PENTAIR

A self-contained system, the 7100 Series ARC® valve has a pressure reducing trim and is in-line repairable.

General Description

The 7100 Series ARC® Valve has been specifically designed and manufactured to meet the demands and operating philosophies of today's high pressure centrifugal pumps. Many power plants are now operating under peaking or throttled conditions, which in turn requires the pumps to operate at less than their optimal design and performance levels. As a result, they are subject to serious damage from hydraulic, mechanical and/or thermal abnormalities.

The 7100 Series ARC® provides the most economical and reliable system to protect pumps from the dangers of low and/or reverse flow. It combines the functions of a check valve, flow sensing device, minimum flow control and pressure letdown into a single valve. The ARC® valve requires no external use of power and installs easily with only three connections. By eliminating at least seven major interdependent components, that ordinarily would be necessary to provide this protection, we have not only simplified the system, but made it much more reliable.

Our quest for ensured pump flow protection does not, however, end at just providing the hardware. We analyze the complete pumping system and piping. Very often the application's fluid hydraulics and dynamics compromise the effectiveness of the protection system. A thorough analysis of conditions up and downstream of both the pump and ARC® valve will provide us with solutions to "reliable" protection... things such as 1) proper pressure throughout the complete bypass piping to prevent any level of flashing or cavitation; (a condition that is prevalent in all pressure breakdown systems); 2) improved bypass manifold arrangements; 3) good piping layouts that promote stable operation; 4) stable and reliable interaction of pump and valve at less than optimal conditions of operation.

The 7100 Series ARC® is made to operate in a low flow condition for extended periods without damage to the valve or bypass piping system. The need is no longer just for emergency, short duration shut down, but for extended operation at low flows.

Our check and bypass/pressure letdown elements are specifically designed to operate under these difficult conditions. There is no need for an auxiliary manual by-pass system which only serves to negate the advantage of an automatic system.

The design of the 7100 Series ARC® is the result of 27 years of experience and over nine thousand ARC® valves in service. And to help ensure every valve works properly, functional tests are performed and the valves are then certified for the application.

7100 Series ARC® (ANSI Class 900-1500)

Features and Benefits

Self-contained valve provides the functions of: Check valve, flow sensing element, bypass flow control valve and multi stage pressure letdown device.

- Simplifies the system.
- Reduces cost of Engineering, Administration, Installation and Maintenance of complex, conventional flow control valve and instrument systems.
- Eliminates requirement for external source of power and/or instrument signals.

One valve replaces seven interdependent components

- Eliminates multi vendor responsibility and coordination.
- Enhances system reliability.

Patented bypass flow control and pressure letdown system

- Helps ensure fail safe operation and pump flow protection.
- Eliminates cavitation, flashing, choked flow and/or damage in bypass line.

Complete in-line accessibility

- Allows for adjustment, inspection and/or maintenance of all internals without removing the valve from the line or disrupting any piping.

Field adjustability

- Enables user to change main flow, bypass flow and switch point.
- Accommodates changes in pump operation.

True bypass flow modulation

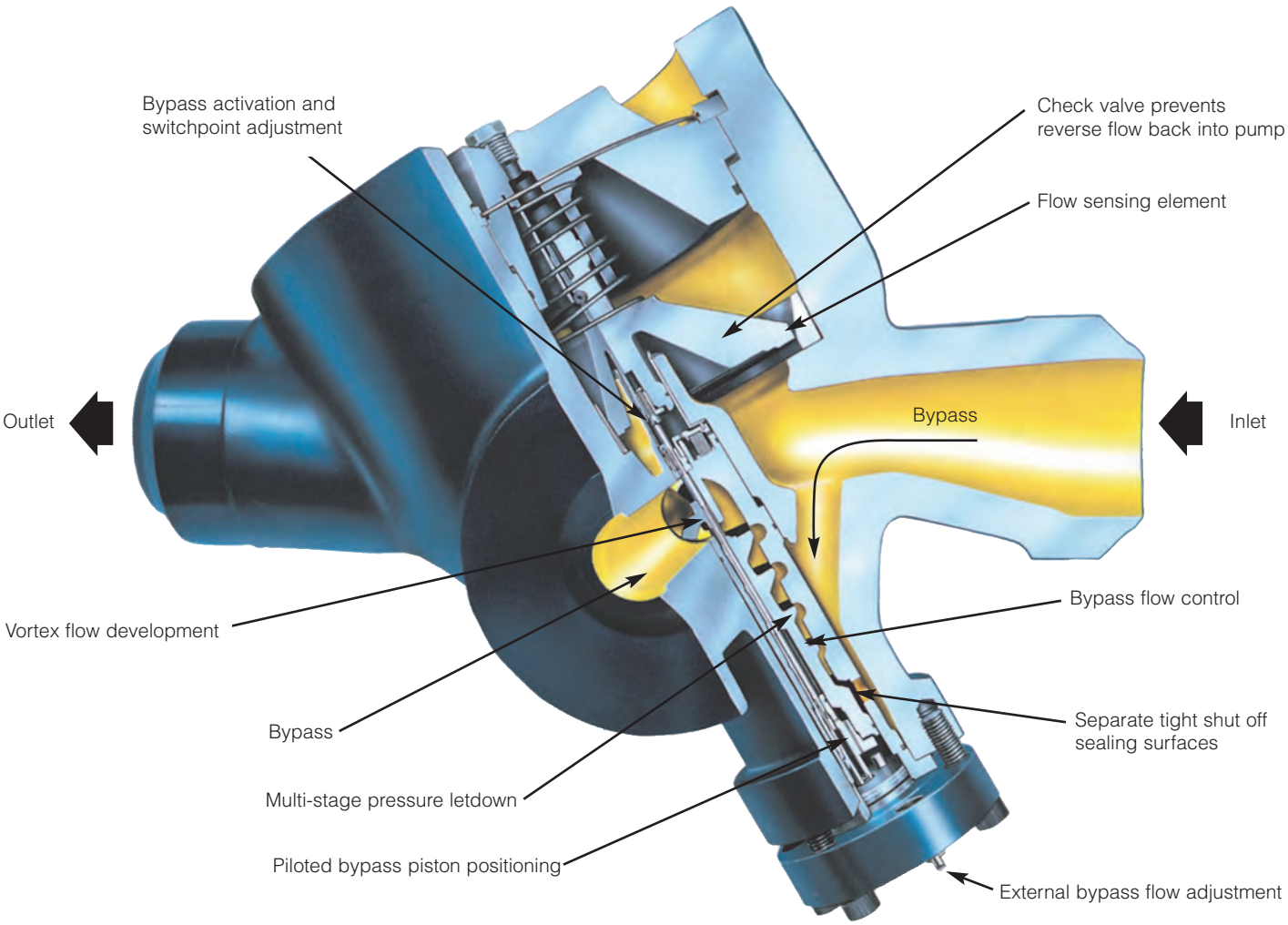
- Help ensure proper minimum pump flow.
- Provides a smooth transition from main flow to bypass flow, thus eliminating piping shock.
- Conserves energy.

