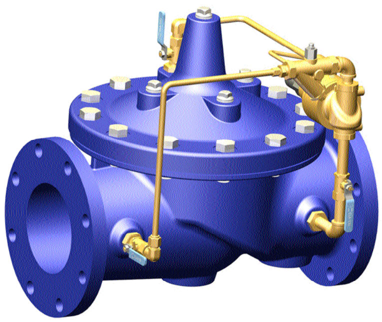
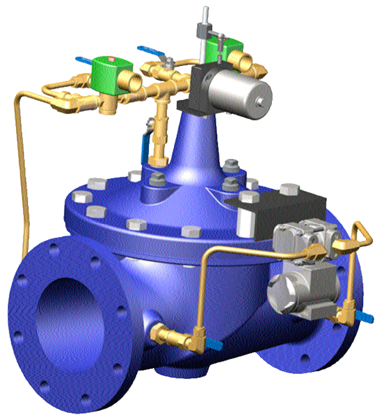
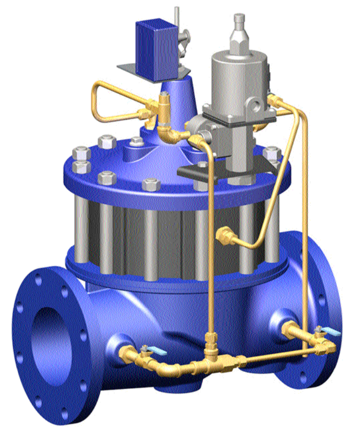
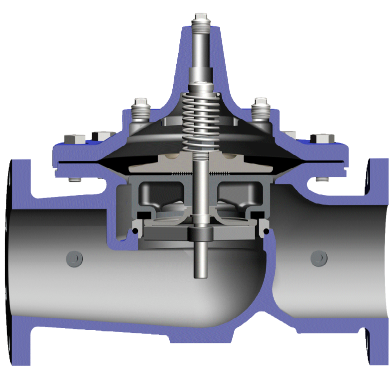
Cla-Val

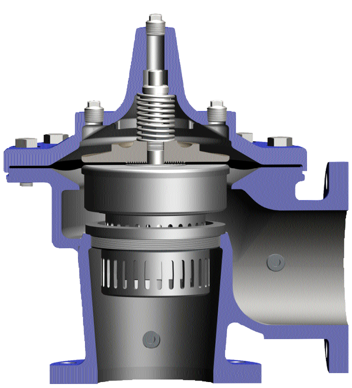
Service Training Manual and Trouble Shooting Guide

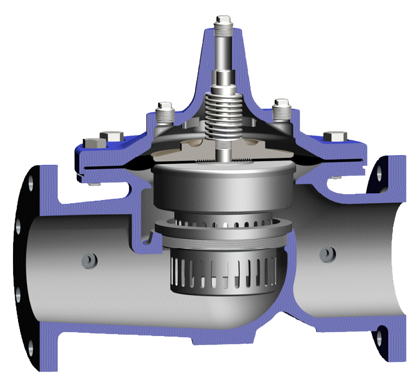












"Simple solutions plus learning with a purpose"

Please contact us....
We are here to help!

HOME OFFICE:
P.O.Box 1325
Newport Beach, CA 92659-0325
Phone: (949) 722-4800
1-800-942-6326
Fax: (949) 548-5441
www.cla-val.com
E-mail: claval@cla-val.com

WESTERN REGION:
11626 Sterling Avenue,Suite F
Riverside,CA 92503
Phone: (951) 687-9145
1-800-247-9090
Fax: (951) 687-9954
E-mail: lvanderk@cla-val.com

SOUTHERN REGION:
14520 Old Katy Road #105
Houston, TX 77079-1000
Phone: (281) 759-9590
1-800-336-7171
Fax: (281) 759-8938
E-mail: blindsey@cla-val.com

NORTHERN REGION:
P.O.Box 863
Elgin, IL 60121
280 Willard Avenue
Elgin, IL 60120
Phone: (847) 697-1413
1-800-238-7070
Fax: (847) 697-5549
E-mail: djurs@cla-val.com

EASTERN REGION:
6911 Richmond Highway, Suite 444
Alexandria, VA 22306
Phone: (703) 721-1923
1-800-451-3030
Fax: (703) 721-1927
E-mail: bmoore@cla-val.com

CLA-VAL CANADA:
4687 Christie Drive
Beamsville, Ontario
Canada LOR 1B4
Phone: (905) 563-4963
Fax: (905) 563-4040
E-mail: sales@cla-val.ca

CLA-VAL EUROPE:
Chemin des Mésanges 1
CH-1032 Romanel/Lausanne
Switzerland
Phone: 011-41-21-643-15-55
Fax: 011-41-21-643-15-50
E-mail: cla-val@cla-val.ch

CLA-VAL UK:
Dainton House, Goods Station Road
GB -Tunbridge Wells
Kent TN1 2 DH
England
Phone: 011-44-1892-514-400
Fax: 011-44-1892-543-423
E-mail: info@cla-val.co.uk

CLA-VAL FRANCE
Porte du Grand Lyon 1
ZAC du Champ du Périer
FR - 01700 Neyron
Phone: 011-33-4-72-25-92-93
Fax: 011-33-4-72-25-04-17
E-mail: cla-val@cla-val.fr

Always remember the entire Cla-Val Technical Support Team is only a telephone call away.

Insist on Quality.... Insist on Cla-Val!

Cla-Val Training Manual & Trouble Shooting Guide

"Simple Solutions Plus Learning with a Purpose"

Introduction

Solutions and Purpose:

The objective of this manual is to provide simple solutions to simple problems and provide product knowledge to assist in smooth and reliable operation and maintenance of your Cla-Val Automatic Control Valves.

This training manual will provide you with the knowledge you will need to do a more effective job in maintaining the Cla-Val Automatic Control Valves that are under your care. This manual will also supply you with simple solutions for troubleshooting and for diagnosing rare problems which you may encounter.

Training Manual Outline:

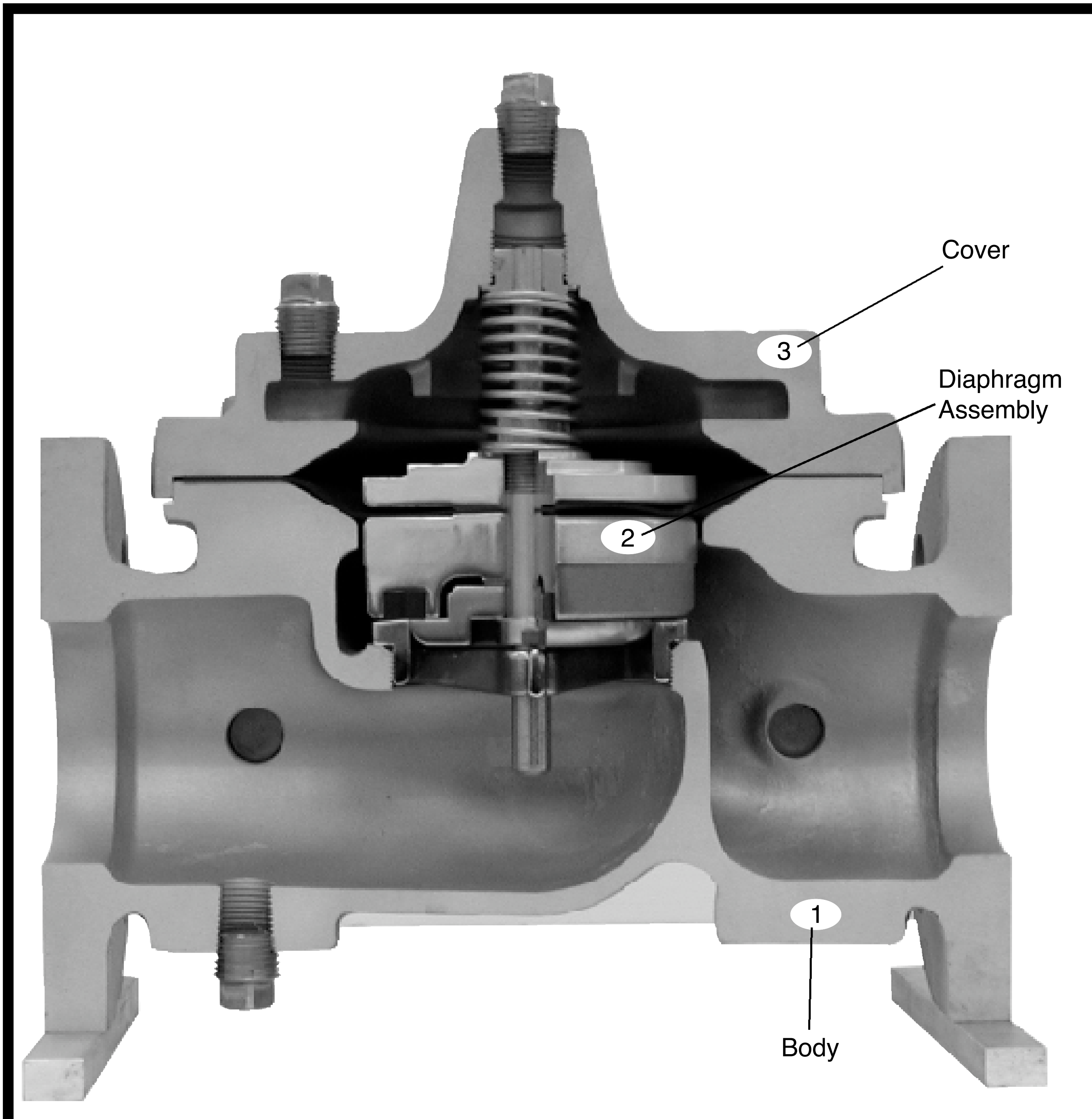
- **Section 1- Main Valves**
    - Hytrol 100-01
    - Hytrol 100-01KO Anti-Cavitation Valve
    - Powertrol-100-02
    - Powercheck- 100-03
    - Hycheck-100-04
    - Reduced Port –100-20
    - Roll Seal-100-42
- **Section 2- Control Components**
    - Pilots
    - Components
- **Section 3- Applications**
    - Series 40- Flow Limiting
    - Series 50-Pressure Relief and Sustaining
    - Series 60-Pump Control
    - Series 90-Pressure Reducing
    - Series 120/420-Level Control (Float type)
    - Series 130- Solenoid Control
    - Series 210- Altitude Control
- **Section 4- Startup**
    - Main Valves
    - Series 40- Flow Limiting
    - Series 50-Pressure relief and sustaining
    - Series 60-Pump Control
    - Series 90-Pressure Reducing
    - Series 120/420-Level Control (Float type)
    - Series 130- Solenoid Control
    - Series 210- Altitude Control
- **Section 5- Trouble Shooting Guide**
    - General
    - Main Valves
    - Series 40- Flow Limiting
    - Series 50-Pressure relief and sustaining
    - Series 60-Pump Control
    - Series 90-Pressure Reducing
    - Series 120/420-Level Control (Float type)
    - Series 130- Solenoid Control
    - Series 210- Altitude Control
- **Section 6- Technical Support**
    - Basic Hydraulics
    - Conversions
    - Cavitation

Table of Contents

Section 1

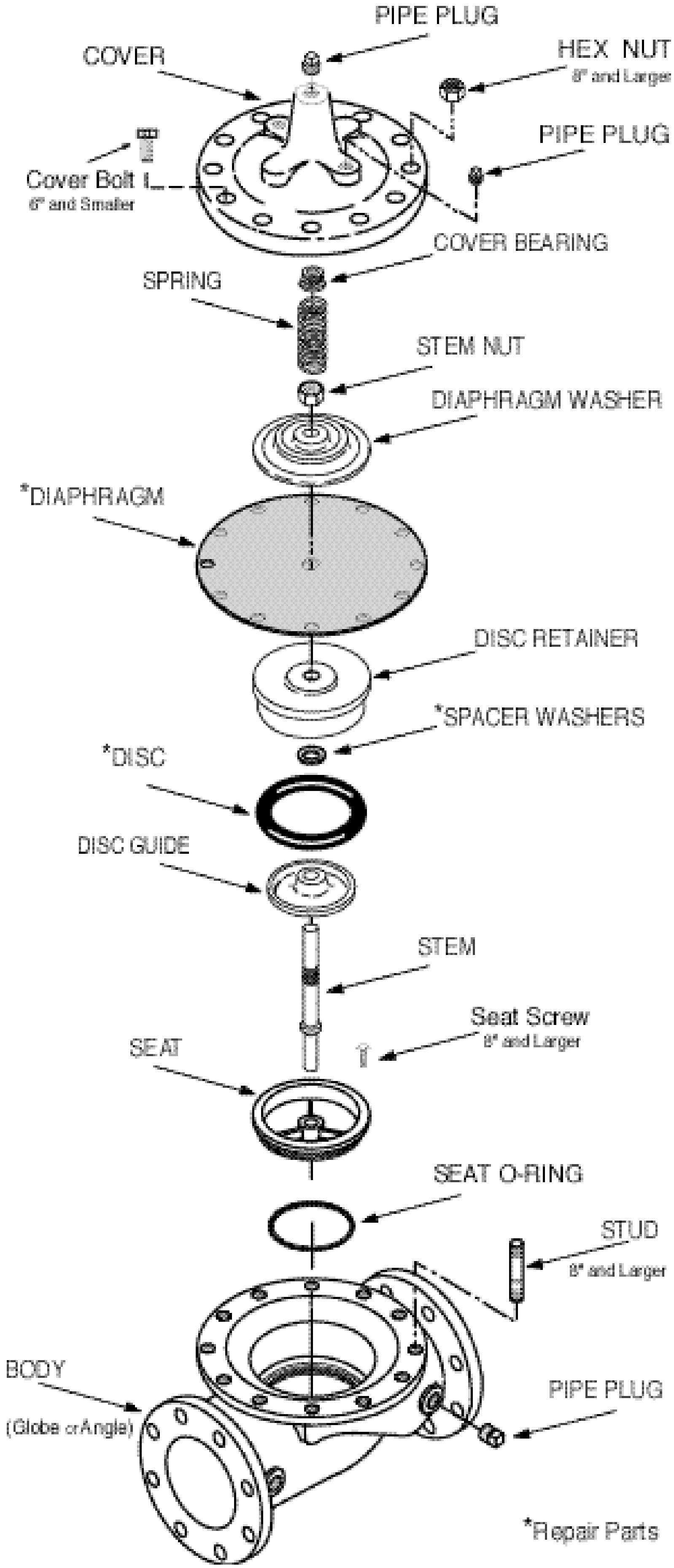
Valves	Model	Section
Hytrol	100-01	1-1
KO Anti-Cavitation	100-01	1-2
Powertrol	100-02	1-3
Powercheck	100-03	1-4
Hycheck	100-04	1-5
600 Series	100-20	1-6
Roll Seal	100-42	1-7

Section
1-1 Hytrol 100-01

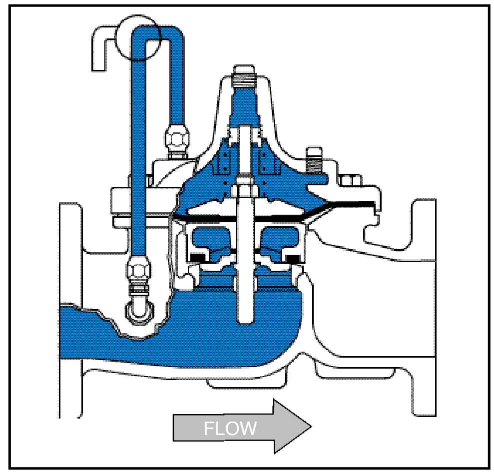


The Cla-Val Model 100-01 Hytrol Valve is a hydraulically operated, diaphragm actuated, automatic control valve. Pictured is a globe pattern valve, but the Hytrol is also available in an angle pattern configuration. It consists of three major components:
1) body, 2) diaphragm assembly, and 3) cover. The diaphragm assembly simply moves up to increase flow through the valve or down to decrease flow.

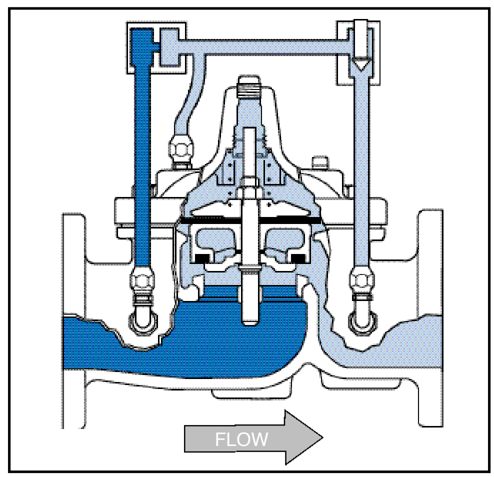
100-01
Hytrol Valve



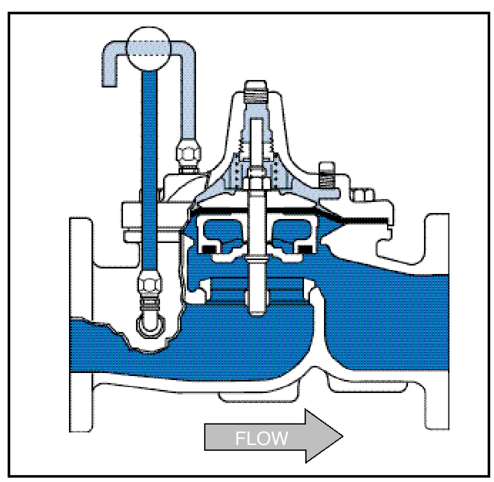
Closed Valve
When pressure from the valve inlet is applied to the cover chamber, the valve closes drip-tight.



Throttling Valve
The valve holds any intermediate position when operating pressures are equal above and below the diaphragm. A Cla-Val "Modulating" Pilot Control will allow the valve to automatically compensate for line pressure changes.

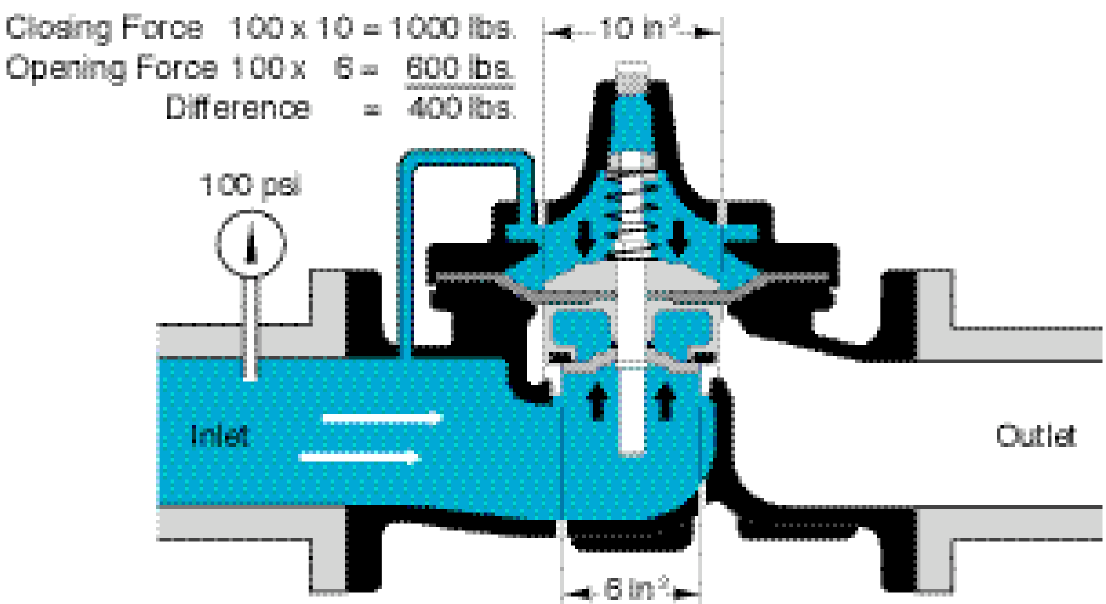


Open Valve
When pressure in the cover chamber is relieved to a zone of lower pressure, the line pressure at the valve inlet opens the valve, allowing full flow.



A Hydraulic actuator is built into every Hytrol. A diaphragm isolates the control or cover chamber. Putting high pressure into the cover chamber closes the valve while relieving pressure from the cover chamber opens the valve. The term diaphragm actuated globe valve is also used to describe a Hytrol. Water is typically the fluid that powers the valve open or closed and that is why the term hydraulically operated is also used to refer to the Hytrol.

The term Automatic Control Valve is also used to describe most of Cla-Val's product lines. In most cases when piloted the Cla-Val Hytrol becomes a fully automatic self-contained valve. There is no need for operator input to tell the valve how to respond.



Operating Principle

The operating principle for both the globe and angle pattern valves is exactly the same. When no pressure is in the valve, the spring and the weight of the diaphragm assembly hold the valve closed. When placed in the pipeline and pressure is applied to valve inlet and with the cover vented to atmosphere or downstream the valve opens. If inlet pressure is piped into the cover chamber, the valve closes tightly.

Example: In a valve with an effective diaphragm area of 10 square inches, and a line pressure of 100 pounds per square inch; with the cover vented to atmosphere, there would be 10 X 100 or 1000 pounds tending to open the valve. When the 100 pounds per square inch is piped into the cover chamber, the closing force would be 10 X100 or 1000 pounds tending to close the valve. In this particular valve the seat area would be 6 square inches. Since the 100 pounds per square inch is acting upward across this area, there would be 6 X 100 or 600 pounds tending to open the valve. The difference between 1000 and 600 or 400 pounds would be the force pushing the rubber disc against the seat to cause the valve to close tightly.

Diaphragm Actuation

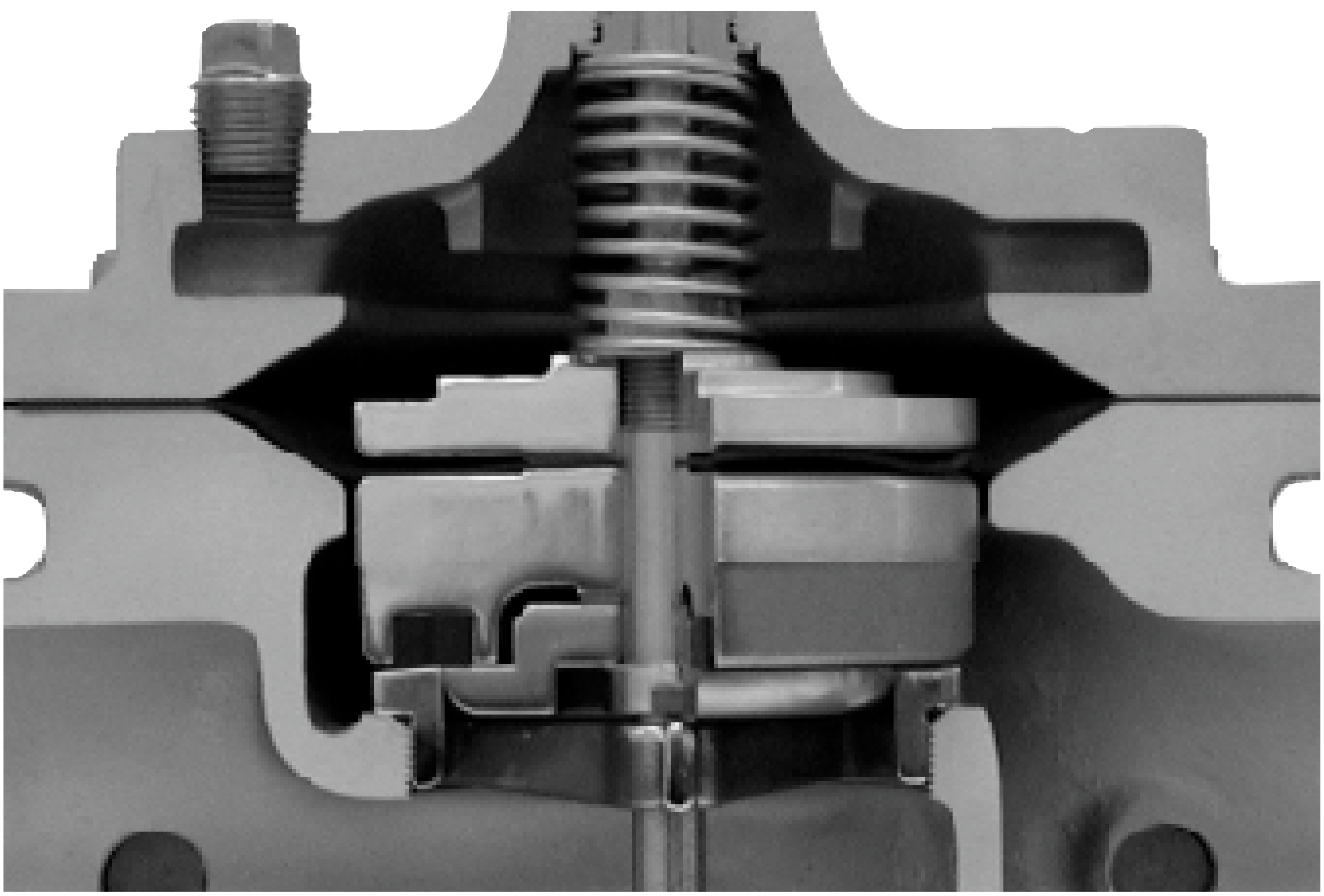
The operation of the Hytrol Valve is called "diaphragm actuation of a globe valve." This simply means that pressure acting across the surface of the diaphragm results in a force which causes the valve either to open or to close depending on which direction the pressure is acting. When the pressure is acting downward in the cover chamber, the valve closes. When the pressure is relieved from the cover chamber, and line pressure is then acting upward the valve opens.

Advantages of the Globe valve design

The globe valve design offers many advantages over other designs. Piston style valves, ball valves, butterfly valves, plug valves, and gate valves are sometimes considered for some of the same applications.

Drip tight shut off

The Hytrol modified globe design automatically compensates for wear on the rubber disc. The closing force of the diaphragm operation presses the disc tightly against the seat at low and high pressure differentials. The closing force is greater than the opening force, which is opening the valve. Most other valves designs do not have the same mechanical advantage.

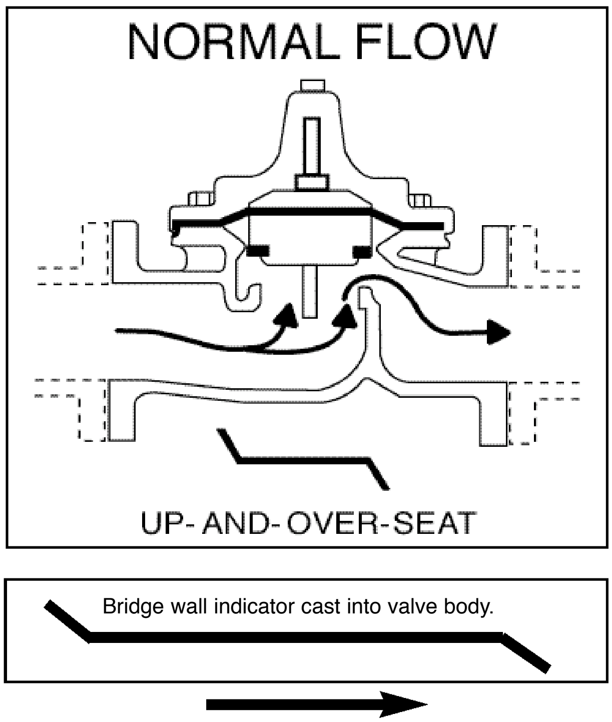


Normally Open Valve

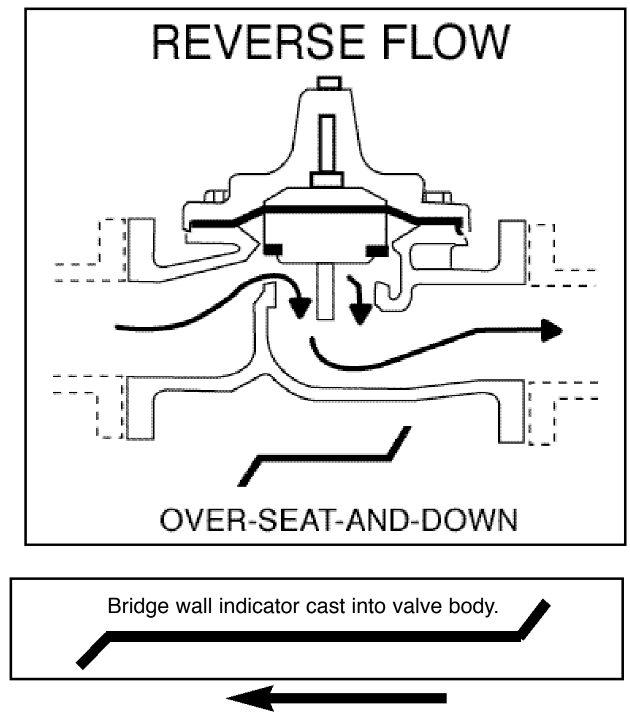
The Hytrol Valve is considered "normally open" because the line pressure opens it when operating pressure is released from the diaphragm. The Hytrol Valve will then close when operating pressure is applied above the diaphragm.

Normal Flow

The direction of the flow through most Cla-Val Hytrols is against the valve disc during the closing stroke. This direction is called "normal flow", or it is also termed "flow-under-the-disc." This has the advantage of cushioning the closing, thereby helping to prevent any closing shock.



Normal Flow



Reverse Flow

Reverse Flow

When the Cla-Val Hytrol valve is turned around so the flow is "over-the-disc" it is said to be installed in "reverse flow." This direction of flow is used when specifications require a valve to close when a diaphragm wears out. Most types of fueling valves must meet this requirement, and are installed in reverse flow.

Pilot Operation

All that is required to make the valve open or close is to arrange some kind of pilot control system to apply pressure to the cover when the valve needs to close, or relieve that pressure when the valve needs to open. Such a system is called a "pilot control system". The use of such a system to control the Cla-Val hytrol valves gives rise to the term "pilot operated" because the valve depends upon some form of pilot control system to make it work. Later chapters will focus on the details of pilot control, both how and why they work.

No Packing Glands

The Cla-Val hytrol has no packing glands, consequently no leakage problem. The diaphragm actuator is an integral part of the valve and there is no packing gland friction so there is very little drag or hysteresis, which can mean better control.

Breakaway Friction

The Cla-Val hytrol globe style valve has virtually no break-away friction which could cause it to jump off of the seat. When water is relieved from the cover chamber the valve opens very smoothly. The other types of valves have high friction forces to overcome to break the valve away from the seat, resulting in higher actuating forces to get the valve open.

External Linkage

The Cla-Val hytrol requires no external linkages. Fluid pressure is the operating medium and simple but reliable pilot controls are used. Other types of valves require wiring for the electric actuator or sometimes an the entire hydraulic oil system for an external actuator.

The flow capacity of a control valve is usually expressed in terms of the valves Cv. Cv is the amount of water in gallons that will pass through a given valve in one minute with a 1 psi pressure drop. Cv values are established by flow testing the valve. So a 3" Cla-Val hytrol has a Cv of 115 will pass 115 gallons per minute with a 1 psi pressure drop.

C_V Factor

Formulas for computing C_V Factor, Flow (Q) and Pressure Drop (ΔP):

$$C_V = \frac{Q}{\sqrt{\Delta P}} \qquad Q = C_V \sqrt{\Delta P} \qquad \Delta P = \left(\frac{Q}{C_V}\right)^2$$

K Factor (Resistance Coefficient)
The Value of K is calculated from the formula: $K = \frac{894d^4}{C_V{}^2}$
(U.S. system units)

Equivalent Length of Pipe
Equivalent lengths of pipe (L) are determined from the formula: $L = \frac{K\,d}{12\,f}$
(U.S. system units)

Fluid Velocity
Fluid velocity can be calculated from the following formula: $V = \frac{.4085\,Q}{d^2}$
(U.S. system units)

Where:

C_V = U.S. (gpm) @ 1 psi differential at 60° F water
or
= (l/s) @ 1 bar (14.5 PSIG) differential at 15° C water

d = inside pipe diameter of Schedule 40 Steel Pipe (inches)

f = friction factor for clean, new Schedule 40 pipe (dimensionless) (from Cameron Hydraulic Data, 18th Edition, P 3-119)

K = Resistance Coefficient (calculated)

L = Equivalent Length of Pipe (feet)

Q = Flow Rate in U.S. (gpm) or (l/s)

V = Fluid Velocity (feet per second) or (meters per second)

Δ **P** = Pressure Drop in (psi) or (bar)

The following chart shows both the Cv and the K factor data for each valve

Functional Data **Model 100-01**

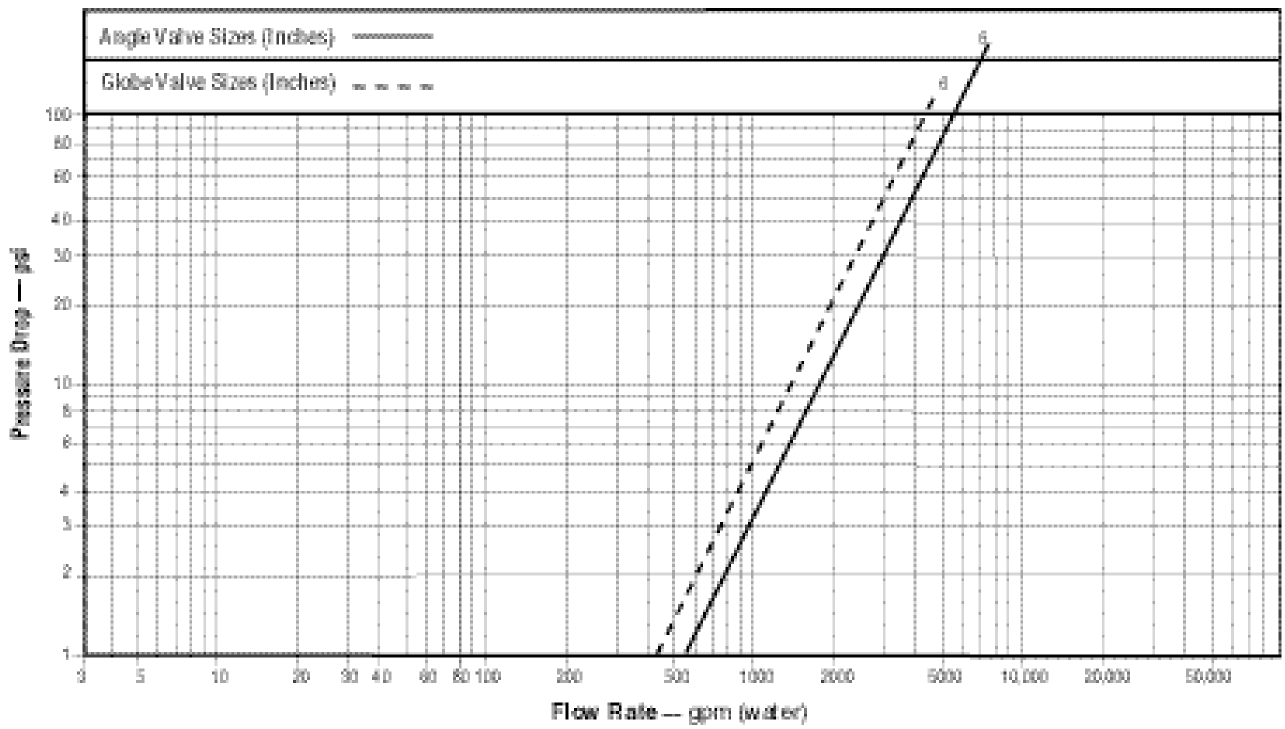
Valve Size		Inches	⅜	½	¾	1	1¼	1½	2	2½	3	4	6	8	10	12	14	16	24	36
		mm.	10	15	20	25	32	40	50	65	80	100	150	200	250	300	350	400	600	900
C_V Factor	Globe Pattern	Gal./Min. (gpm.)	1.8	6	8.5	13.3	30	32	54	85	115	200	440	770	1245	1725	2300	2940	7655	13320
		Litres/Sec. (l/s.)	.43	1.44	2.04	3.2	7.2	7.7	13	20.4	27.6	48	105.6	184.8	299	414	552	706	1837	3200
	Angle Pattern	Gal./Min. (gpm.)	—	—	—	—	—	29	61	101	139	240	541	990	1575	2500*	3060*	4200*	—	—
		Litres/Sec. (l/s.)	—	—	—	—	—	7	14.6	24.2	33.4	58	130	238	378	600	734.4	1008	—	—
Equivalent Length of Pipe	Globe Pattern	Feet (ft.)	25	7	16	23	19	37	51	53	85	116	211	291	347	467	422	503	628	1866
		Meters (m.)	7.6	2.2	4.8	7.1	5.7	11.4	15.5	16.0	25.9	35.3	64.2	88.6	105.8	142.4	128.6	153.6	191.6	569
	Angle Pattern	Feet (ft.)	—	—	—	—	—	46	40	37	58	80	139	176	217	222*	238*	247*	—	—
		Meters (m.)	—	—	—	—	—	13.9	12.1	11.4	17.8	24.5	42.5	53.6	66.1	67.8	72.7	75.2	—	—
K Factor	Globe Pattern		16.3	3.7	5.7	6.1	3.6	5.9	5.6	4.6	6.0	5.9	6.2	6.1	5.8	6.1	5.0	5.2	4.0	7.1
	Angle Pattern		—	—	—	—	—	7.1	4.4	3.3	4.1	4.1	4.1	3.7	3.6	2.9	2.8	2.6	—	—
Liquid Displaced from Cover Chamber When Valve Opens		Fl. Oz	.12	.34	.34	.70	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		U.S. Gal.	—	—	—	—	.02	.02	.03	.04	.08	.17	.53	1.26	2.51	4.0	6.5	9.6	29	42
		ml	3.5	10.1	10.1	20.7	75.7	75.7	121	163	303	643	—	—	—	—	—	—	—	—
		Litres	—	—	—	—	—	—	—	—	—	—	2.0	4.8	9.5	15.1	24.6	36.2	109.8	159

*Estimated

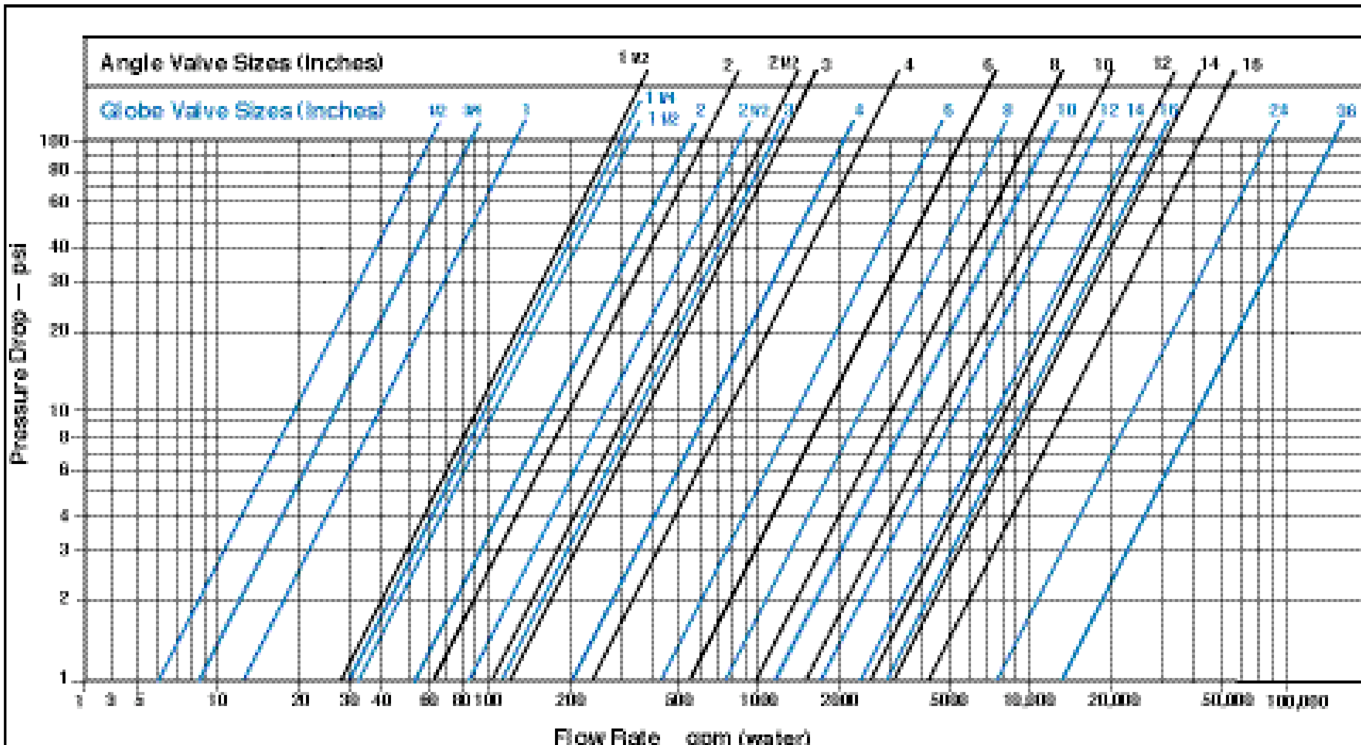
Volume Of Water Displaced

The above chart also shows the volume of water displaced as the valve goes from the closed position to full open. Each time the valve cycles the fixed volume of water will be expelled thru the pilot system from the cover chamber to atmosphere. This information may be useful for various applications.

The head loss that could be anticipated across a wide-open valve is charted for a 6" valve.



While the following chart looks much more complicated it is read the same way.



Low Temperature Diaphragm - suffix KA
This single ply diaphragm uses Buna-N® Synthetic Rubber, formulated for low temperature applications to -65°F. Operating pressures in excess of 125 psi are not recommended.

Viton® Rubber Parts - suffix KB

Optional diaphragm, disc and O-ring fabricated with Viton® (fluorocarbon) synthetic rubber. Viton® is well suited for use with mineral acids, salt solutions, chlorinated hydrocarbons, and petroleum oils; and is primarily used in high temperature applications up to 250° F. Do not use with epoxy coatings above 175° F.

Epoxy Coating - suffix KC

A FDA and NSF-61 approved fusion bonded epoxy coating for use with cast iron, ductile iron or steel valves. This coating is resistant to various water conditions, certain acids, chemicals, solvents and alkalies. Epoxy coatings are applied in accordance with AWWA coating specifications C550-90. Do not use with temperatures above 175° F.

Dura-Kleen Self-cleaning Stem – suffix KD (Can replace standard stem)

The Dura-Kleen stem is designed to protect the valve from deposits that build up on a normal stem. The Dura-Kleen stem is recommended for valve in continuous operation were differential pressures are greater than 20 psid (2" and larger sizes).

Delrin® Sleeved Stem - suffix KG (Can replace standard stem)

The Delrin® sleeved stem is designed for applications where water supplies contain dissolved minerals which can form deposits that build up on the valve stem and hamper valve operation. Scale buildup will not adhere to the Delrin® sleeve stem. Delrin® sleeved stems are not recommended for valves in continuous operation where differential pressures are in excess of 80 psid (2" and larger sizes).

Heavy Spring - suffix KH

The heavy spring option is used in applications where there is low differential pressure across the valve, and the additional spring force is needed to help the valve close. This option is best suited for valves used in on-off (non-modulating) service.

Anti-Cavitation Trim - suffix KO

Anti-Cavitation Trim components consist of a stainless steel radial slotted disc guide and seat. This system is used when high differentials are present across the valve.

Water Treatment Clearance - suffix KW
This additional clearance option is beneficial in applications where water treatment compounds can interfere with the closing of the valve. The smaller outside diameter disc guide provides more clearance between the disc guide and the valve seat. This option is best suited for valves used in on-off (non-modulating) service.

The Hytrol is available in many different alloys for various applications. Currently the Cla-Val foundry pours 45 different alloys. Below are the more common materials that are available.

Materials

Components	Optional Material				
Body & Cover	Ductile Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Available Sizes	1" - 36"	1/2" - 24"	3/8" - 16"	1/2" - 16"	1/2" - 16", 24"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is optional.			Stainless Steel is standard.	
Disc	Buna-N® Rubber				
Diaphragm	Nylon Reinforced Buna-N® Rubber				
Stem, Nut & Spring	Stainless Steel				

BRONZE (RED BRASS)	ASTM B62
VALVE BRONZE (U.S.N.)	MIL-B-16541
MONEL	QQ-N-288 COMP B
ALUMINUM	A356-T6/ASTM B26
CAST IRON	ASTM A48 CL 30 (3" AND SMALLER)
CAST IRON	ASTM A48 CL 40 (4" AND LARGER)
DUCTILE IRON	ASTM A536-65 60-40-18
CAST STEEL	ASTM A216 GR WCB
CAST STEEL (U.S.N.)	MIL-S-150083 CL B
303 STAINLESS STEEL	ASTM A743-CF-16FA
316 STAINLESS STEEL	ASTM A743-CF-8M
CAST IRON	ASTM A126 CL B
420 STAINLESS STEEL	ASTM A743-CA40
MANGANESE BRONZE	MIL-B-16522 CL 1
"G" BRONZE	ASTM B584 ALLOY C90500
VALVE BRONZE (COMM)	ASTM B61
304 STAINLESS STEEL	ASTM A743-CF-8
OUNCE METAL	ASTM QQ-C-390 ALLOY B5
410 STAINLESS STEEL	ASTM A352 GRADE LC3
CAST STEEL	ASTM A352 GRADE LC3
LEADED SEMI-RED BRASS	CLASS 123
DUCTILE IRON	ASTM A536 80-55-06
ALUMINUM (DIE CASTING)	QQ-A-591 ALLOY NO. 380
DUCTILE IRON	MIL-C-24707
DUCTILE IRON	ASTM A536 65-45-12
INCONEL	ASTM A494 ALLOY CY40
17-4PH STAINLESS STEEL	17-4PH PER AMS 5355 (INVESTMENT CAST)
ALUMINUM	A356T6 (INVESTMENT CAST)
303 STAINLESS STEEL	ASTM A743-CF-16F (TUV ONLY)
ALUMINUM	A356-T6/ASTM B26 (TUV ONLY)
DUCTILE IRON	ASTM A536 65-45-12 (TUV ONLY)
CAST IRON	ASTM A48 CL40 (4" & LARGER)
CAST STEEL	ASTM A216 GR WCB (TUV ONLY)
ALUMINUM BRONZE	ASTM B148 ALLOY C95800
CAST STEEL	ASTM A27 (60-30)
COPPER-NICKEL	B369 ALLOY C96400
CAST STEEL	ASTM A352 LCB
304L STAINLESS STEEL	ASTM A-743-GR-CF3
SUPER DUPLEX S. STEEL	UNS S31254
316L STAINLESS STEEL	ASTM A-743-GR-CF3M
SUPER AUSTENITIC STAINLESS STEEL	UNS J93404 (ASTM A890 GR. 5A)
R MONEL	ASTM A494 M3OC
DUPLEX S. STEEL	UNS S32760

End Connections 100-01

The Hytrol is available in either the standard globe pattern or an angle pattern. Only the valve body is different, everything else is identical. The Angle pattern valve is typically used as a piping preference. Many times it is more convenient to use the angle pattern. The angle pattern valve is less restricted than the globe pattern valve so it has a lower head loss across it, which means that in most applications it will flow more with less pressure drop.

Screwed Ends - Globe

Flanged Ends - Globe

Flanged Ends - Angle

Grooved Ends

Pattern	Screwed	Flanged	Grooved End
Globe	3/8" - 3"	1 1/2" - 36"	1 1/2" - 6"
Angle	1 1/2" - 3"	2" - 16"	2" - 4"

Both the standard globe pattern Hytrol valve and the angle pattern Hytrol are available in screwed, 150#, or 300# end connections. Screwed valve end connections are the most economical and the lightest weight. The screwed end connection valves are rated to 400 psi. The Ductile Iron Hytrol with 150# flanges is rated for a maximum operating pressure of 250 psi, while the Ductile Iron 300# flanged Hytrol is rated for 400 psi maximum operating pressure.

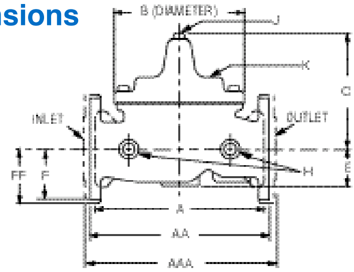
Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class				
		Flanged			Threaded	Grooved End
Grade	Material	ANSI Standards*	150 lb.	300 lb.	End** Details	—
ASTM A536	Ductile Iron	B16.42	250	400	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400	—
ASTM B62	Bronze	B16.24	225	400	400	—
ASTM A743	Stainless Steel	B16.5	285	400	400	—
A356-T6	Aluminum	B16.1	275	—	—	275

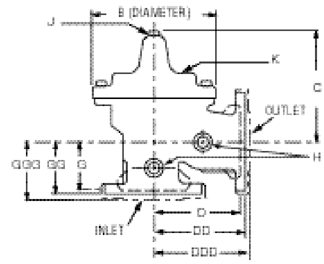
Note: *ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
**End Details machined to ANSI B2.1 specifications.

Dimensions

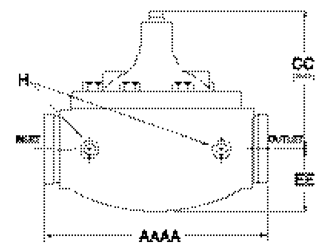
Model 100-01



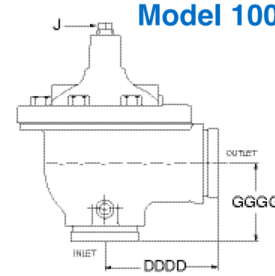
100-01 (Globe)



100-01 (Angle)



100-01 Grooved (Globe)



100-01 Grooved (Angle)

Valve Size (Inches)	⅜	½ - ¾	1	1¼-1½	2	2½	3	4	6	8	10	12	14	16	24	36
A Threaded	2.75	3.50	5.12	7.25	9.38	11.00	12.50	—	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	—	8.50*	9.38	11.00	12.00	15.00	20.00	25.38	29.75	34.00	39.00	41.38	61.50	76.00
AAA 300 ANSI	—	—	—	9.00*	10.00	11.62	13.25	15.62	21.00	26.38	31.12	35.50	40.50	43.50	63.24	78.00
AAAA Grooved End	—	—	—	8.50	9.00	11.00	12.50	15.00	20.00	25.38	—	—	—	—	—	—
B Dia.	2.50	3.12	4.38	5.62	6.62	8.00	9.12	11.50	15.75	20.00	23.62	28.00	32.75	35.50	53.16	66.00
C Max.	2.00	3.00	2.75	5.50	6.50	7.56	8.19	10.62	13.38	16.00	17.12	20.88	24.19	25.00	43.93	61.50
CC Max. Grooved End	—	—	—	4.75	5.75	6.88	7.25	9.62	12.12	14.62	—	—	—	—	—	—
D Threaded	—	—	—	3.25	4.75	5.50	6.25	—	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	—	4.00*	4.75	5.50	6.00	7.50	10.00	12.75	14.88	17.00	19.50	20.81	—	—
DDD 300 ANSI	—	—	—	4.25*	5.00	5.88	6.38	7.88	10.50	13.25	15.56	17.75	20.25	21.62	—	—
DDDD Grooved End	—	—	—	—	4.75	—	6.00	7.50	—	—	—	—	—	—	—	—
E	1.25	0.88	1.63	1.12	1.50	1.69	2.56	3.19	4.31	5.31	9.25	10.75	12.62	15.50	17.75	24.56
EE Grooved End	—	—	—	2.00	2.50	2.88	3.12	4.25	6.00	7.56	—	—	—	—	—	—
F 150 ANSI	—	—	—	2.50	3.00	3.50	3.75	4.50	5.50	6.75	8.00	9.50	10.50	11.75	19.25	28.00
FF 300 ANSI	—	—	—	3.06	3.25	3.75	4.13	5.00	6.25	7.50	8.75	10.25	11.50	12.75	—	—
G Threaded	—	—	—	1.88	3.25	4.00	4.50	—	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	—	4.00*	3.25	4.00	4.00	5.00	6.00	8.00	8.62	13.75	14.88	15.69	—	—
GGG 300 ANSI	—	—	—	4.25*	3.50	4.31	4.38	5.31	6.50	8.50	9.31	14.50	15.62	16.50	—	—
GGGG Grooved End	—	—	—	—	3.25	—	4.25	5.00	—	—	—	—	—	—	—	—
H NPT Body Tapping	—	⅛	¼	⅜	⅜	½	½	¾	¾	1	1	1	1	1	1	2
J NPT Cover Center Plug	⅛	⅛	¼	¼	½	½	½	¾	¾	1	1	1¼	1½	2	1½	2
K NPT Cover Tapping	—	⅛	¼	⅜	⅜	½	½	¾	¾	1	1	1	1	1	1	2
Valve Stem Internal Thread UNF	—	—	—	10-32	10-32	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	⅜-24	½-20	¾-16	¾-16
Stem Travel	—	—	—	0.4	0.6	0.7	0.8	1.1	1.7	2.3	2.8	3.4	4.0	4.5	6.75	10.12
Approx. Ship Wt. Lbs.	3	3	8	15	35	50	70	140	285	500	780	1165	1600	2265	6200	11470

*40mm Size Only *1½" Size Only

Valve Size (mm)	**10**	**15-20**	**25**	**32-40**	**50**	**65**	**80**	**100**	**150**	**200**	**250**	**300**	**350**	**400**	**600**	**900**
A Threaded	70	89	130	184	238	279	318	—	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	—	216*	238	279	305	381	508	645	756	864	991	1051	1562	1930
AAA 300 ANSI	—	—	—	229*	254	295	337	397	533	670	790	902	1029	1105	1606	1981
AAAA Grooved End	—	—	—	216	228	279	318	381	508	645	—	—	—	—	—	—
B Dia.	64	80	111	143	168	203	232	292	400	508	600	711	832	902	1350	1676
C Max.	51	76	70	140	165	192	208	270	340	406	435	530	614	635	1116	1562
CC Max. Grooved End	—	—	—	120	146	175	184	244	308	371	—	—	—	—	—	—
D Threaded	—	—	—	83	121	140	159	—	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	—	102*	121	140	152	191	254	324	378	432	495	528	—	—
DDD 300 ANSI	—	—	—	108*	127	149	162	200	267	337	395	451	514	549	—	—
DDDD Grooved End	—	—	—	—	121	—	152	191	—	—	—	—	—	—	—	—
E	32	23	42	29	38	43	65	81	110	135	235	273	321	394	451	624
EE Grooved End	—	—	—	52	64	73	79	108	152	192	—	—	—	—	—	—
F 150 ANSI	—	—	—	64	76	89	95	114	140	171	203	241	267	298	489	711
FF 300 ANSI	—	—	—	78	83	95	105	127	159	191	222	260	292	324	—	—
G Threaded	—	—	—	48	83	102	114	—	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	—	102*	83	102	102	127	152	203	219	349	378	399	—	—
GGG 300 ANSI	—	—	—	102*	89	110	111	135	165	216	236	368	397	419	—	—
GGGG Grooved End	—	—	—	—	83	—	108	127	—	—	—	—	—	—	—	—
H NPT Body Tapping	—	⅛	¼	⅜	⅜	½	½	¾	¾	1	1	1	1	1	1	2
J NPT Cover Center Plug	⅛	⅛	¼	¼	½	½	½	¾	¾	1	1	1¼	1½	2	1½	2
K NPT Cover Tapping	—	⅛	¼	⅜	⅜	½	½	¾	¾	1	1	1	1	1	1	2
Valve Stem Internal Thread UNF	—	—	—	10-32	10-32	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	⅜-24	½-20	¾-16	¾-16
Stem Travel	—	—	—	10	15	18	20	28	43	58	71	86	102	114	171	257
Approx. Ship Wt. Kgs.	1.4	1.4	4	7	16	23	32	64	129	227	354	528	726	1027	2812	5200

Cla-Val Control Valves operate with maximum efficiency when mounted in horizontal piping with the main valve cover UP, however, other positions are acceptable. Due to c omponent size and weight of 8 inch and larger valves, installation with cover UP is advisable. We recommend isolation valves be installed on inlet and outlet for maintenance. Adequate space above and around the valve for service personnel should be considered essential. A regular maintenance program should be established based on the specific application data. However, we recommend a thorough inspection be done at least once a year. Consult factory for specific recommendations.

CLA-VAL

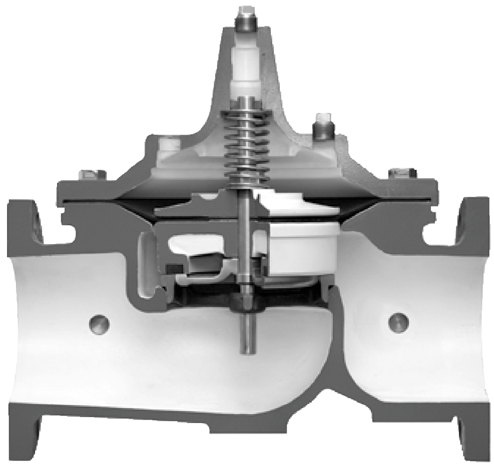
— MODEL — **100-01**

Hytrol Valve

Description

The Cla-Val Model 100-01 Hytrol Valve is a main valve for Cla-Val Automatic Control Valves. It is a hydraulically operated, diaphragm-actuated, globe or angle pattern valve.

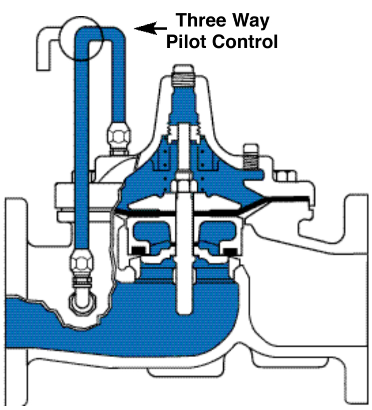
This valve consists of three major components; body, diaphragm assembly, and cover. The diaphragm assembly is the only moving part. The diaphragm assembly uses a diaphragm of nylon fabric bonded with synthetic rubber. A synthetic rubber disc, contained on three and one half sides by a disc retainer and disc guide, forms a seal with the valve seat when pressure is applied above the diaphragm. The diaphragm assembly forms a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.



Installation

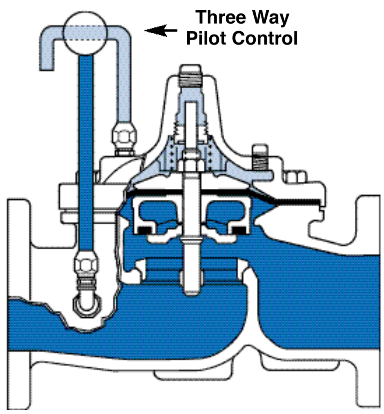
1. Before valve is installed, pipe lines should be flushed of all chips, scale and foreign matter.
2. It is recommended that either gate or block valves be installed on both ends of the 100-01 Hytrol Valve to facilitate isolating the valve for preventive maintenance and repairs.
3. Place the valve in the line with flow through the valve in the direction indicated on the inlet nameplate (See “Flow Direction” Section).
4. Allow sufficient room around valve to make adjustments and for disassembly.
5. Cla- Val 100-01 Hytrol Valves operate with maximum efficiency when mounted in horizontal piping with the cover UP, however, other positions are acceptable. Due to size and weight of the cover and internal components of 8 inch and πlarger valves, installation with the cover UP is advisable. This makes internal parts readily accessible for periodic inspection.
6. If a pilot control system is installed on the 100-01 Hytrol Valve, use care to prevent damage. If it is necessary to remove fittings or components, be sure they are kept clean and replaced exactly as they were.
7. After the valve is installed and the system is first pressurized, vent air from the cover chamber and pilot system tubing by loosening fittings at all high points.

Principles of Operation



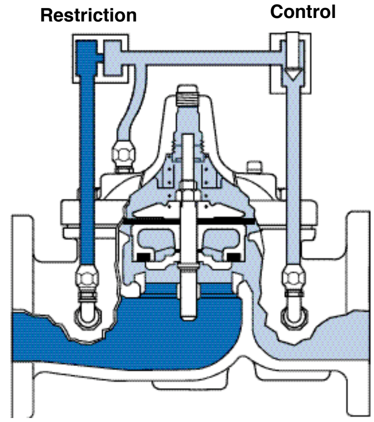
Tight Closing Operation

When pressure from the valve inlet (or an equivalent independent operating pressure) is applied to the diaphragm chamber the valve closes drip-tight.



Full Open Operation

When pressure in diaphragm chamber is relieved to a zone of lower pressure (usually atmosphere) the line pressure (5 psi Min.) at the valve inlet opens the valve.



Modulating Action

Valve modulates when diaphragm pressure is held at an intermediate point between inlet and discharge pressure. With the use of a Cla-Val. "modulating control," which reacts to line pressure changes, the pressure above the diaphragm is varied, allowing the valve to throttle and compensate for the change.

Flow Direction

The flow through the 100-01 Hytrol Valve can be in one of two directions. When flow is “up-and-over the seat,” it is in “normal” flow and the valve will fail in the open position. When flow is “over-the seat-and down,” it is in “reverse” flow and the valve will fail in the closed position. There are no permanent flow arrow markings. **The valve must be installed according to nameplate data.**

Recommended Tools

1. Three pressure gauges with ranges suitable to the installation to be put at Hytrol inlet, outlet and cover connections.

2. Cla-Val Model X101 Valve Position Indicator. This provides visual indication of valve position without disassembly of valve.

3. Other items are: suitable hand tools such as screwdrivers, wrenches, etc. soft jawed (brass or aluminum) vise, 400 grit wet or dry sandpaper and water for cleaning.

Troubleshooting

The following troubleshooting information deals strictly with the Model 100-01 Hytrol Valve. This assumes that all other components of the pilot control system have been checked out and are in proper working condition (See appropriate sections in Technical Manual for complete valve).

All trouble shooting is possible without removing the valve from the line or removing the cover. It is highly recommended to permanently install a Model X101 Valve Position Indicator and three gauges in unused Hytrol inlet, outlet and cover connections.

SYMPTOM	PROBABLE CAUSE	REMEDY
Fails to Close	Closed isolation valves in control system, or in main line.	Open Isolation valves.
	Lack of cover chamber pressure.	Check upstream pressure, pilot system, strainer, tubing, isolation valves, or needle valves for obstruction.
	Diaphragm damaged (See Diaphragm Check).	Replace diaphragm.
	Diaphragm assembly inoperative. Corrosion or excessive scale build up on valve stem (See Freedom of Movement Check).	Clean and polish stem. Inspect and replace any damaged or badly eroded part.
	Mechanical obstruction. Object lodged in valve. (See Freedom of Movement Check)	Remove obstruction.
	Worn disc (See Tight Sealing Check).	Replace disc.
	Badly scored seat (See Tight Sealing Check).	Replace seat.
Fails to Open	Closed upstream and/or downstream isolation valves in main line.	Open valves.
	Insufficient line pressure.	Check upstream pressure (Minimum 5 psi flowing line pressure differential).
	Diaphragm assembly inoperative. Corrosion or excessive buildup on valve stem (See Freedom of Movement Check).	Clean and polish stem. Inspect and replace any damaged or badly eroded part.
	Diaphragm damaged (For valves in "reverse flow" only).	Replace diaphragm.

After checking out probable causes and remedies, the following three checks can be used to diagnose the nature of the problem before maintenance is started. They must be done in the order shown.

Three Checks

The 100-01 Hytrol Valve has only one moving part (the diaphragm and disc assembly). So, there are only three major types of problems to be considered.

First: Valve is stuck - that is, the diaphragm assembly is not free to move through a full stroke either from open to close or vice versa.

Second: Valve is free to move and can’t close because of a worn out diaphragm.

Third: Valve leaks even though it is free to move and the diaphragm isn’t leaking.

CAUTION:
Care should be taken when doing the trouble shooting checks on the 100-01 Hytrol Valve. These checks do require the valve to open fully. This will either allow a high flow rate through the valve, or the downstream pressure will quickly increase to the inlet pressure. In some cases, this can be very harmful. Where this is the case, and there are no block valves in the system to protect the downstream piping, it should be realized that ***the valve cannot be serviced under pressure.*** *Steps should be taken to remedy this situation before proceeding any further.*

Diaphragm Check (#1)

1. Shut off pressure to the Hytrol Valve by slowly closing upstream and downstream isolation valves. **SEE CAUTION**.

2. Disconnect or close all pilot control lines to the valve cover and leave only one fitting in highest point of cover open to atmosphere.

3.With the cover vented to atmosphere, slowly open upstream isolation valve to allow some pressure into the Hytrol Valve body. Observe the open cover tapping for signs of continuous flow. It is not necessary to fully open isolating valve. Volume in cover chamber capacity chart will be displaced as valve moves to open position. Allow sufficient time for diaphragm assembly to shift positions. If there is no continuous flow, you can be quite certain the diaphragm is sound and the diaphragm assembly is tight. If the fluid appears to flow continuously this is a good reason to believe the diaphragm is either damaged or it is loose on the stem. In either case, this is sufficient cause to remove the valve cover and investigate the leakage. (See “Maintenance” Section for procedure.)

COVER CHAMBER CAPACITY
(Liquid Volume displaced when valve opens)

Valve size (inches)	Displacement	
	Gallons	Liters
1 1/4	.020	.07
1 1/2	.020	.07
2	.032	.12
2 1/2	.043	.16
3	.080	.30
4	.169	.64
6	.531	2.0
8	1.26	4.8
10	2.51	9.5
12	4.00	15.1
14	6.50	24.6
16	9.57	36.2
24	29.00	109.8
36	42.00	159.0

Freedom of Movement Check (#2)

4. Determining the Hytrol Valve’s freedom of movement can be done by one of two methods.

5. For most valves it can be done after completing Diaphragm Check (Steps 1, 2, and 3). **SEE CAUTION**. At the end of step 3 the valve should be fully open.

6. If the valve has a Cla-Val X101 Position Indicator, observe the indicator to see that the valve opens wide. Mark the point of maximum opening.

7. Re-connect enough of the control system to permit the application of inlet pressure to the cover. Open pilot system isolation valve so pressure flows from the inlet into the cover.

8. While pressure is building up in the cover, the valve should close smoothly. There is a hesitation in every Hytrol Valve closure, which can be mistaken for a mechanical bind. The stem will appear to stop moving very briefly before going to the closed position. This slight pause is caused by the diaphragm flexing at a particular point in the valve’s travel and is not caused by a mechanical bind.

9. When closed, a mark should be made on the X101 Valve position indicator corresponding to the “closed” position. The distance between the two marks should be approximately the stem travel shown in chart.

STEM TRAVEL
(Fully Open to Fully Closed)

Valve Size (inches)		Travel (inches)	
Inches	MM	Inches	MM
1 1/4	32	0.4	10
1 1/2	40	0.4	10
2	50	0.6	15
2 1/2	65	0.7	18
3	80	0.8	20
4	100	1.1	28
6	150	1.7	43
8	200	2.3	58
10	250	2.8	71
12	300	3.4	86
14	350	4.0	100
16	400	4.5	114
24	600	6.5	165
36	900	8.5	216

10. If the stroke is different than that shown in stem travel chart this is a good reason to believe something is mechanically restricting the stroke of the valve at one end of its travel. If the flow does not stop through the valve when in the indicated “closed” position, the obstruction probably is between the disc and the seat. If the flow does stop, then the obstruction is more likely in the cover. In either case, the cover must be removed, and the obstruction located and removed. The stem should also be checked for scale build-up. (See “Maintenance, section for procedure.)

11. For valves 6” and smaller, the Hytrol Valve’s freedom of movement check can also be done after all pressure is removed from the valve. **SEE CAUTION**. After closing inlet and outlet isolation valve and bleeding pressure from the valve, check that the cover chamber and the body are temporarily vented to atmosphere. Insert fabricated tool into threaded hole in top of valve stem, and lift the diaphragm assembly manually. Note any roughness. The diaphragm assembly should move smoothly throughout entire valve stroke. The tool is fabricated from rod that is threaded on one end to fit valve stem and has a “T” bar handle of some kind on the other end for easy gripping. (See chart in Step 4 of “Disassembly” Section.)

12. Place marks on this diaphragm assembly lifting tool when the valve is closed and when manually positioned open. The distance between the two marks should be approximately the stem travel shown in stem travel chart. If the stroke is different than that shown, there is a good reason to believe something is mechanically restricting the stroke of the valve. The cover must be removed, and the obstruction located and removed. The stem should also be checked for scale build-up. (See “Maintenance” Section for procedure.)

Tight Sealing Check (#3)

13. Test for seat leakage after completing checks #1 & #2 (Steps 1 to 12). **SEE CAUTION.** Close the isolation valve downstream of the Hytrol Valve. Apply inlet pressure to the cover of the valve, wait until it closes. Install a pressure gauge between the two closed valves using one of the two ports in the outlet side of the Hytrol. Watch the pressure gauge. If the pressure begins to climb, then either the downstream isolation valve is permitting pressure to creep back, or the Hytrol is allowing pressure to go through it. Usually the pressure at the Hytrol inlet will be higher than on the isolation valve discharge, so if the pressure goes up to the inlet pressure, you can be sure the Hytrol is leaking. Install another gauge downstream of isolating valve. If the pressure between the valves only goes up to the pressure on the isolation valve discharge, the Hytrol Valve is holding tight, and it was just the isolation valve leaking.

Maintenance

Preventative Maintenance

The Cla-Val Co. Model 100-01 Hytrol Valve requires no lubrication or packing and a minimum of maintenance. However, a periodic inspection schedule should be established to determine how the operating conditions of the system are affecting the valve. The effect of these actions must be determined by inspection.

Disassembly

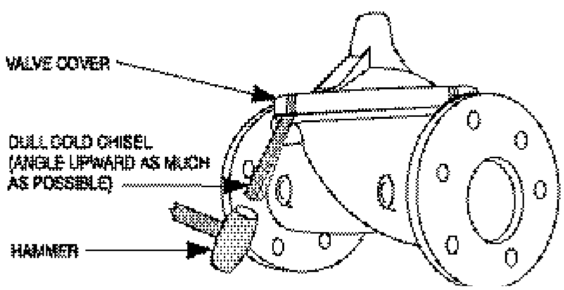
Inspection or maintenance can be accomplished without removing the valve from the line. Repair kits with new diaphragm and disc are recommended to be on hand before work begins.

WARNING: Maintenance personnel can be injured and equipment damaged if disassembly is attempted with pressure in the valve. **SEE CAUTION.**

1. Close upstream and downstream isolation valves **and independent operating pressure when used** to shut off all pressure to the valve.

2. Loosen tube fittings in the pilot system to remove pressure from valve body and cover chamber. After pressure has been released from the valve, use care to remove the controls and tubing. Note and sketch position of tubing and controls for re-assembly. The schematic in front of the Technical Manual can be used as a guide when reassembling pilot system.

3. Remove cover nuts and remove cover. If the valve has been in service for any length of time, chances are the cover will have to be loosened by driving upward along the edge of the cover with a **dull** cold chisel.



On 6” and smaller valves block and tackle or a power hoist can be used to lift valve cover by inserting proper size eye bolt in place of the center cover plug. on 8” and larger valves there are 4 holes (5/8” — 11 size) where jacking screws and/or eye bolts may be inserted for lifting purposes. **Pull cover straight up** to keep from damaging the integral seat bearing and stem.

COVER CENTER PLUG SIZE

Valve Size	Thread Size (NPT)
1 1/4"—1 1/2"	1/4"
2"—3"	1/2"
4"—6"	3/4"
8"—10"	1"
12"	1 1/4"
14"	1 1/2"
16"	2"
24"	2"
36”	2”

4. Remove the diaphragm and disc assembly from the valve body. With smaller valves this can be accomplished by hand by **pulling straight up on the stem so as not to damage the seat bearing.** On large valves, an eye bolt of proper size can be installed in the stem and the diaphragm assembly can be then lifted with a block and tackle or power hoist. Take care not to damage the stem or bearings. The valve won't work if these are damaged.

VALVE STEM THREAD SIZE

Valve Size	Thread Size (UNF Internal)
1 1/4"—2 1/2"	10—32
3"—4"	1/4—28
6"—14"	3/8—24
16"	1/2—20
24"	3/4-16
36"	3/4-16

5. The next item to remove is the stem nut. Examine the stem threads above the nut for signs of mineral deposits or corrosion. If the threads are not clean, use a wire brush to remove as much of the residue as possible. Attach a good fitting wrench to the nut and give it a sharp “rap” rather than a steady pull. Usually several blows are sufficient to loosen the nut for further removal. On the smaller valves, the entire diaphragm assembly can be held by the stem in a vise **equipped with soft brass jaws** before removing the stem nut.

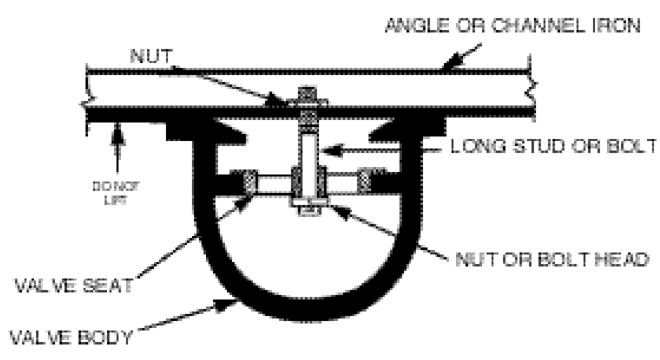
The use of a pipe wrench or a vise without soft brass jaws scars the fine finish on the stem. No amount of careful dressing can restore the stem to its original condition. Damage to the finish of the stem can cause the stem to bind in the bearings and the valve will not open or close.

6. After the stem nut has been removed, the diaphragm assembly breaks down into its component parts. Removal of the disc from the disc retainer can be a problem if the valve has been in service for a long time. Using two screwdrivers inserted along the outside edge of the disc usually will accomplish its removal. Care should be taken to preserve the spacer washers in water, particularly if no new ones are available for re-assembly.

7. The only part left in the valve body is the seat which ordinarily does not require removal. Careful cleaning and polishing of inside and outside surfaces with 400 wet/dry sandpaper will usually restore the seat’s sharp edge. If, however, it is badly worn and replacement is necessary, it can be easily removed.

Seats in valve sizes 1 1/4” through 6” are threaded into the valve body. They can be removed with accessory X109 Seat Removing Tool available from the factory. On 8” and larger valves, the seat is held in place by flat head machine screws. Use a tight-fitting, long shank screwdriver to prevent damage to seat screws. If upon removal of the screws the seat cannot be lifted out, it will be necessary to use a piece of angle or channel iron with a hole drilled in the center. Place it across the body so a long stud can be inserted through the center hole in the seat and the hole in the angle iron. By tightening the nut a uniform upward force is exerted on the seat for removal.

NOTE: Do not lift up on the end of the angle iron as this may force the integral bearing out of alignment, causing the stem to bind.



Lime Deposits

One of the easiest ways to remove lime deposits from the valve stem or other metal parts is to dip them in a 5-percent muramic acid solution just long enough for the deposit to dissolve. This will remove most of the common types of deposits. **CAUTION: USE EXTREME CARE WHEN HANDLING ACID.** Rinse parts in water before handling. If the deposit is not removed by acid, then a fine grit (400) wet or dry sandpaper can be used with water.

Inspection of Parts

After the valve has been disassembled, each part should be examined carefully for signs of wear, corrosion, or any other abnormal condition. Usually, it is a good idea to replace the rubber parts (diaphragm and disc) unless they are free of signs of wear. These are available in a repair kit. Any other parts which appear doubtful should be replaced. WHEN ORDERING PARTS, BE SURE TO GIVE COMPLETE NAMEPLATE DATA, ITEM NUMBER AND DESCRIPTION.

NOTE: If a new disc isn't available, the existing disc can be turned over, exposing the unused surface for contact with the seat. The disc should be replaced as soon as practical.

Reassembly

1. Reassembly is the reverse of the disassembly procedure. If a new disc has been installed, it may require a different number of spacer washers to obtain the right amount of "grip" on the disc. When the diaphragm assembly has been tightened to a point where the diaphragm cannot be twisted, the disc should be compressed very slightly by the disc guide. Excessive compression should be avoided. Use just enough spacer washers to hold the disc firmly without noticeable compression.

2. MAKE SURE THE STEM NUT IS VERY TIGHT. Attach a good fitting wrench to the nut and give it a sharp "rap" rather than a steady pull. Usually several blows are sufficient to tighten the stem nut for final tightening. Failure to do so could allow the diaphragm to pull loose and tear when subjected to pressure.

3. Carefully install the diaphragm assembly by lowering the stem through the seat bearing. Take care not to damage the stem or bearing. Line up the diaphragm holes with the stud or bolt holes on the body. on larger valves with studs, it may be necessary to hold the diaphragm assembly up part way while putting the diaphragm over the studs.

4. Put spring in place and replace cover. Make sure diaphragm is lying smooth under the cover.

5. Tighten cover nuts firmly using a cross-over pattern until all nuts are tight.

6. Test Hytrol Valve before re-installing pilot valve system.

Test Procedure After Valve Assembly

There are a few simple tests which can be made in the field to make sure the Hytrol Valve has been assembled properly. Do these before installing pilot system and returning valve to service. These are similar to the three troubleshooting tests.

1. Check the diaphragm assembly for freedom of movement after all pressure is removed from the valve. **SEE CAUTION.** Insert fabricated tool into threaded hole in top of valve stem, and lift the diaphragm assembly manually. Note any roughness, sticking or grabbing. The diaphragm assembly should move smoothly throughout entire valve stroke. The tool is fabricated from rod that is threaded on one end to fit valve stem (See chart in Step 4 of "Disassembly" section.) and has a "T" Bar handle of some kind on the other end for easy gripping.

Place marks on this diaphragm assembly lifting tool when the valve is closed and when manually positioned open. The distance between the two marks should be approximately the stem travel shown in stem travel chart (See "Freedom of Movement Check" section). If the stroke is different than that shown, there is a good reason to believe something is mechanically restricting the stroke of the valve. The cover must be removed, the obstruction located and removed (See "Maintenance" Section for procedure).

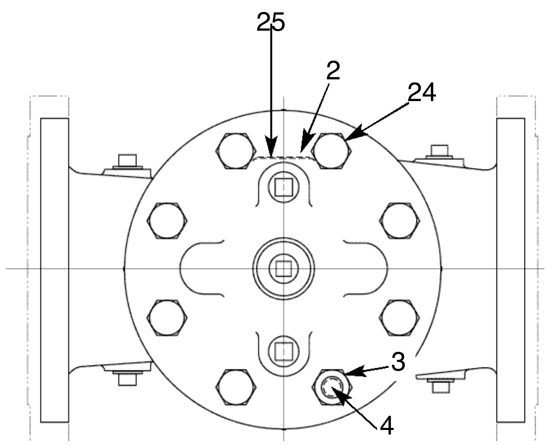
Due to the weight of the diaphragm assembly this procedure is not possible on valves 8" and larger. on these valves, the same determination can be made by carefully introducing a low pressure-less than five psi) into the valve body with the cover vented. **SEE CAUTION**. Looking in cover center hole see the diaphragm assembly lift easily without hesitation, and then settle back easily when the pressure is removed.

2. To check the valve for drip-tight closure, a line should be connected from the inlet to the cover, and pressure applied at the inlet of the valve. If properly assembled, the valve should hold tight with as low as ten PSI at the inlet. See "Tight Sealing Check" section.)

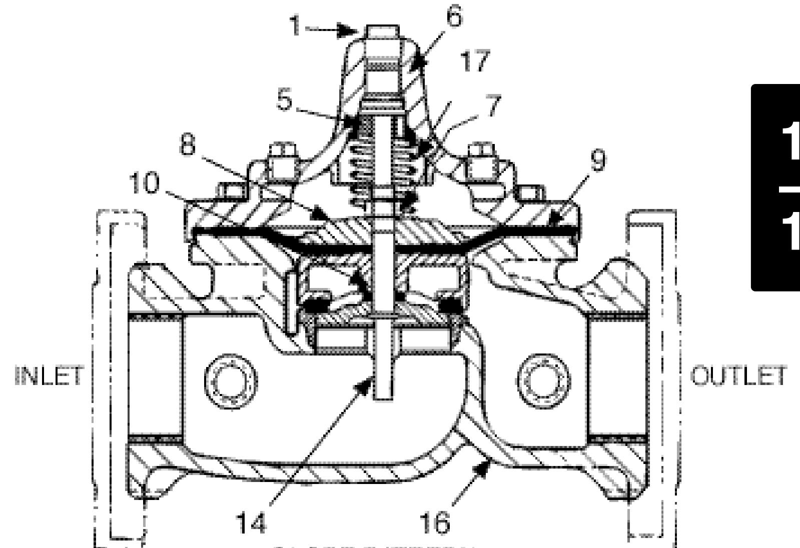
3. With the line connected from the inlet to the cover, apply full working pressure to the inlet. Check all around the cover for any leaks. Re-tighten cover nuts if necessary to stop leaks past the diaphragm.

4. Remove pressure, then re-install the pilot system and tubing exactly as it was prior to removal. **Bleed air from all high points.**

5. Follow steps under "Start-Up and Adjustment" Section in Technical Manual for returning complete valve back to service.

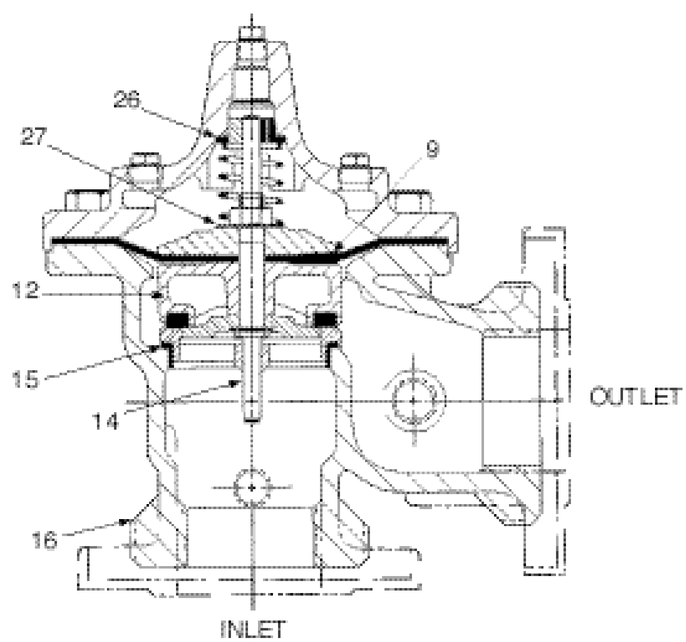


TOP VIEW

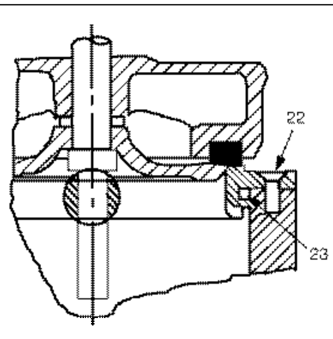


GLOBE PATTERN

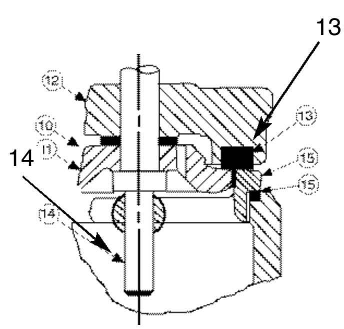
PARTS LIST	
Item	Description
1.	Pipe Plug
2.	Drive Screws (for nameplate)
3.	Hex Nut (8" and larger)
4.	Stud (8" and larger)
5.	Cover Bearing
6.	Cover
7.	Stem Nut
8.	Diaphragm Washer
9.	Diaphragm
10.	Spacer Washers
11.	Disc Guide
12.	Disc Retainer
13.	Disc
14.	Stem
15.	Seat
16.	Body
17.	Spring
22.	Flat Head Screws (8" and larger)
23.	Seat O-Ring
24.	Hex head Bolt (1 1/4" thru 6")
25.	Nameplate
26.	Upper Spring Washer (Epoxy coated valves only)
27.	Lower Spring Washer (Epoxy coated valves only)
28.	Cover Bearing Housing (16" only)
29.	Cover O-Ring (16'" only)
30.	Hex Bolt (16" only)
31.	Pipe Cap (16" only)



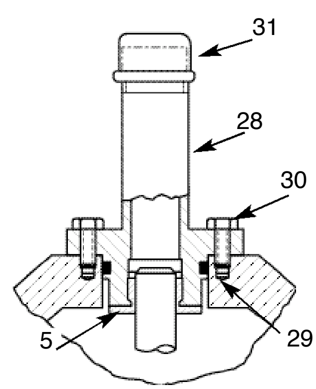
ANGLE PATTERN



1 1/4" - 6" SEAT DETAIL



8" - 16" SEAT DETAIL



16" COVER DETAIL

ANTI-CAVITATION

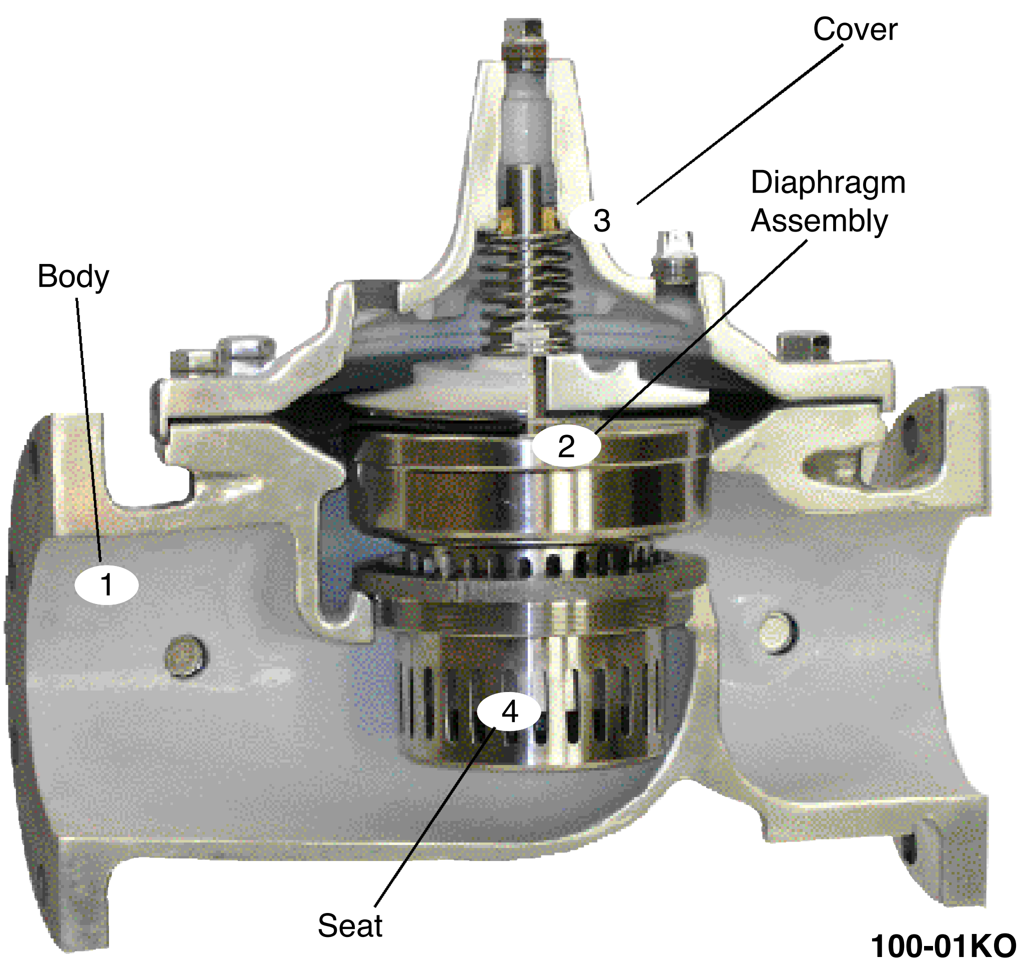
Powertrol

The Cla-Val Model 100-01KO Anti-Cavitation Hytrol Valve is designed for applications where there is a high potential for damage from cavitation. Specify this valve series for a wide variety of control valve applications having pressure differentials up to 300 PSID or for relief valves having atmospheric discharge up to 150 PSID.

The 100-01KO Hytrol main valve provides optimum internal pressure control through a unique anti-cavitation trim (patent-pending) design. Constructed of 316 Stainless Steel, the seat and disc guide trim components feature dual interlocked sleeves containing radial slots that deflect internal flow to impinge upon itself in the center of the flow path, harmlessly dissipating the potential cavitation damage. This unique design also lessens the possibility of fouling if large particles in the water are present due to the large flow path of the radial slots.

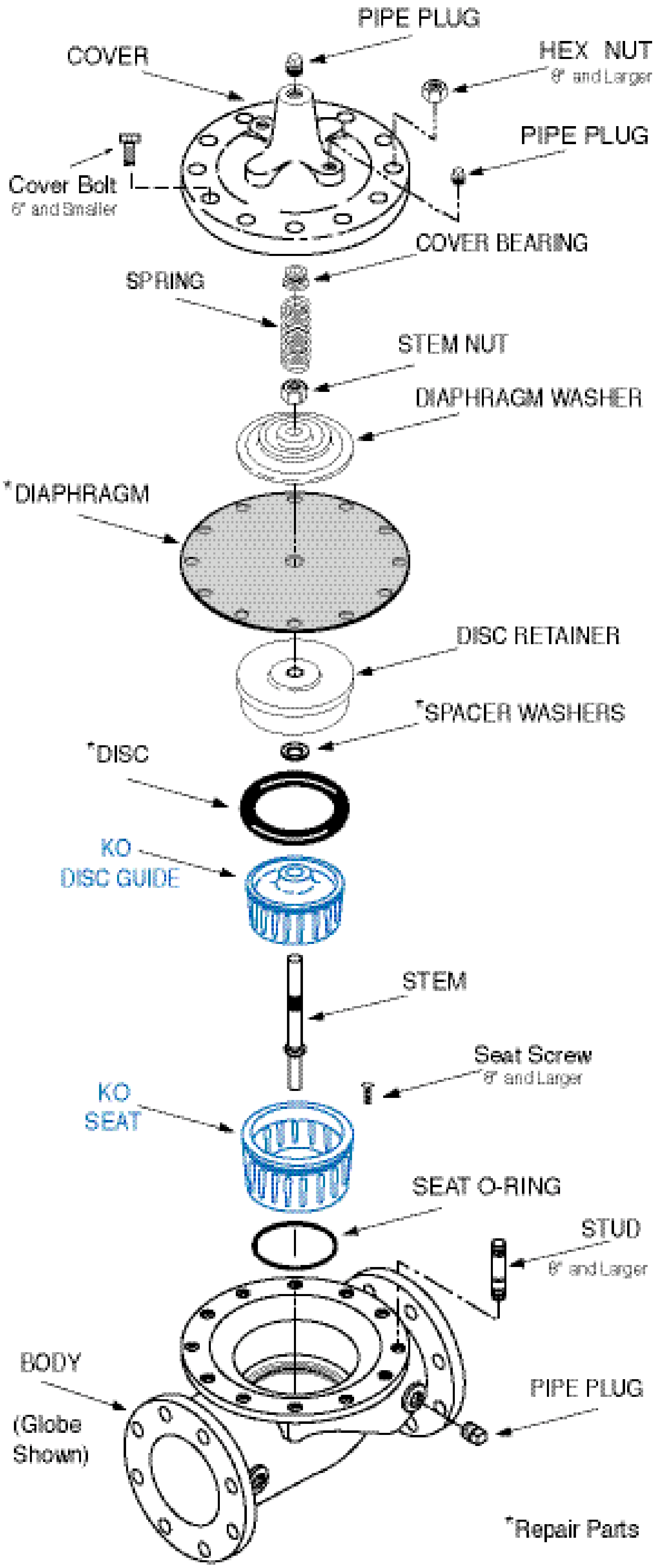
The 100-01KO Hytrol is the basic valve used in Cla-Val Automatic Control Valves for high differential applications requiring remote control, pressure regulation, solenoid operation, rate of flow control, or liquid level control.

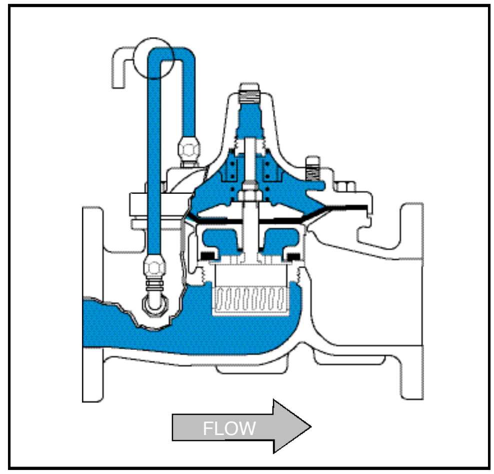
The Anti-Cavitation Trim components can be retrofitted to existing valves if the application indicates an appropriate need. Please see 100-01 maintenance instructions.



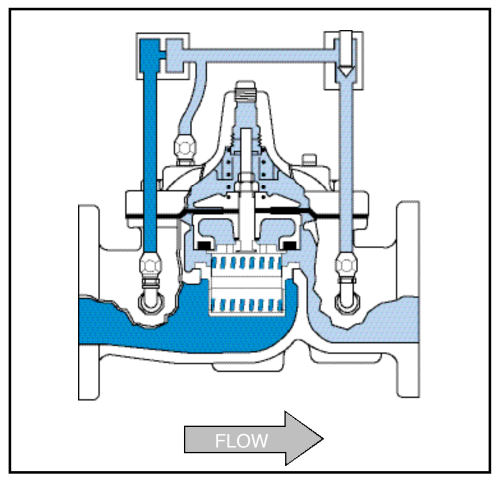
100-01KO

100-01KO Anti-Cavitation Hytrol Valve

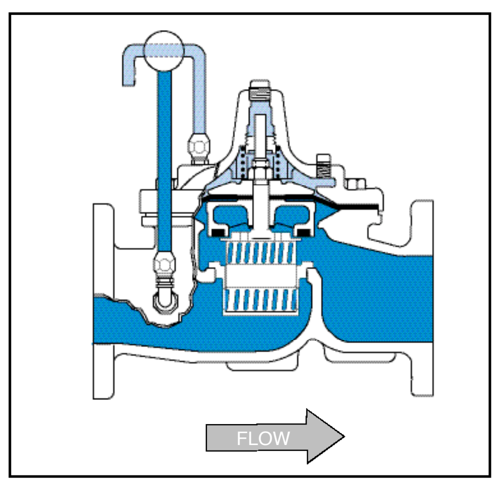




Closed Valve
When pressure from the valve inlet is applied to the cover chamber, the valve closes drip-tight.



Throttling Valve
The valve holds any intermediate position when operating pressures are equal above and below the diaphragm. A Cla-Val "Modulating" Pilot Control will allow the valve to automatically compensate for line pressure changes.



Open Valve
When pressure in the cover chamber is relieved to a zone of lower pressure, the line pressure at the valve inlet opens the valve, allowing full flow.

Specifications

Pattern	Globe	Angle	Grooved End
Size	1½" - 24"	2" - 10"	1½" - 8"

Operating Temp. Range

Fluids
-40° to 180° F

Model 100-01KO

NSF

APPROVED
(4" - 24")

Pressure Ratings (Recommended Maximum Pressure - psi)

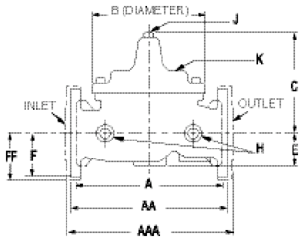
Valve Body & Cover		Pressure Class			
		Flanged			Threaded
Grade	Material	ANSI Standards*	150 lb.	300 lb.	End** Details
ASTM A536	Ductile Iron	B16.42	250	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400
ASTM B62	Bronze	B16.24	225	400	400

Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
** End Details machined to ANSI B2.1 specifications.

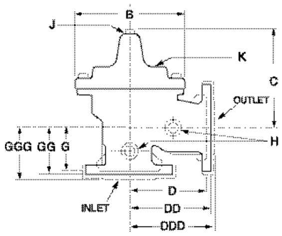
Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	1½" - 24"	1½" - 16"	1½" 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Stainless Steel is Standard		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		

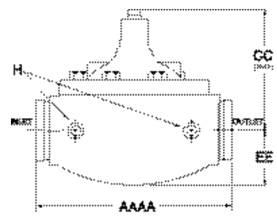
For material options not listed consult factory.
Cla-Val manufactures valves in more than 50 different alloys.



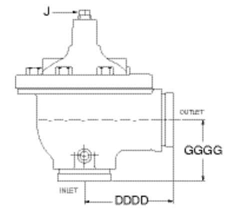
100-01 (Globe)



100-01 (Angle)



100-01 Grooved (Globe)



100-01 Grooved (Angle)

Valve Size (Inches)	1½	2	3	4	6	8	10	12	16	24	(mm)	40	50	80	100	150	200	250	300	400	600
A Threaded	7.25	9.38	12.50	—	—	—	—	—	—	—	**A**	184	238	318	—	—	—	—	—	—	—
AA 150 ANSI	8.50	9.38	12.00	15.00	20.00	25.38	29.75	34.00	41.38	61.50	**AA**	216	238	305	381	508	645	756	864	1051	1562
AAA 300 ANSI	9.00	10.00	13.25	15.62	21.00	26.38	31.12	35.50	43.50	63.24	**AAA**	229	254	337	397	533	670	790	902	1105	1606
AAAA Grooved End	8.50	9.00	12.50	15.00	20.00	25.38	—	—	—	—	**AAAA**	216	228	318	381	508	645	—	—	—	—
B Dia.	5.62	6.62	9.12	11.50	15.75	20.00	26.62	28.00	35.50	53.16	**B**	143	168	232	292	400	508	600	711	902	1350
C Max.	5.50	6.50	8.19	10.62	13.38	16.00	17.12	20.88	25.00	43.93	**C**	140	165	208	270	340	406	435	530	635	1116
CC Max.	4.75	5.75	7.25	9.62	12.12	14.62	—	—	—	—	**CC**	120	146	184	244	308	371	—	—	—	—
D Threaded	3.25	4.75	6.25	—	—	—	—	—	—	—	**D**	83	121	159	—	—	—	—	—	—	—
DD 150 ANSI	4.00	4.75	6.00	7.50	10.00	12.75	14.88	—	—	—	**DD**	102	121	152	191	254	324	378	—	—	—
DDD 300 ANSI	4.25	5.00	6.38	7.88	10.50	13.25	15.56	—	—	—	**DDD**	108	127	162	200	267	337	395	—	—	—
DDDD Grooved End	—	4.75	6.00	7.50	—	—	—	—	—	—	**DDDD**	—	121	152	191	—	—	—	—	—	—
E	1.12	1.50	2.56	3.19	4.31	5.31	9.25	10.75	15.50	17.75	**E**	29	38	65	81	110	135	235	273	394	451
EE Grooved End	2.00	2.50	3.12	4.25	6.00	7.56	—	—	—	—	**EE**	52	64	79	108	152	192	—	—	—	—
F 150 ANSI	2.50	3.00	3.75	4.50	5.50	6.75	8.00	9.50	11.75	19.25	**F**	64	76	95	114	140	171	203	241	298	489
FF 300 ANSI	3.06	3.25	4.13	5.00	6.25	7.50	8.75	10.25	12.75	—	**FF**	78	83	105	127	159	191	222	260	324	—
G Threaded	1.88	3.25	4.50	—	—	—	—	—	—	—	**G**	48	83	114	—	—	—	—	—	—	—
GG 150 ANSI	4.00	3.25	4.00	5.00	6.00	8.00	8.62	—	—	—	**GG**	102	83	102	127	152	203	219	—	—	—
GGG 300 ANSI	4.25	3.50	4.38	5.31	6.50	8.50	9.31	—	—	—	**GGG**	102	89	111	135	165	216	236	—	—	—
GGGG Grooved End	—	3.25	4.75	5.00	—	—	—	—	—	—	**GGGG**	—	83	108	127	—	—	—	—	—	—
H NPT Body Tapping	⅜	⅜	½	¾	¾	1	1	1	1	1	**H** NPT	⅜	⅜	½	¾	¾	1	1	1	1	1
J NPT Cover Center Plug	¼	½	½	¾	¾	1	1	1 ¼	2	1 ½	**J** NPT	¼	½	½	¾	¾	1	1	1 ¼	2	1 ½
K NPT Cover Tapping	⅜	⅜	½	¾	¾	1	1	1	1	1	**K** NPT	⅜	⅜	½	¾	¾	1	1	1	1	1
Valve Stem Internal Thread UNF	10-32	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	½-20	¾-16	**Stem Thread**	10-32	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	½-20	¾-16
Stem Travel	0.4	0.6	0.8	1.1	1.7	2.3	2.8	3.4	4.5	6.75	**StemTr**	10	15	20	28	43	58	71	86	114	171
Approx. Ship Wt. Lbs.	15	35	70	140	285	500	780	1165	2265	6200	**Wt.Kgs**	7	16	32	64	129	227	354	528	1027	2812

Cla-Val Control Valves with KO ANTI-CAVITATION Trim operate with maximum efficiency when mounted in horizontal piping with the main valve cover Up. We recommend isolation valves be installed on inlet and outlet for maintenance. Adequate space above and around the valve for service personnel should be considered essential. A regular maintenance program should be established based on the specific application data. However, we recommend a thorough inspection be done at least once a year. Consult factory for specific recommendations.

Functional Data

Model 100-01KO

Valve Size		Inches	1½	2	3	4	6	8	10	12	16	24
		mm.	40	50	80	100	150	200	250	300	400	600
C_V Factor	**Globe Pattern**	Gal./Min. (gpm.)	14	25	52	90	218	362	469	810	1200	3900
		Litres/Sec. (l/s.)	3.4	6.0	12.5	21.6	52	87	113	194	332	684
	Angle Pattern	Gal./Min. (gpm.)	15	26	55	95	232	388	502	—	—	—
		Litres/Sec. (l/s.)	3.6	6.2	13.2	22.8	56	93	121	—	—	—
Equivalent Length of Pipe	**Globe Pattern**	Feet (ft.)	196	237	416	572	858	1315	2444	2118	2279	4532
		Meters (m.)	60	72	127	174	262	401	745	646	695	1381
	Angle Pattern	Feet (ft.)	171	219	372	514	757	1145	2133	—	—	—
		Meters (m.)	52	67	113	157	231	349	650	—	—	—
K Factor	**Globe Pattern**		30.6	26.1	29.3	29.0	25.5	27.7	41.0	27.7	23.7	28.9
	Angle Pattern		26.7	24.1	26.2	26.0	22.5	24.1	35.8	—	—	—
Liquid Displaced from Cover Chamber When Valve Opens		U.S. Gal.	0.2	.03	.08	.17	.53	1.26	2.5	4.0	9.6	29
		Litres	0.8	.12	.30	.64	2.0	4.8	9.5	15.1	36.2	110

For assistance in selecting appropriate valve options or valves manufactured with special design requirements, please contact our Regional Sales Office or Factory.

