NORRIS Butterfly Valves

How to:

- Select and Specify 200 psi and 285 psi Butterfly Valves
- Select Trim
- Install and Service Norris Butterfly Valves

Solutions through engineered products.

NORRISEAL®

A DOVER COMPANY

NORRIS Butterfly Valves

TABLE OF CONTENTS

Caution: Before disassembly or maintenance, all pressures in this device must be relieved. Failure to relieve pressures may result in personal injury, loss of process control or device damage. The resulting uncontrolled venting or spilling of line fluids may cause personal injury or environmental contamination.

INTRODUCTION TO BUTTERFLY VALVES

Butterfly valves have been around industry for decades; performing well-defined tasks and showing distinct advantages over other valve types.

Butterfly valves produce dependable bubble-tight shutoff and are ideally suited for throttling control applications because the flow is near linear over 70% of the flow range (Figure 1). They are quick opening and highly efficient because the approach velocity of the flow stream is not lost as the fluid passes through the valve bore. They can be operated manually, mechanically, or automatically and they can be used in handling a variety of media, including liquids, solids, slurries, gases and vapor (steam).

A butterfly valve is a simple device. To control or block the flow, a single vane or wafer disc pivots in the valve body. From closed to open position the disc is rotated 90 degrees. Torque requirements to make this rotation are determined by static forces, caused by pressure drop across the disc in the closed position, and by dynamic forces, caused by fluid velocity in the pipe and at the edge of the partly closed disc (See Fig. 2).

Although a butterfly valve is hydraulically balanced when fully open or fully closed, force is required to move the disc from either position. Operating torque, for closing or opening the valve, is made up of bearing or shaft friction torque combined with rubber torque.

Bearing torque, caused by pressure drop across the valve disc, is determined by differential pressure. It is maximum when the disc is closed and minimum when the disc is fully open.

The torque required to seat or unseat the valve disc, rubber torque, is determined by the design of the valve and must be experimentally established by each valve manufacturer. (See Table VI and VII, pages 16 and 17, for Norris operating torque.)

When the disc begins to rotate toward the open position, it behaves like the wing of an airplane, and is subject to both the lift and drag forces of the flow stream. These fluid forces tend to close the valve, and reach a maximum value when the disc is approximately 67 degrees open. (See Table V, page 15, for fluid dynamic torque.)

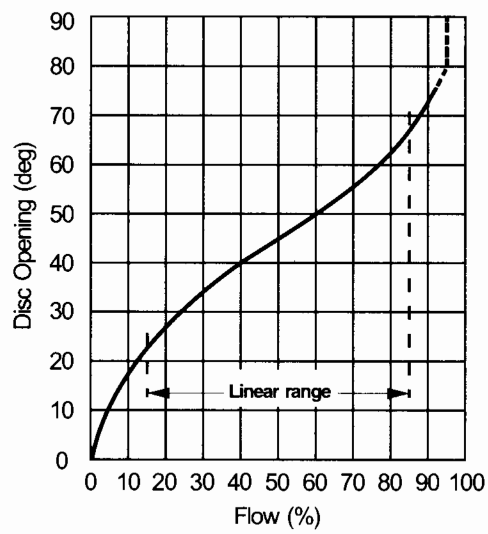


Fig 1 - Butterfly valves used for throttling provide excellent control over approximately 70% of the flow range.

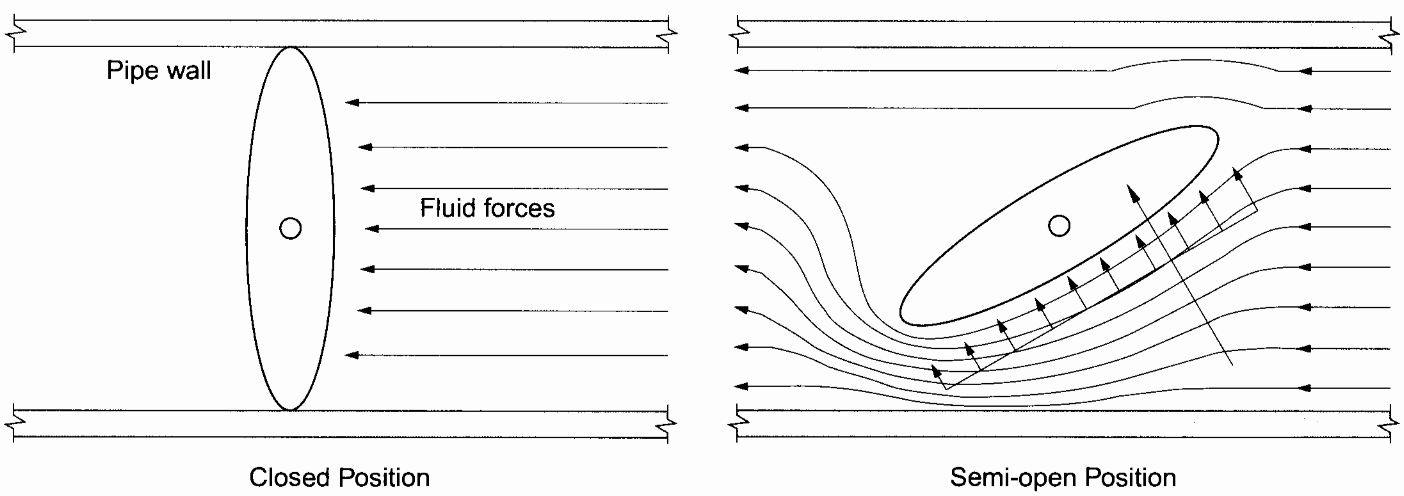


Fig 2 - When the disc is in the closed position, static fluid forces are high but the valve is stable. In the semi-open position, the disc acts like an airplane wing, generating lift and drag forces that attempt to close it. When it reaches an open angle of 67 degrees (shown), dynamic forces are at maximum.

HOW TO SELECT & SPECIFY NORRIS BUTTERFLY VALVES

To select the Norris butterfly valve which will assure maximum valve life and minimum maintenance and operating costs, it is necessary to:

- ❏ Size the valve and operator properly.
- ❏ Select the specific valve model according to: function (block or throttling), pressure, flow rates, body type, temperature, trim material compatible with media, and piping.
- ❏ Select the proper operator.

Sizing the Valve & Operator

The following are simplified guidelines for sizing butterfly valves. See pages 14 thru 17 of this catalog for detailed information on Norris butterfly valve characteristics (flow coefficients, pressure drop, operating torque, etc.) to assist in the proper sizing of the valve and operator.

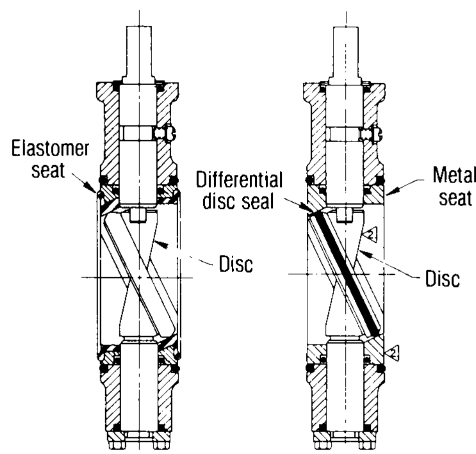
1. Determine the system requirements for flow and pressure drop to calculate the probable line size.
2. Calculate the correct valve size based on pressure drop and flow capacity requirements. (Use the 30 to 60 degrees open range for sizing.)
3. Determine the fluid dynamic torque, compare it with operating torque of the selected valve series to assure that the operator is properly sized to handle both the static and dynamic conditions of the valve.
4. Check the system for factors which could lead to water hammer or cavitation. Make necessary adjustments in valve placement, sizing, and speed of closing to prevent this from occurring.

Selecting the Valve

The Norris Valve Series

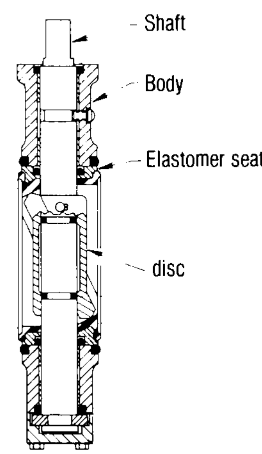
To select the proper valve series (R- M, or D), determine:

1. ***The function of the valve (block and/or throttling) and flow rates of the system.***
   a. For positive shutoff (blocking) select Norris R- or M- Series valves. Both R- and M-Series valves provide positive shutoff from vacuum to full rated working pressure (200 psi or 285 psi).
   b. For smoothest throttling control, select D-Series if positive shutoff is not required and flow rates do not exceed 40 fps. Select R-Series for economy and when positive shutoff is required and flow rates do not exceed 30 fps. M-Series valves are limited to 16 fps for throttling applications.
   D-Series valves are designed specifically for throttling control applications. These high-efficiency, low-leakage valves are capable of controlling both low and high gases. They are especially well suited to applications where a large variation of flow or pressure drop is anticipated. A positioner may not be required for smooth automated control because rubber torque has been eliminated and seating torque is minimum.
2. ***Temperature extremes the system will handle.*** Although selection of trim material influences adaptability to temperature, a general rule is to:
   a. Select R-Series valves for temperatures no lower than -30°F and no higher than 250°F.
   b. Select M-Series or D-Series valves for temperatures as low as -40°F and up to 400°F.



Rubber-lined R-200 | Metal-seated, O-ring sealed M-200

Positive Shutoff or Throttling



Rubber-lined R285

To summarize, check line velocity and pressure drop against the maximum allowable for the valve series selected. Check rating of the valve selected. Check rating of the valve to be sure it complies with the maximum pressure and temperature the system will handle.

3. ***Pressure class ANSI valve(s).***
Norris manufactures two pressure classes of positive shutoff valves:
a. The 200 series are rated at a maximum of 200 psi, and
b. The 285 series are rated at the full ANSI pressure class 150 rating of 285 psi.

Table I - Series Comparison	R-Series		M-Series		D-Series
	R200	R285	M200	M285	D200
Positive Shutoff (bi-directional)	Yes	Yes	Yes	Yes	No
Bi-directional flow	Yes	Yes	Yes	Yes	Yes
Maximum velocity for throttling controls (liquids)	30 fps	30 fps	16 fps	16 fps	40 fps
Temperature range	-30°F to +250°F		-40°F to +350°F		-40°F to +400°F

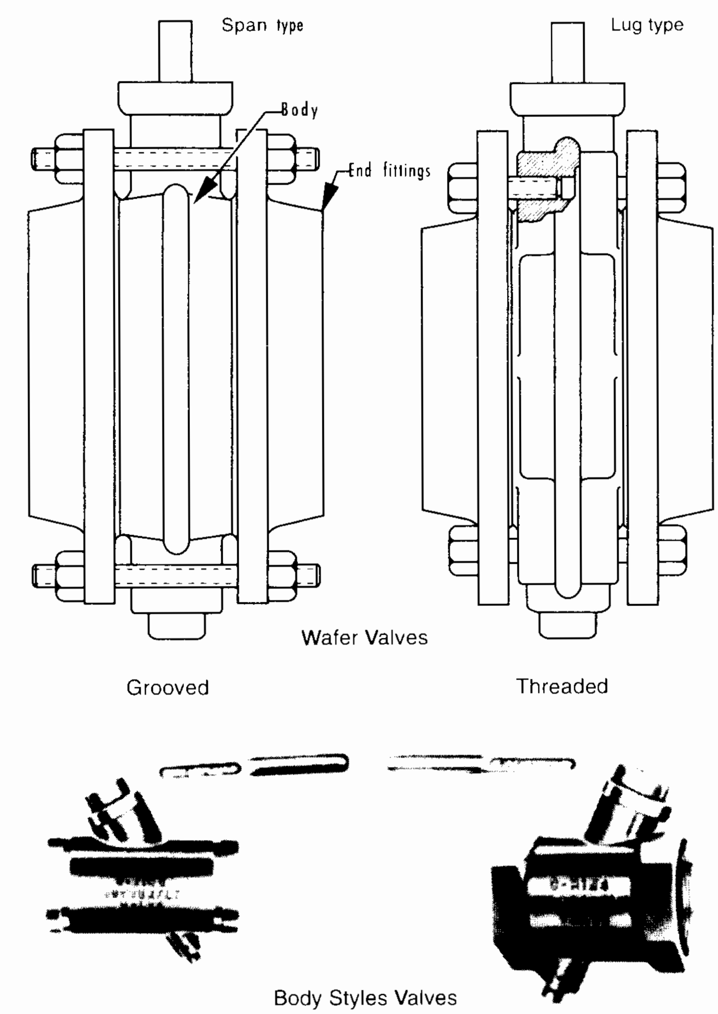


Fig 3 - Different bodies are chosen on the basis of application requirements, user preference, and compatibility with piping.

The Norris Valve Model

The tables on pages 10 & 11 will save considerable time in locating the specific Norris valve model you need. On the basis of valve size, body configuration and pressure rating, it will direct you to the appropriate Valve Data Sheet within the R-,M-, or D-Series section. Each data sheet includes typical specifications, standard model selection tables, material specifications and model number designations, certified dimensions, including disc clearance charts, and specific flange bolt data.

The specific model number is determined by:

1. ***Body type and size.***
Basic Norris butterfly valve body types are slip-in wafer valves, available in span or lug (single flange) configurations, and body styles with threaded or grooved end-connections. Both span and lug type bodies are available in sizes from 2" through 36", including 22", 26" and 28" for comparable metric piping. Body style valves are available from 2" to 4".

All 14" and larger Norris valves will accommodate 2" of insulation on accompanying pipelines. A neck "X-Tender" is available for use with 2" through 12" wafer valves when lines are insulated.

Norris valves are designed for use with ANSI class150 flanges with inside diameter equivalent to schedule 40pipe ID, and can be adapted for ANSI class 300 and DIN flanges. If flanges other than ANSI class150 are required, user must specify type and rating (i.e. ANSI 300, DIN NP-10 or NP-16) as special bolt drilling or spacers may be necessary. Weldneck, socket weld or slip-on flanges can be used with Norris M-Series or D-Series valves. Weldneck or socketweld flanges are recommended for use with R-Series valves to provide proper support of the seat and to assure optimum performance at the full rated pressure of the valve. Norris does not recommend using the R-Series valves with slip-on type flanges. Before ordering valves, check disc clearance charts on individual data sheets to be sure the inside diameters of companion flanges and piping do not interfere with disc movement when the valve is cycled to the open position. Back beveling may be required for disc clearance when heavy wall, plastic, or cement lined pipe is used.

a. For end-of-line suspension, select lug-type valves. Often, butterfly valves are used to isolate other equipment in the line, downstream of the valve, for periodic maintenance and repair. This application requires a lug-body valve with blocking capability which will withstand system pressure and seal the line during the maintenance period.

Without a downstream flange or spool piece, Norris R-Series lug-type valves are derated for safety to 75 psi working pressure when used for end-of-line suspension. Full valve rating may be restored by temporarily installing a downstream flange.

M-Series lug-type valves are not derated and will hold full rated working pressure with the downstream flange removed. When M-Series valves will be dead-ended for more than 8 to 10 hours, it is recommended that a downstream flange be temporarily installed for safety.

b. Where end-of-line suspension is not required, select span-type valves. They are less expensive, weigh less and may be readily inserted between standard flange fittings.

Fourteen inch and larger "span" valves have tapped lug holes at top and bottom for easier installation and accurate centering.

2. ***Differential pressure rating.***

Both Norris R-Series and M-Series valves are available for 200 psi and 285 psi differential working pressure. Valves normally rated at 200 psi may be obtained for 250 psi service with selected trims on special factory order.

Standard production tests require that all Norris valves be shell tested to 150% of rated working pressure and differentially tested to 110% of rated working pressure. (Example: 200 wp valves are tested to 220 psi.)

3. ***Trim material***

The best guides for proper trim selection are the materials that have worked satisfactorily for other equipment in your piping system.

Norris butterfly valves are available in a wide variety of trim materials for compatibility with all types of media at temperatures from -40° to 400°F. See section "How to Select Trim Material" for complete list of materials available and their compatibility with specific media.

Please contact our applications engineering staff for quotations and assistance in selecting the right valve for your applications.

Selecting the Operator

Butterfly valves tend to be self closing because of lift and drag forces exerted on the disc. If a valve is closed too quickly, or slammed shut, the energy of the flow system is transferred to the piping system and may cause dangerous pressure level fluctuations (hydraulic shock or "water hammer") which can damage the system.

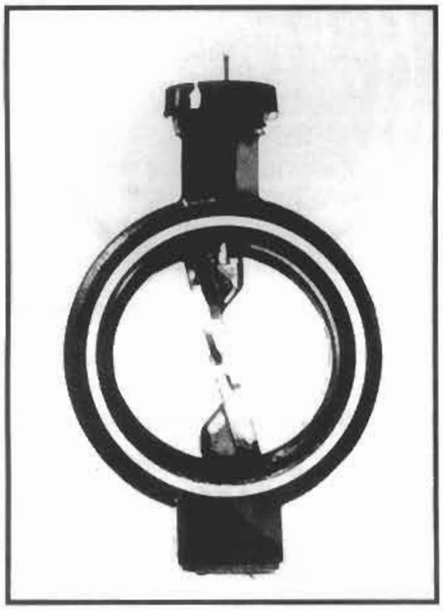
Because of larger disc area and resulting greater fluid dynamic torque, larger valves have a greater tendency to be self closing than small valves. Large valves are therefore best controlled by gear operators, diaphragm actuators, pneumatic or hydraulic cylinders, or electric motors - all of which provide controlled speed of closing and prevent the valve from slamming.

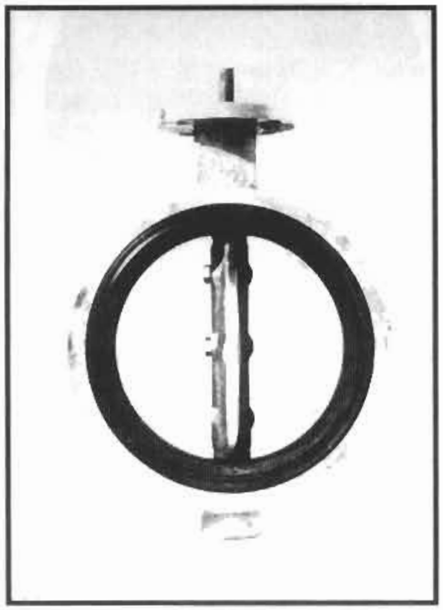
Lever operators can be used for control of butterfly valves 5" and smaller, and up to 12" at flow rates less than 5 fps. Properly applied, levers provide quick valve action, economy and simplicity.

See complete details on our full line of manual and mechanical operators in Norriseal's Butterfly Valve Catalog, section Operators and Accessories. Sizing charts for air operators and Norris diaphragm actuators are included in this section.

NORRIS BUTTERFLY VALVES ARE DESIGNED TO LAST LONGER

Norris' angle disc design eliminates stress areas which cause many of our competitors' performance problems. The untouched photographs of Norris and competitive valves and individual parts illustrate how these differences combined with proper trim selection can mean longer valve life.



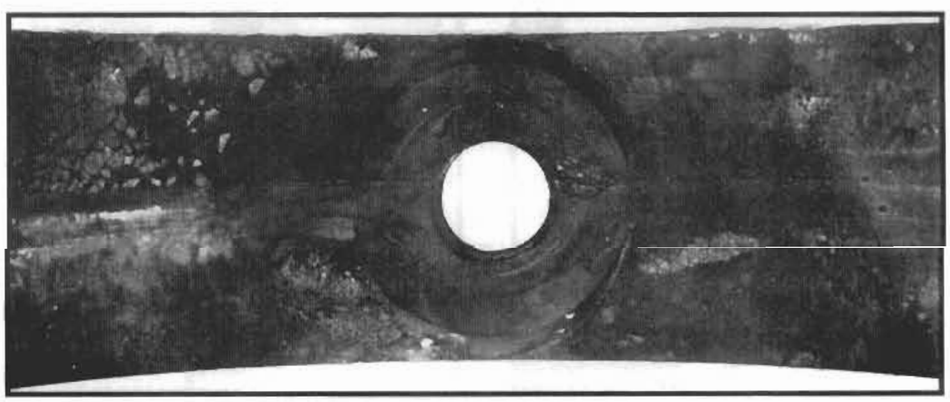


Norris' angle-disc design provides positive shutoff with 360 degree, uninterrupted differential seal. The disc does not seat in shaft hole areas, eliminating compression set and scrubbing in this area which occurs on conventional vertical disc butterfly valves.

