PENTAIR

YARWAY

The Series 9100 ARC provides reliable, economical protection for centrifugal pumps against the serious damage from overheating and instability that can result from even a few minutes of low flow.

Features and benefits

- Self-contained valve functions as integral check valve, flow sensing element, bypass control valve, bypass actuator and multistage pressure letdown valve.
  - Eliminates high cost of installation and maintenance of complex conventional flow control loops.
  - Eliminates multiple vendors of components.
  - Eliminates cavitation in the valving and piping.
  - Only three pipe connections.
  - Eliminates any power source or instrument signal.
- Intrinsically safe design with all static seals, packless design (no stuffing boxes), no leak path to atmosphere, and no electrical wiring.
- The valve is ideal for broadpumping applications in the hydrocarbon industry.
- Totally mechanical self-powered design with no linkages, control signals, pilot valves, etc. that require maintenance.
- Maintenance and operating costs are dramatically reduced.
- Certified Test Curve supplied with each valve lot.
- Assures reliable performance from every valve.

Sizes and Connections

1", 1-1/2", 2", 3", 4", 6", and 8"
1"-8" Class 150-600 ANSI RF flanged
10" & 12" Class 600 ANSI RF
DN 25 to DN 300
DN 25 to DN 200 (PN 16-PN 100)
DN 250 & DN 300 (PN 100)

Ratings

ANSI Class 150-600 / DIN PN 16 - PN 100
Temperature Range -20°F to +500°F (-20°C to + 260°C)

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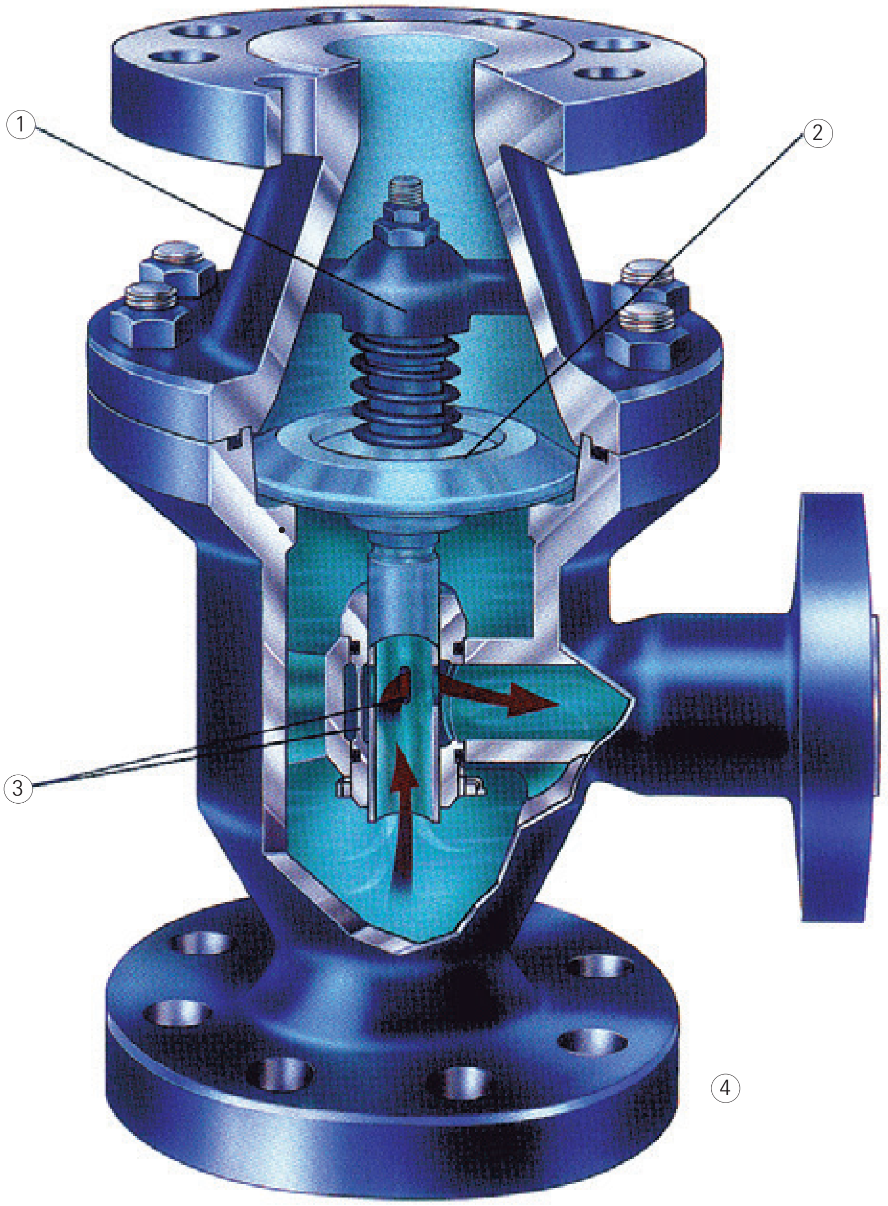