Patent Pending

Model 100-01KO Flow Chart

1
—
2

C_V Factor

Formulas for computing C_V Factor, Flow (Q) and Pressure Drop (ΔP):

$$C_V = \frac{Q}{\sqrt{\Delta P}} \qquad Q = C_V \sqrt{\Delta P} \qquad \Delta P = \left(\frac{Q}{C_V}\right)^2$$

K Factor (Resistance Coefficient)
The Value of K is calculated from the formula: $K = \frac{894d^4}{C_V{}^2}$
(U.S. system units)

Equivalent Length of Pipe
Equivalent lengths of pipe (L) are determined from the formula: $L = \frac{K\,d}{12\,f}$
(U.S. system units)

Fluid Velocity
Fluid velocity can be calculated from the following formula: $V = \frac{.4085\,Q}{d^2}$
(U.S. system units)

Where:

C_V = U.S. (gpm) @ 1 psi differential at 60° F water
or
= (l/s) @ 1 bar (14.5 PSIG) differential at 15° C water

d = inside pipe diameter of Schedule 40 Steel Pipe (inches)

f = friction factor for clean, new Schedule 40 pipe (dimensionless) (from Cameron Hydraulic Data, 18th Edition, P 3-119)

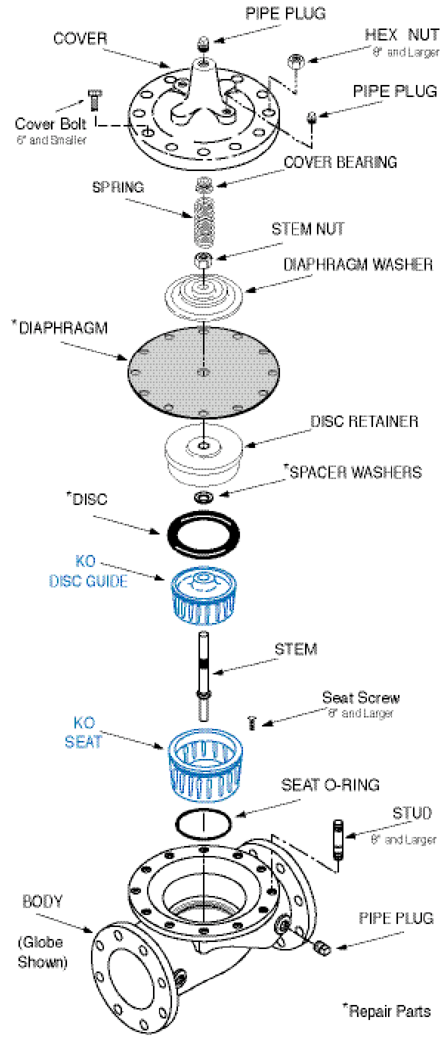
K = Resistance Coefficient (calculated)

L = Equivalent Length of Pipe (feet)

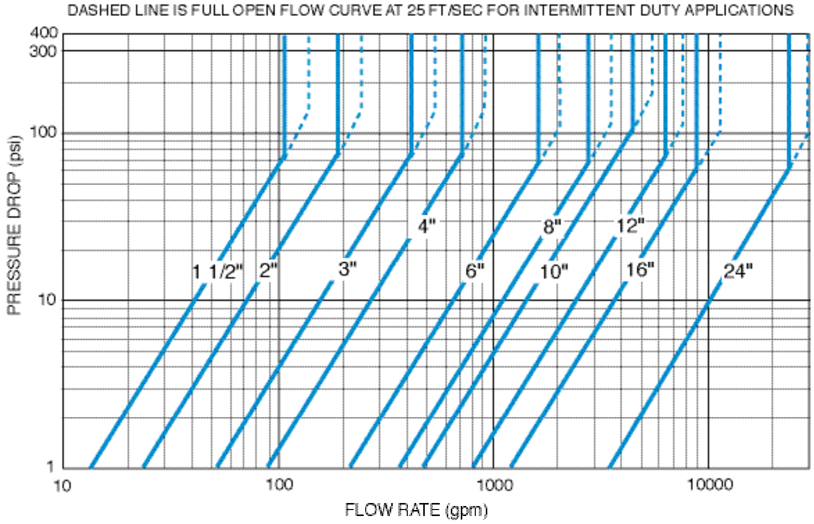
Q = Flow Rate in U.S. (gpm) or (l/s)

V = Fluid Velocity (feet per second) or (meters per second)

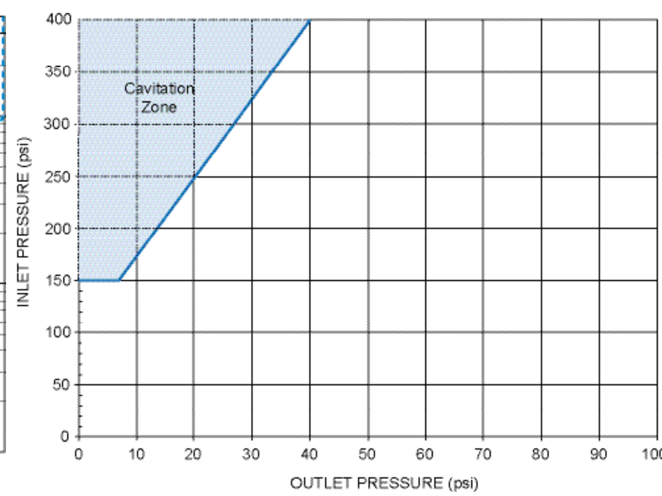
Δ **P** = Pressure Drop in (psi) or (bar)



100G-01KO ANTI-CAVITATION VALVE CURVES
SOLID LINE IS FULL OPEN FLOW CURVES AT 18 FT/SEC FOR CONTINUOUS DUTY APPLICATIONS
DASHED LINE IS FULL OPEN FLOW CURVE AT 25 FT/SEC FOR INTERMITTENT DUTY APPLICATIONS



SELECTION GUIDELINE FOR KO ANTI-CAVITATION VALVES



Notes: On Operating Differential

1. For atmospheric discharge, the maximum inlet pressure cannot exceed 150 psi.
2. For pressure differentials greater than 300 psi the maximum flow velocity should not exceed 18 ft/sec.
3. Flow velocities greater than 25 ft/sec are not recommended.
4. Recommended minimum flow velocity is 1 ft/sec.
5. Consult factory for conditions exceeding these recommendations.

100-01KO Hytrol Main Valve with Anti-Cavitation Trim Purchase Specifications

Function

The valve shall be hydraulically operated, single diaphragm actuated, globe pattern. The valve shall consist of three major components: the body with seat installed, the cover with bearing installed, and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls. Ductile Iron is standard, other materials shall be available. No fabrication or welding shall be used in the manufacturing process.

Description

The anti-cavitation features of the seat and disc guide detail shall have flow slots equally spaced around their perimeters. The seat slots shall be orientated around the perimeter of the seat so that fluid entering the valve shall flow through the seat slot detail such that the fluid flow converges in the center chamber of the seat allowing potential cavitation to dissipate. The disc guide slots shall be positioned around the perimeter of the disc guide, configured and oriented in an angular direction so that fluid flow exiting through the slots is diverted away from direct impact into pressure boundary surfaces. Flow exiting the disc guide slots is directed in an angular path to increase the distance between the slot geometry and pressure boundary surfaces. If cavitation conditions exist, the increased distance between the slots and pressure boundary surfaces minimizes the potential for damage by allowing the cavitation bubbles to dissipate before they come in contact with pressure boundary surfaces. Anti-cavitation characteristics shall be controlled by the described slotted seat and disc guide components. The disc guide shall slide in the seat and allow controlled flow through the seat slots into the central seat chamber where flow shall continue from the seat chamber and exit through the angularly oriented slots of the disc guide. The seat and disc guide features used together shall provide anti-cavitation characteristics suitable for applications where a large controlled pressure drop is desired.

The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The diaphragm must withstand a Mullins burst test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully open or fully closed position.

The valve seat in six inch and smaller size valves shall be threaded into the body. Valve seat in eight inch and larger size valves shall be retained by flat head machine screws for ease of maintenance. The seat shall be of the solid, one-piece design and shall have a minimum of a five degree taper on the seating surface for positive drip-tight shut-off. Pressed-in bearings and/or multi-piece seats shall not be permitted.

To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline.

The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years from date of shipment, provided the valve is installed and used in accordance with all applicable instructions. The valve manufacturer shall be able to supply a complete line of equipment from 1¼" through 48" sizes and a complete selection of complementary equipment.

Material Specification

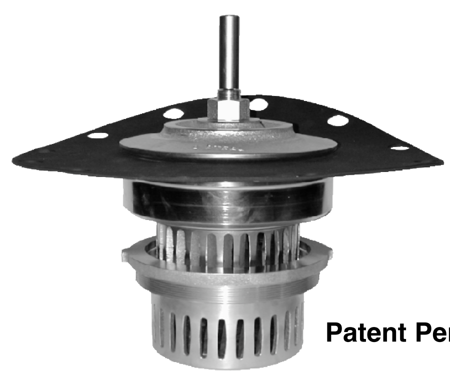
Valve Size:	Pressure Rating:
Main Valve Body and Cover:	Temperature Range:
Main Valve Trim:	Coating:
End Detail:	Desired Options:

Application Information

Inlet/Outlet Pressures:
Flow Rate:
Pipe Diameter:
Function (i.e. - Pressure Reducing, Pressure Relief, etc.):

This valve shall be a C l a - Val Model No. 100-01KO Hytrol Main Valve with Anti-Cavitation Trim as manufactured by Cla-Val, Newport Beach, CA

Note: Add this Hytrol Anti-Cavitation Trim Purchase Specification to main valve specification for control valves where there is a high potential for cavitation damage. Please contact our Regional Sales Offices or Factory for assistance.



Patent Pending

The Anti-Cavitation Trim components can be retrofitted to existing Hytrol valves if the application indicates an appropriate need. Please consult factory for details.

CLA-VAL
PO Box 1325 Newport Beach CA 92659-0325
Phone: 949-722-4800 • Fax: 949-548-5441

CLA-VAL CANADA
4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040

CLA-VAL EUROPE
Chemin dés Mesanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50
www.cla-val.com

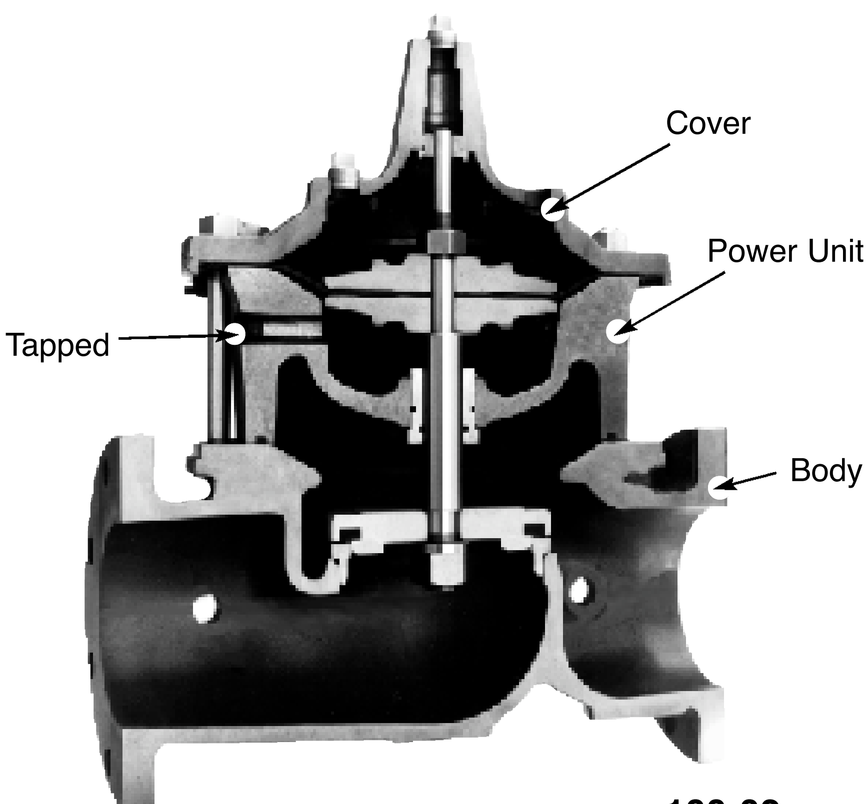
Represented By:

Powertrol

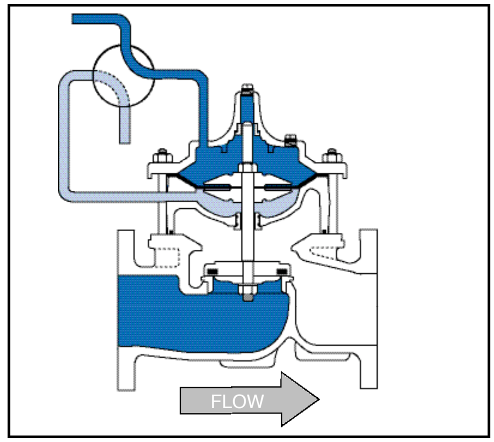
The Cla-Val Model 100-02 is a hydraulically operated, diaphragm actuated, globe, or angle pattern valve. It consists of four major components: body, intermediate chamber, diaphragm assembly, and cover. The diaphragm assembly is the only moving part.

The diaphragm assembly which is guided top and center by a precision machined stem, utilizes a non-wicking diaphragm of nylon fabric bonded with synthetic rubber. The diaphragm forms a seal between the cover chamber and intermediate chamber. A synthetic rubber disc retained on 3 1/2 sides forms a drip-tight seal with the seat when pressure is applied above the diaphragm. As pressure above the diaphragm is relieved and pressure is applied below the diaphragm, the valve opens wide for full flow. The rate of closing or opening can be controlled by modulating flow into or out of the diaphragm chambers.

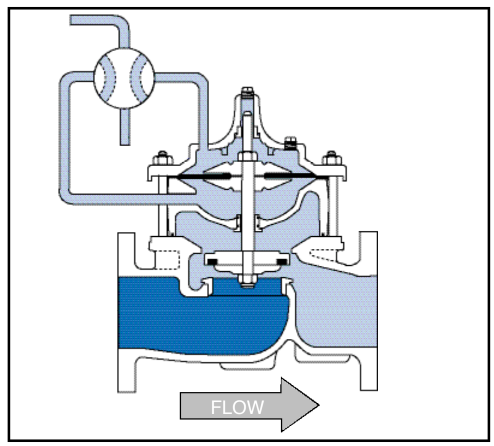
The Model 100-02 is recommended where independent operating pressure is desired. Available in various materials and in a full range of sizes, with either screwed or flanged ends, its applications are many and varied.



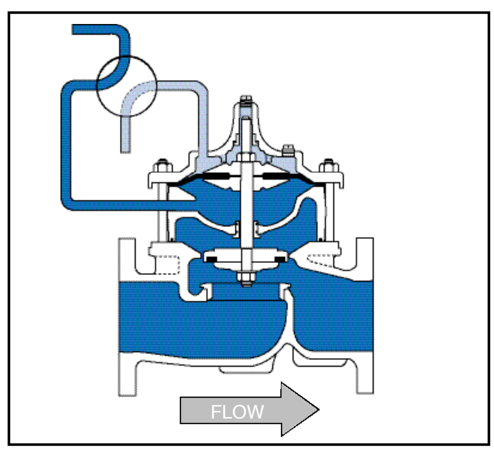
100-02



Closed Valve
When pressure below the diaphragm is relieved and operating pressure is applied to the cover chamber, the valve closes drip-tight.



Throttling Valve
The valve holds any intermediate position when operating pressure is equal above and below the diaphragm. A Cla-Val four-way pilot control with "lock" position can maintain this balance by stopping flow in the pilot control system.



Open Valve
When operating pressure below the diaphragm is applied and operating pressure is relieved from the cover chamber to atmosphere, the valve is held open, allowing full flow.

The flow capacity of a control valve is usually expressed in terms of the valves Cv. Cv is the amount of water in gallons that will pass through a given valve in one minute with a 1 psi pressure drop. Cv values are established by flow testing the valve. So a 3" Cla-Val hytrol has a Cv of 115 will pass 115 gallons per minute with a 1 psi pressure drop.

C_V Factor

Formulas for computing C_V Factor, Flow (Q) and Pressure Drop (ΔP):

$$C_V = \frac{Q}{\sqrt{\Delta P}} \qquad Q = C_V \sqrt{\Delta P} \qquad \Delta P = \left(\frac{Q}{C_V}\right)^2$$

K Factor (Resistance Coefficient)
The Value of K is calculated from the formula: $K = \frac{894d^4}{C_V^2}$
(U.S. system units)

Equivalent Length of Pipe
Equivalent lengths of pipe (L) are determined from the formula: $L = \frac{K\,d}{12\,f}$
(U.S. system units)

Fluid Velocity
Fluid velocity can be calculated from the following formula: $V = \frac{.4085\,Q}{d^2}$
(U.S. system units)

Where:

- C_V = U.S. (gpm) @ 1 psi differential at 60° F water
  or
  = (l/s) @ 1 bar (14.5 PSIG) differential at 15° C water
- d = inside pipe diameter of Schedule 40 Steel Pipe (inches)
- f = friction factor for clean, new Schedule 40 pipe (dimensionless) (from Cameron Hydraulic Data, 18th Edition, P 3-119)
- K = Resistance Coefficient (calculated)
- L = Equivalent Length of Pipe (feet)
- Q = Flow Rate in U.S. (gpm) or (l/s)
- V = Fluid Velocity (feet per second) or (meters per second)
- ΔP = Pressure Drop in (psi) or (bar)

The following chart shows both the Cv and the K factor data for each valve

Functional Data **Model 100 - 02**

Valve Size		Inches	⅜	½	¾	1	1¼	1½	2	2½	3	4	6	8	10	12	14	16	24	36
		mm.	10	15	20	25	32	40	50	65	80	100	150	200	250	300	350	400	600	900
C_V Factor	Globe Pattern	Gal./Min. (gpm.)	1.8	6	8.5	13.3	30	32	54	85	115	200	440	770	1245	1725	2300	2940	7655	13320
		Litres/Sec. (l/s.)	.43	1.44	2.04	3.2	7.2	7.7	13	20.4	27.6	48	105.6	184.8	299	414	552	706	1837	3200
	Angle Pattern	Gal./Min. (gpm.)	—	—	—	—	—	29	61	101	139	240	541	990	1575	2500*	3060*	4200*	—	—
		Litres/Sec. (l/s.)	—	—	—	—	—	7	14.6	24.2	33.4	58	130	238	378	600	734.4	1008	—	—
Equivalent Length of Pipe	Globe Pattern	Feet (ft.)	25	7	16	23	19	37	51	53	85	116	211	291	347	467	422	503	628	1866
		Meters (m.)	7.6	2.2	4.8	7.1	5.7	11.4	15.5	16.0	25.9	35.3	64.2	88.6	105.8	142.4	128.6	153.6	191.6	569
	Angle Pattern	Feet (ft.)	—	—	—	—	—	46	40	37	58	80	139	176	217	222*	238*	247*	—	—
		Meters (m.)	—	—	—	—	—	13.9	12.1	11.4	17.8	24.5	42.5	53.6	66.1	67.8	72.7	75.2	—	—
K Factor	Globe Pattern		16.3	3.7	5.7	6.1	3.6	5.9	5.6	4.6	6.0	5.9	6.2	6.1	5.8	6.1	5.0	5.2	4.0	7.1
	Angle Pattern		—	—	—	—	—	7.1	4.4	3.3	4.1	4.1	4.1	3.7	3.6	2.9	2.8	2.6	—	—
Liquid Displaced from Cover Chamber When Valve Opens		Fl. Oz	.12	.34	.34	.70	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		U.S. Gal.	—	—	—	—	.02	.02	.03	.04	.08	.17	.53	1.26	2.51	4.0	6.5	9.6	29	42
		ml	3.5	10.1	10.1	20.7	75.7	75.7	121	163	303	643	—	—	—	—	—	—	—	—
		Litres	—	—	—	—	—	—	—	—	—	—	2.0	4.8	9.5	15.1	24.6	36.2	109.8	159

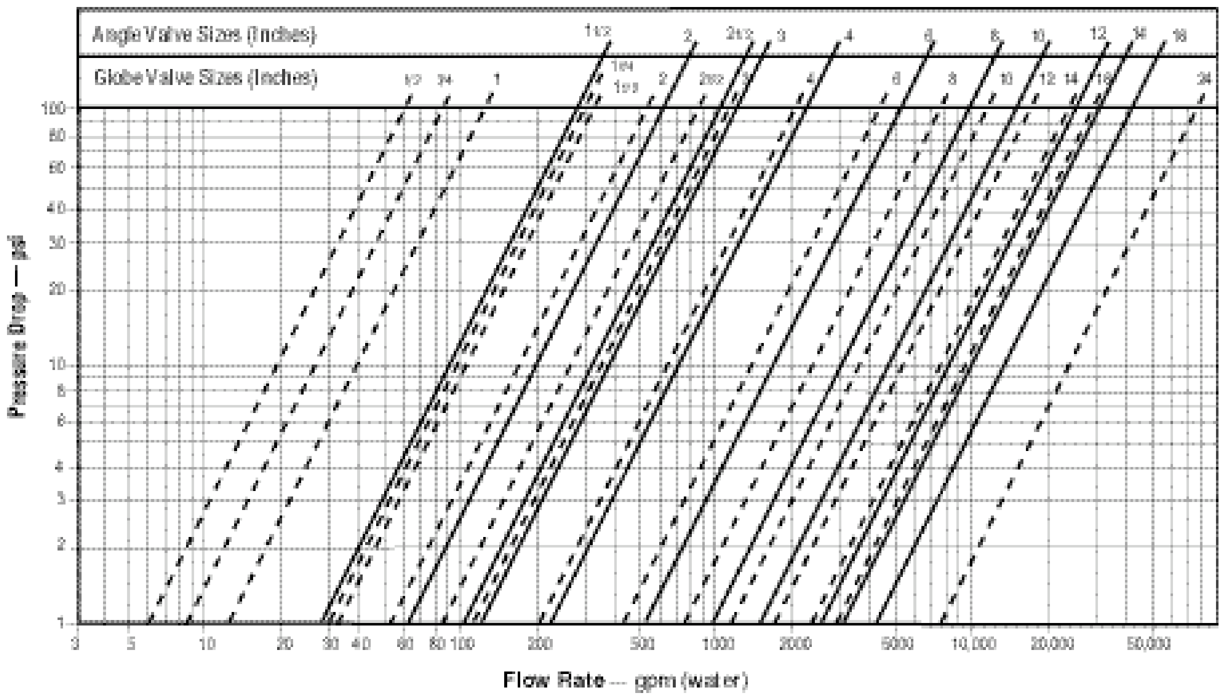
*Estimated

Volume Of Water Displaced

The above chart also shows the volume of water displaced as the valve goes from the closed position to full open. Each time the valve cycles the fixed volume of water will be expelled thru the pilot system from the cover chamber to atmosphere. This information may be useful for various applications.

Flow Chart 100-02

Model 100-02 Flow Chart (Based on normal flow through a wide open valve)



Material of Construction 100-02

The 100-02 is available in many different alloys for various applications. Currently the Cla-Val foundry pours 45 different alloys. The more common materials are shown on page 19.

Materials

Components	Material Optional				
Body & Cover	Ductile Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Available Sizes	1" - 24"	1" - 24"	1/2" - 16"	1/2" - 16"	1/2" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is optional.			Stainless Steel is standard.	
Disc	Buna-N® Rubber				
Diaphragm	Nylon Reinforced Buna-N® Rubber				
Stem, Nut & Spring	Stainless Steel				

Epoxy Coating - suffix KC

A FDA and NSF-61 approved fusion bonded epoxy coating for use with cast iron, ductile iron or steel valves. This coating is resistant to various water conditions, certain acids, chemicals, solvents and alkalies. Epoxy coatings are applied in accordance with AWWA coating specifications C550-90. Do not use with temperatures above 175° F.

Viton® Rubber Parts - suffix KB

Optional diaphragm, disc and o-ring fabricated with Viton® (fluorocarbon) synthetic rubber. Viton® is well suited for use with mineral acids, salt solutions, chlorinated hydrocarbons, and petroleum oils; and is primarily used in high temperature applications up to 250° F. Do not use with epoxy coatings above 175° F.

Heavy Spring - suffix KH

The heavy spring option is used in applications where there is low differential pressure across the valve, and the additional spring force is needed to help the valve close.

Low Temperature Diaphragm - suffix KA

This single ply diaphragm uses Buna-N® Synthetic Rubber, formulated for low temperature applications to -65° F. Operating pressures in excess of 125 psi are not recommended.

End Connections 100-02

The Powertrol is available in either the standard globe pattern or an angle pattern. Only the valve body i s different, everything else is identical. The Angle pattern valve is typically used as a piping preference. Many times it is more convenient to use the angle pattern. The angle pattern valve is less restricted than the globe pattern valve so it has a lower head loss across it, which means that in most applications it will flow more.

2-1/2" Globe, Screwed

4" Globe, Flanged

4" Angle, Flanged

Pattern	Screwed	Flanged
Globe	3/8" - 3"	1 1/2" - 24"
Angle	1 1/2" - 3"	1 1/2"- 16"

Both the standard globe pattern Powertrol valve and the angle pattern Powertrol are available in screwed, 150#, or 300# end connections. Screwed valve end connections are the most economical and the lightest weight. The screwed end connection valves are rated to 400 psi. The Ductile Iron Powertrol with 150# flanges is rated for a maximum operating pressure of 250 psi, while the Ductile Iron 300# flanged Powertrol is rated for 400 psi maximum operating pressure.

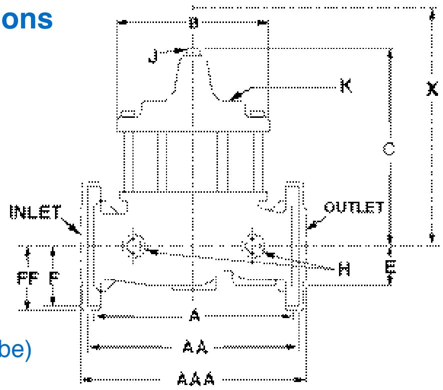
Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class			
		Flanged			Screwed
Grade	Material	ANSI Standards*	150 lb.	300 lb.	End** Details
ASTM A536	Ductile Iron	B16.42	250	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400
ASTM B62	Bronze	B16.24	225	400	400
ASTM A743	Stainless Steel	B16.5	285	400	400
356-T6	Aluminum	B16.1	275	—	—

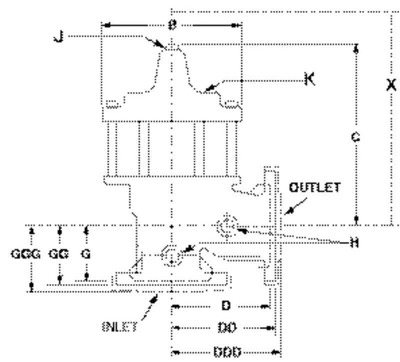
Note: *ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
**End Details machined to ANSI B2.1 specifications.

Dimensions

Model 100-02



100-02 (Globe)



100-02 (Angle)

Valve Size (Inches)	⅜	½ - ¾	1	1 ¼-1 ½	2	2 ½	3	4	6	8	10	12	14	16	24
A Threaded	2.75	3.50	5.12	7.25	9.38	11.00	12.50	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	—	8.50*	9.38	11.00	12.00	15.00	20.00	25.38	29.75	34.00	39.00	41.38	61.50
AAA 300 ANSI	—	—	—	9.00*	10.00	11.62	13.25	15.62	21.00	26.38	31.12	35.50	40.50	43.50	63.24
B Dia.	2.50	3.12	4.38	5.62	6.62	8.00	9.12	11.50	15.75	20.00	23.62	28.00	32.75	35.50	53.16
C Max.	2.33	5.88	6.25	7.62	8.56	10.31	11.19	14.25	18.44	21.81	23.38	29.31	32.12	35.00	56.50
D Threaded	—	—	—	3.25	4.69	5.50	6.25	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	—	—	4.69	5.50	6.00	7.50	10.00	12.69	14.88	17.00	19.50	20.69	—
DDD 300 ANSI	—	—	—	—	5.00	5.81	6.63	7.81	10.50	13.19	15.56	17.75	20.25	21.75	—
E	1.25	0.75	1.25	1.12	1.50	1.69	2.56	3.19	4.31	5.31	9.25	10.75	12.62	15.50	17.75
F 150 ANSI	—	—	—	2.50	3.00	3.50	3.75	4.50	5.50	6.75	8.00	9.50	10.50	11.75	19.25
FF 300 ANSI	—	—	—	3.06	3.25	3.75	4.13	5.00	6.25	7.50	8.75	10.25	11.50	12.75	21.25
G Threaded	—	—	—	1.88	3.25	4.00	4.50	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	—	—	3.25	4.00	4.00	5.00	6.00	8.00	8.62	13.75	14.88	15.69	—
GGG 300 ANSI	—	—	—	—	3.50	4.31	4.38	5.31	6.50	8.50	9.31	14.50	15.62	16.50	—
H NPT Body Tapping	—	⅛	¼	⅜	⅜	½	½	¾	¾	1	1	1	1	1	1
J NPT Cover Center Plug	⅛	⅛	¼	¼	½	½	½	¾	¾	1	1	1¼	1½	2	1½
K NPT Cover Tapping	—	⅛	¼	⅜	⅜	½	½	¾	¾	1	1	1	1	1	1
Valve Stem Internal Thread UNF	—	—	—	10-32	10-32	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	⅜-24	½-20	¾-16
Stem Travel	—	—	—	0.4	0.6	0.7	0.8	1.1	1.7	2.3	2.8	3.4	4.0	4.5	6.75
Approx. Ship Wt. Lbs.	8	8	13	22	40	65	95	190	320	650	940	1675	2460	3100	8150

*40mm Size Only

*1½" Size Only

Valve Size (mm)	10	15-20	25	32-40	50	65	80	100	150	200	250	300	350	400	600
A Threaded	70	89	130	184	238	279	318	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	—	216*	238	279	305	381	508	645	756	864	991	1051	1562
AAA 300 ANSI	—	—	—	229*	254	295	337	397	533	670	790	902	1029	1105	1606
B Dia.	64	80	111	143	168	203	232	292	400	508	600	711	832	902	1350
C Max.	59	149	159	194	217	262	284	362	468	554	594	744	816	889	1435
D Threaded	—	—	—	83	119	140	159	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	—	—	119	140	152	191	254	322	378	432	495	526	—
DDD 300 ANSI	—	—	—	—	127	148	168	198	267	335	395	451	514	552	—
E	32	19	32	28	38	43	65	81	109	135	235	273	321	394	451
F 150 ANSI	—	—	—	64	76	89	95	114	140	171	203	241	267	298	489
FF 300 ANSI	—	—	—	78	83	95	105	127	159	191	222	260	292	324	540
G Threaded	—	—	—	48	83	102	114	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	—	—	83	102	102	127	152	203	219	349	378	399	—
GGG 300 ANSI	—	—	—	—	89	110	111	135	165	216	236	368	397	419	—
H NPT Body Tapping	—	⅛	¼	⅜	⅜	½	½	¾	¾	1	1	1	1	1	1
J NPT Cover Center Plug	⅛	⅛	¼	¼	½	½	½	¾	¾	1	1	1¼	1½	2	1½
K NPT Cover Tapping	—	⅛	¼	⅜	⅜	½	½	¾	¾	1	1	1	1	1	1
Valve Stem Internal Thread UNF	—	—	—	10-32	10-32	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	⅜-24	½-20	¾-16
Stem Travel	—	—	—	10	15	18	20	28	43	58	71	86	102	114	165
Approx. Ship Wt. Kgs.	1.4	4	6	10	18	30	43	86	145	295	426	760	1116	1406	3696

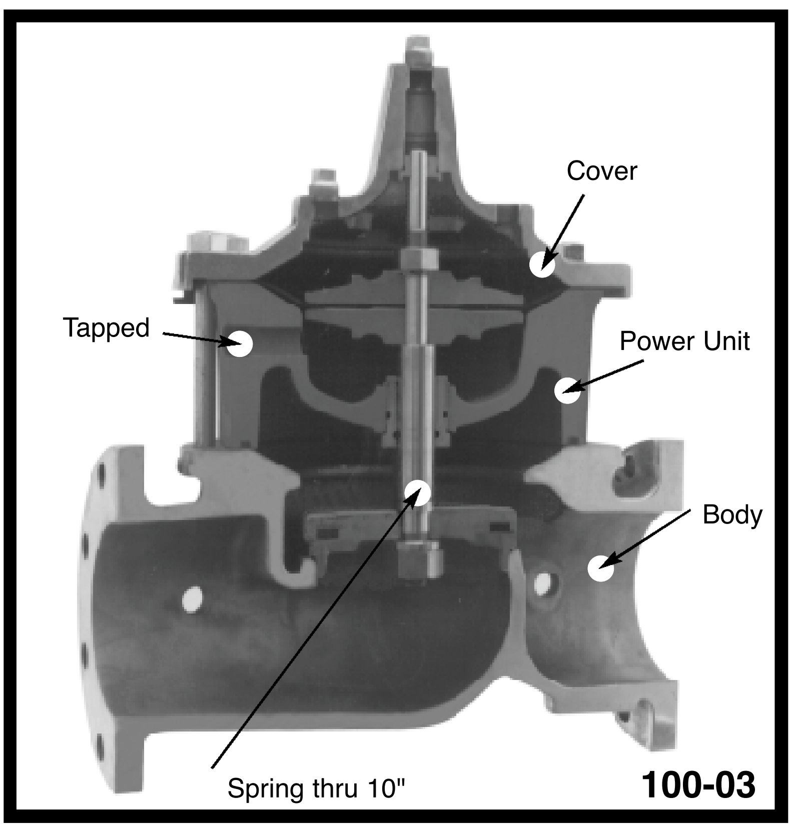
Cla-Val Control Valves operate with maximum efficiency when mounted in horizontal piping with the main valve cover UP, however, other positions are acceptable. Due to component size and weight of 8 inch and larger valves, installation with cover UP is advisable. We recommend isolation valves be installed on inlet and outlet for maintenance. Adequate space above and around the valve for service personnel should be considered essential. A regular maintenance program should be established based on the specific application data. However, we recommend a thorough inspection be done at least once a year. Consult factory for specific recommendations.

Powercheck

The Cla-Val Model 100-03 Powercheck Valve is a hydraulically operated diaphragm valve with a built-in check feature to prevent return flow. Available in globe or angle pattern, it consists of four major components: body, intermediate chamber, diaphragm assembly, and cover. The diaphragm assembly is the only moving part.

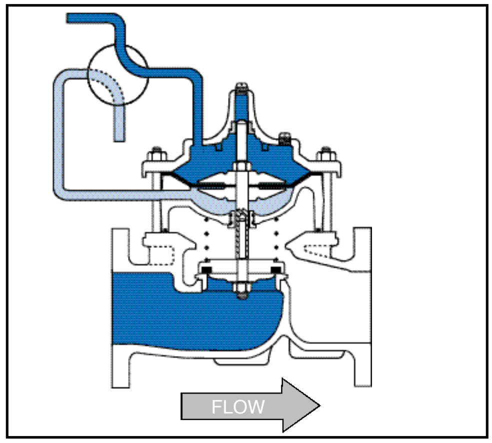
The diaphragm assembly is guided top and center by a precision machined stem and utilizes a non-wicking diaphragm of nylon fabric bonded with synthetic rubber. A synthetic rubber disc retained on three and one half sides forms a drip-tight seal with the seat when pressure is applied above the diaphragm. When pressure above the diaphragm is relieved, the valve opens wide. The rate of closing or opening can be controlled by modulating flow into or out of the diaphragm chambers.

When a pressure reversal occurs the valve will immediately close, preventing reverse flow thru the valve. The split stem design will allow the disc retainer assembly to check closed regardless of the position of the diaphragm.



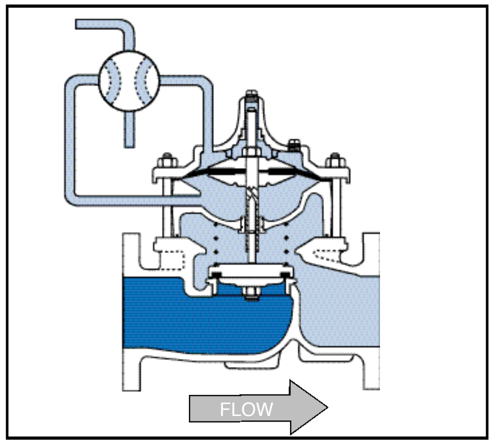
Closed Valve

When pressure below the diaphragm is relieved and operating pressure is applied to the cover chamber, the valve closes drip-tight.



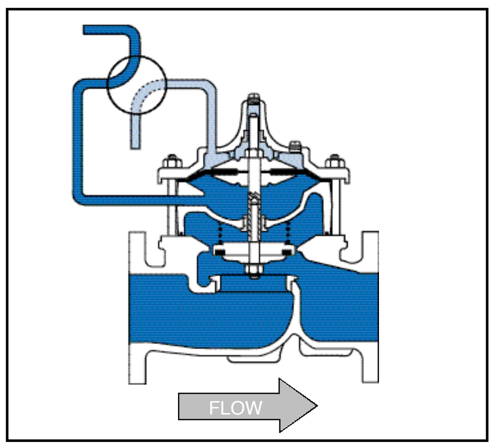
Check Valve

When a static condition or pressure reversal occurs, the split stem design allows the valve to instantly check closed. Return flow is prevented regardless of the diaphragm's position.



Open Valve

When operating pressure below the diaphragm is applied and pressure is relieved from the cover chamber to atmosphere, the valve is held open allowing full flow.



The flow capacity of a control valve is usually expressed in terms of the valves Cv. Cv is the amount of water in gallons that will pass through a given valve in one minute with a 1 psi pressure drop. Cv values are established by flow testing the valve. So a 3" Cla-Val hytrol has a Cv of 115 will pass 115 gallons per minute with a 1 psi pressure drop.

C_V Factor

Formulas for computing C_V Factor, Flow (Q) and Pressure Drop (ΔP):

$$C_V = \frac{Q}{\sqrt{\Delta P}} \qquad Q = C_V \sqrt{\Delta P} \qquad \Delta P = \left(\frac{Q}{C_V}\right)^2$$

K Factor (Resistance Coefficient)
The Value of K is calculated from the formula: $K = \frac{894d^4}{C_V^2}$
(U.S. system units)

Equivalent Length of Pipe
Equivalent lengths of pipe (L) are determined from the formula: $L = \frac{K d}{12 f}$
(U.S. system units)

Fluid Velocity
Fluid velocity can be calculated from the following formula: $V = \frac{.4085\, Q}{d^2}$
(U.S. system units)

Where:

C_V = U.S. (gpm) @ 1 psi differential at 60° F water
or
= (l/s) @ 1 bar (14.5 PSIG) differential at 15° C water

d = inside pipe diameter of Schedule 40 Steel Pipe (inches)

f = friction factor for clean, new Schedule 40 pipe (dimensionless) (from Cameron Hydraulic Data, 18th Edition, P 3-119)

K = Resistance Coefficient (calculated)

L = Equivalent Length of Pipe (feet)

Q = Flow Rate in U.S. (gpm) or (l/s)

V = Fluid Velocity (feet per second) or (meters per second)

Δ **P** = Pressure Drop in (psi) or (bar)

1 — 4

The following chart shows both the Cv and the K factor data for each valve

Functional Data **Model 100 - 03**

Valve Size		Inches	2½	3	4	6	8	10	12	14	16
		mm.	65	80	100	150	200	250	300	350	400
C_V Factor	Globe Pattern	Gal./Min. (gpm.)	85	115	200	440	770	1245	1725	2300	2940
		Litres/Sec. (l/s.)	20.4	27.6	48	105.6	184.8	299	414	552	706
	Angle Pattern	Gal./Min. (gpm.)	101	139	240	541	990	1575	2500*	3060*	4200*
		Litres/Sec. (l/s.)	24.	33.4	58	130	238	378	600	734.4	1008
Equivalent Length of Pipe	Globe Pattern	Feet (ft.)	53	85	116	211	291	347	467	422	503
		Meters (m.)	16.0	25.9	35.3	64.2	88.6	105.8	142.4	128.6	153.6
	Angle Pattern	Feet (ft.)	37	58	80	139	176	217	222*	238*	247*
		Meters (m.)	11.4	17.8	24.5	42.5	53.6	66.1	67.8	72.7	75.2
K Factor	Globe Pattern		4.6	6.0	5.9	6.2	6.1	5.8	6.1	5.0	5.2
	Angle Pattern		3.3	4.1	4.1	4.1	3.7	3.6	2.9	2.8	2.6
Liquid Displaced from Cover Chamber When Valve Opens		Fl. Oz	—	—	—	—	—	—	—	—	—
		U.S. Gal.	.04	.08	.17	.53	1.26	2.51	4.0	6.5	9.6
		ml	163	303	643	—	—	—	—	—	—
		Litres	—	—	—	2.0	4.8	9.5	15.1	24.6	36.2

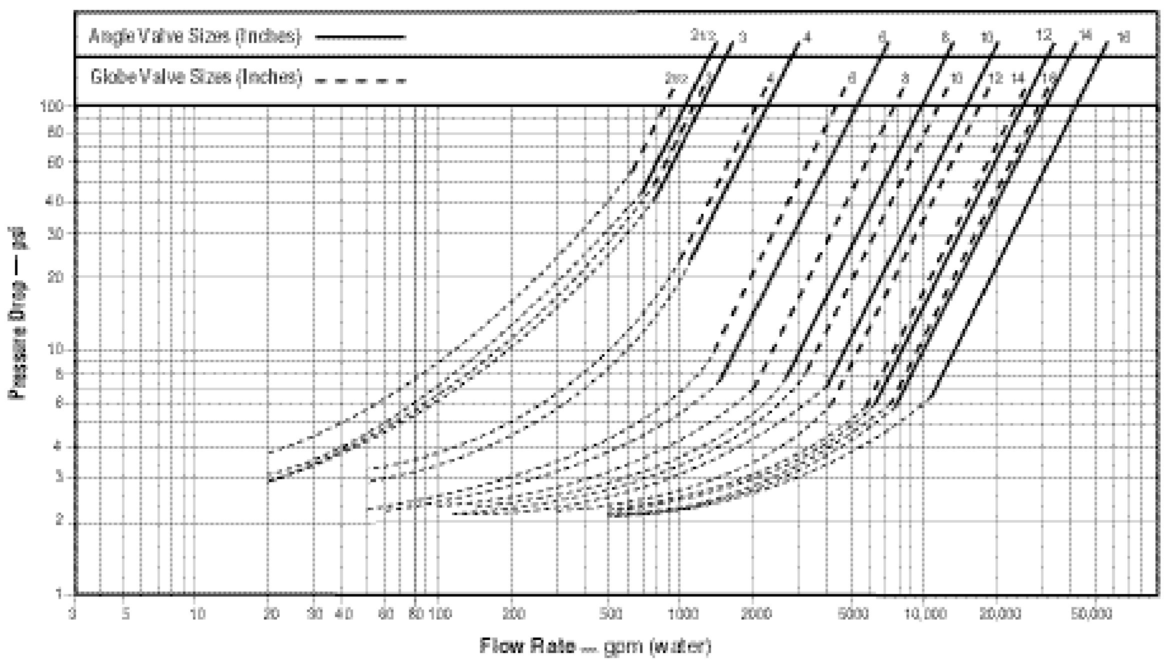
*Estimated

Volume Of Water Displaced

The above chart also shows the volume of water displaced as the valve goes from the closed position to full open. Each time the valve cycles the fixed volume of water will be expelled thru the pilot system from the cover chamber to atmosphere. This information may be useful for various applications.

Flow Chart 100-03

Model 100-03 flow chart. The solid lines are flow valves based on a wide open valve. The dotted lines are flow values based on a based or a wide opened valve. The dotted lines are flow valves. The start of the solid lines is the estimated pressure drop required to achieve a full open calculation.



Material of Construction 100-03

The 100-03 is available in many different alloys for various applications. Currently the Cla-Val foundry pours 45 different alloys. The more common materials are shown on page 19.

Materials

Components	Material Optional				
Body & Cover	Ductile Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Available Sizes	2 1/2" - 16"	2 1/2" - 16"	2 1/2" - 16"	2 1/2" - 16"	2 1/2" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is optional.			Stainless Steel is standard.	
Disc	Buna-N® Rubber				
Diaphragm	Nylon Reinforced Buna-N® Rubber				
Stem, Nut & Spring	Stainless Steel				

Epoxy Coating - suffix KC

A FDA and NSF-61 approved fusion bonded epoxy coating for use with cast iron, ductile iron or steel valves. This coating is resistant to various water conditions, certain acids, chemicals, solvents and alkalies. Epoxy coatings are applied in accordance with AWWA coating specifications C550-90. Do not use with temperatures above 175° F.

Viton® Rubber Parts - suffix KB

Optional diaphragm, disc and o-ring fabricated with Viton® (Flourolcarbon)synthetic rubber. Viton® is well suited for use with mineral acids, salt solutions, chlorinated hydrocarbons, and petroleum oils; and is primarily used in high temperature applications up to 250° F. Do not use with epoxy coatings above 175° F.

Heavy Spring - suffix KH

The heavy spring option is used in applications where there is low differential pressure across the valve, and the additional spring force is needed to help the valve close. This option is best suited for valves used in on-off (non-modulating) service.

Low Temperature Diaphragm - suffix KA

This single ply diaphragm uses Buna-N® Synthetic Rubber, formulated for low temperature applications to -65° F. Operating pressures in excess of 125 psi are not recommended.

End Connections 100-03

The Powercheck is available in either the standard globe pattern or an angle pattern. Only the valve body is different, everything else is identical. The Angle pattern valve is typically used as a piping preference. Many times it is more convenient to use the angle pattern. The angle pattern valve is less restricted than the globe pattern valve so it has a lower head loss across it, which means that in most applications it will flow more.

2 1/2" Globe, Screwed

4" Globe, Flanged

4" Angle, Flanged

Pattern	Screwed	Flanged
Globe	----	2 1/2" - 16"
Angle	2 1/2" - 3"	2 1/2" - 16"

Both the standard globe pattern Powercheck valve and the angle pattern Powercheck are available in screwed,150#, or 300# end connections. Screwed valve end connections are the most economical and the lightest weight. The screwed end connection valves are rated to 400 psi. The Ductile Iron Powercheck with 150# flanges is rated for a maximum operating pressure of 250 psi, while the Ductile Iron 300# flanged Powercheck is rated for 400 psi maximum operating pressure.

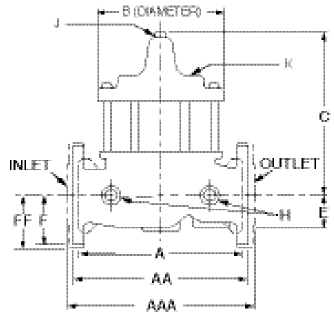
Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class			
		Flanged			Screwed
Grade	Material	ANSI Standards*	150 lb.	300 lb.	End** Details
ASTM A536	Ductile Iron	B16.42	250	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400
ASTM B62	Bronze	B16.24	225	400	400
ASTM A743	Stainless Steel	B16.5	285	400	400
356-T6	Aluminum	B16.1	275	—	—

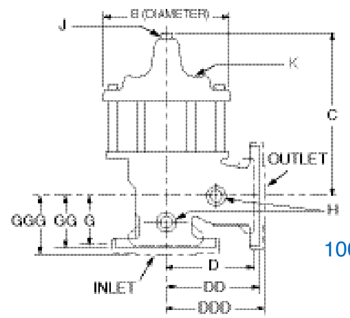
Note: *ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
**End Details machined to ANSI B2.1 specifications.

Dimensions

Model 100-03



100-03 (Globe)



100-03 (Angle)

Valve Size (Inches)	**2 ½**	**3**	**4**	**6**	**8**	**10**	**12**	**14**	**16**
A Threaded	11.00	12.50	—	—	—	—	—	—	—
AA 150 ANSI	11.00	12.00	15.00	20.00	25.38	29.75	34.00	39.00	41.38
AAA 300 ANSI	11.62	13.25	15.62	21.00	26.38	31.12	35.50	40.50	43.50
B Dia.	8.00	9.12	11.50	15.75	20.00	23.62	28.00	32.75	35.50
C Max.	10.31	11.19	14.25	18.44	21.81	23.38	29.31	32.12	35.00
D Threaded	5.50	6.25	—	—	—	—	—	—	—
DD 150 ANSI	5.50	6.00	7.50	10.00	12.69	14.88	17.00	19.50	20.69
DDD 300 ANSI	5.81	6.63	7.81	10.50	13.19	15.56	17.75	20.25	21.75
E	1.69	2.56	3.19	4.31	5.31	9.25	10.75	12.62	15.50
F 150 ANSI	3.50	3.75	4.50	5.50	6.75	8.00	9.50	10.50	11.75
FF 300 ANSI	3.75	4.13	5.00	6.25	7.50	8.75	10.25	11.50	12.75
G Threaded	4.00	4.50	—	—	—	—	—	—	—
GG 150 ANSI	4.00	4.00	5.00	6.00	8.00	8.62	13.75	14.88	15.69
GGG 300 ANSI	4.31	4.38	5.31	6.50	8.50	9.31	14.50	15.62	16.50
H NPT Body Tapping	½	½	¾	¾	1	1	1	1	1
J NPT Cover Center Plug	½	½	¾	¾	1	1	1¼	1½	2
K NPT Cover Tapping	½	½	¾	¾	1	1	1	1	1
Valve Stem Internal Thread UNF	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	⅜-24	½-20
Stem Travel	0.7	0.8	1.1	1.7	2.3	2.8	3.4	4.0	4.5
Approx. Ship Wt. Lbs.	65	95	190	320	650	940	1675	2460	3100

Valve Size (mm)	**65**	**80**	**100**	**150**	**200**	**250**	**300**	**350**	**400**
A Threaded	279	318	—	—	—	—	—	—	—
AA 150 ANSI	279	305	381	508	645	756	864	991	1051
AAA 300 ANSI	295	337	397	533	670	790	902	1029	1105
B Dia.	203	232	292	400	508	600	711	832	902
C Max.	262	284	362	468	554	594	744	816	889
D Threaded	140	159	—	—	—	—	—	—	—
DD 150 ANSI	140	152	191	254	322	378	432	495	526
DDD 300 ANSI	148	168	198	267	335	395	451	514	552
E	43	65	81	109	135	235	273	321	394
F 150 ANSI	89	95	114	140	171	203	241	267	298
FF 300 ANSI	95	105	127	159	191	222	260	292	324
G Threaded	102	114	—	—	—	—	—	—	—
GG 150 ANSI	102	102	127	152	203	219	349	378	399
GGG 300 ANSI	110	111	135	165	216	236	368	397	419
H NPT Body Tapping	½	½	¾	¾	1	1	1	1	1
J NPT Cover Center Plug	½	½	¾	¾	1	1	1¼	1½	2
K NPT Cover Tapping	½	½	¾	¾	1	1	1	1	1
Valve Stem Internal Thread UNF	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	⅜-24	½-20
Stem Travel	18	20	28	43	58	71	86	102	114
Approx. Ship Wt. Kgs.	30	43	86	145	295	426	760	1116	1406

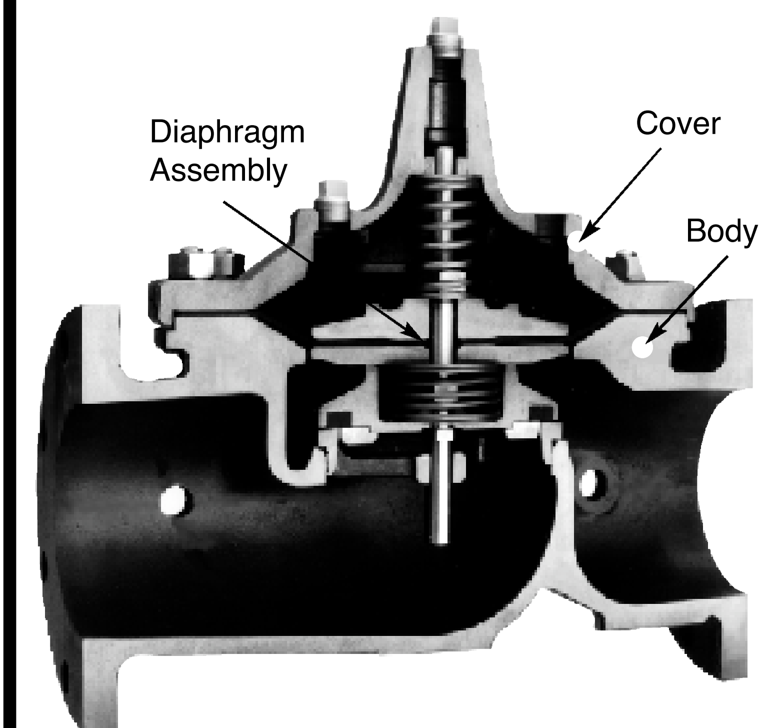
Cla-Val Control Valves operate with maximum efficiency when mounted in horizontal piping with the main valve cover UP, however, other positions are acceptable. Due to component size and weight of 8 inch and larger valves, installation with cover UP is advisable. We recommend isolation valves be installed on inlet and outlet for maintenance. Adequate space above and around the valve for service personnel should be considered essential. A regular maintenance program should be established based on the specific application data. However, we recommend a thorough inspection be done at least once a year. Consult factory for specific recommendations.

Hy-Check

The Cla-Val Model 100-04 Hy-Check Valve is a hydraulically operated diaphragm valve with a built-in check feature to prevent return flow. Available in globe or angle pattern, it consists of a body, cover and diaphragm assembly. The diaphragm assembly which is guided top and bottom by a precision machined stem is the only moving part.

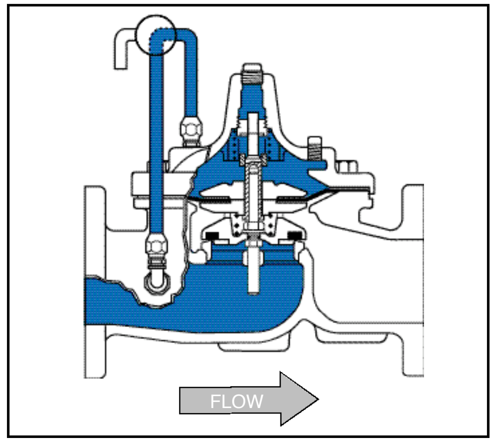
A synthetic rubber disc retained on three and one half sides forms a drip-tight seal with the renewable seat when operating pressure is applied above the non-wicking diaphragm. When pressure above the diaphragm is relieved, the valve opens wide. The rate of closing or opening can be controlled by modulating the flow into or out of the cover chamber. When a pressure reversal occurs the split stem will immediately allow the disc retainer assembly to check closed regardless of the position of the diaphragm.

The Model 100-04 is used on system applications such as remote control, pressure regulation, solenoid control, etc.; wherever a positive check feature is necessary to prevent reverse flow. Its packless construction and simplicity of design minimizes maintenance and assures a long dependable service life.

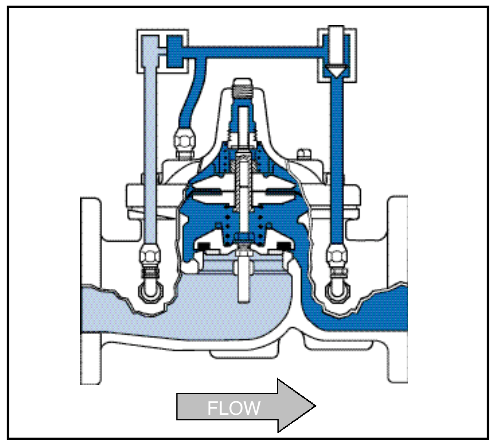


100-04

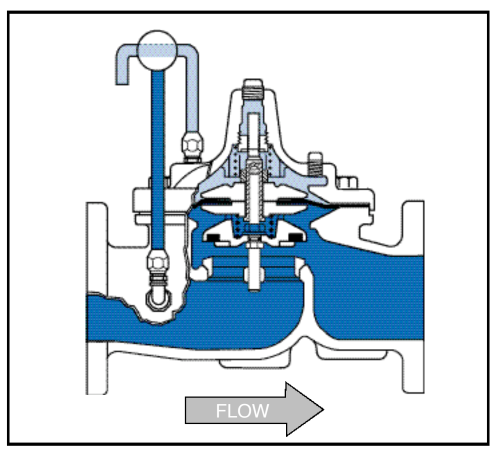
Closed Valve
When pressure from the valve inlet is applied to the cover chamber, the valve closes drip-tight.



Check Valve
When a static condition or pressure reversal occurs, the split stem design allows the valve to instantly check closed. Return flow is prevented regardless of the diaphragm's position.



Open Valve
When pressure in the cover chamber is relieved to atmosphere, the line pressure at the valve inlet opens the valve, allowing full flow.



Valve Capacity 100-04

The flow capacity of a control valve is usually expressed in terms of the valves C_v. C_v is the amount of water in gallons that will pass through a given valve in one minute with a 1 psi pressure drop. C_v values are established by flow testing the valve. So a 4" Cla-Val hytrol has a Cv of 200 will pass 200 gallons per minute with a 1 psi pressure drop.

C_V Factor

Formulas for computing C_V Factor, Flow (Q) and Pressure Drop (ΔP):

$$C_V = \frac{Q}{\sqrt{\Delta P}} \qquad Q = C_V \sqrt{\Delta P} \qquad \Delta P = \left(\frac{Q}{C_V}\right)^2$$

K Factor (Resistance Coefficient)
The Value of K is calculated from the formula: $K = \frac{894d^4}{C_v^2}$
(U.S. system units)

Equivalent Length of Pipe
Equivalent lengths of pipe (L) are determined from the formula: $L = \frac{Kd}{12f}$
(U.S. system units)

Fluid Velocity
Fluid velocity can be calculated from the following formula: $V = \frac{.4085\,Q}{d^2}$
(U.S. system units)

Where:

C_V = U.S. (gpm) @ 1 psi differential at 60° F water
or
= (l/s) @ 1 bar (14.5 PSIG) differential at 15° C water

d = inside pipe diameter of Schedule 40 Steel Pipe (inches)

f = friction factor for clean, new Schedule 40 pipe (dimensionless) (from Cameron Hydraulic Data, 18th Edition, P 3-119)

K = Resistance Coefficient (calculated)

L = Equivalent Length of Pipe (feet)

Q = Flow Rate in U.S. (gpm) or (l/s)

V = Fluid Velocity (feet per second) or (meters per second)

Δ **P** = Pressure Drop in (psi) or (bar)

1 — 5

The following chart shows both the Cv and the K factor data for each valve

Functional Data **Model 100 - 04**

Valve Size		Inches	2	2 1/2	3	4	6	8	10	12	14	16
		mm.	50	65	80	100	150	200	250	300	350	400
C_V Factor	Globe Pattern	Gal./Min. (gpm.)	54	85	115	200	440	770	1245	1725	2300	2940
		Litres/Sec. (l/s.)	13	20.4	27.6	48	105.6	184.8	299	414	552	706
	Angle Pattern	Gal./Min. (gpm.)	61	101	139	240	541	990	1575	2500*	3060*	4200*
		Litres/Sec. (l/s.)	14.6	24.2	33.4	58	130	238	378	600	734.4	1008
Equivalent Length of Pipe	Globe Pattern	Feet (ft.)	51	53	85	116	211	291	347	467	422	503
		Meters (m.)	15.5	16.0	25.9	35.3	64.2	88.6	105.8	142.4	128.6	153.6
	Angle Pattern	Feet (ft.)	40	37	58	80	139	176	217	222*	238*	247*
		Meters (m.)	12.1	11.4	17.8	24.5	42.5	53.6	66.1	67.8	72.7	75.2
K Factor	Globe Pattern		5.6	4.6	6.0	5.9	6.2	6.1	5.8	6.1	5.0	5.2
	Angle Pattern		4.4	3.3	4.1	4.1	4.1	3.7	3.6	2.9	2.8	2.6
Liquid Displaced from Cover Chamber When Valve Opens		Fl. Oz	—	—	—	—	—	—	—	—	—	—
		U.S. Gal.	0.3	.04	.08	.17	.53	1.26	2.51	4.0	6.5	9.6
		ml	121	163	303	643	—	—	—	—	—	—
		Litres	—	—	—	—	2.0	4.8	9.5	15.1	24.6	36.2

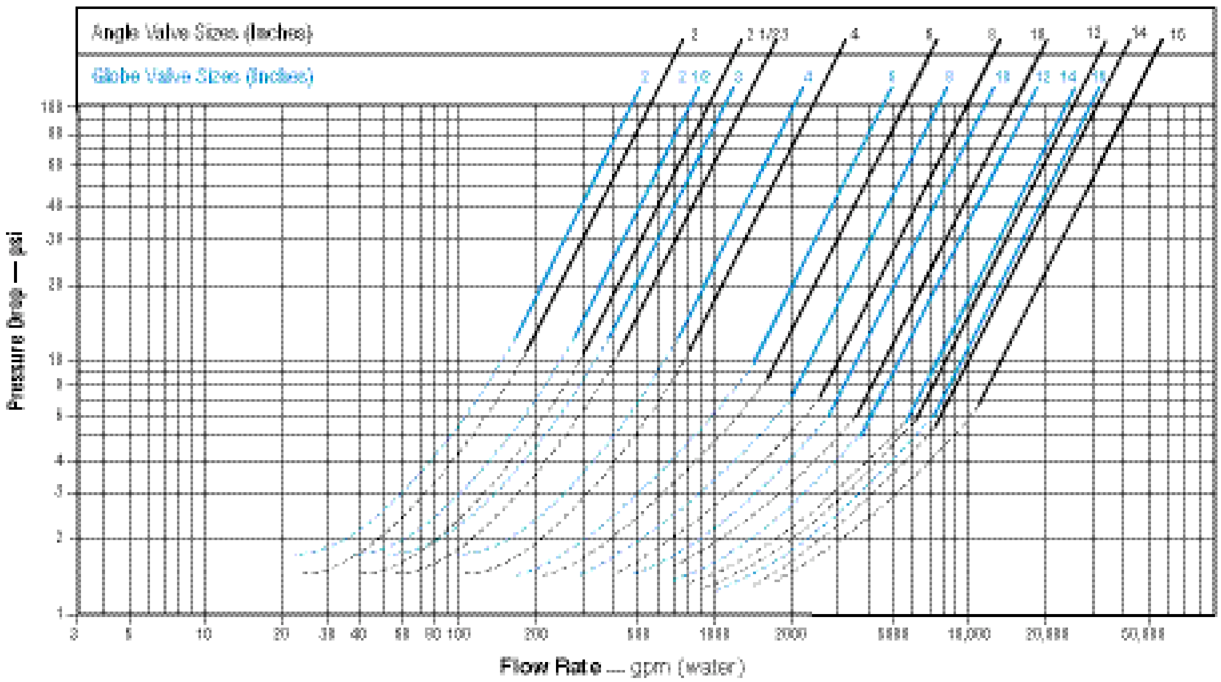
*Estimated

Volume Of Water Displaced

The above chart also shows the volume of water displaced as the valve goes from the closed position to full open. Each time the valve cycles the fixed volume of water will be expelled thru the pilot system from the cover chamber to atmosphere. This information may be useful for various applications.

Flow Chart 100-04

Model 100-04 flow chart. The solid lines are flow valves based on a wide open valve. The dotted lines are flow values based on a based or a wide opened valve. The dotted lines are flow valves. The start of the solid lines is the estimated pressure drop required to achieve a full open calculation.



Material of Construction 100-04

The 100-04 is available in many different alloys for various applications. Currently the Cla-Val foundry pours 45 different alloys. The more common materials are shown on page 19.

Materials

Components	Material Optional				
Body & Cover	Ductile Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Available Sizes	2" - 16"	2" - 16"	2" - 16"	2" - 16"	2" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is optional.			Stainless Steel is standard.	
Disc	Buna-N® Rubber				
Diaphragm	Nylon Reinforced Buna-N® Rubber				
Stem, Nut & Spring	Stainless Steel				

Epoxy Coating - suffix KC

A FDA and NSF-61 approved fusion bonded epoxy coating for use with cast iron, ductile iron or steel valves. This coating is resistant to various water conditions, certain acids, chemicals, solvents and alkalies. Epoxy coatings are applied in accordance with AWWA coating specifications C550-90. Do not use with temperatures above 175° F.

Viton® Rubber Parts - suffix KB

Optional diaphragm, disc and O-ring fabricated with Viton® synthetic rubber.
Viton® is well suited for use with mineral acids, salt solutions, chlorinated hydrocarbons, and petroleum oils; and is primarily used in high temperature applications up to 250° F. Do not use with epoxy coatings above 175° F.

Heavy Spring - suffix KH

The heavy spring option is used in applications where there is low differential pressure across the valve, and the additional spring force is needed to help the valve close. This option is best suited for valves used in on-off (non-modulating) service.

Low Temperature Diaphragm - suffix KA

This single ply diaphragm uses Buna-N® Synthetic Rubber, formulated for low temperature applications to -65° F. Operating pressures in excess of 125 psi are not recommended.

End Connections 100-04

The Hy-Check is available in either the standard globe pattern or an angle pattern. Only the valve body is different, everything else is identical. The Angle pattern valve is typically used as a piping preference. Many times it is more convenient to use the angle pattern. The angle pattern valve is less restricted than the globe pattern valve so it has a lower head loss across it, which means that in most applications it will flow more. Hycheck valve should be installed with cover up for proper operation of the check feature.

4" Globe, Flanged

4" Angle, Flanged

12" Globe, Flanged

16" Globe, Flanged

Pattern	Screwed	Flanged
Globe	--	4" - 16"
Angle	--	4" - 16"

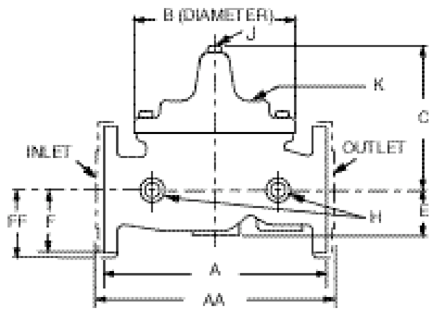
Both the standard globe pattern Hy-Check valve and the angle pattern Hy-Check are available in screwed, 150#, or 300# end connections. The Ductile Iron Hy-Check with 150# flanges is rated for a maximum operating pressure of 250 psi, while the Ductile Iron 300# flanged Hy-Check is rated for 400 psi maximum operating pressure.

Pressure Ratings (Recommended Maximum Pressure - psi)

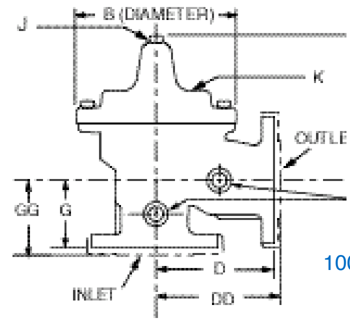
Valve Body & Cover		Pressure Class			
		Flanged			Screwed
Grade	Material	ANSI Standards*	150 lb.	300 lb.	End** Details
ASTM A536	Ductile Iron	B16.42	250	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400
ASTM B62	Bronze	B16.24	225	400	400
ASTM A743	Stainless Steel	B16.5	285	400	400
356-T6	Aluminum	B16.1	275	—	—

Note: *ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
**End Details machined to ANSI B2.1 specifications.

Dimensions 100-04



100-04 (Globe)



100-04 (Angle)

Valve Size (Inches)	2	2 1/2	3	4	6	8	10	12	14	16
A 150 ANSI	9.38	11.00	12.00	15.00	20.00	25.38	29.75	34.00	39.00	41.38
AA 300 ANSI	10.00	11.62	13.25	15.62	21.00	26.38	31.12	35.50	40.50	43.50
B Dia.	6.62	8.00	9.12	11.50	15.75	20.00	23.62	28.00	32.75	35.50
C Max.	6.50	7.56	8.19	10.62	13.38	16.00	17.12	20.88	24.19	25.00
D 150 ANSI	4.75	5.50	6.00	7.50	10.00	12.69	14.88	17.00	19.50	20.69
DD 300 ANSI	5.00	5.88	6.38	7.81	10.50	13.19	15.56	17.75	20.25	21.75
E	1.50	1.69	2.56	3.19	4.31	5.31	9.25	10.75	12.62	15.50
F 150 ANSI	2.50	3.00	3.75	4.50	5.50	6.75	8.00	9.50	10.50	11.75
FF 300 ANSI	3.25	3.75	4.13	5.00	6.25	7.50	8.75	10.25	11.50	12.75
G 150 ANSI	3.25	4.00	4.00	5.00	6.00	8.00	8.62	13.75	14.88	15.69
GG 300 ANSI	3.25	4.31	4.38	5.31	6.50	8.50	9.31	14.50	15.62	16.50
H NPT Body Tapping	⅜	½	½	¾	¾	1	1	1	1	1
J NPT Cover Center Plug	½	½	½	¾	¾	1	1	1¼	1½	2
K NPT Cover Tapping	⅜	½	½	¾	¾	1	1	1	1	1
Valve Stem Internal Thread UNF	10-32	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	⅜-24	½-20
Stem Travel	0.6	0.7	0.8	1.1	1.7	2.3	2.8	3.4	4.0	4.5
Approx. Ship Wt. Lbs.	35	50	70	140	285	500	780	1165	1500	2265

Valve Size (mm)	50	65	80	100	150	200	250	300	350	400
A 150 ANSI	238	279	305	381	508	645	756	864	991	1051
AA 300 ANSI	254	295	337	397	533	670	790	902	1029	1105
B Dia.	168	203	232	292	400	508	600	711	832	902
C Max.	165	192	208	270	340	406	435	530	614	635
D 150 ANSI	121	140	152	191	254	322	378	432	495	526
DD 300 ANSI	127	149	162	200	267	335	395	451	514	552
E	38	43	65	81	109	135	235	273	321	394
F 150 ANSI	76	89	95	114	140	171	203	241	267	298
FF 300 ANSI	83	95	105	127	159	191	222	260	292	324
G 150 ANSI	83	102	102	127	152	203	219	349	378	399
GG 300 ANSI	89	110	111	135	165	216	236	368	397	419
H NPT Body Tapping	⅜	½	½	¾	¾	1	1	1	1	1
J NPT Cover Center Plug	½	½	½	¾	¾	1	1	1¼	1½	2
K NPT Cover Tapping	⅜	½	½	¾	¾	1	1	1	1	1
Valve Stem Internal Thread UNF	10-32	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	⅜-24	½-20
Stem Travel	15	18	20	28	43	58	71	86	102	114
Approx. Ship Wt. Kgs.	16	23	32	64	129	227	354	528	726	1027

Service

Cla-Val Control Valves operate with maximum efficiency when mounted in horizontal piping with the main valve cover UP, however, other positions are acceptable. Due to component size and weight of 8 inch and larger valves, installation with cover UP is advisable. We recommend isolation valves be installed on inlet and outlet for maintenance. Adequate space above and around the valve for service personnel should be considered essential. A regular maintenance program should be established based on the specific application data. However, we recommend a thorough inspection be done at least once a year. Consult factory for specific recommendations.

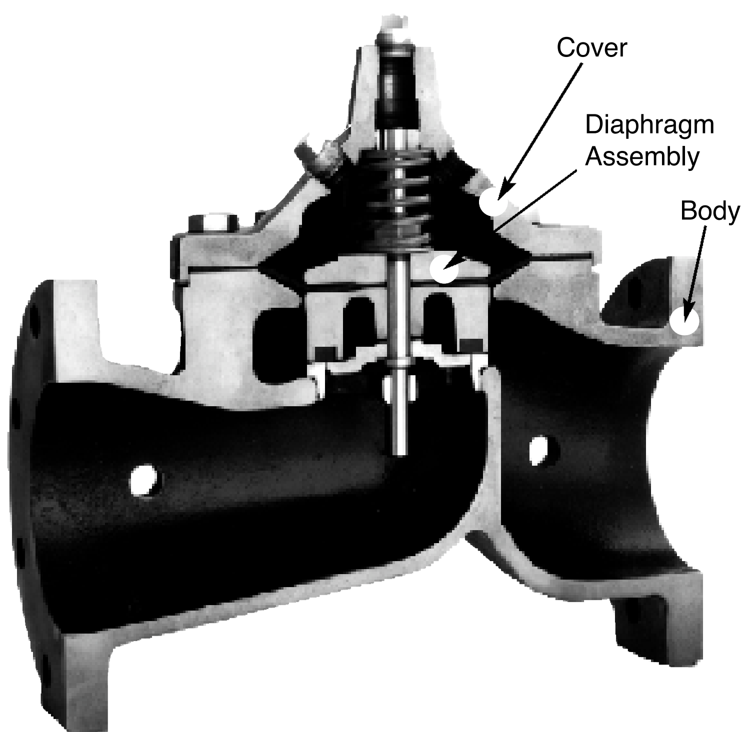
600 Series Valve

The Cla-Val Model 100-20 Hytrol Valve is a hydraulically operated, diaphragm actuated, globe or angle pattern valve. It consists of three major components: body, diaphragm assembly and cover. The diaphragm assembly is the only moving part.

The diaphragm assembly is guided top and bottom by a precision machined stem which utilizes a non-wicking diaphragm of nylon fabric bonded with synthetic rubber. A resilient synthetic rubber disc, retained on three and one-half sides by a disc retainer, forms a drip-tight seal with the renewable seat when pressure is applied above the diaphragm.

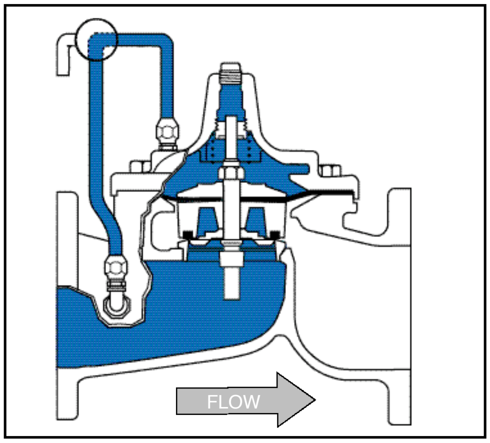
The reduced cavitation characteristics of the 100-20 Hytrol Valve is the basis for the Cla-Val 600 Series. The rugged simplicity of design and packless construction assure a long life of dependable, trouble-free operation. It's smooth flow passages and fully guided disc and diaphragm assembly assure optimum control when used in piping systems requiring remote control, pressure regulation, solenoid operation, rate of flow control or check valve operation.

Available in various materials and in a wide range of sizes. It's applications are unlimited.

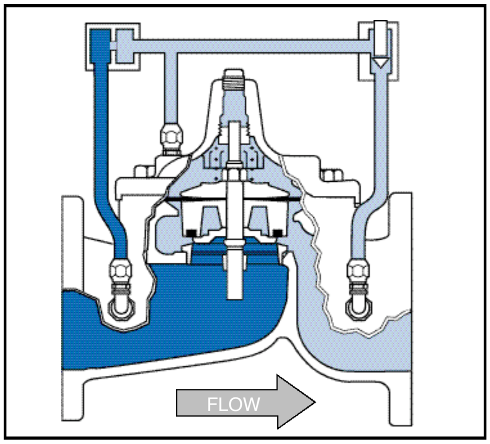


100-20

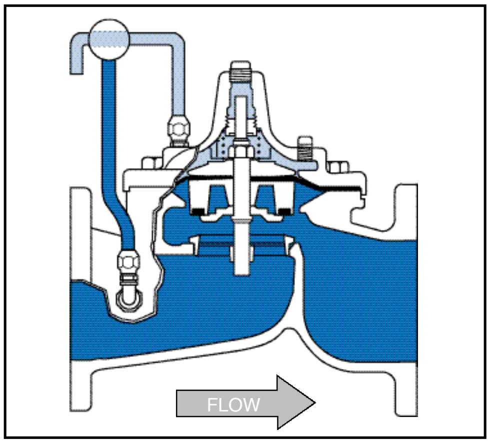
Closed Valve
When pressure from the valve inlet is applied to the cover chamber, the valve closes drip-tight.



Throttling Valve
The valve holds any intermediate position when operating pressures are equal above and below the diaphragm. A Cla-Val “Modulating" Pilot Control will allow the valve to automatically compensate for line pressure changes.



Open Valve
When pressure in the cover chamber is relieved to a zone of lower pressure, the line pressure at the valve inlet opens the valve, allowing full flow.



— MODEL — 100-20

600 Series Hytrol Valve

In 1987, Cla-Val introduced the Model 100-20 Hytrol as the basic main valve for the 600 Series of automatic control valves. To identify all new valves using the 100-20 Hytrol, an existing catalog number is modified. Making a 600 Series catalog number is simply done by using a "6" in front of the two digit catalog numbers or replacing the "2" with a "6" in three digit catalog numbers. Current schematics reflect both catalog numbers together separated by a slash (i.e. - 90-01/690-01, 58-02/658-02, 210-01/610-01, etc). Since these two valves 'share' the same catalog number and schematic, they provide the same function in a system. The only difference between the two valves is the relative capacity of the two main valve series.

The 100-01 Hytrol is the basic main valve for Cla-Val automatic control valves. This valve is the current version of the Clayton Hytrol valve design originated in 1936. The 100-01 Hytrol is designed as a full flow area valve. This means that the inlet, seat and outlet openings are the same size. Thus, the pressure drop is kept to a minimum for this globe style design.

The 100-20 Hytrol valve has all of the basic features and advantages of the original 100-01 Hytrol. Only one part has been changed - the body. It is designed with different size inlet, seat and outlet openings. The 100-20 Hytrol has inlet and outlet flanges one valve size larger than the seat opening size. This results in what is sometimes called a "reduced port' main valve. For example, a 4" 100-20 valve has a 3" seat. Note: valve size is always determined by the flange size. The following chart compares the 100-01 and the 100-20 main valves.

Basic Main Valve Sizes Comparison

Globe Pattern Valves		
Flange Size (inch)	**Seat** Size	
	100-01	100-20 **(600 Series)**
3	**3**	**2**
4	**4**	**3**
6	**5**	**4**
8	**8**	**6**
10	**10**	**8**
12	**12**	**10**
14	**14**	
16	**16**	**12**
20		**16**
24		**16**

Angle Pattern Valves		
Flange Size (inch)	**Seat** Size	
	100-01	100-20 **(600 Series)**
4	**4**	**3**
6	**6**	**4**
8	**8**	**6**

The 100-20 Hytrol is available only in ductile iron, 150 and 300 pressure class, and Bronze trim standard. Available extra cost main valve options include stainless steel trim, epoxy coating, Delrin sleeved stem, and high temperature rubber parts. All four basic main valves have a 600 Series version available with all of the same benefits and size relationships. The following chart shows the relationship of Cla-Val main valve catalog numbers.

Cla-Val Main Valves

	Catalog Number		
Catalog Name	Circa 1936	Current	600 Series
Hytrol	**100 (Angle =2100)**	**100-01**	**100-20**
Powertrol	**100P & 100PA**	**100-02**	**100-21**
Powercheck	**100PC & 100PCA**	**100-03**	**100-22**
Hycheck	**181**	**100-04**	**100-23**

Applications for the 600 Series Valves

The 600 Series valves are a supplement to the 100-01 type control valves and not their replacement. The 100-20 is intended for many applications where a reduced port main valve will improve modulating control. For example, a pressure reducing valve's size is often incorrectly determined by the size of the pipeline regardless of the flow capacity of the control valve. If a 100-01 based pressure reducing valve (90-01) is selected at pipeline size then the maximum flow of the system is often substantially lower than the capacity of the valve, which can lead to control problems at lower flow rates. Proper sizing of the pressure reducing valve usually leads to a smaller than line size valve due to the ability of the control valve to handle larger flows than pipeline flows. For example, 690-01 is the 100-20 version of the 90-01 pressure reducing valve. The relative flow capacity of the 600 series valve is 'in between' the capacity rating of two adjacent standard sized valves. This valve offers the designer a valve that can be pipeline sized and yet has capacity to handle maximum system flow requirements without being oversized. Pipeline size reducers are no longer necessary, which lowers installation costs.

Application of the 600 series valves for modulating service (such as pressure reducing, pressure sustaining, etc.) is ideal. Application of the 600 series valves for ON-OFF service (such as booster pump control, altitude level control, etc.) should be carefully reviewed due to the higher head loss characteristics than the full ported valves. Careful analysis of the specific valve application requirements is needed to make the best valve recommendation. Contact Cla-Val's field sales personnel for assistance.

CLA-VAL

PO Box 1325 Newport Beach CA 92659-0325

800-942-6326 • Fax: 949-548-5441 • Web Site: cla-val.com • E-mail: claval@cla-val.com

CLA-VAL CANADA
4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040
E-mail sales@cla-val.ca

CLA-VAL EUROPE
Chemin des Mésanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50
E-mail: cla-val@cla-val.ch

CLA-VAL UK
Dainton House, Goods Station Road
GB - Tunbridge Wells
Kent TN1 2 DH England
Phone: 44-1892-514-400
Fax: 44-1892-543-423
E-mail: info@cla-val.co.uk

CLA-VAL FRANCE
Porte du Grand Lyon 1
ZAC du Champ du Perier
France - 01700 Neyron
Phone: 33-4-72-25-92-93
Fax: 33-4-72-25-04-17
E-mail: cla-val@cla-val.fr

The flow capacity of a control valve is usually expressed in terms of the valves Cv. Cv is the amount of water in gallons that will pass through a given valve in one minute with a 1 psi pressure drop. Cv values are established by flow testing the valve. So a 3" Cla-Val hytrol has a Cv of 62 will pass 62 gallons per minute with a 1 psi pressure drop.

C_V Factor

Formulas for computing C_V Factor, Flow (Q) and Pressure Drop (ΔP):

$$C_V = \frac{Q}{\sqrt{\Delta P}} \qquad Q = C_V \sqrt{\Delta P} \qquad \Delta P = \left(\frac{Q}{C_V}\right)^2$$

K Factor (Resistance Coefficient)
The Value of K is calculated from the formula: $K = \frac{894d^4}{C_V{}^2}$
(U.S. system units)

Equivalent Length of Pipe
Equivalent lengths of pipe (L) are determined from the formula: $L = \frac{K\,d}{12\,f}$
(U.S. system units)

Fluid Velocity
Fluid velocity can be calculated from the following formula: $V = \frac{.4085\,Q}{d^2}$
(U.S. system units)

Where:

- C_V = U.S. (gpm) @ 1 psi differential at 60° F water
  or
  = (l/s) @ 1 bar (14.5 PSIG) differential at 15° C water
- **d** = inside pipe diameter of Schedule 40 Steel Pipe (inches)
- **f** = friction factor for clean, new Schedule 40 pipe (dimensionless) (from Cameron Hydraulic Data, 18th Edition, P 3-119)
- **K** = Resistance Coefficient (calculated)
- **L** = Equivalent Length of Pipe (feet)
- **Q** = Flow Rate in U.S. (gpm) or (l/s)
- **V** = Fluid Velocity (feet per second) or (meters per second)
- Δ **P** = Pressure Drop in (psi) or (bar)

The following chart shows both the Cv and the K factor data for each valve

Functional Data **Model 100-20**

Valve Size		Inches	3	4	6	8	10	12	14	16	18	20	24	30
		mm.	80	100	150	200	250	300	350	400	460	500	600	760
C_V Factor	**Globe Pattern**	Gal./Min. (gpm.)	62	136	229	480	930	1458	1725	2110	2940*	3400*	4020	7900*
		Litres/Sec. (l/s.)	15	32.5	55	115	223	350	414	506	705	816	965	1895
	Angle Pattern	Gal./Min. (gpm.)	—	135	233	545	—	—	—	—	—	—	—	—
		Litres/Sec. (l/s.)	—	32	56	132	—	—	—	—	—	—	—	—
Equivalent Length of Pipe	**Globe Pattern**	Feet (ft.)	293	251	777	748	621	654	750	977	983	1125	3005	2130
		Meters (m.)	89.3	76.4	237.1	228.1	189.5	199.4	228.7	298.1	299.9	343.2	916.6	649.6
	Angle Pattern	Feet (ft.)	—	254	751	580	—	—	—	—	—	—	—	—
		Meters (m.)	—	77.6	229	176.9	—	—	—	—	—	—	—	—
K Factor		**Globe Pattern**	20.6	12.7	23.1	15.7	10.4	8.5	8.9	10.2	8.4	8.8	19.1	10.5
		Angle Pattern	—	12.9	22.3	12.2	—	—	—	—	—	—	—	—
Liquid Displaced from Cover Chamber When Valve Opens		Fl. Oz	—	—	—	—	—	—	—	—	—	—	—	—
		U.S. Gal.	0.32	.08	.17	.53	1.26	2.51	4.0	4.0	9.6	9.6	9.6	29.0
		ml	—	—	—	—	—	—	—	—	—	—	—	—
		Litres	.12	.30	.64	2.0	4.8	9.5	15.1	15.1	36.2	36.2	36.2	110

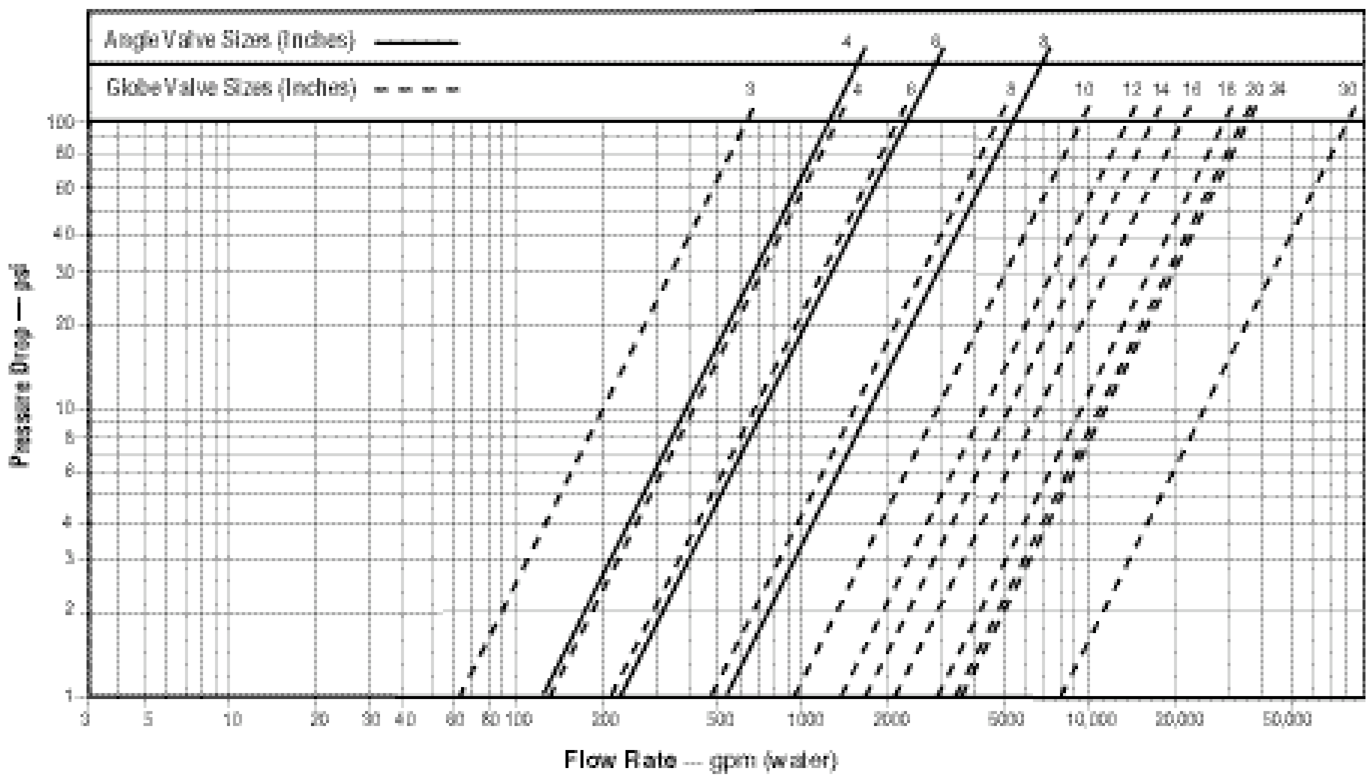
*Estimated

Volume Of Water Displaced

The above chart also shows the volume of water displaced as the valve goes from the closed position to full open. Each time the valve cycles the fixed volume of water will be expelled thru the pilot system from the cover chamber to atmosphere. This information may be useful for various applications.

Flow Chart 100-20

Model 100-20 flow chart. The solid lines are flow valves based on a wide open valve. The dotted lines are flow values based on a based or a wide opened valve. The dotted lines are flow valves. The start of the solid lines is the estimated pressure drop required to achieve a full open calculation.



Material of Construction 100-20

The Hytrol is available in many different alloys for various applications. Currently the Cla-Val foundry pours 45 different alloys. The more common materials are shown on page 19.

Materials

Components	Material Optional				
Body & Cover	Ductile Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Available Sizes	3" - 30"	3" - 30"	3" - 16"	3" - 16"	3" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze	Stainless Steel	Aluminum
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is optional.			Stainless Steel is standard.	
Disc	Buna-N® Rubber				
Diaphragm	Nylon Reinforced Buna-N® Rubber				
Stem, Nut & Spring	Stainless Steel				

Epoxy Coating - suffix KC

A FDA and NSF-61 approved fusion bonded epoxy coating for use with cast iron, ductile iron or steel valves. This coating is resistant to various water conditions, certain acids, chemicals, solvents and alkalies. Epoxy coatings are applied in accordance with AWWA coating specifications C550-90. Do not use with temperatures above 175° F.

Delrin® Sleeved Stem - suffix KG

The Delrin® sleeved stem is designed for applications where water supplies contain dissolved minerals which can form deposits that build up on the valve stem and hamper valve operation. Scale buildup will not adhere to the Delrin® sleeve stem. Delrin® sleeved stems are not recommended for valves in continuous operation where differential pressures are in excess of 80 psi (2" and larger Hytrol valves).

Dura-Kleen Self-cleaning Stem – suffix KD

The Dura-Kleen stem is designed to protect the valve from deposits that build up on a normal stem. The Dura-Kleen stem does not have the differential limits of the Delrin stem.

Water Treatment Clearance - suffix KW

This additional clearance is beneficial in applications where water treatment compounds can interfere with the closing of the valve. The smaller outside diameter disc guide provides more clearance between the disc guide and the valve seat. This option is best suited for valves used in on-off (non-modulating) service.

Viton® Rubber Parts - suffix KB

Optional diaphragm, disc and O-ring fabricated with Viton® synthetic rubber. Viton® is well suited for use with mineral acids, salt solutions, chlorinated hydrocarbons, and petroleum oils; and is primarily used in high temperature applications up to 250° F. Do not use with epoxy coatings above 175° F.

Heavy Spring - suffix KH

The heavy spring option is used in applications where there is low differential pressure across the valve, and the additional spring force is needed to help the valve close. This option is best suited for valves used in on-off (non-modulating) service.

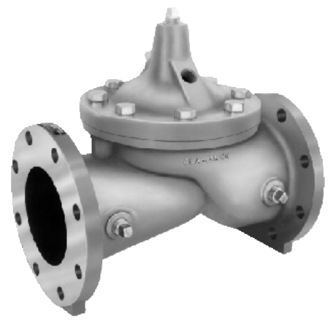
Low Temperature Diaphragm - suffix KA

This single ply diaphragm uses Buna-N® Synthetic Rubber, formulated for low temperature applications to -65° F. Operating pressures in excess of 125 psi are not recommended.

End Connections 100-20

The Hytrol is available in either the standard globe pattern or an angle pattern. Only the valve body is different, everything else is identical. The Angle pattern valve is typically used as a piping preference. Many times it is more convenient to use the angle pattern. The angle pattern valve is less restricted than the globe pattern valve so it has a lower head loss across it, which means that in most applications it will flow more.

3" Globe, Flanged



6" Globe, Flanged

6" Angle, Flanged

Pattern	Flanged
Globe	3" - 30"
Angle	4" - 8"

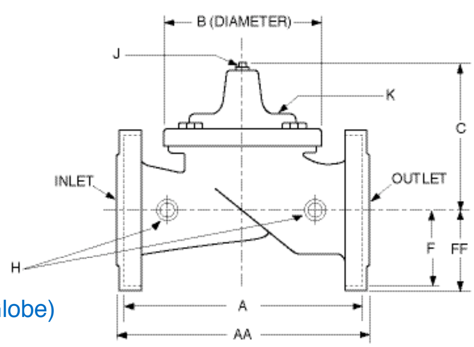
Both the standard globe pattern Hytrol valve and the angle pattern Hytrol are available in 150# or 300# flanged end connections. The Ductile Iron Hytrol with 150# flanges is rated for a maximum operating pressure of 250 psi, while the Ductile Iron 300# flanged Hytrol is rated for 400 psi maximum operating pressure.

Pressure Ratings (Recommended Maximum Pressure - psi)

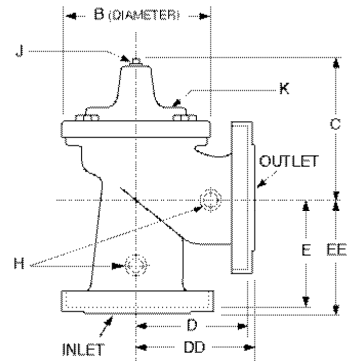
Valve Body & Cover		Pressure Class			
		Flanged			Screwed
Grade	Material	ANSI Standards*	150 lb.	300 lb.	End** Details
ASTM A536	Ductile Iron	B16.42	250	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400
ASTM B62	Bronze	B16.24	225	400	400
ASTM A743	Stainless Steel	B16.5	285	400	400
356-T6	Aluminum	B16.1	275	—	—

Note: *ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
**End Details machined to ANSI B2.1 specifications.

Dimensions 100-20



100-20 (Globe)



100-20 (Angle)

Valve Size (Inches)	**3**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**30**
A 150 ANSI	10.25	13.88	17.75	21.38	26.00	30.00	34.25	35.00	42.12	48.00	48.00	63.25
AA 300 ANSI	11.00	14.50	18.62	22.38	27.38	31.50	—	36.62	43.63	49.62	49.75	—
B Dia.	6.62	9.12	11.50	15.75	20.00	23.62	28.00	28.00	35.44	35.44	35.44	53.19
C Max.	7.00	8.62	11.62	15.00	17.88	21.00	20.88	25.75	25.00	31.00	31.00	43.94
D 150 ANSI	—	6.94	8.88	10.69	—	—	—	—	—	—	—	—
DD 300 ANSI	—	7.25	9.38	11.19	—	—	—	—	—	—	—	—
E 150 ANSI	—	5.50	6.75	7.25	—	—	—	—	—	—	—	—
EE 300 ANSI	—	5.81	7.25	7.75	—	—	—	—	—	—	—	—
F 150 ANSI	3.25	4.50	5.50	6.75	8.00	9.50	11.00	11.75	15.88	14.56	17.00	19.88
FF 300 ANSI	4.12	5.00	6.25	7.50	8.75	10.25	—	12.75	15.88	16.06	19.00	—
H NPT Body Tapping	⅜	½	¾	¾	1	1	1	1	1	1	1	1
J NPT Cover Center Plug	½	½	¾	¾	1	1	1¼	1¼	2	2	2	2
K NPT Cover Tapping	⅜	½	¾	¾	1	1	1	1	1	1	1	1
Valve Stem Internal Thread UNF	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	⅜-24	½-20	½-20	½-20	¾-16
Stem Travel	0.6	0.8	1.1	1.7	2.3	2.8	3.4	3.4	3.4	4.5	4.5	6.5
Approx. Ship Wt. Lbs.	45	85	195	330	625	900	1250	1380	1500	2551	2733	6500

Valve Size (Inches)	**80**	**100**	**150**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**600**	**750**
A 150 ANSI	260	353	451	543	660	762	870	889	1070	1219	1219	1607
AA 300 ANSI	279	368	473	568	695	800	—	930	1108	1260	1263	—
B Dia.	168	232	292	400	508	600	711	711	900	900	900	1351
C Max.	178	219	295	381	454	533	530	654	635	787	787	1116
D 150 ANSI	—	176	226	272	—	—	—	—	—	—	—	—
DD 300 ANSI	—	184	238	284	—	—	—	—	—	—	—	—
E 150 ANSI	—	140	171	184	—	—	—	—	—	—	—	—
EE 300 ANSI	—	148	184	197	—	—	—	—	—	—	—	—
F 150 ANSI	95	114	140	171	203	241	279	298	403	370	432	505
FF 300 ANSI	105	127	159	191	222	260	—	324	403	408	483	—
H NPT Body Tapping	⅜	½	¾	¾	1	1	1	1	1	1	1	1
J NPT Cover Center Plug	½	½	¾	¾	1	1	1¼	1¼	2	2	2	2
K NPT Cover Tapping	⅜	½	¾	¾	1	1	1	1	1	1	1	1
Valve Stem Internal Thread UNF	10-32	¼-28	¼-28	⅜-24	⅜-24	⅜-24	⅜-24	⅜-24	½-20	½-20	½-20	¾-16
Stem Travel	15	20	28	43	58	71	86	86	86	114	114	165
Approx. Ship Wt. Lbs.	20	39	89	150	284	409	568	627	681	1157	1249	2951

For assistance in selecting appropriate valve options or valves manufactured with special design requirements, please contact our Regional Sales Office or Factory.

Service and Installation

Cla-Val Control Valves operate with maximum efficiency when mounted in horizontal piping with the main valve cover UP, however, other positions are acceptable. Due to component size and weight of 10 inch and larger valves, installation with cover UP is advisable. We recommend isolation valves be installed on inlet and outlet for maintenance. Adequate space above and around the valve for service personnel should be considered essential. A regular maintenance program should be established based on the specific application data. However, we recommend a thorough inspection be done at least once a year. Consult factory for specific recommendations.

Roll Seal Valve

The Cla-Val Model 100-42 Roll Seal valve is a hydraulically operated valve used to control liquid flow by means of a flexible control element: the liner.

The basic valve consists of only two parts: a one piece, investment cast body and an elastomeric liner. The valve body is constructed with internal ribs and slots forming a grillwork which surrounds the liner to provide support.

A normally closed type valve is formed by the installed liner which covers the grillwork and seats against the raised seating surface in the valve body.

Upstream pressure actuates the valve to produce valve opening by rolling the liner off the seating surface and the slotted grillwork.

The valve is actuated by upstream pressure as the loading pressure (pressure supplied to the control chamber) is varied by an external pilot control system.

A typical pilot control system used to operate the Model 100-42 valve consists of a restriction and a suitable pilot connected to the valve.

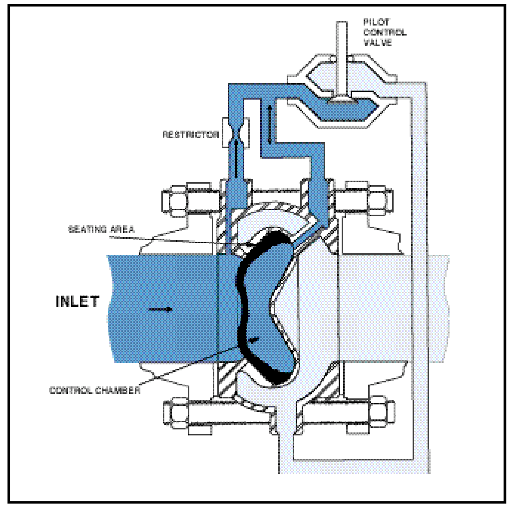
Wafer 100-42

Flange 100-42

Closed Valve

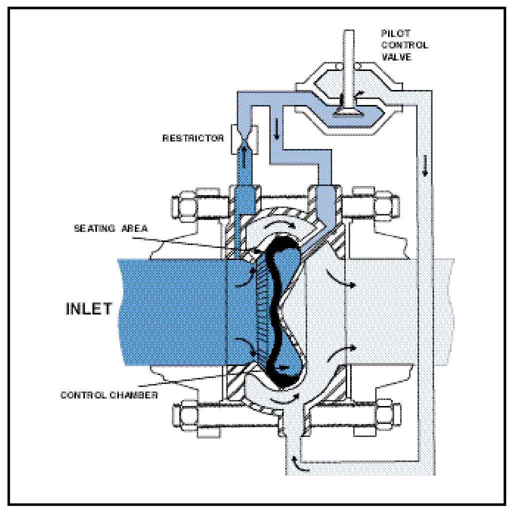
Upstream pressure is introduced to the control chamber (the chamber formed behind the liner) of the Cla-Val Model 100-42 Roll Seal valve through the control piping and restrictor. When the pilot is closed, full inlet pressure is supplied to the control chamber, thus balancing the force developed by inlet pressure acting on the upstream face on the liner. Under these conditions, the liner remains in the fully closed position.

Since the operating pressure in the control chamber is greater than the outlet pressure, an additional closing force is developed across the liner, pressing the liner against the surrounding slotted grillwork area and seating surface.



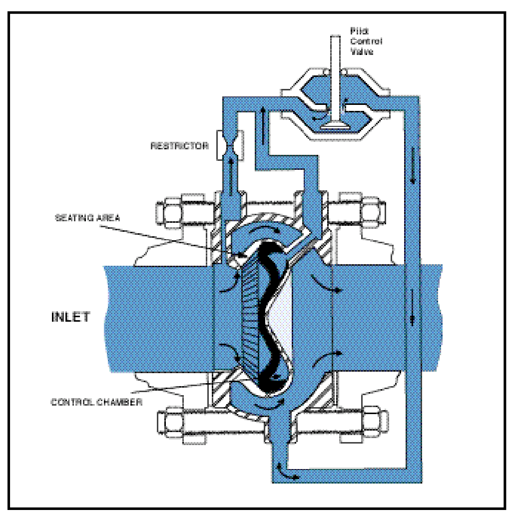
Throttling Valve

As loading pressure is lowered slightly below inlet pressure, the central portion of the liner is forced to invert and come to rest against the tip of the control chamber cavity. Reducing the loading pressure further (but still higher than outlet pressure) causes the liner to drape over the cone shaped portion of the control chamber cavity. This action causes the outer section of the liner to roll off the seating surface and a portion of the grillwork to partially open the valve.



Wide Open Valve

The valve is fully opened when loading pressure is sufficiently reduced to allow the liner to roll back completely and expose the full slot area. Restoring loading pressure reverses the liner rolling action to return the liner to the fully closed position.



