

# 700 ES



**Diaphragm Actuated Valve**

## Basic Valve

The basic Model 700/705 ES diaphragm actuated valves are hydraulically operated globe valves in the standard oblique (Y) design. 700 ES – Anti-cavitation valves, designed to operate under difficult conditions while ensuring minimum cavitation damage and noise.

Each valve comprises two major components:  
The body seat assembly and the actuator assembly.

The actuator assembly is unitized and is removable from the body as an integral unit. It consists of both an upper and a lower control chamber.

Each basic valve can easily be configured on-site, either as a single chamber control valve (Model 705 ES), or a double chamber control valve (Model 700 ES). The shaft sub-assembly, in both single and double chambered versions, is center guided, providing an unobstructed seat area.

The Model 700 ES Basic double chambered valve operation is independent of valve differential pressure since the line pressure actually serves as the actuator differential pressure.

This develops maximum power, ensuring immediate valve response. The upper control chamber is pressurized to close, and vented to open the valve. The lower control chamber is usually vented to the atmosphere, but can also be pressurized to power the valve open.

The Model 705 ES Basic Valve uses valve differential pressure to power the actuator open or closed. The lower control chamber, which serves to cushion the closing of the valve, is exposed to downstream pressure through a fixed orifice connected to the downstream side of the valve. The pressure in the upper control chamber varies, usually resulting from the combined action of a regulating pilot and a fixed orifice. This varying pressure modulates the valve to open or close.

The Basic Hydraulic Valve is available in a wide range of materials, sizes, pressure ratings, and end connections. Single or double chambered versions are used as the main valve in all 700 ES Series applications.





[1]

[3A]

[2]

[5]

[5A]

[7]

700 Series Actuator

[3]

[4]

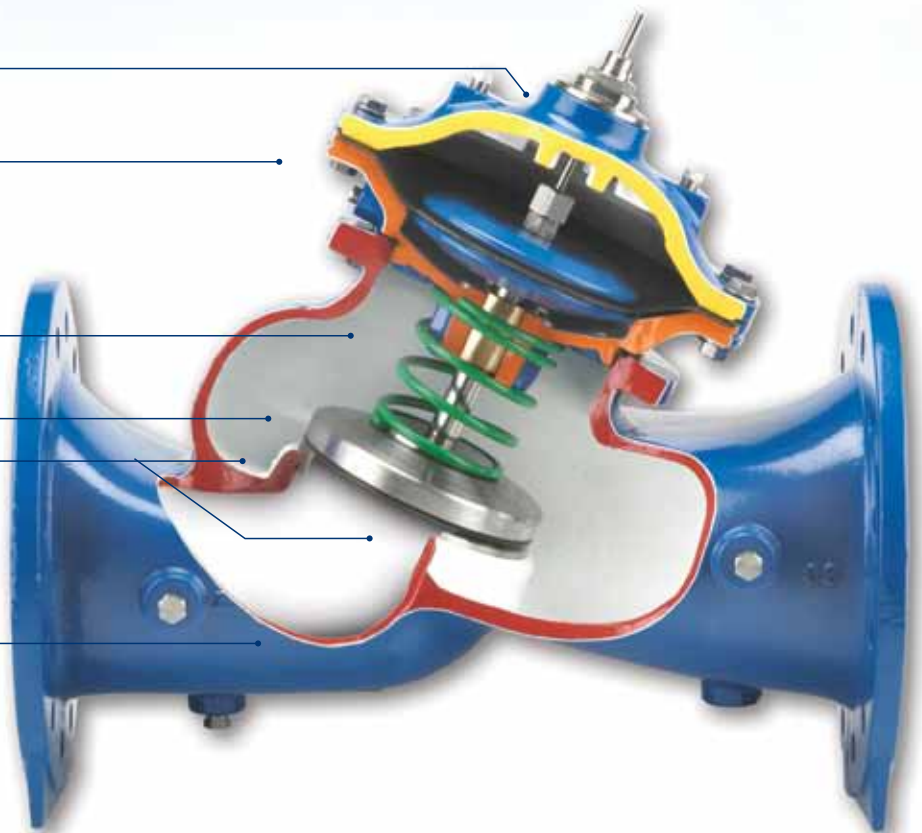
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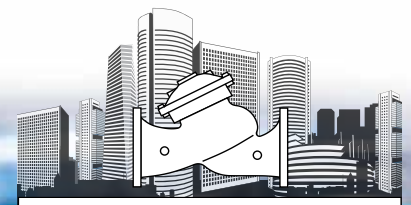
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### [1] **Double-Chambered Actuator**