Valves are completely functional tested

- Valve is certified correct for its application.
- Helps ensure reliable performance from every valve.

One Valve – Four Functions

- Check valve – prevents reverse flow.
- Instrumentation – flow sensing and bypass activation.
- Bypass flow control – helps ensure minimum pump flow.
- Pressure letdown – reduces pressure of fluid returning to its sources.



ARC® system simplifies installation:

- One piece to be installed
- Only three connections
- Eliminates at least seven welds
- No electric or air supply lines to install
- No instrumentation hook up or calibration
- No special piping requirements

ARC® system increases reliability:

- Specifically designed for fail safe operation
- Fewer moving parts cuts down failure potential
- No external source of power to jeopardize operation
- Single vendor responsibility

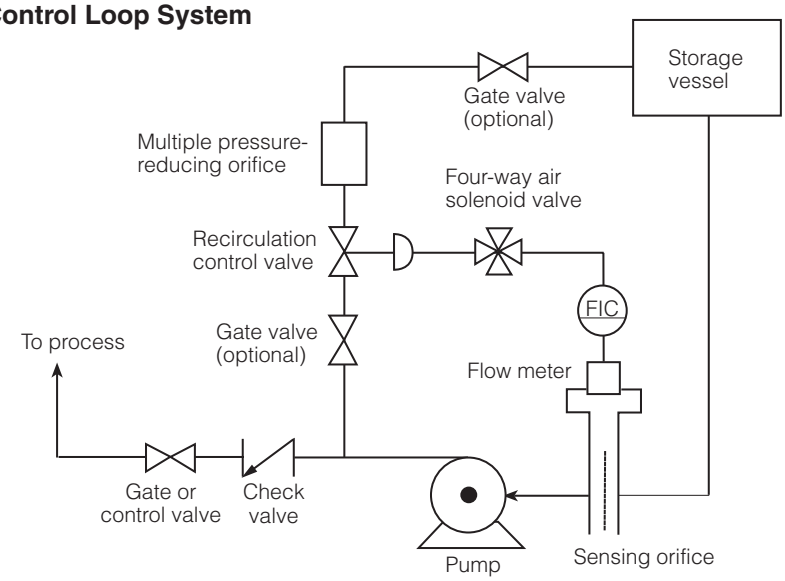
ARC® system eliminates:

- Sensing orifice
- Instrumentation
- Air/electric supply
- Check valve
- Bypass flow control valve
- Pressure letdown valve

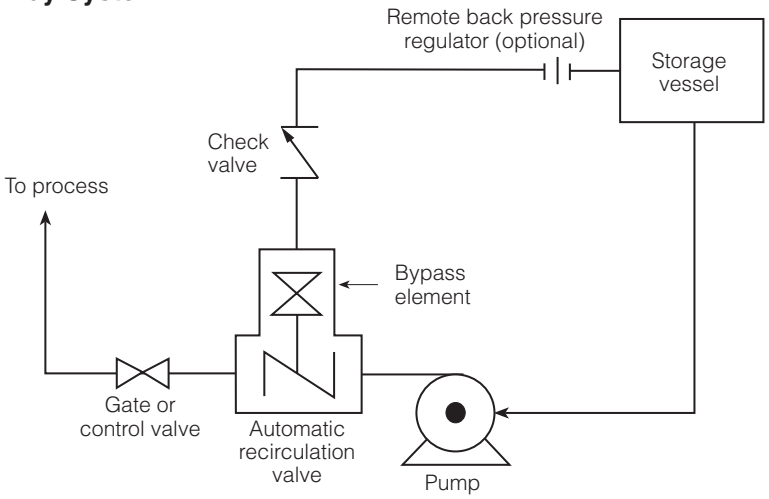
ARC® reduces maintenance:

- All internals are in-line accessible
- Wear points such as levers and linkages are eliminated
- No external source of power required
- Actuators and controls are eliminated
- No calibration required
- No dynamic seals or packing

