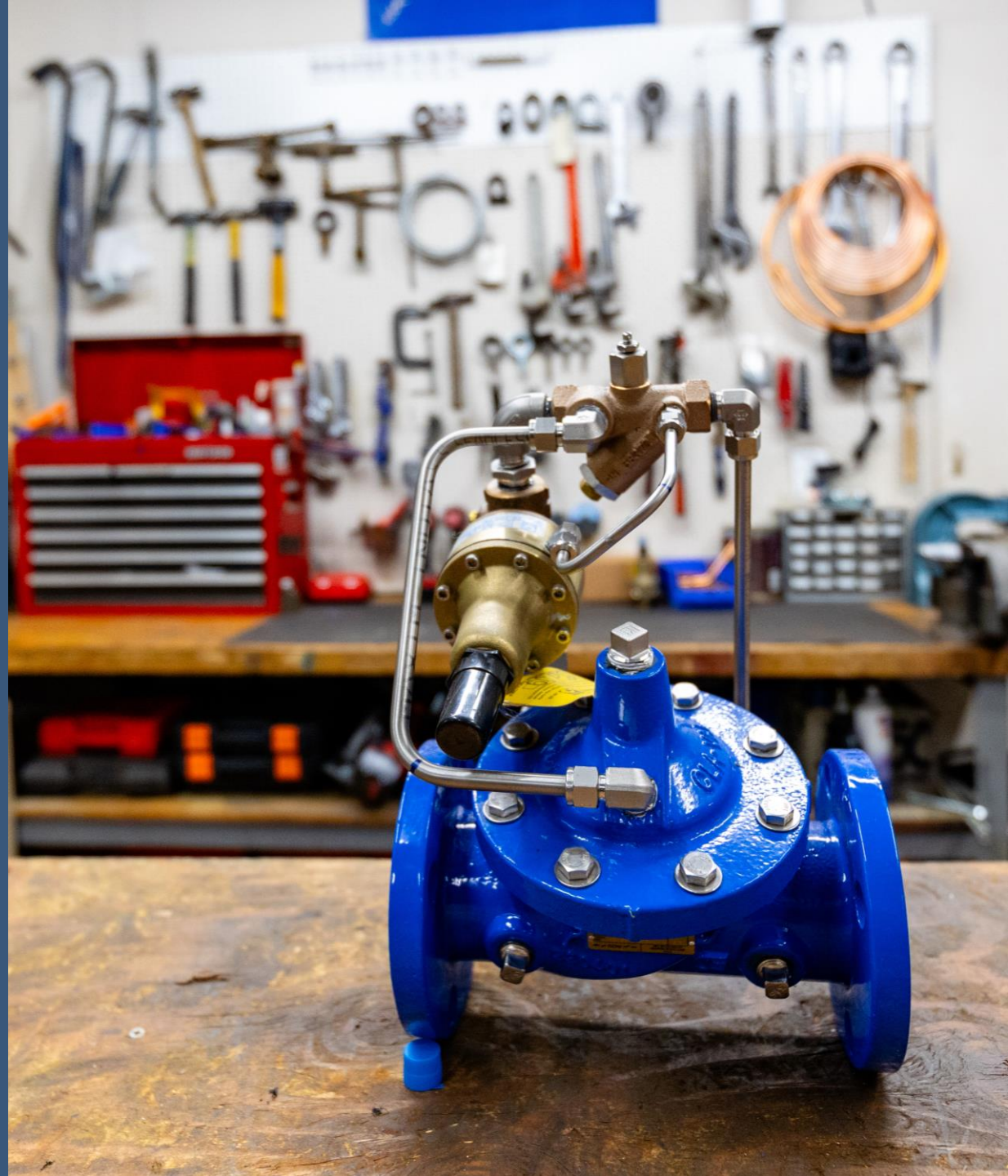
Cimco-GC SYSTEMS

Hands-On With Hydraulic Controls Valves

Part 3: Troubleshooting



Previously On Part 1:

- Why Control Valves? Hydraulics 101
- Control Valve Main Body
- Intro to Pilot Systems
- Pressure Reducing Valves
- Pressure Relief Valves
- Pressure Sustaining Valves

Previously On Part 2:

- Principle of Operations Review
- Control Valve Main Body Parts
- Control Valve Maintenance Overview
- 90-01 Parts & CRD
- 50-01 Parts & CRL

What’s on tap for this:

- Introduction to Cimco-GC Systems and Cla-Val
- Review of Basics
- Troubleshooting Principles
- Start-up/Shutdown Procedure
- Valve sizing and selection

Don’t be afraid to ask questions!

How do I…?

What is the best way to…?

What does it mean when my valve is…?

How can I improve…?

Can I go the bathroom?

How do I keep my spouse happy??

What is the meaning of life??!!

Cimco-GC SYSTEMS

Puyallup, Washington

40+ years in control valves

Technical support and service

Maintenance, troubleshooting, startups

Pressure reducing valves and stations

Cimco-GC SYSTEMS

CLA-VAL

Cimco-GC PACKAGED SYSTEMS

Copperhead INDUSTRIES

ECHOLOGICS
a MUELLER brand

Link-Seal MODULAR SEALS
Garlock RANGER II
GPT an EnPro Industries company

HYDRO-GUARD
a MUELLER brand

MAXADAPTOR ONE&DONE

SAFE-T-COVER

VAL-MATIC

Waterman
A MCWANE PLANT & INDUSTRIAL SOLUTION

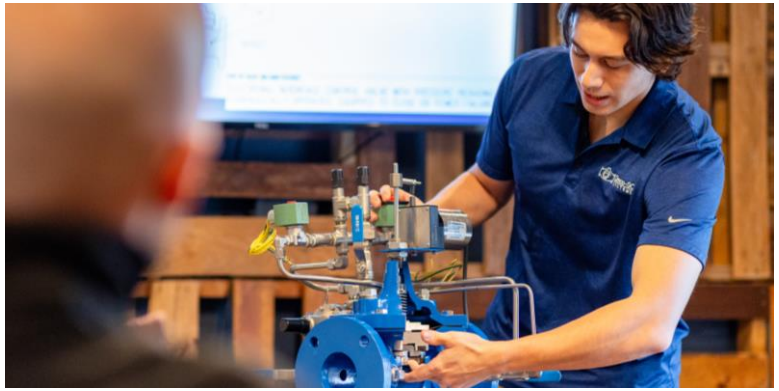
WELD-ON

How we support your region

Engineering/Design Support

Troubleshooting

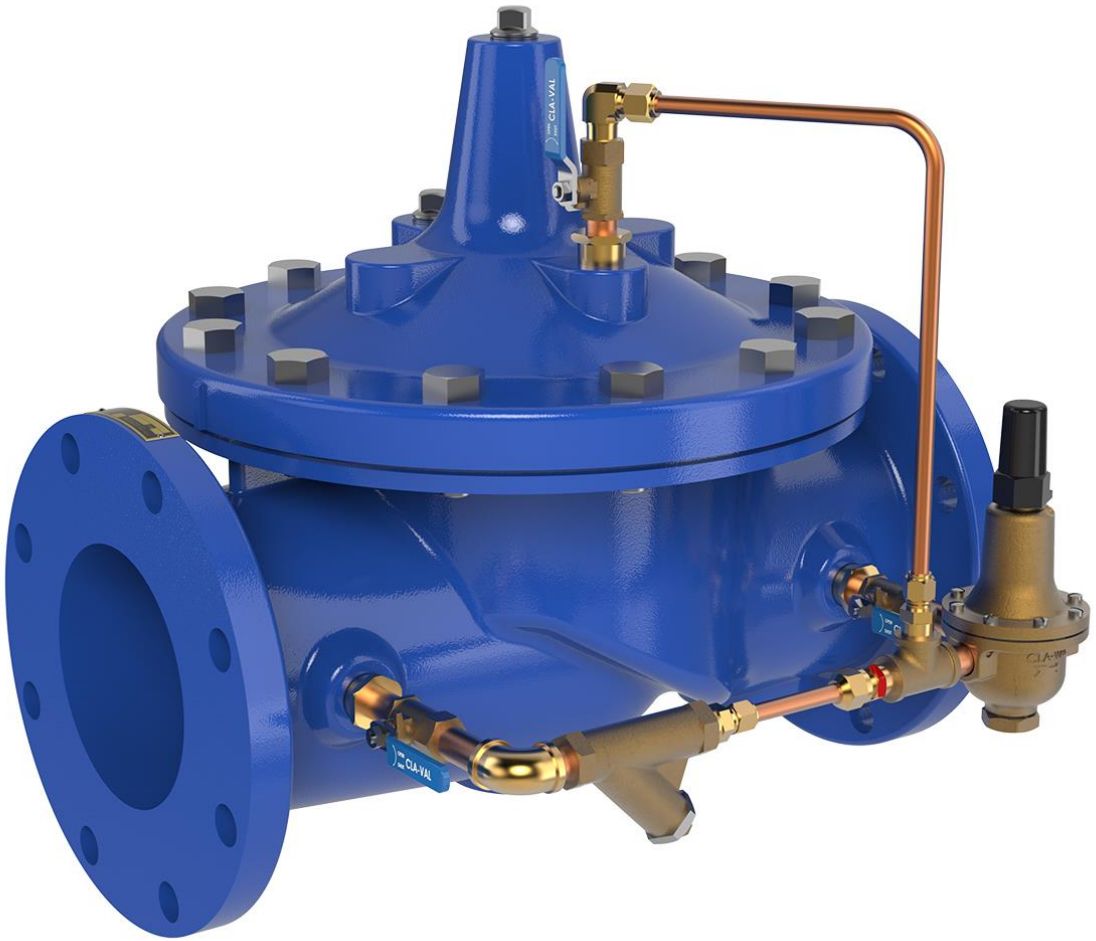
Price and availability



Outside Sales Support

Only factory-authorized Cla-Val Service Team in WA, OR, ID and AK

Inventory: parts, pilot, valve bodies through 8”



Cimco-GC SYSTEMS

Cla-Val Overview

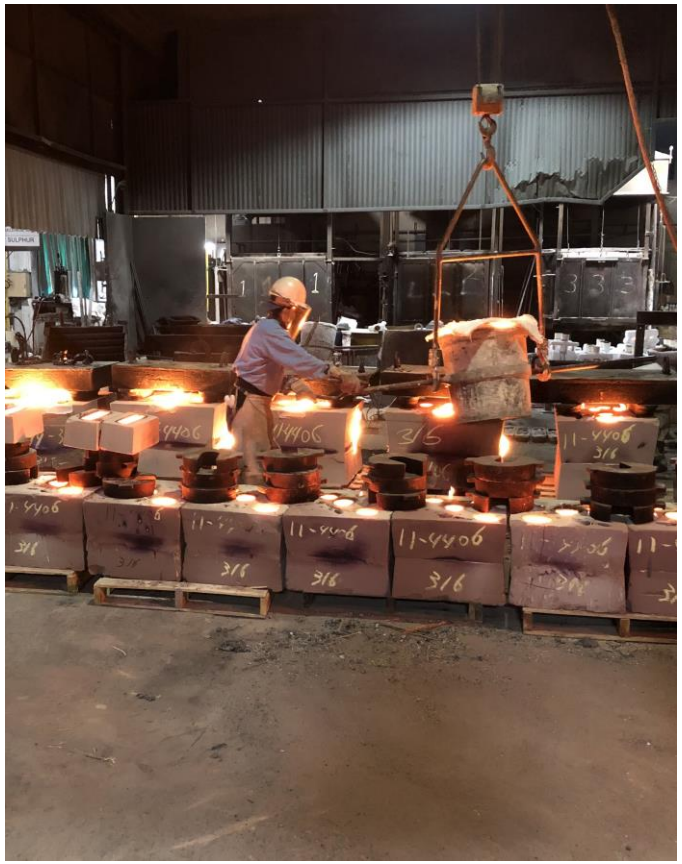
Global HQ: Costa Mesa, California

cla-val.com

Cla-Val Automatic Control Valves

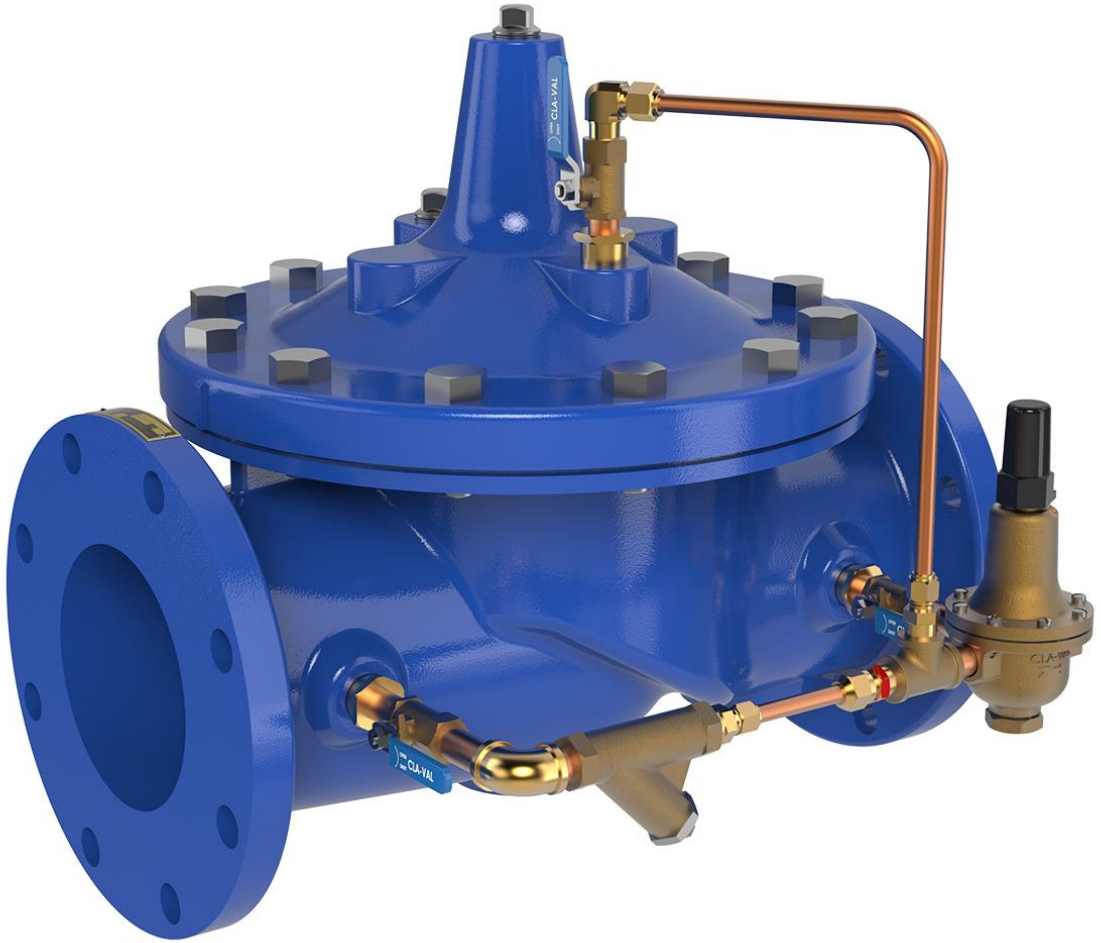
- Founded by Donald G. Griswold 1936
- Based out of Costa Mesa, CA
- Only control valve manufacturer in the US
- Only one generation of valves (no additional phases, styles, etc.)
- Preferred brand worldwide