Design Specification

Sizes:	2, 3, 4, and 6 inch wafer style 6, 8, 10, and 12 inch flanged 6, 8, 10, 12 inch Victaulic® Ends
End Detail Wafer:	Fits ANSI B16.5 class 125,150, 250, and 300 flanges
End Detail Flanged:	ANSI B16.5 class 150 (fits class 125) or ANSI B16.5 class 300 (fits class 250)
End Detail Victaulic®:	Fits standard steel pipe
Operating Pressure:	720 psi maximum Victaulic® Ends - 300 psi max.
Maximum Differential:	150 psid continuous, 225 psid intermittent*
Reverse Pressure:	125 psid maximum
Temperature Range:	32 to 160 degrees F*
Flange Operating Pressure:	Class 125-175 psi maximum Class 150-275 psi maximum Class 250-300 psi maximum Class 300-720 psi maximum
Victaulic® Ends Rating:	300 psi maximum

*Standard natural rubber 65 durometer in water service.
Temperature range depends on liner material. Higher differential pressure ratings available.

For other than standard ANSI flanges consult factory

Din drilling available on all sizes

Performance Specification

Capacity:	See Technical Data Sheet
C_f Factor:	0.9
Cavitation:	See Technical Data Sheet
Rangeability:	500:1
Bearing Friction:	No friction from slip-type bearings

Material Specification

Body:	316L Stainless Steel
Flanges: (Slip on)	Carbon Steel/Clear Cad. Plated**
Bolt Kit:	Carbon Steel/Zinc Plated
Liner:	Natural Rubber, 65 duro (standard) Viton, EPDM, Nitrile, Silicone (available)
Liner Retainer:	316 Stainless Steel

Optional Materials

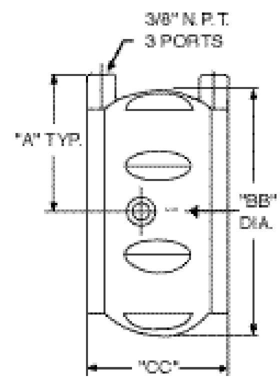
Escoloy 45D
Duplex Stainless Steel
Super Duplex Stainless Steel
Nickel Aluminum Bronze
Titanium

Dimensions (100-42 Main Valve)

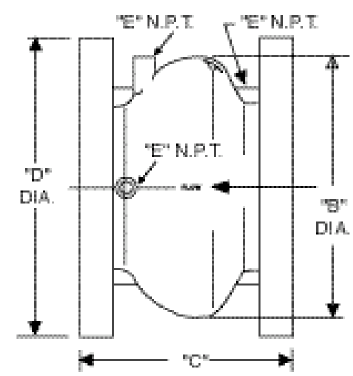
Valve Size (Inches)	2	3	4	6	8	10	12
A	2⅞	3 9/16	4⅛	5¼	--	--	--
B	--	--	--	10⅞	14⅜	18	21⅜
BB	4⅜	5⅞	7⅜	9 13/16	--	--	--
C	--	--	--	9	11	13	15¼
CC	2½	3¼	4	5½	--	--	--
D (ANSI 150)	--	--	--	11	13½	16	19
D (ANSI 300)	--	--	--	12½	15	17½	20½
E (Ports) NPT	--	--	--	⅜	⅜	½	½
Approx. Wt. (150 lbs.)	4	7½	14	58	115	190	290
Approx. Wt. (300 lbs.)	4	7½	14	87	155	250	375
Max. Continuous Flow (gpm)	224	469	794	1787	3177	4964	7148

Valve Size (mm for ANSI)	50	80	100	150	200	250	300
A	73	90	105	133	--	--	--
B	--	--	--	276	356	457	549
BB	111	149	187	249	--	--	--
C	--	--	--	229	279	330	387
CC	64	83	102	140	--	--	--
D (ANSI 150)	--	--	--	279	343	406	483
D (ANSI 300)	--	--	--	318	381	445	521
E (Ports) NPT	--	--	--	⅜	⅜	½	½
Approx. kg. (150 lbs.)	1.81	3.63	6.35	30	54.43	89	151.5
Approx. kg. (150 lbs.)with Studs & Nuts	2.72	4.54	10	--	--	--	--
Approx. kg. (300 lbs.)	1.81	3.63	6.35	41.73	72.57	116.57	191
Approx. kg. (300 lbs.)with Studs & Nuts	5	6.35	11.8	--	--	--	--
Max. Continuous Flow (l/s.)	14	30	50	113	200	301	451

NSF NSF Approved 2" thru 12"



2", 3", 4" and 6" Wafer Style



6", 8",10" and 12" Flanged Style

1
—
7

When Ordering Please Specify:

1. Catalog No. 100-42
2. Valve Size
3. Fluid Being Handled
4. Fluid Temperature Range
5. Inlet Pressure Range
6. Outlet Pressure Range
7. Maximum Differential Pressure
8. Minimum Differential Pressure
9. Maximum Flow Rate

CLA-VAL
PO Box 1325 Newport Beach CA 92659-0325
Phone: 949-722-4800 • Fax: 949-548-5441

CLA-VAL CANADA
4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040

CLA-VAL EUROPE
Chemin dés Mesanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50
www.cla-val.com

E-100-42 (R-5/05)

Represented By:

Capacity Information

Valve Sizing Coefficient - Cv

A very useful expression often used in determining the head loss and/or flow rate capacity of control valves is the C_V factor. Commonly referred to as the flow coefficient or valve sizing coefficient, this empirically determined factor describes the flow capacity of a valve.

The C_V factor is defined as the number of U.S. gallons per minute of water (at 60°F flowing temperature) discharged through a flow restriction with a head loss of one psi. In the case of a control valve, the C_V value is normally stated for the valve in the fully open position. For conditions other than full open, (i.e. modulating valves), contact Cla-Val Technical Services.

Cla-Val 700 Series Valves - Full Open Cv Factors

Valve Size	2"	3"	4"	6"	8"	10"	12"
Cv Factor	48	84	128	451	764	1443	2048

Liquid Flow Equation

The basic flow to pressure drop relationship for liquid service is expressed by the formula:

$$Q = C_V \sqrt{\frac{\Delta P}{G}} \quad \text{or} \quad Q = C_V \sqrt{\Delta P} \times \frac{1}{\sqrt{G}}$$

Where:
- Q = Flow rate in U.S. gallons per minute (GPM).
- C_V = Valve sizing coefficient.
- ΔP = Head loss across valve in psi.
- G = Specific gravity of liquid at flowing temperature referred to water (1.0) at standard conditions (60°F).

However, the above stated relationship only remains valid if the flowing conditions are both turbulent (non-viscous) and non-cavitating. Fortunately, these conditions are the most common encountered in liquid flow applications. In those cases where viscous or cavitating (1) flow conditions are possible, consult factory for guidance in selection of valve size.

Example:

Determine the maximum flow rate capability of a 4" Cla-Val Roll Seal valve in fresh water service with an upstream pressure of 90 psi and downstream pressure of 77 psi. From table, a 4" Cla-Val 700 Series valve has a full open C_V factor of 128; hence:

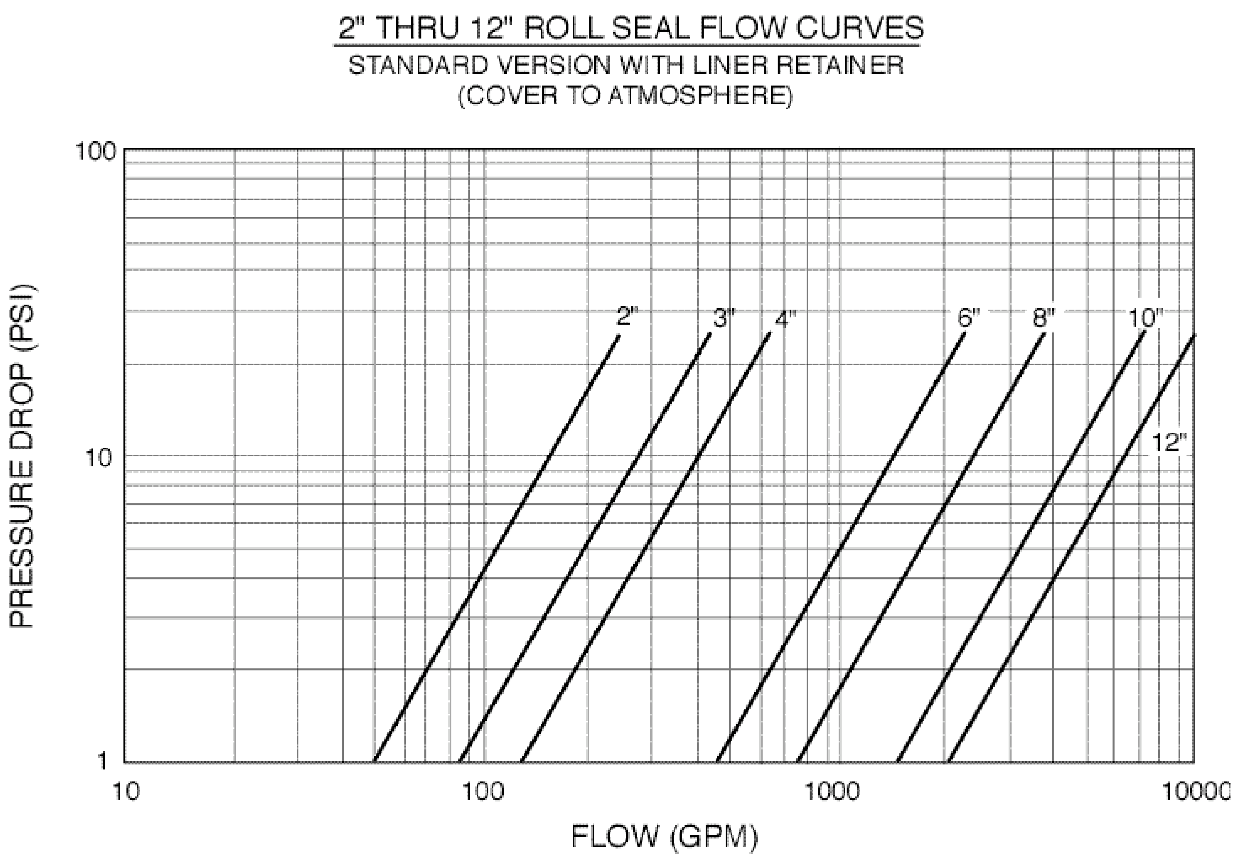
$$Q = 128 \sqrt{13} \times \text{ or } \frac{1}{\sqrt{1}} = 128\,(3.61) = 462 \text{ GPM}$$

(1) Note: For further information on cavitation, see technical data sheet "RS-Cavitation".

Specific Gravity Correction Table

Specific Gravity "G"	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.30	1.40
Correction Factor $\frac{1}{\sqrt{G}}$	1.15	1.12	1.08	1.05	1.03	1.00	0.98	0.95	0.93	0.91	0.88	0.85

To obtain flow capacity of a liquid other than water (specific gravity of 1.00), multiply water flow capacity obtained by the appropriate specific gravity correction factor.



1
—
7

NOTE: The flow rate vs. head loss data presented here is based on a fully open valve condition. The maximum recommended velocity is 20 ft./sec.

Maximum Continuous Flow (U.S. GPM)

Valve Size	2"	3"	4"	6"	8"	10"	12"
Maximum Continuous Flow	224	469	794	1787	3177	4964	7148

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

Cavitation Information

Cavitation

When control valves are used on higher pressure drop applications with liquids, the possibility of incurring cavitation and its detrimental effects should be considered.

Cavitation may be briefly defined as the formation of vapor bubbles in the low pressure regions of a flowing liquid, accompanied by the subsequent collapse of these bubbles when they enter a higher pressure region. The flow of liquid through a control valve meets the criteria for establishing cavitation.

As liquid flows through the throttling section of a control valve, its velocity must increase, resulting in a corresponding decrease in static pressure. If the pressure falls below the vapor pressure of the liquid, vapor bubbles are formed. Once beyond the throttling section, the fluid stream then expands into the larger flow area downstream, with a reduction in stream velocity and increase or "recovery" in static pressure. If the recovered static pressure exceeds the vapor pressure, the vapor bubbles collapse rapidly thereby creating severe shock waves in the flow stream.

Dependent upon the extent of cavitation developed, its effects can range from a mild hissing sound with little or no resulting equipment damage to a highly noisy installation and severe physical damage to the valve and downstream piping.

Cavitation Influenced by Pressure Recovery

Not all control valves will cavitate at the same pressure drop conditions. This is attributable to the individual "pressure recovery" characteristics of the valve. Specifically, the degree of pressure recovered downstream of the throttling section.

An expression relating the tendency of a valve to recover pressure is the Critical Flow factor C_f. Valves with low C_f factors will exhibit high pressure recovery whereas those with C_f factors close to unity produce little recovery. Hence a valve with a C_f rating of 0.9 will be more cavitation resistant than one with a C_f of 0.6.

Cavitation Prediction

The Critical Flow factor may be used to determine the maximum pressure drop a valve may be subjected to without experiencing cavitation damage as computed from the following formula:

$$\Delta P \text{ max.} = C_f^2 (P_1 - F_f P_v)$$

Where:

ΔP max.	=	Maximum allowable pressure drop, psi
C_f	=	Critical flow factor, dimensionless
P_1	=	Inlet pressure (Absolute), psia
P_v	=	Vapor pressure of liquid at inlet temperature, psia
F_f	=	Liquid critical pressure ratio factor, dimensionless

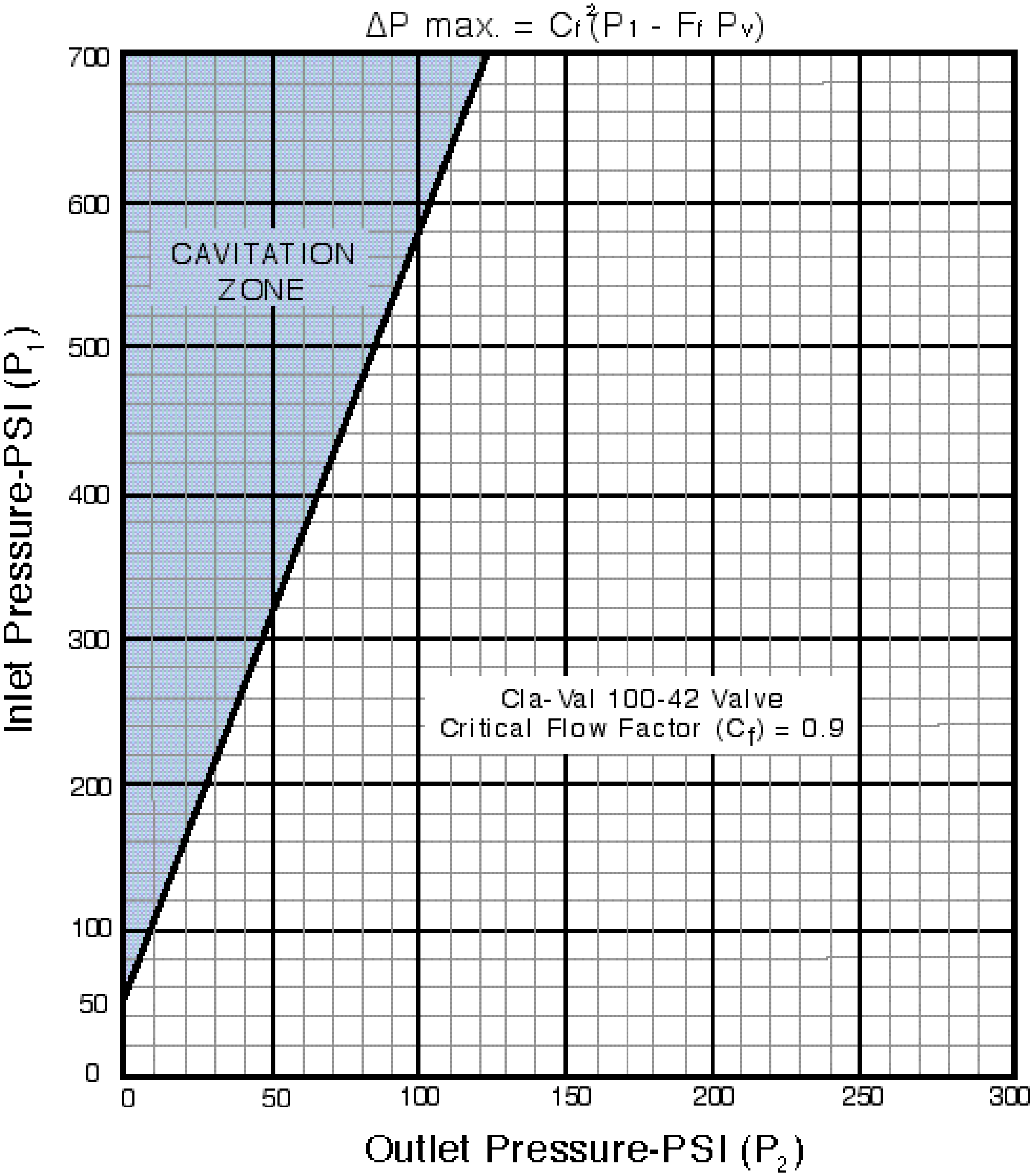
For most water applications a value of 0.96 may be assigned for the F_f factor.

Hence:

$$\Delta P \text{ max.} = C_f^2 (P_1 - 0.96 P_v)$$

Cla-Val 100-42 Valve
Cavitation Chart
for water applications

The cavitation zone is the calculated conditions when cavitation can occur. Cavitation can be mild with no damage to extreme with possible damage to the downstream piping and/or the valve.



1 – 7

N-RS-Cavitation (R-5/05)

CLA-VAL

700 Series
Liner Installation

Liner Retainer Removal 2"-12" Sizes
The 2" and 3" liner retainer is secured to the valve with an Allen screw. Loosen the Allen screw, pull the locking pin back towards center of retainer, and remove the retainer from valve.

To install, insert the retainer, (do not block inlet feed hole), push locking pin into position and tighten Allen screw.

The 4"-12" liner retainers are secured with a snap ring. Remove the snap ring and retainer.

To install, insert retainer and install snap ring into the groove of valve. Be sure snap ring is completely inserted into groove.

Liner Removal 2"-12" Sizes
The tool used for removal should be free of sharp edges to prevent damage to the liner, the valve body seat or control chamber surfaces. A motorcycle tire iron or similar tool works well.

1. Insert the tool between the liner and the valve body as deeply as possible.

2. Using the seat edge as a fulcrum, rock the end of the tool away from the valve in a manner to pull the liner bead out of the body. Grasp the liner and remove from the valve body.

Liner Installation 2", 3", 4" Sizes
Thoroughly clean out the interior of the valve body control chamber cavity.

Liberally apply glycerine inside the control chamber cavity and around the seal bead area of the liner.

DO NOT USE ANY HYDROCARBON OR SILICONE BASED LUBRICANTS ON LINERS AS THESE COMPOUNDS CAN SEVERELY ATTACK THE LINER MATERIAL.

3. Fold the liner as shown and install into the valve body control chamber as deeply as possible.

4. Continuing to force the liner into the control chamber cavity, again fold the liner as shown to insert the liner seal bead section under the valve body seat surface.

5. Work the folded section of the liner into place by pushing against the folded area to slide the seal bead down the conical face of the control chamber.

Liner Seating Instructions 2", 3", 4" Sizes
After installing the liner, it must be seated over the manifold ring in the valve body. The objective of this seating procedure is to place the inside lip of the liner over the outside lip of the manifold ring.

6. 4" valve with liner installed.

7. Pinch, pull and knead the liner 360° around to seat the liner on the manifold ring.

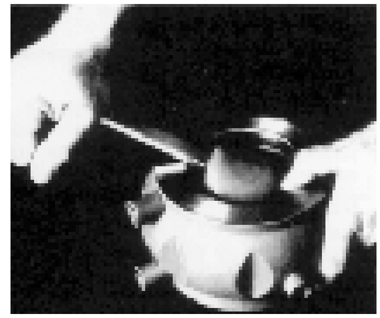
8. Using a dull tool or hammer handle, pry the outer part of the liner towards the center to help "seat" the liner.

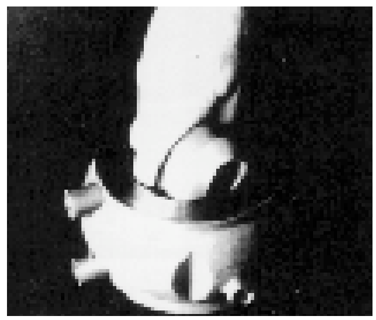
9. Now push the liner down into the valve, holding your hand on the depressed liner, seal off the loading port with your finger.

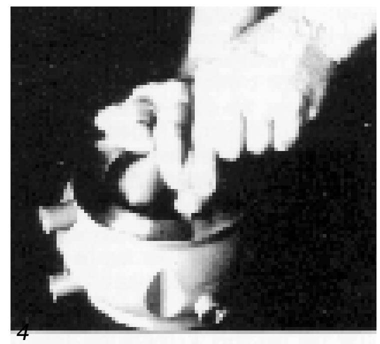
10. Remove your hand from liner and continue holding your finger over the loading port. If liner is seated, it will be held in the open position as long as your finger is over the loading port. When you release your finger, the liner will pop-up. If not seated, repeat with Step 7.

Install liner retainer into body.


1


2


3


4

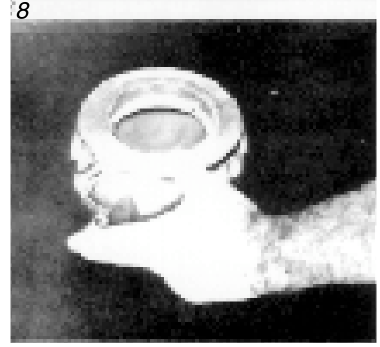

5


6


7


8


9


10

Liner Installation
6", 8", 10", 12" sizes

1. Tools required: Bottle of drugstore glycerine, 30" crowbar, double headed plastic hammer with 14" handle, rubber mallet and large flat blade screwdriver.

2. Liberally wipe glycerine on the inside of the valve and on the outer edge of the liner. Fold liner in half and insert into valve body.

3. Push liner in as far as possible forcing it out side ways.

4. Place the crowbar at the upper 25% point of the liner. Take your other hand and push on nose of liner to bend the liner over the crowbar. The less material folded over, the easier it will go into the valve. If too much is folded over, it will be difficult to complete liner installation.

5. Continue bending liner nose down into the valve. Use your hands and/or hammer handle to continue forcing it down into valve. It is important to keep the "V" of the bend near the 25% point. If it goes over the center, The liner won't go in, and it will be necessary to start over at Step 3.

6. Use the hammer to force the liner down and out into the valve body.

7. Use the hammer handle for the final insertion. Sometimes it is helpful to beat on the liner with the hammer for the final step.

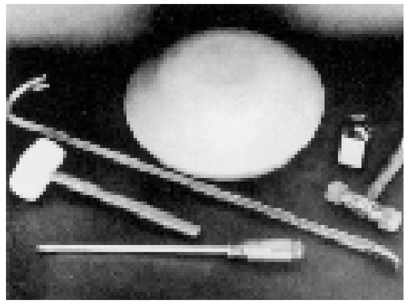
8. To seat the liner on the manifold ring use the hammer handle to push down on the liner near bore of valve inlet and pry handle and liner towards the center. Continue this prying action for 360° around the liner for proper seating.

9. To test for liner seating, push down on the center of liner and close the loading port shut-off isolation valve, or block it with your hand. When you release your hand from the liner, it should remain in the down position until the loading port is opened.

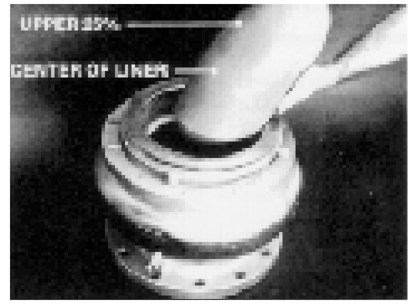
10. If liner appears seated, open loading port isolation valve and liner should pop-up to the closed position. Repeat Steps 6-10 if liner is not seated.

When the liner is fully seated, the inside diameter of the liner will be seated over the outside diameter of the manifold ring. The manifold ring is a raised circular ridge at the bottom of the open cavity which provides for even distribution of the fluid coming in and going out the loading port.

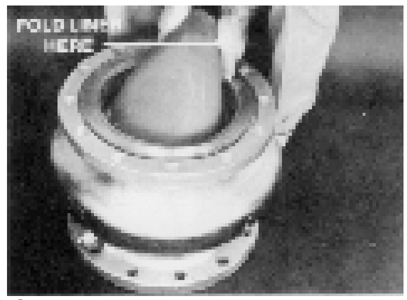
Install liner retainer into body.



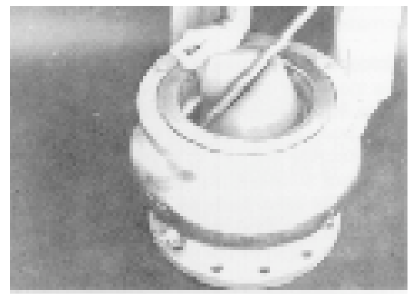
1



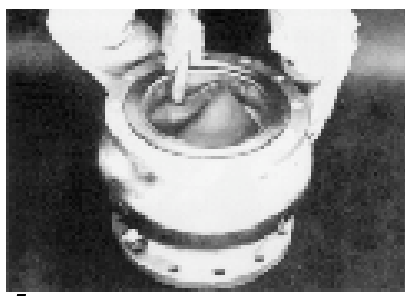
2



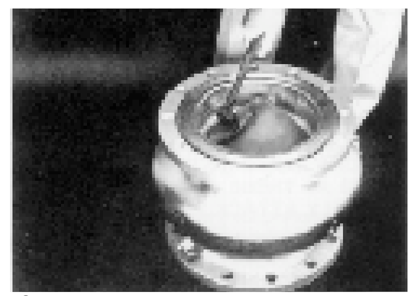
3



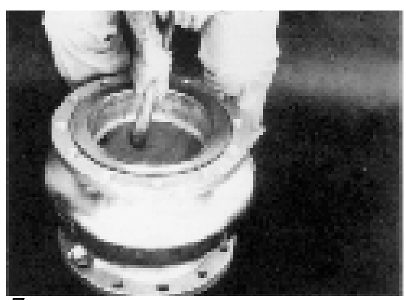
4



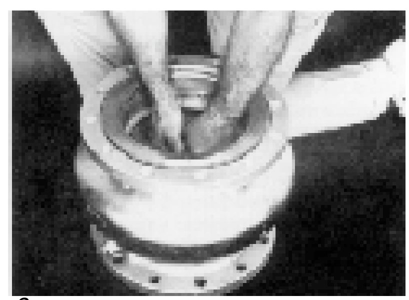
5



6



7



8

9

10

1 — 7

Roll Seal CLA-VAL

Automatic Control Valves

LINER MATERIAL APPLICATION/COMPATIBILITY GUIDE

MATERIAL	FAVORABLE APPLICATION	AVOID	MAX TEMP.
NR65 Natural Rubber	Cold Water Warm Water	Ozone Oils	140°F
S7 Silicone	Low Pressure Water Air Ozone High Temperature	Oils Concentrated Acids Dilute Sodium Hydroxide Silicone Lubricants	185°F
E7 Ethylene Propylene	Chlorine Ozone Hydrogen Peroxide (to 10% concentration) Formaldehyde (to 50% concentration) Animal & Vegetable Oils	Mineral Oils & Solvents Aromatic Hydrocarbons	180-185°F
N7 Nitrile	High ΔP Oils Hydrocarbons	Ozone Keytones Esters Aldehydes Chlorinated & Nitro Hydrocarbons	
V7 Viton	Deionized Water Hot Water Hydrogen Peroxide (to 90% concentration) Formaldehyde (to 40% concentration)	Keytones Low Molecular Weight Esters Nitro-Hydrocarbons	
H65 Hypalon	Bromine Ozone	Esters Keytones Chlorinated Aromatic & Nitro Hydrocarbons	

This information is provided as a general guide to applicability and does not constitute a recommendation by the Cla-Val
The project engineer or customer should determine actual compatibility of material to fluids other than cold water.

Roll Seal CLA-VAL

700 SERIES
Repair Kits

The Cla-Val 700 Series valve repair kit is the only recommended spare part. The valve series is highly reliable due to fewer parts to create problems.

Valve repair kits are recommended over individual liner sales. Kits offer all essentials for easy installation to include: liner, lubricant, liner retainer hardware, and instructions.

REPAIR KIT PART NUMBERS:

	2"	3"	4"	6"	8"	10"	12"
Natural Rubber 65 Durometer	R2001501A	R2001502A	R2001503J	R2001504G	R2001505A	R2001506A	R2001507K
EPDM 70 Durometer	R2002201J	R2002202G	R2002203E	R2002204C	R2002205K	R2002206H	R2002207F
Nitrile 70 Durometer	R2002301G	R2002302E	R2002303C	R2002304A	R2002305H	R20012306F	R2002307D
Silicone 70 Durometer	R2001401F	R2001402D	R2001403B	R2001404K	R2001405G	R2001406E	R2001407C
Viton 70 Durometer	R2002101A	R2002102J	R22002103G	R2002104E	R2002105A	R2002106K	R2002107H

LINER PART NUMBERS:

	2"	3"	4"	6"	8"	10"	12"
Natural Rubber 65 Durometer	R940001	R940101	R940201	R940301	R940401	R940501	R940601
EPDM 70 Durometer	R940006	R940106	R940206	R940306	R940406	R940506	R940606
Nitrile 70 Durometer	R940007	R940107	R940207	R940307	R940407	R940507	R940607
Silicone 70 Durometer	R940003	R940103	R940203	R940303	R940403	R940503	R940603
Viton 70 Durometer	R940005	R940105	R940205	R940305	R940405	R940505	R940605

1 – 7

When ordering, please give complete nameplate data of the valve and/or control being repaired.
MINIMUM ORDER CHARGE APPLIES.

Section 2

Pilots and Accessories

CRD – Cla-Val Reducing Pilot

The CRD is a Normally Open pilot and will shift to close on rise in outlet pressure. The CRD pilot is used for most pressure reducing applications.

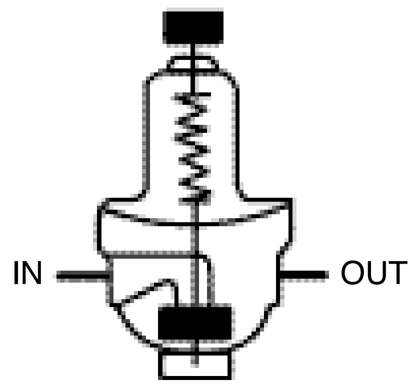
CRD

Normally Open – Shifts to closed on rise in sensed pressure

Adjustment Ranges – 2-30, 15-75, 30-300 psi

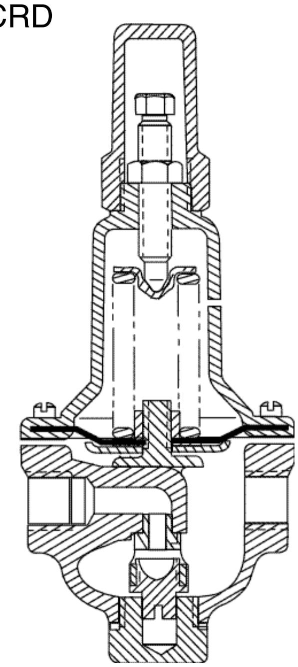
Maximum Working Pressure 400 PSI

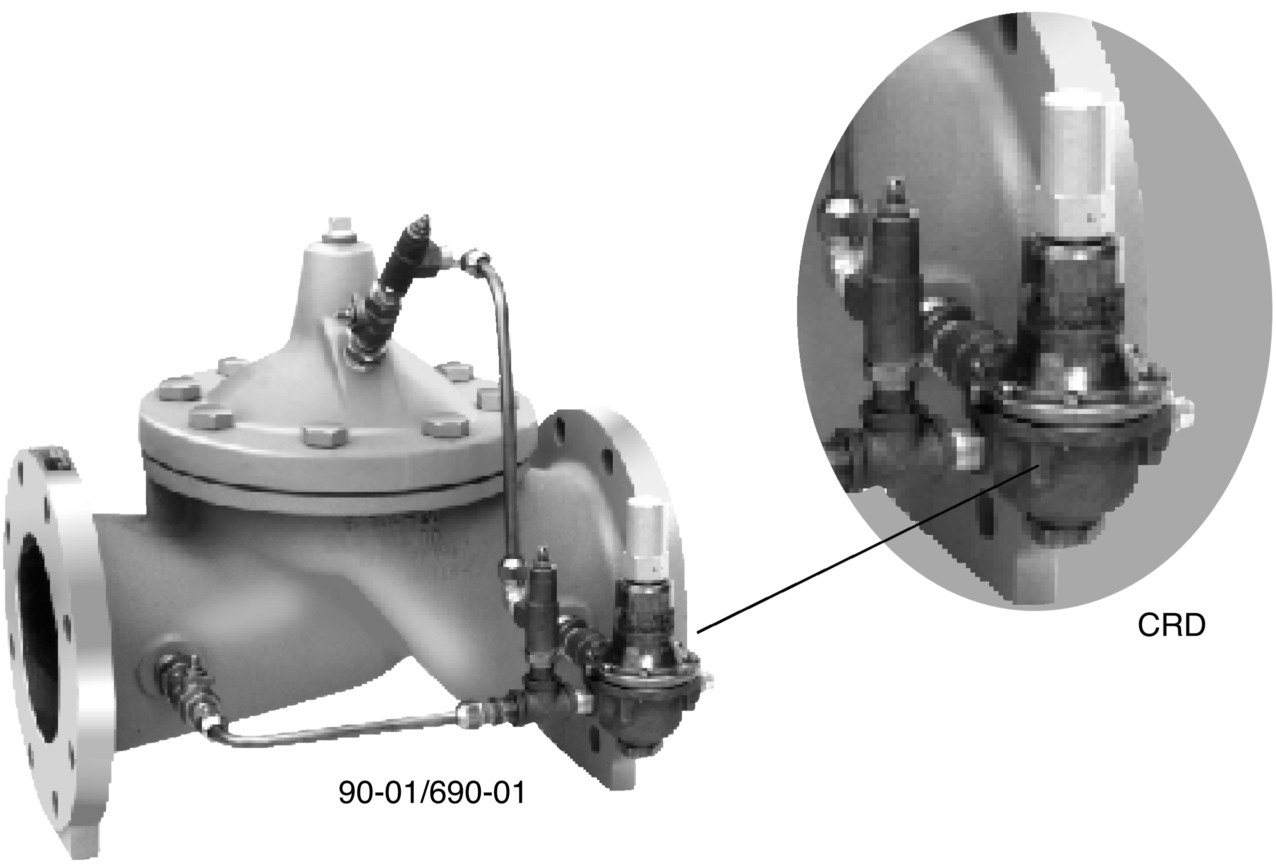
CRD



Schematic Symbol

CRD





CLA-VAL

— MODEL — **CRD**

Pressure Reducing Control

SYMPTOM	PROBABLE CAUSE	REMEDY
Fails to open when deliver pressure lowers	No spring compression	Tighten adjusting screw
	Damaged spring	Disassemble and replace
	Spring guide (8) is not in place	Assemble properly
	Yoke dragging on inlet nozzle	Disassemble and reassemble properly (refer to Reassembly)
Fails to close when delivery pressure rises	Spring compressed solid	Back off adjusting screw
	Mechanical obstruction	Disassemble and reassemble properly (refer to Reassembly)
	Worn disc	Disassemble remove and replace disc retainer assembly
	Yoke dragging on inlet nozzle	Disassemble and reassemble properly (refer to Reassembly)
Leakage from cover vent hole	Damaged diaphragm	Disassemble and replace
	Loose diaphragm nut	Remove cover and tighten nut

DESCRIPTION

The Cla-Val Model CRD Pressure Reducing Control automatically reduces a higher inlet pressure to a lower outlet pressure. It is a direct acting, spring loaded, diaphragm type control that operates hydraulically or pneumatically. It may be used as a self-contained valve or as a pilot control for a Cla-Val main valve. It will hold a constant downstream pressure within very close pressure limits.

OPERATION

The CRD Pressure Reducing Control is normally held open by the force of the compression spring above the diaphragm; and delivery pressure acts on the underside of the diaphragm. Flow through the valve responds to changes in downstream demand to maintain a pressure.

INSTALLATION

The CRD Pressure Reducing Control may be installed in any position. There is one inlet port and two outlets, for either straight or angle installation. The second outlet port can be used for a gage connection. A flow arrow is marked on the body casting.

ADJUSTMENT PROCEDURE

The CRD Pressure Reducing Control can be adjusted to provide a delivery pressure range as specified on the nameplate.

Pressure adjustment is made by turning the adjustment screw to vary the spring pressure on the diaphragm. The greater the compression on the spring the higher the pressure setting.

1. Turn the adjustment screw in (clockwise) to increase delivery pressure.
2. Turn the adjustment screw out (counter-clockwise) to decrease the delivery pressure.
3. When pressure adjustment is completed tighten jam nut on adjusting screw and replace protective cap.
4. When this control is used, as a pilot control on a Cla-Val main valve, the adjustment should be made under flowing conditions. The flow rate is not critical, but generally should be somewhat lower than normal in order to provide an inlet pressure several psi higher than the desired setting

The approximate minimum flow rates given in the table are for the main valve on which the CRD is installed.

Valve Size	1 1/4" -3"	4"-8"	10"-16"
Minimum Flow GPM	15-30	50-200	300-650

MAINTENANCE

Disassembly

To disassemble follow the sequence of the item numbers assigned to parts in the sectional illustration.

Reassembly

Reassembly is the reverse of disassembly. **Caution:** must be taken to avoid having the yoke (17) drag on the inlet nozzle of the body (18). Follow this procedure:

1. Place yoke (17) in body and screw the disc retainer assembly (16) until it bottoms.
2. Install gasket (14) and spring (19) for 2-30 and 2-6.5 psi range onto plug (13) and fasten into body. Disc retainer must enter guide hole in plug as it is assembled. Screw the plug in by hand. Use wrench to tighten only.
3. Place diaphragm (12) diaphragm washer (11) and belleville washer (20) on yoke. Screw on hex nut (10).
4. Hold the diaphragm so that the screw holes in the diaphragm and body align. Tighten diaphragm nut with a wrench. At the final tightening release the diaphragm and permit it to rotate 5° to 10°. The diaphragm holes should now be properly aligned with the body holes.

To check for proper alignment proceed as follows:

Rotate diaphragm clockwise and counterclockwise as far as possible. Diaphragm screw holes should rotate equal distance on either side of body screw holes ±1/8".

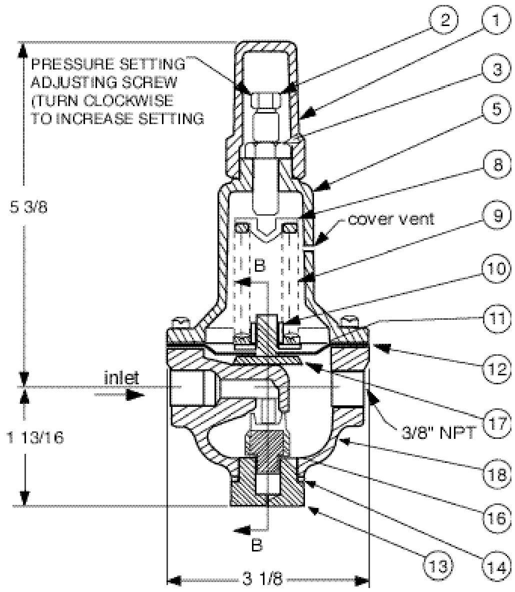
Repeat assembly procedure until diaphragm and yoke are properly aligned. There must be no contact between yoke and body nozzle during its normal movement. To simulate this movement hold body and diaphragm holes aligned. Move yoke to open and closed positions. There must be no evidence of contact or dragging.

5. Install spring (9) with spring guide (8).
6. Install cover (5), adjusting screw (2) and nut (3), then cap (1).

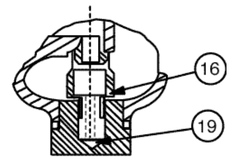
CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

CRD

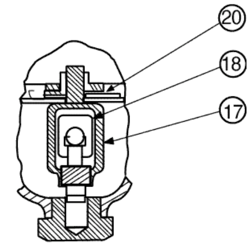
Pressure Reducing Control



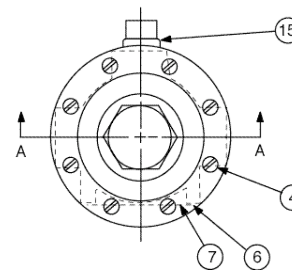
SECTION A-A
OPEN POSTION
FOR HIGH PRESSURE CONTROL



Body and Disc Retainer Detail for Low Pressure Control



SECTION B-B
CLOSED POSITION



Size (inch)	Stock Number	Adjustment Range	
		psi	Ft of Water
3/8	71943-07A	2 - 6.5	4.5 - 15
3/8	71943-08J	2 - 30	4.5 - 69
3/8	71943-03K	15 - 75	35 - 173
3/8	71943-11C	20 - 105	46 - 242
3/8	71943-04H	30 - 300	69 - 692
Factory Set Pressure			**PSI per Turn**
	2 - 6.5 set @ 3.5 psi		.61
	2 - 30 set @ 10 psi		3.0
	15 - 75 set @ 20 psi		9.0
	20 - 105 set @ 60 psi		12.0
	30 - 300 set @ 60 psi		27.0
*Approximate-Final Adjustment should be with a pressure gauge and with flow.			

When ordering parts specify:

- All nameplate data
- Item Description
- Item number

*SUGGESTED REPAIR PARTS

Item	Description	Material	Part Number	List Price
1	Cap	PL	67628J	
2	Adjusting Screw	BRS	7188201D	
3	Jam Nut (3/8-16)	SS	6780106J	
4*	Machine Screw (Fil.Hd.) 8 Req'd	303	6757821B	
5	Cover	BRS	C2544K	
6	Nameplate Screw	SS	67999D	
7	Nameplate	BRS	C0022001G	
8	Spring Guide	302	71881H	
9	Spring (15-75 psi)	CHR/VAN	71884B	
	Spring (2 - 6.5 psi)	SS	82575C	
	Spring (2 - 30 psi)	SS	81594E	
	Spring (20 - 105 psi)	CHR/VAN	20561901H	
	Spring (30 - 300 psi)	CHR/VAN	71885J	
10	Hex Nut	303	71883D	
11	Diaphragm Washer	302	71891G	
12	Diaphragm	NBR	C6936D	
13	Plug, Body	BRS	V5653A	
14*	Gasket	Fiber	40174F	
15	Plug	BRS	6766003F	
16*	Disc Retainer Assy. (15 - 75 psi)	BZ/Rub	C5256H	
	Disc Retainer Assy. (2 - 30 psi)	BZ/Rub	C5255K	
	Disc Retainer Assy. (20 - 105 psi)	BZ/Rub	20561901H	
	Disc Retainer Assy. (30 - 300 psi)	BZ/Rub	C5256H	
17	Yoke	VBZ	V6951H	
18	Body & 1/4" Seat Assy	BR/SS	8339702G	
19*	Bucking Spring (2 - 30 psi)	302	V0558G	
20	Belleville Washer	STL	7055007E	
*	Repair Kit (No Bucking Spring)	Buna®-N	9170003K	
*	Repair Kit (with Bucking Spring)	Buna®-N	9170001D	

CRA – Cla-Val Reducing Pilot with a remote sensing port

The CRA is similar to a CRD but it also has an extra feature; it has a remote sense port. The CRA is a Normally Open pilot and will shift to close on rise in pressure. The CRA pilot is used for pressure reducing applications where a remote pressure needs to be sensed.

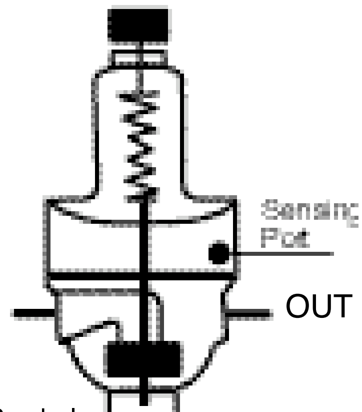
CRA

Normally Open – Shifts to close on rise in sensed pressure.

Adjustment Ranges – 2-35, 15-75, 30-300 psi

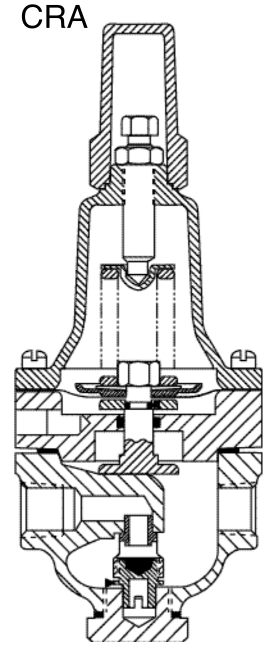
Maximum Working Pressure 400 PSI

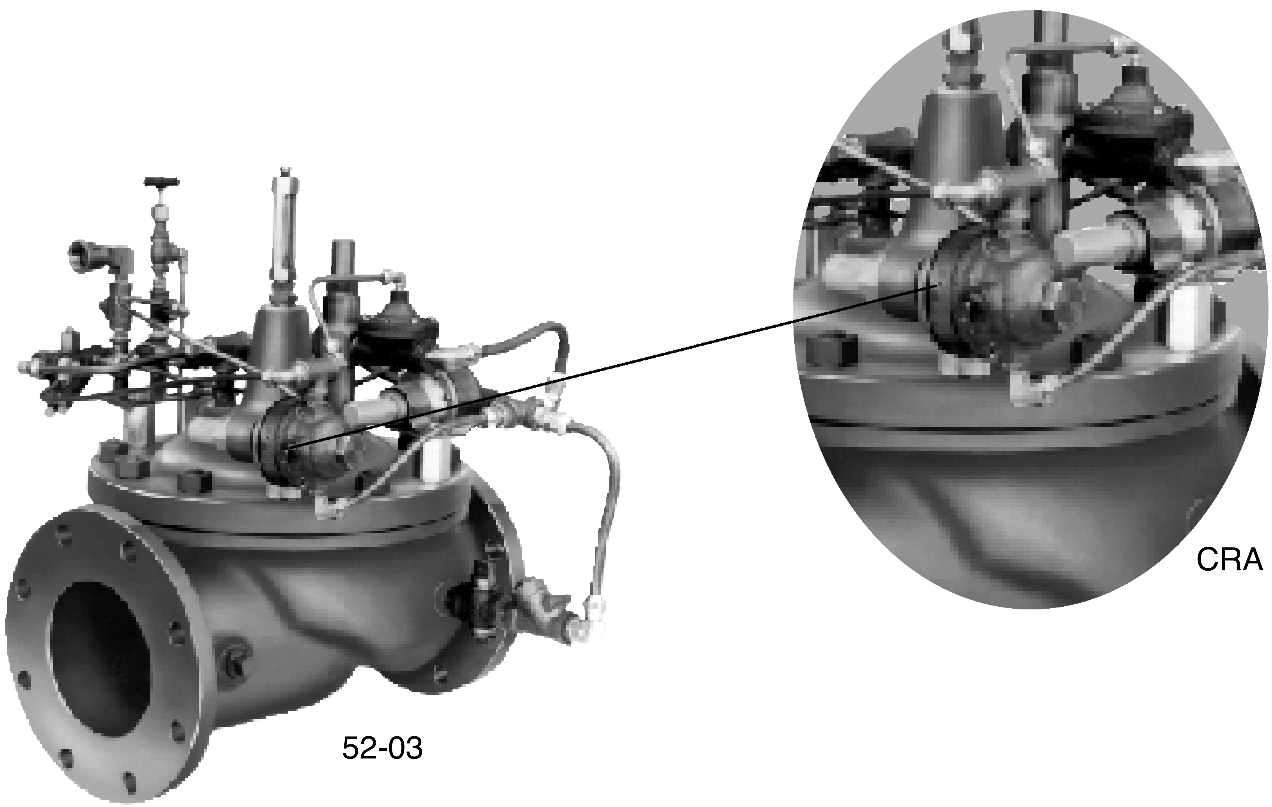
CRA



Schematic Symbol

CRA





— MODEL — **CRA**

REMOTE SENSING TYPE

Pressure Reducing Control

DESCRIPTION

The CRA Pressure Reducing Control automatically reduces a higher inlet pressure to a lower outlet pressure. It is a direct acting, spring loaded, diaphragm type valve that operates hydraulically or pneumatically and is designed to sense pressure from a remote point. It may be used as a self-contained valve or as a pilot control for a Cla-Val main valve. It will hold a constant downstream pressure at the remote sensing point within very close pressure limits.

OPERATION

The CRA Pressure Reducing Control is normally held open by the force of the compression spring above the diaphragm; delivery pressure acts on the underside of the diaphragm. Flow through the valve responds to changes in pressure at the the sensing point.

INSTALLATION

The CRA Pressure Reducing Control may be installed in any position. There is one inlet port and two outlets, for either straight or angle installation. The second outlet port can be used for a gauge connection. A flow arrow is marked on the body casting.

ADJUSTMENT PROCEDURE

The CRA Pressure Reducing Control can be adjusted to provide a delivery pressure range as specified on the nameplate.

Pressure adjustment is made by turning the adjustment screw to vary the spring pressure on the diaphragm. The greater the compression on the spring the higher the pressure setting.

1. Turn the adjustment screw in (clockwise) to increase delivery pressure.
2. Turn the adjustment screw out (counter-clockwise) to decrease the delivery pressure. When pressure adjustment is completed, tighten jam nut on adjustment screw and replace protective cap.

Flow rates are not critical during pressure setting. The approximate minimum flow rates given in the table are for the main valve on which the CRA is installed.

Valve Size	1 1/4"-3"	4"-8"	10"-16"
Minimum Flow GPM	15-30	50-200	300-650

MAINTENANCE

Disassembly

To disassemble follow the sequence of the item numbers assigned to parts in the sectional illustration.

Reassembly

Reassembly is the reverse of disassembly. Caution must be taken to avoid having the yoke (17) drag on the inlet nozzle of the body (18). Follow this procedure:

1. Place yoke (17) in body and screw the disc retainer assembly (16) until it bottoms.
2. Install gasket (14) and spring (19) for 2-30 psi range onto plug (13) and screw into body. Disc retainer must enter guide hole in plug as it is assembled. Screw the plug in by hand. Use wrench to tighten only.
3. Place gasket (25) and powertrol body (21) on yoke extension (17). Refer to sectional view for proper reassembly of (21) onto body (18).
4. Place lower diaphragm washer (24), "O" ring (22), diaphragm (12), upper diaphragm washer (11), and belleville washer (20) on yoke extension (17). Screw on diaphragm nut (10) finger tight.
5. Place two machine screws (4) through (21) (25) and screw into body (18). Do not include the diaphragm (12) in this operation. This holds parts aligned for next step, and allows the diaphragm to move and be properly located during tightening of nut (10).
6. Hold the diaphragm so that screw holes in the diaphragm (12) and powertrol body (21) align. Tighten diaphragm nut (10) with a wrench. At the final tightening release the diaphragm and permit it to rotate approximately 5° to 10°. The diaphragm holes should now be properly aligned with the body holes.

To check for proper alignment proceed as follows:

Rotate diaphragm clockwise and counterclockwise as far as possible. Diaphragm screw holes should rotate equal distance on either side of powertrol body screw holes ±1/8".

Repeat assembly procedure until diaphragm and yoke are properly aligned. There must be no contact between yoke and body nozzle during its normal opening and closing movement. To simulate this movement hold powertrol body and diaphragm holes aligned. Move yoke to open and closed positions. There must be no evidence of contact or dragging.

7. Remove machine screws per step 5.
8. Install spring (9) with spring guide (8) on top of spring.
9. Install cover (5) using eight machine screws (4).
10. Replace adjusting screw (2) and nut (3), then cap (1).

SYMPTOM	PROBABLE CAUSE	REMEDY
Fails to open when pressure lowers	No spring compression	Tighten adjusting screw
	Mineral buildup on yoke extension (17)	Disassemble and clean part, Replace "O" rings (22) and (23).
	Damaged spring	Disassemble and replace.
	Spring guide (8) is not in place	Disassemble and place guide (8) on top of spring (9).
	Yoke dragging on inlet nozzle	Disassembled and reassemble use procedure.
Fails to close when delivery pressure rises	Spring compressed	Back off adjusting screw
	Mineral deposit on yoke extension (17)	Disassemble and clean part. Replace "o" rings (22) and (23).
	Mechanical obstruction	Disassemble and remove obstruction
	Worn disc	Disassemble, remove and replace disc retainer assembly. (16)
	Yoke dragging on inlet nozzle	Refer to paragraph 6
Leakage from cover vent hole	Damaged diaphragm (12)	Disassemble and replace
	Loose diaphragm nut (10)	Remove cover and tighten nut

CRA

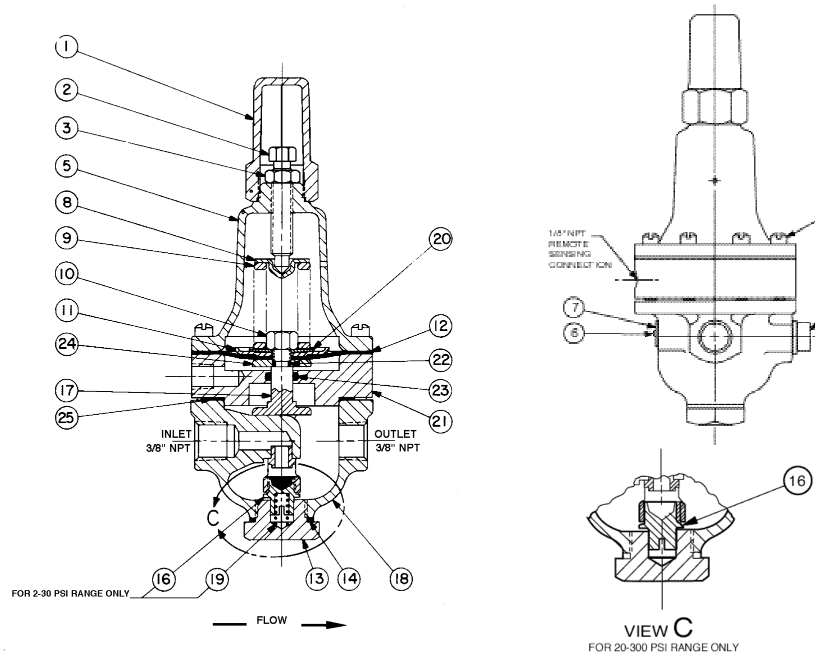
REMOTE SENSING TYPE

Pressure Reducing Control

When ordering parts specify:
- All nameplate data
- Description
- Item number

SIZE (inch)	STOCK NUMBER	SEAT DIA	ADJ. RANGE (psi)
3/8	79744-03D	1/4	15-75
3/8	79744-04B	1/4	30-300
3/8	79744-06G	1/4	2-30
Factory set pressure:			PSI*per turn
15-75 set @ 20 psi			9.0
30-300 set @ 60 psi			27.0
2-30@ 10 psi			3.0

* Approximate - Final adjustment should be made with a pressure gauge and with flow.



ITEM	**DESCRIPTION**	MATERIAL	PART NUMBER	LIST PRICE
1	Cap	PL	67628J	
2	Adjusting Screw	BRS	7188201D	
3	Jam Nut, 3/8—16	303	6780106J	
4*	Machine Screw 10-32 x 1-1/4"(Fil.Hd.) (8 required)	SS	6757874A	
5	Cover	BRS	C2544K	
6	Nameplate Screw	SS	67999D	
7	Nameplate	BRS	C002201G	
8	Spring Guide	302	71881H	
9	Spring			
	(15-75 psi)	CHR VAN	71884B	
	(30-300 psi)	CHR VAN	71885B	
	(2-30 psi)	SS	81594E	
10	Hex Nut 5/16 - 18	303	71883D	
11	Diaphragm Washer (upper)	302	71891G	
12*	Diaphragm	NBR	C6936D	
13	Plug, Body	BRS	V5653A	
14*	Gasket	FIB	40174F	
15	Plug, 3/8 NPT	BRS	6766003F	
16*	Disc Retainer Assy (15-75 psi & 30-300 psi)	BR/RUB	C5256H	
	Disc Retainer Assy (2-30 psi)	BR/RUB	C5255K	
17	Yoke	VBZ	C1799A	
18	Body & Seat Assy, Seat only 1/4"	BS	8339701J	
19*	Bucking Spring (Required with 2-30 psi)	302	VO5586	
20	Belleville Washer	STL	7055007E	
21	Powertrol Body	BRS	C3388A	
22*	O-Ring	NBR	00708J	
23*	O-Ring	NBR	00746J	
24	Diaphragm Washer (lower)	BRS	C1804J	
25	Gasket	NBC	8059401D	
*	Repair Kit (no Bucking Spring) Item 19	Buna®-N	9170003K	
*	Repair Kit (with Bucking Spring) Item 19	Buna®-N	9170001D	

* Suggested Repair Parts

2 — 1

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

CRL – Cla-Val Relief Pilot

The Cla-Val CRL pilot is a Normally Closed pilot that shifts to Open on rise in sensed pressure. The CRL is used for most pressure relief or pressure sustaining applications.

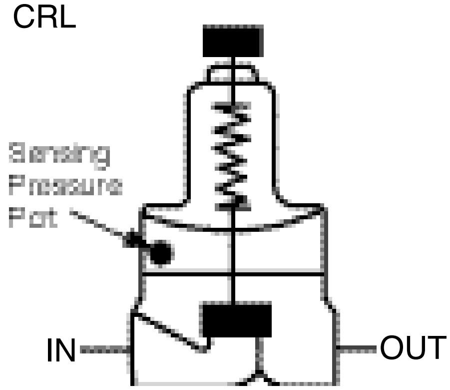
Normally Closed - Shifts to open on rise in sensed pressure

Adjustment Ranges
0-75, 20-200,100-300 psi
Contact Cla-Val for higher ranges

Maximum Working Pressure 400 PSI

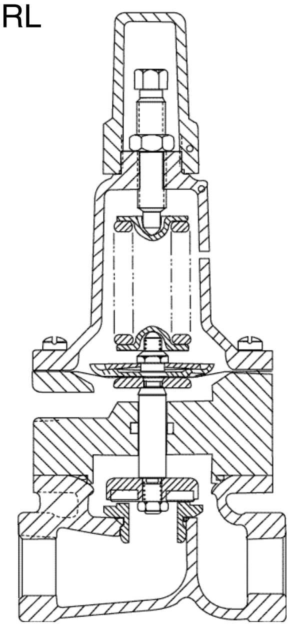
CRL

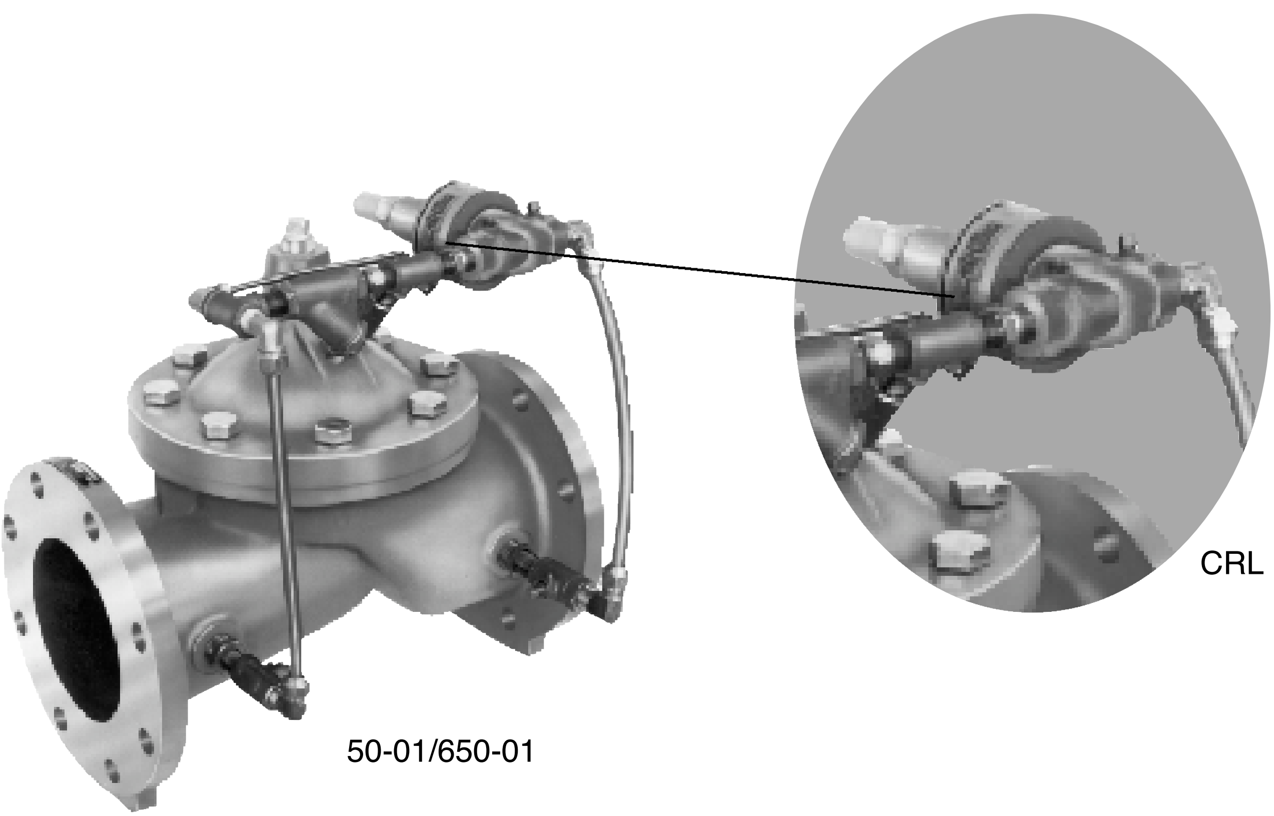
CRL



Schematic Symbol

CRL





CLA-VAL

— MODEL — **CRL**

Pressure Relief Control

DESCRIPTION

The CRL Pressure Relief Control is a direct acting, spring loaded, diaphragm type relief valve. It may be used as a self-contained valve or as a pilot control for a Cla-Val Main valve. It opens and closes within very close pressure limits.

INSTALLATION

The CRL Pressure Relief Control may be installed in any position. The control body (7) has one inlet and one outlet port with a side pipe plug (24) at each port. These plugs are used for control connections or gauge applications. The inlet in the power unit body (6) is the sensing line port. A flow arrow is marked on the body casting.

OPERATION

The CRL Pressure Relief Control is normally held closed by the force of the compression spring above the diaphragm; control pressure is applied under the diaphragm.

When the controlling pressure exceeds the spring setting, the disc is lifted off its seat, permitting flow through the control.

When controlling pressure drops below spring setting, the spring returns the control to its normally closed position.

ADJUSTMENT PROCEDURE

The CRL Pressure Relief Control can be adjusted to provide a relief setting at any point within the range found on the nameplate.

Pressure adjustment is made by turning the adjustment screw (9) to vary the spring pressure on the diaphragm. Turning the adjustment screw clockwise increases the pressure required to open the valve. Counterclockwise decreases the pressure required to open the valve.

When pressure adjustments are complete the jam nut (10) should be tightened and the protective cap (1) replaced. If there is a problem of tampering, lock wire holes have been provided in cap and cover. Wire the cap to cover and secure with lead seal.

DISASSEMBLY

The CRL Pressure Relief Control does not need to be removed from the line for disassembly. Make sure that pressure shut down is accompanied prior to disassembly. If the CRL is removed from the line for disassembly be sure to use a soft jawed vise to hold body during work.

Refer to Parts List Drawing for Item Numbers.

1. Remove cap (1), loosen jam nut (10) and turn adjusting screw counterclockwise until spring tension is relieved.
2. Remove the eight screws (4) holding the cover (3) and power unit body (6). Hold the cover and power unit together and place on a suitable work surface.
   See NOTE under REASSEMBLY.
3. Remove the cover (3) from power unit body (6). The spring (12) and two spring guides (11).
4. Remove nut (13) from stem (19) and slide off the belleville washer (14), the upper diaphragm washer (15) and the diaphragm (16).
5. Pull the stem (19) with the disc retainer assembly (21) through the bottom of power unit. The lower diaphragm washer (17) will slide off of stem top.
6. Remove jam nut (23) and disc retainer assembly (21) from stem. Use soft jawed pliers or vise to hold stem. The polished surface of stem must not be scored or scratched.
7. The seat (22) need not be removed unless it is damaged. If removal is necessary use proper size socket wrench and turn counterclockwise. Note: Some models have an integral seat in the body (7).

INSPECTION

Inspect all parts for damage, or evidence of cross threading. Check diaphragm and disc retainer assembly for tears, abrasions or other da m-age. Check all metal parts for damage, corrosion or excessive wear.

REPAIR AND REPLACEMENT

Minor nicks and scratches may be polished out using 400 grit wet or dry sandpaper fine emery or crocus cloth. Replace all O-rings and any damaged parts.

When ordering replacement parts, be sure to specify parts list item number and all nameplate data.

REASSEMBLY

In general, reassembly is the reverse of disassembly. However, the following steps should be observed:

1. Lubricate the O-Ring (18) with a small amount of a good grade of waterproof grease, (Dow Corning 44 medium grade or equal). Use grease sparingly and install O-ring in power unit body (6).
2. Install stem (19) in power unit body (6). Use a rotating motion with minimum pressure to let stem pass through O-ring.

   Do Not Cut O-Ring.
3. Install O-ring (5) at top of stem (19). Place lower diaphragm washer (17) on the stem with the serrated side up. Position diaphragm (16), upper diaphragm washer (15), with serration down, and belleville washer (14) with concave side down.
4. Position power unit body (6) as shown on parts list drawing (top view).
5. Continue reassembly as outlined in disassembly steps 1 through 3.

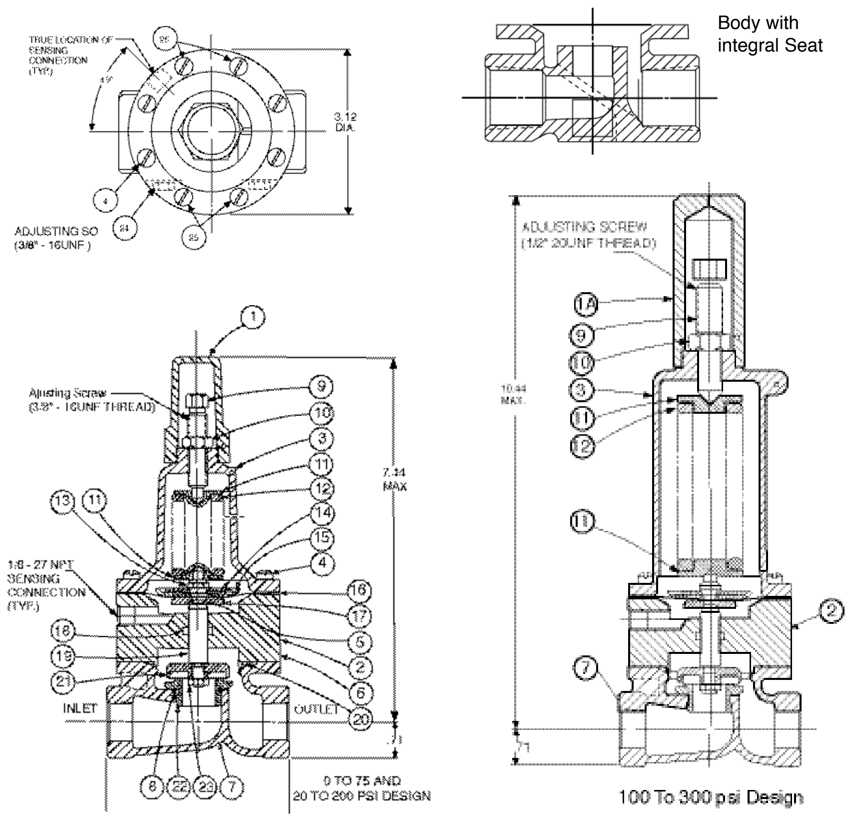
Note: Item (4) Screw will have a quantity of 8 for the 0-75 and 20-200psi design and a quantity of 4 for the 100-300psi design. Item (25) Screw is used on the 100-300psi design only. Install item (25), before item (4) for preload of item (12) spring.

SYMPTOM	PROBABLE CAUSE	REMEDY
Fails to open.	Controlling pressure too low.	Back off adjusting screw until valve opens.
Fails to open with spring compression removed.	Mechanical obstruction, corrosion, scale build-up on stem.	Disassemble, locate,and remove obstruction, scale.
Leakage from cover vent hole when controlling pressure is applied.	Diaphragm Damage	Disassembly replace damaged diaphragm.
	Loose diaphragm assembly.	Tighten upper diaphragm washer.
Fails to close.	No spring compression.	Re-set pressure adjustment.
Fails to close with spring compressed.	Mechanical obstruction.	Disassemble, locate and remove obstruction.

CLA-VAL

CRL

1/2" & 3/4" PRESSURE RELIEF CONTROL



SIZE	SPRING RANGE	PART NUMBER
1/2"	0-75 PSI	79222-01E
1/2"	20-200 PSI	79222-02C
1/2"	100-300 PSI	82809-01D
3/4"	0-75 PSI	79229-01K
3/4"	20-200 PSI	79229-02H
3/4"	100-300 PSI	86005-01E
For 100-450 PSI Contact Factory		

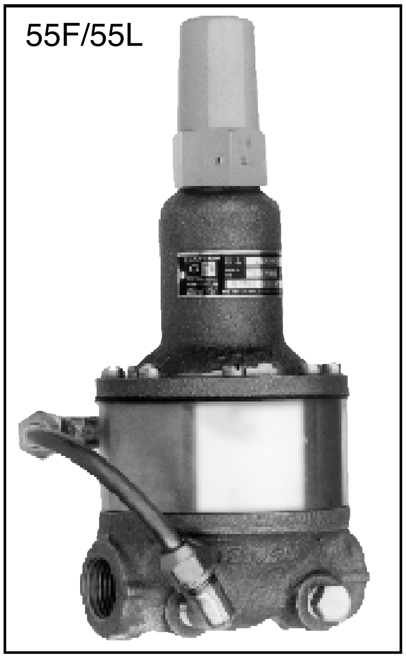
CRL RANGE PSI	APPROX. INCREASE FOR EACH CLOCK-WISE TURN OF ADJUSTING SCREW
0 to 75	8.5 PSI
20 to 200	28.0 PSI
100 to 300	18.0 PSI

When ordering parts please specify:
1. All Nameplate Data
2. Item Part Number
3. Item Description

Item	Description	Material	Part Number	List Price
1	Cap	Plastic	67628J	
2	Nameplate	BRS		
3	Cover	BRZ	C2544K	
4*	Screw Fil.Hd.10-32 x 1.88 . See note other side	303	6757867E	
5*	0-Ring	RUB	00902H	
6	Body, Power unit	BRS	7920504D	
7	1/2" Body	BRZ	C7928K	
	3/4" Body	BRZ	C9083B	
8*	0-Ring, Seat	RUB	00718H	
9	Screw, Adjusting	BRZ	82811B	
10	Nut Hex (Locking)	303	6780106J	
11	Guide, Spring	303	71881H	
12	Spring, (0-75 psi) Range	CHR/VAN	71884B	
	(20-200 psi) Range	CHR/VAN	71885J	
	(100-300psi) Range	CHR/VAN	82813H	
13	Nut, Stem, Upper	BRS	73034B	
14	Washer, Belleville	STL	7055007E	
15	Washer, Diaphragm (upper)	303	71891G	
16*	Diaphragm	RUB	C1505B	
17	Washer, Diaphragm (lower)	SS	45871B	
18*	0-Ring, Stem	RUB	00746E	
19	Stem	SS	8982401F	
20*	0-Ring, Body	RUB	00767E	
21*	Retainer Assembly, Disc	BRZ/Rub	C8964D	
22	Seat	303	62187A	
23	Nut, hex, Stem, Lower	303	6779806G	
24	Pipe Plug	BRS		
25	Screw Fil.Hd, 10-32 x 2.25 (Qty 4 on 100-300 psi)	BRS		
*	Repair Kit		9170007A	

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

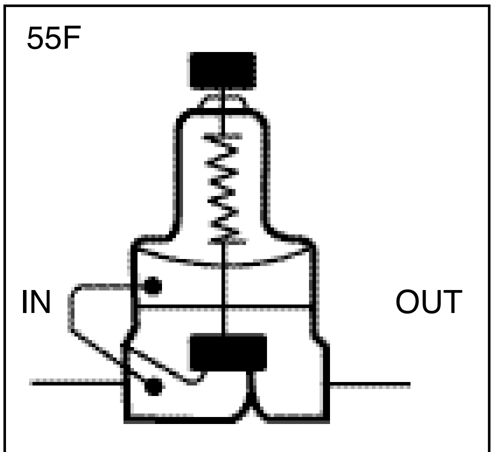
55F – Cla-Val Relief Pilot with external mounted sense line
The Cla-Val 55F pilot is a Normally Closed pilot that shifts to Open on rise in sensed pressure. It is like the CRL but has an extra feature; sense tubing is connected from the inlet of the pilot to the sensing port of the pilot. The 55F is often used as a stand-alone direct acting pressure relief valve.



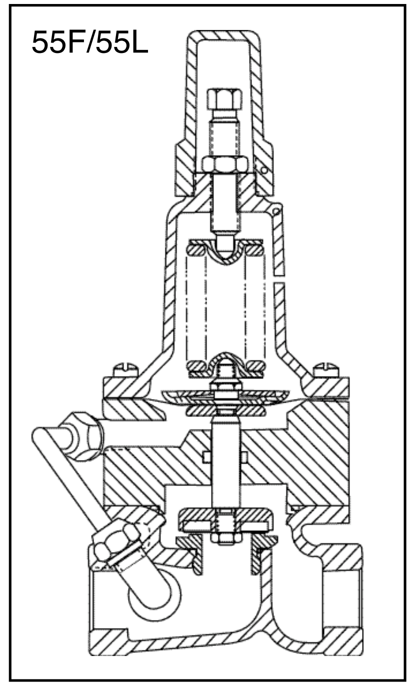
Normally Closed - Shifts to open
on rise in sensed pressure

Adjustment Ranges
0-75,20-200,100-300 psi

Maximum Working Pressure 400 PSI

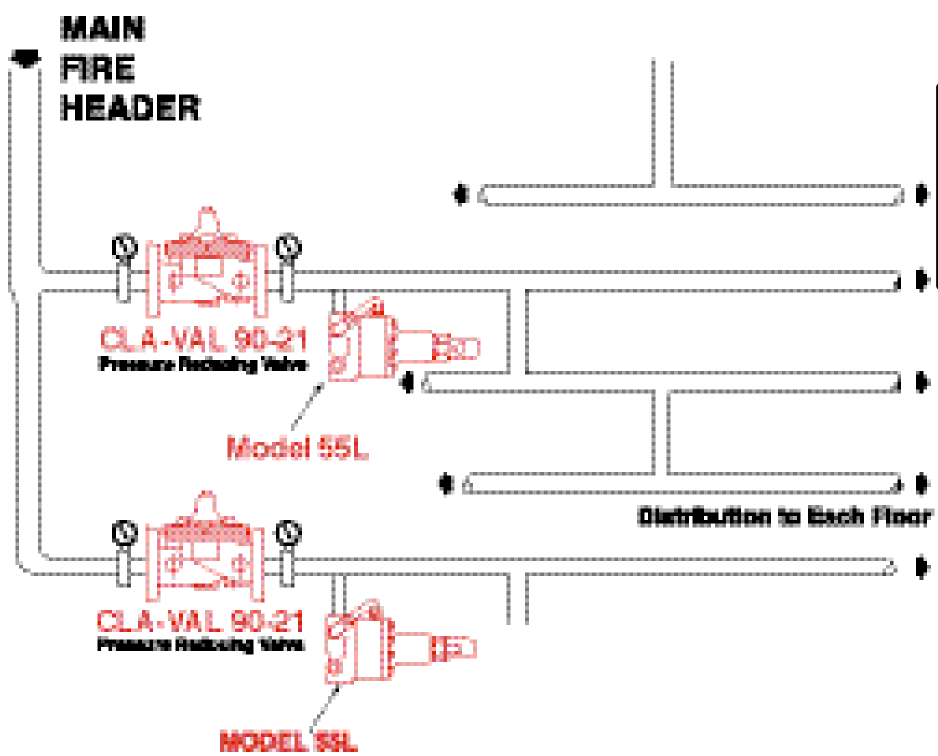


Schematic Symbol



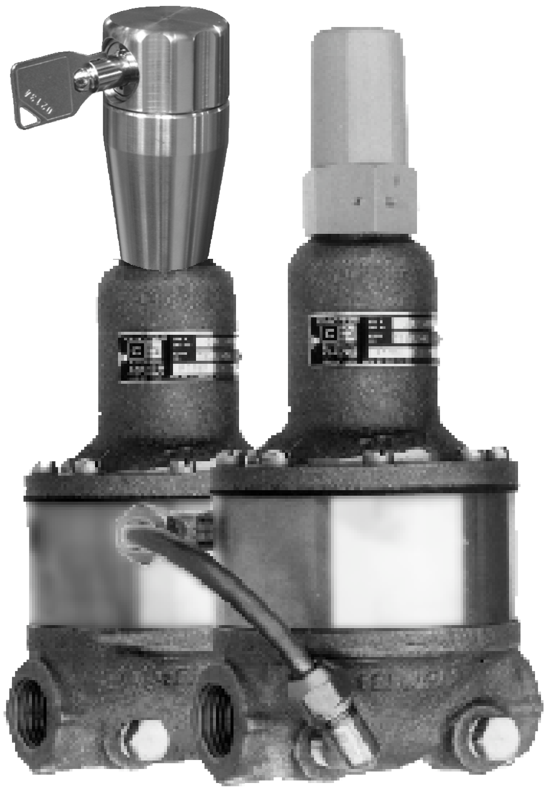
Typical Applications

Fire Protection System Service
Using the **Model 55L** in a fire protection system or other closed type system, prevents pressure build-up whenever line pressure exceeds the setting of the spring. The valve will relieve excess pressure to atmosphere preventing damage to the distribution network.



—MODELS— CRL & 55F

Pressure Relief Valves



- **Direct Acting - Precise Pressure Control**
- **Positive Dependable Opening**
- **Drip Tight Closure**
- **No Packing Glands or Stuffing Boxes**
- **Sensitive to Small Pressure Variations**

The Cla-Val Model CRL and 55F Pressure Relief Valves are direct-acting, spring loaded, diaphragm type relief valves. Often used as pilot controls for Cla-Val hytrol valves, they can also be used as self-contained pressure relief valves. These valves may be installed in any position and open and close within very close pressure limits.

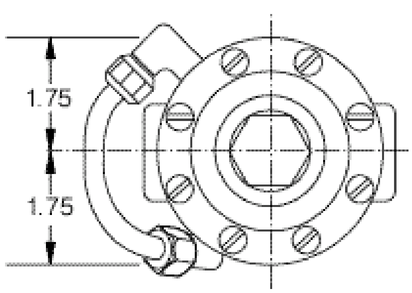
The Model CRL & 55F are normally held closed by the force of the compression spring above the diaphragm; control pressure is applied under the diaphragm. When the controlling pressure exceeds the spring setting, the disc is lifted off its seat, permitting flow through the control. When control pressure drops below the spring setting, the spring forces the control back to its normally closed position. The controlling pressure is applied to the chamber beneath the diaphragm through an external tube on the 55F model and a sensing port on the CRL.

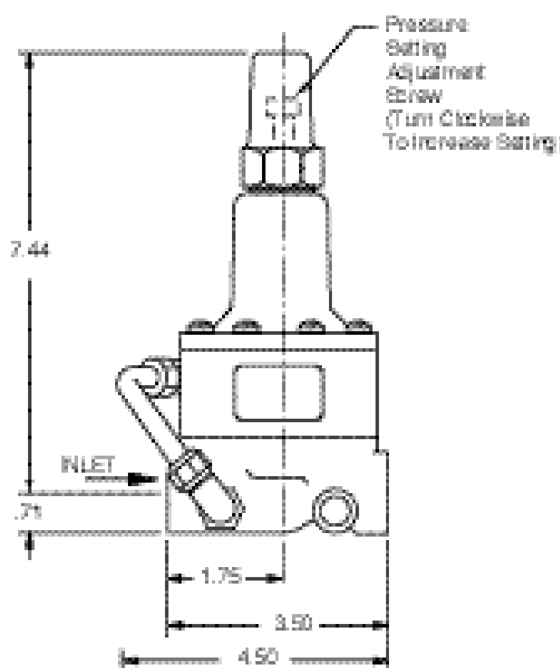
Pressure adjustment is simply a matter of turning the adjusting screw to vary the spring pressure on the diaphragm. The CRL & 55F are available in three pressure ranges; 0 to 75 psi, 20 to 200 psi, and 100 to 300 psi. To prevent tampering, the adjustment cap can be wire sealed by using the lock wire holes provided in the cap and cover.

Note: Also Available in Seawater Service Material

Dimensions (In Inches)

55F Model





MODEL 55L

Pressure Relief Valve

- **UL Listed**
- **Factory Mutual Approved**
- **Direct Acting - Precise Pressure Control**
- **Positive Dependable Opening**
- **Drip Tight Closure**
- **No Packing Glands or Stuffing Boxes**
- **Sensitive to Small Pressure Variations**

The Cla-Val Model 55L **(UL Listed FM approved)** Pressure Relief Valve is a direct-acting, spring loaded, diaphragm type relief valve. The valve may be installed in any position and will open and close within very close pressure limits.

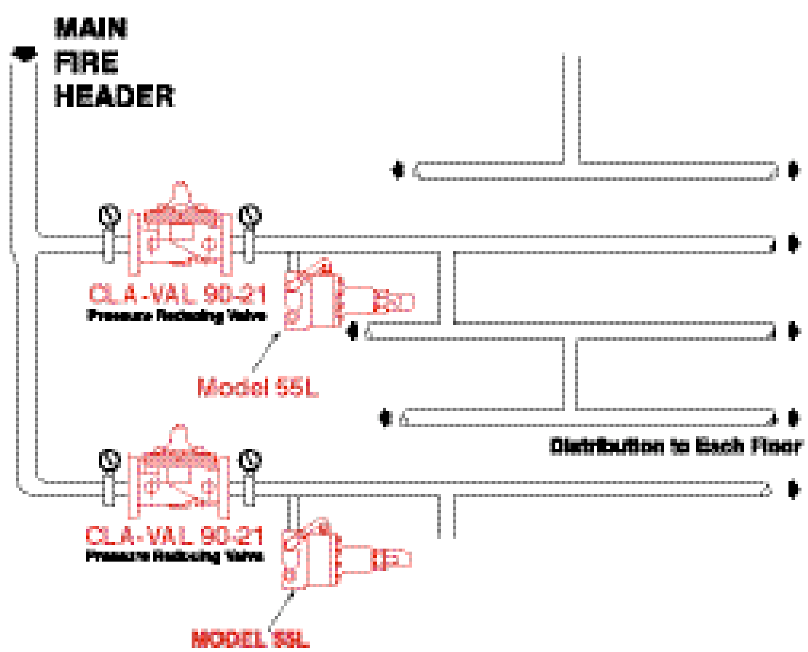
The Model 55L is normally held closed by the force of the compression spring above the diaphragm. When the controlling pressure applied under the diaphragm exceeds the spring setting, the disc is lifted off its seat, permitting flow through the control. When control pressure drops below the spring setting, the spring forces the control back to its normally closed position. The controlling pressure is applied to the chamber beneath the diaphragm through an external tube on the 55L.

Pressure adjustment is simply a matter of turning the adjusting screw to vary the spring load on the diaphragm. The 55L is available in two pressure ranges; 0 to 75 psi, 20 to 200 psi. To prevent tampering, the adjustment cap can be wire sealed by using the lock wire holes provided in the cap and cover.

Note: Also Available in Seawater Service Material

Typical Applications

Fire Protection System Service
Using the **Model 55L** in a fire protection system or other closed type system, prevents pressure build-up whenever line pressure exceeds the setting of the spring. The valve will relieve excess pressure to atmosphere preventing damage to the distribution network.



2 — 1

Specifications

Size 1/2" & 3/4" screwed
Temperature Range Water, Air: to 180°F Max.
Materials

Body & Cover:	Cast Bronze ASTM B62 Cast Aluminum 356-T6 Stainless Steel ASTM A743C7-167A
Trim:	Brass & Stainless Steel 303
Rubber:	Buna-N® Synthetic Rubber

Pressure Ratings Cast Bronze 400 psi Max.
Cast Aluminum 275 psi Max.
Stainless steel 400 psi Max.

Other Materials Available on special order

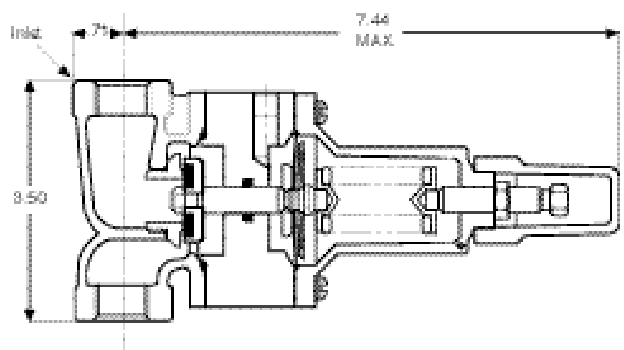
Adjustment Ranges
0 to 75 psi
20 to 200 psi
100 to 300 psi

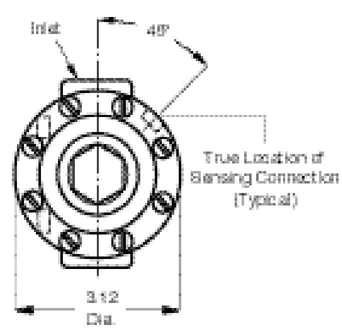
CRL & 55F Range PSI	Approximate Increase For Each Clockwise Turn Of Adjusting Screw
0 to 75	8.5 psi
20 to 200	28.0 psi
100 to 300	18.0 psi

Flow Loss Chart (Full Open Valve)

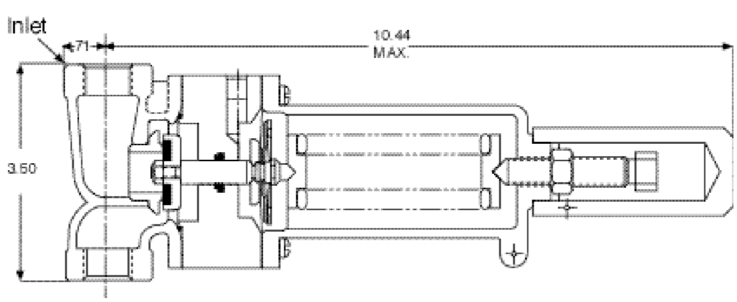
Valve Size	C_V Factor	Flow of Water - Gallons Per Minute				
		5	10	15	20	30
1/2"	6	0.7	2.7	6	11	
3/4"	8.5	0.3	1.4	3.1	5.5	12.2

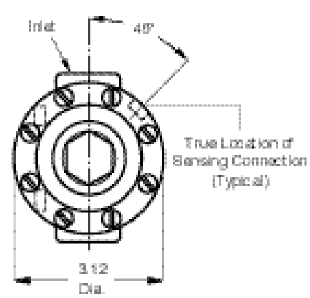
CRL Basic Valve Dimensions (In Inches)





0 to 75 and 20 to 200 psi Design





100 to 300 psi Design

When Ordering, Please Specify

1. Catalog No. CRL & 55F
2. Valve Size
3. Adjustment Range Desired
4. Optional Materials

CLA-VAL
PO Box 1325 Newport Beach CA 92659-0325
Phone: 949-722-4800 • Fax: 949-548-5441

CLA-VAL CANADA
4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040

CLA-VAL EUROPE
Chemin dés Mesanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50
www.cla-val.com

Represented By:

E-CRL/55F (R-5/05)

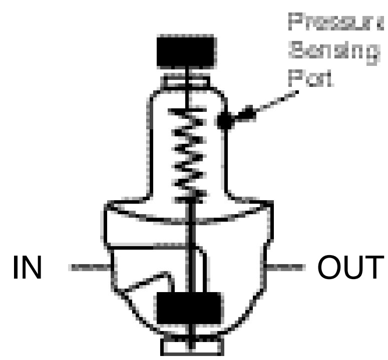
CDHS-18 Differential Control Valve
is a normally open, spring loaded, diaphragm type valve that operates hydraulically and is designed to close on a rising differential pressure. When used as a pilot control with Cla-Val Valves, it acts as a flow limiting control.

CDHS18

Normally Closed - Shifts to open on rise in sensed pressure

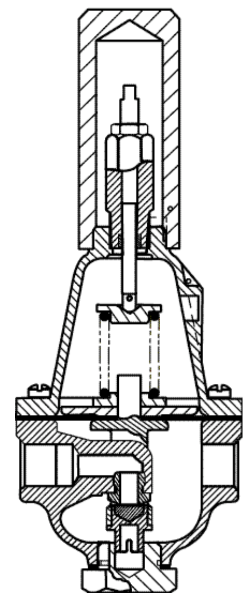
Adjustment Ranges
30-480 psi differential

CDHS18

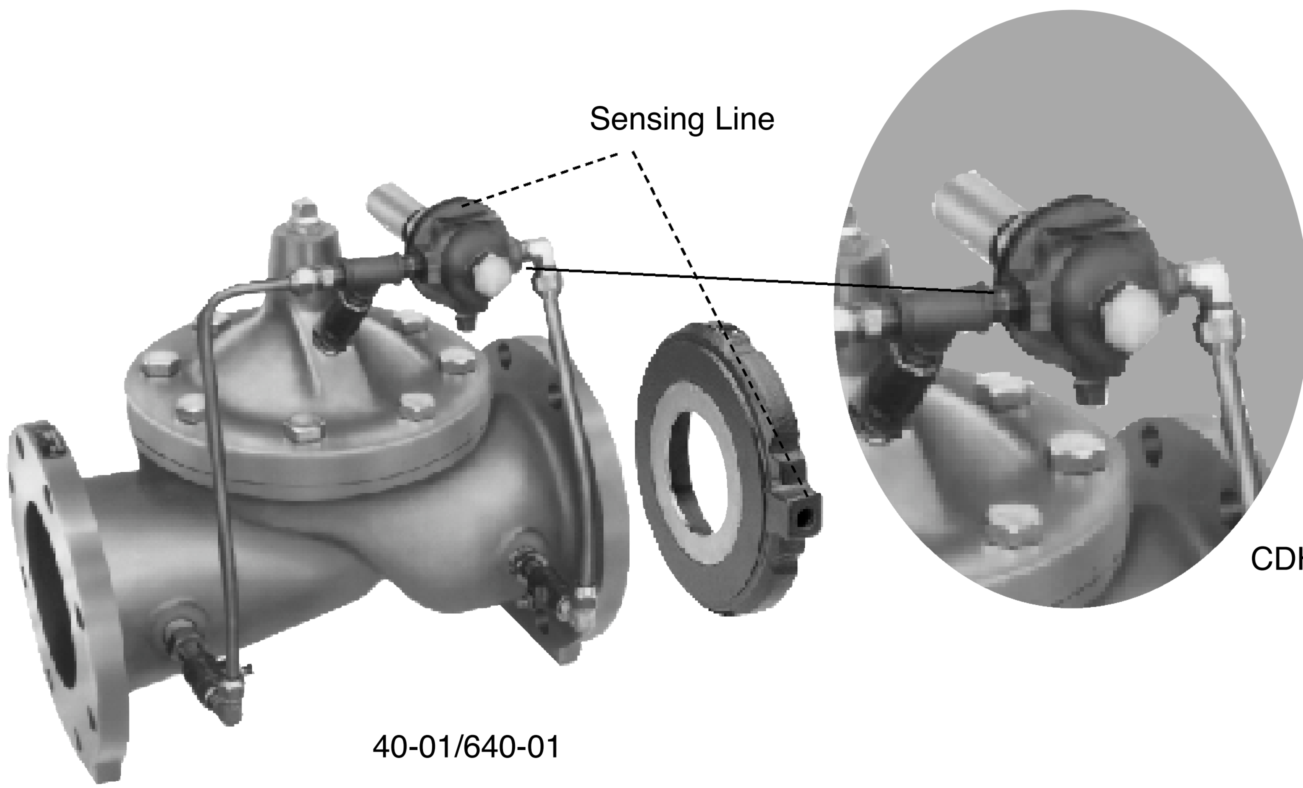


Schematic Symbol

CDHS18



Sensing Line



CDHS18

40-01/640-01

CLA-VAL

—MODEL— **CDHS-18**

3/8" Differential Control

DESCRIPTION

The Cla-Val CDHS-18 Differential Control Valve is a normally open, spring loaded, diaphragm type valve that operates hydraulically and is designed to close on a rising differential pressure. When used as a pilot control with Cla-Val Valves, it acts as a flow limiting control.

INSTALLATION

The Differential Control may be installed in any position. There is one in l e t port and two outlet ports in the body for either straight or angle installation. The outlet port senses the high pressure or inlet to the differential p r o d u c i n g device. One of the outlet ports can be used for a gauge connection. The port above the diaphragm (located in the control cover) is used to sense the low pressure or outlet side of the differential producing device. A flow arrow is marked on the body casting.

OPERATION

The Differential Control is normally held open by the compression spring and the sensing pressure above the diaphragm. When the rate of flow through the main valve increases, the sensing pressure above the diaphragm of the control decreases and the higher pressure at the outlet port closes the control; which, in turn, closes the main valve. When the rate of flow through the main valve decreases, the sensing pressure above the diaphragm increases. This opens the control and in turn opens the main valve. This action causes the main valve to modulate, limiting the flow rate to the setting of the control.

ADJUSTMENT

The Differential Control Valve can be adjusted to limit the rate of flow as specified on the data plate. Rate of flow adjustment is made by turning the adjustment screw to vary the spring pressure on the diaphragm. The greater the compression on the spring the higher the flow rate.

1. Turn the adjustment screw in (clockwise) to increase flow rate.
2. Turn the adjustment screw out (counterclockwise) to decrease flow rate.

DISASSEMBLY

The Differential Control Valve should be removed from the Hytrol Valve assembly. Make sure that pressure shutdown is accomplished prior to disconnecting assembly. During disassembly inspect all threads for damage or evidence of cross-threading.

NOTE: A bench vice equipped with soft brass jaws should be used to hold the valve body during disassembly and reassembly. **DO NOT** t i ghten vice jaws more than enough to hold unit firmly. Excessive pressure may spring or crack casting

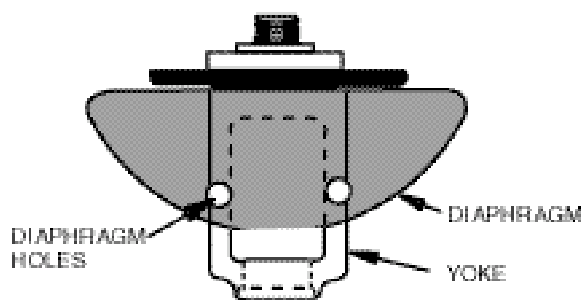
1. Remove adjusting screw cap (16).
2. Loosen lock nut on adjusting stem assembly (9) and turn adjusting screw counterclockwise to relieve tension on spring.
3. Remove bottom plug (8) and gasket (6).
4. Remove disc retainer assembly (5) and inspect sealing surface for damage or wear. Replace if necessary.
5 Remove 8 screws (12) and carefully lift off cover (2) spring guide (10) and spring (13) can now be removed.
6. Remove diaphragm assembly.
7. Remove diaphragm nut (7) and diaphragm washer (4).
8. Remove diaphragm (3), inspect for damage and replace if necessary.
9. Inspect all parts for damage, corrosion, wear, foreign particles, and cleanliness.
10. Repair minor nicks and scratches, these may be polished out using a fine grade of emery or crocus cloth.

REASSEMBLY

Prior to reassembly replace all parts which are damaged or worn. When ordering replacement parts be sure to specify item, part number, and all nameplate data.

1. Place diaphragm (3) on top of yoke (11) place diaphragm washer (4) over diaphragm with rounded edges down or next to diaphragm. Screw on diaphragm nut (7) with the spring guide shoulder in up position. The nut is not tightened at this time.
2. Align diaphragm flange holes with and folding diaphragm as shown. Tighten diaphragm nut, retaining alignment shown.
3. Place yoke assembly in body (1) and screw the disc retainer assembly (5) in until it bottoms.
4. Screw in plug (8).

   NOTE: The yoke arms can be viewed through the 3/8" NPT high pressure sensing outlet. There should be even spacing between the yoke arms and the 3/8' NPT inlet boss seat assembly. There must be no drag or friction between these parts. If there is drag, repeat step 2.
5. Align diaphragm flange holes with the body holes and position spring and spring guide (13) (10).
6. Replace cover (2) and secure with 8 screws (12).
7. Remove plug (8) and turn adjusting screw clockwise until the disc retainer assembly moves down.
8. Replace gasket (6) and plug (8).
9. Replace cap (16).



DIAPHRAGM HOLE ALIGNMENT

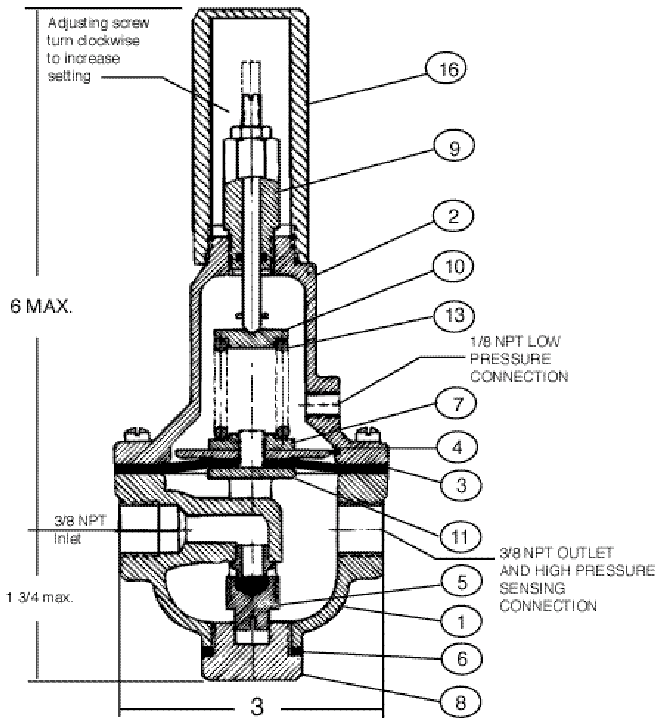
SERVICE SUGGESTIONS

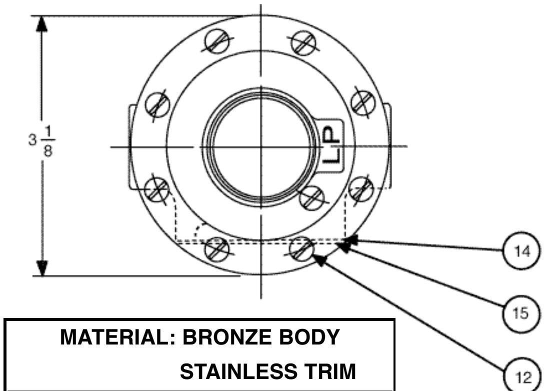
SYMPTOM	PROBABLE CAUSE	REMEDY
Fails to Open	Controlling differential not changing	Check with gauge or manometer
	Diaphragm assembly stuck closed	Disassemble and free
	No spring compression	Screw in adjusting stem
	Foreign object under disc retainer	Disassemble and remove
Fails to Close	Insufficient controlling differential	Increase differential
	Foreign object under disc	Disassemble and remove
	Diaphragm assembly stuck open	Disassemble and free
	Damaged diaphragm	Disassemble and replace
	Spring compressed solid	Back off adjusting stem

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

CDHS-18

3/8" Differential Control





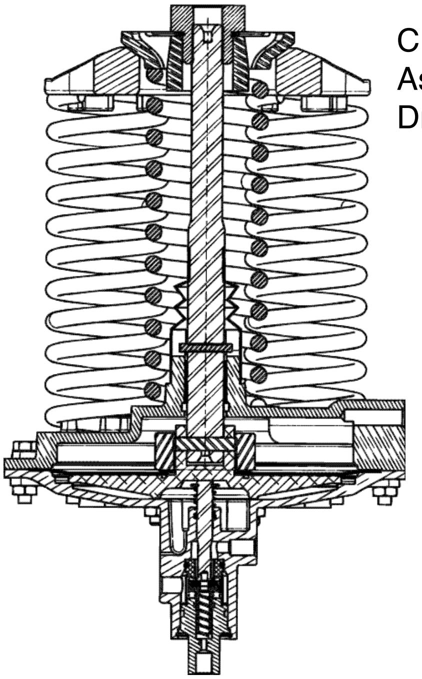
MATERIAL: BRONZE BODY STAINLESS TRIM		
Body Size	Seat Size	Stock Number
3/8"	1/4	68017
3/8"	1/4	69597*
*Same as 68017 except cover at 90°		

Repair Parts Kits*		Part Number
Standard	Buna-N®	9170003K
High Temp.	Viton®	9170009G

Item	DESCRIPTION	MATERIALS	PART NUMBER	LIST PRICE
1	Body & Seat Assembly	BFR/SS	83397-02G	
2	Cover	BRZ	C6657F	
* 3	Diaphragm	Buna N®	C6936JD	
4	Diaphragm Washer	BRS	C1803A	
* 5	Disc Retainer Assembly	BRS/RB	C5256H	
* 6	Gasket	FIB	40174F	
7	Diaphragm Nut	BRS	V5911C	
8	Plug, Body	BRZ	V5653A	
9	Adj. Stem Assembly	BZ/SS	C2002J	
10	Spring Guide	303	C1510B	
11	Yoke	BRZ	V6951H	
* 12	Mach. Screw Fil. Hd. (8)	SS	67578-21B	
13	Spring	316SS	36773A	
14	Nameplate	BRS	C002201G	
15	Nameplate Screw	—	—	
16	Cap, Adj. Screw	PLS	12576-01D	

2 — 1

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com



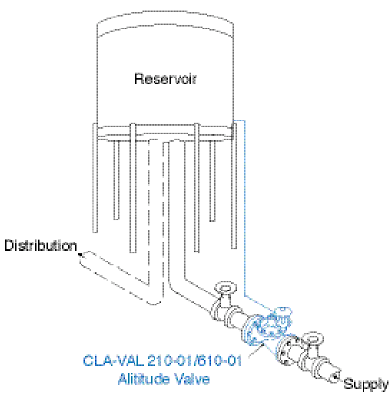
CDS6
Assembly
Drawing

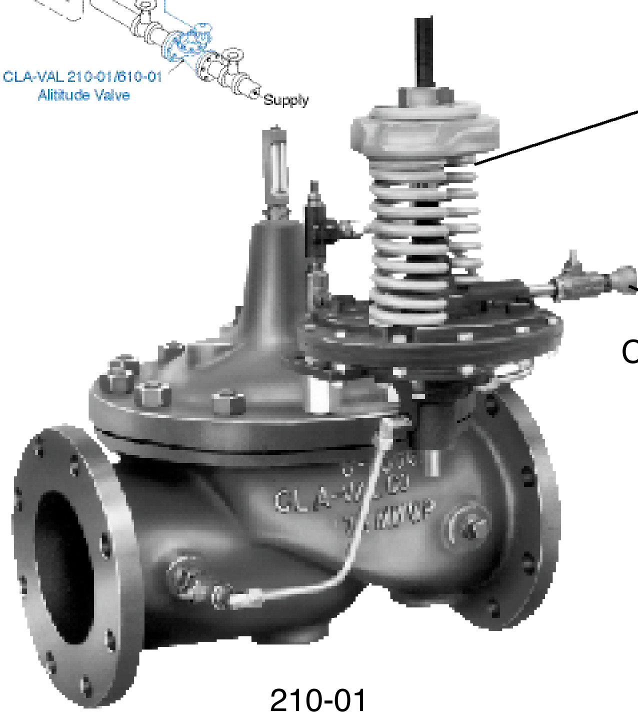
Altitude Range

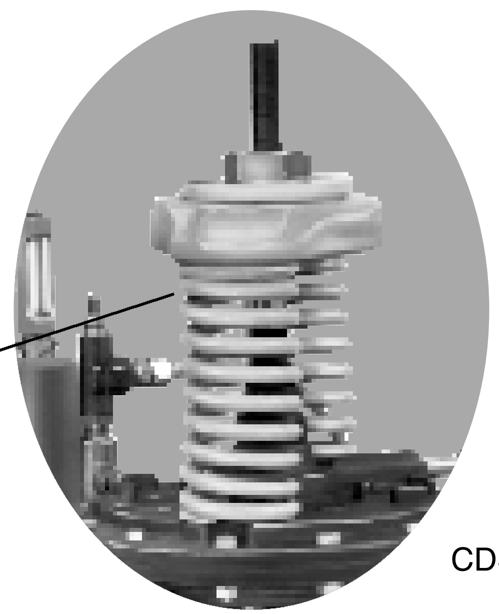
5-40 Ft
30-80 Ft
70-120 Ft
110-160 Ft
150-200 Ft

CDS6

CDS6 Altitude Pilot Control
is a spring-loaded, three-way, diaphragm-actuated control that provides high-level shutoff for Cla-Val 210 Series Altitude Control Valves. The CDS6 controls the high water level in a reservoir or tank without the need for floats or other devices.