1 Stable design
Vibration guide structures at top and botteom of flow sensing disc provide full support to assembly. Top guide includes a snubber to minimize vibration.

2 Bult-in check valve
Spring-loaded against seat, the flow sensing disc acts as a main flow check valve.

3 Precise recirculation control
Characterized orifices in the bypass element provide accurate, modulated recirculation flow.

4 Second stage pressure letdown (optional-not shown)
Provides multistage pressure drop capability.

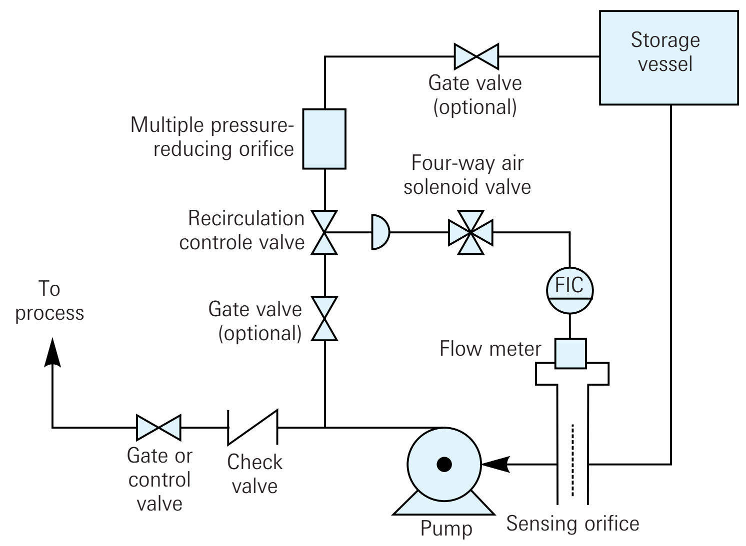
By providing recirculation flow to the inlet of the pump, the 9100 ARC assures a minimum flow for stable pump operation.

The modulating 9100 ARC creates operating economies in several ways. The ARC recirculates only the flow required to assure a minimum flow through the pump at all times. Under full process main flow demand, recirculation flow is not required. But as the process main flow demand decreases, recirculation becomes necessary. Unlike continuous recirculation, the ARC responds directly to this need. The use of an ARC valve eliminates the need to oversize the pump and prime mover. Such oversizing adds significantly to the capital cost of the pump and prime mover as well as to the cost of energy needed for operation.