Cla-Val Factory Tours and Training



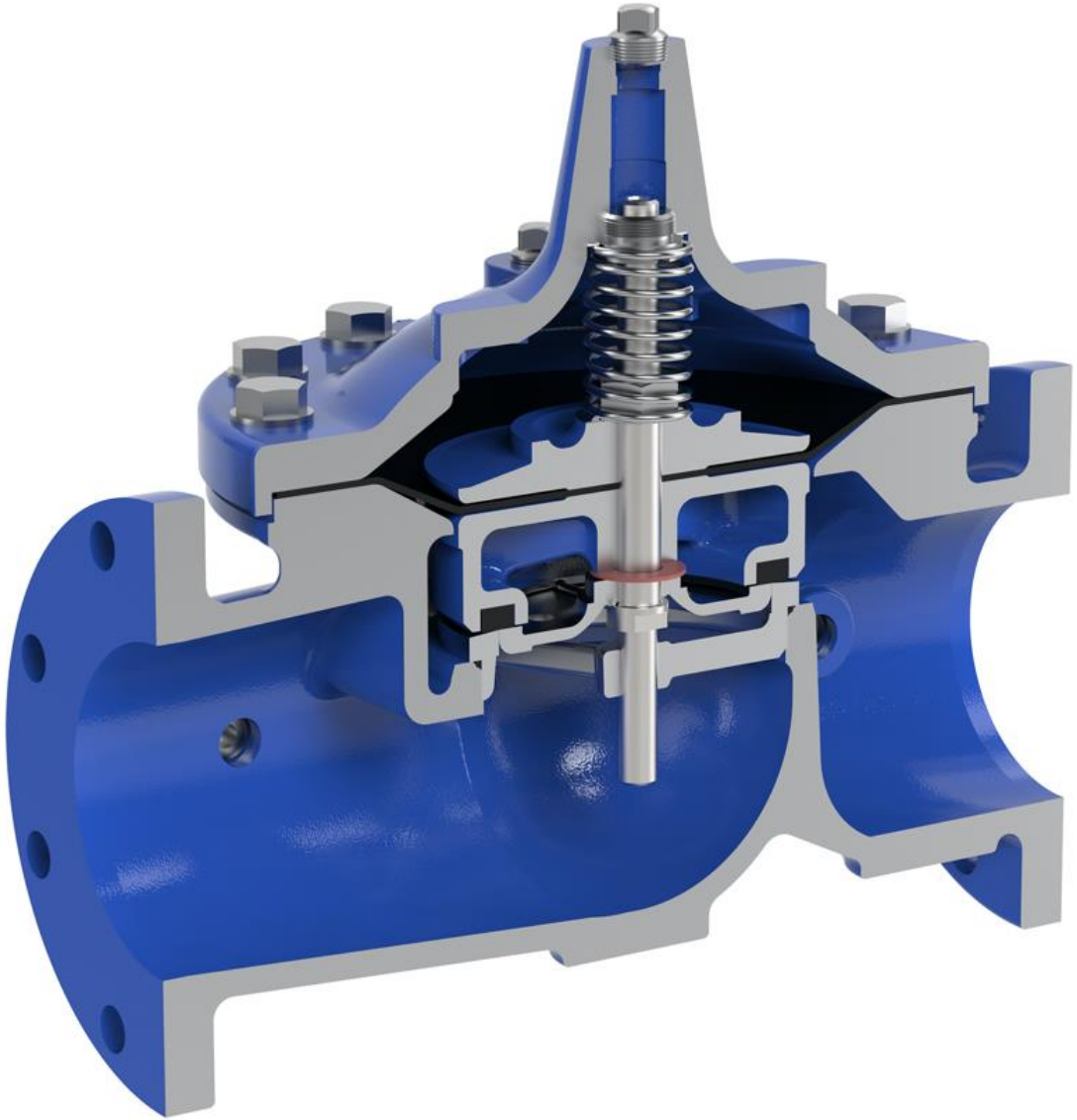
Cimco-GC SYSTEMS

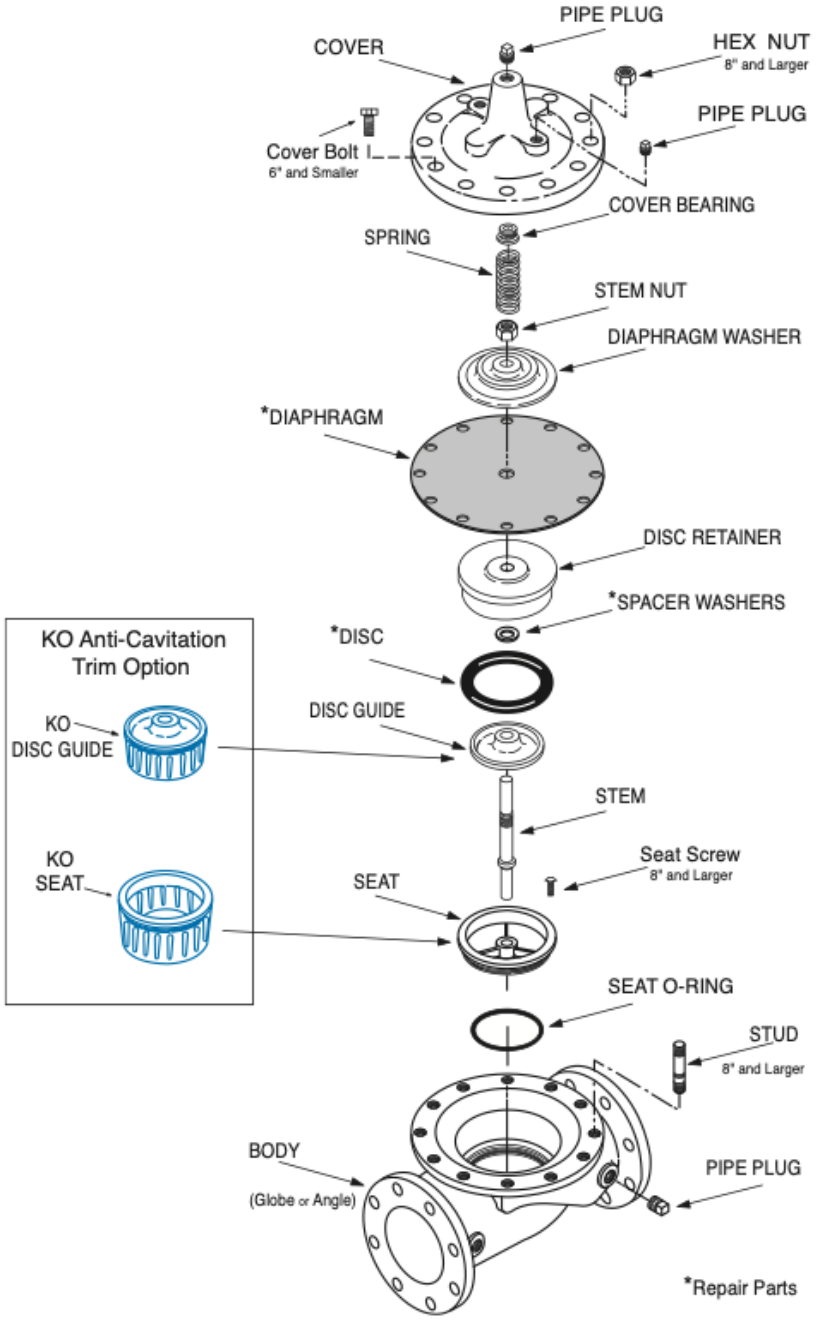
Questions?



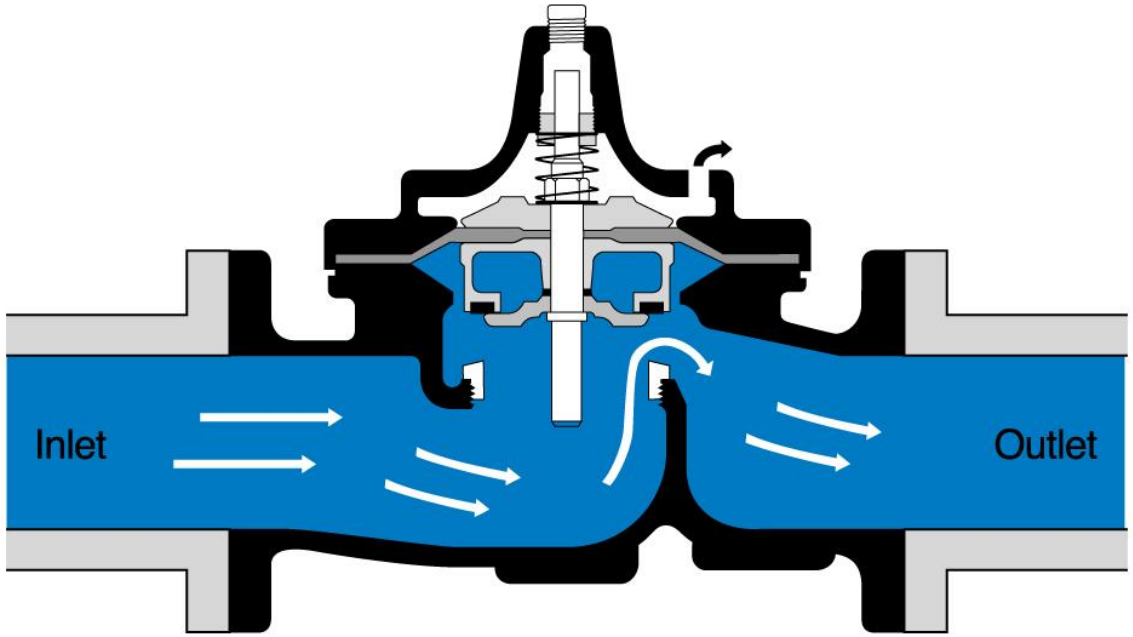
Cimco-GC SYSTEMS

Basic Principles of Control Valves




PIPE PLUG
COVER
HEX NUT
8" and Larger
PIPE PLUG
Cover Bolt
6" and Smaller
COVER BEARING
SPRING
STEM NUT
DIAPHRAGM WASHER
*DIAPHRAGM
DISC RETAINER
*SPACER WASHERS
KO Anti-Cavitation
Trim Option
*DISC
KO
DISC GUIDE
DISC GUIDE
STEM
KO
SEAT
Seat Screw
8" and Larger
SEAT
SEAT O-RING
STUD
8" and Larger
BODY
(Globe or Angle)
PIPE PLUG
*Repair Parts

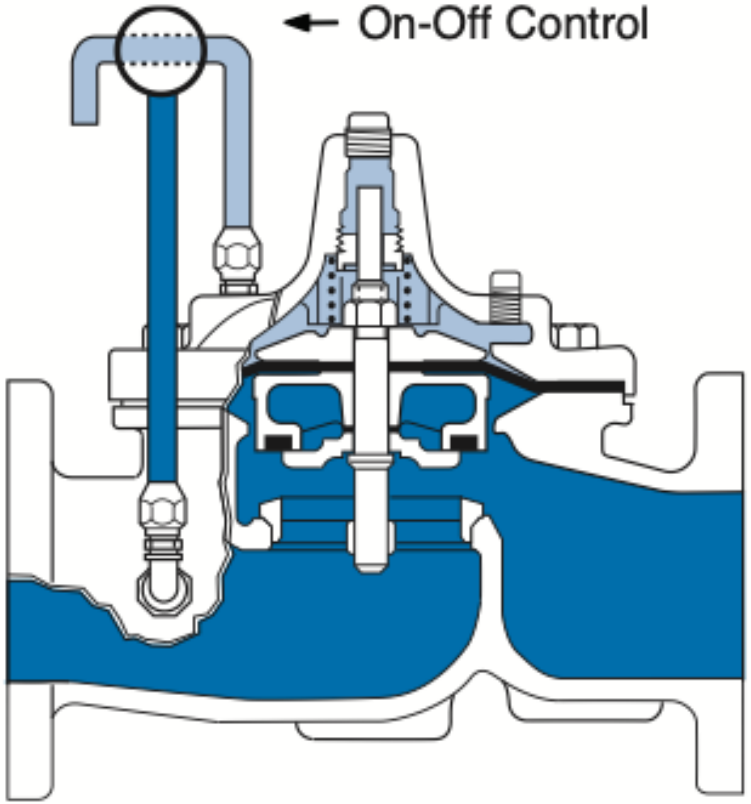
Standard Flow



Up and Over Seat

Principles of Operation

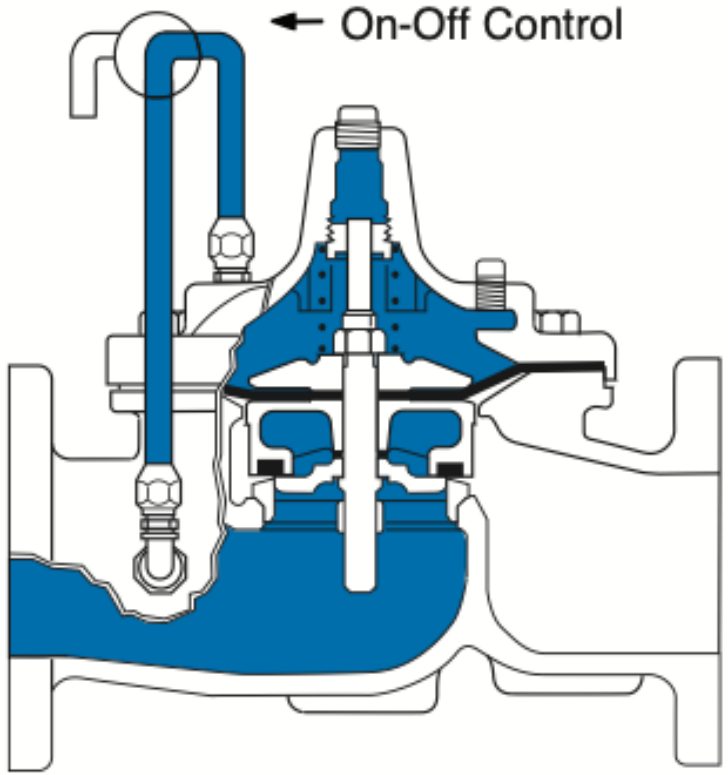
Full Open
When pressure in the cover chamber is relieved to a zone of lower pressure, the line pressure at the valve inlet opens the valve, allowing full flow.



Principles of Operation

Tight Closing

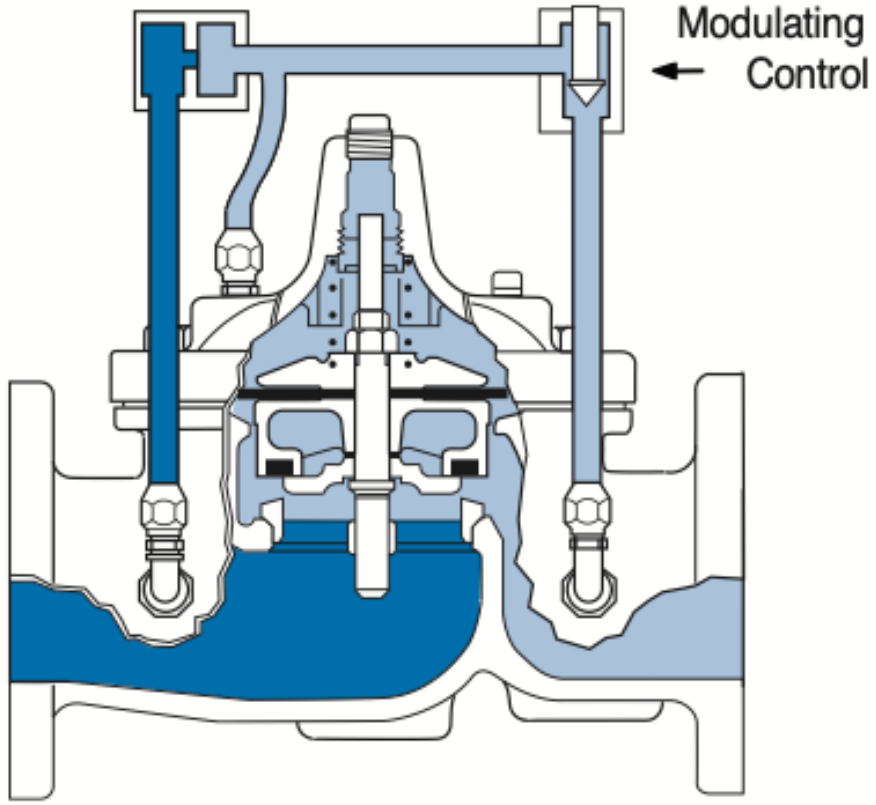
When Pressure from the valve inlet is applied to the cover chamber, the valve closes drip tight.



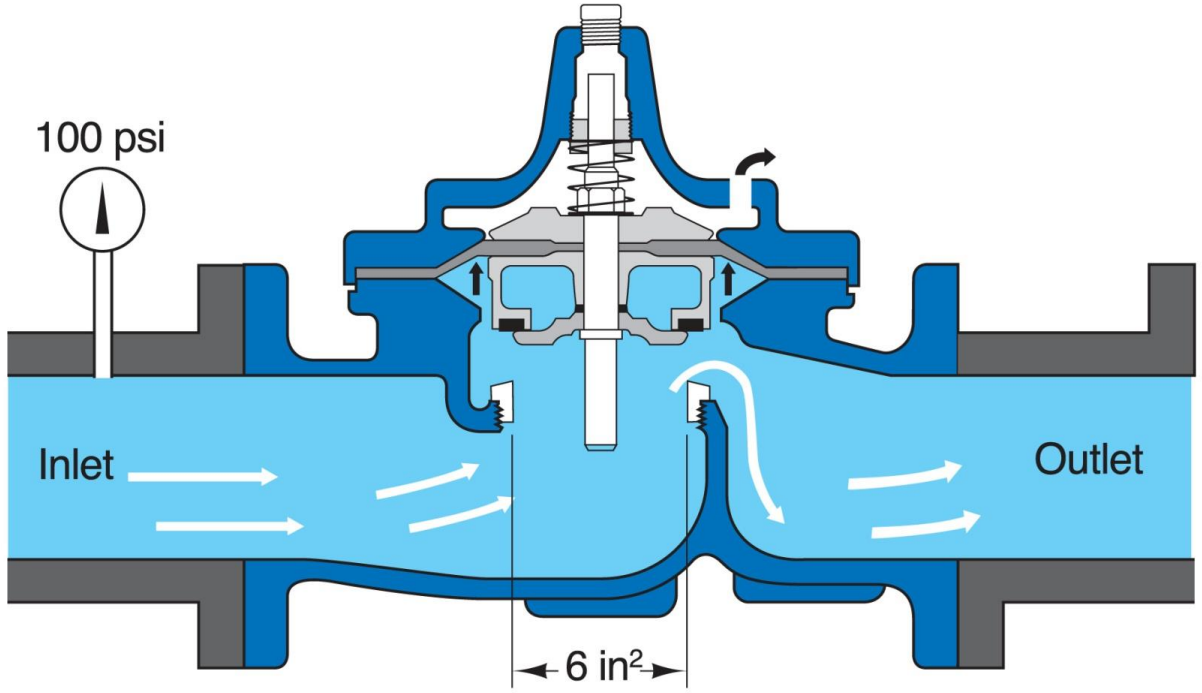
Principles of Operation

Modulation

The valve holds any intermediate position when operating pressures are equal above and below the diaphragm.



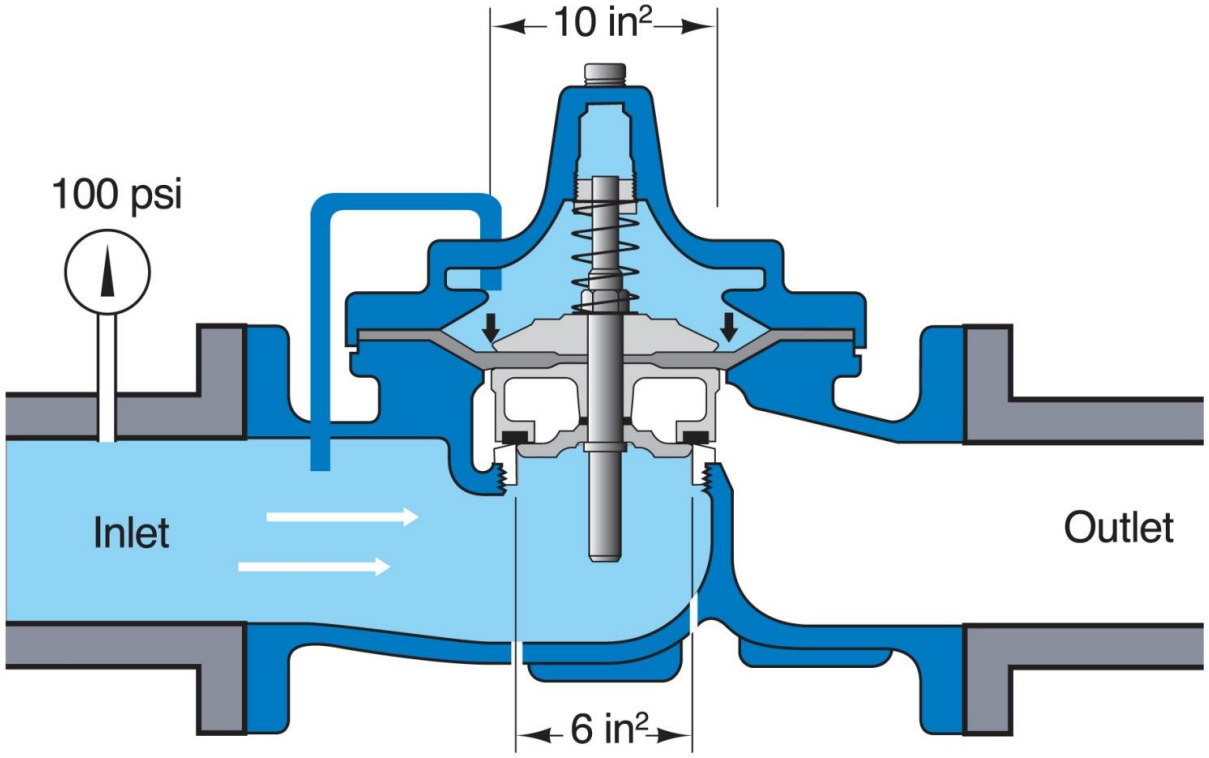
Line Pressure to Open – Opening Force



100psi.x 6 = 600lbs.