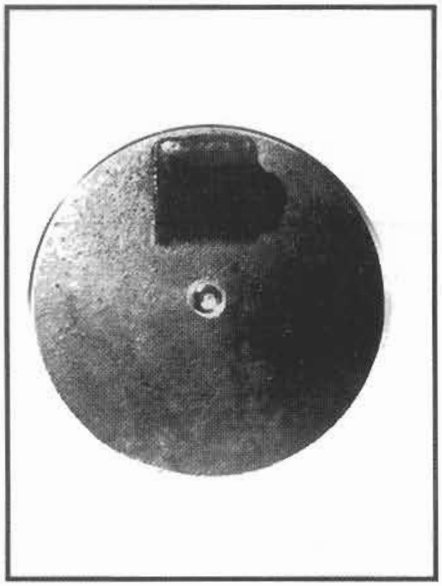
In the manufacturing process, Norris' perfect circle design allows precise control of outside disc dimension and inside seat dimension to a few thousandths of an inch. Because of close dimensional control, positive shutoff is achieved with minimum interference between disc and seat. This unique design minimizes seat and seal wear, reduces operating torque and greatly extends the service life of the valve.

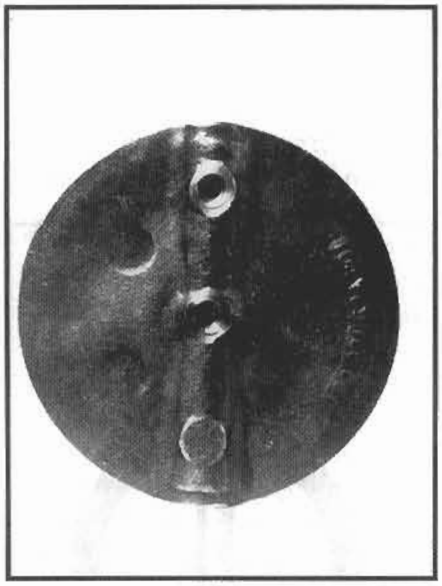
Norris' lower disc/seat interference allows use of harder, high-density seat elastomers which are less porous and less subject to swelling and deterioration by the flow stream than the softer materials which must be used for vertical disc valve seats.

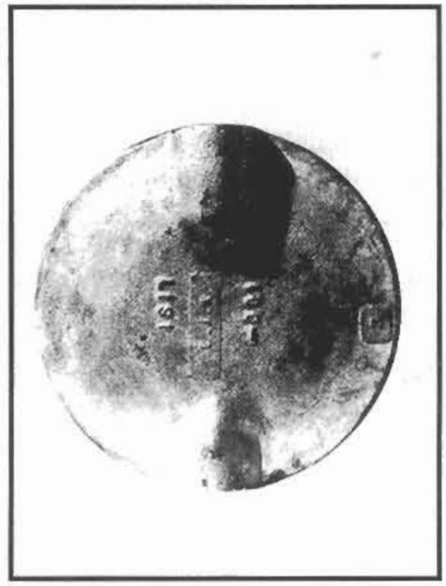
By comparison - Vertical-disc valves have a flattened disc/boss area, making manufacturing variances greater. Increased penetration of disc into seat is required to seal off the flow stream. This produces a scrubbing action, particularly in the flattened disc/boss area, which can cause premature failure of the valve.



This untouched photograph illustrates an elastomer seat which has been damaged at the shaft hole area by the scrubbing action in a vertical disc butterfly valve. The seat also shows deterioration by the media in the flow stream.





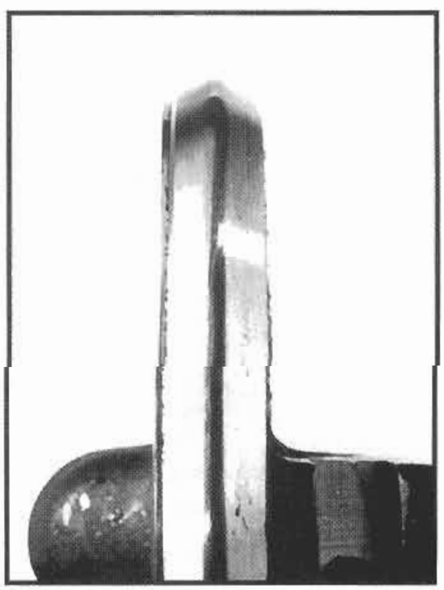


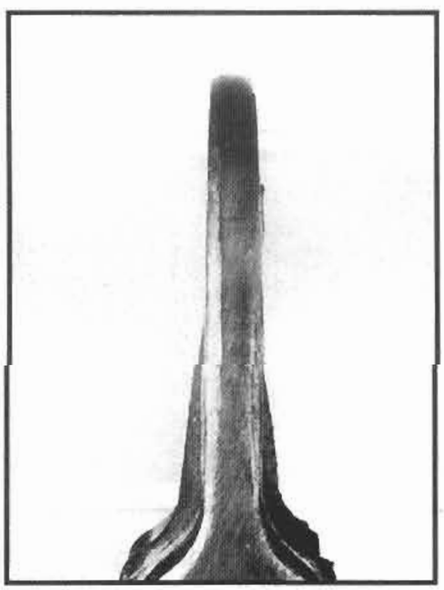
Norris' perfect circle disc design.

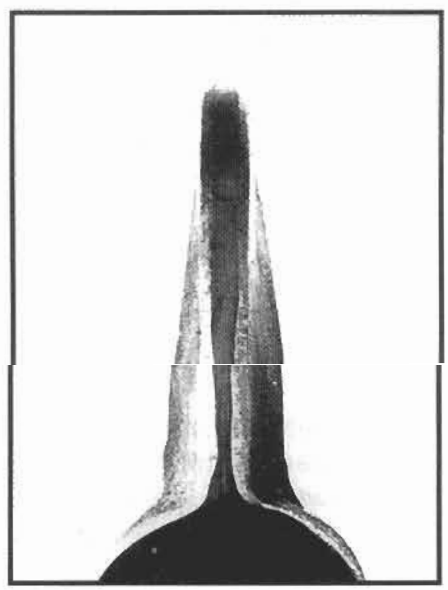
By Comparison - Flattened disc/boss areas of vertical disc design.

Norris' Angle Disc Eliminates Stress Areas

Most butterfly valves obtain their seal by penetrating a metal disc into an elastomer (rubber) seat, creating internal pressure in the elastomer. As long as the internal pressure in the elastomer exceeds the pressure in the pipeline, fluid cannot bypass the valve disc edge. Because of Norris' close dimensional control, positive shutoff is achieved with minimum interference between disc and seat.

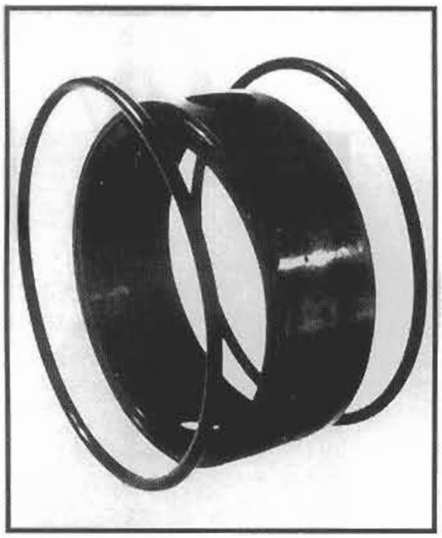






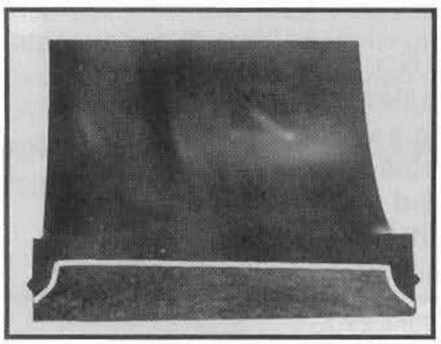
Norris' full circle disc design makes it possible to machine and polish the disc edge to a smooth, rounded surface which cannot damage the seating surface by scrubbing when the valve is cycled.

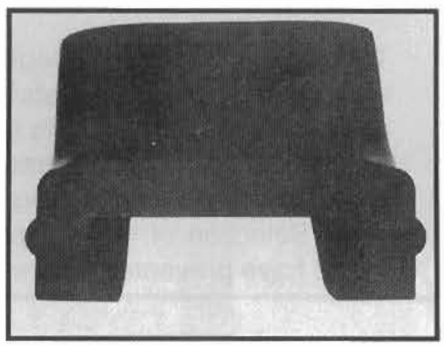
By comparison: The rough-hewn edges of these vertical discs create uneven stresses in the elastomer seat, causing scrubbing of the elastomer and early failure of the differential seal.

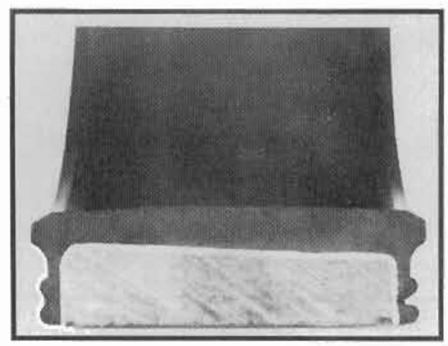


Norris' exclusive separate body O-ring flange seals can be replaced (sometimes simply turned over) without disassembling the valve and replacing the seat. A primary seal bead molded into the face of the elastomer seat (R-Series) serves as an additional seal.

By comparison: All resilient lined butterfly valves depend exclusively on compression of the face of the seat for sealing between flange and valve. If this sealing face is damaged during installation or shipment, the valve must be dismantled and the entire seat must be replaced.







Norris' field-removable and interchangeable resilient seat is bonded to a rigid plastic backing sleeve to prevent the seat from distorting or collapsing in vacuum or high velocity flow. Free fit of seat permits replacement with no special tools. The seat isolates the flow stream from the body of the valve (dry back construction).

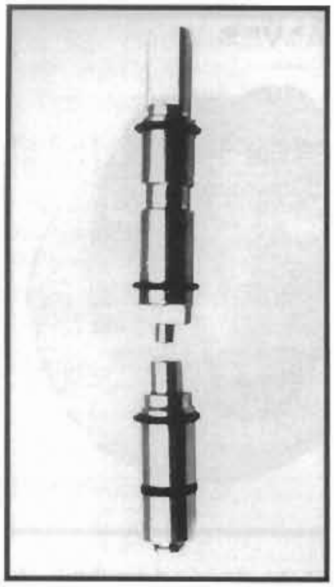
Norris' replaceable metal seat (M-Series and D-Series) also isolates the flow stream from the body of the valve. Because the metal seat is separate from the valve body, expensive alloy seat material can be specified with less expensive grey iron or carbon steel bodies for highly corrosive services at a minimum of expense. Free fit permits easy field replacement of metal seat or conversion to R-Series.

By comparison: Some vertical disc butterfly valves fit a "boot" seat over the body of the valve. Special tools are required to stretch the seat into position and high velocity flow tends to wash the seat downstream.

An adhesive is used to retain some vertical disc seats. These valves are not field repairable and the adhesive maybe attacked by the media in the flow stream.

Other vertical disc seats must be "pressed" into the valve bore making alignment of shaft holes difficult and reassembly unnecessarily complicated.

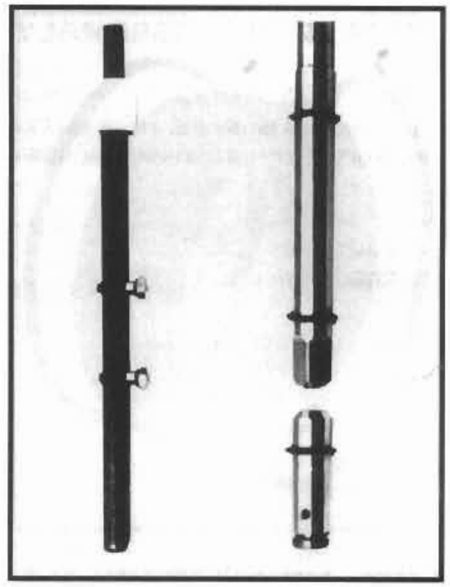
In other metal seated butterfly valves the body serves as the seating surface. For corrosive service the entire body must be made of expensive alloy materials.



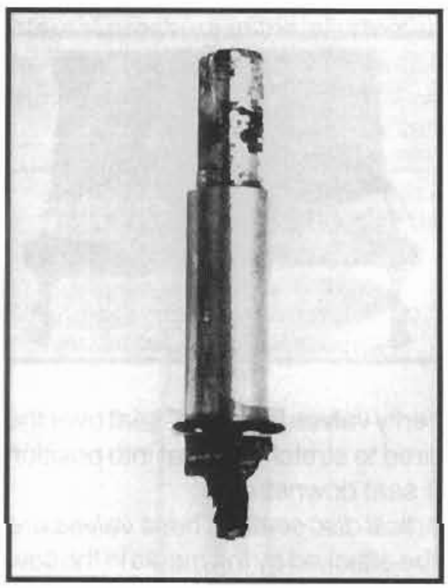
Norris' double O-ring shaft seals, plus the primary shaft seal molded into the R-Series seat, provide triple protection against leakage into shaft bearing areas. Line media and outside atmospheric contamination are sealed out of bearing areas and Teflon impregnated grease is sealed in to assure proper lubrication.

Metal-backed Teflon bushings prevent galling of steel or monel shafts with steel bodies.

By comparison: Some vertical disc valves depend entirely on the squeeze of the seat at the disc bosses to seal the flow stream from shaft bearing areas. Constant scrubbing of the disc on this area results in premature seal failure, loss of media and corrosion of the body and shaft bearing areas.

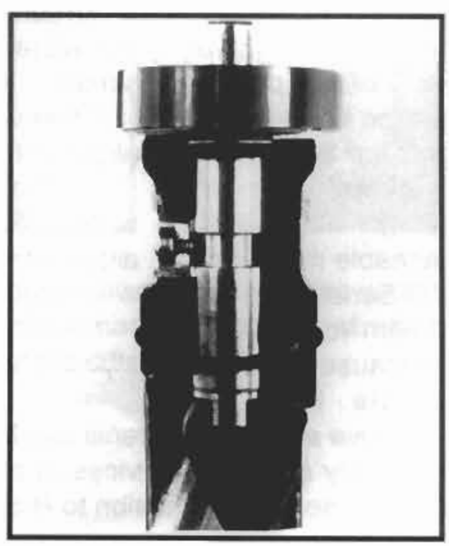


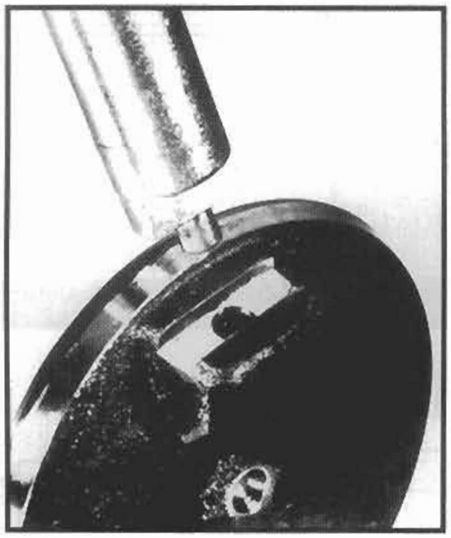
NORRIS'S SEPARATE FLANGE & SHAFT SEALS PREVENT LEAKAGE INTO SHAFT BEARING AREAS AND TO THE ATMOSPHERE

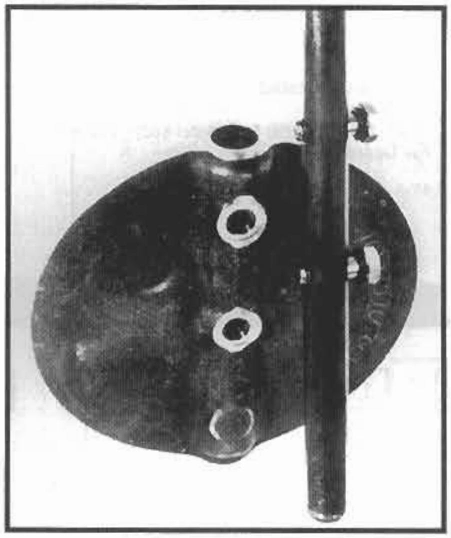


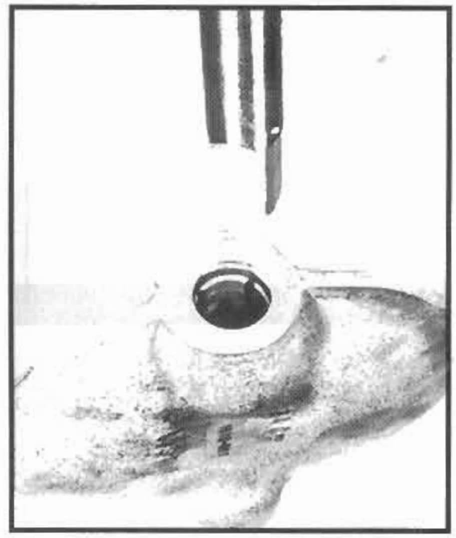
To illustrate the sealing integrity of Norris' shaft O-rings, we photographed this 416 stainless steel shaft which was literally dissolved up to the O-ring seal by chlorinated brine in the flow stream. Note that the seal confined the failure to the pipeline and prevented any external leakage. Selection of the proper shaft material (titanium) would have prevented failure of this valve.

Shaft Retention - The handle shaft of 2" through 12" valves is retained by a sealed retention screw. On 14" and larger valves, the shaft is cross pinned to the disc. A thrust plate provides positive retention of the bottom shaft on all valves.







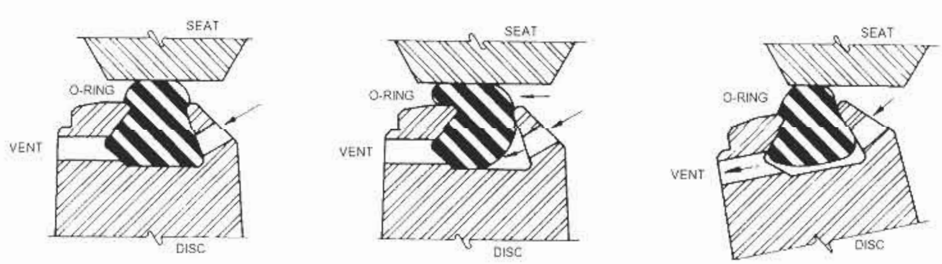


Norris' precision fit disc slot assures positive disc action and prevents disc "flutter." There are no bolts, pins, screws or rivets to corrode or fail (12" and smaller valves).

A through shaft with high-strength 17-4 PH stainless steel or K-Monel straight dowel pin connection assures maximum drive strength and field repairability of larger valves. Norris' straight disc pins do not penetrate the sealing plane of the disc and do not require special fitting of parts when valve repair is necessary.

By Comparison: Bolts, taper pins, or screws which are used to connect vertical discs to the shaft provide leakage pathways through the disc and weaken the shaft.

The vertical disc shaft/disc connection illustrated at upper far right is virtually a "square peg in a round hole." Shaft/disc drive strips easily, and becomes sloppy. Blind assembly connection on all vertical disc valves complicates reassembly.



1. No Pressure 2. Pressurized 3. Opening

The higher the pressure, the tighter the seal.

M-Series Sealing - A pressure energized disc O-ring seal contained in a specially designed groove assures positive shutoff every time with Norris' M-Series valves. After making a nominal seal between the metal seat and the disc O-ring, pressure of the flow stream energizes the O-ring and increases the seal. *The higher the pressure, the tighter the seal.* The disc-edge groove is designed to prevent the O-ring being washed downstream in high velocity service.

