P8100 Liquid Level Controller

The BelGAS^{CP} P8100 series is a mechanically operated liquid level controller with a flexible yet rugged design that allows optimal performance in the harshest environments. Trim options for the pilot valve, arm, spring, and displacer provide the versatility to set the controller to a wide range of spans, levels, and use in most fluids.

Left Hand Mount Shown

Applications

- Separators
- Compressor Scrubbers
- Tanks
- Dehydrators
- Other Process Equipment

Features

- **Snap or Throttle Pilot Valves:** The snap pilot provides an output of 0 PSIG to full supply within the desired span; while the throttle pilot provides a proportional output of 0 PSIG to full supply across the entire desired span.
- **Sealed and Vented Case:** The case is designed to keep the internal mechanism isolated from the environment while also allowing gasses from the pilot valves to escape.
- **Hybrid Pilot:** Is a snap-acting pilot that utilizes a soft seat design. This design allows for positive seat seal making the controller a non-bleed unit.
- **Field Reversible:** The unit can easily be reoriented to left or right handed and direct or reverse acting in the field using the instructions included.
- **Adjustable Level and Span:** With simple internal adjustments to the spring (level) and sensitivity arm (span) the unit can provide a wide range of options. Instructions are listed on the inside of the door for easy access.

Specifications

Pilot	Input (PSIG)	Output (% of Input)	Span (% of Displacer)
Snap	0-30/0-60	100%	5%-100%
Throttling	0-30/0-60	0-100%	5%-100%
Hybrid	0-30/0-60	100%	5%-100%

Electric Specification	
Code	UL and CSA Listed
"E" EXD-Q	10 amps, 125 or 250 VAC
	0.30 amp, 125 VDC
	0.15 amp, 250 VDC

Displacer		Minimum Allowable Fluid Specific Gravity	
Size (in.)	Arm Length (in.)	Top Level Control	Liquid Interface Level Control
1.88 dia. x 12	15	0.3	0.035

Connections	
Body	1 1/2" or 2" MNPT and Flanges
Pilot	1/4" FNPT

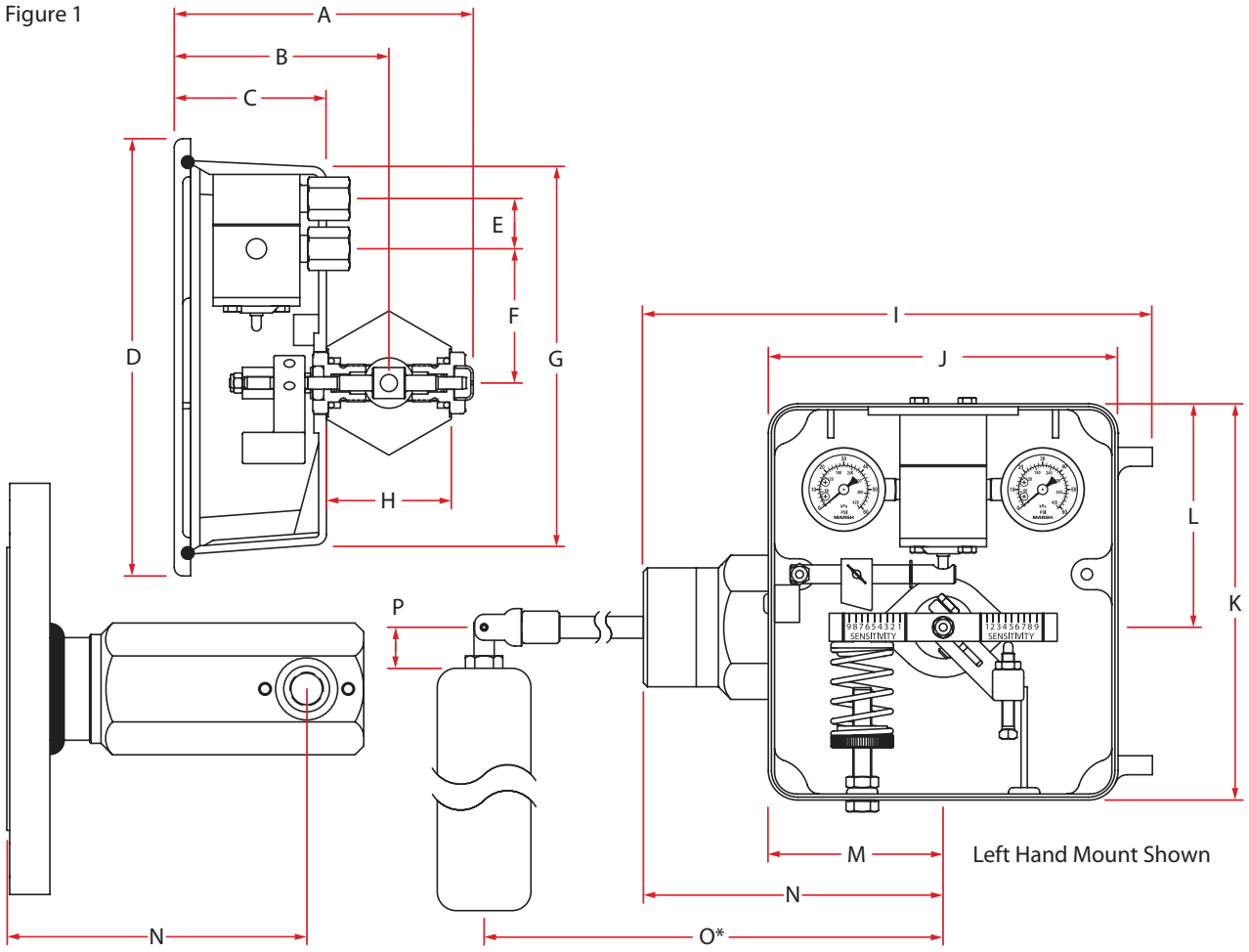
Displacer Material	Seal Material	Temperature Limits (˚F)	Max Pressure (PSIG)
PVC	Nitrile or Fluorocarbon	-40 to 140	6000
Acrylic		-40 to 180	6000
316 SS		-40 to 225	2000 at 180˚F 1500 at 400˚F

