Installation, Operation, and Maintenance Manual



API 6D
Two Piece Cast
Trunnion Mounted Ball Valves – BTN Series

+

API 6D
Two Piece Cast Floating Ball Valves –
BF & BU Series



This manual will describe the method of installation, operation and maintenance of the Force "BTN", "BF" & "BU" series flanged ball valves.

CAUTION AND WARNING

To ensure safe and trouble-free function and performance, please read all the contents of this manual before handling, transportation, mounting and operation of the valves.

Keep this manual accessible to the operator.

The signs "WARNING" and "CAUTION" are defined as follows:

⚠ WARNING	Indicating potentially hazardous conditions which may result in injury to personnel if such conditions are ignored.
⚠ CAUTION	Indicating potentially hazardous conditions which may result in injury to personnel or property damage if such conditions are ignored.
	Indicates mandatory implementation of an action.
	Indicates prohibition of an action

Responsibility for valve application

The End User is responsible for ordering the correct valves for the intended application. Force valves are to be installed in observance of the pressure rating and design temperature. Prior to installation, the valves and nameplates should be checked for proper identification to be sure the valve is of the proper type, material, and is of a suitable pressure class and temperature limit to satisfy the application requirements.

⚠ CAUTION	Do not use any valve in applications where either the pressure or temperature is higher than the allowable working values. Also, valves should not be used in service media if not compatible with the valve material of construction, as this may cause premature failure.

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I. Construction and Design features

1.1 BTN series Trunnion ball valve

1.2 BF series Trunnion ball valve

1.3 BU series Trunnion ball valve

1.1 BTN series Trunnion ball valve

1. **Construction and Design features**

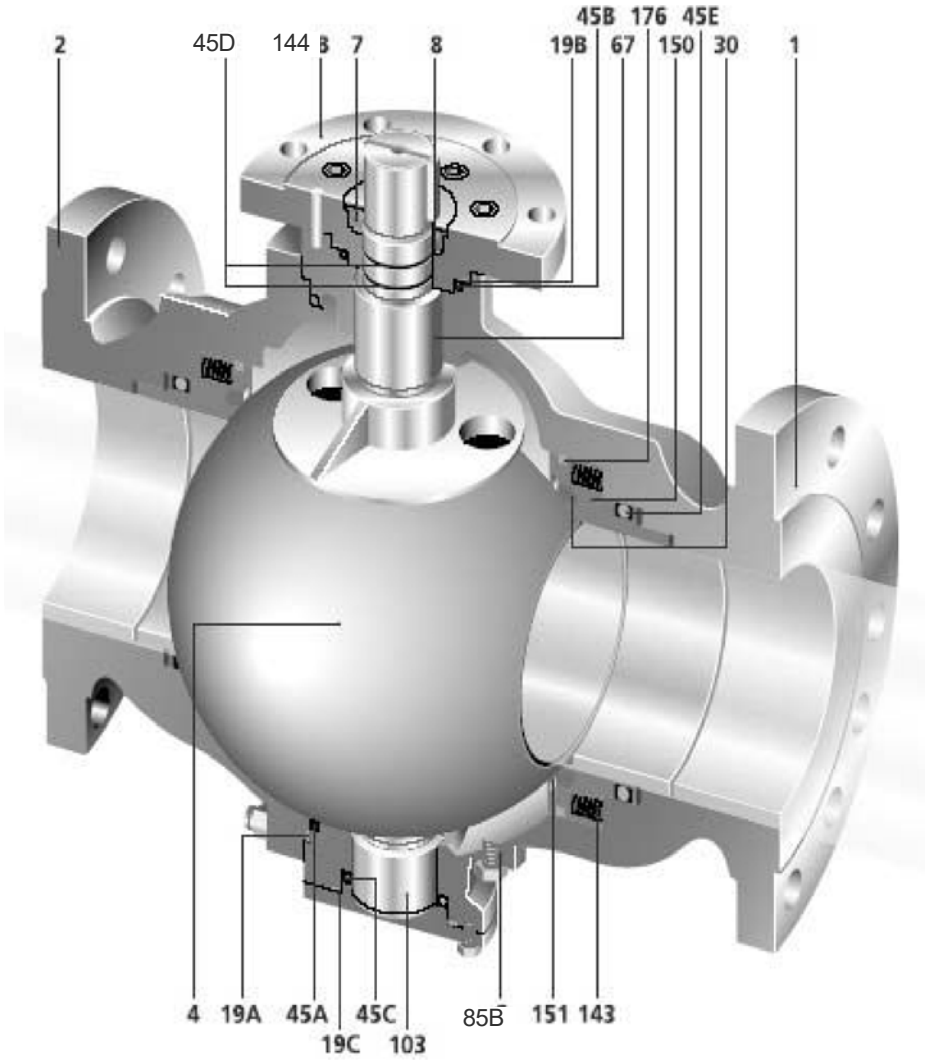
1.1 Construction and part names are illustrated below.

1.2 The valve can be operated by rotating the stem by 90°to open or close.

1.3 The valve is designed for use in the full open or fully closed position only.

1.4 The valve has two stems, at the top and bottom, supporting the ball, the design of which gives the valve less impact on its operationtorque.

1.5 This is a bi-directional valve.



NO.	NAME OF PARTS
1	BODY
2	BODY CAP
4	BALL
7	GLAND
8	GLAND PACKING
19A	GASKET
19B	GASKET
19C	GASKET
30	BALL SEAT
45A	O-RING
45B	
45C	
45D	
45E	
67	STEM BEARING
85B	PLUG
103	BOTTOM STEM
143	SEAT SPRING
144	GLAND PLATE
150	SEAT RETAINER
151	RETAINER RING
176	RETAINER PACKING

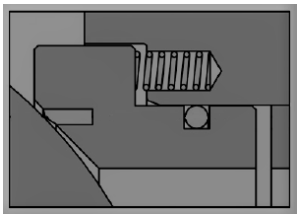
This illustration shows typical construction.

NOTE: This figure is for reference only, as components may vary according to size/class and design. Consult CNC Flow Control for appropriate component list.

2. Design features

2.1 Single Piston Effect (SPE) (API 6D DBB)

A trunnion valve seat design that allows automatic relief to the pipeline from excessive pressure built up inside the body cavity. With the SPE design the trunnion valve only seals on the upstream side.



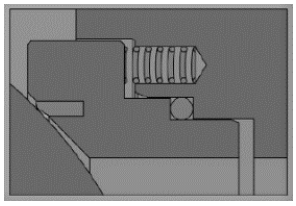
Single Piston Effect (SPE)



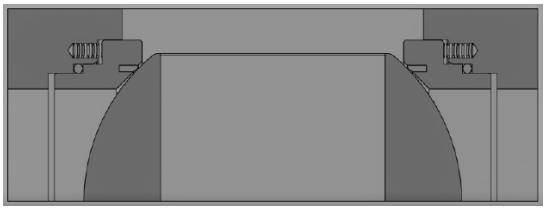
(SPE) (SPE)

2.2 Double Piston Effect (DPE) (API 6D DIB-1)

A trunnion valve seat design that allows both seats to seal with pressure acting from the same side of the valve. This double barrier, provides better sealing capability and extends mean time between maintenance. On the downside, the DPE doesn't allow self relief of over pressure from the valve cavity. Body cavity over-pressurization can be released through a relief valve on the body.



Double Piston Effect (DPE)

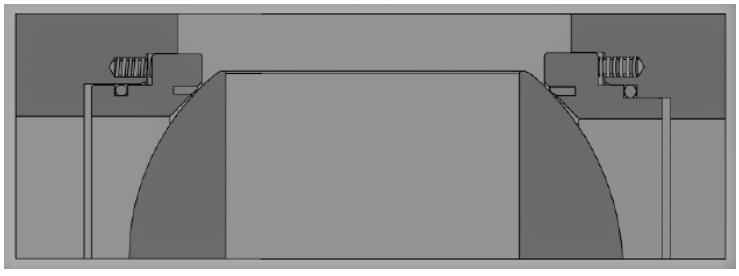


(DPE) (DPE)

2.3 Mixed design of DPE and SPE (API 6D DIB-2)

A combination of double sealing features on the downstream side and single sealing on the upstream seat is available upon request. This configuration maintains the sealing capacity of the valve in case of failure of the upstream seat and release of the body cavity over pressure through the upstream seat. Valves with a mixed DPE and SPE seat design will be Uni-directional and equipped with highly visible arrow flow plate.

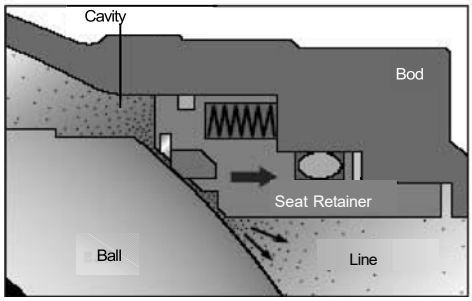
NOTE: *The term upstream and downstream refer to the pressure source and open end/equipment respectively and do not refer to flow direction.*



(SPE) (DPE)

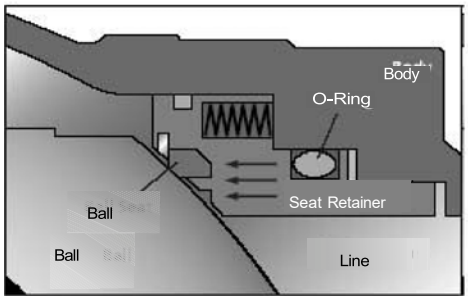
2.4 Excessive cavity pressure relief mechanism

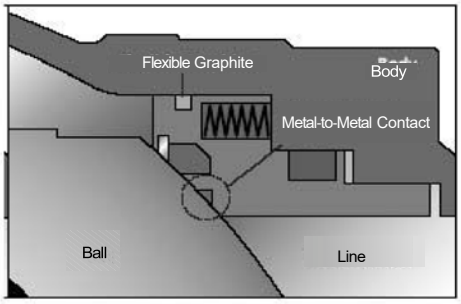
Seal is made on the upstream side by the seat retainer whose seat spring pushes the ball seat against the ball at fully closed position. In case the line fluid trapped in the body cavity evaporates and causes excessive rise in the cavity pressure for some reasons, especially when the cavity pressure exceeds the line pressure, the ball seat will move slightly away from the ball surface to relieve the excessive cavity pressure into the valve bore.



2.5 Fire safe ball design

When the ball seats are decomposed or deteriorated by a plant fire, the edge of the metal seat retainer preloaded by the seat spring comes into contact with the ball to shut off the line fluid to minimize internal leakage through the valve bore.