CDS6

Connection to tank

Spring Ranges

5-40 Ft
30-80 Ft
70-120 Ft
110-160 Ft
150-200 Ft

210-01

CLA-VAL™

— MODEL — **CDS6**

ALTITUDE CONTROL

INTRODUCTION

The Cla-Val Model CDS6 Altitude Control is a spring loaded, 3-way, diaphragm-actuated control that provides high-level shut-off for Cla-Val Altitude Control Valves. It remotely senses pressure in the reservoir or tank. There are five altitude ranges available, 5 to 40 feet, 30 to 80 feet, 70 to 120 feet, 110 to 160 feet and 150 to 200 feet. The spring adjusting nut can be set to stop flow into the reservoir within these ranges.

INSTALLATION

The CDS6 Altitude Pilot Control is normally supplied mounted on a Cla-Val 210 Series Altitude Valve which should be installed in a horizontal run of pipe with the main valve cover up. Two line block valves are recommended for valve servicing. If the CDS6 is mounted from the main valve by a few feet, then it must be installed with adjustment springs up for ease of adjustment and servicing. Consult factory for recommendations.

After the Cla-Val 210 Series Altitude Valve is installed in the pipeline close to the reservoir, install the required remote sensing line from the CDS6 to the reservoir or tank. The sensing line allows the CDS6 to sense the static pressure head of the reservoir. The sensing line should not be installed in the flowing line between the valve and the reservoir or into turbulent flow area. These locations do not reflect the true static head of the reservoir.

The remote sensing line should be 3/4" or larger copper tubing or Schedule 40 PVC pipe. Galvanized pipe is not recommended. The sensing line should slope (minimum 2 degrees) upward from the CDS6 toward the reservoir to self -purge air out of the line. The sensing line should have no high points to entrap air. A shutoff valve at the reservoir connection is recommended. For above ground reservoirs, the connecting point for the sensing line should be a minimum of 12" to 18" above reservoir bottom (if filling from bottom) or at fill pipe connection (if filling from side). Minimum high-level set-point adjustment is approximately five feet above the remote sensing point of connection.

CDS6 STOCK NUMBER 2" SIZE	CDS6 STOCK NUMBER 2 1/2" SIZE & LARGER	ALTITUDE RANGE (FT H_2O)	NUMBER OF SPRINGS	PSI CHANGE PER TURN	ALTITUDE CHANGE PER TURN
29330-06F	29330-01E	5 - 40	1	0.32	0.75
29330-07H	29330-02G	30 - 80	2	0.64	1.50
29330-08K	29330-03J	70 - 120	3	0.96	2.20
29330-09B	29330-04A	110 - 160	4	1.28	3.00
29330-10D	29330-05D	150 - 200	5	1.60	3.70

OPERATION, START-UP AND ADJUSTMENT

When the reservoir pressure (head) is lower than the set point of the spring on the CDS6 Altitude Control ports "1" and "D" are interconnected. This relieves the main valve cover pressure to atmosphere. Line pressure then opens the main valve to start filling the reservoir.
Reservoir sensing pressure increases as the liquid level rises in the reservoir. When the sensing pressure increases to the set point of the CDS6 control spring, the control shifts interconnecting port "S" and port "1". This pressurizes the main valve cover chamber and the main valve closes.

By turning the adjusting nut the liquid level shutoff point will be changed. Turn the adjusting nut clockwise to raise the liquid level shutoff point; counterclockwise to lower the liquid level shutoff point. Follow the general operation and start-up instructions regarding purging air from the valve control system.

MAINTENANCE AND INSPECTION

Under normal operating conditions the CDS6 Altitude Control will be trouble free. There is a visual check possible to determine if there is damage to the diaphragm in the control. The Lower Cover/Pilot (a) is vented to atmosphere by means of a small hole in the wall of the casting. If water is discharging out of this opening, the diaphragm should be inspected for damage.

One other visual check and indication of a problem is continuous discharge from the drain port ("D") at the bottom of the CDS6.

The volume of drained water will vary according to the valve size. Continuous draining after main valve has fully opened will indicate a problem. Refer to the service suggestions to check for probable causes and remedies.

DISASSEMBLY

During preventive maintenance or service to the CDS6 Altitude Control, all pressure to the control must be shutoff. The CK2 shutoff isolation valves in the main valve control lines should be closed before starting disassembly. Main valves 4" and larger have CK2 isolation valves installed, however main valves smaller than 4" normally do not, therefore requiring closure of shutoff valves in the main line at the valve inlet and outlet. The shutoff isolation valve or valve in the sensing line to the reservoir must also be closed.

WARNING: Failure to shutoff and release pressure prior to any disassembly can result in serious damage to equipment or injury to personnel.

1. Disconnect tubing at the CDS6 Altitude Control.
2. Remove two mounting caps screws and two lock washers.
3. Remove CDS6 Altitude Control from main valve to work bench or clean area. Parts must be kept clean.

DISASSEMBLY OF UPPER SPRING SECTION

1. Unscrew adjusting nut (4) from upper stem (5).
   NOTE: Count the number of turns required to remove the nut (4), record this information for reference when reassembling.
   The CDS6 Altitude Control can then be approximately reset for the same reservoir liquid level shut-off point.

2. Remove the thrust washer (3), swivel retainer (2) and spring retainers if applicable.

3. Remove Spring(s) (6), bellows (7) and set-screw (8)

4. Remove twelve hex nuts (33), and twelve bolts (32), and set mounting bracket (29) aside.

Note: Assembly contains two (of twelve) longer bolts which are used for the mounting bracket.

5. Remove upper cover (13) from lower assembly, and push stem assembly through.

6. Remove diaphragm washer nut (12), diaphragm nut washer (16) and diaphragm (14)

7. Separate upper stem from diaphragm washer by removing stem retaining pin. (11)

8. Inspect all parts for damage, wear and mineral deposits.
Check O-ring (10) for wear, inspect and remove any deposit in O-ring area. Also inspect diaphragm for wear or cracks. Clean parts thoroughly and replace damaged parts as necessary. If, upon disassembly, sand and silt are found in the CDS6 Altitude Control, every effort must be made to eliminate this problem. Filters, or relocating the reservoir sensing line may be required if deposits are found in the sensing chamber of the control.

REASSEMBLY OF UPPER SPRING ASSEMBLY

1. Reassembly is in general, the reverse of disassembly. NOTE: A light coating of Dow Corning 33 grease, or equivalent, should be applied to CDS6 Altitude Control stems (5), before reassembly.

2. When replacing adjusting nut (4) tighten the same number of turns as referred to in **note** in paragraph (1) of "Disassembly Of Upper Spring Section".

DISASSEMBLY OF LOWER PILOT VALVE SECTION

1. Disassemble control per steps 1 through 5 in "Disassembly of upper section", to work on lower (pilot) cover (17)

2. Remove lower stem (21) spring (19) and retaining ring (18) as an assembly, inspect stem for damage.

3. Remove Poppet guide (28) and o-ring (27) from lower cover (17).

4. Remove Poppet (22-1) and poppet spring (26) and inspect poppet and disc for damage.

5. Remove Strainer screen (25)

6. Remove seat (24), **Note**: be sure not to nick or ding exposed sealing surface. To prevent binding and damage, use a wood dowel to evenly tap out the seat from TOP of lower cover (area from which lower stem was removed).

7. Inspect all parts for damage, wear and mineral deposits. If there has been discharge from vent hole, remove o-ring (20) from lower cover (17) and poppet guide (28). Inspect o-rings for wear or damage and o-ring groove for material build-up. Clean and/or replace as necessary. Inspect seat (24) and disc poppet assembly (22) for wear or damage. If poppet and/or disc are damaged they must be replaced as an assembly (item 22). Otherwise clean and polish surfaces of moving parts with 600 wet/dry sandpaper. Also clean strainer screen (25) of any deposits

REASSEMBLY OF LOWER PILOT VALVE SECTION

1. Reassembly is in general, the reversal of disassembly. **Note**: A light coating of Dow Corning 33 grease, or equivalent should be applied to all o-rings and moving part surfaces (20,21,22-1 23 and 27).

2. Lay lower cover (17) on its top (do not damage serrated surface), insert the seat (24) with o-ring (23) in lower (pilot) cover with finger. Use a wood dowel to push the seat in fully with hand pressure ONLY. **Note**: damage to the seat can compromise the sealing ability of the control, and careful efforts must be applied on reassembly of this component.

3. Insert strainer (25).

4. Install poppet guide, o-ring, spring and poppet assembly. (See Note #1 for greasing)

5. Thread and securely fasten poppet guide assembly into lower cover (recommended 200-250 in/lbs.)

6. Turnover lower cover, and assemble as an assembly lower stem (21) retainer (18) and spring (19) into lower cover, being careful not damage o-ring (20).

COMPLETING ASSEMBLY

1. Reassembly of twelve nuts (33) and bolts (32) should be torqued to 200-250 in/lbs. **Note:** assembly contains two longer bolts (item 32) for the support bracket. These two bolts are to be assembled with bracket (29) on the two larger support flats located on the lower cover located 90 degrees from common/supply ports.

3. Install CDS6 Altitude Control assembly on main valve.

4. Replace tube lines and fittings exactly as removed.

SERVICE SUGGESTIONS

UPPER (SPRING) SECTION

SYMPTOM	PROBABLE CAUSE	REMEDY
Vent leaks in lower cover (17)	Diaphragm (14) damaged Diaphragm nut (12) loose O-ring (20) damaged	Replace diaphragm Tighten nut (12) Replace O-ring (20)
Leakage past stem stem (5)	O-ring (10) damaged	Replace O-ring
Stem (5) movement restricted or erratic	*Sand or silt in sensing chamber above diaphragm	Remove foreign matter from sensing chamber
	Sensing line clogged	Clean line
	Sensing line valve closed	Open valve fully
	Sensing line sagging or bent collecting sediment	Straighten and support sensing line to reservoir
	Sensing line has high point trapping air in the line	Straighten sensing line. Must slope upward from altitude control to the reservoir

*NOTE: if this problem occurs, a sand trap should be installed in the sensing line, or the line moved to a point on the reservoir where sand or silt cannot enter this line.

SERVICE SUGGESTIONS

LOWER (PILOT VALVE) SECTION

SYMPTOM	PROBABLE CAUSE	REMEDY
Vent in lower cover (17) leaks	O-ring (20) worn or damaged. See Upper Spring Section service suggestion	Replace O-ring (20)
Flow from supply port to valve cover port restricted	Clogged strainer screen (25)	Remove screen and clean
	Silt packed in seat (24) and lower stem (21)	Clear area of blockage
Continuous drain leak. Main valve closed	Seat (24) damaged	Inspect and replace
	Disc in poppet assembly (22) damaged	Inspect and replace poppet assembly (22)
	Foreign object between disc and seat (24)	Remove object
	O-ring (20) in poppet guide (28) damaged	Replace O-ring
Continuous drain leak. Main valve open	Main valve diaphragm worn or stem nut loose	Service main valve. Replace diaphragm or tighten stem nut

Technical Bulletin

CDS6 Improvements

April 2 2003

Recently, our Engineering Department redesigned a few internal parts of the CDS6 Pilot Control used on 210 Series Altitude Valves. These new parts improve its sensitivity at high differential pressures and allow it to work with inlet supply pressures up to 300 psi (previous maximum recommended pressure was 150 psi). The new control is identified as CDS6A and new part numbers are assigned to distinguish it from the original CDS6. Adjustment ranges remain the same.

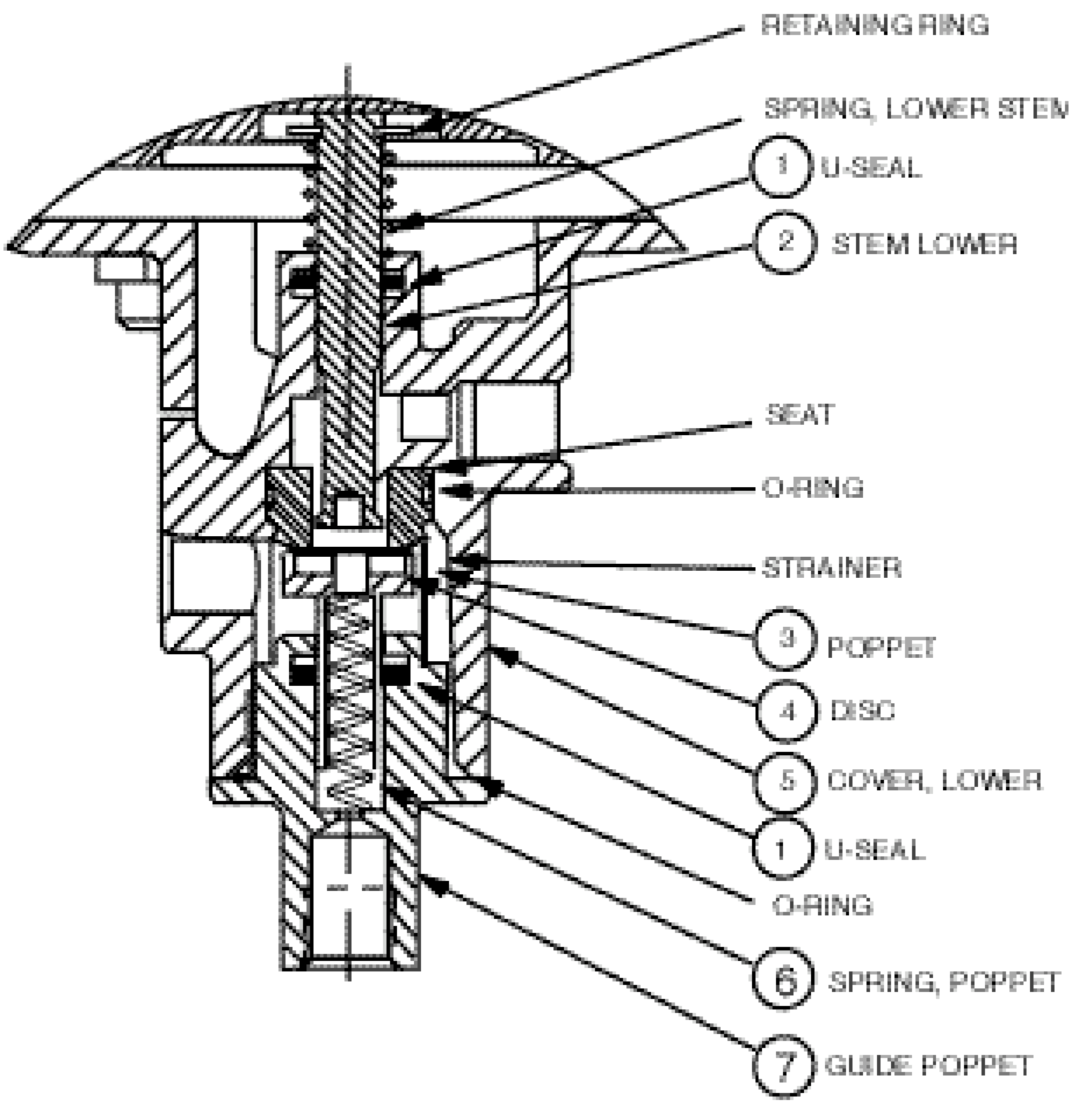
New parts inside the CDS6A are a) stem seals, b) disc and poppet assembly, c) lower stem, d) lower cover, e) poppet guide, and f) poppet spring. The CDS6A uses new low-friction seals on the lower stem and the disc and poppet assembly. Also, the new stem and poppet have a special low-friction nickel-Teflon coating and are dimensionally interchangeable with CDS6 parts. The new lower cover and poppet guide have larger internal dimensions for the new seals and are not interchangeable with CDS6 parts. Also, the poppet spring has a heavier load and is not interchangeable. All other parts remain the same.

All bills of material for top assemblies using the CDS6 have been changed to the new control. It will take some time for us to change assembly drawings and deplete existing parts before we begin using the CDS6A. We plan to finalize the change during first quarter of 2003.

A new CDS6A repair kit is p/n 20349401C and will not work with existing CDS6 controls. The repair kit will include instructions and tools to install new stem seals. When servicing existing CDS6 controls the current repair kit p/n 20119301A should be used.

A modification kit consisting of all new parts and instructions is p/n 20354801G. Field modification is recommended only for installations where it is determined to be necessary.

Range (ft)	size	p/n	size	p/n
5 - 40	2 _" & larger	20354701K	2" & smaller	20354706E
30 - 80	2 _" & larger	20354702J	2" & smaller	20354707D
70 - 120	2 _" & larger	20354703H	2" & smaller	20354708C
110 - 160	2 _" & larger	20354704G	2" & smaller	20354709B
150 - 200	2 _" & larger	20354705F	2" & smaller	20354710J



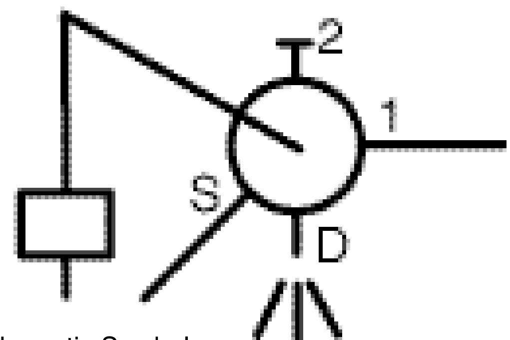
NEW CDS6A PARTS ARE ABOVE NUMBERED ITEMS.

A) All other parts are the same as current CDS6 parts.
B) Two new low-friction U-Seals, Item 1, will not fit into O-ring grooves of CDS6 lower cover and poppet guide. The machined groove dimensions are different between the O-ring version and the new U-seal version parts. New Lower Cover, Item 5, and Poppet Guide, Item 7, have proper dimensions for U-Seal.
C) Lower Stem, Item 2, and Poppet, Item 3, are dimensionally interchangeable with CDS6 parts that are now obsolete. These new parts have a special low-friction coating which may enhance CDS6 performance.
D) Poppet Spring, Item 6, has a heavier load rating and is not interchangeable with CDS6 poppet spring. Sensitivity will be greater than a 12" differential, if used in CDS6 controls.

CF1-C1 Float Control
is a float-actuated multiport pilot control which provides non-modulating, two-position, on-off operation. It is used primarily to operate remotely located Cla-Val valves requiring three-way or four-way pilot valve operation for level control. Control can be remotely located.

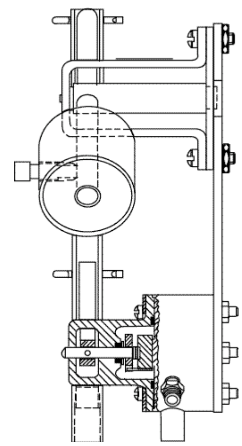
CF1-C1

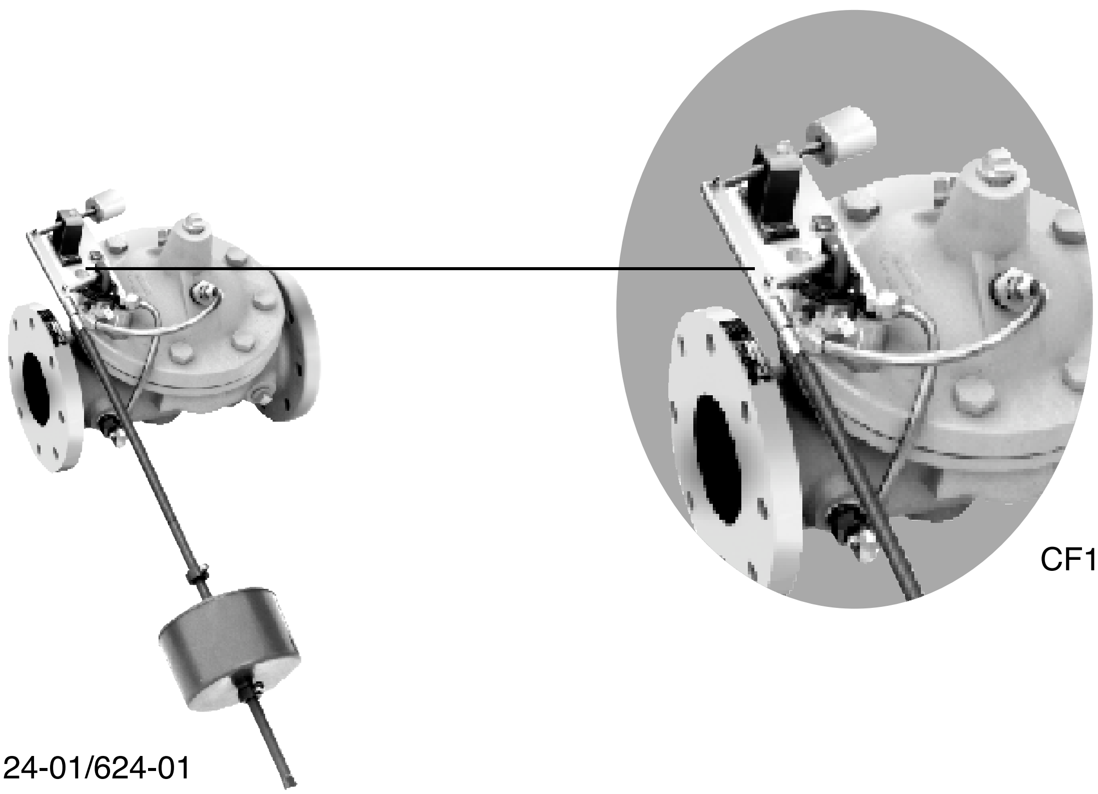
CF1-C1



Schematic Symbol

CF1-C1





124-01/624-01

CF1-C1

CLA-VAL

CF1 Series

CF1 Series Float Controls

Initial Adjustment CF1 Series Float Controls

Check installation to be sure that liquid surface is not subject to wind or currents, if so, a stilling well should be installed around the float and rod assembly. A short section of 8" pipe (PVC) mounted vertically in the tank around the float and rod is suggested.

1. See parts sheet (other side of this sheet) for proper assembly of the float rod, float, and stop collars and for threading into the Link Assembly of the CF1-C1.

2. Balance the Float Rod Assembly. This compensates for the buoyancy of the float rod in the water. Temporarily remove float by removing float rod and float from the link assembly. Remove float from float rod, reinstall rod assembly (leave stop collars on float rod) back into link assembly.

Adjust counterweight on round rod to balance the weight of the float rod assembly less the float. Loosen setscrew on counterweight and move weight in or out until round rod remains horizontal without shifting. Tighten setscrew. Check by pushing up or down on float rod assembly and seeing that entire assembly returns to balanced position. Replace float between the stop collars. The counterweight size changes as float rod is lengthened. Consult factory for more information.

3. Set Float High Level Shut-Off. Move float rod to "up" position. Adjust the upper stop collar on the float rod assembly approximately three inches above the desire high water level. Move float rod to "down" position. Adjust the lower stop collar on the float rod assembly approximately three inches below the desired low water level. Tighten collar set screws.

If the closing level is too high, allowing tank to overflow, then the top stop collar on the float rod should be lowered. If the opening level is too low, then the bottom stop collar should be raised.

If the counterweight has been properly adjusted the float will move freely on the float rod, without causing the pilot arm to raise or lower, until the float actually contacts one of the stop collars.

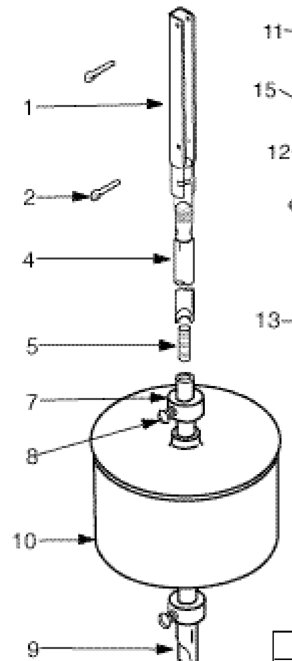
4. For reference: with a new control and supply pressure less than 40 psi the maximum level differential available will be: 18 to 20 inches with PVC float and rod assembly and 48 to 50 inches with Stainless Steel or Brass float and rod assembly.

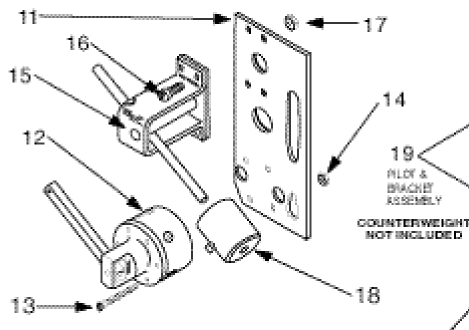
CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

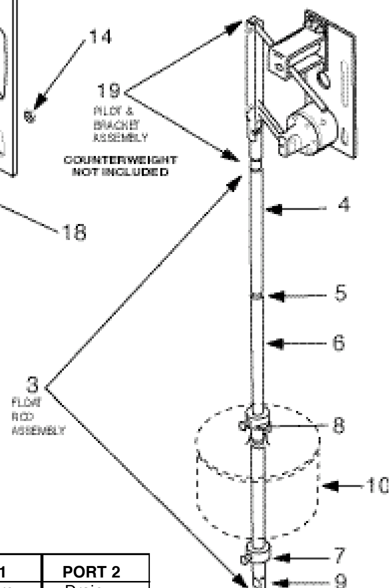
CLA-VAL

CF1-C1

Float Control







OPERATION

FLOAT POSITION	PORT 1	PORT 2
Up	Pressure	Drain
Down	Drain	Pressure

CF Series Float Control Counterweight

(CF1-C1, CFM-9,CF-122,CF-125)
Counterweight and Set Screw Material: Steel, Zinc plated
Counterweight Assembly is complete Counterweight with Set Screw installed.

Float Rod Material: PVC	
Rod Length (ft.)	Cwt. Assembly
1’ - 5’	20160501C
6’ - 10’	20160502B
11’ - 20’	20160503A
Float Rod Material: Brass or Stainless Steel	
Rod Length (ft.)	Cwt. Assembly
1’ - 2’	20160501C
3’ - 6’	20160502B
7’ - 12’	20160503A
13’ - 16’	20160504K
17’ - 20’	20160505J

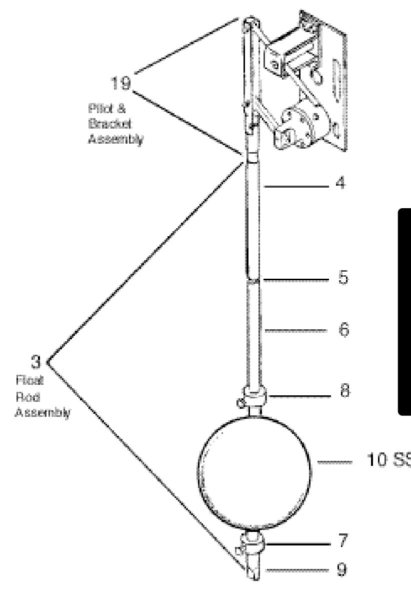
Part Number (ref. Dwg. no. 8901616
890160J Complete CF1 Float Control with Ball and Rod (Plastic float ball and two-piece 2ft. PVC float rod)

89016A complete CF1-C1 Float control (Less Ball and rod and counterweight)

89541H Pilot assembly only for CF1 (Items: 3,4,5,6,7,8,9,10,11,12,13,14,15, 24,26,29

Counterweight, float Ball, Float rod, and Stop collars are available separately. Consult factory.

Optional Stainless Steel Float



2 – 1

ITEM	DESCRIPTION
1	Link Assembly
2	Cotter Pins (2 req'd)
3	Float Rod Assembly (2 ft.)
	FLOAT ROD ASSY. BREAKDOWN ITEMS 4 - 9
4	Upper Float Rod (1 ft.)
	Upper Float Rod (2 ft.)
5	Stud (Req. for connecting upper and lower rods and one for each extension rod)
6	Extension Float Rod (1 ft.)
	Extension Float Rod (2 ft.)
7	Stop Collar (2 req'd)
8	Set Screw (1 ea. stop collar)
9	Lower Float Rod (1 ft.)
	Lower Float Rod (2 ft.)

ITEM	DESCRIPTION
10	Float Ball
10 SS	Float Ball (Stainless Steel)
11	Base and Mounting Plate
12	Pilot Valve Assembly CF1-Cl
13	Machine Screw 6/32 x 1 1/2" (6 req'd.)
14	Hex Nut 6/32 (6 req)
15	Counter Balance Bracket Assy.
16	Machine Screw 10/32 x 9/16" (4 req'd.)
17	Hex Nut 10/32 (4 req'd.)
18	Counterweight (varies with rod length, includes set screws)
19	Pilot & Bracket Assembly CF1-Cl **COUNTERWEIGHT NOT INCLUDED**

When ordering parts, please specify:

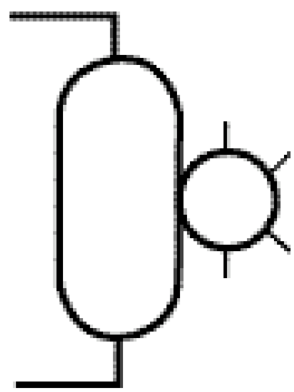
- All nameplate data
- Description
- Item Number

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

CFC2 Float Control
is a float-actuated multiport pilot control which provides non-modulating, two-position, on-off operation. It is used primarily to operate remotely located Cla-Val Main Valves requiring three-way or four-way pilot valve operation.

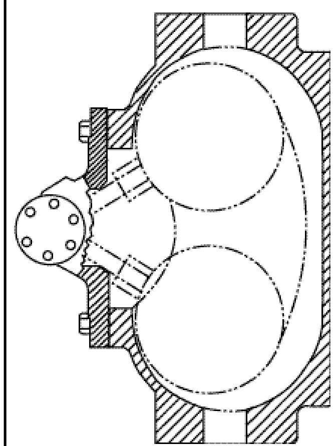
CFC2

CFC2

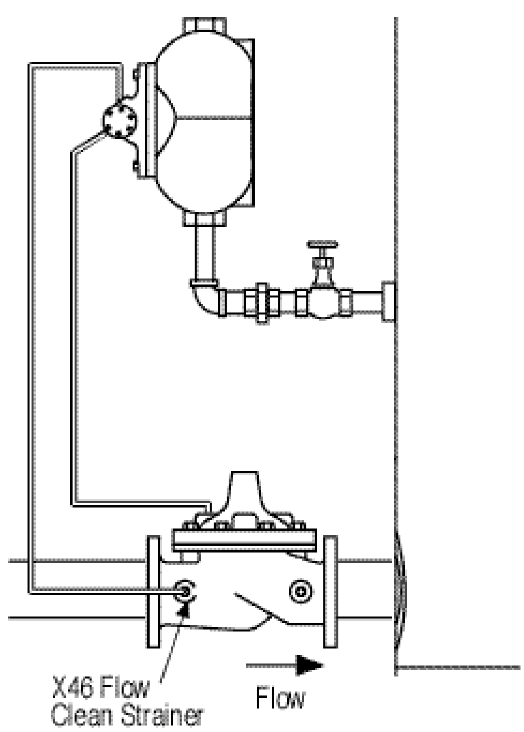


Schematic Symbol

CFC2



CFC2



— MODEL — **CFC2**

Float Control For Closed Tanks

- **Accurate Liquid Level Control**
- **Fully Hydraulic Operation**
- **Simple Design, Easy Maintenance**
- **No Lubrication Necessary**
- **No Gears, No Mechanical Linkage Between Valve and Control**

The Cla-Val Model CFC2 Float Control is a float-actuated multiport pilot control which provides non-modulating, two-position, on-off operation. It is used primarily to operate remotely located Cla-Val Valves requiring three-way or four-way pilot valve operation. Designed for use in closed tanks, this control operates on a minimum level change of approximately 1". Maximum level change of 51/2" is needed for full capacity.

Note: We recommend protecting the control tubing and valve from freezing temperatures.

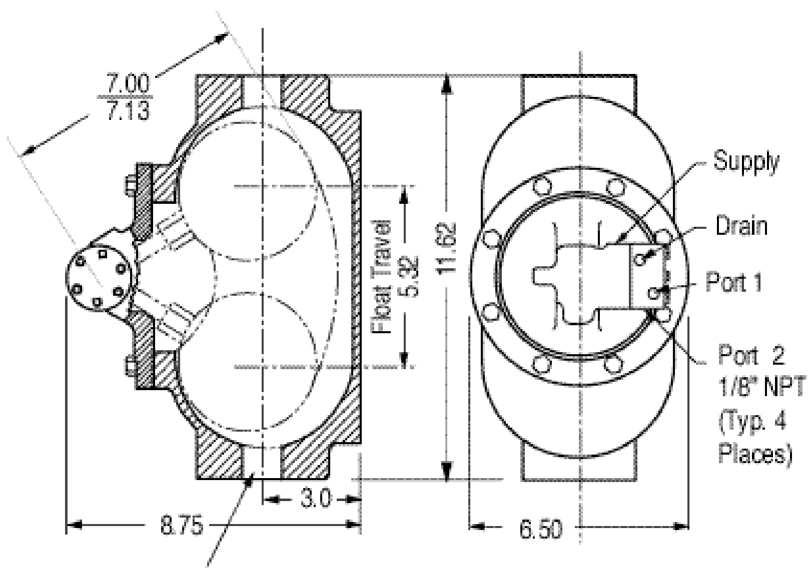
Specifications

Control Piping Connections	1/8" NPT
Reservoir Connections	1" NPT
Pressure Rating	0-300 psi
Temperature Rating	Water: to 180°F.
Materials	In contact with operating fluid: Brass, stainless steel, monel, with Buna-N® Seals Float chamber: Cast Iron Pilot valve housing: Bronze Materials in contact with operating fluid: Brass, Stainless Steel, Monel with Buna-N® Seals Float ball: Stainless Steel Float arm: Brass Other material available: Cast steel or aluminum chamber and pilot valve housing. All

stainless steel

Level Differential	Approximately 1" minimum required to change pilot valve operation. 5 5/16" required to develop full capacity.
Operating Fluids	Clean liquids or gases compatible with specified materials.
Shipping Weight	12 Lbs.

Dimensions (In Inches)



2 – 1

CLA-VAL

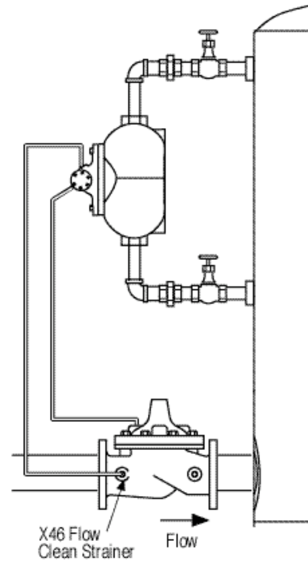
Installation Data

The float control is mounted at the high water level in the tank. The remote Cla-Val valve is installed in the line leading to the tank and is connected to the float control pilot by tubing. (Min. 3/8" for valves 6" and smaller, 3/4" or larger for valves 8" or larger.)

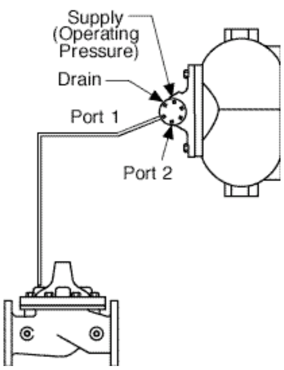
When line pressure is used to operate the valve, tubing connections are made from the float control pilot to the valve cover, and also to the inlet side of the valve. An X46 Flow Clean Strainer must be installed in the inlet side of the valve. The control may be installed at any elevation above the valve, providing that the flowing line pressure in psi is equal to, or greater than, the vertical distance in feet between the valve and the float control.

An independent source of air or water may be used to operate the valve. The pressure from this independent source must constantly be equal to or greater than pressure at the valve inlet. The independent source is connected to the float control pilot in place of the supply line connected to the inlet side of the valve. If the Model 100-01 under the control of the CFC2 is 8" or larger, auxiliary Hytrols may be required. Consult factory for details.

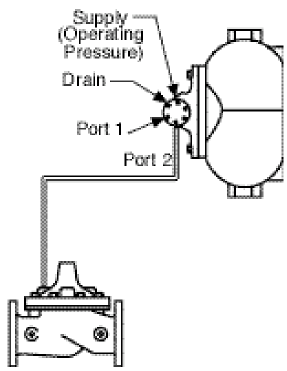
Note: We recommend protecting the control tubing and valve from freezing temperatures.



For Controlling Hytrol Valve



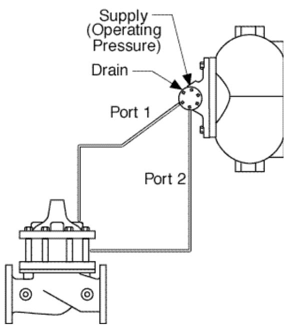
Float Up Closes Valve



Float Down Closes Valve

When Ordering, Please Specify

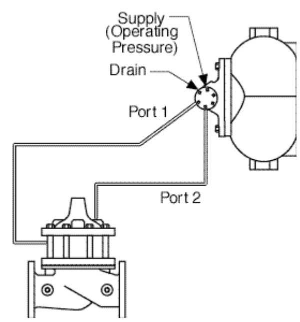
1. Catalog No. CFC2-C1
2. Size and type of Valve to be controlled.
3. Materials if different from standard
4. Specify gravity of fluid if other than water.

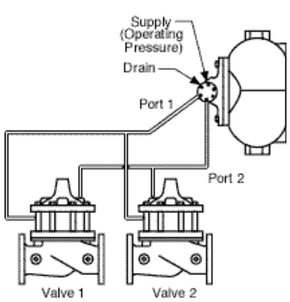


For Controlling Powertrol Valves

Float Up Closes Valve

Float Up Opens Valve

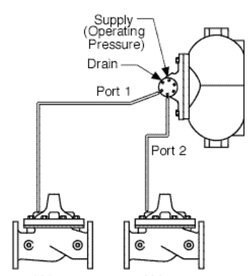




For Controlling Two Valves Simultaneously

Operation

Float Position	Valve 1	Valve 2
UP	CLOSED	OPEN
DOWN	OPEN	CLOSED



CLA-VAL

PO Box 1325 Newport Beach CA 92659-0325
Phone: 949-722-4800 • Fax: 949-548-5441

CLA-VAL CANADA
4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040

CLA-VAL EUROPE
Chemin dès Mesanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50
www.cla-val.com

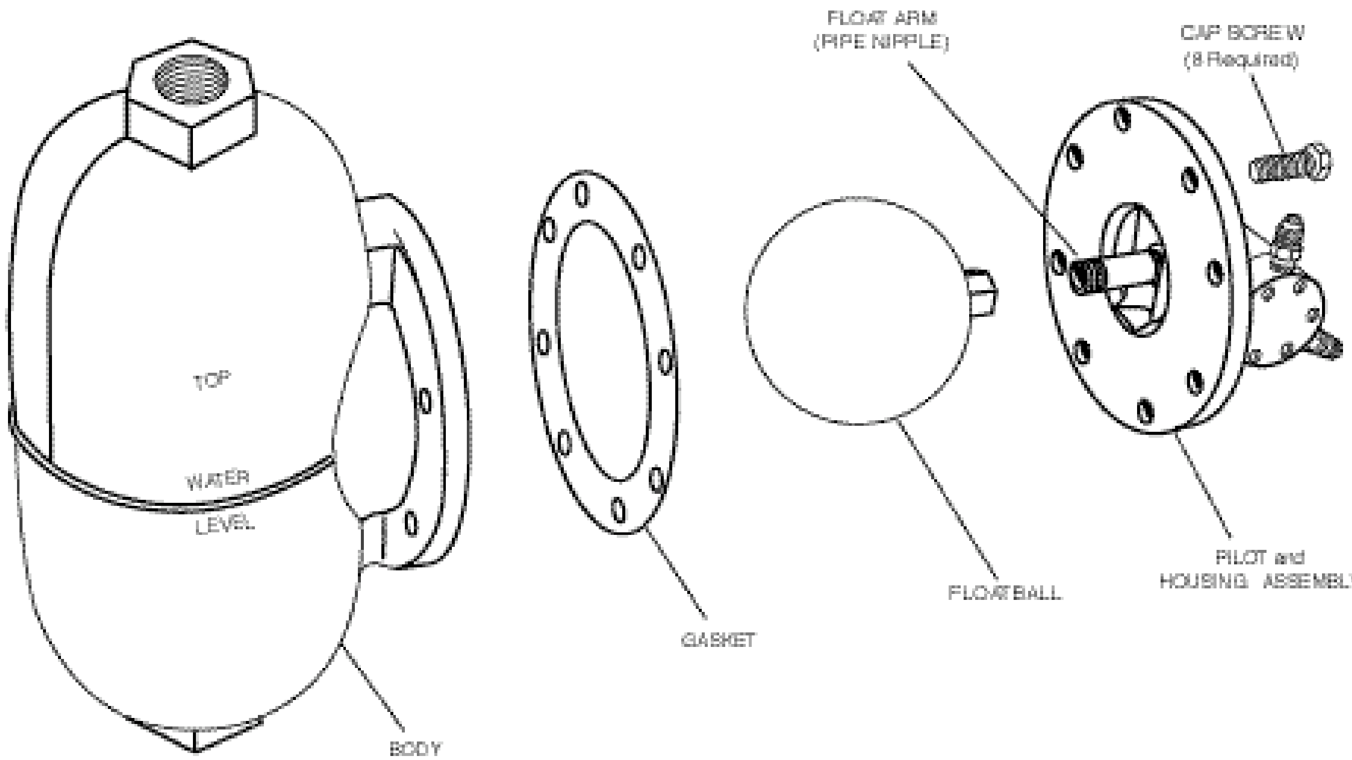
Represented By:

E-CFC2 (R-5/05)

CLA-VAL

— MODEL — **CFC2**

Float Chamber Control



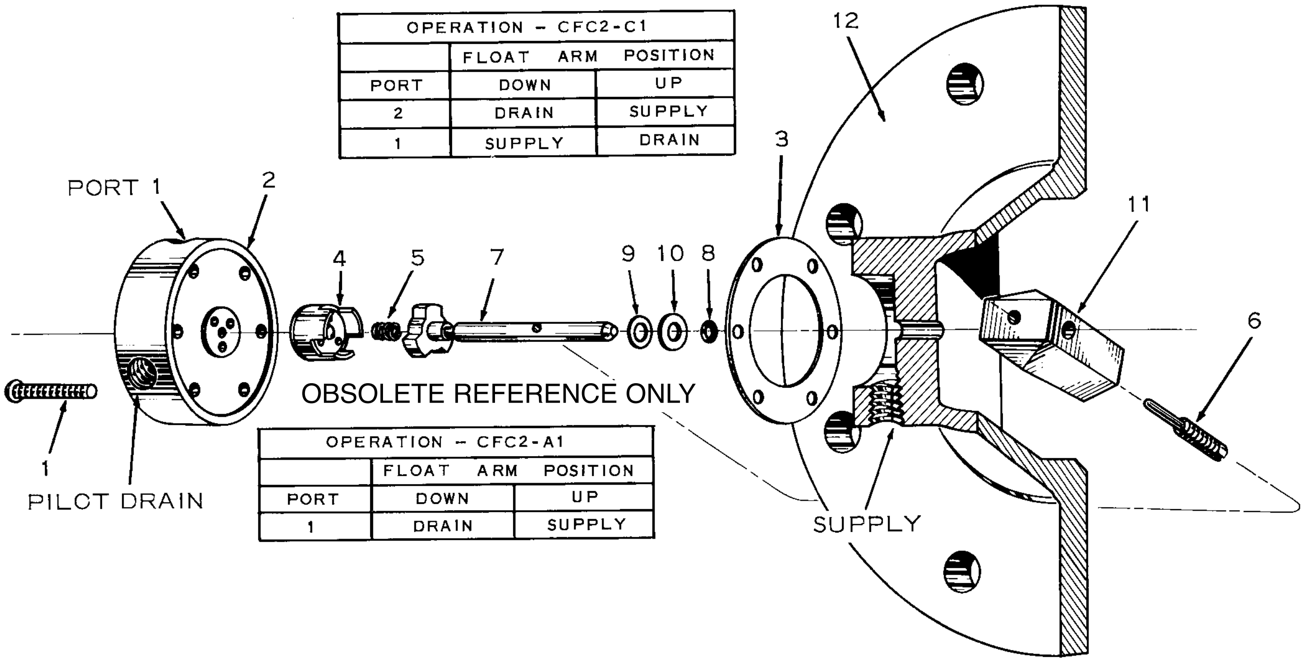
Description	Material
Float Ball	Stainless Steel
*Gasket	Neoprene
Cap Screws	Steel Cad.
3/8-16 x 7/8	Plated
Body	Iron
Float Arm Pipe Nipple 1/4"x1/2" npr	Bronze/Stainless Steel

2 — 1

CLA-VAL

— Model — **CFC2**

Pilot & Housing Assembly For Float Chamber Control



PILOT & HOUSING ASSEMBLY (BRONZE W/STAINLESS STEEL)		
ITEM	DESCRIPTION	MATERIAL
1	Machine Screw, Rd. Hd., 6/32 x 1", 6 Required	Brass
*2	Distributor for C426-1	S.S.
	Distributor for C-2035	S.S.
	Distributor for C-2149-1	S.S.
*3	Gasket	Buna-N®
*4	Disc Assembly	S.S.
		S.S.
*5	Spring	S.S.
6	Pin, Lock	S.S.
7	Stem Assembly	Brass - S.S.
*8	"O" Ring	Buna-N®
9	Washer	Brass
10	Washer, Thrust	Brass
11	Arm, Float	Brass
12	Housing	Bronze

* Repair Kit Parts

CFC2-A1-3 Float Chamber Control CONVERSION
(also CFC2-A2-3 Float Chamber Control)

This control is obsolete and is replaced by the CFC2-C1 Float Chamber Control. The differences between these controls are few. Refer to E-CFC2-C1 data sheet.

A. The pilot housing assembly is now installed on the float chamber so that the distributor is on the right of the vertical centerline of the control. The word "top" is cast into the pilot housing flange. There is an "O" ring seal between the pilot housing and the float chamber instead of earlier flat gasket.

B. The disc and distributor are the same as those of the CF1-C1 Float Pilot Control.

C. The CFC2-C1 has 4 ports. "Supply" is found on the housing. "Port 1", "Port 2" and "Drain" are located and marked on the Distributor. Port 2 is for special applications and will have a pipe plug in it. "Supply" port on the distributor is not used and has an Allen socket plug in it.

1. When service is required for the CFC2-A1-3 (or CFC2-A2-3) Control, then conversion to CFC2-C1 is recommended.

2. For converting to the current design control, use Repair Parts Kit for the CFC2-C1 control. Order Kit P/N 2674701E (in standard materials). Also, use this kit for maintenance or servicing the CFC2-C1 control after conversion. This kit includes new disc, distributor, ‘O’ rings, gasket, spring and screws. Spare Parts Kit P/N 9696630E had only 'O' ring, gasket and spring and is obsolete and no longer available.

3. The new CFC2-C1 pilot housing flange seal is redesigned from a flat gasket to a groove for an 'O' ring seal with the chamber. This 'O' ring is in repair parts kit. The flat gasket is still available, order part number C3580C, it is also in the kit.

4. Be sure to install parts so that the pilot housing is mounted with the distributor located to the right of the vertical centerline of the control. Pilot tubing and connections will have to be relocated when converting.

5. The repair kit comes with a 1/8" hex-head pipe plug to be installed in pilot port 2. This will give the ON-OFF operation from Port 1 the same as the previous CFC2-A1. By removing this plug from Port 2 and installing in Port 1, the operation of the control becomes that of the previous CFC2-A2. By not installing the plug, the operation becomes that of the previous CFC2-C1.

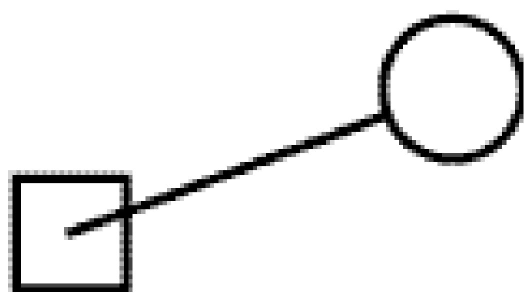
Also, there is a 1/8" Allen socket pipe plug to be installed in the "S" supply port on the distributor. Once installed THIS PLUG SHOULD NOT BE REMOVED. Supply pressure is to be connected to the supply port on the pilot housing of the control.

Pilot Identification

CFM2 Modulating Float Control
is a precision-lapped, rotary-disc, plate-type valve directly operated by the movement of a float ball. It is designed to control a Cla-Val Hytrol Main valve to maintain level in liquid storage tanks.

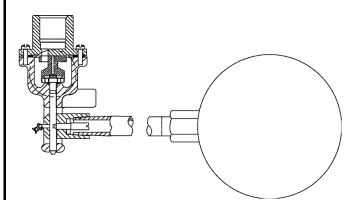
CFM2

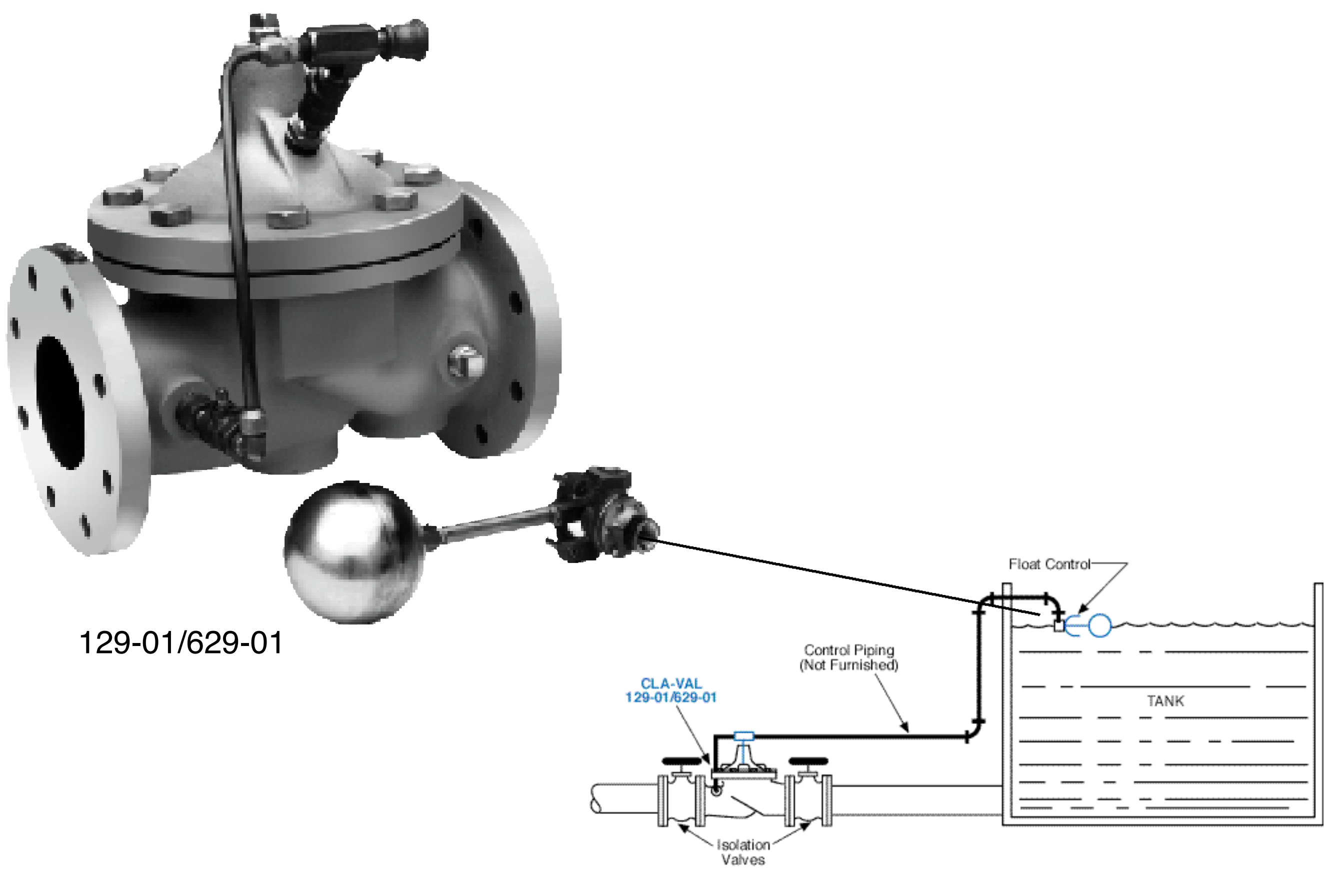
CFM2



Schematic Symbol

CFM2





129-01/629-01

CLA-VAL

— MODEL — **CFM2**

Modulating Float Control

DESCRIPTION
The Type CFM2 Float Control is a precision-lapped, rotary-disc, plate-type valve directly operated by the movement of a float ball. It is designed to control a Cla-Val Hytrol Main valve to maintain level in liquid storage tanks.

OPERATION
Any change in the level of the storage tank is detected instantly by the ball of the Float Control mounted inside the tank. The float ball is attached to a lever arm which transmits a turning motion to the valve disc as the float rises and falls.

In the closed position, the holes in the valve disc do not meet with the holes in the distributor, and completely prevent all flow through the Float Control. In the half-open or modulating position, the holes in the valve disc only partially coincide with the holes in the distributor, permitting a restricted flow through the Float Control. In the open position, the holes in the valve disc line up completely with the holes in the distributor permitting full flow through the Float Control.

INSTALLATION
The Float Control can be installed to be either fully closed or fully open when float is in the "up" position. Normal applications require the Control to be installed so that it is in the closed position when the float ball is raised.

DISASSEMBLY
Follow the sequence of item numbers assigned to the parts in the cross-sectional illustration for recommended order of disassembly. Mark parts so they may be reassembled in their proper position.

CLEANING
Wash all parts with cleaning solvent, Federal specification P-S-661, or approved equivalent. Dry with compressed air, or a clean, lint-free cloth. Protect parts from damage and dust until reassembled.

INSPECTION
Inspect all threads for damage or evidence of cross-threading. Check float ball for crushing and punctures. Check spring for visible distortion, cracks and breaks. Inspect distributor and valve disc for clogged holes.

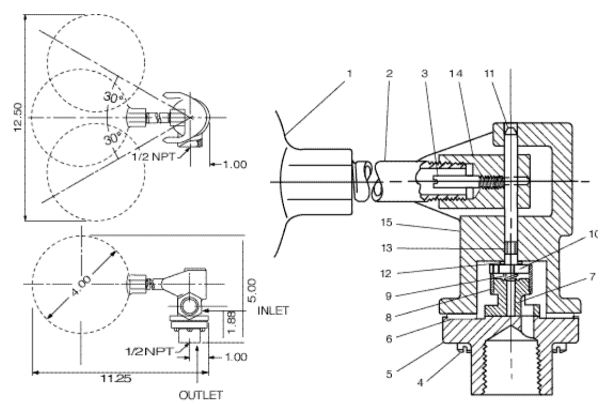
REPAIR AND REPLACEMENT
Replace O-Ring packing and distributor gasket each time valve is overhauled. Replace float ball if at all crushed or punctured. Minor nicks and scratches may be polished out using a fine grade of emery or crocus cloth.

Replace all parts which are defective, and any which create the slightest doubt that they may not afford completely satisfactory operation. Use inspections outlined above as a guide.

Lapping of disc and distributor in the field is not recommended because of the difficulties involved in getting perfectly flat surfaces. If repair is need on either of these parts, replace the control with a spare, and return defective unit to Cla-Val for repair.

REASSEMBLY
Replace valve disc in the position previously marked to obtain proper flow pattern through holes.

TEST PROCEDURE
Attach a source of pressure (air or water) to "inlet" port and check for tight sealing when float is "up".



ITEM	DESCRIPTION	QTY	PART NO.
1	FLOAT	1	
2	ARM EXTENSION NIPPLE	1	
3	LOCK PIN	1	
4	SCREW -RD HD MACHINE	6	
5	DISTRIBUTOR	1	
6	GASKET	1	
	DISC ASSEMBLY	1	
7	DISC	1	
8	SKIRT	1	
9	SPRING	1	
	STEM ASSEMBLY	1	
10	DRIVER	1	
11	STEM	1	
12	THRUST WASHER	1	
13	O-RING PACKING	1	
14	FLOAT ARM	1	
15	HOUSING	1	

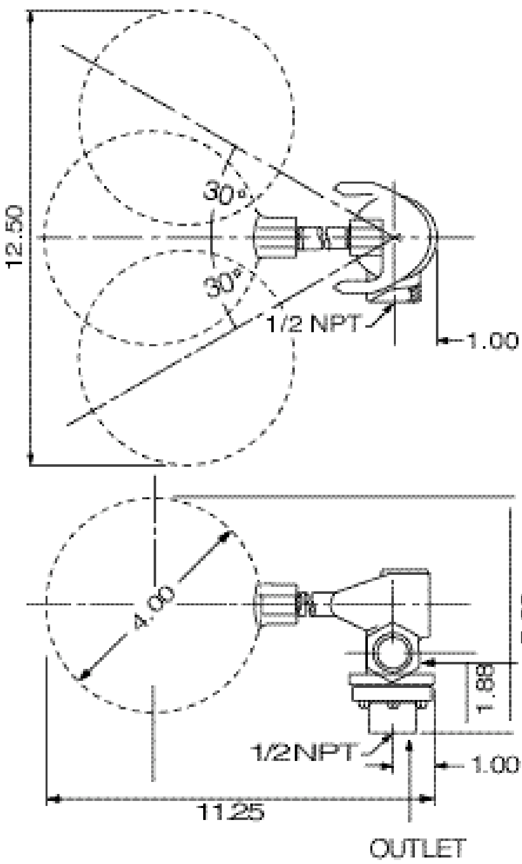
2 — 1

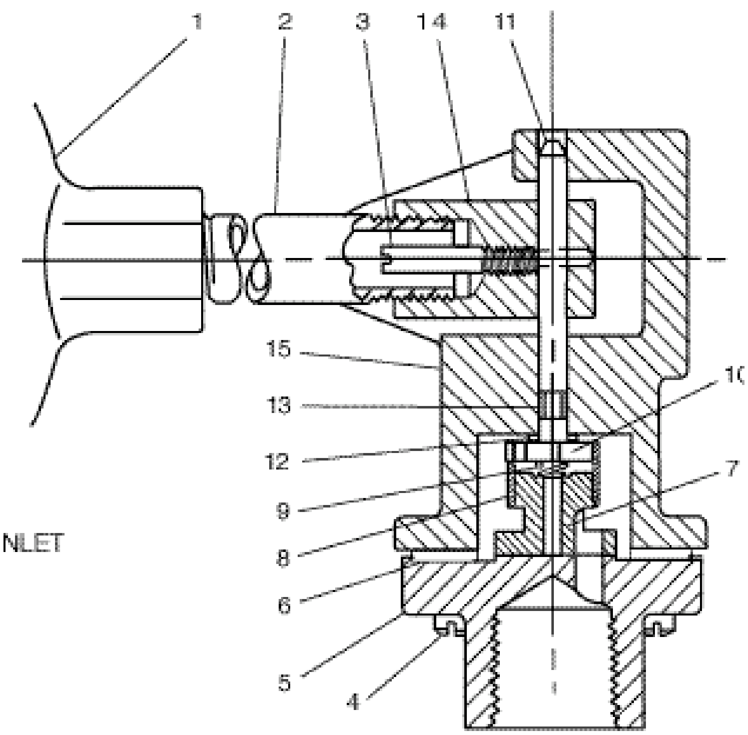
CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

CFM2

Modulating Float Control

SIZE	DESCRIPTION
1/2"	W/COPPER FLOAT BALL, BRASS ARM AND BRASS ARM EXTENSION
1/2"	W/S.S. FLOAT BALL, ARM & ARM EXTENSION





Item	Description
1	Float Ball
2	Arm Extension 1/4" Dia. X 5" Long
3	Lock Pin
4	Machine Screw, Fil. Hd. 6.32 x 5/8 (6 Req'd)
5*	Distributor
6*	Gasket

Item	Description
7 & 8*	†Disc Assembly (7-Disc / 8-Skirt)
9*	Spring
10 & 11	†Stem Assembly (10-Driver) (11-Stem)
12	Thrust Washer
13*	"0" Ring 3855-B
14	Float Arm
15	Housing

†Permanently Joined Assembly

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

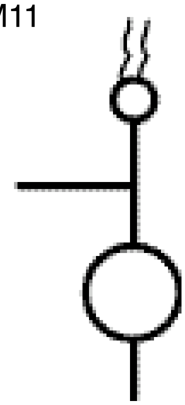
PL-CFM2 (R-5/05)

CSM-11 Solenoid Control with Manual Operator
is a direct-acting solenoid valve for use in four-way, three-way, and interceptor service. It is a continuous duty type which assures positive and dependable operation over the entire pressure range.

Cla-Val can refurbish into new condition when needed.

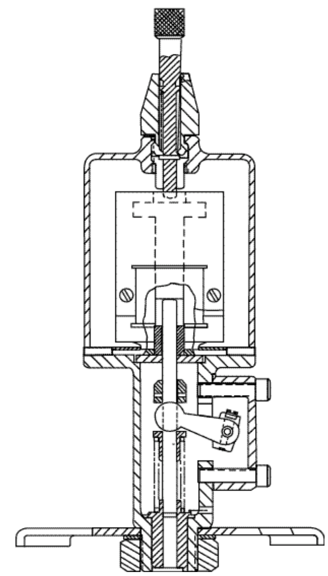
CSM11

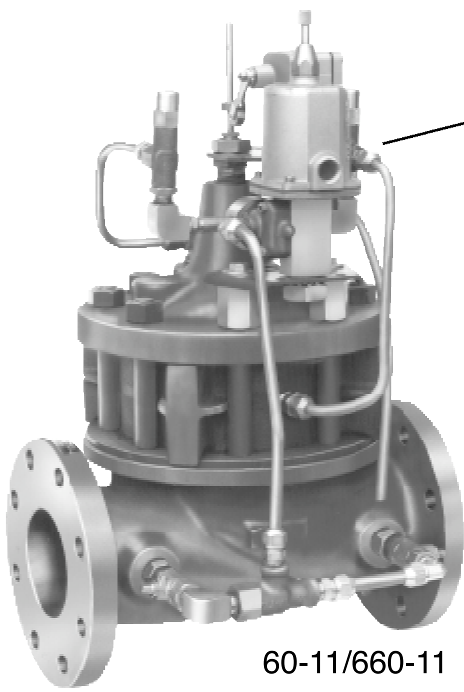
CSM11



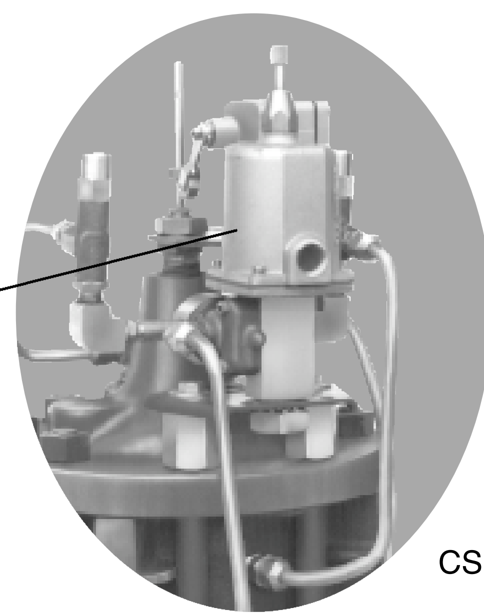
Schematic Symbol

CSM11





60-11/660-11



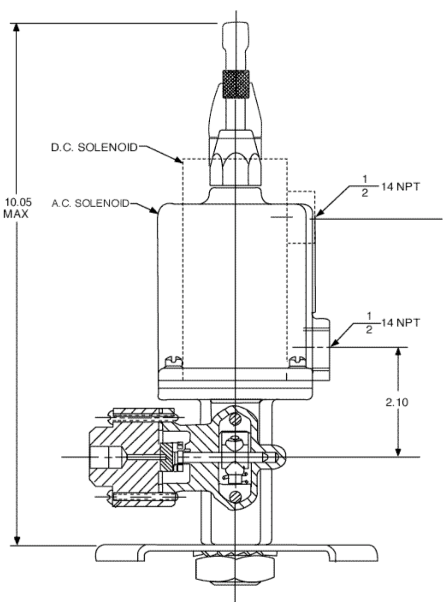
CSM-11

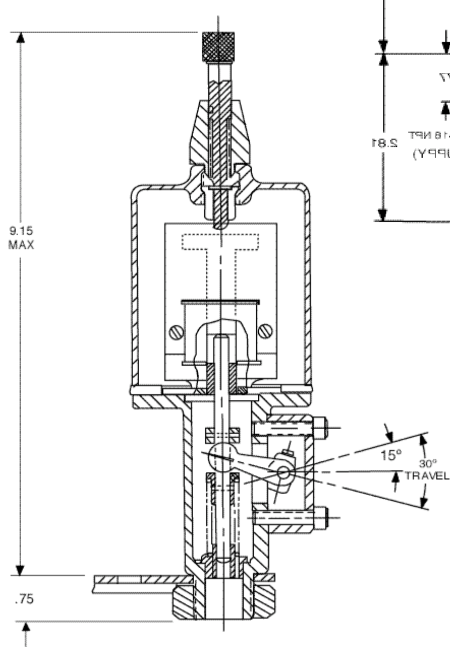
— MODEL — CSM-11

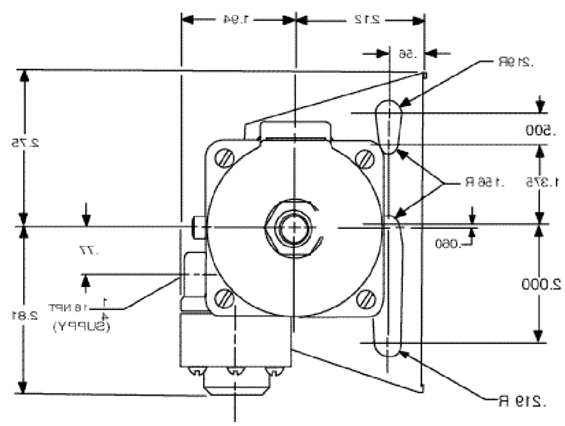
Solenoid Control with Manual Operator

- **Positive Operation Through Full Pressure Range**
- **Both Manual and Electrical Operation**
- **Coil is Protected Against Foreign Matter by Seal-tight Gasket Cover**
- **Moving Parts of Solenoid are Cushioned**
- **Modular Pilot Assembly Provides for Easy Replacement and Minimum Down Time**

The Cla-Val CSM-11 is a direct-acting solenoid valve for use in four-way, three-way, and interceptor service. It is a continuous duty type which assures positive and dependable operation over the entire pressure range. The valve is positioned to direct pressure into pre-determined flow patterns by means of the solenoid and connecting linkage. The valve is a rotary disc, plate type, lapped for drip tight operation. The control is designed for manual as well as electric operation.



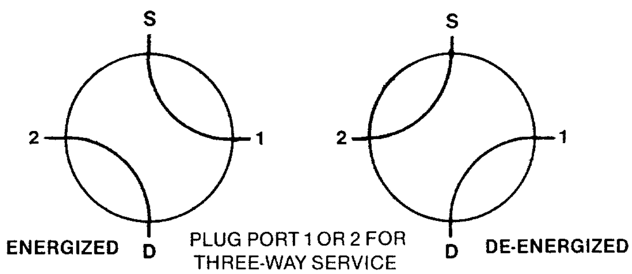




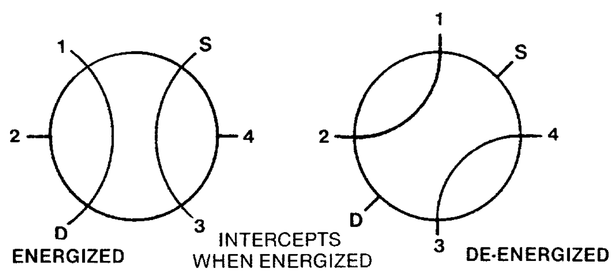
Operation

The Cla-Val CSM-11 Solenoid Control meets varied service requirements depending upon the flow pattern used. Catalog number SUFFIXES are used to designate specific flow patterns. Other variations are available on special order.

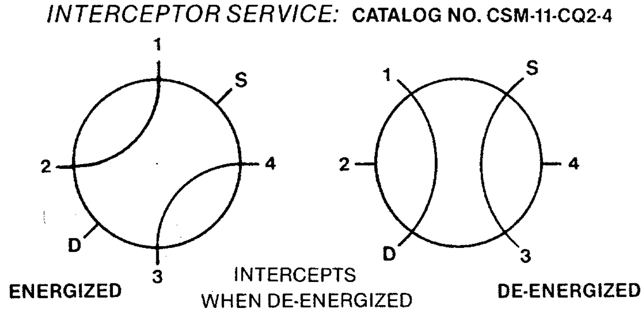
FOUR-WAY SERVICE: **CATALOG NO. CSM-11-A2-2**



INTERCEPTOR SERVICE: **CATALOG NO. CSM-11-N2-4**



INTERCEPTOR SERVICE: **CATALOG NO. CSM-11-CQ2-4**



Purchase Specifications

The control shall include a continuous duty direct acting solenoid, and shall be designed for both manual and electrical operation. The valve shall be integral, of a rotary disc, plate type, and shall be actuated by the solenoid through a linkage. The control shall be similar in all respects to the CSM-11 Solenoid Control as manufactured by Cla-Val., Newport Beach, California.

When Ordering, Please Specify

1. Catalog No. CSM-11
2. Include suffix of desired type of service
   Four-way or Interceptor
3. Voltage and Hertz

Power Consumption

Volts	Ampere		Volts	Ampere		Coil Resistance (ohms)
(DC)	Holding	Pull In	(AC 60 Hz)	Holding	Inrush	
24	.603	24	24	2.88	25.4	0.5
28	.629	15.6	120	.575	5.1	14.1
32	.500	18.6	208	.330	2.93	40
48	.293	10.8	240	.288	2.54	56
115	.122	4.42	440	.156	1.38	174
125	.119	4.44	480	.143	1.27	233
250	.072	2.45				
			Volts	Ampere		Coil Resistance (ohms)
			(AC 50 Hz)	Holding	Inrush	
			110	.48	4.6	15.7
			220	.24	2.3	66
			240	.22	2.1	88

Service Specifications

Solenoid Enclosure	General Purpose, NEMA Type 3
Size (Fluid Connection)	1/4" NPT Supply Port and 1/8" NPT Connector Ports
Operating Media	Water, air, gas (compatible with materials)
Coil Insulation	Class A (molded)
Operating Pressure	300 psi maximum working pressure
Temperature	Water to 150° maximum
Materials (Fluid Contacts)	Bronze, Stainless Steel and Monel* Aluminum Body—Stainless Steel Trim

*Other materials available - consult factory.

2
—
1

CLA-VAL ®
CLA-VAL ™
CLA-VAL
PO Box 1325 Newport Beach CA 92659-0325
Phone: 949-722-4800 • Fax: 949-548-5441

CLA-VAL CANADA
4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040

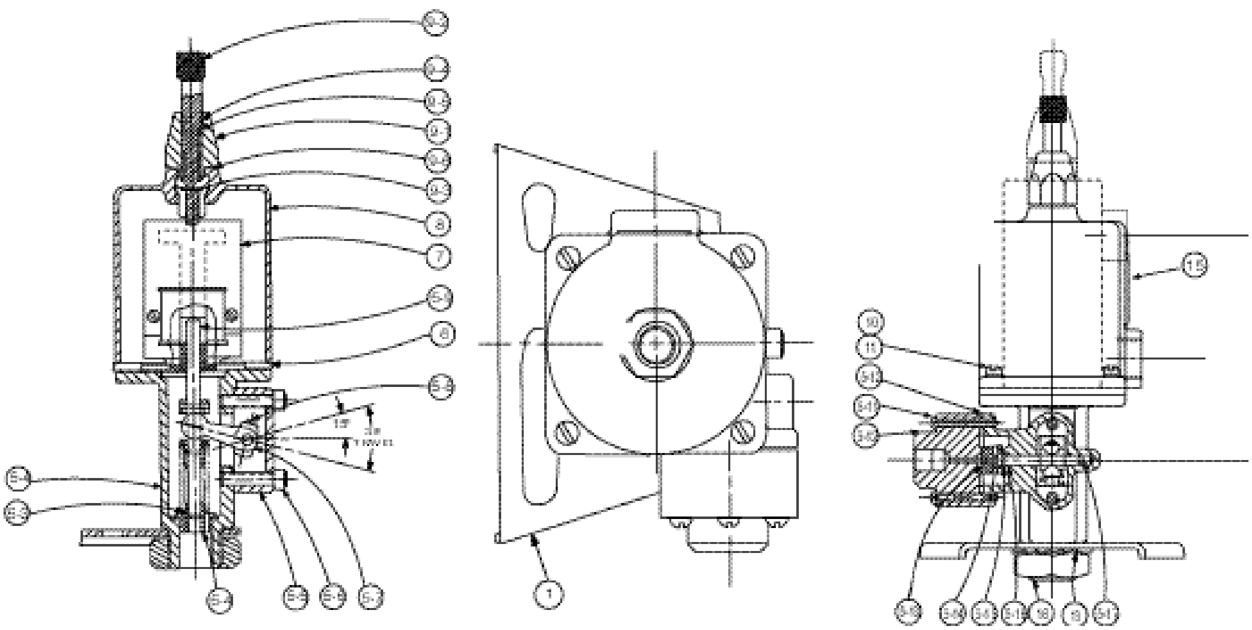
CLA-VAL EUROPE
Chemin dès Mesanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50
www.cla-val.com

E-CSM-11 (R-5/05)

Represented By:

CSM-11

Solenoid Control



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Mounting Bracket	7	Solenoid Assy.
5	Mechanical Parts Assy.		(See table other side)
5-2	Housing	8	Cover (A.C. only)
5-3	Spring	9	Manual operator assy
5-4	Guide	9-1	Housing, Manual Operator
5-5	Side Housing	9-2	Plunger
5-6	Cap Screw 1/4'	9-3	Pin, groove-3/8"
5-7	Lever Arm	9-4	"O"- Ring
5-8	Lever Screw	9-5	Spring, Manual Operator
5-9	Stem assy. (Solenoid)	9-6	Gasket, Manual Operator
5-10	Distributor Gasket	10	Machine Screw Fil. Hd.
5-11	Machine Screw, RDH		(A.C. Only 10/32 x 5/8-4 req'd.)
	(6/32 x 1 1/4 - 6 req'd.)		(4 req'd.)
5-12	Distributor (CSM11-A2-2)	11	Lockwasher
5-13	Disc Assy.	12	Machine Screw Fil. Hd.
5-14	Spring (Disc Assy.)		(D.C. Only) 10/32 x 7/16 (4 required)
5-15	Thrust Washer	13	Lockwasher
5-16	"O"- Ring	14	Coil only: (See table other side)
5-17	Stem Assy. (Pilot)	15	Nameplate
6	Spacer Gasket (A.C. only)	16	Hex Nut, Jam 1-14 UNS

When ordering parts, please specify:

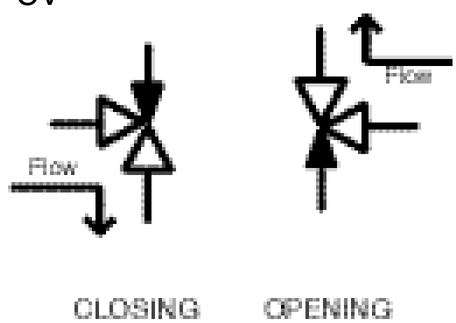
- All Nameplate Data
- Item Number
- Description
- Material
- Recommended Spare Parts

CV-Speed control
is used to control opening or closing speed. The CV allows restricted flow in one direction and restricted flow in the opposite direction. To be cleaned up sample only.

End Connection 3/8 male NPT and 3/8" Female NPT
Bronze or Stainless Steel body/ stainless steel trim.
Maximum working Pressure 400 PSI

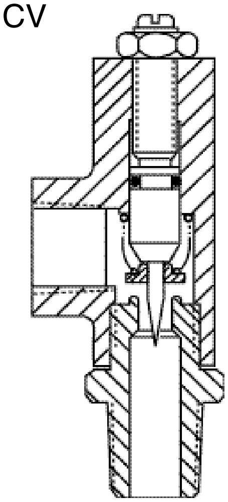
CV

CV



Schematic Symbol

CV



CLA-VAL

— MODEL — CV

Flow Control

DESCRIPTION

The Cla-Val Model CV Flow Control is a simply-designed, spring-loaded check valve. Rate of flow is full flow in one direction and restricted in other direction. Flow is adjustable in the restricted direction. It is intended for use in conjunction with a pilot control system on a Cla-Val Automatic Control Valve.

OPERATION

The CV Flow Control permits full flow from port A to B, and restricted flow in the reverse direction. Flow from port A to B lifts the disc from seat, permitting full flow. Flow in the reverse direction seats the disc, causing fluid to pass through the clearance between the stem and the disc. This clearance can be increased, thereby increasing the restricted flow, by screwing the stem out, or counter-clockwise. Turning the stem in, or clockwise reduces the clearance between the stem and the disc, thereby reducing the restricted flow.'

INSTALLATION

Install the CV Flow Control as shown in the valve schematic All connections must be tight to prevent leakage.

DISASSEMBLY

Follow the sequence of the item numbers assigned to the parts in the cross sectional illustration for recommended order of disassembly.

Use a scriber, or similar sharp-pointed tool to remove O-ring from the stem.

INSPECTION

Inspect all threads for damage or evidence of cross-threading. Check mating surface of seat and valve disc for excessive scoring or embedded foreign particles. Check spring for visible distortion, cracks and breaks. Inspect all parts for damage, corrosion and cleanliness.

CLEANING

After disassembly and inspection, cleaning of the parts can begin. Water service usually will produce mineral or lime deposits on metal parts in contact with water. These deposits can be cleaned by dipping the parts in a 5-percent muramic acid solution just long enough for deposits to dissolve. This will remove most of the common types of deposits. **Caution: use extreme care when handling acid.** If the deposit is not removed by acid, then a fine grit (400) wet or dry sandpaper can be used with water. Rinse parts in water before handling. An appropriate solvent can clean parts used in fueling service. Dry with compressed air or a clean, lint-free cloth. Protect from damage and dust until reassembled.

REPAIR AND REPLACEMENT

Minor nicks and scratches may be polished out using a fine grade of emery or crocus cloth; replace parts if scratches cannot be removed.

Replace O-ring packing and gasket each time CV Flow Control is overhauled.

Replace all parts which are defective. Replace any parts which create the slightest doubt that they will not afford completely satisfactory operation. Use Inspection steps as a guide.

REASSEMBLY

Reassembly is the reverse of disassembly; no special tools are required.

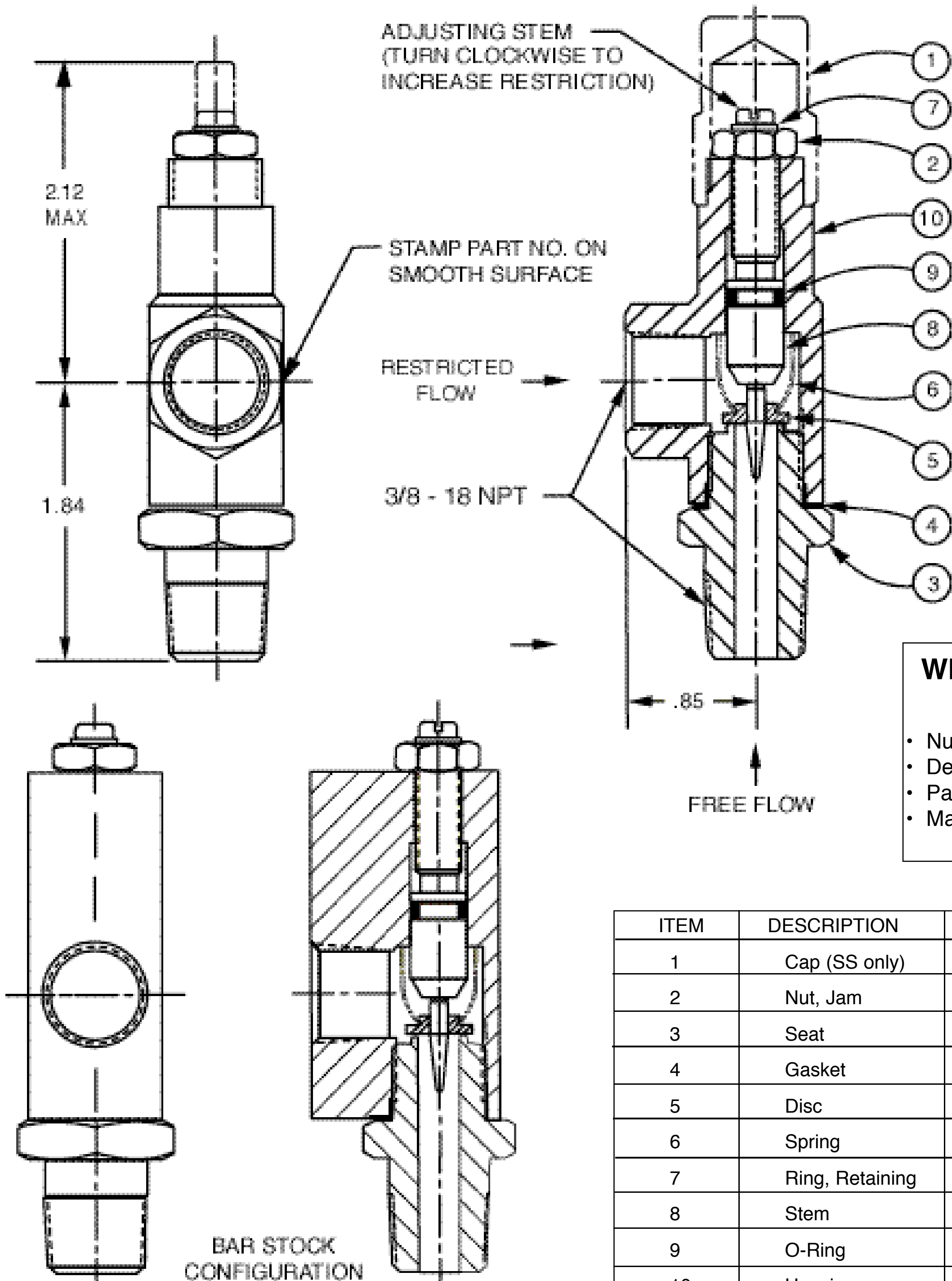
TEST PROCEDURE

No testing of the flow Control is required prior to reassembly to the pilot control system on Cla-Val Main Valve.

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

CV

3/8" Flow Control



When ordering parts, please specify:

- Number Stamped on Side
- Description (CV Flow Control)
- Part Description
- Material

2 — 1

ITEM	DESCRIPTION	QUAN.
1	Cap (SS only)	1
2	Nut, Jam	1
3	Seat	1
4	Gasket	1
5	Disc	1
6	Spring	1
7	Ring, Retaining	1
8	Stem	1
9	O-Ring	1
10	Housing	1

CLA-VAL

Regulator Spring Color Coding Chart

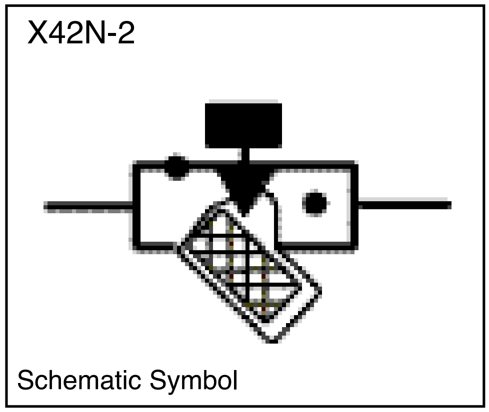
Dwg#47117

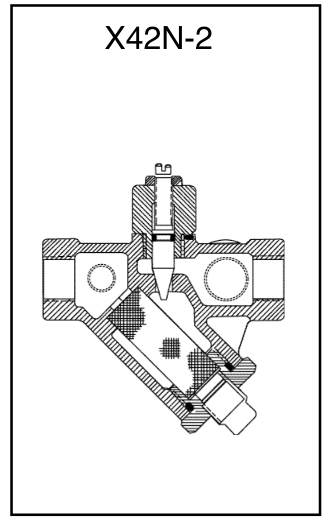
*** THESE FIGURES ARE ONLY APPROXIMATE. FINAL ADJUSTMENTS SHOULD BE MADE WITH A PRESSURE GAGE.**

WIRE SIZE	SPRING NUMBER	COLOR	WIRE MATERIAL	CATALOG NUMBER	PSI RANGE	*PSI PER TURN
.080 DIA.	C0492D	BLUE	S.S.	CDB-7	0-7 0-7	.75 .75
.080 DIA.	82575C	--	S.S.	CRD CRD-10A	1.9-6.5 1.9-6.5	.61 .49
.116 DIA.	81594E	--	S.S.	CRD CRD-10A	2-30 2-30	3.0 2.4
.120 DIA.	V5654J	GREEN	CHR VAN	CRL-5A CRD	5-25 10-40	4.0 4.0
.162 DIA.	32447F	NATURAL	S.S.	CDB-7 CRL-5A CRL-13	10-60 10-60 10-60	12.0 12.0 12.0
.162 DIA.	V5695B	YELLOW	MUSIC WIRE	CDB-7 CRL-5A CRL-13	20-80 20-80 20-80	14.5 14.5 14.5
.207 DIA.	C1124B	CAD PLT	MUSIC WIRE	CDB-7 CRL-13 CRL-5A	50-150 50-150 50-150	29.5 29.5 29.5
.225 DIA.	V6515A	RED	MUSIC WIRE	CDB-7 CRL-13 CRL-5A	65-180 65-180 65-180	44.0 44.0 44.0
.115 X .218	71884B	RED	CHR VAN	CRL CRD CRD-10A	0-75 15-75 15-75	8.5 9.0 7.2
.118 X .225	71885J	GREEN	CHR VAN	CRL CRD CRD-10A	20-200 30-300 30-300	28.0 27.0 22.4
.225 X .295	163021A	CAD PLT	CHR VAN	CRL-5A CRL	100-300 100-300	18.0 18.0
.440 X .219	48211H	CAD PLT	STEEL	CRA-18 CRD-22 CRL-4A	200-450 200-450 100-450	17.0 17.0 17.0
WIRE SIZE	SPRING NUMBER	COLOR	WIRE MATERIAL	CATALOG NUMBER	PSI RANGE	*PSI PER TURN
.080 DIA.	C0492D	BLUE	S.S.	CRA CRD-2	4.5-15 4.5-15	.82 .82
.375 DIA.	87719B 1 SPRING 2 SPRINGS 3 SPRINGS 4 SPRINGS 5 SPRINGS	EPOXY COATED	CHROME SILICON	CDS-5	 5.40 30-80 70-120 110-120 150-200	 1.0 2.0 3.0 4.0 5.0
.072 DIA.	V0597A	--	302SS	CVC	1-17	.7
.375 DIA.	V2933502H 1 SPRING 2 SPRINGS 3 SPRINGS 4 SPRINGS 5 SPRINGS	EPOXY COATED	CHROME SILICON	CDS-6	 5.40 30-80 70-120 110-120 150-200	 .75 1.50 2.20 3.00 3.70

THE FOLLOWING CONTROL & SPRING P/N#'S WERE REMOVED, 32656B, 31554K, 44591G, V65695B, & V5695B.
ADDED CRL-13, CRL-5A, CRA, CRA-10A, CHANGED SPRING RANGES TO MATCH CURRENT CONTROLS.

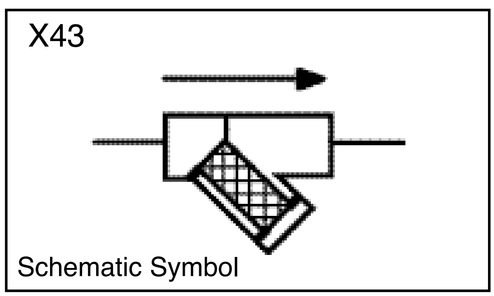
X42N-2 Strainer and Needle Valve Assembly

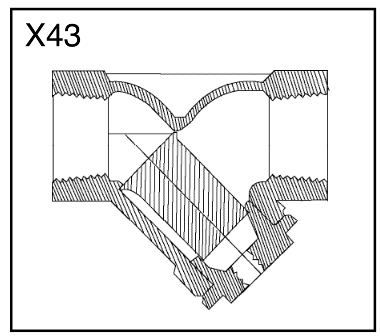




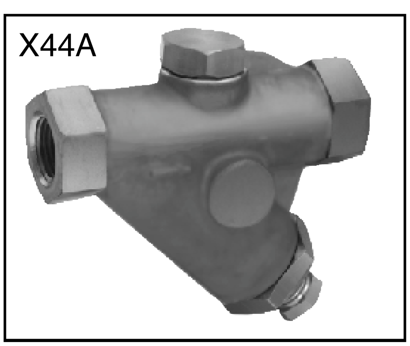
X43- Y-Strainer
is used to keep solids out of the pilot system. The standard is 40 mesh (Note other materials available)

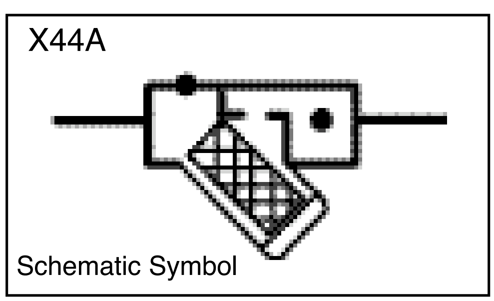
Available in 1/4" - 3/4" female NPT
Bronze body, brass plug, stainless steel screen
Maximum Working Pressure 400 psi

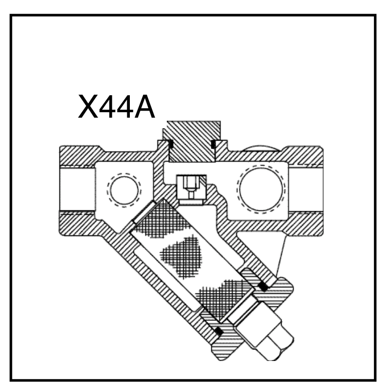




X44A Strainer and Orifice Assembly



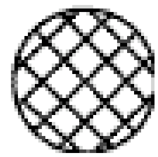




X46 Strainer
is designed to prevent passage of foreign particles larger than .015". It is especially effective against such contaminant as algae, mud, scale, wood pulp, moss, and root fibers.

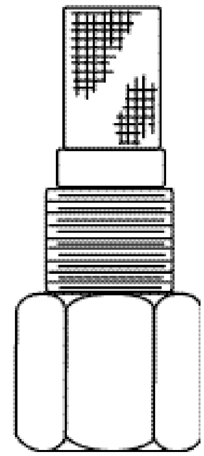
X46

X46



Schematic Symbol

X46



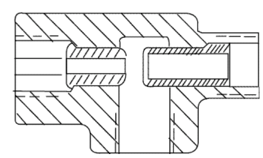
X47A Ejector
X47A Ejector is a compact, precision fitting, incorporating a primary and a secondary jet, designed to create a low-pressure area at the suction port.

X47A

X47A

Schematic Symbol

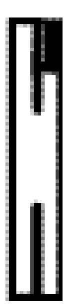
X47A



X52E Orifice Plate Assembly
X52E Orifice Plate Assembly is typically used with Cla-Val flow control valves. The orifice plate is an essential component used to generate a specific predictable pressure drop in the system.

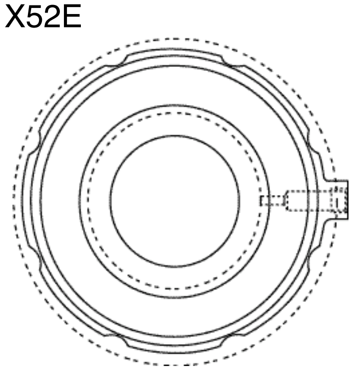
X52E

X52E



Schematic Symbol

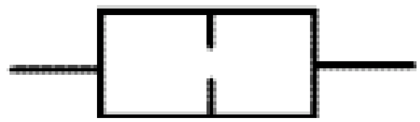
X52E



X58C Restriction Assembly
is composed of a modified standard (45 degree flare) tube connector with a precision delrin orifice fitting installed.

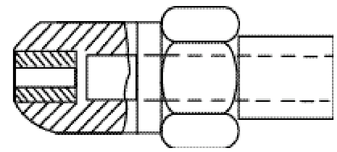
X58C

X58C



Schematic Symbol

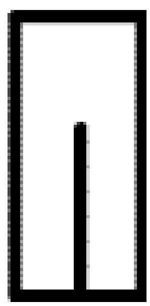
X58C



X101 Valve Position Indicator -
is very helpful in troubleshooting

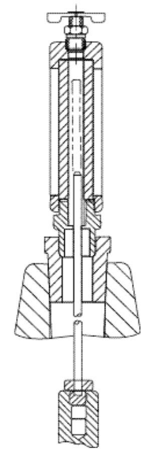
X101

X101



Schematic Symbol

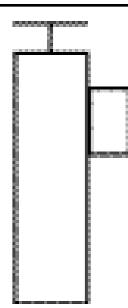
X101



X102 Flow Limiting Assemblies
regulates flow through Cla-Val Automatic Valves from full flow to shut-off. These adjustable assemblies control flow by limiting the amount of the valve opening. Limited to 6" & smaller.

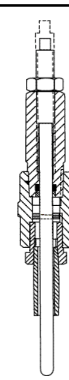
X102

X102



Schematic Symbol

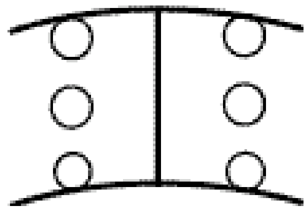
X102



X103 Spring Lift

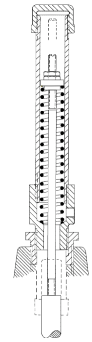
X103

X103



Schematic Symbol

X103

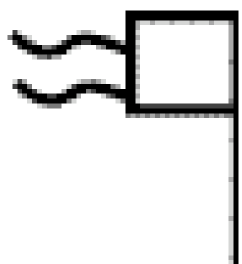


X105LCW Limit Switch Assemblies

X105L Limit Switch Assembly is a rugged, dependable and positive acting switch assembly actuated by the opening or closing of a Cla-Val control valve on which it is mounted.

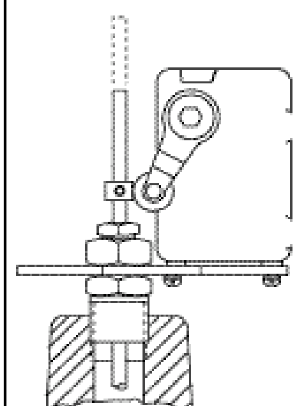
X105LCW

X105LCW



Schematic Symbol

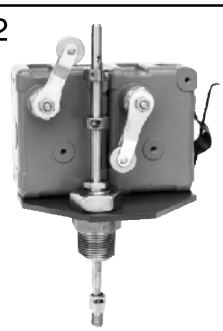
X105LCW



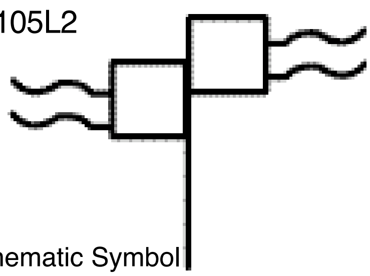
X105L2W Limit Switch Assemblies

X105L2 Limit Switch Assembly is a rugged, dependable and positive acting switch assembly actuated by the opening or closing of a Cla-Val control valve on which it is mounted.

X105L2

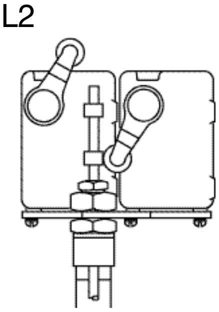


X105L2

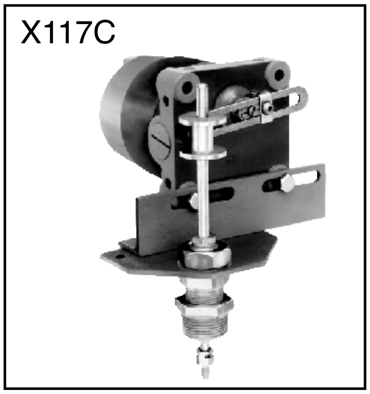


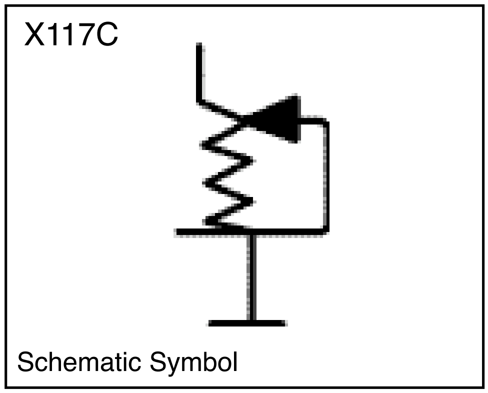
Schematic Symbol

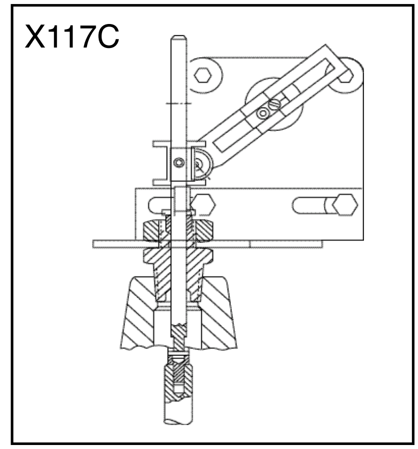
X105L2



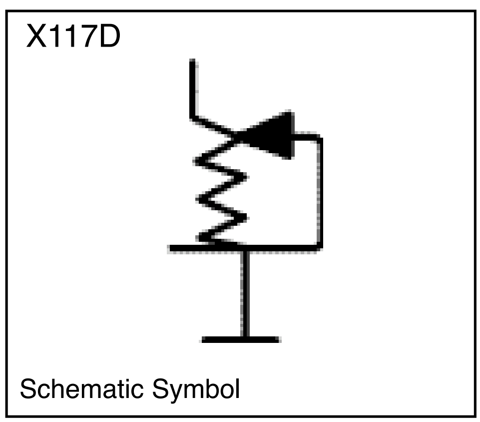
X117C Valve Position Transmitter
is an accurate monitor of valve position. Through an industry standard 4-20 mA output, the X117C delivers the level of accuracy required for computer control valve systems (SCADA type).

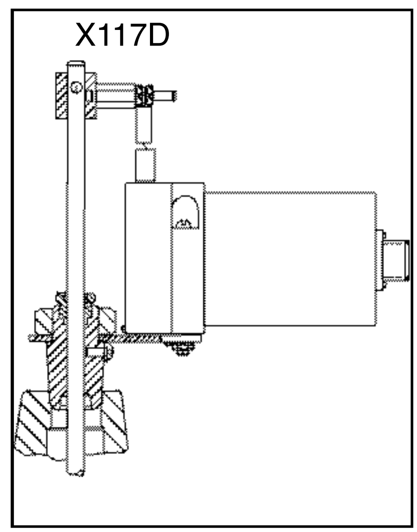






X117D Valve Position Transmitter
is an accurate monitor of valve position. Through an industry standard 4-20 mA output, the X117D delivers the accuracy required for computer control valve systems (SCADA type).

