Valve•ology

B&K VALVES & EQUIPMENT, INC.

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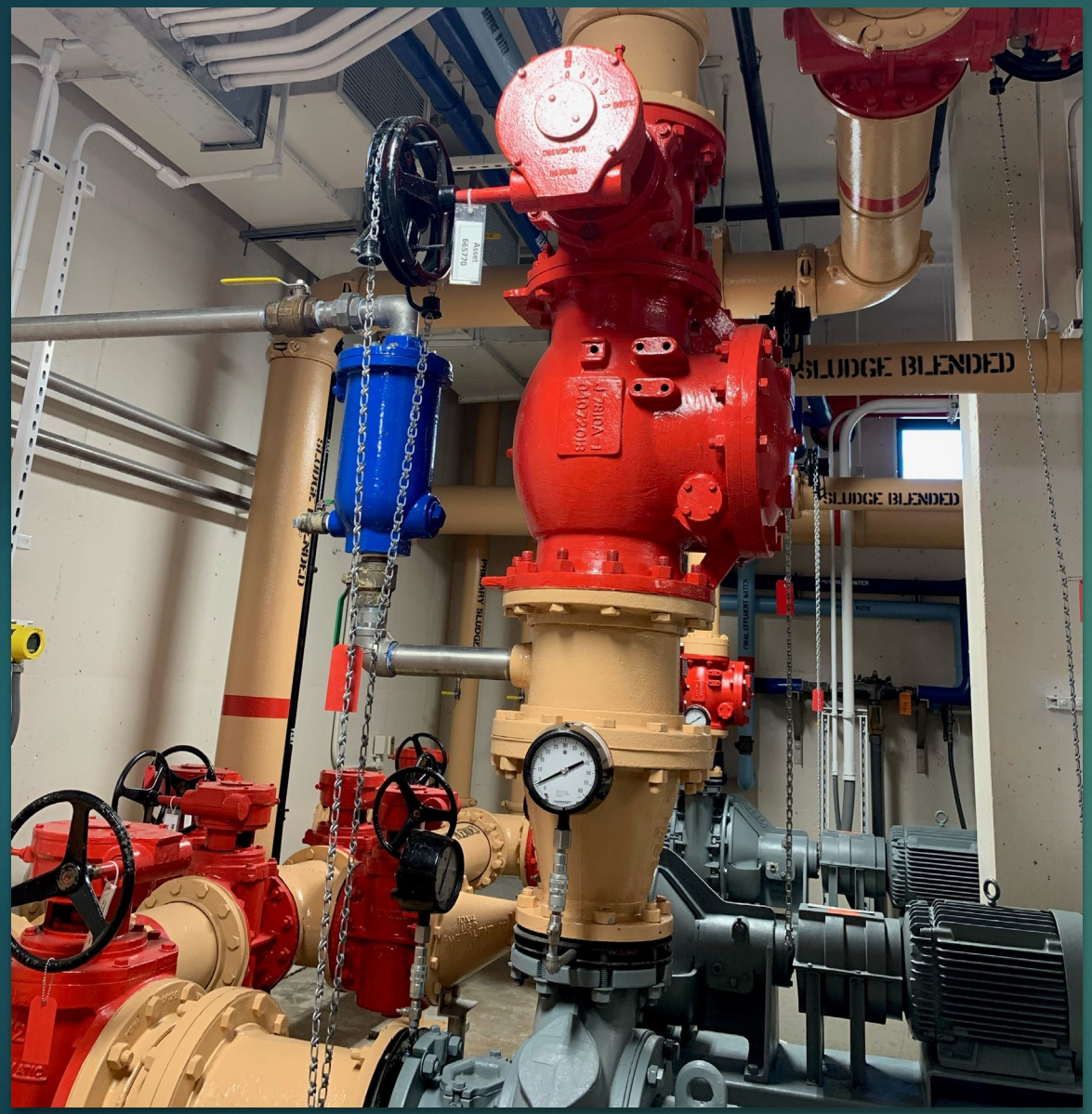


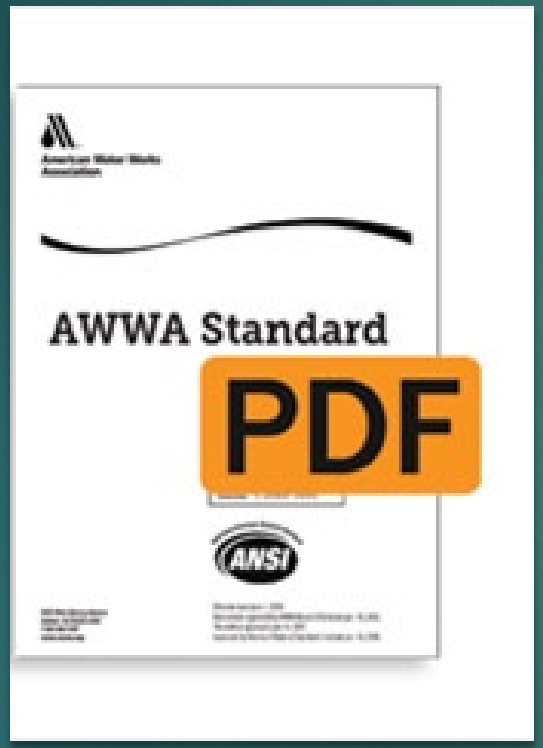
A valve is a valve…

AWWA Valves

- Application & Selection Criteria
- Review of Common Valve types
  - Features
  - Maintenance & Design Considerations
  - Specifications
- Resources
- Review & questions

The Lingo

- Actuator
  - How you want to operate the valve
  - I.E. Hand Wheel, Nut, Electric Motor, etc
- Cv: The valve flow coefficient is the number of US gallons per minute of 60°F water that will flow through a valve at a specified opening with a pressure drop of 1psi across the valve.
- Differential Pressure: aka Delta P
  - Maximum difference between the inlet and outlet of valve
  - Critical for torque/actuator sizing
  - Consideration for cavitation
- Face-to-Face: the length of the valve end to end (aka laying length/lay length)
- Head Loss: Pressure loss, as measured through the valve
- Port: Describing opening of the valve in which media travels through
- Modulating/Throttling: Terms used to describe positioning of the valve for flow control, not just full open or closed.
  - Some key points for actuators is (1) how many starts/stops (2) if you want feedback on position (3) Time to Close/Open



AWWA Standards

Valve applications

- SERVICE CONDITIONS
  - MEDIA
  - PRESSURE
  - FLOW RATES
  - INSTALLATION LOCATION
- CHECK, ON/OFF, OR THROTTLING
- OPERATOR REQUIREMENTS
  - MANUAL OR AUTOMATIC
  - ACCESSORIES REQUIRED
- LONG-TERM MAINTENANCE & SERVICEABILITY

Air Valves

Air Valves

Function

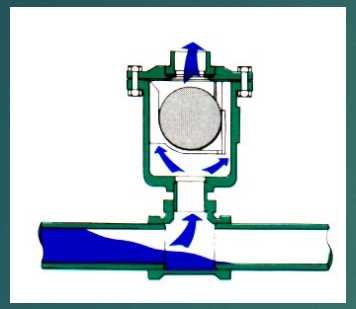
- Prevents a vacuum which may collapse/damage the pipeline or damage pipe joint seals
- Allows large volumes of Air to escape during filling of pipe system
- Vents accumulated air while the system is pressurized to prevent reduce flow or a complete stop of the flow of water by air bind in the pipeline

Types

- Air & Vacuum Valves
- Pressure Air Release
- Combination Air Valves

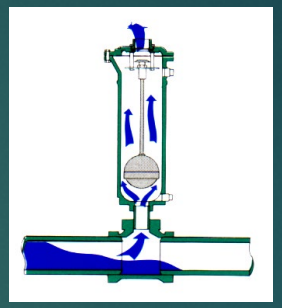
Air and Vacuum Valve

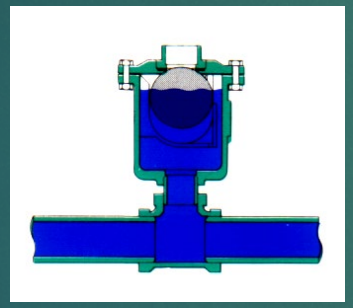
Potable Water



The air and vacuum valve releases air at a high point as the system is filling. The air exhausts through the valve and out the large discharge orifice.

Wastewater

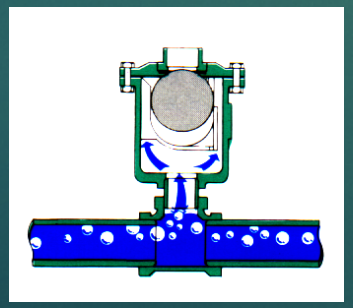




As the liquid enters the body of the valve, the float becomes buoyant and the discharge orifice is sealed.

The valve stays CLOSED during pressurized operation

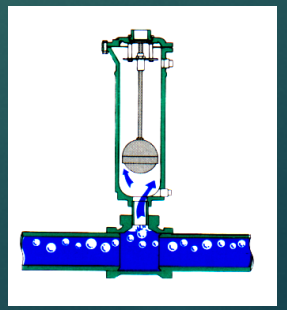
Any air captured in the valve body become compressed



As the liquid level drops air enters the body

This prevents a vacuum from occurring

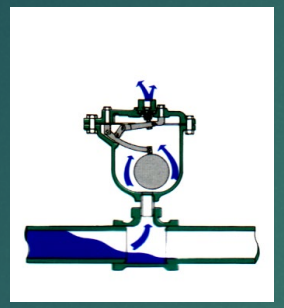
The valve will remain OPEN until the pipeline is filled with liquid



Without protection against vacuum a pipeline collapse can occur

Pressure Air Release Valve

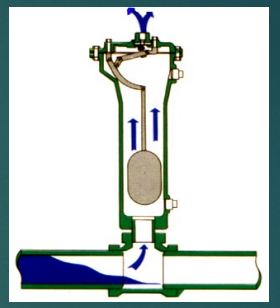
Potable Water

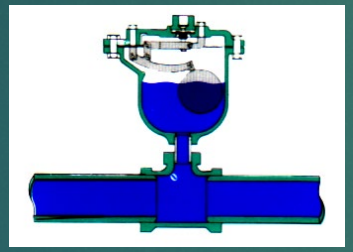


Operate under same basic principle as Air & Vacuum valves as they are applied at system high points.

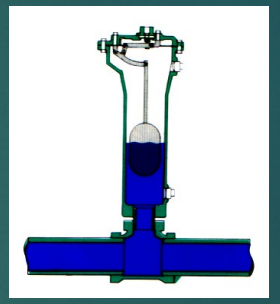
Air is forced through the small discharge orifice while the pipeline is filling

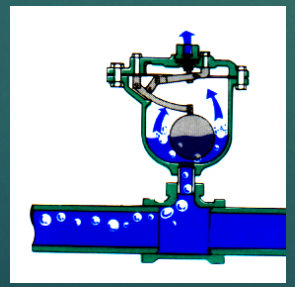
Wastewater





As the liquid fills the valve body the float is made buoyant and seals the outlet orifice via its operating mechanism





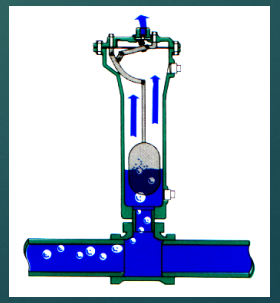
The system will continue to collect air at the high point

As compressed air enters the body of the vale it gradually displaces or pushes the liquid back through the valve inlet

The float will drop as the liquid level drops

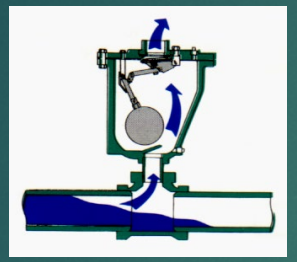
The lever system opens the valve causing the collected compressed air to escape

The water level will rise as the air is released and the float will seal the orifice again

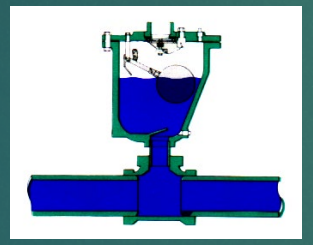


Combination Air Valve

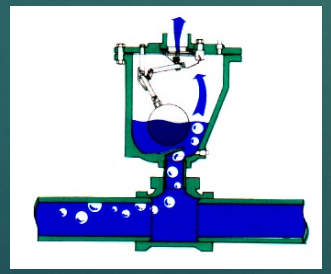
Potable Water



The Combination Air Valve releases air through a large air and vacuum orifice as the system fills



The liquid enters the valve body which raises the float and simultaneously seats the air and vacuum orifice and pressure air release



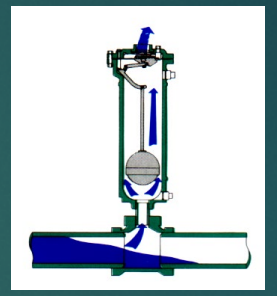
As compressed air entering the valve displaces the liquid level the float drops to open the pressure air release orifice

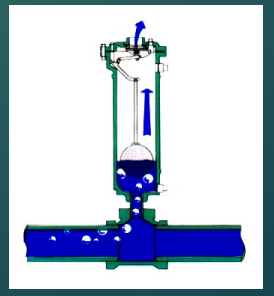
Air and Vacuum orifice remains closed because of its large cross section and relative system pressure

The float will rise as air is exhausted to again seal the valve via the compound lever system

