WILLAMETTE BALL AND CONE VALVES

List 22
Series 2200
Metal Seated Cone Valves

List 26
Series 2600
AWWA Metal Seated Ball Valves
List 26 Series 2600 Ball Valves
When You Can't Afford a Lesser Valve, Specify the Best . . .

Series 2600 — A Valve That Will Last for Decades.
The Willamette List 26 Metal Seated Ball Valve is the absolute premium quality valve for municipal applications. Water and sewage districts the world over recognize it as the best valve available for performance and reliability in critical service applications. List 26 valves are designed for standard pipe sizes from six to sixty inches. Standard design pressures are up to 300 psig (2068kpa), certain special designs are available for pressures in excess of 400 psig (2758kpa).

The List 26 is a heavy duty Ball Valve built especially for pump stop and check, pressure regulating, flow control and critical shut-off service in municipal systems. It is a superior valve because of its unique design features, uncompromising use of quality materials and the precision of its fabrication and assembly. The valve consists of four main elements: the body, the ball, the torque unit and the operator.

The body is a pressure vessel that houses the ball sub-assembly. It is cast in four pieces: two body halves and two adaptors, which are sealed together with O-rings to prevent leakage. The adaptors carry the body seats, made of 400 Series monel, and also serve as flanges for connecting the valve to the line.

The ball controls flow through the valve. It is, in effect, two intersecting cylinders, one being the full ported waterway, the other retaining the seats. The ball rotates on support trunnions that are integrally cast with the ball, ensuring maximum rigidity in the body. An operating shaft connects with one trunnion and extends through the body of the valve to the torque unit. Due to the trunnion mounted arrangement, the shaft acts as a rotating element only. Therefore, Willamette valve shafts do not fall victim to fatigue. They are made of 17-4PH high strength stainless steel. Other materials are available. Attached to the ball are 300 series stainless steel seats. The stainless steel seats have a flexible outer rim which deflects slightly to contact the mating monel body seat when the valve is closed.

The torque unit provides the multiplication of leverage to rotate the ball. It utilizes a lever attached to the ball operating shaft and a pair of metal links which work with a crosshead to rotate the ball its full ninety degrees. This link/lever action provides a large mechanical advantage when seating/unseating the valve. It also produces a variable ball rotation speed as the valve opens or closes, minimizing hazardous surge and water hammer.

The standard list of operators offered by Willamette is documented later in this brochure. Each one of them is fully capable of meeting the demands of any specific application.
List 26
Cutaway View Metal Seated Ball Valve

Wide choice of operators available

Torque Unit

Alloy Steel Shaft

Integrally cast ball and trunnions mounted at both ends

Circular full ported waterway through both ball and body results in minimum head loss

Valve Body

External ball-position indicator

Solid bronze bearings for low maintenance — longer life

Precise machining of body and ball seats gives drop-tight seal

Monel body seats mate with stainless steel ball seats for long life

Bronze bushing

Link and lever operating mechanism provides maximum mechanical advantage, minimizes water hammer

Adaptor Flanges

Ball

Alloy Steel Shaft

Bronze bushing

Link and lever operating mechanism provides maximum mechanical advantage, minimizes water hammer

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List 26 Series 2600 Ball Valves
Metal Seated Ball Valve with Link and Lever Torque Unit

Torque Unit Controls Pump Start-Up and Shut-Down Surges
Precise Flow Regulation

The Willamette Link and Lever valve operating mechanism is designed to minimize water pressure surges and water hammer. In closing, 81% of the flow area is cut off during the first 50% of the operating stroke. The final 19% of the flow area is then slowly closed in the last 50% of the stroke. By shutting off the majority of the flow quickly, then slowly reducing the last 19% of the flow area, water hammer and system shock are virtually eliminated. The opposite occurs in the opening cycle, with a slow ball movement during the first half of the operating stroke.

These drawings illustrate the desirable effects of the List 26 Link and Lever Torque Unit. The variable plug rotation speed and mechanical advantage are obtained from the constant, linear operator movement. When the valve is closed, the links are at right angles to the lever. In theory, this arrangement provides a maximum mechanical advantage.

Lower Operator Torque

The Willamette Link and Lever Torque Unit has two other basic functions. First, it provides the ball shaft with a maximum amount of torque with a minimum amount of input. Operator torque requirements are reduced and easier operation is the result. Secondly, the torque unit provides adjustable mechanical stop, limiting devices for positioning the seats for final sealing and also ensuring a full port opening through the valve.
List 26 Series 2600 Ball Valves
Advanced Components

These top and side views clearly define each component part that goes into the making of a Willamette List 26 AWWA Ball Valve.

Top View/Section

1. Thrust Screw . . . . . . . . Steel
2. Thrust Pin . . . . . . . . . . Bronze
3. Body – Trunnion End . . . . Cast or Ductile Iron
4. Body Bushing . . . . . . . . Bronze
5. Adaptor . . . . . . . . . . Cast or Ductile Iron
6. Adaptor Seat . . . . . . . . Monel
7. Body – Operator End . . . . Cast or Ductile Iron
8. Indicator Shaft . . . . . . . Steel
9. Indicator . . . . . . . . . . Cast Steel
10. Ball Journal . . . . . . . . Bronze
11. Ball Seat Ring . . . . . . . Stainless Steel
12. Ball . . . . . . . . . . . . . Cast or Ductile Iron
13. Ball Journal . . . . . . . . Bronze
14. Thrust Washers . . . . . . . Bronze
15. Ball Shaft . . . . . . . . . Steel
16. Torque Pin . . . . . . . . . Steel
17. Lock Ring . . . . . . . . . . Steel
18. Sidemember . . . . . . . . Cast Bronze
19. Crosshead . . . . . . . . . Cast Bronze
20. Link . . . . . . . . . . . . . Cast Steel – Bronze Bushed
21. O-Ring Retainer . . . . . Cast Bronze
22. Lock Ring . . . . . . . . . Cadmium Plated Steel
23. Torque Unit Housing . . . Cast Iron
24. Lever . . . . . . . . . . . . Cast Steel
25. Torque Unit Cover . . . . Cast Iron

Note:
For ASTM numbers and materials for higher pressure class valves, see specifications on pages 26 and 27.