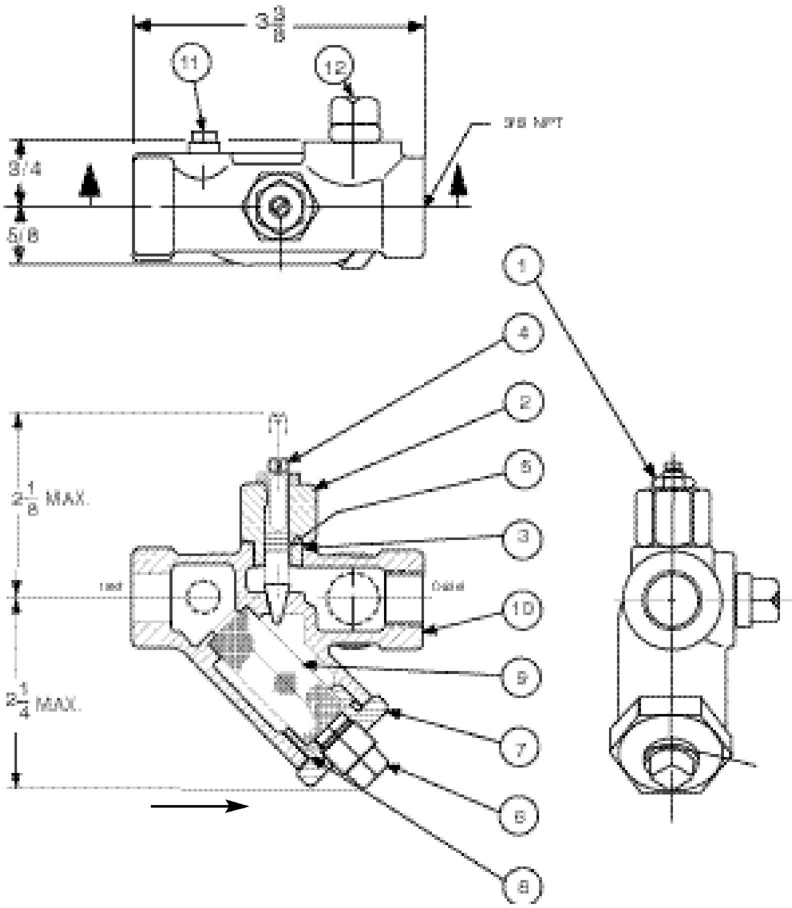




CLA-VAL

X42N-2

Strainer and Needle Valve Assembly



When ordering parts, please specify:

- All nameplate data
- Item Number
- Description

Size	Stock Number
3/8" x 3/8"	68372C

ITEM	DESCRIPTION	MATERIAL	PART NO.
1	Jam Nut —Hex	Sil Brz	
2	Bonnet	S.S.	
3	"O" Ring—Bonnet	Syn Rub	
4	Stem	S.S.	
5	"O" Ring—Stem	Syn Rub	
6	Plug—Pipe 1/4	Bre.	
7	Strainer Plug	303	
8	"O" Ring—Plug	NBR	
9	Screen	Monel	
10	Body	Rd Brs	
11	Plug—Pipe 1/8	Brass	
12	Plug—Pipe 3/8	Brass	

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

CLA-VAL

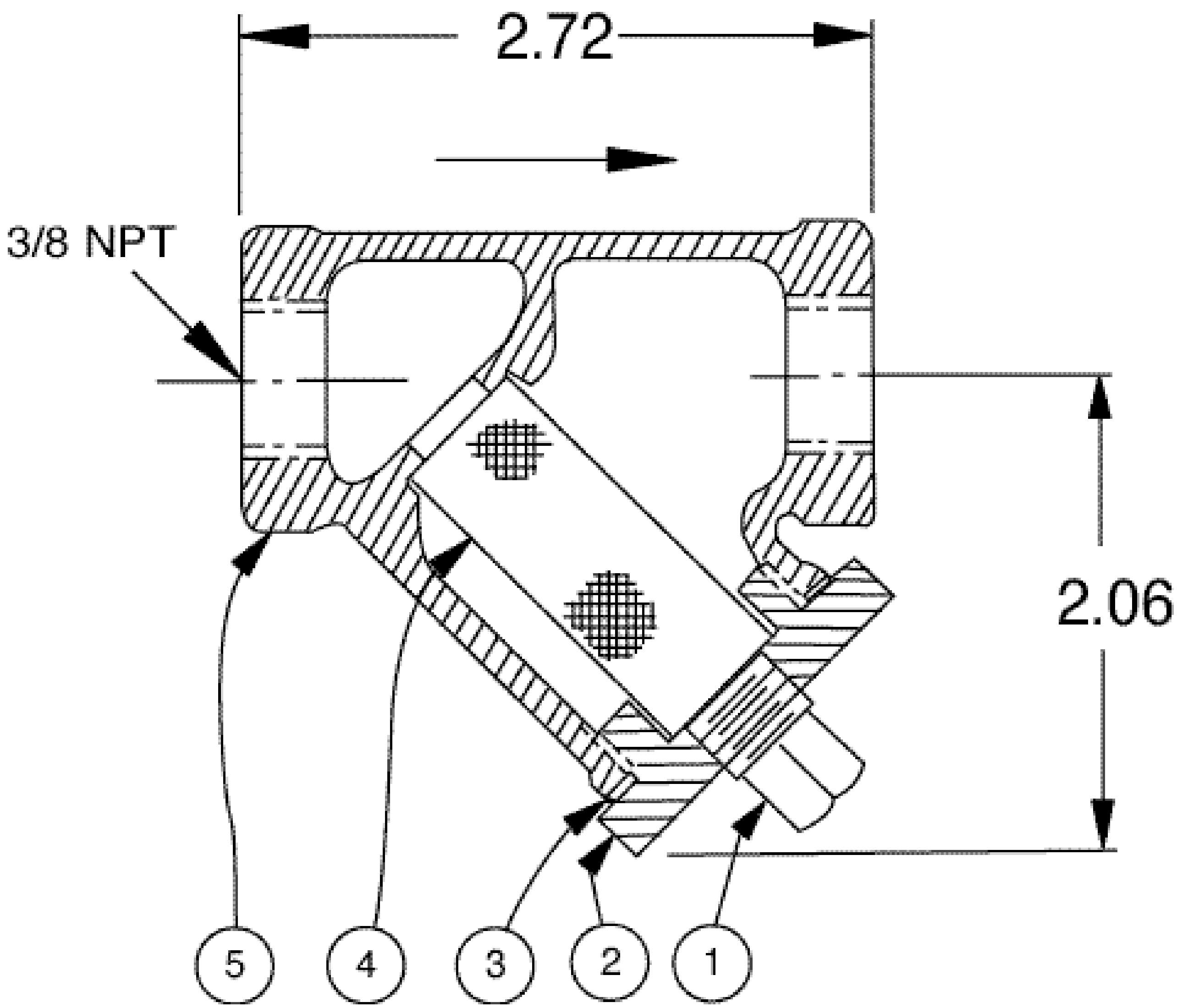
X43
Strainer

ITEM	DESCRIPTION	MATERIAL
1	Pipe Plug	Steel
2	Strainer Plug	Brass
3	Gasket	Copper
4*	Screen	Monel
5	Body	Brass

*Replacement screen stock number 68373A.
All other parts available only in replacement assembly.

Standard 60 mesh pilot system strainer for fluid service.

SIZE	STOCK NUMBER
3/8 x 3/8	33450J

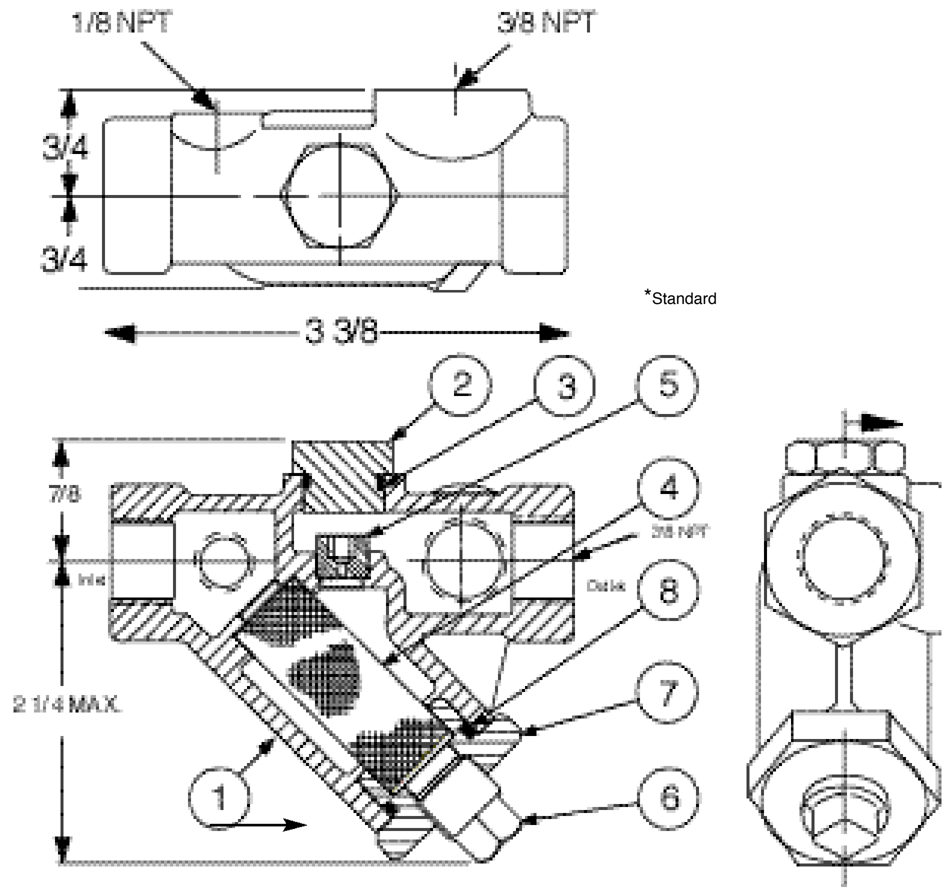


2 – 2

X44A

Strainer and Orifice Assembly

BRONZE BODY — S.S. ORIFICE



When ordering parts, please specify:

- All Nameplate Data
- Item Number
- Description
- Recommended Spare Parts

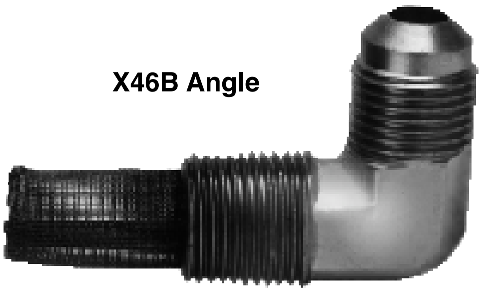
ITEM	DESCRIPTION	MATERIAL	QTY.
1	Body	Red Brs.	1
2	Plug, Top	Brass	1
3	"O" Ring, Plug Top	Syn. Rub.	1
4	Screen	Monel	1
5	Orifice Plug	Delrin	1
6	Plug, Pipe	Brass	1
7	Strainer Plug	S.S.	1
8	"O" Ring, Strainer Plug	Syn. Rub.	1

CLA-VAL

— MODEL — **X46**

Flow Clean Strainer

X46A Straight



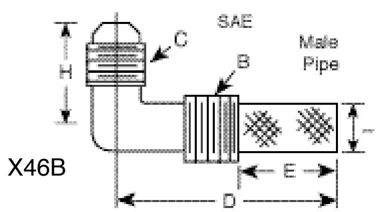
X46B Angle

- **Self Scrubbing Cleaning Action**
- **Straight Type or Angle Type**

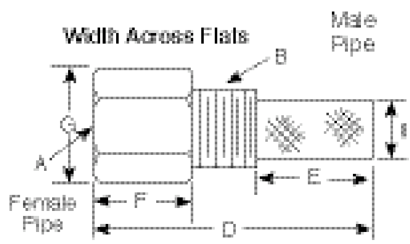
The Cla-Val Model X46 Strainer is designed to prevent passage of foreign particles larger than .015". It is especially effective against such contaminant as algae, mud, scale, wood pulp, moss, and root fibers. There is a model for every Cla-Val. valve.

The X46 Flow Clean strainer operates on a velocity principle utilizing the circular "air foil" section to make it self cleaning. Impingement of particles is on the "leading edge" only. The low pressure area on the downstream side of the screen prevents foreign particles from clogging the screen. There is also a scouring action, due to eddy currents, which keeps most of the screen area clean.

Dimensions (In Inches)



X46B



X46A

X46 Angle Type B (In Inches)

B(NPT)	C(SAE)	D	E	H	I
1/8	1/4	1-3/8	5/8	7/8	1/4
1/4	1/4	1-3/4	3/4	1	3/8
3/8	1/4	2	7/8	1	1/2
3/8	3/8	1-7/8	7/8	1	1/2
1/2	3/8	2-3/8	1	1-1/4	5/8

When Ordering, Please Specify:

- Catalog Number X46
- Straight Type or Angle Type
- Size Inserted Into and Size Connection
- Materials

X46A Straight Type A (In Inches)

A (NPT)	B (NPT)	D	E	F	G	I
1/8	1/8	1-3/4	3/4	1/2	1/2	1/4
1/4	1/4	2-1/4	1	3/4	3/4	3/8
3/8	3/8	2-1/2	1	7/8	7/8	1/2
3/8	1/2	2-1/2	1-1/4	1/2	7/8	3/4
1/2	1/2	3	1-1/4	1	1-1/8	3/4
3/8	3/4	3-3/8	2	1/2	1	7/8
3/4	3/4	4	2	1	1-1/2	7/8
3/8	1	4-1/4	2-3/4	1/2	1-3/8	7/8
1	1	4-1/2	2-3/4	1-1/4	1-3/4	7/8
1/2	1	4-1/4	2-3/4	1/2	1-3/8	7/8

INSTALLATION

The strainer is designed for use in conjunction with a Cla-Val Main Valve, but can be installed in any piping system where there is a moving fluid stream to keep it clean. When it is used with the Cla-Val Valve, it is threaded into the upstream body port provided for it on the side of the valve. It projects through the side of the Main Valve into the flow stream. All liquid shunted to the pilot control system and to the cover chamber of the Main Valve passes through the X46 Flow Clean Strainer.

INSPECTION

Inspect internal and external threads for damage or evidence of cross-threading. Check inner and outer screens for clogging, embedded foreign particles, breaks, cracks, corrosion, fatigue, and other signs of damage.

DISASSEMBLY

Do not attempt to remove the screens from the strainer housing.

CLEANING

After inspection, cleaning of the X46 can begin. Water service usually will produce mineral or lime deposits on metal parts in contact with water. These deposits can be cleaned by dipping X46 in a 5-percent muriatic acid solution just long enough for deposit to dissolve. This will remove most of the common types of deposits. **Caution: use extreme care when handling acid.** If the deposit is not removed by acid, then a fine grit (400) wet or dry sandpaper can be used with water. Rinse parts in water before handling. An appropriate solvent can clean parts used in fueling service. Dry with compressed air or a clean, lint-free cloth. Protect from damage and dust until reassembled.

REPLACEMENT

If there is any sign of damage, or if there is the slightest doubt that the Model X46 Flow Clean Strainer may not afford completely satisfactory operation, replace it. Use Inspection steps as a guide. Neither inner screen, outer screen, nor housing is furnished as a replacement part. Replace Model X46 Flow Clean Strainer as a complete unit.

When ordering replacement Flow-Clean Strainers, it is important to determine pipe size of the tapped hole into which the strainer will be inserted (refer to column A or F), and the size of the external connection (refer to column B or G).

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

CLA-VAL

— MODEL — X47A
Ejector

DESCRIPTION
The Cla-Val Model X47A Ejector is a compact, precision fitting, incorporating a primary and a secondary jet, designed to create a low-pressure area at the suction port.

OPERATION
The X47A Ejector is designed for use in a pilot control system on a Cla-Val Main Valve. Pressure is applied to the inlet port (A). As the fluid passes through the center portion of the X47A Ejector, the high velocity entrains particles of fluid from suction port (B), which results in a reduced pressure at this port.

In actual operation, the pressure port (A) is connected to the upstream side of the Main Valve; the discharge port (C) is connected to the Pilot Control; and the suction port (B) is connected to the cover chamber of the Main Valve.

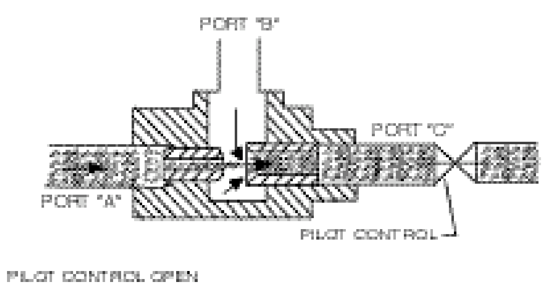
Fluid line pressure enters at the inlet port (A). When the Pilot Control is closed, no flow occurs through the X47A Ejector, and full line pressure is directed into the Main Valve cover chamber, closing the Main Valve tight. As the Pilot Control opens, and flow through the X47A Ejector begins, pressure at the suction port (B) decreases until the Main Valve is permitted to open. Further changes in the flow rate resulting from opening and closing of the Pilot Control produce corresponding changes in the flow through the Main Valve.

DISASSEMBLY
Do not attempt to remove primary or secondary jets from X47A Ejector housing.

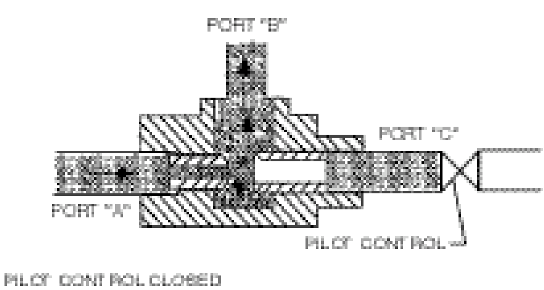
INSPECTION
Inspect port threads for damage or evidence of cross-threading. Check primary and secondary jets for clogging or embedded foreign particles. Check for breaks, cracks, fatigue, and other signs of damage.

CLEANING
After inspection, cleaning of the X47A can begin. Water service usually will produce mineral or lime deposits on metal parts in contact with water. These deposits can be cleaned by dipping the X47A in a 5-percent muriatic acid solution just long enough for deposits to dissolve. This will remove most of the common types of deposits **Caution: use extreme care when handling acid.** If the deposit is not removed by acid, then a fine grit (400) or dry sandpaper can be used with water. Rinse parts in water before handling. An appropriate solvent can clean parts used in fueling service. Dry with compressed air or a clean, lint-free cloth. Protect from damage and dust until reassembled.

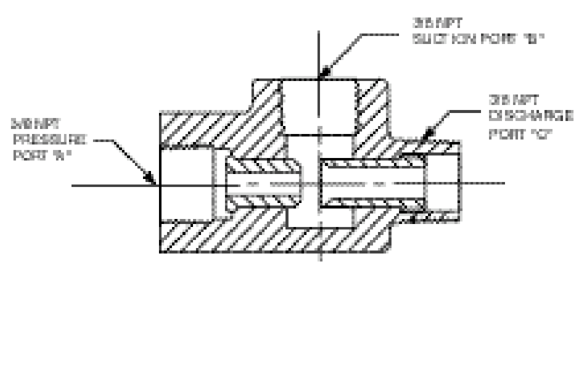
REPLACEMENT
If there is any sign of damage, or if there is the slightest doubt that the X47A Ejector may not afford completely satisfactory operation, replace it. Use Inspection steps as a guide. Neither the primary jet, secondary jet, or bare housing is furnished as a replacement part. Replace X47A Ejector as a complete unit.



PILOT CONTROL OPEN



PILOT CONTROL CLOSED



NOTE: OBTAIN AS COMPLETE ASSEMBLY ONLY. SPECIFY NUMBER STAMPED ON SIDE OF EJECTOR WHEN RE-ORDERING.

— MODEL — **X52E**

Orifice Plate Assembly

- **Wafer Design**
- **Fits ANSI 125, 150, 250, 300**
- **Optional Materials Available**
- **Easy to use size Selection Chart**

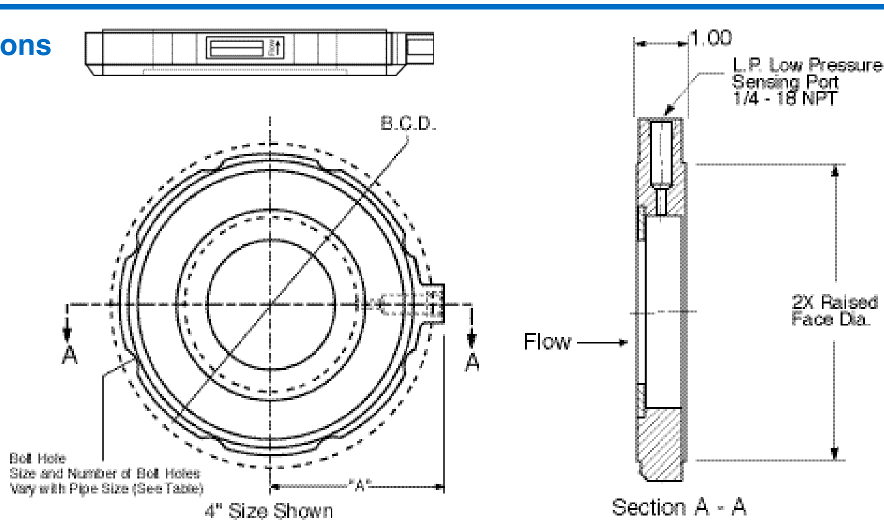
The Cla-Val Model X52E Orifice Plate Assembly is typically used with Cla-Val flow control valves. The orifice plate is an essential component used to generate a specific predictable pressure drop in the system. The X52E uses a wafer design holder which offers a compact lightweight assembly that is easy to install. The X52E has a Chamfered "Inlet" side so even after installation, correct orientation can be easily verified.

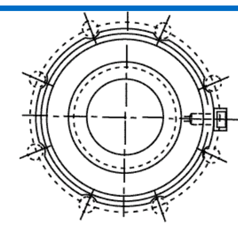
The orifice plate portion of the assembly is made of 302 stainless steel wi t h other materials optional. The plate is machined to a recommended "square edge". The plate holder portion of the assembly is Ductile Iron standard. Fusion-bonded epoxy coating is an option. The holder may be made of other materials.

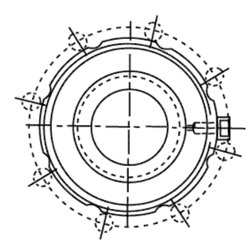
Selecting an orifice plate bore size is made by using charts provided.

We recommend installation of this assembly with the sensing port to the side of the pipeline to prevent air pockets and obstructions in the sensing line. Installation adjacent to a butterfly valve is not recommended as the orifice plate assembly may interfere with the opening of this type of valve.

Dimensions




150 LB CONFIGURATION


300 LB CONFIGURATION

NOMINAL PIPE SIZE (inches)		1½	2	2½	3	4	6	8	10	12	14	16
Diameter of Flange		3.63	4.25	5.00	5.75	7.00	9.75	12.00	14.12	16.50	19.00	21.12
Diameter of Raised Face		2.88	3.63	4.13	5.00	6.19	8.50	10.63	12.75	15.00	16.25	18.50
"A" Dim from CL to top of boss		2.31	2.62	3.00	3.38	4.00	5.38	6.50	7.62	8.75	10.00	11.06
Diameter of Bolt Circle (B.C.D.)		3.88	4.75	5.50	6.00	7.50	9.50	11.75	14.25	17.00	18.75	21.25
150 Lb.	Number of Bolts	4	4	4	4	8	8	8	12	12	12	16
	Radius of Bolt Holes	.31	.38	.38	.38	.38	.44	.44	.50	.50	.56	.56
300 Lb.	Diameter of Bolt Circle	4.50	5.00	5.50	6.63	7.88	10.63	13.00	15.25	17.75	20.25	22.50
	Number of Bolts	4	8	8	8	8	12	12	16	16	20	20

Sizing An Orifice Plate Bore

1. In determining a bore size, the nominal flow rate (or range of flow) and the pipe size in which the orifice plate assembly will be installed, must be known.
2. Sizing a bore for:

   A constant flow rate:

   Select the sizing chart that matches pipe size and locate the flow rate under the nominal column which is closest to required flow; select the corresponding bore size dimension.

Example:
A 6" pipe with a desired constant flow of 700 GPM. Using the 6" chart, the closest flow in the nominal column is 670 GPM which has a corresponding bore size of 3.80".

6" Valve/Pipe Size

Bore	Flow — GPM		
Size	Min	Max	Nominal
4.60	490	1960	1100
4.40	435	1740	980
4.20	380	1520	850
4.00	330	1320	750
3.80	300	1200	670
3.60	265	1060	590
3.40	230	920	520
3.20	200	800	450
3.00	175	700	395
2.80	150	600	340
2.60	130	520	295
2.40	110	440	245

A flow range:

Select the sizing chart that matches pipe size and locate required flow range between the minimum and maximum limits of an orifice bore. Frequently the flow range will fit between more than one bore size. To resolve this, decide the flow rate that system will be operated at most frequently. Locate the flow which is closest to this under the nominal flow column, and select the corresponding bore size dimension.

Example:
A 6" pipe with a flow range of 300-1000 GPM. Using the 6" chart, more than one bore size can accommodate this range. The most frequent flow rate will be 500 GPM. Using the nominal flow column, the closest flow is 670 GPM which has a corresponding bore size of 3.40"

6" Valve/Pipe Size

Bore	Flow — GPM		
Size	Min	Max	Nominal
4.60	490	1960	1100
4.40	435	1740	980
4.20	380	1520	850
4.00	330	1320	750
3.80	300	1200	670
3.60	265	1060	590
3.40	230	920	520
3.20	200	800	450
3.00	175	700	395
2.80	150	600	340
2.60	130	520	295
2.40	110	440	245

Orifice Plate Bore Chart

2"* Valve/Pipe Size

Bore	Flow — GPM		
Size	Min	Max	Nominal
1.55	55	220	125
1.50	50	200	115
1.40	42	168	95
1.20	29	116	65
1.00	19	76	45
.80	12	50	28

*For 1 1/2" bore information please consult the factory

2 1/2" Valve/Pipe Size

Bore	Flow — GPM		
Size	Min	Max	Nominal
1.87	80	330	180
1.60	55	220	120
1.40	40	160	88
1.20	28	115	62
1.00	19	80	43
.80	12	50	28

3" Valve/Pipe Size

Bore	Flow — GPM		
Size	Min	Max	Nominal
2.29	120	480	270
2.20	105	420	240
2.00	84	336	190
1.80	65	260	145
1.60	50	200	115
1.40	38	152	86
1.20	28	112	62
1.00	19	76	43

4" Valve/Pipe Size

Bore	Flow — GPM		
Size	Min	Max	Nominal
3.00	205	820	450
2.80	170	680	390
2.60	140	560	310
2.40	115	460	260
2.20	96	384	215
2.00	78	312	175
1.80	63	252	140
1.60	49	196	110
1.40	38	152	84
1.20	28	112	62

6" Valve/Pipe Size

Bore	Flow — GPM		
Size	Min	Max	Nominal
4.60	490	1960	1100
4.40	435	1740	980
4.20	380	1520	850
4.00	330	1320	750
3.80	300	1200	670
3.60	265	1060	590
3.40	230	920	520
3.20	200	800	450
3.00	175	700	395
2.80	150	600	340
2.60	130	520	295
2.40	110	440	245

8" Valve/Pipe Size

Bore	Flow — GPM		
Size	Min	Max	Nominal
6.00	830	3320	1850
5.80	760	3040	1700
5.60	680	2720	1550
5.40	620	2480	1400
5.20	570	2280	1275
5.00	515	2060	1150
4.80	470	1880	1050
4.60	425	1700	950
4.40	385	1540	860
4.20	345	1380	780
4.00	310	1240	700

10" Valve/Pipe Size

Bore	Flow — GPM		
Size	Min	Max	Nominal
7.50	1300	5200	2900
7.00	1075	4300	2400
6.50	880	3520	1950
6.00	730	2920	1650
5.50	600	2400	1350
5.00	490	1960	1100
4.50	390	1560	870
4.00	310	1240	690
3.50	235	940	525
3.00	175	700	385

12" Valve/Pipe Size

Bore	Flow — GPM		
Size	Min	Max	Nominal
9.00	1850	7400	4200
8.50	1575	6300	3500
8.00	1350	5400	3000
7.50	1150	4600	2600
7.00	980	3920	2200
6.50	840	3360	1875
6.00	700	2800	1575
5.50	580	2320	1300
5.00	480	1920	1075
4.50	385	1540	870

14" Valve/Pipe Size

Bore Size	Flow — gpm Min	Max	Nominal
10.00	2350	9400	5200
9.50	2025	8100	4500
9.00	1750	7000	3900
8.50	1500	6000	3400
8.00	1300	5200	2900
7.50	1150	4600	2500
7.00	960	3840	2150
6.50	820	3280	1850
6.00	700	2800	1550
5.50	585	2340	1300
5.00	480	1920	1075
4.50	385	1540	860

18" Valve/Pipe Size

Bore Size	Flow — gpm Min	Max	Nominal
13.00	5200	15500	9000
12.00	4100	12300	7100
11.50	3700	11000	6400
11.00	3300	9850	5700
10.50	2950	8800	5100
10.00	2600	7850	4550
9.50	2350	6200	3600
9.00	2100	6200	3600
8.50	1850	5500	3200
8.00	1650	4850	2800
7.50	1400	4250	2450
7.00	1250	3650	2100

24" Valve/Pipe Size

Bore Size	Flow — gpm Min	Max	Nominal
17.00	8500	25500	15000
16.00	7500	21500	12500
15.00	6100	18400	10500
14.50	5700	17000	9800
14.00	5200	15600	9000
13.50	4800	14400	8300
13.00	4400	13200	7600
12.50	4000	12100	7000
12.00	3700	11100	6400
11.50	3400	10100	5800
11.00	3100	9200	5300
10.50	2800	8300	4800
10.00	2500	7500	4400

16" Valve/Pipe Size

Bore Size	Flow — gpm Min	Max	Nominal
11.50	3100	12400	7000
11.00	2700	10800	6100
10.50	2400	9600	5400
10.00	2100	8400	4700
9.50	1850	7400	4200
9.00	1650	6600	3650
8.50	1450	5800	3250
8.00	1250	5000	2850
7.50	1100	4400	2450
7.00	950	3800	2150
6.50	810	3240	1800
6.00	700	2800	1550
5.50	575	2300	1300

20" Valve/Pipe Size

Bore Size	Flow — gpm Min	Max	Nominal
14.00	6000	18000	10500
13.50	5300	16000	9500
13.00	4800	14500	8500
12.50	4300	12900	7500
12.00	3900	11700	6700
11.50	3400	10500	6100
11.00	3200	9500	5500
10.50	2900	8600	5000
10.00	2600	7700	4500
9.50	2300	6100	3600
9.00	2000	6100	3600
8.50	1800	5400	3200

36" Valve/Pipe Size

Bore Size	Flow — gpm Min	Max	Nominal
26.00	20000	60000	35000
24.00	16000	48500	28000
22.00	13000	39000	22500
21.00	12000	35000	20500
20.00	10500	31000	18000
19.00	9500	28000	16000
18.00	8500	24500	14500
17.00	7500	22000	12500
16.00	6500	19300	11000
15.00	5600	16900	9800
14.00	4900	14600	8500
13.00	4200	12600	7300

CLA-VAL
PO Box 1325 Newport Beach CA 92659-0325
Phone: 949-722-4800 • Fax: 949-548-5441

CLA-VAL CANADA
4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040

CLA-VAL EUROPE
Chemin dés Mesanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50
www.cla-val.com

Represented By:

X-52 Series Orifice Assemblies

The X52 Series Orifice Assembly consists of a calibrated, precision-machined orifice plate and flange holder. It is typically supplied with 40 Series valves. Flange holder material is same as main valve body. The 1/8" thick orifice plate (X55A) is made of 303 Stainless Steel with 316 Stainless Steel optional. Small screws hold the orifice plate into the holder (at approximately half the thickness of holder) on X52B and X52D-1 assemblies. The orifice plate is staked in place (at inlet side) on X52A-1 and X52E assemblies. The X52 is assembled prior to epoxy coating when an epoxy coated main valve is specified (orifice bore is masked). Pressure class (125/150 or 250/300) must be specified for proper fit in pipeline. X52E is a wafer style redesign of the X52A-1 and is suitable for 150 and 300 class flanges.

Cat. No.	Dwg.	Sensing Holes	Thickness	Comments
X52E	201278	One 1/4" NPT for downstream sensing	1"	NEW wafer style assembly. Replaces X52A-1(after Jan 2001). Suitable for 150 and 300 class flanges. Used with CDHS-18 pilot Intended for downstream of valve.
X52A-1	81225	One 1/4" NPT for downstream sensing	1"	Current assembly. Replaced old 2 sensing hole assembly when we changed pilot from CDHS-2 to CDHS-18. (circa mid 1970's) Intended for downstream of valve.
X52B	41241	Two 1/8" NPT for sensing DP	3/4"	Obsolete. For AF valves and available in aluminum or steel only. Used with CDHS-2 pilot. Intended for upstream of valve.
X52D-1	43831	-Two 1/8" NPT for sensing DP -One 1/2" NPT for pilot supply	1 1/2"	Current assembly. Used with CDHS-2 pilot. Intended for upstream of valve.

X55A is catalog number for orifice plate used in X52 assemblies. Typically used for replacement in existing holders or for installation in customer supplied flange holder.

X55B is catalog number for paddle type orifice plate installed between two pipe flanges. Paddle handle is stamped with bore size. For flow control applications, two pipeline tap connections for pilot valve sensing must be customer supplied. When used for cavitation control it is typically mounted downstream of control valve. Pressure class (125/150 or 250/300) must be specified for proper fit in pipeline.

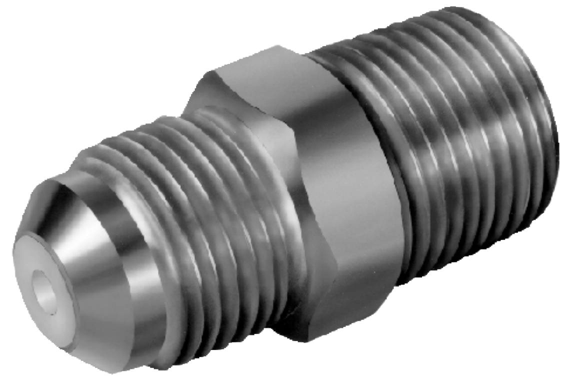
CLA-VAL

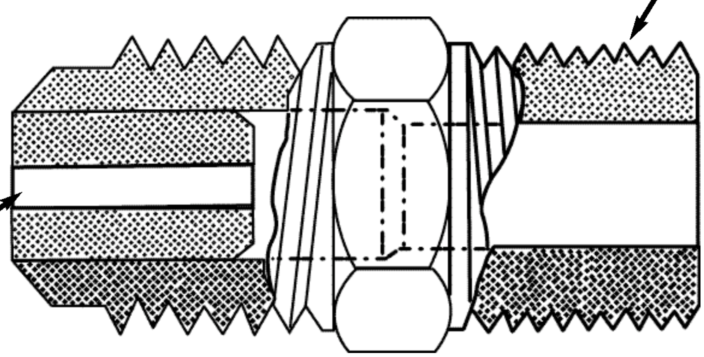
— MODEL — **X58C**

Restriction Assembly

Description

The Cla-Val Model X58C Restriction Assembly is composed of a modified standard (45 degree flare) tube connector with a precision delrin orifice fitting installed. Flow direction is from tube to pipe connections. Orifice size color code is stained onto brass tube connector wrench flats. The X58C is installed as a part of pilot control systems on Cla-Val Valves.





Note: No replacement parts available - to be sold as complete assembly only.

When ordering please specify: Valve size, Stock Number

X58C Pilot System Orifice Restriction Fittings

SUITABLE FOR 3" AND SMALLER VALVES (BLUE)

Size TxNPT	Orifice	Mat'l	Part Number
3/8" x 3/8"	.094 (3/32)	BP	68565B (std)
3/8" x 3/8"	.094 (3/32)	BS	9932901D
3/8" x 3/8"	.094 (3/32)	TP	9787003E (SWS)
3/8" x 3/8"	.094 (3/32)	TS	9787015J
3/8" x 3/8"	.062 (1/16)	BP	46946A
3/8" x 3/8"	.062 (1/16)	BS	64672K
3/8" x 3/8"	.062 (1/16)	TP	9787001J

SUITABLE FOR 4" AND LARGER VALVES (RED)

Size TxNPT	Orifice	Mat'l	Part Number
3/8" x 3/8"	.125 (1/8)	BP	64673H (std)
3/8" x 3/8"	.125 (1/8)	BS	4883405F
3/8" x 3/8"	.125 (1/8)	TP	9787002G (SWS)
3/8" x 3/8"	.125 (1/8)	TS	9787016G
3/8" x 3/8"	.188 (3/16)	BP	43302K

Made from Tube Connector (Male Tube x Male NPT)

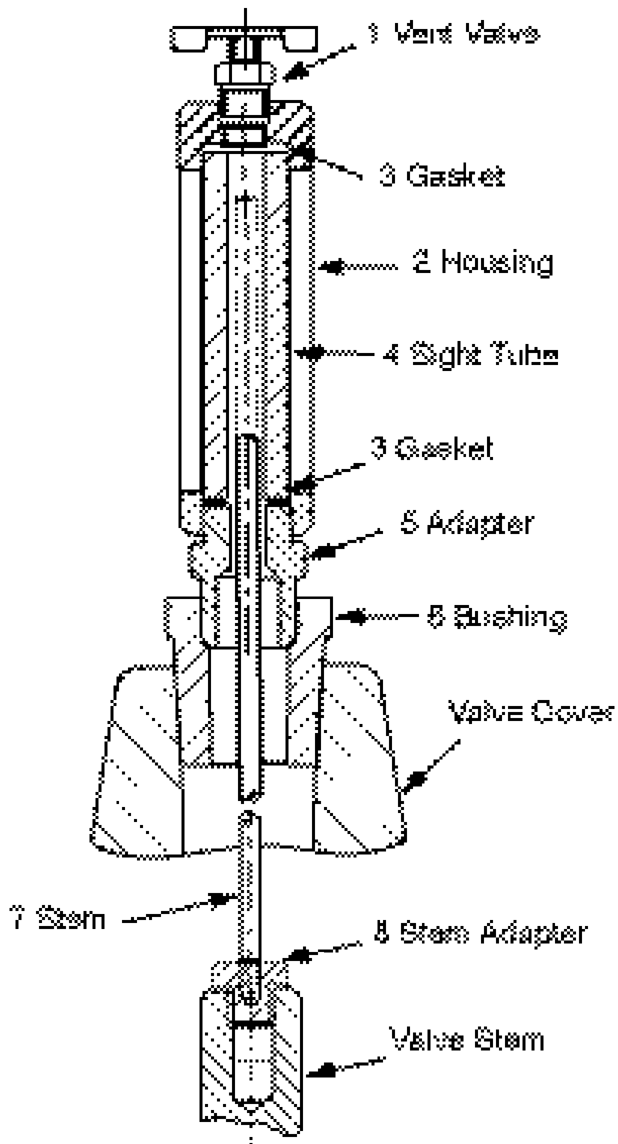
Material CODE
1st letter = fitting, 2nd letter = orifice insert
B = Brass
P = Delrin Plastic
S = 303 Stainless Steel
T = 316 Stainless Steel Parker fitting

NOTE:
High Differential Pressure (100+dpsi) over time can cause
Delrin orifice to extrude or copper tubing to erode.
Usually recommend upgrade to Stainless Steel.

X-101

Valve Position Indicator

COMPLETE X101- BRONZE SIZE	STOCK NO.
1 1/4 - 1 1/2	C2812A
2	C8972G
2 1/2	C2607E
3	C2609A
4	9710001A
6	9710002J
8	C8581F
10	C9187A
12	31420D
14	30256C
16	30251D



ITEM	DESCRIPTION	MATERIAL
1	Vent Valve	Brass
2	Housing	Brass
3	*Gasket (2 Required)	Buna-N®
4	*Sight Tube	Pyrex
5	Adapter	Brass
6	Busing	Brass
7	Stem	Brass
8	Stem Adapter	Brass

* Repair Kit Parts

When ordering parts, please specify:
- All Nameplate data
- Item Number
- Description
- Material
- Part Number

—MODEL— **X102**

Flow Limiting Assembly & Pilot System Components

X102A

X102B

X102D

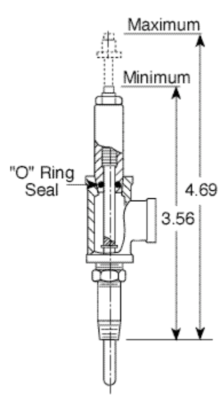
- **Automatic Operation**
- **Corrosion Resistant**
- **No Lubrication**
- **Easy Adjustment**
- **Easy Maintenance**

The Cla-Val Model X102 Flow Limiting Assemblies regulate flow through Cla-Val Automatic Valves from full flow to shut-off. These adjustable assemblies control flow by limiting the amount of the valve opening.

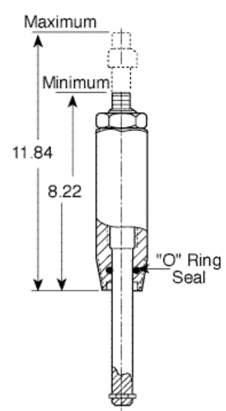
The X102A and X102D maintain a pressure seal during adjustment by means of an internal “O" Ring.

The X102B is pressure sealed by means of an external resilient washer, compressed when the Jam Nut is tightened, after adjustment.

X102A

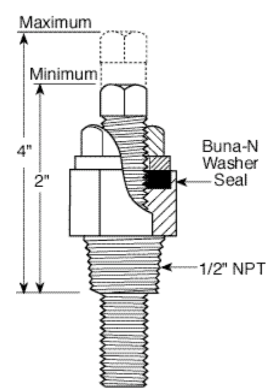


1/2”, 3/4”, 1” Sizes



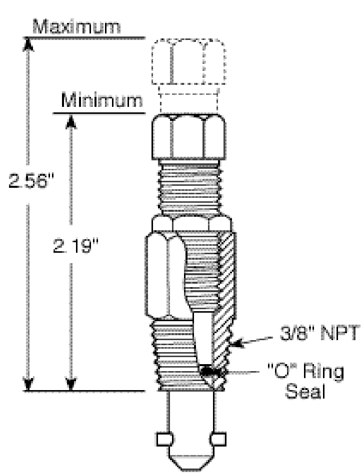
1-1/4” - 10” Sizes

X102B



1 1/4" - 3" 7100 Series Valves

X102D



1" 7100 Series Valves

Specifications

Pressure Ratings:

Valves 1/2" through 3"	150 psi maximum
Valves 4" and 6"	100 psi maximum
Valves 8"	30 psi maximum
Valves 10"	20 psi maximum

Materials:

Body (all models)	Brass
Stem X102A	303 Stainless Steel
X102B	Brass
X102D	Brass

2 – 2

When Ordering, Please Specify

When ordering please specify the following information:

1. Flow Limiting Assembly Catalog Number
2. Valve Catalog Number
3. Valve Size

CLA-VAL

— MODEL — **X103**

Spring Lift

DESCRIPTION

The Spring Lift Assembly is externally mounted on the Clayton valve cover, and houses an extension stem and a compression spring. The upper nd of the extension stem is threaded to provide spring tension adjustment, the lower end is attached to the valve stem.

OPERATION

The Spring Lift Assembly is designed to assure a wide open valve position. This is a normal position when there is no pressure in the main valve cover chamber, under static and during certain flowing conditions. An independent source of operating pressure generally will be required when low line pressure exists.

ADJUSTMENT

CAUTION– The Spring Lift Assembly will pull the valve open should the Independent Operating Pressure Fail. Consult factory for complete details.

Normally, the tension on the spring should be great enough to hold the valve wide open when the system is not in use. This adjustment can be made before the valve is installed. If the valve is installed. If the valve is in the system, remove all pressure before proceeding. (Refer to P-X103 sectional view).

1. Remove cap 1 and nipple 2.
2. Lift the spring lift stem 6 manually. If any upward travel is evident, increase spring tension until no upward travel is felt. If no upward travel is felt it can be assumed the adjustment has been made. However, to insure that too much tension has not been applied previously, decrease the spring tension until an upward travel can be felt when pulling on the spring stem; then carefully increase the spring tension until the upward travel has been removed.

To increase spring tension:

1. Loosen jam nut 3.
2. Turn lower adjusting nut clockwise until proper tension is obtained.
3. Tighten jam nut 3.
4. Replace nipple 2 and cap 1.

To decrease jam nut 3.

1. Loosen jam nut 3.
2. Turn lower adjusting nut counter-clockwise until proper spring tension is obtained.
3. Tighten jam nut 3.
4. Replace nipple 2 and cap 1.

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

CLA-VAL

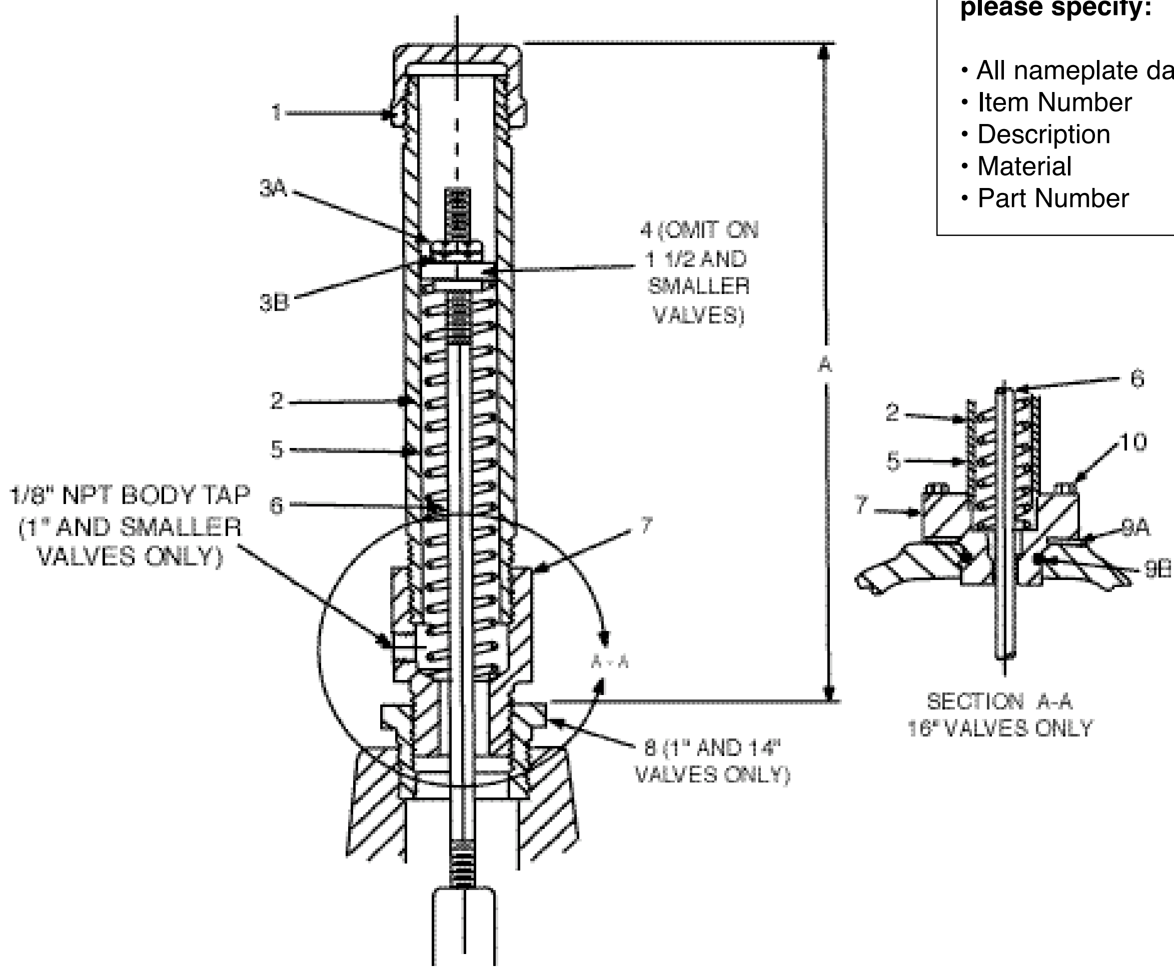
X103

Spring Lift

CAUTION– The Spring Lift Assembly will pull the valve open should the Independent Operating Pressure Fail. Consult factory for complete details.

When ordering parts, please specify:

- All nameplate data
- Item Number
- Description
- Material
- Part Number

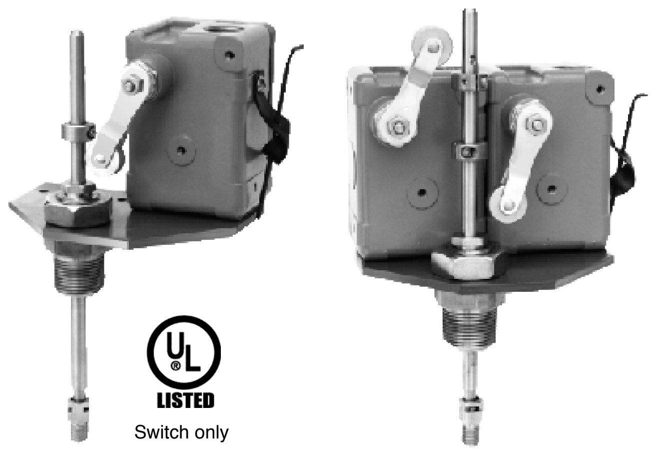


PARTS LIST — DIMENSIONS

ITEM NO.	DESCRIPTION	Valve Size - Inches	Dimension A
1	Pipe Cap	1/2 - 3/4 - 1	3.75
2	Nipple	1 1/2	3.31
3	Nut	2- 2 1/2	3.75
4	Spring Guide	3	6.13
5	Spring	4	7.25
6	Stem	6	9.13
7	Body	8	10.00
8	Pipe Bushing	10	17.50
9	Gasket	12	26.50
10	Cap Screw	14	24.00
		16	19.50

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

Limit Switch Assemblies

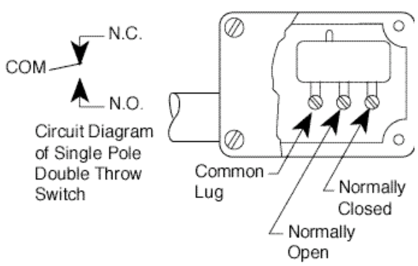


- **UL Listed Switches**
- **Positive Action**
- **Rugged and Dependable**
- **Weather Proof or Explosion Proof**
- **Easy To Adjust**

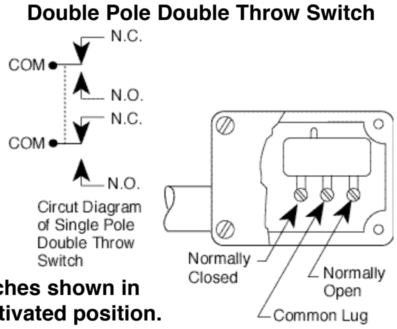
The Cla-Val Model X105L/X105L2 Limit Switch Assembly is a rugged, dependable and positive acting switch assembly actuated by the opening or closing of a Cla-Val control valve on which it is mounted. The single pole, double throw micro switch can be connected either to open or to close an electrical circuit when actuated. By loosening the allen screw on the actuating collar and raising or lowering the collar on the stem, the X105L is easily adjusted to signal that the valve has fully reached the desired position (open or closed).

Installation

Single Pole Double Throw Switch



Double Pole Double Throw Switch

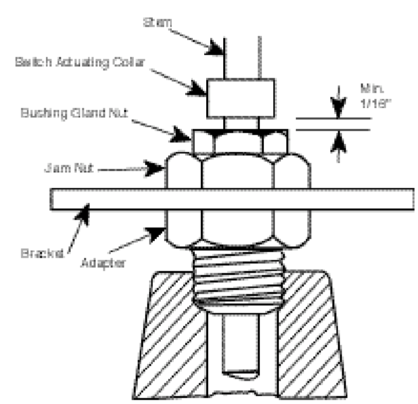


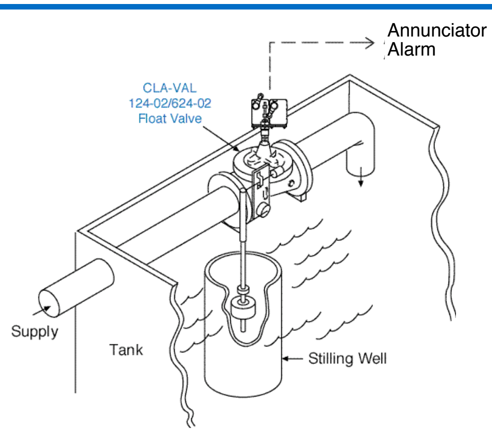
Switches shown in unactivated position.

1. Remove plug in top of valve cover.
2. Screw actuating stem into main valve stem.
3. Slip adapter down over stem and screw into place on valve cover.
4. Attach micro switch housing and bracket to adapter with jam nut.
5. Bring electrical supply circuit into unit through the 1/2" tapping in micro switch housing.
6. Adjust switch collars. (Set collar to trip switch after valve is positioned fully open or fully closed)

**Actuating Collar Adjustment
Minimum Setting**

When adjusting actuating collar for proper switch action, a clearance of at least 1/16" (1/8" for 24" valve) must be provided between the collar and the bushing gland nut when valve is in the fully closed position.

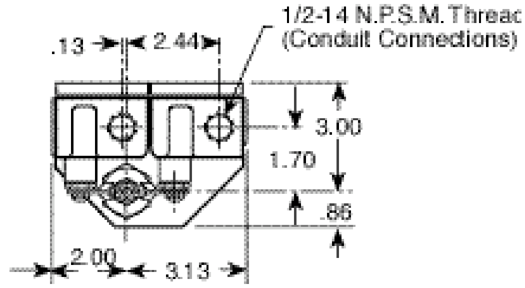




Typical Application

Used for any electrical operation which can be performed by either opening or closing a switch; such as alarm systems, process control, pump control, motor starting or stopping, etc. Readily attached to most Cla-Val Valves.

Dimensions (In Inches)



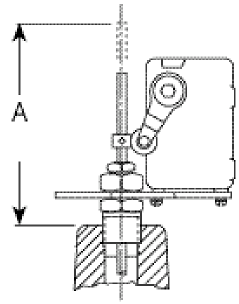


Fig. 2
Valve Size
1 1/4" Thru 24"
X105LCW
X105LCX

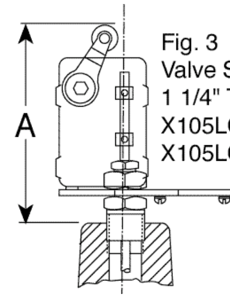


Fig. 3
Valve Size
1 1/4" Thru 8"
X105LOW
X105LOX

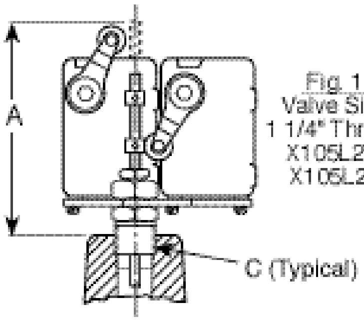


Fig. 1
Valve Size
1 1/4" Thru 8"
X105L2W
X105L2X

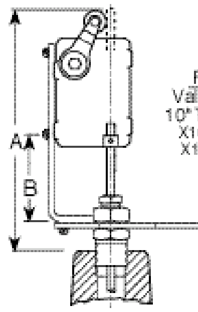


Fig. 4
Valve Size
10" Thru 24"
X105LOW
X105LOX

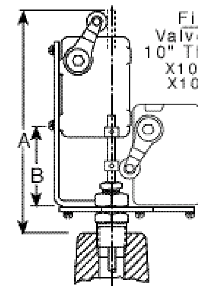


Fig. 5
Valve Size
10" Thru 24"
X105L2W
X105L2X

VALVE SIZE	11/4" & 11/2"	2" & 21/2"	3"	4"	6"	8"	10"	12"	14"	16"	20"	24"
Dim "A"	10.19	7.16	7.34	7.00	6.69	6.91	9.88	9.59	9.16	10.78	10.78	10.78
Dim "B"						1.69	2.44	2.94	2.94	2.94	2.94	2.94
C (NPT)	1/4	1/2	1/2	3/4	3/4	1	1	11/4	11/2	2	2	2

Specifications

Materials: Aluminum switch housing
Steel bracket and brass adapter
Stainless steel stem

Electrical: 1/2" Conduit connection

Switch Type: SPDT UL, File No. E12252,
CSA Certified, File No. LR57325
Weather proof
NEMA 1,3,4, and13

Switch Rating: UL/CSA rating: L96
15 amp. 125, 250, or 480 volts AC
1/2 amp. 125 volts DC
1/4 amp. 250 volts DC

Switch Options: DPDT switches available on request
UL/CSA Rating: L59, 10 amps

Explosion proof micro switches are NEMA 1,7, and 9
UL Listed, File No. E14274 and CSA Certified, File No. LR57324: Class I, Group C and D and Class II, Group E, F and G.

When Ordering, Please Specify

1. Valve Size
2. Catalog Number from Table Below
3. All Valve Name Plate Data
4. Select Single or Double Pole Switch
5. Explosion Proof or Weather Proof Type Enclosure
6. Amperes and Voltage, AC or DC
7. Actuating Position (Valve Open or Closed)

CATALOG NO.	ACTUATION POSITION	SWITCH ENCLOSURE
X105LCW	Valve Closed	Weather Proof
X105LCX	Valve Closed	Explosion Proof
X105LOW	Valve Open	Weather Proof
X105LOX	Valve Open	Explosion Proof
X105L2W	Dual	Weather Proof
X105L2X	Dual	Explosion Proof

2 – 2

CLA-VAL
PO Box 1325 Newport Beach CA 92659-0325
Phone: 949-722-4800 • Fax: 949-548-5441

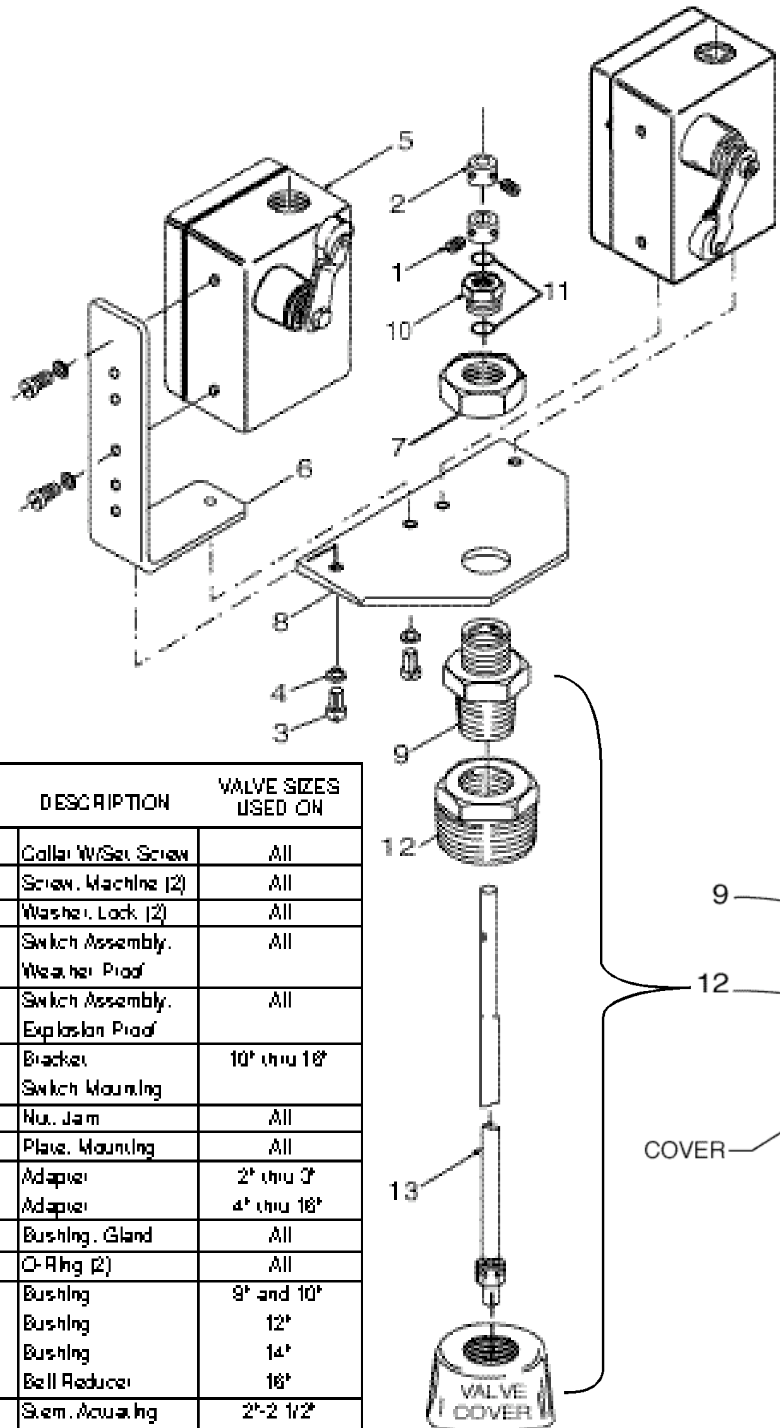
CLA-VAL CANADA
4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040

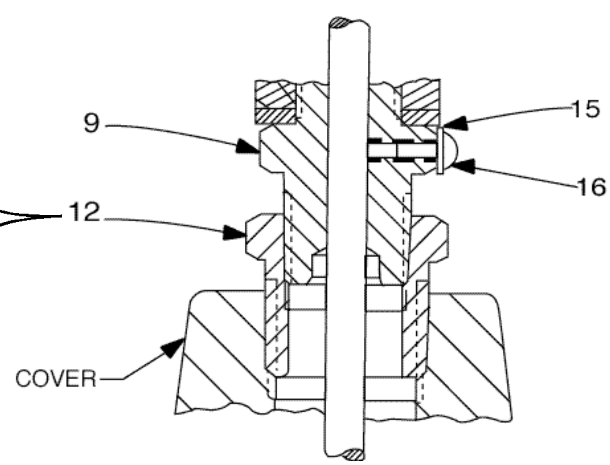
CLA-VAL EUROPE
Chemin dés Mesanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50
www.cla-val.com

Represented By:

X105L

Limit Switch Assembly





ITEM	PART NUMBER	DESCRIPTION	VALVE SIZES USED ON
1-2	90047-01C	Collar W/Set Screw	All
3	67579-21B	Screw, Machine (2)	All
4	67594-23F	Washer, Lock (2)	All
5	34607K	Switch Assembly, Weather Proof	All
	34603J	Switch Assembly, Explosion Proof	All
6	64310G	Bracket Switch Mounting	10" thru 16"
7	67915-08J	Nut, Jam	All
8	60674G	Plate, Mounting	All
9	2939201J	Adapter	2" thru 3"
	2939202G	Adapter	4" thru 16"
10	60399C	Bushing, Gland	All
11	00951E	O-Ring (2)	All
12	67644-17K	Bushing	9" and 10"
	67644-19H	Bushing	12"
	67644-19F	Bushing	14"
	67656-91J	Bell Reducer	16"
13	99701-01F	Stem, Actuating	2"-2 1/2"
	99701-02D	Stem, Actuating	3"-4"
	99701-03B	Stem, Actuating	6"-8"
	99701-04K	Stem, Actuating	10"-12"-14"
	99701-05G	Stem, Actuating	16"
15	6551201H	Fiber Wshr	All
16	6924421K	Screw 9-32 x 3/8	All

When ordering parts, please specify:

- Item Number
- Description
- Part Number

X105L Series Adjustment Procedure

Applies to ALL X105L, X101C, X117C and X117D Series Assemblies

Bleed Air Procedure

When bleeding air out of valve cover chamber, loosen small bleed screw on Adapter (it is found on one of the large wrench flats) enough to allow air to slowly bleed from the valve cover. Do not take screw out. When a steady flow of water occurs retighten screw.

If X105L does not have bleed screw (before 1998) then use the following procedure. First, lower valve pressure below 60 psi. Loosen gland-bushing enough to allow air to slowly bleed through the threads. Do not unscrew gland-bushing too far, this will dislodge the sealing O-ring. When the gland-bushing is retightened, it can easily damage the O-ring. When a steady flow of water occurs, slowly retighten gland-bushing by hand only till no water comes out. With wrench, tighten only one-half turn or until snug. Do NOT over tighten. If water continues to leak, then the O-ring is damaged and needs to be replaced (Part number 00951E).

INITIAL ADJUSTMENT

For X105LCW, X105LCX, X117DLCW and X117DLCX Assemblies:

1. Valve must be in fully CLOSED position.

2. Adjust "roller arm" so that the wheel is close to but not touching the vertical valve actuating stem. The arm should be angled downward towards the stem.

3. Place collar on stem above wheel. Move collar down until it pushes roller away from actuating stem enough to activate switch. You should be able to hear the "click" of the switch when this occurs. Without moving collar, tighten its screw to fasten it in this position on the actuating stem. The collar should trip the switch just before the valve is fully closed.

4. A minimum gap is required of 1/16" (1/8" for 24" valves) between the collar and the gland-bushing when the valve is in the closed position. The disc in the diaphragm assembly compresses when the main valve is pressurized in the closed position. This causes the actuating collar to move closer to the gland-bushing. If sufficient spacing is not provided, the force generated causes the swivel to break and the roll pin to shear off. When this occurs, the actuating stem should be replaced.

— MODEL — **X117C**

Valve Position Transmitter

DESCRIPTION

The Model X117C Valve Position Transmitter is designed to provide analog signal (4 - 20 mA, 2 wire) output of valve position for Cla-Val Main Valves. A stem extension is fitted to the main valve stem with the position transmitter mechanically linked to it. The valve stem is mechanically linked to the electronics for an output signal that is in direct proportion to valve position. Optional limit switches (2 SPDT or 2 DPDT) are provided on the Model X117CLS for signaling when valve has reached fully open or closed position. Provisions are made for bleeding air from valve cover through a small bleed screw and washer located on one wrench flat of adapter.

INSTALLATION

Normally, the X117C is supplied mounted on the Cla-Val main valve. If X117C has not been installed at factory, then install stem, adapter, mounting bracket and transmitter (in order) as shown on drawing 16767. Necessary field setting of the X117C requires some adjustment to the position of the transmitter relative to the stem and the spool, so you may need to loosen transmitter on the bracket. Refer to Drawing No. 16767.

OPERATION

The signal from the position sensing linkage mechanism is converted to a two-wire 4 to 20 mA current output appearing at the output terminals. The voltage compliance range is 12.5 to 40 Volts DC. Initial resistance will range from 975 ohms at transmitter full over travel (Valve open) to 500 ohms at transmitter free position (Valve closed)

Wiring

Orient transmitter and bracket to conduit. Loosen jam nut holding transmitter and bracket to adapter for connecting transmitter to field wiring conduit. Tighten jam nut after connection is made. After unthreading housing from transmitter connect wires to OUTPUT screw terminals. DO NOT USE HOUSING AS WIRING PULLBOX.

Use good field wiring practices for low voltage DC analog instrumentation wiring (suggest 18-gage multistrand wire minimum). Avoid potential ground loops. See drawing for typical wiring connections. Calibration of transmitter should be done with a temporary hookup of test equipment before final wiring connections are made. The enclosure is NEMA rated 1, 3, 4, 4X, 6, 6P, 7, 9, and 13. Appropriate measures should be taken to avoid internal condensation.

CALIBRATION

1. When properly adjusted, the transmitter arm TOTAL arc of travel, as valve moves from full closed to full open will be approximately 60 to 70 degrees. Thus, the transmitter-actuating arm will be horizontal when the valve is halfway open (approximately 30 degrees up and 30 degrees down). At valve closed position the transmitter will have a 4 mA output and at fully open position the transmitter will have a 20 mA output.

2. You will need the following tools to calibrate and align the X117C:
   A.) A small flat blade screwdriver to fit the span and null potentionmeters.
   B.) A ruler for measuring location of transmitter arm and valve actuating stem and spool.

   C.) A 4-20 mA calibration/tester or multiamp-tester/meter or some means of measuring the 4-20 mA transmitter output,
   D.) A small (9/64 inch) hexagon key wrench to fit the transmitter adjustable roller arm,
   E.) A small (3/32 inch) hexagon key wrench to fit the spool setscrew,
   F.) Hand tools to tighten X117C assembly after calibration is complete.

IMPORTANT CAUTION: The transmitter does not have over travel stops. Use care to insure that rotary travel does not exceed 80 degrees from "center" (free) position in either direction during start up and operation. Damage to the transmitter could occur.

3. Make preliminary mechanical settings (Refer to Drawing No. 16767). Be sure that the valve is in the fully closed position. See Technical Manual for main valve for information on this. Be sure that line isolation or block valves are closed. Be sure that the Function Switch in the transmitter is in the “CW" position.

4. Adjust bracket and transmitter to preliminary centerline distance “C" for valve size. See Table. This is distance between valve actuating stem centerline (actuates vertically up and down) and transmitter actuating arm pivot centerline (rotates vertically up and down). Install spool on actuating stem.

5. Position the actuating arm. With valve in closed position, loosen setscrews on spool and actuating arm. First, completely loosen actuating arm adjusting screw to allow the knurled shaft of the transmitter to return to "center" (free) position. Then, adjust actuating arm in or out on the knurled shaft so that the actuating arm roller is making good contact with the lower lip of the spool and does not contact the center of the spool. The actuating arm should be about 30 degrees down from pivot horizontal centerline.

After loosening the setscrew, move the spool by hand (up and down) to check that the roller and spool are in alignment throughout entire valve stroke. The actuating arm should not be moved more than 30 degrees up or down from horizontal centerline of knurled shaft. The centerline of the roller should not be past the lower lip or rim of the spool at any valve position. You may have to adjust the length of the actuating arm when doing this.

You will feel the spring restoring force of the transmitter as you do this step. This restoring force allows the roller to maintain contact with the lower lip of the spool throughout the entire valve stroke. The spool must now be adjusted into place by moving the spool slightly (approximately 1/4") upward to engage this spring force. Tighten spool setscrew when the actuating arm is angled about 30 degrees downward.

6. Remove transmitter cover and temporarily connect calibration wiring equipment (milliamp meter and power supply or portable instrumentation calibrator/tester to transmitter screw terminals.).

Refer to calibration equipment and adjust potentiometer marked “NULL" until the meter reads 4 mA. A clockwise turn increases output. Use care in adjusting the potentiometer by not pressing in on the adjusting stem while turning the screwdriver. This will affect the reading.

ALTERNATE METHOD: Loosen setscrew on spool and adjust until its centerline is lined up with centerline of transmitter actuating arm pivot centerline (actuating stem and actuating arm should be at 90 degrees to each other). Mark top and bottom of spool location on stem at this ‘halfway’ position. Determine valve stroke by multiplying .281 times the valve <u>seat</u> diameter. Measure half the valve stroke down from bottom of the spool and mark the stem. Move the spool down until the bottom of the spool is aligned with the new mark on the stem. Tighten the spool setscrew. Loosen the screw that holds roller arm in place and move roller arm end into spool. Adjust location of transmitter on bracket so that roller is in place inside spool and slightly touching the bottom lip or rim of spool. The transmitter spring restoring force helps locate the roller on the lower lip of the spool throughout the entire valve stroke. The roller arm should be at an angle of between 30 and 40 degrees below the horizontal centerline of the pivot arm.

7. For the most accurate calibration it is necessary to open valve fully. **<u>CAUTION</u>**: This will either allow a high flow rate through the valve, or the downstream pressure will quickly increase to the inlet pressure. In some cases, this can be very harmful. Where this is the case, and there are no block valves in the system to protect the downstream piping, it should be realized that steps should be taken to remedy this situation before proceeding further. Normally, block valves are to be used to protect downstream piping while the valve is in the open position. Close downstream block valve. Vent cover chamber to atmosphere. Slightly open inlet block valve. Allow valve to open while fluid is vented from cover chamber. When flow stops valve is in the fully open position. Note: continuous leakage from cover chamber could mean additional troubleshooting of the main valve or pilot system must be done.

8. With valve in fully open position, inspect position of spool and roller arm. Actuating arm roller should be making good contact with the lower lip or rim of the spool and the centerline of the roller should not be past the lower lip or rim of the spool (see Step 5). Adjust if necessary.

Refer to calibration equipment (see Step 6) and adjust potentiometer marked “SPAN" until the meter reads 20 mA. A clockwise turn increases output. Use care in adjusting the potentiometer by not pressing in on the adjusting stem while turning the screwdriver. This can affect the reading.

ALTERNATE METHOD: If it is not possible to cycle valve position without damage, then with valve remaining in the “valve closed" position loosen the spool piece setscrew and slide spool upward to the original “halfway” marks on the stem. Adjust the “SPAN” potentiometer until the meter reads 12 mA. Slide the spool piece down until the meter reads 4 mA and tighten setscrew on spool. This method is less accurate than fully cycling valve but will work.

9. There is some interplay between: 1.) The “span” and “null” settings, 2.) The 4 to 20 mA signal and, 3.) The actual valve open and closed positions. Repeat steps above. Cycle valve from open to closed positions and check settings as necessary to achieve desired valve position signal accuracy.

10. Remove all calibration equipment and attach permanent wiring. Recheck wiring and output signals at remote location. See **Wiring** section. Reinstall housing on transmitter. Recheck and tighten all fasteners. Bleed air from main valve cover through small bleed screw and washer located on one wrench flat of adapter.

ADJUSTING OPTIONAL LIMIT SWITCHES

These switches are supplied with X117CLS models and are factory set to operate at valve closed position.

1. Lift cam follower arm.

2. Move cam wheel axially to disengage teeth on wheel from teeth on shaft disc.

3. Turn cam wheel to desired position. Turning in direction of shaft rotation advances operate point. Pretravel **decreases** and over travel thereby **increases**. Each notch on the cam wheel represents an operating point change of 7 degrees 20 seconds arc. The symbols on the cam wheel simplify changing rotation from clock wise to counterclockwise to center neutral, or vice versa.

The switch operates on clockwise **and** counterclockwise rotation, the pointer on the cam follower lines up with symbol [I\ ] or symbol [/I] on the cam wheel. Maximum pretravel of 15 degrees occurs when symbol [/I] lines up. Maximum pretravel of 80 degrees occurs when symbol [I\ ] lines up. Operation is in the direction of the inclined surface of the symbol when [I\ ] or [/I] lines up with the pointer on the cam follower.

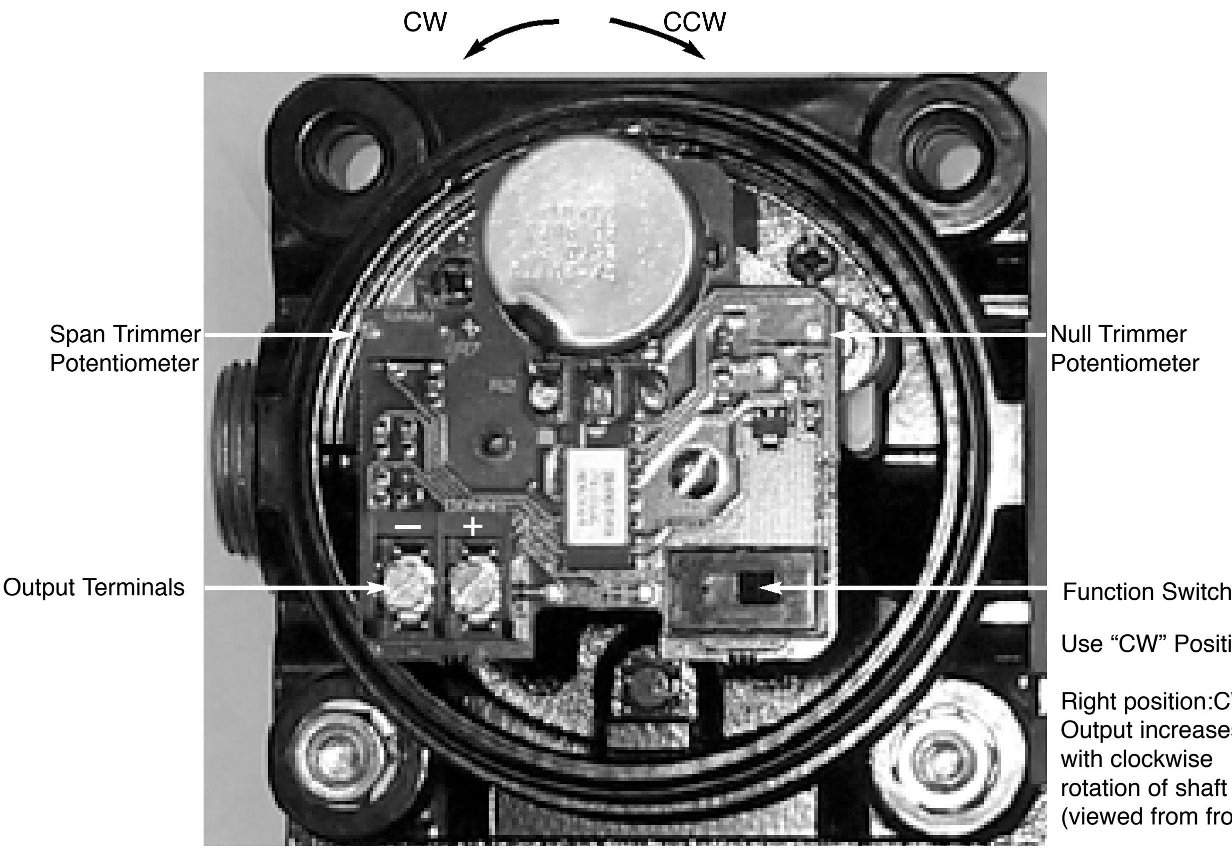
4. When cam wheel has been rotated to desired location, release cam wheel to engage with mating shaft disc.

5. Release cam follower arm.

MAINTENANCE

The X117C and X117CLS are constructed of durable materials which normally requiring no lubrication or periodic maintenance. The two 'O' rings (2) (p/n 00951E) in the adapter (5) that seal against the stainless steel actuating stem (1) will need replacement if signs of leakage at the stem occur.

For replacement circuit board use p/n 3080206A. When installing a new circuit board be sure that the small black and white plastic bearing piece connecting the X117C main shaft to the circuit board mounted potentiometer shaft remains in the transmitter housing. It is not part of the replacement circuit board.



Use "CW" Position

Right position:CW
Output increases with clockwise rotation of shaft (viewed from front).

Left position:CCW
Output increases with counter-clockwise rotation of shaft (viewed from front).

Figure 2. Rear View with Cover Removed

REFERENCE:

Valve Size (inch)		"C" Dim. (inch)
100 Series	600 Series	
1 1/4 & 1 1/2		.60
2		.75
2 1/2		.88
3	4	1.00
4	6	1.13
6	8	1.50
8	10	1.88
10	12	2.00
12	16	2.87
14		3.00
16	20 & 24	3.25

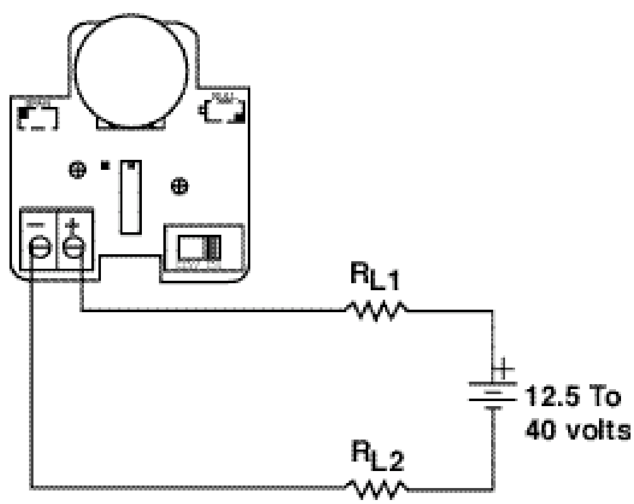
SPECIFICATIONS:

Voltage compliance range: 12.5 to 40 VDC
Maximum load resistance:

$$RL\ Max. = \frac{V\ Supply - 12.5}{20\ mA}$$

Current signal output: 4-20mA
Span: Adjustable from 15˚ to 90˚ of angular rotation
Null: 4 mA position may be set at any angular position
R_L2 is current monitoring instrumentation load

Typical Wiring Connections:

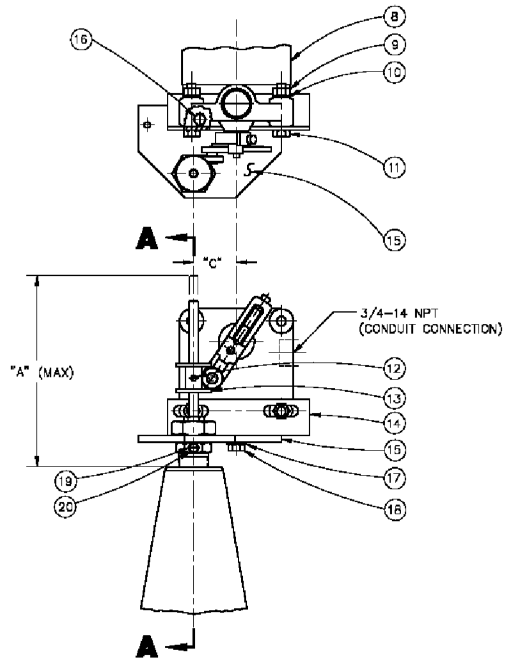


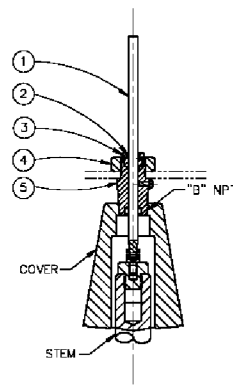
CATALOG NUMBER	SWITCH
X117C	ANALOG OUTPUT ONLY, SHORT HOUSING
X117CLS	ANALOG, 15 AMPS SPOT EXPLOSION PROOF

DWG NO. 16767 SH 1 REV C

REVISIONS

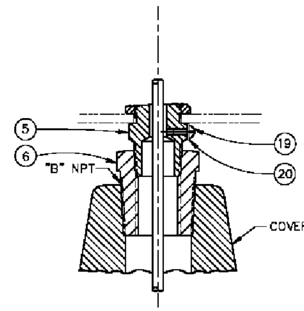
REV	DESCRIPTION	DATE	APPROVED
A-B	SEE REVISION FILE.		
C	REDRAWN ON CAD, ADDED ITEMS 19 & 20. (ECO 16671)	8-20-97	MW



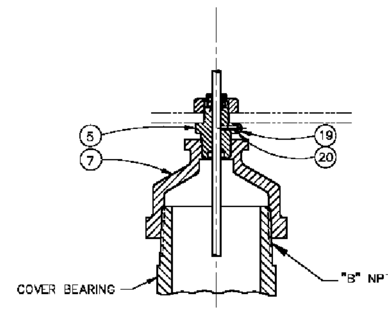


2" THRU 6" SIZES
(6" SIZE SHOWN)

SECTION **A - A**
(ROTATED 90° C.C.W.)



8", 10", 12" & 14" SIZES ONLY



16" SIZE ONLY

ITEM NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION
20	1	WASHER, FIBER
19	1	SCREW, RDH 8-32 X 3/8"
18	2	NUT, HEX 1/4-20
17	2	WASHER, SPRING LOCK 1/4"
16	2	BOLT, HEX 1/4-20 X 3/4"
15	1	PLATE, SWITCH MTG.
14	1	BRACKET, ANGLE MTG.
13	1	ROLLER GUIDE
12	1	SET SCREW, 10-32 UNF
11	2	BOLT, HEX 5/16-18 X 1 1/2"
10	2	WASHER, SPRING LOCK 5/16
9	2	NUT, HEX 5/16-18
8	1	MICRO SWITCH ASSEMBLY
7	1	REDUCER, BELL, PIPE (16" SIZE ONLY)
6	1	BUSHING, PIPE, HEX (8" THRU 14" SIZES ONLY)
5	1	ADAPTER
4	1	NUT, HEX (ASF JAM)
3	1	BUSHING, GLAND
2	2	O-RING
1	1	STEM, ASSEMBLY

PARTS LIST

VALVE SIZE	1 1/4" 1 1/2"	2"	2 1/2"	3"	4"	6"	8"	10"	12"	14"	16"
"A" MAX	10.19	7.16	7.16	7.34	7.00	6.69	6.91	9.88	9.09	9.16	10.78
"B" NPT	1/4"	1/2"	1/2"	1/2"	3/4"	3/4"	1"	1"	1 1/4"	1 1/2"	2"
"C"	.50	.75	.88	1.00	1.13	1.50	1.88	2.00	2.88	3.00	3.25

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ±1/32 DECIMALS .XX ±.03 .XXX ±.010 ANGULAR ±.5°
SURFACE FINISH 125
BREAK CORNERS .010 MAX
—DO NOT SCALE DRAWING—

APPROVALS		DATE
DRAWN	KS	11-24-87
CHECKED	DF	12-17-87
APPROVED	CH	1-19-88
ENGR		

CLA-VAL CO. NEWPORT BEACH, CALIFORNIA

TITLE X117C SERIES POS. TRANSMITTER 4 TO 20 MA. DC OUTPUT SIGNAL WITH LIMIT SWITCH

SIZE D CAGE CODE 86184 DWG NO. 16767 REV. C

SCALE N.T.S. SHEET 1 OF 1

MW 8-25-97

DIST. CODE 007A

2-2

CLA-VAL

— MODEL — X117D

Valve Position Transmitter

DESCRIPTION

The Cla-Val Model X117D Valve Position Transmitter is designed to provide analog signal (4 - 20 mA, 2 wire) output of valve position for Cla-Val Main Valves. A stem extension is fitted to the main valve stem with the position transmitter mechanically linked to it. The valve stem is mechanically linked to the electronics for an output signal that is in direct proportion to valve position. Provisions are made for bleeding air from valve cover through a small bleed screw and washer located on adapter.

INSTALLATION

Normally, the X117D is supplied mounted on the Cla-Val main valve. If X 117D has not been installed at factory, then install stem, adapter, mounting bracket with transmitter (in that order) as shown on drawing No. 200000.

OPERATION

The signal from the position sensing linkage mechanism is converted to a two-wire 4 to 20 mA current output appearing at the output terminals. The excitation voltage ranges from 12 to 35 Volts DC. The minimum supply voltage is a function of total loop resistance. It may be calculated using the formula:

V(min) = (0.02 x Load Resistance) + 12 VDC

WIRING

Loosen jam nut holding transmitter and bracket to adapter when connecting transmitter to field wiring. Tighten jam nut after connections and adjustments are made.

Use good field wiring practices for low voltage DC analog instrumentation wiring (suggest minimum of 18-gauge multistrand wire). Avoid potential ground loops. Calibration of transmitter should be done with a temporary hookup of test equipment before final wiring connections are made.

Units with NEMA 6, IP-68 enclosures have permanently attached 8' shielded cable leads. Use Red wire for positive and Black wire for negative.

Units before Feb. 2000 have NEMA 6 enclosure with MS3102E-14S-6PAmphenol plug and socket for attaching leads. Use "A" contact for positive and "B" contact for negative.

For best noise immunity, use twisted pair shielded cable to connect field wiring to the transmitter. The shield of the cable should be open at the transducer and grounded at the other end. Units with permanently attached cable are supplied with shield open inside transmitter.

CALIBRATION

1. When properly adjusted, the transmitter will have the valve closed position within 0% to 30% of total transmitter range and the valve open position within 80% to 100% of total transmitter range. At valve closed position the transmitter will have a 4 mA output and at fully open position the transmitter will have a 20 mA output.

IMPORTANT CAUTION: The transmitter wire rope mechanism is spring loaded to retract and can be damaged by a sudden release of the wire rope. Use care to insure that it is returned to the transmitter very slowly during start up and operation. This damage may not be covered by warranty.

2. You will need the following tools to calibrate and align the X117D:
   A.) A small flat blade screwdriver (.105 Max. width x .023" max. thickness) with non-metallic handle to fit the span and null potentiometer
   B.) A 4-20 mA calibration/tester or multiamp-tester/meter or some means of measuring the 4-20 mA transmitter output
   C.) Hand tools to adjust and tighten X117D assembly during calibration

3. Preliminary mechanical settings. (Refer to Drawing No. 200000) Be sure that the valve is in the fully **closed** position. See Technical Manual for the main valve for information on this. Check that line isolation or block valves are closed.

Adjust Nut Coupler (9) up or down on stem until gap between wire rope end and transmitter housing is according to table (below). The Hex Coupler (10) is used to tighten nut coupler to stem. A minimum gap is required, see Reference Table. (Refer to Drawing No. 200000)

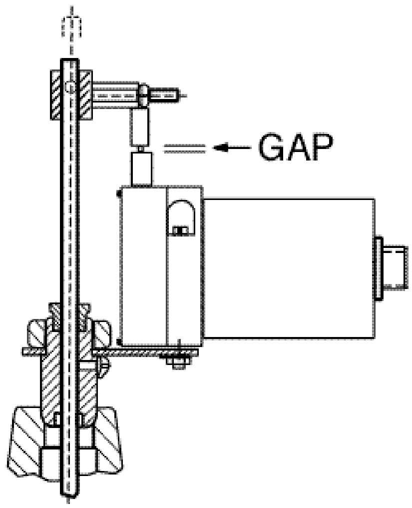
Long threaded end of Hex Coupler (10) has two hex nuts (11) for adjusting position of end of wire rope directly over the opening in the top of the transmitter. Use one hex nut on each side of the wire rope end. Wire rope should go vertically up and down without noticeable angle from vertical.

4. Temporarily connect calibration equipment (milliamp meter and power supply or portable instrumentation tester) to transmitter wiring. Calculate total loop resistance to determine minimum load resistor. See OPERATION section. Remove two calibration cover screws found on housing end.

Refer to calibration equipment and adjust transmitter potentiometer marked “NULL” until the meter reads 4 mA. A clockwise turn increases output. Use care in adjusting the potentiometer while turning the screwdriver.

5. For the most accurate calibration it is necessary to open valve fully. CAUTION: This will either allow a high flow rate through the valve, or the downstream pressure will quickly increase to the inlet pressure. In some cases, this can be very harmful. Where this is the case, and there are no block valves in the system to protect the downstream piping, it should be realized that steps should be taken to remedy this situation before proceeding further. Normally, block valves are to be used to protect downstream piping while the valve is in the open position. Close downstream block valve. Vent cover chamber to atmosphere. Slightly open inlet block valve. Allow valve to open while fluid is vented from cover chamber. When flow stops valve is in the fully open position. Note: continuous leakage from cover chamber could mean additional troubleshooting of the main valve or pilot system must be done.

6. With valve in fully open position, inspect position of wire rope and nut coupler. (See Step 3). Adjust if necessary.



Coupler gap is set with valve in fully closed position. This establishes the minimum mechanical position for 4 mA output.

ADJUSTMENT: Zero and span adjustments allow setting the 4 mA position (valve closed) within 0% to 30% of total transmitter range and setting the 20 mA position (valve fully open) within 80% to 100% of total transmitter range.

X117D Part Number	Valve Size (inch) 100-01	Valve Size (inch) 100-20	Valve Stem Travel (inch)	“GAP” Coupler Setting **GAP** (inch)	Transmitter Total Range
20000019F	1 1/4		0.400	3/16"	1"
20000019F	1 1/2		0.490	3/16"	1"
20000020A	2	3	0.590	1/8"	1"
20000020A	2 1/2		0.714	1/16"	1"
20000021A	3		0.835	1/16"	1"
20000001A	4	6	1.109	9/16"	2"
20000002A	6	8	1.584	3/16"	2"
20000003A	8	10	2.242	7/16"	3"
20000004A	10	12	2.711	1/8"	3"
20000005A	12	16	3.343	5/16"	4"
20000006A	14	N/A	3.920	9/16"	5"
20000007K	16	20 & 24	4.584	3/16"	5"
20000008J	24	N/A	6.504	2 1/4"	10"

Refer to calibration equipment (see Step 4) and adjust potentiometer marked “SPAN” until the meter reads 20 mA. A clockwise turn increases output. Use care in adjusting the potentiometer while turning the screwdriver.

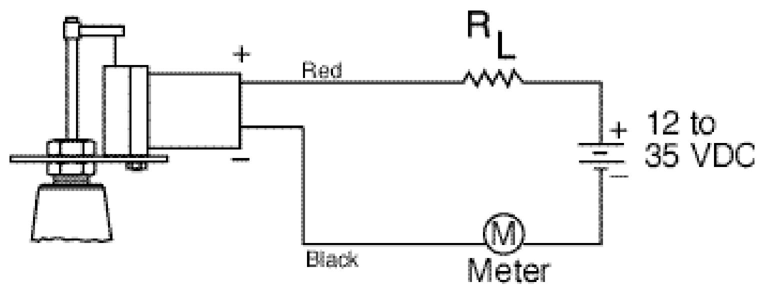
7. There is some interplay between:
   1.) the “span” and “null” settings,
   2.) the 4 to 20 mA signal and,
   3.) the actual valve open and closed positions.

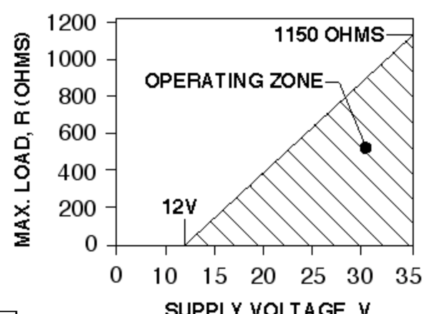
Repeat steps 4-6 above. Cycle valve from open to closed positions and check settings as necessary to achieve desired valve position signal accuracy.

8. Remove all calibration equipment and attach permanent wiring. Recheck wiring and output signals at remote location. See **Wiring** section. Reinstall two cover screws on housing. Recheck and tighten all fasteners. Bleed air from main valve cover through small bleed screw and washer located on one wrench flat of adapter.

MAINTENANCE

The X117D is constructed of durable materials which normally requiring no lubrication or periodic maintenance. The two ‘O’ rings (2) (p/n 00951E) in the adapter (5) that seal against the stainless steel actuating stem (1) will need replacement if signs of leakage at the stem occur.



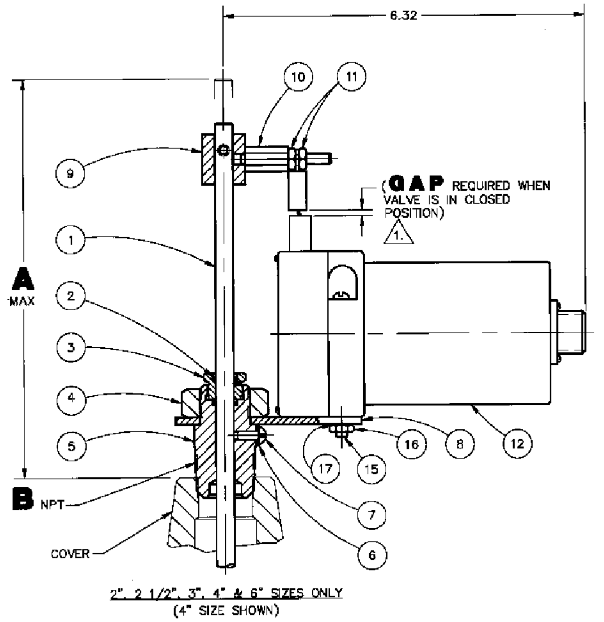


2
–
2

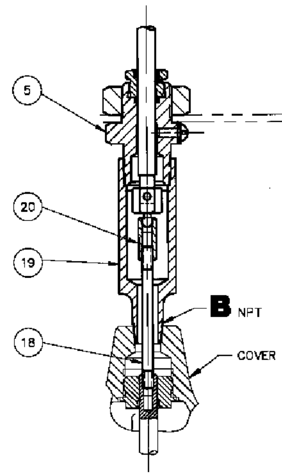
DWG NO. 200000	SH 1	REV D

REVISIONS

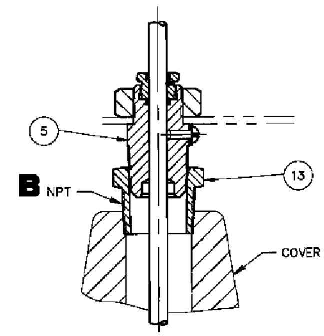
REV	DESCRIPTION	DATE	APPROVED
–	RELEASED FOR PRODUCTION. (NED 43195)	5-18-98	VL
A	ADDED BALLOON CALLOUTS 15, 16 & 17 & NO.15, 16 & 17 TO PART LIST (ECO 17225)	8-10-98	AK
B	REVISED DIM "A" FOR ALL SIZES (ECO 17739)	6-4-99	AK
C	CHANGED QUANTITY OF ITEM 11 FROM 1 TO 2; REMOVED DIM. .200/.100 GAP AND ADDED GAP DIM. TO THE TABLE (ECO 18357)	10-11-00	AK
D	ADDED SIZES 1 1/4", 1 1/2", 2", 2 1/2" & 3" TO THE DWG (NED 46402)	10-01-01	AK



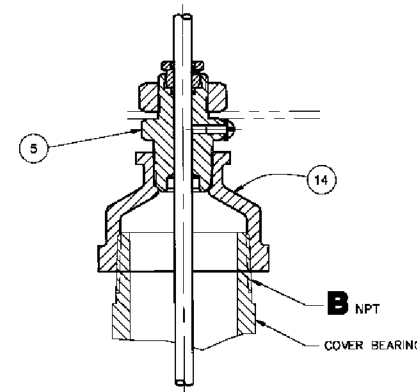
2", 2 1/2", 3", 4" & 6" SIZES ONLY
(4" SIZE SHOWN)



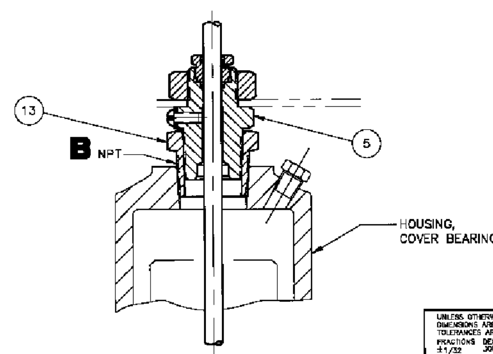
1 1/4" & 1 1/2" SIZES ONLY
(1 1/4" SIZE SHOWN)



8", 10", 12" & 14" SIZES ONLY
(8" SIZE SHOWN)



16" SIZE ONLY



24" SIZE ONLY

VALVE SIZE	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	6"	8"	10"	12"	14"	16"	24"
A (MAX)	10.68	10.68	7.75	7.50	7.65	10.00	10.00	10.62	10.75	11.44	12.75	12.75	14.75
B NPT	1/4"	1/4"	1/2"	1/2"	1/2"	3/4"	3/4"	1"	1"	1 1/4"	1 1/2"	2"	1"
GAP	1/8"	1/8"	1/8"	1/8"	1/8"	1/2"	1/16"	3/8"	1/16"	1/16"	1/8"	1/16"	1 1/2"

1. GAP IS SET WITH VALVE IN FULLY CLOSED POSITION. THIS ESTABLISHES THE MINIMUM MECHANICAL POSITION FOR 4mA OUTPUT.

NOTE: UNLESS OTHERWISE SPECIFIED.

PARTS LIST

ITEM NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION
20	1	ADAPTER, STEM (1 1/4" & 1 1/2" SIZES ONLY)
19	1	ADAPTER, SWITCH ASSY (1 1/4" & 1 1/2" SIZES ONLY)
18	1	STUD (1 1/4" & 1 1/2" SIZES ONLY)
17	2	LOCKWASHER #10
16	2	NUT, HEX
15	2	SCREW, FILLISTER HEAD 10-32 X 2.50
14	1	REDUCER, BELL PIPE (16" SIZE ONLY)
13	1	BUSHING, HEX PIPE (8"-14" & 24" SIZES ONLY)
12	1	TRANSDUCER ASSEMBLY, POSITION
11	2	NUT, HEX 10-32
10	1	HEX, COUPLER
9	1	NUT, COUPLER
8	1	PLATE, MOUNTING
7	1	SCREW, RDH 8-32 X 3/8"
6	1	WASHER, FIBER
5	1	ADAPTER
4	1	NUT, HEX (ASF JAM)
3	1	BUSHING, GLAND
2	2	O-RING
1	1	STEM ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS ±1/32; DECIMALS .XX ± .03, .XXX ± .010; ANGULAR ± .5°
MAX = +.00 -.09
MIN = +.09 -.00
SURFACE FINISH 125
BREAK CORNERS .010 MAX
—DO NOT SCALE DRAWING—

APPROVALS		DATE
DRAWN	VL	5-18-98
CHECKED	CE	6-2-98
APPROVED	EK	6-2-98

CLA-VAL CO. NEWPORT BEACH, CALIFORNIA

TITLE: X117D VALVE POSITION TRANSMITTER 1 1/4" – 24" SIZE

SIZE D | CAGE CODE 86184 | DWG NO. 200000 | REV D
SCALE 1/1 | SHEET 1 OF 1

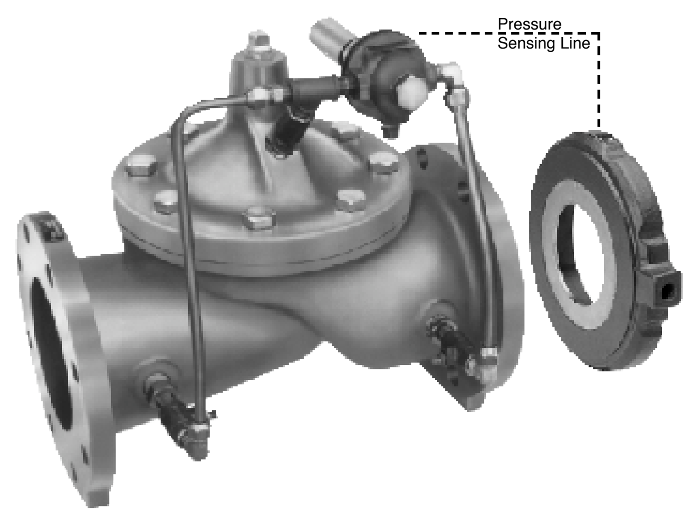
AK 10-23-01

DIST CODE 007

Section 3

Applications

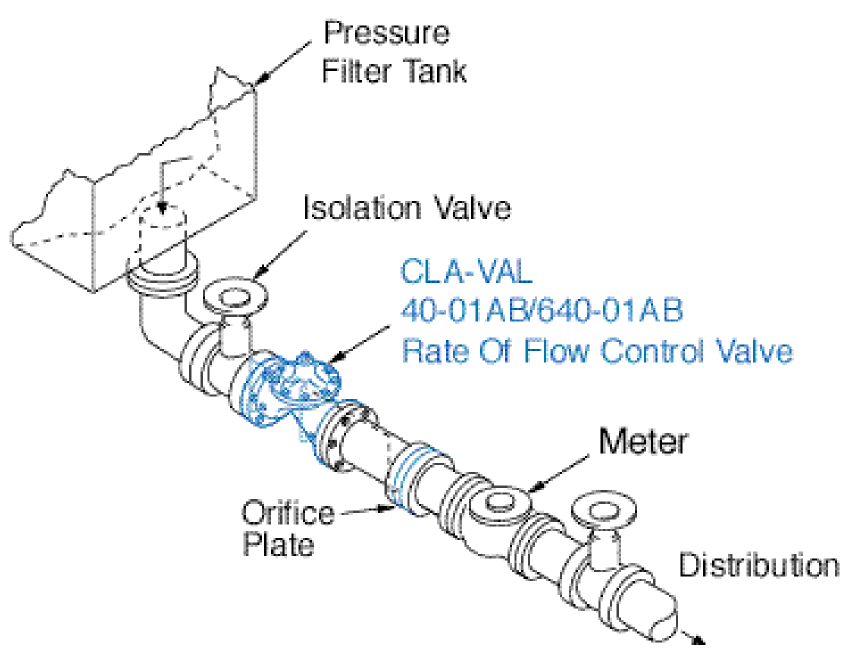
Application	Series	Section
Rate of Flow	40 Series	3-1
Pressure Relief	50 Series	3-2
Pump Control Valves	60 Series	3-3
Pressure Reducing	90 Series	3-4
Float Valves	120/420 Series	3-5
Solenoid Operated Valves	130 Series	3-6
Altitude Valves	210 Series	3-7



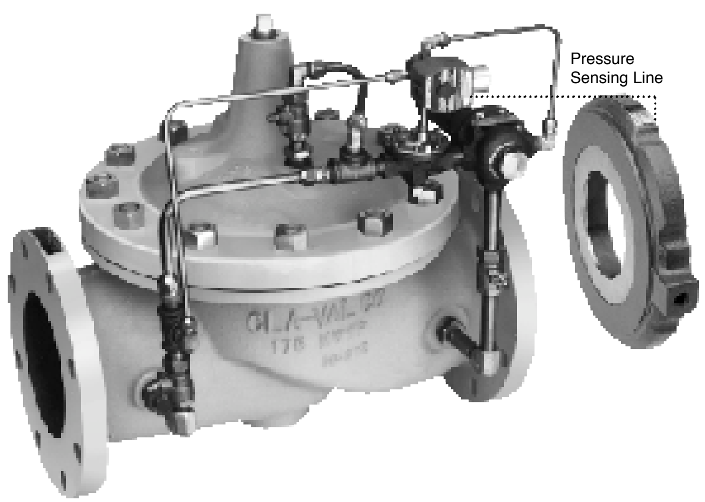
40-01/640-01 Rate of Flow Control

Model 40-01/640-01

The Cla-Val Model 40-01/640-01 Rate of Flow Control Valve prevents excessive flow by limiting flow to a preselected maximum rate regardless of changing line pressure. It is a hydraulically operated, pilot controlled, diaphragm valve. The pilot control responds to the differential pressure produced across an orifice plate installed downstream of the valve. Accurate control is assured as very small changes in the controlling differential pressure produce immediate corrective action of the main valve. Flow rate adjustments are made by turning an adjusting screw on the pilot control.



