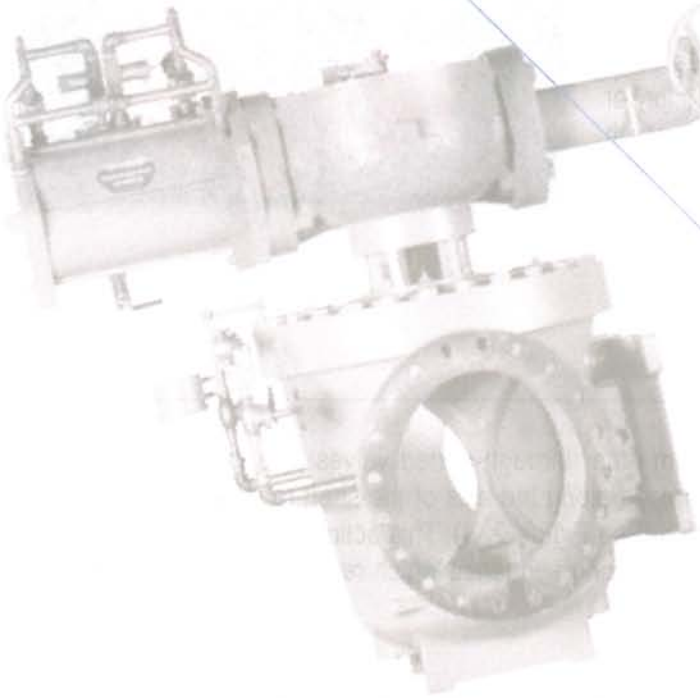
DETROIT CONTRACTING, INC.



Cone Valve

General Overview

Flow and Pressure Control

Raied S Hindi
5/8/2009

What is The Cone Valve?

A cone valve is a rugged and highly dependable liquid control valve which can accurately modulate flows under extreme velocity, pressure, and temperature.

The cone valve is simple in basic configuration, and made up of three primary components:

- ***Actuation Mechanism:*** Serves the function of lifting and rotating the plug in the body.
- ***Plug:*** Conically shaped element with a cylindrical bore (full pipe diameter).
- ***Body:*** Supporting member for the plug. The body enables connection to adjacent piping or equipment, and supports the head which provides a mounting surface for the mechanism.

How does the Cone Valve Operate?

The Rotovalve cone valve is different from other through-ported valves (like the ball valve) in its unique seating/unseating operation. The plug is raised along the axis of the shaft to initiate opening of the valve, and lowered to complete closing of the valve (See Figure 2, 3). This action permits the plug to rotate freely on journal bearings during the entire opening/closing sequence which reduces torque and eliminates seat wear.

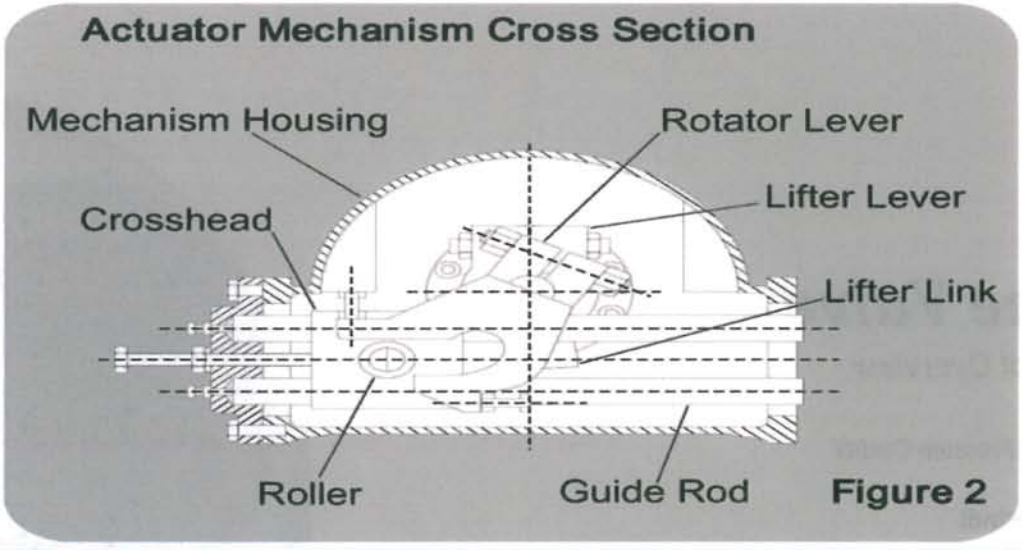


Figure 2

Operation Positions

The closed position: The Rotovalve seats drip-tight with the machined Monel faces on both sides of the plug seating against the machined Monel surfaces on each side of the body.