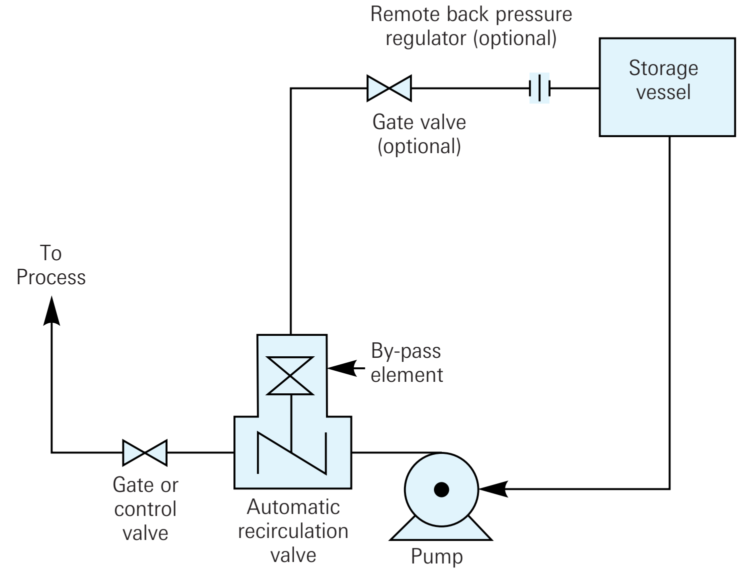
An ARC valve also saves most of the costs of a conventional multiple component flow control loop because the valve itself is a completely self-contained system: it is a flow sensing orifice; a check valve; a recirculation control valve and a pressure letdown device. As a self-contained system, it requires no instrument signal or power source, or any of the associated maintenance.

Manufactured and tested in the U.S.A., the 9100 ARC is one of an entire family of ARC (automatic recirculation control) valves. These valves have delivered consistent and reliable service for over three decades. In the U.S.A. alone, more than 10,000 ARC valves have been installed in power plants, refineries, and chemical plants.

Control loop system



Yarway system



How It Works

ARC Operation and Pump/System Curve

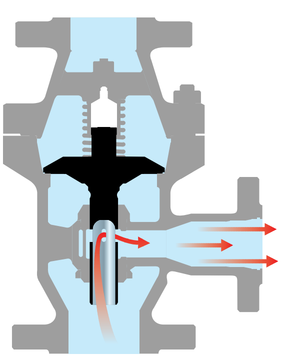
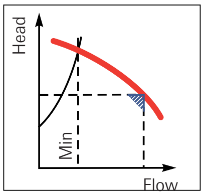


Fig. 3
No process flow
full recirculation



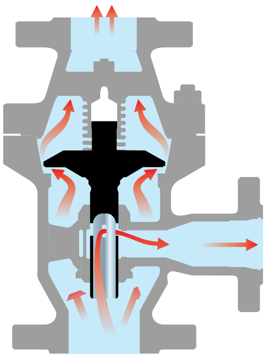
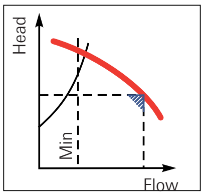


Fig. 4
Changing process flow
controlled recirculation



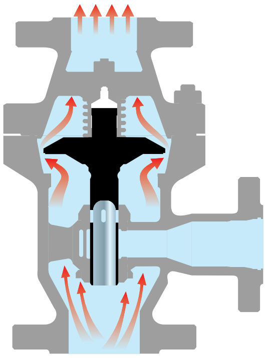
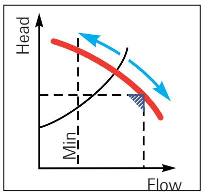


