Waterworks

BERMAD SEMINAR – JAKARTA – MAY 2018

HYDRAULIC CONTROL VALVE
“THE BASICS”

HYDRAULIC CONTROL VALVE – “THE BASICS”

- Flow and pressure in distribution networks are constantly changing due to many parameters:
  - Consumption and demand
  - Pumps – starting and stopping
  - Water level in reservoirs
  - Topography
  - Pipes sizes and materials

- To ensure system efficiency we need to use a smart variable resistance device, also called:

  REGULATING CONTROL VALVE

HYDRAULIC CONTROL VALVE – “THE BASICS”

A control valve that uses the existing fluid line pressure as its operating energy, enabling it to operate independently is a:

“SELF OPERATED HYDRAULIC CONTROL VALVE”

HYDRAULIC CONTROL VALVE – “THE BASICS”

Terminology

A1 = Seat area

A2 = Diaphragm area

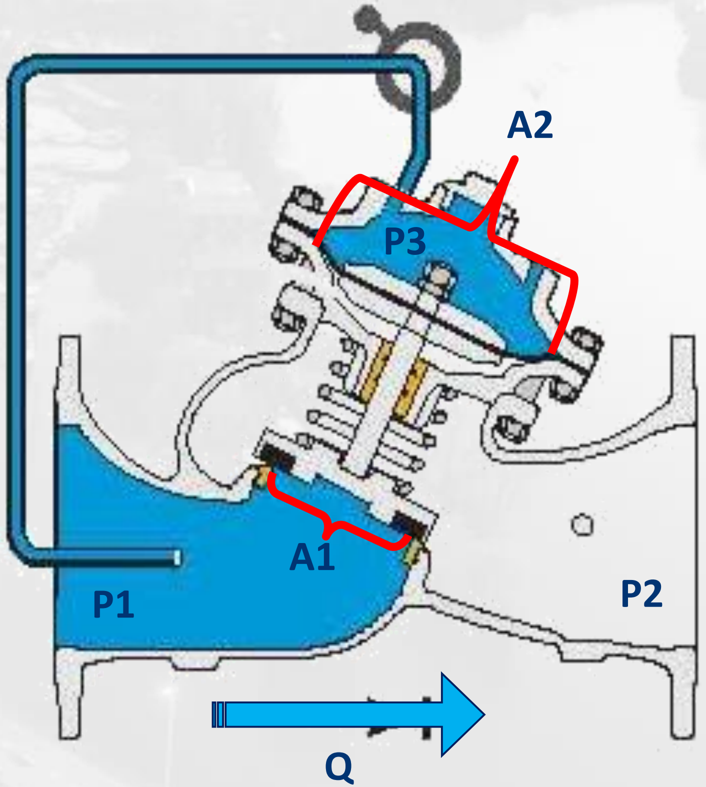
P1 = Upstream pressure

P2 = Downstream pressure

P3 = Control Chamber pressure

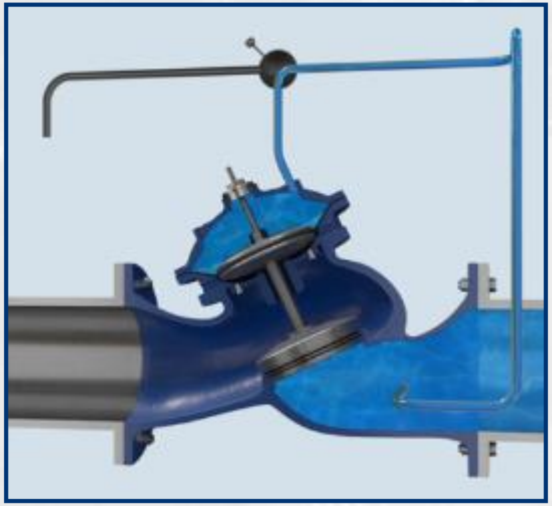
ΔP = Pressure drop (P1-P2)

Q = Flow



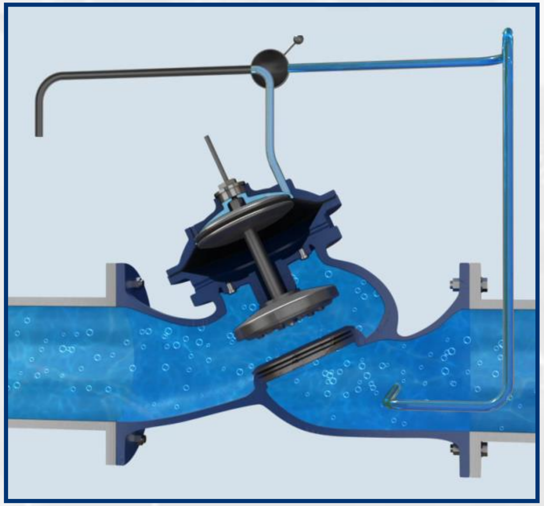
HYDRAULIC CONTROL VALVE – "THE BASICS"

Operating Modes



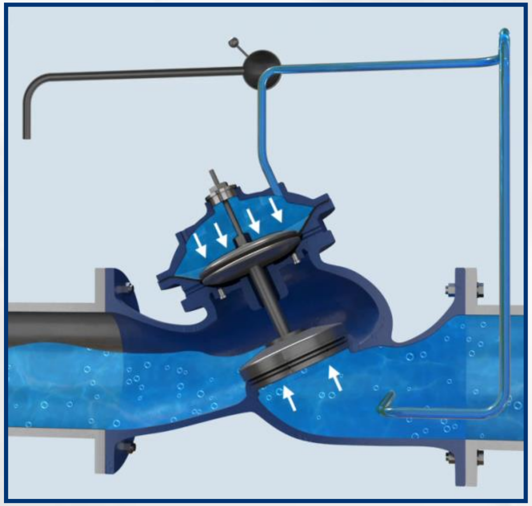
Closed

Upstream pressure connected to Control Chamber



Open

Control Chamber is vented to atmosphere

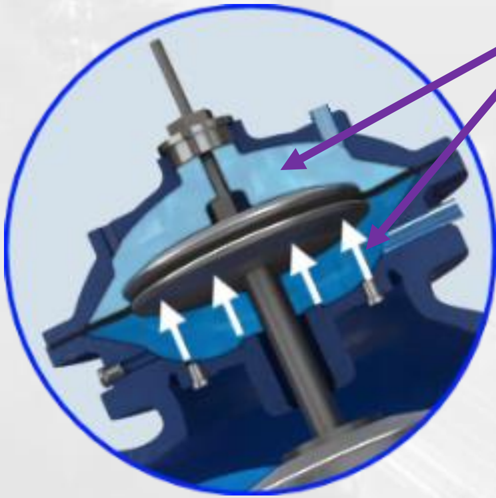


HYDRAULIC CONTROL VALVE – “THE BASICS”

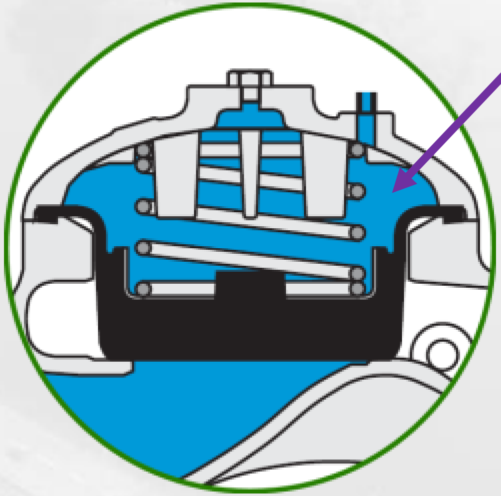
Actuator types

Hydraulic control valves are defined in many ways, and one of the important parameters is the number of control chambers, or the actuator type of the valve