Materials of Construction

Part	Material
Displacer	PVC, Acrylic, or 316 Stainless Steel
Spring	Stainless Steel
Door/Case	Cast Aluminum
Body	1018 Carbon Steel
Torque Bar	Aluminum
Displacer Bar	316 Stainless Steel
Bearing Block	316 Stainless Steel
Bearing	Chrome Steel/Rubber
Flapper Bar	Stainless Steel
Level Adjustment Bar	Aluminum

Dimensional Data

Figure 1



A		B		C		D		E		F		G		H	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
6.00	152.40	4.30	109.22	3.05	77.47	8.75	222.25	1.00	25.40	2.69	68.33	7.57	192.28	2.50	63.50

I		J		K		L		M		N	O*		P	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm		in.	mm	in.	mm
10.19	258.83	7.00	177.80	7.93	201.42	4.47	113.54	3.50	88.90	See Below	16.00	406.40	0.82	20.83

*With 15" displacer arm.

N											
ANSI Rating	End Connection	Body Size (in.)									
		1.5		2		3		4		6	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
150	RF	—	—	6.50	165.10	6.56	166.70	6.56	166.70	6.50	165.10
	RTJ	—	—	6.69	169.88	6.88	174.63	6.88	174.63	6.69	169.88
300	RF	—	—	6.81	173.05	6.75	171.45	6.88	174.63	6.94	176.73
	RTJ	—	—	7.06	179.40	7.00	177.80	7.25	184.15	7.19	182.58
600	RF	—	—	7.19	182.58	7.13	180.98	7.50	190.50	7.63	193.68
	RTJ	—	—	7.25	184.15	7.31	185.75	7.56	192.10	7.69	195.28
900	RF	—	—	8.00	203.20	9.63	244.48	10.13	257.18	—	—
	RTJ	—	—	8.06	204.80	9.69	246.08	10.19	258.78	—	—
1500	RF	—	—	8.00	203.20	10.25	260.35	10.63	269.88	—	—
	RTJ	—	—	8.06	204.80	10.31	261.95	10.69	271.48	—	—
	MNPT	6.00	152.40	6.00	152.40	—	—	—	—	—	—

P8100 Part Matrix

P81	01					N					A	
Controller Case												
Standard Case	**01**											
Arm Length (in.)*												
7.75 **E** 15 **A**												
8 **F** 18 **T**												
9 **H** 22 **W**												
10 **K** 24 **Y**												
12.5 **N** 32 **5**												
End Connection (in.)												
1.5 (MNPT)		**14**										
2 (MNPT, RF, RTJ)		**16**										
3 (RF, RTJ)		**20**										
4 (RF, RTJ)		**24**										
5 (RF, RTJ)		**25**										
6 (RF, RTJ)		**26**										
8 (RF, RTJ)		**28**										
End Connection Type												
Screwed MNPT			**MS**									
Raised Face Flange (RF)			**RF**									
Ring Type Joint Flange (RTJ)			**RJ**									
End Connection Rating												
MNPT **0** ANSI 600				**6**								
ANSI 150 **1** ANSI 900				**9**								
ANSI 300 **3** ANSI 1500				**5**								
Materials • Body, Shaft and Bearing Block												
1018 Carbon Steel/316 Stainless Steel NACE						**N**						
Pilot												
Snap (Pneumatic On/Off)							**S**					
Throttling (Pneumatic Modulating)							**T**					
Hybrid Non-Bleed Pilot (Pneumatic ON/OFF)							**N**					
DPDT Electric Switch							**E**					
Mounting Controller Action**												
Left Hand/Direct								**LD**				
Left Hand/Reverse								**LR**				
Right Hand/Direct								**RD**				
Right Hand/Reverse								**RR**				
Seal Material												
Buna-N									**0**			
Fluorocarbon									**2**			
Displacer (in.)*												
1.88 x 12/ PVC										**A**		
1.88 x 12/Acrylic										**J**		
1.88 x 12/316 Stainless Steel										**0**		
Gauge Type (Range/Material)												
0-30 PSI/316 Stainless Steel											**3**	
0-60 PSI/316 Stainless Steel											**6**	
Electric (E Pilot Options Only)											**E**	
Enclosure												
Standard Case (8101)												**A**
Spring (Consult Factory for Selection of Spring Type)												
Light Duty (Green)	**L**	Heavy Duty (Yellow)	**H**									
Medium Duty (Silver)	**M**	X-Heavy Duty (Red)	**K**									