Side View

1. Handwheel . . . . . . . . Cast Iron
2. Thrust Collar . . . . . . . . Cast Iron
3. Grease Fitting . . . . . . . Stainless Steel
4. Adaptor . . . . . . . . . . Cast or Ductile Iron
5. Dowel Pin . . . . . . . . . Steel
6. Leadscrew . . . . . . . . . Stainless Steel
7. Torque Key . . . . . . . . . Steel
8. Sidemember . . . . . . . . Cast Bronze
9. Lever . . . . . . . . . . . . Cast Steel
10. Links . . . . . . . . . . . . Cast Steel – Bronze Bushed
11. Link Pin . . . . . . . . . Stainless Steel
12. Lock Screw . . . . . . . . Steel
13. Adaptor Seat . . . . . . . Monel
14. Ball Seat Ring . . . . . . . Stainless Steel
15. O-Ring . . . . . . . . . . . Rubber
List 26 Series 2600 Ball Valves
Exploded Views

List 26
AWWA
Ball Valve

Four piece body and ball sub-assembly of the Willamette
List 26 Ball Valve (except the 6", 8", 48", 54" and 60" valves),
(150, 200, 1200, 1400, 1500mm)

* The overwhelming majority of metal seated ball valve
applications are for single seated valves.

Standard Link
and Lever
Torque Unit
**List 26 Series 2600 Ball Valves**

**Cost/Performance Characteristics**

100% Full Port Design Cuts Costs

Full ported valves are far more cost effective than other valve types, mainly because of lower head loss. This table shows annual power costs for different valve types. All amounts are based on $.09/kWh, continuous pumping (8,760 hours/year) at 70% overall efficiency with a line velocity of 16 ft/sec.

Example: When using a typical butterfly/swing check valve pump control combination for a 36" (900mm) diameter system, the check valve costs $22,284.00/year and the butterfly costs $8,969.00/year, compared to List 26 costs of $1279.00/year—a savings of $149,870.00 over five years.

Full Port Design Makes Sense!

Variable Ball Rotation Controls Surge

This graph compares Willamette List 26 opening characteristics with the opening characteristics of other major valve types. The curves show that the opening flow through a List 26 is an optimum accelerating pattern, slow at first, then smoothly increasing to full port. Closing is just the reverse, with the first 50% of the stroke reducing flow by 81%, and the final 50% closing the valve completely. This flow pattern is more effective at controlling water hammer and surge than any other valve. It constitutes one of the major design advantages of the List 26.

Ball Angle, Flow Area Accelerate During Stroke

This graph shows the relationships of stroke, ball angle and valve discharge rate during the List 26 opening rotation. As the ball rotates slowly early in the stroke, discharge rate is low and highly controlled. As the stroke continues, the ball angle accelerates, allowing a corresponding increase in discharge rate. At full port, discharge is at maximum and flow obstruction is near zero. This function, which minimizes pressure changes, is accomplished on the List 26 without complicated variable speed operators or controls.

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**Estimated Annual Power Costs (in U.S. Dollars)**

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<tr>
<th>Valve Diameter</th>
<th>Ball &amp; Cone Valve</th>
<th>Gate Valve</th>
<th>Swing Check Valve</th>
<th>Butterfly Valve</th>
<th>Globe Valve</th>
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<tr>
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<td>119</td>
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<td>494</td>
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**Inch**

**Millimeter**
List 26 Series 2600 Ball Valves
Cost/Performance Characteristics

Venturi Allows Smaller-Than-Line-Size Valve Use
The venturi-type installation allows effective use of the List 26 in smaller-than-line-size applications, such as distribution systems, pressure reducing service and gravity mains. The List 26 is ideal for these applications because of its unobstructed waterway. In many venturi installations, it can be specified one or two sizes smaller than normal line size.

The user benefits from the superior operating and maintenance features of the List 26 at a cost competitive with the larger obstructed-waterway valves. In some cases, headloss resulting from the venturi-List 26 combination is actually less than from the larger obstructed-waterway valves. Tests have shown a 24” (600mm) venturi, for example, to produce less head loss than a 30’ (750mm) gate or butterfly valve in certain applications.

Flow
24” (600mm) Ball Valve

24” (600mm) Ball Valve

30° Diameter (762mm)
21°

24” Diameter (610mm)
8°

30° Diameter (762mm)

Approximate CV Values
APCO Willamette Cone Valve for Closed Loop System Plug Angle in Degrees from Closed

<table>
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<tr>
<th>Valve Size (inches)</th>
<th>5°</th>
<th>10°</th>
<th>30°</th>
<th>50°</th>
<th>70°</th>
<th>Fully Open</th>
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<tr>
<td>6” 150</td>
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<td>70</td>
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<td>484</td>
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<td>8” 200</td>
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<td>401</td>
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<td>30” 750</td>
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<td>60” 1500</td>
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<td>22,571</td>
<td>48,367</td>
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Note:
For more specific flow information, please contact your DeZURIK APCO Willamette representative.