The Air and Vacuum orifice will only open again when a vacuum occurs

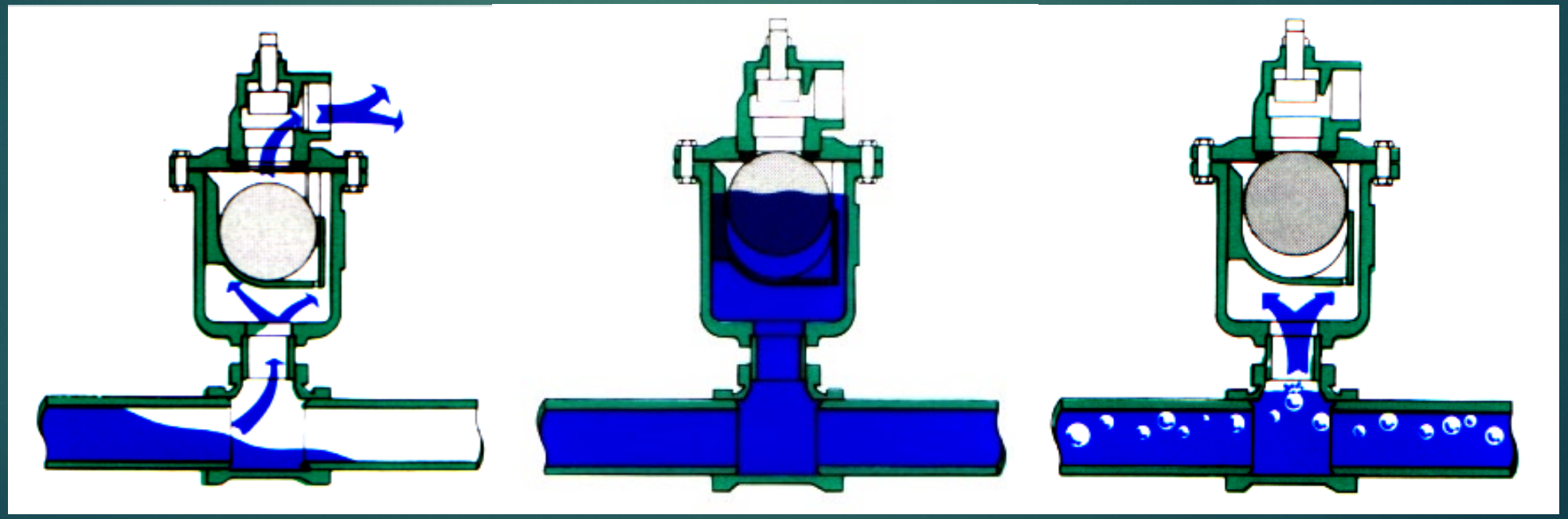
Wastewater





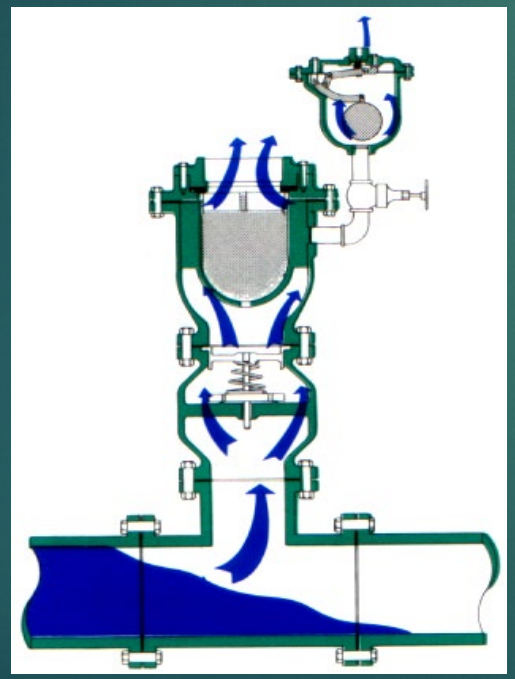
Deep Well Air Release Valve

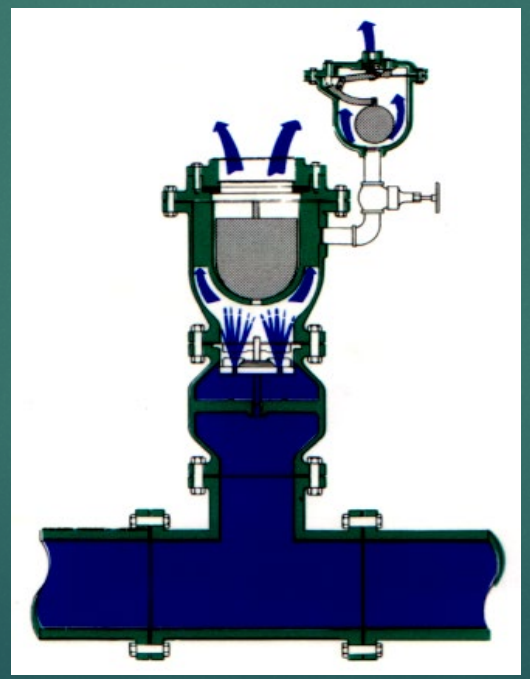
- Deep Well Air Release Valve will vent air from the discharge side of a vertical turbine pump upon start-up.
- The valve should be located between the pump discharge and the check valve.
- The liquid will enter the valve body causing the float to become buoyant and close the valve.
- As compressed air collects in the valve body. The weight of the float is less than the pressure forcing it into the seat. This valve will only open again under vacuum.

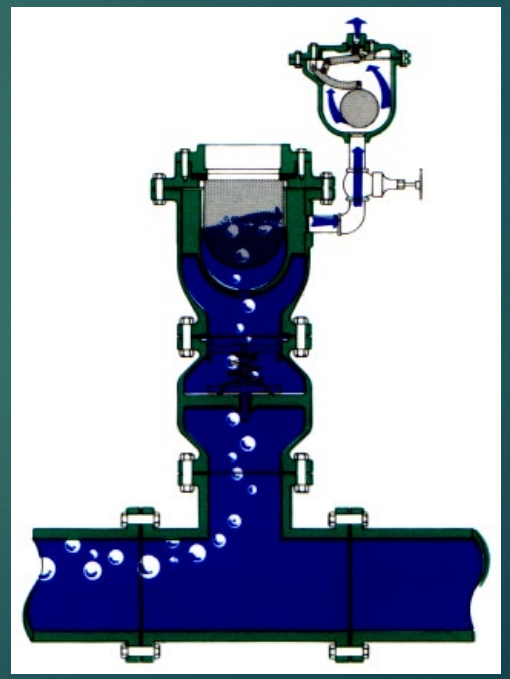


Air Valves on Well Pumps

- A surge check valve is fitted to the inlet of the air/vacuum valve to control the closure speed of the valve.
- The surge check valve receives the initial impact from the pump column and prevents the air/vacuum valve seat and float from being damaged.
- Normally fitted on valves flanged 4-inch and larger







Air Valves

- Protects systems from air and vacuum issues within a pressured pipeline
- Air Release Valves: Maintains system flow efficiency, releases air pockets during system operation, protects against air related surges
- Air/Vacuum Valves: Exhausts large quantities of air during system startup, provides pipeline vacuum protection
- Applies to AWWA C512
- NSF/ANSI 372 Certified Lead-Free
- Certified to NSF/ANSI Standard 61 for Drinking Water System Components
- Installed at high points
- Material of construction: Ductile Iron, Composites.

Check Valves

Check Valves

Function

- Required to (1) prevent reverse flow, (2) keep pipeline full, (3) minimize water hammer & prevent surge
- Most valves are "automatic" and are controlled by the flow itself, though power checks are available
- Slam (and surge) is a major consideration in some applications

Types

- Ball Check
- Double Disc
- Silent Check
- Swing Check
- Resilient Hinge (Rubber Flapper)
- Tilted Disc

Check Valve Service / Application

Clean Service ONLY

- Double Disc
- Silent Check
- Tilted Disc

Clean or Dirty Service

- Ball Check*
- Swing Check
- Rubber Hinge

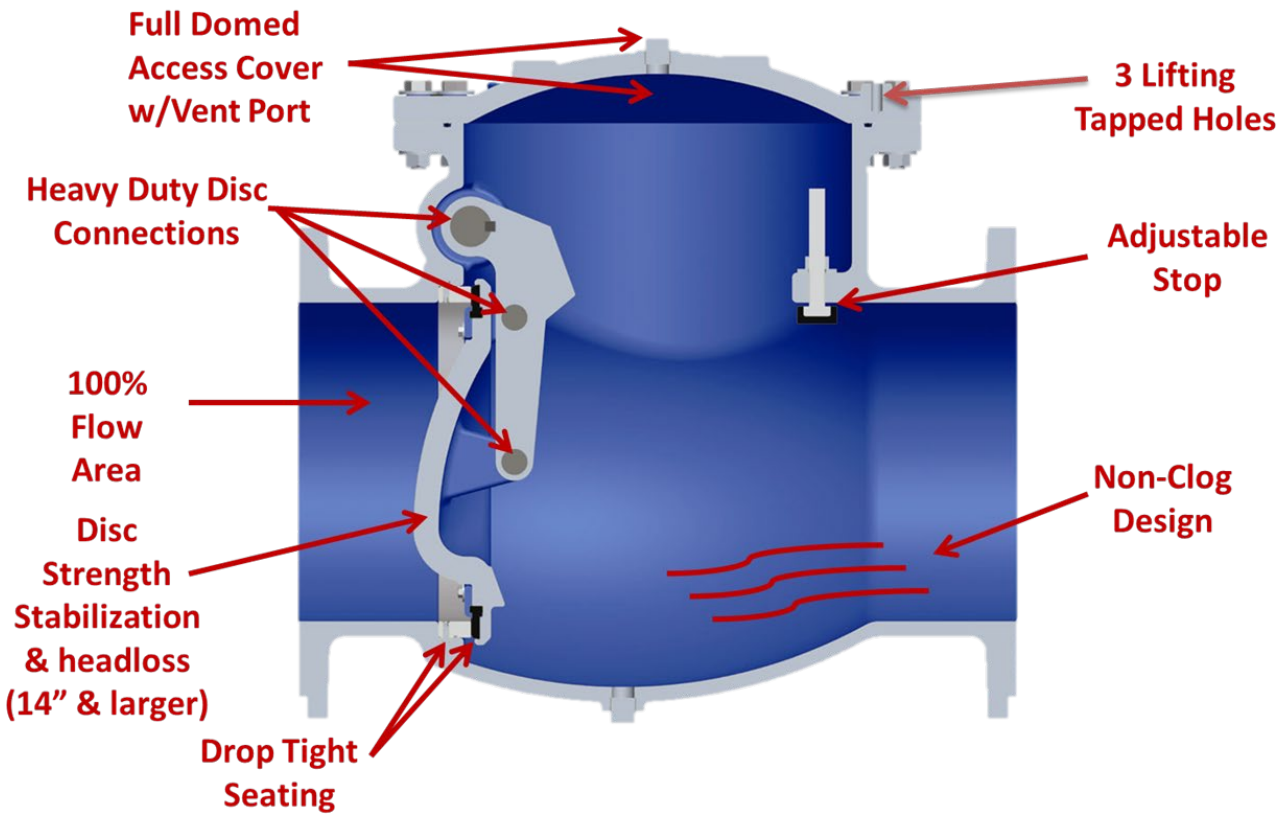
Air/Gas Service

- Double Disc
- Rubber Duckbill

AWWA Swing Check Valves

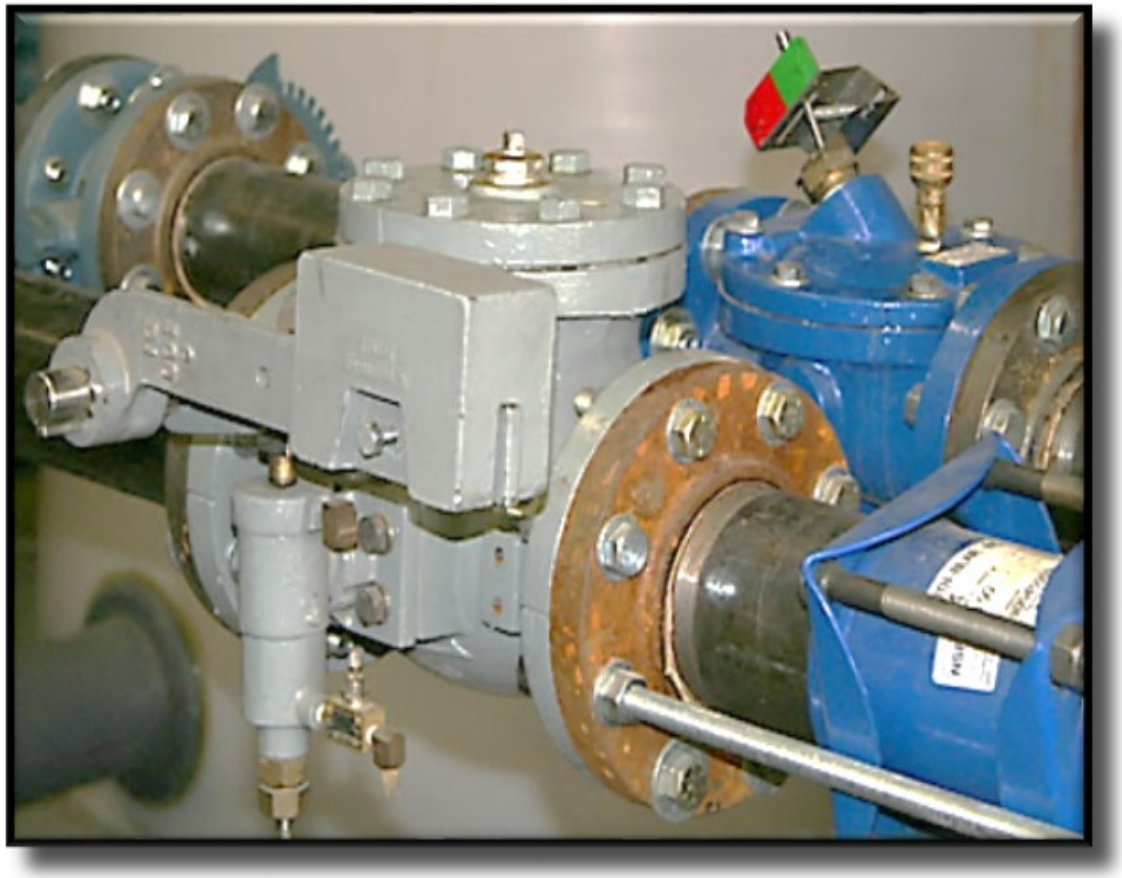
- "standard" for many wastewater applications
- Applies to AWWA C508
- Valve contains a hinged disc that rests on a seat to prevent back flow
- May be installed horizontally or vertically
- Full Flow when Disc is Open
- Head loss is higher than other options
- Slam is a MAJOR concern
- Can come equipped with Lever & Weight, Lever & Spring, Air Cushion, Oil Dashpot