- Actuator assembly can be removed as one integral unit
- Simple on-site conversion to single-chambered
- Same valve body accepts both actuators (Diaphragm and Piston)

### [2] **Diaphragm Assembly**

The flexible, unshaped, nylon-reinforced diaphragm is supported over the majority of its surface. Diaphragm load is limited to only the stretching forces applied to the active area.

### [3] **Cover Plug**

Enables on-site retrofit of:

- Indicator [4A]: For visual valve position indication
- Limit Switch: For signaling valve position
- Position Transmitter: For analog transmission of valve position

### [4] **Inherent Separation Partition**

The inherent separation includes the bearing [5A], which provides complete central guiding for the valve moving assembly. The separation partition separates the lower control chamber from the flow in both the single-chambered, and the double-chambered configurations.

### [5] **Spring**

Required for single-chambered configurations. Superfluous for double-chambered configurations (unless check feature is required).

### [6] **Seal Disc Assembly**

Self-aligning, seal disk assembly provides balanced, free movement and a resilient seal for perfect, drip-tight sealing. It enables using several variations of seals and plugs for a wide range of applications and working conditions.

### [7] **Seat**

Stainless steel, raised, replaceable in-line and on-site.

### [8] **Wide Body (“Y” pattern)**

Hydro-dynamically designed for efficient flow with minimal pressure loss and excellent resistance to cavitation. Full bore, valve port area clear of obstructions; no ribs or stem guides. Increases capacity by 25% over standard globe valves.

### [9] **End Connections**

Conforms to pressure ratings and standards of: ISO, 7005-2 (ISO 10, 16 and 25).

## **Valve Plug Options**



### **Flat Disc**

“Quick opening plug”: Standard plug provides high flow and quick response.

### **Throttling Plug**

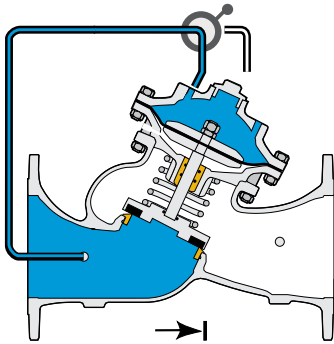
A throttling plug is used in order to provide more accurate, stable and smooth response for pressure and flow regulation while reducing noise and vibration.





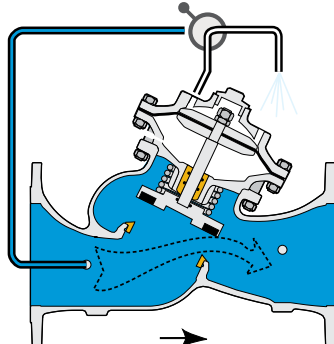
### Principle of Operation

#### On-Off Modes



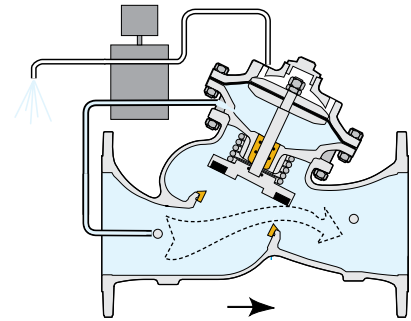
##### Closed Position

Line pressure applied to the upper control chamber of the valve creates a superior force that moves the valve to the closed position and provides drip-tight sealing.