Improved Valve Flow Coefficients
CV values are based on the amount of flow through a full ported ball valve in a closed loop system at 1.0 psig (6.9 kpa) constant pressure drop.

\[ CV = Q \times \sqrt{SG} \]

- \(Q\) = Flow in U.S. gallons per minute (GPM)
- \(\Delta P\) = Pressure drop (PSI)
- \(SG\) = Specific gravity of fluid (Water = 1.0)
- \(CV\) = Valve flow coefficient

\(CV\) calculations based on:
List 26 Series 2600 Ball Valves
Metal to Metal Seats

Spring Seat Design

Closing Action
The ball is fully rotated and positioned for final sealing using positive mechanical stops in the valve actuating mechanism. (Figure A)

Closed and Seated
The differential pressure (high pressure/low pressure) acting on the back side of the ball seat ring causes the outer rim to deflect slightly, causing the ball and ball seat ring to move forward and make contact with the body seat ring. (Figure B)

Opening Action
The ball is rotated to open the valve by the valve actuating mechanism. After the ball rotates approximately one half degree, the offset eccentric action is sufficient to pull the ball seat back far enough to overcome the ball seat ring deflection. Seats never again make contact during rotation of the ball. The ball stays in the open position using positive mechanical stops in the valve actuating mechanism to form a smooth, unobstructed water passage.

Metal to Metal Seats Last Decades Longer Than Rubber Seats

Rubber seated valves that are initially less expensive, can become very costly and inconvenient when your system is shut down due to inevitable rubber seat repair and/or replacement. Our design has resulted in metal-to-metal seats that can handle tough applications and provide long maintenance-free life without wedging, galling, scraping or seat replacement.

Metal to Metal Seats Are Designed For Severe Throttling Service. Rubber Seats Are Not!

48” (1200mm) 300# Class Turbine Guard Valve with High Pressure Accumulator Installed in Northern California. Hydro Electric Project Emergency Shut-Off Valve.
List 26 Series 2600 Ball Valve Features

Precise Flow Regulation
List 26 Ball Valves will control pressure differentials and flow rates to extremely close limits without hunting, vibrating or excessive noise. List 26 valves act as an energy absorber in any throttled position due to the back pressure inside the valve body and around the ball. This, together with durable metal to metal seats which allow line velocities in excess of 100 ft./sec. (30 m/sec.), make Willamette Ball Valves ideal for throttling applications.

Virtually Maintenance Free
Thousands of Willamette Ball Valves have been in service for over a 40 year period almost completely trouble-free.

Self Cleaning, Non-Clogging Design
When the valve is opening or closing, flow goes through and around the ball, flushing out debris. This makes the List 26 ideally suited for raw sewage service, assuring complete closing of the valve.

Drop-Tight Shutoff
Metal to metal seats mate precisely, maintaining a drop-tight seal. The seal lasts the life of the valve because of the durability of the metal and the eccentric motion of the seats. (Standard leakage is defined as 1oz. (29.57 mL) per nominal inch size per hour.)

No Measurable Head Loss
True full port opening results in no more head loss than an equivalent length of pipe.

Trunnion Mounted
The trunnion mounted ball allows the majority of the hydraulic load to be supported by the trunnions, resulting in low bearing pressure and no shaft fatigue.

Longer Bearing Life
Bearing materials are made of different degrees of hardness preventing galling and extending life. Bearing pressures are low compared to similar valves (900 psig (6205kpa) for 150# class and 1500 psig (10342kpa) for 250# class). Solid bronze construction means longer, trouble-free service, and like our metal seats, the bearings will last the life of the valve.

Lifetime Seats
Our competitors say their seats are easily replaceable because they have to replace their seats. Under normal operating conditions you won’t have to replace List 26 metal seats.
List 26 Series 2600 Ball Valves
Valve and Operating Mechanism Dimensions

Envelope dimensions of the ball valve assembly (valve and operating mechanism) are shown below.

For more specific dimensions, please contact your DeZURIK AWCPO Willameet representative.

Dimensions and specifications given in this publication were correct at time of printing, but should not be used in lieu of certified drawings.

Note: All Dimensions For Class 250# Valves
Also Apply to Class 300# Valves.

APCPO Willameet List 26 Ball valves are manufactured to AWWA C-507 standard for ball valves 6" - 48" (150 - 1200mm) 150, 250 and 300psi pressure classes. 54" - 60" (1400 - 1500mm) also available.

Hydraulic Cylinder Operator

Torque unit (valve operating mechanism) complete with appropriate operator is shown in its customary vertical orientation, (perpendicular to pipeline), however, torque unit complete with operator may be rotated in any of 90° increments (parallel with pipe-line) if so desired to suit installation requirements.

Valve accessories such as control piping, limit switches, etc., not shown.

List 26 – AWWA Metal Seated Ball Valve

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List 26 – Hydraulic Cylinder Operator

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Inch
Millimeter

The tables provided contain dimensions and weights for various diameters, showing the progression of measurements and weights as the diameter increases.
# List 26 Series 2600 Ball Valves

## Valve and Operating Mechanism Dimensions

### Air/Oil Tandem Cylinder Operator

<table>
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Inch
Millimeter
List 26 Series 2600 Ball Valves
Valve and Operating Mechanism Dimensions

### Electric Motor Operator with 90° Direct Drive

#### List 26 – Motor Operator with 90° Direct Drive

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#### Manual Operator

#### List 26 – Manual Operator

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List 26 Ball Valves and List 22 Cone Valves

Operators
Willamette List 26 Ball Valves can be supplied with standard manual, electric motor or cylinder operators for most applications. Other operator control accessories can be supplied that allow the user to tailor the List 26 to specific performance requirements.

These same operators are used with the List 22 Cone Valves described in the second part of this brochure.

Cylinder Operators
Cylinder operators are specified for automatic operations.

Hydraulic Cylinder
This operator uses a double-acting piston which opens and closes the valve when pressure is introduced. This is a standard cylinder powered by water or oil, designed per AWWA C540.