(opening force)

Line Pressure to Close – Closing Force



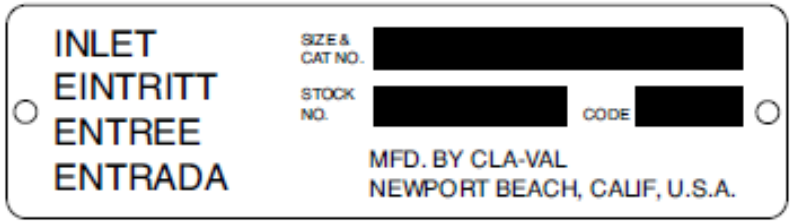
Closing Force 100 x 10 = 1000 lbs.
Opening Force 100 x 6 = 600 lbs.
Difference = 400 lbs.

Cla-Val 100-01 Hytrol Main Valve X101 Valve Position Indicator

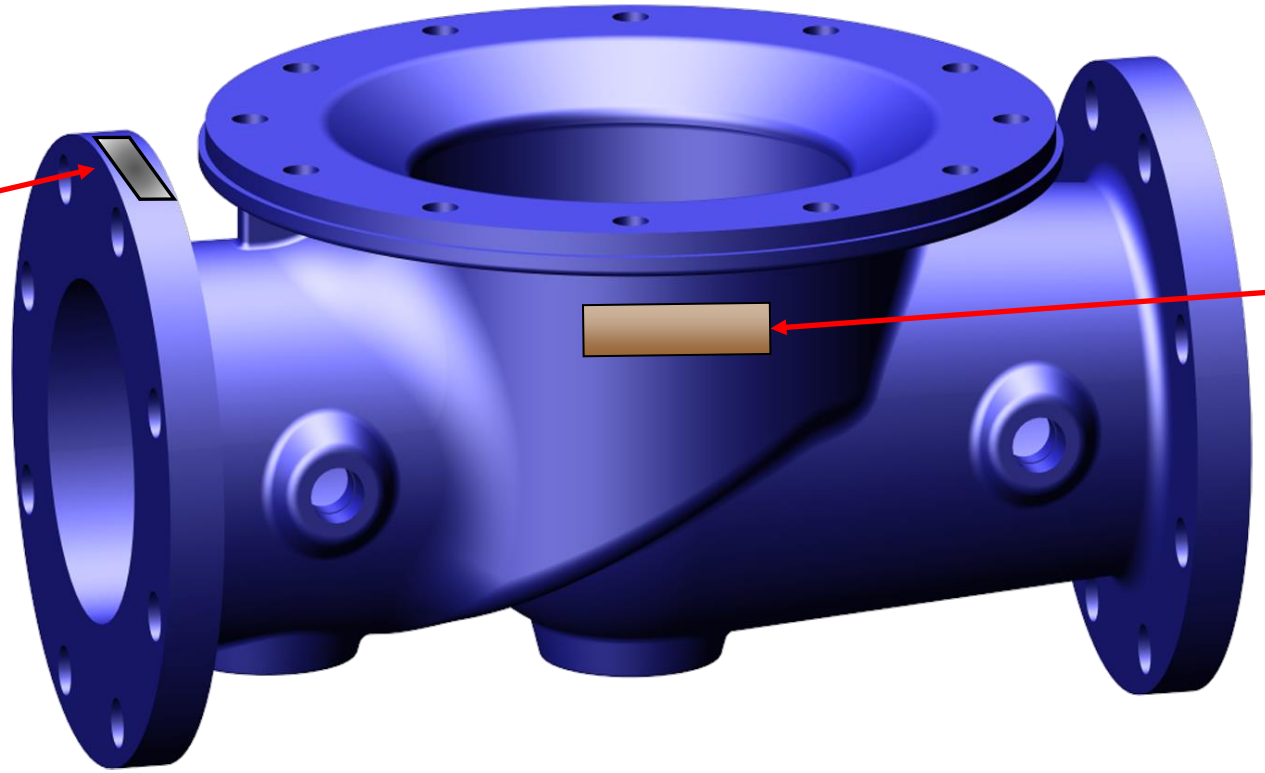
Hammer this in!

- Water **on** the cover valve goes **closed**
- Water **off** the cover valve goes **open**
- Remembering this will help when you have to troubleshoot

Cla-Val Nameplate Locations



2-1/2” and larger flanged valves



2” and smaller flanged valves and all threaded and grooved valves

Can you read this nameplate?

Record the information before the tag looks like this!

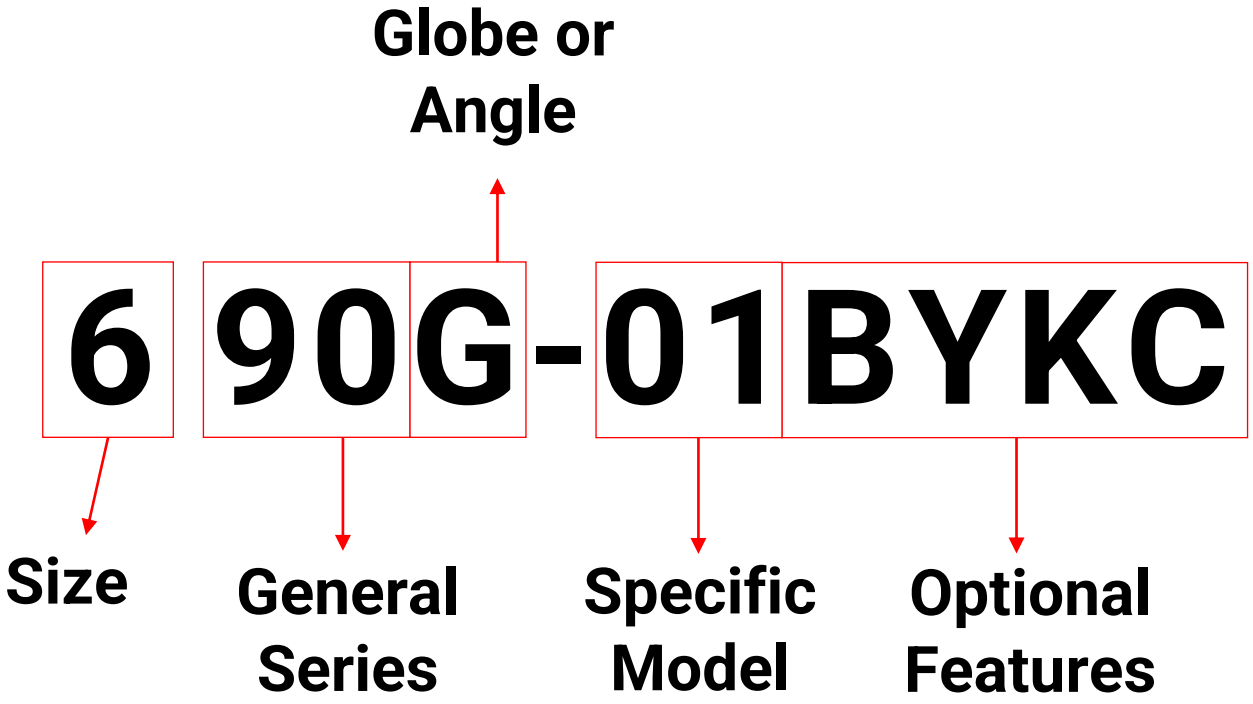
Link-2-Valves

- A simple to use tool to manage the service scheduling of your automatic control valves.
- Works on Desktop and Mobile App
- Secure

Link2Valves™

Simplified Control Valve Service Management

Catalog Numbering System



Model Numbers

6" 90G-01BYKC

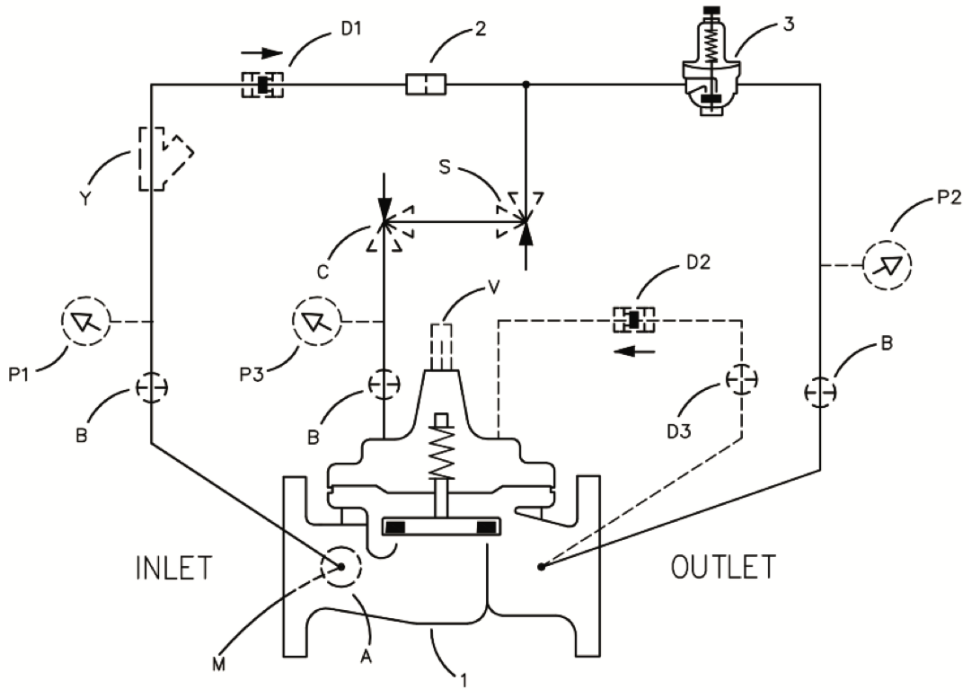
Model numbers are based on application category

Thousands of specific models in each category

APPLICATION CATEGORIES	SERIES
Rate of Flow (Flow Limiting)	40 - 49
Pressure Relief/Sustaining	50 - 59
Pump Control (Booster/Deep Well)	60 - 69
Check	80 - 89
Pressure Reducing	90 - 99
Float (Modulating & Non-Modulating)	120 - 129
Solenoid /Electronic & Metering	130 - 139
Altitude (Level Control)	206 - 210
Differential Relief	250 - 259
Float (Modulating Only)	420 - 429

Optional Features

6" 90G-01BYKC



Schematic Diagram

Item	Description
1	100-01 Hytrol Main Valve
2	X58 Restriction Fitting
3	CRD Pressure Reducing Control

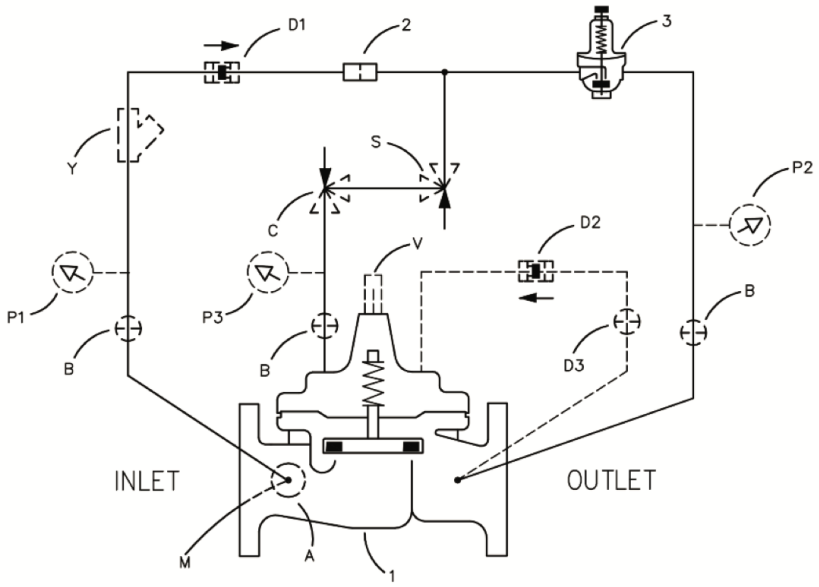
Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
C	CV Flow Control (Closing)*
D	Check Valves with Isolation Valve
M	X144 e-FlowMeter
P	X141 Pressure Gauge
S	CV Flow Control (Opening)
V	X101 Valve Position Indicator
Y	X43 "Y" Strainer

*The closing speed control (optional) on this valve should always be open at least three (3) turns off its seat.

Optional Features

6" 90G-01BYKC



SUFFIX / OPTIONS	
A	X46 Flow Clean Strainer
Y	X43 “Y” Pattern Strainer
B	CK2 Isolation Valves
F	Independent Operating Pressure
C	CV Closing Speed Control
D	Check Valves with Isolation Valves
E	X117D Valve Position Transmitter
H	Atmospheric Drain
N	VC-22D Electronic Controller
M	X144D Flow Meter
S	CV Opening Speed Control
P	Inlet/Outlet Pressure Gauges
V	X101 Valve Position Indicator
KC	Epoxy Coating (Main Valve)
KD	Dura-Kleen® Stem
KE	Motorized Pilot Valve
KG	Delrin Stem Sleeve
KO	Anti-Cavitation Trim
KR	Reverse Flow (Main Valve)
KB	KB Viton Rubber Parts
X	Extra/Unique, i.e. Adders

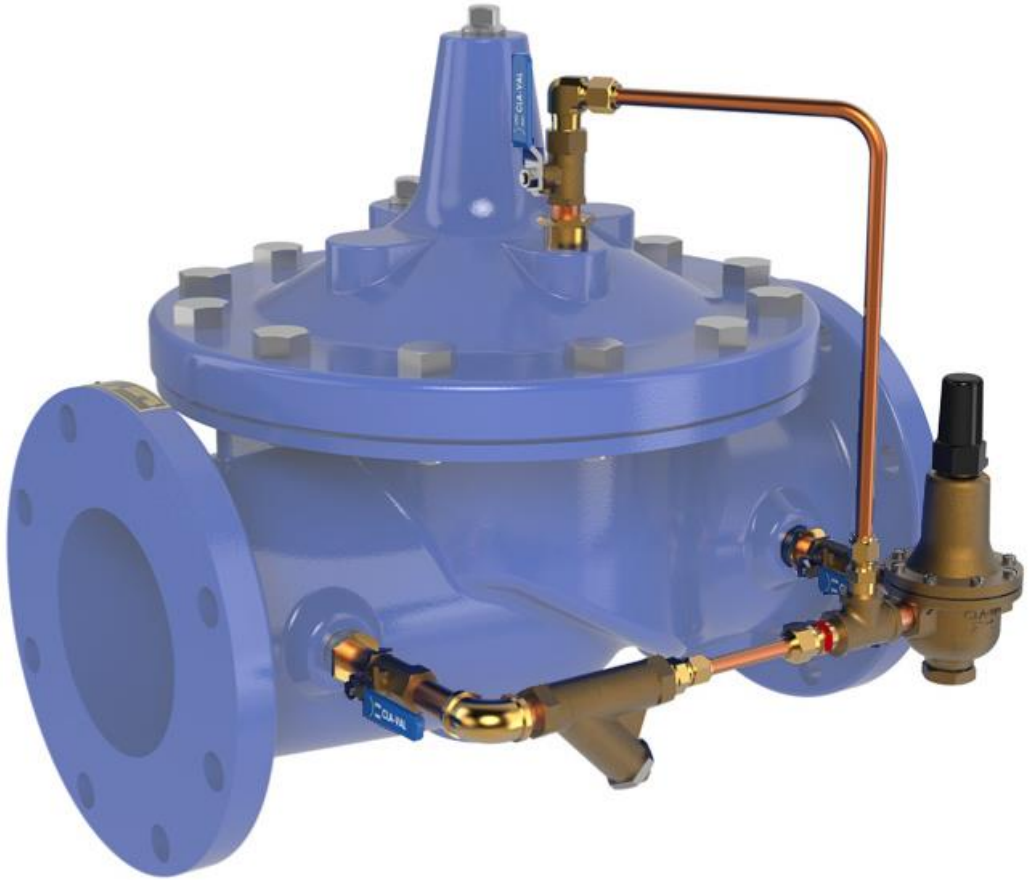
Pressure Gauges are Essential

- Set Pressure on Start-Up
- Troubleshooting
- Field Adjustments
- Record Keeping & Maintenance

Use the appropriate gauge for your system’s pressures

Would you use this for Outlet Pressure of 75psi?

Would you use this for Outlet Pressure of 15psi?

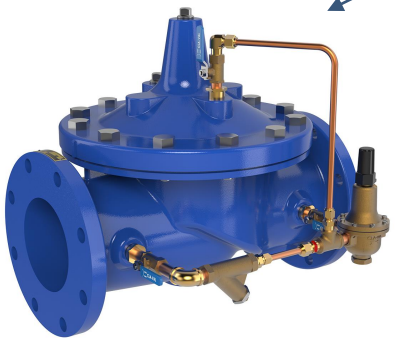


Cimco-GC SYSTEMS

Pilot System Review

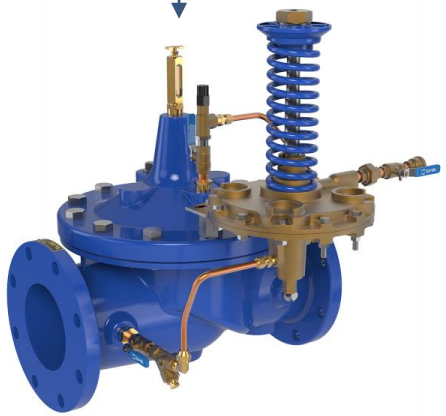
Pilot Systems Provide Functionality for a Valve

Base Valve
(No Function)



Reduces Pressure

Relieves Pressure



Controls Water Level

Controls Flow

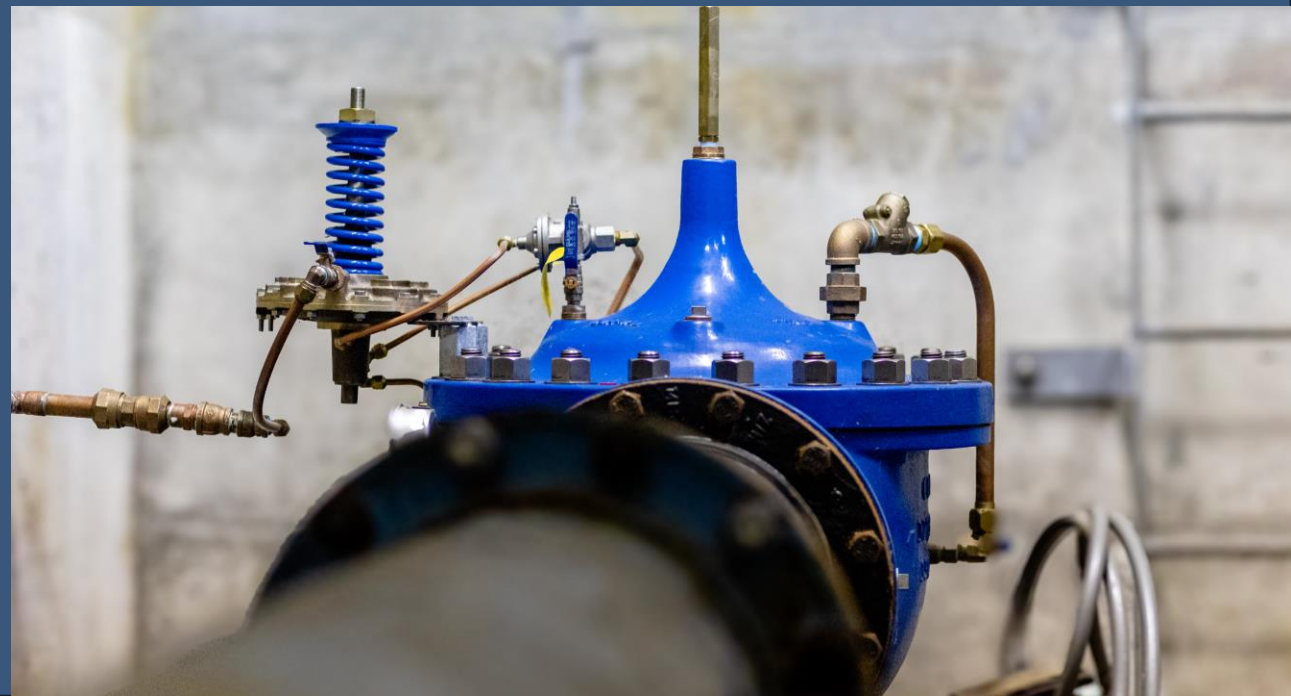
Electronic Interface

Pilot Controls

Move water on and off the cover of the valve

Common Features

- Mechanical pilots
  - CRD, CRL, CRA, CDS6A, etc.
- Solenoid controls
- Tubing and fittings
  - Copper tubing and brass fittings standard
  - *We highly recommend Stainless Steel tubing and fittings due to new low-lead copper and brass*
- Strainers, speed controls, sensors, check valves, ball valves, auxiliary Hytrols, etc.