Lift actuation: The first movement of the actuator (manual, electric, or cylinder) moves the crosshead laterally toward the rotator lever. This initial lateral movement of the crosshead moves the lifter lever, which turns the lift nut and raises the plug away from the body seat. The plug has not turned.

Opening: once the crosshead contacts the rotator lever, further lateral movement of the crosshead then turns the plug.

Opening: Close-to-open and open-to-close sequence can be adjusted for water hammer control. The two orifices of the valve (influent and effluent) drop the unbalanced pressure in two stages, reducing the potential for cavitations and vibration.

Fully open: once the plug is fully rotated, continued movement of the crosshead turns the lift nut, reseating the plug.

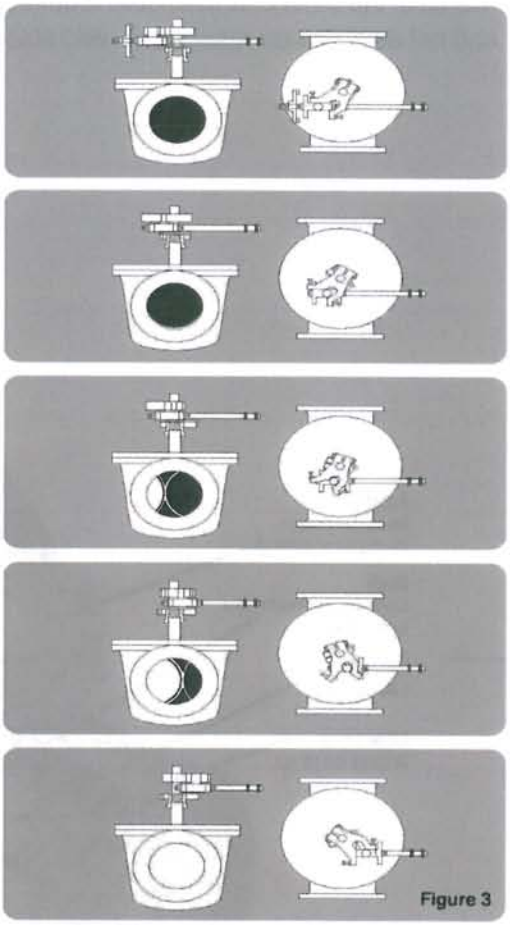


Figure 3

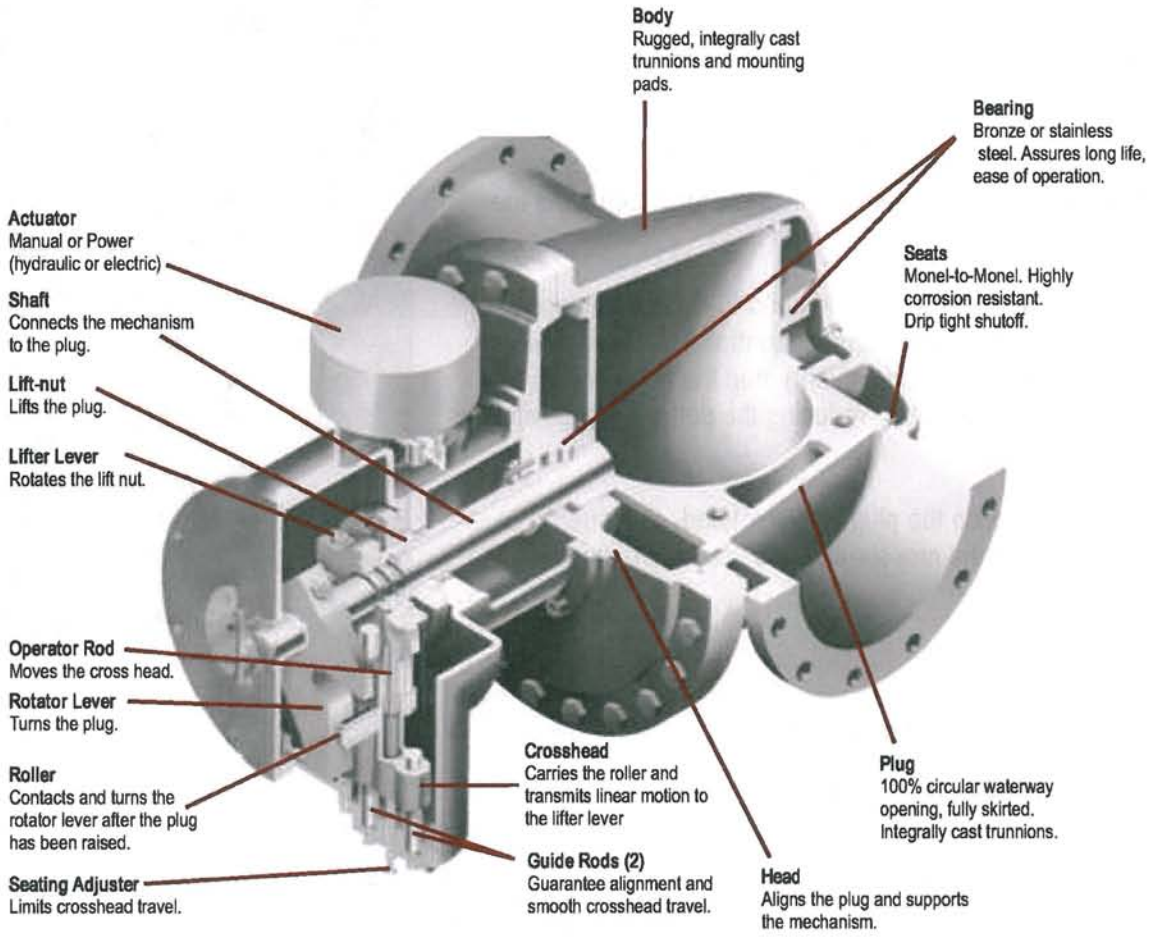
Standard Materials Of Construction

Plug, Body, and Head: Generally, the plug, body, and head materials of the Rotovalve are specified as follows:
0-150 psi Cast Iron
150-250 psi Ductile Iron
250-350 psi Cast Steel

Special Applications: Valves for special applications, larger (over 54") dimensions, and higher pressures/temperatures are either cast or fabricated steel.

Seats: Plug and body seats are Monel. Monel has the properties necessary to handle all known applications. Monel seats are welded to the body and plug, then both the body and plug seats are machined to effect drip-tight shutoff.

Monel is a nickel/copper alloy. The high nickel content makes it the most corrosion resistant material that has all of the other characteristics required for this service. In comparison, stainless steel is a ferrous alloy, and not as corrosion resistant or weld able to cast iron.



Size Availability

Standard sizes from 6"-48" are normally cast iron. Sizes 54" and larger are ductile iron, cast or

fabricated steel. The largest cone valve manufactured to date is 84".

Cone Valve Design in the History