Air/Oil Tandem Cylinder
The tandem cylinder above is our preferred operator. This air/oil system eliminates the installation of a costly hydraulic accumulator system by using a compressed air supply for a power source. This supply of compressed air also furnishes an accumulated source of energy to provide an emergency closure of the valve during power failure or other unexpected conditions.

A clean reliable source of air (for best results, 85-125 psig (586 - 862kpa) is provided to the upper cylinder to power the valve. The lower cylinder is oil filled and is used to provide control of the opening and closing times with the smooth operation of oil.

For all valves, emergency fast closing function can be provided for rapid closure in the event of loss of power.

Manual Operator
The manual operator is used for any stop service where dependability is critical and where automation is not necessary. Since the valve can be easily operated by one person, no bypass is necessary. The operator is supplied with a standard AWWA handwheel or 2" (50mm) square operating nut.

Motor Operator
For applications requiring motor operated valves, we will gladly make recommendations and supply the dimensions and characteristics for the valve, operator and controls required.

On the List 26, the electric motor operator is also available with a 90° direct drive unit (instead of our standard link and lever torque unit) for remote modulating, flow control applications requiring a more direct 1 to 1 ratio of opening and closing.

Buried and Submersible Service
The operating mechanism is permanently lubricated and can be sealed making it suitable for submersible service to approximately 20 feet (6m) for extended periods of time. A complete range of stem extensions, valve street boxes complete with indicators as well as floor stands are also available.
List 26 Ball Valves And List 22 Cone Valves
Schematic/Standard Controls

Hydraulic Cylinder (Oil or Water) for Modulating Control

Operation:
1. Normal Opening of Valve
   A. Open solenoid valve (1) (4 way/3 position) is energized
   B. Pressure (P) to port B
   C. Port A exhausts to E
2. Normal Closing of Valve
   A. Close solenoid valve (1) (4 way/3 position) is energized
   B. Pressure (P) to port A
   C. Port B exhausts to E

Manual Override — Push in and rotate knob fully clockwise. There is a manual operator for both opening and closing functions. Both must be rotated fully counterclockwise for normal electrical operation.

Hydraulic Cylinder (Oil or Water) with 2 Fast Close Solenoids

Operation:
1. Normal Opening of Valve
   A. Solenoid valve (2) (4 way/2 position) is energized.
      Pressure (P) to port B and A exhausts to E.
   B. Solenoid valves (3) (2 way normally open) are energized. No flow.
2. Normal Closing of Valve
   A. Solenoid valve (2) (4 way/2 position) is de-energized.
      Pressure (P) to port A and B exhausts to E.
   B. Solenoid valves (3) (2 way normally open) are de-energized. No flow.
3. Emergency Close
   A. Solenoid valve (2) (4 way/2 position) is de-energized.
      Pressure (P) to port A and B exhausts to E.
   B. Solenoid valves (3) (2 way normally open) are de-energized. Cylinder extends to close valve at high speed rate.

Manual Override — Rotate fully clockwise for opening function (lifts solenoid plunger to its energized position). Rotate fully counterclockwise for closing function. Rotate fully counterclockwise before operating electrically. Close ball valves (4) when operating manually.

Tandem Air/Oil Cylinder for Pump Stop and Check with Emergency Close Loop

Operation:
1. Normal Opening of Valve
   A. Solenoid valve (2) (4 way) is energized.
      Pressure (P) to port B and A exhausts to E.
   B. Solenoid valve (3) (2 way normally open) is energized. No flow.
2. Normal Closing of Valve
   A. Solenoid valve (2) (4 way) is de-energized.
      Pressure (P) to port A and B exhausts to E.
   B. Solenoid valve (3) (2 way normally open) is de-energized. No flow.
3. Emergency Close
   A. Solenoid valve (2) (4 way) is de-energized.
      Pressure (P) to port A and B exhausts to E.
   B. Solenoid valve (3) (2 way normally open) is de-energized. Cylinder extends to close valve at high speed rate.

Manual Override — Same as hydraulic cylinder with 2 fast close solenoids described above.
List 22 Series 2200 Cone Valves
Proven Dependability

Series 2200
Valves That will Last for Decades.

Willamette List 22 Cone Valves are built tough to last under the most severe conditions. They are 100% full port, conical plug-type valves with a circular waterway through both body and plug in the fully open position. Each valve consists of: a tapered cone (plug) that fits precisely into a mating body, cover, valve operating mechanism and actuating unit.

The valve body has weld-overlayed monel seats around the bore. After welding, they are accurately machined and ground. In operation, they engage the seat rings on the plug when the plug is seated. Bronze pivot bearings are provided on the plug trunnions.

The plug has two pairs of monel seats; one pair mates with the body seat in the open position, while the other pair mates in the closed position (rotated 90 degrees). In operation, the plug is first lifted to separate the plug seat from the valve body seat. It is then rotated 90° to the open or closed position. The plug is then lowered to reseat in the desired position. Monel body and plug seats provide a solid, dependable and drop-tight closure.

Willamette offers standard List 22 Cone Valves of cast gray iron or ductile iron construction with ANSI B16.1, class 125/150 lb. flanges for working pressures to 175 psig (1207kpa). For working pressures to 275 psig (1896kpa), we offer cast ductile iron construction with ANSI B16.1, class 250/300 lb. flanges. Cone Valves of cast steel construction are available with ANSI B16.5, class 150 lb. and class 300 lb. flat-face and raised-face flanges for working pressures to 720 psig (4964kpa). Valves are provided with a skirted plug.