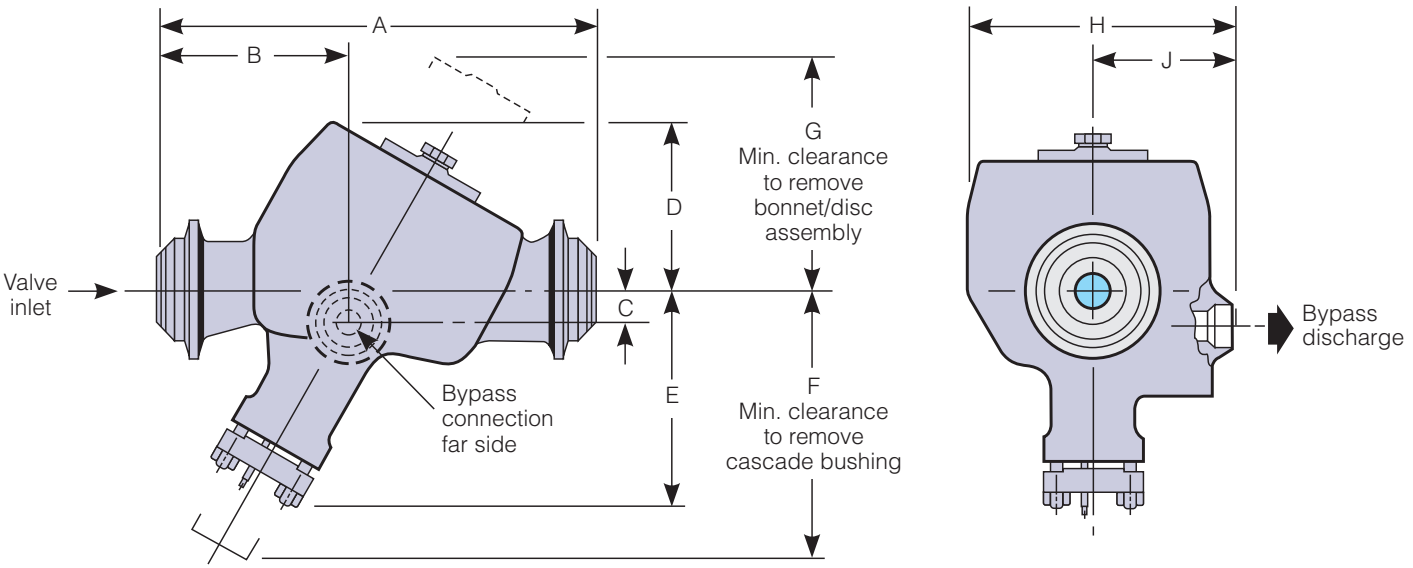
Control Loop System



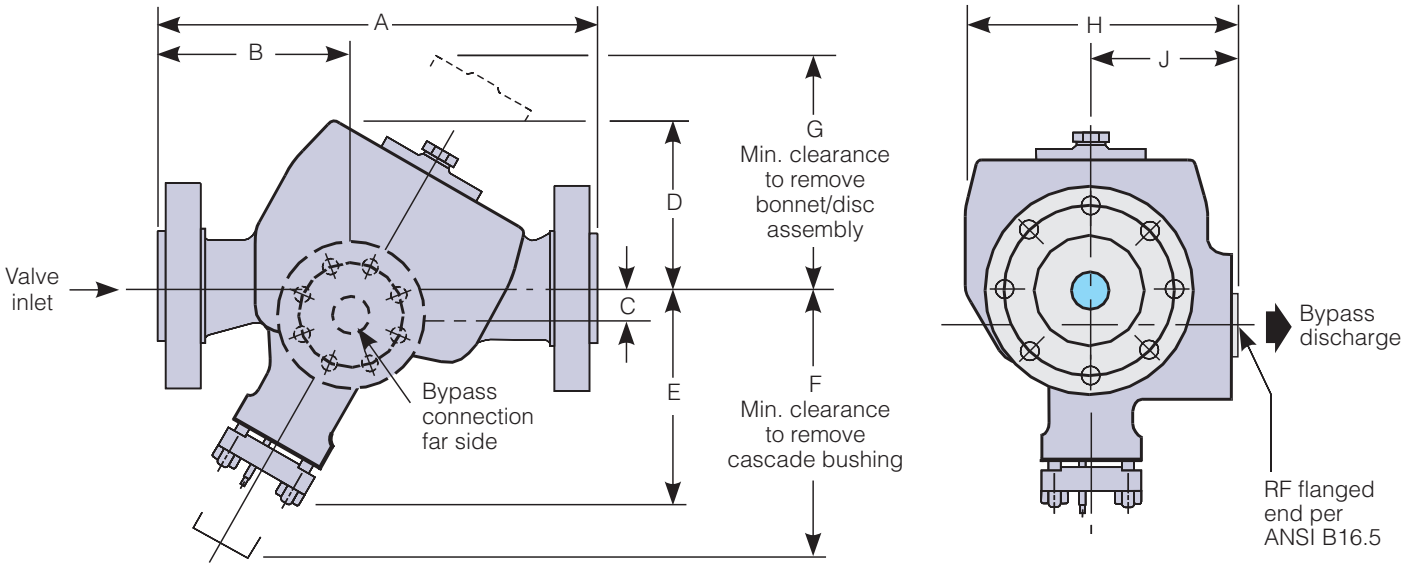
Yarway System



7100 Series – Butt Weld Ends



7100 Series – Flanged Ends



Dimensions and Weights for Class 900 and 1500 Valves, inches [mm]

Valve Size	Bypass Conn.	A	B	C	D	E	F	G	H	J	Nominal Weight Butt Weld lb. (kg)	Nominal Weight Flanged lb. (kg)
3" [80]	1 1/2" [40]	20 1/2 [520.7]	8 11/16 [220.7]	1 13/32 [35.7]	8 [203.2]	10 [254]	18 [457.2]	12 [304.8]	13 1/2 [342.9]	7 1/2 [190.5]	260 (118)	360 (163)
4" [100]	2" [50]	25 1/2 [647.7]	11 [279.4]	1 3/4 [44.5]	11 [279.4]	14 [355.6]	24 [609.6]	15 [381]	17 [431.8]	9 1/2 [241.3]	500 (227)	640 (290)
6" [150]	2 1/2" [65]	36 [914.4]	15 5/8 [396.9]	2 3/8 [60.3]	14 [355.6]	20 [508]	34 [893.6]	21 [533.4]	22 1/2 [571.5]	12 [304.8]	1450 (658)	1725 (782)
8" [200]	3" [80]	42 [1066.8]	18 1/4 [463.6]	3 [76.2]	18 [457.2]	24 [609.6]	41 [1041.4]	28 [711.2]	28 [711.2]	15 [381]	2650 (1202)	3150 (1429)

Dimensions are the same for Flanged and Butt Weld end valves. Available in DIN and JIS end connections. Valve size and bypass connection – in., [DN]; Dimensions – in., [mm]; Weight – lb., (kg).

Sizing Guide

Valve Size	3"	4"	6"	8"
Main Flow Range	120-400 GPM 27-91 M³/hr	300-715 GPM 68-162 M³/hr	600-1575 GPM 136-358 M³/hr	700-2675 GPM 159-608 M³/hr
Bypass C_V Range 2 Stage[1] 4 Stage[2]	 0.3-0.4 (0.26-3.5K_V) 0.2-2.0 (0.17-1.7K_V)	 1.0-11.5 (0.87-9.9K_V) 0.8-8.0 (0.69-6.9K_V)	 3.0-24.0 (2.6-20.8K_V) 2.0-17.0 (1.7-14.7K_V)	 5.0-40.0 (4.3-34.6K_V) 4.0-28.0 (3.5-24.3K_V)