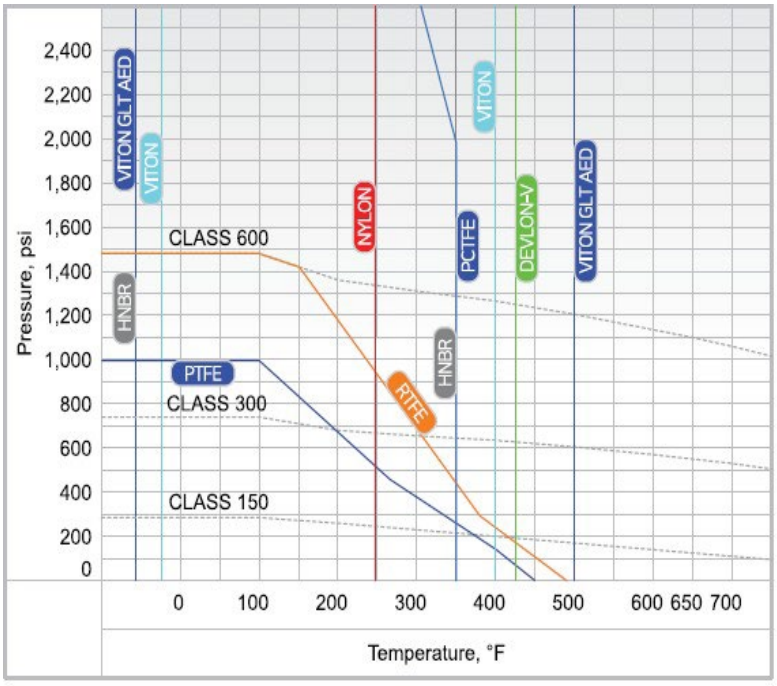


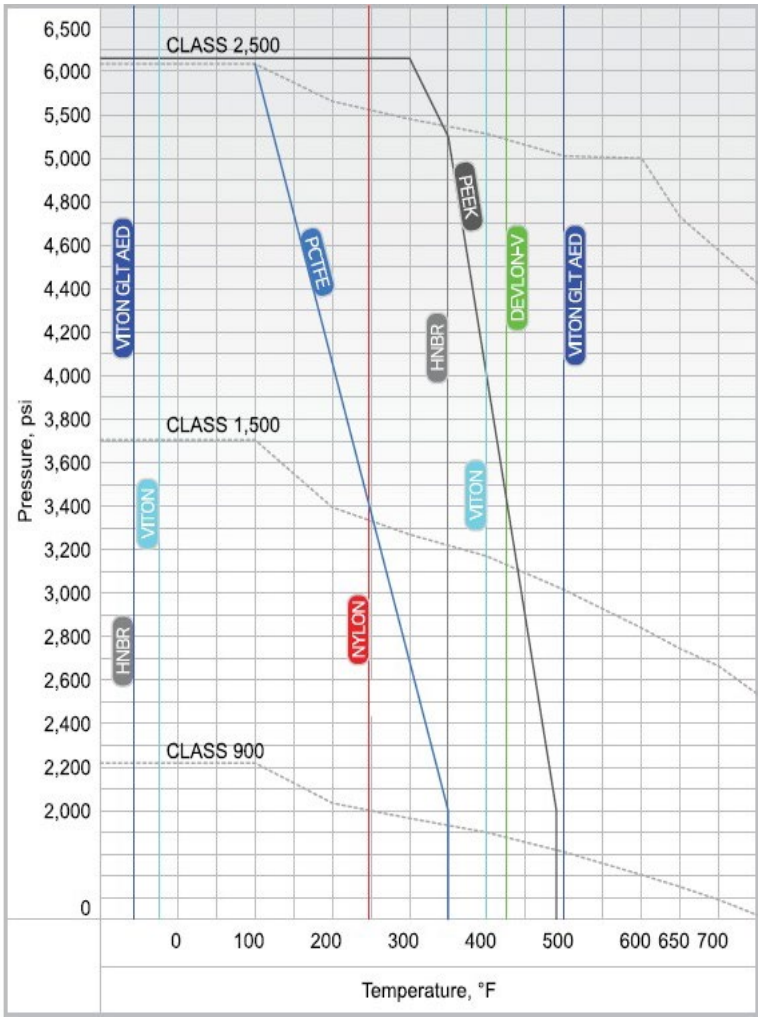
2.6 Drain port

The valve has the block and bleed structure that allows a valve or other types of connection to be installed at the drain port though which the fluid in the cavity can be discharged.

2.7 Pressure Temperature Chart

The selection of sealing material is dependent upon the medium passing through valve, valve working temperature, pressure and velocity of flow. As the Pressure-temperature rating varies according to different valve working conditions, the following Pressure-temperature rating value is calculated assuming stable valve working condition


Pressure, psi
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
VITON GLT AED
VITON
CLASS 600
NYLON
PCTFE
VITON
DEVLON-V
VITON GLT AED
HNBR
PTFE
CLASS 300
RTFE
HNBR
CLASS 150
0
100
200
300
400
500
600 650 700
Temperature, °F


Pressure, psi
6,500
6,000
5,500
5,000
4,800
4,600
4,400
4,200
4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
0
CLASS 2,500
VITON GLT AED
PCTFE
PEEK
DEVLON-V
HNBR
VITON GLT AED
CLASS 1,500
VITON
VITON
HNBR
NYLON
CLASS 900
0
100
200
300
400
500
600 650 700
Temperature, °F

1.2 BF series Floating ball valve

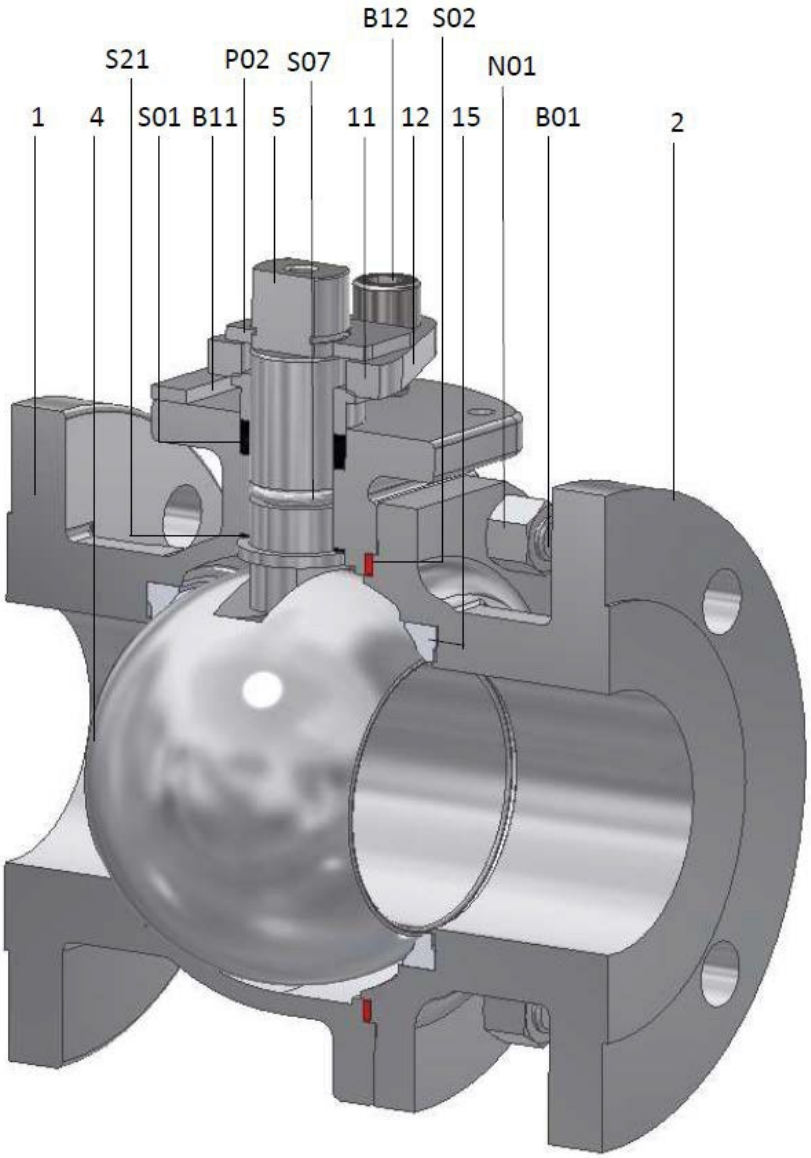
2. Construction and Design features

2.1 Construction and part names are illustrated below.

2.2 The valve can be operated by rotating the stem by 90°to open or close.

2.3 The valve is designed for use in the full open or fully closed position only.

2.4 This is a bi-directional valve.



NO.	NAME OF PARTS
1	BODY
2	CAP
4	BALL
5	STEM
11	GLAND RING
12	GLAND FLANGE
15	SEAT RING
S01	PACKING
S02	GASKET-A (CAP)
S07	O-RING (STEM)
S21	T/WASHER-A
P02	STOPPER
P03	LOCKING PLATE
B01	CAP BOLT
N01	CAP NUT
B11	LOCKING PLATE BOLT
B21	TOP BOLT
B12	GLAND BOLT<WRENCH>

NOTE: This figure is for reference only, as components may vary according to size/class and design. Consult CNC Flow Control for appropriate component list.

1.3 BU series Floating ball valve

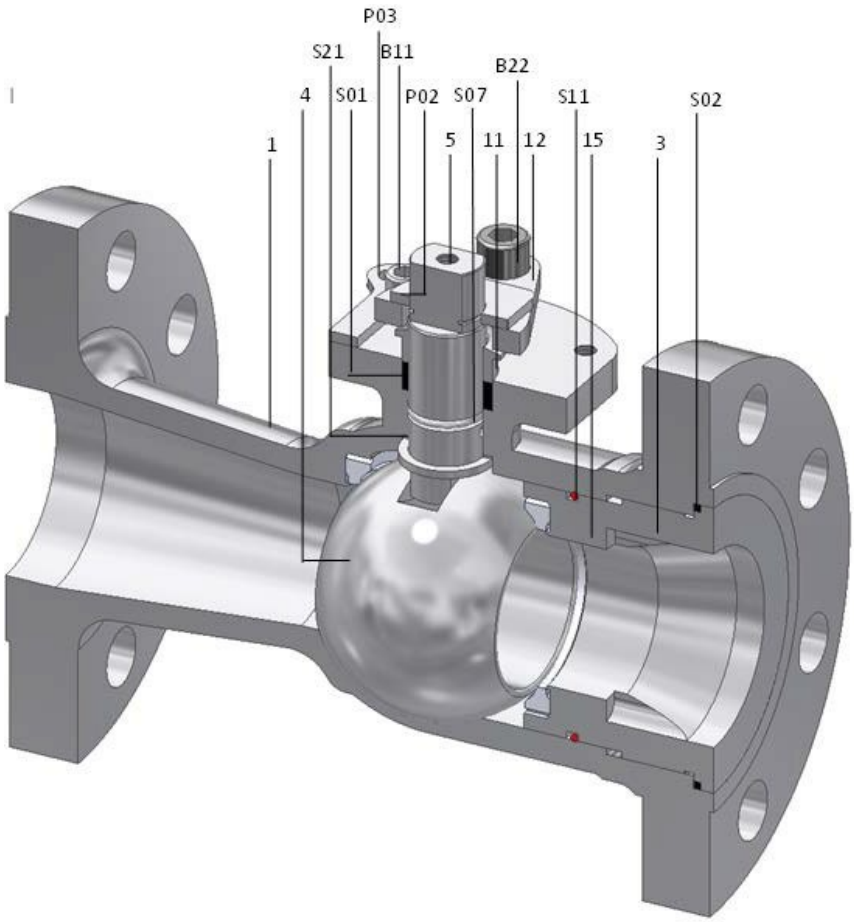
3. Construction and Design features

3.1 Construction and part names are as illustrated below.

3.2 The valve can be operated by rotating the stem by 90° to open or close.

3.3 The valve is designed for use in the full open or fully closed position only.

3.4 This is a bi-directional valve.



NO.	NAME OF PARTS
1	BODY
3	INSERT
4	BALL
5	STEM
11	GLAND RING
12	GLAND FLANGE
15	SEAT RING
S01	PACKING
S02	GASKET-A (CAP)
S07	O-RING (STEM)
S11	O-RING (CAP)
S21	T/WASHER-A
P02	STOPPER
P03	LOCKING PLATE
B11	LOCKING PLATE BOLT
B22	GLAND BOLT<WRENCH>

4. Design features

4.1 Seat Design

Standard valves utilise reinforced PTFE seats for maximum chemical compatibility and are designed to FLEX ensuring positive sealing performance across a wide pressure range whilst providing controlled operational torque and cavity relief capability. Reliable sealing is enhanced via precise pre-compression of the ball between the two flexing seat rings allowing the ball to float along the valve axis providing bubble tight and bi-directional performance.

4.2 Blow-out proof STEM

Stem is made separately from the ball, anti blow-up design with suitable PTFE and graphite rings and antistatic device. The lower end of the stem is designed with an integral collar to be blow-out proof. It also functions as the backseat for assured stem sealing.