The valve operating mechanism is mounted on the head cover and has a removable cover for inspection, adjustment or repairs. This mechanism consists of a crosshead to lift, rotate and lower the plug; this is connected to an independent link and lever arrangement. Lifting the plug is accomplished by means of a lift nut and rotation is accomplished by means of a rotator lever. A position indicator on the outside of the mechanism lets you know the orientation of the plug at a glance.

Thousands of installations have proven the design quality and reliability of the Willamette Cone Valve. Continuous design improvements by Willamette have produced the best Cone Valves currently available in the marketplace. Every valve is designed and built for precise operation, long life and low maintenance. Our history proves it. Willamette Cone Valves have been in operation for over 60 years, demonstrating that they stay on the job and require minimum maintenance.

Willamette is proud of the excellence of the List 22 Cone Valve. It confirms again the position of leadership in design and manufacture of fluid control apparatus that the company has held throughout this century.
List 22 Series 2200 Cone Valves
Unsurpassed Performance

Metal to Metal Seats
List 22 Cone Valves feature wide, weld-on monel metal seats which eliminate the erosion and abrasion failures common to polymer and elastomer seals in other types of valves.

Under normal conditions the metal to metal monel seats do not require replacement or preventive maintenance and guarantee dependable operation.

Metal to metal seating allows the valve to be installed in tough applications where velocities are high and continuous throttling is necessary.

List 22’s Unique Operating Cycle
The unique operating mechanism of the List 22 unseats the plug axially without rotation then smoothly rotates the plug 90°. After rotation, crosshead travel reseats the plug creating a full port unobstructed waterway. This operation provides positive protection for the seats at all times assuring long, maintenance free service.

The progressive effects of this movement are as follows:

• Actuator input shaft moves the crosshead assembly.
• Motion from crosshead is coupled through a link and lever to a threaded lift nut. As the crosshead moves, it causes the lift nut to rotate. This action causes the threaded stem to rise which lifts the plug off its seat.
• As crosshead continues to travel, it engages the rotator which causes the plug stem to rotate. This action slowly opens the valve.
• Valve pointer always indicates the position of the valve plug.
• At the end of the opening cycle, rotator stop screw contacts actuator housing which stops all rotation of the plug.
• Further travel of crosshead causes the threaded lift nut to lower the plug to engage the valve body and plug seats.

Cone Valve Link and Lever Torque Unit
The mechanism is totally enclosed in its own housing separate from the valve itself and is easily accessible for stem packing replacement or inspection maintenance. Maintenance does not require shut-down of the pipeline. Included in the mechanism housing is an external valve position indicator.

The operating mechanism is designed to allow slight repositioning of the seats in case of future wear.
List 22 Series 2200 Cone Valves
Advanced Components/Exploded Views

The cutaway view on page 20 can be used in conjunction with the exploded views on this page to identify every part that composes a List 22 Cone Valve.

**List 22 Torque Unit**
1. Indicator . . . . . . Cast Steel
2. Shaft . . . . . . . . . Steel
3. Crosshead Roller . . . . . . Steel
4. Crosshead . . . . . . Cast Bronze
5. Link . . . . . . . . . . Cast Steel
6. Bushing . . . . . . Bronze
7. Lever . . . . . . . . . . Cast Steel
8. Lift Nut . . . . . . Bronze
9. Rotator . . . . . . . . Cast Steel
10. Cover . . . . . . . . Cast or Ductile Iron
11. Housing . . . . . . Cast or Ductile Iron
12. Housing End . . . . Cast or Ductile Iron
14. Leadscrew . . . . Stainless Steel
15. Guide Rod . . . . Stressproof Steel
16. Thrust Washer . . . Bronze
17. Lock Nut . . . . . . Steel
18. Spacer . . . . . . . . Steel

**List 22 Cone Valve**
19. Packing Gland . . . . Steel
20. Vee Packing . . . . Nitrile Elastomer
21. Operator Shaft . . . . Steel
22. Dowel . . . . . . . . . Steel
23. Journal . . . . . . Bronze
24. Bushing . . . . . . Bronze
25. Capscrew . . . . . . Steel
26. Cover . . . . . . . . Cast or Ductile Iron
27. Plug. . . . . . . . Cast or Ductile Iron
28. Body . . . . . . . . Cast Or Ductile Iron
29. Mounting Base . . . Cast Iron

**Note:**
For ASTM designations and for higher pressure class valves, see specifications on page 27.
List 22 Series 2200 Cone Valves
Cutaway View

9. Rotator
Link and lever type operator for smooth operating cycle and maximum mechanical advantage

14. Cylinder Rod or Lead Screw

15. Guide Rod

4. Crosshead

5. Link

7. Lever

26. Cover
Trunnion reinforcing rib
Weld-on monel seats for long life
Precise machining of metal body seat and metal plug seat gives drop-tight shutoff

10. Internal Plug Position Indicator
Wide choice of operators available (See pages 14-15)

2. Shaft
Totally enclosed operating mechanism

8. Lift Nut
Shaft Coupling
Shaft Seals
Flat-faced flanges

28. Body
Circular waterway through both plug and body reduces head loss

Trunnion reinforcing rib

27. Plug
Bronze bushings for low maintenance and longer life

(For illustrative purposes only)
List 22 Series 2200 Cone Valves

Valve And Operating Mechanism Dimensions

Envelope dimensions of the cone valve assembly (valve and operating mechanism) are shown below.

For more specific dimensions, please contact your DeZURIK APCO Willamette representative.

Dimensions and specifications given in this publication were correct at time of printing, but should not be used in lieu of certified drawings.

Note: A II dimensions for class 250# valves also apply to class 300# valves.

Flat-faced flanges per ANSI B16.1, class 125 lb. or 250 lb. are normally furnished. Other flange facing is available. Consult your DeZURIK APCO Willamette representative.