AWWA Swing Check Valve

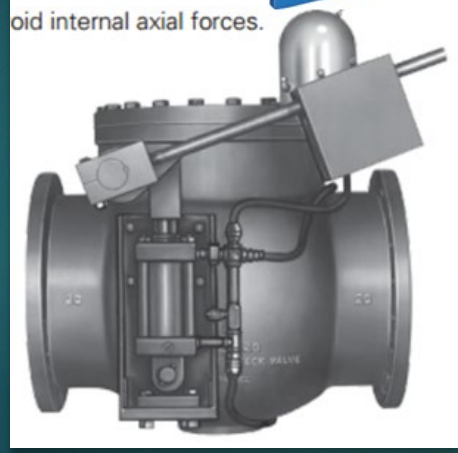


Specifications

- Ductile Iron Body, Cover & Disc (up to 48"), Cast Iron (above 48")
- Fusion Bonded Epoxy Interior/ Exterior
- Stainless Steel Hinge Pin, Body Seat, & Interior Bolting
- Resilient Seat for drop tight closure (Buna-N, EPDM, Viton)
- Stainless Steel External Bolting
- AWWA C508 Compliant
  - BEWARE OF LAY LENGTH DIFFERENCES
- NSF 372 Certified Lead Free
- NSF 61 Certified Drinking Water
- AIS/ Buy American Requirements
- Accessories required (I.E. Switches, Slam Prevention, etc)



Slam PREVENTION

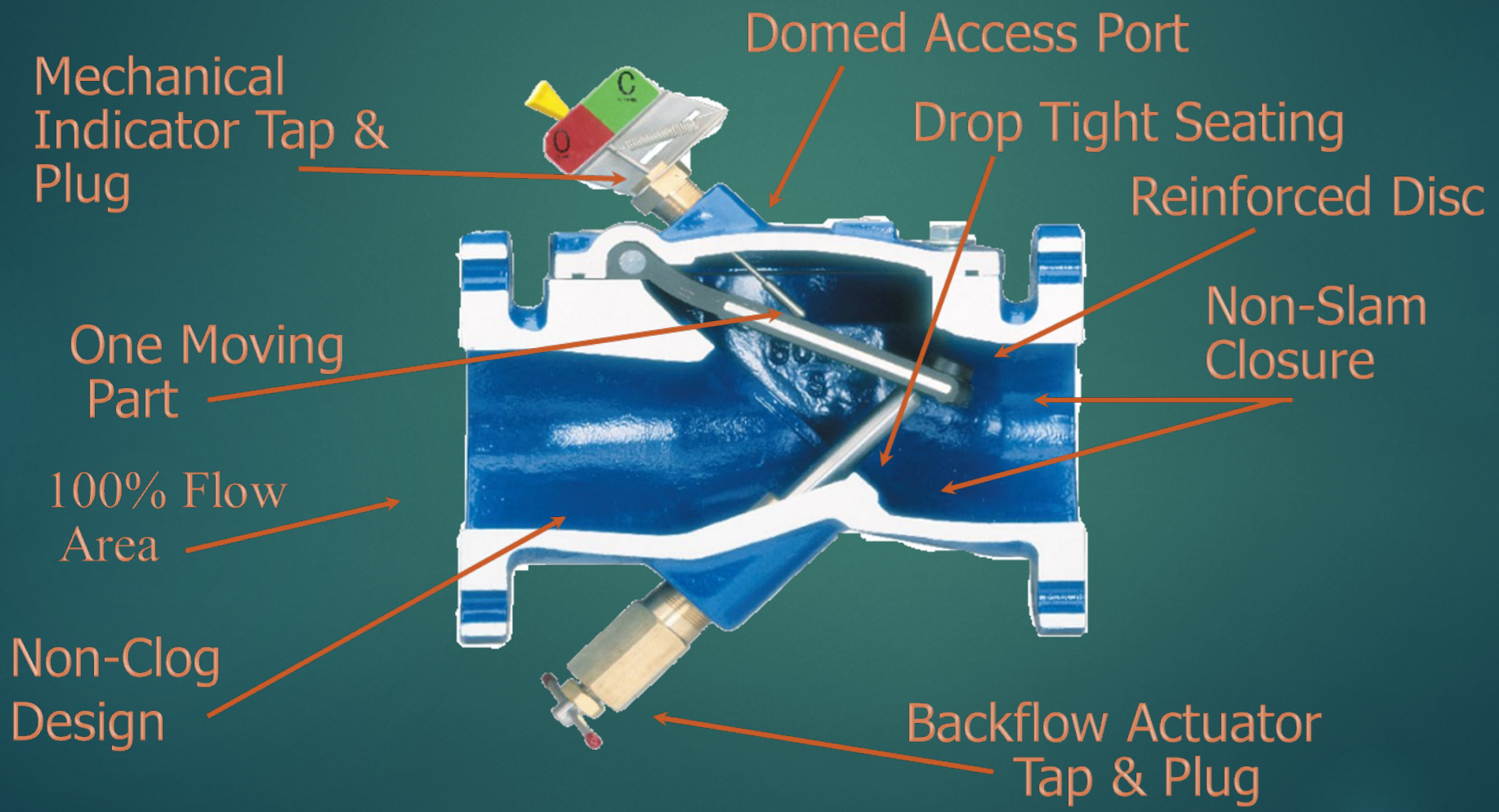


- May be equipped with:
  - Air Cushioned External Lever & Weight
    - Free Open, Fast Closure
    - Allows for controlled closure over last 10° of valve stroke
  - Oil Dampened (Bottom Buffer)
    - Free Open, Fast Closure
    - Allows for controlled closure over last 10° of valve stroke
  - Oil Control (Side Mounted)
    - Free Open, Multi-Stage Closure

AWWA Resilient hinge check valves

- Growing in popularity due to many excellent features
- Complies with AWWA C508
- Valve contains hinged disc which rests on seat to prevent backflow
- May be installed horizontally or vertically
- Only 35° to reach full open
- 100% flow
- Significantly reduced head loss
- Only ONE moving part, less prone to clogging & debris hanging up
- Reduced slam potential
- Can be equipped with disc accelerator, position indicator/switches, backflow device, bottom buffer, etc.
- Special linings (glass, rubber) available

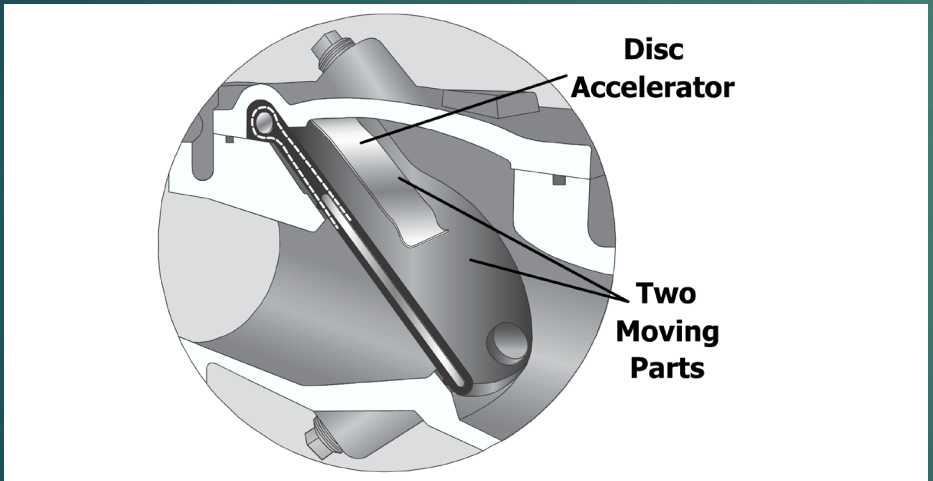
AWWA Resilient hinge check valves



Feature	Swing-Flex®	Traditional Swing Check
Low Head Loss/Non-Slam Closing	Yes	No[1]
Backflow Capability	Yes	Yes
Rubber Lining Capability	Yes	No
Number of Wear Parts	1	10-15
Low Maintenance	Yes	No
Open/Closed Indication	Yes	Yes
Optional SCADA Compatible Signal Switch	Yes	No
Positive Shut-Off	Yes	No[2]
Competitively Priced	Yes	Yes
Independent 1,000,000 Cycle Test	Yes	No
Twenty-Five Year Disc Warranty[3]	Yes	No
Water /Wastewater Service	Yes	Yes
Sludge Service	Yes	Yes
Abrasive Service	Yes	No[4]
Corrosive Service	Yes[5]	No
Vertical Flow-up Service	Yes	Yes
Full Top Access Cover	Yes	Yes
Full Flow Area	Yes	Yes[1]

Slam prevention

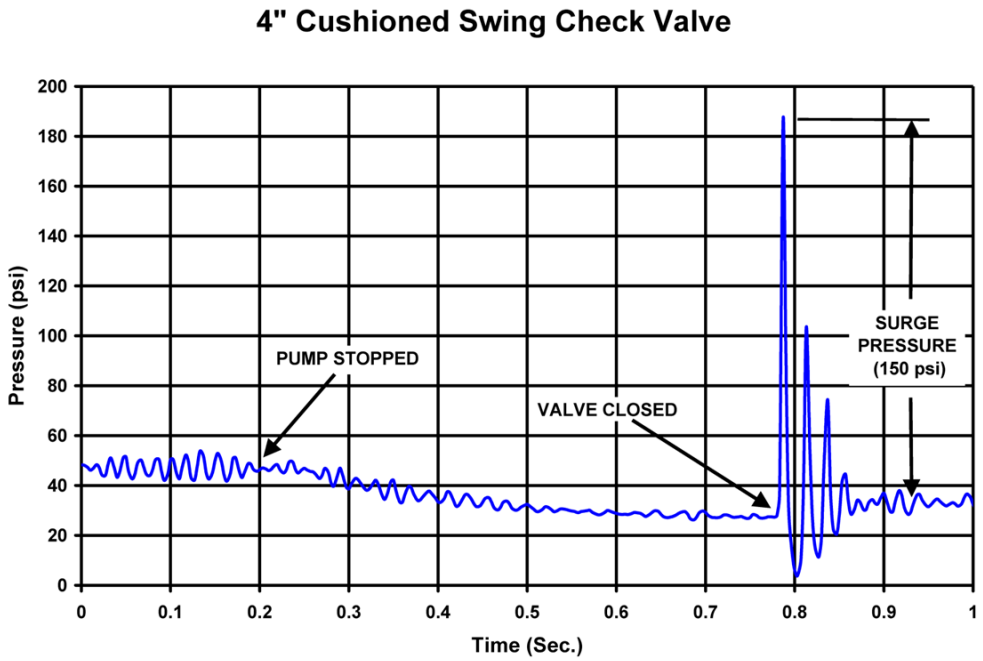
Quick Closure- Allows disc to close BEFORE flow surge

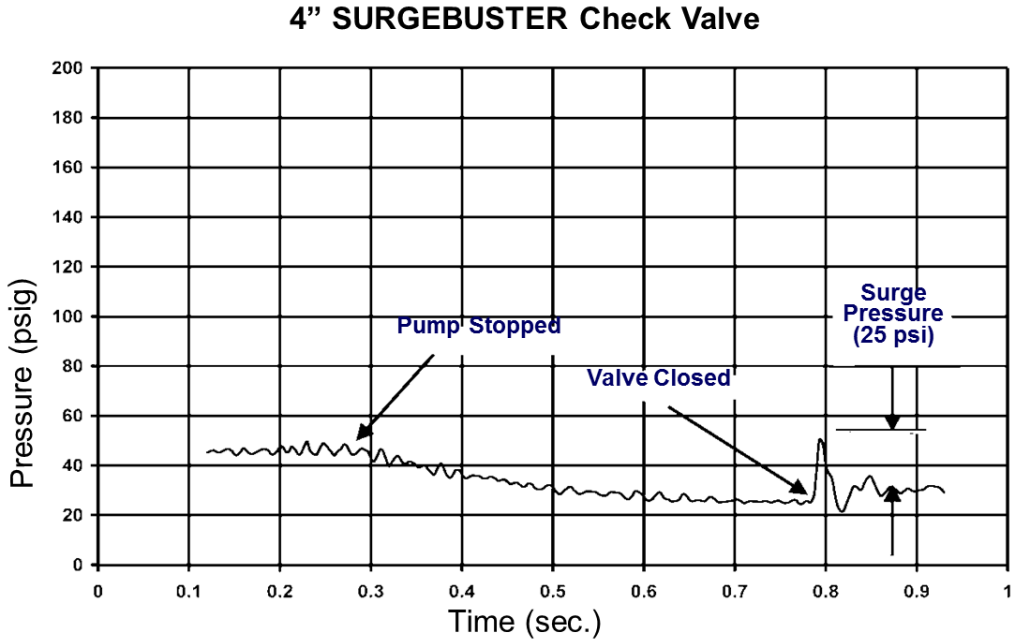


Bottom Buffer- Dampens closure to help prevent surge

specifications

- Ductile Iron (up to 48")
- Reinforced Disc with 25yr warranty
- 45° Seat angle, 35 ° open-to-close
- 4" Valve capable of passing 4" solid
- Pressure rating up to 250psi
- Fusion Bonded Epoxy Interior/ Exterior
- Stainless Steel External Bolting
- AWWA C508 Compliant
  - Again, watch out for that F-F
- Lead Free NSF 372 / Certified for Drinking Water NSF 61
- AIS/ Buy American Requirements
- Accessories required (I.E. Switches, Slam prevention, etc)





Why use the resilient hinge?