VALVE MODEL NUMBER SYSTEM 200 WP

Position 1: Valve Size (In Inches)		
2" - 36"	R - Resilient Seat M - Metal Seat D - Metal to Metal Seat (Damper Style)	00 - Special to be described. 10 - Span Wafer Body 20 - (1.50"-12) Double Rib Span Wafer Body. 200 WP. 30 - Full Tapped Lug Body

VALVE SIZE | **SEAT SIZE** | **VALVE CONFIGURATION**

6" M 30 11 — 4 2 3 B A [A] 2R

BODY MATERIAL

11 - (D) Ductile Iron, ASTM A395 60-40-18
20 - (WCB) Cast Steel, ASTM A216 GR WCB
21 - (3) Stainless Steel, ASTM A743 GR CF-8M*
22 - Alloy 20, ASTM A743 GR CN7M
30 - (L) Valve Bronze, ASTM B61
31 - (FK) NI-CU-AL Bronze, ASTM B148, Alloy C95800
40 - (A) Aluminum Alloy 356T6, ASTM B26 Alloy SG70A

* Special Order - Consult Factory

DISC MATERIAL

1 - (D) Ductile Iron, ASTM A395 60-40-18
2 - (3) Stainless Steel 316, ASTM A743 GR CF-8M
3 - (C) Alloy 20, ASTM A743 GR CN-7M
4 - (AL) ASTM B148 C95500
5 - (A) Aluminum Alloy 356T6 ASTM B26 Alloy
6 - (M) Nickel-Copper Alloy (Monel) ASTM A494, M30C
9 - (AJ) Titanium ASTM B367 GR 8A
0 - ( ) Special to be described
B - (BH) Hastelloy B, ASTM A494
C - (AM) Hastelloy C, ASTM A494 CW 12-MW
G - (W) Inconel 600 ASTM, A494 Alloy CY-40
K - (EA) Illium PD
P - (FK) NI-CU-AL Bronze ASTM B148 Alloy C95800

SHAFT MATERIAL

1 - (C) Alloy 20, ASTM B473, UNS N08020
2 - (3) Stainless Steel, ASTM A276, Type 316
3 - (F) Stainless Steel, ASTM A276, Type 416
4 - (M) Nickel Copper Alloy (Monel) ASTM B164 Class A
5 - (EN) Nitronic 50
6 - (K) NI-CU-AL Alloy QQ-N-286A (K-MONEL)*
7 - (AP) Stainless steel 17-4PH ASTM A564 Type 630
8 - (W) Inconel 600
9 - (AJ) Titanium ASTM B348 GR 4
0 - ( ) Special to be described
B - (BH) Hastelloy B, ASTM B335
C - (AM) Hastelloy C, ASTM B574 Alloy N102:76

* K-Monel std. in 22" & larger valves with Monel shaft

SEAT MATERIAL

Seat "M" Series

1 - (G) Cast Iron, ASTM A126 Class B
2 - (3) Stainless Steel 316, ASTM A743 GR CF-8M
3 - (AB) Aluminum Bronze, ASTM B148 Alloy C95300
4 - (A) Aluminum Alloy 356T6, ASTM B26 Alloy SG70A
5 - (M) NI CU Alloy (Monel), ASTM A494, M30C
6 - (W) INCONEL No. 610
7 - (C) Stainless Steel Alloy 20, ASTM A743 GR CN7M
9 - (AJ) Titanium ASTM B367 GR 8A
0 - ( ) Special to be described
B - (BH) Hastelloy B, ASTM A494 N-12MV
C - (AM) Hastelloy C, ASTM A494 CW 12-MW
F - (EA) Illium PD
G - (FK) Ni-Cu-Al Bronze ASTM B148 Alloy C95800

Seat "R" Series

A- Buna N
B- Fluoroelastomer (Viton)
B2 - Viton GF/Epoxy Backing
B3- Fluoroelastomer/Epoxy Backing
D - TFE Impregnated Fluoroelastomer
E - Neoprene (Black)
E2 -Neoprene /Epoxy Backing
G - Neoprene (White)
J - Nitrile, Abrasive Resistant
K - Hypalon
L - ECO
N - Natural Rubber
S - EPDM, Peroxide cured
4 - HSN, Highly Saturated Nitrile/ Epoxy Backing
5 - Natural Red Rubber
8 - Peroxide Cured Nitrile

SEALS (Note 2)

A - Buna N	K - Hypalon	Y - Kalrez
B - Fluoroelastomer	L - ECO	Z - Zalak
C - Fluorosilicone	M - Nitrile (LOW TEMP)	4 - Highly Saturated Nitrile
D - PTFE Impregnated Fluoroelastomer	N - Natural Rubber	8 - Peroxide Cured Nitrile
E - Neoprene (Black)	R - AFLAS	9A- TFE/SIL
G - Neoprene (White)	S - EPDM	
	v - Low Temp Neoprene	

MANUAL OPERATORS

1A	(1.5 - 12)	STD Handle with 1J Topworks
1F	(2 - 12)	Squeeze Trigger 10 Pos
1FM	(1.5 - 12)	1F with Marine Trim
1J	(2 - 12)	STD Topworks On-Off
1AM	(2 - 5)	STD Handle with 1S Topworks
1P	(2 - 8)	Locking Topworks
1Q	(2 - 5)	1P Topworkswith STD Handle
1JS	(2 - 8)	STD On-Off Topworks, Stainless steel

MECHANICAL OPERATORS

2E	(2 - 12)	Gear - W.P. - Aluminum Bronze Marine Trim
2ES	(2 - 12)	2E Subm. for Salt Water
2R	(2 - 12)	Gear Operator Aluminum Case
2T	(2 - 36)	Gear Operator Cast Iron Case
2RM		2R with Marine Trim
2TM		2T with Marine Trim

DIAPHRAGM OPERATORS

**

2G11	(2 - 4)	35 SR Diaphragm Actuator
2G12	(2 - 4)	35 PB Diaphragm Actuator
2G13	(2 - 8)	70 SR Diaphragm Actuator
2G14	(2 - 8)	70 PB Diaphragm Actuator
2G15	(6 - 12)	180A SR Diaphragm Actuator
2G16	(6 - 12)	180A PB Diaphragm Actuator
2G17	(12 - 20)	180 SR Diaphragm Actuator
2G18	(12 - 20)	180 PB Diaphragm Actuator

** 2G Numbers listed are Basic Numbers only. Complete actuator Model Number must be used when ordering.

SR-Spring Return. Specify Fail/Open or Fail/Closed.
PB-Pressure Balanced/Double Acting.

Norris Operators

Valve Model Number System R & M Series 285 WP

VALVE SIZE	SERIES	PRESSURE CLASS	BODY CONFIGURATION
2.5" - 36"	R - Resilient Seat M - Metal Seat D - Damper Style	ANSI 150 Valve - 285 PSI	A - Single Rib B - Lug, Full F - Single Rib Longneck (1400) Limited Availability C - Double Rib G - Full Lug Longneck

Notes:

1. If Material Specification is not shown Consult Factory For Materials.
   R-Series: Seat Material, Seal Materials. ❐ ❐
   M-Series: Face Seal, Shaft Seals, Disc Seal. ❐ ❐ ❐

Example: 4" M 285 B — 1 6 6 A A [A] A — 2K

BODY MATERIAL

- 1 - (D) Ductile Iron, ASTM A395 60-40-18
- 2 - (WCB) Cast Steel, ASTM A216 GR WCB
- 5 - (3) Stainless Steel, ASTM A743 GR CF-8M*
- 6 - NI-CU-AL Bronze ASTM B148 Alloy C98500

* Special Order - Consult Factory

DISC MATERIAL

- 1 - Ductile Iron ASTM A395 60-40-18
- 2 - 316 Stainless Steel ASTM A743 Gr. CF8M
- 3 - Alloy 20 Stainless Steel ASTM A743 Gr. CN7M
- 4 - Aluminum Bronze ASTM B148 Alloy C95400 2" thru 14"
  Aluminum Bronze ASTM B148 Alloy C95500 16" thru 36"
- 6 - Ni Cu Alloy (Monel) ASTM A494 Alloy M30C
- C - Hastelloy C ASTM A494 Alloy CW-12MW
- G - Inconel 600 ASTM A494 Alloy CY-40
- O - Special - to be described

SHAFT MATERIAL

- 6 - (K) NI-CU-AL Alloy QQ-N-286 A (K-MONEL)*
- 7 - (AP) Stainless steel 17-4PH ASTM A564 Type 630
- 0 - Special to be described
- C - Hastelloy C ASTM B574 Alloy N10276

SEAT MATERIAL

Seat "R" Series

- A - Buna N
- B - Fluoroelastomer (Viton)
- B2- Viton GF/Epoxy Backing
- B3- Fluoroelastomer/Epoxy Backing
- D - PTFE Impregnated Fluoroelastomer
- E - Neoprene (Black)
- E2- Neoprene/Epoxy Backing
- G - Neoprene (White)
- J - Nitrile, Abrasive Resistant
- K - Hypalon
- L - ECO
- S - EPDM Peroxide Cured
- X - Special to be described
- 4 - HSN, Highly Saturated Nitrile
- 6 - White EDPM
- 7 - SBR
- 8 - Peroxide Cured Nitrile

Seat "M" Series

- 2 - (3) Stainless Steel 316, ASTM A743 GR CF-8M
- 3 - (AB) Aluminum Bronze ASTM B148 Alloy C95300 (9B)
- 5 - (Monel) ASTM A494,M30C QQ-N-288 COMP A OR E
- 6 - Inconel 600 ASTM A494 Alloy CY-40
- 7 - Alloy 20 Stainless Steel ASTM A743 Gr. CM7M
- C - Hastelloy C ASTM A494 Alloy CW - 12MW
- H - Aluminum Bronze ASTM A148 Alloy C95300 Electroless Nickel Plated
- 0 - Special to be described

SEALS

- A - Buna N
- B - Fluoroelastomer
- C - Fluorosilicone
- D - PTFE Impregnated Fluoroelastomer
- E - Neoprene (Black)
- G - Neoprene (White)
- K - Hypalon
- L - ECO
- M - Nitrile (LOW TEMP)
- N - Natural Rubber
- R - AFLAS
- S - EPDM (NORDEL)
- V - Low Temp Neoprene
- Y - Kalrez
- Z - ZALAK
- 4 - Highly Saturated Nitrile
- 6 - White EPDM
- 7 - SBR
- 8 - Peroxide Cured Buna N
- 9A- PTFE/SIL
- 9B- PTEE/ Viton

MANUAL OPERATORS

1A	(1.5 - 12)	STD Handle with 1J Topworks
1F	(2 - 12)	Squeeze Trigger 10 Pos
1FM	(1.5 - 12)	1F with Marine Trim
1J	(2 - 12)	STD Topworks On-Off
1AM	(2 - 5)	STD Handle with 1JS Topworks
1Q	(2 - 5)	1P Topworkswith STD Handle
1JS	(2 - 5)	STD On-Off Topworks, Stainless steel

MECHANICAL OPERATORS

2E	(2 - 12)	Gear - W.P. - Aluminum Bronze Marine Trim
2ES	(2 - 12)	2E Subm. for Salt Water
2R	(2 - 12)	Gear Operator Aluminum Case
2T	(2 - 36)	Gear Operator Cast Iron Case
2RM		2R with Marine Trim
2TM		2T with Marine Trim

DIAPHRAGM OPERATORS

**

2G11	(2 - 4)	35 SR Diaphragm
2G12	(2 - 4)	35 PB Diaphragm
2G13	(2 - 8)	70 SR Diaphragm
2G14	(2 - 8)	70 PB Diaphragm
2G15	(6 - 12)	180A SR Diaphragm
2G16	(6 - 12)	180A PB Diaphragm
2G17	(12 - 20)	180 SR Diaphragm
2G18	(12 - 20)	180 PB Diaphragm

** 2G Numbers listed are Basic Numbers only. Complete actuator Model Number must be used when ordering.

SR-Spring Return. Specify Fail/Open or Fail/Closed.
PB-Pressure Balanced/Double Acting.

Norris Operators

LIQUID SIZING EQUATIONS

English Formula

$$C_V = Q\sqrt{\frac{G}{\Delta P}}$$

$$Q = C_V\sqrt{\frac{\Delta P}{G}}$$

$$\Delta P = \frac{Q^2 \times G}{C_V^2}$$

$$V = \frac{Q \times 0.321}{A}$$

Where:

C_V = Valve flow coefficient

Q = Volume rate of flow in U.S. gpm

G = Specific gravity (water = 1.0)

ΔP = Pressure drop (psi)

V = Velocity in feet per second

A = Area of pipe in square inches

W = Flow in pounds per hour $Q = \frac{W}{500 \times G}$

Sample problem - (solve for C_V)

Q = 5500 gpm (kerosene) @ 150 psi

ΔP = 2 psi

G = 0.824

hence:

$$C_V = Q\sqrt{\frac{G}{\Delta P}} = 5500\sqrt{\frac{0.824}{2.0}} =$$

$$5500 \times 0.6419 = 3530$$

1. For on-off, an 8" Norris R-200 Series has a C_V of 4100 at 90° open. Checking the liquid velocity of an 8" valve, where A = 50.0 sq. in., V = Q x 0.321/A = 35 fps which is above the velocity limits of M-Series (16 fps). Therefore, a 10" R-Series would be required. To be within the flow velocity limits of M-Series (16 fps), a 12" valve would be required.

2. For a throttling application, a 16" valve would be required, which has a C_V range of 720 @ 30° open and 3850 at 60° open.

Metric Formula

$$C_V = 1.16 \times Q\sqrt{\frac{G}{\Delta P}}$$

$$Q = 0.86 \times C_V\sqrt{\frac{\Delta P}{G}}$$

$$\Delta P = \frac{Q^2 \times G}{(0.86 \times C_V^2)}$$

$$V = \frac{Q \times 2.783}{A}$$

Where:

C_V = Valve flow coefficient

Q = Volume rate of flow in m^3/hr

G = Specific gravity (water = 1.0)

ΔP = Pressure drop (bar)

V = Velocity in meters per second

A = Area of pipe in square centimeters

W = Flow in kilograms per hour $Q = \frac{W}{500 \times G}$

Sample problem - (solve for C_V)

Q = 1247 m^3/hr (kerosene) @ 9.7 bar

ΔP = 0.138 bar

G = 0.824

hence:

$$C_V = 1.16 \times Q\sqrt{\frac{G}{\Delta P}} = 1447\sqrt{\frac{0.824}{0.138}} =$$

$$1447 \times 2.44 = 3530$$

1. For on-off, a 200mm Norris R-200 Series has a C_V of 4100 at 90° open. Checking the liquid velocity of a 200mm valve, where A = 322.58 cm^2, V = Q x 2.783/A = 10.7 m/s which is above the velocity limits of R-Series (9.14 m/s). Therefore, a 250mm R-Series would be required. To be within the flow velocity limits of an M-Series (4.88 m/s), a 300mm valve would be required.

2. For a throttling application, a 400mm valve would be required, which has a C_V range of 720 @ 30° open and 3850 at 60° open.

METRIC CONVERSIONS RELATIVE TO FLOW CALCULATIONS

To convert	into	multiply by
pounds/hour	kilograms/hour	0.4536
$inches^2$	$centimeters^2$	6.4516
feet/second	meters/second	0.3048
$pounds/inch^2$ (psi)	Bar	0.0689
$pounds/inch^2$ (psi)	$kilograms/meters^2$	0.2268
gallons/minute	$meters^3/hour$	0.2268
inches	millimeters	25.40

SPECIFIC GRAVITY OF VARIOUS LIQUIDS

(at standard temp. °F)

Industrial

Acetic acid	0.79
Alcohol-butyl	0.81
Alcohol-ethyl	0.798
Alcohol-methyl	0.79
Ammonia	0.662
Automobile oil	0.88-94
Benzene	0.879
Brine	1.2
Bromine	2.9
Carbon tet.	1.59
Formic acid	1.221
Freon 11	1.49
Freon 12	1.33
Freon 21	1.37
Fuel oils	0.82-95
Gasoline	0.72
Glycol ethylene	1.125
Hydrochloric acid 31.5%	1.15
Kerosene	0.824
Nitric acid 60%	1.37
Sulfuric acid 100%	1.83
Sulfuric acid 95%	1.83
Sulfuric acid 60%	1.50
Water - fresh	1.0
Water sea	1.03

Oilpatch

Fresh water	1.0
Produced water	1.02
Crude oil	
20° API	0.934
30° API	0.876
40° API	0.825
50° API	0.779
Potassium chloride	
8.53 lb/gal	1.024
9.09 lb/gal	1.091
Calcium chloride	
9.0 lb/gal	1.079
10.0 lb/gal	1.199
Sodium chloride	
9.0 lb/gal	1.079
10.0 lb/gal	1.199
Sodium chloride - calcium chloride solution	
10.1 lb/gal	1.211
11.0 lb/gal	1.319
Drilling muds	
10 lb/gal	1.20
13 lb/gal	1.56
16 lb/gal	1.92
19 lb/gal	2.28
HCL 10%	1.050
20%	1.100
30%	1.152
40%	1.200
Diesel Fuel	0.8156

TABLE II - FLOW COEFFICIENT (C_v) FOR 200 PSI VALVES

Valve Open		20°	30°	40°	50°	60°	70°	80°	90°
		DEGREES OPEN							
2"	50 mm	11.2	17.8	27.5	44	68	107	142	170
2.5"	65 mm	16.5	26	42	67	105	165	225	290
3"	75 mm	22	36	58	94	150	238	330	430
3.5"	90 mm	29	47	78	127	200	320	460	610
4"	100 mm	36	60	100	160	260	420	610	830
5"	125 mm	52	90	152	248	400	650	980	1,400
6"	150 mm	70	125	215	350	580	930	1,420	2,100
8"	200 mm	112	210	365	610	1,000	1,620	2,600	4,100
10"	250 mm	160	310	560	920	1,550	2,520	4,150	6,900
12"	300 mm	220	430	800	1,300	2,200	3,600	6,100	10,500
14"	350 mm	285	570	1,050	1,750	3,000	4,950	8,600	15,000
16"	400 mm	350	720	1,350	2,250	3,850	6,400	11,500	20,000
18"	450 mm	430	880	1,700	2,800	4,900	8,000	14,400	26,800
20"	500 mm	510	1,080	2,100	3,400	6,000	9,900	18,000	34,000
22"	550 mm	600	1,280	2,450	4,100	7,200	11,900	22,000	42,000
24"	600 mm	690	1,490	2,880	4,800	8,500	14,100	26,300	51,800
26"	650 mm	790	1,720	3,350	5,600	10,000	16,500	31,500	62,000
28"	700 mm	900	1,950	3,800	6,400	11,500	19,200	37,000	74,000
30"	750 mm	1,000	2,200	4,300	7,400	13,000	22,000	42,000	85,000
32"	800 mm	1,100	2,500	5,000	8,400	15,000	25,000	50,000	100,000
36"	900 mm	1,400	3,200	6,300	10,600	19,000	31,600	63,000	126,000

NOTE: Use 30° to 60° range (shaded area) for sizing throttling valves.