Hydraulic Cylinder Operator

Torque unit (valve operating mechanism) complete with appropriate operator is shown in its customary vertical orientation, (perpendicular to pipeline), however, torque unit complete with operator may be rotated in any of 90° increments (parallel with pipeline) if so desired to suit installation requirements.

Valve accessories such as control piping, limit switches, etc., not shown.

List 22 – Metal Seated Cone Valve

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Inch Millimeter

List 22 – Air/Oil Tandem Cylinder Operator

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<th>B (Height)</th>
<th>C (Width)</th>
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Inch Millimeter
**LIST 22 SERIES 2200 Cone Valves**  
**Valve and Operating Mechanism Dimensions**

**Air/Oil Tandem Cylinder Operator**

<table>
<thead>
<tr>
<th>Dia.</th>
<th>A (Length)</th>
<th>B (Height)</th>
<th>C (Width)</th>
<th>Weight (Approx. lbs/kg)</th>
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</thead>
<tbody>
<tr>
<td>6&quot;</td>
<td>256</td>
<td>562</td>
<td>256</td>
<td>600</td>
</tr>
<tr>
<td>7&quot;</td>
<td>335</td>
<td>646</td>
<td>335</td>
<td>1000</td>
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<td>421</td>
<td>789</td>
<td>421</td>
<td>1750</td>
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<td>894</td>
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<td>3200</td>
</tr>
<tr>
<td>12&quot;</td>
<td>595</td>
<td>1046</td>
<td>595</td>
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<td>14&quot;</td>
<td>690</td>
<td>1194</td>
<td>690</td>
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<tr>
<td>16&quot;</td>
<td>785</td>
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<td>785</td>
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<td>880</td>
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<td>1849</td>
<td>1070</td>
<td>23000</td>
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<td>1225</td>
<td>2302</td>
<td>1225</td>
<td>40000</td>
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<td>57000</td>
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<td>1535</td>
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<td>48&quot;</td>
<td>1690</td>
<td>3658</td>
<td>1690</td>
<td>95000</td>
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</tbody>
</table>

Inch  
Millimeter

Envelope dimensions of the cone valves on these pages show the valve positioned with operator in a vertical position. The drawings above show how the valve will look when operators must be in a horizontal position.

Dimensions and specifications will be supplied on request.  
Please consult your DeZURIK APCO Willamette representative.
# LIST 22 SERIES 2200 Cone Valves

## Valve and Operating Mechanism Dimensions

### Motor Operator

<table>
<thead>
<tr>
<th>Dia. (mm)</th>
<th>A (Length)</th>
<th>B (Height)</th>
<th>C (Width)</th>
<th>Weight (Approx. lbs/kg)</th>
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</thead>
<tbody>
<tr>
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<td>125#</td>
<td>125#</td>
<td>150</td>
</tr>
<tr>
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</tr>
<tr>
<td>800</td>
<td>700</td>
<td>800</td>
<td>700</td>
<td>173</td>
</tr>
<tr>
<td>1000</td>
<td>900</td>
<td>1000</td>
<td>900</td>
<td>197</td>
</tr>
<tr>
<td>1200</td>
<td>1100</td>
<td>1200</td>
<td>1100</td>
<td>220</td>
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</table>

### Manual Operator

<table>
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<tr>
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<th>B (Height)</th>
<th>C (Width)</th>
<th>Weight (Approx. lbs/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125#</td>
<td>150</td>
<td>125#</td>
<td>125#</td>
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<tr>
<td>250#</td>
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<td>113</td>
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<td>400</td>
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<td>132</td>
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<td>148</td>
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<td>173</td>
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<td>1000</td>
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<td>197</td>
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<tr>
<td>1200</td>
<td>1100</td>
<td>1200</td>
<td>1100</td>
<td>220</td>
</tr>
</tbody>
</table>

### Millimeter Dimensions

- **Dia.**
- **A (Length)**
- **B (Height)**
- **C (Width)**
- **Weight (Approx. lbs/kg)**

### Inch Dimensions

- **Dia.**
- **A (Length)**
- **B (Height)**
- **C (Width)**
- **Weight (Approx. lbs/kg)**

**Notes:**
- Dimensions are approximate and subject to change. Please refer to the manufacturer's specifications for the most accurate and up-to-date information.
List 22 Series 2200 Cone Valves
Performance Characteristics

### APPROXIMATE CV VALUES
APCO Willamette Cone Valve for Closed Loop System Plug Angle in Degrees from Closed

<table>
<thead>
<tr>
<th>Valve Size (inches)</th>
<th>10°</th>
<th>20°</th>
<th>30°</th>
<th>60°</th>
<th>80°</th>
<th>90°</th>
<th>Fully Open</th>
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<tbody>
<tr>
<td>6&quot; 150</td>
<td>27</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>240</td>
<td>320</td>
<td>420</td>
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<tr>
<td>8&quot; 200</td>
<td>48</td>
<td>120</td>
<td>180</td>
<td>240</td>
<td>320</td>
<td>390</td>
<td>480</td>
</tr>
<tr>
<td>10&quot; 250</td>
<td>75</td>
<td>150</td>
<td>225</td>
<td>300</td>
<td>390</td>
<td>480</td>
<td>560</td>
</tr>
<tr>
<td>12&quot; 300</td>
<td>120</td>
<td>240</td>
<td>330</td>
<td>420</td>
<td>520</td>
<td>630</td>
<td>720</td>
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<td>14&quot; 350</td>
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<td>450</td>
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<td>750</td>
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<td>1050</td>
</tr>
<tr>
<td>16&quot; 400</td>
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<td>400</td>
<td>600</td>
<td>800</td>
<td>1000</td>
<td>1200</td>
<td>1400</td>
</tr>
<tr>
<td>18&quot; 450</td>
<td>240</td>
<td>600</td>
<td>900</td>
<td>1200</td>
<td>1500</td>
<td>1800</td>
<td>2100</td>
</tr>
<tr>
<td>20&quot; 500</td>
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<td>900</td>
<td>1500</td>
<td>2100</td>
<td>2500</td>
<td>3100</td>
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**Estimated Annual Power Costs**