12 inch Check Valve Total Cost over 40 Years					
TYPE OF CHECK VALVE		Installed Cost	Energy Cost*	Maintenance Cost	Total Cost
LIFT	Ball Check	$9,300	$56,300	$6,000	$71,600
	Silent Check	$4,800	$112,700	$6,000	$123,500
	Nozzle Check	$10,000	$31,100	$6,000	$47,100
SWING	Dual Disc®	$2,100	$41,300	$6,000	$49,400
	Swing Check & Weight	$8,000	$60,100	$24,000	$92,100
	Resilient Hinge	$5,800	$30,000	$6,000	$41,800
	Tilted Disc® with Bottom Dashpot	$19,500	$23,600	$72,000	$115,100

*For 40 Years, based on 50% usage, $.08/kW-h, 12.76 ft/sec velocity.

Cost savings comparison

Isolation & Regulating Valves

ISOLATION VALVES

- Ball
- Butterfly
- Cone
- Diaphragm
- Gate
  - Metal Seated
  - Resilient Wedge
  - Knife
- Pinch
- Plug

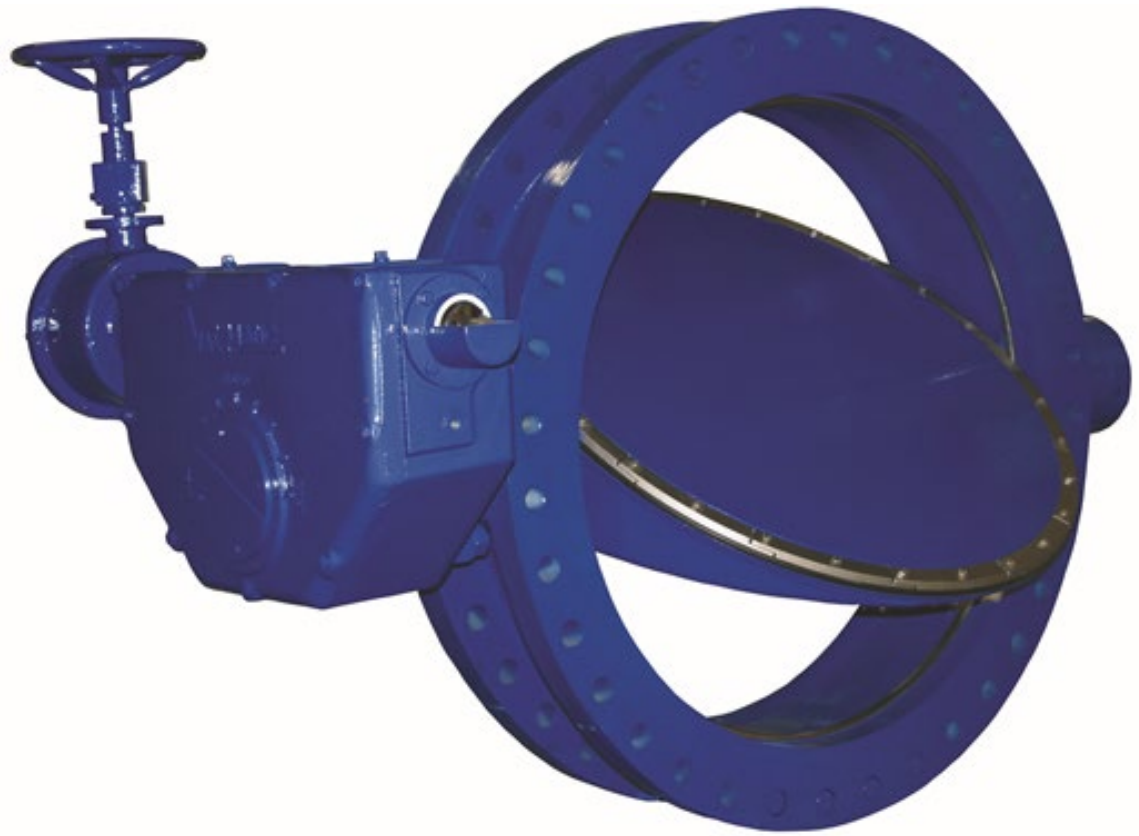
Flow Control/Regulation

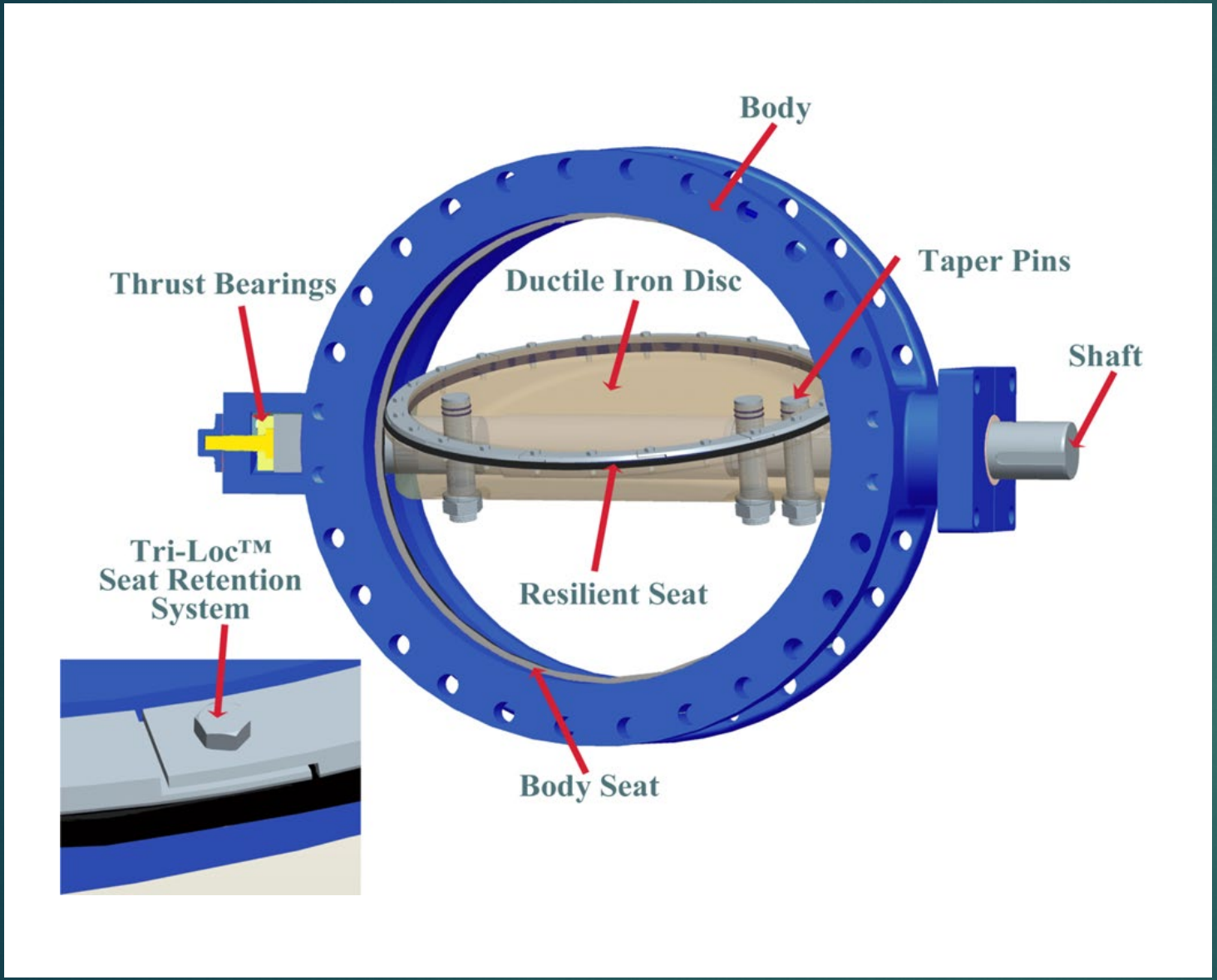
- Ball
- Butterfly**
- Cone
- Diaphragm
- Pinch
- Plug

Butterfly Valves

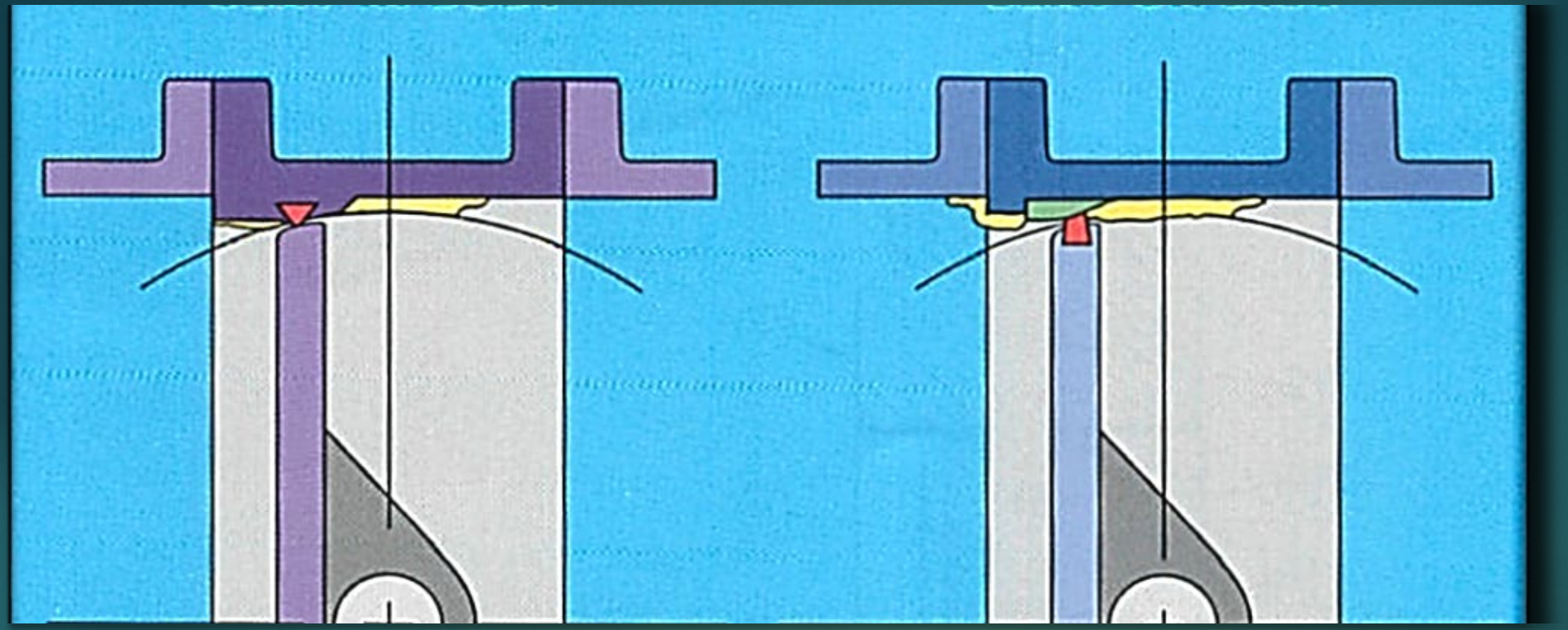
AWWA butterfly valves

- On/Off (Isolation)or Limited Throttling
- Relatively high head loss
- Clean Applications, common in drinking water
- ¼ Turn Operation (smaller sizes)
- May be used for Air or Liquid, however the Industrial Style Valve is more economical and smaller
- 150B & 250B classes available