Today, the Rotovalve cone valve is manufacture based upon designs and patterns acquired from AC Valve, Inc. The original design developed by S. Morgan Smith Company over 50 years ago was acquired by the Allis-Chalmers Corporation in 1959, and subsequently by AC Valve, Inc. (1988). In 1990, Rodney Hunt Company acquired all product lines of AC Valve, Inc., including the Rotovalve cone valve.

The acquisition included inventory, patterns, drawings, engineering documentation, and sales records. This enables Rodney Hunt Company to supply parts and service as required for all new and existing Rotovalves.

The Features and Benefits

Feature	Benefit
Lift and Turn Operation	▪ ***Low torque, no seat wear.***
Full Circular Waterway Opening	▪ ***Lower pumping costs.*** ▪ ***Ability to pig.***
Rugged Construction, Simple Design	▪ ***Extremely low maintenance.*** ▪ ***Long life.*** ▪ ***Highly corrosion resistant seats.***
Precisely Machined Monel Body and Plug Seats	▪ ***Drip-tight shutoff.*** ▪ ***Long life.***
Fully Skirted	▪ ***Reduces potential for cavitations and vibration.*** ▪ ***Eliminates areas that trap sediments.***
Hydraulic Characteristics	▪ ***Precise flow control*** ▪ ***Minimizes water hammer.***
Two Stage Pressure Reduction	▪ ***Ability to handle wide pressure ranges.*** ▪ ***Excellent for throttling applications.***

Typical Applications

Location	▪ ***Water Treatment and Transmission*** ▪ ***Wastewater Treatment*** ▪ ***Dams*** ▪ ***Steel Industry*** ▪ ***Process Plants*** ▪ ***Refineries*** ▪ ***Steam Power Plants*** ▪ ***Hydroelectric Power Plants*** ▪ ***Pump Stations*** ▪ ***Wind Tunnels*** ▪ ***Hydraulic Test Facilities***
Media	▪ ***Water*** ▪ ***Wastewater*** ▪ ***Sludge and Slurry*** ▪ ***Air*** ▪ ***Gases*** ▪ ***Steam*** ▪ ***Oil***

Functions

- ***Pump Check***
- ***Stop Service***
- ***Emergency Shutoff***
- ***Pressure Regulation***
- ***Level Regulation***
- ***Pressure Modulation***
- ***Velocity or Flow Modulation***
- ***Turbine Control***
- ***Vacuum Service***
- ***Surge Control***
- ***Energy Dissipation***
- ***Smaller Than Line Size Service***

Where precise control is required especially under extreme conditions such as high velocity, high pressure, speed of closing, or frequent operation.