Double Chamber

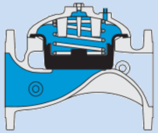
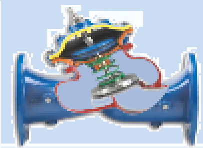
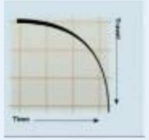
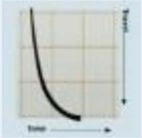
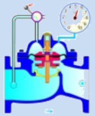
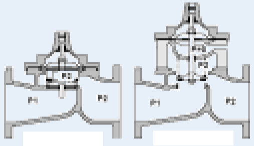
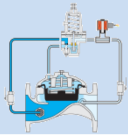
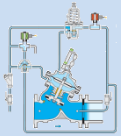


Single Chamber



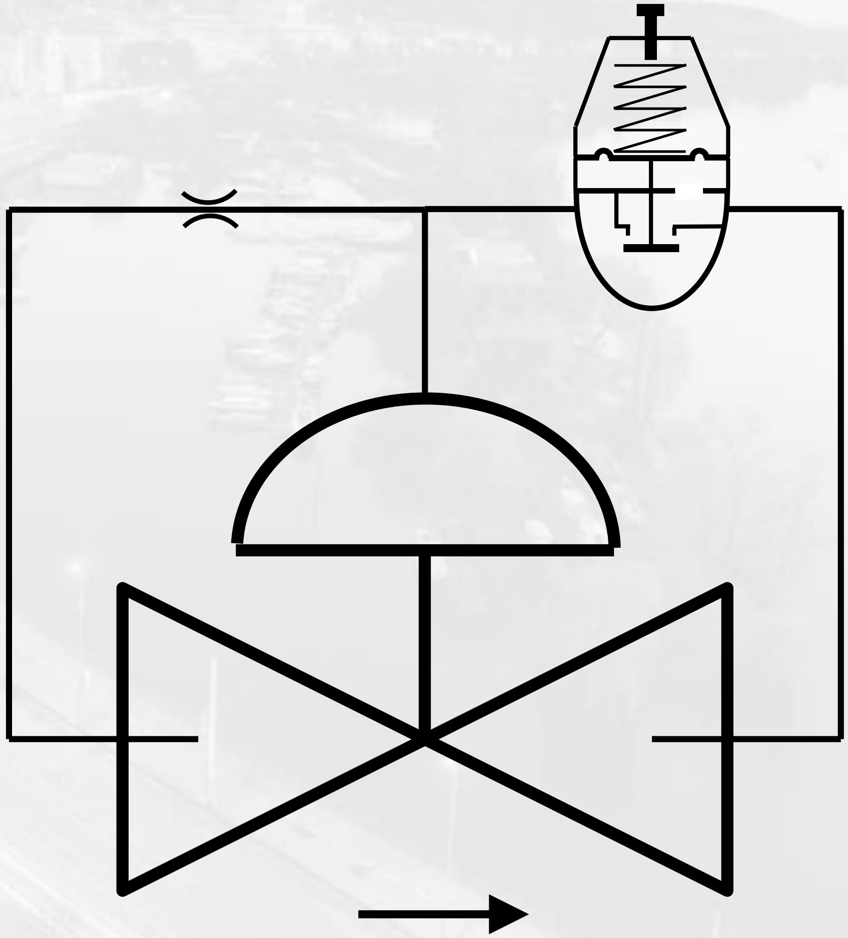
HYDRAULIC CONTROL VALVE – "THE BASICS"

Actuator types - comparison

Parameter	Single Chamber		Double Chamber	
Construction	Simple		Complex	
Closing	Slow with slam		Fast with slowdown	
Opening	Accelerating		Fast and controlled	
Conversion	Difficult to impossible		Simple and Easy	
Applications	Limited		Wide range	

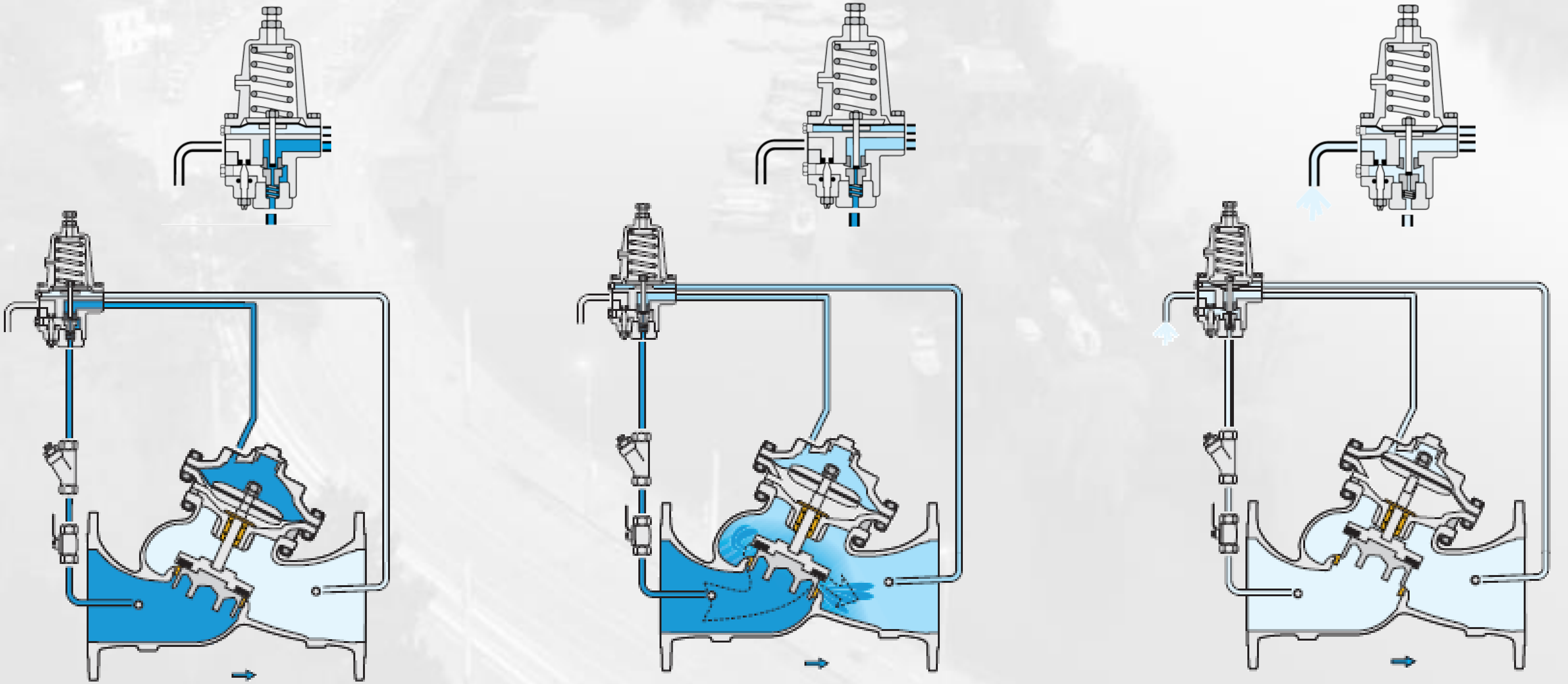
HYDRAULIC CONTROL VALVE – "THE BASICS"

Pilot Control – 2-way



HYDRAULIC CONTROL VALVE – "THE BASICS"

Pilot Control – 3-way



HYDRAULIC CONTROL VALVE – “THE BASICS”

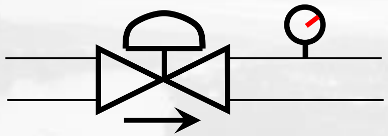
Pilot Control – 2-way & 3-way – comparison