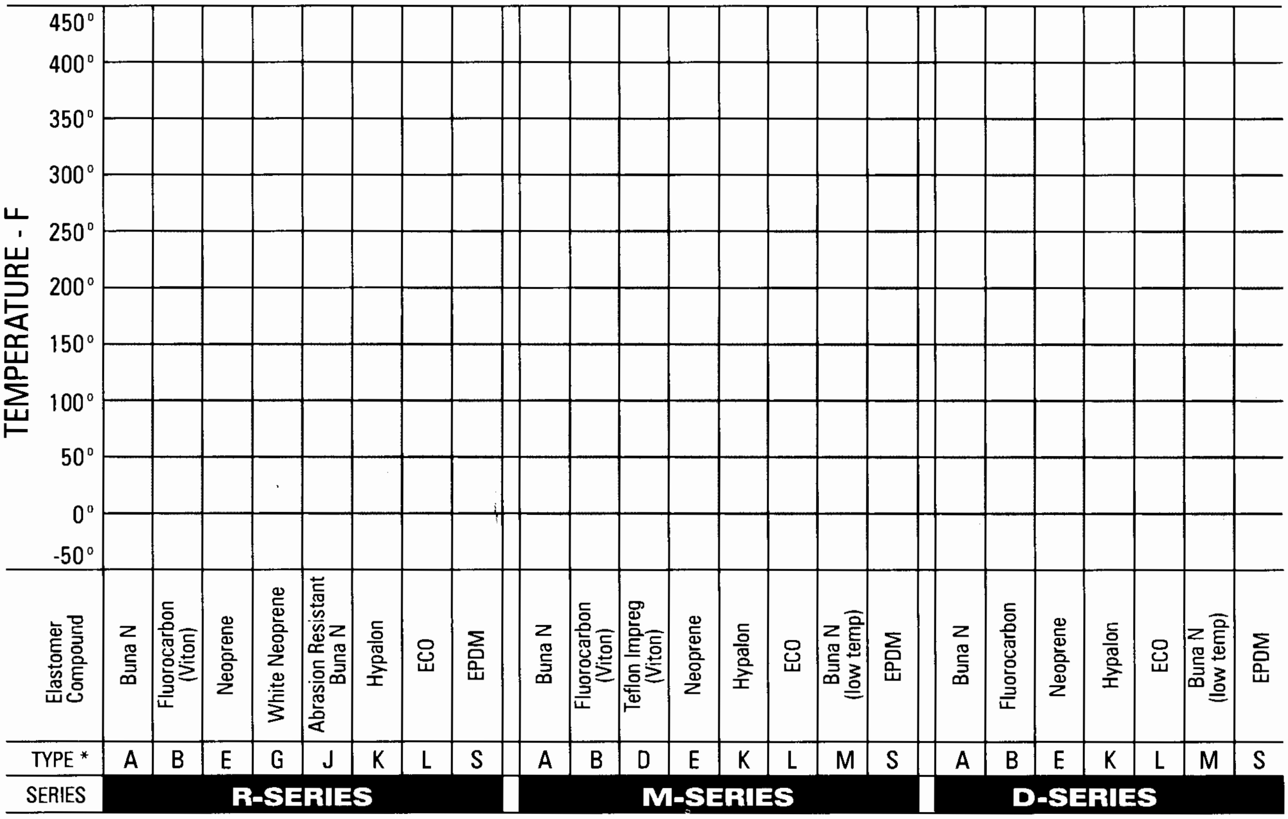
TABLE III - FLOW COEFFICIENT (C_v) FOR ANSI 150 , (285 SERIES) 285 PSI VALVES

Valve Open		20°	30°	40°	50°	60°	70°	80°	90°
		DEGREES OPEN							
2.5"	65 mm	15	23	38	60	84	132	180	232
3"	75 mm	20	32	52	85	120	190	264	344
4"	100 mm	32	54	90	144	208	336	488	664
5"	125 mm	47	81	137	223	320	520	784	1,120
6"	150 mm	63	113	194	315	464	744	1,136	1,680
8"	200 mm	101	189	329	549	800	1,296	2,080	3,280
10"	250 mm	144	279	504	828	1,240	2,016	3,320	5,520
12"	300 mm	198	387	720	1,170	1,760	2,880	4,880	8,400
14"	350 mm	285	570	1,050	1,750	3,000	4,950	8,600	15,000
16"	400 mm	350	720	1,350	2,250	3,850	6,400	11,500	20,000
18"	450 mm	430	880	1,700	2,800	4,900	8,000	14,400	26,800
20"	500 mm	510	1,080	2,100	3,400	6,000	9,900	18,000	34,000
22"	550 mm	600	1,280	2,450	4,100	7,200	11,900	22,000	42,000
24"	600 mm	690	1,490	2,880	4,800	8,500	14,100	26,300	51,800
26"	650 mm	790	1,720	3,350	5,600	10,000	16,500	31,500	62,000
28"	700 mm	900	1,950	3,800	6,400	11,500	19,200	37,000	74,000
30"	750 mm	1,000	2,200	4,300	7,400	13,000	22,000	42,000	85,000
32"	800 mm	1,100	2,500	5,000	8,400	15,000	25,000	50,000	100,000
36"	900 mm	1,400	3,200	6,300	10,600	19,000	31,600	63,000	126,000

NOTE: Use 30° to 60° range (shaded area) for sizing throttling valves.

TABLE IV - TEMPERATURE CHART - ELASTOMER SEATS & SEALS

Caution: Temperature extremes are affected by the media being handled by the valve. Consult factory for specific guidelines.



* Highly Saturated Nitrile (HSN) available as seat material on R-series valves. Consult factory for temperature limits.

TABLE V - FLUID DYNAMIC TORQUE

(Use for 200 and 285 series)

VALVE SIZE		DEGREES OPEN 20°	30°	40°	50°	60°	70°	80°	90°
2"	50 mm	.013	.021	.041	.096	.19	.34	.68	.28
2.5"	65 mm	.031	.052	.10	.23	.45	.81	1.6	.64
3"	75 mm	.062	.105	.20	.46	.90	1.6	3.2	1.3
3.5"	90 mm	.115	.19	.36	.80	1.6	2.8	5.6	2.3
4"	100 mm	.19	.32	.59	1.3	2.6	4.7	9.2	3.8
5"	125 mm	.45	.74	1.35	3.1	6.0	11.0	21.5	8.8
6"	150 mm	.90	1.4	2.7	6.0	12.0	22.0	43.0	18.0
8"	200 mm	2.6	4.3	7.8	17.5	34.0	62.0	130.0	53.0
10"	250 mm	6.3	10.0	18.5	41.0	80.0	155.0	300.0	123.0
12"	300 mm	12.3	20.0	35.0	80.0	155.0	300.0	600.0	250.0
14"	350 mm	22.0	35.0	64.0	145.0	285.0	550.0	1,100.0	440.0
16"	400 mm	36.0	56.0	103.0	235.0	450.0	900.0	1,800.0	710.0
18"	450 mm	57.0	89.0	160.0	365.0	720.0	1,420.0	2,809.0	1,125.0
20"	500 mm	84.0	132.0	240.0	540.0	1,080.0	2,100.0	4,100.0	1,700.0
22"	550 mm	120.0	190.0	340.0	780.0	1,600.0	3,000.0	5,800.0	2,500.0
24"	600 mm	170.0	260.0	480.0	1,120.0	2,150.0	4,300.0	8,400.0	3,400.0
26"	650 mm	230.0	350.0	650.0	1,500.0	2,950.0	5,800.0	11,600.0	5,800.0
28"	700 mm	310.0	480.0	850.0	2,000.0	3,900.0	7,800.0	15,500.0	6,500.0
30"	750 mm	395.0	600.0	1,100.0	2,600.0	5,100.0	11,000.0	20,000.0	8,400.0
32"	800 mm	500.0	780.0	1,450.0	3,300.0	6,500.0	13,000.0	26,000.0	11,000.0
36"	900 mm	840.0	1,310.0	2,350.0	5,460.0	10,600.0	21,300.0	42,000.0	17,800.0

All values are in inch pounds and are based on 1 psi total pressure drop across the valve.
NOTE: To obtain total fluid dynamic torque, multiply value for selected size and disc angle required by total pressure drop.
(Constant) x (ΔP) = Fluid dynamic torque in inch-pounds.

TABLE VII - OPERATING TORQUES 200 SERIES (Inch Pounds)

Operating torques for wet service shown in table below include 50% service factor. For dry torques, multiply the values shown by 1.33.

Valve Size		R-Series - Wet Service Line Pressure - PSI								M-Series - Wet Service Line Pressure - PSI								D-Series - Wet Service Line Pressure - PSI							
IN	MM	0	50	75	100	125	150	175	200	0	50	75	100	125	150	175	200	0	50	75	100	125	150	175	200
2	50	64	89	101	114	126	138	150	162	50	93	114	135	156	178	199	220	24	63	81	98	115	131	146	164
2.5	65	72	96	109	121	134	146	158	170	75	116	137	158	178	199	219	240	24	63	81	98	115	131	146	164
3	75	100	129	143	158	172	187	202	216	100	150	175	200	225	250	275	300	31	84	106	126	144	166	184	203
3.5	90	128	172	194	216	238	260	282	304	140	230	275	320	365	410	455	500	31	84	106	126	144	166	184	203
4	100	160	220	248	280	308	340	368	400	180	285	338	390	443	495	548	600	64	162	205	249	285	327	368	410
5	125	245	352	400	440	488	544	584	640	270	478	581	685	789	893	996	1100	98	260	330	391	451	530	591	656
6	150	720	800	840	896	940	984	1032	1080	500	789	934	1078	1223	1367	1512	1656	297	600	704	806	881	972	1045	1154
8	200	1512	1728	1848	1968	2096	2224	2320	2448	750	1413	1744	2075	2406	2738	3069	3400	624	1231	1478	1697	1912	2113	2262	2479
10	250	2160	2512	2688	2872	3040	3216	3408	3600	1050	2038	2531	3025	3519	4013	4506	5000	648	1601	1949	2262	2508	2814	3067	3330
12	300	3448	3960	4200	4440	4696	4944	5192	5440	1300	3425	4488	5550	6613	7675	8738	9800	690	2947	2625	3053	3463	3832	4154	5032
14	350	5700	6500	6900	7300	7700	8200	8600	9000	1510	4250	5600	7000	8400	9800	11100	12500	855	2898	3600	4078	4463	4743	4990	5118
16	400	7100	8100	8600	9000	9500	10000	10500	11000	1790	5350	7100	8900	10700	12400	14200	16000	710	3404	4510	5260	5780	6265	6705	6975
18	450	9550	10800	11500	12100	12700	13300	14000	14600	2000	5900	7800	9800	11700	13600	15600	17500	860	4576	6145	7328	8102	8826	9986	9824
20	500	10100	12100	13100	14000	15000	16000	17000	18000	2250	7300	9850	12400	14900	17400	20000	22500	1010	5162	6985	8286	9231	10122	10939	11475
22	550	11500	13500	14400	15200	16300	17000	17700	18500	2500	8125	10938	13750	16563	19375	22188	25000	1265	5730	6480	7600	8802	9690	10443	11285
24	600	14500	17000	18000	19000	20250	21500	22750	24000	2700	9400	12750	16100	19450	22800	26150	29500	1595	6460	8100	9500	10935	12255	13423	14640
26	650	17500	20500	22000	23500	25200	27000	28500	30000	2950	10463	14219	17975	21731	25488	29244	33000	1925	7790	9900	11750	13608	15390	16865	18300
28	700	20000	25000	27500	30000	32500	35000	37500	40000	3100	13825	19188	24550	29913	35275	40638	46000	2000	8000	10175	12300	14625	16800	19125	21200
30	750	35000	38750	40625	42500	44375	46250	48150	50000	3400	15300	21250	27200	33150	39100	45050	51000	2100	11625	15031	17425	19969	22200	24544	26500
32	800	30000	36000	39000	42500	45600	48800	52000	55000	3900	16675	23063	29450	35838	42225	48613	55000	2200	13500	17575	20500	23625	26400	29325	31800
36	900	40000	47500	52200	55000	58800	62500	66300	70000	4500	23300	33000	42000	52000	61000	71000	80000	2600	14500	20400	26300	32700	38200	44100	50000

TABLE VIII - ANSI 150 OPERATING TORQUES 285 SERIES (Inch Pounds)

Operating torques for wet service shown in table below include 50% service factor. For dry torques, multiply the values shown by 1.33.

Valve Size		R 285 - Wet Service						M 285 - Wet Service					
		Line Pressure - PSI						Line Pressure - PSI					
IN	MM	0	50	100	150	200	285	0	50	100	150	200	285
2.5	65	100	134	169	204	238	275	86	133	181	229	276	390
3	75	140	180	221	261	302	504	115	172	230	288	345	448
4	100	224	308	392	476	560	672	207	328	448	569	690	897
5	125	343	492	616	761	896	1050	310	550	787	1027	1265	1782
6	150	1000	1120	1254	1377	1512	1820	575	907	1240	1572	1904	2645
8	200	2116	2419	2755	3113	3427	4060	862	1625	2386	3148	3910	5175
10	250	3024	3516	4020	4502	5040	5880	1207	2343	3478	4615	5750	7360
12	300	4827	5544	6216	6921	7616	9100	1495	3938	6382	8826	11270	15100
14	350	6500	7475	8400	9500	10300	12600	1730	4900	8000	11300	14500	21000
16	400	8000	9300	10300	11500	12500	15000	2050	6150	10200	14300	18400	26500
18	450	11000	12500	14000	15300	17000	21000	2300	6800	11300	15700	20000	29000
20	500	11600	14000	16000	18500	20700	25300	2600	8400	14300	20000	26000	38000
24	600	16700	19500	22000	25000	27000	33000	3100	10800	18500	26000	34000	50600
30	750	40000	45000	49000	53000	58000	68000	3900	17600	31300	45000	59000	86250
36	900	46000	55000	63000	72000	81000	98000	5200	27000	49000	70000	92000	126000

HOW TO SELECT TRIM MATERIAL FOR NORRIS BUTTERFLY VALVES

The following data is intended as a guide to selecting metals and elastomers for internal wetted parts of Norris butterfly valves in specific applications.

Because of Norris' dry back construction, body materials are not affected by the flow stream. Pressure, temperature and external environment are the critical considerations in selection of body materials.

Norris elastomer seats are harder, less porous and less subject to swell and deterioration than those used in vertical disc butterfly valves. The specially compounded elastomers are of greater density and higher durometer. Use of these harder elastomers is possible because Norris' precision-machined angle disc doesn't have to penetrate as deep into the seat to give positive, bubble-tight shutoff.

When premium elastomers are required for an application, selection of Norris M-Series valves with replaceable metal seats may be more economical because of the limited amount of elastomer used for sealing.

How To Use The Guide

This guide has been prepared from published data, vendor ratings, laboratory and field experience. Recommendations are based on 75°F. Because of varying temperature, aeration, inhibiting and accelerating contaminates often encountered, Norris does not guarantee corrosion resistance of any material. When chemicals are mixed, it cannot be assumed a metal or elastomer will provide the same corrosion resistance as described for the pure chemical.

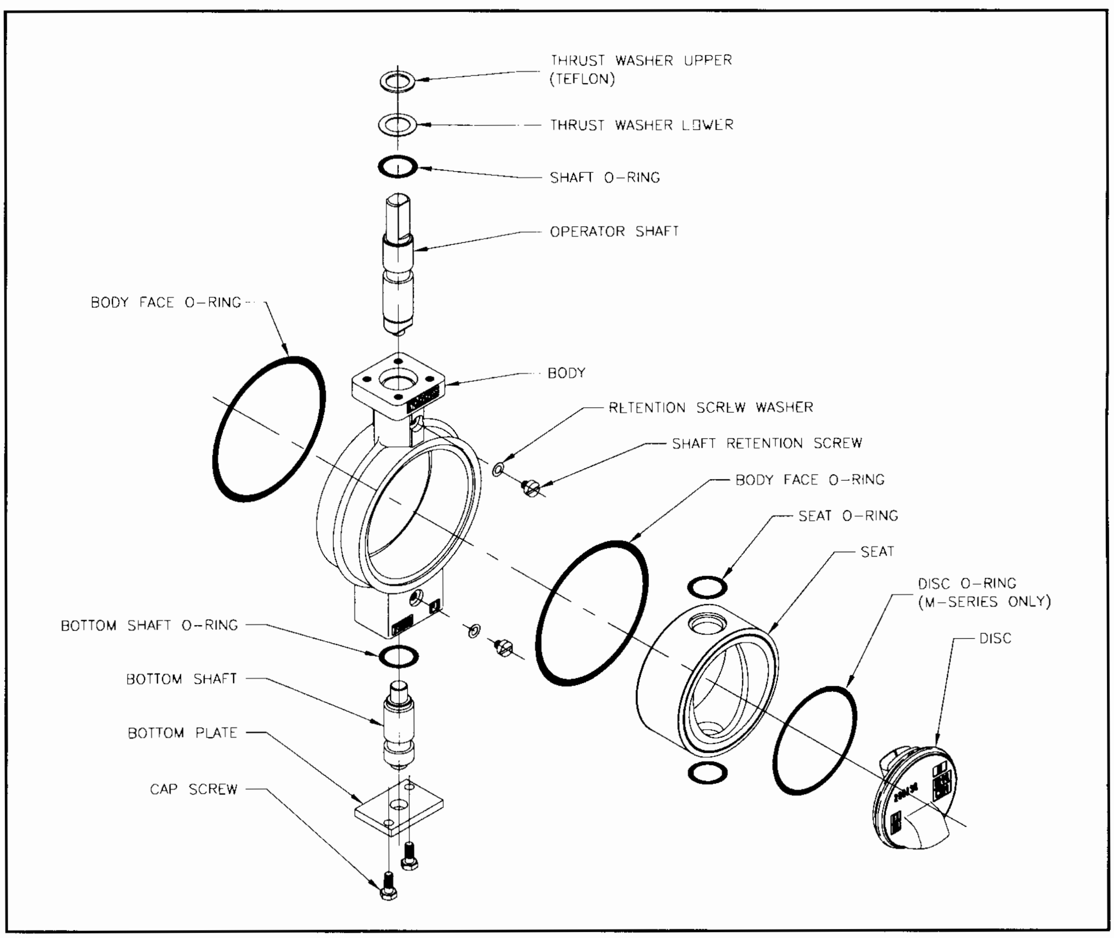
The ratings reported in this brochure should be considered as a guide and not as an unqualified recommendation. It is necessary that the user approve each material for a specific application. Where valve performance is critical, we suggest actual product testing be done to assure material compatibility with the flow stream.

For applications which require clarification or for additional information, contact Norris Butterfly Valve Application Engineering Department, Houston, Texas 713-466-3552.

Explanation of Ratings

1 - Fully resistant
2 - Satisfactorily resistant (slightly attacked)
3 - Test for application
X - Not recommended
- - Insufficient data.

For your convenience, the media are presented in alphabetical order.