##### Open Position

Discharging the pressure in the upper control chamber to atmosphere or some other lower pressure zone causes the line pressure acting on the seal-disk to move the valve to the open position.

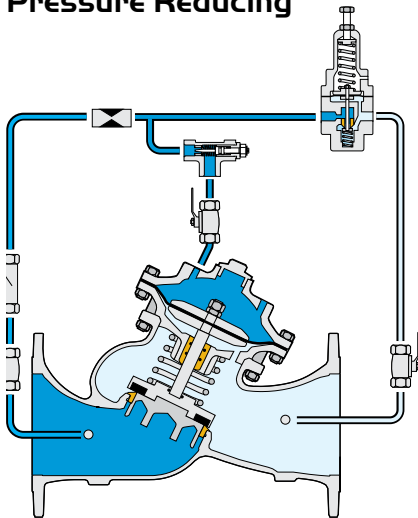


##### Powered Open Position

Line pressure is applied to the lower control chamber as pressure in the upper control chamber is vented. This, together with the line pressure acting on the seal-disk, creates a force that powers the valve to the open position.

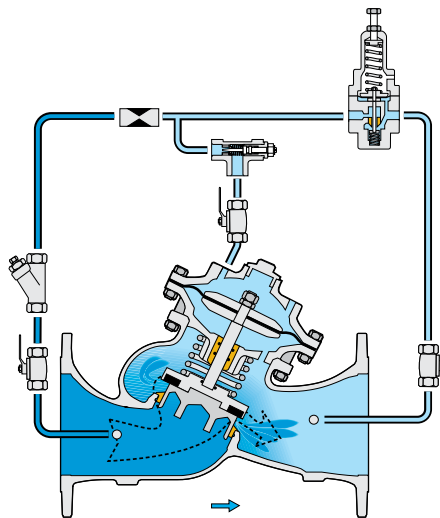
#### Modulating Mode

##### Pressure Reducing



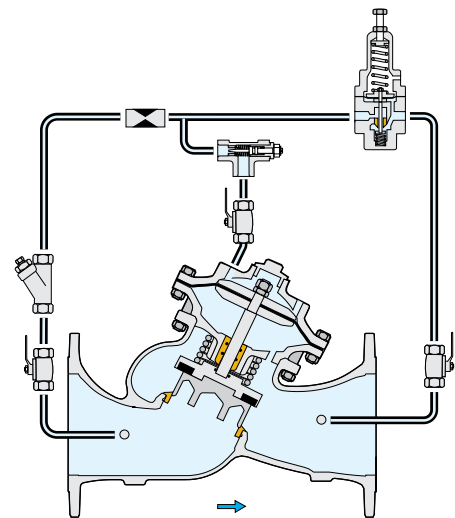
##### Closed Position

The closed adjustable pilot valve traps line pressure in the upper control chamber. The resulting superior force moves the valve to the fully closed position and provides drip-tight sealing.



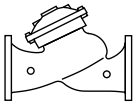
##### Modulating Position

The pilot valve senses line pressure changes and opens or closes accordingly. It controls the accumulated pressure in the valve upper control chamber, causing main valve to modulate to an intermediate position and maintain the preset pressure value.



##### Open Position

The open pilot valve releases line pressure from the upper control chamber. The line pressure acting on both the lower control chamber and the seal-disk, moves the valve to the open position.