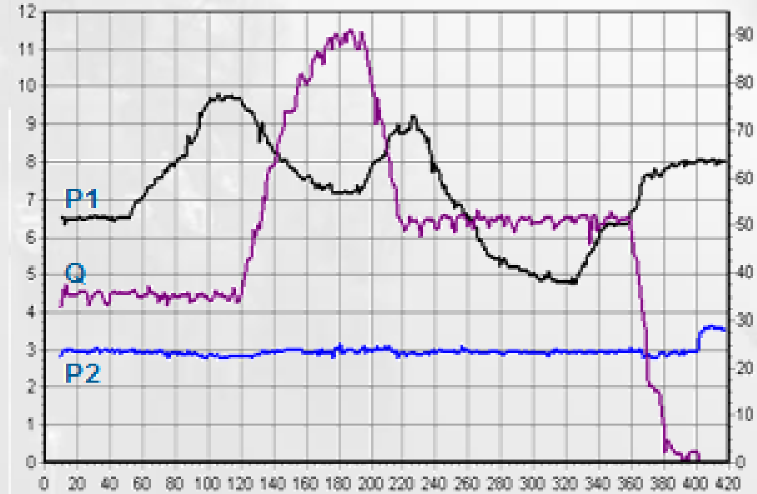
Parameter	3-way	2-way
Code	X	NA (standard)
Dp	Low (dp = $(Q/Kv)^2$)	4.0m aprox.
Accuracy	++	+++
Sensitivity	++	++++
Stability	++++	+++
Complexity	++++	++
Setting	Low	Very Low
Water quality	Poor	Potable
drainage	Atmosphere	Downstream

PRESSURE REDUCING

BERMAD PRESSURE REDUCING VALVES

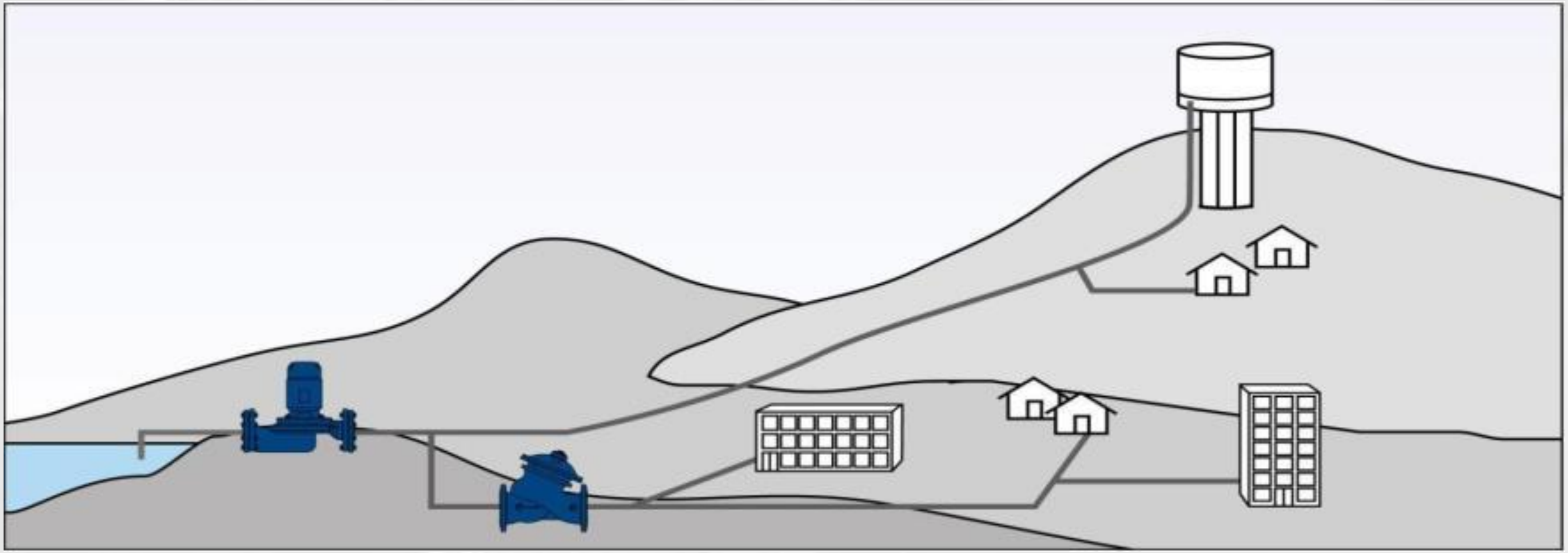
Pressure Reducing Control Valves (P.R.V.s) are automatic control valves which reduce a higher inlet/upstream pressure into a lower constant outlet/downstream pressure, regardless of fluctuating flow and varying inlet pressure