1) For ΔPs up to 1500 psid

2) For ΔPs between 1500 and 3000 psid

Pressure and Temperature Selector Guide

Model No.	Butt Weld Flanged	7105 7106	7107 7108
ANSI Pressure Class		900	1500
Temperature		Working Pressures (psig)	
100°F		2220	3705
200°F		2025	3375
300°F		1970	3280
400°F		1900	3170
500°F		1795	2995

Notes:

1. Determine pressure class and model no. by consulting pressure and temperature selector guide above.
2. To select valve size: refer to ARC® sizing guide above. Be sure normal and maximum pump operation flows fall within the flow range noted for the given valve.
3. Verify that bypass capacity meets minimum pump flow requirement:

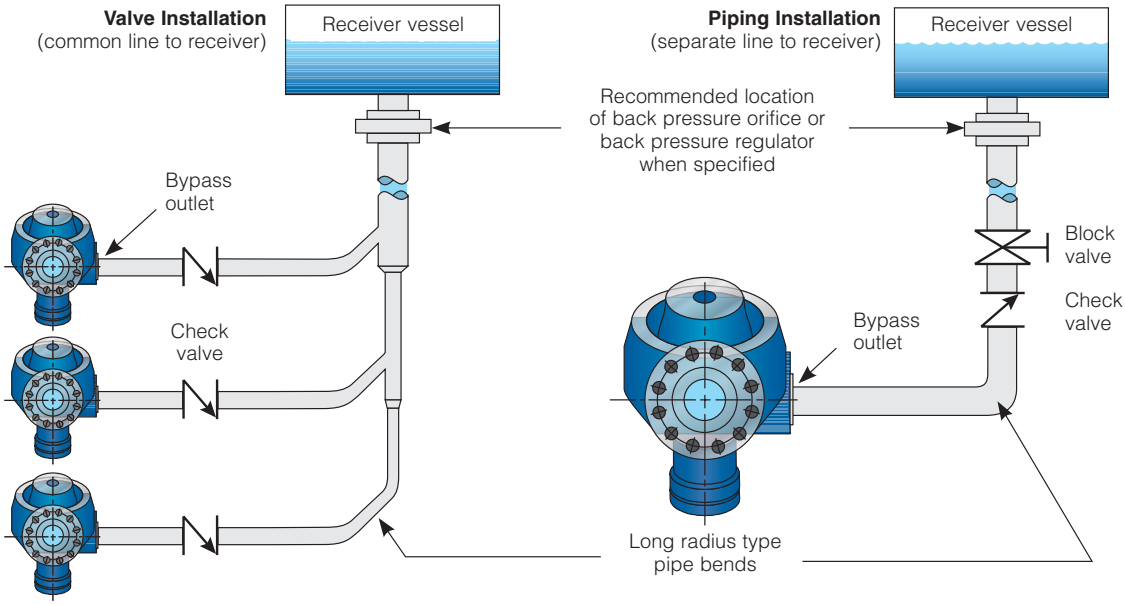
$$\text{Calculate } C_V: \quad = \sqrt{\frac{Q\ min}{\frac{DP}{S.G.}}}$$