ENVIRONMENT	CHEMICAL FORMULA	ELASTOMERS - 75 F					METALS - 75 F									
		Buna N	EPDM	Neoprene	Fluorocarbon	Hypalon	Ductile & Cast Iron	Aluminum Bronze	416 SS	316 SS	17-4PH SS	Monel & K-Monel	Illium PD & Nitronic 50	Alloy 20	Hastelloy B	Hastelloy C
Acetic Acid, 20%	CH_3COOH	1	1	1	1	1	X	X	2	1	2	2	1	1	1	1
Acetic Acid, 50%	CH_3COOH	1	1	1	1	1	X	X	2	1	2	1	1	1	1	1
Acetone	CH_3COCH	X	1	X	X	X	1	2	1	1	2	1	-	1	1	1
Air	-	1	1	1	1	1	2	1	2	1	1	1	1	1	1	1
Aluminum Chloride	$AlCl_3$	1	1	1	1	1	X	X	X	X	X	X	3	1	1	1
Aluminum Fluoride	AlF_3H_2O	1	1	1	1	1	X	2	X	2	X	2	3	1	1	2
Aluminum Sulfate	$Al_2(SO_4)_3$	1	1	1	1	1	X	X	X	1	2	1	-	1	1	1
Ammonia	NH_3	1	1	1	X	1	2	2	-	1	-	X	1	1	1	1
Ammonia-Anydrous	NH_3	2	1	1	X	X	2	X	2	1	1	X	1	1	2	2
Ammonium Chloride	NH_4Cl	2	1	1	1	2	X	X	2	X	X	1	-	1	1	1
Ammonium Hydroxide, 10%	NH_4OH	1	1	1	1	1	1	X	2	1	1	X	-	1	2	1
Ammonium Hydroxide, 18%	NH_4OH	1	1	2	1	1	1	X	1	1	1	X	-	1	1	1
Ammonium Nitrate	NH_4NO_3	1	1	1	X	1	X	X	1	1	2	X	-	1	2	2
Ammonium Phosphate	$(NH_4)_2HPO_4$	1	1	1	1	1	X	2	1	1	-	2	-	1	1	1
Ammonium Sulfate	$(NH_4)_2SO_4$	1	1	1	1	1	X	2	X	2	-	2	-	1	1	2
Amyl Acetate	$CH_3COOC_5H_{11}$	X	1	X	X	2	2	2	2	1	2	1	-	1	1	1
Amyl Alcohol	C_5H_2O	1	1	1	1	1	2	2	2	1	2	1	1	1	1	2
Aniline	$C_6H_5NH_2$	X	1	X	1	2	1	2	2	1	2	2	3	1	2	2
Arsenic Acid	$H_3A_5O_4 1/2H_20$	1	1	1	1	1	X	X	2	2	2	X	-	1	2	2
Asphalt, Emulsion	-	1	3	2	1	3	2	2	1	1	1	1	-	1	1	1
Asphalt, Liquid	-	3	X	3	1	X	2	2	1	1	1	1	-	1	1	1
ASTM #1 Oil	-	1	X	1	1	1	3	1	2	1	1	1	-	1	1	1
ASTM #3 Oil	-	1	X	2	1	X	3	1	2	1	1	1	-	1	1	1
ASTM Fuel A	-	1	X	2	1	X	3	1	2	1	1	1	-	1	1	1
ASTM Fuel B	-	2	X	X	1	X	3	1	2	1	1	1	-	1	1	1
ASTM Fuel C	-	X	X	X	1	X	3	1	2	1	1	1	-	1	1	1
Barium Carbonate	$BaCO_3$	1	1	1	1	1	X	1	2	2	1	2	-	1	2	2
Barium Chloride	$BaCl_2 \cdot 2H_20$	1	1	1	1	1	X	2	2	2	2	2	-	1	1	1
Barium Hydroxide	BaOH	1	1	1	1	1	X	X	2	2	2	1	-	1	2	2
Barrium Sulfate	$BaSO_4$	1	1	1	1	1	X	2	2	2	2	2	-	1	2	2
Barrium Sulfide	BaS	1	1	1	1	1	3	X	2	2	2	2	-	1	-	2
Beer (Alcohol Industry)	-	1	1	1	1	1	X	2	1	1	2	1	1	1	1	1
Beer (Beverage Industry)	-	2	1	2	1	2	X	2	X	1	1	1	1	1	1	1
Beet Sugar Liquors	-	1	1	1	1	1	X	2	2	1	2	1	1	1	1	1
Benzaldehyde	C_6H_5CHO	X	1	X	X	X	X	2	2	2	2	2	3	1	2	2
Benzene	C_6H_6	X	X	X	1	X	2	2	2	2	2	2	3	1	2	2
Benzoic Acid	$C_6H_5CO_2H$	X	X	1	1	1	X	2	2	2	2	2	-	1	2	1
Black Sulfate Liquor (Also see Sulfate)		1	1	1	1	X	3	X	2	2	1	2	1	1	X	X
Borax Liquors	-	2	1	1	1	1	X	2	2	1	1	1	-	1	1	1
Boric Acid	H_3BO_3	1	1	1	1	1	X	2	2	2	2	2	-	1	1	1
Brine (Also see Water, Sea)	-	1	1	1	1	1	X	X	2	2	2	2	1	1	2	1
Brine (Aerated)	-	1	1	1	1	1	X	X	2	2	2	2	1	1	2	1
Bromine (Dry Gas)	-	X	X	X	1	1	X	X	X	X	X	1	3	X	1	1
Bromine (Wet)	-	X	X	X	1	1	X	X	X	X	X	X	X	X	1	1
Bunker Oils (Fuel Oils)	-	1	X	X	1	X	2	2	1	1	1	1	-	1	1	1
Butadiene	$H_2C:C_2H_2:CH_2$	1	X	1	1	X	X	2	1	2	2	1	-	1	2	2
Butane	C_4H_{10}	1	X	1	1	1	2	2	2	2	2	1	-	1	2	2
Butyl Acetate	$C_5H1_2O_2$	X	X	X	X	X	2	X	2	2	2	2	-	1	2	2
Butylene	-	1	X	1	1	1	2	2	2	2	2	1	-	1	3	2
Butyraldehyde	$C_4H_8O_2$	X	2	X	X	X	X	2	3	2	2	1	3	-	-	-
Butyric Acid	$CH_3CH_2CH_2COOH$	X	1	X	2	X	X	2	2	2	2	2	-	1	2	1
Calcium Bisulfite	$Ca(HSO_3)_2$	1	X	1	1	1	X	X	X	2	2	X	1	2	-	2
Calcium Carbonate	$CaCO_3$	1	1	1	1	1	X	X	1	2	2	2	1	1	2	2
Calcium Chloride	$CaCl_2$	1	1	1	1	1	3	X	X	2	2	2	-	2	2	1
Calcium Hypochlorite	$Ca(ClO)_2$	X	1	1	1	1	X	X	X	2	X	X	3	2	X	1
Calcium Hydroxide, 20%	$Ca(OH)_2$	1	1	1	1	1	2	1	X	2	2	2	-	1	2	1
Calcium Sulfate	$CaSO_4$	1	1	1	1	1	X	X	2	2	2	2	-	1	2	2
Carbolic Acid	C_6H_5OH	X	2	X	1	X	X	3	2	1	1	1	-	1	1	1
Carbon Bisulfide	CS_2	X	X	X	1	X	X	2	2	2	1	X	-	1	2	2
Carbon Dioxide	CO_2	1	1	1	2	1	2	2	1	2	2	2	-	1	1	2
Carbon Dioxide (Dry Gas)	CO_2	1	1	1	2	1	2	2	1	2	2	1	-	1	1	2
Carbon Tetrachloride (Dry)	CCl_4	X	X	X	1	X	X	2	1	1	2	1	-	1	1	1
Carbon Tetrachloride (Wet)	CCl_4	X	X	X	1	X	X	2	1	1	2	1	-	2	1	1
Carbonated Water	-	1	1	1	1	1	X	1	1	1	1	1	-	1	1	1
Carbonic Acid	H_2CO_3	1	1	1	1	1	X	X	2	2	2	X	-	1	1	1
Castor Oil	-	1	1	1	1	1	2	2	2	2	1	1	1	X	1	1
China Wood Oil (Tung)	-	1	X	2	1	3	X	X	3	1	2	2	1	1	1	1
Chlorine (Dry)	Cl_2	X	X	X	1	X	X	1	X	2	X	1	3	2	2	1
Chlorine (Wet)	Cl_2	X	X	X	1	1	X	X	X	X	X	X	X	X	X	1
Chlorinated Solvents (Dry)	-	X	1	X	1	1	X	X	X	X	X	X	-	1	3	1
Chloroacetic Acid	CH_2ClCO_2H	X	1	X	X	X	X	2	X	X	X	X	X	X	1	1

ENVIRONMENT	CHEMICAL FORMULA	ELASTOMERS - 75 F					METALS - 75 F									
		Buna N	EPDM	Neoprene	Fluorocarbon	Hypalon	Ductile & Cast Iron	Aluminum Bronze	416 SS	316 SS	17-4PH SS	Monel & K-Monel	Illium PD & Nitronic 50	Alloy 20	Hastelloy B	Hastelloy C
Chlorobenzene (Dry)	C_6H_5Cl	X	X	X	1	X	2	2	1	2	2	2	3	2	2	1
Chloroform	$CHCl_3$	X	X	X	1	X	X	2	2	1	2	1	-	1	2	2
Chloroform (Dry)	$CHCl_3$	X	X	X	1	X	X	2	2	1	2	1	-	1	2	2
Chlorosulfonic Acid (Dry)	$ClSO_2OH$	X	X	X	X	X	X	X	X	X	X	2	X	X	1	1
Chlorosulfonic Acid (Wet)	$ClSO_2OH$	X	X	X	X	X	X	X	X	X	X	2	X	X	1	1
Chlorotoluene	$CH_3C_6H_4Cl$	X	X	X	1	X	2	1	2	2	2	1	3	-	-	-
Chrome Alum	$CrK(SO_4)_2\ 12H_2O$	1	1	1	1	1	2	2	3	2	2	2	-	1	X	2
Chromic Acid, 10%	CrO_3	1	2	1	1	1	X	X	X	1	X	2	-	1	1	1
Citric Acid	$C_6H_8O_7$	1	1	1	1	1	X	X	2	2	2	2	1	1	1	1
Citrus Juices	-	1	1	1	1	1	X	2	2	1	1	1	1	1	1	1
Coke Oven Gas	-	X	1	1	1	X	2	2	2	2	2	2	-	1	1	1
Cooking Oil	-	2	1	2	1	2	2	2	2	1	1	1	-	1	1	1
Copper Acetate	-	1	1	1	X	X	X	X	2	2	2	X	-	1	2	2
Copper Chloride	$CuCl_2$	1	1	1	1	1	X	X	X	X	3	X	3	X	2	2
Copper Nitrate	-	1	1	1	1	1	X	X	2	1	2	X	-	1	X	2
Copper Sulfate	$CuSO_4$	1	1	1	1	1	X	X	2	2	2	X	3	1	2	1
Corn Oil	-	1	X	1	1	1	2	1	2	2	2	2	1	1	1	1
Cottonseed Oil	-	1	X	1	1	1	2	1	2	2	2	1	1	1	1	1
Creosote Oil	-	1	X	X	1	X	X	X	2	2	2	2	-	1	X	2
Cresylic Acid	-	X	1	X	1	X	X	X	2	2	2	X	-	1	1	1
Crude Oil (Sweet)	-	1	X	X	1	X	2	2	2	1	2	1	-	1	1	1
Crude Oil (Sour)	-	2	X	X	1	X	X	3	2	1	2	1	-	1	1	1
Cutting Oils, Water Emulsions	-	1	X	2	1	3	2	1	1	1	1	1	-	-	1	1
Cyclohexane	C_6H_{12}	1	X	X	1	X	X	2	2	2	2	1	-	1	2	2
Diacetone Alcohol	-	X	1	X	X	3	X	2	2	2	2	1	-	1	1	1
Diesel Fuels	-	1	X	1	1	1	2	2	2	1	2	1	1	1	2	2
Diethylamine	$(C_2H_5)_2NH$	2	2	1	2	X	X	X	2	2	2	1	-	1	-	1
Dowtherms	-	X	X	X	2	X	X	1	1	1	1	-	-	1	-	-
Drilling Mud	-	1	X	X	1	X	2	1	1	1	1	1	1	1	1	1
Drip Cocks, Gas	-	3	X	X	1	X	2	2	1	1	1	1	-	1	1	1
Dry Cleaning Fluids	-	3	X	X	2	X	X	3	2	1	1	1	-	1	1	1
Drying Oil	-	1	X	3	1	X	3	X	2	1	2	2	-	1	1	1
Ethane	C_2H_6	1	X	2	1	3	X	2	2	1	1	1	-	1	1	1
Ethanolamine, Mono	C_2H_7ON	1	1	1	X	2	2	X	1	1	2	2	-	-	2	2
Ethanolamine, Tri	$C_6H_{15}O_3N$	3	1	1	X	1	2	X	2	2	2	2	-	-	-	2
Ethyl Acetate	$C_4H_8O_2$	X	1	X	X	1	2	2	2	2	2	2	-	1	2	2
Ethyl Acrylate	$CH_2{:}CHCO_2C_2H_5$	X	2	X	X	X	X	2	2	2	2	2	-	-	-	1
Ethyl Alcohol	C_2H_6O	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1
Ethyl Chloride (Dry)	C_2H_5Cl	1	1	X	1	X	2	2	1	1	2	2	-	1	2	2
Ethyl Chloride (Wet)	C_2H_5Cl	3	X	X	1	X	X	3	2	1	2	3	-	1	2	2
Ethylene Chloride (Dry)	CH_2ClCH_2Cl	X	2	X	1	X	3	1	1	2	2	2	-	1	1	3
Ethylene Chloride (Wet)	CH_2ClCH_2Cl	X	X	X	2	X	X	2	X	X	X	2	X	-	X	X
Ethylene Diamine	$C_2N_8N_2$	1	1	X	1	1	3	X	2	2	2	3	3	-	2	X
Ethylene Dichloride (Dry)	CH_2ClCH_2Cl	X	X	X	1	X	X	2	1	2	2	1	3	-	1	2
Ethylene Dichloride (Wet)	CH_2ClCH_2Cl	X	X	X	1	X	X	2	1	2	2	1	3	-	1	2
Ethylene Glycol	$C_2H_6O_2$	1	1	1	1	1	2	2	2	2	2	2	-	1	1	1
Ethylene Oxide	CH_2CH_2O	X	X	X	X	X	2	2	2	1	2	2	-	1	1	1
Fatty Acids	-	1	X	1	1	1	X	2	2	1	2	2	1	1	1	1
Ferric Chloride	$FeCl_3$	1	1	1	1	1	X	X	X	X	X	X	X	X	2	2
Ferric Nitrate	$Fe(NO_3)_3$	1	1	2	1	2	X	X	X	2	2	X	-	1	X	2
Ferric Sulfate	$Fe(SO_4)_3$	1	1	1	1	1	X	X	X	1	2	2	-	1	X	1
Ferrous Chloride	Fe_2Cl_2	1	1	1	1	1	X	X	X	X	X	X	X	1	2	2
Ferrous Nitrate	$Fe_2(NO_3)_2$	1	1	1	1	2	X	X	2	2	2	X	-	1	-	1
Ferrous Sulfate	$FeSO_4$	1	1	1	1	1	X	X	2	2	2	2	-	1	2	2
Ferrous Sulfate (Saturated)	$FeSO_4$	1	1	1	1	1	X	X	2	2	2	2	-	1	2	2
Fertilizer Solutions	-	2	3	2	1	3	X	X	2	1	1	1	1	1	1	1
Fluorosilicic Acid	H_2SiF_6	1	1	2	2	1	X	2	3	2	2	1	-	1	2	2
Food Fluids & Pastes	-	2	3	2	1	3	X	2	2	1	1	1	1	1	1	1
Formaldehyde	HCHO	X	1	3	1	2	X	2	2	2	2	2	3	1	2	2
Formic Acid	HCOOH	X	1	1	2	1	X	1	2	2	1	2	3	1	2	1
Fruit Juices	-	1	1	1	1	1	X	2	1	2	2	1	1	1	1	1
Fuel Oil	-	1	X	1	1	1	2	1	1	2	1	2	-	1	2	2
Furfural	C_4H_3OCHO	X	2	1	X	1	X	2	2	2	2	2	-	1	2	2
Gallic Acid	-	2	2	2	1	2	X	X	2	2	2	2	-	1	2	2
Gas, Manufactured	-	1	X	3	1	X	3	1	2	2	1	1	-	1	1	1
Gas, Natural	-	1	X	1	1	1	2	1	1	1	1	1	-	1	1	1
Gasoline (Aviation)	-	3	X	X	1	X	2	1	1	1	1	1	-	1	1	1
Gasoline (Leaded)	-	1	X	1	1	1	3	2	1	2	2	2	-	1	1	1
Gasoline (Motor)	-	3	X	X	1	X	2	1	2	1	1	1	-	1	1	1
Gasoline (Sour)	-	1	X	1	1	X	X	2	2	2	2	X	-	1	2	2
Gasoline (Unleaded)	-	1	X	1	1	1	X	2	1	2	2	2	-	1	1	1
Gelatin	-	1	1	1	1	1	X	1	1	2	2	2	-	1	2	X
Glacial Acetic Acid	CH_3COOH	X	2	X	X	2	X	2	X	2	2	2	-	-	-	-

ENVIRONMENT	CHEMICAL FORMULA	ELASTOMERS - 75 F					METALS - 75 F									
		Buna N	EPDM	Neoprene	Fluorocarbon	Hypalon	Ductile & Cast Iron	Aluminum Bronze	416 SS	316 SS	17-4PH SS	Monel & K-Monel	Illium PD & Nitronic 50	Alloy 20	Hastelloy B	Hastelloy C
Glucose	-	1	1	1	1	1	2	2	1	2	2	2	-	1	1	1
Glycerine (Glycerol)	-	1	1	1	1	1	1	2	1	1	2	1	1	1	1	1
Glycols	-	1	1	1	1	1	1	2	1	2	1	2	-	1	1	1
Grease	-	1	X	X	1	X	2	1	1	1	1	1	-	1	1	1
Heptane	$CH_3(CH_2)_5CH_3$	1	X	1	1	1	X	2	2	2	2	2	-	1	1	1
Hexane	C_6H1_4	1	X	1	1	1	2	2	2	1	2	2	-	1	1	1
Hydraulic Oil (Petroleum Base)	-	1	X	2	1	2	2	11	1	1	11	1	-	1	1	1
Hydrobromic Acid	HBr	X	1	X	1	1	X	X	X	X	X	X	X	X	2	2
Hydrochloric Acid, 10%	HCl	1	1	1	1	1	X	X	X	X	X	2	X	X	2	1
Hydrochloric Acid, 20%	HCl	1	1	1	1	1	X	X	X	X	X	2	X	X	2	1
Hydrochloric Acid, 37%	HCl	X	1	1	1	1	X	X	X	X	X	X	X	X	2	1
Hydrocyanic Acid	HCN	1	1	1	1	1	X	X	2	2	2	2	-	1	2	2
Hydrofluoric Acid, 48%	HF	X	X	1	1	1	X	X	X	X	X	1	3	3	1	2
Hydrofluorosilicic Acid	H_2SIF_6	1	1	1	1	1	X	2	2	2	X	2	3	3	2	2
Hydrogen Gas	H_2	1	1	1	1	1	1	2	1	1	2	1	-	1	1	1
Hydrogen Peroxide (Concent.)	H_2O_2	X	1	X	1	1	X	X	2	1	2	1	-	2	1	1
Hydrogen Peroxide (Dilute)	H_2O_2	1	1	X	1	1	X	X	X	2	2	2	-	1	1	1
Hydrogen Sulfide (Dry)	H_2S	1	1	1	X	1	2	1	2	1	2	2	-	1	2	2
Hydrogen Sulfide (Wet)	H_2S	X	1	1	1	1	X	X	X	2	X	X	3	1	2	2
Hypo (Sodium Thiosulfate)	-	1	2	1	1	2	X	3	2	1	2	1	-	1	3	2
Iodine (Wet)	-	1	2	1	1	2	X	X	X	X	X	X	X	X	2	2
Iodoform	CHI_3	X	1	X	1	X	X	X	2	1	1	X	-	1	X	X
Iso-octane	C_8H1_8	1	X	1	1	1	3	2	2	2	2	2	-	1	2	2
Isopropły Alcohol	C_3H_8O	1	1	1	1	1	2	2	2	2	2	2	-	1	2	2
Isoropyl Ether	$(CH_3)_2CHOCH(CH_3)$	2	X	X	X	X	3	2	2	2	2	2	-	1	1	2
JP-4 Fuel	-	1	X	X	1	X	2	2	1	2	2	2	-	1	1	1
JP-5 Fuel	-	1	X	X	1	X	1	2	1	2	2	2	-	1	2	2
JP-6 Fuel	-	1	X	X	1	X	1	2	1	2	2	2	-	1	2	2
Kerosene	-	1	X	1	1	X	2	2	1	2	2	2	-	1	2	2
Ketones	-	X	X	X	X	X	2	2	2	2	2	2	-	1	1	1
Lactic Acid (Dilute, Cold)	-	1	1	1	1	1	X	2	2	1	1	X	-	1	2	2
Lactic Acid (Concent., Cold)	-	X	X	1	1	1	X	1	2	2	2	X	-	2	2	2
Lead Acetate	-	1	1	1	1	1	X	2	2	2	2	2	-	1	2	2
Linoleic Acid	-	1	X	X	1	X	2	X	1	2	2	2	-	1	2	2
Linolenic Acid	$C1_8H_{32}O_2$	2	X	3	3	3	X	2	3	1	2	1	-	-	-	-
Linseed Oil	-	1	X	1	1	1	2	2	1	2	2	2	1	1	2	2
LPG	-	1	X	1	1	1	2	1	1	1	1	1	1	1	1	1
Lubricating Oil	-	1	X	1	1	1	1	2	1	2	2	2	1	1	1	1
Magnesium Chloride	$MgCl_2$	1	1	1	1	1	X	2	2	2	X	2	-	1	1	1
Magnesium Hydroxide	$Mg(OH)_2$	1	1	1	1	1	X	2	2	1	2	2	-	-	1	1
Magnesium Nitrate	$Mg(NO_3)_2$	1	1	1	1	1	3	2	1	2	2	2	-	1	2	1
Magnesium Sulfate	$MgSO_4$	1	1	1	1	1	X	2	2	2	2	1	-	1	1	2
Maleic Acid	$C_4H_4O_4$	X	1	X	1	X	X	2	1	2	2	2	-	2	2	2
Malic Acid	-	1	X	1	1	2	X	2	2	1	2	2	-	1	2	2
Mercuric Chloride	$HgCl_2$	1	1	X	1	1	X	X	X	2	X	X	X	X	X	2
Mercuric Cyanide	$Hg(CN)_2$	1	1	X	1	1	X	X	X	2	3	2	-	1	2	2
Mercury	-	1	1	1	1	1	1	X	1	1	2	2	-	1	2	1
Methane	CH_4	1	1	1	1	1	2	2	1	1	2	1	-	1	1	1
Methyl Acetate	$CH_3CO_2CH_3$	X	X	X	X	X	X	2	3	2	2	1	-	-	2	1
Methyl Acetone	-	X	1	1	X	X	3	2	2	2	2	2	-	1	1	1
Methyl Alcohol	CH_3OH	1	1	1	X	1	2	2	2	2	2	1	-	1	1	1
Methyl "Cellosolve"	-	X	1	1	X	1	X	1	2	2	2	2	-	1	1	1
Methyl Chloride (Dry)	CH_3Cl	X	X	X	1	X	2	X	2	1	2	2	-	1	2	2
Methyl Ethyl Ketone	$C_5H_{10}O$	X	1	X	X	X	2	2	2	2	2	2	-	1	2	2
Methyl Formate	$HCOOCH_3$	X	1	2	X	X	X	2	2	2	2	2	-	-	-	2
Methyl Isobutryl Ketone	C_6H1_2O	X	1	X	X	X	2	2	2	2	2	2	-	-	2	2
***Methyl Tertiary Butyl Ether**	(MTBE)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylamine	CH_3NH_2	3	2	2	3	2	2	2	2	1	1	2	-	-	-	-
Methylene Chloride	CH_2Cl_2	X	X	X	2	X	2	1	2	2	2	1	-	2	1	1
Mine Waters (Acid)	-	1	1	1	1	1	X	X	X	2	3	X	3	2	2	1
Mineral Oil	-	1	X	1	1	1	2	2	1	1	1	1	-	1	1	1
Mineral Spirits	-	1	X	2	1	2	2	2	1	2	2	1	-	2	1	2
Molasses, Edible	-	1	1	1	1	1	X	X	X	1	1	2	-	1	1	1
Molasses, Crude	-	1	1	1	1	1	1	2	1	1	2	2	-	1	1	1
Muriatic Acid (Hydrochloric)	HCl	X	2	X	1	1	X	X	X	X	X	X	X	X	1	1
Naphtha	-	1	X	X	1	X	X	2	1	2	2	2	-	1	2	2
Naphthalene	$C10H_8$	X	X	X	1	X	3	1	1	1	2	2	-	1	2	2
Nickel Ammonium Sulfate	-	1	2	2	1	2	X	X	3	1	2	2	3	-	-	-
Nickel Chloride	$NiCl_2$	1	1	1	1	1	X	X	X	2	3	3	3	1	1	1
Nickel Nitrate	$Ni(NO_3)_2 \cdot {}_6H_2O$	1	1	1	1	1	X	2	2	1	2	2	-	1	2	2
Nickel Sulfate	$NiSO_4$	1	1	1	1	1	X	2	2	2	1	2	-	1	X	2
Nitric Acid, 10%	HNO_3	X	1	X	1	1	X	X	2	1	2	X	1	1	X	1