700-ES Metric

### Technical Specifications

#### Series Patterns and Sizes

- 700-ES Series – "Y" Pattern – DN40-500

#### Connection Standard

- Flanged: ISO 7005-2 (ISO 10, 16 & 25)

#### Water Temperature

- Up to 80°C

#### Working pressure

- ISO PN 16: 16 bar
- ISO PN 25: 25 bar

#### Standard Materials

- **Main valve body and cover**  
Ductile Iron to EN 1563
- **Main valve internals**  
Stainless Steel, Bronze & Epoxy coated Steel
- **Control Trim**  
Brass, Bronze accessories  
Stainless Steel 316 fittings & tubing  
or forged Brass fittings & Copper tubing
- **Elastomers**  
NBR
- **Coating**  
Electrostatic Polyester Powder Blue  
Blue fusion bonded Epoxy

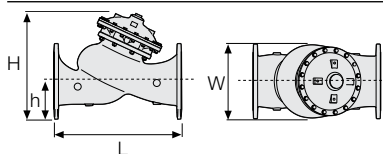
#### Optional Materials

- **Main valve body and cover**  
Carbon Steel to EN 10083-1  
Stainless Steel 316 to EN 10088-1  
Nickel Aluminum Bronze to BS-EN 1400 AB-2  
Other materials on request
- **Control Trim**  
Stainless Steel 316, Nickel Aluminum Bronze  
Hastalloy C-276 accessories  
Monel fittings & tubing
- **Elastomers**  
EPDM  
FPM

### Dimensions & Weights

#### Flanged

700-ES



	DN	40	50	65	80	100	125	150	200	250	300	400	500
PN 10; 16; 25	L (mm)	230	230	290	310	350	400	480	600	730	850	1,100	1,250
	W (mm)	150	165	185	200	235	270	300	360	425	530	626	838
	h (mm)	80	90	100	105	125	142	155	190	220	250	320	385
	H (mm)	240	250	250	260	320	375	420	510	605	725	895	1,185
	Weight (Kg)	10	10.8	13.2	15	26	40	55	95	148	255	436	1,061

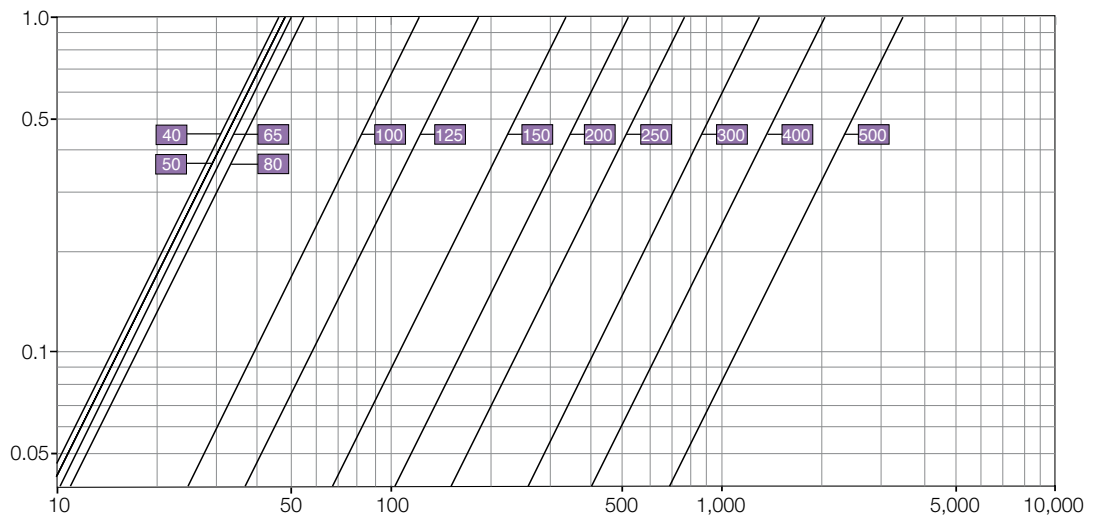
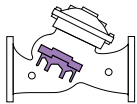
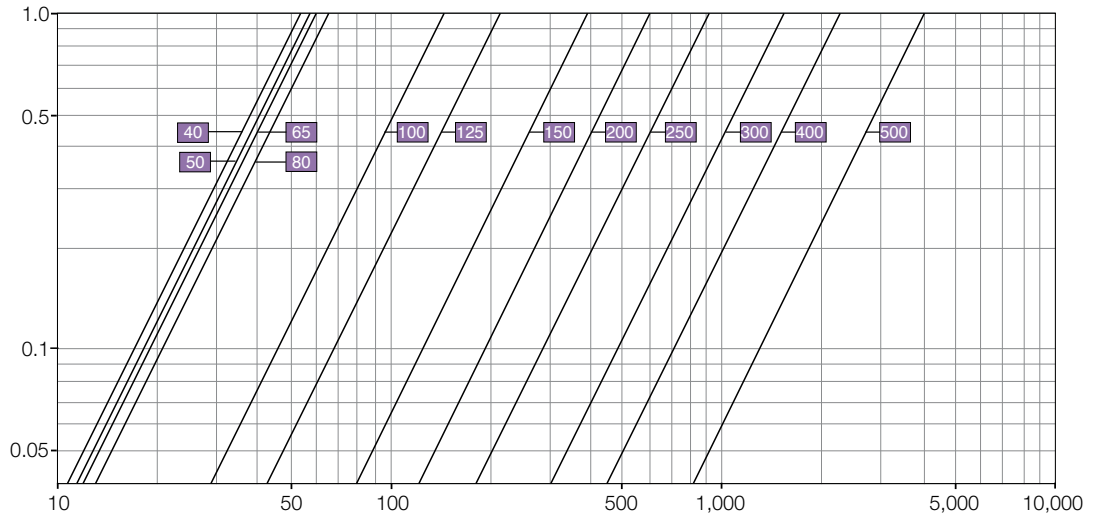
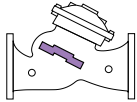
#### Control Chamber Displacement Volume (liter)