Fig. 5
Increased process flow
no recirculation



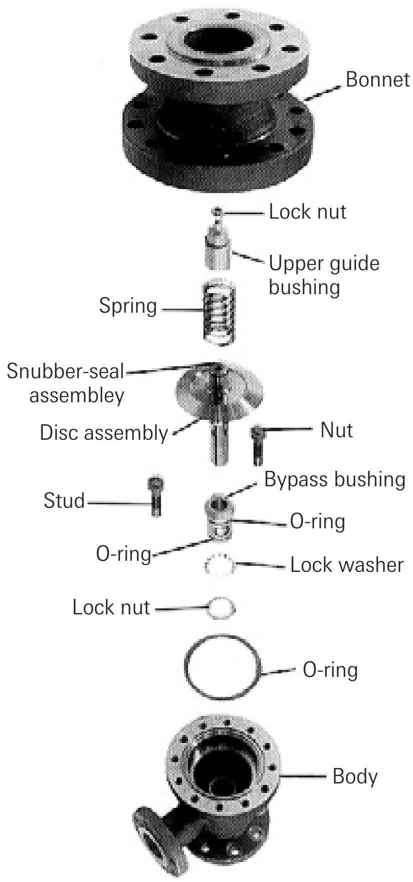
The heart of the recirculation valve is a main flow sensing check valve disc, which is flow sensitive, not pressure sensitive. The disc modulates to the demand for process flow at the same time assuring a minimum flow through the pump. This modulating characteristic results in a consistent, stable, and repeatable performance over full pressure range.

The disc is shown in the closed position in Figure 3. In this position there is no process flow and the bypass is full open. This protects the pump against planned or accidental "dead heading" which can result from a closed down stream pump isolation valve or process control valve.

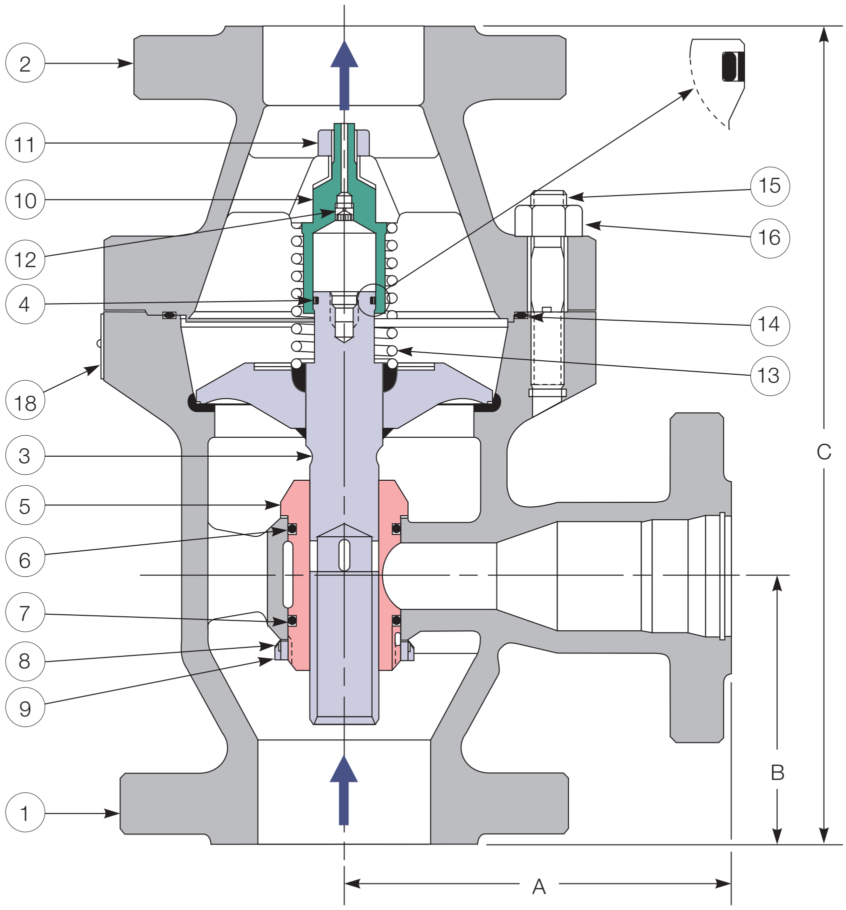
As the disc lifts (Figure 4) in response to an increase in flow to the process, the bypass element which is integral to the disc, closes the bypass flow orifices reducing recirculation flow. Recirculation flow is controlled with disc position. This modulation feature assures that the total of process flow and recirculation flow exceed the minimum flow through the pump as specified by the pump manufacturer.