Pressure Gauge Repair Kit			
971P81	**0**	**0**	
Range			
0-30 PSIG Gauges (Left and Right)			**1**
0-60 PSIG Gauges (Left and Right)			**2**

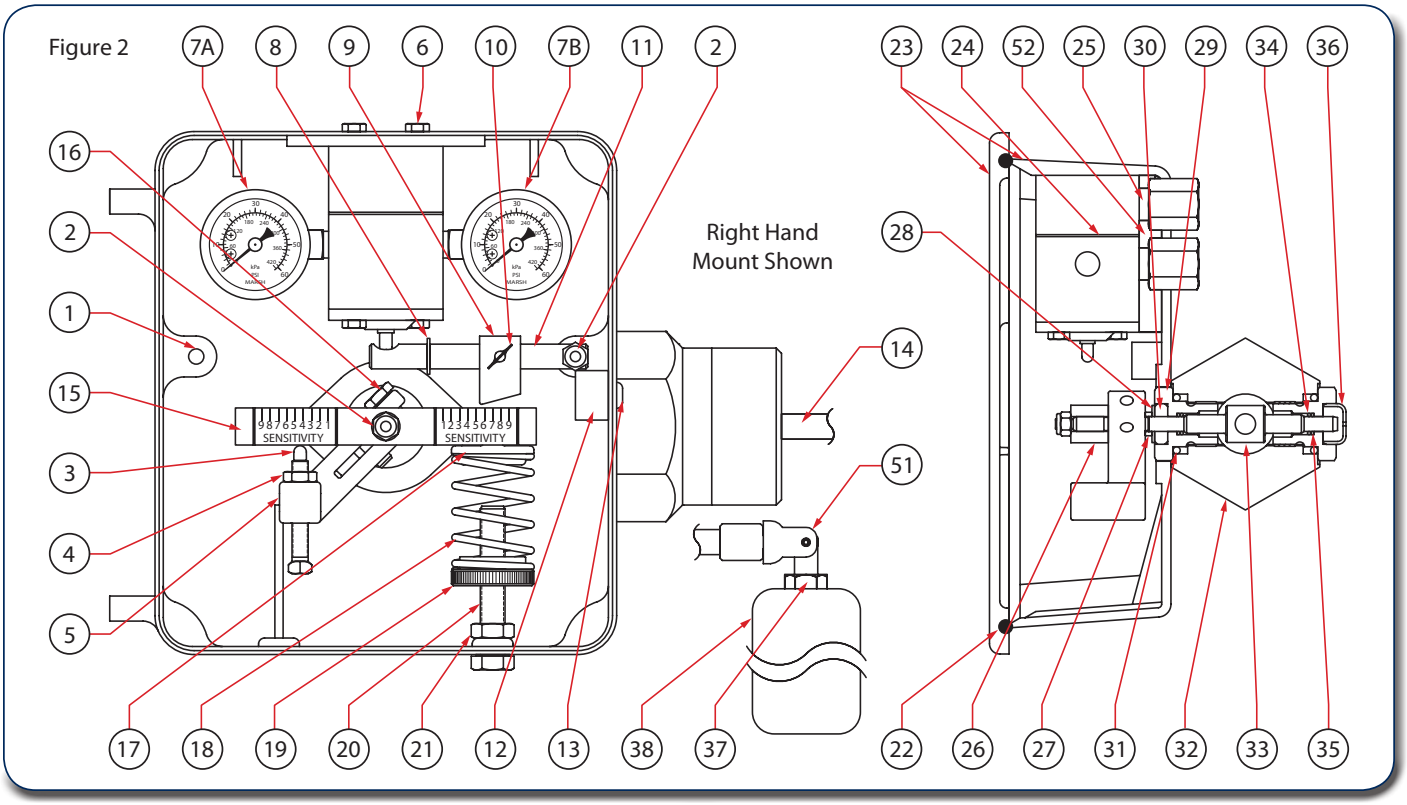
Pilot Valve Repair Kit			
971P81			
Part Combination			
Pilot Valve Only (w/connections & sponge)	**1**		
Pilot Valve w/Gauges (w/connections & sponge)	**2**		
Pilot Valve w/Gauges (wo/connections & sponge)	**4**		
Pilot Valve Repair Parts	**5**		
Valve Type			
Snap		**1**	
Throttle		**2**	
Hybrid		**3**	
Range			
0-30 PSIG Gauges (Left and Right)			**1**
0-60 PSIG Gauges (Left and Right)			**2**

Elastomeric Parts Repair Kit			
971P81			**0**
Kit Type			
Elastomeric Repair Kit	**3**		
Material			
Nitrile		**1**	
Fluorocarbon		**2**	

*More options available upon request.