One Valve, Multiple Jobs

Example

Four Solenoid controls

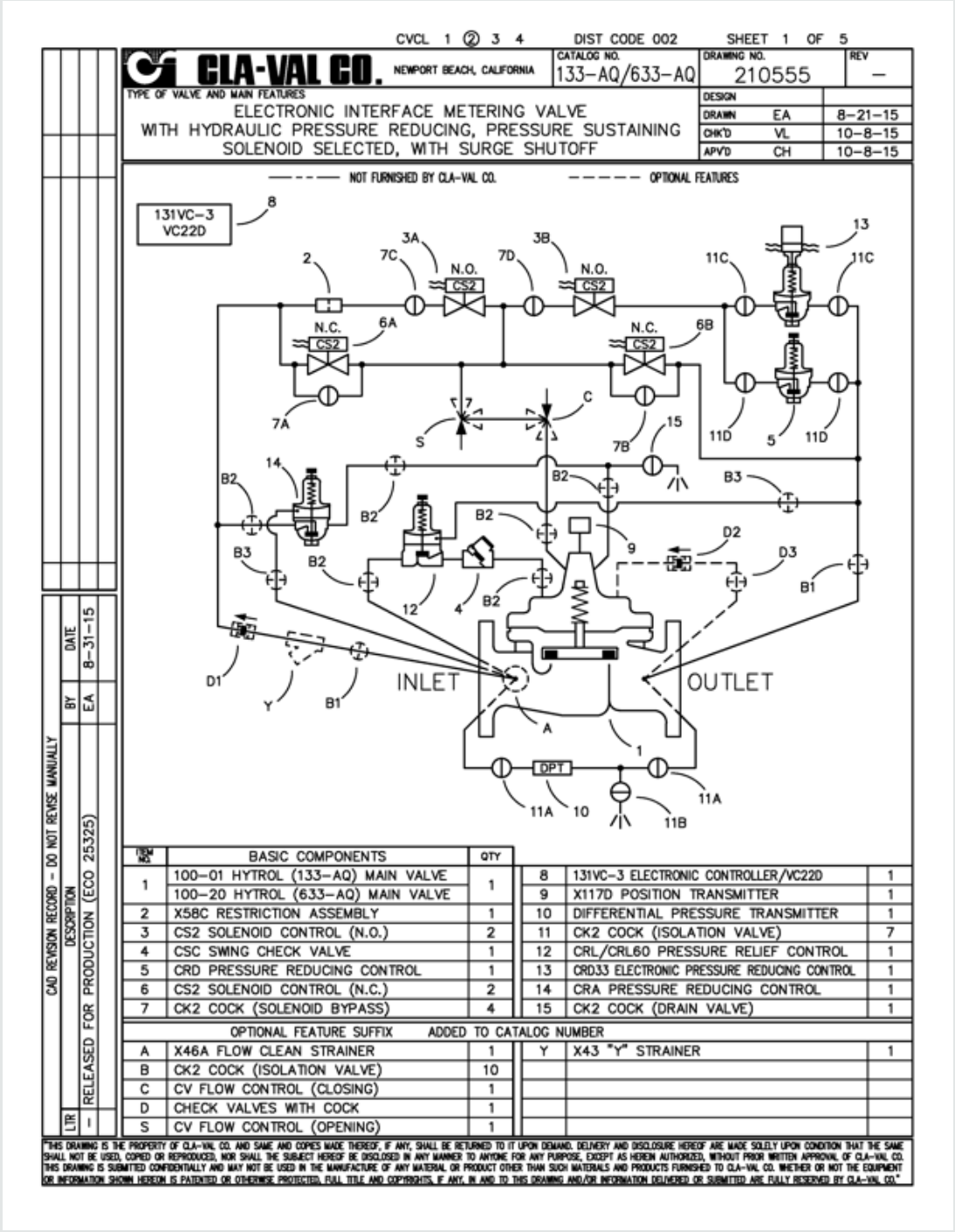
- Electronic interface control
- Solenoid selection control

Four Mechanical Pilots

- Electronic pressure reducing pilot
- Backup pressure reducing pilot
- Pressure Sustaining Pilot
- Surge shut-off pilot

Many Complementary features

- Strainer, fixed restriction, speed controls, check valves, ball valves, pressure transducers, etc



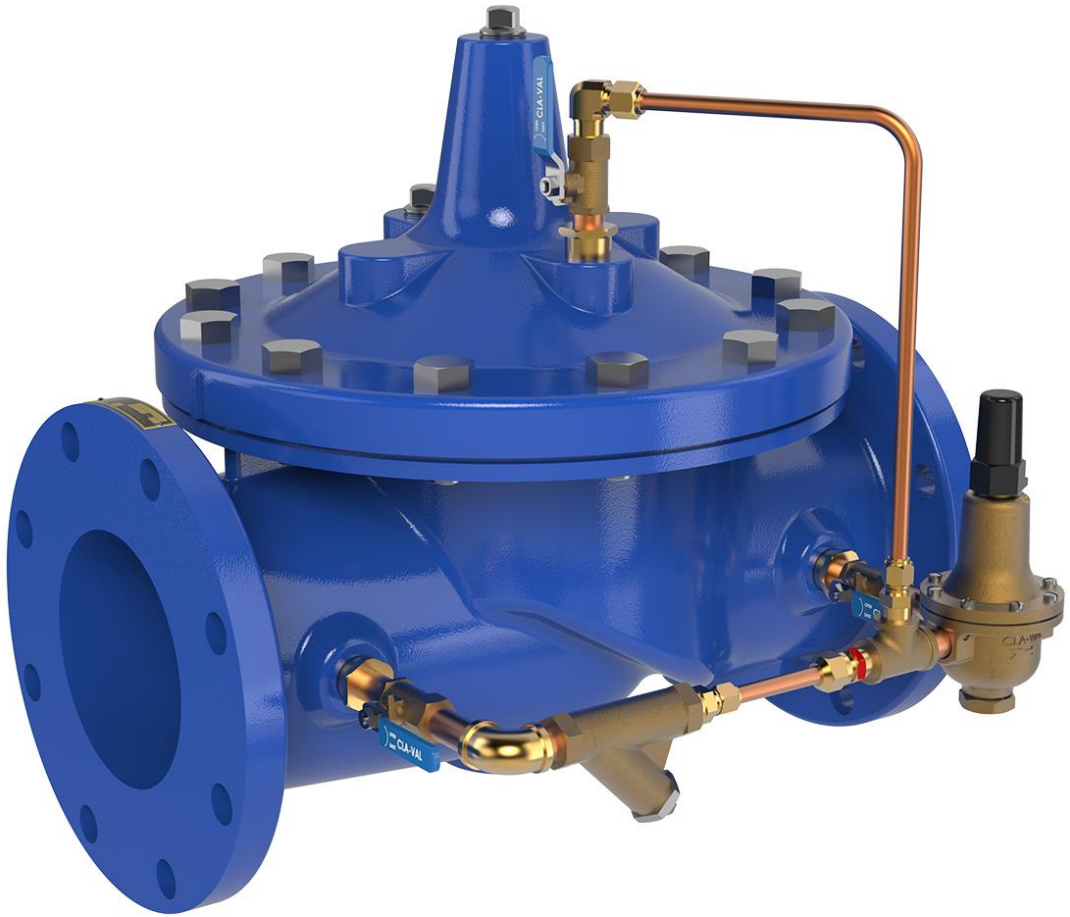
Pilot Systems Divided into Two Groups

Modulating

1. Pressure Reducing
2. Pressure Sustaining/Relief
3. Rate of Flow
4. Electronic

Non-Modulating

1. Pump Control
2. Solenoid Operated
3. Level Control



Cimco-GC SYSTEMS

Trouble Shooting Principles

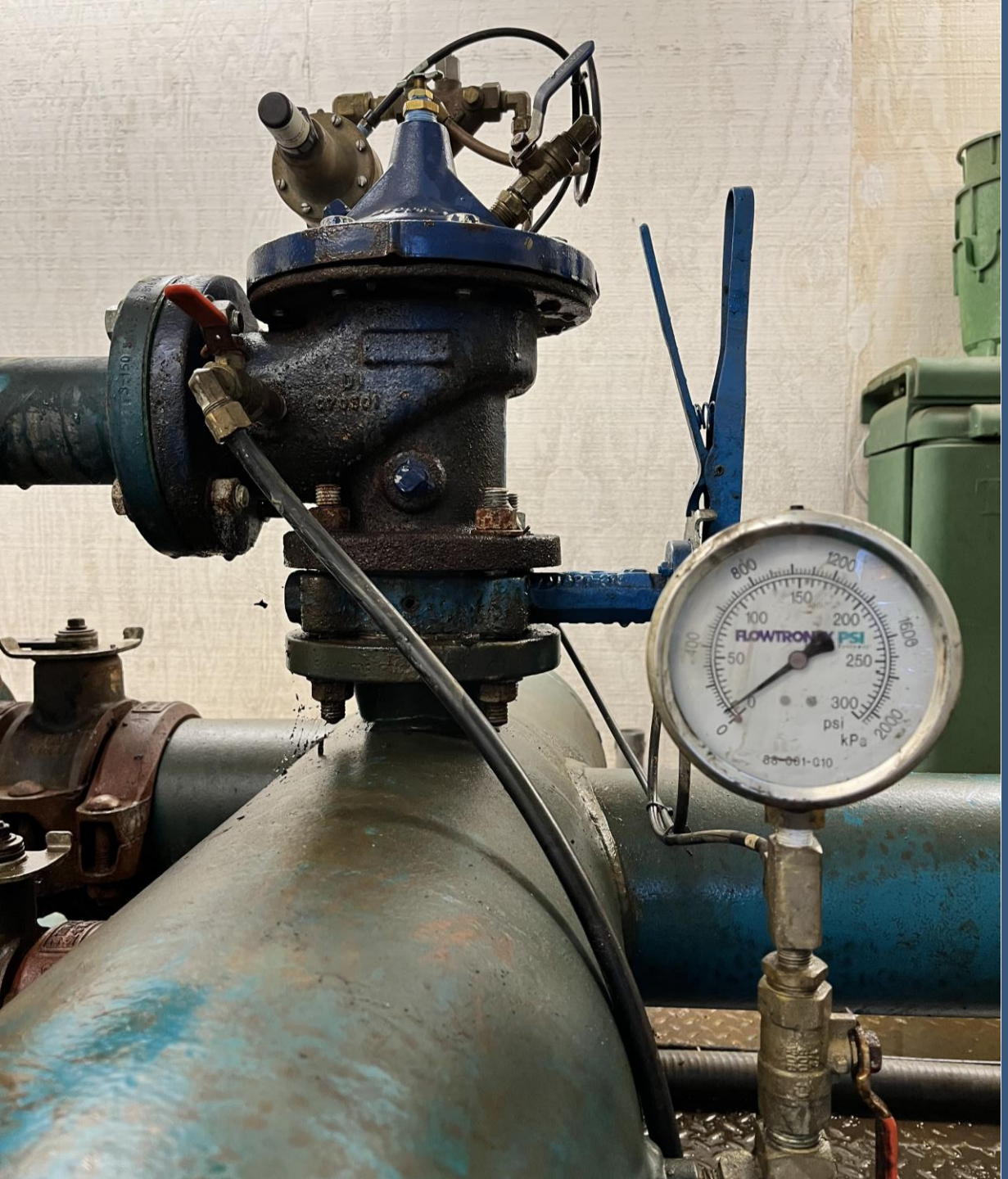
Trouble shooting principles

Blues Anatomy - Valve Doctors

Trouble shooting principles

Blues Anatomy - Valve Doctors

- Identify the Symptoms and Diagnose the Root Cause
- Isolate and Test Each Variable
- Start with the Easiest to Get To
- Separate out Pilot System and Main Valve Issues
- At a Certain Point, Clean the Slate and Do a Full Rebuild



Cimco-GC SYSTEMS

Main Valve Troubleshooting

Troubleshooting Questions

- Is the valve installed properly?
- What is the valve’s function in the system?
- Have any modifications been made?
- Do you have accurate inlet and outlet pressure gauges?
- Are the mainline isolation valves open?
- If solenoid operated – power to the coil?
- Need a Technical Manual?