The 40-01/640-01 is typically installed where water supply to a system must be limited to a pre-set maximum flow rate. The valve is easily set to maintain the maximum allowable flow rate.

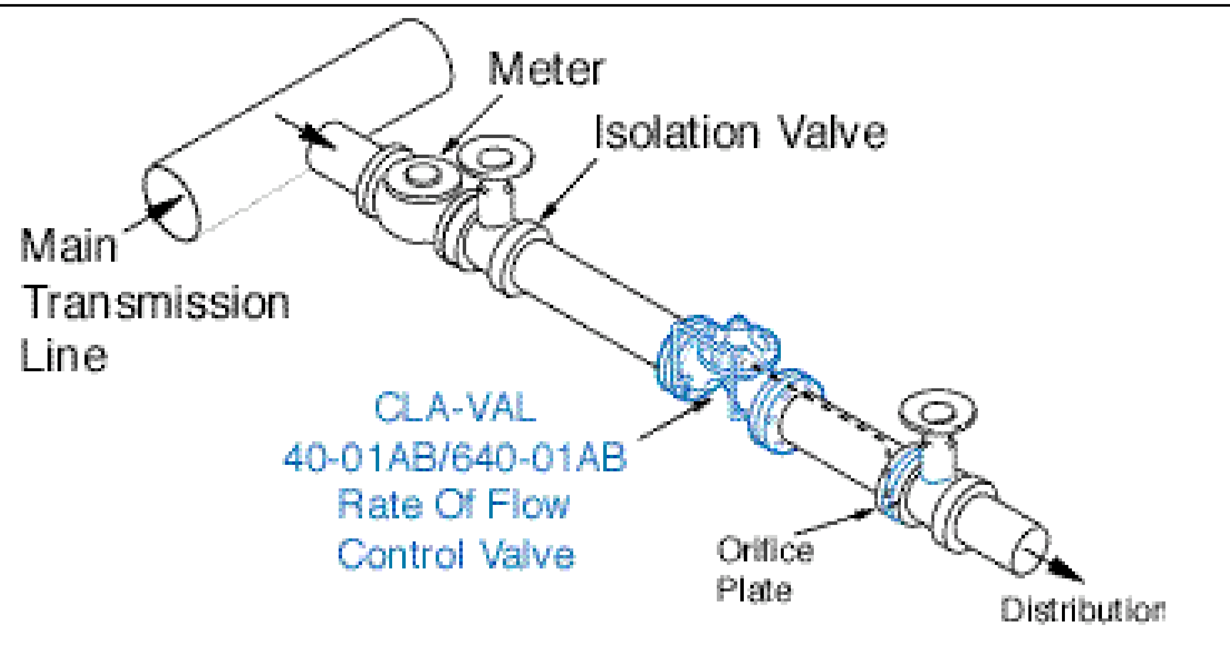


43-01/643-01 Combination Rate of Flow Controller & solenoid Shut-off Valve

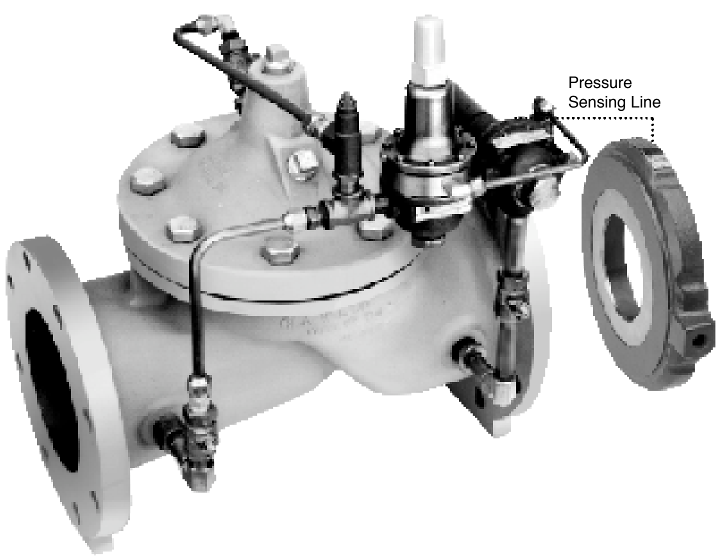
Model 43-01/643-01

The Cla-Val Model 43-01/643-01 Combination Rate of Flow Controller and Solenoid Shut-off Valve limits the maximum flow rate regardless of changing line pressure. It is a hydraulically operated, pilot controlled, diaphragm valve. The pilot control is actuated by the differential pressure produced across an orifice plate installed downstream of the valve. Accurate control is assured as very small changes in the controlling differential pressure produce immediate corrective action of the main valve. A solenoid control is provided to intercept the operation of the differential control and close the main valve.

The Model 43-01/643-01 includes a orifice plate with a holder that should be installed one to five pipe diameters downstream of the main valve. If the check feature option is added and a pressure reversal occurs, the downstream pressure is admitted into the main valve cover chamber and the valve closes to prevent return flow.



The 43-01/643-01 is typically installed where water supply to a system must be limited to a pre-set maximum flow rate at certain times of day. The valve is easily set to maintain the maximum allowable flow rate and is to open or close on an electrical signal.



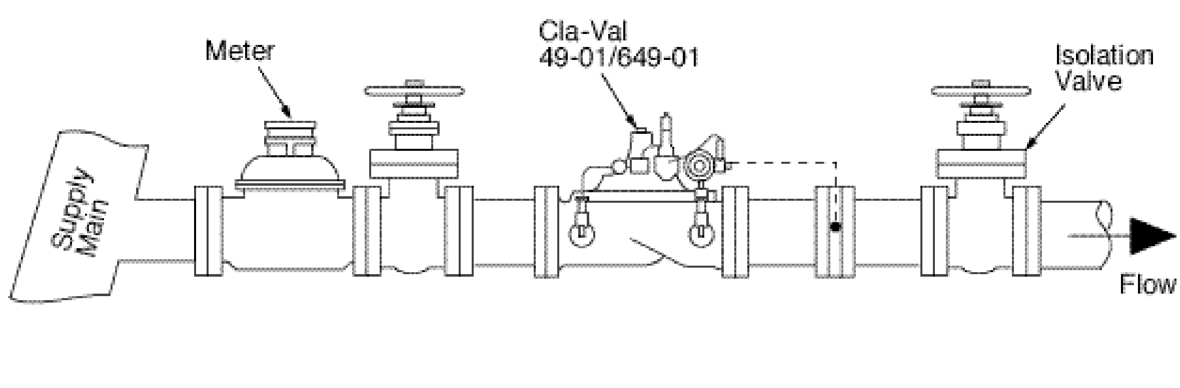
49-01/649-01 Combination rate of Flow & Pressure Reducing Valve

Model 49-01/649-01

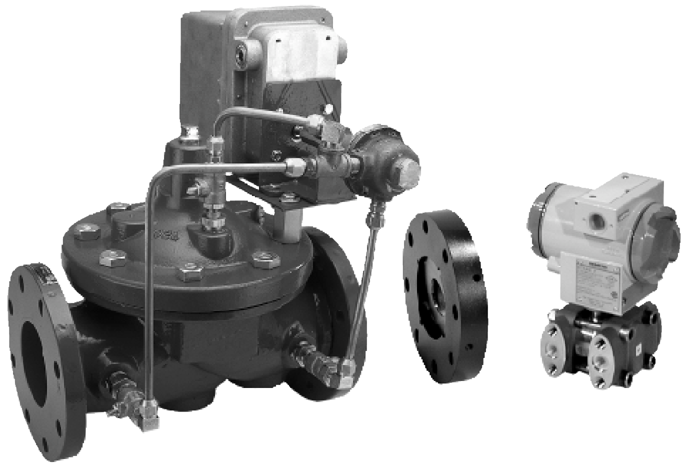
The Cla-Val Model 49-01/649-01 Rate of Flow and Pressure Reducing Valve automatically reduces a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate and/or varying inlet pressure, as long as the flow rate is below a preset maximum. It also prevents excessive flow by limiting flow to a preselected maximum rate.

This valve is a hydraulically operated, pilot controlled diaphragm valve. The pilot system includes a direct acting pressure reducing pilot and a rate of flow differential control. The pressure reducing pilot is responsive to slight variations in downstream pressure and immediately controls the main valve to maintain the desired line pressure.

The rate of flow control responds to the differential pressure produced across an orifice plate in the main line. Accurate control is assured as very small changes in the controlling differential pressure produce immediate corrective action by the main valve.



Installed where water supply to a system must be limited to a preset flow to prevent lowering the supply pressure. Easily set to maintain the maximum allowable flow rate.

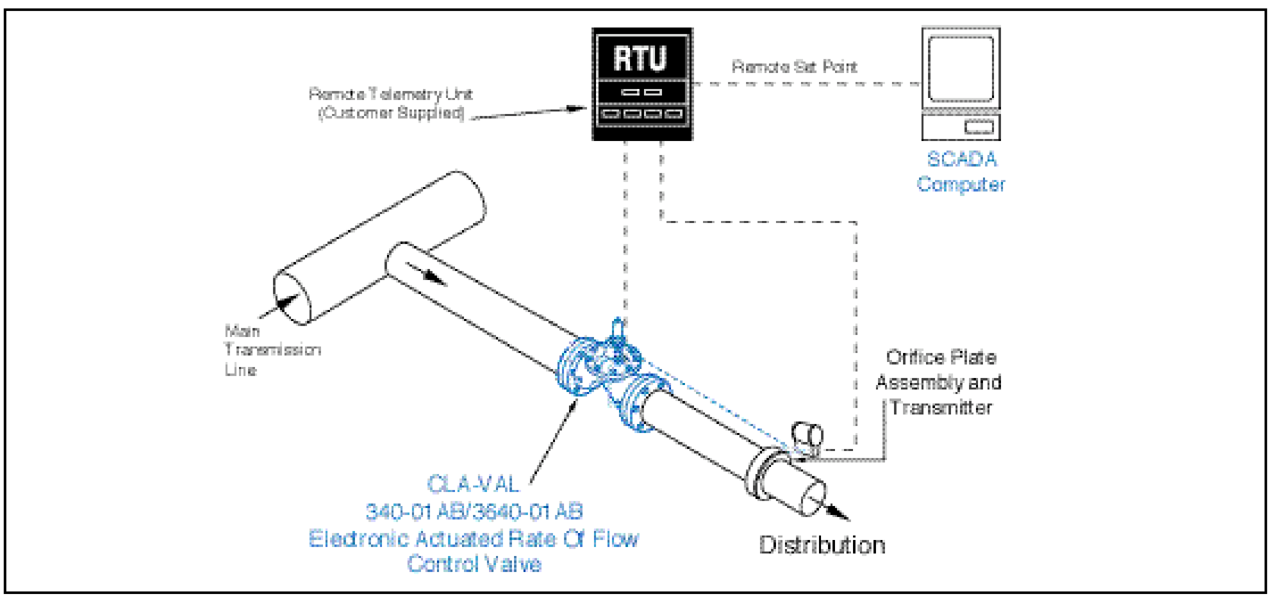


340-01/3640-01 Electronic Actuated Rate of Flow Control Valve

Model 340-01/3640-01

The Cla-Val Model 340-01/3640-01 Electronic Actuated Rate of Flow Control Valve combines the precise control of field proven Cla-Val hydraulic pilots and the convenience and versatility of remote set point control. The Model 340-01/3640-01 control valve prevents excessive flow by limiting flow to a preselected maximum rate regardless of changing line pressure. It is a hydraulically operated, pilot controlled, diaphragm actuated control valve.

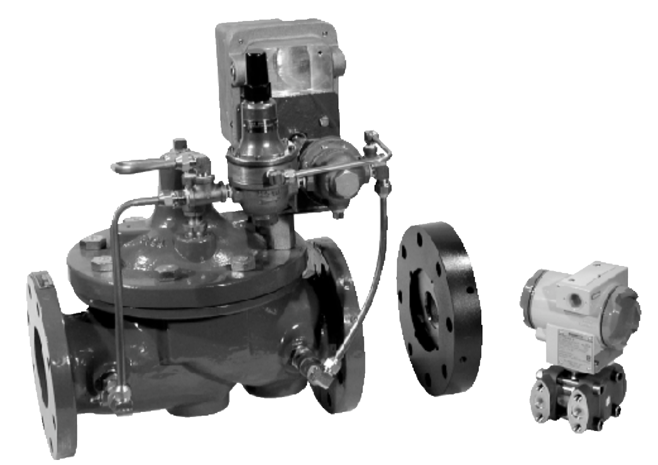
The pilot control responds to the differential pressure produced across an orifice plate or other differential producing devices installed downstream of the valve. Accurate control is assured as very small changes in the controlling differential pressure produce immediate corrective action of the main valve. The pilot control, consisting of a hydraulic pilot and integral controller accepts a set point and compares it with the flow or internal position potentiometer signal and makes incremental adjustments to modulate the valve to a set point.



This valve is designed to be used with supervisory control systems having an isolated remote analog set point output and a process variable flow transmitter input. The 340-01/3640-01 is typically installed in systems requiring remote set point changes of flow rates.

It is also an effective solution for lowering costs associated with “confined space” requirements by eliminating the need for entry into valve structure for set point adjustment and system information.

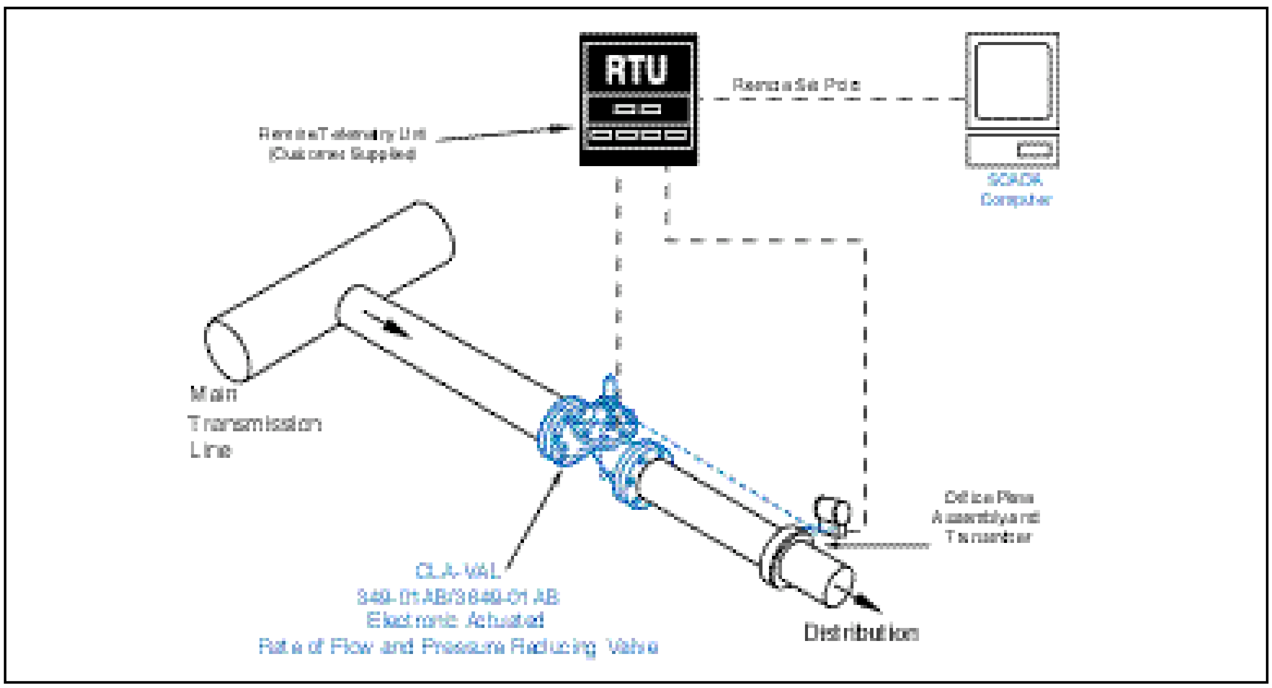
Additional Pilot Controls, hydraulic and/or electronic, can be easily added to perform multiple control functions to fit exact system requirements.



349-01/3649-01 Electronic Actuated Rate of Flow and Pressure Reducing Valve

Model 349-01/3649-01

The Cla-Val Model 349-01/3649-01 Electronic Actuated Rate of Flow and Pressure Reducing Control Valve combines the precise control of field proven Cla-Val hydraulic pilots and the convenience and versatility of remote set point control. The Model 349-01/3649-01 control valve automatically reduces a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate and/or varying inlet pressure, as long as the flow rate is below a preset maximum. It also prevents excessive flow by limiting flow to a remotely set maximum rate.



This valve is designed to be used with supervisory control systems having an isolated remote analog set point output and a process variable flow transmitter input. The 349-01/3649-01 is typically installed in systems requiring remote set point changes of flow rates. It is also an effective solution for lowering costs associated with "confined space" requirements by eliminating the need for entry into valve structure for set point adjustment and system information.

Additional Pilot Controls, hydraulic and/or electronic, can be easily added to perform multiple control functions to fit exact system requirements.

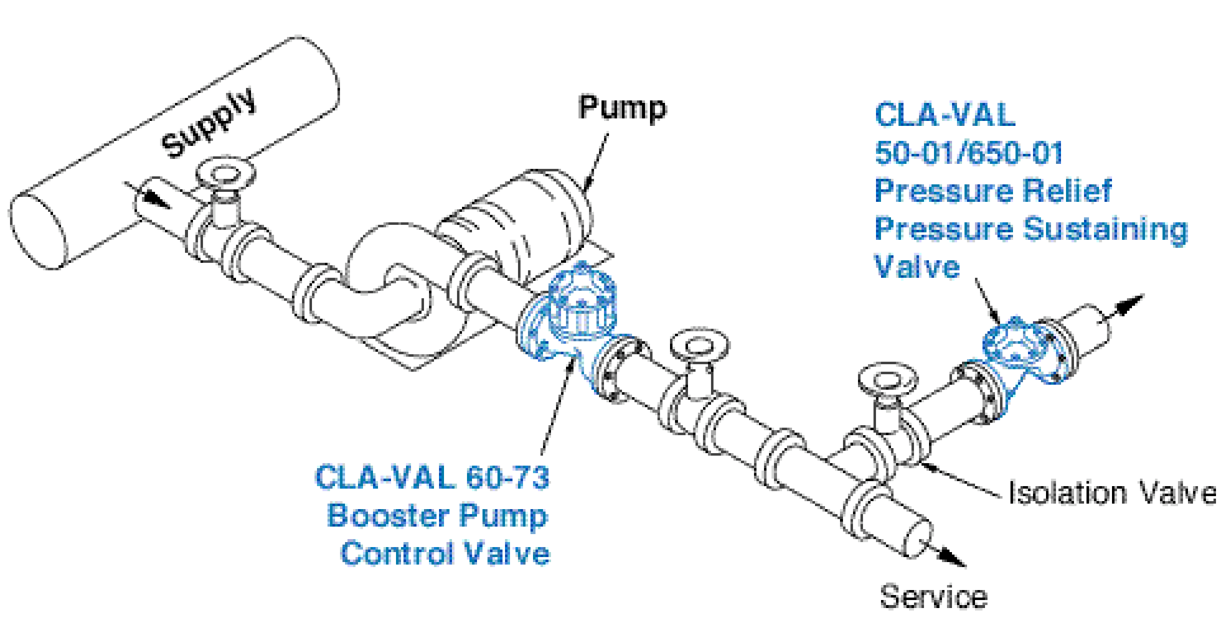
50-01/650-01 Pressure Relief, Pressure Sustaining Valve

Model 50-01/650-01

The Cla-Val Model 50-01/650-01 Pressure Relief Valve is a hydraulically operated, pilot-controlled, modulating valve designed to maintain constant upstream pressure within close limits. This valve can be used for pressure relief, pressure sustaining, back pressure, or unloading functions in a by-pass system.

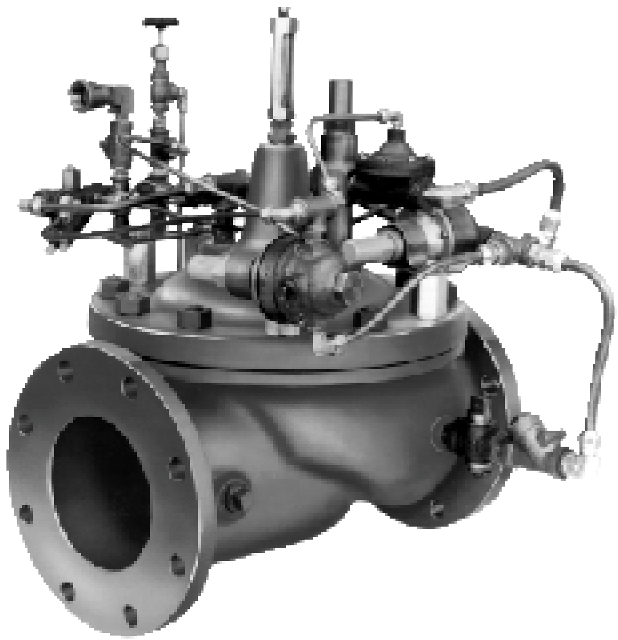
In operation, the valve is actuated by line pressure through a pilot control system, opening fast to maintain steady line pressure but closing gradually to prevent surges. Operation is completely automatic and pressure settings may be easily changed.

If the optional check feature "D" is added, and a pressure reversal occurs, the valve closes to prevent return flow.



The 50-01/650-01To provide protection for the system against high pressure surges when pumps are shut down, this fast opening – slow closing relief valve dissipates the excess pressure.

Cla-Val Model 52-03 Typical Application



52-03/652-03 Pressure Relief & Surge Anticipator Valve

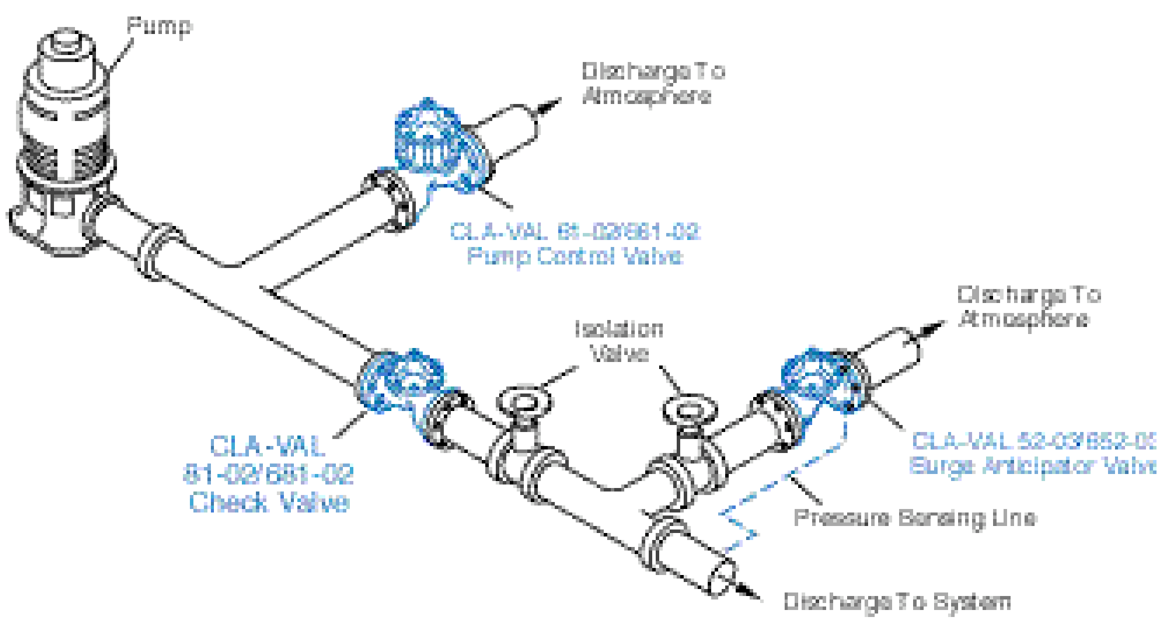
Model 52-03/652-03

The Cla-Va Model 52-03/652-03 Surge Anticipator Valve is indispensible for protecting pumps, pumping equipment and all applicable pipelines from dangerous pressure surges caused by rapid changes of flow velocity within a pipeline.

When pumping systems are started and stopped gradually, harmful surges do not occur. However, should a power failure take place, the abrupt stopping of the pump can cause dangerous surges in the system which could result in severe equipment damage.

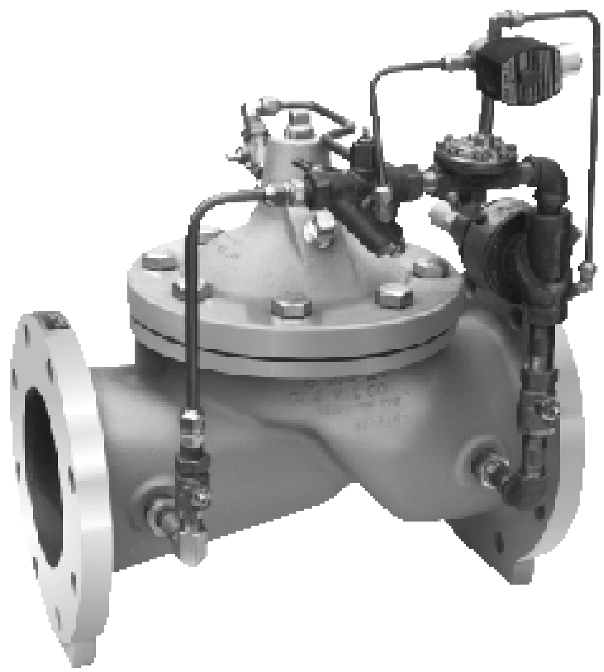
3 – 2

Power failure to a pump will usually result in a down surge in pressure, followed by an up surge in pressure. The surge control valve opens on the initial low pressure wave, diverting the returning high pressure wave from the system.*In effect, the valve has anticipated the returning high pressure wave and is open to dissipate the damage causing surge. The valve will then close slowly without generating any



The 52-03/652-03 discharges to atmosphere from a tee in the pump discharge header. The valve anticipates surges caused by power failure as well as acting as a standard over pressure relief valve.

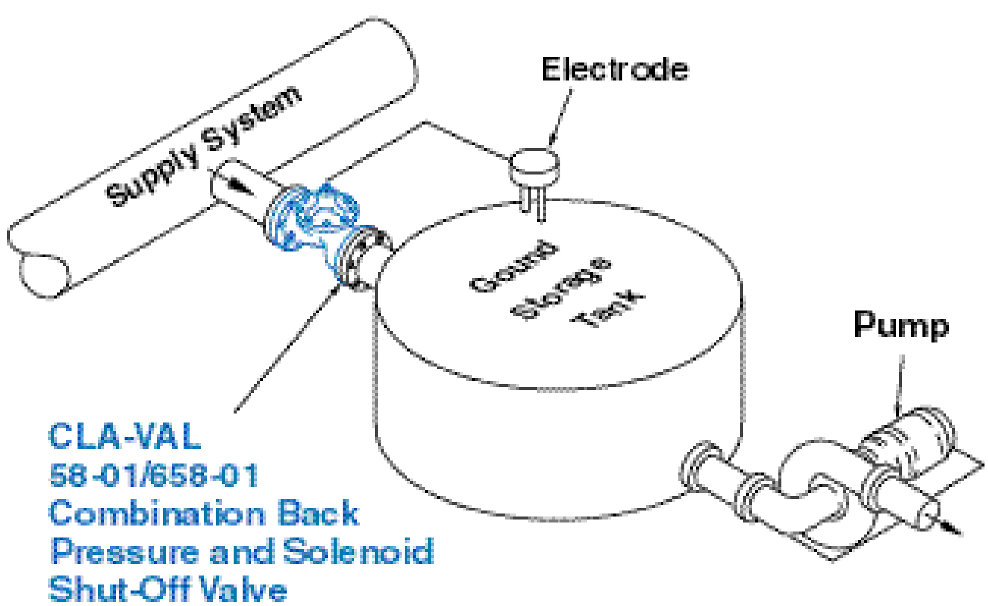
Cla-Val Model 58-01 Typical Application



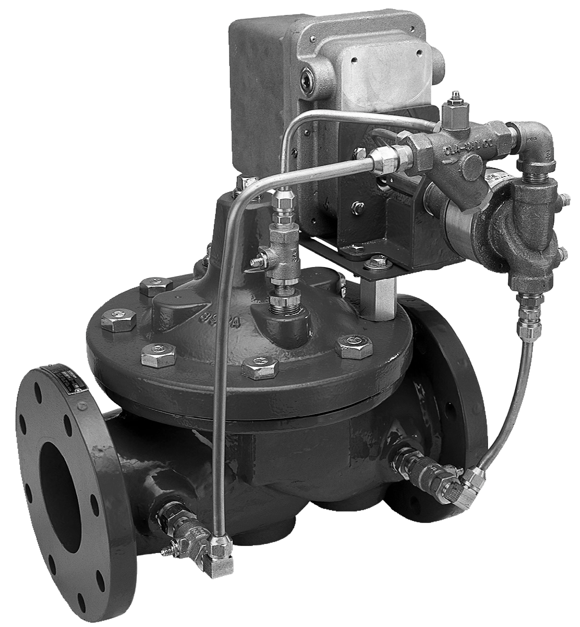
58-01/658-01 Combination Back Pressure and Solenoid Shut-Off Valve

Model 58-01/658-01

The Cla-Val Model 58-01/658-01 valve performs two separate functions. It maintains a constant back pressure by discharging excess pressure downstream and when the solenoid is activated the valve closes drip tight. In operation, the valve is actuated by hydraulic line pressure through the pilot control system. When inlet pressure is greater than the control setting, the valve opens. When inlet pressure is equal to the control setting, the pilot modulates the valve maintaining the preselected back pressure. When inlet pressure is less than the control setting, the pilot system closes the valve drip tight. Changing the pressure setting simply involves turning an adjusting screw on the pilot control.



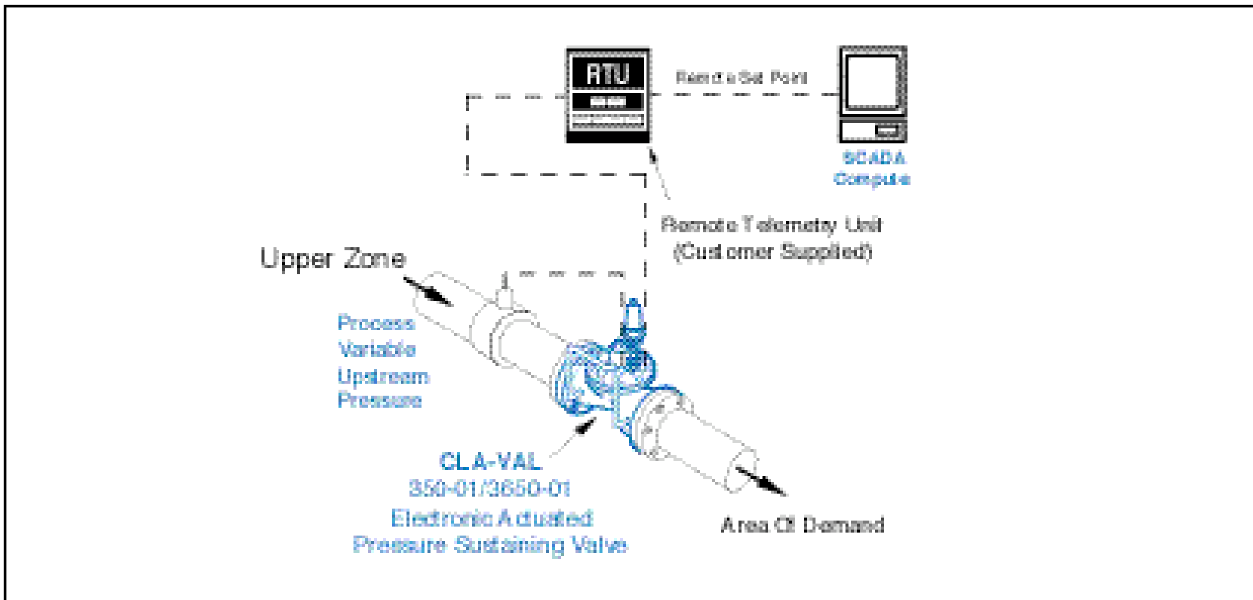
The 58-01/658-01 A frequent application of this valve is to maintain minimum back pressure in the system while supplying water to a reservoir. The electrode in the storage tank activates the solenoid shutoff feature when the tank reaches a pre-set level.



350-01/3650-01 Electronic Actuated Pressure Sustaining Control Valve

Model 350-01/3650-01

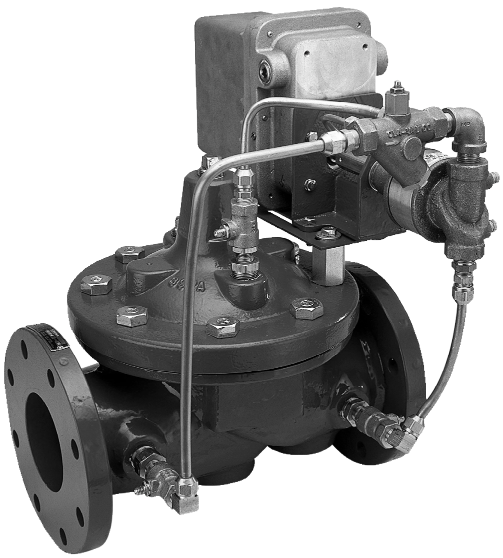
The Cla-Val Model 350-01/3650-01 Electronic Actuated Pressure Sustaining Control Valve combines the precise control of field proven Cla-Val hydraulic pilots and the convenience and versatility of remote set point control. The Model 350-01/3650-01 control valve is a hydraulically operated, pilot controlled, modulating valve designed to maintain constant upstream pressure within close limits. This valve can be used for pressure sustaining, back pressure, or unloading functions in a by-pass system. The pilot control, consisting of a hydraulic pilot and integral controller, accepts a set point and compares it with a pressure or internal potentiometer signal and makes incremental adjustments to modulate the valve to a set point.



The valve is designed to be used with supervisory control systems having a isolated remote analog set point output and a process variable upstream pressure input. When installed in a line between an upper zone and a lower area of demand, the valve acts to maintain desired upstream pressure to prevent "robbing" of the upper zone. Water in excess of pressure setting flows to area of demand, control is smooth, and pressure r egulation is positive.

It is also an effective solution for lowering costs associated with "confined space" requirements by eliminating need for entry into valve structure for set point adjustments and system information.

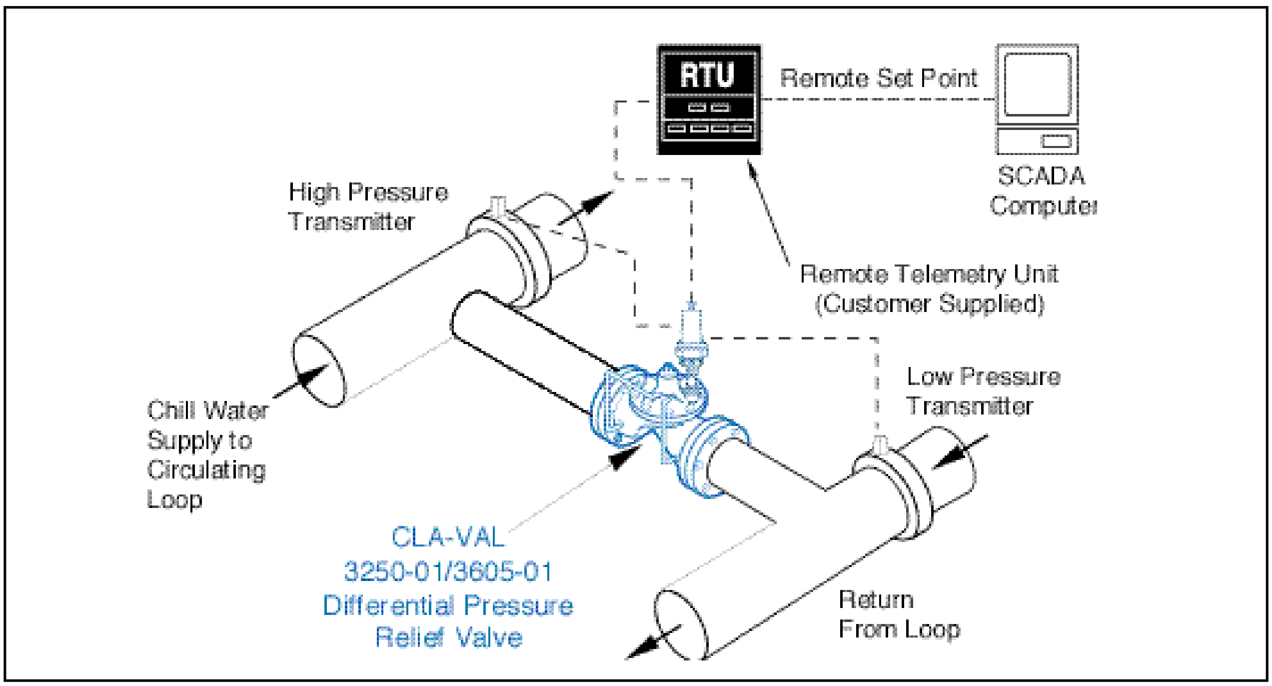
Cla-Val Model 3250-01 Typical Application



3250-01/3605-01 Electronic Actuated Differential Relief Pressure Control Valve

Model 3250-01/3605-01

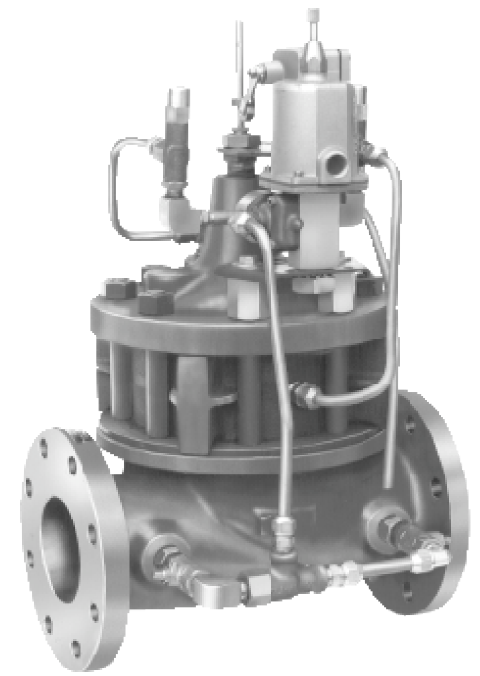
The Cla-Val Model 3250-01/3605-01 Electronic Actuated Differential Relief Pressure Control Valve combines the precise control of a field proven Cla-Val hydraulic pilot and the convenience and versatility of remote set point control. The Model 3250-01/3605-01 Control Valve is a hydraulically operated, pilot controlled, modulating valve. It is designed to maintain a constant pressure differential between any two pressure points in a system where the closing of the valve directly causes the differential pressure to increase. The valve tends to open on an increase in differential pressure and close on a decrease in differential pressure. The pilot control, consisting of a hydraulic pilot and integral controller, accepts a set point and compares it with a differential pressure or internal potentiometer position signal and makes incremental adjustments to modulate the valve to a set point.



The valve is designed to be used with supervisory control systems having an isolated remote analog set point output and a process variable system differential pressure input. On a chill water circulating closed-loop system the 3250-01/3605-01 Differential Pressure Relief Valve is installed between loop supply and return lines to maintain a constant differential across the loop. The loop differential pressure remains constant regardless of the loop demand changes thereby increasing cooling system efficiency.

It is also an effective solution for lowering costs associated with "confined space" requirements by eliminating need for entry into valve structure for set point adjustment and system information.

Additional Pilot Controls, hydraulic and/or electronic, can be easily added to perform multiple control functions to fit exact system requirements.

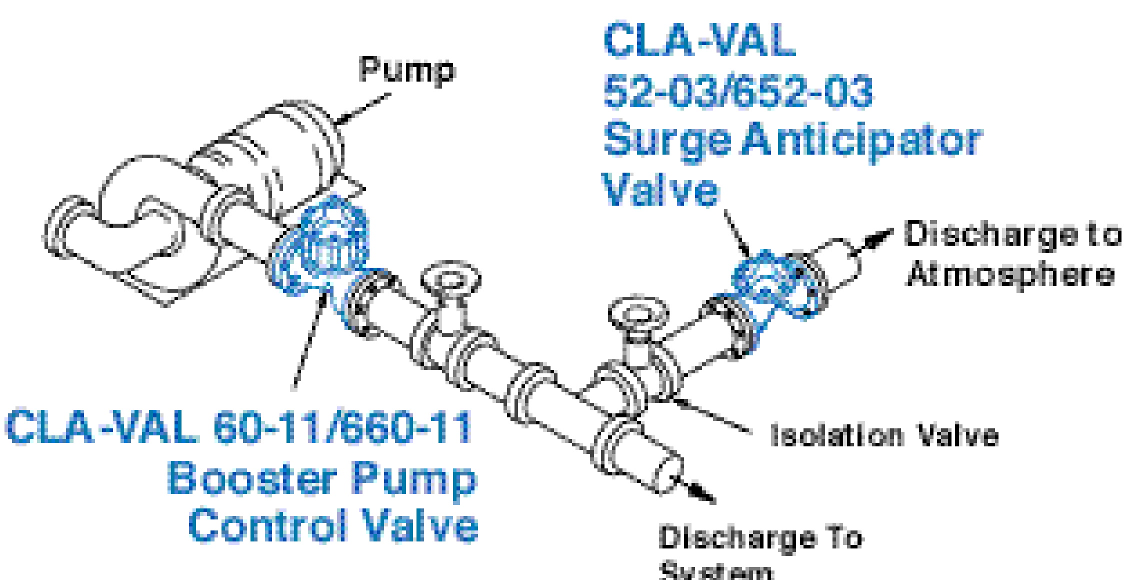


60-11/660-11 Booster Pump Control Valve

Model 60-11/660-11

The Cla-Val Model 60-11/660-11 Booster Pump Control Valve is a pilot-operated valve designed for installation on the discharge of booster pumps to eliminate pipeline surges caused by the starting and stopping of the pump.

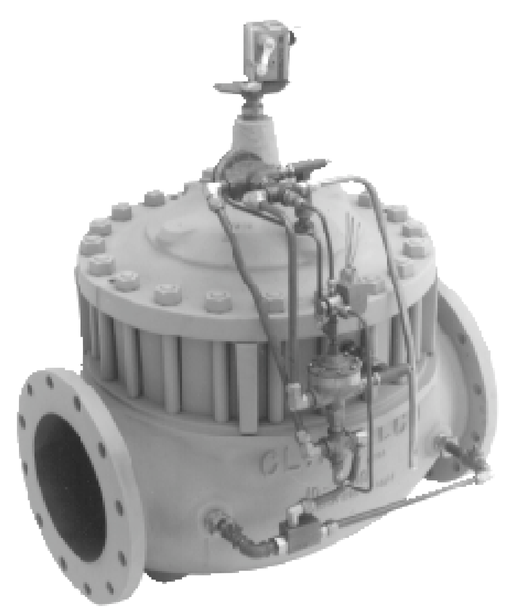
The pump starts against a closed valve. When the pump is started, the solenoid control is energized and the valve begins to open slowly, gradually increasing line pressure to full pumping head. When the pump is signaled to shut-off, the solenoid control is de-energized and the valve begins to close slowly, gradually reducing flow while the pump continues to run. When the valve is closed, a limit switch assembly, which serves as an electrical interlock between the valve and the pump, releases the pump starter and the pump stops.



Wiring Diagram is Included

Install Model 60-11/660-11 valve as shown. Flexible conduit should be used for electrical connections to the solenoid control and the limit switch. A Model 52-03/652-03 Surge Anticipator Valve is recommended for power failure protection.

Cla-Val Model 60-19 Typical Application

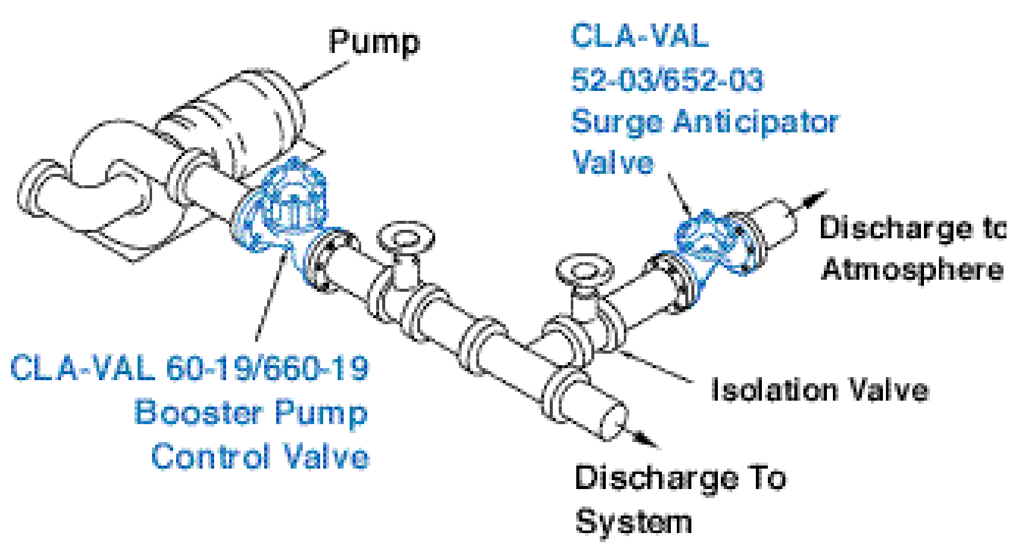


60-19/660-19 Booster Pump Control Valve

Model 60-19/660-19

The Cla-Val Model 60-19/660-19 Pump Control Valve is a pilot-operated valve designed for installation on the discharge of booster pumps to eliminate pipeline surges caused by the starting and stopping of the pump.

The pump starts against a closed valve. When the pump is started, the solenoid control is energized and the valve begins to open slowly, gradually increasing line pressure to full pumping head. When the pump is signaled to shut-off, the solenoid control is de-energized and the valve begins to close slowly, gradually reducing flow while the pump continues to run. When the valve is closed, a limit switch assembl y, which serves as an electrical interlock between the valve and the pump, releases the pump starter and the pump stops.



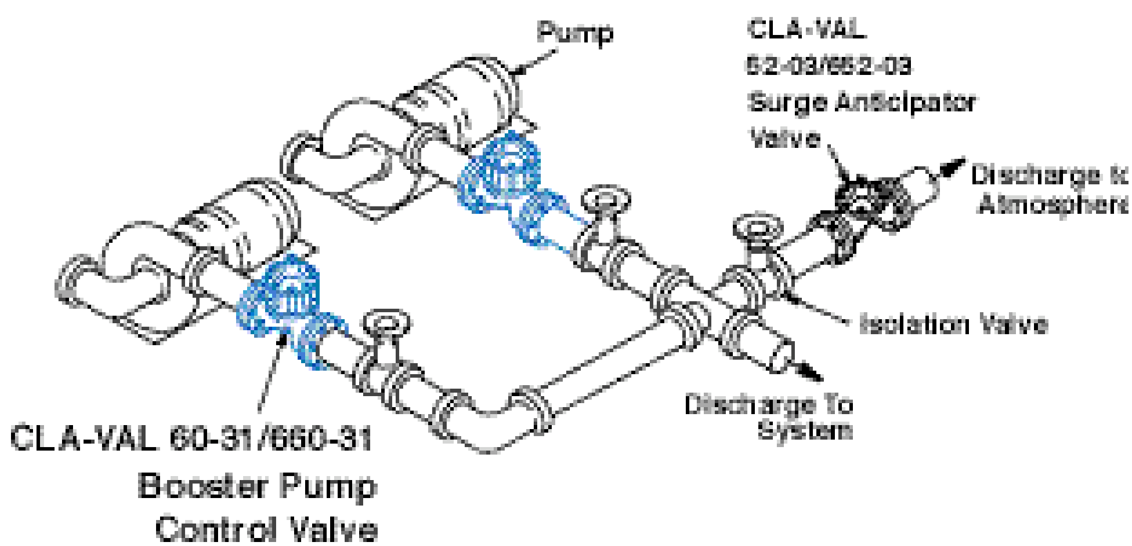
Install Model 60-19/660-19 valve as shown. Flexible conduit should be used for electrical connections to the solenoid control and the limit switch. A Model 52-03/652-03 Surge Anticipator Valve is recommended for power failure protection.

60-31/660-31 Booster Pump Control Valve

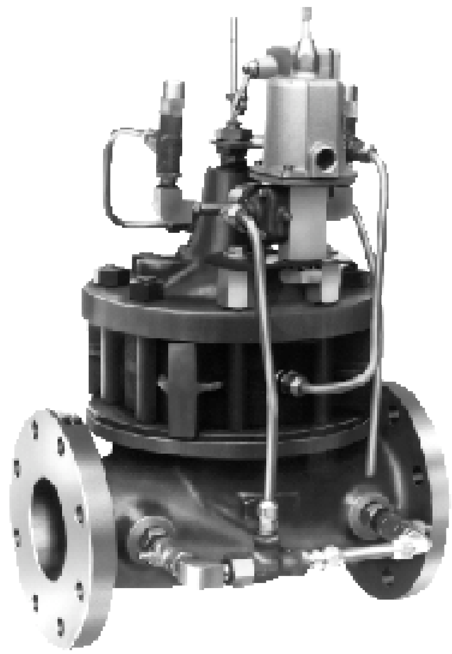
Model 60-31/660-31

The Cla-Val Model 60-31/660-31 Booster Pump Control valve is a pilot-operated valve designed for installation on the discharge of booster pumps to eliminate pipeline surges caused by the starting and stopping of the pump.

The pump starts against a closed valve. When the pump is started, the solenoid control is energized and the valve begins to open slowly, gradually increasing line pressure to full pumping head. When the pump is signaled to shut-off, the solenoid control is de-energized and the valve begins to close slowly, gradually reducing flow while the pump continues to run. When the valve is closed, a limit switch assembly, which serves as an electrical interlock between the valve and the pump, releases the pump starter and the pump stops.



Install Model 60-31/660-31 valve as shown. Flexible conduit should be used for electrical connections to the solenoid control and the limit switch. A Model 52-03/652-03 Surge Anticipator Valve is recommended for power failure protection.
Designed for multiple pump applications.

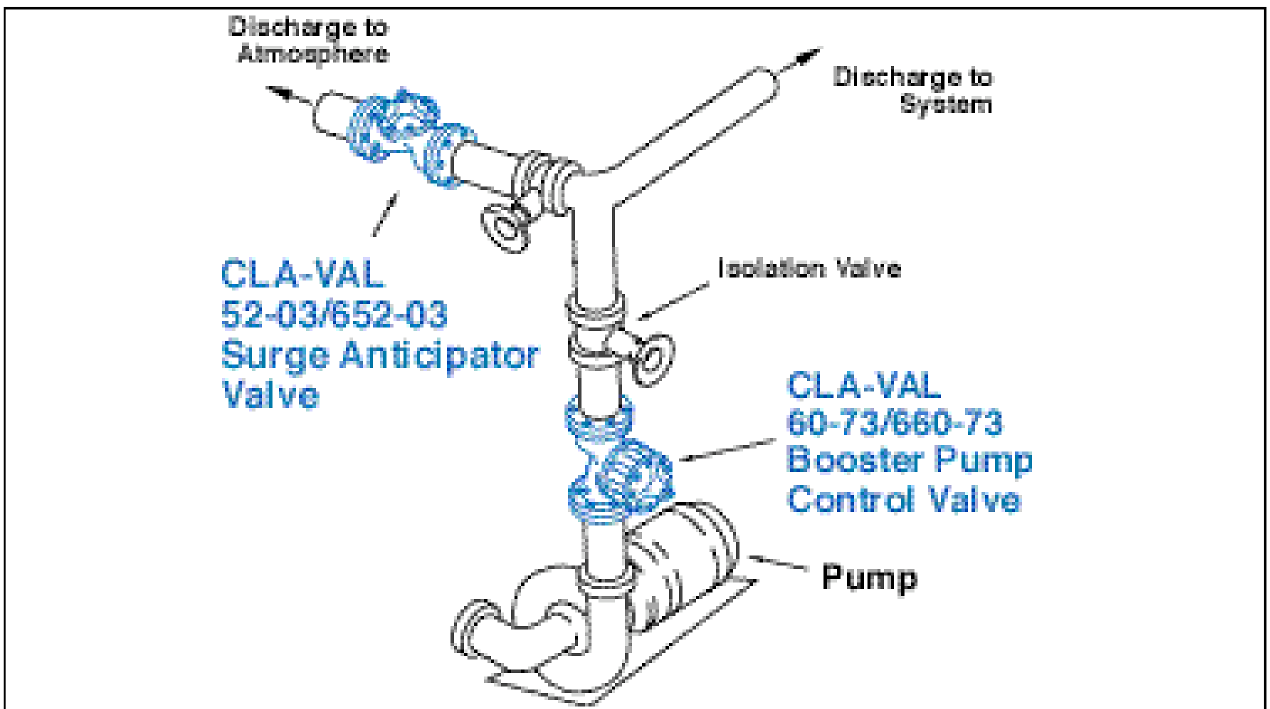


60-73/660-73 Booster Pump Control Valve

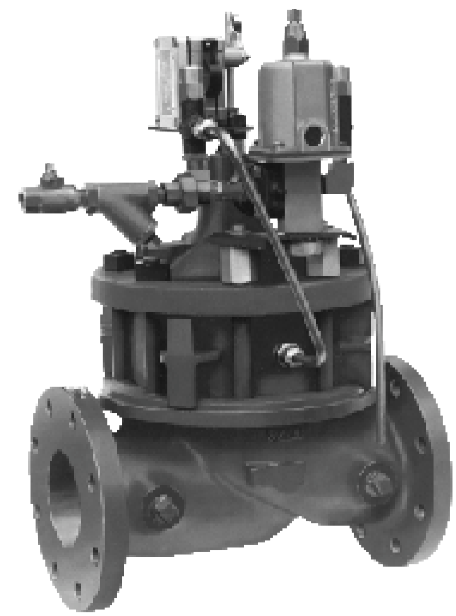
Model 60-73/660-73

The Cla-Val Model 60-73/660-73 Booster Pump Control Valve is a pilot-operated valve designed for installation on the discharge of booster pumps to eliminate pipeline surges caused by the starting and stopping of the pump.

The pump starts against a closed valve. When the pump is started, the solenoid control is energized and the valve begins to open slowly, gradually increasing line pressure to full pumping head. When the pump is signaled to shut-off, the solenoid control is de-energized and the valve begins to close slowly, gradually reducing flow while the pump continues to run. When the valve is closed, a limit switch assembly, which serves as an electrical interlock between the valve and the pump, releases the pump starter and the pump stops.



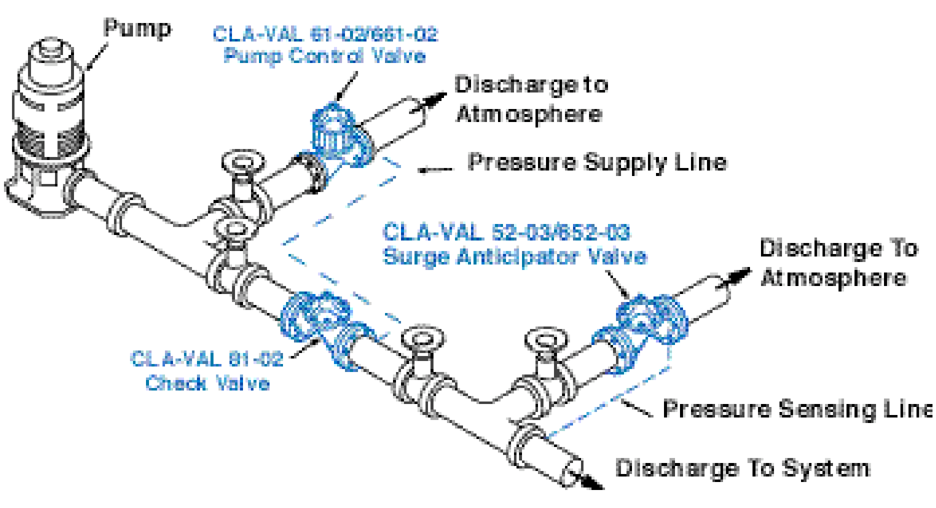
Install Model 60-73/660-73 valve as shown. Flexible conduit should be used for electrical connections to the solenoid control and the limit switch. A Model 52-03/652-03 Surge Anticipator Valve is recommended for power failure protection.



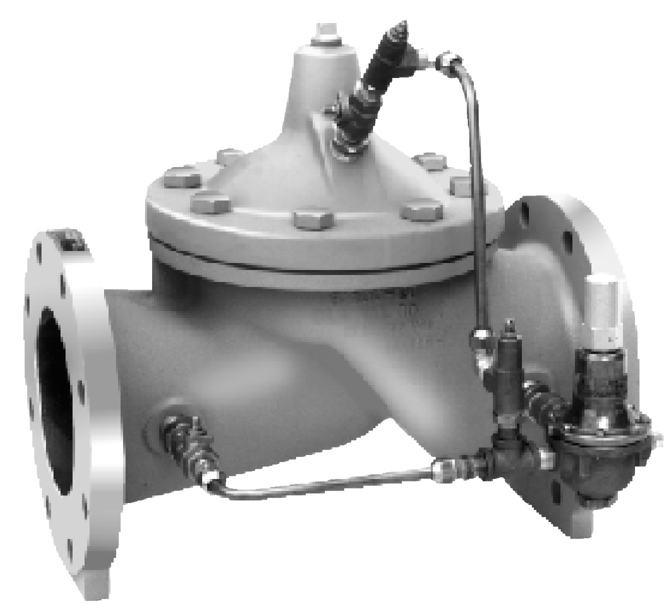
61-02/661-02 Deep Well Pump Control Valve

Model 61-02/661-02

The Cla-Val Model 61-02/661-02 Deep Well Pump Control Valve is designed to protect pipelines from surges caused by the starting and stopping of deep well pumps. This is a hydraulically operated diaphragm valve which is controlled by a solenoid pilot valve. Separate adjustable flow control valves in the pilot system regulate the opening and closing rates. A limit switch on the valve stem serves as an electrical interlock between the valve and the pump motor.



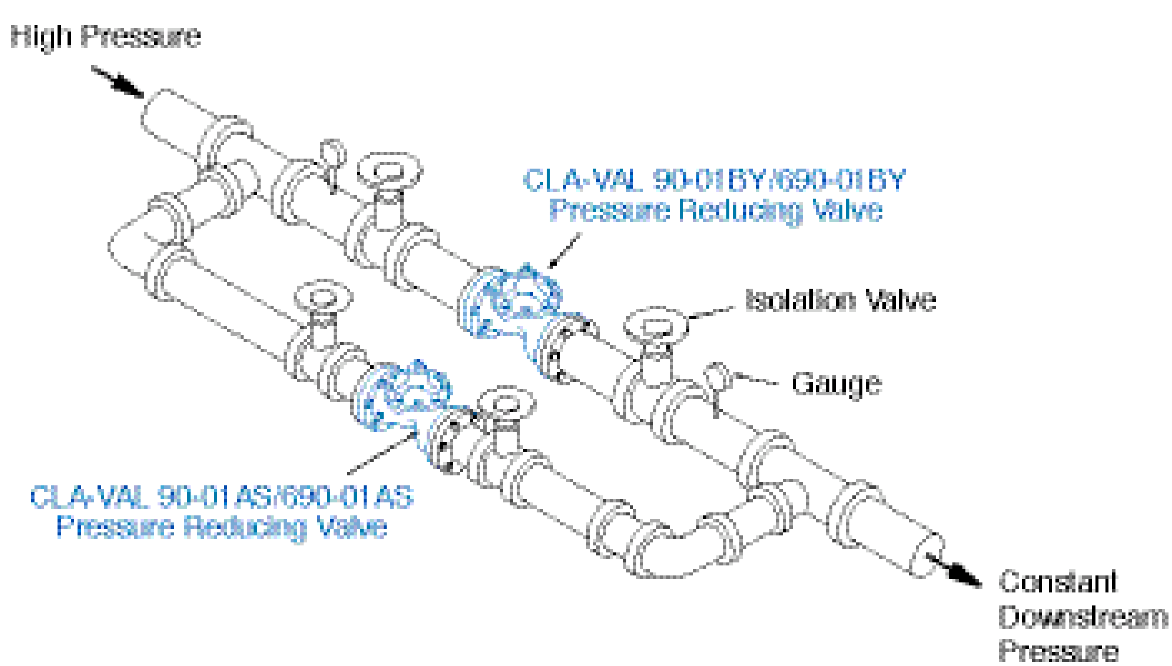
Install Model 61-02/661-02 valve as shown. Use a minimum of 1/2" tubing to connect operating pressure connection of the valve to the system side of check valve. Flexible conduit should be used for electrical connections to the solenoid control and the limit switch assembly. A Model 52-03/652-03 Surge Anticipator is recommended for power failure and surge protection.



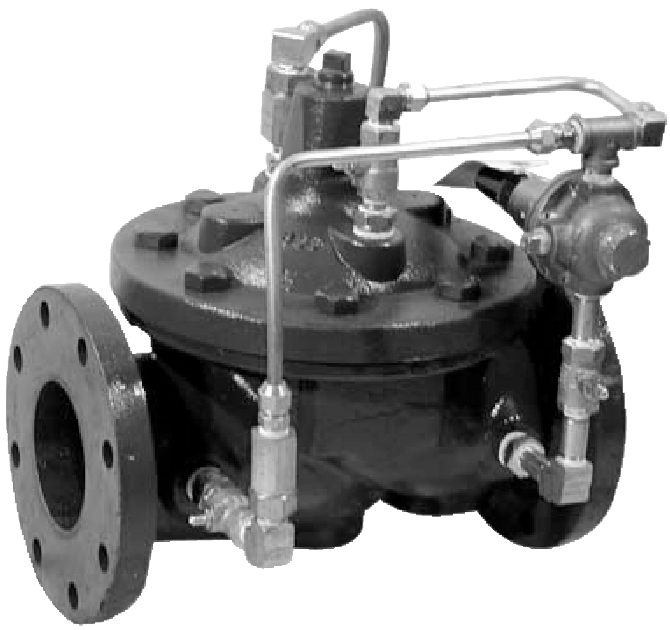
90-01/690-01 Pressure Reducing Valve

Model 90-01/690-01

The Cla-Val Model 90-01/690-01 Pressure Reducing Valve automatically reduces a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate or varying inlet pressure. This valve is an accurate, pilot-operated regulator capable of holding downstream pressure to a pre-determined, adjustable set point. When downstream pressure exceeds the pressure setting of the control pilot the pilot valve closes which then forces the main valve to close drip tight.



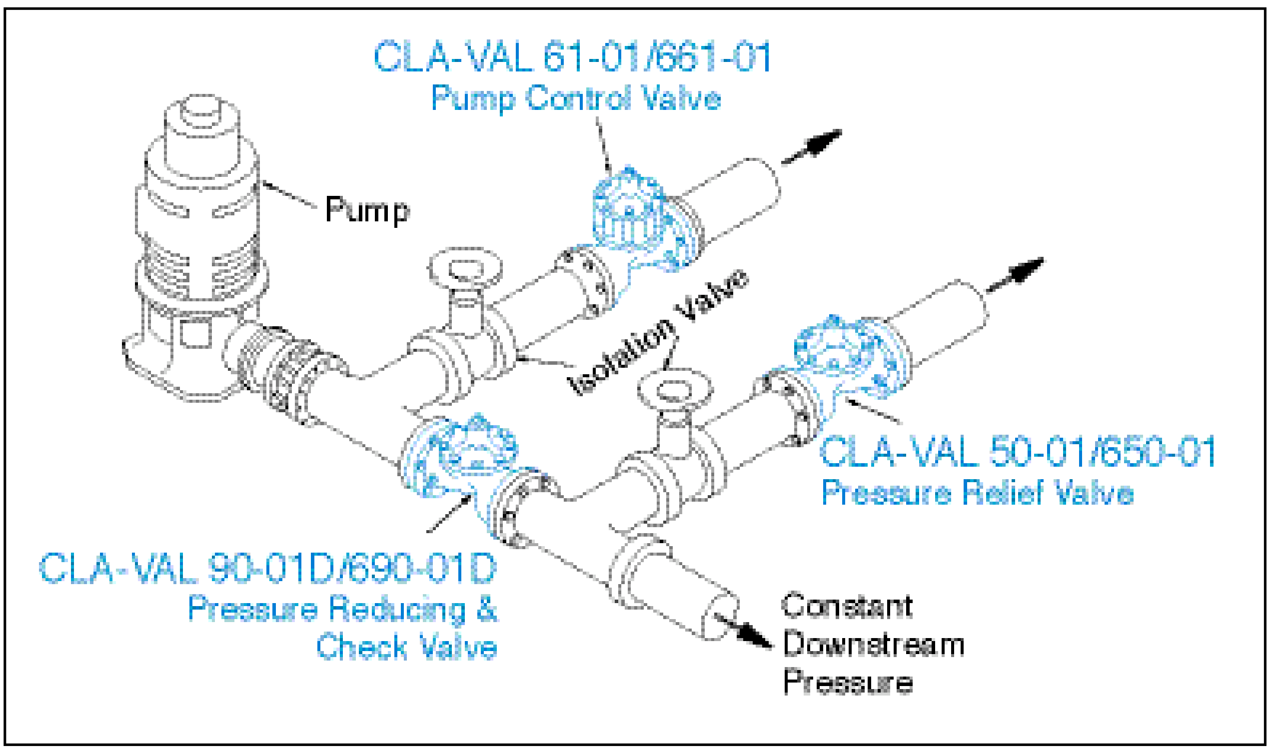
Typical pressure reducing valve station using two Series 90-01 valves in parallel to handle wide range flow rates. The larger Model 90-01 valve takes care of peak loads and smaller 90-01 handles low flows. The low flow valve is usually set 5 psi higher than the larger valve.



90-01D/690-01D Pressure Reducing with Check Valve

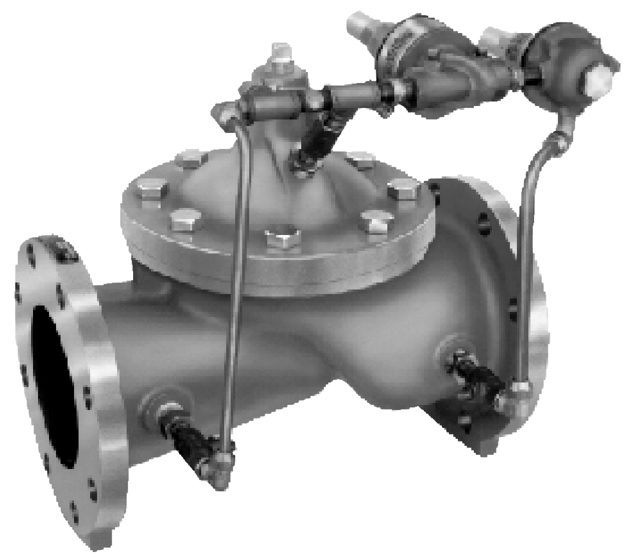
Model 90-01D/690-01D

The check feature is added to prevent flow from outlet to inlet if the inlet pressure should fall below the outlet pressure. The check feature is designated by the suffix “D”. When a check feature is added, and a pressure reversal occurs, the downstream pressure is forced into the main valve cover chamber closing the valve preventing return flow.



The 90-01D Combination Pressure Reducing and Check Valve is installed downstream of a pump where a constant system pressure is required. The check feature is to prevent reverse flow through the pump and to hold system pressure when the pump is off.

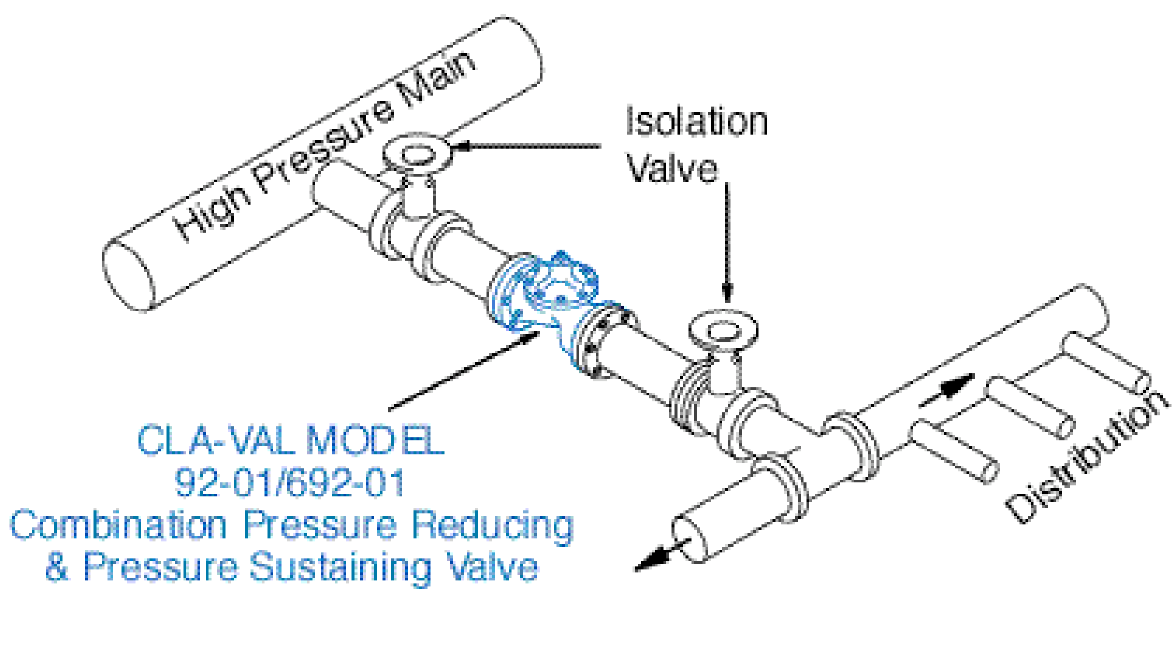
Cla-Val Model 92-01 Typical Application



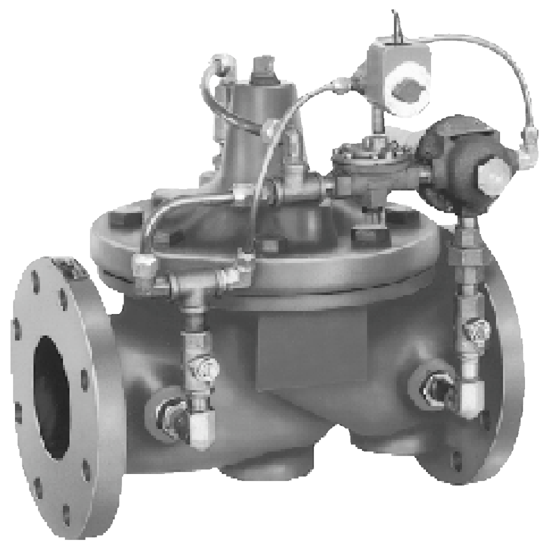
92-01/692-01 Pressure Reducing and Sustaining Valve

Model 92-01/692-01

The Cla-Val Model 92-01/692-01 Combination Pressure Reducing and Pressure Sustaining Valve maintains a constant downstream pressure regardless of fluctuating demand and, in addition, it sustains the upstream pressure to a predetermined minimum. The pressure reducing control responds to slight variation in downstream pressure and immediately repositions the main valve to maintain the desired downstream pressure. The pressure sustaining control is normally held open by the upstream pressure. but closes should the pressure drop to the sustaining pilot set point. This in turn closes the main valve to sustain the desired upstream pressure. If a check feature is added, and a pressure reversal occurs, the downstream pressure is forced into the main valve cover chamber and the valve closes to prevent return flow.



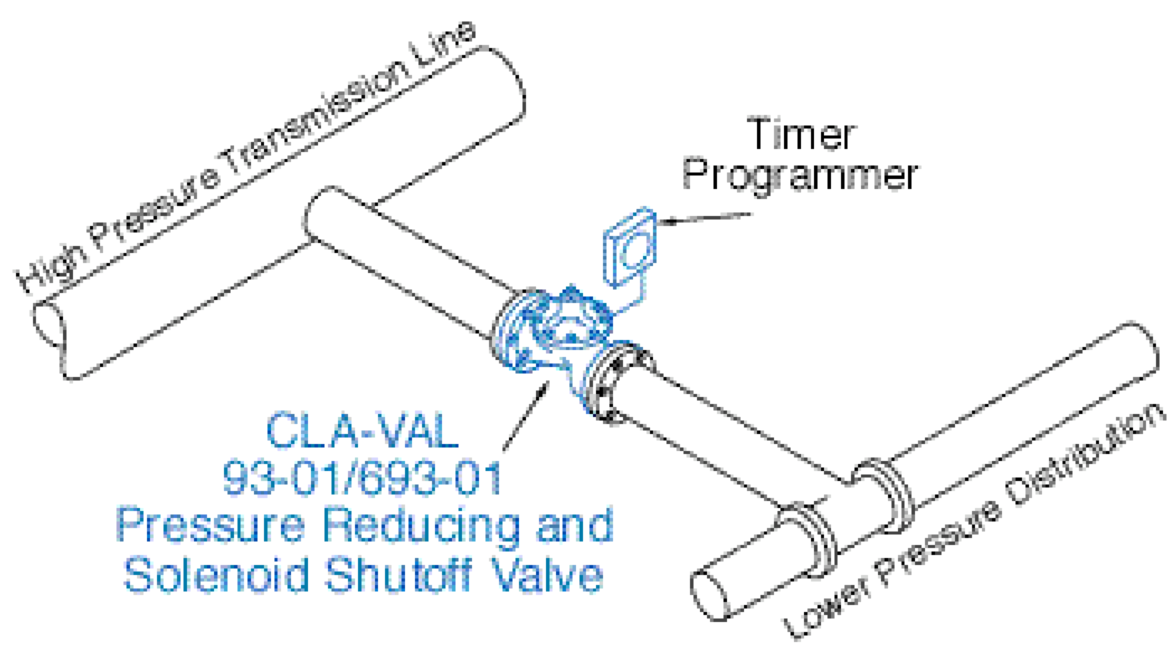
A typical application for a Combination Pressure Reducing and Pressure Sustaining Valve is to automatically reduce pressure for the downstream distribution network and sustain a minimum pressure in the high pressure main regardless of distribution demand.



93-01/693-01
Pressure Reducing with Solenoid

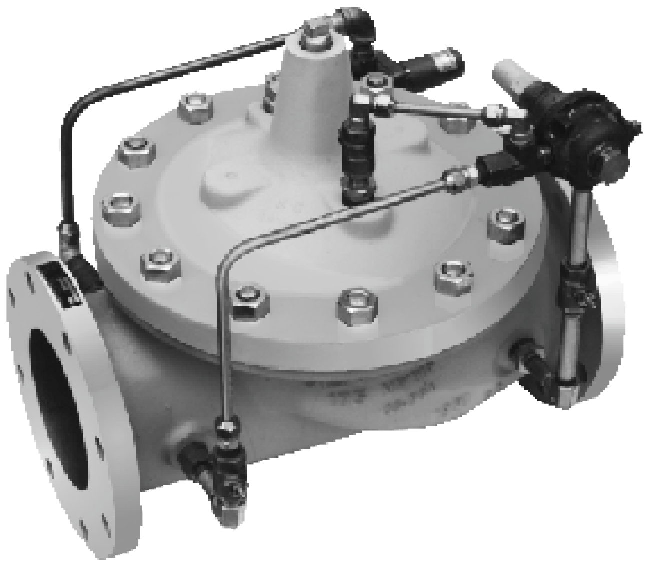
Model 93-01/693-01

The Model 93-01/693-01 Combination Pressure Reducing and Solenoid Shutoff Valve automatically reduces higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate and/or varying inlet pressure. The 93-01/693-01 is an accurate, pilot-operated regulator capable of holding downstream pressure to a predetermined delivery pressure. When downstream pressure exceeds the pressure setting of the control pilot, the pilot valve closes causing the main valve to close drip-tight. A solenoid control is provided to override the operation of the pressure reducing control and close the main valve. This valve is furnished either normally open (de-energized to open), or normally closed (energized to open). Pressure setting adjustment is made with single adjusting screw.

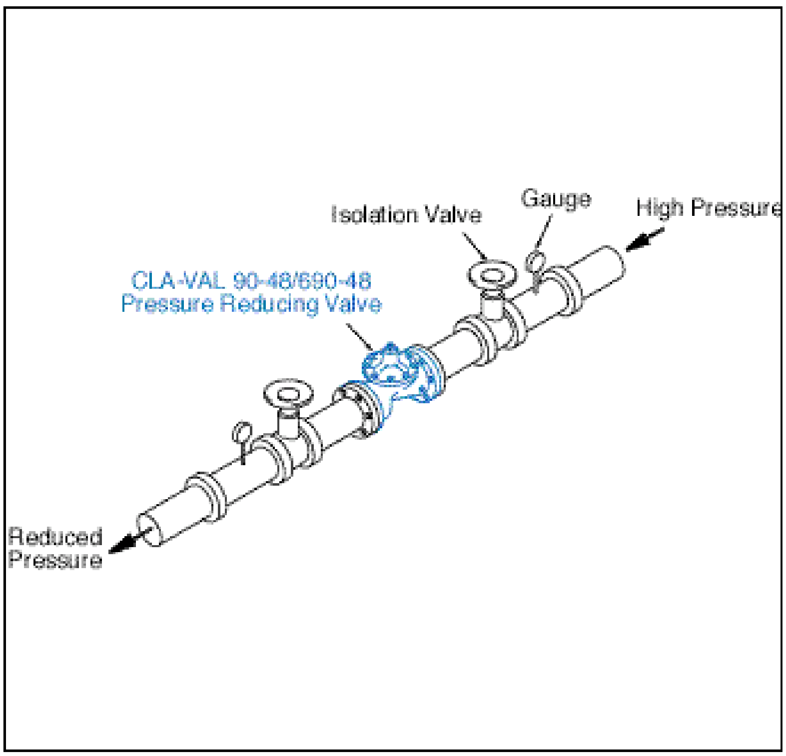


A typical application for this valve is reducing high transmission line pressures to lower distribution system levels, while opening and closing on command. The solenoid control feature can be activated by an electrical signal from a timer or from a control room.

Cla-Val Model 90-48 Typical Application



90-48/690-48 Pressure Reducing with low flow by-pass



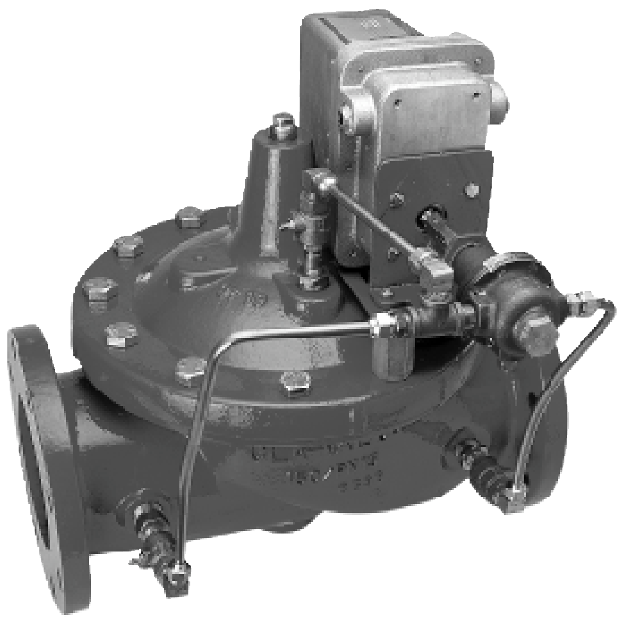
Model 90-48/690-48

The Cla-Val Model 90-48/690-48 Pressure Reducing Valve with Low Flow By-Pass automatically reduces a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate. The low flow by-pass capability is achieved by using the Cla-Val Model 990 Balanced Direct Acting Pressure Reducing Valve as an integral part of the main valve. By doing this, space is saved and installation and maintenance become much easier.

The pressure reducing valve is hydraulically operated and controlled by a Cla-Val CRD pilot control, which senses pressure at the main valve outlet. An increase in outlet pressure forces the CRD pilot control to close and a decrease in outlet pressure opens the control. This causes the main valve cover pressure to vary, modulating the main valve and thereby maintaining constant outlet pressure.

The Model 990 low flow pressure reducing by-pass is preset to a higher pressure than the CRD pilot control. The 990 responds to pressure changes from the main valve outlet. When the CRD closes, the Model 990 remains open allowing water to flow through, by-passing the main valve. The 990 closes when the flow decreases and the downstream pressure reaches its set point.

This valve has the flexibility to be installed in a distribution system where the demand varies over a wide range. This frequently occurs in industrial, residential, educational, high-rise buildings and other applications. Another important feature of the valve is its space efficient configuration, allowing easy installation and maintenance.

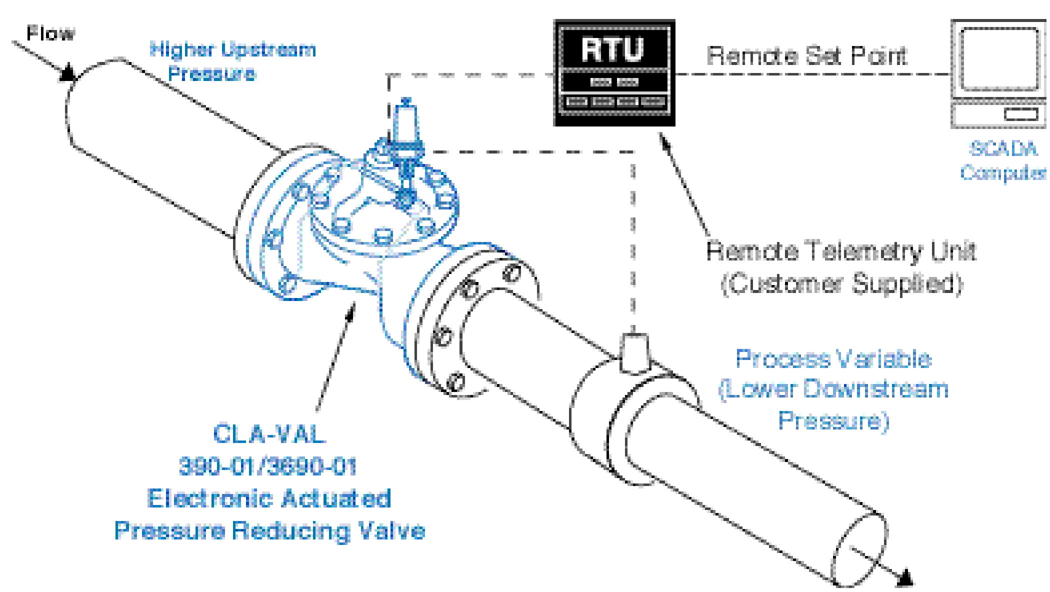


390-01/3690-01 Pressure Reducing with Solenoid

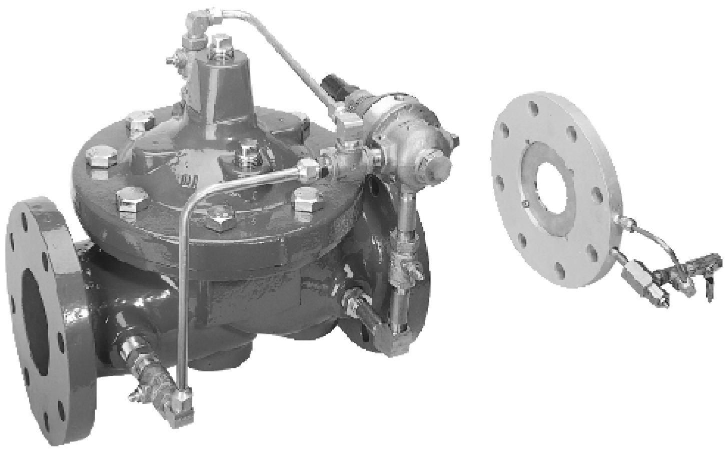
Model 390-01/3690-01

The Cla-Val Model 390-01/3690-01 Electronic Actuated Pressure Reducing Control Valve combines the precise control of field proven Cla-Val hydraulic pilots and the convenience and versatility of remote setpoint control. The Cla-Val Model 390-01 Pressure Reducing Valve automatically reduces a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate and/or varying inlet pressure. This valve is an accurate, pilot-operated regulator capable of holding downstream pressure to a pre-determined limit. The pilot control, consisting of a hydraulic pilot and integral controller, accepts a setpoint and compares it with a pressure or internal potentiometer position signal and makes incremental adjustments to modulate the valve to a setpoint.

Adjustable solid state limit switches eliminate over ranging. In the event of a power or transmitter failure, the CRD-30 pilot remains in hydraulic control virtually assuring system stability under changing conditions. If check feature ("D") is added, and pressure reversal occurs, the valve closes to prevent return flow.



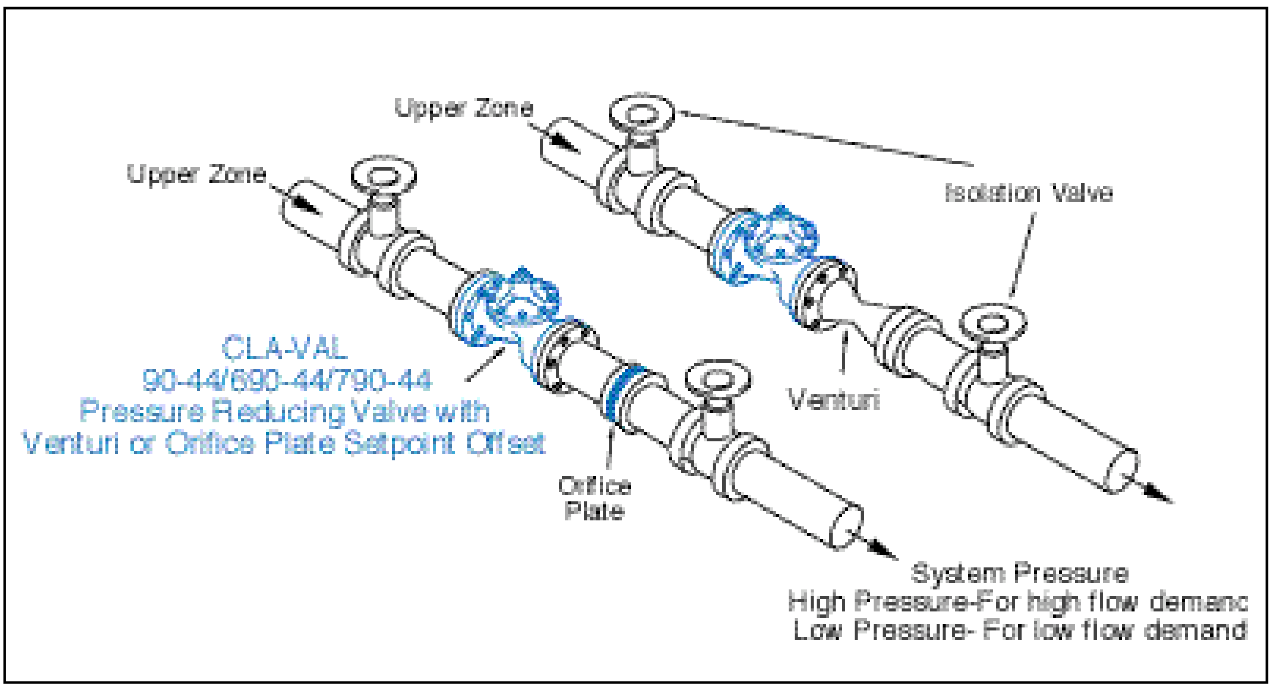
The valve is designed to be used with supervisory control systems having an isolated remote analog set point output and a process variable downstream pressure input. It is also an effective solution for lowering costs associated with "confined space" requirements by eliminating need for entry into valve structure for set point adjustment and system information. Additional Pilot Control, hydraulic and/or electronic, can be easily added to perform multiple control functions to fit exact system requirements.



90-44/690-44 Pressure Reducing Valve with Venturi or Orifice Plate Set point Offset

Model 90-44/690-44

The Cla-Val Model 90-44/690-44 is a pressure reducing valve with an orifice plate or venturi tube downstream of the valve. The venturi, or orifice plate, is used to create a pressure drop, which lowers the sensed pressure to the pilot as the system demand increases. The result of lowering the pilot sensed pressure is to automatically increase the pressure immediately downstream of the orifice plate, which compensates for system loss. The pilot system will automatically provide a lower pressure downstream of the orifice plate as the flow rate decreases. While the pressure immediately downstream of the orifice plate varies with flow, the system pressure at a point downstream remains more constant. An orifice plate is the most economical device for creating the required pressure drop. However, a venturi should be considered when pressure recovery is the primary factor. Pressure recovery is much better downstream of a venturi tube than downstream of an orifice plate. The 90-44 is very simple to maintain and operate. It requires no power.



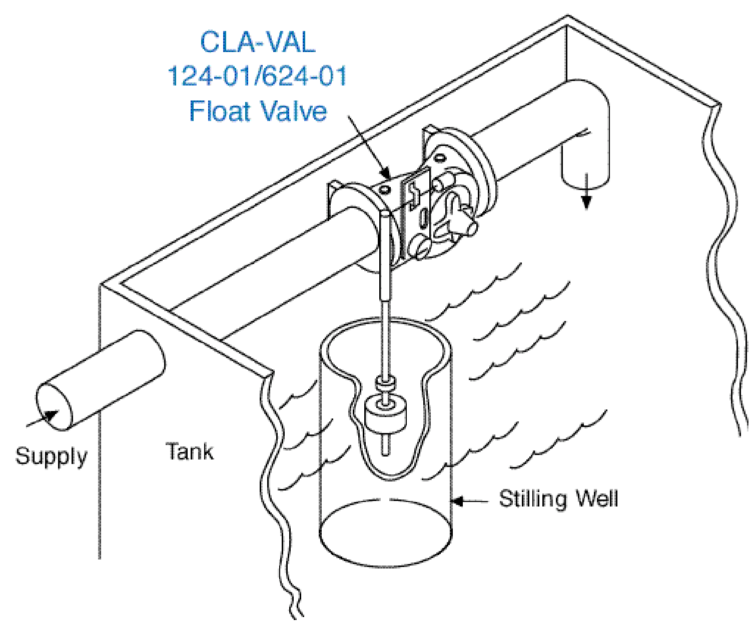
The valve can be used to conserve water by lowering the system pressure during low demand periods. The set point will be increased as the flow rate increases. The venturi lowers the pilot sensing pressure at higher flow rates which increases the downstream pressure. This provides a more constant pressure at the system critical point.

124-01/624-01 Float Valve

Model 124-01/624-01

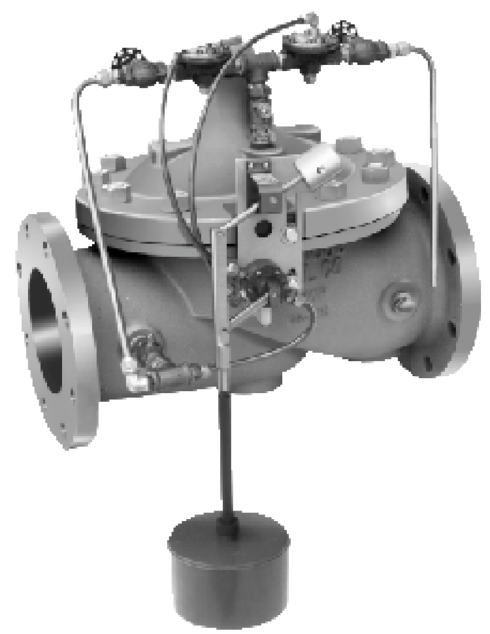
The Cla-Val Model 124-01/624-01 Float Valve is a non-modulating valve which accurately controls the liquid level in tanks. This valve is designed to open fully when the liquid level reaches a preset low point and close drip tight when the level reaches a preset high point.

This is a hydraulically operated, diaphragm valve with the pilot control and float mechanism mounted on the cover of the main valve. The float positions the pilot control to close the valve when the float contacts the upper stop. The high and low liquid levels are adjusted by positioning the stop collars on the float rod. The difference between high and low levels can be adjusted to as little as one inch, or to as much as 18 inches.



The Model 124-01/624-01 Float Valve is commonly mounted above the high water level in a tank. Globe pattern valves are supplied standard with the float control mounted on the cover as illustrated, with a horizontal discharge. Angle valves are configured to discharge downward. Note: We recommend protecting tubing and valve from freezing temperatures.

Cla-Val Model 124-02 Typical Application

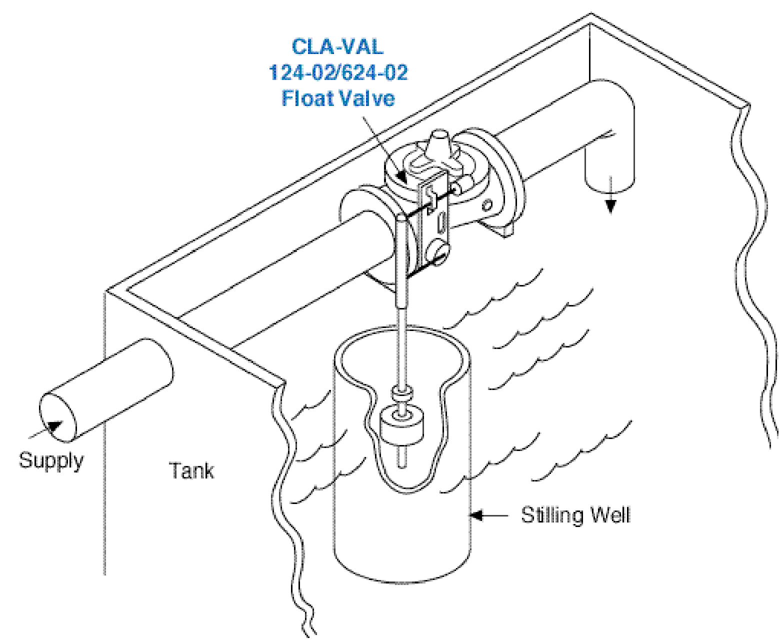


124-02/624-02 Float Valve

Model 124-02/624-02

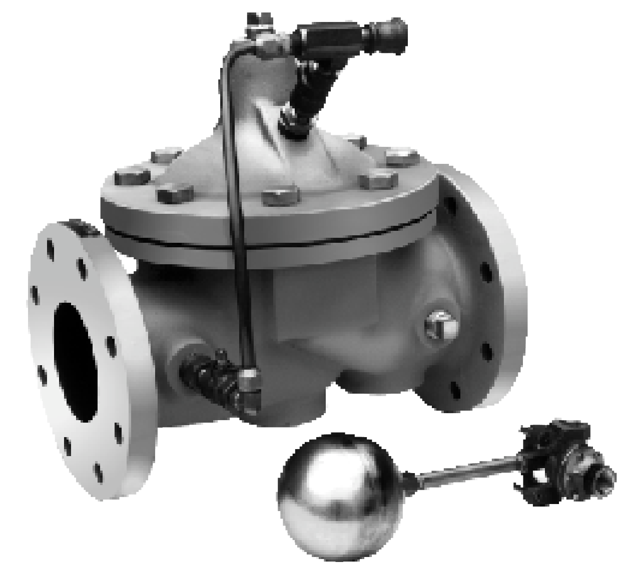
The Cla-Val Model 124-02/624-02 Float Valve is a non-modulating valve which accurately controls the liquid level in tanks. This valve is designed to open fully when the liquid level reaches a preset low point, and close drip tight when the level reaches a preset high point.

This is a hydraulically operated, diaphragm valve with the pilot control and float mechanism mounted on the cover of the main valve. The float positions the pilot control to close the valve when the float contacts the upper stop. The high and low liquid levels are adjusted by positioning the stop collars on the float rod. The difference between high and low levels can be adjusted to as little as one inch, or to as much as 18 inches. Level settings can be as much as 11-1/2 feet below the valve.The float mechanism may be located remotely from the main valve. See the technical data sheet on Model CF1-C1 Float Control for additional information.



The Model 124-02/624-02 Float Valve is commonly mounted above the high water level in a tank. Globe pattern valves are supplied standard with the float control mounted on the right side of the cover as illustrated, with a horizontal discharge. Angle valves are configured to discharge downward.

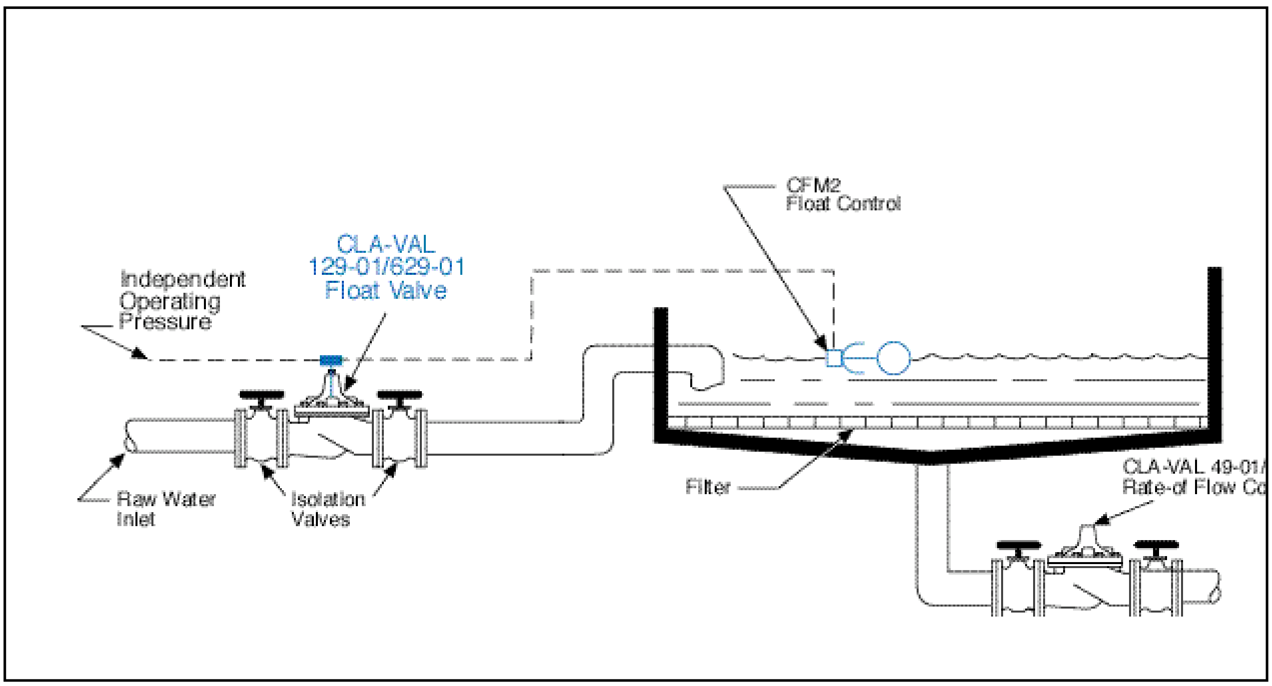
Note: We recommend protecting tubing and valve from freezing temperatures.



129-01/629-01 Float Valve

Model 129-01/629-01

The Cla-Val Model 129-01/629-01 Float Valve maintains a relatively constant level in storage tanks and reservoirs by admitting flow into the tank in direct proportion to the flow out of the tank. It is a hydraulically operated, pilot controlled, diaphragm valve. The rotary disc type float operated pilot control is installed at the high liquid level in the reservoir and is connected via tubing or pipe to the main valve. As the liquid level changes, the float control proportionally opens or closes the main valve, keeping the liquid level nearly constant. If the check feature option is added and a pressure reversal occurs, the downstream pressure is admitted into the main valve cover chamber and the valve closes to prevent return flow.