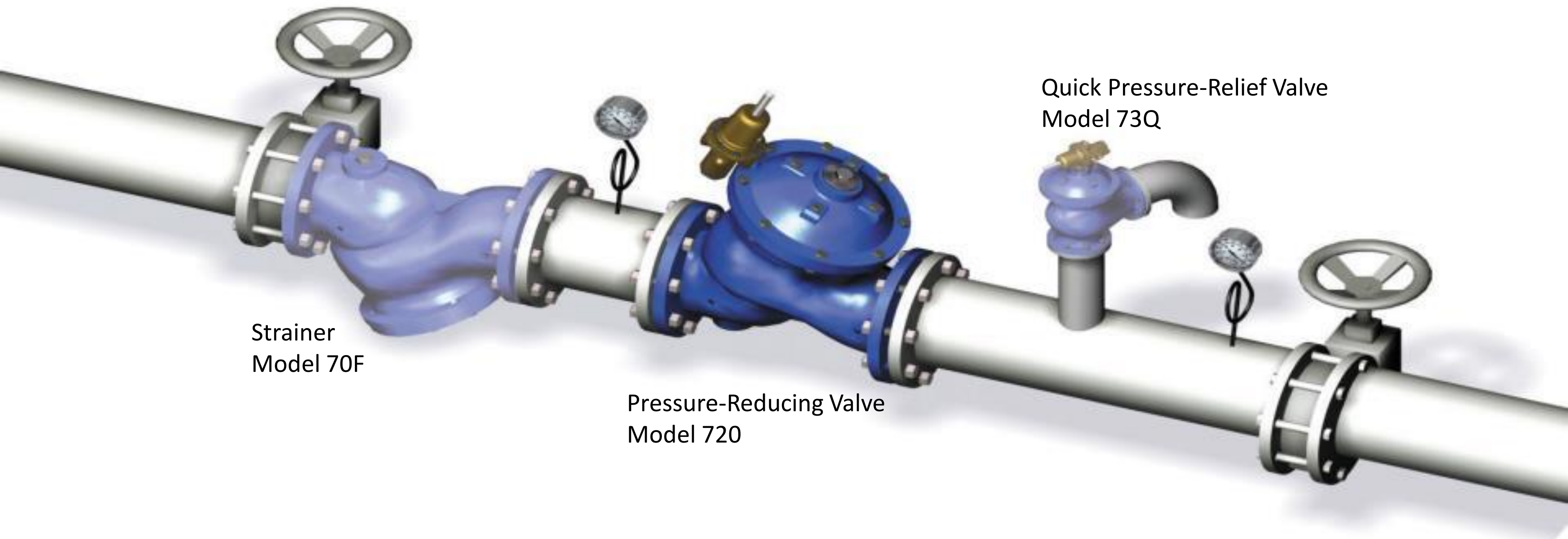
BERMAD PRESSURE REDUCING VALVES

Typical applications - Distribution Networks



BERMAD PRESSURE REDUCING VALVES

Typical Installation – Single branch

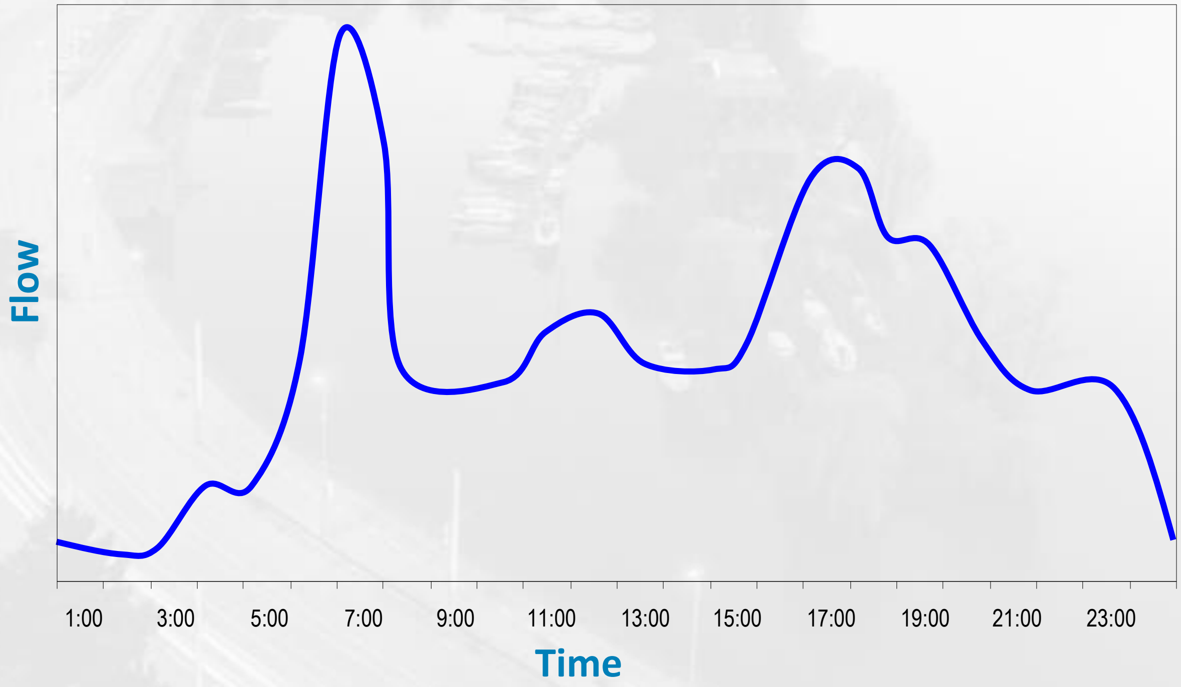


BERMAD PRESSURE REDUCING VALVES

Typical Installation – Parallel branches

BERMAD PRESSURE REDUCING VALVES

Sizing and selection – Varying conditions



BERMAD PRESSURE REDUCING VALVES

Sizing and selection – What influences the sizing of the valve ?

- Flow velocity
- Downstream pressure value
- Ratio of upstream & downstream
- Differential Pressure

Also consider:

- Line size
- Future demand

BERMAD PRESSURE REDUCING VALVES

Sizing and selection – Examples of influence by parameters

Example # 1 – Flow as a variable

Model: 6”-720-V (Ductile Iron body, V-Port plug)

P1= 90m

P2= 40m

Flow (m^3/h)		
50	120	200

BERMAD PRESSURE REDUCING VALVES

Sizing and selection – Examples of influence by parameters

Example # 2 – Upstream & Downstream pressure as variable

Model: 6”-720-V (Ductile Iron body, V-Port plug)

Q = 150m3/h

ΔP = 60m

Pressure (m) P1 >>> P2		
160 >>100	120 >> 60	70 >>10

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Sizing and selection – Examples of influence by parameters

Example # 3 – Downstream pressure as a variable

Downstream pressure as a variable

Model: 6"-720 (Ductile Iron body, V-Port plug)

Q= 150m3/h

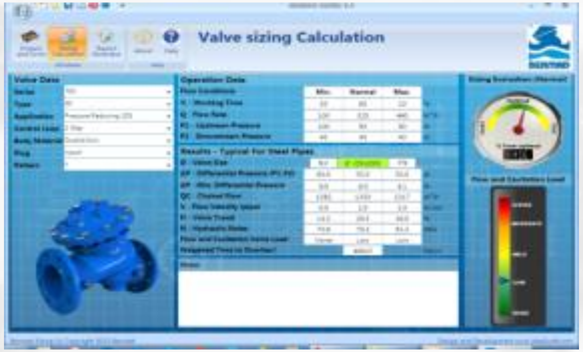
P1= 200m

Downstream Pressure (m)		
100	50	15

BERMAD PRESSURE REDUCING VALVES

Sizing and selection – Solutions

- Sizing according to actual working conditions
  BERMAD SIZING
- Better valve body design
  BERMAD 700 VALVES
- Two stage reduction
  Proportional Pressure Reducing Valves
- Higher cavitation resistant body materials
  Cast steel, etc.



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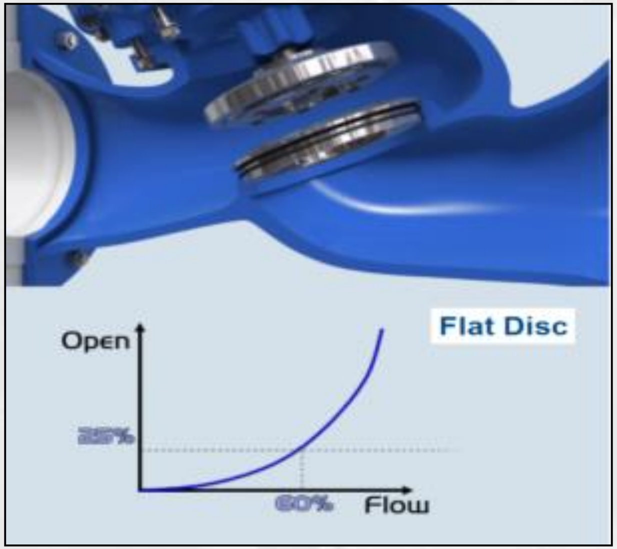
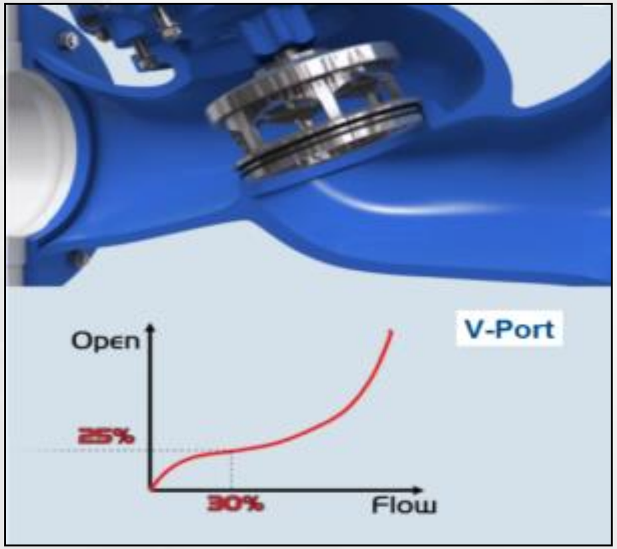
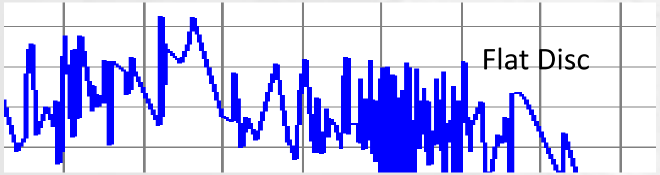
Sizing and selection – Additional Features