**Left hand mount is designated by the displacer arm on the left hand side when looking at the front of the unit.

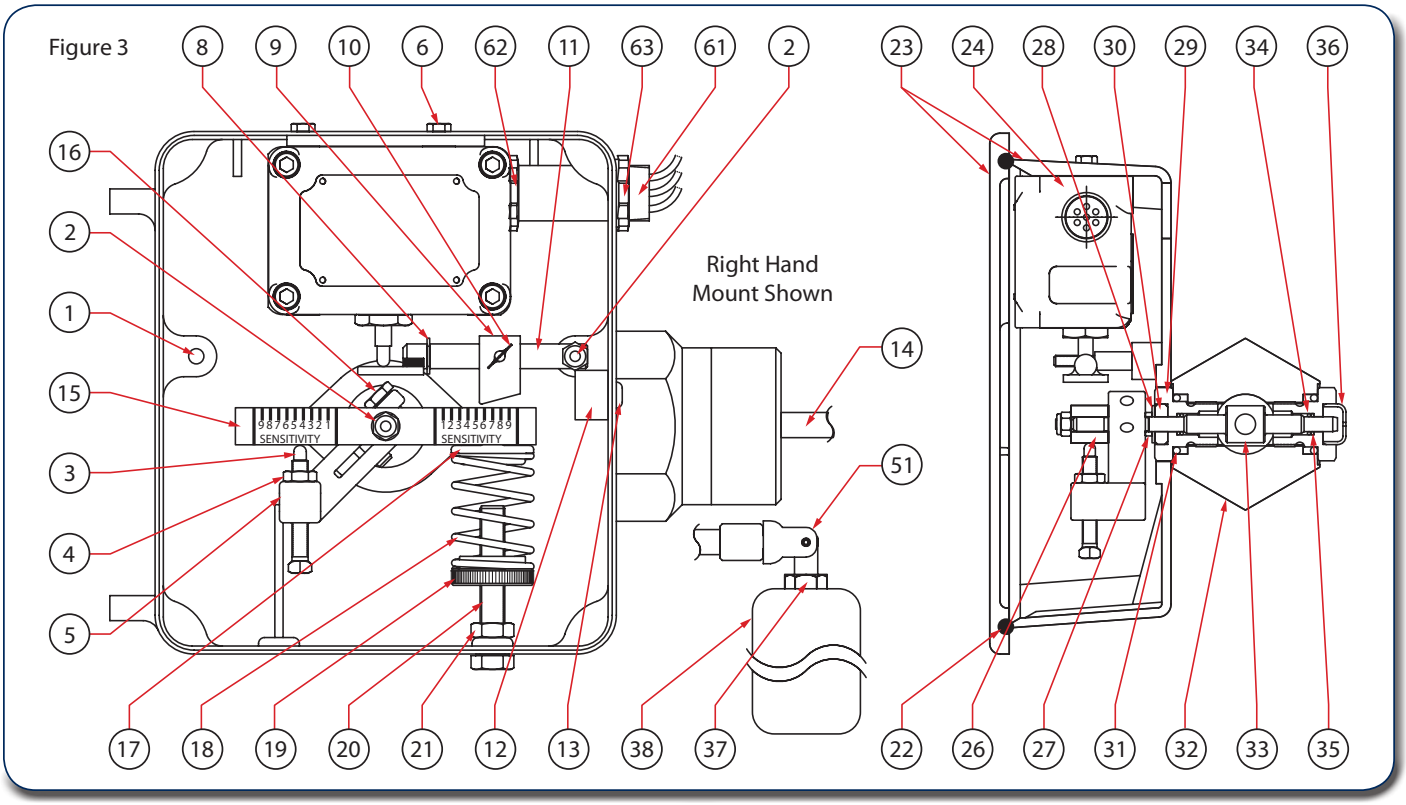
P8100 Parts List (Pneumatic)



Item	Description		Qty.	Part Number
1	Stud		2	657-018-000
2	Stop Nut		2	634-208-000
3	Adjustment Screw		1	648-558-000
4	Adjustment Screw Jam Nut		1	634-209-000
5	Level Adjustment Bar		1	670-038-000
6	Pilot Assembly Screw		2	648-562-000
7A	Left Gauge (0-30 & 0-60 PSIG)		2	See Repair Kits
7B	Right Gauge (0-30 & 0-60 PSIG)			
8	Retaining Ring		1	693-030-000
9	Fulcrum		1	694-002-001
10	Thumb Screw		1	648-565-000
11	Flapper Bar		1	670-037-000
12	Latch		1	607-310-000
13	Latch Rivet		2	645-031-000
14	Displacer Bar	7.75"	1	646-549-002K
		8"		646-549-009K
		9"		646-549-005K
		10"		646-549-004K
		12.5"		646-549-000K
		15"		646-549-001K
		18"		646-549-006K
		22"		646-549-003K
		24"		646-549-007K
		32"		646-549-008K
15	Sensitivity Adjustment Plate		1	632-568-000
16	Level Adjustment Screw		2	648-563-001
17	Upper Spring Retainer		1	643-217-000
18	Spring	Light	1	655-761-000
		Medium		655-762-000
		Heavy		655-763-000
		Extra Heavy		655-764-000