Pump Control Valve

• used as a pump control valve. The unobstructed flow allows for very low head loss that results in low pumping costs. The valve also offers drop tight closure which prevents back flow. The valve has an uninterrupted operating cycle that allows for precise regulation of flow and prevention of water hammer.

Control Valve

• The Pratt Cone Valve is suitable to maintain constant flow or pressure downstream when used in combination with a flow pressure measuring device and a regulating actuator.

Shut Off Valve

• The Pratt Cone Valve offers a drop tight closure that is suitable for use to shut off a pipeline. The valve is commonly used in applications where high velocities and pressures can occur.

24" cone valves in operation since 1956.

Work Conditions

Pressure	"Standard" pressure classes can be summarized as follows: 150 psi-cast iron 250 psi-cast iron 300 psi-cast steel [There is virtually no pressure limitation for a custom engineered Rotovalve.10" valves have been designed and supplied to NASA that operates at 3,200 psi].
Temperature	Recommended temperature range is minus 30°F to steam applications. Special materials can be provided to meet specific applications.
Velocity	Essentially there is no maximum velocity. The Rotovalve can perform with long life in applications where the velocity is 50-100 feet per second.

Water Hammer Control

The smooth and linear operating cycle of the Rotovalve is highly effective in controlling surge and water hammer while providing precise flow regulation.

Water hammer, a phenomenon occurring in pipelines carrying incompressible fluids, is the result of a sudden change in fluid velocity. Such a change in velocity could be caused by a sudden closing or opening of a valve, which creates a series of pressure pulsations in the line. The intensity of the initial pressure pulsation can sometimes break the pipe. Water hammer must be a consideration in any system design.

The magnitude of the increase in pressure from water hammer is a function of time and liquid velocity. It is generally accepted that the maximum pressure rise will occur in the first wave whenever the valve is closed completely within one period. One period is defined as the time it takes the shock wave to travel from the valve to the end of the pipe and return. Succeeding waves are progressively less in magnitude the complete closure of a valve in a time longer than one period limits the degree of pressure rise in the first wave. The longer the elapsed closing time, the lesser the magnitude of the first and succeeding waves. Controlled closing time is tile key to reducing the intensity of water hammer.

A fully skirted Rotovalve is ideal for water hammer control because of its design and the ease by which the stroke time can be adjusted. The two orifices (influent and effluent) drop the unbalanced pressure in two stages, greatly reducing the potential for cavitations and vibration.

Two of the primary causes of water hammer are as follows:

- At the discharge side of a pump, when the pump stops suddenly due to loss of power.
- When a valve closes of those fluids. Such a quickly.

Every water hammer problem is different, and must be considered on a case-by-case basis. In most situations, slowing the speed of valve closure will greatly reduce the dangers of water hammer. Because of the Rotovalve's ability to with stand liquids moving at high velocities, and to precisely control valve opening/closing speeds, the Rotovalve is highly effective in handling these potentially dangerous water hammer conditions.

Smaller Than Line Size Applications

Another reason is that when a smaller valve is installed in a pipeline, higher velocities will result, allowing more precise flow control. In this situation, the Rotovalve has distinct performance advantages over other quarter-turn valves:

- The valve is fully skirted, eliminating sediment entrapment and ensuring that all flow passes through the port. Full skirting also reduces the potential for cavitations that can occur with other valves.
- The metal seating of the Rotovalve withstands high velocities, which may cause failure of resilient seats.

- There are two points of pressure reduction in the valve the inlet and the outlet orifices. This reduces the potential for vibration and cavitations and results in more precise control.

"Smaller than line size" installations provide cost savings to the user in permitting the use of a smaller (and less expensive) valve, as well as the potential for downsizing the entire facility.