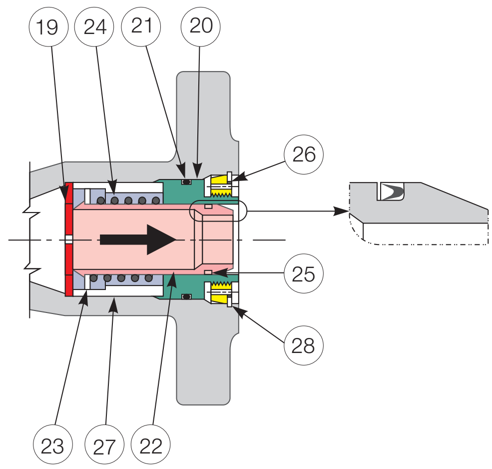
When the disc is set at full lift position, as in Figure 5, the bypass is closed. As process flow decreases, the reverse action occurs and the recirculation flow again increases. Flow enters the bypass element at the bottom of the disc assembly and is controlled by characterized orifices inside the disc stem. Flow continues through an annulus in the bypass bushing and is directed to the outlet of the valve.

The valve provides for single phase flow in the bypass eliminating the possibility of flashing or cavitation. This is accomplished by the valve design, and if necessary, an integral second stage pressure letdown device or external back pressure regulator.



SERIES 9100 ARC - 2" through 8" Size





Integral second stage pressure letdown (when required)
Available only on 600 Class 2" and larger valves

Part list

Item		Part	Material	Item		Part	Material
1		Body	ASTM A–216 GR. WCB	15		Stud	ASTM A–193 GR B7
2		Bonnet	ASTM A–216 GR. WCB	16		Nut	ASTM A–194 GR 2H
3	*	Disc Assembly (Bypass Element)	Stainless Steel	18		Nameplate	Stainless Steel
4	*	Snubber-seal Assembly	Teflon & Fluoraz	19	**	Seat	Stainless Steel
5	*	Bypass Bushing	Stainless Steel	20	**	Plunger Guide	Stainless Steel
6	*	O-Ring	Fluoraz	21	**	O-Ring	Fluoraz
7	*	O-Ring	Fluoraz	22	**	Plunger	Stainless Steel
8	*	Lock Washer	Stainless Steel	23	**	Spring Retainer	Stainless Steel
9	*	Lock Nut	Stainless Steel	24	**	Spring	Stainless Steel
10	*	Upper Guide Bushing	Stainless Steel	25	**	Seal	TFE
11	*	Lock Nut	Stainless Steel	26	**	Retaining Ring	Stainless Steel
12	*	Snubber Orifice	Stainless Steel	27	**	Spacer	Stainless Steel
13		Spring	Stainless Steel	28	**	Spiral Ring	Stainless Steel
14		O-Ring	Fluoraz				