***Note: For MTBE Service: Available Elastomers-Teflon Encapsulated Compounds, Kalrez, Zalak • Available Metals-See Gasoline.**

ENVIRONMENT	CHEMICAL FORMULA	ELASTOMERS - 75 F					METALS - 75 F										
		Buna N	EPDM	Neoprene	Fluorocarbon	Hypalon	Ductile & Cast Iron	Aluminum Bronze	416 SS	316 SS	17-4PH SS	Monel & K-Monel	Illium PD & Nitronic 50	Alloy 20	Hastelloy B	Hastelloy C
Nitric Acid, 30%	HNO_3	X	1	X	1	1	X	X	2	1	2	X	1	1	X	1
Nitric Acid, 80%	HNO_3	X	X	X	1	X	X	X	2	1	X	X	2	2	X	1
Nitric Acid, 100%	HNO_3	X	X	X	1	X	X	X	X	1	2	X	2	X	X	2
Nitrobenzene	$C_6H_5NO_2$	X	X	X	2	X	X	2	2	2	2	2	-	1	X	2
Nitrogen (Gas)	N_2	1	1	1	1	1	2	2	1	1	2	1	-	1	1	1
Nitrous Oxide	N_2O	X	2	X	1	2	X	1	3	2	-	X	-	1	X	2
Oils, Animal	-	1	2	2	2	2	1	1	1	1	1	1	-	1	1	1
Oils, Fuel	-	1	X	2	1	2	2	1	1	1	1	1	-	1	1	1
Oils, Lubricating	-	1	X	2	1	2	1	1	1	1	1	1	-	1	1	1
Oils, Mineral	-	1	X	1	1	1	2	1	1	1	1	1	-	1	1	1
Oil, Petroleum (Refined)	-	1	X	2	1	2	1	1	1	1	1	1	-	1	1	1
Oil, Petroleum (Sour)	-	2	X	3	1	3	X	X	3	2	2	2	-	2	1	1
Oil, Water Mixtures	-	1	X	2	1	2	2	1	1	1	1	1	-	1	1	1
Oleic Acid	$C_{18}H_{34}O_2$	1	X	X	1	X	X	2	2	1	2	1	-	1	2	2
Ortho Dichlorobenzene	$C_6H_4Cl_2$	X	X	X	2	X	3	2	2	2	2	1	-	-	-	-
Oxalic Acid, 25%	$C_2H_2O_42H_2O$	X	1	1	1	1	X	X	2	2	2	2	-	2	2	2
Oxygen	-	1	1	1	1	1	2	2	1	2	2	2	-	1	1	1
Ozone (Wet)	-	X	1	1	1	1	X	2	2	2	2	2	-	1	1	1
Ozone (Dry)	-	X	1	1	1	1	2	1	2	2	2	2	-	1	1	1
Plamitic Acid	$C_{16}H_{32}O_2$	1	1	X	1	X	3	2	2	2	2	2	-	1	2	2
Paraformaldehyde	$(HCHO)_6$	2	2	2	2	2	2	2	2	2	2	-	-	-	-	-
Pentane	$CH_3(CH_2)_3HC_3$	1	X	2	1	2	2	2	2	2	2	2	-	1	2	1
Perchloroethylene (Dry)	$Cl_2C{:}CCl_2$	X	X	X	1	X	X	2	2	1	2	1	-	1	2	2
Petrolatum	-	1	X	1	1	X	X	2	3	2	3	2	3	-	-	-
Phenol	C_6H_5OH	X	1	X	1	X	X	X	2	1	2	1	-	1	1	1
Phosphoric Acid, 10%	H_3PO_4	X	1	1	1	1	X	X	1	1	2	X	1	1	1	1
Phosphoric Acid, 50%	H_3PO_4	X	1	1	1	1	X	X	2	2	2	X	2	1	1	1
Phosphoric Acid, 85%	H_3PO_4	X	1	1	1	1	X	X	X	2	X	X	2	1	1	1
Phthalic Acid	$C_8H_6O_2$	X	X	1	1	1	X	2	2	1	2	2	-	1	2	2
Phthalic Anhydrine	$C_6H_4(CO)_2O$	X	1	2	1	2	X	2	1	1	2	1	-	1	1	1
Picric Acid	$C_6H_2(NO_2)_3OH$	1	1	1	1	1	X	X	2	2	2	X	3	1	2	2
Potassium Bisulfite	$KHSO_3$	1	1	1	1	1	X	X	3	2	2	X	-	1	-	-
Potassium Bromide	KBr	1	1	1	1	1	X	2	2	2	1	2	-	1	2	1
Potassium Carbonate	K_2CO_3	1	1	1	1	1	2	2	2	1	2	2	-	1	2	2
Potassium Chlorate	$KClO_3$	1	1	1	1	1	2	2	2	1	2	2	-	1	X	2
Potassium Chloride	KCl	1	1	1	1	1	X	2	2	1	2	1	-	1	2	2
Potassium Cyanide	KCN	1	1	1	1	1	X	X	2	2	2	2	-	1	2	2
Potassium Dichromate	$K_2CR_2O_7$	1	1	1	1	1	2	X	2	2	2	2	-	1	2	2
Potassium Diphosphate	KH_2PO_4	1	1	1	1	1	2	2	2	1	1	1	-	-	-	-
Potassium Ferricyanide	$K_3Fe(CN)_6$	1	1	1	1	1	X	2	2	2	2	2	-	1	2	2
Potassium Ferrocyasnide	-	1	1	1	1	1	X	X	X	2	3	2	-	1	2	2
Potassium Hydroxide (Dil.)	KOH	1	1	1	1	1	3	2	2	2	2	1	-	2	2	2
Potassium Hydroxide (to 70%)	KOH	1	1	1	X	1	3	2	2	2	2	2	-	2	2	2
Potassium Iodide	KI	1	1	1	1	1	2	2	2	2	2	2	-	1	2	2
Potassium Nitrate	KNO_3	1	1	1	1	1	X	2	2	2	2	2	-	1	X	2
Potassium Permanganate	$KMnO_4$	X	1	1	1	1	2	2	2	2	2	2	-	1	X	1
Potassium Sulfate	K_2SO_4	1	1	1	1	1	X	2	2	2	2	2	-	1	2	2
Potassium Sulfide	K_2S	1	3	1	X	3	X	X	2	2	2	X	-	1	2	2
Potassium Sulfite	$K_2SO_{32}H_2O$	1	1	1	1	2	X	2	3	2	2	2	1	-	-	1
Propane	C_3H_6	1	X	1	1	X	X	2	1	2	2	1	-	1	2	2
Propyl Alcohol	-	1	1	1	1	1	2	2	1	1	2	2	-	1	1	1
Propylene Glycol	-	1	2	1	1	2	2	2	2	2	2	2	-	-	2	2
Pyrogallic Acid	$C_6H_3(OH)_3$	1	3	1	1	1	X	2	2	2	2	2	-	1	2	2
Quench Oil	-	1	X	2	1	3	2	1	1	1	1	1	-	-	-	-
Resins & Rosins	-	X	X	X	1	X	X	1	2	1	1	1	-	1	1	1
Salicylic Acid	$C_6H_4(OH)(COOH)$	1	1	1	1	1	X	2	2	2	2	2	-	2	X	1
Sea Water	-	1	1	1	1	1	X	X	2	2	2	2	1	1	2	1
Silver Nitrate	$AgNO_3$	1	1	1	1	1	X	X	2	1	2	X	-	1	1	1
Sodium Acetate	$NaC_2H_30_2$	2	1	1	X	X	X	2	2	2	2	2	-	1	2	2
Sodium Aluminate	$NaAlO_2$	1	1	1	1	3	X	2	2	2	2	2	-	1	X	2
Sodium Bicarbonate	$NaHCO_3$	1	1	1	1	1	X	2	2	1	2	1	-	1	1	1
Sodium Bisulfate, 10%	$NaHSO_4$	1	1	1	1	1	X	X	1	1	2	2	-	2	2	2
Sodiumbisulfite, 10%	$NaHSO_3$	1	1	1	1	1	X	2	3	2	3	2	-	1	2	2
Sodium Borate	-	1	1	1	1	1	2	1	1	2	1	2	-	1	2	2
Sodium Bromide, 10%	NaBr	1	1	1	1	1	2	1	X	2	1	2	-	1	2	2
Sodium Carbonate	Na_2CO_3	1	1	1	1	1	2	1	2	2	2	1	-	1	2	2
Sodium Chlorate	$NaClO_3$	1	1	1	1	1	3	2	2	2	2	1	-	1	X	1
Sodium Chloride	NaCl	1	1	1	1	1	2	2	X	2	2	1	2	2	2	2
Sodium Chromate	-	1	1	1	3	3	3	1	3	1	3	1	-	-	1	2
Sodium Cyanide	NaCN	1	1	1	1	1	X	X	1	1	2	X	-	1	2	2
Sodium Fluoride	NMaF	1	1	1	1	1	X	X	3	2	2	1	-	-	2	2
Sodium Hydroxide, 20%	NaOH	1	1	1	X	1	2	2	2	1	2	1	-	1	1	2

		ELASTOMERS - 75°F					METALS - 75°F									
ENVIRONMENT	CHEMICAL FORMULA	Buna N	EPDM	Neoprene	Fluorocarbon	Hypalon	Ductile & Cast Iron	Aluminum Bronze	416 SS	316 SS	17-4PH SS	Monel & K-Monel	Illium PD & Nitronic 50	Alloy 20	Hastelloy B	Hastelloy C
Sodium Hydroxide, 50%	**NaOH**	1	1	1	X	1	2	X	2	1	X	1	-	1	1	1
Sodium Hydroxide, 70%	**NaOH**	1	1	1	X	1	2	X	2	2	2	1	-	2	1	1
Sodium Metaphosphate	**$NaPO_3$**	1	1	1	1	1	3	X	2	2	3	2	-	1	-	-
Sodium Metasilicate	Na_2SiO_3	1	2	1	1	1	X	2	2	2	2	1	-	-	1	1
Soidum Nitrate	$NaNO_3$	1	1	1	X	1	X	2	1	1	2	2	-	1	X	2
Sodium Perborate	-	1	1	1	1	1	X	2	2	2	2	2	-	1	2	2
Sodium Peroxide	Na_2O_2	1	1	1	1	1	X	X	1	2	2	2	-	1	2	2
Sodium Phosphate (Dibasic)	Na_2HPO_4	1	2	2	1	1	X	2	2	1	1	1	-	2	1	1
Sodium Phosphate (Tribasic)	-	2	2	2	1	1	X	3	X	1	1	1	-	2	1	-
Sodium Silicate	-	1	1	1	1	1	X	1	1	2	2	2	-	1	2	2
Sodium Sulfate	**Na_2SO_4**	1	1	1	1	1	2	1	2	1	2	2	-	1	2	2
Sodium Sulfide	**Na_2S**	1	1	1	1	1	X	X	X	2	1	2	-	2	2	2
Sodium Sulfite	Na_2SO_3	1	1	1	1	1	X	X	2	1	2	2	-	1	X	2
Sodium Thoisulfate	-	1	1	1	1	1	X	X	1	2	2	2	-	1	2	2
Soybean Oil	-	1	X	1	1	1	2	1	2	2	2	2	-	1	1	1
Stannic Chloride	-	1	1	1	1	1	X	X	X	X	X	X	X	3	2	2
Steam(212°F.)	-	X	X	X	X	X	X	X	2	2	2	X	1	1	-	2
Stearic Acid	**$C_{18}H_{36}O_2$**	1	X	1	1	1	X	X	2	1	2	2	-	1	1	1
Styrene Monomer	-	X	X	X	1	X	2	X	2	2	2	2	-	1	-	2
Sugar Liquids	-	1	1	1	1	1	3	1	2	1	1	1	-	1	2	1
Sulfate, Black Liquor	-	1	2	1	1	1	X	X	1	2	2	2	2	-	2	2
Sulfate, Green Liquor	-	1	2	1	1	1	X	X	1	2	2	2	2	-	2	2
Sulfate, White Liquor	-	1	2	1	1	1	X	X	1	2	2	2	2	-	2	2
Sulfur	-	X	1	1	X	1	X	X	2	1	2	1	-	2	X	1
Sulfur Dioxide (Dry)	SO_2	X	1	X	X	X	X	2	2	2	2	2	-	1	X	2
Sulfur Dioxide (Wet)	SO_2	1	1	X	X	X	X	X	X	2	X	X	-	1	X	1
Sulfur Trioxide (Dry)	-	X	1	X	1	X	X	2	2	2	2	2	-	1	X	2
Sulfuric Acid, 0-7%	**H_2SO_4**	1	1	1	1	1	X	X	X	X	3	X	2	1	1	1
Sulfuric Acid, 20%	**H_2SO_4**	1	1	1	1	1	X	X	X	X	X	X	3	1	1	1
Sulfuric Acid, 50%	**H_2SO_4**	1	1	1	1	1	X	X	X	X	X	X	X	1	1	1
Sulfuric Acid, 98%	**H_2SO_4**	X	X	X	1	1	X	X	X	2	1	X	2	1	2	1
Sulfurous Acid	H_2SO_3	2	X	X	1	1	X	X	X	1	2	X	3	1	2	2
Tannic Acid	$C1_4H_{10}O_9$	1	1	1	1	1	X	2	2	2	2	2	-	2	2	2
Tar & Tar Oil	-	3	X	1	1	1	X	2	2	2	2	2	-	1	2	2
Tartaric Acid	-	1	X	1	1	1	X	X	2	1	2	2	-	1	2	2
Tetraethylead	$P_6(C_2H_5)_4$	X	X	2	1	X	X	2	3	2	2	2	-	-	-	-
Toluene or Toluol	**$C_6H_5CH_3$**	1	X	X	1	X	2	2	1	1	2	1	-	1	1	1
Transfomer Oil	-	1	X	1	1	X	2	2	2	2	2	2	-	-	2	2
Tributyl Phosphate	**$(C_4H_9)_3PO_4$**	1	X	X	X	X	X	3	3	2	3	2	-	1	2	2
Trichloroethylene	**$CHCl:CCl_2$**	X	X	X	1	X	X	2	1	2	2	1	-	1	1	1
Trisodium Phosphate, 10%	**Na_3PO_4**	1	X	1	1	1	2	2	2	1	2	2	-	-	1	1
Tung Oil	-	1	X	1	1	2	2	1	1	1	1	1	-	1	1	1
Tutpentine	-	1	X	X	1	X	2	2	2	1	2	1	-	1	2	2
Urea	**$CO(NH_2)_2$**	1	1	1	1	1	X	2	2	2	2	2	-	-	2	2
Water, Distilled (Air Free)	**H_2O**	1	1	1	1	1	3	1	1	1	2	X	-	1	2	1
Water, Distilled (Aerated)	**H_2O**	1	1	1	1	1	X	1	1	1	2	X	-	1	2	1
Water, Salt (Brackish)	**H_2O**	1	1	1	1	1	X	X	X	2	3	2	1	2	1	1
Water, Salt (Flowing)	**H_2O**	1	1	1	1	1	X	X	X	2	2	2	1	1	1	1
Water, Sea	H_2O	1	1	1	1	1	X	X	X	2	3	2	1	2	2	1
Water, pH Approx. 7	H_2O	1	1	1	1	1	3	1	1	1	1	1	-	1	-	1
Whiskey & Wine	-	1	1	1	1	1	X	X	X	1	1	2	1	1	1	1
Xylene	**C_8H_{10}**	X	X	X	2	X	2	2	1	2	2	2	-	1	2	1
Xylene (Dry)	C_8H_{10}	X	X	X	2	X	2	2	1	2	2	2	-	1	2	1
Zinc Chloride	$ZnCl_2$	1	1	1	1	1	X	X	X	2	X	2	X	1	2	2
Zinc Hydrosulfite	ZNS_2O_4	1	1	1	1	1	X	3	2	1	1	2	-	-	-	1
Zinc Nitrate	$Zn(NO_3)_2$	1	1	1	1	1	X	3	2	2	2	2	-	-	-	-
Zinc Sulfate	$ZnSO_4$	1	1	1	1	1	X	2	1	1	3	1	-	1	1	1

Reference: Corrosion Resistance Tables
4th Edition
Philip A. Schweitzer, P.E.

HOW TO INSTALL AND SERVICE NORRIS BUTTERFLY VALVES

Installation of Norris butterfly valves is a simple procedure that requires no special tools. Special care should be taken, however, in unpacking and installing the valve to avoid damage to the sealing surfaces (O-ring flange seals, seat and disc edge or disc O-ring).

Installation Compatibility

Norris wafer span and lug type valves 2" through 36" are designed for use with ANSI 150 flanges with an inside diameter equivalent to Schedule 40 pipe ID. Check disc clearance charts on individual Valve Data Sheets to be sure the inside diameter of companion flanges and piping does not interfere with disc movement when the valve is cycled to the open position. Back beveling of heavy wall, plastic or cement pipe may be required for disc clearance.

Weldneck, socket weld or slip-on flanges can be used with Norris metal-lined M-Series and D-Series valves with no special preparation.

Weldneck or socket weld flanges are recommended for use with elastomer-lined R-Series valves. Slip on type flanges are not recommended for use with R-Series valves. Slip on type flanges should only be used with R-Series valves when the flanges have been installed with single beveled, fillet-reinforced weld, per Mil-Std-22A, P43.

Norris automated valves and those with gear operators should be installed between flanges with the operator in place. Lever operated valves are shipped with the handle removed. Attach handle to operator shaft and check disc to be sure it seats on raised sealing surface before installing between flanges.

Required Tools and Materials

The only tool required to install Norris butterfly valves is a wrench suitable for tightening flange bolts and nuts or cap-screws. A hoist may be required for 10" and larger valves. Smaller sizes can usually be handled by one man. Temporary pipe supports may be used to keep the flange faces parallel and aid in installing the valve.

Flange gaskets are not required since O-ring flange-face seals are a built-in feature of the Norris valve design.

Flange bolts and nuts or capscrews are not included with valve shipment unless ordered as a separate item. The individual Valve Data Sheets will indicate the required number and size of bolts or capscrews which are available from most supply stores or distributors.

Preparing Valve and Flanges

If the valve and flanges are properly prepared for installation, problems can be avoided later. Flange faces should be free of dirt, grit, dents or surface irregularities which might damage the body O-ring flange seals and cause leakage at the flange. Also inspect the valve and wipe away any grit or dirt which might be around the seat seals or disc. The valve must be in the "closed position" to protect the sealing edge of the disc.