Item	Description		Qty.	Part Number
19	Lower Spring Retainer		1	643-219-000
20	Spring Bolt		1	648-564-000
21	Spring Bolt Jam Nut		1	634-209-001
22	Gasket		1	See Repair Kits
23	Door/Case		1	842-002-000
24	Pneumatic Pilot	Snap	1	See Repair Kits
		Throttle		
		Hybrid		
25	Pipe Adapter		2	See Repair Kits
26	Bar Torque		1	670-040-000
27	Spacer		1	654-191-000
28	Washer		1	662-431-000
29	Bearing Block		2	602-130-000
30	Radial Ball Bearing		1	602-132-000
31	Bearing Block O-ring	Nitrile	2	See Repair Kits
		Fluorocarbon		
32	Body (Other Options Available)	1.5" MNPT	1	664-414-000
		2" MNPT		664-411-000
		4" 150 RF		805-380-000
		4" 300 RF		805-381-000
33	Shaft		1	651-104-000
34	Shaft O-ring	Nitrile	2	See Repair Kits
		Fluorocarbon		
35	Shaft Back-up Ring		2	See Repair Kits
36	Bearing Block Cap		1	610-079-000
37	Hex Bushing		1	608-085-000
38	Displacer 1.88" x 12"	PVC	1	660-106-000K
		Acrylic		660-107-000K
		Stainless Steel		818-008-000K
51	Vertical Displacer Kit		1	821-000-003
52	Sealing Sponge		1	See Repair Kits

P8100 Parts List (Electric)