Materials of Construction Options

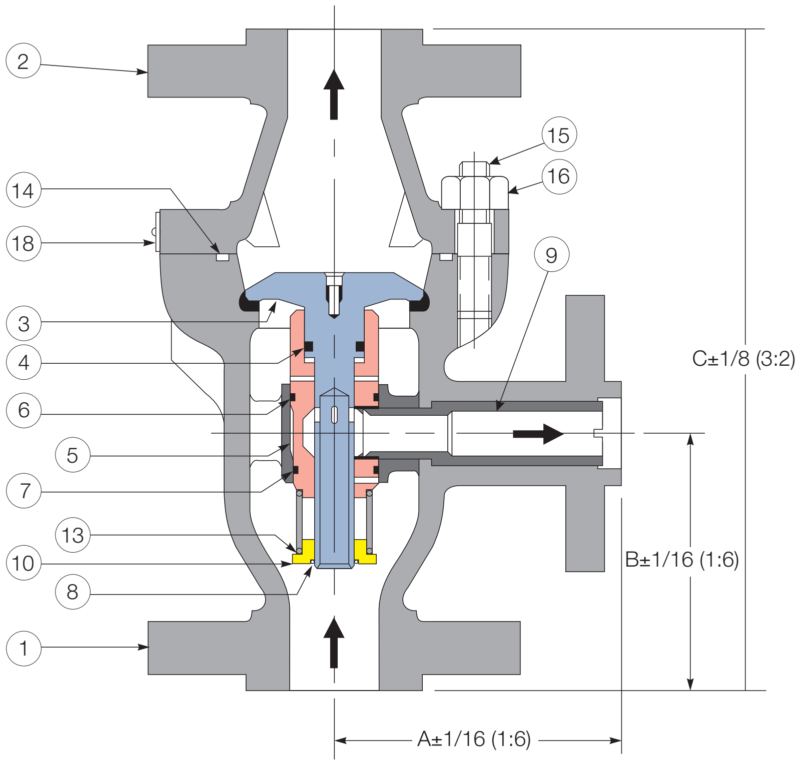
NACE Valve conforming to MR-01-75 External Back Pressure Regulator (if required)
Sea water service valve
DIN, BS, JIS, and RTJ flanges optional
Duplex Stainless Steel Construction,
6 Mo S/S Construction

Recommended spare parts

* Disc Assembly furnished with items 3 and 4. Bypass Bushing furnished with items 5, 6, 7, 8, and 9. Upper guide bushing furnished with items 10, 11, and 12.

** Second stage pressure letdown device spare parts available only as a replacement capsule (parts 19 through 28).

Series 9100 ARC - 1” and 1-1/2” Size



Parts List

Item	Part
1	Body
2	Bonnet
3 *	Disc
4 *	Snubber-seal Assembly
5 **	Bypass Bushing
6 **	O-Ring
7 **	O-Ring
8 **	Spiral Ring
9 **	Bypass Tube (St. Steel)
10	Spring Retainer
13	Spring (Inconel)
14	O-Ring
15	Stud
16	Nut
18	Nameplate

Items 3 through 14 recommended valve spare parts.

* Disc furnished with item 4 installed.

** Bypass Bushing furnished with items 6, 7, 8, and 9.

Note

See 2”-8” parts list for materials of parts not noted above.

Dimensions / Weights

Valve Size, in. (DN)		Class ANSI	Dimensions, in. (mm) A		B		C		Bypass Flange Size in. (DN)		Weight, lb (kg)	
1	(25)	150	4-1/2	(115)	4	(102)	10-1/2	(267)	3/4	(19)	27	(12.2)
		300	4-1/2	(115)	4	(102)	10-1/2	(267)			32	(14.5)
		600	4-3/4	(120)	4-1/4	(108)	11	(280)			34	(15.4)
1-1/2	(40)	150	4-1/2	(115)	4	(102)	10-1/2	(267)	3/4	(19)	30	(13.6)
		300	4-1/2	(115)	4	(102)	10-1/2	(267)			39	(17.7)
		600	4-3/4	(120)	4-1/4	(108)	11	(280)			40	(18.1)
2	(50)	150	5-15/16	(151)	4	(102)	11-1/2	(292)	1-1/2	(40)	45	(20)
		300	6-3/16	(157)	4-1/4	(108)	12	(305)			53	(24)
		600	6-1/2	(165)	4-5/8	(117)	12-3/4	(324)			55	(25)
3	(80)	150	7-1/8	(181)	5	(127)	15-1/4	(387)	2	(50)	97	(44)
		300	7-3/8	(187)	5-3/8	(137)	16	(406)			107	(49)
		600	7-3/4	(197)	5-3/4	(146)	16-3/4	(425)			110	(50)
4	(100)	150	9	(229)	5-15/16	(150)	18-7/8	(479)	3	(80)	205	(93)
		300	9-3/8	(238)	6-1/4	(159)	19-1/2	(495)			230	(104)
		600	9-3/4	(248)	6-3/4	(171)	20-1/2	(521)			250	(113)
6	(150)	150	11-11/16	(297)	6-7/8	(175)	21-3/4	(552)	4	(100)	310	(141)
		300	12	(305)	7-5/16	(186)	22-5/8	(575)			340	(154)
		600	12-1/2	(318)	8	(203)	24	(610)			450	(204)
8	(200)	150	17-11/16	(449)	11-1/2	(292)	34-1/2	(786)	6	(150)	580	(263)
		300	18-1/8	(460)	12	(305)	35-1/2	(902)			660	(299)
		600	18-13/16	(478)	12-13/16	(325)	37-1/8	(943)			770	(349)
10	(250)	600	Consult factory									
12	(305)	300	Consult factory									