DN	40	50	65	80	100	150	200	250	300	350	400	450	500	600-900
700-ES	0.125	0.125	0.125	0.125	0.3	0.5	2.15	4.5	8.5	N/A	12.4	N/A	29.8	N/A



700-ES Metric

### Flow Charts



### Flow Properties

	DN	40	50	65	80	100	125	150	200	250	300	350	400	450	500
700-ES Y-Pattern Flat Disc	<b>Kv</b>	54	57	60	65	145	215	395	610	905	1,520	N/A	2,250	N/A	4,070
	<b>K</b>	1.4	3.0	7.8	15.2	7.5	8.3	5.1	6.7	7.5	5.5	N/A	7.9	N/A	5.9
	<b>Leq - m</b>	2.8	7.5	25.3	60.8	37.3	51.7	38.1	96.3	138.4	126.8	N/A	253.6	N/A	246.3
700-ES Y-Pattern V-Port	<b>Kv</b>	46	48	51	55	123	183	336	519	769	1,292	N/A	2,027	N/A	3,460
	<b>K</b>	1.9	4.3	10.8	21.2	10.4	11.4	7.0	9.3	10.4	7.6	N/A	9.8	N/A	8.2
	<b>Leq - m</b>	3.8	10.6	34.9	84.9	51.8	71.4	52.7	133.0	191.7	175.5	N/A	312.4	N/A	340.8

For spare parts ordering, please use BERMAD "Spare Parts Ordering Guide."

## Differential Pressure Calculation

Valve flow coefficient, Kv or Cv  $Kv(Cv) = Q \sqrt{\frac{Gf}{\Delta P}}$

Where:

Kv = Valve flow coefficient (flow in m<sup>3</sup>/h at 1bar Diff. Press.)

