STANDARD LOW EMISSION FORGED STEEL GATE, GLOBE AND CHECK VALVE

INSTALLATION, OPERATION & MAINTENANCE MANUAL

SEPTEMBER 2016

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1.0. Introduction

Choosing the correct valve for a particular operation or service is very important; however, it is not within the scope of this document to provide information regarding valve selection. It is the intent of this manual to provide detailed information directed towards proper installation, operation, and maintenance of Bonney Forge forged steel valves.

The types of valves discussed herein are:

- Gate Valves: Used in the fully open or fully closed position for on-off service.
- Globe Valves: Used for throttling control as well as on-off service.
- Self-Actuated Check Valves: Used to prevent backflow (fluid flow reversal).

With proper care and regular maintenance, users can expect long life and excellent performance from all Bonney Forge valves.

NOTICE	If major repairs become necessary, it is recommended that the valves be returned to the factory for inspection and possible rework.

NOTICE	In addition to the installation, operation, and maintenance instructions provided herein, further guidance and information on these topics can be found in MSS SP-92, *MSS Valve User Guide*, published by the Manufacturer's Standardization Society (MSS). Information in this manual that was extracted from MSS SP-92 is indicated by a footnote.

2.0. Receiving, Handling, and Storage

Bonney Forge forged steel valves are packaged in a variety of manners:

- Cardboard boxes
- Cardboard boxes and palletized
- Wooden Containers

The packing method depends on factors such as valve size/weight, purchase order quantities, and customer packing requirements. All valves are carefully and securely packaged in a manner to prevent damage during shipment. Gate and globe valves are shipped in the closed position.

2.1. Receiving and Handling

Upon receipt of shipment, verify the integrity of the boxes or containers, examine external package markings, and verify the presence of a packing list.

- Open boxes or remove the container lid using suitable hand tools.
- Check contents for valve type, size, class, material, and quantity against the packing list.
- Inspect the condition of all valves for shipping damage. If the end protectors have been removed for inspection purposes, they must be re-installed to maintain internal cleanliness.

NOTICE	If the caps are missing, an inspection of the valve cavity is required. Foreign material must be removed. Valves should not be opened when cleaning prior to removal of foreign material. If cleaning of the valve is required, care must be taken as to the type of solvents used, particularly if the valve is to be connected to the line by welding. Solvents such as acetone or alcohol are recommended. Do not use solvents containing fluoride or chloride. Additionally, care must be taken to prevent damage to seating surfaces during cleaning. Removal of foreign material from the valve and areas around the seats is critical. Any foreign material that cannot be removed around or on the seating areas may require the valves to be disassembled and repaired at a Bonney Forge approved modification shop.

NOTICE	Care shall also be taken in the proper handling of valves to prevent damage. Valves should never be thrown or dropped. Lifting the valve by the stem is not advisable and, for larger valves, lifting the valve by the hand wheel or the packing gland flange is not recommended.

2.2. Valve Storage

All Bonney Forge carbon steel and alloy steel forged valves are shipped from the factory with a phosphate coating on un-machined surfaces and with a rust preventative sprayed on machined surfaces. In addition, plastic end protectors are installed on both end connections for protection from damage and to prevent entrance of foreign materials into the valve.

Valves received in the above condition and in their original shipping containers may be stored for up to one year with no additional protection; provided they are stored indoors, above floor level, and in a low humidity atmosphere.

NOTICE	If the valves are removed from their original shipping containers, they should be placed above floor level on suitable storage shelves.