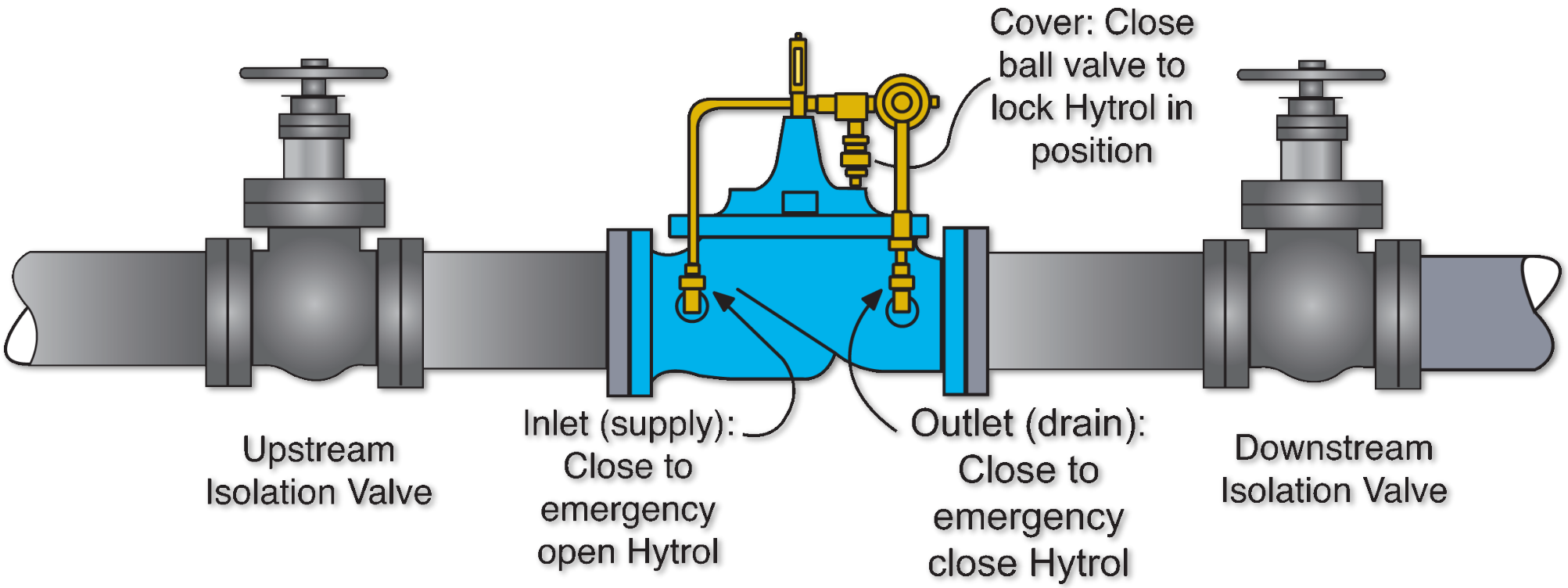
Valves Fail in 3 Ways

1. Fail to Open
2. Fail to Close
3. Fail to Modulate

Cimco-GC SYSTEMS

Three Hytrol Tests

Manual Override Operation with Pilot System Isolation Valves

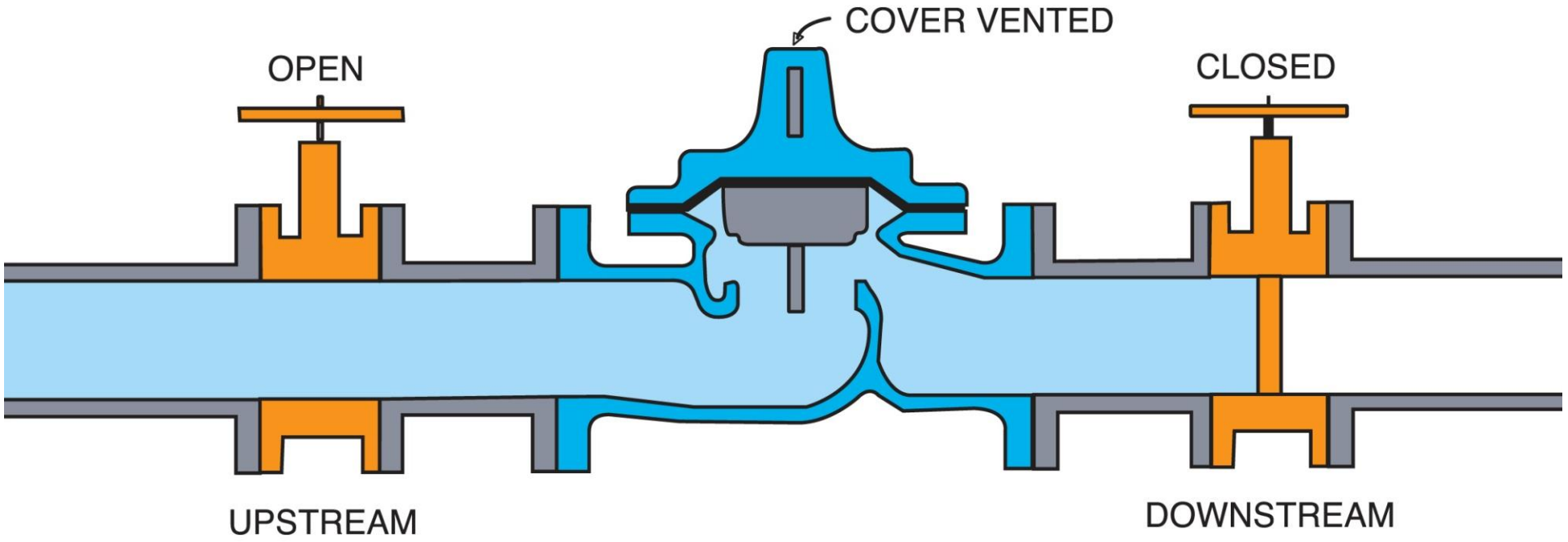


Check the effect in the system before using

3 Hytrol Checks

1.Diaphragm Test
2. Stem Movement Test
3. Disc & Seat Test

1. Diaphragm Test

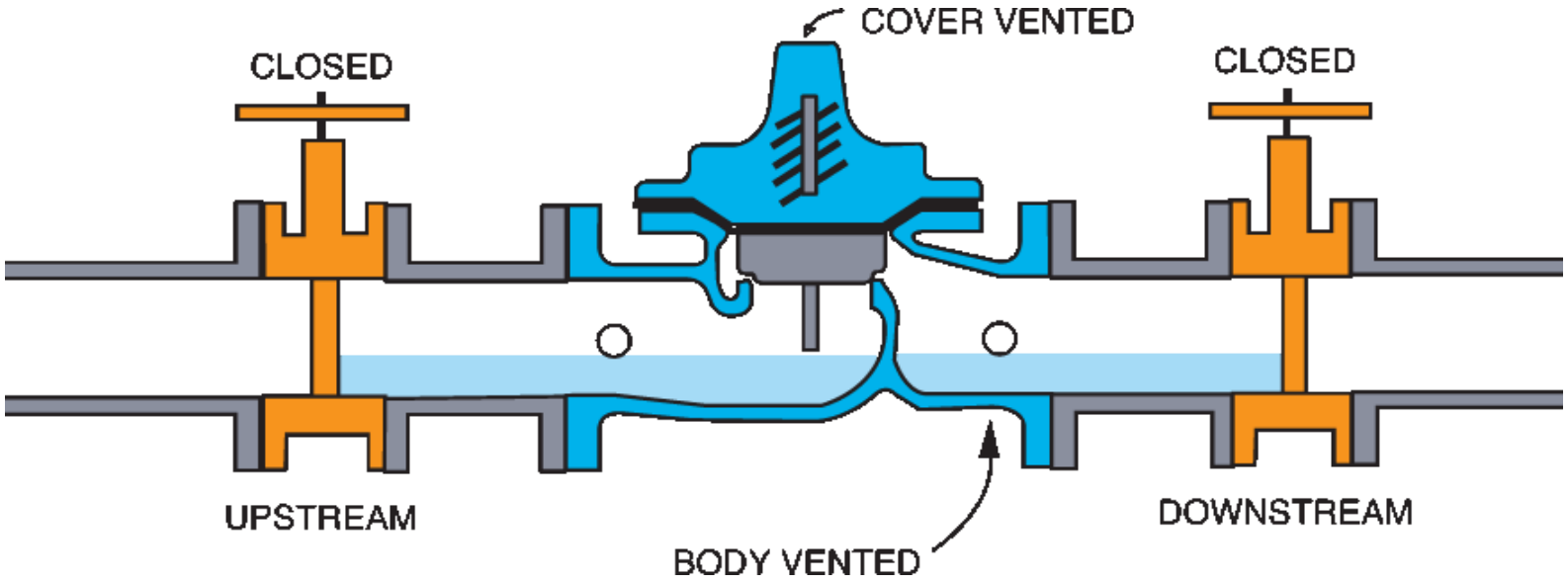


Cover should evacuate its fluid and stop all flow
Blown diaphragm if it continues to flow

Volume Displaced From Diaphragm Chamber When Valve Opens

Size	Displacement	Size	Displacement
3/8”	.012 Fl. Oz.	4”	.17 Gals.
½”	.34 Fl. Oz.	6”	.53 Gals.
¾”	.34 Fl. Oz.	8”	1.26 Gals.
1”	.7 Fl. Oz.	10”	2.51 Gals.
1 ¼”	.02 Gals.	12”	4 Gals.
1 ½”	.02 Gals.	14”	6.5 Gals.
2”	.03 Gals.	16”	9.6 Gals.
2 1/2”	.04 Gals.	24”	29 Gals.
3”	.08 Gals.	36”	42 Gals.

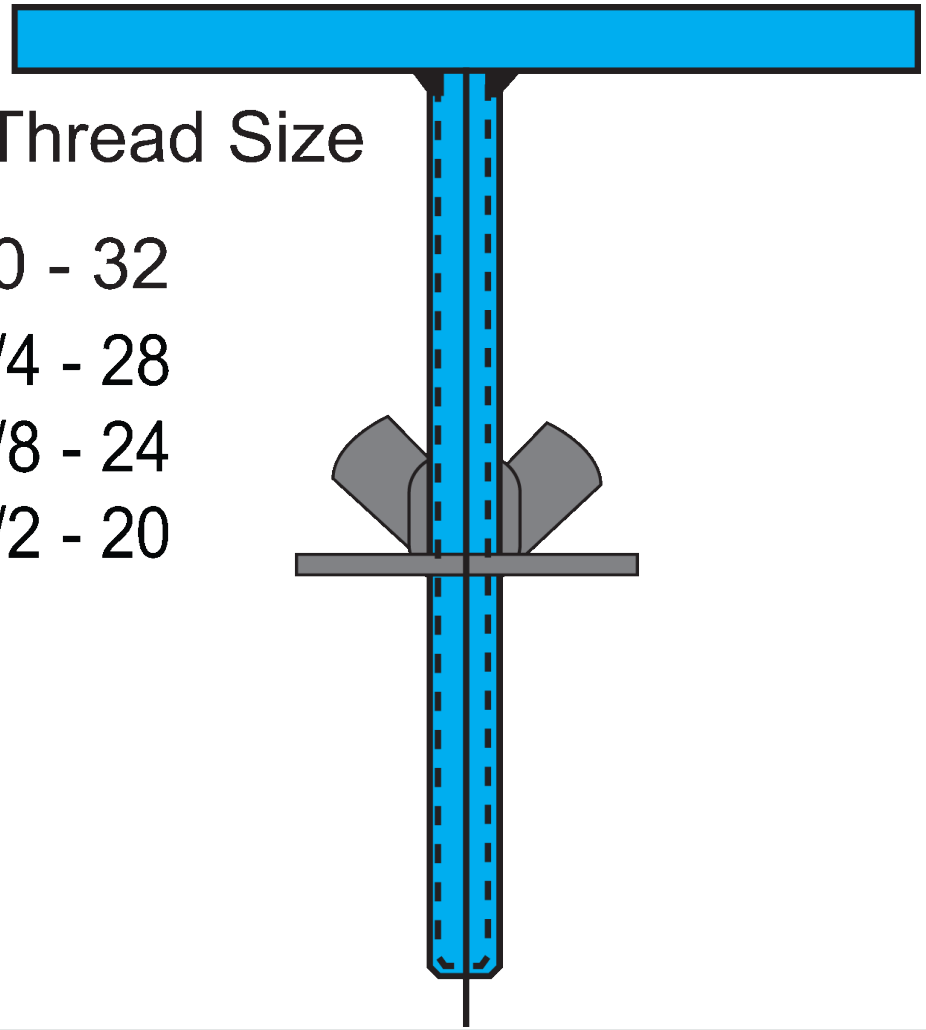
2. Stem Movement Test



From the open position, drain the downstream body port
Stem should move all the way down into the closed position

Stem Puller Tool

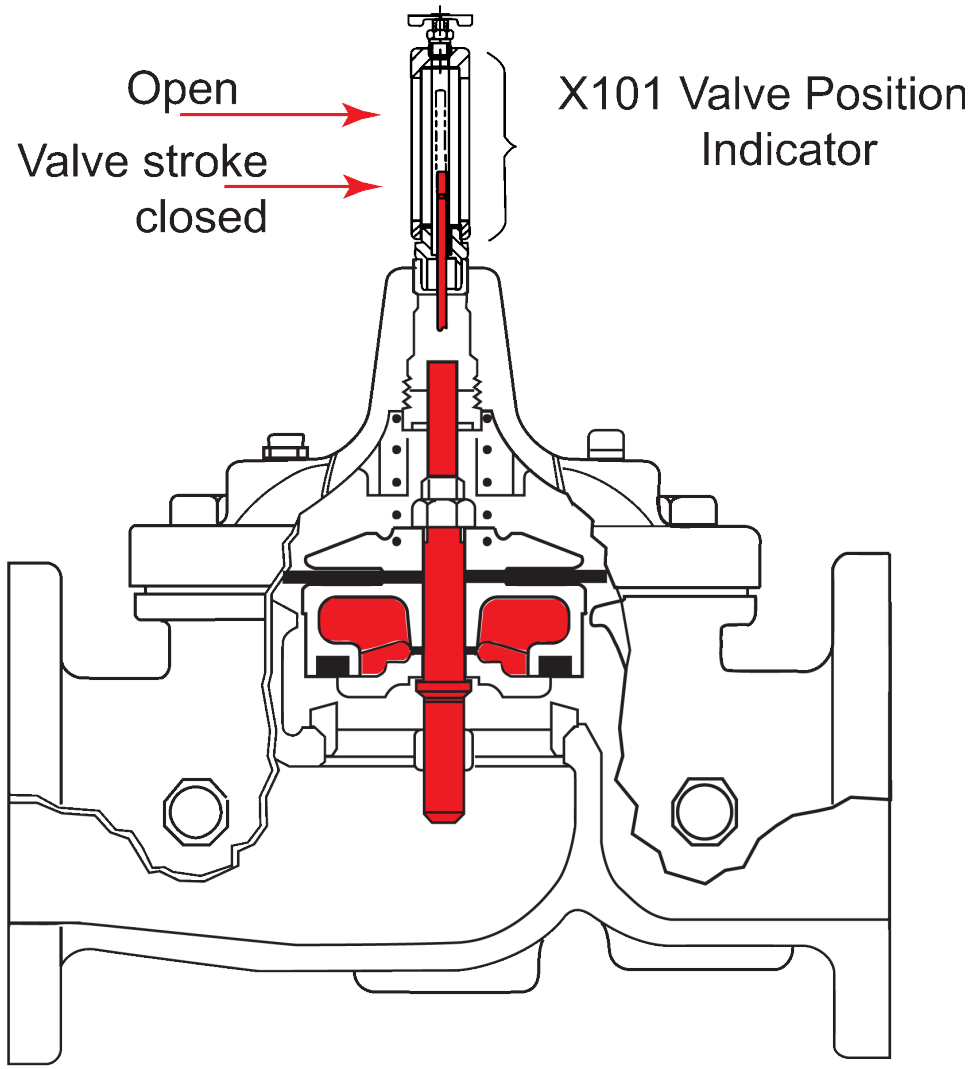
Valve Size	Stem Thread Size
1/2” – 2-1/2”	10 - 32
3” – 4”	1/4 - 28
6” - 14”	3/8 - 24
16”	1/2 - 20



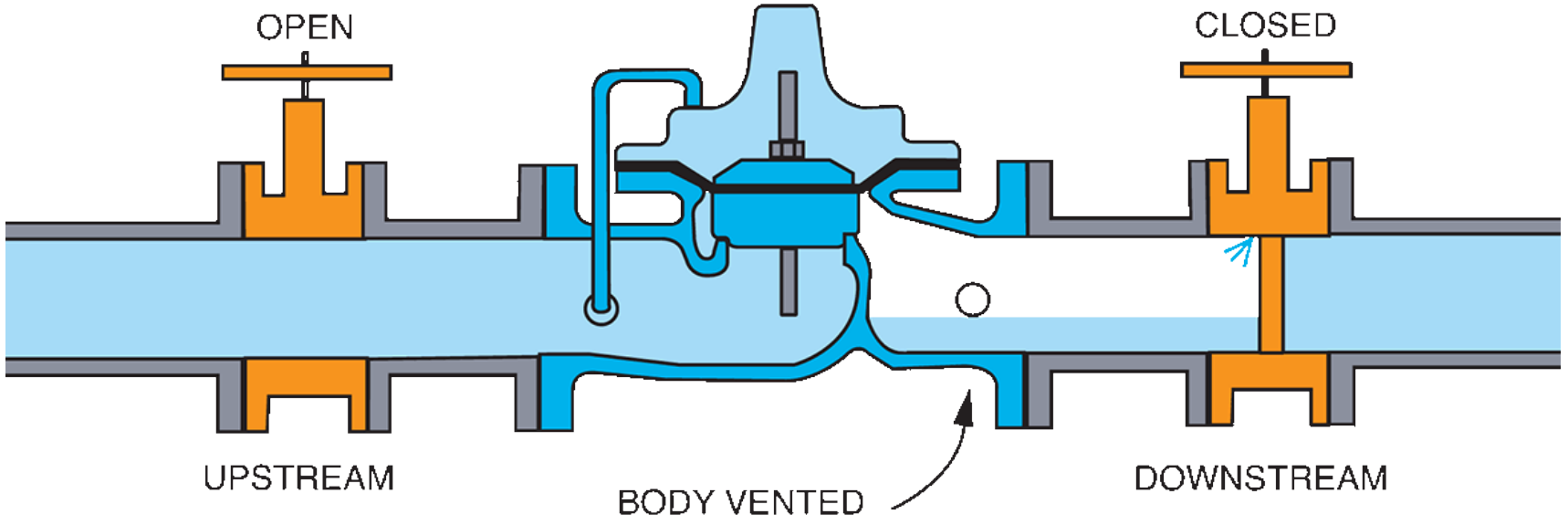
Measured Stroke Formula

Valve stroke equals .28 x valve size on full ported valves

Valve stroke equals .28 x seat size on reduced port valves



3. Disc & Seat Test



Leave downstream port open, connect pilot line to cover
Open inlet gate valve, should see no water coming out open port

Cimco-GC SYSTEMS

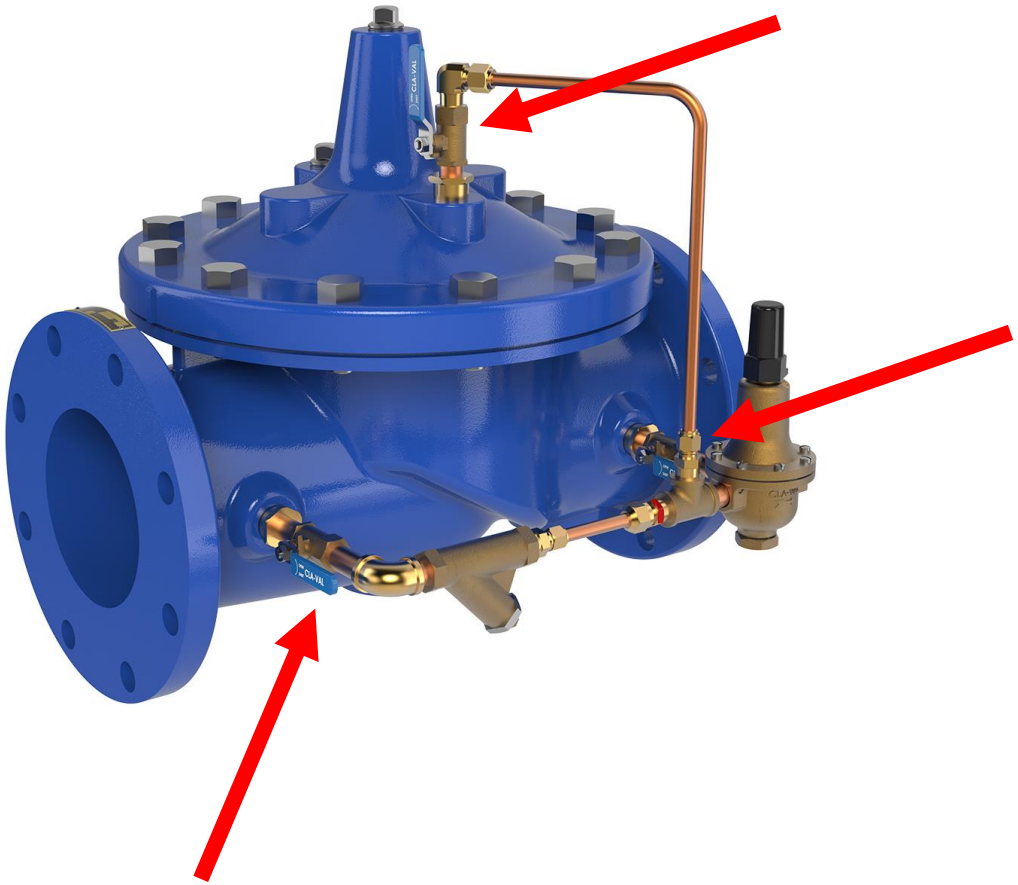
Questions?

Cimco-GC SYSTEMS

Troubleshooting Pressure Reducing Valves

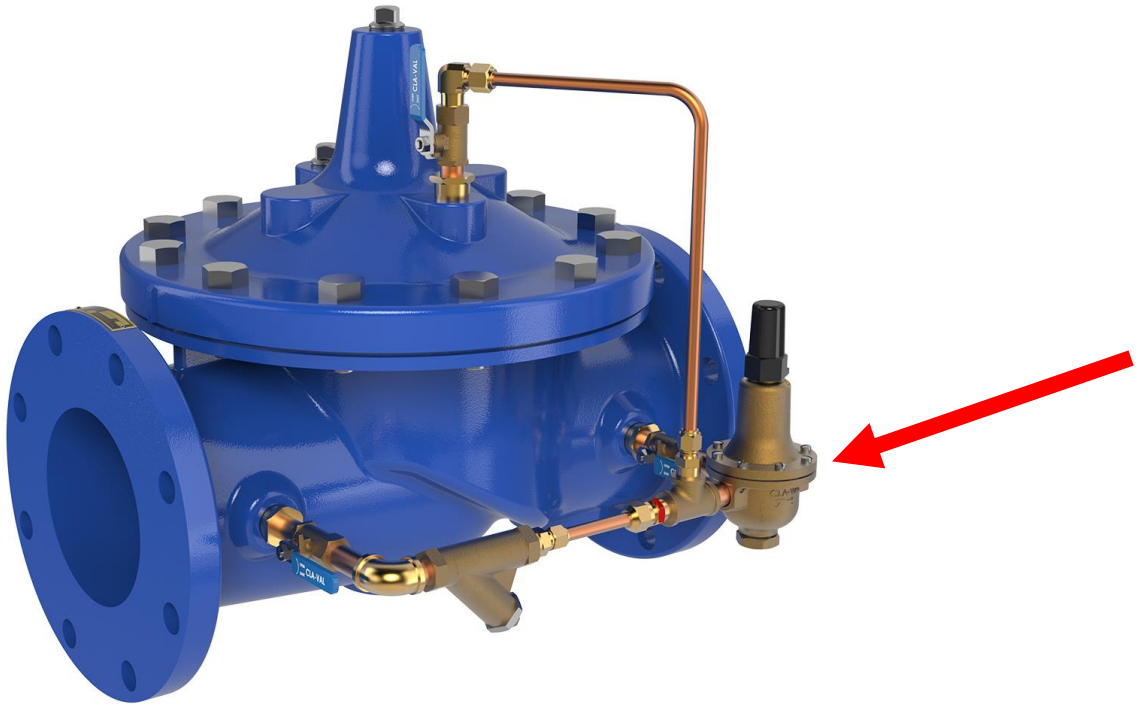
PRV Troubleshooting

Make sure all 3 isolation valves are open first!