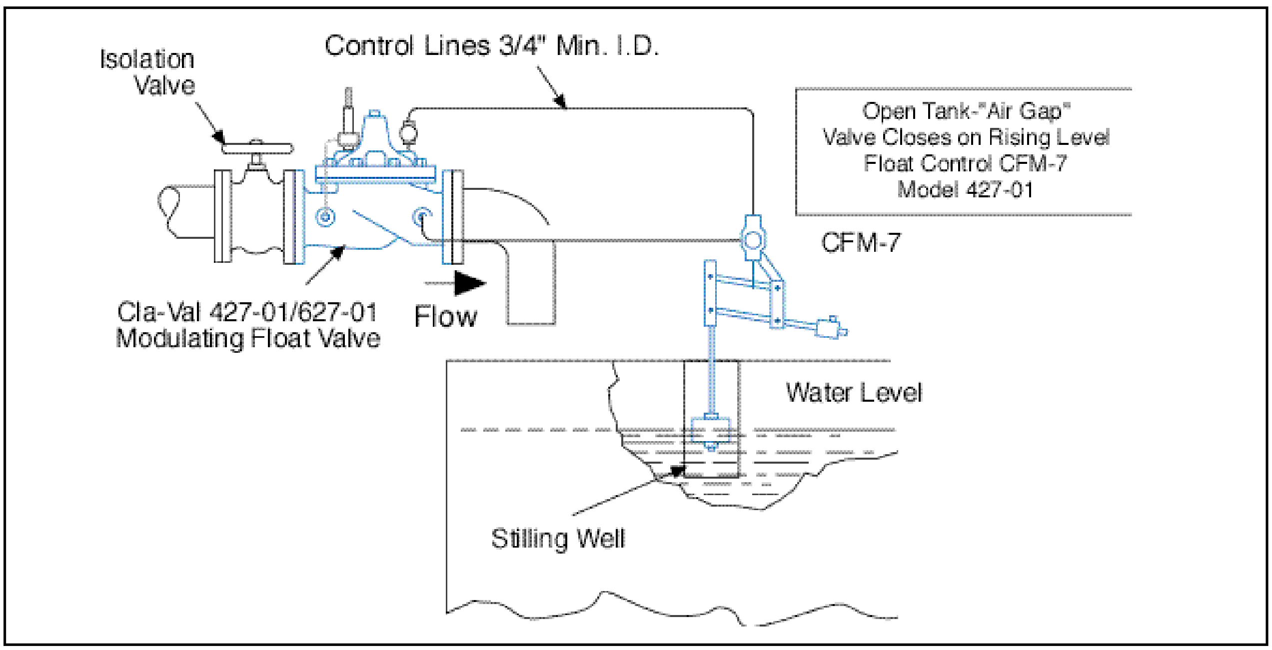
Install valve and control as shown in the diagram above. The float control should be located in a still liquid surface. If it is necessary to install the float control in a stilling well to reduce wave action. Mount the control on the connecting piping with the outlet port at the desired high water level.

427-01/627-01 Modulating Float Valve

Model 427-01/627-01

The Cla-Val Model 427-01/627-01 Float Valve modulates to maintain a constant liquid level in a storage tank by compensating for variations in supply or demand. It can be installed to control either the flow into or out of the tank by either Closing on a rising level or Opening on a rising level. This valve is a hydraulically-operated, pilot controlled diaphragm valve.

The Pilot Control System consists of a Variable Orifice Pilot Control mounted on the valve cover, and a Remote Mounted Float Control. A slight change in liquid level moves the float control. This action varies the pressure in the valve cover, causing the main valve to seek a new position. The Variable Orifice Pilot tracks the valve movement, automatically regulating the flow into the cover until the valve attains a position that is in direct relation to the position of the float control.



The valve may be installed in any position. The Remote Float Control may be mounted at any convenient location above the liquid level. Float rods are available in lengths from 2' to 12' in two-foot increments.

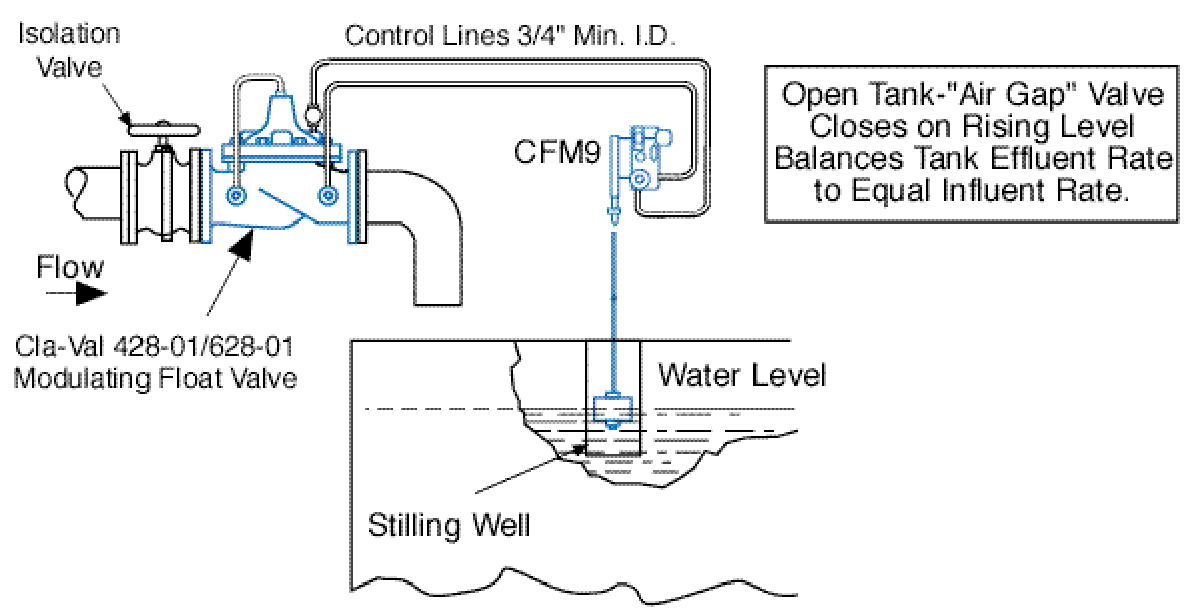
A stilling well (8” min. diameter) should be provided around the float if the liquid surface is subject to turbulence, ripples or wind.

428-01/628-01 Modulating Float Valve

Model 428-01/628-01

The Cla-Val Model 428-01/628-01 Float Valve modulates to maintain a constant liquid level in a storage tank by compensating for variations in supply or demand. It can be installed to control the flow into or out of the tank by either closing on a rising level or opening on a rising level. This valve is a hydraulically-operated, pilot-controlled diaphragm valve.

The Pilot Control System consists of an integral variable orifice in the main valve cover and a remotely mounted float control. A slight change in liquid level moves the float control. This action varies the pressure in the valve cover, causing the main valve to seek a new position. The integral variable orifice automatically regulates the flow into the cover chamber until the valve reaches a position that is in direct relation to the position of the float control.

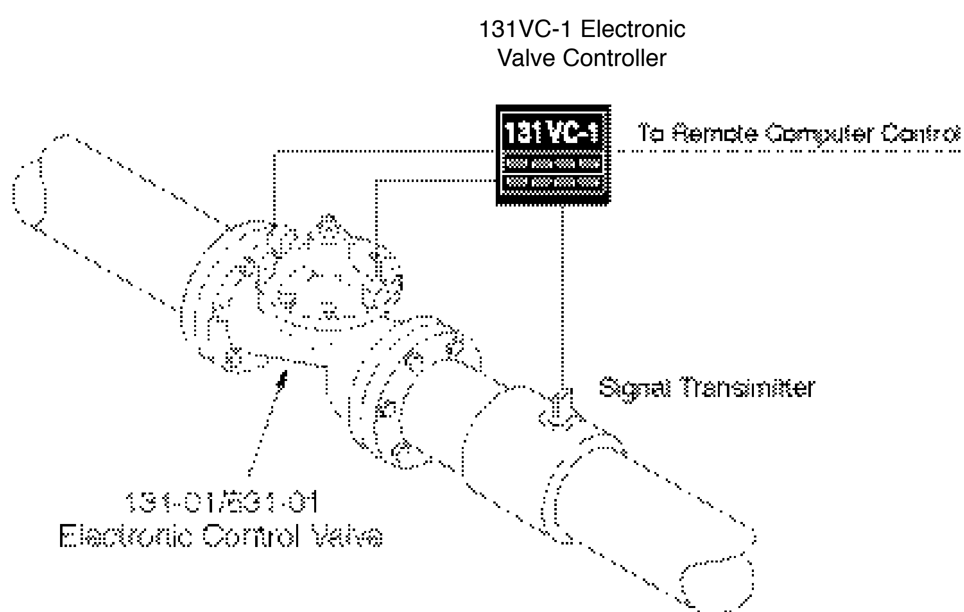


The valve may be installed in any position. The Remote Float Control may be mounted at any convenient location above the liquid level. Float rods are available in lengths from 2' to 12' in one-foot increments. A stilling well (8" min. diameter) should be provided around the float if the liquid surface is subject to turbulence, ripples or wind.

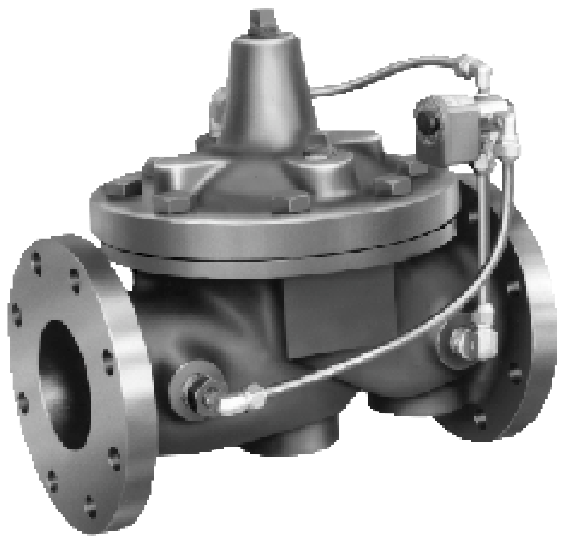
131-01/631-01 Electronic Control Valves

Model 131-01/631-01

The Cla-Val Series 131/631 Electronic Control Valves are designed specifically for applications where control of the valve with electrical signals is preferred. It is a hy d r a u l i-cally operated, pilot controlled, diaphragm valve. The solenoid pilot controls are actuated by electrical signals from the optional 131VC-1 Electronic Valve Controller. The solenoid pilots either add or relieve line pressure from the cover chamber of the valve, causing it to open or close as directed by the electronic controller.



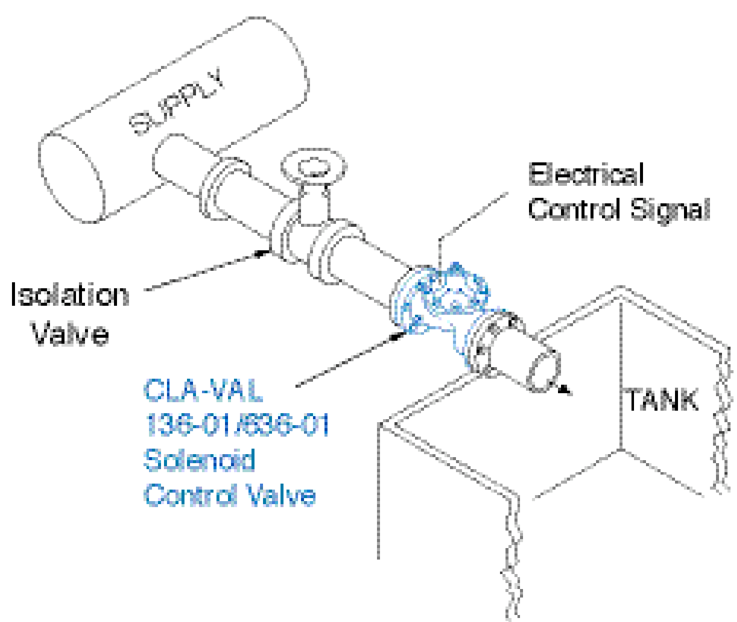
The Model 131-01/631-01 Electronic Control Valve is typically installed in a pipeline with an electronic signal transmitter and the Model 131VC-1 Electronic Valve Controller. This system can be designed to control flow, pressure, tank level or valve position. The 131VC-1 Electronic Valve Controller enables remote computer control over valve operations.



136-01/636-01 Solenoid Control Valve

Model 136-01/636-01

The Cla-Val Model 136-01/636-01 Solenoid Control Valve is an on-off control valve which either opens or closes upon receiving an electrical signal to the solenoid pilot control. This valve consists of a Hytrol main valve and a three-way solenoid valve which alternately applies pressure to or relieves pressure from the diaphragm chamber of the main valve. It is furnished either normally open (de-energize solenoid to open) or normally closed (energize solenoid to open).



Industrial uses for the solenoid control valve are many and include accurate control of process water for batching, mixing, washing, blending or other on-off type uses.

3 – 6

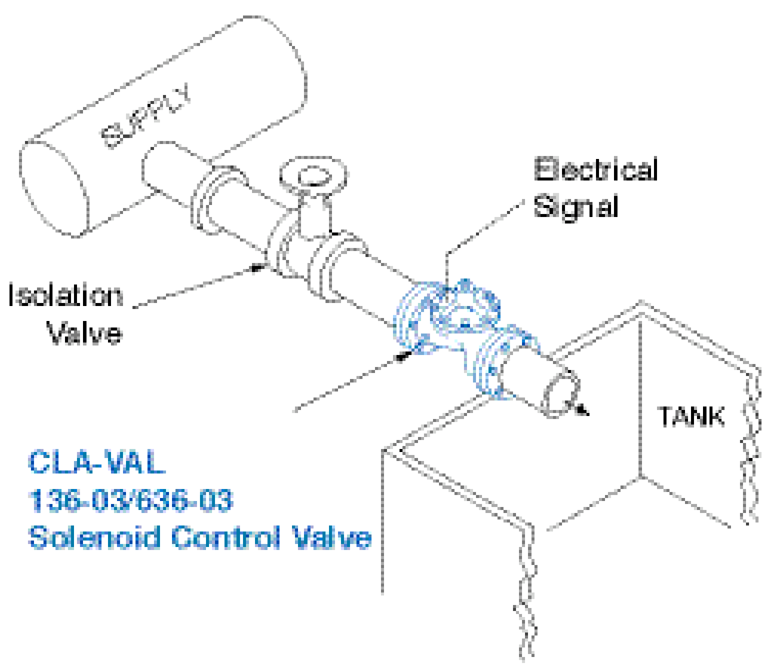
Cla-Val Model 136-03 Typical Application

136-03/636-03 Solenoid Control Valve

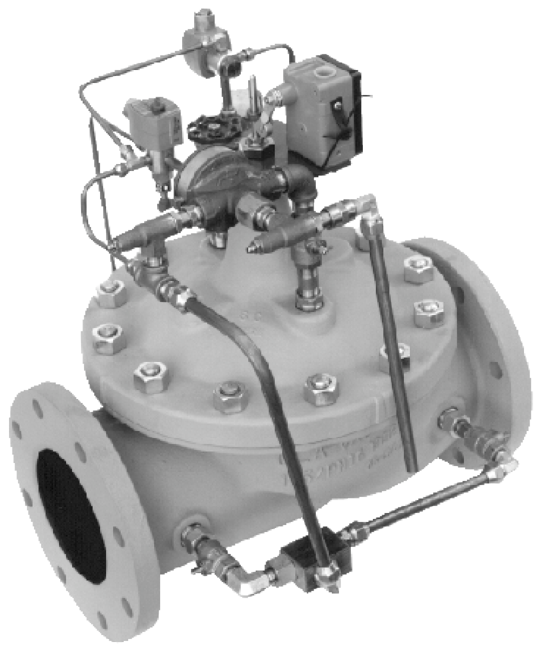
High Capacity Pilot Systems for Larger Valves and Rapid Operation

Model 136-03/636-03

The Cla-Val Model 136-03/636-03 Solenoid Control Valve is an on-off control valve which either opens fully or closes drip tight upon receiving an electrical signal to the solenoid pilot control. This valve consists of a Hytrol main valve, a three way solenoid and a high capacity three way pilot valve. The solenoid control operates the three way valve which alternately applies pressure to or relieves pressure from the diaphragm chamber of the main valve. It is furnished either normally open (de-energize solenoid to open) or normally closed (energize solenoid to open).



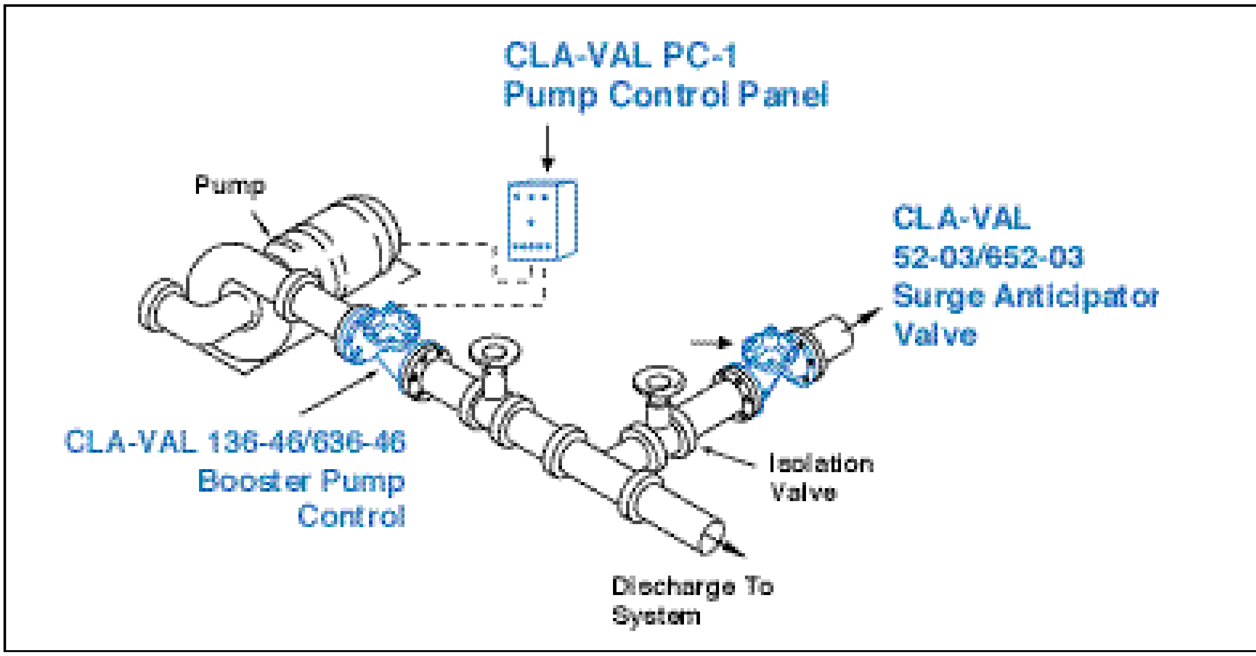
Industrial uses for the solenoid control valve are many and include accurate control of process water for batching, mixing, washing, blending or other on-off type uses.



136-46/636-46 Booster Pump Control Valve

Model 136-46/636-46

The Cla-Val Model 136-46/636-46 Booster Pump Control Valve is designed for installation on the discharge of booster pumps to eliminate pipeline surges caused by the starting and stopping of the pump. The booster pump starts against a closed valve. The main solenoid control of this pilot operated valve is energized when the pump starts. The valve begins to open slowly, gradually increasing line pressure to full pumping head. When the pump is signaled to shut-off, the main solenoid control is de-energized and the valve begins to close slowly, gradually reducing flow while the pump continues to run. When the valve is in the closed position, a limit switch assembly, which serves as an electrical interlock between the valve and the pump, releases the pump starter and the pump stops. The limit switch assembly is adjustable over the entire valve travel. Pilot system includes power failure solenoid to accelerate valve closure during power outage.



Install Model 136-46/636-46 valve as shown. Flexible conduit should be used for electrical connections to the solenoid controls and the limit switch. The recommended Cla-Val PC-1 pump control panel sequences the pump and control valve during all modes of operation. A Cla-Val Model 52-03/652-03 Surge Anticipator Valve is recommended for power failure protection.

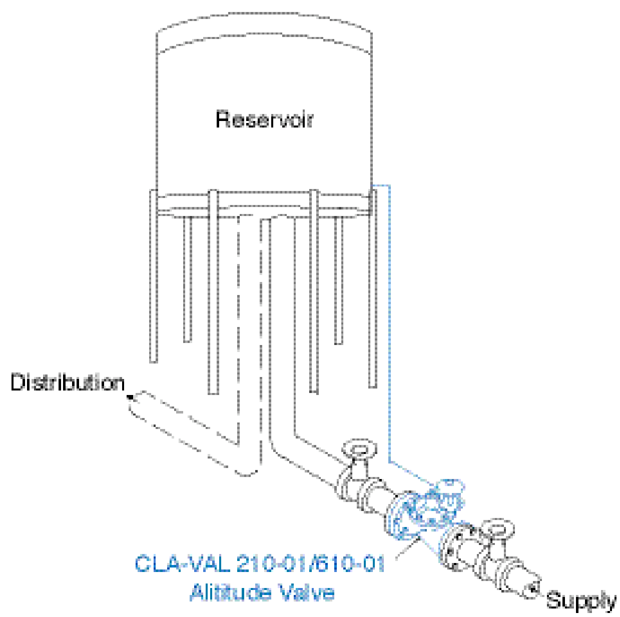
3 – 6

210-01/610-01 Altitude Valve for One-Way Flow

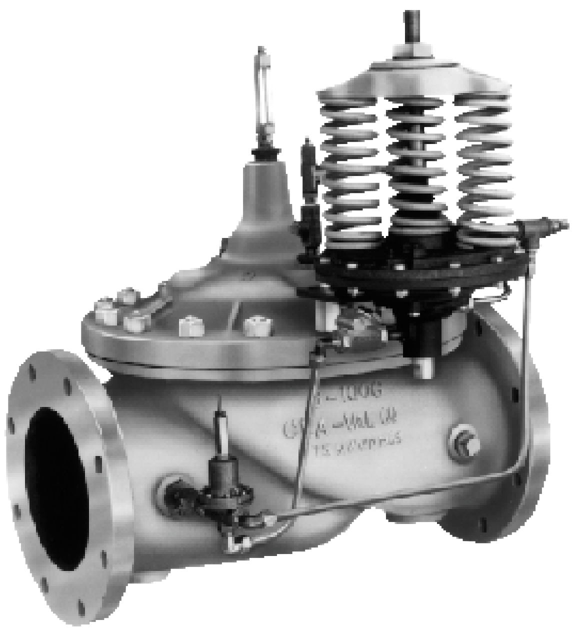
Model 210-01/610-01

The Cla-Val Model 210-01/610-01 Altitude Valve controls the high water level in reservoirs without the need for floats or other devices. It is a non-throttling valve that remains fully open until the shut-off point is reached. This valve is designed for one-way flow only.

This valve is hydraulically operated and pilot controlled. The pilot control operates on the differential in forces between a spring load and the water level in the reservoir. The desired high water level is set by adjusting the spring force. The pilot control measures the reservoir head through a customer supplied sensing line* connected directly to the reservoir.



Used on reservoirs where the water is withdrawn through a separate line or through a bypass equipped with a check valve. The valve opens to refill the reservoir when the water lowers below the shutoff level. For more information see data sheet E-CDS6

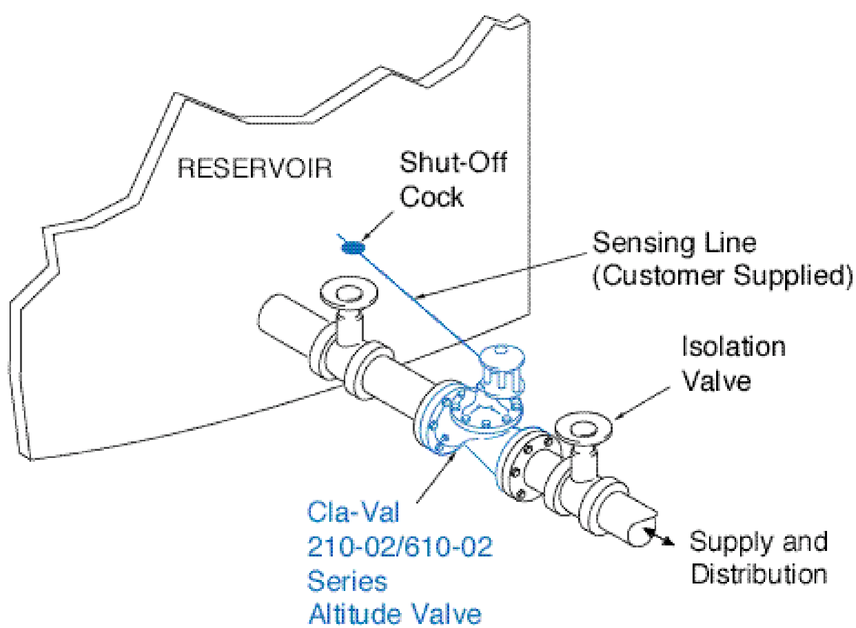


210-02/610-02 For Two-Way Flow
with Delayed Opening

Model 210-02/610-02

The Cla-Val Model 210-02/610-02 Altitude Valve controls the high water level in reservoirs without the need for floats or other devices. It is a non-throttling valve that remains fully open until the shut-off point is reached. This valve closes at the high water level, and for return flow, delays its opening until the pressure at the valve inlet lowers to a pre-set adjustable pressure of one to seven pounds.

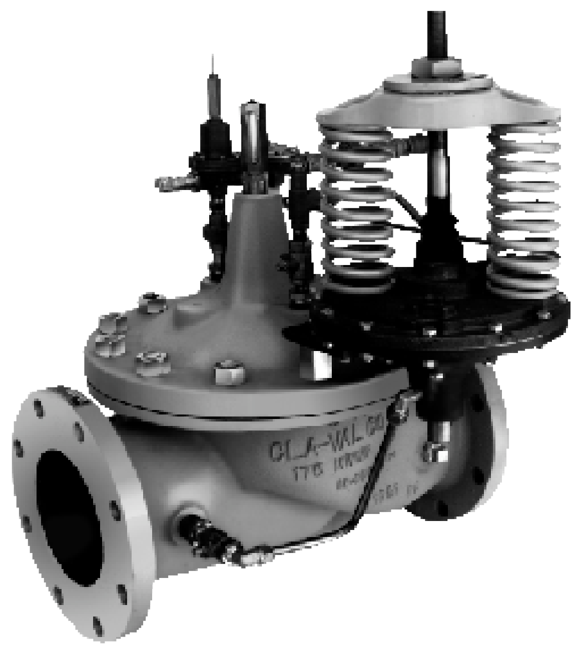
This valve is hydraulically operated and pilot controlled. The pilot control operates on the differential in forces between a spring load and the water level in the reservoir. When the force of the spring is overcome by the force of the reservoir head, the pilot closes the main valve. The desired high water level is set by adjusting the spring force. The pilot control measures the reservoir head through a customer supplied sensing line* connected directly to the reservoir.



Used on reservoirs where water is supplied and withdrawn through the altitude valve. The valve closes at the high water level. When pressure at the valve inlet lowers to the desired opening point, the pilot control opens the main valve for return flow to the system. The return flow pressure setting is adjustable to 6 psi below the shutoff pressure.

3 – 7

Cla-Val Model 210-03 Typical Application

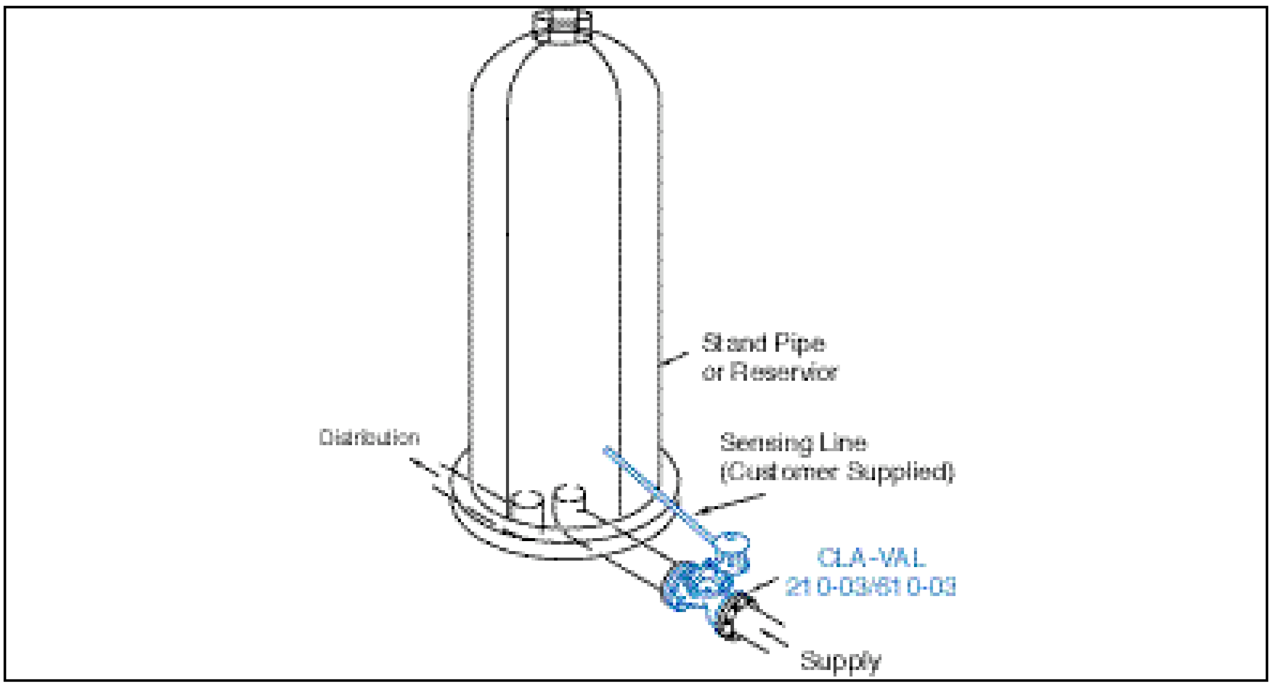


210-03/610-03 Altitude Valve For One-Way Flow with Delayed Opening

Model 210-03/610-03

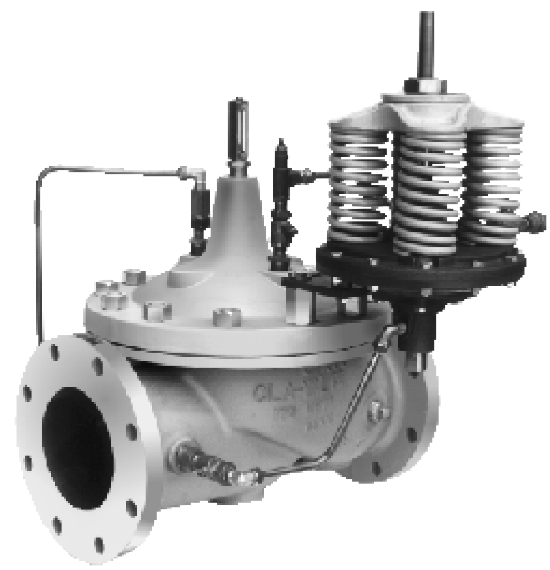
The Cla-Val Model 210-03/610-03 Altitude Valve controls the high water level in reservoirs without the need for floats or other devices. It is a non-throttling valve that remains fully open until the shut-off point is reached. This valve closes at a high water level. Water is withdrawn from the reservoir through a separate discharge line or through a check valve located in a by-pass line around the altitude valve. The valve delays opening until the water in the reservoir lowers to a desired level. The low level is adjustable from 1 to 15 feet from the high water shutoff point.

This valve is hydraulically operated and pilot controlled. The pilot control operates on the differential in forces between a spring load and the water level in the reservoir. When the force of the spring is overcome by the force of the reservoir head, the pilot closes the main valve. The desired high water level is set by adjusting the spring force. The pilot control measures the reservoir head through a customer supplied sensing line* connected directly to the reservoir.



Used on reservoirs where water is withdrawn from the reservoir through a separate line. When the water level lowers to the desired opening point, the pilot control opens the main valve to refill the reservoir. The difference between the high level shutoff and the low level opening is adjustable between a minimum of one and a maximum of 15 feet.

For more information see data sheet E-CDS6

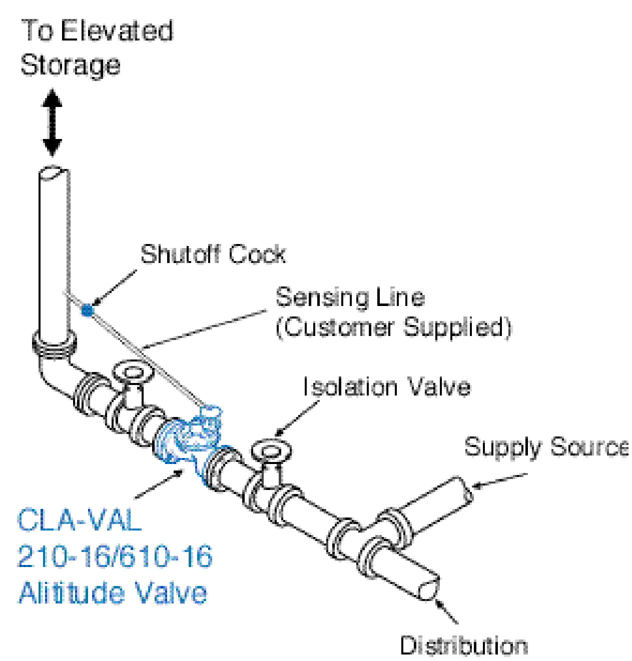


210-16/610-16 Altitude Valve For Two-Way flow

Model 210-16/610-16

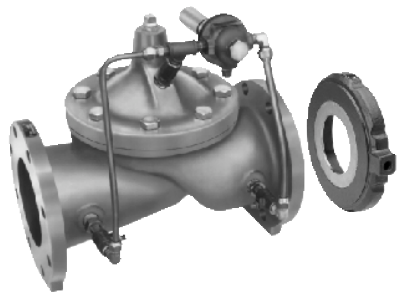
The Cla-Val Model 210-16/610-16 Altitude Valve controls the high water level in reservoirs without the need for floats or other devices. It is a non-throttling valve that remains fully open until the shut off point is reached. This valve closes at a high water level, and opens for return flow when the pressure at the valve inlet is less than the reservoir pressure.

This valve is hydraulically operated and pilot controlled. The pilot control operates on the differential in forces between a spring load and the water level in the reservoir. When the force of the spring is overcome by the force of the reservoir head, the pilot closes the main valve. The desired high water level is set by adjusting the spring force. The pilot control measures the reservoir head through a customer supplied sensing line* connected directly to the reservoir.



Used on reservoirs where water is withdrawn through the Altitude Valve. The valve closes at the high water level and opens for return flow when the pressure at the valve inlet lowers below the reservoir pressure.

Section 4



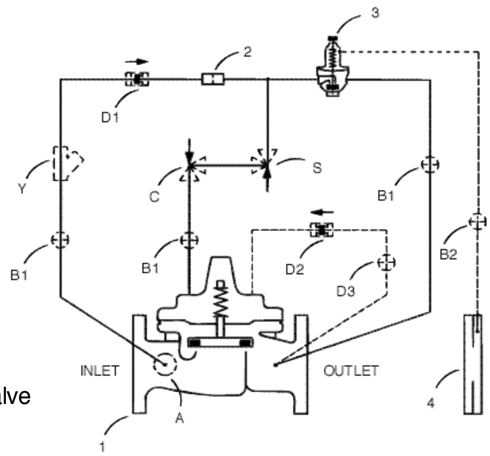
40-01/640-01 Rate of Flow Control

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	X58C Restricting Fitting
3	CDHS18 Differential Control
4	X52E Orifice Plate Assembly

Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
C	CV Flow Control (Closing)
D	Check Valves with Isolation valve
S	CV Flow Control (Opening)
Y	X43 "Y" Strainer



Rate of Flow Start-up and Adjustment Instructions 40-01/640-01

1. Install pressure gauges at main valve inlet/outlet. Place gauges in unused body tappings. Downstream gauge can be installed in unused 3/8" CDHS-18 Differential Control (item # 3) body tapping. In addition a flow meter is required to set the rate of flow through the valve.

2. Install X101 Valve Position Indicator in center cover tapping of main valve (if available).

3. Make sure low pressure sensing line (not supplied by Cla-Val) is connected to the low pressure sensing port on the X52A-1 Orifice Plate Assembly (item # 4) from cover of CDHS-18 Differential Control (item # 3). Orifice plate assembly should be 1-5 pipe diameters downstream of main valve.

4. Open all isolation valves in pilot system (valves 4" and larger). Remove pilot caps and loosen all jam nuts.

5. Adjust CV flow controls (opening/closing speeds) if included in pilot system. Turn control clockwise until closed then back out three turns to start.

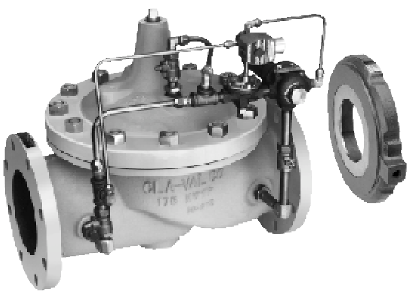
6. Open inlet isolation valve slowly to pressurize main valve.

7. Bleed air from main valve cover by loosening pipe plug in center of main valve cover or X101 Valve position Indicator housing. If valve is installed in vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover (Limit vertical installation to valves 6" and smaller). Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

8. Open downstream isolation valve and establish a flow in the system.

9. Slowly adjust the CDHS-18 Differential Control (item # 3) observing the flow rate via the meter until the desired flow rate is achieved (clockwise to increase setting or counter-clockwise to decrease setting). Adjust CV flow controls until desired valve opening or closing speeds are obtained. Adjust opening rate so that valve opens slowly to desired flow rate and does not over shoot setting. Adjust closing rate so valve does not cause excessive system pressure surging upon closing.

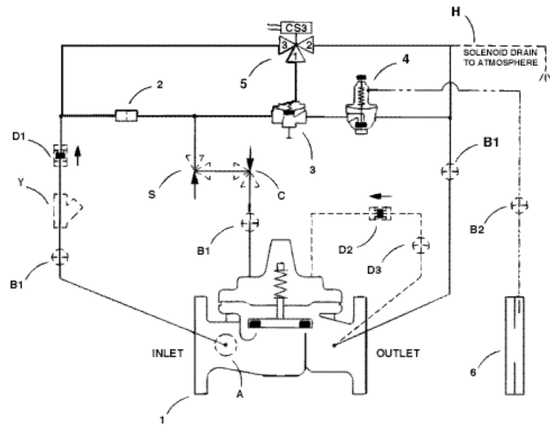
10. All valve adjustments are now set. Lockup all jam nuts to retain settings. Replace all pilot caps.



43-01/643-01 Combination Rate of Flow Controller & Solenoid Shut-off Valve

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	X58C Restriction Fitting
3	100-01 Hytrol (Reverse Flow)
4	CDHS18 Differential Control
5	CS3 Solenoid Control
6	X52E Orifice Plate Assembly



Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
C	CV Flow Control (Closing)
D	Check Valves with Isolation valve
H	Solenoid Drain to Atmosphere
S	CV Flow Control (Opening)
Y	X43 “Y” Strainer

Combination Rate of Flow Controller & Solenoid Shut-off Valve and Adjustment Instructions 43-01/643-01

1. Install pressure gauges at main valve inlet/outlet. Place gauges in unused body tappings. Downstream gauge can be installed in the unused 3/8" CDHS-18 Differential Control (item # 3) body tapping. In addition a flow meter is require to set the rate of flow through the valve.

2. Install X101 Valve Position Indicator in center cover tapping of main valve (if available).

3. Open all isolation valves in pilot system (valves 4" and larger). Remove pilot caps and loosen all jam nuts.

4. Make sure low pressure sensing line (not supplied by Cla-Val) is connected to the low pressure sensing port on the X52A-1 Orifice Plate Assembly (item # 6) from the cover of the CDHS-18 Differential Control (item # 4). Orifice plate assembly should be 1-5 pipe diameters downstream of main valve.

5. Adjust CV flow controls (opening/closing speeds) if included in pilot system. Turn control clockwise until closed then back out three turns to start.

6. Locate the CS3 Solenoid Control (item # 5) in the pilot system. Make sure proper voltage is supplied to the coil. If the unit is equipped with a manual operator make sure it is backed all the way out counter-clockwise (rotating the red thumb screw clockwise simulates energization of the coil). Solenoid can be supplied energized to open main valve or de-energized to open main valve. You can determine the valve operation in two ways:

A. Energized to open main valve supply pressure comes to port # 3 on CS3 solenoid (item #5), port # 1 is connected to the cover of the 3/8" auxiliary hytrol (item # 3), and port # 2 is vented to atmosphere (catalog number suffix H) or to the downstream side of the valve standard. Also check the Asco Solenoid catalog number 8320G136 normally open.

B. De-energized to open main valve supply pressure comes to port # 2 on CS3 solenoid (item # 5), port # 1 is connected to the cover of the 3/8" auxiliary hytrol (item # 3), and port # 3 is vented to atmosphere (catalog number suffix H) or to the downstream side of the valve standard. Also check the ASCO Solenoid catalog number 8320G132 normally closed.

7. Open inlet isolation valve slowly to pressurize main valve.

8. Bleed air from main valve cover by loosening pipe plug in center of main valve cover or X101 Valve position Indicator housing. If valve is installed in a vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover (Limit vertical installation to valves 6" and smaller). Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

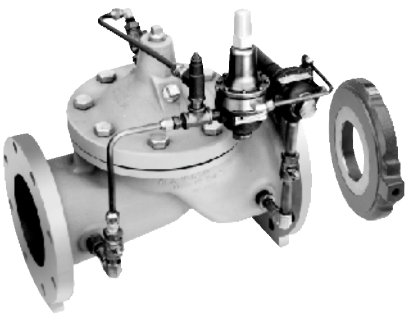
9. Open downstream isolation valve and establish a flow in the system. To accomplish this the CS3 solenoid (item #5) must be electrically energized to open the main valve under command of the CDHS-18 Differential Control (item # 4) in valves so equipped. If the valve is de-energized to open no electrical power is required to open the main valve. In valves so equipped if the CS3 solenoid (item #5) is energized the main valve closes. The porting sequence for the CS3 solenoid (energized to open or de-energized to open) appears in the valve schematic. Always check the effect in the system before starting.

10. Slowly adjust the CDHS-18 Differential Control observing the flow rate via the meter until the desired flow rate is achieved (clockwise to increase setting or counter-clockwise to decrease setting). Adjust CV flow controls until the desired valve opening or closing speeds are obtained. Adjust the opening rate so that valve opens slowly to the desired flow rate and does not over shoot the setting. Adjust closing rate so the valve does not cause excessive system surging upon closing.

11. All valve adjustments are now set. Lockup all jam nuts to retain settings. Replace all pilot caps.

12. To close the main valve on solenoids energized to open remove electrical power from the solenoid. This will connect ports 3 & 1 on the solenoid directing inlet pressure into the cover of the 3/8" auxiliary hytrol closing it. This will in turn direct inlet pressure into the cover of the main valve closing it.

13. To close the main valve on solenoids de-energized to open apply electrical power to the solenoid. This will connect ports 2 & 1 on the solenoid directing inlet pressure into the cover of the 3/8" auxiliary hytrol closing it. This will in turn direct inlet pressure into the cover of the main valve closing it.



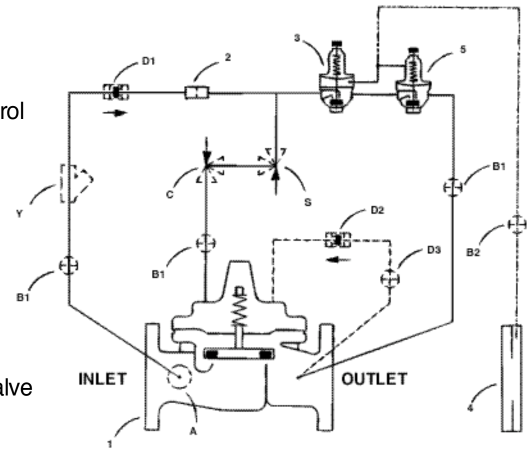
49-01/649-01 Combination Rate of Flow & Pressure Reducing Valve

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	X58A Restriction Fitting
3	CRA Pressure Reducing Control
4	X52E Orifice Plate Assembly
5	CDHS18 Differential Control

Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
C	CV Flow Control (Closing)
D	Check Valves with Isolation valve
S	CV Flow Control (Opening)
Y	X43 "Y" Strainer



1. Install pressure gauges at main valve inlet/outlet. Place gauges in unused body tappings. Downstream gauge can be installed in unused 3/8" CDHS-18 Differential Control (item # 3) body tapping. In addition a flow meter is required to set the rate of flow through the valve.

2. Install X101 Valve Position Indicator in center cover tapping of main valve (if available).

3. Open all isolation valves in pilot system (valves 4" and larger). Remove pilot caps and loosen all jam nuts.

4. Observe the setting on the CRA Pressure Reducing Control (item #3). There is a tag attached to the pilot cover with the factory setting. If the pilot has a 15-75 PSI spring range each 360 degree turn in/out changes the setting 9 PSI. The 30-300 PSI spring range has a 27 PSI change for each 360 degree turn in/out. Alter the factory setting (turn adjustment clockwise/counter-clockwise) until the set point of the control is close to the required setting. This setting is approximate and may have to be changed once the valve is pressurized. Actual pressure settings must be made under a flowing condition.

5. Adjust CV flow controls (opening/closing speeds) if included in pilot system. Turn control clockwise until closed then back out three turns to start.

6. Make sure low pressure sensing line (not supplied by Cla-Val) is connected to the low pressure sensing port on the X52A-1 Orifice Plate Assembly (item # 4) from the cover of the CDHS-18 Differential Control (item # 5). Orifice plate assembly should be 1-5 pipe diameters downstream of main valve.

7. Open inlet isolation valve slowly to pressurize main valve.

8. Bleed air from main valve cover by loosening pipe plug in center of main valve cover or X101 Valve position Indicator housing. If valve is installed in vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover (Limit vertical installation to valves 6" and smaller.) Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

9. Open downstream isolation valve and establish a low flow in the system. Refer to minimum flow requirements for each valve size to set CRA Pressure Reducing Control. Always check the effect in the system before starting.

Size	Minimum Flow (gpm)
1 1/4-1 1/2"	15
2"	15
2 1/2"	20
3"	30
4"	50
6"	115
8"	200
10"	300
12"	400
14"	500
16"	650
24"	1500

10. Slowly adjust the CRA Pressure Reducing Control (item #3) observing the down stream pressure gauge until the desired pressure is achieved (clockwise to increase setting or counter-clockwise to decrease setting). Adjust CV flow controls until desired valve opening or closing speeds are obtained. Adjust opening rate so that valve opens slowly to desired outlet pressure and does not over shoot setting. Adjust closing rate so valve does not cause excessive system pressure surging upon closing.

11. Next adjust CDHS-18 Differential Control until desired flow rate is achieved. Observe flow meter during adjustment (clockwise to increase flow rate and counter-clockwise to decrease flow rate). The adjustment range on the control is 30-480 inches of water. This is the only spring range supplied for this pilot. In most cases the orifice bore supplied in the orifice plate assembly is sized to produce a minimum of 100 inches of differential at the rated flow.

12. All valve adjustments are now set. Lockup all jam nuts to retain settings. Replace all pilot caps.

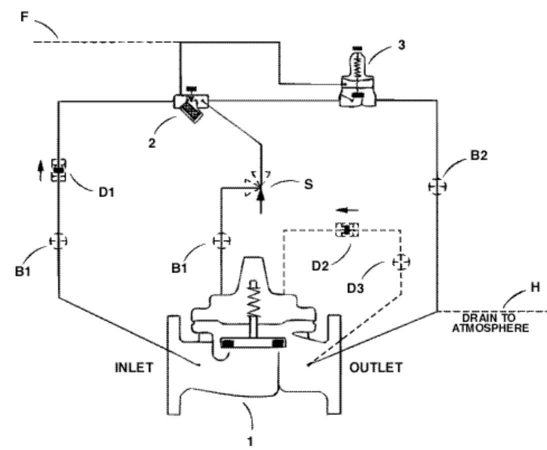
50-01/650-01 Pressure Relief, Pressure Sustaining Valve

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	X42N-2 Strainer & Needle Valve
3	CRL Pressure Relief Control

Optional Features

Item	Description
B	CK2 Isolation Valve
D	Check Valves with Isolation valve
F	Remote Pilot Sensing
H	Drain to Atmosphere
S	CV Speed Control (Opening)



Pressure Relief, Pressure Sustaining Valve Start-up and Adjustment Instructions — 50-01/650-01

1. Install pressure gauge at main valve inlet. Place gauge in unused inlet body tapping.

2. Install X101 Valve Position Indicator in center cover tapping of main valve (If available).

3. Open all isolation valves in pilot system (valves 4" and larger). Remove pilot caps and loosen all jam nuts.

4. Adjust needle valve in X42N-2 (Item # 2). Open needle valve 1/4 turn to start. Do not close needle valve all the way or main valve will not close. The needle valve may require further adjustment depending on valve size.

5. Close the CRL Pressure Relief Control (Item # 3) all the way by turning the adjustment clockwise. Observe the setting on the control. There is a tag attached to the pilot cover with the factory setting. If the pilot has a 0-75 PSI spring range each 360 degree turn in/out changes the setting 9 PSI. The 20-200 PSI spring range has a 27 PSI change for each 360 degree turn in/out. Increase the factory setting (turn adjustment clockwise) until the set point of the control is at least 20 PSI above the normal system operating pressure. This setting is approximate and may have to be increased once the valve is pressurized.

6. Open inlet isolation valve slowly to pressurize main valve. If relief valve begins to open adjust CRL Pressure Relief Control clockwise until valve closes.

7. Bleed air from main valve cover by loosening pipe plug in center of main valve cover or X101 Valve Position Indicator housing. If valve is installed in a vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover. Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed. It may be necessary to loosen several screws on the cover of the CRL Pressure Relief Control (item # 3) to completely exhaust air from the control. This depends on the orientation of the control in the pilot system.

8. Raise normal system operating pressure 10 PSI under a flowing condition. Always check the effect in the system before starting. Slowly adjust the CRL Pressure Relief Control (item # 3) counter-clockwise to allow the main valve to just begin to open then stop. turn CRL adjustment clockwise until main valve closes. Lower system pressure to its normal flowing setting. Pressure relief valve is now set approximately 10 PSI above normal operating pressure. Using the above procedure the relief valve can be set at any pressure above normal system operating pressure.

9. Raise the system pressure to test the relief valve set point and opening speed. The relief valve is designed to open quickly and close slowly. If the o pening speed requires adjustment change setting on needle valve of X42N-2. Turn needle valve clockwise to increase opening speed response and counter-clockwise to decrease opening speed response.

10. All valve adjustments are now set. Lockup all jam nuts to retain settings. Replace all pilot caps.

Note: The 50-01/650-01 Pressure Relief Valve can also be used as a pressure sustaining or back pressure control valve. There are no modifications required to the main valve or pilot control system to use this valve in a pressure sustaining or back pressure application. However the adjustment procedure is different. Refer to items 1,2,&3 to start the adjustment procedure.

Then:
11. Adjust needle valve in X42n-2 (item # 2). Open needle valve 1/2 turn to start. Do not close needle valve all the way or main valve will not close. The needle valve may require further adjustment depending on valve size.

12. Observe the setting on the CRL Pressure Relief Control (item # 3). There is a tag attached to the pilot cover with the factory setting. If the pilot has a 15-75 PSI spring range each 360 degree turn in/out changes the setting 9 PSI. The 20-200 PSI spring range has a 27 PSI change for each 360 degree turn in/out. Using this information adjust the pilot control setting to the desired back pressure. This setting is approximate and may have to be changed under a flowing condition.

13. Open inlet isolation valve slowly to pressurize main valve.

14. Bleed air from main valve cover by loosening the pipe plug in the center of the main valve cover or X101 Valve Position Indicator housing. If valve is installed in a vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from the main valve cover. Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points to remove air from the pilot control system. Tighten tube nuts after all air is removed. It may be necessary to loosen several screws on the cover of CRL Pressure Relief Control (item # 3) to completely exhaust air from the control. This depends on the orientation of the control in the pilot system.

15. Open the down stream isolation valve and establish a flow in the system. Always check the effect in the system before starting.

16. Slowly adjust the CRL Pressure Relief Control (item #3) observing the inlet pressure gauge until the desired back pressure is achieved.

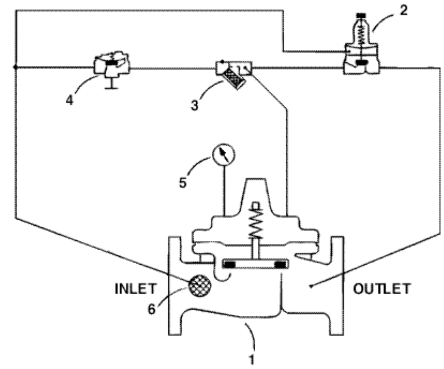
17. All valve adjustments are now set. Lock up all jam nuts to retain settings. Replace all pilot caps.

Note: The 50-01/650-01 control valve uses the X42N-2 Strainer and Needle Valve Assembly. The strainer screen in this assembly has a small surface area. This screen can clog up quickly especially on the start up of a new system. When the screen clogs up the valve malfunctions due to loss of the supply pressure to the pilot control system. Check the screen periodically.

50B-4KG-1/2050B-4KG-1
Fire Pump Relief Valve

Schematic Diagram

Item	Description
1	100-06 Hytrol (Main Valve)
2	CRL Pressure Relief Control
3	X44A Strainer & Orifice Assembly
4	81-01 Check Valve
5	Pressure Gauge
6	X46A Flow Clean Strainer



Fire Pump Relief Valve Start-up and Adjustment Instructions 50B-4KG-1/2050B-4KG-1

1. Install pressure gauge at main valve inlet. Place gauge in unused inlet body tapping of main valve.

2. Install X101C Valve Position Indicator in center cover tapping of main valve (If available).

3. Remove pilot cap and loosen jam nut on CRL Pressure Relief Control (item # 2).

4. Observe the setting on the control. There is a tag attached to the pilot cover with the factory setting. The 20-200 PSI spring range has a 28 PSI change for each 360 degree turn in/out. The 100-300 PSI spring range has an 18 PSI change for each 360 degree turn in/out. Change the factory setting (turn adjustment clockwise to increase setting or counter-clockwise to decrease setting) until the required set point of the control is obtained. This setting is approximate and the final pilot control setting must be made under a flowing condition.

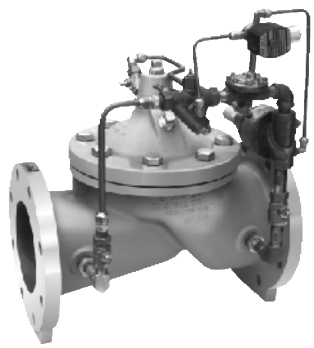
5. On centrifical pump systems, open an isolation valve in the system and slowly pressurize the valve using the pump suction pressure only. For vertical turbine pump systems the pump must be started to supply pressure to the relief valve.

6. Bleed air from main valve cover by loosening the pipe plug in the center of main valve cover or the bushing gland on the X101C Valve Position Indicator. If valve is installed in a vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover. Tighten pipe plug, cover bolts, or bushing gland after all air is removed. **Caution:** only loosen pipe plug, cover bolts or bushing gland enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed. It may be necessary to loosen several screws on the cover of the CRL Pressure Relief Control (item # 2) to completely exhaust air from the control. This depends on the orientation of the control in the pilot system. Please note that for vertical turbine pump systems the air bleeding procedure can only be performed when the pump is running and there is flow through the valve. Always check the effect in the system before starting.

7. Start the pump and observe the flow through the valve with the system sight cone and X101C valve position indicator. On vertical turbine pump systems perform the air bleeding procedure at this time before adjusting the pilot control. Adjust the relief valve inlet pressure by changing the setting on the CRL Pressure Relief Control (item # 2) and observing the inlet pressure gauge. Make setting changes slowly. Turn the adjustment clockwise to increase the inlet pressure and counter-clockwise to decrease the inlet pressure. The 50B-4KG-1 Fire Pump Relief Valve is designed to open quickly and close slowly. The valve pilot control system includes a check valve (item # 4) and a pressure gauge in the valve cover (item # 5). When cover p r essure is higher then inlet pressure, the check valve (item # 4) closes. This maintains the higher pressure in the main valve cover chamber keeping the main valve closed. The cover pressure gauge (item # 5) should always indicate a positive pressure even when the valve is closed.

8. The valve adjustment is now set. Lockup the jam nut on the CRL Pressure Relief Control (item # 2)to retain the setting and replace the pilot cap. Turn off the pump after the initial test is complete.

Note: Periodic cleaning of the strainer screen in the X44A Strainer & Orifice assembly (item #3) is recommended.



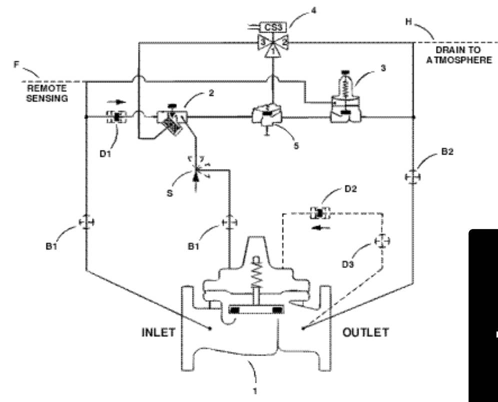
58-01/658-01 Combination Back Pressure & Solenoid Shut-off Valve

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	X42N-3 Strainer & Needle Valve
3	CRL Pressure Relief Control
4	CS3 Solenoid Control
5	100-01 Hytrol (Reverse Flow)

Optional Features

Item	Description
B	Shutoff Isolates Pilot System
D	Check Valves with Isolation valve
F	Remote Pilot Sensing
H	Drain to Atmosphere
S	CV Speed Control (Opening)



Combination Back Pressure & Solenoid Shut-Off Valve Start-up and Adjustment Instructions 58-01/658-01

1. Install pressure gauges at main valve inlet/outlet. Place gauges in unused body tappings.

2. Install X101 Valve Position Indicator in center cover tapping of main valve (if available).

3. Open all isolation valves in pilot system (valves 4" and larger). Remove pilot caps and loosen all jam nuts.

4. Observe the setting on the CRL Pressure Relief Control (item # 3). There is a tag attached to the pilot cover with the factory setting. If the pilot has a 0-75 PSI spring range each 360 degree turn in/out changes the setting 8.5 PSI. The 20-200 PSI spring range has a 28 PSI change for each 360 degree turn in/out. Alter the factory setting (turn adjustment clockwise/counter-clockwise) until the set point of the control is close to the required se t t i n g . This setting is approximate and may have to be changed once the valve is pressurized. Actual pressure settings must be made under a flowing condition.

5. Adjust CV flow control (opening speed) if included in pilot system. Turn control clockwise until closed then back out three turns to start.

6. Adjust X42N-3 Needle Valve and Strainer Assembly (item # 2). Loosen jam nut and close needle valve all the way clockwise. Then back out 1/2 turn to start. Needle valve may require further adjustment depending on valve size.

7. Locate the CS3 Solenoid Control (item # 4) in the pilot system. Make sure proper voltage is supplied to the coil. If the unit is equipped with a manual operator make sure it is backed all the way out counter-clockwise (rotating the red thumb screw clockwise simulates energization of the coil.) Solenoid can be supplied energized to open main valve or de-energized to open main valve. You can determine the valve operation in two ways:
A) Energized to open main valve supply pressure comes to port # 3 on solenoid, port # 1 is connected to the cover of the 3/8" auxiliary hytrol (item # 5), and port # 2 is vented to atmosphere (catalog number suffix H. or to the downstream side of the valve standard. Also check the ASCO Solenoid catalog number 8320G136 normally open.

B. De-energized to open main valve supply pressure comes to port # 2 on CS3 solenoid (item # 5), port # 1 is connected to the cover of the 3/8" auxiliary hytrol (item # 5), and port # 3 is vented to atmosphere (catalog number suffix H) or to the downstream side of the valve standard. Also check the ASCO Solenoid catalog number 8320G132 normally closed.

8. Open inlet isolation valve slowly to pressurize main valve.

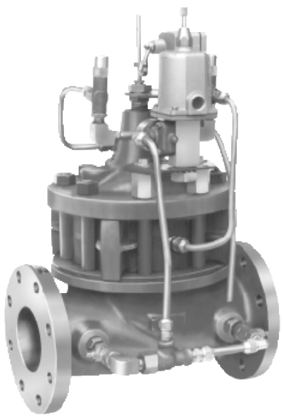
9. Bleed air from main valve cover by loosening pipe plug in center of main valve cover or X101 Valve position Indicator housing. If valve is installed in a vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover (Limit vertical installations of valves to 6" and smaller). Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

10. Open downstream isolation valve and establish a low flow in the system. To accomplish this the CS3 solenoid (item # 5) must be electrically energized to open the main valve under command of the CRL Pressure Relief Control (item #3) in valves so equipped. If the valve is de-energized to open no electrical power is required to open the main valve. In valves so equipped if the CS3 solenoid (item #4) is energized the main valve closes.The porting sequence for the CS3 solenoid (energized to open or de-energized to open appears in the valve schematic) Refer to minimum flow requirements for each valve size. Always check the effect in the system before starting.

11. All valve adjustments are now set. Lock all jam nuts to retain settings. Replace all pilot caps.

12. To close the main valve on solenoids energized to open remove electrical power from the solenoid. This will connect ports 3 & 1 on the solenoid directing inlet pressure into the cover of the main valve closing it.
To close the main valve on solenoid de-energized to open apply electrical power to the solenoid.
This will connect ports 2 & 1 on the solenoid directing inlet pressure into the cover of the 3/8" auxilliary hytrol (item #5) closing it. This will inturn direct inlet pressure into the cover of the main valve closing it.

Refer to valve schematic for location of pilot controls.



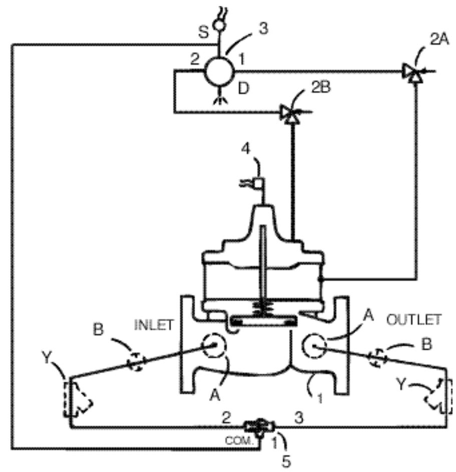
60-11/660-11 Booster Pump Control Valve

Schematic Diagram

Item	Description
1	Powercheck (Main Valve)
2	CV Flow Control
3	CSM11-A2-2 Solenoid Control
4	X105LCW Switch Assembly
5	CVS-1 Shuttle Valve

Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
Y	X43 "Y" Strainer



Booster Pump Control Valve Start-up and Adjustment Instructions — 60-11/660-11

1. Install pressure gauges at main valve inlet/outlet using main valve body tappings.

2. Open all isolation valves in pilot system (valves 4" and larger).

3. Adjust CV Flow Controls (opening speed item 2B/closing speed item 2A) in pilot system. Turn control clockwise until closed then back out three turns to start.

4. Adjust X105 Micro Switch (item # 4) collar on actuating stem. Loosen collar set screws and slide collar along stem until it contacts micro switch arm roller. Slide collar to push back micro switch arm to open switch. You will hear a click indicating the switch is open. Tighten set screws in collar at this point.

5. Locate the CSM-11 Solenoid Control (item #3) in the pilot system. Make sure proper voltage is supplied to the coil. Make sure the plunger style manual operator is not engaged. Rotate the plunger clockwise and push down at the same time to activate the manual operator feature. This simulates energization of the coil. The manual operator will lock in this position. Rotate the manual operator counter-clockwise and the spring load in the coil will return the plunger to its original or “up" position.

6. Open outlet isolation valve slowly to pressurize the main valve.

7. Bleed air from main valve cover by loosening packing gland nut on the X105 Micro Switch Assembly. (item # 4) Tighten packing gland nut after all air is removed. **Caution:** only loosen packing gland nut enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

8. Open upstream isolation valve and start the pump to establish a flow and open the valve. To accomplish this the CSM-11 solenoid (item # 3) must be electrically energized to open the valve. As the valve opens the collar on the actuating stem of the micro switch (item #4) travels upward, away from the micro switch arm. This closes the micro switch and locks the pump starter circuit on line. Always check the effect in the system before starting.

9. Observe the opening rate of the valve and adjust the CV opening speed control (item # 2B) to prevent the pump starting surge from being transmitted into the system. Turning the adjustment clockwise decreases the valve opening speed. Turning the adjustment counter-clockwise increases the valve opening speed.

10. Engage the pump stopping sequence. The pump should continue to run and the CSM-11 solenoid (item# 3) should de-energize. This initiates the closing cycle of he valve. Observe the closing rate of the valve and adjust the CV closing speed control (item # 2A.) to prevent the pump stopping surge from being transmitted into the system. Turning the adjustment clockwise decreases the closing rate. Turning the adjustment counter-clockwise increases the closing rate. As the valve closes the actuating stem collar moves toward the micro switch (item # 4) opening it and stopping the pump.

11. All valve adjustments are now set. Lockup all jam nuts to retain settings.

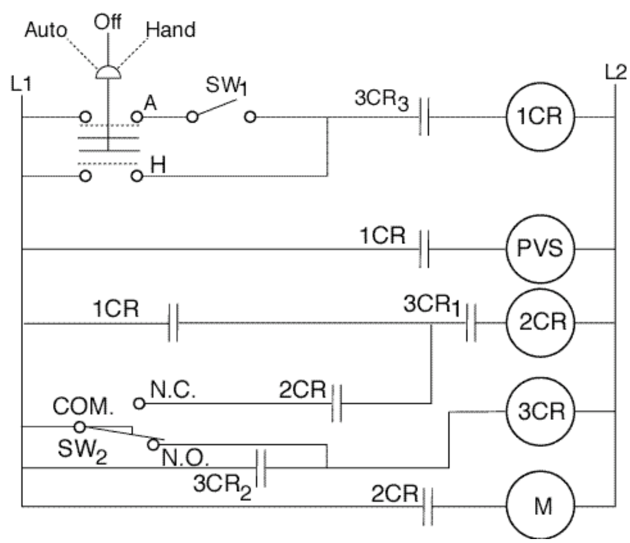
Refer to the valve schematic for location of pilot controls.

Suitable for 60 & 61 Series Valves

Wiring Diagram

Auto-Off-Hand	=	Selector Switch
1CR	=	Relay, DPST Normally Open
2CR	=	Relay, DPST Normally Open
3CR	=	Relay, TPST Normally Open
SW_1	=	Switch, Remote Start,Automatic
SW_2	=	Switch, SPDT, Valve Limit Switch Connect to N.C. Terminal
PVS	=	Pilot Valve Solenoid
M	=	Pump Motor Starter

<ins>Note:</ins> SW_2 and PVS supplied by Cla-Val. All other electrical items supplied by customer. SW_2 is included in the X105L switch assembly which is mounted on the pump control valve cover.

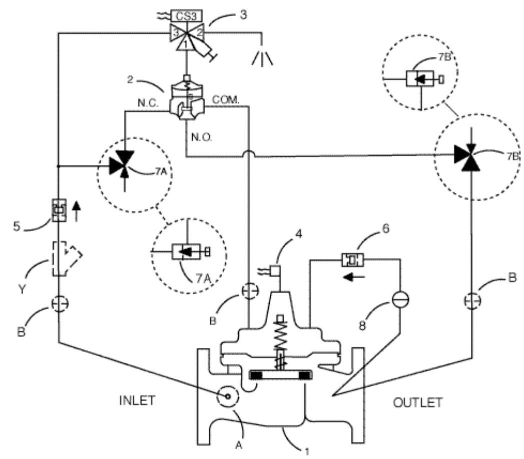


60-31/660-31 Booster Pump Control Valve

Schematic Diagram

Item	Description
1	Hycheck (Main Valve)
2	102C-3H Three Way Hytrol
3	CS3SM Solenoid Control
4	X105LCW Switch Assembly
5	CDC Disk Check Valve
6	CDC/CSC Check Valve
7	CNA Angle Valve
8	CK2 Isolation Valve

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
Y	X43 "Y" Strainer



Booster Pump Control Valve Start-up and Adjustment Instructions 60-31/660-31

1. Install pressure gauges at main valve inlet/outlet using main valve body tappings.
2. Open all isolation valves in pilot system.

3. Adjust CNA Angle valve (opening speed item # 7B/closing speed item # 7A) in pilot system. Turn control clockwise until closed then back out three turns to start. Do not leave these controls closed all the way or the valve will not open or close.

4. Adjust X105 Micro Switch (item # 4) collar on actuating stem. Loosen collar set screws and slide collar along stem until it contacts micro switch arm roller. Slide c ollar to push back micro switch arm to open switch. You will hear a click indicating the switch is open. Tighten set screws in collar at this point.

5. Locate the CS3SM Solenoid Control (item # 3) in the pilot system. Make sure proper voltage is supplied to the coil. Make sure the manual operator is not engaged. Rotate the red thumb screw all the way out counter-clockwise to disengage the manual operator feature. Rotating the red thumb screw clockwise simulates energization of the coil.

6. Open outlet isolation valve slowly to pressurize the main valve.

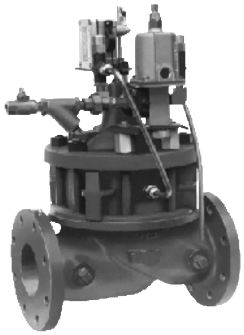
7. Bleed air from main valve cover by loosening packing gland nut on the X105 Micro Switch Assembly. (item # 4) Tighten packing gland nut after all air is removed. **Caution:** only loosen packing gland nut enough to allow the air trapped in the cover to es c a p e . Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

8. Open upstream isolation valve and start the pump to establish a flow and open the valve. To accomplish this the CS3SM solenoid (item # 3) must be electrically energized to open the valve. As the valve opens the collar on the actuating stem of the micro switch (item #4) travels upward, away from the micro switch arm. This closes the micro switch and locks the pump starter circuit on line. Always check the effect in the system before starting.

9. Observe the opening rate of the valve and adjust the CNA angle valve opening speed control (item # 7B) to prevent the pump starting surge from being transmitted into the system. Turning the adjustment clockwise decreases the valve opening speed. Turning the adjustment counter-clockwise increases the valve opening speed.

10. Engage the pump stopping sequence. The pump should continue to run and the CS3SM solenoid (item# 3) should de-energize. This initiates the closing cycle of he valve. Observe the closing rate of the valve and adjust the CNA angle valve closing speed control (item # 7A) to prevent the pump stopping surge from being transmitted into the system. Turning the adjustment clockwise decreases the closing rate. Turning the adjustment counter-clockwise increases the closing rate. As the valve closes the actuating stem collar moves toward the micro switch (item # 4) opening it and stopping the pump.

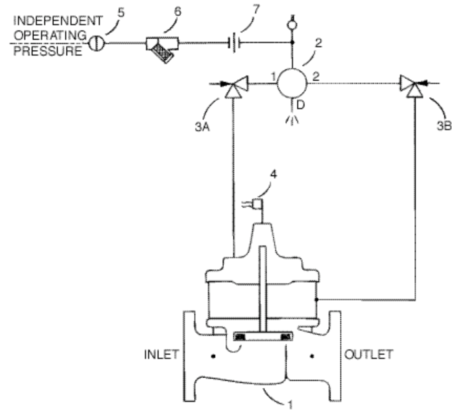
11. All valve adjustments are now set. Lockup all jam nuts to retain settings.



61-02/661-02 Pump Control Valve

Schematic Diagram

Item	Description
1	Powertrol (Main Valve)
2	CSM11-A2-2 Solenoid Control
3	CV Flow Control
4	X105LOW Switch Assembly
5	CK2 Isolation Valve
6	X43 "Y" Strainer
7	Union



1. Install pressure gauge at main valve inlet using main valve body tapping.

2. Open isolation valve in pilot system.

3. Adjust CV Flow Controls (opening speed item 3A/closing speed item 3B) in pilot system. Turn control clockwise until closed then back out three turns to start.

4. Adjust X105 Micro Switch (item # 4) collar on actuating stem. Loosen collar set screws and slide collar along stem until it contacts micro switch arm roller. Slide collar to push back micro switch arm to open switch. You will hear a click indicating the switch is open. Tighten set screws in collar at this point.

5. Locate the CSM-11 Solenoid Control (item # 2) in the pilot system. Make sure proper voltage is supplied to the coil. Make sure the plunger style manual operator is not engaged. Rotate the plunger clockwise and push down at the same time to activate the manual operator feature. This simulates energization of the coil. The manual operator will lock in this position. Rotate the manual operator counter-clockwise and the spring load in the coil will return the plunger to its original or normal position.

6. This valve is held open by the static system pressure. To bleed the air from the main valve cover, power section, and pilot system turn the manual operator on the CSM-11 Solenoid Control (item # 2) as indicated in paragraph # 5 to close the valve. When the valve is completely closed bleed the air from the main valve cover by loosening packing gland nut on the X105 Micro Switch Assembly. (item # 4) Tighten packing gland nut after all air is removed. **Caution:** only loosen packing gland nut enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed. Return the manual operator on the CSM-11 Solenoid Control (item # 2) to its normal position and the valve will open. When the valve is completely open the air can be vented from the main valve power section by loosening the tubing nut by the closing speed control (item # 3B). Tighten tube nut after all air is vented. Always check the effect in the system before starting.

7. Start the pump to establish a flow through the valve. The CSM-11 solenoid (item # 2) must be electrically energized to close the valve. As the valve closes the collar on the actuating stem of the micro switch (item # 4) travels downward, away from the micro switch arm. This closes the micro switch and locks the pump starter circuit on line. Always check the effect in the system before starting.

8. Observe the closing rate of the valve and adjust the CV closing speed control (item # 3B) to prevent the pump starting surge from being transmitted into the system. Turning the adjustment clockwise decreases the valve opening speed. Turning the adjustment counter-clockwise increases the valve opening speed.

9. Engage the pump stopping sequence. The pump should continue to run and the CSM-11 solenoid (item# 2) should de-energize. This initiates the opening cycle of the valve. Observe the opening rate of the valve and adjust the CV opening speed control (item # 3A) to prevent the pump stopping surge from being transmitted into the system. Turning the adjustment clockwise decreases the opening rate. Turning the adjustment counter-clockwise increases the opening rate. As the valve opens the actuating stem collar moves toward the micro switch (item # 4) opening it and stopping the pump.

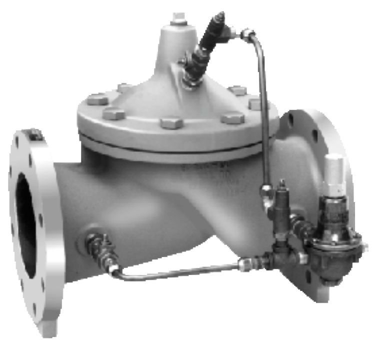
10. All valve adjustments are now set. Lockup all jam nuts to retain settings.

Refer to the valve schematic for location of pilot controls.

Section

4-4 Pressure Reducing Valve 90 Series

Start-up and Adjustments



90-01/690-01
Pressure Reducing Valve

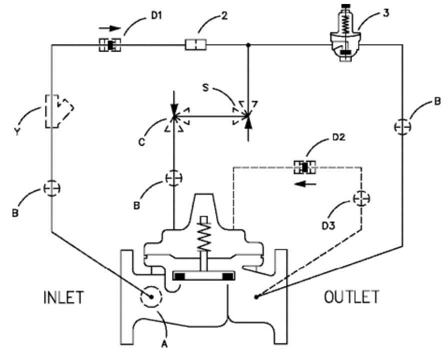
Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	X58 Restriction Fitting
3	CRD Pressure Reducing Control

Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
C	CV Flow Control (Closing)*
D	Check Valves with Isolation valve
S	CV Flow Control (Opening)
Y	X43 "Y" Strainer

*The closing speed control (optional) on this valve should always be open at least three (3) turns off its seat.



Pressure Reducing Valve Start-up and Adjustment Instructions — 90-01/690-01

1. Install pressure gauges at main valve inlet and outlet. Place gauges in unused body tappings. Downstream gauge can be installed in unused 3/8" CRD Pressure Reducing Control (item # 3) body tapping.

2. Install X101 Valve Position Indicator in center cover tapping of main valve (if available).

3. Open all isolation valves in pilot system (valves 4" and larger). Remove pilot caps and loosen all jam nuts.

4. Observe the setting on the CRD Pressure Reducing Control (item #3). There is a tag attached to the pilot cover with the factory setting. If the pilot has a 15-75 PSI spring range each 360 degree turn in/out changes the setting 9 PSI. The 30-300 PSI spring range has a 27 PSI change for each 360 degree turn in/out. Alter the factory setting (turn adjustment clockwise/counter-clockwise) until the set point of the control is close to the required setting. This setting is approximate and may have to be changed once the valve is pressurized. Actual pressure settings must be made under a flowing condition.

5. Adjust CV flow controls (opening/closing speeds) if included in pilot system. Turn control clockwise until closed then back out three turns to start. CV opening speed included as standard equipment on valves 3" and smaller.

6. Open inlet isolation valve slowly to pressurize main valve.

7. Bleed air from main valve cover by loosening pipe plug in center of main valve cover or X101 Valve position Indicator housing. If valve is installed in vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover. Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

8. Open downstream isolation valve and establish a low flow in the system. Refer to minimum flow requirements for each valve size Always check the effect in the system before starting.

9. Slowly adjust the CRD Pressure Reducing Control (item # 3) observing the down stream pressure gauge until the desired pressure is achieved (clockwise to increase setting or counter-clockwise to decrease setting). Adjust CV flow controls until desired valve opening or closing speeds are obtained. Adjust opening rate so that valve opens slowly to desired outlet pressure and does not over shoot setting. Adjust closing rate so valve does not cause excessive system pressure surging upon closing.

10. All valve adjustments are now set. Lockup all jam nuts to retain settings. Replace all pilot caps.

Size	Minimum Flow (gpm)
1 1/4-1 1/2"	15
2"	15
2 1/2"	20
3"	30
4"	50
6"	115
8"	200
10"	300
12"	400
14"	500
16"	650
24"	1500

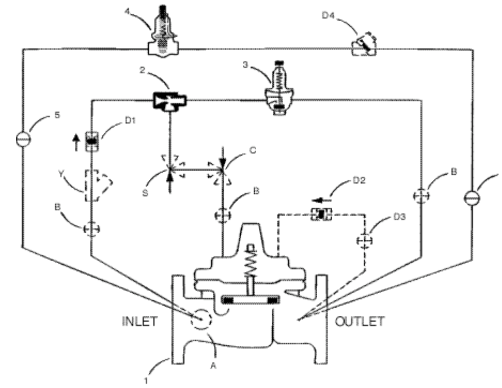
90-48/690-48
Pressure Reducing Valve with
Low Flow By-Pass

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	X47A Ejector
3	CRD Pressure Reducing Control
4	CRD40 Pressure Reducing Control
5	CK2 Isolation Valve

Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
C	CV Flow Control (Closing)*
D	Check Valves with Isolation valve
S	CV Flow Control (Opening)
Y	X43 "Y" Strainer



Pressure Reducing Valve Start-up and Adjustment Instructions

90-48/690-48

1. Install pressure gauges at main valve inlet/outlet. Place gauges in unused body tappings. Downstream gauge can be installed in unused 3/8" CRD40 Pressure Reducing Control (item # 3) body tapping.

2. Install X101 Valve Position Indicator in center cover tapping of main valve (if available).

3. Open all isolation valves in pilot system (valves 4" and larger). Remove pilot caps and loosen all jam nuts.

4. Observe the settings on the CRD Pressure Reducing Control (3) and CRD40 (4). There is a tag attached to the pilot cover with the factory setting. If the CRD has a 15-75 PSI spring range each 360 degree turn in/out changes the setting 9 PSI. The 30-300 PSI spring range has a 27 PSI change for each 360 degree turn in/out. You can alter the factory setting (turn adjustment clockwise/counter-clockwise) using this information until the set point of the control is close to the required setting. This setting is approximate and may have to be changed once the valve is pressurized. Actual pressure settings must be made under a flowing condition.

5. Adjust CV flow controls (opening/closing speeds) if included in pilot system. Turn control clockwise until closed then back out three turns to start. CV opening speed included as standard equipment on valves 3" and smaller.

6. Open inlet isolation valve slowly to pressurize main valve.

7. Bleed air from main valve cover by loosening pipe plug in center of main valve cover or X101 Valve position Indicator housing. If valve is installed in vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover. Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

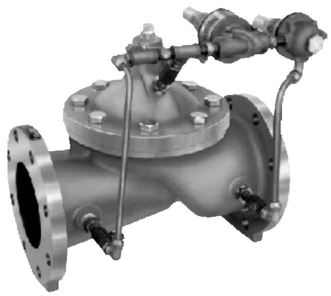
8. Open downstream isolation valve and establish a low flow in the system. Refer to minimum flow requirements for each valve size. Always check the effect in the system before starting.

9. Slowly adjust the CRD Pressure Reducing Control (3) observing the down stream pressure gauge until the desired pressure is achieved (clockwise to increase setting or counter-clockwise to decrease setting). Adjust CV flow controls until desired valve opening or closing speeds are obtained. Adjust opening rate so that valve opens slowly to desired outlet pressure and does not over shoot setting. Adjust closing rate so valve does not cause excessive system pressure surging upon closing.

10. Next adjust the CRD40 Pressure Reducing Control (4). This is the low flow bypass. This control must be set 5 PSI higher then the CRD Pressure Reducing Control (3). Use the CK2 isolation valves in the pilot system to isolate each pressure reducing pilot before attempting to adjust the control. The capacity of the low flow bypass is very small (4-5 gpm). So lower the system flow to with in these limits before setting the low flow bypass. Example: If the system pressure is to be maintained at 140 PSI set the low flow bypass CRD40 (4) at 140 PSI and set the CRD (3) at 135 PSI. Set CRD (3) first, then set CRD40 (4) second.

11. All valve adjustments are now set. Lockup all jam nuts to retain settings. Replace all pilot caps.

Size	Minimum Flow (gpm)
1 1/4-1 1/2"	15
2"	15
2 1/2"	20
3"	30
4"	50
6"	115
8"	200



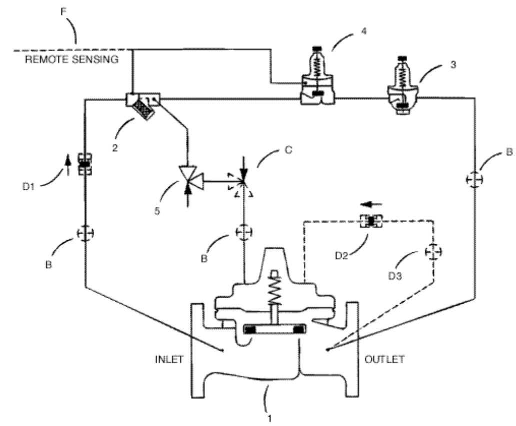
92-01/692-01 Combination Pressure Reducing Sustaining & Pressure Sustaining Valve

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	X44A Strainer & Orifice
3	CRD Pressure Reducing Control
4	CRL Pressure Relief Control
5	CV Flow Control (Opening)

Optional Features

Item	Description
B	CK2 Isolation Valve
C	CV Flow Control (Closing)*
D	Check Valves With Isolation valve
F	Remote Pilot Sensing



Combination Pressure Reducing & Pressure Sustaining Start-up and Adjustment Instructions 92-01/692-01

1. Install pressure gauges upstream/downstream of valve. Place inlet gauge in unused main valve body inlet tapping. Downstream gauge can be placed in unused 3/8" CRD body tapping in pilot system.

2. Open all isolation valves in pilot system. Isolation valves included in pilot systems on 4" and larger valves standard (4 CK2 Isolation Valves Total). Remove all pilot caps and loosen all jam nuts.

3. Adjust CV Opening Speed Control (Item # 5). Turn adjusting screw clockwise until its all the way in. Back out adjustment 3 full turns to start.

4. Back out adjustment on the CRL Back pressure Control (Item # 4) all the way.

5. Observe setting on CRD Pressure Reducing Control (Item # 3). There is a tag attached to the pilot cover with the factory setting. You can change the pressure setting by using the following information. If the CRD has a 15-75 PSI spring range each 360 degree turn in or out changes the setting 9 PSI. The 30-300 PSI spring range has a 27 PSI change for each 360 degree turn in or out. You can approximate the downstream pressure by changing the factory setting using this information. Actual pressure settings must be made under a flowing condition.

6. Open inlet and outlet system isolation valves slowly to pressurize valve. Make sure downstream pressure stays within system limits.

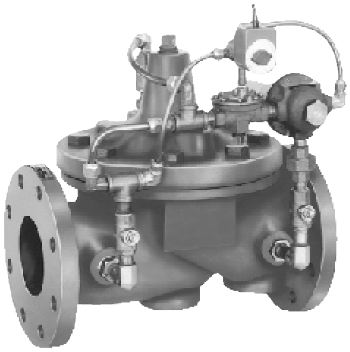
7. Bleed air from main valve cover and high points in pilot system. Tighten nut after all air is removed. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

8. Establish a low flow in the system. Adjust CV Opening Speed Control clockwise to decrease ope n-ing rate and counter-clockwise to increase opening rate. A slow valve opening rate will prevent the pump starting surge from being transmitted into the system.

9. Adjust CRD Pressure Reducing Control to provide desired outlet pressure. A clockwise adjustment increases outlet pressure and a counter-clockwise adjustment decreases outlet pressure.

10. Establish the maximum flow rate for this system. Turn on the maximum number of sprinklers the pump is designed to handle. Then slowly adjust the CRL Back pressure Control clockwise until the outlet pressure drops off 3-5 PSI then stop. Next slowly turn CRL adjustment counter-clockwise until outlet pressure returns to normal. Then stop setting is complete.

11. All valve adjustments are now set. Lockup all jam nuts to retain settings. Replace all pilot caps. Vary flow rates in system to make sure valve is set properly.



93-01/693-01
Pressure Reducing Valve &
Solenoid Shut-off

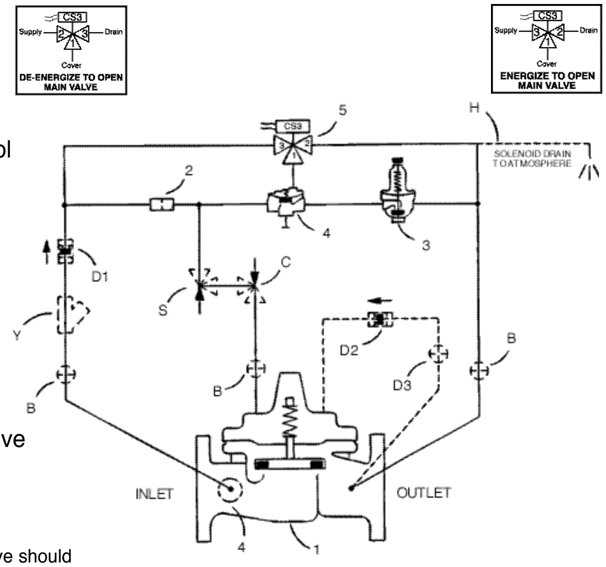
Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	X58C Restriction Assembly
3	CRD Pressure Reducing Control
4	100-01 Hytrol (Reverse Flow)
5	CS3 Solenoid Control

Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
C	CV Flow Control (Closing)*
D	Check Valves with Isolation valve
H	Solenoid Drain To Atmosphere
S	CV Flow Control (Opening)
Y	X43 "Y" Strainer

*The closing speed control (optional) on this valve should always be open at least three (3) turns off its seat.



Pressure Reducing Valve & Solenoid Shut-Off Start-up and Adjustment Instructions 93-01/693-01

4 – 4

1. Install pressure gauges at main valve inlet and outlet. Place gauges in unused body tappings. Downstream gauge can be installed in the unused 3/8" CRD Pressure Reducing Control (item # 3) body tapping.

2. Install X101 Valve Position Indicator in center cover tapping of main valve (if available).

3. Open all isolation valves in pilot system (valves 4" and larger). Remove pilot caps and loosen all jam nuts.

4. Observe the setting on the CRD Pressure Reducing Control (item # 3). There is a tag attached to the pilot cover with the factory setting. If the pilot has a 15-75 PSI spring range each 360 degree turn in/out changes the setting 9 PSI. The 30-300 PSI spring range has a 27 PSI change for each 360 degree turn in/out. Alter the factory setting (turn adjustment clockwise/counter-clockwise) until the setpoint of the control is close to the required setting. This setting is approximate and should have to be changed once the valve is pressurized. Actual pressure settings must be made under a flowing condition.

5. Adjust CV flow controls (opening/closing speeds) if included in pilot system. Turn control clockwise until closed then back out three turns to start. CV opening speed included as standard equipment on valves 3" and smaller.

6. Locate the CS3 Solenoid Control (item # 5) in the pilot system. Make sure proper voltage is supplied to the coil. If the unit is equipped with a manual operator make sure it is backed all the way out counter-clockwise (rotating the red thumb screw clockwise simulates energization of the coil.)

.Solenoid can be supplied energized to open main valve or de-energized to open main valve. You can determine the valve operation in two ways:

A. Energized to open main valve supply pressure comes to port # 3 on solenoid, port # 1 is connected to the cover of the 3/8" auxiliary hytrol (item # 4), and po r t #2 is vented to atmosphere (catalog number suffix H. or to the downstream side of the valve standard. Also check the Asco Solenoid catalog number 8320G136 normally open.

B. De-energized to open main valve supply pressure comes to port # 2 on CS3 solenoid (item # 5), port # 1 is connected to the cover of the 3/8" auxiliary hytrol (item #4), and port # 3 is vented to atmosphere (catalog number suffix H) or to the downstream side of the valve standard. Also check the ASCO Solenoid catalog number 8320G132 normally closed.

7. Open inlet isolation valve slowly to pressurize main valve.

8. Bleed air from main valve cover by loosening pipe plug in center of main valve cover or X101 Valve position Indicator housing. If valve is installed in a vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover. Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

9. Open downstream isolation valve and establish a low flow in the system. To accomplish this the CS3 solenoid (item # 5) must be electrically energized to open the main valve under command of the CRD Pressure Reducing Control (item # 3) in valves so equipped. If the valve is de-energized to open no electrical power is required to open the main valve. In valves so equipped if the CS3 solenoid (item # 5) is energized the main valve closes. The porting sequence for the CS3 solenoid (energized to open or de-energized to open appears in the valve schematic) Refer to minimum flow requirements for each valve size. Always check the effect in the system before starting.

Size	Minimum Flow (gpm)
1 1/4-1 1/2"	15
2"	15
2 1/2"	20
3"	30
4"	50
6"	115
8"	200
10"	300
12"	400
14"	500
16"	650
24"	1500

10. Slowly adjust the CRD Pressure Reducing Control observing the down stream pressure gauge until the desired pressure is achieved (clockwise to increase setting or counter-clockwise to decrease setting) .Adjust CV flow controls until the desired valve opening or closing speeds are obtained. Adjust the opening rate so that valve opens slowly to the desired outlet pressure and does not over shoot the setting. Adjust closing rate so the valve does not cause excessive system pressure surging upon closing.

11.) All valve adjustments are now set. Lockup all jam nuts to retain settings. Replace all pilot caps.

12. To close the main valve on solenoids energized to open remove electrical power from the solenoid. This will connect ports 3 & 1 on the solenoid directing inlet pressure into the cover of the 3/8" auxiliary hytrol closing it. This will in turn direct inlet pressure into the cover of the main valve closing it.

To close the main valve on solenoids de-energized to open apply electrical power to the solenoid. This will connect ports 2 & 1 on the solenoid directing inlet pressure into the cover of the 3/8" auxiliary hytrol closing it. This will in turn direct inlet pressure into the cover of the main valve closing it.

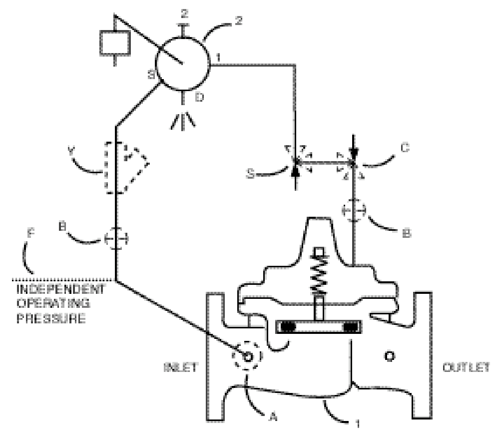
124-01/624-01 Float Valve

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	CF1-C1 Float Control

Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
C	CV Flow Control (Closing)
F	Independent Operating Pressure
S	CV Flow Control (Opening)
Y	X43 "Y" Strainer



Float Valve Start-up and Adjustment Instructions

124-01/624-01

1. Install pressure gauge at main valve inlet.

2. Install X101 Valve Position Indicator in center cover tapping of main valve (if available).

3. Open all isolation valves in pilot system (valves 4" and larger).

4. Adjust CV flow controls (opening/closing speeds) if included in pilot system. Turn control clockwise until closed then back out three turns to start.

5. Balance the CF1-C1 Float Control (item #2) by removing the float rod and float from the control. Remove the float from the float rod and leave on the stop collars. Reinstall the float rod on the CF1-C1 Float Control. Loosen set screw on counterweight and move weight in or out until float control is balanced. Tighten set screw. Push down on the float rod assembly and make sure the control returns to its balanced position. When balancing is achieved reinstall the float. Set the stop collars the required distance apart. Several different counterweights are available. Use counter weight:

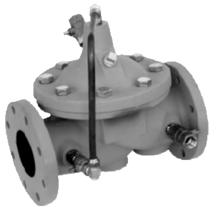
P/N	Float Rod Length
V006903J (standard)	2 Feet
V6230G	3-6 Feet
V6231E	7-12 Feet

Do not exceed 12 feet of float rod.
A stilling well (8" minimum diameter) should be provided for the float to minimize the effects of turbulence, ripples or wind.

6. Open inlet isolation valve slowly to establish flow through main valve. Most float valve applications only have one inlet isolation valve because they discharge directly to atmosphere.

7. Bleed air from main valve cover by loosening pipe plug in center of main valve cover or X101 Valve position Indicator housing. If valve is installed in vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover. Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

8. All valve adjustments are now set. Lockup all jam nuts to retain settings.



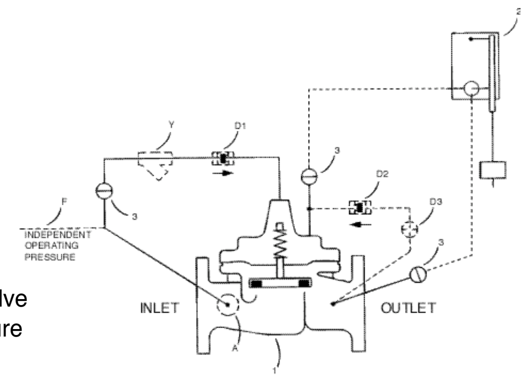
428-01/628-01
Modulating Float Valve

Schematic Diagram

Item	Description
1	Hytrol Main Valve
2	CFM-9 Float Control
3	CK2 Isolation Valve

Optional Features

Item	Description
A	X46A Flow Clean Strainer
D	Check Valves with Isolation valve
F	Independent Operating Pressure
Y	X43 “Y" Strainer



Modulating Float Valve Start-up and Adjustment Instructions 428-01/628-01

1. 428-01 main valve should be installed in a horizontal pipe, cover up. Install pressure gauge at main valve inlet.

2. The CFM-9 Float Control must be installed in an accessible location at any elevation above the valve providing that the amount of flowing line pressure in PSI is equal to or greater then the vertical distance in feet between the valve and the float control.

3. The float control discharge must be piped back to the main valve outlet port. Both lines connecting the valve and the float control (not supplied by Cla-Val) must be large enough to minimize pressure drop under maximum flow conditions. Use 3/4" I.D. pipe up to 20 feet and 1" pipe to 30 feet. Do not exceed 30 feet in any one run of pipe and try to minimize the number of elbows used.

4. Install pressure gauge at main valve inlet.

5. Open all isolation CK2 valves in pilot system (valves 4" and larger).

6. Balance the CFM-9 Float Control (item #2) by removing the float rod and float from the control. Remove the float from the float rod and leave on the stop collars. Reinstall the float rod on the CFM-9 Float Control. Loosen set screw on counterweight and move weight in or out until float control is balanced. Tighten set screw. Push down on the float rod assembly and make sure the control returns to its balanced position. When balancing is achieved reinstall the float. For best performance, lock the stop collars on either side of the float. Several different counter-weights are available. Use counter weight:

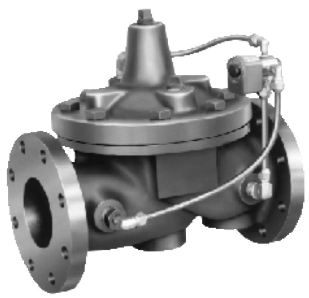
P/N	Float Rod Length
V006903J (standard)	2 Feet
V6230G	3-6 Feet
V6231E	7-12 Feet

Do not exceed 12 feet of float rod. A stilling well (8" minimum diameter) should be provided for the float to minimize the effects of turbulence, ripples or wind.

7. Open inlet isolation valve slowly to establish flow through main valve. Most float valve applications only have one inlet isolation valve because they discharge directly to atmosphere.

8. Bleed air from main valve cover by loosening tube nut on the pilot control line from main valve inlet. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

9. All valve adjustments are now set.



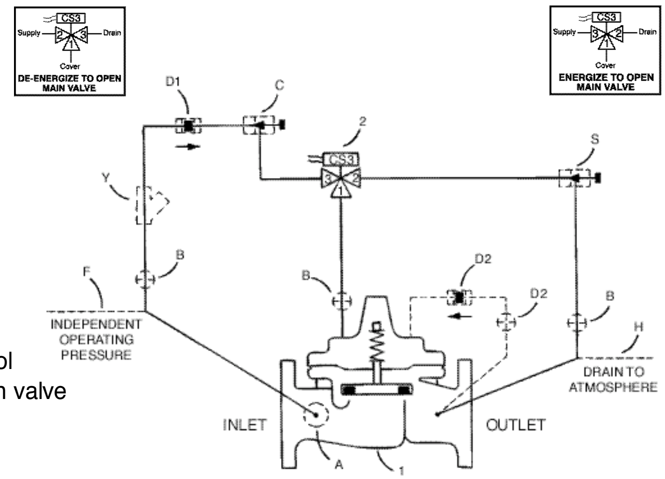
136-01/636-01
Solenoid Control Valve

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	CS3 Solenoid Control

Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
C	CNA Closing Speed Control
D	Check Valves with Isolation valve
S	CNA Needle Valve
Y	X43 "Y" Strainer



Solenoid Control Valve Start-up and Adjustment Instructions

136-01/636-01

1. Install pressure gauges at main valve inlet/outlet using main valve body tappings.

2. Install X101 Valve Position Indicator in center cover tapping of main valve (if available).

3. Open all isolation valves in pilot system (valves 4" and larger).

5. Adjust CNA speed controls (opening/closing speeds) if included in pilot system. Turn control clockwise until closed then back out three turns to start.

6. Locate the CS3 Solenoid Control (item # 2) in the pilot system. Make sure proper voltage is supplied to the coil. If the unit is equipped with a manual operator make sure it is backed all the way out counter-clockwise (rotating the red thumb screw clockwise simulates energization of the coil). Solenoid can be supplied energized to open main valve or de-energized to open main valve. You can determine the valve operation in two ways:
A. Energized to open main valve supply pressure comes to port # 3 on solenoid, port # 1 is connected to the cover of the main valve (item #1), and port # 2 is vented to atmosphere (catalog number Suffix "H") or to the downstream side of the valve standard. Also check the ASCO Solenoid catalog number 8320G136 normally open.
B. De-energized to open main valve supply pressure comes to port # 2 on CS3 solenoid (item # 2), port # 1 is connected to the cover of the main valve (item # 1), and port # 3 is vented to atmosphere (catalog number Suffix "H") or to the downstream side of the valve standard. Also check the ASCO Solenoid catalog number 8320G132 normally closed.

7. Open inlet isolation valve slowly to pressurize the main valve.

8. Bleed air from main valve cover by loosening pipe plug in center of main valve cover or X101 Valve position Indicator housing. If valve is installed in a vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover (Limit vertical installations to valves 6" and smaller). Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

9. Open downstream isolation valve and establish a flow in the system. To accomplish this the CS3 solenoid (item # 2) must be electrically energized to open the main valve in valves so equipped. If the valve is de-energized to open no electrical power is required to open the main valve. In valves so equipped if the CS3 solenoid (item # 2) is energized the main valve closes. The porting sequence for the CS3 solenoid (energized to open or de-energized to open appears in the valve schematic) Always check the effect in the system before starting.

10. Adjust CNA speed controls until the desired valve opening or closing speeds are obtained. Adjust the opening rate so that valve opens slowly (Turning counter-clockwise increases valve opening speed/ Turning clockwise decreases valve opening speed). Adjust closing rate so the valve does not cause excessive system pressure surging upon closing (Turning counter-clockwise increases valve closing rate and turning clockwise decreases valve closing rate).

11. All valve adjustments are now set. Lockup all jam nuts to retain settings.

12. To close the main valve on solenoids energized to open remove electrical power from the solenoid. This will connect ports 3 & 1 on the solenoid directing inlet pressure into the cover of the main valve closing it. To close the main valve on solenoids de-energized to open apply electrical power to the solenoid. This will connect ports 2 & 1 on the solenoid directing inlet pressure into the cover of the main valve closing it.

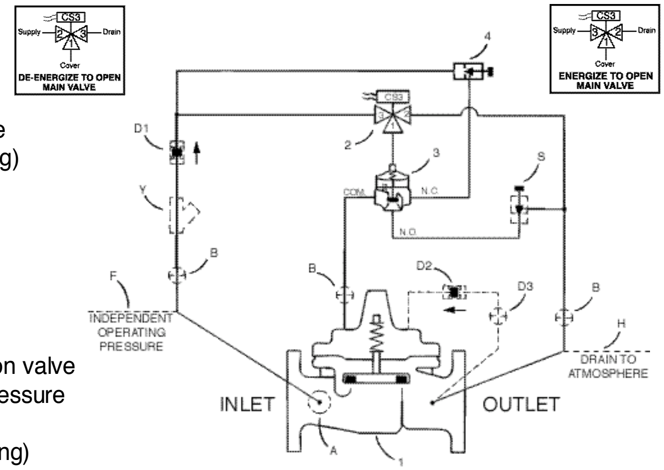
136-03/636-03 Solenoid Control Valve

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	CS3 Solenoid Control
3	102C-3HThree-Way Valve
4	CNA Needle Valve (Closing)

Optional Features

Item	Description
A	X46 Flow Clean Strainer
B	CK2 Isolation Valve
D	Check Valves With Isolation valve
F	Independent Operating Pressure
H	Atmospheric Drain
S	CNA Needle Valve (Opening)
Y	X43 "Y" Strainer



Solenoid Control Valve Start-up and Adjustment Instructions 136-03/636-03

1. Install pressure gauges at main valve inlet/outlet using main valve body tappings.

2. Install X101 Valve Position Indicator in center cover tapping of main valve (if available).

3. Open all isolation valves in pilot system (valves 4" and larger).

5. Adjust CNA speed controls (opening/closing speeds) if included in pilot system. Turn control clockwise until closed then back out three turns to start.