4.3 Fire Safe Design

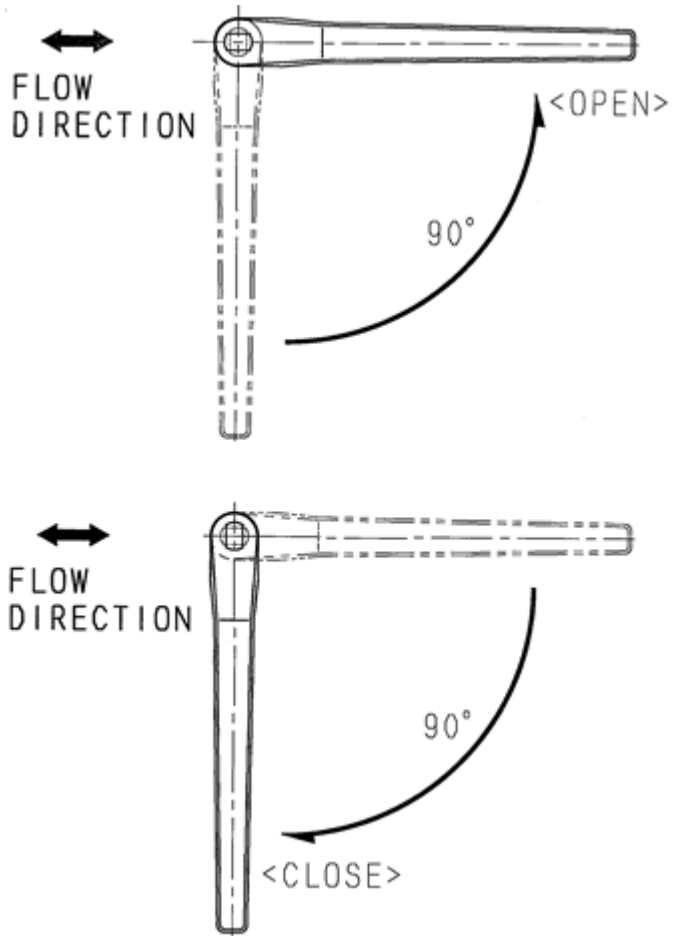
All fire-safe valves conform to **API 607**, **ISO 10497** and **API 6FA** standard. When a fire accident occurs at a jobsite where the valve is operating, components such as seat ring, stem back seat, stem packing and mid-metallic material such as PTFE were broken or destroyed. **FORCE**'s particularly metal to metal added seal seated designed ball valves can effectively control external or internal leakage.

II. Operator

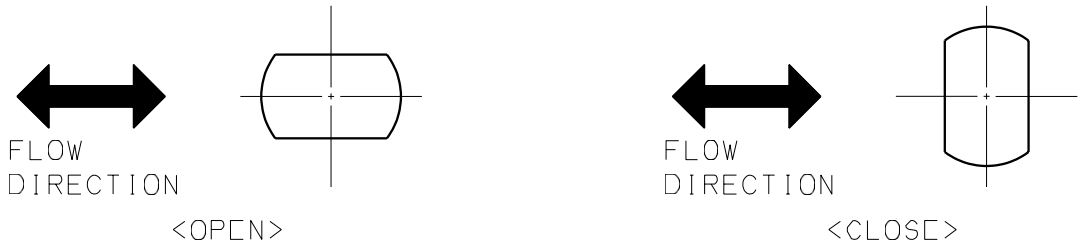
1 Lever type operator

1.1 The lever handle is directly mounted on the valve stem.

1.2 Rotate the lever handle clockwise by 90°to close and counterclockwise by 90°to open the ball.



1.3 **Rotation of the stem by 90°fully opens and fully closes the valve for Bare Stem Type.**
An appropriate tool or handle shall be applied to operate the valve and the flow direction shall be checked by the top orientation of stem.



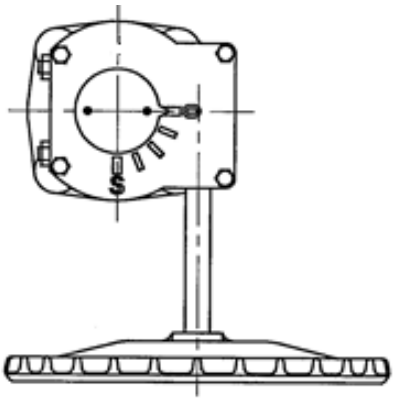
2 Gear operator

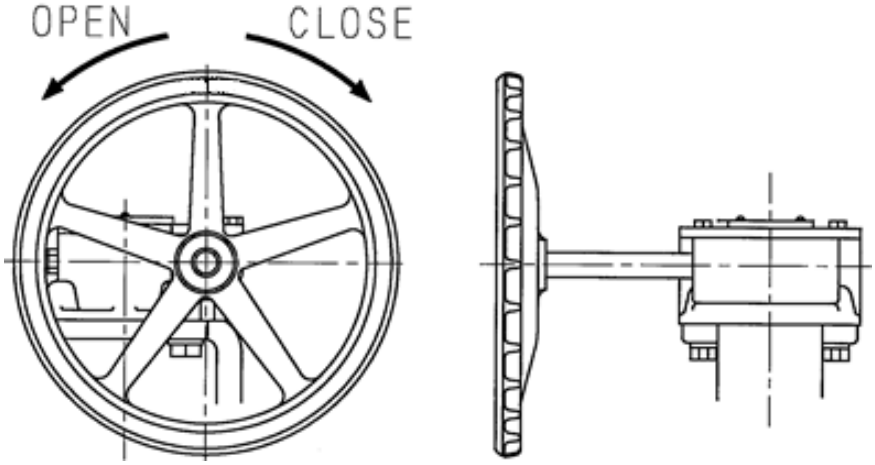
2.1 The gear operator shall be mounted on the valve.

2.2 There should be an arrow or letter on the gear handwheel to indicate the proper direction to rotate the wheel for opening (counterclockwise) or closing (clockwise) valves.

2.3 Handwheel operation forces differ in the valve opening position and fluid pressure and /or temperature.

2.4 Gear operator is the device to multiply and convey force from the operator to the stem through reduction gear.





⚠ CAUTION	Gear operator shall be correctly sized for the valve. Incorrect sizing may result in damage to personnel and the valve.

III. Shipping, Handling and Storage

1. Shipping and Handling Valves

1.1 Care for Shipping and Handling Valves

⚠ WARNING	
	• Keep off the valve lifting area to prevent injuries caused by the unsecured valves. Unstable stacking may also result in personal injuries.

⚠ CAUTION	
	• Pay attention not to damage painted valve surfaces during transportation, which may subsequently cause corrosion to the valve. Repair is required if the surface is damaged. • Pay attention to handling and storage of carton packed products. The high humidity may damage the cartons.

1.2 Shipment

1.2.1 Maintain original packing condition during shipment. Provide appropriate protection covers if they are found missing during transportation.

1.2.2 Handle valves carefully so that they may not fall or drop on the ground. Any extraordinary mechanical impact should be avoided.

2. Storage

2.1 Care for Valve storage

⚠ CAUTION	
	• DO NOT store valves in the corrosive environment, which may cause corrosion from the valve threaded areas. • DO NOT remove protection covers until installation. They prevent any foreign objects from intruding valves. • DO NOT place any objects on valves, and DO NOT step on them. Overloading may cause damage to valves. • DO NOT pile up products carelessly to avoid damage to the products and personal injury caused by unstable piling.
	• Keep the valves in the open position, during storage. - Storing the valves in halfway position may deform the ball seats, leading to cause of the seat leakage. And storing the valves in fully closed position may damage the ball, when the flange protections or covers are torn or removed.

2.2 Storage

2.2.1 Indoor storage of valves in a dust-free, low humidity and well-ventilated place is recommended.

2.2.2 Storage of valves directly on the ground or concrete floor is not recommended. place packed valves on the pallets or the racks for storage.

2.2.3 Take some appropriate measures to protect valves from direct exposure to dust, rain, or sunlight if they are temporarily stored outdoors.

2.3 Safety Working Point (lifting)

2.3.1 Remove the valve from the box using proper D-Shackle or lifting hooks and straps. These must be sized depending upon the weight that must be lifted at lifting points (lifting lugs) provided on valve as shown in Figure 1.

Do not use chains or hooks in contact with machined or painted surfaces.

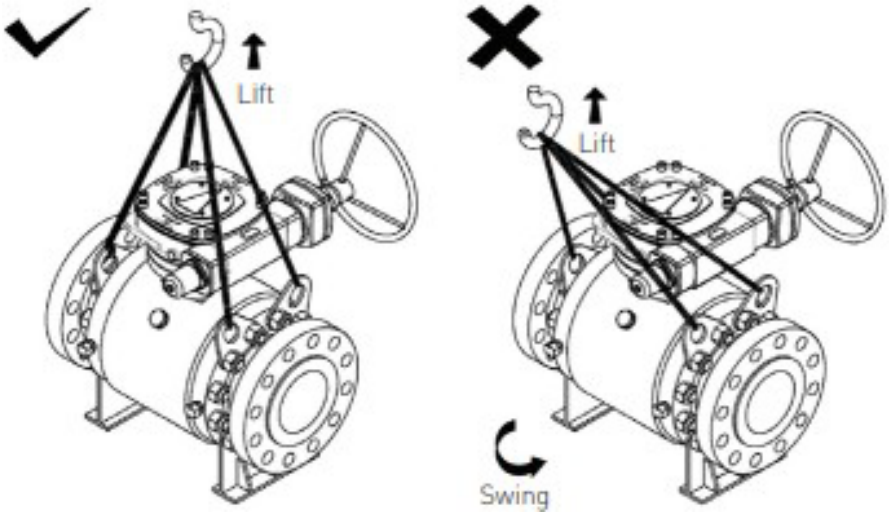


Figure 1

2. 2. 5 If lifting lugs are not provided on the valve, hold the valve with lifting strap around neck area and gently lift it as shown in Figure 2.

Ensure the lifting strap is sized appropriately for the weight that must be lifted and is holding the neck area of valve firmly, to prevent damage.

2. 2. 6 If the valve is supplied with an operator (gear operator or actuator) do not use the operator or the operator lifting lugs to lift the valve assembly.

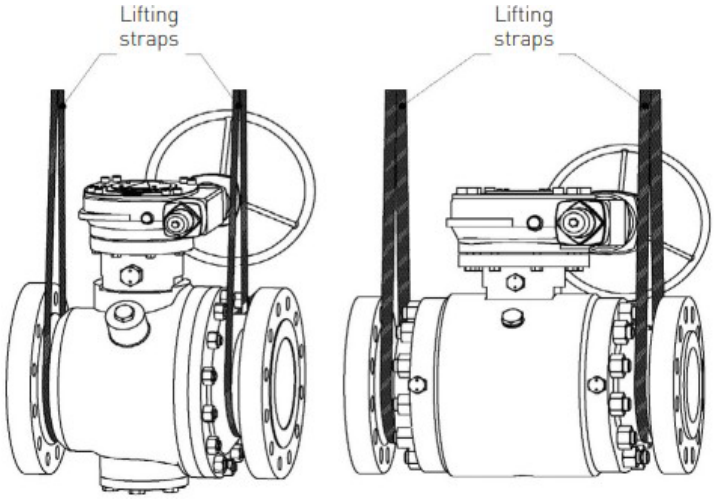


Figure 2

IV. Valve installation

1 Care for Valve installation

⚠ WARNING	
	• Check the valve specifications with the identification plate or tag and the relevant catalogue, to ensure that the exact valves specified in your piping arrangement plan was provided. The service fluid, pressure and temperature determine the compatibility of sealing materials and ball seat materials. Incorrect application of a specific valve could be hazardous.
	• DO NOT install pipe end service, which may cause the external leakage. In such a case, use the blank flange or spacer and blank flange, in which the ball. protrudes from end flange, to prevent the leakage.