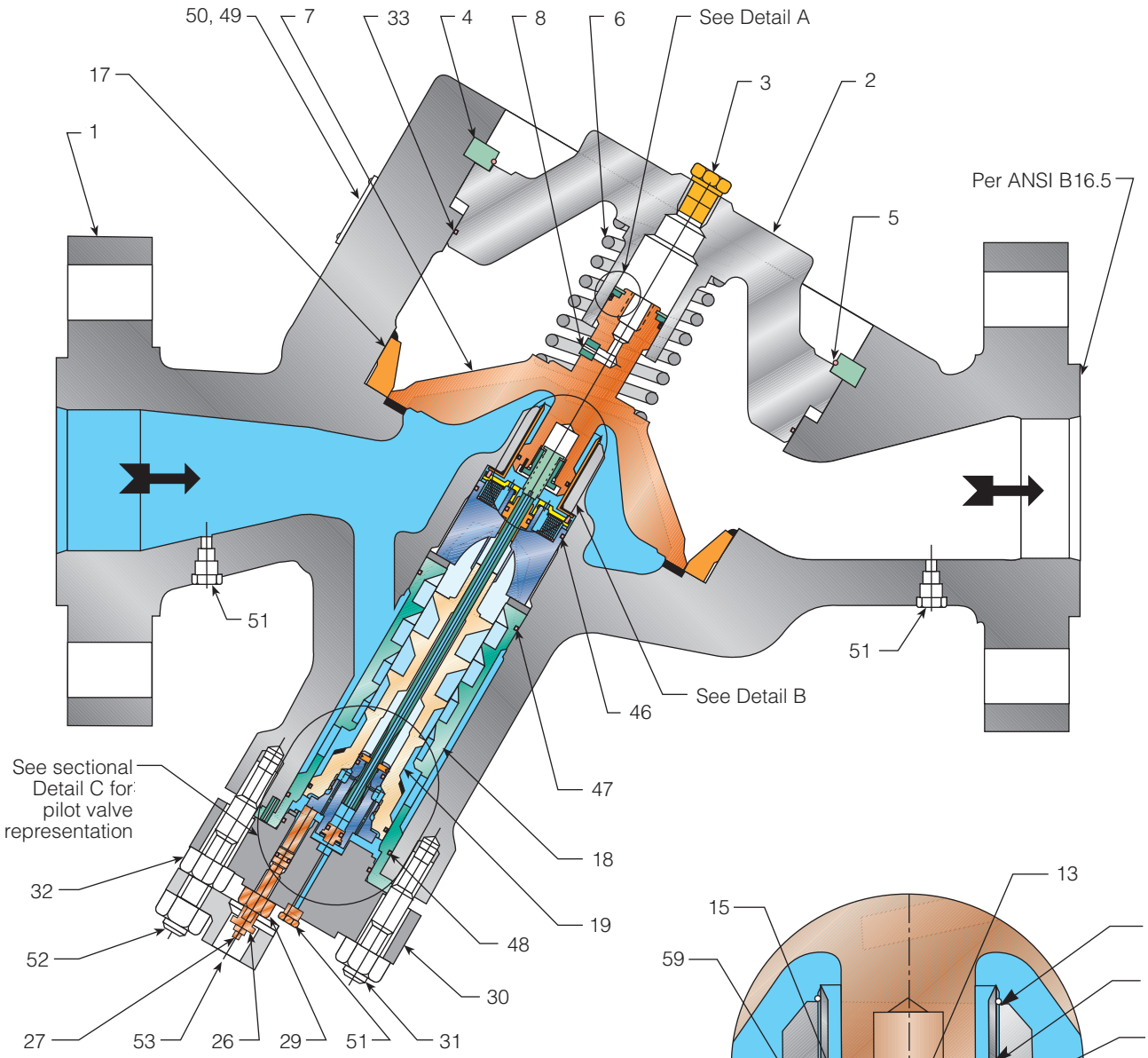
Q min = Minimum pump flow

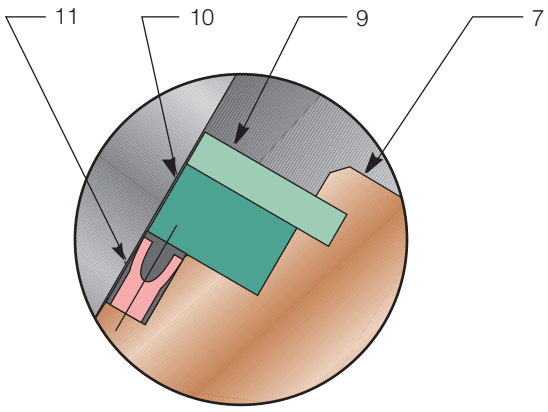
ΔP = Pump discharge pressure minus bypass line pressure

S.G. = Specific gravity of fluid pumped

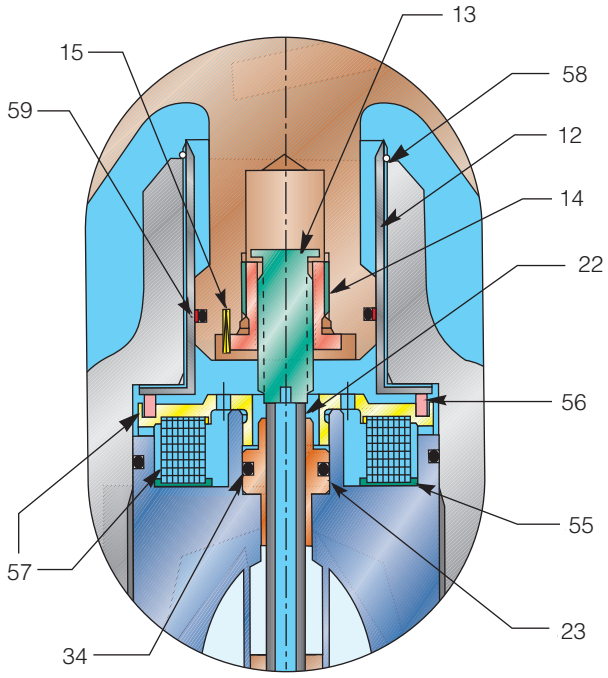
Installation







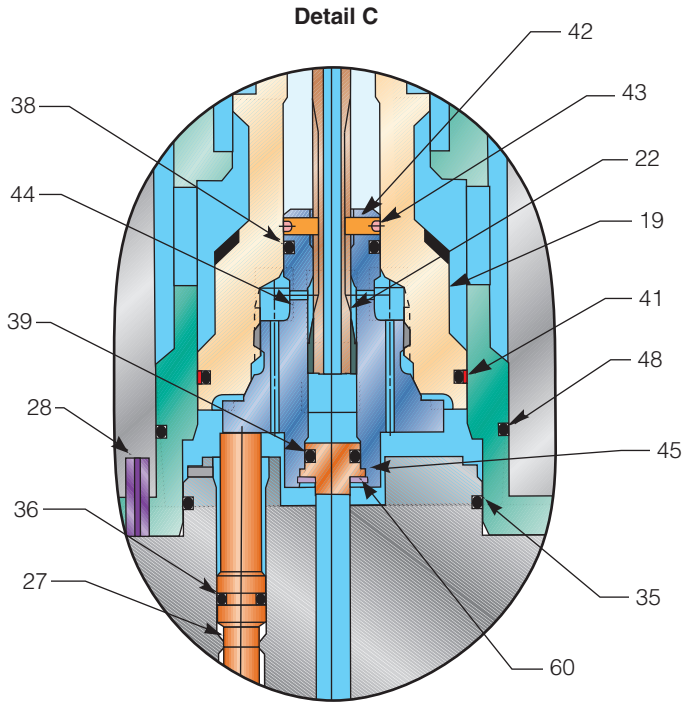
Detail A



Detail B

Notes:

1. Recommended spare parts for service inspection.
2. Recommended spare parts for service overhaul.
3. Optional on body.



Parts and Materials

Item	Part	Material	Specification
1	Body	Cast Steel	ASME SA216 Gr. WCB
2	Bonnet	Cast Steel	DIN 17245–Material No.1.0619 GS-C-25
3	Pipe Plug	SS	Type 316
4	Segmented Retaining Ring	SS	ASME A487 Gr. CA6NMCL. A
5	Segmented Ring Retainer	SS	Type 17-7 PH
6	Spring	SS	Type 17-7 PH
7	Disc	SS	ASME SA351 Gr. CF8M
8	Orifice Snubber	SS	Type 316
9	Retaining Ring	SS	PH 15-7 Mo
10	Washer	SS	ASTM A276-XM19
11[1,2]	Seal Assembly	Elastomer	TFE and SS
12	Disc Lower Guide Bushing	SS	ASTM A479 Type XM19
13	Switch Point Adjustment Screw	SS	ASTM A582 Type 416
14	Switch Point Adj. Screw Bushing	SS	ASTM A582 Type 416
15	Spring Pin (Bushing)	SS	Type 18-8
17	Flow Element	SS	Type 316
18[2]	Bypass Bushing	SS	ASTM A747 Gr. CB7 Cu-1
19[2]	Piston	SS	ASME SA479 Type 410
22[1,2]	Pilot Tube	SS and Stellite	ASME SA564 Gr. 630 w/ Stellite 6 seat
23[1,2]	Metering Orifice	SS	Type 431
26	Spring Pin	SS	Type 18-8
27	Stroke Adjustment Screw	SS	ASME SA564 Gr. 630
28	Spring Pin	SS	Type 18-8
29	Lock Nut	SS	Type 18-8