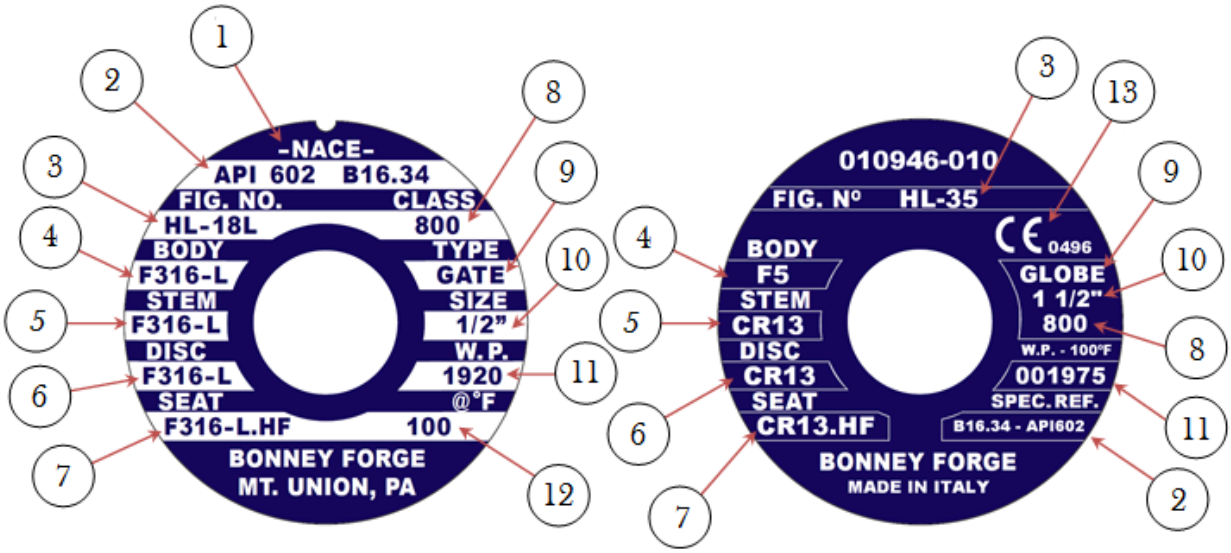
If valves are to be stored indoors for a longer period of time in a high humidity atmosphere, it is suggested that each item be periodically inspected, inside and out, for rust and/or corrosion.

The valves should be cycled open and closed, during which time each valve stem should be inspected for corrosion. Any external rust and/or corrosion should be removed by cleaning the affected area with a wire brush followed by the application of a suitable rust preventative.

3.0. Valve Identification

Each Bonney Forge valve is identified with a nameplate, which is placed over the hand wheel and secured with the hand wheel nut on gate and globe valves, and riveted to the cover on check valves.

Below are (2) examples of Bonney Forge nameplates, the nameplates differ depending on where the valve was manufactured.



1. NACE marking indicating the valve is in compliance with NACE MR0103 & MR0175.
2. Applicable Design Codes.
3. Bonney Forge Valve Figure Number
4. Shell Material (e.g. Body, Bonnet)
5. Stem Material
6. Closure Member Material (In case of hard face overlay, “HF” will be marked.)
7. Seat Material (In case of hard face overlay, “HF” will be marked.)
8. Rated Pressure Class
9. Valve Type
10. Nominal Pipe Size
11. Maximum Working Pressure (PSI) at Reference Ambient Temperature per ASME B16.34
12. Reference Ambient Temperature per ASME B16.34
13. CE Marking which complies with the requirements of European Pressure Equipment Directive 97/23/EC.

4.0. Installation

4.1. Preliminary Installation Considerations

Bonney Forge Valves are tested and shipped ready for installation. Prior to installation, consideration shall be given to the following:

- Only experienced, trained personnel should install, operate, and perform maintenance on all valves.
- Observe all State and Local Codes as well as National Standards and Safety Procedures that pertain to the installation of all valves.
- Always use tools to the intent for which they were designed, to prevent damage to the valve, and to prevent injury or death to the user.
- Examine valve nameplate and tags to ensure the correct valve is being installed.
- Remove all end protectors.
- Inspect the inside of the valve for cleanliness through the valve end ports. Remove any debris or foreign material. See Section 2.1.
- Consult flow arrows marked on valve body for proper installation.
- Packing stud bolt nuts must be tightened to the correct torque shown in Table 3 prior to operation.

⚠ CAUTION Packing gland bolts may loosen during shipment. Installing a valve with loose packing nuts can result in packing leakage.

4.2. Valve Connection Type

Depending on valve end configuration, three (3) basic installation procedures are used:

Welded Connection:

- Socket Weld - In accordance with ASME B16.11[1]
- Butt Weld - In accordance with ASME B16.25[1]

Screwed Connection:

- Threaded - In accordance with ASME B1.20.1 (Female NPT)[1]

Flanged Connection:

- Flanged - In accordance with ASME B16.5[1]

[1] Standard used unless otherwise specified.

Bonney Forge valves are manufactured from forged bodies and bonnets of carbon, alloy and stainless steel material. The materials have excellent welding properties, which allow the valves to be welded directly in the pipe run.