<table>
<thead>
<tr>
<th>Valve Diameter (inches)</th>
<th>Ball &amp; Cone Valve</th>
<th>Gate Valve</th>
<th>Swing Check Valve</th>
<th>Butterfly Valve</th>
<th>Globe Valve</th>
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</thead>
<tbody>
<tr>
<td>6&quot; 150</td>
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<td>133</td>
<td>885</td>
<td>800</td>
<td>6,046</td>
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<td>8&quot; 200</td>
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<td>216</td>
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<td>1,312</td>
<td>9,916</td>
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<tr>
<td>10&quot; 250</td>
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<td>269</td>
<td>2,322</td>
<td>1,811</td>
<td>15,667</td>
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<tr>
<td>12&quot; 300</td>
<td>236</td>
<td>369</td>
<td>3,060</td>
<td>2,160</td>
<td>20,976</td>
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<tr>
<td>14&quot; 350</td>
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<td>494</td>
<td>4,158</td>
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<td>16&quot; 400</td>
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<td>874</td>
<td>5,434</td>
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<td>37,233</td>
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<td>1,025</td>
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<td>3,203</td>
<td>43,500</td>
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<td>1,264</td>
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<td>24&quot; 600</td>
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<td>2,610</td>
<td>15,476</td>
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<td>3,576</td>
<td>22,284</td>
<td>8,969</td>
<td>152,396</td>
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<td>9,032</td>
<td>56,328</td>
<td>22,546</td>
<td>382,648</td>
</tr>
</tbody>
</table>

Low Head Loss — Power Cost Savings

Full ported valves are far more cost effective than other valve types, mainly because of lower head loss. List 22 Cone Valves are 100% full ported. There is no more head loss through the valve than there would be in an equivalent length of pipe of the same diameter. Full ported List 22 Cone Valves can even be pigged.

This table shows annual power costs for different valve types. All amounts are based on $.09/kWh, continuous pumping (8,760 hours/year) at 70% overall efficiency with a line velocity of 16 ft/sec (4.9 m/sec). Power costs are much lower than with restricted-port valves such as the butterfly, check, plug or globe valves.

Smooth Operation Gives Precise Flow and Pressure Regulation

The smooth operating cycle of the List 22 is highly effective in controlling surge and water hammer while providing precise flow regulation. The operating cycle is shown in the graph at right. Notice that only 2% of the flow area is opened with nearly 20% of actuator stroke. This is due to the lifting of the conical plug prior to rotation.
LIST 22 SERIES 2200 Cone Valves

Features

Metal to Metal Seats
List 22 Cone Valves feature wide, weld-on monel metal seats which eliminate the erosion and abrasion failures common to polymer and elastomer seals in other types of valves. Under normal conditions the metal to metal monel seats do not require replacement or preventive maintenance and guarantee dependable operation. Metal to metal seating allows the valve to be installed in tough applications where velocities are high and continuous throttling is necessary.

Virtually Maintenance Free
Thousands of APCO Willamette Cone Valves have been in service up to 60 years and have proven to be almost completely trouble-free.

Drop-Tight Shutoff
Metal to Metal Seats mate firmly and accurately to maintain a drop-tight seal.* Under normal operating conditions, the seal will last the life of the valve. *0.4 oz/minute/inch of diameter, (13.3mL/minute/inch of diameter)

Solid Bronze Bearings
List 22 valves are built with solid bronze bearings at the upper and lower trunnion of the plug. Solid bronze construction means longer, trouble-free service.

Wide Range of Sizes
List 22 valves are designed for a wide range of sizes and applications. Standard design pressures up to 350 psig (2413kpa). Certain special configurations are available for pressures of more than 720 psig (4964kpa).

Easily Operated by One Person
One person can always operate the valve — even one that has been static for several years.

Reduced Pressure Loss
This graph shows the head loss between 5 and 70% of the valve opening angle. This is caused by the smooth operation and long stroke of the valve actuator in rotating the valve plug. The result is precise flow and pressure control with no hunting. For additional List 22 Cone Valve head loss characteristics, contact your DeZURIK APCO Willamette representative.
Suggested Specifications

List 26 Series 2600 Awwa Ball Valves

1.0 Valve Construction

1.1 General

Each ball valve shall consist of four main elements: A pressure vessel (body), a rotatable closing element (ball), a torque unit, and an operator. Standard ball valves shall be furnished in either cast iron ASTM A48 CL-35 (150# class); ductile iron ASTM A536 (250# class); GR65-45-12 or cast steel ASTM A27 GR65-35 (300# class). Ball valve construction shall be in complete accordance with AWWA specifications C507 for ball valves 6" thru 48" with metal seats per specification section 3.2.3.2.

1.2 Body

The “Standard” body shall have ANSI B16.1 CL. 125/150 or CL. 250/300 flanges and shall house the ball. The body shall have integrally cast, bronze bushed trunnions. It shall provide rigid means for supporting the torque unit without the necessity of additional supports. There shall be two (2) pipe connections, one for an air vent and the other for drain. The body shall have rigidly attached corrosion resistant metal seat(s) made of 400 series monel. Maximum seat bearing pressure shall not exceed 1,000 lb/sq. inch.