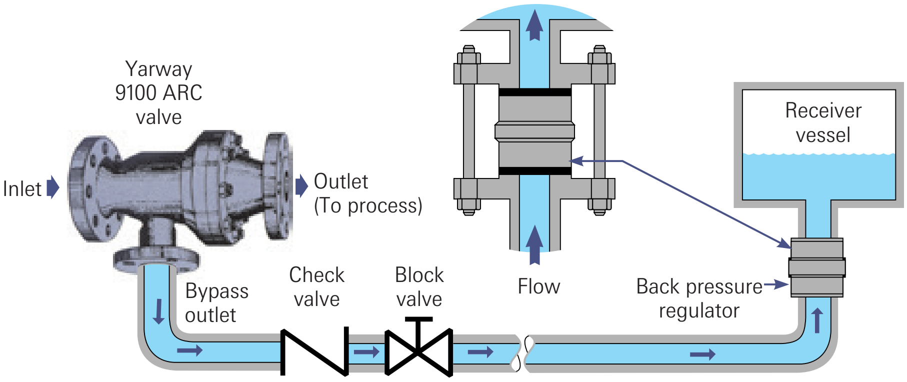
Back Pressure Regulator

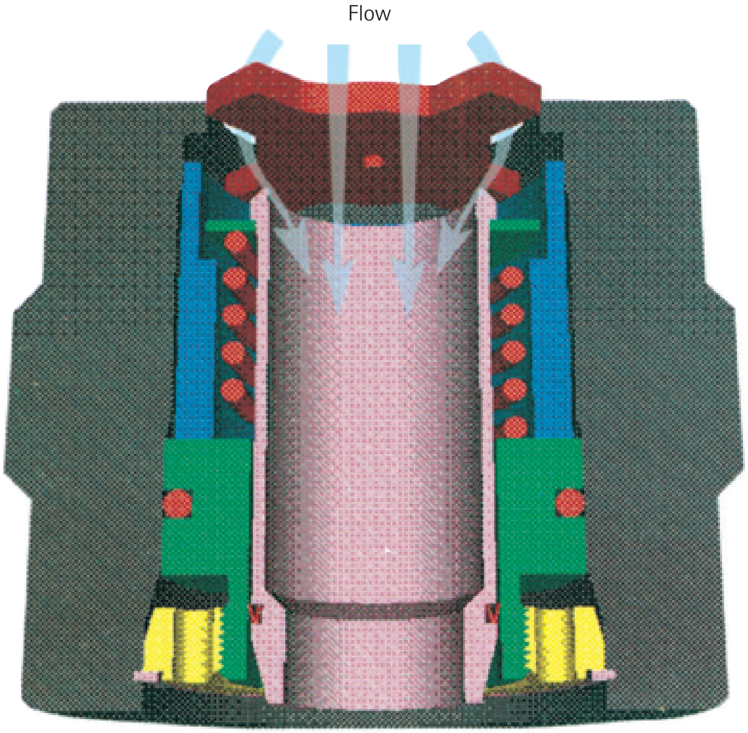
In high pressure pumping applications the system often does not provide adequate pressure in the bypass line to prevent cavitation or flashing. Either of these conditions is undesirable in that it can cause damage to both valves and the pipe system or cause a reduction in flow beyond the minimum desired, jeopardizing the pump protection system. All PRV's will experience a velocity induced recovery effect which will limit the amount of pressure drop a valve can take and cause a reduction in flow capacity.