4.2.1. Valves Installed by Butt Weld or Socket Weld

These items require proper welding to insure a pressure tight seal and to retain their ability to withstand stress. The valve, pipe, and weld rod must be of compatible materials and the welding shall be performed by a certified welder using qualified welding procedures. The welds must be inspected as required by all applicable local and national codes and specifications.

NOTICE	Prior to welding, inspect the end surfaces to be welded for required dimensions, defects, and cleanliness and correct any condition that might interfere with assembly or satisfactory welding. Additionally, ensure the valve end and pipe end are properly aligned[1].

When welding socket end valves, be sure to leave 1/16" gap between the end of the pipe and bottom of the valve socket. This will allow for expansion of the material as it is welded. Since the valve body is compact, having a short end-to-end dimension, any extended welding time could cause excessive heat build-up on the valve seat area. This excessive heat build-up could cause damage; such as loosening of gate valve seat rings, surface distortion, etc. To avoid this problem, we suggest allowing the part to cool after each pass of the weld, to alternate welding passes from one valve to the next, and if possible to envelope the valve with wet cloth to decrease heat build-up.

⚠ CAUTION	It is recommended that the valve being welded **not** be located between the hot lead and the ground strap of the welding equipment. Failure to do so can cause arcing across the disc/seat and the stem/stem bushing areas, resulting in permanent damage or failure of the valve to operate. In addition, do **not** use yoke, hand wheel, or stem for welding ground. See Figure 1 for details.

Prior to welding, gate and globe valves should be tightened down to the closed position then opened approximately 1/16 of a turn after the hand wheel slack is run out. This will allow for material expansion as well as help hold the valve seats in place (on gate valves) while welding. The gate valve design is such that the valve seat rings are pressed in and swadged in place. Our experience shows there is a 10% to 15% risk of the seats becoming loose due to excessive heat or welding while the valve is in the open position, which may also result in valve seat leakage.

Additional considerations for welding in cold temperatures below 50°F (10°C) may require preheating to reduce condensation and the potential for localized cracking in welded areas.

[1] Paragraph extracted from MSS SP-92, with permission of the publisher, the Manufacturers Standardization Society.

NOTICE	Bonney Forge globe, piston, and ball check valves do not run the risk of seat loosening during welding due to the fact that they are supplied with integral Stellite body seats.

Subsequent to welding, clean and inspect the finished weld(s) and, if necessary, repair any defects using a qualified weld repair procedure. In addition, cycle the valve open-closed to check for proper operation, making sure no binding has occurred due to weld heat.

⚠ CAUTION	Special design valves, such as valves with PTFE packing and gaskets that have maximum temperature limits less than the valve, may require special welding and heat treatment considerations which are not included herein.