⚠ CAUTION	
	• Keep a secure footing for valve installation and operation. • Sufficient lighting should be prepared for valve operation. • Piping should be properly supported, if needed.

1.1 Allow sufficient room for operation, installation, removal, and subsequent maintenance of valves, considering the valve height and the stem direction.

1.2 Take appropriate measures for smooth operation, inspection and maintenance of valves if they are forced to be installed in small spaces.

1.3 Try not to install valves in the places where valve functions may be hampered by outer forces such as vibrations.

1.4 It is recommended to install valves to horizontal pipes in upright positions

2 Care for Piping

⚠ CAUTION	
	• Keep off the valve lifting area to prevent injuries caused by the unsecured valves. • Care should be taken to keep hands clear of valves while placing them between pipe flanges. • Pay attention not to damage flange surfaces and gaskets. • Piping should be properly supported to align pipes on both sides. • For valves with the gland packing structure, retighten gland packing before operation. Pressure applied to the gland packing may be lowered due to the stress relaxation taking place during transportation or storage, which may cause leakage. • Use new gaskets when installing valves into pipelines.

2.1 Check the following items before installation of the valves.

2.1.1 The service conditions should be within the range of the relevant valve specification.

2.1.2 Valve flanges should correspond with pipeflanges.

2.1.3 Gasket contact surfaces of pipe and valve flanges must be free from scratches or any other damages.

2.1.4 The appropriate length should be kept between pipe flanges for the valve face-to-face dimensions including the gasket thickness.

2.1.5 Pipes and valves should be accurately aligned.

2.1.6 Pipe flanges should face parallel to each other. The bolt holes of flanges should be symmetrically lined up against the center line of flanges.

2.2 Before installation of the valves, the connecting pipes should be cleaned to remove any foreign objects such as sand, dust, and welding spatters.

2.3 Do not give extraordinary shock to valves by throwing, dropping, dragging, or toppling them down.

2.4 Remove flange covers from valves just before installation.

2.5 Check all threaded areas after installation and retighten them, if needed.

2.6 Flush inside of the valves and pipes after installation to remove foreign objects. The valves should be opened while flushed. Do not operate the valves while flushing.

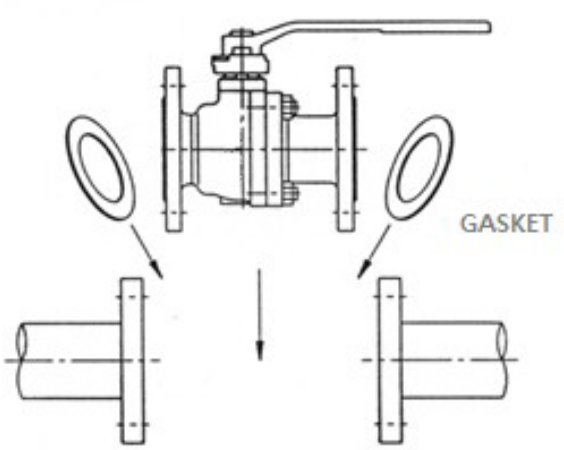
3 Valve installation procedure

3.1 Pipes and valves should be accurately aligned.

3.2 The appropriate length should be kept between pipe flanges for the valve face-to-face dimensions including the gasket thickness.

3.3 Place the valve between the pipe flanges. Insert bolts through the bottom bolt holes and tighten them lightly. This will support the valve during the remaining steps of installation.

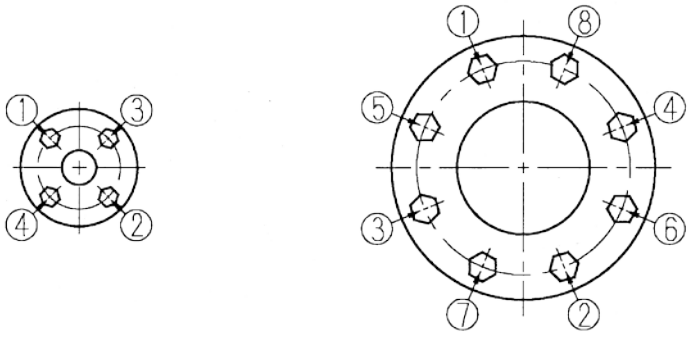
3.4 Insert gaskets between the valve and pipe flanges.
It is recommended to apply lubricant (gasket paste) to gasket faces.



3.5 Make sure the correct alignment of gaskets, which are held in place with the bottom bolts.

3.6 Thread bolts through the other holes of flanges and lightly tighten them.

3.7 Evenly tighten the bolts alternately in a star pattern as shown below. Once the bolting is properly tightened, both ends of each bolt should evenly protrude beyond the nuts.



3.8 Gradually raise the line temperature and pressure during the test run. Retighten valve bolting, if needed.

3.9 Gradually raise the line temperature and pressure during the test run. Retighten valve bolting, if needed.

3.10 The valve is horizontal installation is basic, and it should be installed with the stem facing upside, refer.

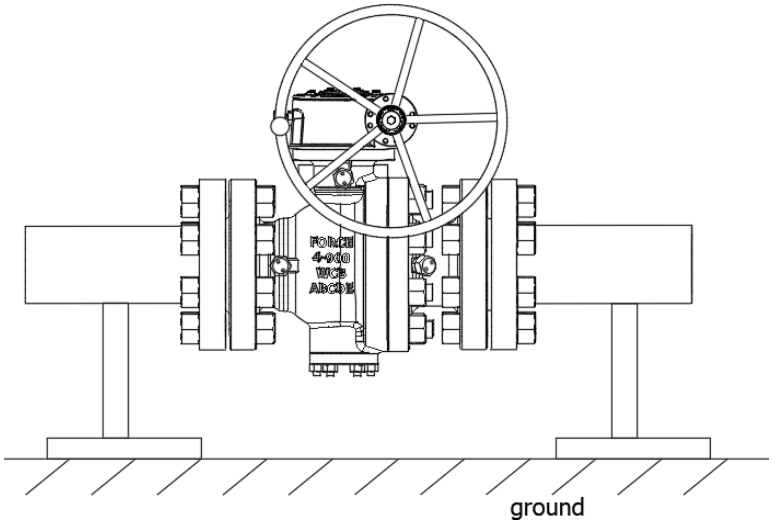


Figure 3

3.11 Never install the Valve with the Actuator upside down on the pipeline, refer Figure 4.

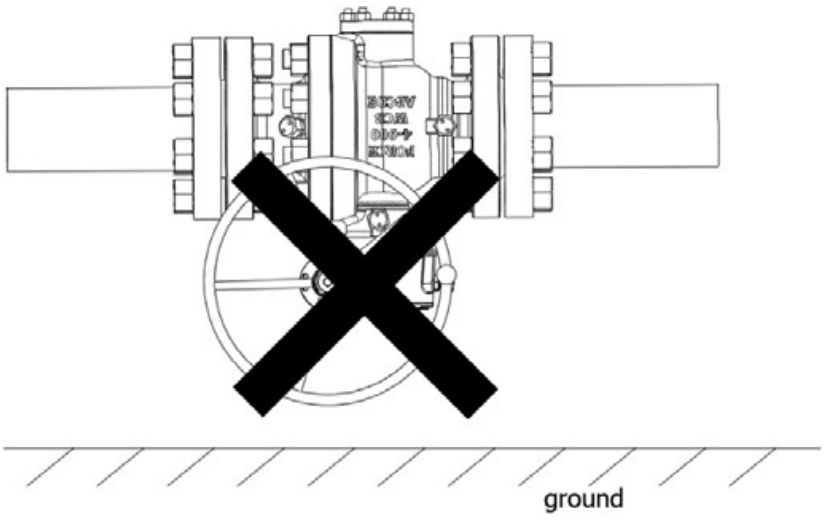


Figure 4

3.12 Examples of valve support configurations are shown in Figure 5.

3.13 The extended bonted type valve, Be sure to install the ground supprot on the neck. refer Fiqure 3

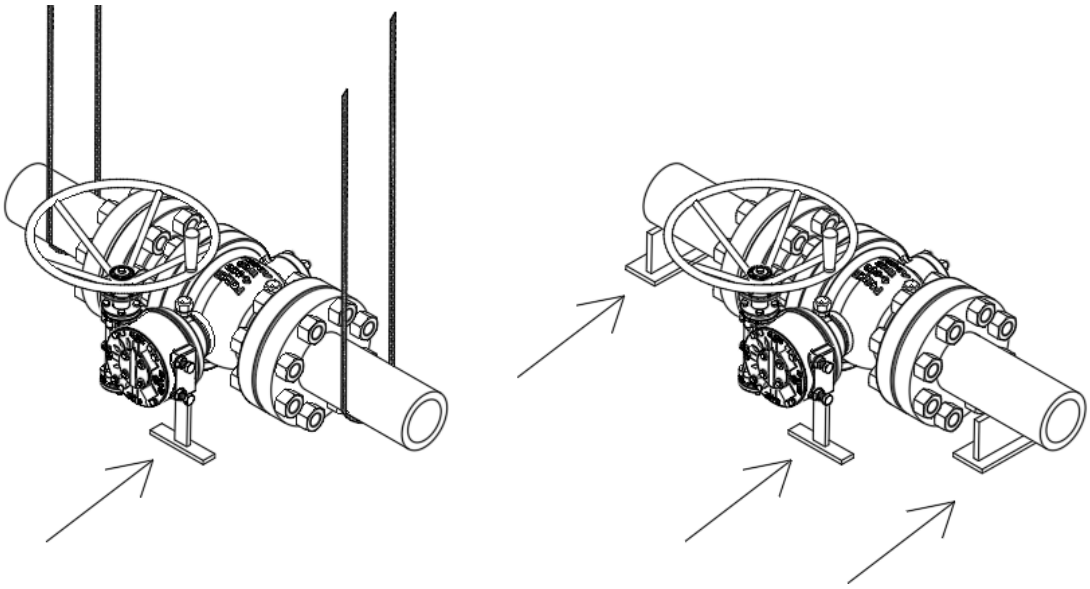


Figure 5

3.14 The mounting/support stand is only for handling and transportation and not for carrying piping loads.

3.15 Hook the valve at the end of the flange bolt holes as shown in Figure 6 and lift with the help of suitable crane.

3.16 Alternately, valve can be lifted with the help of forklift as shown in Figure 7.

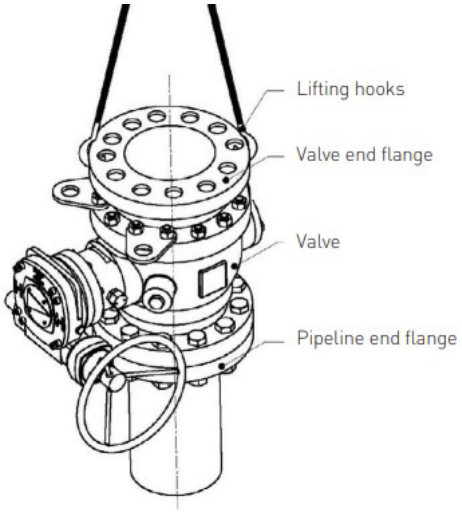


Figure 6

OR

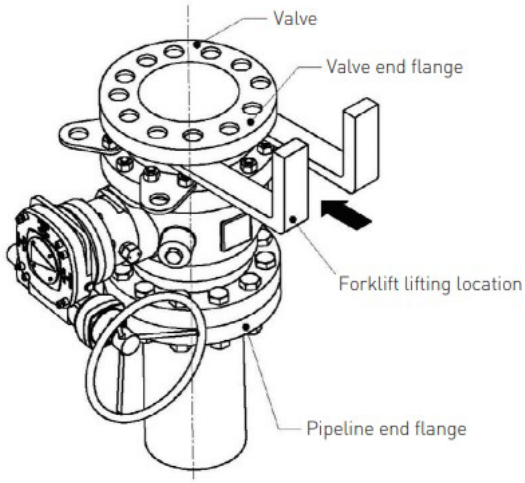


Figure 7

V. Valve operation

1. Care for Valve Installation

⚠ CAUTION	
	• DO NOT apply excessive force to operate the valves by using a pipe or hand wheel rotating device. • Never loosen bolts or nuts used in the gland, cap flanges and end flanges of pressurized valves. • DO NOT use valves in an intermediate position. Such use may damage ball seats and cause internal through-bore leakage.
	• For valves with the gland packing structure, retighten gland bolts and nuts before operation of valves. Check a handle torque while retightening the bolts and nuts so that the operation will not become too difficult due to overtightening. Gland bolts should be alternately tightened with an even force. • Valves should be kept fully open during the line test or pressure test. Fully closing valves during the test may deform the ball seats, leading to the occurrence of internal through-bore leakage. • In case service temperature fluctuates, retighten all bolts and nuts after the temperature is stabilized against occurrence of stress relaxation of the gland packing and/or gasket. • Gradually open valves to prevent damage of pipe when high temperature fluids such as steam are handled. • Take some appropriate measures to prevent freezing, as needed.