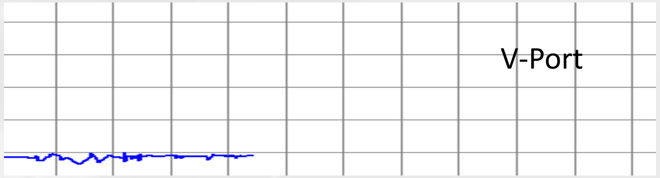
Plug Types – Flat or V-port







WW-8”-720
P1 = 10 bar



More accurate, stable regulation, especially at low flows

BERMAD PRESSURE REDUCING VALVES

Proportional Pressure Reducing Valve

$$\sum F \uparrow = P_1 \times A$$

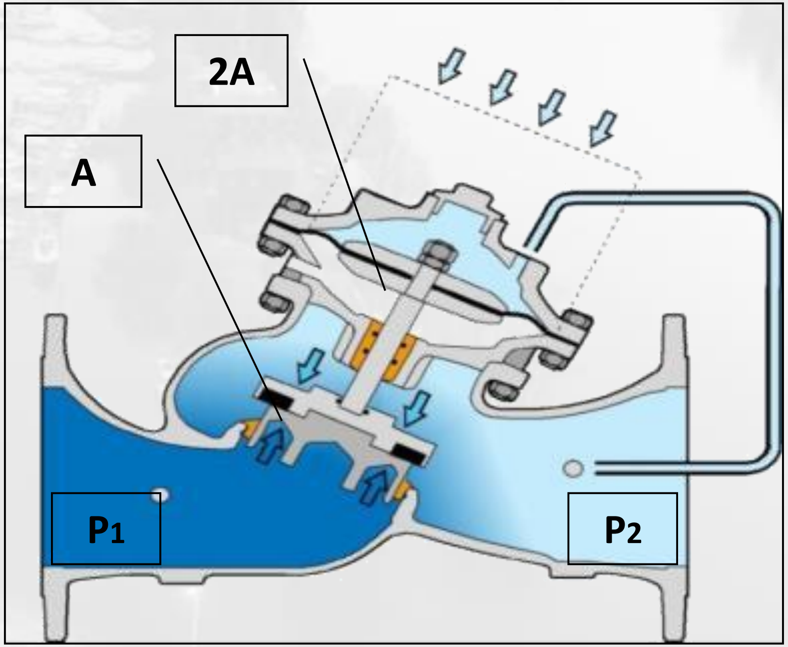
$$\sum F \downarrow = P_2 \times A + P_2 \times 2A = P_2 \times 3A$$

$$\sum F \uparrow = \sum F \downarrow$$

$$\Rightarrow P_1 \times A = P_2 \times 3A \quad \Big| \div P_2 \times A$$

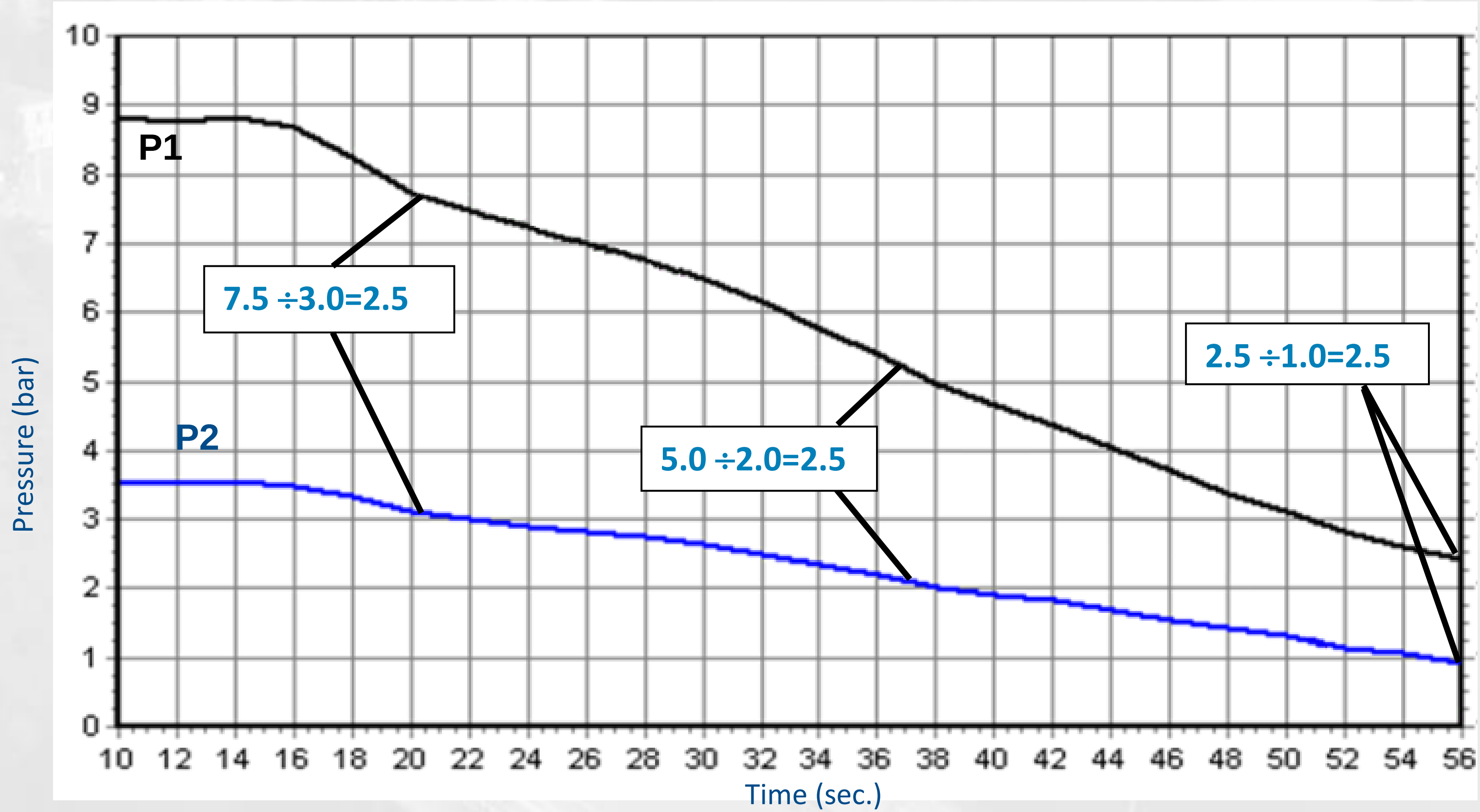
$$P_1 / P_2 = 3$$

$$\boxed{\Rightarrow P_2 = \frac{1}{3} P_1}$$



BERMAD PRESSURE REDUCING VALVES

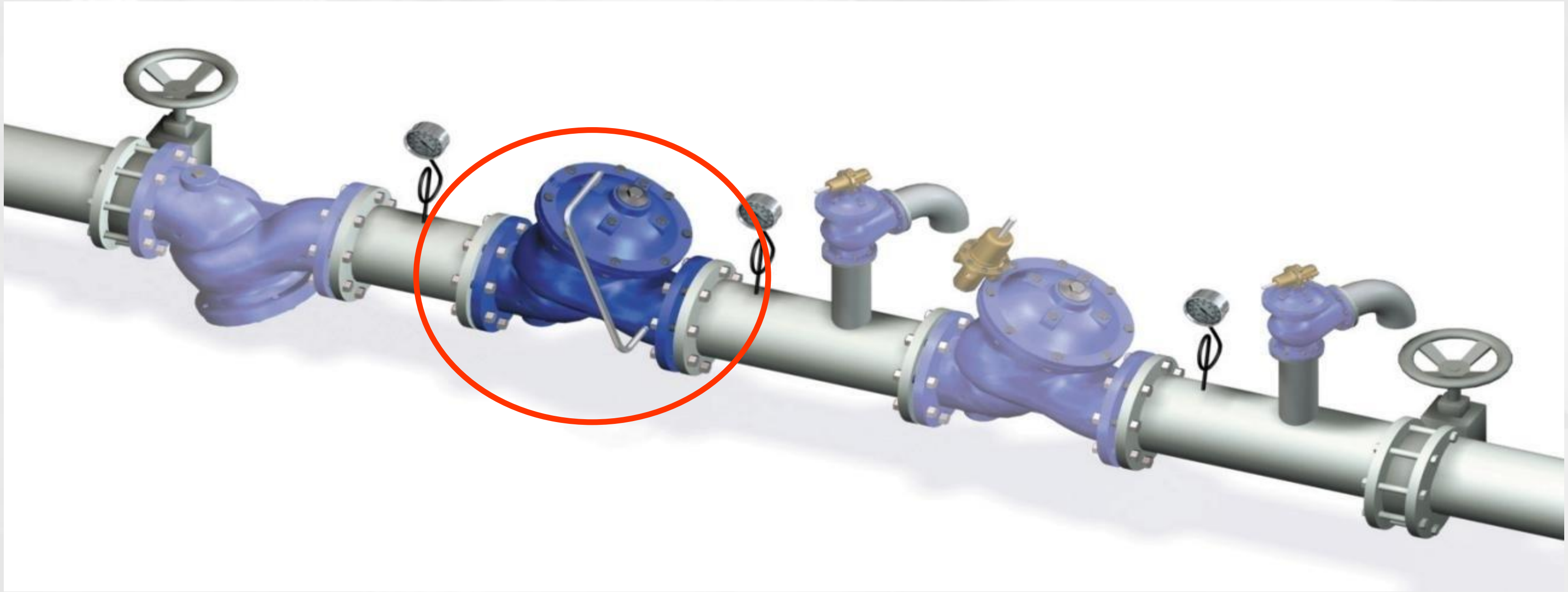
Proportional Pressure Reducing Valve – Constant Ratio