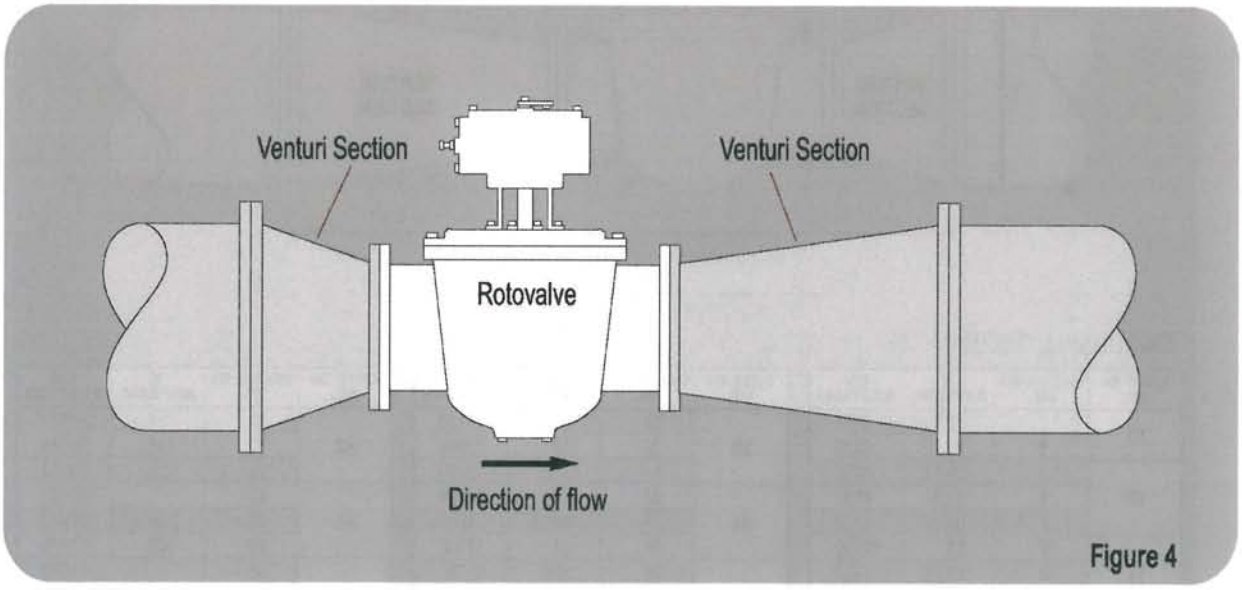
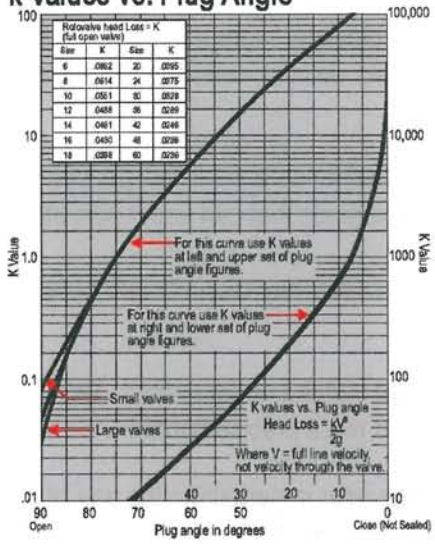


Figure 4

Characteristics

k Values vs. Plug Angle



Rotovalve C_V Values for Closed Systems

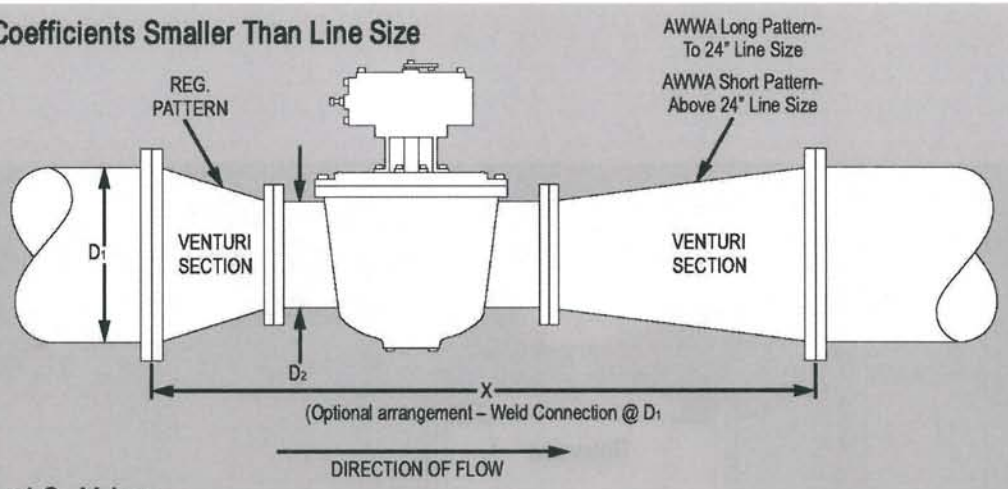
VALVE SIZE	PLUG ANGLE IN DEGREES FROM CLOSED								
	90	80	70	60	50	40	30	20	10
RESISTANCE FACTOR "K"		46	1.9	5.2	13	31	74	180	580
6	3596	1566	826	472	300	193	123	78	44
8	7423	2784	1468	839	534	343	219	139	78
10	12165	4350	2294	1311	834	536	342	217	122
12	18466	6265	3304	1888	1201	772	493	313	176
14	25613	8527	4497	2567	1635	1051	671	426	239
16	34820	11138	5874	3356	2136	1373	877	556	312
18	45515	14096	7434	4248	2703	1738	1110	704	395
20	56191	17403	9178	5244	3337	2145	1370	870	488
24	80915	25060	13216	7552	4806	3089	1974	1253	703
30	134100	39157	20651	11880	7509	4827	3084	1957	1100
36	200780	56386	29738	16993	10813	6951	4441	2819	1583
42	277053	76748	40476	23129	14718	9462	6045	3837	2155
48	372356	100242	52867	30210	19224	12358	7895	5012	2815