2. Valve operation

2.1 Lever handle operation

Rotating the lever handle by 90° will close the valve and counterclockwise rotation by 90°will open the valve.

2.2 Gear operation

Rotating clockwise the handwheel according to the letters and the mark indicating the direction will close the valve. Counterclockwise rotation will open the valve.

3. **Daily Valve Inspection during Operation**

To operate your valves safely and satisfactorily, daily inspection is very important. Here are the items essential to your daily inspection.

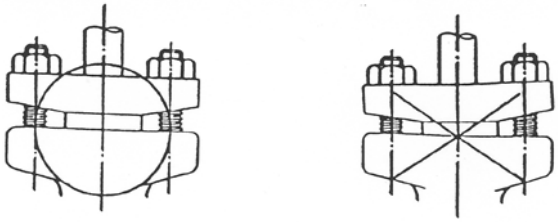
Inspection items	Areas to be inspected	Inspection method	Remedial measure
External leakage	Gland area	Visual check, Soapy water	Replace the packing rings. Replace the O rings.
	Flanged areas	Visual check, Soapy water	Retighten the flange bolts. Replace the O rings
	Threaded areas	Visual check, Soapy water	Retighten each threaded area. Replace the relevant components.
	Body	Visual check, Soapy water	Replace the valves.
Abnormal noises	Valve body	Auditory check	Consult a piping engineer
	Loosened bolting	Auditory check	Retighten bolting
	Pipe Vibration	Auditory check	Consult a piping engineer.
Loosened bolting	Bolts and nuts	Visual and tactile check	Retighten the bolts and nuts.
Internal thru-bore leakage	-	-	Remove foreign objects. Disassemble and inspect the valves, (Replace ball seats), Replace valves.
Valve operation	Valve operating position	Visual check	Ensure that the valve in the predetermined operating position.
	Disturbed operation	Tactile check, auditory check	Disassemble and inspect the valve components.

4. Trouble Shooting and Corrective Measures

⚠ CAUTION	
	• Operators should always take protective measures to prevent direct exposure to the media including wearing protective goggles, gloves, and safety shoes a minimum. • More stringent protective measures may be necessary when handling toxic, inflammable or corrosive media. • Ensure to reduce the line pressure to the atmospheric level, before retightening gland or flange bolting, and loosening or replacing packing rings and gaskets. • When retightening the flange bolts, care should be taken for a possible gasket blow out. Operation should be carried out at the position where operators do not get a direct exposure of the media, even if such a blow out occurs. • Ensure to reduce the line pressure to the atmospheric level, before replacing packing rings, gaskets and O rings or loosening bolts and nuts. Operation should be carried out at the position where operators do not get a direct exposure of the media.

4.1 Leakage from the gland area (Valves with the gland packing structure)

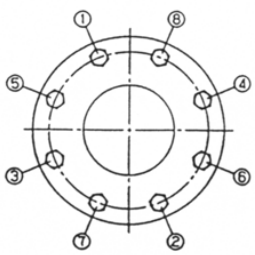
Retighten the gland bolts or nuts if leakage from this area is detected. Evenly tighten the bolts or nuts alternately as shown below. Adequate torque should be applied when retightening the bolts or nuts so that the valve operation will not become difficult. If it does not stop the leakage, the packing rings should be replaced.



⚠ CAUTION	Over tightening will cause the packing to fail prematurely as well as increasing the force required to operate the valve.

4.2 Leakage from the flanged areas

Evenly tighten the bolting alternately and gradually in a star pattern as shown.



4.3 Fastening bolting Torque

STD. FASTENING TORQUE									
Bolt Size	Torque Values [ft-lbf]				Bolt Size	Torque Values [ft-lbf]			
Inch	B7	B8/ B8M	B7M	SS 630	Inch	B7	B8/ B8M	B7M	SS 630
1/4	5	5	4	4	1-1/4	744	655	595	560
5/16	10	10	9	7	1-3/8	1019	897	815	766
3/8	18	16	15	13	1-1/2	1348	1185	1077	1013
7/16	29	26	23	22	1-5/8	1695	1492	1356	1305
1/2	44	39	35	34	1-3/4	2182	1918	1744	1640
9/16	64	57	51	48	1-7/8	2671	2349	2135	2745
5/8	87	77	70	66	2	3328	2928	2662	2503
3/4	154	136	124	116	2-1/4	4803	4226	3841	3613
7/8	246	216	197	184	2-1/2	6659	5858	5325	5009
1	354	312	283	266	2-3/4	8914	7843	7130	6705
1-1/8	531	467	425	399	3	11630	10233	9301	8747

STD. FASTENING TORQUE									
Bolt Size	Torque Values [ft-lbf]				Bolt Size	Torque Values [ft-lbf]			
Metric	B7	B8/ B8M	B7M	SS 630	Metric	B7	B8/ B8M	B7M	SS 630
M6	5	5	4	4	M30	687	605	550	517
M8	12	10	10	9	M33	926	815	741	696
M10	23	20	19	17	M36	1227	1079	981	923
M12	41	35	32	30	M39	1581	1391	1265	1189
M14	63	55	51	47	M42	1990	1750	1591	1496
M16	98	86	77	74	M45	2481	2183	1985	1867
M18	135	119	108	102	M48	3052	2684	2439	2295
M20	193	170	154	145					
M22	265	235	212	198					

5. Trouble shooting

Defect	Possible cause	Remedial measure
Difficult valve operation	Foreign objects may have choked up the valve body cavity and stuck around the ball seats.	Disassemble and inspect the valve components.
Excessive valve torque	Foreign objects may have stuck to the stem.	Remove the foreign objects and ensure no further problems on the area.
	Foreign objects may have choked up the valve body cavity and stuck around the ball seats	Flush the built-up objects by the media with the ball slightly open. Disassemble and inspect the valve.
	The gland bolts may have been over-tightened. (In case of valves with the gland packing structure)	Loosen the gland bolts once and adequately retighten them so that the leakage through the gland does not occur.
Leakage fromthe gland area	Loosen the gland	Retighten the gland.
	Damage of O-rings	Replacement of O-rings
	Uneven tightening of the gland bolts (In case of valves with the gland packing structure)	Loosen the bolts once and evenly retighten them.
	Damage on the gland packing (In case of valves with the gland packing structure)	Replace the gland packing.
Internal through-bore leakage	Damage on the ball seats.	Disassemble and inspect the valve. Replace ball seats.
Abnormal noise or vibration	Loosen bolts and nuts at body/endcap, trunnion, and gland.	Retighten the bolts and nuts.

VI. Periodic inspection

1. Periodic inspection

1.1 A periodic inspection with valves mounted to pipelines is recommended at least once a year.

1.2 Ensure the smooth operation and safety of valves during inspection.

1.3 Inspection items and methods are same as daily inspection. See Chapter V for the items and methods suggested.

1.4 Where valves and adjoining piping are not daily inspected or not operated for a long period time, a periodic inspection is recommended. (A periodic inspection should be carried out on all valves.)

1.5 It is particularly important to thoroughly check the valves used for the following service:

a) Where performance failure of valves could result in a major shutdown of an entire plant unit.

b) Where the media contain high viscosity and may get stuck to and built up inside the valves.

c) Where corrosion and/or wear by the media is expected.

Remove the valves from the pipelines for inspection, if needed.

In case the disassembly of the valves is required, it is recommended to call the valve manufacturer for inspection and repairs.

2. Inspection and maintenance

In case pipelines or facilities where valves are installed are shut down for the pipeline inspection, provide the valves with the body and seat pressure test and operation test, if needed. If any defect is detected, disassemble the valves for further inspection. The valves must pass required inspections before being sent back to the pipelines or facilities for reinstallation.

2.1 Care for removal of the valves from pipelines or installation of the valves on pipelines

⚠ WARNING

- Discharge the fluid from pipes and reduce line pressure to the atmospheric level when dismantling valves from pipelines.
- Discharge the fluid and pressure trapped within the valve body with the valve intermediate position before disassembling.
- In case fluid is toxic, inflammable or corrosive, remove the fluid completely from pipes and internal valves
- Take protective measures to prevent direct exposure to the fluid and catching fire.
- Keep off the working area to prevent personal injury if valves are installed at higher places.

⚠ CAUTION

- Wear protective items such as goggles, gloves and work boots.
- Keep a secure footing at dismantling and mounting valves.
- Pipes and valves should be properly supported to avoid misalignment when the valves are removed or installed.
- Mark both pipes and valve flanges, before valves are removed from pipelines. Valves should be reinstalled with these marks mated.
- Ensure to use new gaskets when valves are reinstalled in pipelines.

2.2 Disassembly

Refer to Chapter VII for disassembly procedure.

2.3 Inspection items for disassembly inspection.

Refer to the table below for the items, methods, judgment, and remedial measures of disassembly inspection.

Inspection components	Inspection items	Detection	Method	Judgment	Remedial measures
Body, Body Cap	Flange	Corrosion, Damage, Crack	Visual check, Measuring flange thickness	No appearance of corrosion, damage or crack.	Welding repair or scrap
	Fluids contact surface	Corrosion, Scratch, Crack	Visual check, Measuring wall thickness, N.D.E	No appearance of corrosion. Propriety of wall thickness	Welding repair or scrap
Ball seat, Ball	Seat surface	Corrosion, Scratch, Crack	Visual check	No appearance of wear or damage.	Replacement of ball seat.
	Ball	Corrosion, Scratch, Crack	Visual check	No appearance of wear or damage.	Replacement of ball.
Stem	-	Corrosion, Scratch, Distortion	Visual check Dimensional check	No appearance of corrosion, damage or distortion.	Correction of defects or replacement.
O ring Packing Gasket	-	-	-	Replace these parts at disassembly.	Replacement.

2.4 Maintenance

Under the normal conditions the Force Trunnion mounted Ball valve's simplistic design will allow for a long Service life with low maintenance costs over the life of the valve.
It is recommended to adopt a regular maintenance schedule. Valve bodies should be regularly drained to discourage the formation of scale, corrosion products, or accumulation of sediment within the valve body. If, for some reason, a routine program cannot be adopted it is recommended to drain the vales under the following circumstances.

A.) After Hydrostatic testing
B.) After Cleaning the line.
C.) When valve cannot be fully stroked with ease.