The requirement of backpressure is generic to all pressure reducing applications. Pressure reduction even by multiple stage cascading such as in the 7100 Series ARC can minimize the requirement, however no valve design will redefine a fluid's physical properties.

This becomes especially important in modulating systems. A fixed orifice will not provide the proper backpressure at all flow levels. As the flow in the bypass line is reduced, the orifice becomes less effective. Proper system design should be used to optimize valve pressure reduction and consider all fluid dynamic effects downstream of any pressure reducing device. When adequate backpressure is not available downstream of a pressure reducing valve, vapor bubbles will form in the zone just downstream of the valve last stage control surface. This zone is defined as the "Vena Contracta" and represents the point of highest fluid velocity and lowest pressure. The potential for 1) damage to downstream piping components and 2) flow reduction exists from this point. When line pressure remains below the fluid vapor pressure, any existing bubbles will remain and expand as piping friction further reduces line pressure. This can be defined as a "FLASHING CONDITION" and is characterized by a polished appearance on affected surfaces. When the line pressure drops below the fluid vapor pressure and then recovers, any entrapped vapor bubbles will collapse (implode). This is defined as a "CAVITATING CONDITION" and is characterized by a cinder like appearance on affected surfaces... The resolution of either condition is best addressed by eliminating vapor formation. This can be asured by the provision of adequate backpressure. The "Backpressure Factor" is key to reliable system operation and must not be ignored in piping design considerations.

As such we feel it is the obligation of a responsible Automatic Recirculation Control Valve manufacturer to analyze the system needs and supply a Back Pressure Regulator (BPR) when it is warranted by the laws of fluid dynamics. For on/off systems this could be a simple orifice, but for modulating conditions it must be a device like the BPR noted herein.

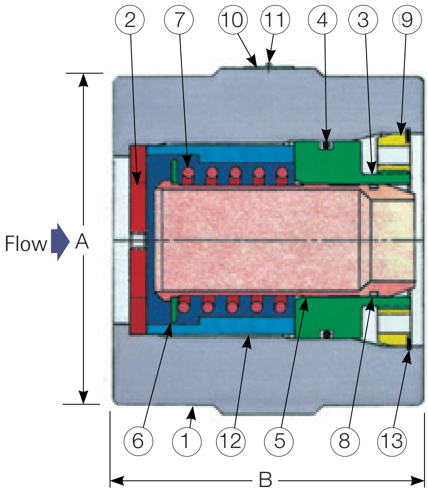




Parts/Materials

Item	Part	Material
1	Body	ASME SA105
2	Seat	Stainless Steel
3	Plunger Guide	Stainless Steel
4	“O”-Ring	Fluoraz
5	Plunger	Stainless Steel
6	Spring Retainer	Stainless Steel
7	Spring	Inconel
8	Seal	TFE
9	Retaining Ring	Stainless Steel
10	Nameplate	Stainless Steel
11	Drive Screw	Stainless Steel
12	Spacer	Stainless Steel
13	Spiral Ring	Inconel

Back Pressure Regulator
1-1/2” through 6”



BPR Size	Dimensions, in. (mm) A	B	Approx. Weight, lb. (kg)
3/4”	4 (101.6)	2-3/8 (60.3)	4 (1.8)
1-1/2”	2-7/8 (73.0)	2-7/8 (73.0)	5 (2.3)
2”	3-5/8 (92.1)	3-3/8 (85.7)	8 (3.6)
3”	5 (127.0)	4-5/8 (117.5)	21 (9.5)
4”	6-3/16 (157.2)	5-3/4 (146.0)	40 (18.1)
6”	8-1/2 (215.9)	7-1/2 (190.5)	96 (43.5)