1. The maximum controllable valve position is determined by the dynamic characteristics (k) of the complete system, including the valve, the reducer and increaser sections.
2. Estimates for a regulating valve size, excluding the line, the reducer and the increaser losses, are based on maximum valve control at the 80 Deg. from closed position.

$$C_V = 29.8\, D_v^2 \sqrt{\frac{1}{K}}$$

D_v = Valve I.D. in inches

Flow Coefficients Smaller Than Line Size



Optional C_V Values

LINE D_1 IN.	VALVE D_2 IN.	X APPROX.	CV STATION
10	8	47.5	5170
	6	51.12	2070
12	10	56.12	8790
	8	53.5	4150
	6	60.12	1850
14	12	63	12710
	10	60.12	7120
	8	62.5	3700
16	14	71.5	17452
	12	67	10930
	10	69.12	6210
18	16	77	25720
	14	73.5	16520
	12	73	9620

LINE D_1 IN.	VALVE D_2 IN.	X APPROX.	CV STATION
20	18	80.75	34130
	16	79	22690
	14	78.5	13800
24	20	95	37690
	18	89.75	24760
	16	93	17140
30	24	116	51750
	20	115	26990
	18	117.75	19710
36	30	136	87000
	24	138	38870
	20	143	23150

LINE D_1 IN.	VALVE D_2 IN.	X APPROX.	CV STATION
42	36	154.5	130900
	30	148	66030
	24	166	33990
48	42		190600
	36	164.5	101700
	30	180	57840
54	48		261400
	42	183.25	159200
	36	193	89300
60	54		321600
	48	199	218200
	42	211.25	129800

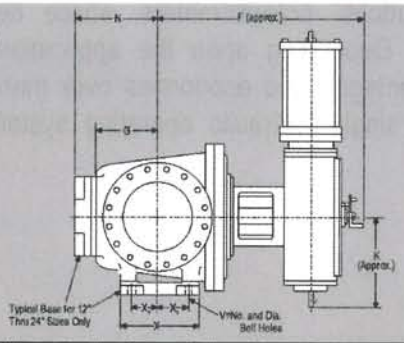
Other size variations available upon request.

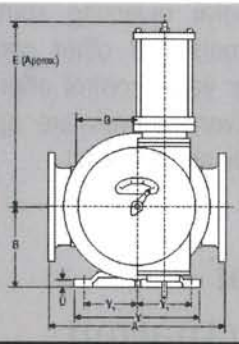
Material and Dimensions

Body, Plug and Head Castings	ASTM A126 Class C cast iron (for 150 psi service) or ASTM A536 Grade 65-45-12 ductile iron or A216 Grade WCB cast steel (for 250 psi service)
Head and Body Bushing	Bronze
Mechanism Housing	Cast iron
Cover	Cast iron
Lift Nut	Bronze
Crosshead	Bronze
Thrust Ring	Steel
Roller	Steel
Guide Rods	Stainless Steel
Seat Rings	Monel
Trunnion Bearings	Bronze or Stainless Steel
Flanges	ANSI Class 125, 250, 300 or metric
Valve Shaft	Stainless Steel ASTM Type 630
O-Ring	Buna-N
Packing	Fiber and Graphite
Packing Gland	Bronze

Sizes.....6" -84"