2.4.1 Draining Procedure.

A.) Make sure to use safety glasses, and other appropriate safety apparel before attempting to drain a valve.
B.) Verify the bore position. bleed ports should never be opened when the valve bore is in the partially open position!
C.) verify the location of the drain fitting. note the direction of the hole where the fluid will exit the fitting, and make sure the hole is free of dirt or debris.
D.) apply a backup wrench to the body of the fitting to prevent the fitting itself from being unscrewed, and with the port of the bleed fitting pointed in the opposite direction from your body begin to loosen the bleed plug with a second wrench. continue to loosen the plug until a sufficient discharge rate has been achieved.
E.) When fluid ceases to flow from the bleed fitting, you have completely drained the valve body. use the wrench to close the bleed plug.
F.) Move the bore position 15-20 degrees, and then return it to the fully open/closed position. This will allow pressurized fluid to enter the body cavity again. Observe the bleed plug to be sure it is not leaking. If the bleed plug Is not leaking, the valve is ready for use.
G.) Note: all fluids discharged from a valve should be properly disposed in accordance with local/state/federal Laws.
Note: only hand wrenches should be used to loosen bleed fittings. Wrenches should be appropriately sized so as not to provide an excess of leverage which may damage the bleed fitting. Pneumatic wrenches should not be used.

2.4.2 If a leak develops through the stem journal the packing gland may need to be tightened. The packing gland bolts should only be tightened by a hand wrench and should not be over tightened. see the **Chapter V. Valve operation Section 2.5.5 Fastening bolting Torque** for torque recommendations.

2.4.3 It is not necessary under normal circumstances to add grease to a force trunnion ball valve because the seats will ordinarily lubricate themselves. Adding grease without just cause will only serve to trap dirt and debris in the body cavity, or worse yet, between the seat and the ball, which will ultimately degrade sealing performance.

2.4.4 Field Repair of a Seat Leak

A seat leak develops, the first step in attempting to remedy the problem should be to flush the valve. Follow these steps to flush the valve:

A.) Purchase a valve flushing compound from a reputable grease/sealant manufacturer. Verify that the flushing compound purchased is compatible with the valve materials of construction & process media.

B.) Place the valve in the fully closed position and drain the valve body using steps given in section.

C.) Remove the cap from the grease zerk, taking care not to unscrew the actual grease fitting.

D.) load the flush into your grease gun.

* Note: Thoroughly familiarize yourself with the workings of your grease gun by reading the Manufacturer's manual. Proper use will help prevent injuries and extend the life of your grease gun significantly.

2.4.5 Grease or sealant injection

If the leak has not been corrected by flushing, a grease or sealant (hereafter "g/s") may need to be added to the valve to temporarily restore sealing. Follow these steps to add g/s to a valve:

A.) Purchase g/s from a reputable manufacturer. Verify that the g/s purchased is compatible with the valve materials of construction & process media.

Recommended Grease: Kixx Grease EP 00 or equivalent. (Required one (1 oz.) ounce per inch of valve size in case of emergency seal)

KEY PROPERTIES

NLGI Grade	000
Dropping Point, °C	164
Oxidation stability, kgf/cm²	0.35
Copper Corrosion @ 100°C, 24h	No Tarnish
Penetration, Worked @ 25°C	460
Evaporation loss, wt%	7.5
Package (kg)	15

B.) Place the valve in the fully closed position and drain the valve body using the steps given in section **Chapter VI. Periodic inspection Section 2.4.1 Draining Procedure**. fitting.

C.) Remove the cap from the grease zerk, taking care not to unscrew the actual grease fitting.

D.) Load the g/s into your grease gun.

* Note: Thoroughly familiarize yourself with the workings of your grease gun by reading the Manufacturer's manual. Proper use will help prevent injuries and extend the life of your grease gun significantly.

E.) Attach the button head grease fitting to the grease zerk on the valve and pump the g/s into the valve through the grease zerks.

F.) Replace the cap onto the grease zerk once a sufficient amount of g/s has been added.

G.) Repeat above steps "A ~ F" for each of the grease zerks on the

Valve body.

H.) Once lubrication is complete, the valve should be cycled 2-3 times and checked to see if sealing has been restored.

* Note: the use of g/s to repair a leaking valve should be carefully considered by the owner/operator of the piping system. g/s may be a viable long-term alternative to valve repair in some circumstances depending on how critical the service requirement may be. for valves where drop tight sealing is important to prevent injuries, death, environmental hazards, or costly damage, etc. g/s should only be used as a temporary solution, and the valve should be promptly repaired by a qualified valve repair specialist.

The lubricant / sealant must be displaced before the heavier sealant fills the sealant system. The same calculations used for injecting valve cleaner are applicable (one (1 oz.) ounce per inch of valve size into each seat ring plus riser pipe quantities).

2.4.6. Recommend Spare parts for Repair.

- Table A (Recommend Spare parts for Repair) -

Part No	Parts	Q'ty	Part No	Parts	Q'ty
8	GLAND PACKING	1	45A	O-RING	1
19A	GASKET	1	45B	O-RING	1
19B	GASKET	1	45C	O-RING	1
19C	GASKET	1	45D	O-RING	2
150	SEAT RETAINER	1set	45E	O-RING	2
151	RETAINER RING	1set	45F	O-RING	1

*Note: See the Chapter Ⅶ. Disassembly and Reassembly Section 3. Cross-sectional assembly drawing.

* Note: The table represents only a typical part of the Force Trunnion valve. Should repair (that is not solved by flushing or sealant injection) become necessary, please obtain the valve part number and serial number, and contact the manufacturer or manufacturer's representative.

2.5 Reassembly

Refer to Chapter VII for reassembly procedure.

2.5.1. Valve test and inspection

Confirm the following items for test and inspection before and after maintenance operation.

2.5.2. Operation test

(1) Check smooth operation of valves without galling or sticking of internal valve components.

(2) Check that the stem is firmly assembled with the ball.

(3) Ensure that there should be no offset of the ball ports and ball seats at the fully open position. The ball should not be protruded into the valve port other than the rounded surface of the ball port edges.

2.5.3 Shell test and seat leakage test

(1) Care for shell test and seat leakage test.

⚠ CAUTION	
	• Wear protective items such as goggles, gloves and working boots. • Before shell test and seat leakage test, take some precautions for operators' safety.

(2) Shell test and seat leakage test

All valves should be subjected to a hydrostatic or pneumatic shell test and seat leakage test at the required test pressures afterreassembly.

Refer to API 598 or EN 12569 for test methods and procedures.

Ⅶ. Disassembly and Reassembly

7.1 BTN series Trunnion ball valve

7.1.1 Disassembly procedures

1.1 **Care for disassembly.**

⚠ WARNING	
	• Operator should take an appropriate caution for not being exposed to the fluid or caching fire.

⚠ CAUTION	
	• Wear protective items such as goggles, gloves, and work boots. • Pay attention not to catch fingers during disassembly. • When disassembling valves of big mass one, use an appropriate lifting machine for safety operation.

1.2 Before disassembly

1.2.1 Place the valve in a dust-free area.

1.2.2 Take care not to damage the flange surfaces, ball, and stem.

1.2.3 Give identification marks on edges of the coupled flanges for adequate and easy coupling of the body and the body cap on subsequent reassembly.

1.2.4 If bolting is found seized or stuck to each other because of rust, apply some lubricant and leave it for a while for easier unthreading.

1.3 Disassembly sequence.

1.3.1 Depressurizing the valve interior.

1.3.2 Disassembly of the gland

1.3.3 Disassembly of the stem.

1.3.4 Disassembly of the bottom stem.

1.3.5 Disassembly of the body cap.

1.3.6 Disassembly of the ball.

1.3.7 Disassembly of the ball seats.

1.4 Disassembly

1.4.1 Before disassembly, partially open the valve and loosen the plug to reduce the internal pressure trapped inside of the valve to a safe level. After having confirmed reduction of the internal pressure to a safe level, remove the plug and drain the line fluid and other internal residue remaining inside the valve.

1.4.2 Hold the ball in fully closed position.

1.4.3 The gland is clockwise threaded into the gland plate. Loosen the gland counterclockwise by lightly hammering the tool placed on its groove as illustrated below.

1.4.4 Remove the gland plate and then the stem together with the stem bearing and other adjacent parts.

If it is difficult to remove these parts, make use of the threaded tap on top of the stem and follow the procedure shown below. (Refer to the figure below)

(1) Firmly screw a bolt into the threaded tap on top of the stem and secure it with a nut.

(2) Assemble a wooden board, pipe, steel plate, washer and nut as illustrated below.

(3) Tighten the nut clockwise to easily remove the upper stem from the body.

1.4.5 Remove the end plate. Pull out the sub-assembled small parts first, and then the bottom stem.

The top of the bottom stem is also provided with threaded tap for easier removal. Please refer to the previous page for its procedure. The figure shown below illustrates the construction of the bottom stem area.

1.4.6 Place the valve on the floor with the body flange facing the floor.

(1) Loosen the cap nuts evenly and alternately in a star pattern until the seat springs lose their loading force.

(2) Remove the nuts after the seat springs lose their loading force.

(3) Some of the ball valves, depending on their size and nominal pressure, are provided with lifting lugs mounted with flange bolting. As lifting lugs are factory-mounted at the most convenient locations, be sure to mark their locations during disassembly for easier subsequent reassembly.

(4) Lift out the body cap slowly, confirming that the seat retainer and its sub-assembly, which has been housed with the body cap, is now exposed left on the ball. If the seat retainer sub-assembly is still left within the body cap, lightly hammer the body cap to detach the seat retainer sub-assembly. Never leave the seat retainer sub-assembly within the body cap. If it is difficult to remove the seat retainer sub-assembly, life out the

body cap carefully not to drop off the seat retainer sub-assembly and place it on the floor with the seat retainer facing upside then remove the seat retainer.

1.4.7 Here the ball port is disclosed. Put a cloth belt into the port and lift the ball slowly. Take care to prevent the ball surface from damage or scratch during disassembly, storage and subsequent reassembly.

1.4.8 Remove the seat retainer sub-assembly from the body. Mark the removed seat retainers for proper identification with the body or the body cap.

1.4.9 Remove the O-rings from the body and body cap or seat retainer.

1.4.10 Remove the boll seats from the seat retainer sub-assembly as described below. Unthread the set bolts and unscrew the retainer rings. Remove the ball seats from the seat retainer.

7.1.2 Reassembly procedure

1.5 Care for reassembly.

⚠ CAUTION	
	• Wear protective items such as goggles, gloves and work boots. • No open flame or smoking should be allowed in the work area. • Pay attention not to catch fingers during reassembly. • Ensure to replace consumable parts for new ones, such as the gland packing rings, gaskets, O rings, back-up rings, ball seats, thrust washers, stem bearings and gland bushes. Reuse of these parts may cause leakage. • When reassembling valves of big mass one, use an appropriate lifting machine for safety operation.
	• In case the valves are to be used for oxygen service, do not apply lubricant to all valve interior and valve internal parts which will directly contact the media. Use fluorine base lubricant for moving parts and O rings.

1.6 Before reassembly.

1.6.1 New parts for replacement should be prepared beforehand.

1.6.2 The consumables (gland packing rings, gaskets, O rings, backup rings, ball seats, thrust washers, stem bearings, gland bushes, retainer packing and retainer rings) should be replaced with new ones. Reuse of these parts may cause leakage.

1.6.3 Be sure to clean the parts to remove dust, oil, and other foreign objects, in case the parts are reused. Ensure to remove rust and other soils out of the seat retaining area of the body and the body cap to have satisfactory sealing performance.

1.6.4 For carbon steel and low alloy steel valves apply rust preventative to the inner surface of the body and body cap, including stem holes. To O-rings and adjacent areas, apply lithium soap grease lubricant unless otherwise specified. To set bolts, apply them to prevent losing.