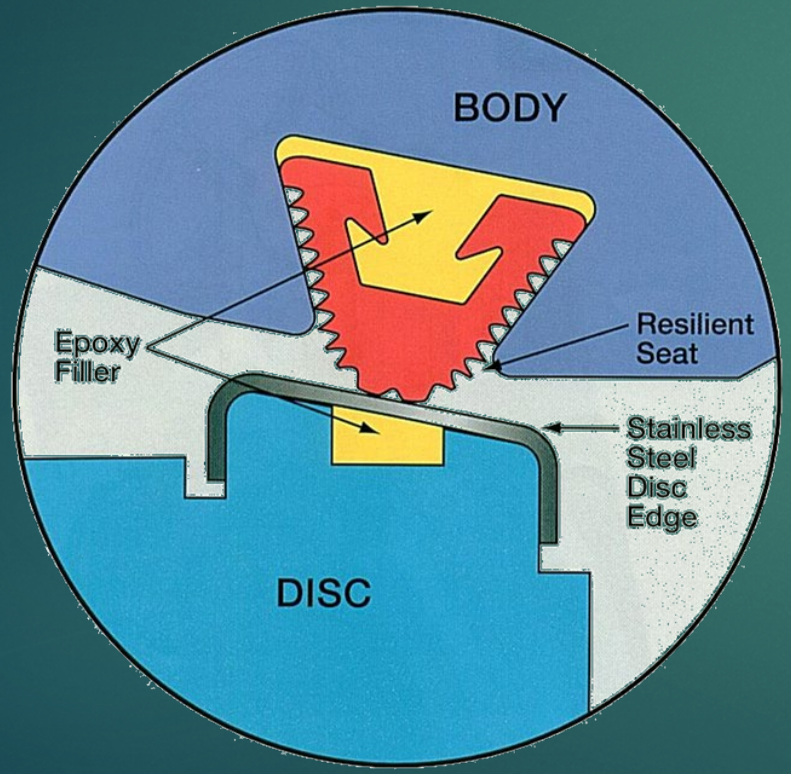
AWWA Butterfly valves



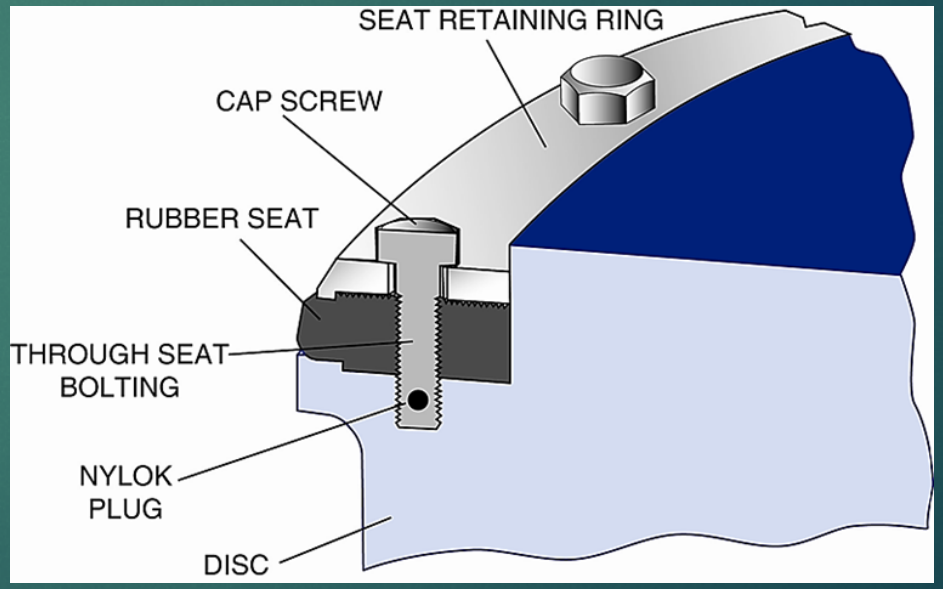
Seat location- the great debate

SEAT LOCATION- 30” + UP

SEAT IN BODY

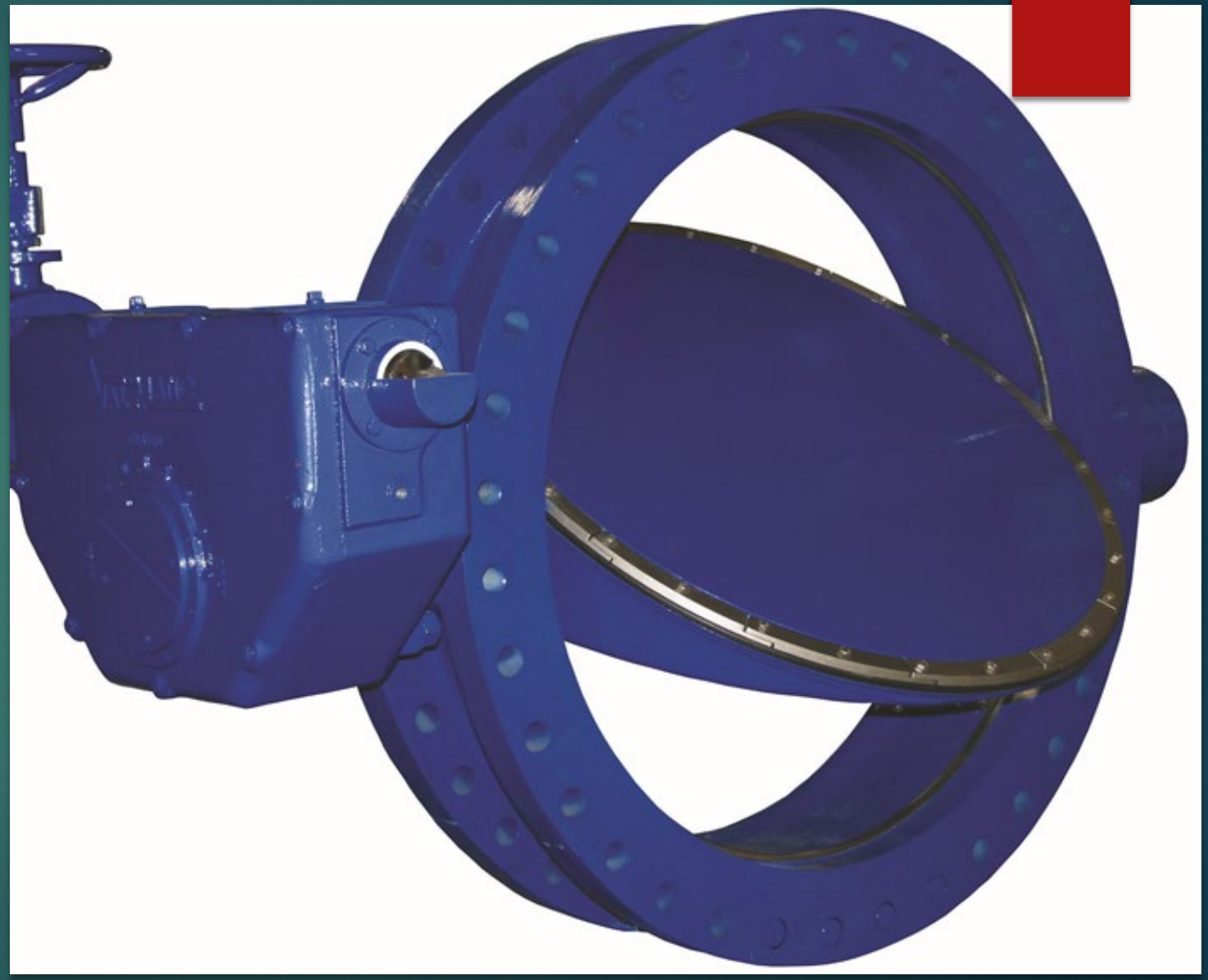


SEAT ON DISC



SPECIFICATIONS

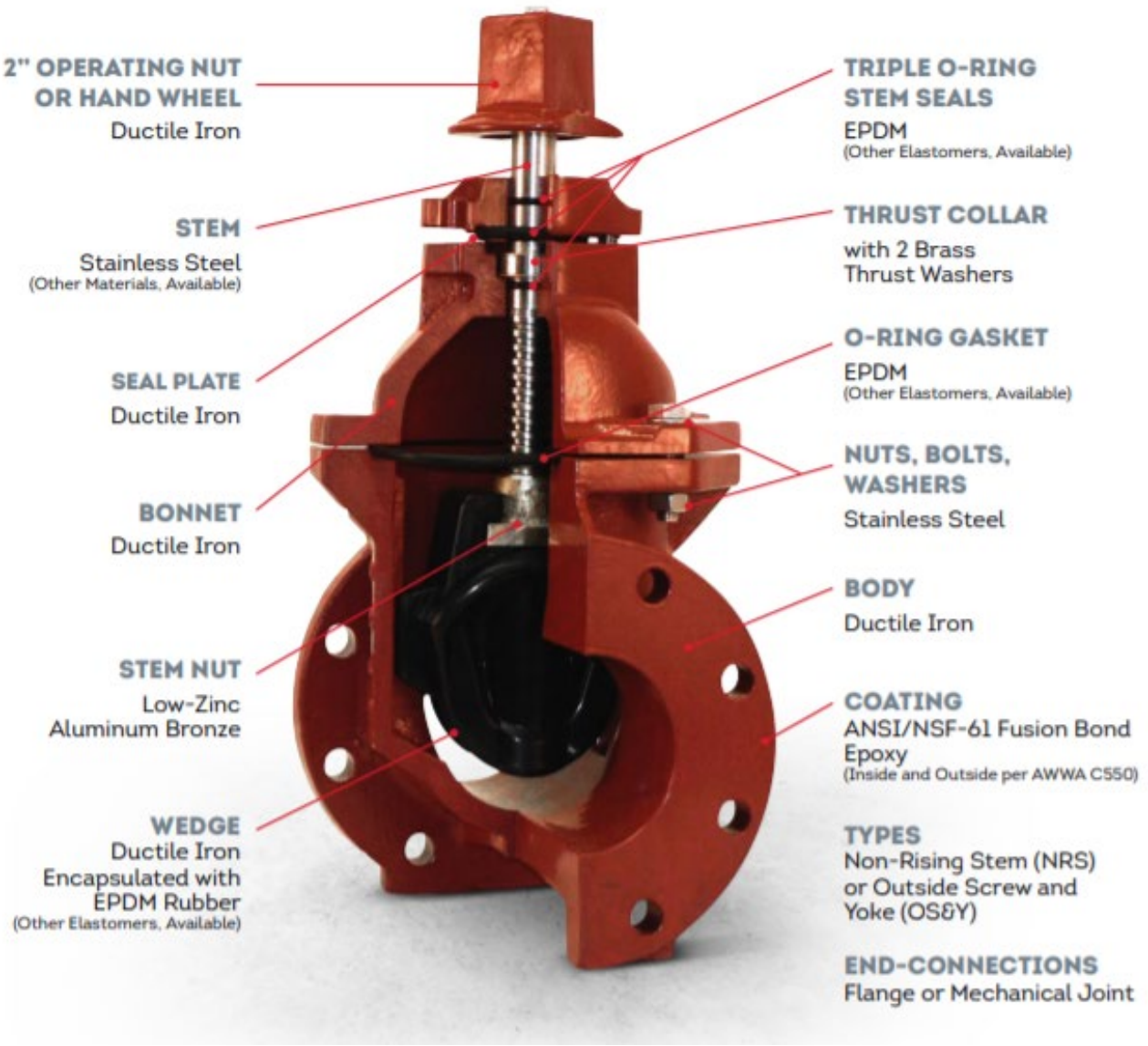
- Cast Iron Body, Ductile Iron Disc with SS Seat, SS Shaft (150B)
- Ductile Iron Body & Disc with SS seat, SS Shaft 17-4 (250B)
- Adjustable packing
- Fusion Bond Epoxy In/Out
- Traveling Nut Style Operators with External Adjustable Stops
- Actuator & Accessory Requirements
- Maximum Pressure for the line
- NSF/ANSI 372 Certified Lead-Free
- Certified to NSF/ANSI Standard 61 for Drinking Water System Components



Gate Valves

AWWA Gate Valves- Resilient Wedge

- On/off (Isolation) Only
- Clean or Dirty Service, Liquids
- Complies with AWWA C509/515
  - C509 Cast Iron Body, Thick Wall
  - C515 Ductile Iron Body, Reduced Wall
- 100% Port
- Low Head loss
- Multi-turn

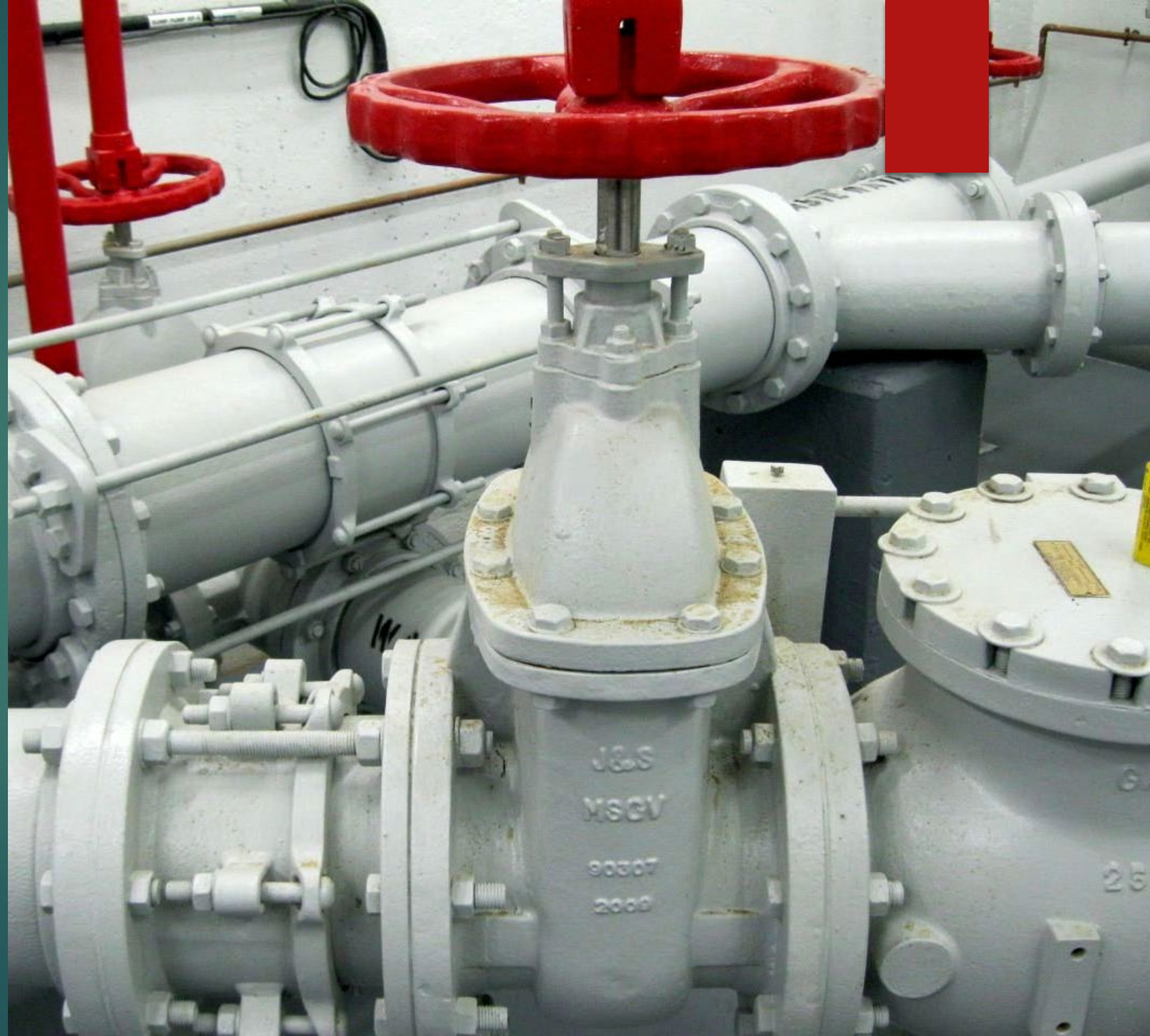

2" OPERATING NUT OR HAND WHEEL
Ductile Iron
STEM
Stainless Steel
(Other Materials, Available)
SEAL PLATE
Ductile Iron
BONNET
Ductile Iron
STEM NUT
Low-Zinc Aluminum Bronze
WEDGE
Ductile Iron Encapsulated with EPDM Rubber
(Other Elastomers, Available)
TRIPLE O-RING STEM SEALS
EPDM
(Other Elastomers, Available)
THRUST COLLAR
with 2 Brass Thrust Washers
O-RING GASKET
EPDM
(Other Elastomers, Available)
NUTS, BOLTS, WASHERS
Stainless Steel
BODY
Ductile Iron
COATING
ANSI/NSF-61 Fusion Bond Epoxy
(Inside and Outside per AWWA C550)
TYPES
Non-Rising Stem (NRS) or Outside Screw and Yoke (OS&Y)
END-CONNECTIONS
Flange or Mechanical Joint