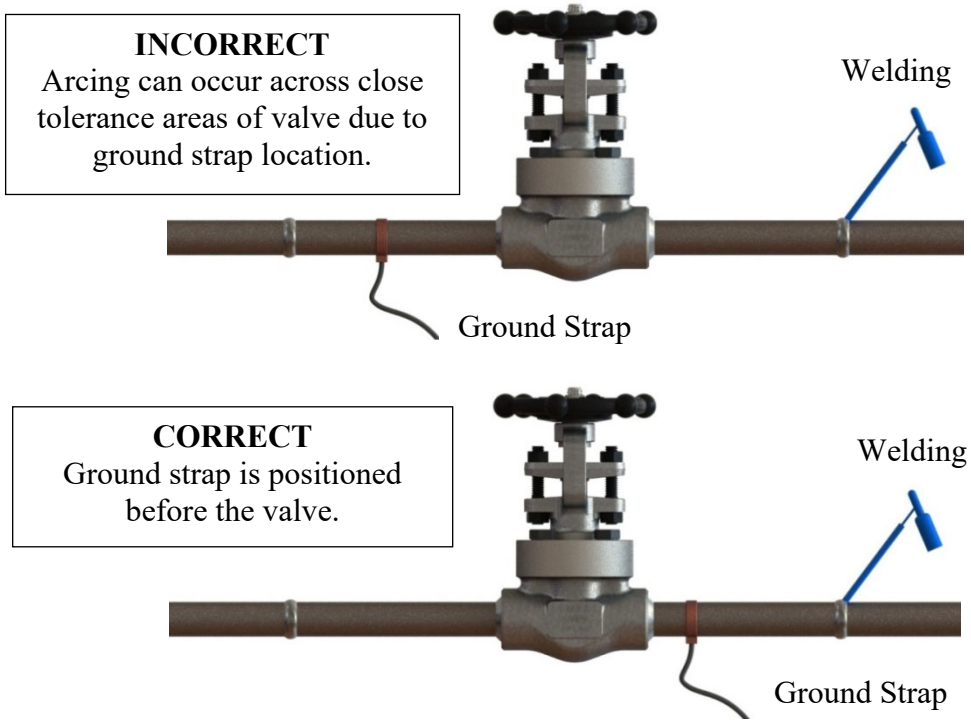


Figure 1 - Weld Set Up

4.2.1.1. Post Weld Heat Treatment (PWHT)

The recommended method of PWHT is via local ceramic resistance heaters, individually monitored with thermocouples. Thermocouples are attached to the weld or welds. Properly sized ceramic heaters are wrapped around the weld area, extending approximately 1/4" past the weld on the valve side. Do not wrap the valve body with a heating element. See Figure 2 for details. Wrap flexible insulation around valve ends, extending approximately 1/2" past the valve on the valves side. It is not recommended to wrap the entire valve body with insulation. Prior to heat input close the valve completely, then open the valve approximately 1/16 of a turn after the handwheel slack is run out. This very slight opening will allow the trim components to expand during the thermal cycle.

Following PWHT, inspect the valve for smooth operation by cycling open and closed. If possible, perform a seat closure pressure test prior to service operation.

ITEM	DESCRIPTION
1	THERMOCOUPLE
2	VALVE
3	FIBER INSULATION
4	CERAMIC HEATERS

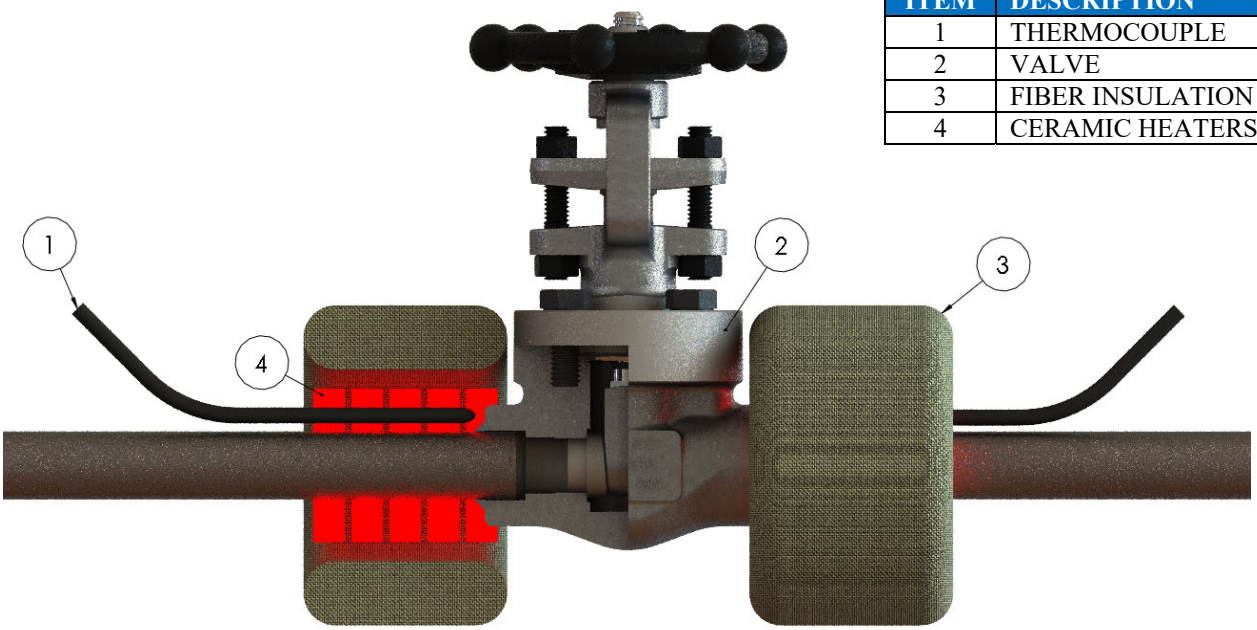


Figure 2 - Post Weld Heat Treatment

NOTICE	Bonney Forge does not make any recommendations in regards to the actual PWHT details of temperature and time. This work is not within the scope of the Bonney Forge Corporation. Bonney Forge recommends that all applicable "Piping Code" requirements be considered.