Adjust the CRD

Varying the adjustment on the CRD control pilot is one of the best ways to know if you PRV is functioning properly with pressure gauges up and downstream



PRV Won’t Go Open

(We cannot depressurize/remove water from the cover.)

- Check the pilot adjustment.
    - It may be set too low / set screw is “out too far”.
- Upstream pressure may be insufficient.
    - AKA low/no differential
- Make sure restriction fitting is installed; cover may be flooded without.
- Confirm all ball valves are open.

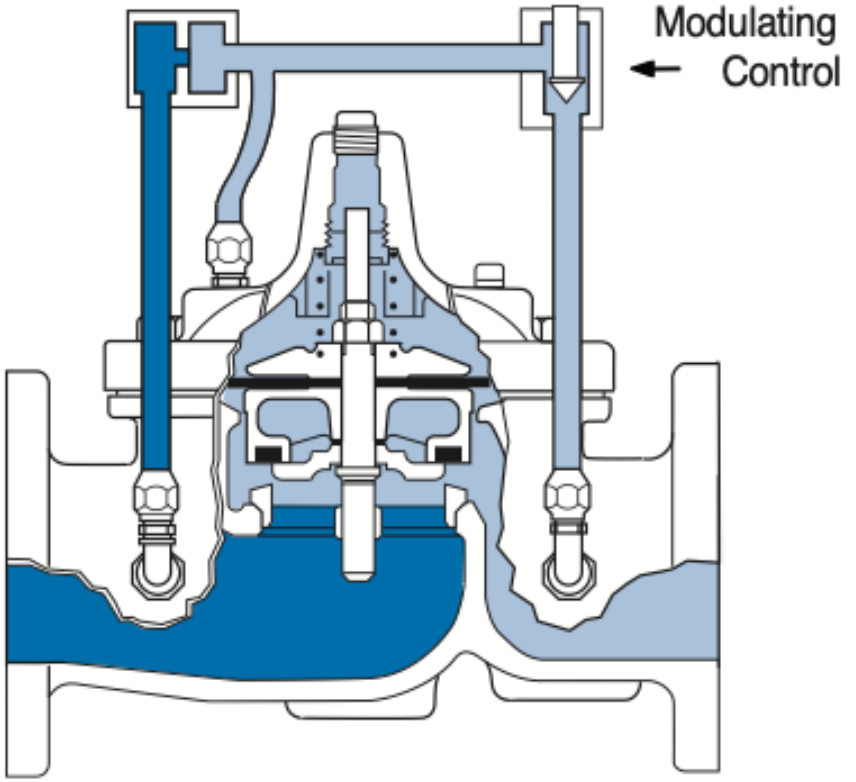
PRV Won’t Go Closed

(We cannot pressurize/”put water on” the cover.)

- Pilot adjustment may be set too high / set screw “is in too far”.
- Clogged pilot strainer or restricted orifice… Water can’t get to cover.
- If valve has a check feature, inspect it
- Check the CRD disc assembly; pilot not closing/seating properly.

Failure to Modulate

Water is not moving smoothly on and off the cover.

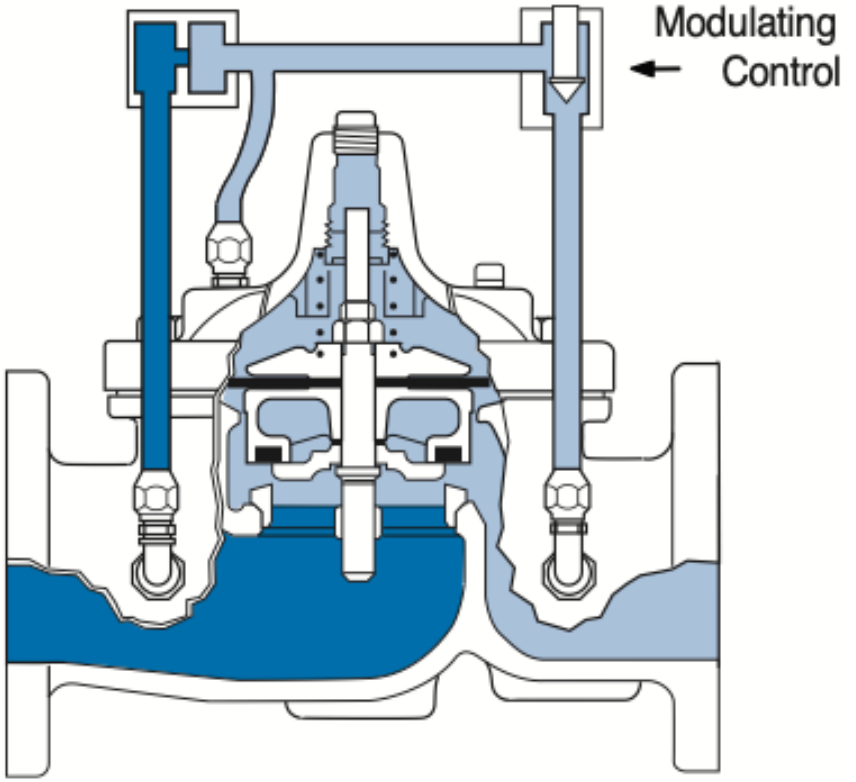


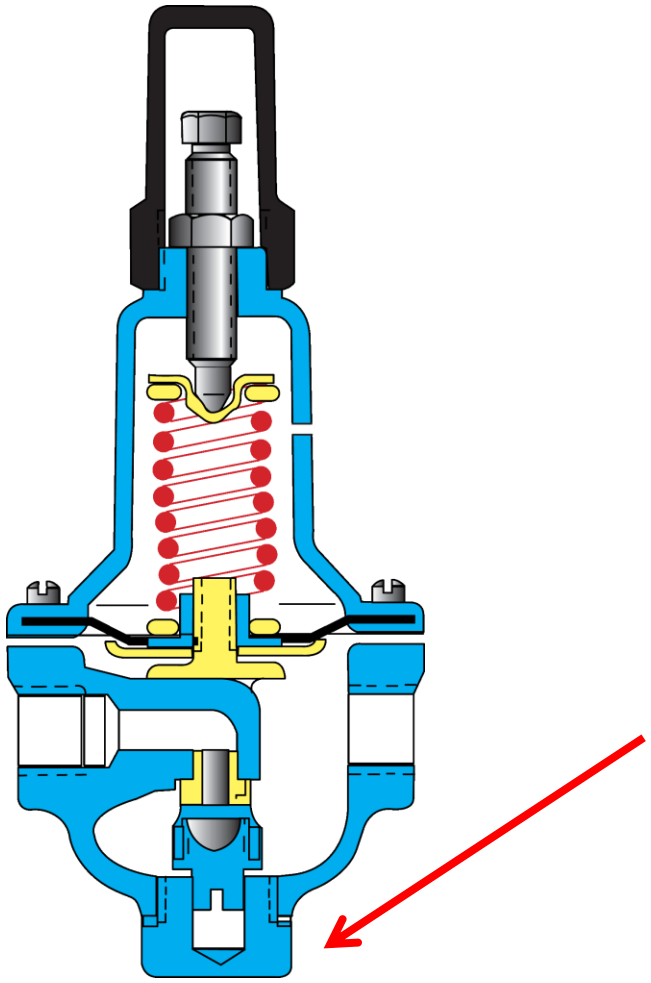
Failure to Modulate

Water is not moving smoothly on and off the cover.

Unless it’s a bent stem or debris in the cover chamber, this is a piloting issue.

Check pilot for water leaking, worn out disc retainer assembly, and blown pilot diaphragm.



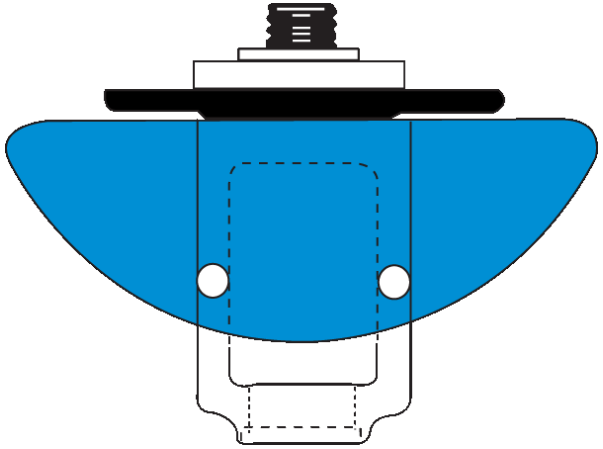


When pressure at the outlet control valve rises to the same value as the inlet pressure, the disc retainer assembly on the CRD control pilot probably needs to be replaced.

(Our pilot cannot go “water-tight” closed.)

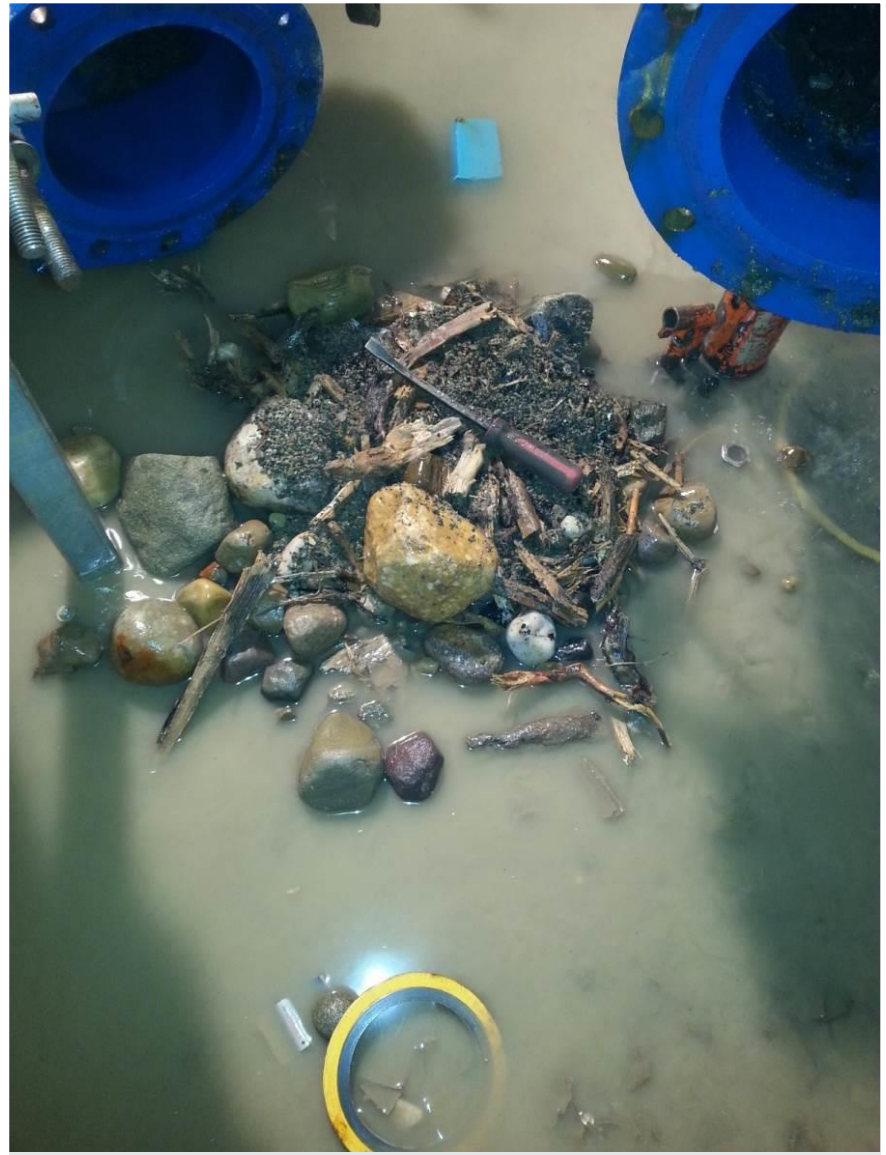
CRD Troubleshooting

- Make a visual check
- Vary the control adjustment
- Check the disc
- Check the yoke alignment
- If water is coming out of cover venthole, this mean blown diaphragm or a loose stem nut

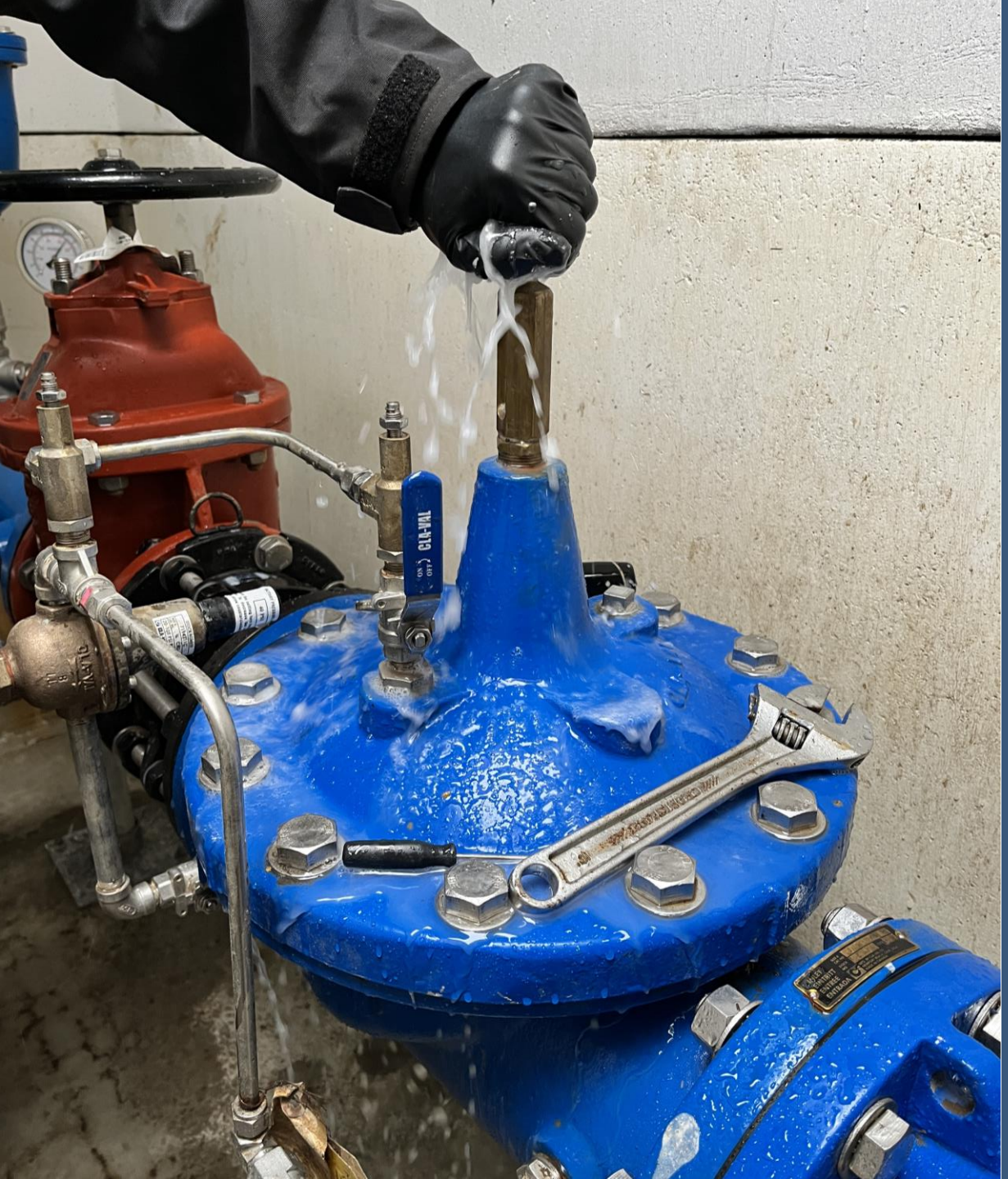


X43-H Style Strainer

If a PRV can’t go closed, what happens?

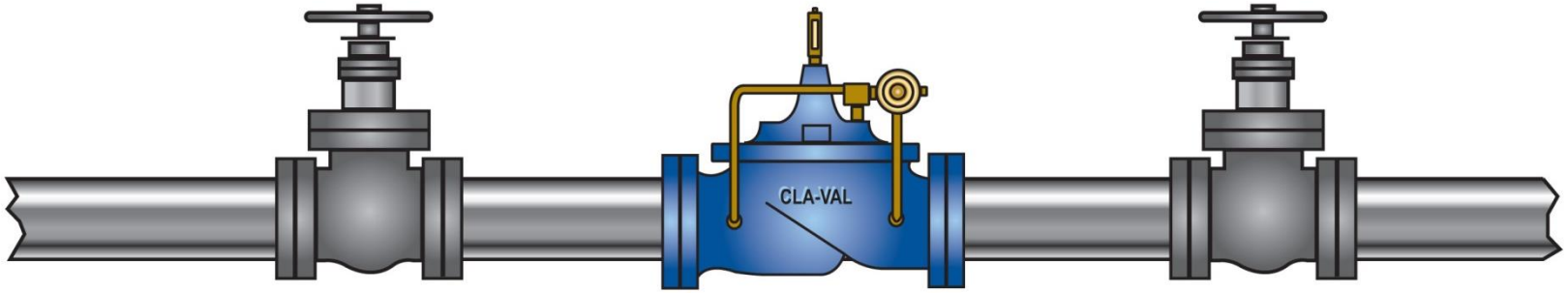


Don’t forget to flush the lines!