Cv = Valve flow coefficient (flow in gpm at 1psi Diff. Press.)

$$(Cv = 1.155 Kv)$$

Q = Flow rate (m<sup>3</sup>/h; gpm)

ΔP = Differential pressure (bar; psi)

Gf = Liquid specific gravity (Water = 1.0)

Practical formulas for water:  $Q = Kv \sqrt{\Delta P}$   $\Delta P = \left(\frac{Q}{Kv}\right)^2$

Flow resistance or Head loss coefficient,  $K = \Delta H \frac{2g}{V^2}$

Where:

K = Flow resistance or Head loss coefficient (dimensionless)

ΔH = Head loss (m; feet)

V = Nominal size flow velocity (m/sec; feet/sec.)

g = Acceleration of gravity (9.81 m/sec<sup>2</sup>; 32.18 feet/sec<sup>2</sup>)

Practical formula:  $\Delta H = K \frac{V^2}{2g}$

## Equivalent Pipe Length - Leq

In order to simplify system head loss calculation, add the Leq value to the pipe length of the relevant size.

**Note:** The Leq values given are for general consideration only. Actual Leq may vary somewhat with each of the valve sizes.

## Cavitation

The cavitation phenomenon has a significant affect on control valve and system performance.

Cavitation may damage the valve and piping by the affects of erosion and vibration. Cavitation also generates noise and may limit and ultimately choke the flow.

As the pressure differential across the valve increases, the static pressure of the flow passing through the throttling area of the valve (Vena Contracta) drops sharply.

When the fluid's static pressure reaches liquid vapor pressure, vapor cavities (bubbles) form and grow until they violently implode by the recovered pressure downstream to the valve seat.

The implosion of these cavities generates high-pressure surges, micro jets and intensive heat, which erode valve components and downstream piping. In its final stage, cavitation flashes and chokes the flow.

The above Cavitation Guides for Bermad 700 Series valves are based on the formula commonly used in the valve industry:

$$\sigma = (P2 - Pv) / (P1 - P2)$$

Where:

σ = Sigma, cavitation index, dimensionless

P1 = Upstream pressure, absolute

P2 = Downstream pressure, absolute

Pv = Liquid vapor pressure, absolute

(Water, 18°C = 0.02 bar-a; 65°F = 0.3 psi-a)

Use these guides and your applications upstream and downstream pressures to determine whether their intersection lies in or out of the cavitation damage zone.

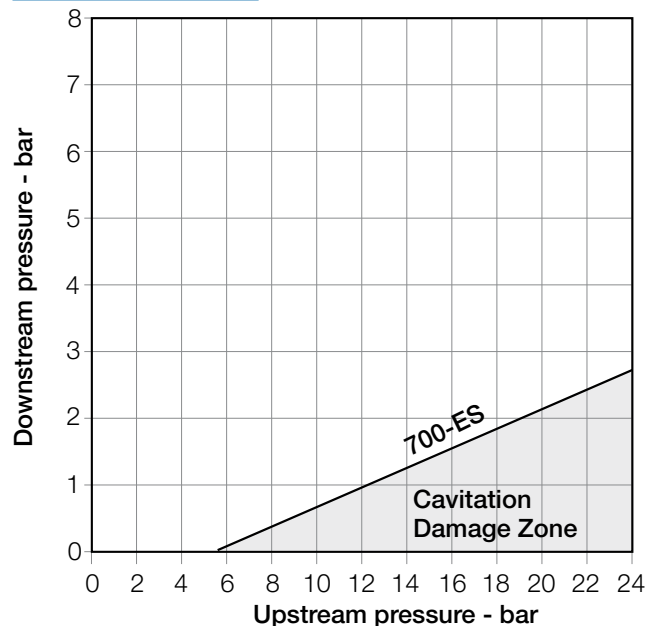
Considerations to avoid cavitation damage:

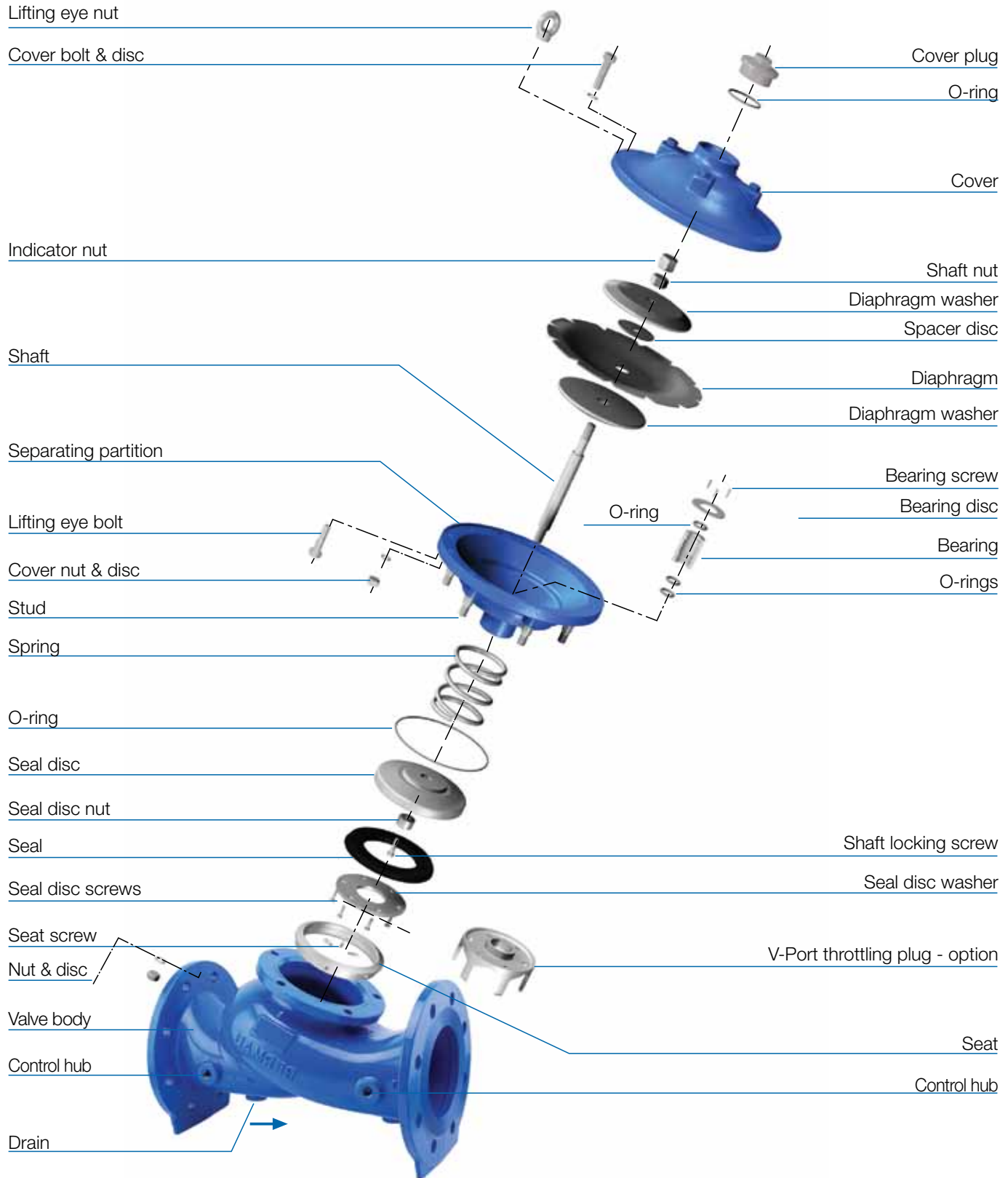
- Reduce system pressure in stages designing each pressure stage to be above cavitation conditions.
- Consider using other valve selection criteria
  - Valve body and plug type
  - Valve size
  - Valve material

**Notes:**

- An alternate cavitation index formula introduced by ISA is:  $\sigma_{ISA} = (P1 - Pv) / (P1 - P2)$  which equals σ+1
- The above charts should be considered only as a general guide.
- For optimum system and control valve application please consult Bermad.

## Cavitation Guide





For spare parts ordering, please use BERMAD "Spare Parts Ordering Guide."