6. Locate the CS3 Solenoid Control (item #2) in the pilot system. Make sure proper voltage is supplied to the coil. If the unit is equipped with a manual operator make sure it is backed all the way out counter-clockwise (Rotating the red thumb screw clockwise simulates energization of the coil). Solenoid can be supplied energized to open main valve or de-energized to open main valve. You can determine the valve operation in two ways:
A. Energized to open main valve supply pressure comes to port # 3 on solenoid, port # 1 is connected to the cover of the 1/2" 102C-3H three way valve (item # 3), and port # 2 is vented to atmosphere (catalog number Suffix "H") or to the downstream side of the valve standard. Also check the ASCO Solenoid catalog number 8320G136 normally open.
B. De-energized to open main valve supply pressure comes to port # 2 on CS3 solenoid (item # 2), port # 1 is connected to the cover of the 1/2" 102C-3H three way valve (item # 3), and port # 3 is vented to atmosphere (catalog number Suffix "H") or to the downstream side of the valve standard. Also check the ASCO Solenoid catalog number 8320G132 normally closed.

7. Open inlet isolation valve slowly to pressurize the main valve.

8. Bleed air from main valve cover by loosening pipe plug in center of main valve cover or X101 Valve position Indicator housing. If valve is installed in a vertical line it will be necessary to loosen the cover bolts between 10 o'clock and 2 o'clock to vent air from main valve cover (Limit vertical installations to valves 6" and smaller). Tighten pipe plug or cover bolts after all air is removed. **Caution:** only loosen pipe plug or cover bolts enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

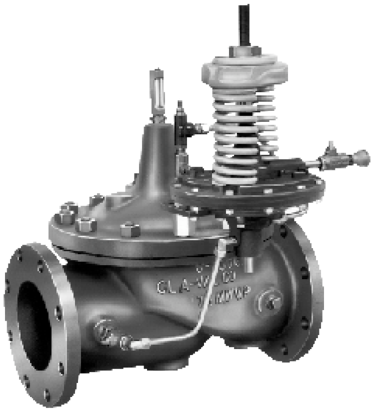
9. Open downstream isolation valve and establish a flow in the system. To accomplish this the CS3 solenoid (item # 2) must be electrically energized to open the main valve in valves so equipped. If the valve is de-energized to open no electrical power is required to open the main valve. In valves so equipped if the CS3 solenoid (item # 2) is energized the main valve closes. The porting sequence for the CS3 solenoid (energized to open or de-energized to open appears in the valve schematic) Always check the effect in the system before starting.

10. Adjust CNA speed controls until the desired valve opening or closing speeds are obtained. Adjust the opening rate so that valve opens slowly (Turning counter-clockwise increases valve opening speed/ Turning clockwise decreases valve opening speed). Adjust closing rate so the valve does not cause excessive system pressure surging upon closing (Turning counter-clockwise increases valve closing rate and turning clockwise decreases valve closing rate).
11. All valve adjustments are now set. Lockup all jam nuts to retain settings.

12. To close the main valve on solenoids energized to open remove electrical power from the solenoid. This will connect ports 3 & 1 on the solenoid directing inlet pressure into the cover of the main valve closing it. To close the main valve on solenoids de-energized to open apply electrical power to the solenoid. This will connect ports 2 & 1 on the solenoid directing inlet pressure into the cover of the main valve closing it.

210 Series

Start-up and Adjustments



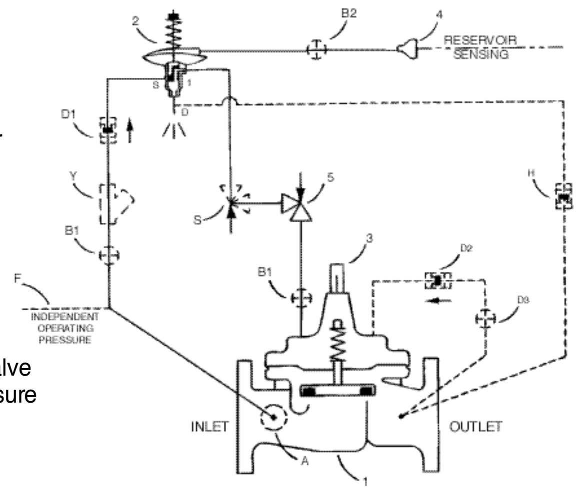
210-01/610-01 Altitude Valve for One-Way Flow

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	CDS6 Altitude Control
3	X101 Valve Position Indicator
4	Bell Reducer
5	CV Flow Control (Closing)

Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
D	Check Valve with Isolation valve
F	Independent Operating Pressure
H	Dry Drain
S	CV Flow Control (Opening)
Y	X43 "Y" Strainer



Altitude Valve for One-Way Flow Start-up and Adjustment Instructions 210-01/610-01

1. Install pressure gauges at main valve inlet and outlet using the inlet /outlet body tappings on the main valve.

2. The CDS6 Altitude Control (item # 2) sensing line (not supplied by Cla-Val) should run from the pilot control directly to the storage tank. This way the pilot control senses the static height of the liquid in the tank directly. Accurate and consistent valve performance is achieved with this approach.

3. Open all isolation valves in pilot system (valves 4" and larger) and loosen all pilot control jam nuts.

4. Observe the adjustment on the CDS6 Altitude Control (item #2). There is a tag attached to the pilot with the factory setting. There are 5 spring ranges available with this pilot control:

Springs	Range
1	5-40 Feet
2	30-80 Feet
3	70-120 Feet
4	110-160 Feet
5	150-200 Feet

Using this information you can change the factory setting to approximate the shut-off height of the valve. This setting is not exact and may have to be corrected under actual conditions.

5. Adjust CV flow controls (opening/closing speeds) if included in pilot system. Turn control clockwise until closed then back out three turns to start. CV closing speed included as standard equipment on all altitude valves.

6. Open inlet isolation valve slowly to pressurize main valve.

7. Bleed air from main valve cover by loosening pipe plug in center of X101 Valve Position Indicator housing (standard on all altitude valves). Tighten pipe plug after all air is removed. **Caution:** only loosen pipe plug enough to allow the air trapped in the cover to escape. Loosen tubing nuts in high points in pilot system to remove air from the pilot control system. Tighten tube nuts after all air is removed.

8. Open downstream isolation valve and establish a flow to the tank (Always check the effect in the system before starting). It may be necessary to increase the setting on the CDS6 Altitude Control to allow the valve to open. The water in the cover of the valve will discharge to atmosphere through the altitude control (unless supplied with dry drain feature Suffix "H"). The volume of water will depend on the valve size: Make provision for

this discharge to be handled safely.

Size	Cover Capacity
2"	.032
2 1/2"	.042
3"	.080
4"	.169
6"	.513
8"	1.26
10"	2.51
12"	4.0
14"	6.50
16"	9.57
24"	29.0

9. As the water level rises to the shutoff point in the tank slowly adjust the CDS6 Altitude Control (item # 2) until the valve starts to close when the desired level is achieved (clockwise to increase water level or counter-clockwise to decrease water level). Adjust CV flow controls until desired valve opening or closing speeds are obtained. Adjust opening rate so that valve opens slowly (turn clockwise to decrease valve opening rate and counter-clockwise to increase valve opening rate). Adjust closing rate so valve does not cause excessive system pressure surging upon closing (Turn clockwise to decrease valve closing rate and counter-clockwise to increase valve closing rate).

10. All valve adjustments are now set. Lockup all jam nuts to retain settings.

Section 5

Application	Series	Section
General	Identify What Valve You Have	5-1
Rate of Flow	40 Series	5-2
Pressure Relief	50 Series	5-3
Pump Control	60 Series	5-4
Pressure Reducing	90 Series	5-5
Float Valves	124 Series	5-6
Solenoid Operated Valves	136 Series	5-7
Altitude Valves	210 Series	5-8
Main Valves	100-01 Hytrol	5-9

5-1 General Information

How do I identify the valve I have?

When asking about one of our valves that is already in your system and is working or not working the first thing you need to do is to identify the valve you have. The following suggestions will help.

Cla-Val control valves consist of two basic elements: the main valve and its pilot control system. We identify the valve assembly by the catalog number information stamped on a small brass nametag. You will find the nametag on the top of the inlet flange of 4" and larger valves and on the side of the main valve on 3" and smaller valves. The pilot controls often have their own nametag, and if they don't, they are identified as a part of the complete valve nametag information. We use raised cast-in letters on the main valve body to identify it alone without any pilot system.

To help you identify your valve accurately, we should have all of the nameplate data, including: 1.) Valve size, 2.) Valve catalog number, 3.) Valve part number, and 4.) Valve Date Code (two letters). To see what our nameplates look like, click our website, "cla-val.com", then click on "Electronic Catalog", then "More about Cla-Val automatic control valves", then "Valve Identification".

When the nameplate is not readable, then get as close an approximation as possible. Sometimes buffing the brass nameplate with steel wool and using a flashlight across the stampings can help make them readable. If the nameplate is missing, then we can help you identify the valve by other means. Is it possible to send photos (close-ups of the valve and controls)? Any descriptive information you can supply (measurements, poems, etc) to help us identify your valve would be useful. A complete description of the valve's function in the system with flow and pressure information often can help.

You may need a copy of the Installation-Operation-Maintenance Manual for your valve. It contains operating data, repair kit part numbers and maintenance information on all valve components. The manual is based on the valve catalog number from the valve nameplate. Visit our web site, "www.cla-val.com" to obtain our standard Technical Manuals or to locate the nearest regional sales office. If you are not located in the domestic U.S., then our export sales department at the home office can help you.

SERVICE SUGGESTIONS

SYMPTOM	POSSIBLE CAUSE	SOLUTIONS
Main valve won't open	Orifice plate assembly and/or orifice sensing line clogged	Remove sensing line and clean orifice port Clean or replace line
	Adjustment below desired set point	Readjust control
	Control line shutoff valve to cover or main outlet closed	Open shutoff valve
	Pilot valve stuck closed Mineral deposits or foreign matter under disc retainer assembly	Remove bottom plug and disc retainer assembly clean or replace
	Main valve stuck closed Mineral buildup on stem Stem damaged	Disassemble main valve clean parts and/or replace damaged parts
Main valve won't close	Pilot adjustment above desired set point	Readjust control
	Pilot control diaphragm nut loose or diaphragm leaks (damaged)	Disassemble tighten nut or replace diaphragm
	Clogged restriction assembly	Remove and clean or replace
	Control line shutoff valve from inlet to restriction closed	Open shutoff valve and readjust
	CV Flow control closed or clogged	Disassembled and clean
	Pilot control disc worn or nicked Clogged Flow Clean Strainer	Remove disc retainer assembly and replace Remove and clean
	Worn Diaphragm	Remove and replace

SERVICE SUGGESTIONS

SYMPTOM	PROBABLE CAUSE	REMEDY
Main valve won't open	Inlet pressure below setting of pilot valve	Reset pilot valve. If change in setting is from tampering, seal cap with wire and lead seal
	Pilot valve stuck closed Mineral deposit or foreign material between disc retainer and power unit body	Disassemble control and clean
	Pilot valve diaphragm ruptured or diaphragm nut loose. Water coming out of the vent hole in cover	Disassemble and replace diaphragm Tighten nut
clean	Main valve stuck closed Mineral buildup on stem Stem damaged	Disassemble main valve, parts and/or replace damaged part. Check downstream and cover CK2 isolation valves are open
Main valve won't close	Inlet pressure above setting of	Reset pilot valve
	pilot valve	
	Clogged needle valve or strainer Pilot valve stuck open. Mineral deposit or foreign material under disc retainer or under diaphragm	Disassemble and clean Disassemble and clean
	assembly Main valve stuck open. Mineral buildup on stem. Foreign material	Disassemble and clean
	between seat and disc assembly Worn diaphragm	Remove and replace
Valve leaks Continuously	Pilot valve disc worn out Main valve disc worn or small	Disassemble and replace Disassemble and replace
	pin hole in main valve diaphragm Set point too close to inlet pressure	Reset CRL Pilot

5 – 3

SERVICE SUGGESTIONS

SYMPTOM	POSSIBLE CAUSE	TEST PROCEDURE	REMEDY
Valve fails to close.	Stem stuck in open position.	Vent power unit chamber. Apply pressure to cover chamber. Valve should close.	Disassemble,examine all internal parts for cause of the sticking condition and clean off scale deposits.
	Worn diaphragm or loose upper stem nut.	Apply pressure in power unit chamber and vent cover. Continuous flow from cover indicates this trouble.	Disassemble and replace diaphragm or tighten the valve stem nut.
	Foreign object on valve seat.	Valve opens okay, but only closes part way.	Try operating valve a few times. This might dislodge the object. If this fails, disassemble and remove the obstruction.
	Pressure not being released from power unit chamber.	Make sure pressure is being released by opening a fitting into the chamber. It valve then closes, refer to remedy.	Check control system. Tube line or nipple might be plugged up.
	Operating pressure not getting into valve cover.	Use pressure gauge or loosen cover plug to check for pressure.	Clean tubing or pipe fittings into cover chamber. Open CK2 Isolation valves in control lines.
Valve fails to open.	Insufficient line pressure. Stem stuck in Closed or semi-open position.	Check line pressure. Vent cover. Apply pressure to power unit chamber.	Establish line pressure. Disassemble, examine all internal parts for cause of the sticking problem, and clean off scale deposits.
Valve closes but leakage occurs.	Worn diaphragm or loose upper stem nut.	Apply pressure in power unit chamber and vent cover. Continuous flow from cover indicates this problem.	Disassemble and replace diaphragm or tighten valve stem nut.
	Foreign object on top of disc retainer.	Valve closed okay but won't open all the way.	Try operating valve a few times. This might dislodge the object It this tails, disassemble and remove the obstruction.
	Pressure not being released from cover chamber.	Open a fitting or remove a plug from cover chamber. It cover chamber vents and valve opens, see remedy.	Check control system. Check lines or pipe fittings. Clean out any plugged lines.
	Operating pressure not applied into power unit chamber.	Loosen a fitting in this chamber to check for pressure at this point.	Clean tubing or pipe fittings into power unit chamber.
	Worn disc or seat.	The best procedure here is to disassemble the valve and inspect these parts.	Replace worn parts.
O-Ring failure.	Mineral deposits on stem cause abrasion on O-Ring.	Remove pressure from both cover and power unit chambers and apply line pressure to valve. Open line from power unit chamber and observe continuos flow.	Disassemble and replace O-ring.

Note:
Please refer to Cla-Val. drawing #69548, the Product Data Catalog and the Installation, Operation, & Maintenance Manual shipped with the Control Valve.

Start Up Procedure

The limit switch (SW2) on the valve should be adjusted before the pump control valve is placed in service. The stop collar on the limit switch stem should be adjusted to strike the switch arm roller as the valve travels closed to the 95% (approx.) closed position. The N.O. contacts on the SW2 limit switch will close when the adjustable collar strikes the limit switch roller and moves the switch arm.

Please read the operating instructions carefully. Make all adjustments (opening speed control, closing speed control and limit switch) before starting the booster pump or turning on the electrical control power.

After the above adjustments have been made the H-O-A switch should be placed in the “off" position and the electrical control power should be turned on. The 60 Series control valve should then be permitted to close (please see manual) and allow the limit switch (SW2) stop collar to contact the SW2 switch roller. This action closes the N.O. contacts on SW2 and energizes the coil on relay 3CR.

The H-O-A switch can now be placed in the “automatic" position and the following operation should result:

Pump Starting - Pump Running Cycle

There are two ways in which the pump motor (M) starting cycle may be “called" on:

1 - The pump motor may be “called" on by manually placing the H-O-A switch in the hand position. This action bypasses the automatic remote switch (SW1) and calls the pump on.

2 - The pump motor may be “called" on by manually placing the H-O-A switch in the “automatic" position provided that the automatic switch (SW1) contacts close. This action places the pump motor under the command of SW1 and the associated safety controls. The pump motor (M) can <u>not</u> be called on, under any conditions, if the H-O-A switch is manually placed in the “off" position.

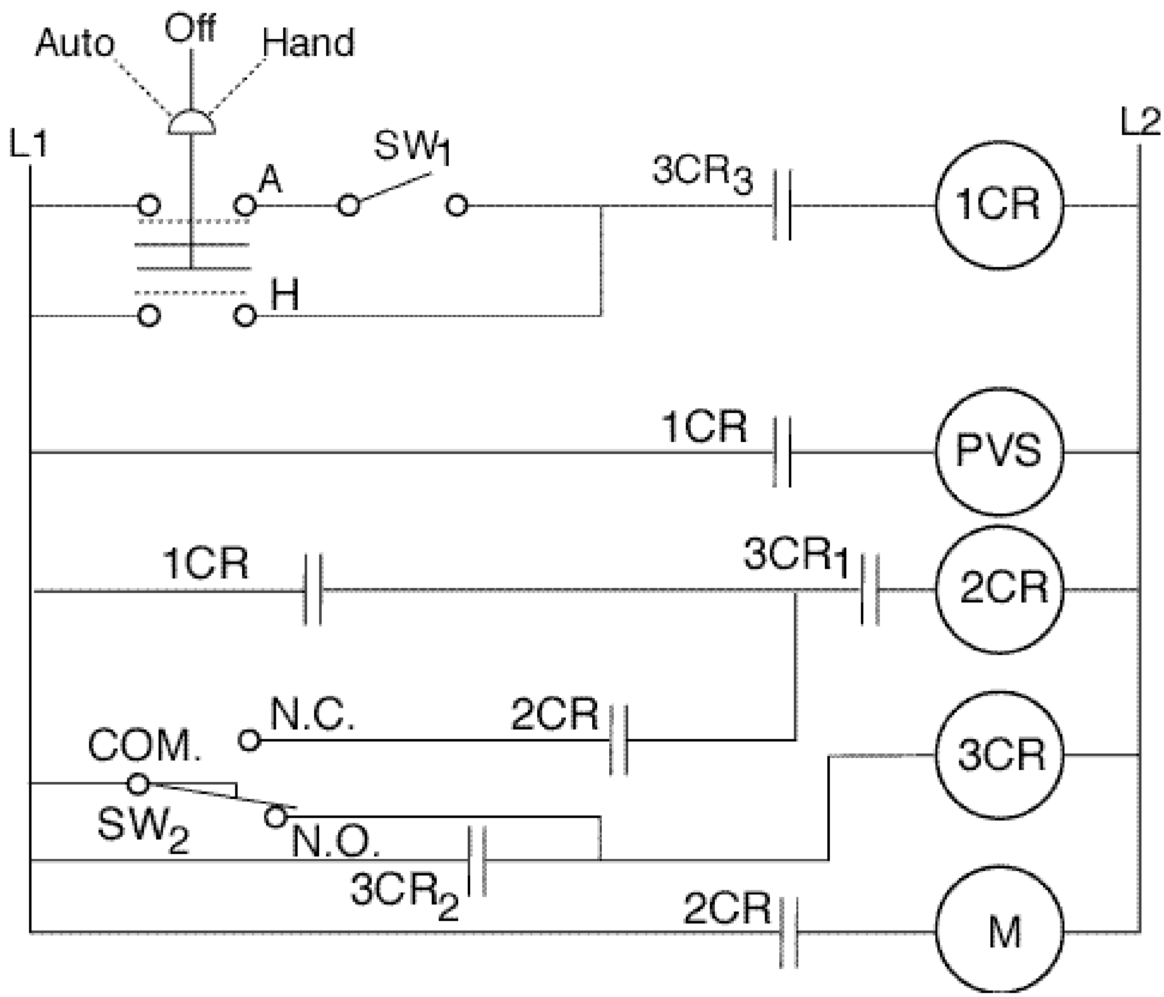
When SW1 contacts close (assuming that 3CR coil is energized—see start up procedure above) coil 1CR is energized, both contacts 1CR close to energize pilot valve solenoid (PVS) and relay coil 2CR. Both contacts 2CR close and the pump motor (M) starts immediately as the valve begins to open. As the limit switch SW2 stem collar lifts off the roller, SW2 contacts N.C., close. The pump is now locked on the line by SW2 and the valve slowly continues to go completely open, directing all liquid flow to the pipeline.

Power Failure (While Pump Is Running) Conditions

If a momentary power failure should occur while the pump is running, relay coil 3CR would be de-energized and contacts $3CR_1$, $3CR_2$, and $3CR_3$ would open. This action would completely lock the pump motor out from restarting and keep the valve solenoid PVS de-energized until the diaphragm assembly lowers to the setpoint of SW2 limit switch. The Cla-Val 60 Series valve is equipped with an integral “drop" check that will close immediately when the pump motor stops and prevent backflow. However, a time period of several seconds is required for the diaphragm assembly to travel to the down position to hold the valve closed when the pump restarts. Thus, even though the power is restored immediately following the power failure the pump cannot restart until the system is “ready", hydraulically, for a new start up.

Pump Stopping - Pump Off Conditions

When SW1 contacts are opened, or the H-O-A switch is manually placed in the off position, coil 1CR contacts open and the PVS coil is de-energized. Since the SW2 contacts are in the normally closed position the pump motor (M) continues to run as the pump control valve slowly closes. When the SW2 stop collar reaches the roller arm, the SW2 N.C. contacts will open, 2CR coil will be de-energized, both 2CR contacts will open and the pump motor (M) will stop. The pump motor will remain off under these conditions. Coil 3 CR will remain energized and contacts $3CR_1$, $3CR_2$, and $3CR_3$ will remain closed. The Cla-Val 60 Series will remain closed under these conditions.



Wiring Diagram

Auto-Off-Hand	=	Selector Switch
1CR	=	Relay, DPST Normally Open
2CR	=	Relay, DPST Normally Open
3CR	=	Relay, TPST Normally Open
SW_1	=	Switch, Remote Start,Automatic
SW_2	=	Switch, SPDT, Valve Limit Switch Connect to N.C. Terminal
PVS	=	Pilot Valve Solenoid
M	=	Pump Motor Starter

Note: SW_2 and PVS supplied by Cla-Val. All other electrical items supplied by customer. SW_2 is included in the X105L switch assembly which is mounted on the pump control valve cover.

61 Series
Deep Well Pump Control Valves - Electrical Controls

Note:
Please refer to Cla-Val drawing #69548, the Product Data Catalog and the Installation, Operation, & Maintenance Manual shipped with the Control Valve.

Start Up Procedure

The limit switch (SW2) on the valve should be adjusted before the pump control valve is placed in service. The stop collar on the limit switch stem should be adjusted to strike the switch arm roller as the valve travels open to the 95% (approx.) closed position. The N.O. contacts on the SW2 limit switch will close when the adjustable collar strikes the limit switch roller and moves the switch arm.

Please read the operating instructions carefully. Make all adjustments (opening speed control, closing speed control and limit switch) before starting the well pump or turning on the electrical control power.

After the above adjustments have been made the H-O-A switch should be placed in the “off" position and the electrical control power should be turned on. The 61 Series control valve should then be permitted to open (please see manual) and allow the limit switch (SW2) stop collar to contact the SW2 switch roller. This action closes the N.O. contacts on SW2 and energizes the coil on relay 3CR.

The H-O-A switch can now be placed in the “automatic" position and the following operation should result:

Pump Starting - Pump Running Cycle

There are two ways in which the pump motor (M) starting cycle may be “called" on:

1 - The pump motor may be “called" on by manually placing the H-O-A switch in the hand position. This action bypasses the automatic remote switch (SW1) and calls the pump on.

2 - The pump motor may be “called" on by manually placing the H-O-A switch in the “automatic" position provided that the automatic switch (SW1) contacts close. This action places the pump motor under the command of SW1 and the associated safety controls. The pump motor (M) can not be called on, under any conditions, if the H-O-A switch is manually placed in the “off" position.

When SW1 contacts close (assuming that 3CR coil is energized—see start up procedure above) coil 1CR is energized, both contacts 1CR close to energize pilot valve solenoid (PVS) and relay coil 2CR. Both contacts 2CR close and the pump motor (M) starts immediately as the valve begins to close. As the limit switch SW2 stem collar drops off the roller, SW2 contacts N.C., close. The pump is now locked on the line by SW2 and the valve slowly continues to go completely closed, directing all liquid flow to the pipeline.

Power Failure (While Pump Is Running) Conditions

If a momentary power failure should occur while the pump is running, relay coil 3CR would be de-energized and contacts $3CR_1$, $3CR_2$, and $3CR_3$ would open. This action would completely lock the pump motor out from restarting and keep the valve solenoid PVS de-energized until the valve opens to the set point of SW2 limit switch. Thus, even though the power is restored immediately following the power failure the pump cannot restart until the system is “ready" , hydraulically, for a new start up.

Pump Stopping - Pump Off Conditions

When SW1 contacts are opened, or the H-O-A switch is manually placed in the off position, coil 1CR contacts open and the PVS coil is de-energized. Since the SW2 contacts are in the normally closed position the pump motor (M) continues to run as the pump control valve slowly opens. When the SW2 stop collar reaches the roller arm, the SW2 N.C. contacts will open, 2CR coil will be de-energized, both 2CR contacts will open and the pump motor (M) will stop. The pump motor will remain off under these conditions. Coil 3CR will remain energized and contacts $3CR_1$, $3CR_2$, and $3CR_3$ will remain closed. The Cla-Val 61 Series will remain open under these conditions.

SERVICE SUGGESTIONS

SYMPTOM	PROBABLE CAUSE	REMEDY
Main valve fails to open	No pressure at valve inlet	Check inlet pressure
	Main valve diaphragm assembly inoperative	Disassemble, clean and polish stem, replace detective parts
	Pilot Valve (CRD) not opening: No spring compression	 Tighten adjusting screw
	Damaged spring	Disassemble and replace
	Spring guide not in place	Assemble properly
	Yoke dragging on inlet nozzle	Assemble properly
	Flow Control (CV) disc inoperative. corrosion or excessive scale buildup on stem	Disassemble, clean and polish stem. Replace worn parts
Main valve fails to close	Foreign matter between disc and seat or worn disc. Scale on stem or worn Diaphragm Flow Clean Strainer plugged CK2 (isolation valves) closed	Disassemble main valve, remove matter, clean parts and replace defective parts Remove and clean or replace Open isolation valves
	Pilot Valve (CRD) remain open: Spring compressed solid Mechanical obstruction	 Back off adjusting screw Disassemble and remove obstruction
	Worn disc	Disassemble remove and replace disc retainer assembly
	Yoke dragging on inlet nozzle diaphragm nut	Assemble properly
	Worn Diaphragm	Disassemble. replace diaphragm and/or tighten nut
	Clogged Flow Clean Strainer	Remove and clean
Fails to regulate	Air in main valve cover and/or tubing	Loosen top cover plug and fittings and bleed air
	Pilot Valve (CRD) yoke dragging on inlet nozzle Pilot Valve (CRD) spring not in correct range to control	Assemble properly Check outlet pressure requirements and compare existing spring with Spring Chart

SERVICE SUGGESTIONS

SYMPTOM	PROBABLE CAUSE	REMEDY
Continuous flow from float pilot system discharge port	Damaged valve diaphragm	Replace diaphragm
	Loose main valve (1) stem nut	Tighten stem nut
	Damaged float pilot control (2)	Replace pilot valve assembly (See P-CFI-CI)
Main Valve fails to close	Differential pressure too low across main valve (Need 5 psid Min)	Restrict valve opening with Cla-Val X102A flow limiting under flowing conditions) assembly (Contact Cla-Val)
	Isolation valve in control tubing closed or clogged X46 strainer	Open isolation valve. clean strainer
	Float and float rod fails to move with liquid level change (stays in down position)	Free float mechanism
	Clogged Flow Clean Strainer	Remove and clean
	Worn Diaphragm	Remove and replace
Main Valve fails to open	Float and float rod fails to move with liquid level change (stays in up position)	Free float mechanism
	Inlet gate or block valve closed Check Restriction	Open valve
Main Valve Vibrates when closing	Air in cover	Bleed all air with float in the up position by loosening the top four cover bolts if valve is on its side or installed vertically

SERVICE SUGGESTIONS

SYMPTOMS	PROBABLE CAUSE	REMEDY
Main valve Fails to Close	To low pressure differential across valve (Need 5 psi d Min under flowing conditions)	Restrict valve opening with Cla-Val X102A flow limiting assembly. (Contact Cla-Val)
	Closed isolation valves in pilot system, or in main line	Open valves
	Lack of cover chamber pressure	Check upstream pressure, tubing, needle valves for restriction
	Worn Diaphragm	Remove and replace
	Mechanical obstruction Object lodged in valve Worn disc	Remove obstruction Replace disc
	Badly scored seat	Replace seat
	CNA needle valve closed	Open this speed control to allow pressure to cover
	Clogged Flow Clean Strainer	Remove and clean
Main valve Fails to Open	Closed isolation valves in pilot system, or in main line Insufficient line pressure Diaphragm assembly inoperative	Open valves Check pressure Clean & polish stem
Main Valve Vibrates when closing	Worn stem or cover bearing Air in cover	Replace any defective or damaged parts Bleed all air from valve

CDS6/CDS6A Pilot

SERVICE SUGGESTIONS — **UPPER (SPRING) SECTION**

SYMPTOM	PROBABLE CAUSE	REMEDY
Vent leaks in lower cover (17)	Diaphragm (14) damaged	Replace diaphragm
	Diaphragm nut (12) loose	Tighten nut (12)
	O-ring (20) damaged	Replace O-ring (20)
Leakage past stem stem (5)	O-ring (10) damaged	Replace O-ring
Stem (5) movement restricted or erratic	*Sand or silt in sensing chamber above diaphragm	Remove foreign matter from sensing chamber
	Sensing line clogged	Clean line
	Sensing line valve closed	Open valve fully
	Sensing line sagging or bent collecting sediment	Straighten and support sensing line to reservoir
	Sensing line has high point trapping air in the line	Straighten sensing line. Must slope upward from altitude control to the reservoir

*NOTE: if this problem occurs, a sand trap should be installed in the sensing line, or the line moved to a point on the reservoir where sand or silt cannot enter this line.

SERVICE SUGGESTIONS — **LOWER (PILOT VALVE) SECTION**

SYMPTOM	PROBABLE CAUSE	REMEDY
Vent in lower cover (17) leaks	O-ring (20) worn or damaged. See Upper Spring Section service suggestion	Replace O-ring (20)
Flow from supply port tovalve cover port restricted	Clogged strainer screen(25)	Remove screen and clean
	Silt packed in seat (24) and lower stem (21)	Clear area of blockage
Continuous drain leak. Main valve closed	Seat (24) damaged	Inspect and replace
	Disc in poppet assembly (22) damaged	Inspect and replace poppet assembly (22)
	Foreign object between disc and seat (24)	Remove object
	O-ring (20) in poppet guide (28) damaged	Replace O-ring
Continuous drain leak. Main valve open	Main valve diaphragm worn or stem nut loose	Service main valve. Replace diaphragm or tighten stem nut

100-01 HYTROL
SERVICE SUGGESTIONS

SYMPTOMS	PROBABLE CAUSE	REMEDY
Main valve Fails to Close	Closed isolation valves in control system, or in main line. Lack of cover chamber pressure.	Open Isolation valves. Check upstream pressure, pilot system, strainer, tubing, isolation valves, or needle valves for obstruction.
	Worn Diaphragm	Remove and Replace diaphragm.
	Diaphragm assembly inoperative. Corrosion or excessive scale build up on valve stem	Clean and polish stem. Inspect and replace any damaged or badly eroded part.
	Mechanical obstruction. Object lodged in valve	Remove obstruction.
	Worn disc	Replace disc.
	Badly scored seat	Replace seat.
	Closed upstream and/or downstream isolation valves in main line.	Open valves.
Main valve Fails to Open	Insufficient line pressure.	Check upstream pressure (Minimum 5 psi flowing line pressure differential).
Main Valve Vibrates when closing	Diaphragm assembly inoperative. Corrosion or excessive buildup on valve stem (See Freedom of Movement Check).	Clean and polish stem. Inspect and replace any damaged or badly eroded part.

For Troubleshooting Instructions for Pilot Controls & Accessories

See Section 2

Section 6

Technical Support

AN INTRODUCTION TO THE SCIENCE OF HYDRAULICS AND ITS APPLICATION IN CLA-VAL VALVES

SECTION I DEFINITIONS

HYDRAULICS:

The word hydraulics has its origin from two Greek words meaning water and pipe. When first used, it referred only to that branch of science which treats liquids in motion. The word is now used to include the scientific study of all fluids, both in motion (dynamic) and at rest (hydrostatic).

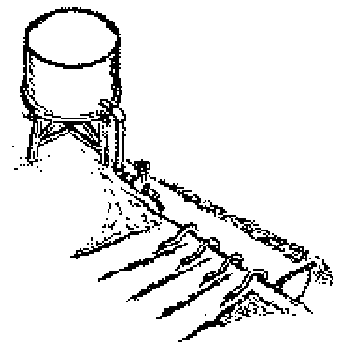
SCIENCE OF HYDRAULICS:

The science of hydraulics involves the study and application of the manner in which fluids act in containers such as tanks, valves and pipes and the study of the properties of fluids and the utilization of these properties. It also includes the laws of floating bodies, the treatment of flow under various conditions and the ways of directing this flow to useful ends.

PHYSICAL PROPERTIES OF FLUIDS:

Fluids are substances such as water, oil or air which are capable of changing their shapes and flow--as contrasted to solids. Fluids are divided into two classes: liquids and gases. Liquids do not substantially change in volume when subjected to pressure and are less compressible than solids. When a force is applied to a confined liquid, that liquid is substantially as rigid as a solid. Gases fill all parts of a containing vessel and they are far more compressible than liquids.

All fluids have **weight** (density). The molecules which make up these fluids resist movement; this resistance is known as **viscosity.**

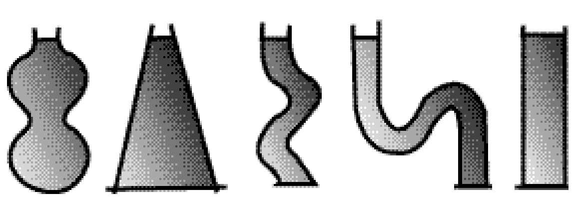


Because of their nature, liquids flow through open channels, as well as through closed conduits (pipe), by the force of gravity or by other applied forces.

When considering the control of flow or pressure of a fluid, it is important to know the **specific gravity, viscosity, and temperature** of the fluid (In the case of gases, other characteristics must be known).

SPECIFIC GRAVITY:

The specific gravity of a substance is the ratio of the weight density of a unit volume of that substance to the weight density of a similar unit volume of a standard substance. Water is the standard substance for liquids and solids. Air is the standard substance for gases. Both water and air are designated as having a specific gravity of 1.0 under standard conditions.



Fluids conform to the shape of their container.

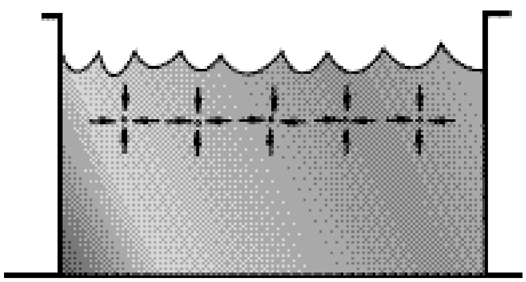
WEIGHT DENSITY: The number of units of mass of a substance which is contained in a unit of volume is called the weight density of that substance (ie. the weight density of water is 62.4 pounds mass per cubic foot of volume).

VISCOSITY: Resistance to movement in fluids is called viscosity. Fluids differ greatly in mobility (viscosity) due to the differences in their resistance to the movement in the molecules of different fluids. Viscosity is expressed in many ways; for example: Seconds Saybolt Universal (SSU), Kinematic, Viscosity-Centistoke, etc. SSU is most commonly used to express the degree of viscosity.

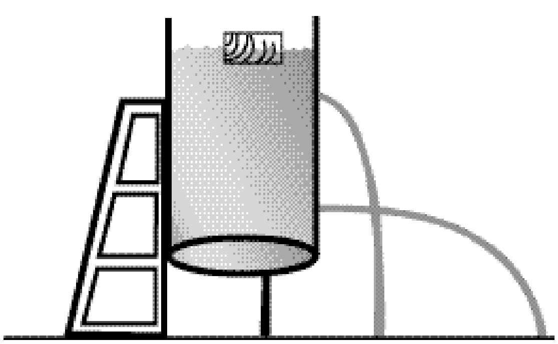
TEMPERATURE: Temperature affects the weight density and viscosity of fluids to a greater or lesser degree, depending upon the fluid concerned. Temperature is commonly expressed as degrees Fahrenheit or degrees Centigrade. Standard temperature for water is 60° F.

SECTION II

FLUIDS EXERT PRESSURE: At any point in a fluid at rest, the pressure is the same in every direction.



Therefore, in a fluid at rest, the pressure is the same at all points at the same level.

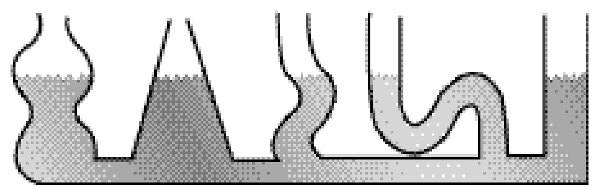


FOR EXAMPLE:

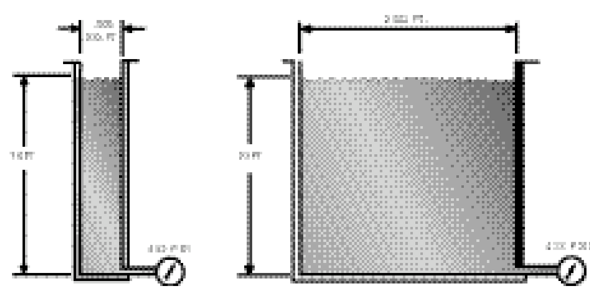
If a hole were to be bored in the bottom of a wooden tank full of water, the water would flow out; this would prove that fluids push downward. If a hole were to be bored in the side of the tank, the water would flow out; this would prove that fluids also exert pressure in a sideways direction. If a piece of wood were pushed down into the water, it would rise to the surface as soon as it was released. The upward push which liquids exert upon objects submerged in them makes them to seem to lose weight. From these examples, it must be concluded that fluids exert pressure in all directions.

LIQUID PRESSURE AND CONTAINERS:

Since fluid pressure is measured in unit area and is exerted equally in all directions, the shape of a container or vessel has no effect upon the amount of pressure exerted by the contained liquid. For example, the area of the liquid surface inside the body of a teakettle is much greater than the area of the liquid in the spout, but the pressure per unit area at the same depth is the same in both cases. If the pressure increased with the area, water would always flow out of the spout. The depth of the liquid in the container would determine the pressure exerted at any point, regardless of the shape or size of the container.

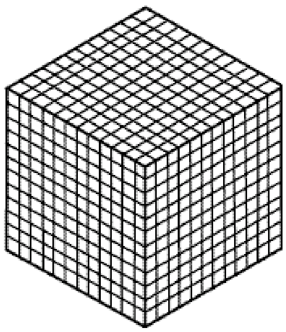


A liquid will come to rest at the same height in open vessels that are interconnected regardless of the shape of the area in these vessels. Simply stated, water seeks its own level.



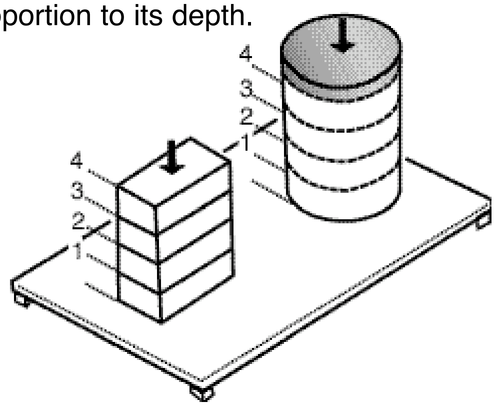
Hydrostatic paradox describes a condition when the force exerted on the bottom of a vessel is greater than the weight of all the liquid in that vessel.

In our study of liquids, water is most commonly used for illustration purposes. The weight density of water varies; but, for the purpose of standard measurement, its weight is considered to be 62.4 pounds per cubic foot.



If the bottom area of a straight-sided container is one square foot and the water which it contains is one foot deep, the pressure exerted would be 62.4 pounds per square foot at its base [or 62.4 divided by 144 equals 0.433 pounds per square inch (psi)].

Fluid pressure is proportional to the depth of the fluid, just the same as a brick lying on a table exerts force on pressure upon the table. When several bricks are piled one upon another, the downward pressure is increased. Likewise, each layer of fluid sustains the weight of the layer or layers above it; hence, the pressure of the fluid increases in direct proportion to its depth.



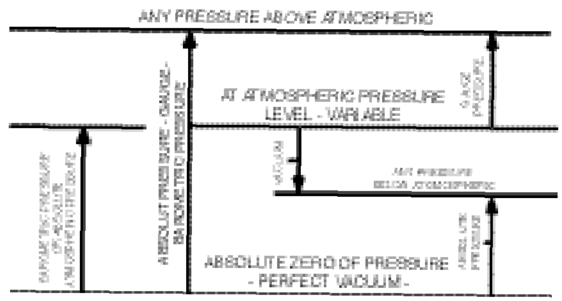
Because pressure exerted by any liquid is governed by its weight density as well as by its depth, the pressure in psi exerted by any liquid at any depth is determined as follows: multiply the depth of the liquid in feet by 0.433 and multiply that result by the specific gravity of the liquid (If the liquid is water, omit multiplying by specific gravity).

Example: To find the psi exerted at the base of a column of gasoline 18 feet in depth (specific gravity 0.7):

$$18 \times 0.433 = 7.794$$

$$7.794 \times 0.7 = 5.4558 \text{ or } 5.46 \text{ psi}$$

MEASUREMENT OF PRESSURE: There are several types of pressure: absolute, barometric, gauge and vacuum.



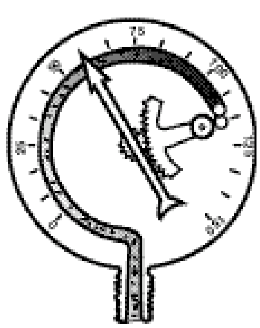
Perfect vacuum cannot exist on the surface of the earth, but it nevertheless makes a convenient starting point or datum for the measurement of pressure. Barometric pressure is the level of atmospheric pressure above perfect vacuum. Standard atmospheric pressure is 14.695 (14.7) pounds per square inch or 760 millimeters of mercury. Gauge pressure (psi) is measured above atmospheric pressure, while absolute pressure (psia) always refers to perfect vacuum as a base. Vacuum, usually expressed in inches of mercury, is the depression of pressure below the atmospheric level.

6
—
1

POUNDS PER SQUARE INCH GAUGE (PSIG): Normally, in an hydraulic system's equipment, the atmosphere has access to both ends (top and bottom) or actually surrounds the system. Consequently, in everyday engineering, the local atmospheric pressure is taken as zero. Almost all gauges are calibrated to read zero when exposed to local atmospheric pressure. When we see the term psig used, this means that the design engineer wishes no mistake made as to his reference point.

FEET OF HEAD: Pressure can also be referred to in these terms: head (in feet) or head (in inches). When using these terms, the type of fluid concerned must be stated (ie: head in feet of water or head in inches of mercury). Pressure instruments in one type of units can be converted to another type of units mathematically. Pressure of one foot of head is equal to pressure of .433 pounds per sq. inch. Also, 1 psi equals 2.31 of head

There are different instruments which measure pressure. The most common instrument for measuring pressure is the Bourdon tube type of pressure gauge. The Bourdon tube is fixed at the open end and free at the closed end. The closed end is attached to a lever gear and pinion system which rotates a pointer when the free end of the Bourdon tube moves. The dial in the Bourdon tube is usually calibrated in pounds per square inch.



Pressure applied to the open end of the tube tends to straighten out the curved tube, causing the free end to move.

By transmitting this movement through the linkage, gears and pointer, the magnitude of the pressure applied is indicated.

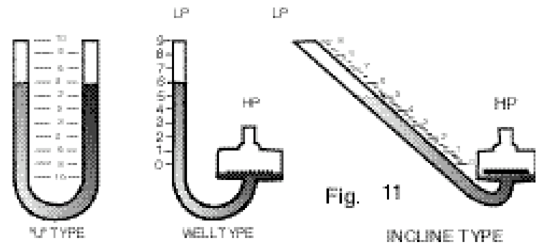


Fig. 11

The manometer is another instrument used for measuring pressure. It comes in several forms: Well type, U type and Incline type. It utilizes various liquids as the gauging medium. Because of its relatively heavy weight, low congealing point and high surface tension which prevents adherence to the gauge walls, mercury is the most commonly used gauging medium (A column of mercury one inch high is the equivalent of 0.49 pounds per square inch).

SECTION III
FORCE AND PRESSURE: In order to determine answers to hydraulic problems, the terms force and pressure are commonly used and must be clearly defined. Force may be defined as a push or a pull. If we push against a wall, we are using force; if we pull on a rope, we are using force.

FORCE: Force is the total amount of pressure exerted on any given surface or area. Force is most commonly expressed in pounds (lb.).

PRESSURE: Pressure is the amount of force applied to a unit area and is generally expressed in pounds per square inch (psi).

FORCE, PRESSURE AND HEAD RELATIONSHIP: In dealing with liquids, forces are practically always considered in relation to the area over which they are applied; thus, a force acting over a unit area is a pressure.

Pressures can alternatively be stated either in that form (pounds per square inch), or in terms of head which is the vertical height (feet) of the column of liquids whose weight would produce that pressure.

MATHEMATICALLY RELATED:

$$F = P \times A, \quad P = \frac{F}{A} \quad A = \frac{F}{P}$$

Where: F = Force in pounds

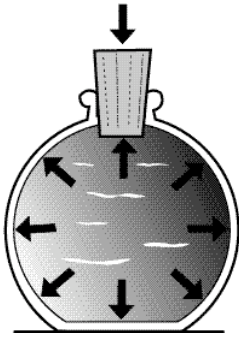
P = Pressure in psi

A = Area in square inches

PASCAL'S PRINCIPLE: Although the modern development of hydraulics is comparatively recent, ancient civilizations were familiar with many hydraulic principles and their application. About three or four hundred years ago, the physical sciences, as we now know them began to flourish. It was in this period that one of the fundamental laws underlying the whole science of hydraulics was discovered and was stated by Blaise Pascal in the year 1653.

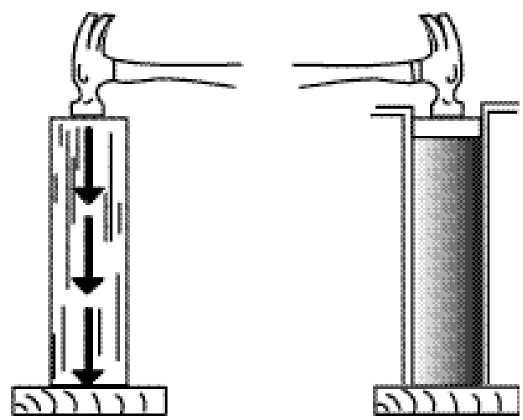
Pascal's principle is that pressure is transmitted equally in all directions throughout a mass of fluid at rest; therefore, if pressure of a confined fluid is increase at any point, pressure is increased everywhere throughout the fluid mass by that same amount.

In a simple example, a farm hand went to a well, filled a jug with water and inserted a stopper. He hit the stopper a sharp blow with the palm of his hand; and, much to his astonishment, the bottom fell out of the jug. What happened?



As the stopper was driven into the jug by the force of the blow, its pressure upon the confined liquid was transmitted equally in all directions. For convenience, assume that the neck of the jug had an area of exactly one square inch and that a ten-pound force was used in driving the stopper into the jug. That means that every square inch of the inside surface was subjected to a pressure of ten pounds in addition to the pressure of its weight. If the bottom of the jug had an area of forty square inches, the total force acting upon it must have reached a total of four hundred pounds. The bottom of the jug was not strong enough to withstand so great a force.

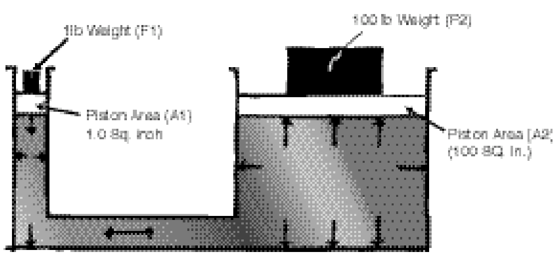
TRANSMISSION OF FORCES: When the end of a solid column is struck, the force of that blow is carried straight through the solid in the direction of the blow only. If the end of a column of a confined fluid is struck, the force is transmitted not only to the opposite end, but is transmitted equally in all directions through the column causing the container to literally be filled with pressure.



Forces can be transmitted through fluids (up or down and around corners or curves) with great efficiency. Although fluids are not rigid, the laws of fluids permit them to be used like levers. A small force can be used to balance a larger force.

6 — 1

Let us consider a hydraulic system filled with liquid which consists of two interconnected cylinders; one with a piston area of one square inch and the other with a piston area of one hundred square inches. Disregarding friction, a downward force of one pound on the small piston would create a pressure of one pound per square inch in the liquid. This pressure would be transmitted, undiminished, in all directions throughout the system and would act at right angles against all internal surfaces. Thus, the upward force on the one hundred square inch piston would support a weight of one hundred pounds (1 psi x 100 sq. in.) The basic formula is pressure = Force/Area. For equilibrium in the below examples F1/A1 = F2/A2 or 1/1 = 100/100.

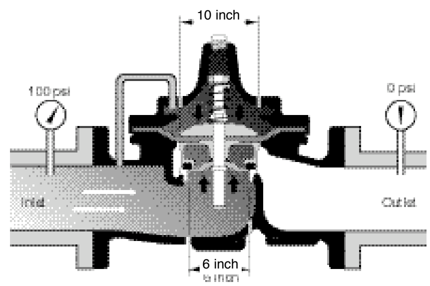


SECTION IV

PRESSURE, FORCE AND THE OPERATION OF CLA-VAL VALVES:

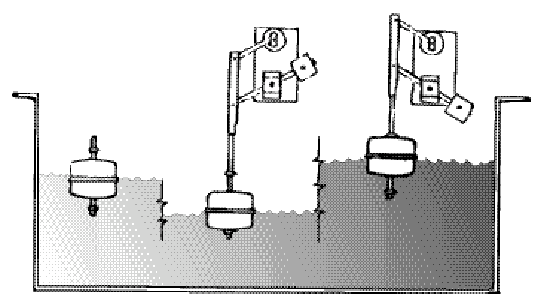
The CLA-VAL Hytrol main valve employs a flexible diaphragm instead of a piston for its operation. The diaphragm assembly of the main valve has an effective area. Assuming that the effective area is 10 square inches for the diaphragm and 6 square inches for the seat opening of the valve, a pressure of 100 psi at the valve inlet would create a force of 600 pounds (100 psi x 6 sq. in.) acting upward, which would push the disc away from the seat tending to open the valve.

By being connected to the valve inlet through a pilot system, the cover chamber also contains a pressure 100 psi. This pressure on the effective area of the diaphragm would create a force 1000 pounds (100 psi x 10 sq. in), acting downward to push the disc toward the seat. The net difference between the two opposed forces would be a force of 400 pounds, acting downward. This force would hold the disc closed against the seat to prevent flow through the valve. By using simple pilot controls in the pilot system, the pressure in the valve cover chamber can be easily changed. This will cause the operating force to move the disc to any point desired between drip-tight closed and wide open.

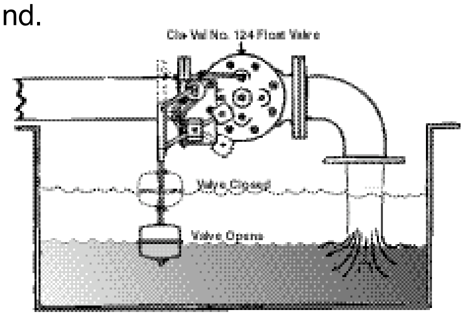


SECTION V

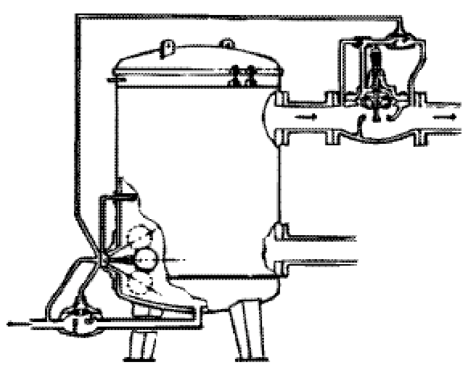
BUOYANCY: The lifting force of a liquid upon a body immersed in it is called buoyancy. The law of buoyancy discovered by Archimedes at about 420 B.C is: a body immersed in a liquid is buoyed up by a force equal to the weight of the liquid displaced by it.



It follows that when a body floats on a liquid with a portion protruding above the surface of the liquid, the weight of the liquid displaced is equal to the weight of the floating body. A float is a body designed to float in liquids in order to perform useful tasks. If a float is constructed so that its total weight is one pound and the liquid displace by one half of its volume is also one pound, the float will rest on a liquid with one half submerged. This float will have a thrust or upward lift which is equal to one pound.



A float must be designed for the liquid in which it floats. A float can be used to control the level of liquid in reservoirs or tanks. By utilizing mechanical and hydraulic linkages, the float will control the opening and closing of a CLA-VAL valve which allows the valve to automatically control the liquid level in the tank.



If a quantity of gasoline (specific gravity of 0.7) and water (specific gravity of 1.0) is poured into a container and is thoroughly mixed and then allowed to settle, it will be noted that the two liquids will quickly separate and the gasoline will float on top of the water. When completely at rest, the two liquids will be separated by a clear-cut line. The two liquids are said to be immiscible. Immiscible liquids can be defined as liquids that will not remain in solution when mixed together but will tend to separate (as with oil and water).

The line of separation is called the interface. The liquid on the top will be lighter than the liquid at the bottom. If two immiscible liquids are contained in the same vessel, a float can be constructed in such a manner that it will come to rest at the interface of two immiscible liquids with one half of its volume above the interface and one half of its volume below the interface. With such a float and with the proper mechanical and hydraulic linkage (as can be accomplished by a CLA-VAL valve), the volume of either liquid in the vessel can be controlled.

FLUIDS IN MOTION: In order to understand hydraulic systems and the flow of fluids through valves, it is necessary to become acquainted with some of the characteristics of fluids in motion and their definition.

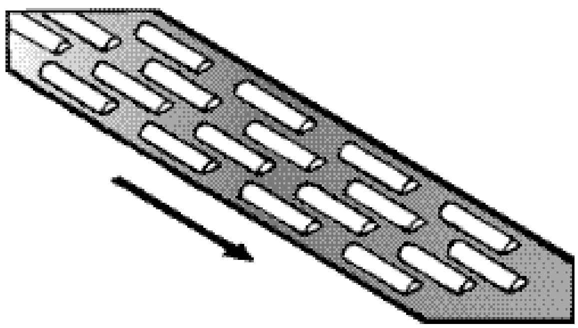
VOLUME OF FLOW: Volume of flow, or flow rate, means the quantity of liquid that will pass a given point in a system in a unit of time. The unit of measure for volume of flow is stated in many different ways: cubic feet per second, barrels per hour, acre feet, gallons per minute and others. Gallons per minute is the most commonly used measure of volume of flow.

VELOCITY OF FLOW: Velocity of flow means the rate of speed of the liquid flowing past a given point in a system. There are several units of measure for velocity. The usual method of stating velocity is in feet per second. Volume of flow and velocity of flow are interrelated since volume can be determined by multiplying the area of a pipe (in sq. ft.) by the velocity in feet per second, resulting in volume in cubic feet per second.

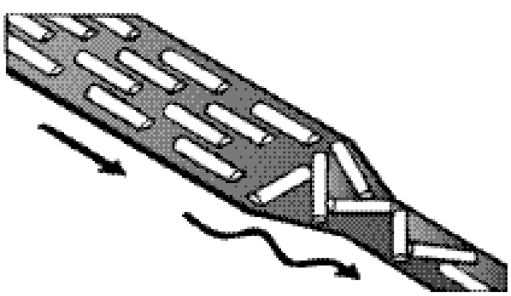
6 – 1

STEADY AND UNSTEADY FLOW: Few hydraulic systems have uniformly steady flow rates. Changes in demand and pressure usually alter the flow rate in most systems.

LAMINAR AND TURBULENT FLOW: Flowing liquid tends to flow in a Laminar streamline manner in small diameter pipes and at low velocities. Streamline means that the particles of liquid will follow one another and move alongside each other without bumping into each other.



When flow velocities are increased and/or pipe diameters are enlarged, liquid particles tend to tumble and jostle each other and the flow becomes turbulent.
Flow through valves is generally accepted as being turbulent. Some valve designs are less inclined to cause turbulence than others.



In a pipe or channel, the liquid lying next to the wall of a conduit or pipe will have very little velocity. The closer to the center, the greater the velocity; the more turbulent the flow, the less difference in velocity (wall to center). Velocities, when stated, are the average of velocities across a cross section of pipe.

REYNOLDS NUMBER: Experiments which were conducted by Osborne Reynolds revealed that the nature of flow (turbulent or laminar) could be given a numerical value. This value is determined by the internal diameter of the pipe, the roughness factor, the average velocity of flow, the weight density of the fluid and the absolute viscosity in pounds mass per foot second. These calculations are not within the scope of this report. For those who wish to pursue the subject further, excellent study material can be found in any library.

FIVE FACTORS OF HYDRAULIC ACTION:
There are just five physical factors which can act upon a liquid to affect its behavior. All of the physical actions of liquids in all possible systems are determined by the relationships of these five factors to each other. These five factors are:

• **Gravity -** acts at all times upon all bodies regardless of all other forces.

• **Atmospheric Pressure -** acts whenever any part of a system is exposed to the open air.

• **Specific Applied Forces -** May or may not be present; but which, in any event, are entirely independent of the presence or absence of motion.

• **Inertia -** Comes into play whenever there is a change from rest to motion (or vice versa), or whenever there is a change in direction or in rate of motion.

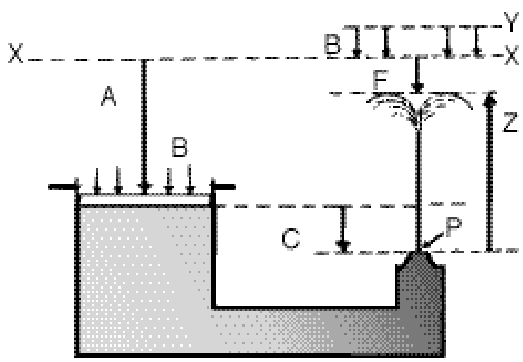
• **Friction -** is always preset whenever there is motion.

INERTIA: Inertia is used by scientists to describe the ability of all forms of matter to resist being moved if it is at rest and likewise resist any change in its rate of motion if it is moving. This is simply saying, in more scientific terms, what everyone has learned by experience--that one must push on an object to get it moving and push in the opposite direction (or offer an opposing force) in order to stop it.

INERTIA AND FORCE: In order to overcome the tendency of an object to resist any change in its state of rest or motion, some force which is not otherwise canceled or balanced must act upon the object.

Some unbalanced force must be applied whenever liquids are set in motion or speeded up. Conversely, forces are made available to do work elsewhere whenever liquids in motion are retarded or stopped.

There is a direct relationship between the magnitude of the force exerted and the inertia against which it acts. This force is dependent upon two factors: on the mass of the subject (which is proportional to its weight), and on the rate at which the velocity of the object is changed. While the mathematical relationship between inertia and force is outside the scope of this report, it is included here for completeness and for those who may be interested. The rule is that the force in pounds required to overcome inertia is equal to the weight of the object, multiplied by the change in velocity measured in feet per second, and divided by 32.2 times the time in seconds required to accomplish the change. Thus, the rate of change in the velocity of an object is directly proportionate to the force applied. The number 32.2 appears because it is the conversion factor between weight and mass.



The figure above diagrams a possible relationship between the five factors (gravity, atmosphere, pressure, specific applied forces, inertia and friction) with respect to a particle of liquid P in a system. The different forces are shown in terms of head; or, in other words, in terms of the vertical columns of liquid required to produce the forces. At the particular moment under consideration, a particle of water P is being acted upon by an applied force equivalent to a head of A, by atmospheric pressure equivalent to a head of B and by gravity head C produced by the weight of the liquid standing over it. The particle possesses sufficient inertia or velocity head to rise to a level **Z**, since head equivalent to **F** was lost in friction as **P** passed through the system. Since atmospheric pressure **B** acts downward on the system on both sides, what was gained on one side was lost on the other.

If all the pressure acting on **P** to force it through the nozzle could be recovered in the form of elevation head, it would rise to level **Y**; or, if account is taken of the balance in atmospheric pressure, in a frictionless system it would rise to level **X** or precisely as high as the sum of gravity head and the head equivalent to the applied force.

KINETIC ENERGY: As pointed out above, a force must be applied to an object in order to impart velocity to it or to increase the velocity it already has. Of necessity, the force must act while the object is moving over some distance. Since a force acting over a distance is work and that work and all forms into which it can be changed are classified as energy, then energy is obviously required to give an object velocity. The greater the energy used, the greater the velocity. Likewise, for an object to be brought to rest (disregarding friction) or if its motion is to be slowed down, an opposing force to its motion must be applied.

This force also acts over some distance. In this way, energy is given up by the object and is delivered in some form to whatever opposes its continued motion. The moving object is, therefore, a means of receiving energy at one place (where it is speeded up) and delivering it to another point (where it is stopped or retarded). While it is in motion, it is said to contain this energy as energy of motion or **kinetic energy.**

For those who may be interested, the mathematical relationship for kinetic energy is equal to the force in pounds which created it, multiplied by the distance through which it was supplied; or, kinetic energy in foot pounds is equal to the weight of the moving object in pounds, multiplied by the square of its velocity in feet per second, divided by 64.3.

FACTORS IN FLOWING LIQUIDS:

All five of the factors which control the actions of liquids can be expressed either as forces or in terms of alternative or equivalent pressure or in heads. In each situation, however, the different factors are commonly referred to in the same terms (or units), since on this common basis it is possible to add to and subtract from them and also study their relationship to each other.

Some terms in general use should be explained.

• **Gravity head -** when it is of sufficient importance to be considered, is sometimes known simply as head.

• **Atmospheric Pressure** - the effect of atmospheric pressure is frequently, and improperly, referred to as suction.

• **Velocity Head** - inertia effect, because it is always directly related to velocity, is usually called velocity head.

• **Friction Head** - friction is usually referred to as friction head because it represents a loss of pressure or head.

STATIC AND DYNAMIC FACTORS:

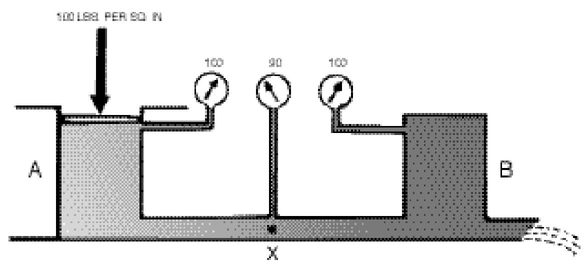
Gravity, applied forces and atmospheric pressure (static factors) apply equally to liquids at rest or in motion, while inertia and friction (dynamic factors) apply only to liquids in motion. The arithmetic sum of the first three (gravity, applied forces and atmospheric pressure) is the static pressure obtained at any one point in a liquid at a given time. Static pressure exists in addition to any dynamic factors which may also be present at the same point and time.

Pascal's Law states that a pressure set up in a liquid acts equally in all directions and at right angles to its containing surfaces. This covers the situation only for liquids at rest, or practically at rest. It is true only for the factors making up static head. it is for this reason that most problems involving fluids at rest disregard friction completely.

When velocity becomes a factor, it must obviously have a direction; and, as already explained, the force related to the velocity must also have a direction. So, Pascal's Law alone does not apply to the dynamic factors of liquid flow.

RELATION BETWEEN STATIC AND DYNAMIC FACTORS:

In one sense, however, the dynamic factors of inertia and friction are related to static factors. Velocity head and friction head are obtained at the expense of static head. On the other hand, at least a portion of velocity head can always be reconverted to static head. Force, which can be produced by pressure or head when we are dealing with liquids, is necessary to start a body moving if it is at rest, and is always present in some form when the motion of the body is arrested. In other words, whenever a liquid is given velocity, some part of its original static head is used to impart this velocity, which then exists as velocity head.

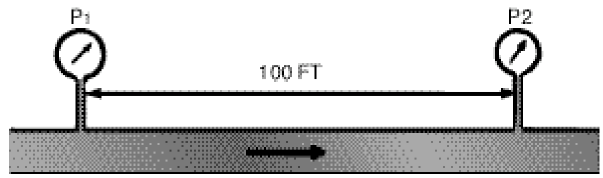


The relationship of static and dynamic factors can be illustrated in a system which consists of chamber A (under pressure), connected by a tube to chamber B which is also under pressure. The pressure in chamber A will be a wholly static pressure of, say, 100 pounds per square inch. The pressure at some point, X, along the connecting tube will consist of a velocity pressure of, say, 10 pounds per square inch exerted in a direction parallel to the line flow, plus the unused static pressure of 90 pounds per square inch which still obeys Pascal's Law and operates equally in all directions. As the liquid enters chamber B, it is slowed down. In so doing, its velocity head is changed back into pressure head. In other words, force is required to get the liquid moving in the first place so that the static pressure in chamber B will again be equal to that in chamber A, although it was lower at an intermediate point.

This example disregards friction and does not represent actual practice. Friction also requires force or head to overcome it; but, contrary to the inertia affect, this force cannot be recovered again, although the energy represented still exists somewhere as heat. In an actual system, therefore, the pressure in chamber B would be less than that in chamber A by the amount of pressure used in overcoming friction along the way.

BERNOULLI'S THEOREM: At all points in a system, therefore, the static pressure will always be the original static pressure less any velocity head at the point in question, and less the friction head consumed in reaching that point. Since both velocity head and friction head represent energy which comes from the original static head; and, since energy cannot be destroyed, the sum of the static head, velocity head and friction head at any point in a system must add up to the original static head. This general truth is known as Bernoulli's Theorem and is another important basic law of hydraulics. it governs the relationship between static and dynamic factors, while Pascal's Law states the manner in which the static factors behave when taken by themselves.

FLOW THROUGH PIPE:
Flow requires energy and the energy used is reflected in loss of static head. For example, if ordinary Bourdon tube-type pressure gauges were installed in a pipe at 100 foot intervals and flow was occurring through the pipe, the gauge downstream would show a lower pressure than the upstream gauge. The amount of pressure would depend of the velocity of the flow.



The loss of static head or the pressure different (P) in psi between P1 and P2 can be expressed mathematically as:

$$\Delta P = \frac{p\, fLV^2}{144\ D2g}$$

where:

ΔP = Pressure Differential (in psi)

p (Rho) = weight (density) of the fluid in pounds per cubic feet

f = friction factor (determined experimentally)

L = length of pipe in feet through which flow occurs

V = velocity of flow in feet per second

D = inside diameter of pipe in feet

g = acceleration due to gravity (32.2)

The above equation is a form of the Darcy formula which is generally used for determining pressure loss.

6 — 1

SECTION VII

FLOW THROUGH VALVES: The preceding has been devoted to the flow of fluids, in general, in order to explain the causes and results of the flow of fluids. When a fluid is flowing steadily through a long straight pipe of uniform diameter, the flow pattern of the velocity-head distribution across the pipe diameter will assume a certain characteristic form. Any impediment in the pipe which changes the direction of the whole stream, or even part of it, will alter the characteristic flow pattern which will create turbulence and cause an energy loss greater than that normally accompanying flow in a straight pipe. Because valves and fittings in a pipeline disturb the blow pattern, they produce an additional pressure drop.

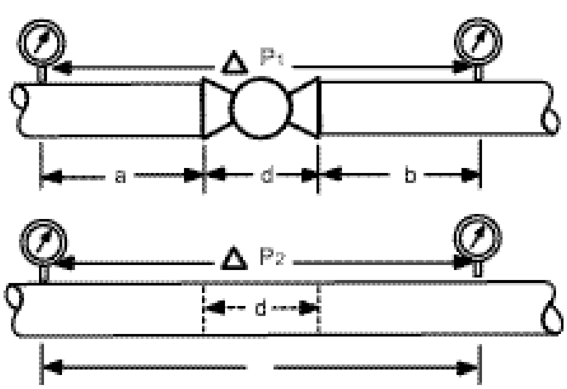
The loss of pressure produced by a valve consists of the following:

• The pressure drop within the valve itself.

• The pressure drop in the upstream piping in excess of that which would normally occur if there were no valve in the line. This effect is small.

• The pressure drop in the downstream piping in excess of that which would normally occur if there were no valve in the line. This effect may be comparatively large.

From an experimental point of view, it is difficult to measure the three items separately. However, their combined effect is the desired quantity and can be accurately measure by well-known methods.



The illustration shows two sections of pipeline of the same diameter and length. The upper section contains a globe valve. If the pressure drops ΔP1 and ΔP2 were measured between the points indicated, it would be found that ΔP1 is greater than ΔP2.

Many experiments have shown that pressure loss due to valves is proportional to a constant power of the velocity. For all practical purposes, it can be assumed that pressure (or head) loss due to the flow of fluids in the turbulent range varies as to the square of the velocity (V2).

When the pressure loss caused by a valve has been determined experimentally at several rates of flow, the losses can be plotted, and losses at all flow rates can then be predicted. The plot is usually illustrated on logarithmic coordinates and the curve is, therefore, a straight line.

Pressure loss through valves is normally given for a wide-open valve. Not all valves are wide open during flow. The pressure (head) loss caused by valves can be expressed in several different terms, each having its specific value to engineers in their work. These terms are:

• Differential pressure in psi (ΔP)

• Equivalent length in pipe diameters L/D

• Resistance coefficient K

• Flow coefficient C_v

DIFFERENTIAL PRESSURE ΔP:
Directly expresses (in pounds per square inch) the loss in static head caused by the valve (valve inlet pressure minus outlet pressure) at the specified rate of flow.

EQUIVALENT LENGTH IN PIPE:
The L/D factor is the equivalent length, in pipe diameters, of a straight pipe which will cause the same pressure loss as a valve (wide open) at the same flow rate.

Generally, the L/D factor is converted to length of pipe (of equivalent sizes in feet). EXAMPLE: Let us assume that a 6-inch valve flowing 600 gpm of water has a pressure loss of 2.02 psi (determined experimentally). From pressure loss tables, we find that the pressure loss at 600 gpm through 100 feet of 6-inch schedule 40 pipe is 2.34 feet of head or (2.34 x 0.433 x 1.0) 1.01 psi or 0.0101 psi per foot of pipe. Therefore the number of feet 6-inch schedule 40 pipe that would cause the same loss as the valve at 600 gpm would be the valve loss (2.02) divided by the loss per foot of pipe (0.0101) or 200 feet of pipe.

RESISTANCE COEFFICIENT:
Since velocity in a pipe is obtained at the expense of static head and the loss of head through a valve is also at the expense of static head, this reduction of static head can be expressed in terms of velocity heads. Most head-loss charts on pipe also give the velocity head loss at various flow rates.

EXAMPLE:
If a flow of 100 gpm through a pipe causes a loss in static head of 1 psi due to velocity head loss and a valve of the same size as the pipe causes a loss of 8 psi in static head at 100 gpm flow, it can be stated that the valve has a resistance coefficient K of 8. Thus, if at another flow rate through the pipe the velocity head loss was 1.2 psi, the loss through the valve at that flow rate would be 8 x 1.2 or 9.6 psi.

FLOW COEFFICIENT C_v:
It is often convenient to express the flow characteristics of a valve in terms of the number of gpm of water that will flow through the valve with a pressure loss across the valve of 1 psi. EXAMPLE: If a wide-open valve will flow 80 gpm at a pressure loss of 1 psi across the valve, the valve has a Cv factor of 80. With the Cv factor known, we can calculate: 1) ΔP (pressure differential of pressure loss) at any flow rate; or 2) the flow rate in gpm at any pressure loss. This can be expressed mathematically as:

$$C_v = \frac{Q}{\sqrt{\Delta P}}$$

Where: Q = rate of flow in gpm

P = pressure differential in psi

C_v = flow coefficient

Pressure loss charts on CLA-VAL valves are determined from laboratory test data and are for the flow of water. Problems involving other liquids should be referred to CLA-VAL

HYDRAULIC GRADIENT
(OR HYDRAULIC GRADE LINE): If open-water columns were installed at intervals along a pipeline in which water is flowing, the water in these columns would rise to a height equal to the pressure head at each point. The imaginary line connecting the points to which the water would rise in these columns is called the hydraulic grade line or hydraulic gradient.

WATER HAMMER: This is the series of shocks, like hammer blows, produced by suddenly checking or stopping the flow of fluid (usually water) in a pipe. If a valve, turbine gate or faucet is suddenly closed, the kinetic energy of the arrested column of water is expended in compressing the water and in stretching the pipe walls if no relief devices have been provided. Starting at the suddenly closed valve, a wave of increased pressure is transmitted back through the pipe with constant velocity and intensity. The shock pressure is not concentrated at the valve; but if a bursting pressure is produced, it may show its effects near the valve simply because it acts there first.

The velocity of the pressure wave for an ordinary cast-iron pipe, 2 to 6-inches in diameter, is about 4200 feet per second; and for a 24-inch pipe, it is about 3300 feet per second. It depends on the elasticity of the metal and upon the ratio of its thickness to the diameter of the pipe. If the pipe were perfectly rigid, the velocity would be that of sound through water of about 4700 feet per second.

The increase of pressure is proportional to the destroyed velocity of flow and to the speed of propagation of the pressure wave. This increase is about 60 pounds per square inch for each foot per second of extinguished velocity for 2 to 6-inch pipes, and about 45 pounds per square inch for each foot per second for 24-inch cast-iron pipe. These increase of pressure will be attained only in case the valve is closed in less time than one round trip of the pressure wave.

When the pressure wave has traveled upstream to the end of the pipe where there is a reservoir or a larger main (the whole pipe then being under increased pressure with checked flow throughout), the elasticity of the compressed water and that of the distended pipe reverse the flow at that tend of the pipe and a wave of normal pressure (that of the reservoir or main) travels downstream, the flow being progressively reversed as the compressed water expands.

When this wave of normal pressure reaches the valve, the kinetic energy of the column of water with reversed flow tends to create a vacuum at the valve. There the reversed flow is checked and the checking proceeds progressively upstream accompanied by a wave of subnormal pressure. When this wave reaches the upstream end (the whole pipe then being under subnormal pressure), the greater normal pressure in the reservoir or large main starts flow into the pipe; and a wave of normal pressure and forward flow travels downstream. When this wave reaches the valve, there is forward flow throughout the pipe (the conditions being the same as when the valve was suddenly closed) and a wave of increased pressure and of checked flow again starts upstream.

A complete cycle of pressure waves and reversal of flow occupies the time required for two round trips. The amplitude of the pressure vibrations becomes less with succeeding cycles because of friction, but the time interval remains constant.

If a high-pressure wave in its travel through the pipe enters a branch pipe with a closed of dead end, there will be almost a doubling in the increase of pressure when the wave strikes the closed end. In some pipe systems, dangerous water-hammer pressures are built up if the back wave from a branch pipe with a dead end has access to another branch, the high pressure may receive further augmentation.

As the intensity of the excess pressure in the water-hammer wave is dependent upon the amount of extinguished velocity, the same excess pressure can be produced by suddenly reducing the velocity from 7 to 4 feet per second the same as by entirely stopping a velocity of 3 feet per second. If the flow is not checked rapidly so that the wave from the first movement of the valve has time to travel upstream to the end and back again several times while the checking is in progress, the excess pressure is very much reduced. Hence, the wisdom of using slow-closing valves on long pipe lines is derived.

SURGE: Much work has been done concerning the study of water-hammer surge pressures created by quick-closing valves; however, very little has been published on water-hammer surge pressure caused when pumps stop under power-failure conditions. It is generally acknowledge that an analysis of just what happens hydraulically is quite difficult, and very little experimental data is available to determine what will happen under various conditions. it can be assumed that the surge wave will be similar to the surge wave created by a quick-closing valve. The surge pressure would, however, be started in a different manner than when the surge pressure is caused by a quick closure of the valve. When a pump stops, the fluid continues to flow upstream with diminishing velocity until the energy provided by the pump is expended. The extent of the low-pressure wave thus created is very difficult to predict. It can become a minor subnormal pressure, or the pressure can go to below atmospheric and might cause the water column in the conduit to actually separate. The magnitude of a low-pressure wave will depend upon the initial flow velocity, the length of transmission line (to the first abrupt change), the hydraulic gradient of the transmission line, the abruptness with which the pump will stop and also the inlet pressure conditions at the pump.

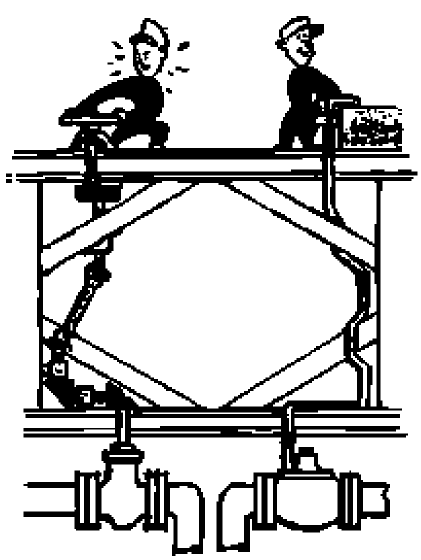
The extent of the subnormal pressure created and the distance that the flow moves away from the pump will determine the velocity of the return flow. The velocity of the return flow when it reaches the closed check valve will generate a surge pressure wave in a similar manner to that of a quick closure of a valve.

Power-failure pump stops, or a pump stop without pump control valves, can cause damaging surge pressure waves to be generated in the intake of a booster pump when the supply line to the pump is relatively long and velocities are fairly high. These surge pressure are generated in the same manner as by a quick-closing valve. Should the high-pressure surge in the inlet line and the high-pressure surge in the discharge line meet at the pump, considerable stress will be imposed upon the pump and serious damage could result.

SURGE CONTROL: Several means of protection from, and elimination of, the surge pressures due to an electrical power outage and pump stopping are available through the use of proper surge relief valves. Inlet or suction line surges can be prevented by the use of quick-opening, slow-closing relief valves such as the CLA-VAL 50-Series Relief Valve installed at the pump and discharging to atmosphere.

Discharge line surges being generated by the sudden stopping of return flow can be successfully eliminated by installing (downstream of the check valve) a surge control valve discharging to atmosphere. This valve begins opening upon power failure and subsequent low-pressure conditions, so that it is open when the returning flow reaches the check valve and then slowly closes and gradually stops the surge reverse flow. The CLA-VAL 52-03 surge-anticipator control valve offers this type of operation and will successfully prevent surge pressure by eliminating the cause.

Contact Your Cla-Val Factory Representative For More Information



- Factory- Newport Beach ,Ca.
1-800-942-6326
- Western Region- Riverside,Ca.
1-800-247-9090
- Southern Region-Houston, Tx.-
1-800-336-7171
- Northern Region-Elgin,Il.-
1-800-238-7070
- Eastern Region-Alexandria,Va.-
1-800-451-3030

Section
6-2 Simple Conversion Formulas

MULTIPLY	BY	TO OBTAIN
Atmosphere	14.5	PSI (G)
Atmosphere	1.0133	Bar
Bar	14.5	PSI (G)
Centimeters	.03281	Feet
Cubic centimeters	.06102	Cubic inches
Cubic centimeters	.0002642	Gallons (liquid)
Cubic feet	7.4805	Gallons (liquid)
Cubic feet	.1728	Cubic inches
Cubic feet / sec (CFS)	448.831	GPM
Cubic feet / sec (CFS)	.646317	Millions gallons / day
Cubic feet / min.	.4720	Liters / sec.
Cubic feet / min.	28317	Cubic meters / min.
Cubic inches	.004329	Gallons
Cubic inches	16.387	Cubic cm.
Cubic inches	.0005787	Cubic feet
Cubic meters	264.17	Gallons (liquid)
Cubic meters	35.31	Cubic feet
Cubic meters / min.	.00026	GPM
Feet	30.48006	Centimeters
Feet	.3048006	Meters
Feet of water	.4335	PSI (G)
Feet of water	.8826	Inches of Mercury
Feet / sec	.305	Meters per sec.
Gallons	3,785.43	Cubic Centimeters
Gallons	231	Cubic inches
Gallons	.83268	Gallons (Imperial)
Gallons	.13368	Cubic feet
Gallons	8.345	Lbs of water
Gallons	.003785	Cubic meter
Gallons / min. (GPM)	2228	Cubic Ft / sec.
Gallons / min. (GPM)	.0000630902	Cubic meter / sec.
Gallons / min. (GPM)	3.785	Liters / min.
Gallons / min. (GPM)	.06308	Liters / sec.
Inches	25.40	Millimeters (mm)
Inches of Mercury	1.133	Feet of water
Kilograms / sq. cm.	14.2233	PSI (G)
Liters	.264178	Gallons
Liters / min.	.0005886	Cubic Ft / sec.
Meters	3.2808	Feet
Pounds / sq. in. (psi)	2.036	Inches of Mercury
Pounds / sq. in. (psi)	2.31	Feet of water
Pounds / sq. in. (psi)	6895	Pascal (Pa)
Pounds / sq. in. (psi)	.0689	Bar
Square inches	6.4516	Square cm.

NOTE: 1 cubic foot = .028317 cubic meter
NOTE: 1 Atmosphere (U.S.) = 14.7 psi = 1.033 bar = 1.033 kgs / Sq. cm.

CONTROL VALVE CAVITATION CAUSES & PREVENTION

By Harold W. Ensign, Vice President Engineering
Cla-Val Newport Beach, California

PREFACE

This paper is intended to serve as a reference on cavitation in valves, its causes, and effects and how to use the Cla-Val Cavitation Program. The cavitation program is a guide to determining if there is damage cavitation in the Hytrol main valve, at what flow rate it occurs and how to minimize or eliminate the damage caused by cavitation.

Studies to determine the flow characteristics, incipient, critical and incipient damage cavitation have been performed on the Cla-Val 100-01 and 100-20 series valves at the Utah Water Research Laboratory, Utah State University Foundation. These tests were divided into four basic parts: 1) development of techniques for detecting cavitation damage on the interior surfaces of the valve body, 2) evaluating the location where damage first occurs at various valve openings, 3) evaluating the magnitude of the cavitation index corresponding to incipient cavitation damage, and 4) a study of the influence of pressure on the onset of cavitation damage. The studies were conducted under the direction of Dr. J. Paul Tullis, Professor of Civil and Environmental Engineering at Utah State University.

CAVITATION

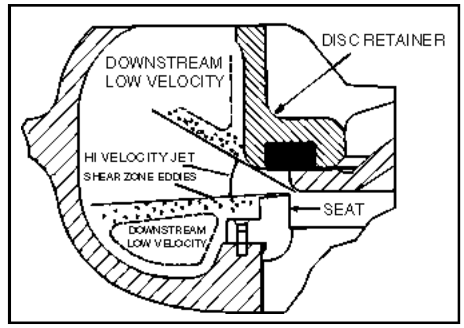
Cavitation prevention and protection is an important consideration in the design and operation of valves used in water distribution systems. One should be able to determine if cavitation exists, and if so its intensity and effects on the system. Cavitation in valves is a destructive condition that seriously affects the operation and service of the valve and occurs when fluid passing through the valve lowers to the vapor pressure of the fluid causing vapor cavities (bubbles) to form. When the fluid passes out of the low pressure area into a higher pressure area, the vapor cavity becomes unstable and collapses. This collapse is what can sometimes be heard or seen and is the reason we must be concerned about its presence in pipeline systems. The collapse can be violent and is accompanied by noise, vibrations, and possible erosion damage to the valve or surrounding pipeline.

ORIGIN OF CAVITATION

There are three fundamental requirements for cavitation to occur. First, there must be gas bubbles (nuclei) or voids in the fluid that serves as a basis for vaporization to occur. Second, the internal pressure in the fluid must drop to or below vapor pressure. Third, the pressure surrounding the vapor bubble must be greater than the vapor pressure in order for it to collapse. For cavitation to occur, there must be nuclei present. If the water was completely deaerated and there were no contaminant's, voids or entrapped air, either in the water or in the boundary of the valve, the water could sustain tension and would not cavitate when the pressure dropped to the normal vapor pressure. Therefore, nuclei is one of the primary requirements for cavitation to occur. The primary sources of nuclei are from free air bubbles and air bubbles trapped in crevasses of suspended material and crevasses in the valve body material (boundary).

SOURCES OF LOW PRESSURE

The mean pressure at the inlet to a valve is equal to the static head or pump pressure, minus the dynamic head. The local pressure in a valve is the sum of the mean pressure, which is uniform over a certain flow range and the dynamic pressure which depends on fluid motion which causes friction losses and local accelerations due to changes in the cross sectional flow area and on the formation and dissipation of eddies and vortices in turbulent shear zones. Flow at the inlet to a valve for example, has a relatively low velocity and high pressure. As the flow approaches the partially open valve, the velocity has to increase in order to maintain the same flow rate and this causes the pressure to drop. When the high velocity jet



enters the larger downstream area of the valve, a shear layer is created along the boundary of the high velocity jet and the lower velocity in the larger downstream area. The high velocity gradients created along this shear area creates eddies is considerably less than the already lower pressure of the high velocity jet. If nuclei is entrapped inside these eddies and the pressure drops to vapor pressure, it will begin to grow. If the pressure remains at vapor pressure long enough for the nuclei to reach a critical diameter, it then begins to grow rapidly vaporization. As the size of the vapor pressure cavity increases, the strength of the eddy is rapidly destroyed, the rotational speed reduces, and the pressure is no longer vapor pressure.

Since surrounding pressure is above vapor pressure, the cavity becomes unstable and collapses inward. The time that a nucleus is subjected to low pressure inside the eddy is important. If the time is so short the bubble cannot reach its critical diameter, it will not become cavitation event.

PRESSURE RECOVERY

In the third phase of cavitation there must be a pressure in the cavitation zone greater than vapor pressure in order for the cavity to collapse. If the bubble collapses before reaching the boundary areas there will be no cavitation damage, only noise, vibrations and possible reduction of flow.

DAMAGE

If the vapor cavities are carried to the solid boundary of the valve before they collapse, erosion damage will occur. Prior research has indicated that the collapse must occur approximately one bubble diameter from the boundary in order to cause erosion damage. Since the bubbles are generally small, this indicates that only collapses near or on the surface of the boundary will cause erosion damage. High pressure shock waves are generated by the collapse of the vapor cavities and in severe cases have been estimated to be over 1,000,000 psi. No material can withstand this type of beating very long. Once a system reaches a point where erosion damage occurs, damage increases very rapidly as the velocity of the system is increased. Because of this it is important that when selecting conditions corresponding to the onset of erosion or cavitation damage, one should be conservative because a slight increase in velocity could cause a large increase in the damage rate.

EFFECTS OF CAVITATION

There are five basic problems associated with cavitation: noise, vibrations, pressure fluctuations, erosion damage and loss of flow capacity. The type and intensity of noise in a valve usually depends on the size of the valve. Cavitation in a small valve is usually identified as a hissing or a light crackling sound. In large valves, the noise may sound more like small explosions and can vary with the design of the valve. The shock waves generated by the collapsing vapor cavities can produce pressure fluctuations and system vibration. As the intensity of the cavitation increases, the magnitude of the vibration increases many times over and can cause serious damage to mounting bolts, pipe fitting and structural failure. If the vapor cavities collapse close to a boundary inside the valve, erosion damage can occur. In many cases cavitation damage has eroded holes through the side of valve bodies and in some cases has eroded holes in the bridgewall and valve seat areas. This is one of the most common types of failure.

During advanced stages of cavitation, large vapor cavities form, which can alter the flow characteristics of the valve and drastically reduce the efficiency. This is referred to as Choking cavitation and represents the condition at which the flow coefficient (Cv) is drastically reduced because of the large vapor cavities. Just prior to choking cavitation, erosion damage, noise and vibration are at their maximum, then will start to drop off rapidly. Once the valve fully chokes, the vapor cavity will extend out beyond the discharge of the valve and into the downstream piping where the collapsing vapor cavities can cause major damage to the downstream piping and fittings.

DESIGN PARAMETERS

If we understand cavitation, its causes and effects, we can probably think of several ways to prevent damage to the valve. One easy method would be to limit operation of the system to a level that would not produce enough energy to carry the vapor cavity to the boundary of the valve and there would be no cavitation damage. Another method would be to change the internal geometry of the valve to remove the boundary out of the immediate damage cavitation zone. We made use of the data obtained from 25 years of studying cavitation and associated problems. We changed the internal geometry of the valve and by doing this we are able to increase the operating differentials of the valve tremendously without causing cavitation damage.

DETERMINING CAVITATION LIMITS

There is no analytical solution for determining the cavitation characteristics of a valve. Every valve design has its own "footprint" so to speak and for this reason the only way to properly evaluate the cavitation parameters is by laboratory experimentation. Once these parameters are obtained for a specific valve geometry then it is possible to develop empirical relationships for predicting the various levels of cavitation. If the internal geometry is changed then new experimental data must be obtained to develop new empirical relationships. For this reason the empirical data developed for one company's products cannot be transferred to another manufacturer's products.

Most any laboratory instrument that can detect noise, pressure fluctuations, vibrations, pitting or loss of efficiency can be used to detect cavitation. An important factor in determining the cavitation parameters is to do the experimentation in a laboratory that is relatively free from other noises such as pumps, control valves and vibrations that could effect the data obtained. Probably the most common instrument used to detect cavitation is the accelerometer because it is easy to use and is sensitive to the lightest and heaviest levels of cavitation. To obtain the flow conditions for incipient damage, polished soft aluminum plates were installed flush with the inside surfaces of the valve, in the proper locations to record the pitting.

Nearly all of the experimental data taken in the laboratory is taken at reduced pressures and flows from actual applications and for this reason just scaling the experimental data up to actual conditions in the field will not give true cavitation data. Therefore pressure scale effects for a given valve geometry have to be determined in the laboratory.

CLA-VAL CAVITATION STUDIES

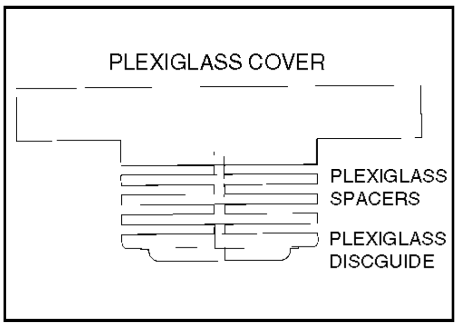
In the summer of 1970, Dr. J. Paul Tullis, Assistant Professor of Civil Engineering at Colorado State University, in Fort Collins, Colorado, sponsored a seminar on "Control of Flow in Closed Conduits". There were several well known authors who presented papers at this seminar on subjects ranging from flow in closed conduits to determining when cavitation will occur. After attending this program it became obvious that to assist in making the right valve selection for critical applications, Cla-Val should embark on a program to have the Hytrol main valves tested for the onset of cavitation. The tests were started at Colorado State University and later transferred to Utah State University when Dr. Tullis transferred to Utah State and became Professor of Civil and Environmental Engineering. When the tests were completed on various selected sizes, we had a world of information for the onset of cavitation (Critical Cavitation). With the data obtained from these tests we were able to develop a computer program to aid in selecting valves to operate in what we hoped would be a cavitation free condition. Unfortunately we soon found that in nearly all applications there was some degree of cavitation and we did not know to what degree of cavitation the valve could operate without damage. As a result, the program was of little value as far as determining the maximum safe operating conditions with regard to cavitation damage.

CAVITATION DAMAGE STUDIES

At Cla-Val we felt that if we knew the conditions at which cavitation damage started we would be able to develop a program that would allow us to determine the maximum operating limits without incurring cavitation damage. It was decided to have Dr. Tullis conduct further testing on the hytrol main valves to determine the conditions of incipient cavitation damage. Several sizes and types of valves were sent to Utah State University where Dr. Tullis and Stephen L. Barfus conducted tests to determine the flow conditions where cavitation noise first begins (Critical Cavitation), the pressure scale effects on critical cavitation, the flow conditions where cavitation damage begins, (Incipient Damage) and the flow conditions where choking cavitation begin to occur.

A dimensionless cavitation parameter sigma was used to quantify the intensity of cavitation at different flow conditions. The most common formula for determining sigma is (= (Pd - Pvg)/Pu - Pd) where Pd is the downstream pressure, Pvg is the gage vapor pressure and Pu is the valve inlet pressure. Data were collected at every 10 percent of opening to provide a valve opening versus Cv curve. The intensity of cavitation at critical level consists of steady light popping sounds. This level of cavitation does not cause erosion damage or reduce the service life of the valve and for most applications is recommended for what could be termed "cavitation free operation". The critical cavitation levels were determined by ear during these tests.

To determine the sigma value at incipient damage, it was first necessary to



determine the location inside the valve where actual cavitation was occurring. This was done by making a valve cover and valve disc from Lucite with spacers for each 10 percent of valve opening. When installed, one could actually observe where inside the valve, cavitation occurred when operated at various percentages of opening. Polished soft aluminum plugs were then inserted through the walls of the valve body and positioned flush with the inside wall in the locations where cavitation was observed. Plates were also fastened flush with the bridgewall boundary inside the valve. The internals were then re-installed in the valves and the valves operated at each 10 percent opening at various differentials and flow rates until pitting was observed on the soft aluminum plates. This was a very time consuming test because the valve had to be operated at a known condition for 10 to 20 minutes, then disassembled and the plates examined to see if there were any pits in the soft aluminum plates. If there were no pits the valve was reassembled and the process repeated at a lower sigma value until the proper number of pits were obtained. Incipient damage for these tests was taken as one pit per square inch per minute on the soft aluminum plates. This procedure was then repeated at each 10 percent of valve opening.

At the conclusion of the cavitation damage studies, the cavitation program was modified to include the condition of incipient damage and we found that some body designs would tolerate a much higher degree of cavitation than others before the onset of cavitation damage.

Over the years different series of valves have been developed and much of the information obtained from the cavitation studies is incorporated in the design. When designing a valve with a reduced seat diameter to eliminate the need for reducing flanges that are required in many installations, it gave us the opportunity to design a valve that had improved cavitation characteristics. As a result, the 100-20 series of valves was developed and tested by Dr. Tullis for incipient damage. The results were far better than expected. This series of valves will operate at much greater velocities without experiencing cavitation damage. All new designs, including our new 24 inch 100-01 Hytrol, utilize our many years of experience from operation and testing.

Valves that operate intermittently such as some relief applications may be able to operate at a higher degree of cavitation. In this type of service, erosion damage may not be the deciding factor. If the system is designed to withstand the vibration and noise the valve may be able to operate at choke flows. The intensity of cavitation, noise, vibration and erosion damage is usually at their maximum just before the valve chokes and the flow may be very unstable. The cavitation program shows the occurrence of choking cavitation.

VALVE APPLICATION

When specifying a valve, the Cla-Val Cavitation Program can be used to determine the cavitation characteristics of the valve for the specific application. As in **example 1**, lets say we have a 4 inch 100-01 Hytrol, located at the end of a long pipeline flowing from 400 to 700 gpm. The long supply pipeline has a pressure loss of 50 psi at 700 gpm. The static inlet pressure is 120 psi, the outlet pressure is 20 psi and the valve is at 800 feet elevation. The cavitation program shows cavitation damage over the entire range of flow. Now that we know there will be cavitation damage, what can we do about it? One method of combating cavitation damage is to add back pressure to the valve. This is done in the cavitation program by entering a value for the back pressure, which must be greater than the normal outlet pressure. As the flow rate increases, the pressure at the outlet of the valve increases causing the valve to open further which reduces the velocity of the jet through the partially open valve and increases the outlet pressure which may raise the internal pressure above vapor pressure.

CLA-VAL NEWPORT BEACH
100-01/100-20 HYTROL
Cavitation Characteristics

Cla-Val Cavitation Analysis - EXAMPLE 1 　　　　Project -

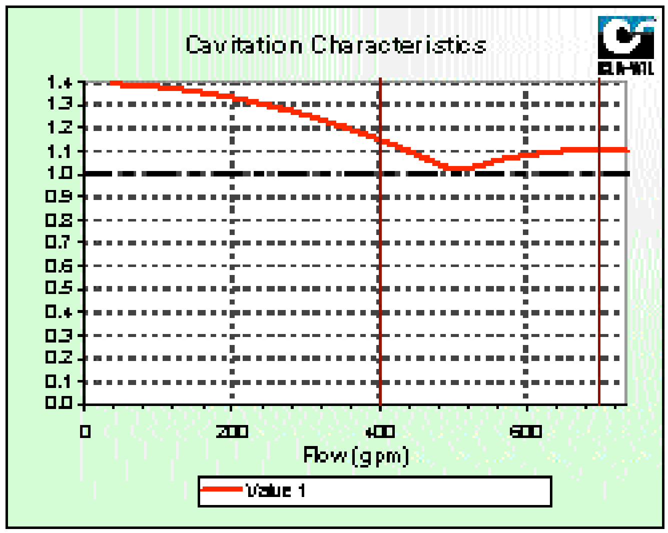
Valve 1

Valve size	4" 100-01	
Maximum flow rate	700	gpm
Minimum flow rate	400	gpm
Static inlet pressure	120	psi
Static outlet pressure	20	psi
Elevation above S.L.	800	ft
Water temperature	60	deg F
Dynam. inlet pressure	70.0	psi
Dynam outlet pressure	20.0	psi
Backpressure orifice	None	
Orifice backpressure	0	
Orifice discharge to	Downstream piping	

Valve operation

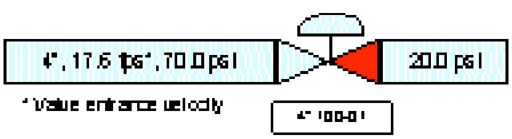
Continuous (>50%)

Avoid operation near (within 10%) cavitation damage level of 1.0.



If the lines go above 1.0 there will be cavitation damage

No damage
Caution - near damage
Damaging cavitation



* Valve entrance velocity

Valve 1 Flow Rate GPM	Inlet (psi)	Outlet (psi)	% Open	Pipe Vel. (fps)	Cav Damage
35	119.9	20.0	6.6	0.9	Yes
175	116.9	20.0	20.6	4.4	Yes
350	107.5	20.0	28.5	8.8	Yes
525	91.9	20.0	36.8	13.2	Yes
700	70.0	20.0	48.1	17.6	Yes

In **example 2**, a back pressure of 44 psi at a maximum flow was added and the cavitation damage was completely eliminated. Adding back pressure to a valve can be accomplished by adding an orifice plate downstream of the valve. In a pressure reducing valve application, the pressure regulating pilot must sense the pressure downstream of the orifice plate. If there is considerable resistance in the discharge line of the valve, then the back pressure on the valve will automatically increase as the flow increases and this must be taken into consideration when entering the data. If the discharge line is long and the valve is anything but a pressure reducing valve, then the discharge pipe Cv must be entered which will automatically raise the outlet pressure as the flow increases. This should be done before entering back pressure to eliminate damage cavitation.

Still another method of reducing cavitation damage in a valve installation is to use two or more valves in series or add KO trim to the valve. Using the cavitation program, one can determine the maximum pressure conditions for each valve that will permit them to operate free of cavitation damage.

CLA-VAL NEWPORT BEACH
100-01/100-20 HYTROL
Cavitation Characteristics

Cla-Val Cavitation Analysis - EXAMPLE 2

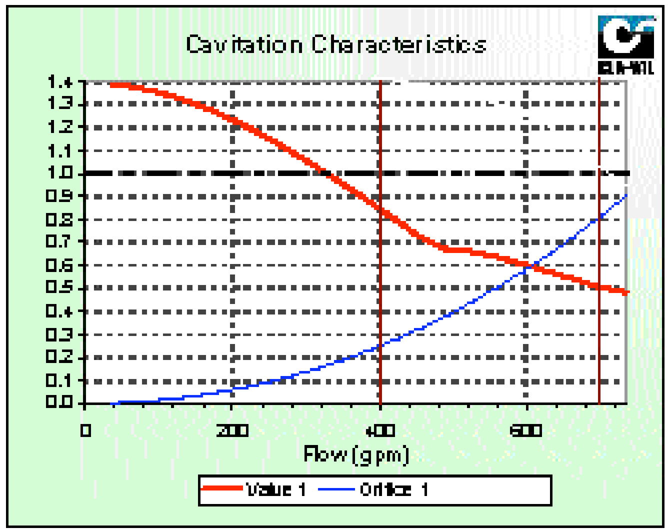
Project -

Valve 1		
Valve size	4" 100-01	
Maximum flow rate	700	gpm
Minimum flow rate	400	gpm
Static inlet pressure	120	psi
Static outlet pressure	20	psi
Elevation above S.L.	800	ft
Water temperature	60	deg F
Dynam. inlet pressure	70.0	psi
Dynam outlet pressure	20.0	psi
Backpressure orifice	Single	
Orifice backpressure	44.2	psi
Orifice discharge to	Downstream piping	

Valve operation

Continuous (>50%)

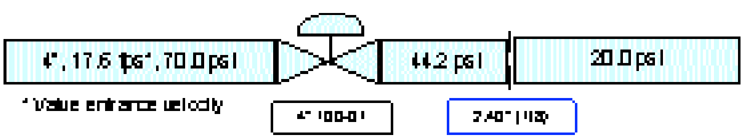
Avoid operation near (within 10 %) cavitation damage level of 1.0.



If the lines go above 1.0 there will be cavitation damage

No damage
Caution - near damage
Damaging cavitation

Valve damage occurs < 15 psi.



Valve 1 Flow Rate GPM	Inlet (psi)	Outlet (psi)	% Open	Pipe Vel. (fps)	Cav Damage
35	119.9	20.1	6.6	0.9	Yes
175	116.9	21.5	20.6	4.4	Yes
350	107.5	26.1	29.0	8.8	Near
525	91.9	33.6	38.9	13.2	No
700	70.0	44.2	59.4	17.6	No

CONCLUSION

Cla-Val has over twenty-five years of time proven experience in understanding, identifying, minimizing and eliminating cavitation damage associated with our control valves in water distribution systems. We offer free of charge, assistance in proper selection and sizing of valves to engineers, suppliers or end users in their quest for a more trouble free system. Cla-Val has the experience, the products, solution and trained technical assistance to deal with cavitation.

Data for portions of this paper was taken by permission from "Hydraulics of Pipelines" by J. Paul Tullis, Professor of Civil and Environmental Engineering at Utah State University, Logan, Utah.