INSTALLATION OF ALL 2"-12" SPAN TYPE VALVES

Loosely bolt lower half of flanges together. Make sure the flanges are separated enough to allow the valve to be inserted without damaging flange seals and the face of the elastomer seat.

Insert valve between flange faces with care and lower into bolt cradle. Special care should be taken, especially when raised-face flanges are used, to prevent damage to face of seat and O-ring flange seals during installation.

Loosely install remaining flange bolts and nuts.

Snug all flange bolts. Tighten first one bolt and then the opposite, 180° apart, keeping flange faces parallel. Make sure there is full metal-to-metal contact between flange and valve face. The O-ring seal makes excessive bolt loading unnecessary.

INSTALLATION OF 14"-36" SEMI-LUG & 2"-36" FULL LUG VALVES.

Attach valve to one flange and then the other using the tapper flange holes. Loosely install all capscrews in tapped holes on one flange. Tighten evenly, working with alternate capscrews 180° apart. Keep flange and valve faces parallel.

Tighten capscrews evenly in the same manner, alternating between screws that are 180° apart. Make sure there is full metal-to-metal contact between flange and valve face. Do not over-tighten capscrews. The O-ring flange seal makes excessive bolt loading unnecessary.

Repeat procedure for second flange.

In the case of semi-lug 14" through 36" valves, install remaining bolts after valve is attached to both flanges.

MAINTENANCE AND REPAIR

Norris butterfly valves are designed and manufactured to exacting standards to help avoid operating problems. However, trouble with valves can occur if they are improperly handled, if they are used beyond the recommended working pressure and flow rates, or if the wetted parts are not compatible with the flow medium.

Operating maintenance and lubrication is not required. Shaft bearing surfaces have been factory lubricated. O-ring seat and shaft seals are permanently locked in lubricant to prevent flow medium from penetrating major bearing surfaces.

Under normal conditions, operating torques will not exceed a comfortable range for manual operation of the valve although valve torques may increase somewhat with age.

Repairs which may be required:

❶ O-ring flange seal replacement if a leak develops between flange and valve body. Flange seal can be replaced without disassembling the valve and replacing the seat. See Step 6 of assembly procedure on following pages. Flange face should be inspected for dirt, grit or irregularities which could prevent sealing, or damage replacement seal.

❷ Seat, disc or disc O-ring replacement if the valve develops a leak through the valve bore.

❸ Replacement of O-ring shaft seals if valve develops a leak at top or bottom shaft or operating torque increases beyond comfortable limits.

❹ Shaft replacement if shaft becomes corroded or operating torque increases appreciably.

❺ Disc or shaft replacement if drive slot or shaft is damaged by pressure surges or flow velocity exceeding recommended limits.

DISASSEMBLY/ASSEMBLY INSTRUCTIONS FOR 2" - 12" 200 PSI VALVES

Caution: It is not safe to make any valve repairs while the valve is under pressure. Do not loosen capscrews or attempt to remove topworks, operator or bottom plate until all pressure has been eliminated and valve removed from line.

Removing Valve from Line

Remove all pressure from line. Close valve and remove flange bolts or capscrews. Spread flanges so valve can be removed without damaging face of elastomer seat.

How to Disassemble 2" - 12" Valves

❶ Open disc (Ref. #2) enough to clear raised seating surface.
❷ Remove topworks, gear operator or other actuator.
❸ Remove capscrews (#13) and bottom plate (#12).
❹ Remove top shaft retention screw (#14) and washer (#15).
❺ Pull top and bottom shaft (#3 & #4) from body with pliers or visegrips. O-ring shaft seal (#7) and thrust washers (#10 & #11) will come out with top shaft. Bottom O-ring shaft seal (#7) will come out with bottom shaft.
❻ Push disc (#2) from seat carefully so as not to damage sealing edge.
❼ Tap seat (#5) from body with plastic or rubber mallet. O-ring flange seals (#6) will come free as seat is removed. Seat O-rings (#7) will be in counterbore of seat.

FOR M-SERIES VALVES ONLY:
Inspect disc O-ring for damage or compression set. If replacement is necessary, carefully cut the O-ring (#16) and remove from disc edge groove. DO NOT PRY THE O-RING LOOSE WITH SHARP TOOLS WHICH COULD DAMAGE THE DISC OR GROOVE. See special instructions for replacing disc O-ring (page 29).

How to Assemble 2" - 12" Valves

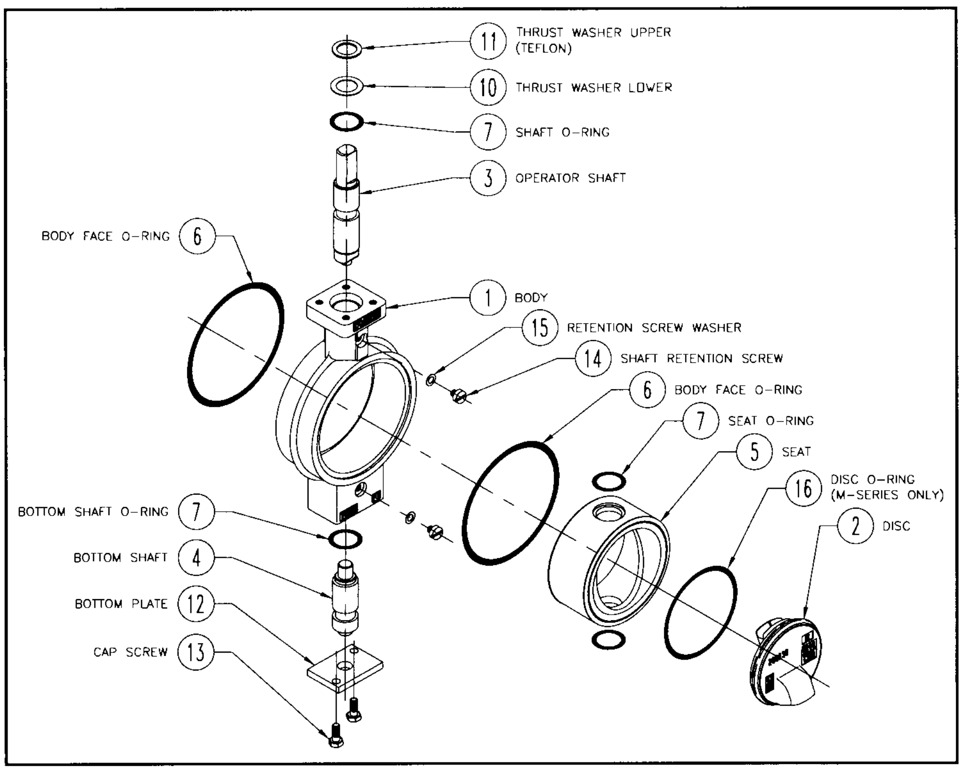
❶ Thoroughly clean all parts, then grease outside diameter and raised sealing surface of seat, all O-rings, and disc edge with a silicon based lubricant such as Dow Corning Valve-Seal or Magnalube.

Caution: Valve must not be put under pressure until topworks, operator and bottom plate have been installed.

❷ Place shaft O-rings (#7) in seat counterbores, slip seat (#5) into body (#1), accurately aligning shaft holes in seat with shaft bores in body. A "soft" plastic or rubber mallet may be used to tap seat into place if necessary.
❸ Grease bearing surface (nub) of bottom shaft (#4) and full length of operator shaft (#3) with a general purpose lubricant. Insert operator shaft and bottom shaft to check alignment of shaft bore in seat and body. Carefully revolve shaft past the seat and seat O-rings to prevent damage to these sealing surfaces. *Do not force shaft past seat O-ring and seat.* If necessary, realign seat with shaft bores. Withdraw the shafts enough to allow clearance for disc.
❹ Insert disc (#2) perpendicular to shaft holes and raised sealing surface, then rotate 90° to align disc bosses with shaft bores. Engage bottom shaft (#4) with bottom disc boss. Insert shaft O-ring (#7) in counterbore of body, attach bottom plate (#12) with two capscrews (#13). Align flats of operator shaft (#3) with milled slot in disc boss and insert as far as it will go. *Do not hammer shaft into place.*
❺ Install retention washer (#15) and shaft retention screw (#14) in valve. Rotate top shaft (#3) to be sure retention screw (#14) does not interfere with shaft movement.

Check to be sure disc seats on raised sealing surface.
If it does not, rotate disc 180°. Disc can be rotated 360° without damaging valve.
❻ Insert O-ring flange seal (#6) in groove between body and seat. Avoid stretching O-ring by first pressing it into place at four points - 12, 3, 6, and 9 o'clock-then pressing it into place alternately at points between until the entire O-ring is smooth and evenly secured.
❼ Insert shaft O-ring (#7), stainless steel washer (#10) and Teflon washer (#11) in counterbore of mounting pad. Install topworks or operator. Again, check to be sure disc seats on raised sealing surface.
❽ Install valve between flanges.

CAUTION: Valve must not be put under pressure until topworks or operator is installed.



DISASSEMBLY/ASSEMBLY INSTRUCTIONS FOR 14" - 36" 200 PSI VALVES

CAUTION: It is not safe to make any valve repairs while the valve is under pressure. Do not loosen capscrews or attempt to remove topworks, operator or bottom plate until all pressure has been eliminated and valve removed from line.

To Remove Valve from Line

Remove all pressure from line. Close valve. Attach hoist to support valve and aid in removing valve from line. Use of temporary pipe supports will help prevent damage to the valve.

Remove flange bolts. All capscrews should be removed from one flange and then the other. Spread flanges so valve can be lifted from the line without damaging disc edge, O-ring flange seals, or face of elastomer seat.

To Disassemble 14" - 36" Valves

Lay valve body flat between two blocks or sawhorses to simplify disassembly and assembly.

❶ Open disc, then remove gear operator or other actuator and shaft key (#11).

❷ Remove capscrews (#18) and thrust cap (#9). Remove split thrust washer (#10), shim set (#8) and O-ring shaft seal (#16) from shaft bore, taking care not to damage the shaft.

❸ Remove capscrews (#22) from disc pin and tap pin (#7) out with a "soft" hammer.

❹ Attach a sling to support disc and prevent damage to the sealing edge as the shaft is removed from body.

❺ Remove shaft (#3) through bottom bore of body. Tap top of shaft with a soft plastic or rubber hammer to loosen, then pull from the opposite end. Disc (#2) will come free when shaft has been removed.

❻ Tap seat (#6) from body with plastic or rubber mallet. O-ring flange seals (#15) will come free as seat is removed. Seat O-rings (#16) will be in counterbores of seat.

❼ Remove shaft O-rings (#17) from grooves in shaft.

❽ Remove O-ring shaft seal (#16) and Teflon washer (#27) from top shaft bore.

FOR M-SERIES VALVE ONLY:

Inspect disc O-ring for damage or compression set. If replacement is necessary, carefully cut the O-ring (#25) and remove from disc edge groove. DO NOT PRY THE O-RING LOOSE WITH SHARP TOOLS WHICH COULD DAMAGE THE DISC OR GROOVE. See special instructions for replacing disc O-ring, (page 29)

To Assemble 14" - 36" Valves

❶ Thoroughly clean all parts, then grease outside diameter and raised sealing surface of seat, all O-rings, and disc edge with a silicon based lubricant such as Dow Corning Valve-Seal or Magnalube.

CAUTION: Petroleum based lubricants can cause damage to some elastomers and should not be used on rubber parts.

❷ Place shaft O-rings (#16) in seat counterbores, slip seat (#6) into body (#1), accurately aligning shaft holes in seat with shaft bores in body. A "soft" plastic or rubber mallet may be used to tap seat into place if necessary.

❸ Carefully roll shaft O-rings (#17) into shaft grooves.

❹ Attach a sling to disc (#2). With the hoist, carefully lower disc into seat perpendicular to shaft bores and raised sealing surface. Rotate disc to align bosses with shaft bores.

❺ Grease shaft (#3) thoroughly with general purpose lubricant. Insert shaft, carefully revolving it past O-rings and seat to prevent damage to these sealing surfaces. Do not force shaft past seat O-rings and seat. *Do not hammer into place.*

❻ Rotate disc to align disc pin hole with hole in shaft. Insert disc pin (#7) and attach capscrews (#22). A soft hammer may be used to tap the disc pin into place. Close the disc.

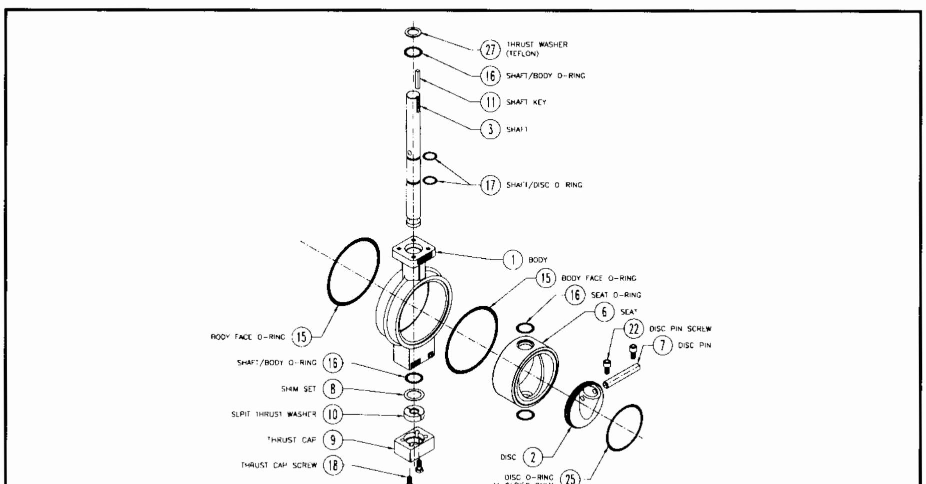
❼ Insert bottom shaft O-ring (#16) in counterbore of body. A set of shims (#8) is provided to balance the self centering disc. A split thrust washer (#10) and thrust cap (#9) hold them in place. The number of shims necessary for each valve may vary because of manufacturing tolerances. Insert the thrust washer (#10), determine the correct number of shims required for a tight fit. Remove shim and thrust washer. Install the required shims, thrust washer and close with thrust cap (#9) and capscrews.

❽ Insert O-ring flange seals (#15) in groove between body and seat. Avoid stretching O-ring by first pressing it into place at four points -12, 3,6 and 9 o'clock - then pressing it into place alternately at points between until the entire O-ring is smooth and evenly secured.

❾ Insert O-ring (#16) and Teflon washer (#27) in counterbore of mounting pad.

❿ Insert shaft key (#11) and install gear operator or other actuator. Close valve to be sure disc seats on raised sealing surface. If it does not, rotate disc 180°. Disc can be rotated a full 360° without damaging the valve.

⓫ Use hoist to install valve between flanges. Temporary pipe supports should be used to keep flanges parallel during installation and prevent damage to disc edge, O-ring flange seals, and face of elastomer seat.



DISASSEMBLY/ASSEMBLY INSTRUCTION FOR 2 1/2" - 12" 285 PSI VALVES

Caution: It is not safe to make any valve repairs while the valve is under pressure. Do not loosen capscrews or attempt to remove topworks, operator or thrust cap until all pressure has been eliminated and valve removed from line.

Removing Valve from Line

Remove all pressure from line. Close valve and remove flange bolts or capscrews. Spread flanges so valve can be removed without damaging O-ring flange seals or face of elastomer seat.

To Disassemble 2 1/2" - 12" Valves

Lay valve body flat between two blocks or secure rim of body in vise to simplify disassembly and assembly.

1. Open disc, then remove gear operator or other actuator and key.
2. Remove shaft retention screws (#14) and washers (#15).
3. Remove capscrews (#16) and thrust cap (#13). Remove split thrust washer (#12), shim set (#11) and O-ring shaft seal (#7) from shaft bore, taking care not to damage the shaft.
4. Remove capscrews (#8) from disc pin and tap pin (#9) out with a "soft" hammer.
5. Support the disc to prevent damage to the seal edge as the shaft is removed from body.
6. Remove shaft (#3) through bottom bore of body. Tap top of shaft with a soft plastic or rubber hammer to loosen, then pull from the opposite end. Disc (#2) will come free when shaft has been removed.
7. Tap seat (#5) from body with rubber mallet. O-ring flange seals (#6) will come free as seat is removed. Seat O-rings (#7) will be in counterbores of seat.
8. Remove shaft O-rings (#17) from grooves in shaft.
9. Remove O-ring shaft seal (#7) and TFE washer (#10) from top shaft bore.

FOR M-SERIES VALVE ONLY:

Inspect disc O-ring for damage or compression set. If replacement is necessary, carefully cut the O-ring (#19) and remove from disc edge groove.

DO NOT PRY THE O-RING LOOSE WITH SHARP TOOLS WHICH COULD DAMAGE THE DISC OR GROOVE.

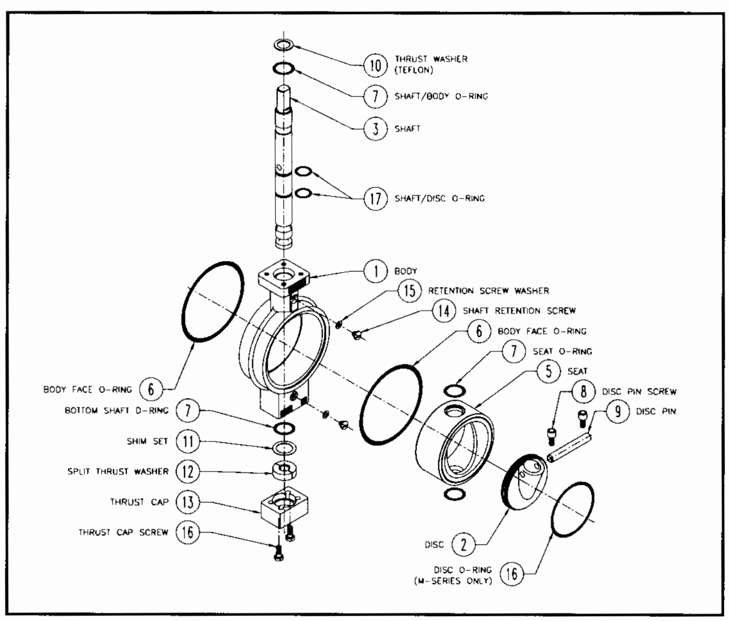
See special instructions for replacing disc O-ring (page 29).

To Assemble 2 1/2" - 12" Valves

1. Thoroughly clean all parts, then grease outside diameter and raised sealing surface of seat, all O-rings, and disc edge with a silicon based lubricant such as Dow Corning Valve-Seal or Magnalube.

CAUTION: Petroleum based lubricants can cause damage to some elastomers and should not be used on rubber parts.

2. Place O-ring seat seals (#7) in seat counterbores. Slip seat (#5) into body (#1), accurately aligning shaft holes in seat with shaft bores in body. A "soft" plastic or rubber mallet may be used to tap seat into place if necessary.
3. Carefully roll shaft O-rings (#7) into shaft grooves.
4. Carefully lower disc (#2) into seat perpendicular to shaft bores and raised sealing surface. Rotate disc to align disc bosses with shaft bores.
5. Grease shaft (#3) thoroughly with general purpose lubricant. Insert shaft, carefully revolving it past O-rings and seat to prevent damage to these sealing surfaces. Do not force shaft past seat O-rings and seat. *Do not hammer into place.*
6. Rotate disc to align disc pin hole with hole in shaft. Insert disc pin (#9) and attach capscrews (#8). A soft hammer mav be used to tap the disc pin into place. Close the disc.
7. Install shaft retention screws (#14) and washers (#15).
8. Insert bottom shaft O-ring (#7) in counterbore of body. A set of shims (#11) is provided to balance the self centering disc. A split thrust washer (#12) and thrust cap (#13) hold them in place. The number of shims necessary for each valve may vary because of manufacturing tolerances. Insert the thrust washer (#12), determine the correct number of shims required for a tight fit. Remove shims and thrust washer. Install the required shims, thrust washer and close with thrust cap (#13) and capscrews (#16).
9. Insert O-ring flange seals (#6) in groove between body and seat. Avoid stretching O-ring by first pressing it into place at four points - 12, 3, 6 and 9 o'clock - then pressing it into place alternately at points between until the entire O-ring is smooth and evenly secured.
10. Insert O-ring (#7) and TFE washer (#10) in counterbore of mounting pad.
11. Insert key and install gear operator or other actuator. Close valve to be sure disc seats on raised sealing surface. If it does not, rotate disc 180°. Disc can be rotated a full 360° without damaging valve.
12. Use hoist to install valve between flanges. Temporary pipe supports should be used to keep flanges parallel during installation and prevent damage to disc edge, O-ring flange seals and face of elastomer seat.



