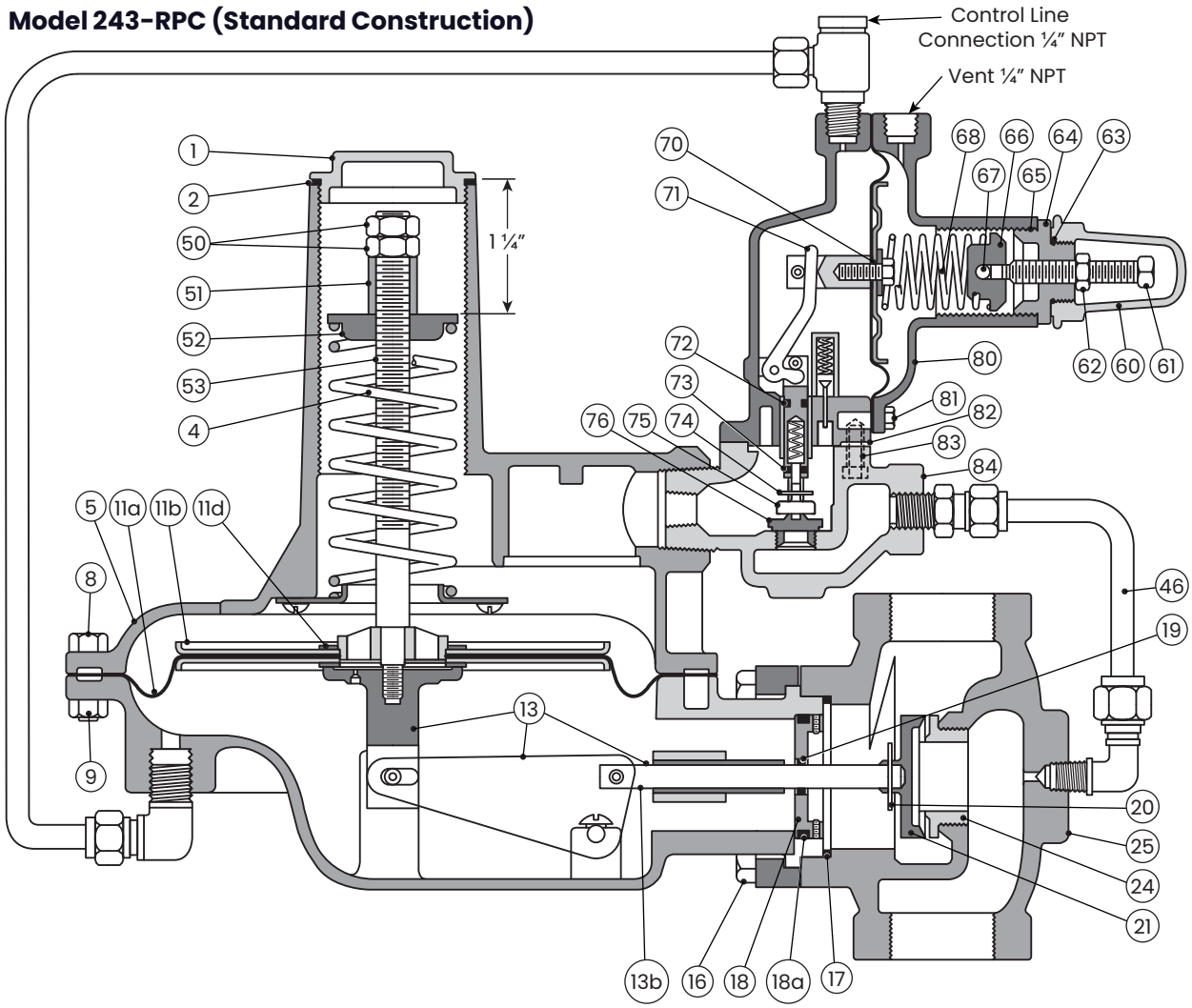
Condensed Parts List

The following are parts generally required in maintenance and servicing.