BERMAD PRESSURE REDUCING VALVES

Proportional Pressure Reducing Valve

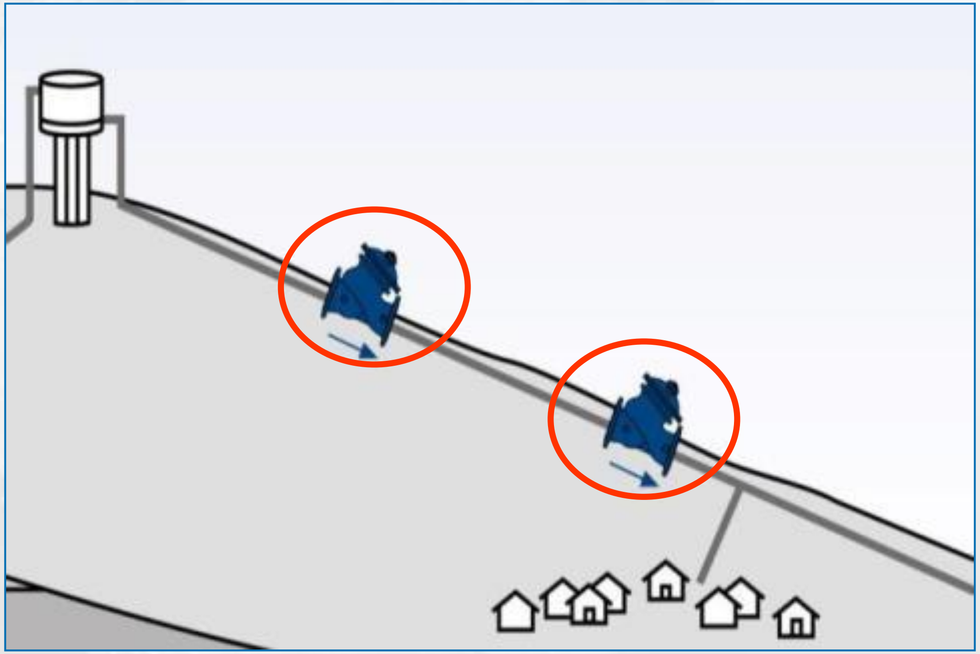
- Typical application – Two Stage Reduction



BERMAD PRESSURE REDUCING VALVES

Proportional Pressure Reducing Valve

- Typical application – Gravity system



BERMAD PRESSURE REDUCING VALVES

Proportional Pressure Reducing Valve

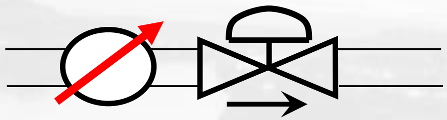
- Typical application – Level Control

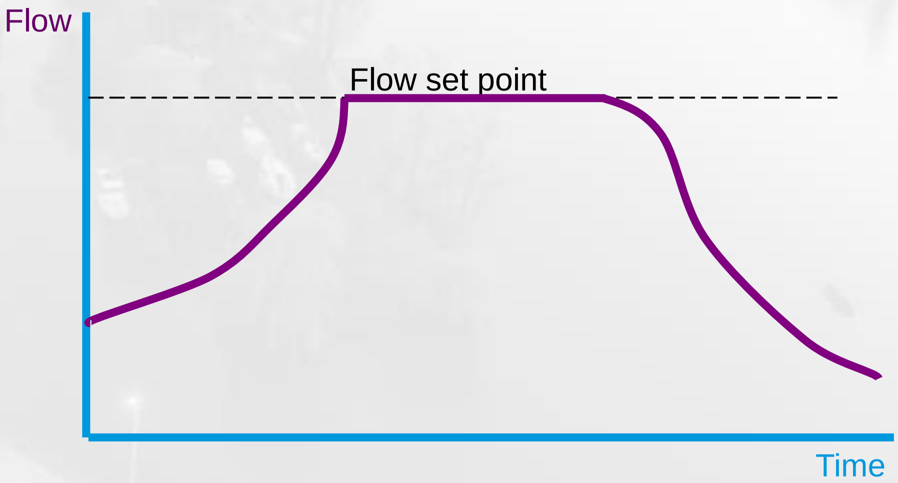
Proportional P.R.V. - Model 720-PD
Typical Installation – Reservoir Filling

FLOW CONTROL

BERMAD FLOW CONTROL VALVES

Flow Control Valves prevent excessive flow by limiting flow to a pre-set maximum value regardless of changing system pressures and demand





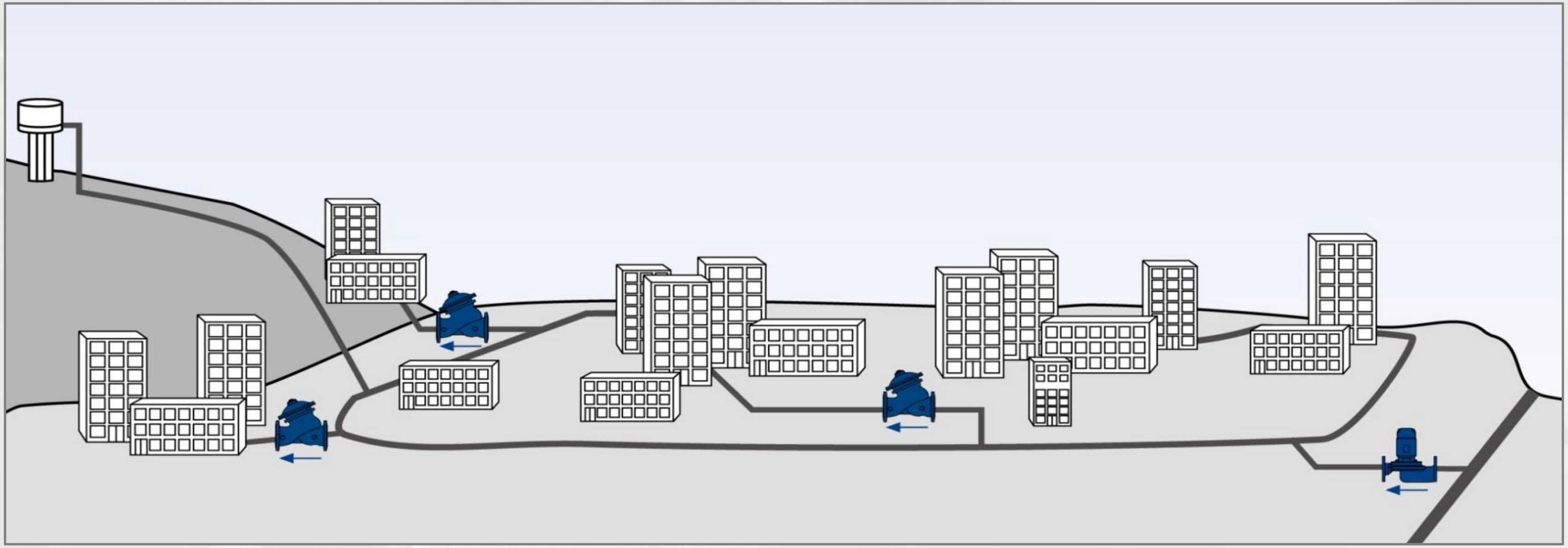
BERMAD FLOW CONTROL VALVES

Applications:

- Distribution networks – ensures design flow rates
- Reservoir fill-up
- Pumping stations:
  - Overload protection
  - Cavitation protection
- Filtration systems:
  - Water level control
  - Backwash flow control
- HVAC systems:
  - Heat exchangers
  - Chillers
  - Cooling towers
- Etc.