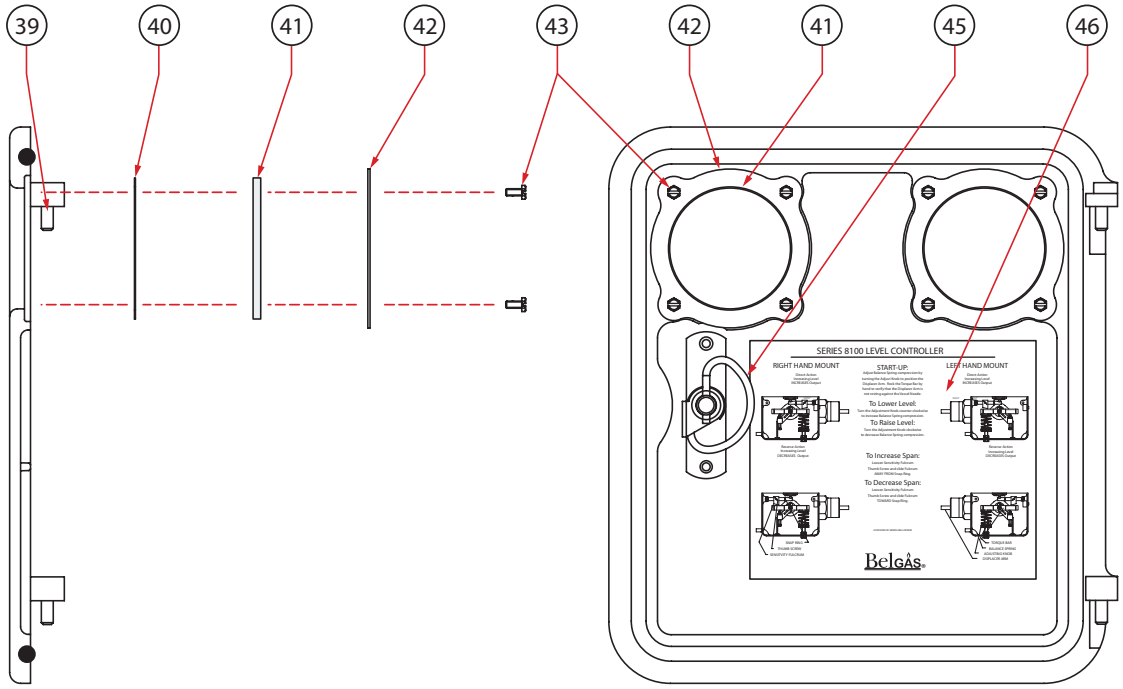


Item	Description		Qty.	Part Number
1	Stud		2	657-018-000
2	Stop Nut		2	634-208-000
3	Adjustment Screw		1	648-558-000
4	Adjustment Screw Jam Nut		1	634-209-000
5	Level Adjustment Bar		1	670-038-000
6	Pilot Assembly Screw		2	648-562-001
8	Retaining Ring		1	693-030-000
9	Fulcrum		1	694-002-001
10	Thumb Screw		1	648-565-000
11	Flapper Bar		1	811-084-000
12	Latch		1	607-310-000
13	Latch Rivet		2	645-031-000
14	Displacer Bar	7.75″	1	646-549-002K
		8″		646-549-009K
		9″		646-549-005K
		10″		646-549-004K
		12.5″		646-549-000K
		15″		646-549-001K
		18″		646-549-006K
		22″		646-549-003K
		24″		646-549-007K
		32″		646-549-008K
15	Sensitivity Adjustment Plate		1	632-568-000
16	Level Adjustment Screw		2	648-563-001
17	Upper Spring Retainer		1	643-217-000
18	Spring	Light	1	655-761-000
		Medium		655-762-000
		Heavy		655-763-000
		Extra Heavy		655-764-000
19	Lower Spring Retainer		1	643-219-000

Item	Description		Qty.	Part Number
20	Spring Bolt		1	648-564-000
21	Spring Bolt Jam Nut		1	634-209-001
22	Gasket		1	See Repair Kits
23	Door/Case		1	842-003-000
24	Electric Pilot		1	659-004-000
26	Bar Torque		1	670-040-000
27	Spacer		1	654-191-000
28	Washer		1	662-431-000
29	Bearing Block		2	602-130-000
30	Radial Ball Bearing		1	602-132-000
31	Bearing Block O-ring	Nitrile	2	See Repair Kits
		Fluorocarbon		
32	Body (Other Options Available)	1.5″ MNPT	1	664-414-000
		2″ MNPT		664-411-000
		4″ 150 RF		805-380-000
		4″ 300 RF		805-381-000
33	Shaft		1	651-104-000
34	Shaft O-ring	Nitrile	2	See Repair Kits
		Fluorocarbon		
35	Shaft Back-up Ring		2	See Repair Kits
36	Bearing Block Cap		1	610-079-000
37	Hex Bushing		1	608-085-000
38	Displacer 1.88″ x 12″	PVC	1	660-106-000K
		Acrylic		660-107-000K
		Stainless Steel		818-008-000K
51	Vertical Displacer Kit		1	821-000-003
61	Conduit Tubing		1	660-134-000
62	Conduit Nut		1	634-227-000
63	Sealed Conduit Nut		1	634-228-000

P8100 Parts List

Figure 4



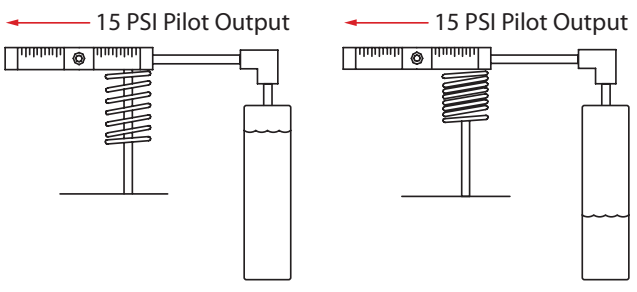
Item	Description		Qty.	Part Number
39	Hinge Pin		2	635-082-000
40	Lens Gasket		2	See Repair Kits
41	Lens		2	619-070-000
42	Lens Holder		2	643-216-000
43	Lens Holder Screw		8	648-561-000
45	Latch		1	669-032-000
46	Door Nameplate		1	632-569-000
47	Nameplate	Not Shown	1	632-566-000
48	Bearing Tolerance Ring		1	644-311-000

Item	Description		Qty.	Part Number
49	Screen	Not Shown	1	647-019-000
50	Body Assembly Screw		2	648-563-000
53	Washer		1	662-246-000
54	Body Gasket		1	See Repair Kits
55	Name Plate Drive Screw		2	648-573-000

Theory of Operation

The P8100 liquid level controller operates on the force balance principle. Force is applied to one side of the torque bar by the weight of a displacer type level sensing element. On the opposite side of the torque bar, this force is balanced by a compressed spring which produces an opposing force. As the level rises, the displacer increases immersion in the liquid. Produced buoyancy force results in relative weight decreases and decreased force on the torque bar. Forces are balanced as the torque bar rotates until it is detected by the pilot through a fulcrum mounted to the flapper bar to achieve desired controller output. A snap pilot is used for pneumatic on/off output signals, a throttle pilot is used for pneumatic modulating signals and electric pilots are used for SPDT or DPDT output signals.