Item	Part	Material	Specification
30	Bypass Cover	CS	ASTM A105
31	Stud	Alloy Steel	ASME SA193 Gr. B7
32	Nut	Alloy Steel	ASME SA194 Gr. 2H
33[1,2]	O-ring	Elastomer	TFE Propylene
34[1,2]	O-ring	Elastomer	TFE Propylene
35[1,2]	O-ring	Elastomer	TFE Propylene
36[1,2]	O-ring	Elastomer	TFE Propylene
38[1,2]	O-ring	Elastomer	TFE Propylene
39[1,2]	O-ring	Elastomer	TFE Propylene
41[1,2]	Seal Assembly	Elastomer	TFE Propylene
42[1,2]	Anti-Rotation Key	SS	ASTM A276 Gr. 440C
43[1,2]	Retainer (O-ring)	Elastomer	TFE Propylene
44[1,2]	Pilot Valve Seat	SS	Type 431
45[2]	Pilot Tube Seal Plug	SS	Type 431
46[1,2]	O-ring	Elastomer	TFE Propylene
46a[1,2]	Back-up Ring (3" Valve Only)	Elastomer	Carbon/graphite reinforced PTFE
47[1,2]	O-ring	Elastomer	TFE Propylene
48[1,2]	O-ring	Elastomer	TFE Propylene
49	Drive Screws	SS	Type 18-8
50	Nameplate	SS	Type 302
51[3]	Pipe Plug (Pressure Tap)	SS	Type 316
52	Stud	Alloy Steel	ASME SA 193 Gr. B7
53	Stroke Adjustment Screw Cover	CS	ASTM A105
55[1,2]	Filter Gasket, Lower	Elastomer	TFE Propylene
56[1,2]	Filter Gasket, Upper	Gasket	Reinforced Teflon®
57	Filter Housing and Screen Assembly	SS	Type 316
58	Retaining Ring	SS	Type 17-7 PH
59[1,2]	Seal Assembly	Elastomer	TFE Propylene
60[2]	Retaining Ring	SS	PH 15-7 Mo

Back Pressure Regulator (BPR)

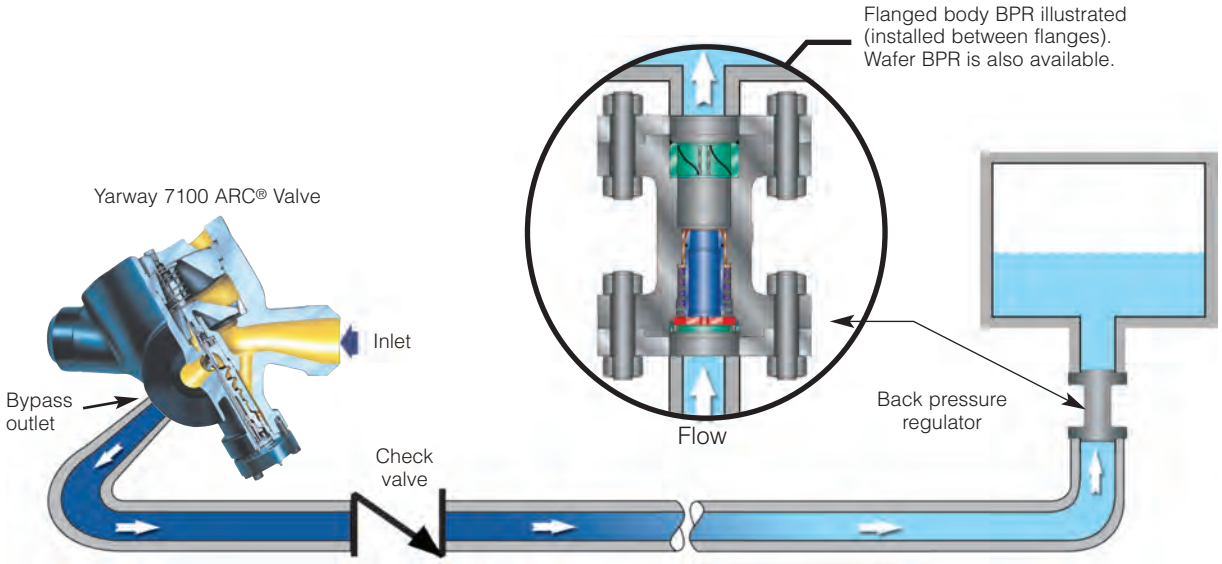
In high pressure pumping applications the system often does not provide adequate pressure in the bypass line to prevent cavitation or flashing. Either of these conditions is undesirable in that it can cause damage to both valves and the pipe system or cause a reduction in flow beyond the minimum desired, jeopardizing the pump protection system. All PRVs 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 back pressure 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 back pressure 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.

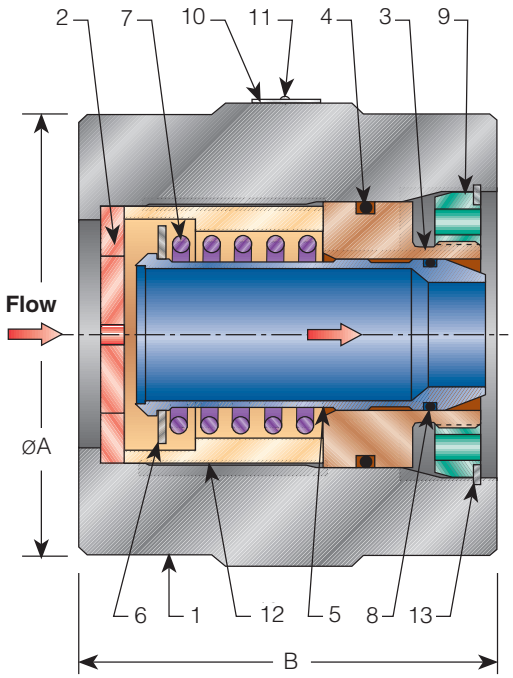
When adequate back pressure is not available downstream of a pressure reducing valve, vapor bubbles will form in the zone just downstream of the valve last stage control surface. This zone is defined as the "Vena Contracta" and represents the point of highest fluid velocity and lowest pressure. The potential 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 ensured by the provision of adequate back pressure. 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.