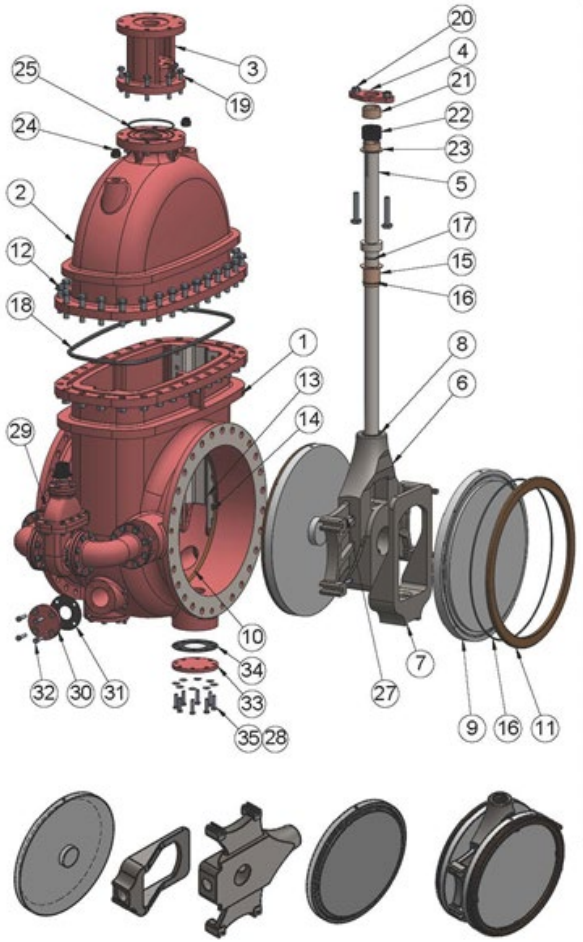
specifications

- Ductile Iron Body & Bonnet
- Stainless Steel Stem (NRS)
- Fully Encapsulated Resilient Wedge
- Compliance with C509/C515
- Fusion Bond Epoxy Int/Ext
- Stainless Steel Bolting
- Operator Requirements
- NSF 61 for drinking water (if req'd)

AWWA Metal Seated Gate Valves

- On/off (Isolation) Only
- Clean or Dirty Service, Liquids
- Complies with AWWA C500
- 100% Port
- Low Head loss
- Multi-turn
- Long lasting, long history
- Higher capital cost





ITEM	DESCRIPTION	MATERIAL
1	BODY	DUCTILE IRON A536 65-45-12
2	BONNET	DUCTILE IRON A536 65-45-12
3	YOKE	DUCTILE IRON A536 65-45-12
4	FOLLOWER FLANGE	DUCTILE IRON A536 65-45-12
5	STEM	STAINLESS STEEL
6	UPPER WEDGE	DUCTILE IRON A536 65-45-12
7	LOWER WEDGE	DUCTILE IRON A536 65-45-12
8	UPPER WEDGE BUSHING	ALUMINUM BRONZE
9	DISC	DUCTILE IRON A536 65-45-12
10	BODY SEAT RING	BRONZE
11	DISC SEAT RING	BRONZE
12	BODY BOLT, NUT,WASHER	STAINLESS STEEL
13	TRACK	316 STAINLESS STEEL
14	TRACK SCREW	316 STAINLESS STEEL
15	BONNET BUSHING	BRONZE
16	O-RING	EPDM
17	O-RING	EPDM
18	O-RING	EPDM
19	YOKE BOLT, NUT, WASHER	STAINLESS STEEL
20	GLAND BOLT, NUT	STAINLESS STEEL
21	GLAND	BRONZE
22	PACKING	GRAPHITE
23	YOKE BUSHING	BRONZE
24	1-1/2" NPT PLUG	BRONZE
25	O-RING	EPDM
26	SCRAPER	BRONZE
27	SCRAPER BOLT	STAINLESS STEEL
28	O-RING	EPDM
29	BYPASS	ASSEMBLY
30	CLEAN-OUT COVER	DUCTILE IRON A536 65-45-12
31	GASKET	EPDM
32	BOLT, WASHER	STAINLESS STEEL
33	BYPASS COVER	DUCTILE IRON A536 65-45-12
34	GASKET	EPDM
35	BOLT, WASHER	STAINLESS STEEL

Specifications

- Ductile Iron Body & Bonnet
- Stainless Steel Stem (NRS)
- Compliance with C500
- Fusion Bond Epoxy Int/Ext
- Stainless Steel Bolting
- Bronze to Bronze seating
- Operator Requirements
- NSF 61 for drinking water (if req'd)
- Stainless Steel Tracks

Forcemains

GATE VALVES

- Traditionally used on water & force mains
- Multi-Turn (all sizes)
- 100% Opening, low head loss
- Materials can accumulate in bonnet prohibiting wedge from operating
- Resilient Material issues, focus on metal seated

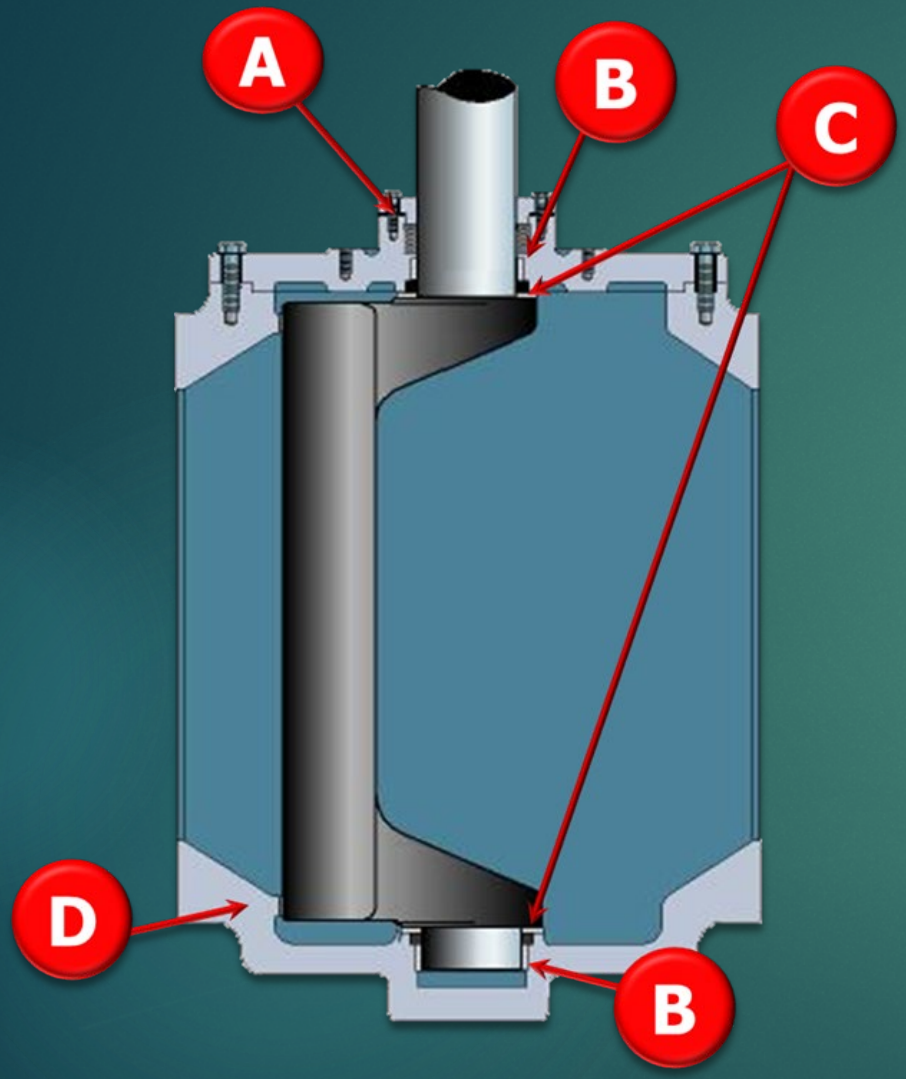
PLUG VALVES

- Recently becoming more popular for force main applications
- Multi-turn for larger sizes
- 100% port allows for improved flow, although it is NOT clear opening
- Eccentricity & design of the plug valve allows for minimal wear over time and reduced likelihood of valve sticking

Plug Valves

AWWA Eccentric Plug Valves

- On/Off or Throttling
- Clean or Dirty Service
- Liquid or Gas
- Complies with AWWA C517
- ¼ Turn in smaller sizes
- Eccentric action allows for superior performance in dirty applications with minimal wear
- Designed to eliminate problems experienced with gate valves



AWWA eccentric plug valve

- 3 main components
  - Body w/ Nickle Seat
  - Plug
  - Bonnet
- Grit Excluders
- V-Type Packing
- 316 SS permanently lubricated bearings

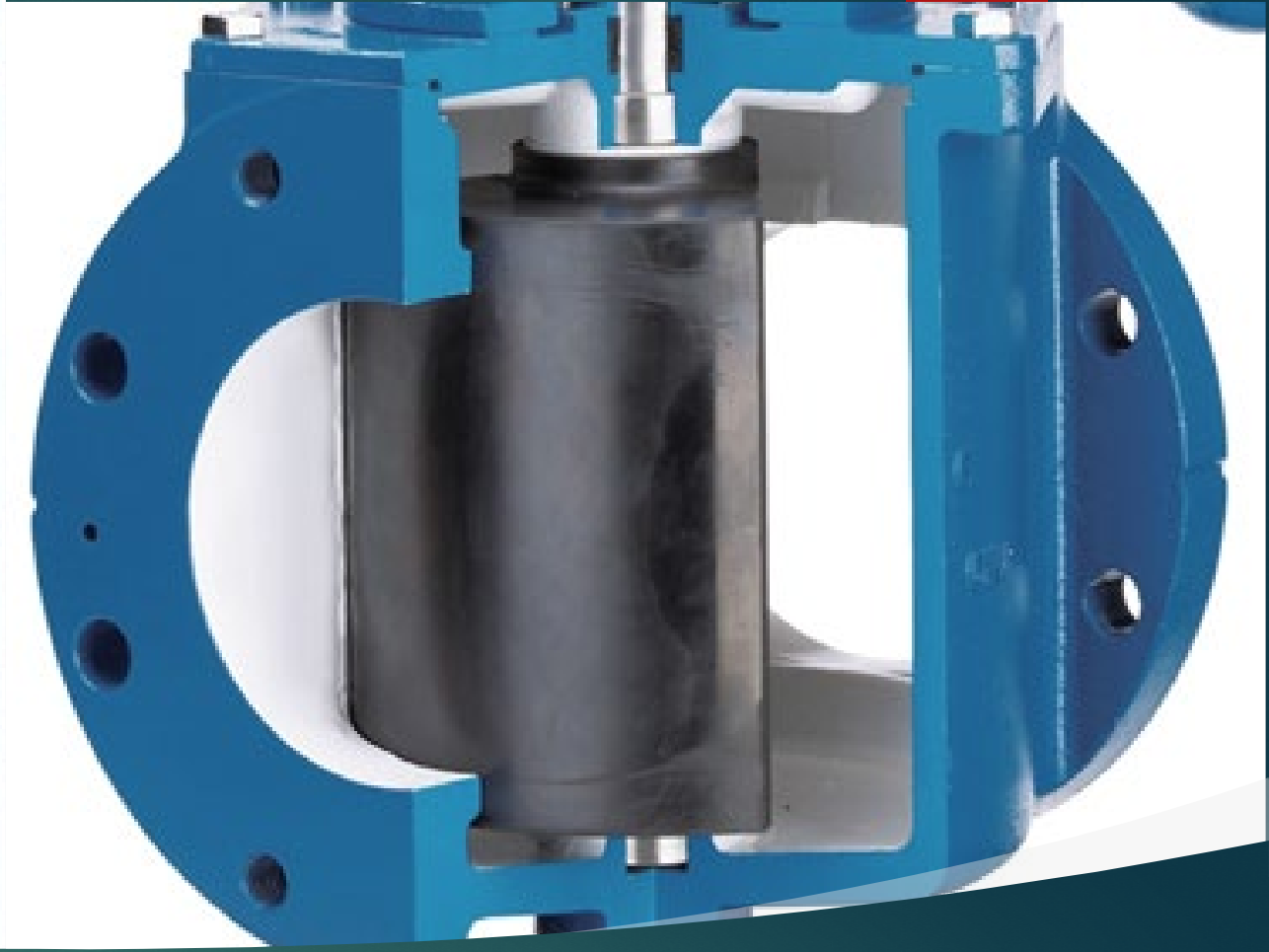
Port design

RECTANGULAR

- Cylindrical plug with Rectangular Port
- Approx. 80% port on standard valves
- 100% port available
- Adjustable & replaceable packing without removal of actuator
- No concern for vertical or horizontal alignment
  - Plug is wider than valve opening
- Reduces wear on plug
  - Plug does NOT contact seat until final degrees of closure
  - No “point to point seating”