Figure 5



Level Adjustment

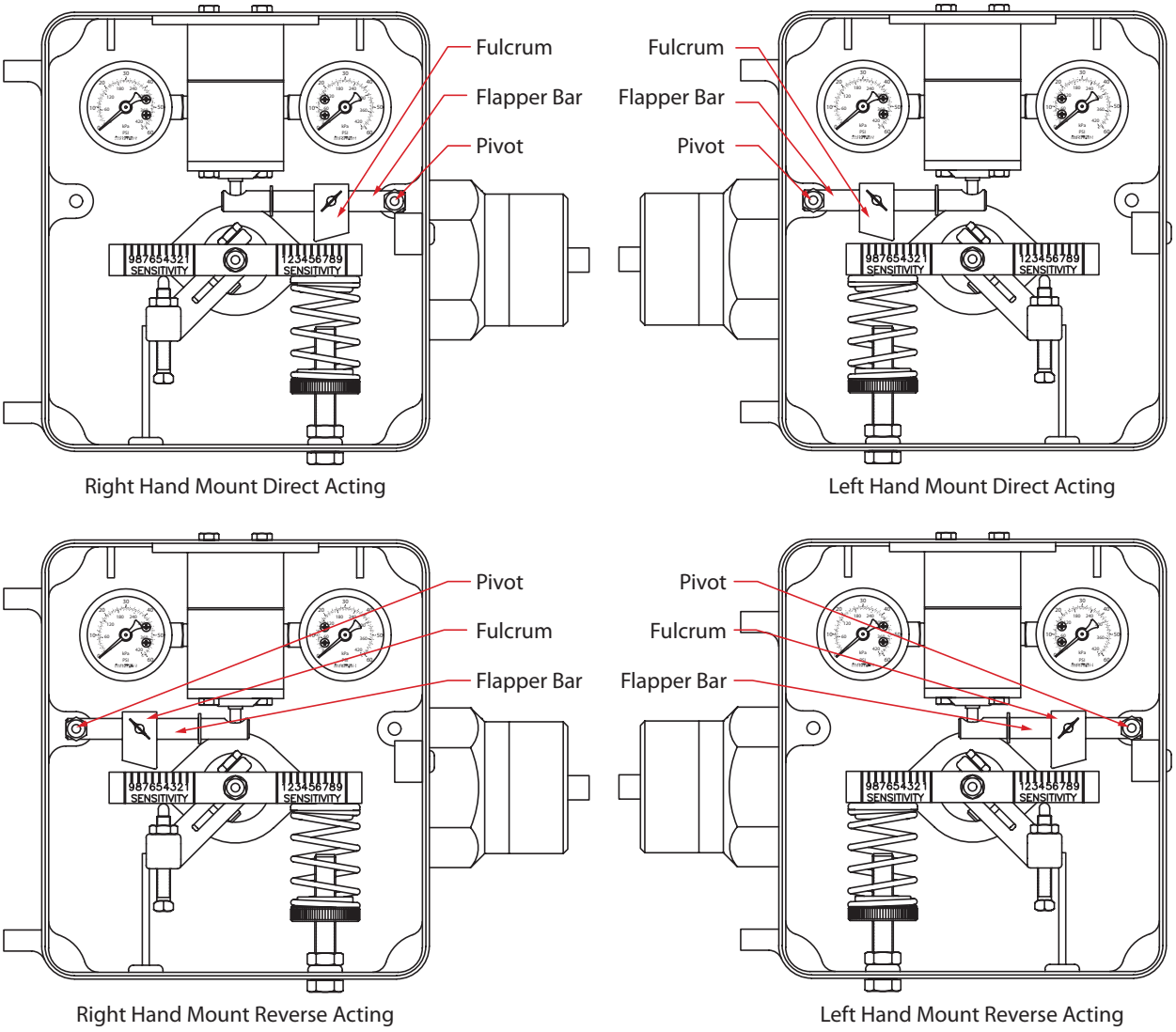
The liquid level control point is changed by adjusting compression to the balance spring using an adjusting knob. Compression to the balance spring is applied until the force of the spring to the torque bar is equal to opposing force caused by displacer weight.

The liquid level control point is increased by decreasing compression on the balance spring. Increased liquid level causes decreased relative displacer weight. Less opposing force is needed to achieve balance.

The liquid level control point is decreased by increasing compression on the balance spring. Decreased liquid level causes increased relative displacer weight. More opposing force to is needed to achieve balance. (Figure 5)

P8100 Controller Mounting & Action Configurations

Figure 6



Action Configuration

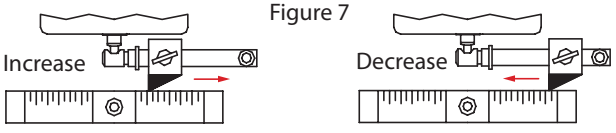
Controller action is determined by the position of the flapper bar as shown in Figure 6.
A direct acting controller has the flapper bar pivot point on the same side as the balance spring. Direct action occurs when the controller output flows in the same direction as the liquid level. The controller output signal will increase and decrease as the liquid level rises and lowers.
A reverse acting controller has the flapper bar pivot point on the oppisite side as the balance spring. Reverse action occurs when the controller output flows in the opposite direcion as the liquid level.

The P8100 controller can be installed using right hand or left hand mounting, as shown in Figure 6. Mounting orientation is easily changed in the field. When facing the front of the controller, the position of the level controller mounted to the unit determines the mounting style. If the controller is positioned on the right side of the unit, it is right hand mounting and if positioned on the left side of the unit, it is left hand mounting.