For alloy steel valves or when welding specification or service conditions require field PWHT, the valve may be ordered with pipe nipples already welded and heat treated in the factory before valve assembly. The specified PWHT can then be performed in line without affecting the valve.

4.2.2. Valves Installed by Threaded Connection

Inspect all threads on both the valve and the mating pipe for correct thread form (no thread damage) and cleanliness (no chips or grit present) before assembly[1]. Use a pipe thread compound during assembly, always applying the threading compound to pipe threads, never to valve threads.

Excess compound on pipe threads will be pushed out of the valve allowing easy removal, whereas excess compound on the valve threads will be pushed into the valve where it will be difficult to remove.

NOTICE	When installing threaded end valves, do **not** turn the valve by applying force to the bonnet, yoke, or handwheel. Proper pipe spanners or wrenches should be used, one engaging the valve and the other engaging the corresponding pipe.

NOTICE	Every attempt should be made to avoid possible damage to the valves and/or piping as a result of applying excessive wrenching forces during assembly[1]. Additionally, substantial wrenching forces should not be applied until the threads are properly engaged[1].

NOTICE	Open end wrenches should not be used on the valve. The valve may not be provided with hexagon or octagon ends and the end dimensions may not always correspond to wrench openings. For this reason, pipe spanners, Stillson type or similar wrenches of proper size, should be used.

4.2.3. Valves Installed by Flanged End Connection

Make sure the flanges are properly aligned (parallel) so that forcing the flanges together, which may damage the valve and/or pipe, is not necessary. Inspect the mating flange faces for radial grooves, dents, or any other condition that may cause leakage and correct any existing condition before assembling the flanges[1]. Also, inspect the gaskets for defects or damage.

Tighten the flange bolts in a crossover pattern as follows:

a) Slightly torque all bolts using a crossover bolt sequence. Bolts should be tightened evenly to prevent misalignment of the flanges and uneven gasket loading. Only one gasket shall be used between the contact faces of the flanged joint.

b) Repeat Step (a) using additional torque until all bolts are tightened properly. This may require additional crossover sequences since as one stud is torqued it will loosen the adjacent studs.

[1] Sentence extracted from MSS SP-92, with permission of the publisher, the Manufacturers Standardization Society.

⚠ CAUTION	If while tightening the bolts, the torque applied to each bolt has been increasing with each turn, then is found to remain unchanged or increase less with each turn, the bolt is yielding. The bolts should be scraped and replaced was they will no longer be able to hold the proper torque needed to maintain a preload[1].

Consult the appropriate Code (see Section 4.2) for the proper matching of flanges, bolting, and gaskets.

4.3. Valve Position

Positioning the valve in the pipe run is very important to ensure valve function and to prevent damage. Prior to installation, perform the following:

- Check for clearance around the valve to assure adequate room for proper operation/maintenance.
- Clean the system of all foreign matter. Whenever possible, blow out the pipe line with clean compressed air or flush it out with water to remove grit and dirt.
- Refer to the preliminary installation considerations outlined in Section 4.1.

4.3.1. Positioning Check Valves in the Pipe Run

These valves must be fitted in horizontal pipe runs with the cover facing vertically upward. Variance to either side of the vertical axis must not exceed five (5) degrees. Swing-check valves and spring-loaded check valve designs can be positioned in vertical pipe runs with upward flow.

NOTICE	Check valves must not be installed in a vertical down flow pipe run or in a horizontal pipe run with the cover in the vertical down position. Always install valves in the direction indicated by the flow arrow stamped on the body. See Figure 3 for details.

Flow disturbances caused by the system components (e.g. pipe fittings, discharge of pumps, etc.) can lead to valve chatter, which can cause rapid wear of seats and trim and ultimately lead to valve malfunction. Bonney Forge recommends that a sufficient distance be maintained between the check valve and any component that can cause flow disturbance as follows:

- System Components that Create Flow Disturbance – Examples are pumps, fittings, and valves. When installing a check valve near system components, Bonney Forge recommends a minimum of 10 pipe diameters of straight pipe between the upstream system component and the inlet of the check valve and a minimum of 2 pipe diameters of straight pipe between the downstream system component and the outlet of the check valve.

[1] Sentence extracted from MSS SP-92, with permission of the publisher, the Manufacturers Standardization Society.

- Pipe Bends and Transitions – Examples are elbows, tees, branch connections, and reducers. Bonney Forge recommends a minimum of 5 pipe diameters of straight pipe between the upstream system component and the inlet of the check valve and a minimum of 2 pipe diameters of straight pipe between the downstream system component and the outlet of the check valve.