ROUND

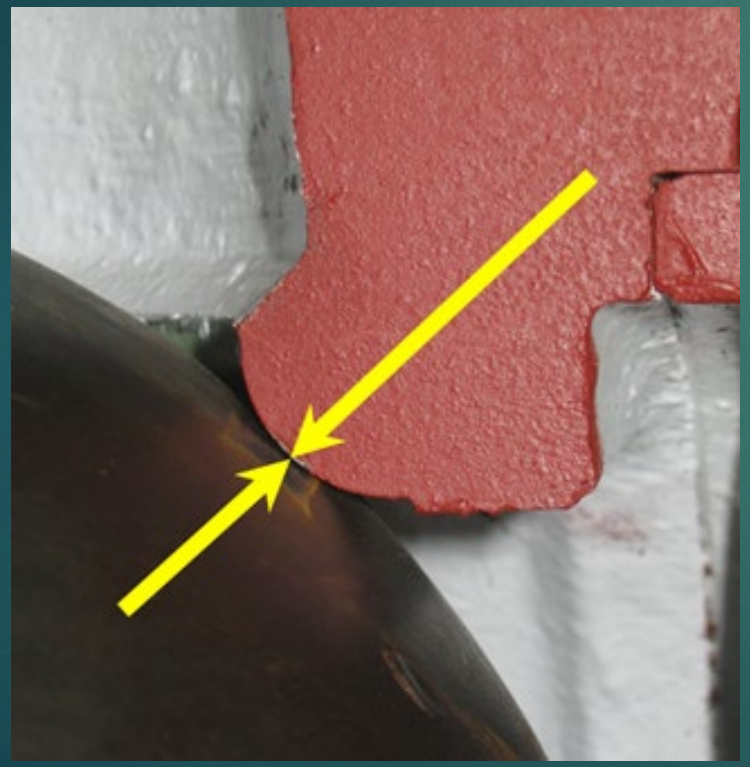
- Segmented ball plug with Round port
- Slightly higher than 80% on standard valves
- Oblong port opening
- Typically supply with non-adjustable packing that requires removal of actuator to replace
- Seat infringes on plug as the valve closes to insure drip tight closure
- Plug must align perfectly with seat for a position seal
  - Horizontal & Vertical alignment is critical