Proportional Band

Proportional band is the ratio of used displacer length to total displacer length. Used displacer length is changed input that causes a corresponding 100% change in controller output in the control valve position.
Example: If a change of 4”in level causes controller output to change from 0-100% with a 12”displacer, the proportional band is 33%. Changing the proportional band to 50% will achieve the same 100% change in and output would be 6”. Increasing proportional band from 33% to 50% decreased controller sensitivity from 4” to 6”.
Decrease proportional band and increase controller sensitivity by sliding the fulcrum away from pivot point toward the pilot. Increase proportional band and decrease controller sensitivity by sliding the fulcrum toward pivot point away from the pilot. (Figure 7)

Figure 7

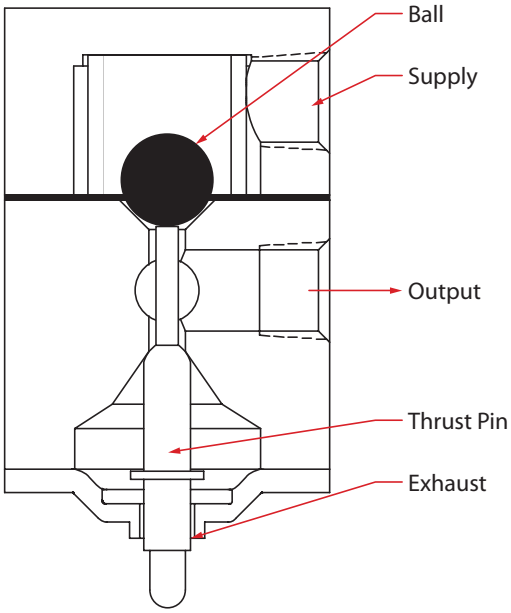


P8100 Pilot Operation

Snap Pilot Operation

The snap pilot is a two valve unit as shown in Figure 8. One valve takes in system supply pressure and the other valve is for system pressure exhaust. The ball controls supply gas flow into the pilot. Supply pressure holds the ball closed on the pilot seat and acts upon the seating area of the ball. Force from the flapper bar to the thrust pin increases to overcome the force that keeps the ball seated. The ball snaps off the pilot seat and allows supply gas to flow past the ball and through the pilot output port. The circular seating end of the thrust pin seats and closes the exhaust port at the same time the ball snaps open. The seating area of the thrust pin has a smaller seating area than the ball and will remain seated against the supply pressure until force on the thrust pin from the flapper bar decreases. At the same time an action occurs as force from the flapper bar on the thrust pin is removed. Supply pressure unseats the thrust pin and opens the pilot exhaust port. The ball reseats and closes off the supply port. The pilot's snap action comes from the differance in seating areas.

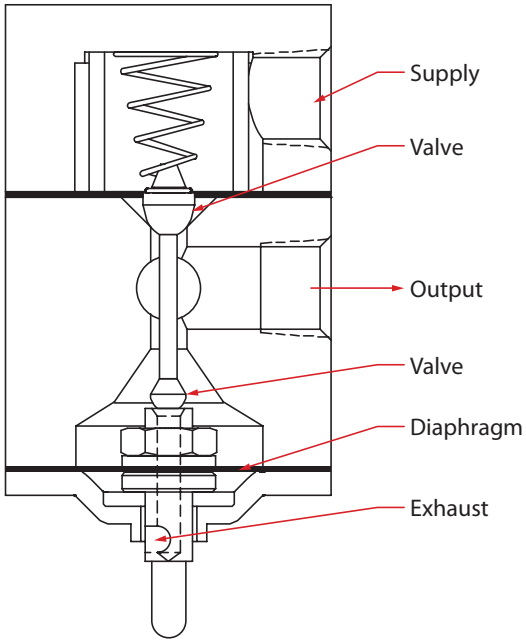
Figure 8



Throttle Pilot Operation

The throttle pilot is also a two valve unit and uses a resilient diaphragm with the valves to create a force balance pilot as shown in Figure 9.
Output supply pressure is put on the diaphragm and the diaphragm pushes back with equal force being applied to the thrust pin by the flapper bar to create force balance.
The throttle pilot functions the same way as the snap pilot but output pressure is in proportion to the force being applied to the lower seat by the flapper bar. Increasing force on the peanut will produce a proportionate increase in output pressure.
Changing force on the peanut requires the pilot to seek a new balance point by exhausting the supply output of the upper valve or unseating the lower valve to increase output pressure. While pilot is in balance, supply gas does not flow.

Figure 9



Contact your BelGAS^{CP} representative or go to www.BelGASCP.com to learn more about our products.

BelGAS CP Control Products

Trusted. Proven. Better.

8019 Ohio River Blvd.
Newell, WV 26050
Toll Free: 800-727-5646
sales@belgas.net
www.BelGASCP.com

2221 SE 69th Street
Oklahoma City, OK 73149
Toll Free: 800-833-3127

LTBCPP8100 - Rev 7/18
Qty 1000