Cylinder Operator

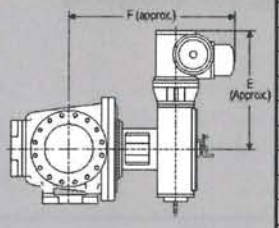




SIZE	A 125 Lb	A 250 Lb	B	E	F	G	K	N*	U*	V*	X*	X_1*	Y*	Y_1*	APPROX. Wts. (Lbs.)
6	23 1/8	24	—	27	26 1/2	6 3/4	10	9 3/8	1 3/8	(4)-1	10	3 3/4	15 1/4	6 5/8	730
8	23 1/2	24 1/2	—	27	27 1/2	8 1/4	10	10 3/4	1 3/8	(4)-1	10	3 3/4	15 1/4	6 5/8	890
10	28 1/8	29 1/2	—	27	28 1/2	9 3/4	10	12 3/8	1 3/8	(4)-1	10	3 3/4	15 1/4	6 5/8	1,235
12	31	32 1/2	14	37	34 1/2	13 1/4	15 1/2	15 3/4	1 1/2	(4)-1 3/8	14	5	22	9 1/2	2,260
14	35 1/2	37	15 1/2	37	35 1/2	14 1/4	15 1/2	16 3/4	1 1/2	(4)-1 3/8	14	5	22	9 1/2	2,520
16	39	40 3/8	17 1/8	37	36 1/2	16 1/2	15 1/2	19	1 1/2	(4)-1 3/8	14	5	22	9 1/2	3,170
18	41 3/4	43 3/8	19 1/4	37	37 1/2	18 3/8	15 1/2	20 3/8	1 1/2	(4)-1 3/8	14	5	22	9 1/2	3,515
20	47	48 3/8	22 1/4	49	47 3/4	20 3/4	21	24 3/4	1 3/4	(4)-1 3/4	20	8	31 1/2	14	5,840
24	56	57 3/4	26 1/4	49	50 1/2	22 3/8	21	26 3/8	1 3/4	(4)-1 3/4	20	8	31 1/2	14	8,320
30	64	65 3/4	31 1/2	56 1/2	58 3/4	29 1/2	29 3/4	34	1 3/4	(4)-2 1/4	28	11 1/2	40 1/2	18	13,520
36	70 1/2	74	36 1/2	56 1/2	61 3/4	31	29 3/4	35 1/2	1 3/4	(4)-2 1/4	28	11 1/2	40 1/2	18	19,400
42	83 1/4	85 3/8	47	67 1/4	70	38	40 1/2	42	2 1/4	(4)-2 3/8	42	15 1/2	42	18	34,700
48	88	90 1/2	47 1/2	67 1/4	92	42	40 1/2	46	2 1/2	(4)-3	48	21	46	21	43,900
54	101	—	54	—	95	51 1/4	45	54	2 3/4	(4)-3	48	21	46	21	63,200
60	119 1/2	—	61	—	102	56	45	58 3/4	2 3/4	(4)-3	48	21	46	21	80,600

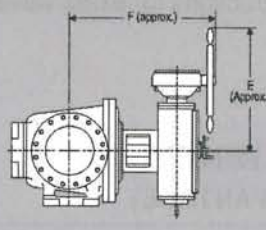
All dimensions are in inches. Dimensions for larger sizes or higher pressure ratings available upon request.
125 Lb & 250 Lb FLANGES CONFORM FULLY TO ANSI B6.1 LATEST EDITION BOTH DIMENSIONALLY & FOR BOLTING PATTERN AND ALL FLANGES ARE FULLY FACED.

Motor Operator



SIZE	E	F	APPROX. Wts. (Lbs.)
6	24 1/8	34	680
8	24 1/8	35	820
10	24 1/8	36	1,100
12	27 1/8	41	2,050
14	27 1/8	42	2,550
16	27 1/8	43	2,910
18	27 1/8	44	3,430
20	32	49	5,300
24	32	52	7,700
30	36	70	13,000
36	36	73	17,750
42	48	80	31,570
48	48	96	40,100
54	63	95	57,500
60	63	102	73,500

Manual Operator



SIZE	E	F	APPROX. Wts. (Lbs.)
6	25 1/2	28 1/2	610
8	25 1/2	29 1/2	750
10	25 1/2	30 1/2	1,030
12	30 1/8	36 3/16	1,830
14	30 1/8	37 3/16	2,330
16	30 1/8	38 3/16	2,690
18	30 1/8	39 3/16	3,200
20	34 5/8	49 3/16	5,080
24	34 5/8	51 3/16	7,480
30	41 1/8	68 5/8	12,600
36	41 1/8	71 5/8	17,350
42	48	74 1/2	31,100
48	48	77 1/2	39,600
54	63	85	57,000
60	63	93	72,800

Dimensions for all three methods of operation are identical, except for E and F, as shown in the drawings above.
*Valve can be mounted in a horizontal or vertical line. Shaft can be horizontal or vertical. Actuator can be oriented in any direction relative to the shaft.