1.6.5 Assemble the valve in a dust-free area.

1.6.6 Take care not to damage flange surfaces, ball, ball seat, stem, and all internal machined parts.

1.6.7 Ensure to mating the marks given before disassembly.

1.6.8 Keep in mind that all threads should be securely tightened.

1.7 **Reassembly sequence.**

1.7.1 Reassembly of the cap bolts.

1.7.2 Reassembly of the ball seat.

1.7.3 Reassembly of the seat retainer on the body side.

1.7.4 Reassembly of the stem.

1.7.5 Reassembly of the seat retainer on the body cap side.

1.7.6 Reassembly of the body cap.

1.7.7 Reassembly of the small parts around the stem and bottom stem.

1.8 **Reassembly procedure**

1.8.1 Place the cap bolts to the valve body, tightening them securely.

1.8.2 According to Figure below, assemble the seat retainer, a new ball seat, the set bolt, the retainer ring, the seat springs, the retainer packing and the O-ring. Securely tighten the set bolt so that the ball seat stays in the seat retainer satisfactorily.

1.8.3 Insert the seat retainer sub-assembly into the valve body. Lift the ball with a cloth belt and place it into the valve body slowly with care to protect it from damage or scratch.

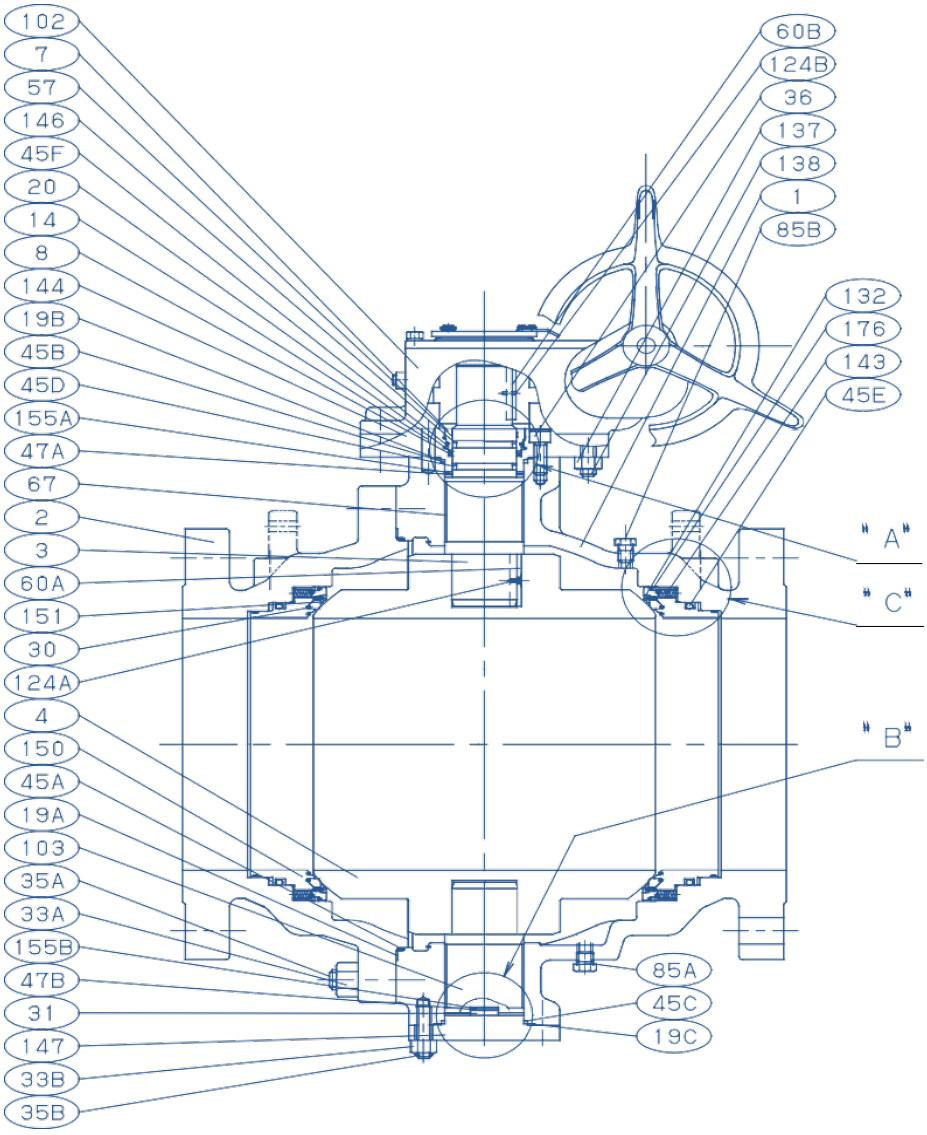
1.8.4 Adjust the location of the stem hole of the ball by means of a hydraulic press machine for correct centering with the stem hole of the valve body. Protective measures such as a soft pad should be taken to prevent the ball surface from contact to the hydraulic press machine. Assemble the stem and bottom stem through the stem holes of the body, after the stem bearing and other small parts have been assembled.

1.8.5 Place the seat retainer sub-assembly on the ball. Adjust the location of the ball seat for correct alignment with the body.

1.8.6 Place the O ring and gasket in the coupling flanges of the body and body cap. Lift the body cap with a crane and lower it slowly on the seat retainer while adjusting it for correct alignment with the ball seat. Evenly tighten the cap bolt nuts alternately and gradually in a star pattern.

1.8.7 Ensure all threaded parts are securely tightened. Retighten them if any loosened parts are found.

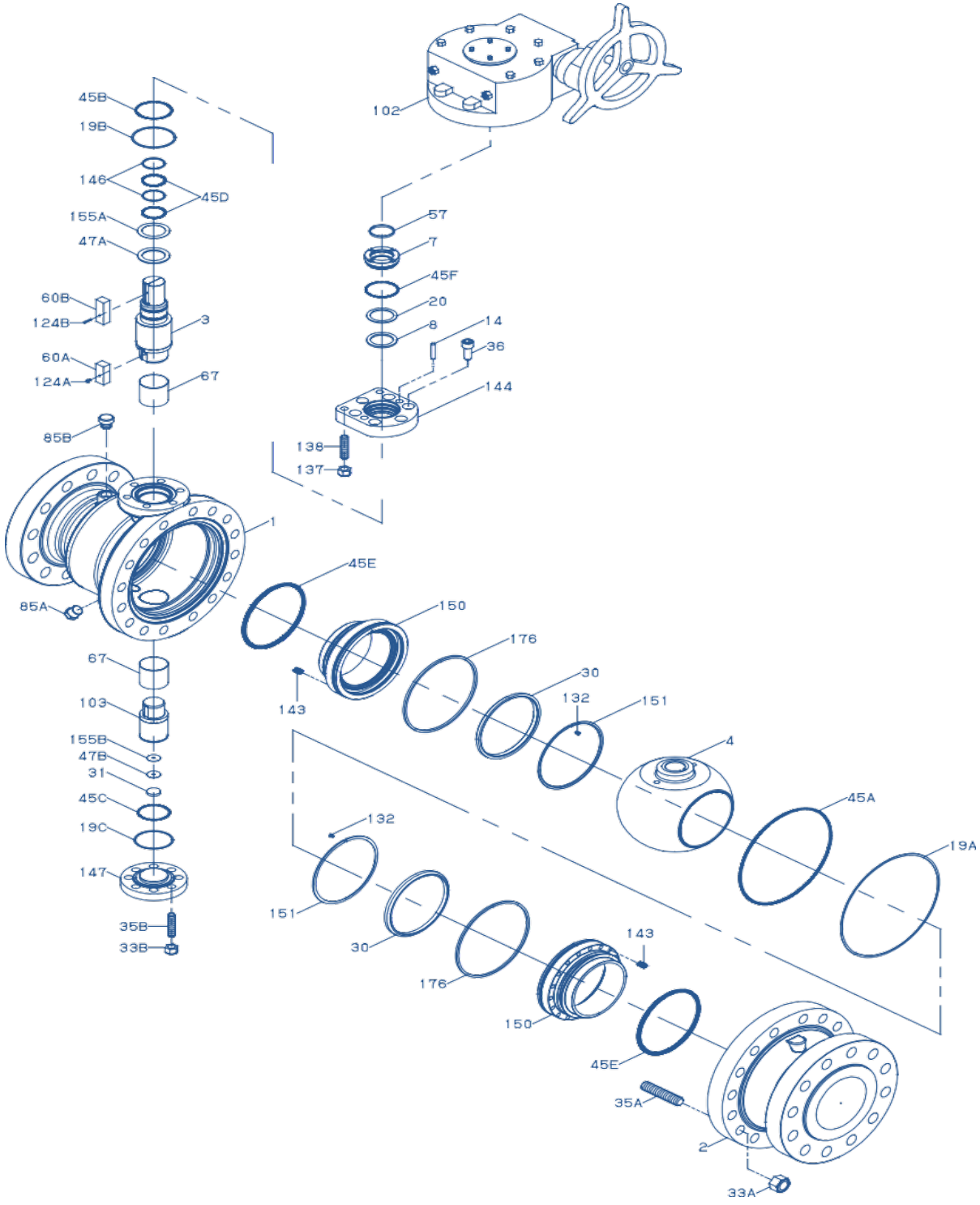
B. Assembly drawing (BTN series Trunnion ball valve)



This drawing represents only a typical construction of the valve.
Please refer to the approved drawing for assembly and disassembly.

NO.	NAME OF PARTS	QTY
1	BODY	1
2	BODY CAP	1
3	STEM	1
4	BALL	1
7	GLAND	1
8	GLAND PACKING	1
14	SET PIN	1S
19A	GASKET	1
19B	GASKET	1
19C	GASKET	1
20	PACKING WASHER	1
30	BALL SEAT	2
31	STEM WASHER	1
33A	CAP NUT	1S
33B	COVER NUT	1S
35A	CAP BOLT	1S
35B	COVER BOLT	1S
36	GLAND BOLT	1S
45A	O-RING	1
45B		1
45C		1
45D		2
45E		2
45F		1
47A	THRUST WASHER	1
47B	THRUST WASHER	1
57	GLAND BUSH	1
60A	KEY	1
60B	KEY	1
67	STEM BEARING	2
85A	PLUG	1
85B	PLUG	1
102	GEAR UNIT	1
103	BOTTOM STEM	1
124A	SET BOLT	1
124B	SPRING PIN	1
132	SET BOLT	2
137	NUT	1S
138	BOLT	1S
143	SEAT SPRING	2S
144	GLAND PLATE	1
146	BACK-UP RING	2
147	END PLATE	1
150	SEAT RETAINER	2
151	RETAINER RING	2
155A	SHIM	1S
155B	SHIM	1S
176	RETAINER PACKING	2

C. **Exploded view drawing (BTN series Trunnion ball valve)**



This drawing represents only a typical construction of the valve. Please refer to the approved drawing for assembly and disassembly.

7.2 BF series Trunnion ball valve

7.2.1 Disassembly procedures (Floating)

1.1 Care for disassembly.

⚠ WARNING	
	• Operator should take an appropriate caution for not being exposed to the fluid or caching fire.

⚠ CAUTION	
	• Keep valves fully open position during valve swing-away in order to protect the ball surface. • Wear protective items such as goggles, gloves and working boots. • Pay attention not to catch fingers during disassembly.

1.2 Disassembly procedure

1.2.1 Full open the valve.

1.2.2 Remove the cap bolts (B01), then disassemble the body (001) and body cap (002). It is available to swing away the body from the body cap loosening bolts and remove bolt.

1.2.3 Remove the gasket(s02) and ball seats (015) from the body (001).

1.2.4 Full close the valve and remove the ball (004) from the body (001).

1.2.5 Remove the handle nut (B21), washer (B21), lever handle(P04) and gland from the stem (005) or the body (001).

1.2.6 Push the stem (005) down into the body cavity to remove it from inside the body (001).

1.2.7 Remove the packing (S01) from the body (001).

1.2.8 Remove the thrust washer (P01) and o-ring(s07) from the stem (005) or the body (001).

Ⅶ. Disassembly and Reassembly

7.2.2 Reassembly procedure

3.17 Care for reassembly.

⚠ CAUTION	
	• Wear protective items such as goggles, gloves and work boots. • No open flame or smoking should be allowed in the working area. • Take care not to catch fingers in flanges during assembly. • Soft parts such as packing, o-ring, ball seat and thrust washer shall be replaced to the new one. It may cause the leakage when they are reused.
	• DO NOT apply the lubricant to the pipes and any parts of contact with fluid, which handles oxygen.