BERMAD FLOW CONTROL VALVES

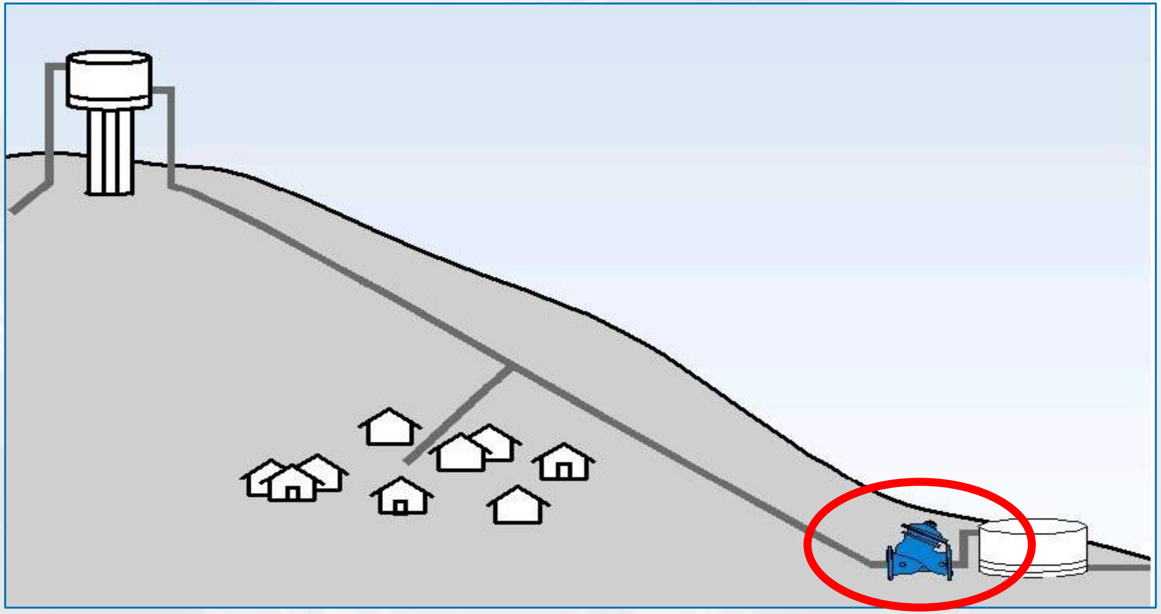
Distribution Networks – ensures design flow rates



BERMAD FLOW CONTROL VALVES

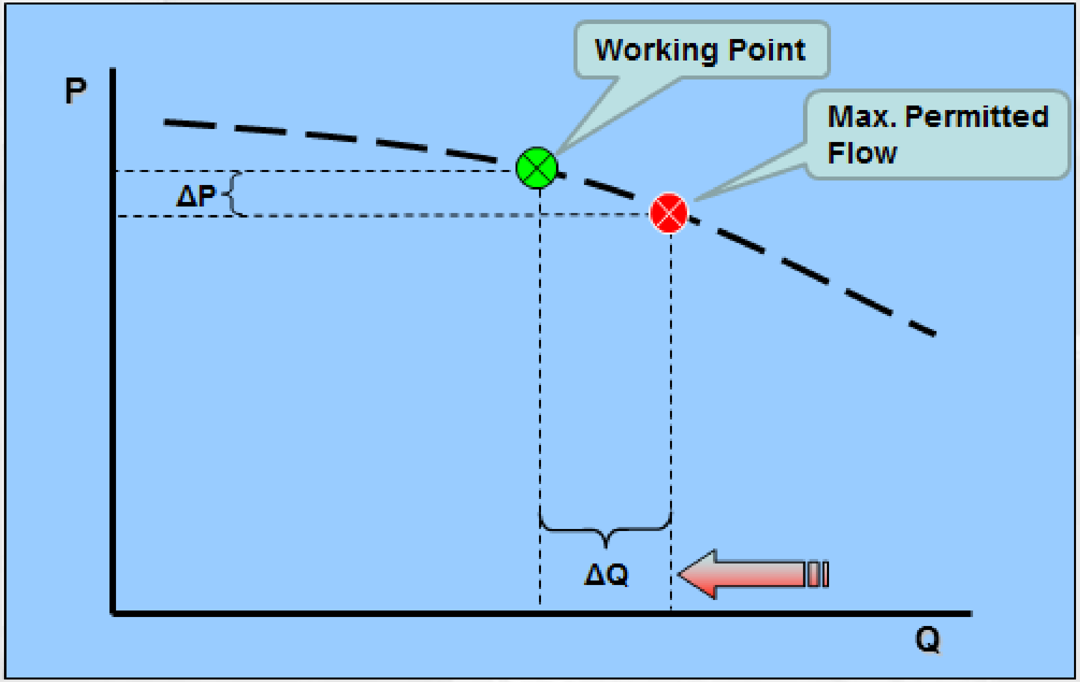
Reservoir fill-up

- Prioritizing consumers over reservoir filling
- Cavitation protection combined with reservoir level control



BERMAD FLOW CONTROL VALVES

Pump Overload and Cavitation Protection



BERMAD FLOW CONTROL VALVES

Filtration systems

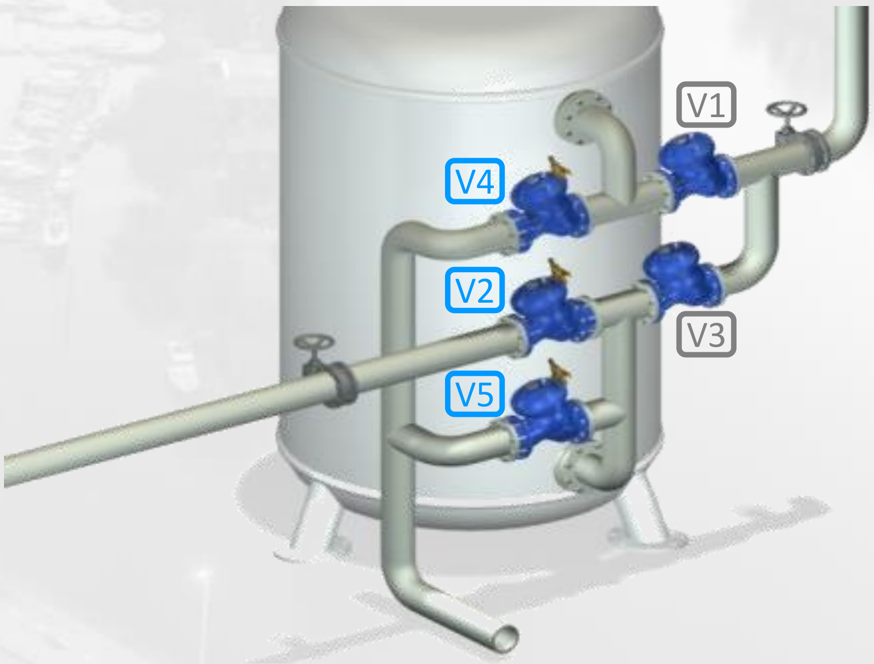
[V1] Untreated water inlet - Model 710 (N.O.)