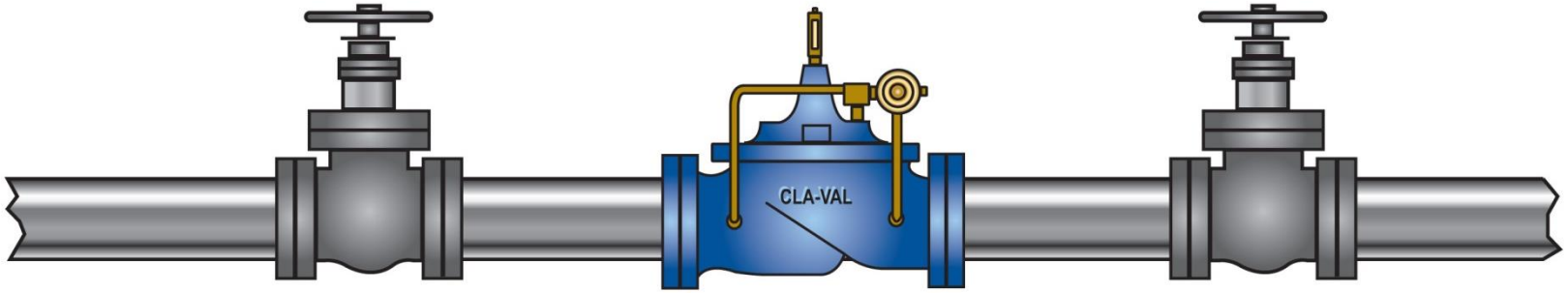


Cimco-GC SYSTEMS

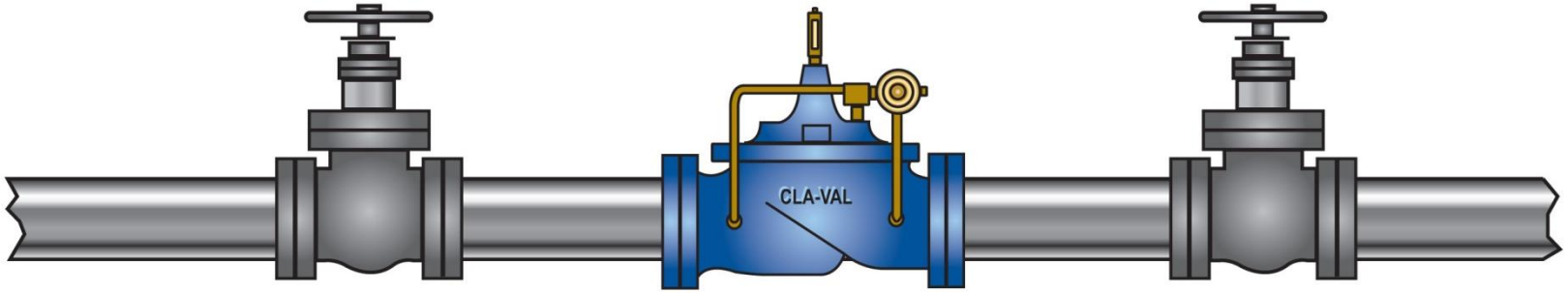
Valve Startup Procedures



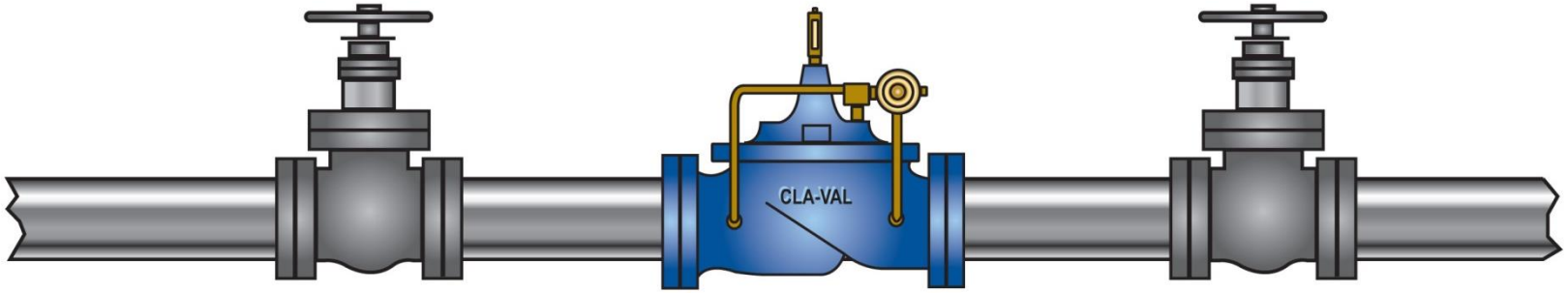
- Make sure all mainline isolation valves are closed



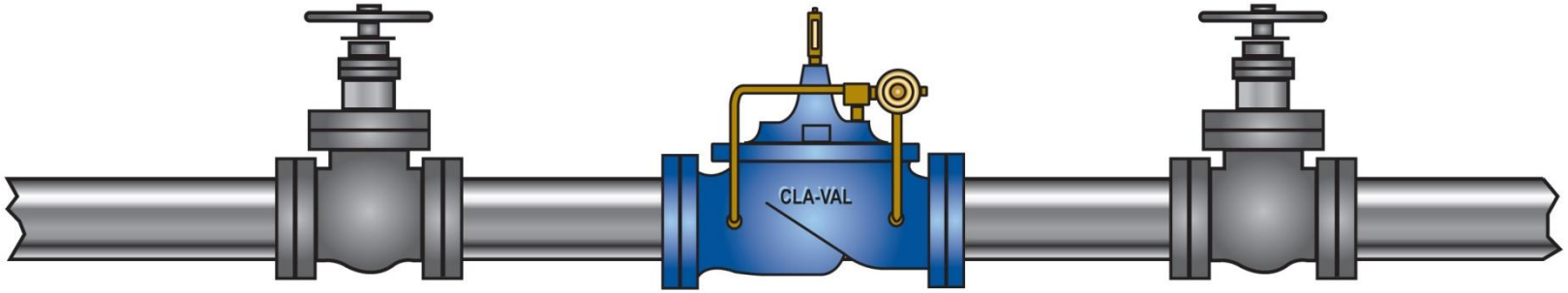
- Make sure all mainline isolation valves are closed
- Have X101 and pressure gauges installed



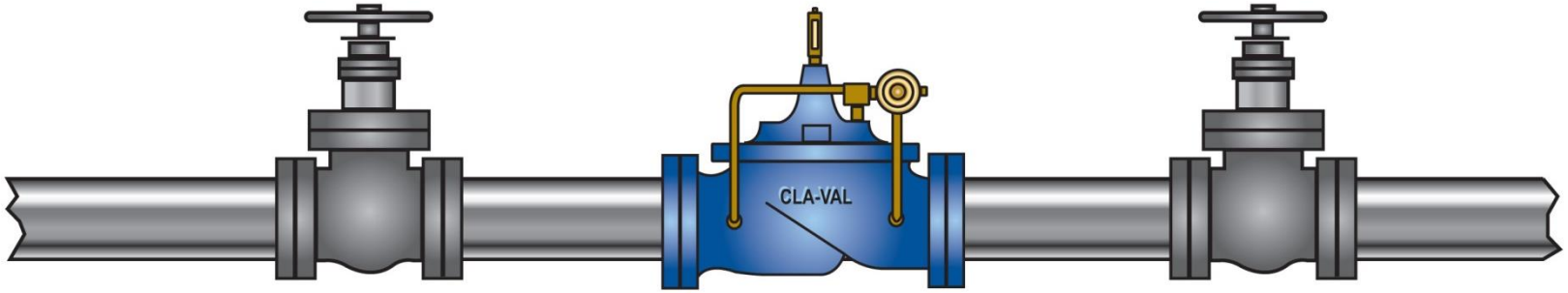
- Make sure all mainline isolation valves are closed
- Have X101 and pressure gauges installed
- Slowly open mainline inlet isolation valve slightly



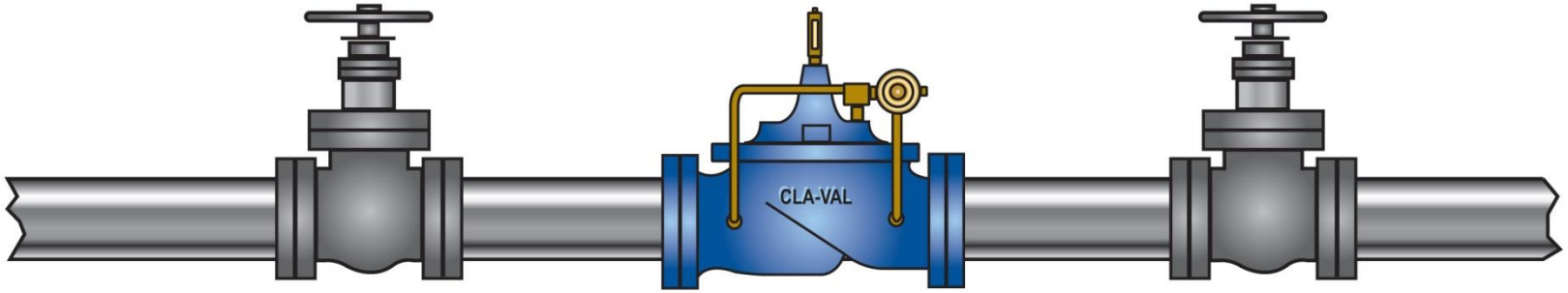
- Make sure all mainline isolation valves are closed
- Have X101 and pressure gauges installed
- Slowly open mainline inlet isolation valve slightly
- Open all ball valves, start with ‘upstream’ ball valve



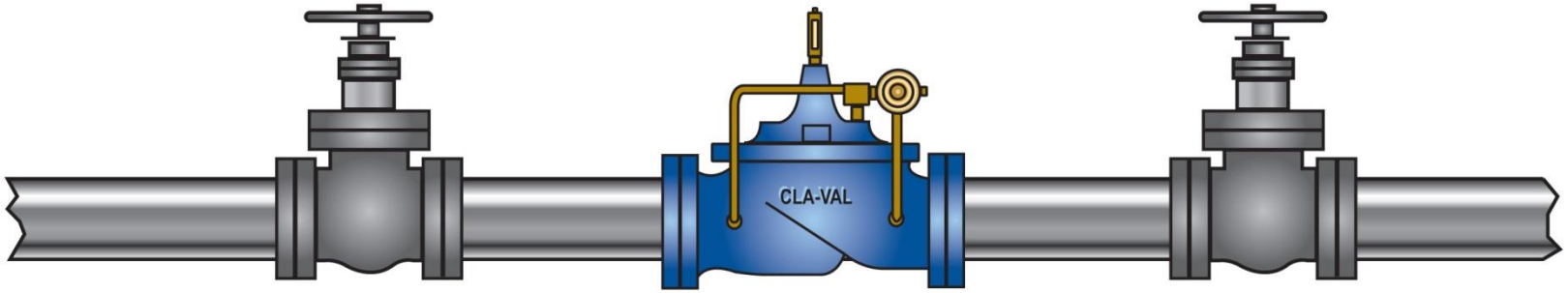
- Make sure all mainline isolation valves are closed
- Have X101 and pressure gauges installed
- Slowly open mainline inlet isolation valve slightly
- Open all ball valves, start with ‘upstream’ ball valve
- Bleed air from high points



- Make sure all mainline isolation valves are closed
- Have X101 and pressure gauges installed
- Slowly open mainline inlet isolation valve slightly
- Open all ball valves, start with ‘upstream’ ball valve
- Bleed air from high points
- Fully open mainline inlet isolation valve



- Make sure all mainline isolation valves are closed
- Have X101 and pressure gauges installed
- Slowly open mainline inlet isolation valve slightly
- Open all ball valves, start with ‘upstream’ ball valve
- Bleed air from high points
- Fully open mainline inlet isolation valve
- Slowly open downstream mainline isolation valve



- Make sure all mainline isolation valves are closed
- Have X101 and pressure gauges installed
- Slowly open mainline inlet isolation valve slightly
- Open all ball valves, start with ‘upstream’ ball valve
- Bleed air from high points
- Fully open mainline inlet isolation valve
- Slowly open downstream mainline isolation valve
- Check pressure gauges for proper set points

Cimco-GC SYSTEMS

Questions?

Cimco-GC SYSTEMS

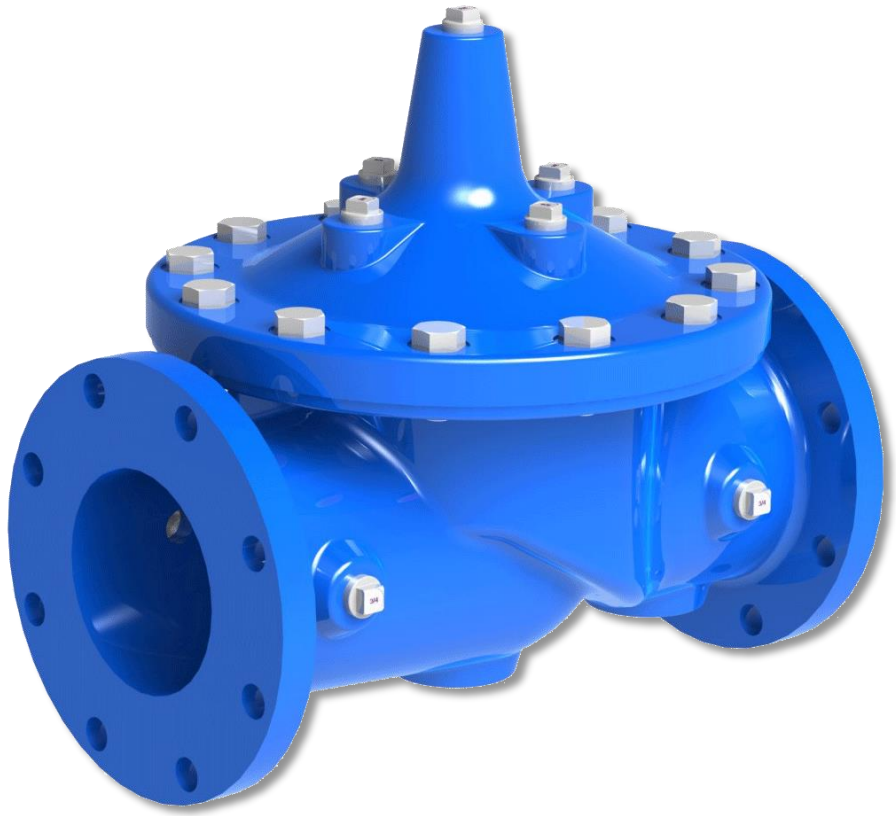
Selecting the Right Valve

Selecting the right valve

1. Function
2. Size
3. Features

1. Selecting Function

- Control Valve are extremely versatile
- 1 valve can have multiple functions
- Electronic control systems can be combined with hydraulic pilots

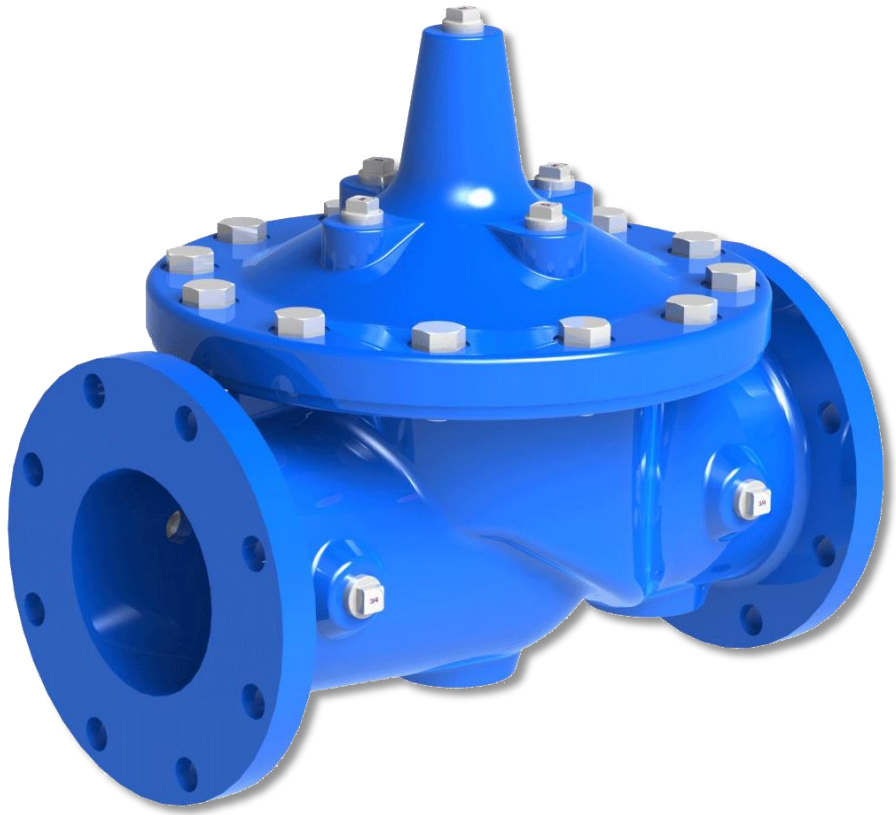


Necessary for many applications throughout the distribution system

- **Pressure Control**
  - Pressure Reducing
  - Pressure Sustaining
  - Pressure Relief
- **Flow Control**
  - Hydraulic Rate-of-Flow
  - Electronic flow control
- **Level Control**
  - Tank/Reservoir Fill
- **Surge Control**
  - Downstream Surge control
  - Surge Anticipators
- **Pump Control Valves**
  - Booster Pump Control
  - Deep Well Pump Control
- **Electronic Control Valves**
  - Programmable Features
  - SCADA Integration
- **Check Valves**

Selecting Function Tips

- Identify the Main Function
  - *Series*
- Identify secondary functions desired
  - *Specific model*



Function – Flow Direction

- 80 series control valves are primarily check function
- Check feature can be added to almost any control valve
- Return flow feature can be added to promote return flow
- Two-direction control is also available

Function – Flow Direction

Pressure Reducing and Sustaining in both directions

2. Selecting Size

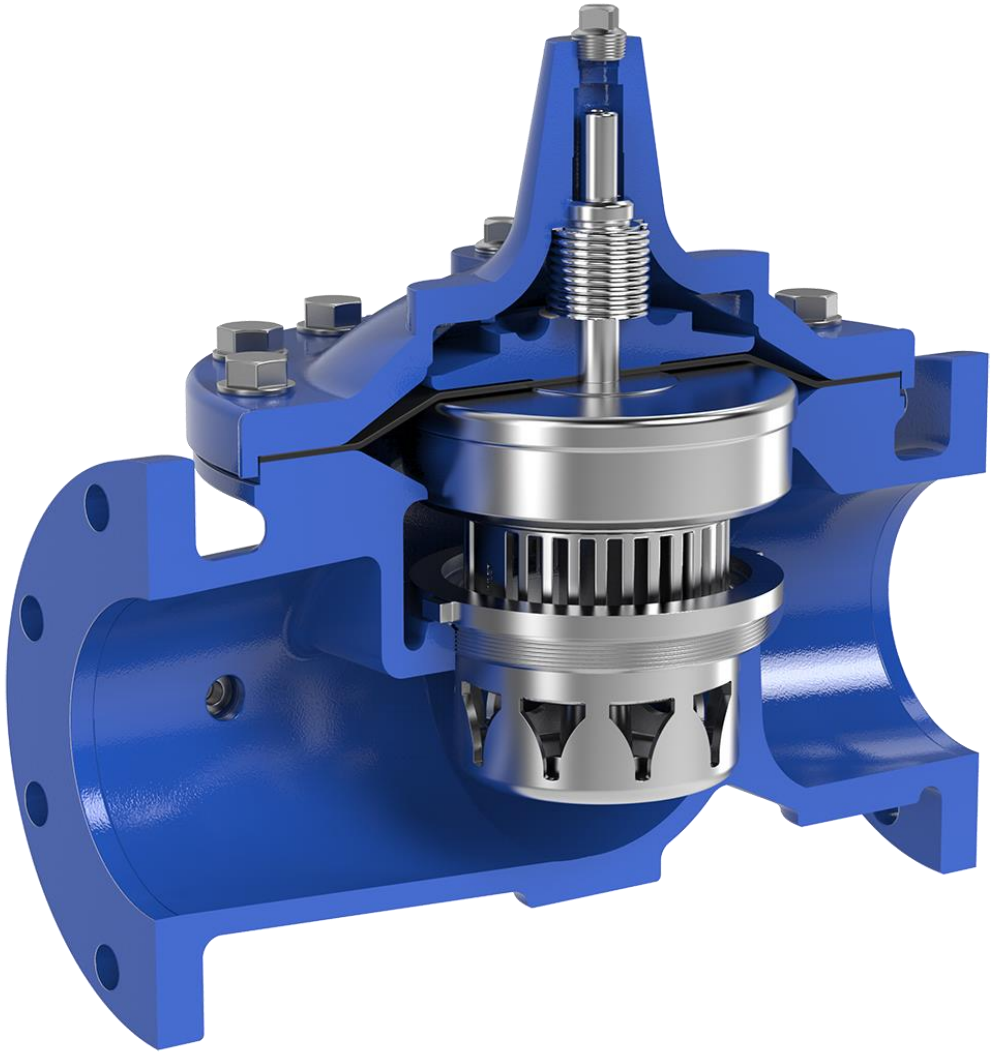
- Sizing criteria for control valves depends upon application:
  - *Pressure Reducing*
  - *Pressure Relief*
  - *Check, Altitude, etc*
- Globe and Angle Patterns
- Full and Reduced Port