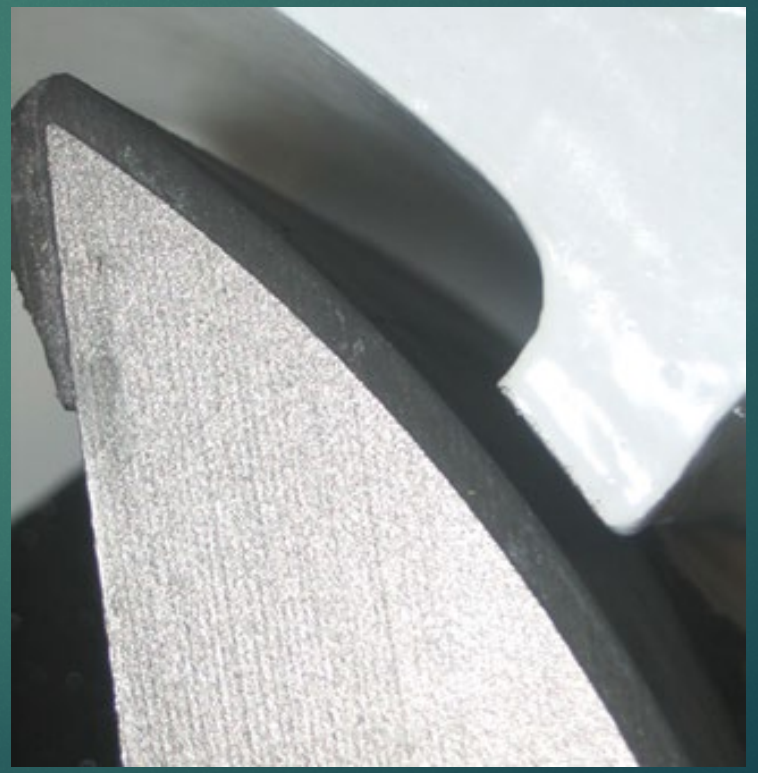
Port comparisons

Port comparisons

ROUND PORT



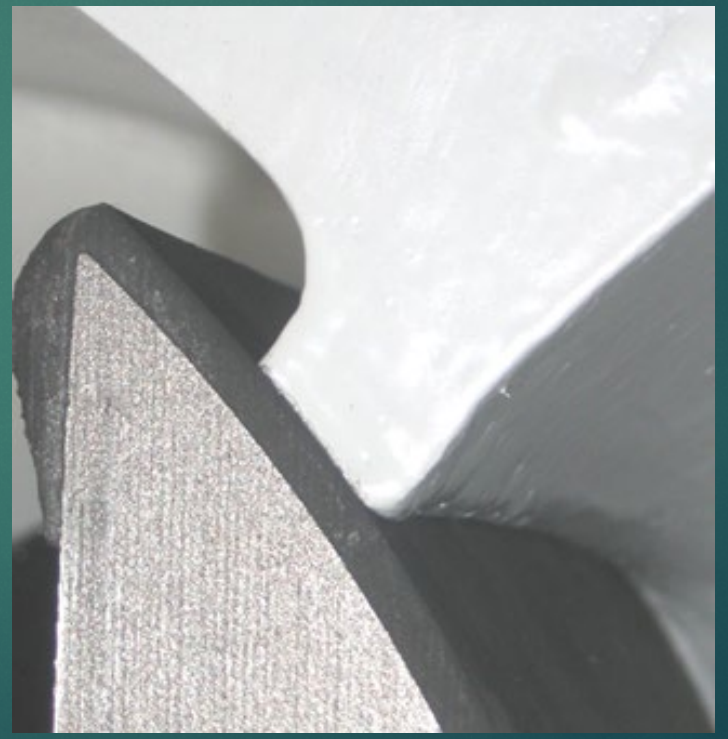
RECTANGULAR PORT



Port comparisons

ROUND PORT

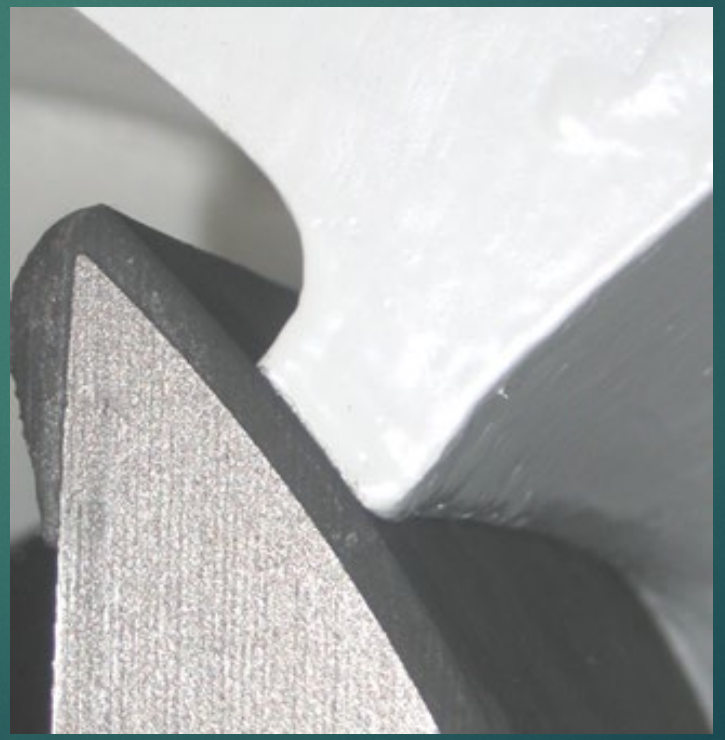
RECTANGULAR PORT



Port comparisons

ROUND PORT

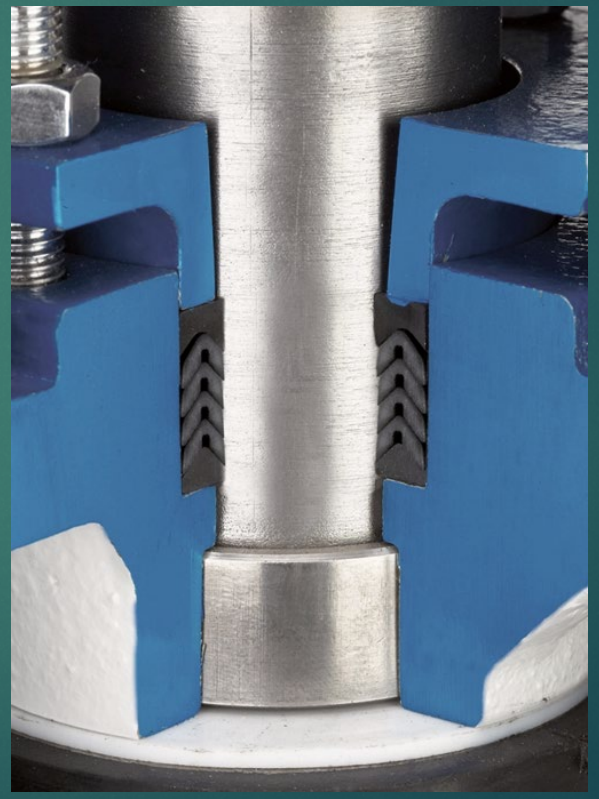
RECTANGULAR PORT



Port design- Packing

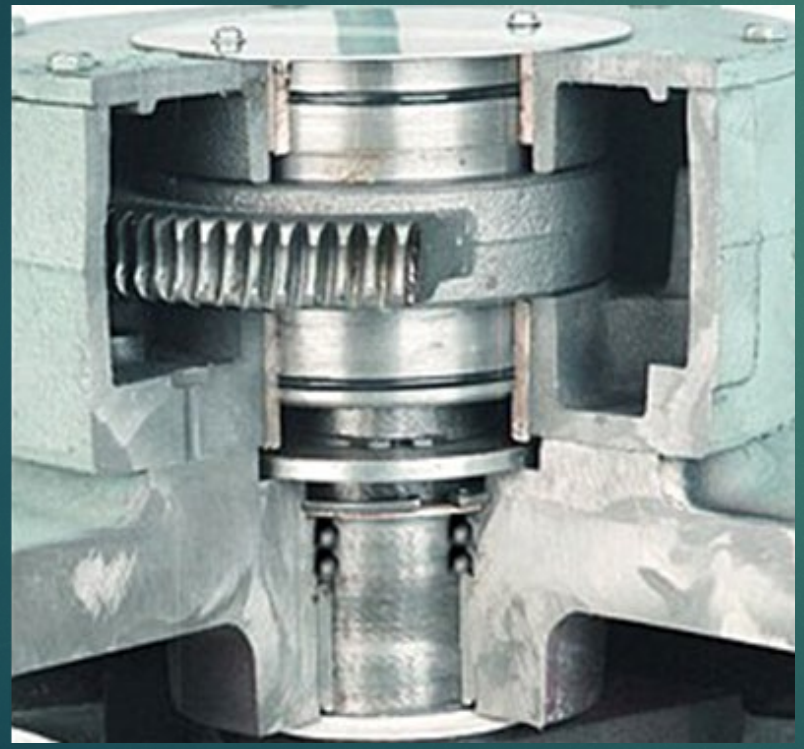
Round Port

Rectangular Port

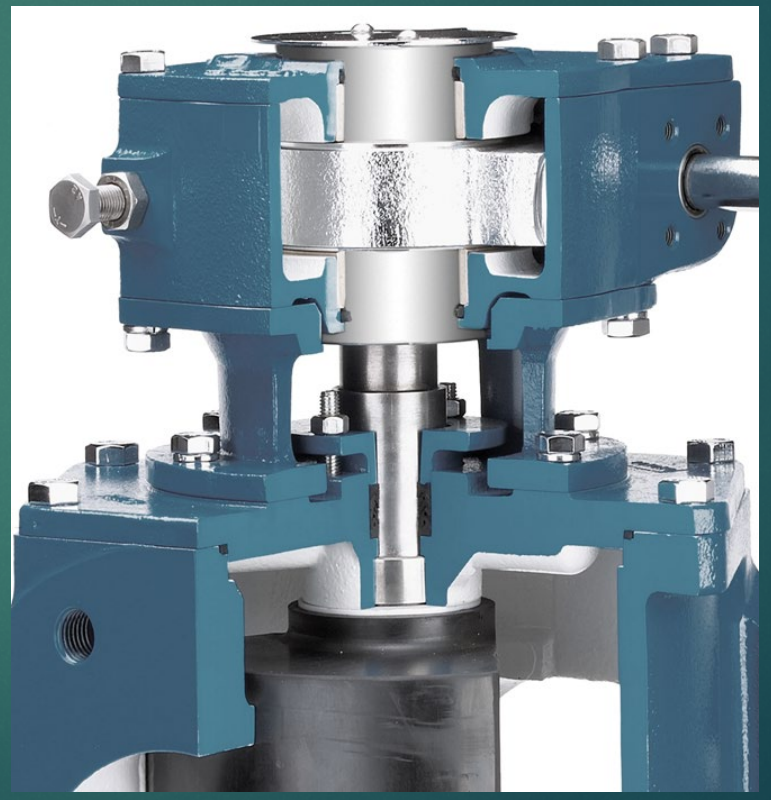


Port design- Gear operators

Round Port

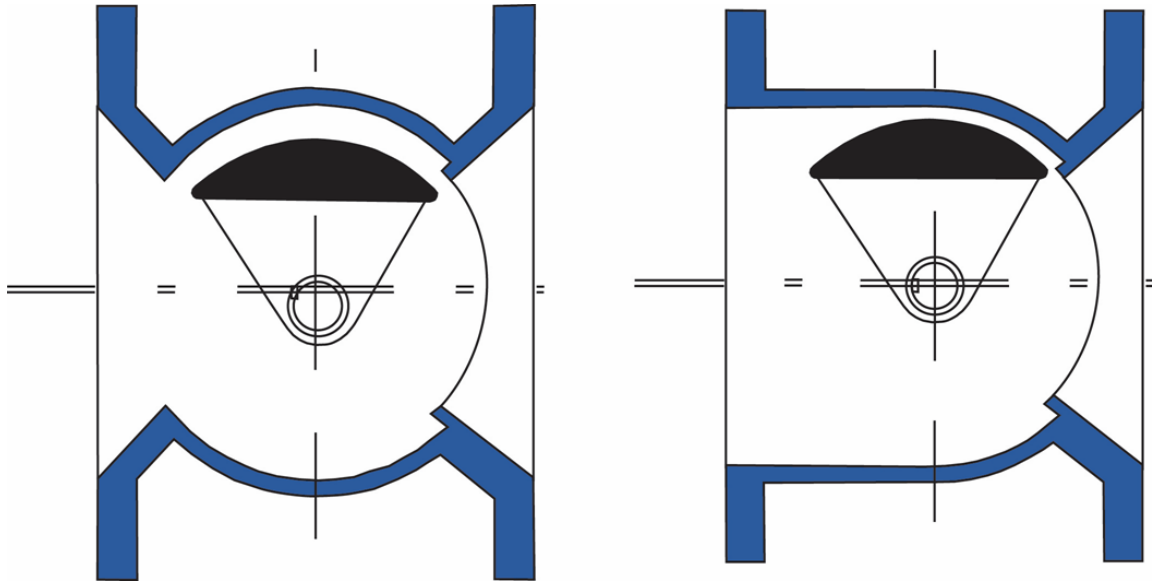


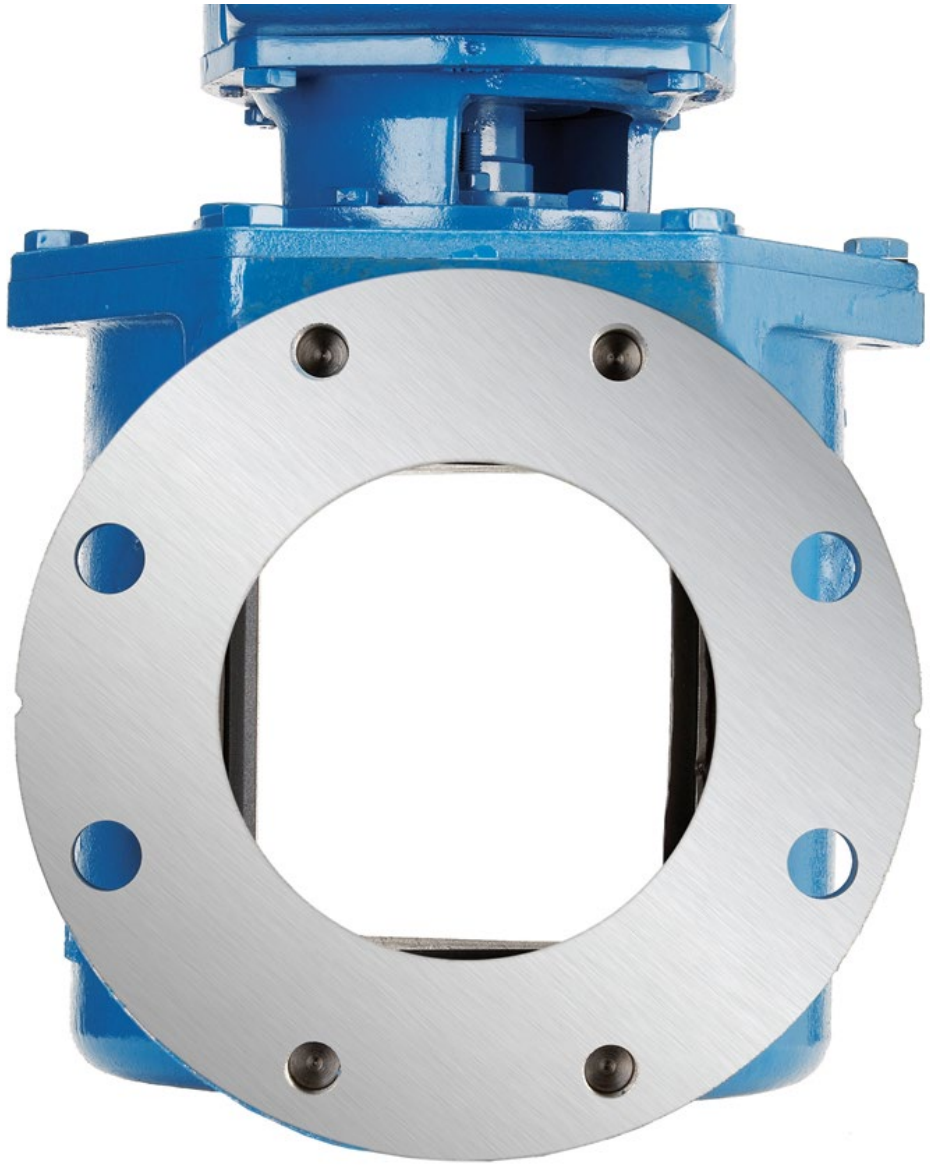
Rectangular Port



100% Port

- Rectangular Ported Plug valves now 100% Port
- % Open Area Exceeds 100% area of pipe
- Not a “clear opening”
- Allows for passage of larger solids, reduced headloss, better throttling capabilities
- Body concaves allow for “self-flushing”
- Some manufacturers are standardizing on the 100% design





100% port

Installation

- **Liquids without suspended solids:**
  Install with greater pressure opposite seat end. (Direct Pressure)

- **Liquids containing suspended solids:**
  Install with seat end up allowing solids to settle outside the rotational path of the plug.

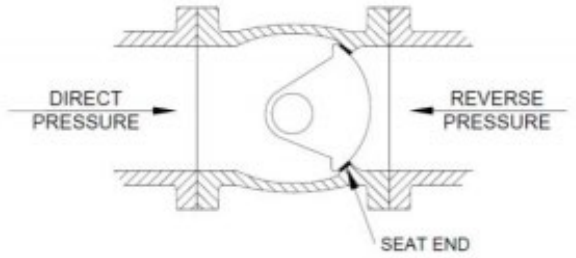


FIGURE 4. INSTALLATION ORIENTATION

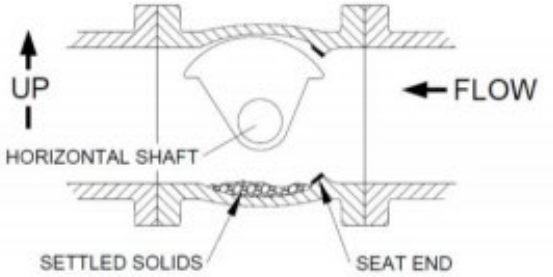


FIGURE 5. HORIZONTAL PIPE WITH SOLIDS

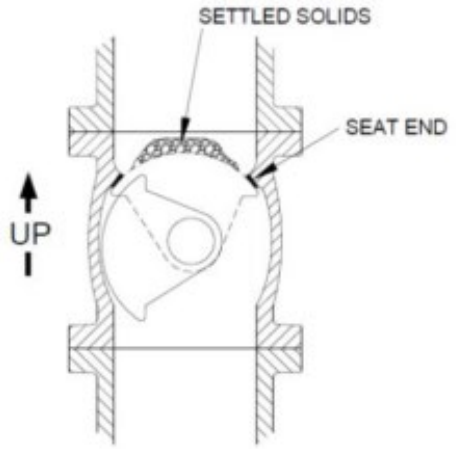
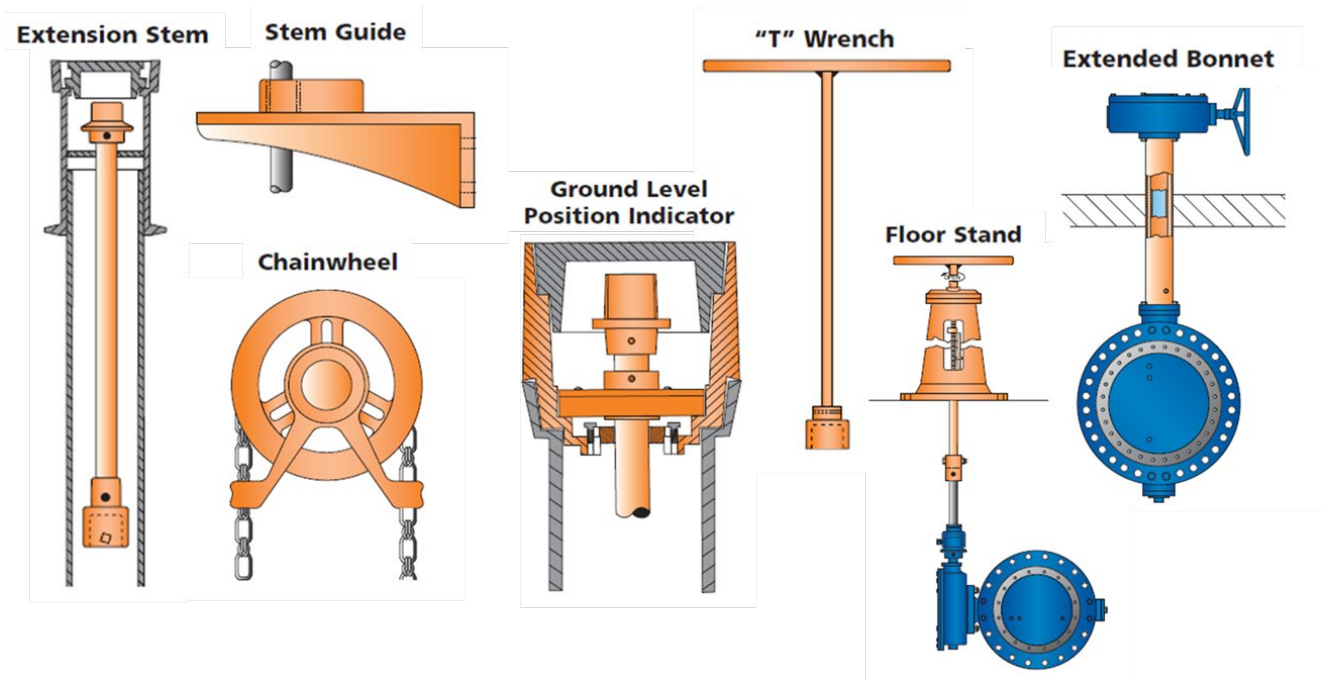


FIGURE 6. VERTICAL PIPE WITH SOLIDS

SPECIFICATIONS

- Fully encapsulated resilient plug
- Welded 94%+ Nickel Seat
- Grit Guard Shaft Seals – Upper & Lower Journals
- Vee Type Packing
- Heavy Duty 316 Stainless Steel Shaft Bearings – Permanently lubricated
- FBE Capability
- Note required Port Preference
- Operator Requirements
- Paint!

Other Considerations



Accessories galore

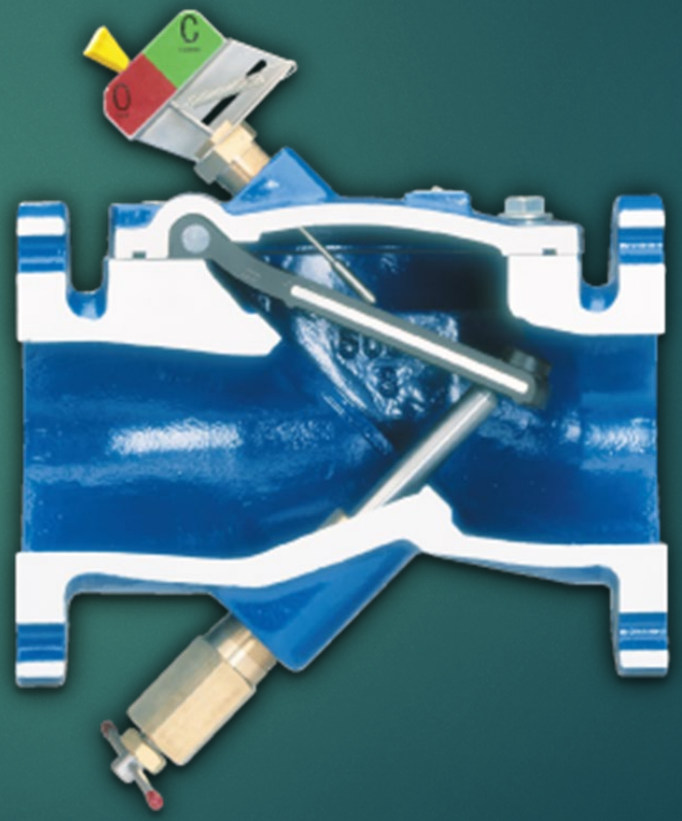
A word about Actuators

- Line pressure
  - Don't use design pressure
- Available Power
- Function
- Enclosure Rating
- Function
- Support
- Service

The 36" Val-Matic Cam Centric Eccentric Plug Valves assembled and tested at Crossness with Rotork Actuators orientated for horizontal shaft mounting

What's your valve IQ?

- Which of the following check valves has the lowest TOTAL Cost over the life of the valve?
  - Ball Check
  - Silent Check
  - Swing Check with Outside Lever & Weight
  - Resilient Hinge (Swing Flex)



What's your valve IQ? True or False

- Plug valves should only be used in "dirty" applications?

- TRUE
- FALSE

What's your valve IQ?

- Which valve can be used in open/close applications like pump isolation in clean water and on air but has limited throttling capabilities?
  - Gate Valve
  - Plug Valve
  - Check Valve
  - Butterfly Valve

What's your valve IQ? True or False

- Valves are "one size fits all" and can work in any application
- True
- False

Resources to help…

- Local Manufacturer's Rep
  - Selection & sizing recommendations
  - Budget prices
  - Specifications
    - Base spec review & suggestions
    - Project Specific
  - Start Up & Warranty Assistance
  - Training
  - End User Support

Thank You

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MOBILE: 916-878-0728