Illustration Number	Descriptions	Part Number
2	Tetraseal	951357
4	Spring (Green)	143-16-021-05
11a	Main Diaphragm	143-82-150-00
11b	Diaphragm Pan	143-82-017-00
11d	Seal Washer (Cement Seal Washer to Pan)	143-16-115-00
13	Coupling-Lever-Stem Assembly	143-82-530-03
17	Tetraseal	904075
18	Throat Block (243-RPC only)	143-16-008-00
	Throat Block ⅛" opening (243-RPC-A and 243-RPC-B only)	143-16-008-01
18a	O-ring	905809
19	O-ring	934007
20	Hair Cotter Pin	143-62-118-00
21	Valve 10°, Buna-N	143-16-511-09
	Valve 30°, Buna-N (Do not use in Model 243-RPC)	143-16-511-10

Illustration Number	Descriptions	Part Number
24	1 ¼" Orifice, Brass	143-16-023-03
	1" Orifice, Brass	143-16-023-02
	¾" Orifice, Brass	143-16-023-01
	½" Orifice, Brass	143-16-023-00
	⅜" Orifice, Brass	143-16-023-04
	¼" Orifice, Brass	143-16-023-10
63	Tetraseal	906515
65	Tetraseal	904076
68	Pilot Spring (See table Page 1)	-
70	Pilot Diaphragm Assembly	138-18-550-00
72	O-ring	934005
73	Pilot Stem Assembly	138-18-316-00
74	Hair Cotter Pin	906494
75	Pilot Valve (Poly-U Tan)	138-18-311-03
76	Pilot Orifi ce (Stainless Steel)	143-08-023-12
82	Tetraseal	904076

Model 243-RPC (Standard Construction)



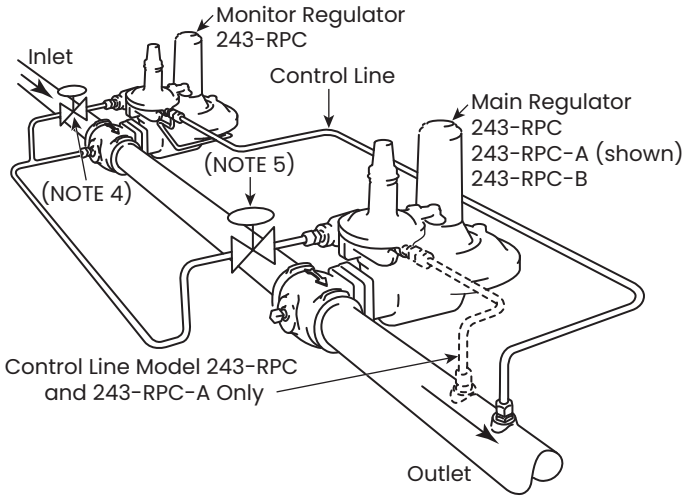
Monitoring

Monitoring is used to guard against a regulator failure causing excessive pressure downstream. A monitor set consists of two regulator in series, one of which is a standby. The main regulator controls normally. The standby monitor is adjusted for a somewhat higher setpoint pressure so it is normally open and allows the gas to fl ow freely. If a failure in the main regulator causes the outlet pressure to rise, the monitor takes over and controls outlet pressure to its somewhat higher setpoint. 243-RPC Regulators can be used for monitoring as illustrated.

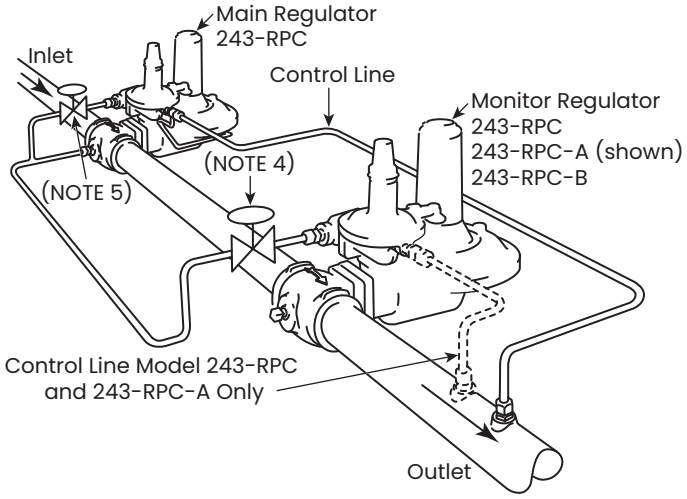
Note the following:

1. Either regulator can be used as the monitor (main regulator upstream and monitor downstream, or monitor upstream and main regulator downstream). Both arrangements have their advantages. Which arrangement is used depends on individual requirements and preferences.
2. The upstream regulator (whether the main regulator or monitor) must have a blocked throat with stem seal and an external control line. Only use the standard 243-RPC in the upstream position.
3. The downstream regulator (whether the main regulator or monitor) can be the same as 2 above or have internal control. A standard 243-RPC, 243-RPC-A or 243-RPC-B can be used.
4. For the monitor (whether upstream or downstream), a load limiting regulator should be used on the inlet supply to the pilot as illustrated. Adjust it for a set-point 3 to 4 psi higher than the monitor set-point.
5. For the main regulator, a load limiting regulator is necessary only for outlet pressures below 1 psi where inlet exceeds 40 psi. Adjust it for a set-point 3 to 4 psi higher than the main regulator set-point.
6. The capacity of the regulators in a monitor set should be calculated by taking 70% of the capacity of the smaller regulator in the monitor set or 70% of either unit if they are the same size.

Monitor 243-RPC Upstream



Monitor 243-RPC Downstream



Over-Pressurization Protection

The method of providing over-pressurization protection could be a relief valve, a monitor regulator, a shutoff device or any similar device. This protection must be provided for the downstream piping system and the regulator's low-pressure chambers to avoid the potential of over-pressurization due to a regulator malfunction or a failure of the regulator to lock up. The maximum allowable pressure is the lowest of the maximum pressures permitted by federal codes, state codes, Utility Solutions Group document USG-IG-038, and other applicable standards.

Maximum Emergency Pressure

The maximum pressure the regulator inlet may be subjected to under abnormal conditions without causing damage to the regulator are:

¼", ⅜", ½", and ¾" orifices ..... 175 psi
1" orifice ..... 110 psi
1 ¼" orifice ..... 80 psi

The maximum pressure that the control line connection on the Model 243-RPC and 243-RPC-A may be subjected to without causing damage to the internal parts of the regulator is:

Maximum control line pressure ..... set-point +5 psi

NOTE: Set-point is defined as the outlet pressure the regulator is adjusted to deliver.

CAUTION

If any of the pressure limits are exceeded, the regulator must be taken out of service and inspected. All damaged or otherwise unsatisfactory parts must be repaired or replaced.

The maximum pressure that can be safely contained by the diaphragm cases is:

Maximum pressure ..... 45 psi

NOTE: "Safely contained" means no leakage as well as no bursting.

Before using any of the above data, make sure this entire section is clearly understood.

Temperature Limits

The Model 243-RPC Regulator can be used for flowing temperatures from -20°F to 150°F.

Buried Service

The Model 243-RPC Regulator is not recommended for buried (underground) service.

Other Gases

243-RPC regulators are mainly used on natural gas. However, they perform equally as well on liquid propane gas (LPG), nitrogen gas (N_2), dry carbon dioxide (CO_2), air and others.

For capacities, multiply the table values by the following correction factors:

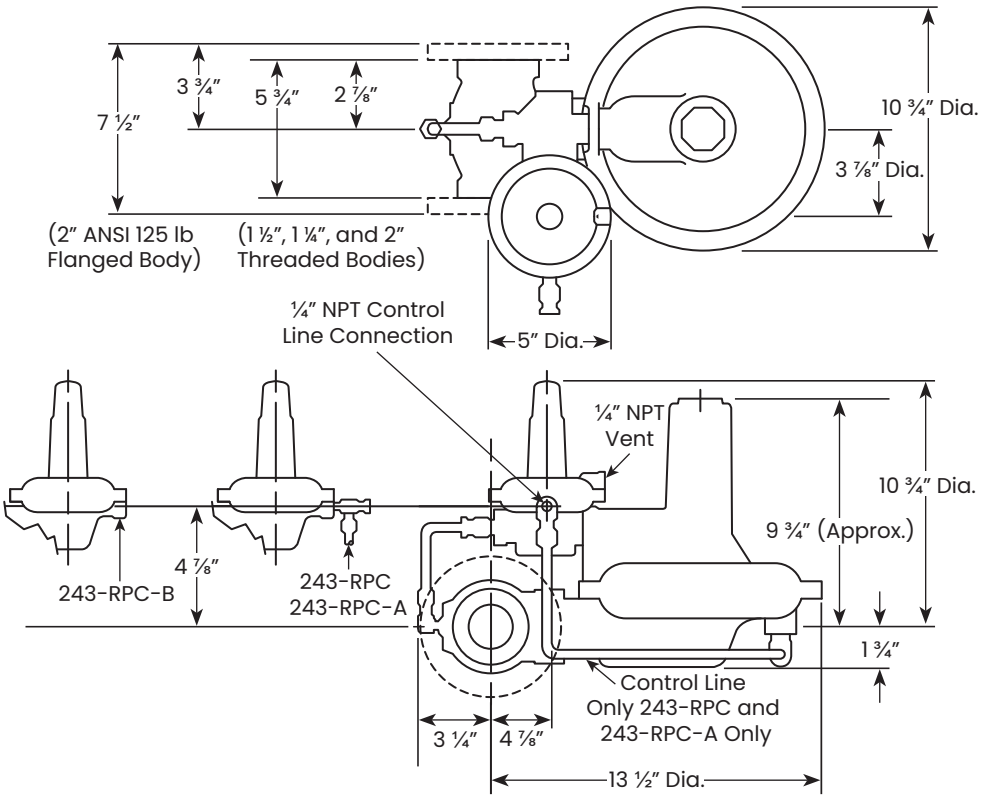
Type of Gas	Correction Factor
Air (Specific Gravity 1.0)	0.77
Propane (Specific Gravity 1.53)	0.63
1350 BTU Propane-Air Mix (Specific Gravity 1.20)	0.71
Nitrogen (Specific Gravity 0.97)	0.79
Dry Carbon Dioxide (Specific Gravity 1.52)	0.63

For other non-corrosive gases, use the following formula:

$$\text{Correction factor} = \sqrt{\frac{0.60}{\text{Specific gravity of the gas}}}$$

Special material may be available for certain corrosive gases. For details contact your Utility Solutions Group Representative or Authorized Distributor.

Dimensions



Construction Materals

Component	Material
Bodies	Cast Iron (ASTM A 126 Class B)
Diaphragm Cases	Die-Cast Aluminum Alloy
Diaphragms	Buna-A with Nylon Fabric Insert
Diaphragm Pans	Plated Steel
Main Diaphragm Coupling	Zinc Die-Casting
Orifice	Brass
Valve	Buna-N Soft Seat in Aluminum Holder
Stem	Brass
Levers	Plated Stamped Steel
O-rings and Tetraseals	Buna-N
Main Spring Seal Cup	Zinc Die-Casting
Pilot Adjustment Screw	Steel
Pilot Seal Cap	Cast Iron
Pilot Trim	Stainless Steel
Pilot Diaphragm Coupling	Plated Steel
Pilot Load Relief	Plated Steel
Pilot Tubing	Steel
Tubing Fittings	Brass

Metrication

Use the following information for metric conversions

Std. Meters³/hr × 35.31 = ft³/hr (SCFH)
Std. Ft³/hr (SCFH) × 0.0283 = m³/hr
kilograms/centimeter² (kg/cm²) × 14.22 = psi
psi × 0.0703 = kilograms/centimeter² (kg/cm²)
kilo-pascals (kPa) × 0.145 = psi
psi × 6.90 = kilo-pascals (kPa)
bars × 14.50 = psi
psi × 0.69 = bars
millimeters water (mm H_2O) × 0.0394 = in. w.c.
in. w.c. × 25.4 = millimeters water (mm H_2O)
millimeters mercury (mm Hg) × 0.535 = in. w.c.
in. w.c. × 1.868 = millimeters mercury (mm Hg)
in. w.c. × 27.7076 = psi
psi × 0.03609 = in. w.c.

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