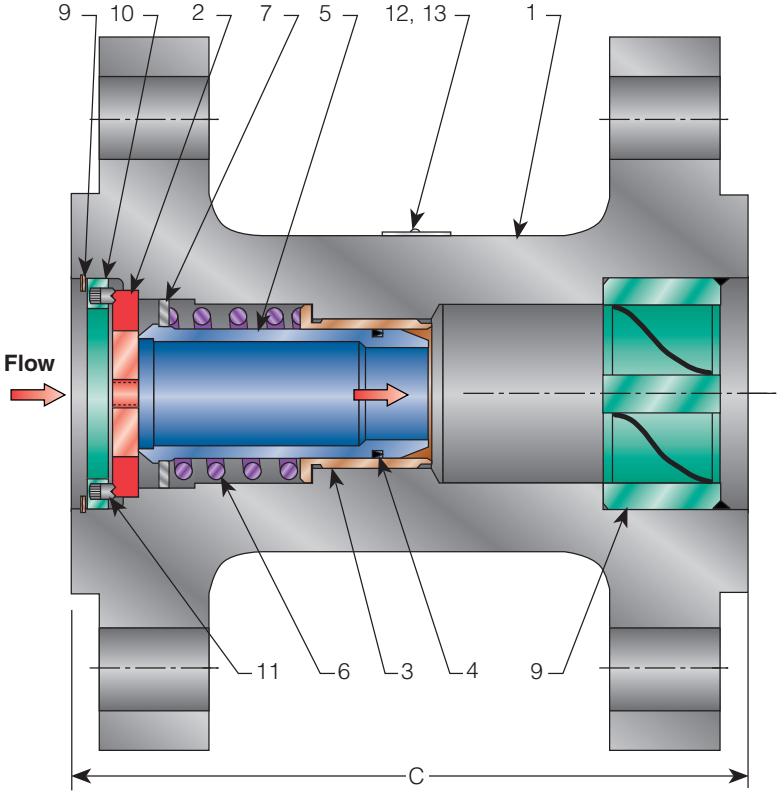


Back Pressure Regulator (BPR)

Wafer BPR – 3/4" to 6"



Remote Mounted Flange BPR – 1 1/2" to 10"



Parts and Materials

Item	Part	Material
1	Body	ASME SA105
2	Seat	ASTM A747-CB7Cu-1 with Heat Treatment
3	Plunger Guide	ASTM A276-S21800 (Nitronic 60 Bar)
4	O-ring	TFE/P (Fluoraz 799)
5	Plunger	AISI 431 Stainless Steel with Heat Treatment
6	Spring Retainer	AISI 304 Stainless Steel
7	Spring	ASTM A564 Type 631 (17-7 PH) H-900 Heat Treatment
8	Energized "U" Cup Seal	Filled TFE
9	Retaining Ring	AISI 304 Stainless Steel
10	Nameplate	AISI 300 Series Stainless Steel
11	Drive Screw	Stainless Steel
12	Spacer	A269-304
13	Spiral Ring	Inconel® X-750

Parts and Materials

Item	Part	Material
1	Body	ASME SA105
2	Seat	ASTM A747-CB7Cu-1 with Heat Treatment
3	Plunger Guide	ASME SA564 Type 630 (17-4 PH) H-900 Heat Treatment
4	Energized "U" Cup Seal	Filled TFE
5	Plunger	ASTM A479-431 Stainless Steel with Heat Treatment
6	Spring	ASTM A564 Type 631 (17-7 PH) H-900 Heat Treatment
7	Spring Retainer	AISI 304 Stainless Steel
8	Spiral Ring	AISI 302
9	Flow Conditioner	ASME SA747-CB7Cu-1
10	Retaining Ring	AISI 316 Stainless Steel
11	Set Screw	ASTM A194 Grade 8 (18-8)
12	Nameplate	AISI 300 Series Stainless Steel
13	Drive Screw	Stainless Steel

Option: BPR is available in stainless steel configuration upon request.

Dimensions and Weights

BPR Size	Dimensions, in. [mm] A +/- 1/16" [1.6]	B +/- 1/16" [1.6]	Flanged C +/- 1/16" [1.6]	Wafer Approx. Weight lb. (kg)
3/4"	1 1/16 [42.9]	4 [101.6]	N/A	5 (2.3)
1 1/2"	2 7/8 [73.0]	2 7/8 [73.0]	6 [152.4]	5 (2.3)
2"	3 5/8 [92.1]	3 3/8 [85.7]	6 [152.4]	8 (3.6)
3"	5 [127.0]	4 5/8 [117.5]	8 [203.2]	21 (9.5)
4"	6 3/16 [157.2]	5 3/4 [146.0]	12 [304.8]	40 (18.1)
6"	8 1/2 [215.9]	7 1/2 [190.5]	17 [431.8]	96 (43.5)

For Flanged 8" and 10", contact your sales representative.

Hydraulic Performance Test Lab

Performance – Profiled in Yarway's Hydraulic Performance Test Lab

In our hydraulic performance test laboratory, state-of-the-art data acquisition and computer graphics techniques are called upon for evaluation of the significant performance characteristics of Yarway recirculation control valves. The lab's equipment makes it possible to test a valve over its complete flow range for factors including:

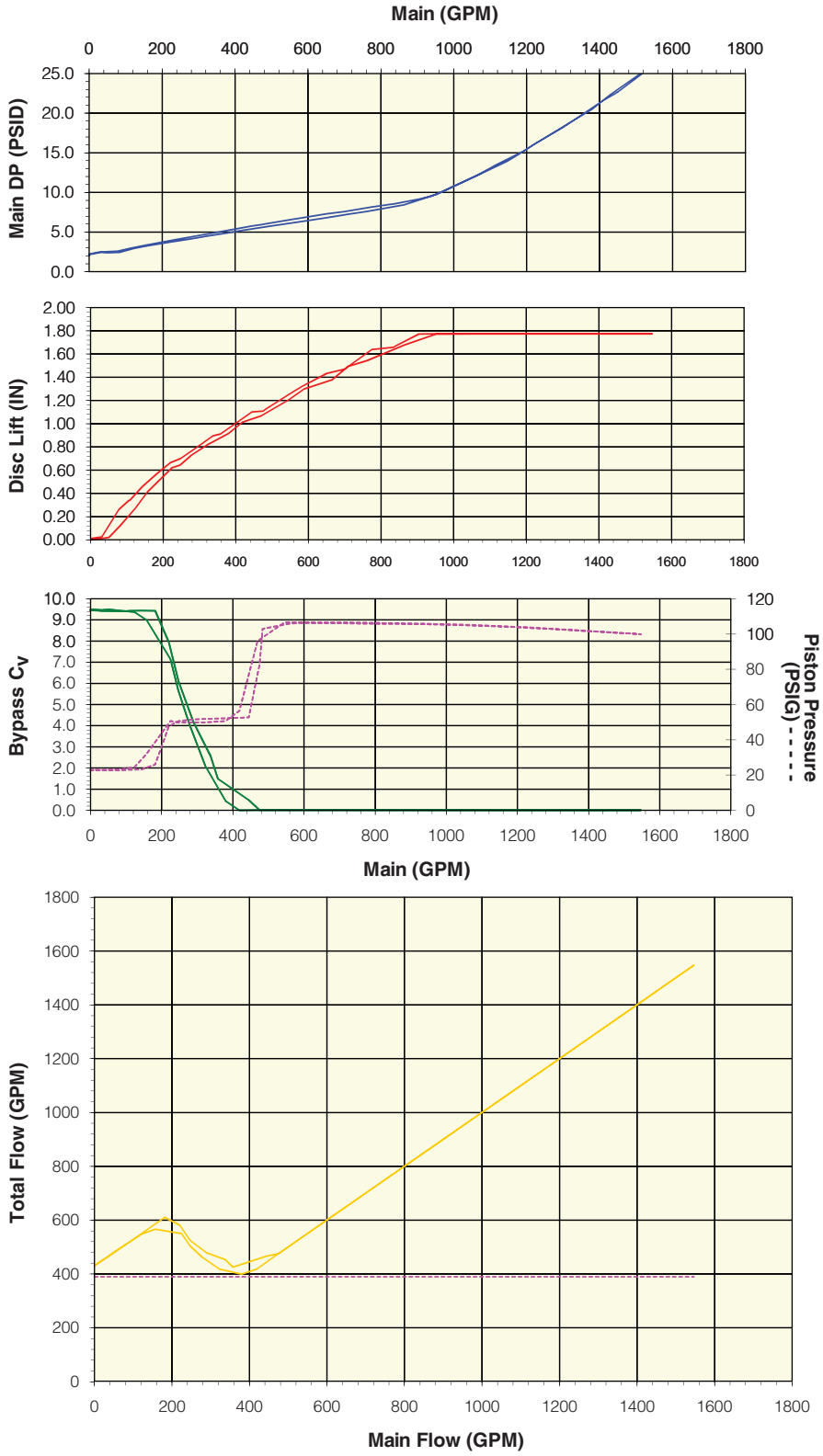
- Total flow through the pump
- Disc position
- Pressure drop across the main check
- Bypass C_v
- Bypass ΔP
- Valve response to sudden changes in flow
- Bypass piston pressure

These detailed analyses are the user's complete assurance that the valve meets performance requirements in all respects and can be supplied with the valve.

A certified test curve is shipped with each valve (see page 11 for example).

Insist on it, as you would for your pump!

Certified Test Curve



How to Order

Our sales representatives will help you select the correct valve for your application.
Please complete this form before contacting the sales office to help ensure all necessary information is provided.

Automatic Recirculating Control (ARC®) Valve Data Sheet

Customer:
Company:
Project:
Location:
Phone: E-Mail:
Qty Required: Delivery Required: Additional Info:
Tag(s) ID:

Pump Flow — Please Complete Flow Requirements

Normal -Process- flow:		GPM☐ M³/H☐ BPD☐
Maximum -Process- flow:		
Minimum -Process- flow (optional):		(if Minimum Flow is to be considered in sizing)
Minimum pump protection flow:		(Minimum required "Recirculation Flow")

Pump Discharge Pressure — Please Complete Pressure Requirements

Pump pressure at Shut-off (zero flow):		psi☐ bar☐ KgF/cm²☐ Kpa☐
Pump pressure at Normal -Process- flow:		
Pump pressure at Minimum -Process- flow (optional):		(if Minimum Flow is to be considered in sizing)
Pump pressure at Minimum pump protection flow:		(at Minimum required "Recirculation Flow")
ARC Valve Bypass line pressure:		(Line pressure at ARC Valve bypass port)

Temperature — Please Enter Both Temperatures

Normal temperature at ARC Valve:		°F☐ °C☐
Maximum temperature at ARC Valve:		

Fluid

Liquid: Boiler Feed Water (In this case disregard S.G. and V.P.)
Other (Please specify) _____

Specific Gravity:
Vapor Pressure:
Viscosity:

Orientation of ARC Valve: Vertical☐ Horizontal☐

Desired End Connections:
- Raised Face Flange ☐
- Ring Type Joint (RTJ) ☐
- Flat Face Flange ☐
- Butt Weld Ends ☐
- Other - Specify in "Comments" ☐

Desired Pressure Class: 150☐ 300☐ 600☐ 900☐ 1500☐ 2500☐

Desired Body Material:
- A216 Gr. WCB ☐
- A351 Gr. CF8M ☐
- A351 Gr. CK3MCuN (6Mo) ☐
- A995 Gr. CD3MWCuN (Super Duplex) ☐

Desired Seal Material (except 2" to 8" 9200 and 9300):
- Ethylene Propylene (EPR or EPDM) ☐
- TFE Propylene (Aflas or Fluoraz) ☐
- Fluorocarbon Rubber (Viton®) ☐
- Other - Specify in "Comments" ☐

Pump Drive Type:
- Constant Speed - Motor Driven ☐
- Variable Speed (VFD) - Motor Driven ☐
- Variable Speed - Turbine Driven ☐
- Other - Specify in "Comments" ☐

Comments:

NACE Materials Required? ☐
Flow Test with Performance Certificate Required? ☐
Customer Inspection Required Prior to Shipment? ☐
Certificate of Compliance for Hydro Test Required? ☐
Magnetic Particle Test Required? ☐
Radiograph Inspection Required (specify scope)? ☐
Certified Material Test Report (Pressure Containing Components only)? ☐

Flow tests are generally conducted on all model 5300 and 7100 ARC® valves and one model 9100 or 9200 ARC® valve per sales order line item at no additional cost. Model 9300 ARC® valves and other flow test requirements are upon request and at additional cost. If flange drilling is other than ANSI, please specify in "Comments." Please include Pump Curve if available.