Actuation and Control

Manual or Power Actuation

Manual: Self -locking, threaded stem attached to a geared unit with hand wheel, chain-wheel or operating nut input.
Hydraulic: Cylinder using line pressure or separate external power source.
Electric Motor: Available for open-close or throttling service, complete with limit switches and torque switches as required. Manual override is standard. Also available for modulating service with position feedback for continuously adjustable automatic controls. Complete accessories are available and include indicator lights, integral reversing starters, push buttons, potentiometers, space heaters, sensors, transmitters, transducers and other control features. Depending upon the application, Rodney Hunt hydraulic systems for valve control offer specific advantages and economies over manual and electric actuation. Where several valves are operated by a single hydraulic operating system, for example, considerable cost savings can result.

Advantage of Hydraulic Actuation

Economical: Hydraulic actuation is the most cost-effective type of power actuation currently available.
Increased control: Valve can be designed to open and close at different speeds, and to permit easy field adjustment of speed.
Less wear: Hydraulic cylinders provide long, trouble-free service especially where valve cycles frequently, or is used for modulating service.
Flexible functions: Systems can vary from a simple pushbutton station to sophisticated programmablePositioning.
Emergency "fail-safe" operation: Can be easily configured to open or close valve in the event of power failure, line breakage, or other emergency.

Hydraulic actuation system engineering includes development of hydraulic power units that respond to computer instructions for exact valve positions, continuous monitoring, and emergency operation.

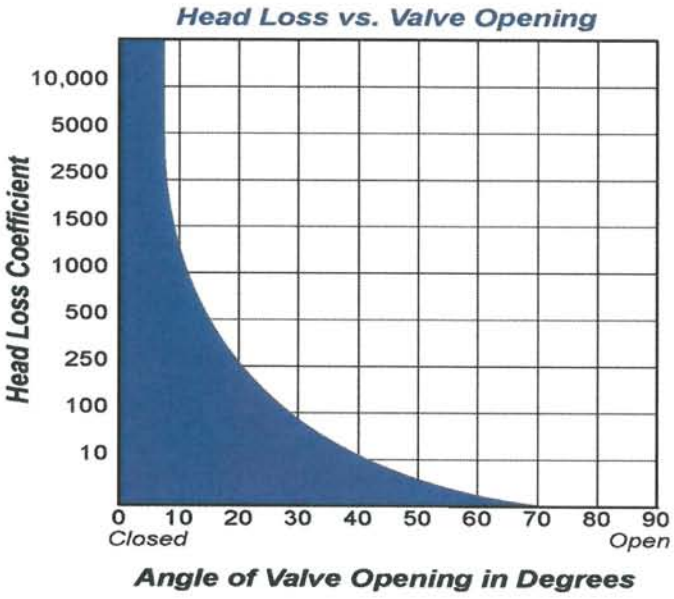
Cost and Efficiency

(LOW HEAD LOSS ADVANTAGE)

In the open position the cone valve has a full bore opening through the valve. The flow is Unobstructed which results in a head loss that is comparable to that of a straight pipe the same length and diameter.

Figure illustrates the head loss between 5% and 70% of the valve opening angle. Precise flow is achieved by the smooth operation and long stroke of the valve actuator in rotating the valve plug.

The cone valve requires very little maintenance due to its high strength design, metal seats, and long service life. These features allow for a low yearly operating cost.



References and Recommended Manufacturers

- ***PRATT, Henry Pratt Company,***
  401 South Highland Avenue,
  Aurora, Illinois 60506-5563
  http://www.henrypratt.com/
  Phone: 630.844.4000
  Fax: 630.844.4160
  Toll free: 877.436.7977

- ***RODNEY HUNT Company,***

  Hamlett Engineering Sales Company
  Van Dyke Road
  Warren, MI 48093-2706
  Telephone: 586-978-7200
  Fax: 586-978-2200
  Email: glenn@hesco-mi.com
  Email: kevin@hesco-mi.com
  Email: dave@hesco-mi.com
  Email: rick@hesco-mi.com
  Email: heather@hesco-mi.com
  WEB: www.hesco-mi.com

Detroit Contracting, Inc.
660 Woodward Avenue Suite 1625
Detroit, Michigan 48226
Tel: 313 962 8472
Fax: 313 962 8478
www.detroitcontracting.com