3.18 Before reassembly.

3.18.1 Check all parts before assembly.

3.18.2 If any problem is detected, replace the valve.

3.18.3 Prepare new soft parts (ball seat, packing, o-ring and thrust washer) before assembly.

3.18.4 Clean all parts for reuse to thoroughly remove dust and other foreign objects.

3.18.5 Assemble the valve in a dust-free area.

3.18.6 Take care not to damage all parts especially the ball, ball seats and stem.

3.18.7 Keep in mind that all threads should be secure.

3.19 Reassembly procedure

3.19.1 Mount the thrust washer (s21) and o-ring(s07) on the stem (005).

3.19.2 Assemble the stem (005) into the body (001) from the body interior. Ensure that the stem collar securely contacts the body and place the stem (005) in a closed position.

3.19.3 Assemble the packing (s01) to body (001) and tighten it by the gland (011,012).

3.19.4 Assemble the lever handle (p04) and washer (p01) to the stem (005), then tighten the handle bolt (b21) temporarily. Keep the valve fully closed position.

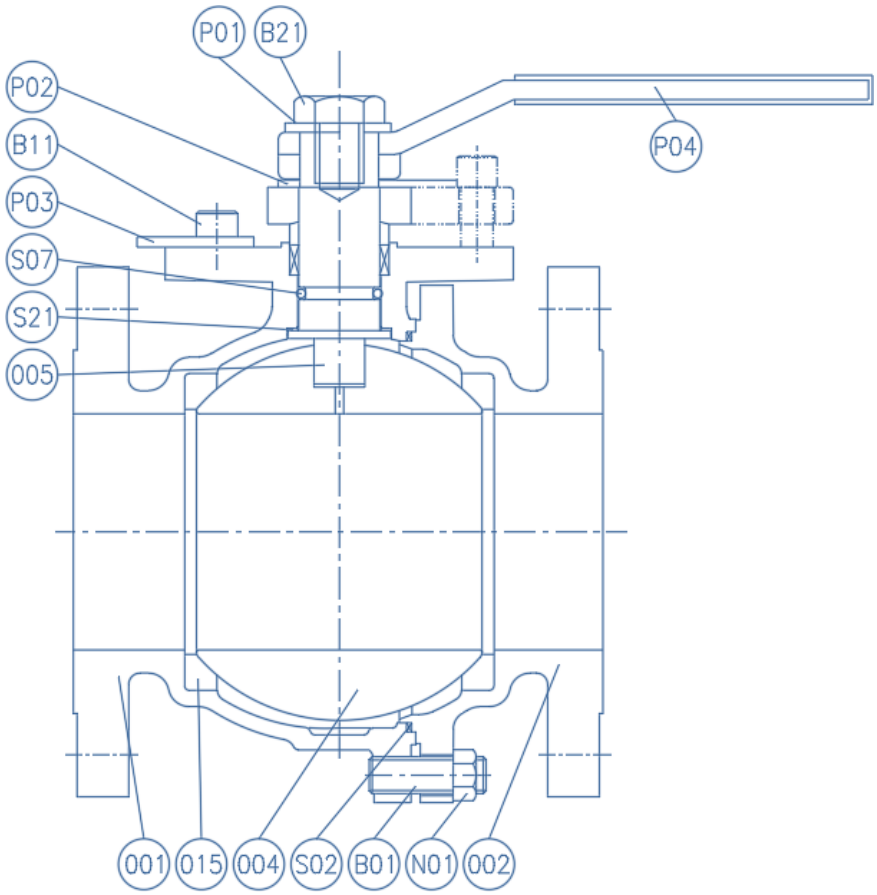
3.19.5 Place the ball (004) into the body (001) while connecting to stem.

3.19.6 Open the valve then assemble the ball seats on the body (001).

3.19.7 Securely screw the hexagonal bolts (b01) and nuts (n01) after body (001) install between the two body caps. Bolts/nuts should be tightened evenly, gradually, and alternately in a star pattern.

3.19.8 Tighten the handle bolt (b21). Through the inspection, finally to protect the bore with plastic/wooden caps and deliver the valves to the test area for pressure testing.

4 Assembly drawing (BF series Floating Type)



NO.	NAME OF PARTS	QTY
001	BODY	1
002	CAP	1
004	BALL	1
005	STEM	1
011	GLAND RING	1
012	GLAND FLANGE	1
015	SEAT RING	2
S01	PACKING	1S
S02	GASKET-A(CAP)	1
S07	O-RING(STEM)	1
S21	T/WASHER-A	1
S29	SNAP RING	1
P01	TOP WASHER	1
P02	STOPPER	1
P03	LOCKING PLATE	1
P04	LEVER	1
B01	CAP BOLT	1S
N01	CAP NUT	1S
B11	LOCKING PLATE BOLT	2
B21	TOP BOLT	1
B12	GLAND BOLT	2

7.3 BU series Floating ball valve

7.3.1 Disassembly procedures

1.1 Care for disassembly.

⚠ WARNING	
	• Operator should take an appropriate caution for not being exposed to the fluid or caching fire.

⚠ CAUTION	
	• Keep valves fully open position during valve swing-away in order to protect the ball surface. • Wear protective items such as goggles, gloves and work boots. • Pay attention not to catch fingers during disassembly.

1.2 Disassembly procedure

1.2.1 Full open the valve.

1.2.2 Remove the insert (002) from the body (001) by turning it.

1.2.3 Remove the o-ring (S07), ball seats (015), gasket(s02) from the body (001).

1.2.4 Full close the valve and remove the ball (004) from the body (001).

1.2.5 Remove the handle bolt (B21), washer (B21), lever handle(P04) and gland from the stem (005) or the body (001).

1.2.6 Push the stem (005) down into the body cavity to remove it from inside the body (001).

1.2.7 Remove the packing (S01) from the body (001).

1.2.8 Remove the thrust washer (P01), o-ring(s07) from the stem (005) or the body (001).

7.3.2 Reassembly procedure

1.3 Care for reassembly.

⚠ CAUTION	
	• Wear protective items such as goggles, gloves and work boots. • No open flame or smoking should be allowed in the working area. • Take care not to catch fingers in flanges during assembly. • Soft parts such as packing, o-ring, ball seat and thrust washer shall be replaced to the new one. It may cause the leakage when they are reused.
	• DO NOT apply the lubricant to the pipes and any parts of contact with fluid, which handles oxygen.

1.4Before reassembly.

1.4.1 Check all parts before assembly.

2.4.1 If any problem is detected, replace the valve.

3.4.1 Prepare new soft parts (ball seat, packing, o-ring and thrust washer) before assembly.

4.4.1 Clean all parts for reuse to thoroughly remove dust and other foreign objects.

5.4.1 Assemble the valve in a dust-free area.

6.4.1 Take care not to damage all parts especially the ball, ball seats and stem.

7.4.1 Keep in mind that all threads should be securely.

1.5Reassembly procedure

1.5.1 Mount the thrust washer (s21) and o-ring(s07) on the stem (005).

2.5.1 Assemble the stem (005) into the body (001) from the body interior. Ensure that the stem collar securely contacts the body and place the stem (005) in a closed position.

3.5.1 Assemble the packing (s01) to body (001) and tighten it by the gland (011,012).

4.5.1 Assemble the lever handle (p04) and washer (p01) to the stem (005), then tighten the handle bolt (b21) temporarily. Keep the valve fully closed position.

5.5.1 assemble the ball seats on the body.

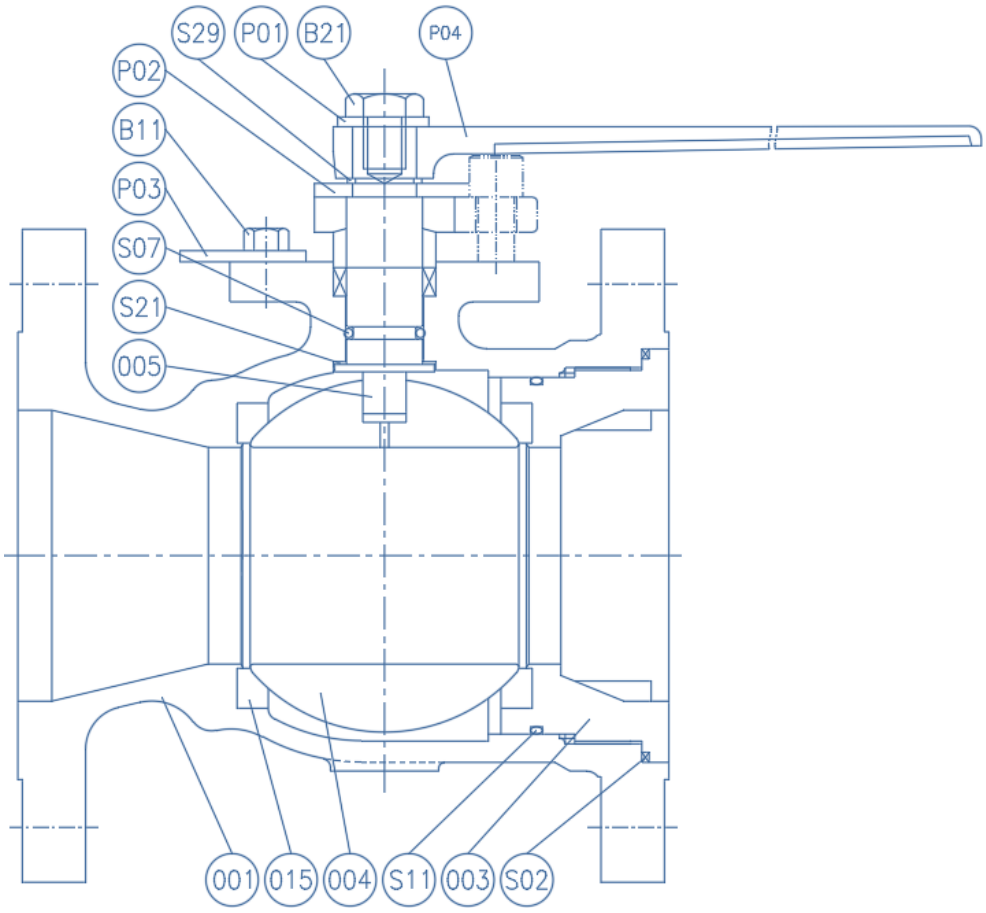
6.5.1 Place the ball (004) into the body (001) while connecting to stem.

7.5.1 assemble the seats (015) on the insert(002)

8.5.1 Tighten by turning the insert.

9.5.1 Tighten the handle bolt (b21). Through the inspection, finally to protect the bore with plastic/wooden caps and deliver the valves to the test area for pressure testing.

8 Assembly drawing (BU series Floating Type)



NO.	NAME OF PARTS	QTY
001	BODY	1
002	INSERT	1
004	BALL	1
005	STEM	1
011	GLAND RING	1
012	GLAND FLANGE	1
015	SEAT RING	2
S01	PACKING	1S
S02	GASKET	1
S07	O-RING(STEM)	1
S11	O-RING(BODY)	1
S21	T/WASHER-A	1
S29	SNAP RING	1
P01	TOP WASHER	1
P02	STOPPER	1
P03	LOCKING PLATE	1
P04	LEVER	1
B01	CAP BOLT	1S
N01	CAP NUT	1S
B11	LOCKING PLATE BOLT	2
B21	TOP BOLT	1
B12	GLAND BOLT	2

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