[V2] Treated water outlet - Model 770-55-U (N.O.)

[V3] Back flushing inlet - Model 710 (N.C.)

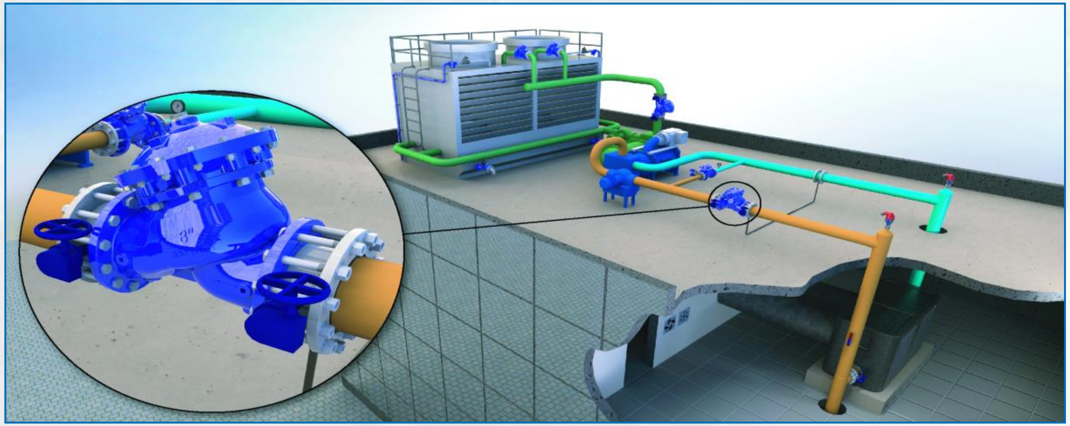
[V4] Back flushing outlet - Model 727-55-U (N.C.)

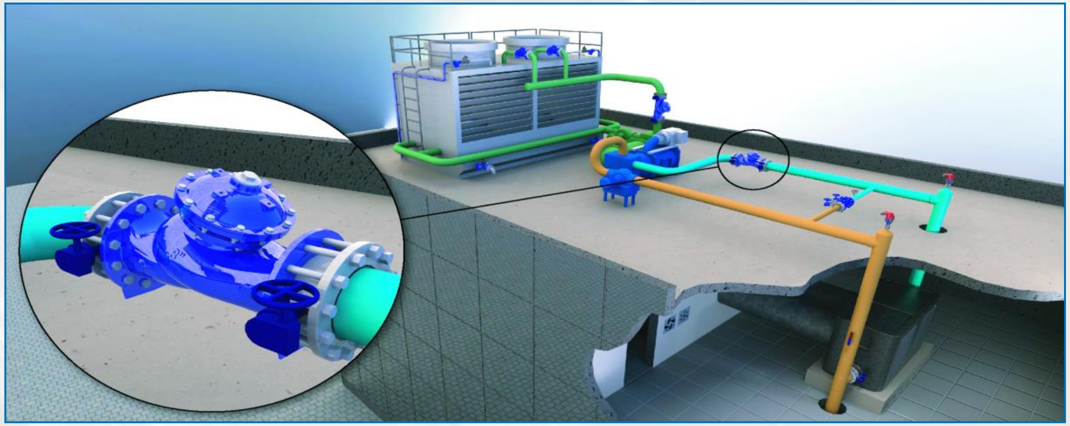
[V5] Rinse water outlet - Model 727-55-U (N.C.)



BERMAD FLOW CONTROL VALVES

HVAC systems



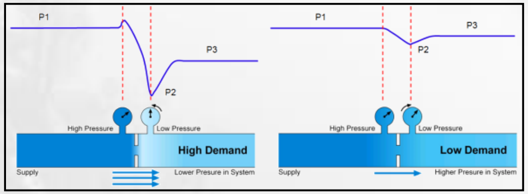


BERMAD FLOW CONTROL VALVES

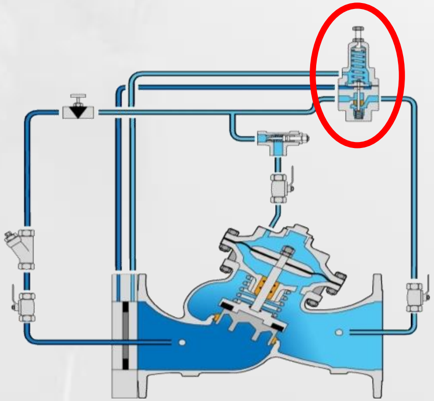
Principal of operation – Orifice Assembly

- Used for measuring the volumetric flow rate
- The Bernoulli principle – states that there is a relationship between the pressure and the flow velocity

- Flow velocity increase causes an increase in pressure drop, and vice versa



- The pressure drop (ΔP) created by the orifice plate is sensed by the pilot which then controls the Flow Control Valve to throttle



BERMAD FLOW CONTROL VALVES

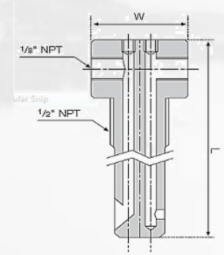
Orifice Assembly - information

- Orifice internal diameter is calculated for each valve according to project design data, using the Bersoft program
- Flow setting range of a differential sensing orifice can be: (-)15% to (+)25% from calculated flow

BERMAD FLOW CONTROL VALVES

Principal of operation – Pitot Tube

- When minimum head loss is essential and/or in large pipe diameters, measuring the volumetric flow rate can be done with a Pitot Tube



- The Bernoulli principle – states that there is a relationship between the pressure and the flow velocity

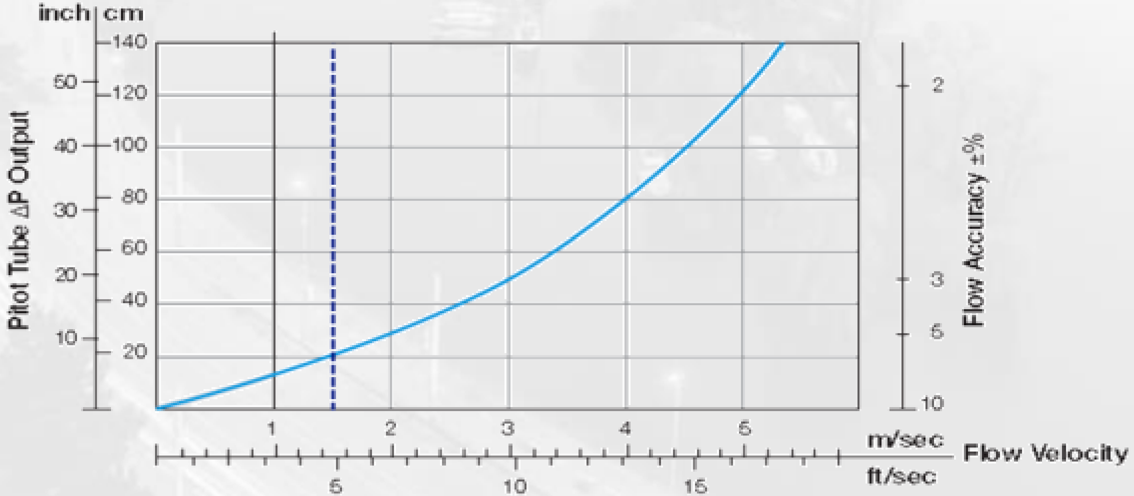
- The pressure drop (ΔP) created by the Pitot Tube is sensed by the high sensitivity pilot which then controls the Flow Control Valve to throttle

BERMAD FLOW CONTROL VALVES

Pitot Tube - information

- **Pitot Tube can fit a wide range of valve and pipe size**
- **Minimum design flow velocity – 1.0 m/sec**

  (recommended to be at least 1.5 m/sec)



THANK YOU!