Sizing Pressure Reducing Valves

- Sized for Maximum and minimum flow requirements
- Do not exceed 20 ft/s velocity for continuous flow
- Up to 25 ft/s for fire flow
- Minimum 10 psi differential
- High differentials can lead to cavitation concerns

Cavitation

- Results from high pressure differentials or atmospheric discharge
- Can cause noise, flow reduction, and valve damage
- KO Anti-Cavitation Cage available to protect the valve



Cavitation Damage

90-01 Sizing Chart

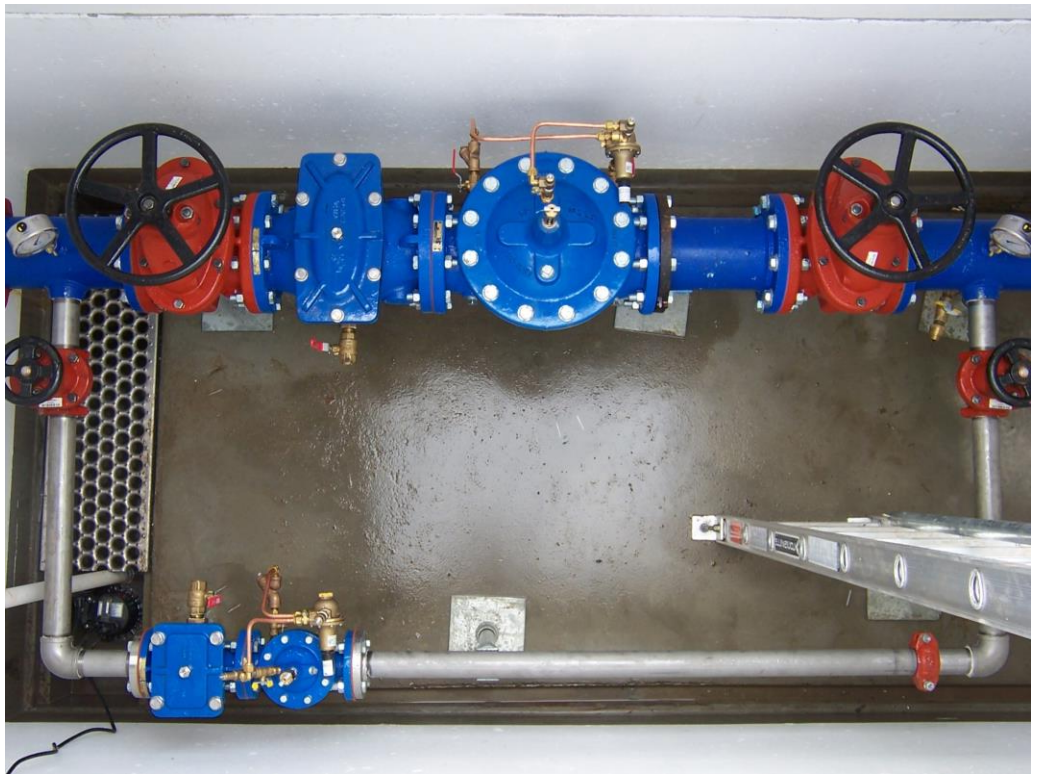
90-01 Valve Selection	100-01 Pattern: Globe (G), Angle (A), End Connections: Threaded (T), Grooved (GR), Flanged (F) Indicate Available Sizes																	
	Inches	1	1¼	1½	2	2½	3	4	6	8	10	12	14	16	18	20	24	30	36
	mm	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900
Main Valve 100-01	Pattern	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G	G	G, A	G	G
	End Detail	T	T	T, F, Gr*	T, F, Gr	T, F, Gr*	T, F, Gr	F, Gr	F, Gr*	F, Gr*	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	55	93	125	210	300	460	800	1800	3100	4900	7000	8400	11000	14000	17000	25000	42000	50000
	Maximum Intermittent	68	120	160	260	370	580	990	2250	3900	6150	8720	10540	13700	17500	21700	31300	48000	62500
	Minimum	1	1	1	1	2	2	4	10	15	35	50	70	95	120	150	275	450	650
Suggested Flow (Liters/Sec)	Maximum	3.5	6	8	13	19	29	50	113	195	309	442	530	694	883	1073	1577	2650	3150
	Maximum Intermittent	4.3	7.6	10	16	23	37	62	142	246	387	549	664	863	1104	1369	1972	3028	3940
	Minimum	.03	.03	.03	.06	.09	0.13	0.25	0.63	0.95	2.2	3.2	4.4	6.0	7.6	9.5	17.4	28.4	41.0

100-01 Series is the full internal port Hytrol. **For Lower Flows Consult Factory** *Globe Grooved Only

Sizing Pressure Reducing Stations

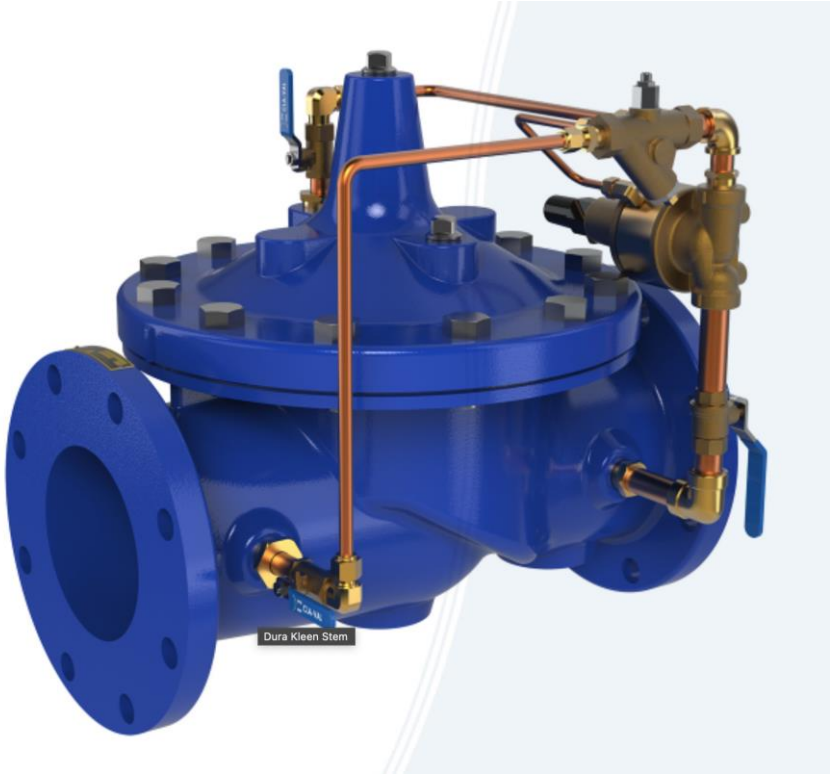
Bypass system standard:

- Large Valve is sized for maximum flows (Fire/high usuage)
- Small valve is sized to pair with large and provide low flow
- Common pairings
  - 6” + 2”
  - 8” + 3”
  - 10” + 4”



Sizing Pressure Relief Valves

- Generally sized to relieve excess pressure, not full flow
  - 33%-50% of flow depending on pressures and velocities
- Up to 45 feet per second velocity acceptable for maximum surge capacity



50-01 Sizing Chart

50-01 Valve Selection	100-01 Pattern: Globe (G), Angle (A), End Connections: Threaded (T), Grooved (GR), Flanged (F) Indicate Available Sizes																	
	Inches	1	1¼	1½	2	2½	3	4	6	8	10	12	14	16	18	20	24	30	36
	mm	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900
Main Valve 100-01	Pattern	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G	G	G, A	G	G
	End Detail	T	T	T, F, Gr*	T, F, Gr	T, F, Gr*	T, F, Gr	F, Gr	F, Gr*	F, Gr*	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	55	93	125	210	300	460	800	1800	3100	4500	7000	8400	11000	14000	17000	25000	42000	50000
	Maximum Surge	120	210	280	470	670	1000	1800	4000	7000	11000	16000	19000	25000	31000	35000	56500	63000	85000
Suggested Flow (Liters/Sec)	Maximum	3.5	6	8	13	19	29	50	113	195	309	442	530	694	883	1073	1577	2650	3150
	Maximum Surge	7.6	13	18	30	42	63	113	252	441	693	1008	1197	1577	1956	2461	3560	3975	5360

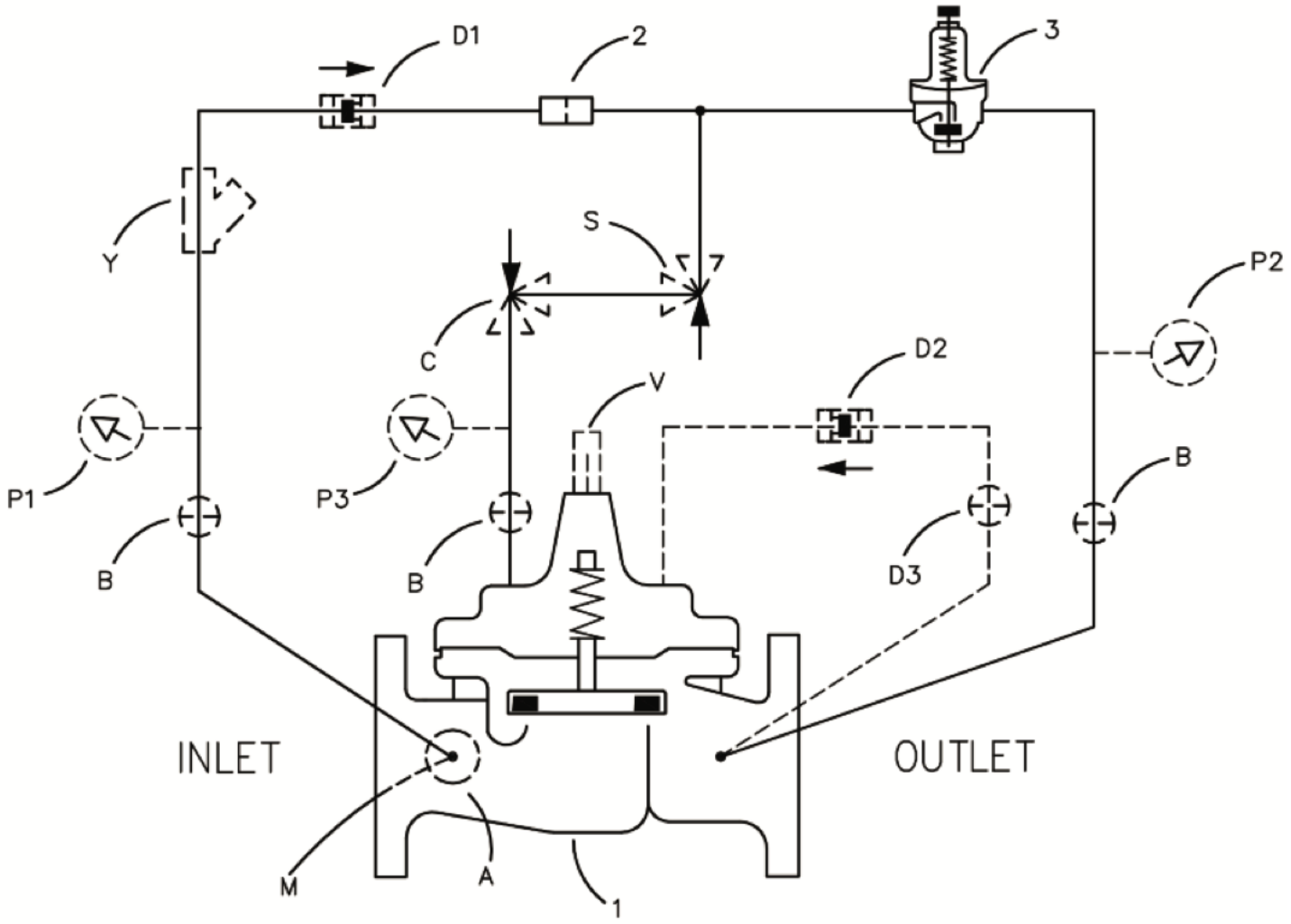
100-01 Series is the full internal port Hytrol.

*Globe Grooved Only

3. Selecting Features

- “Optional” features do not affect the primary function of the valve but impact operation, usability, and maintenance
- Depending on the application, some optional features are required

Schematic Features



Schematic Diagram

Item	Description
1	100-01 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
M	X144 e-FlowMeter
P	X141 Pressure Gauge
S	CV Flow Control (Opening)
V	X101 Valve Position Indicator
Y	X43 "Y" Strainer

*The closing speed control (optional) on this valve should always be open at least three (3) turns off its seat.

Additional Optional Features

- Some options are available even if not listed on schematic
- Not all optional features are available for a valve
  - Some conflict
  - Some will not fit

SUFFIX / OPTIONS	
A	X46 Flow Clean Strainer
Y	X43 “Y” Pattern Strainer
B	CK2 Isolation Valves
F	Independent Operating Pressure
C	CV Closing Speed Control
D	Check Valves with Isolation Valves
E	X117D Valve Position Transmitter
H	Atmospheric Drain
N	VC-22D Electronic Controller
M	X144D Flow Meter
S	CV Opening Speed Control
P	Inlet/Outlet Pressure Gauges
V	X101 Valve Position Indicator
KC	Epoxy Coating (Main Valve)
KD	Dura-Kleen® Stem
KE	Motorized Pilot Valve
KG	Delrin Stem Sleeve
KO	Anti-Cavitation Trim
KR	Reverse Flow (Main Valve)
KB	KB Viton Rubber Parts
X	Extra/Unique, i.e. Adders

Example model numbers

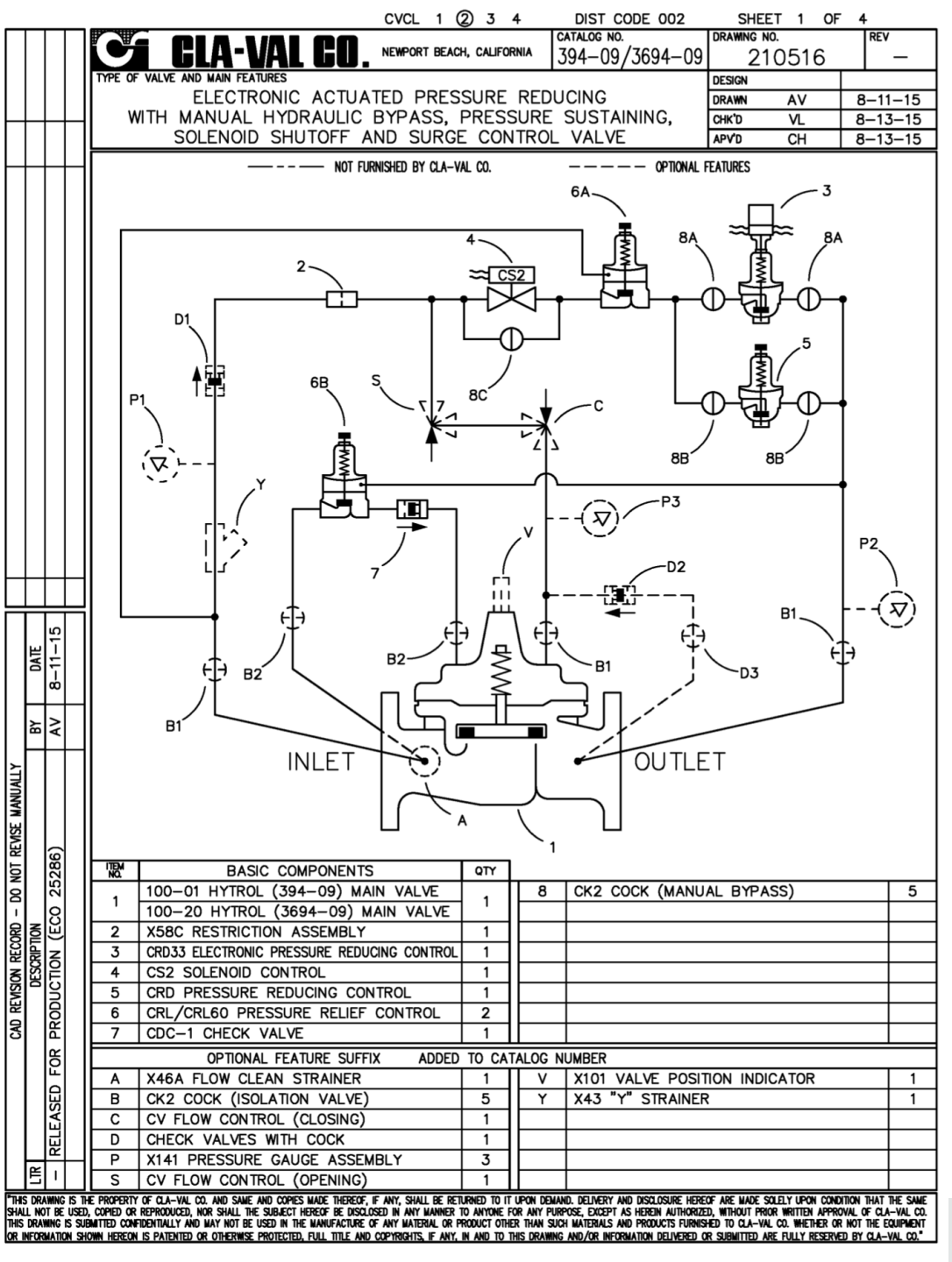
- 2” 90G-01BCSVYKCD

Example model numbers

8” 3694G-09BCDMYKCO

Example model numbers

8” 3694G-09BCDMYKCO



Material Options

- Body
  - Ductile iron, epoxy coating, stainless steel, bronze, etc...
- Valve Trim
  - Stainless steel, monel, KO, Dura-Kleen, etc...
- Pilot System
  - Tubing and fittings
  - Pilots, speed controls, sensors, etc...

Questions?

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