DISASSEMBLY/ASSEMBLY INSTRUCTIONS FOR 14" - 36" 285 PSI VALVES

Caution: It is not safe to make any valve repairs while the valve is under pressure. Do not loosen capscrews or attempt to remove topworks, operator or thrust cap until all pressure has been eliminated and valve removed from line.

To Remove Valve from Line

Remove all pressure from line. Close valve. Attach hoist to support valve and aid in removing valve from line. Use of temporary pipe supports will help prevent damage to the valve.

Remove flange bolts. All capscrews should be removed from one flange and then the other. Spread flanges so valve can be lifted from the line without damaging disc edge, O-ring flange seals, or face of elastomer seat.

To Disassemble 14" - 36" Valves

Lay valve body flat between two blocks or sawhorses to simplify disassembly and assembly.

1 Open disc, then remove gear operator or other actuator and key (#11).

2 Remove capscrews (#18) and thrust washer (#10), shim set (#8) and O-ring shaft seal (#16) from shaft bore, taking care not to damage the shaft.

3 Remove capscrews (#22) from disc pin and tap pin (#7) out with a "soft" hammer.

4 Attach a sling to support disc and prevent damage to the sealing edge as the shaft is removed from body.

5 Remove shaft (#3) through bottom bore of body. Tap top of shaft with a soft plastic or rubber hammer to loosen, then pull from the opposite end. Disc (#2) will come free when shaft has been removed.

6 Tap seat (#6) from body with plastic or rubber mallet. O-ring flange seals (#15) will come free as seat is removed. Seat O-rings (#16) will be in counterbores of seat.

7 Remove shaft O-rings (#17) from grooves in shaft.

8 Remove O-ring shaft seal (#16) and teflon washer (#27) from top shaft bore.

FOR M-SERIES VALVE ONLY:

Inspect disc O-ring for damage or compression set. If replacement is necessary, carefully cut the O-ring (#25) and remove from disc edge groove.

DO NOT PRY THE O-RING LOOSE WITH SHARP TOOLS WHICH COULD DAMAGE THE DISC OR GROOVE. See special instruction for replacing disc O-ring. (page 29)

To Assemble 14" - 36" Valves

1 Thoroughly clean all parts, then grease outside diameter and raised sealing surface of seat, all O-rings and disc edge with a silicon based lubricant such as Dow Corning Valve-Seal or Magnalube.

CAUTION: Petroleum based lubricants can cause damage to some elastomers and should not be used on rubber parts.

2 Place shaft O-rings (#16) in seat counterbores, slip seat (#6) into body (#1), accurately aligning shaft holes in seat with shaft bores in body. A "soft" plastic or rubber mallet may be used to tap seat into place if necessary.

3 Carefully roll shaft O-rings (#17) into shaft grooves.

4 Attach a sling to disc (#2). With the hoist, carefully lower disc into seat perpendicular to shaft bores and raised sealing surface. Rotate disc to align bosses with shaft bores.

5 Grease shaft (#3) thoroughly with general purpose lubricant. Insert shaft, carefully revolving it past O-rings and seat to prevent damage to these sealing surfaces.

Do not force shaft past seat O-rings and seat. Do not hammer into place.

6 Rotate disc to align disc pin hole with hole in shaft. Insert disc pin (#7) and attach capscrews (#22). A soft hammer may be used to tap the disc pin into place. Close the disc.

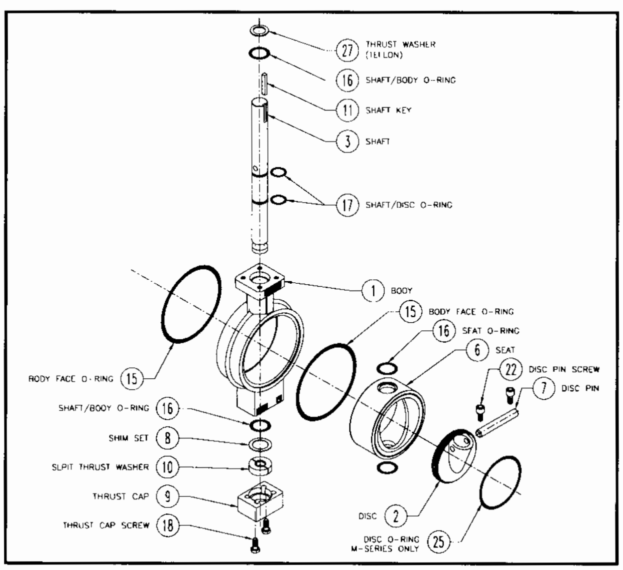
7 Insert bottom shaft O-ring (#16) in counterbore of body. A set of shims (#8) is provided to balance the self centering disc. A split thrust washer (#10) and thrust cap (#9) hold them in place. The number of shims necessary for each valve may vary because of manufacturing tolerances. Insert the thrust washer (#10), determine the correct number of shims required for a tight fit. Remove shim and thrust washer. Install the required shims, thrust washer and close with thrust cap (#9) and capscrews.

8 Insert O-ring flange seals (#15) in groove between body and seat. Avoid stretching O-ring by first pressing it into place at four points -12, 3,6 and 9 o'clock - then pressing it into place alternately at points between until the entire O-ring is smooth and evenly secured.

9 Insert O-ring (#16) and teflon washer (#27) in counterbore of mounting pad.

10 Insert key (#11) and install gear operator or other actuator. Close valve to be sure disc seats on raised sealing surface. If it does not, rotate disc 180°. Disc can be rotated full 360° without damaging valve.

11 Use hoist to install valve between flanges. Temporary pipe supports should be used to keep flanges parallel during installation and prevent damage to disc edge, O-ring flange seals and face of elastomer seat.



INSTALLING DISC O-RING ON 2" - 36" M-SERIES VALVES (200 PSI AND 285 PSI RATED VALVES)

Inspect disc edge for damage. Thoroughly clean the groove lips of dirt and grit which might damage O-ring. Use an emery cloth to smooth edges if necessary. Use a generous amount of silicon based grease such as Dow Corning Valve-Seal or Magnalube on the O-ring. The groove may be lightly greased but excessive amounts of grease in the groove may prevent O-ring from seating properly.

Caution: Petroleum based lubricants can cause damage to some elastomers and should not be used on rubber parts.

Step #1.

Place O-ring about half way around disc groove. Holding it in place with one hand, pull O-ring to position on edge of disc with index finger of other hand.

Step #2.

With finger still under O-ring, rotate disc completely to equalize rubber tension.

Step #3.

To ensure equal distribution of the O-ring around the disc, press it into place at four equally spaced points - 12, 3, 6 and 9 o'clock. Six inch and larger valve discs are more easily handled if placed in a vise or laid flat on a clean surface. A smooth bar or hammer handle can be used to press the O-ring into place at the four points.

Step #4.

Continue pressing the o-ring into place at points between the original four, alternately on one side and then the other until the entire O-ring is smooth and evenly secured. Large discs are easily handled by putting the edge of the disc against the chest and working the opposite side. Hold the bar at a slight angle and roll a small section of the O-ring into place. Rotate the disc 180° to work the opposite area.

Disc O-rings on large valves can be installed most efficiently with especially prepared sheet metal visegrips. The grips are heated, flattened and finished so the lips are flush and smooth. They are available from Norris at a nominal charge (Part# 51843A001).

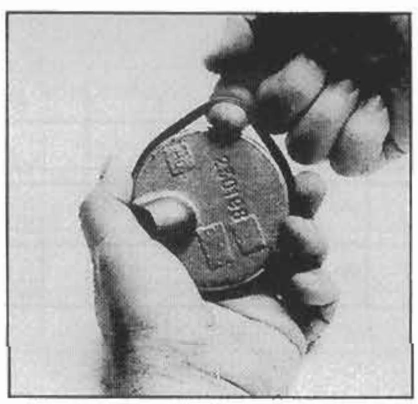
Follow Step #1 and Step #2 above. Then, adjust end screw of vise-grip to close flat plates. Open the grips and turn the end screw one half-turn.

Taking care not to cut through it, squeeze the O-ring with the grips to flatten. The O-ring should slip into the groove easily. Proceed in the same way at 3, 6, and 9 o'clock, then at points between until the O-ring is smoothly secured in the groove.

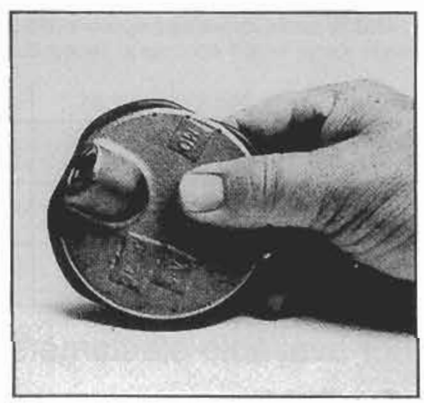
NOTE: A little practice will enable you to determine the exact adjustment for installing the O-ring. Adjustments will vary for different sizes of valves.

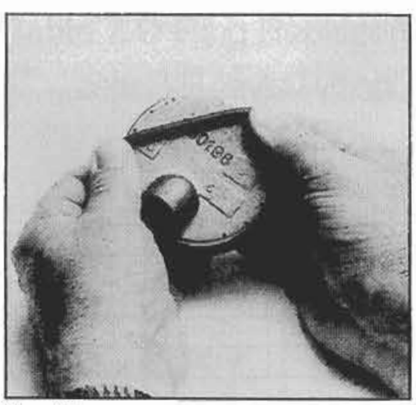
DO NOT install O-ring by rolling it up the side of disc into groove. This will cause the O-ring to twist and early failure will result. DO NOT stretch O-ring so cross section is reduced. This will cause it to become large in diameter and even distribution of the O-ring around the disc edge will be more difficult. NEVER pound the O-ring into the groove with a hammer! This will result in damage to the groove lips and prevent the valve from closing properly.

Step #1



Step #2





Step #3

Step #4

REPAIR KITS FOR R & M SERIES BUTTERFLY VALVES - 200 & 285 PSI

Kits include installation instructions and all rubber goods, washers, shims and lubrication required to rebuild valves. (replacement kit tables - see table copy)

R-Series
repair kit
R200 & R285

Table 1 Seat/O-Ring Replacement Kits for 200 psi Rubber Seated Butterfly Valves -R-Series

Use "54000" as a prefix when ordering replacement kits.
Example: Order 54000-A001 for 2" Type A Buna N Replacement Kit.

Elastomer	2"	2.5"	3"	4"	5"	6"	8"	10"	12"
Type A Buna N	A001	A004	A007	A010	A013	A016	A019	A021	A024
Type B Viton	B001	B004	B007	B010	B013	B016	B019	B021	B024
Type S EPDM	S001	S004	S007	S010	S013	S016	S019	S021	S024

M-Series
repair kit
M200 & M285

Table 2 O-Ring Replacement Kits for 200 psi Metal Seated Butterfly Valves-M-Series

Use "54000" as a prefix when ordering replacement kits.
Example: Order 54000-A003 for 2" Type A Buna N Replacement Kit.

Elastomer	2"	2.5"	3"	4"	5"	6"	8"	10"	12"
Type A Buna N	A003	A005	A008	A011	A014	A017	A027	A022	A025
Type B Viton	B003	B005	B008	B011	B014	B017	B027	B022	B025
Type S EPDM	S003	S005	S008	S011	S014	S017	S027	S022	S025

Other available elastomers:

Type E	Black Neoprene	Type K	Hypalon
Type G	White Neoprene	Type L	ECO
Type J	Abrasion Resistant Buna	Type 4	HSN

Table 3 Seat/O-Ring Replacement Kits for Rubber Seated 285 psi Butterfly Valves R-Series

Use "54000" as a prefix when ordering replacement kits.
Example: Order 54000-A127 for 2" Type A Buna N Replacement Kit.

Elastomer	2"	2.5"	3"	4"	5"	6"	8"	10"	12"
Type A Buna N	NA	A127	A128	A129	A130	A131	A132	A133	A134
Type B Viton	NA	B127	B128	B129	B130	B131	B132	B133	B134
Type S EPDM	NA	S127	S128	S129	S130	S131	S132	S133	S134

Table 4 O-Ring Replacement Kits for Metal Seated 285 psi Butterfly Valves - M-Series

Use "54000" as a prefix when ordering replacement kits.
Example: Order 54000-A119 for 2.5" Type A Buna N Replacement Kit.

Elastomer	2"	2.5"	3"	4"	5"	6"	8"	10"	12"
Type A Buna N	NA	A119	A121	A120	A122	A123	A124	A125	A126
Type B Viton	NA	B119	B121	B120	B122	B123	B124	B125	B126
Type S EPDM	NA	S119	S121	S120	S122	S123	S124	S125	S126

Table 5 O-Ring Replacement Kits for Rubber Seated 200 & 285 psi Butterfly Valves - R-Series

Use "54000" as a prefix when ordering replacement kits.
Example: Order 54000-A034 for 14" Type A Buna N Replacement Kit.

Elastomer	14"	16"	18"	20"	24"	26"	28"	30"	32"	36"
Type A Buna N	A034	A035	A036	A037	A039	A040	A041	A042	A043	A044
Type B Viton	B034	B035	B036	B037	B039	B040	B041	B042	B043	B044
Type S EPDM	S034	S035	S036	S037	S039	S040	S041	S042	S043	S044

Table 6 O-Ring Replacement Kits for Metal Seated 200 & 285 psi Butterfly Valves - M-Series

Use "54000" as a prefix when ordering replacement kits.
Example: Order 54000-A045 for 14" Type A Buna N Replacement Kit.

Elastomer	14"	16"	18"	20"	24"	26"	28"	30"	32"	36"
Type A Buna N	A045	A046	A047	A048	A050	NA	A052	A053	A054	C.F.
Type B Viton	B045	B046	B047	B048	B050	NA	B052	B053	B054	C.F.
Type S EPDM	S045	S046	S047	S048	S050	NA	S052	S053	S054	C.F.

Table 7 O-Ring Replacement Kits Norris Body Style Valve

Use "54000" as a prefix when ordering replacement kits.
Example: Order 54000-A103 for 1.5" Type A Buna N Replacement Kit.

	Threaded End					Grooved End			
Elastomer	1.5"	2"	2.5"	3"	4"	2"	2.5"	3"	4"
Type A Buna N	A103	A104	A105	A106	A107	A108	A109	A110	A111
Type B Viton	B103	B104	B105	B106	B107	B108	B109	B110	B111
Type S EPDM	S103	S104	S105	S106	S107	S108	S109	S110	S111

VALVE STORAGE PROCEDURES

The proper storage of Norris valves should consist of:

1. A clean, weathertight, well-ventilated, fire-resistant storage area. This storage area must provide protection from the weather, plus flooring that seals against dust and dirt and will not be subject to flooding.

2. Valves should be protected against rodent and insect damage.

3. The valves must be protected from mechanical damage. The proper use of racks, pallets, and handling equipment shall be used. The valves should be arranged so as to prevent damage to the stored valves during handling.

4. The valves should be stored off the floor on suitable skids, pallets or racks. They must be protected from excessive dust and dirt.

5. Valves should not be stored in direct sunlight. They should also be covered with black flame retardant visqueen or fire retardant canvas cloth. This is to keep as much light as possible from the valves to protect & prolong the life of the elastomers. After completion of storage and upon installation of the valves, the following steps and precautions should be taken:

   A. Valves should not be taken out of storage until ready for installation. If valves must be taken to the installation site before piping is ready, the same storage requirements as above should be followed. Care should be taken to protect the valves from dirt, foreign particles, and weather.

   B. Care should be taken in unpacking and installing the valve so damage to the sealing surfaces (face of seat, O-ring flange seals, and disc edge) does not occur.

   C. Flange faces should be free from dirt, grit, or other irregularities which might damage the flange seals.

   D. Inspect valve and clean off any dirt or grit that might have accumulated around seat, seals or disc.

   E. Install valves per Norriseal's standard installation instructions.

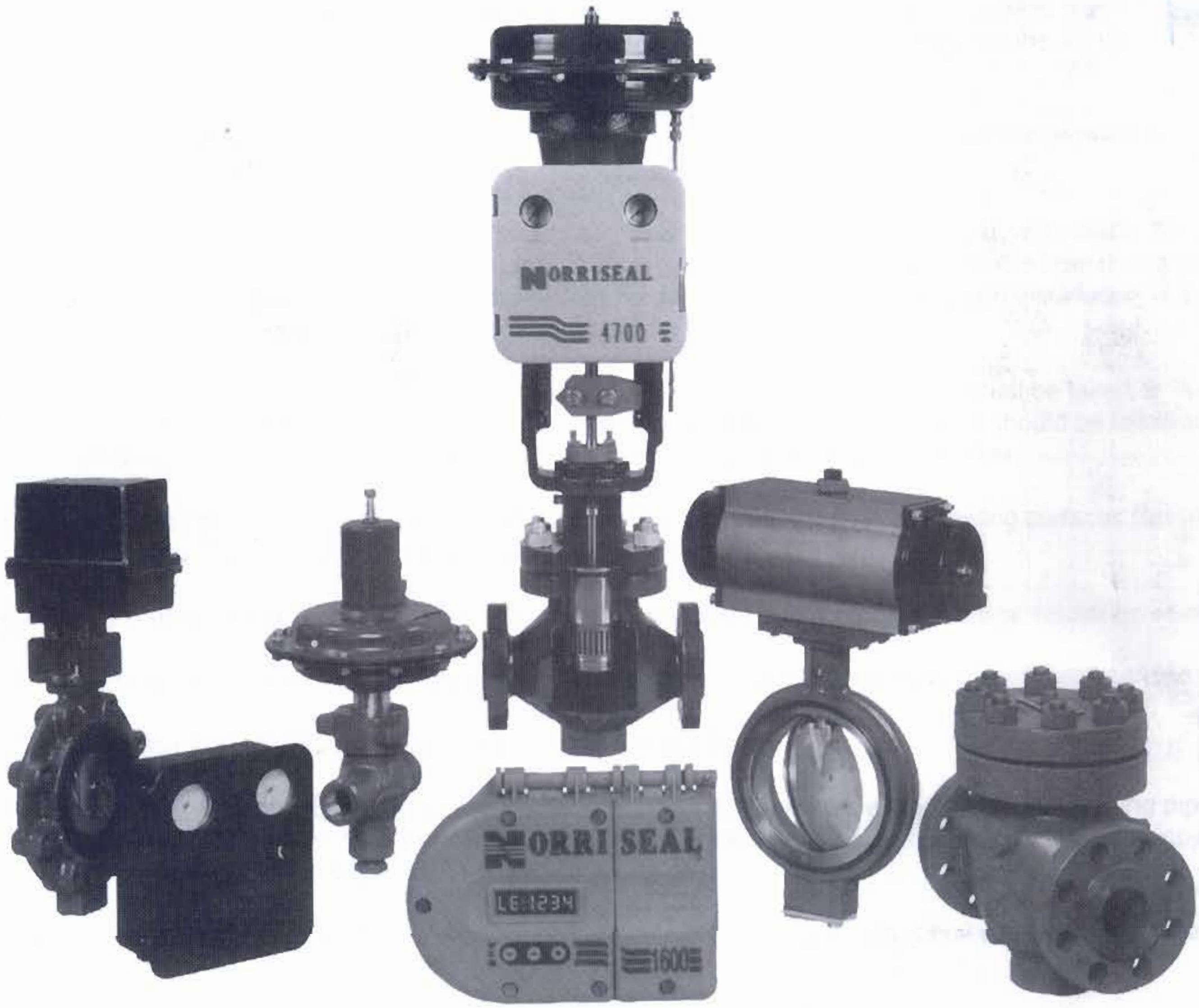
   F. Before operating or cycling the valves, flush pipe thoroughly (with valves open). After flushing pipe, slowly cycle valves from full open to full closed approximately 10 times. Leave in the partially open position until shut-off is required.

   G. If valves have not been cycled for an extended period, cycle them 5-10 times before operation start-up.

NORRISEAL

Family of Products

For more information, contact your nearest Norriseal Office or Representative



Solutions through engineered products.

NORRISEAL®

A DOVER COMPANY

P.O. Box 40525 – Houston, TX 77240-0525
Phone: (713) 466-3552 • Fax (713) 896-7386
www.norriseal.com

MJ18448
1000-0704