1.3 Ball

The ball shall have integrally cast, bronze bushed trunnions. An extension of one trunnion, called the operating shaft, shall pass through a sealing device (o-ring retainer) and connect to the torque unit. The operating shaft shall be 17-4PH high strength stainless steel. The sealing device shall be capable of being removed and having its seals replaced without removing the valve from the line. The ball shall have corrosion resistant metal seat(s) of 300 series stainless steel rigidly attached and fully adjustable to provide drop-tight sealing (1 oz. per inch per hour exceeding AWWA C507 standards). The ball shall be so designed that the factor of safety for all combined stresses shall be at least five to one. Maximum torsional deflection shall not exceed 1/6 degree per foot of unsupported length using a seat coefficient of friction of 0.5 and a bearing coefficient of friction of 0.3.

1.4 Torque Unit (Valve Operating Mechanism)

The torque unit shall employ a traveling crosshead to impart positive rotary movement to the ball by means of a link and lever connected to the ball shaft. A ball shaft support bearing shall be connected to the ball shaft. The torque unit shall be designed so that during the first 50 percent of stroke in closing, the flow area is reduced by approximately 81 percent. The remaining flow area shall be gradually reduced to a complete shutoff throughout the last 50 percent of closing stroke. All materials of the torque unit subject to rubbing shall be of different hardness. The torque unit shall be capable of being inspected, lubricated, removed and repaired without removing the valve proper from the line. The torque unit shall also be designed so that the o-ring seals on the main shaft can be replaced without removing the torque unit housing and while the valve is in the line.

1.5 Bearings

For prolonged bearing life, bearing loading shall not exceed 900 psi (6205kPa) at 150 psig (1034kPa) differential pressure, nor 1,500 psi (10342kPa) at 250 psig (1724kPa) differential pressure, shall be long life bronze, of low zinc content, of dissimilar hardness to prevent galling, and shall not be constructed of synthetic materials. Bronze bushing for body is ASTM B271-C95400; bronze journal for ball is ASTM B584-C93200.

2.0 Types of Operation

Manual operator (handwheel or AWWA square nut), electric motor (local or remote controls), or cylinder per AWWA C540 Standard for hydraulic or pneumatic control.

3.0 Testing

As per AWWA specification #C507. (Ball valve only)

4.0 Experience and Design Standard

The valve shall be the latest standard product of a manufacturer regularly engaged in the production of equipment of this nature. The valve manufacturer shall be experienced in the design and construction of Ball Valves for a period of not less than five years. The valve shall be Willamette Ball Valves or approved equal.
Suggested Specifications

List 22 Series 2200 Cone Valves

1.0 Valve Construction
The cone valve shall be of the conical plug type employing axial motion to unseat the plug, followed by a rotary motion to open or close the valve, and then followed by an axial motion to reseat the plug.

The valve shall be the latest standard product of a manufacturer regularly engaged in the production of equipment of this nature. The valve manufacturer shall be experienced in the design and construction of Cone Valves for a period of not less than five years. The valve shall be Willamette Cone Valves or approved equal.

1.1 Valve Components
The valve shall consist essentially of four main parts:

a. A valve body having waterway inlet and outlet diameters equal to the nominal size of the valve.

b. A conical plug having a clear waterway diameter equal to the nominal size of the valve.

c. A head cover to enclose the plug in the body.

d. An operating mechanism mounted on the head cover.

1.2 Materials
Standard Cone Valve shall be furnished in either cast gray iron ASTM A48 CL-35(125# class); ductile iron ASTM A536(250# class); GR65-45-12 or cast steel ASTM A27 GR65-35(300# class).

2.0 Body
The cast or ductile iron body of the valve shall consist of a housing having flanged inlet and outlet waterways and a head flange opening. The head flange opening shall permit removal of the plug. Waterway flanges shall conform to the dimensions and drilling of ANSI B16.1, class 125/150 lb. or 250/300 lb. and shall be flat faced. Inside the cast iron body of the valve, two monel seat rings shall be provided to engage the seat rings on the plug when the plug is seated. A bronze pivot bearing (ASTM B271-C95400) shall be provided for the plug trunnion.

2.1 Plug
The cast or ductile iron plug shall have the shape of a frustum of a cone with a clear waterway opening through it. The plug shall rotate on large diameter, integrally cast, bronze bushed (ASTM B584-C93200), top and bottom trunnions. The operating shaft shall be securely attached to the plug to transmit the lifting force and operating torque. The operating shaft shall be 17.4PH high strength stainless steel. The plug shall be provided with monel seats to engage the monel seat rings on the body when seated in both open and/or closed positions.

2.2 Head Cover
The valve shall be provided with a cast iron head cover to close the body head flange opening. The head cover shall make a registered connection with the valve body. A bronze pivot bearing (ASTM B271-C95400) in an integrally cast trunnion shall be provided for the plug.

3.0 Operating Mechanism
The operating mechanism shall be mounted on the head cover and shall be provided with a removable cover which shall permit inspection, adjustment and repair of the operating mechanism. The mechanism of the valve shall consist of a crosshead device which will lift, rotate and lower the plug. The crosshead shall travel in a straight line and shall operate through an independent link and lever arrangement, so that lifting shall be accomplished by means of a lift nut and rotation shall be accomplished by means of a rotator lever. The operating shaft shall be of sufficient strength to withstand any stresses to which it may be subjected under the design operating conditions. The valve shall be provided with a rotational position indicator which will at all times indicate the position of the valve plug.

4.0 Types of Operation
Manual operator (handwheel or AWWA square nut), electric motor (local or remote controls), or cylinder per AWWA C540 Standard for hydraulic or pneumatic control.

DeZURIK, Inc. hereby reserves the right to change any component parts which, in the opinion of its engineering department, will improve the product or increase its serviceability.