4.3.2. Positioning Gate and Globe Valves in the Pipe Run

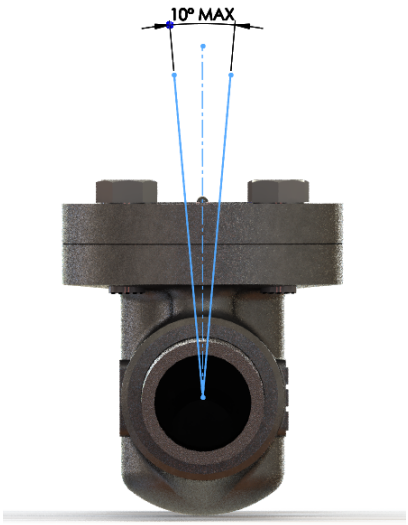
Gate and globe valves should be installed with the stem in a vertical up position on horizontal lines. Other acceptable stem positions are at an angle between the vertical and horizontal axis which still allows for complete drainage. If installed with the stem below the horizontal axis, complete drainage is not possible and solids may accumulate in the valve bonnet, which will greatly affect the valve operation and service life. Gate and globe valves may also be installed in vertical lines. See Figure 4 for details.

NOTICE	Unless marked with a flow arrow, gate valves can be installed in line with disregard to flow direction. Globe valves should be installed so that the arrow stamped on the body points in the direction of the fluid flow.

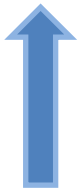
4.3.3. Purging and Testing of Line

Once the valve is in line, open the valve and flush or blow out the line again to remove any dirt or foreign objects which may have collected during installation. Check for tightness of body-bonnet bolts and for proper packing gland adjustment. Cycle the valve to ensure proper operation. Pressure test the valve to verify the integrity of all joints.

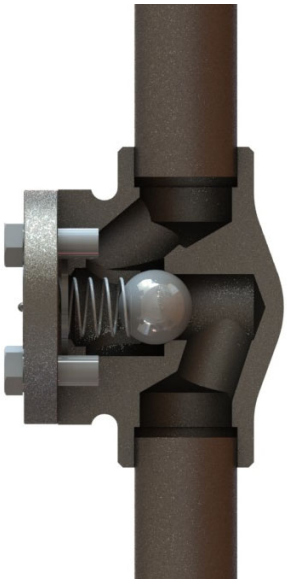
Horizontal Line with Flow Arrow



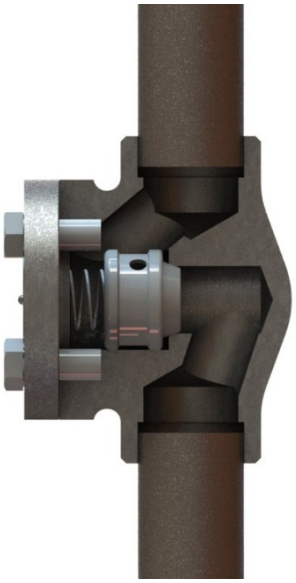
Maximum Rotation



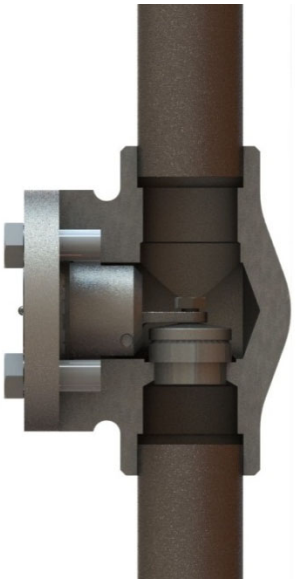
Flow Direction



Spring Loaded Ball Check



Spring Loaded Piston Check

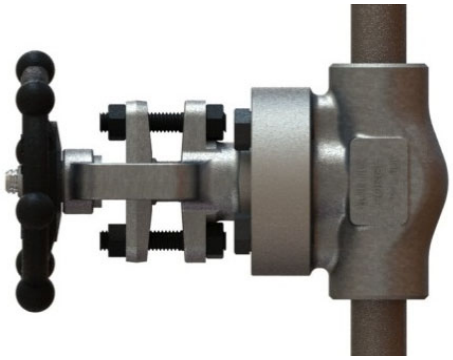


Swing Check

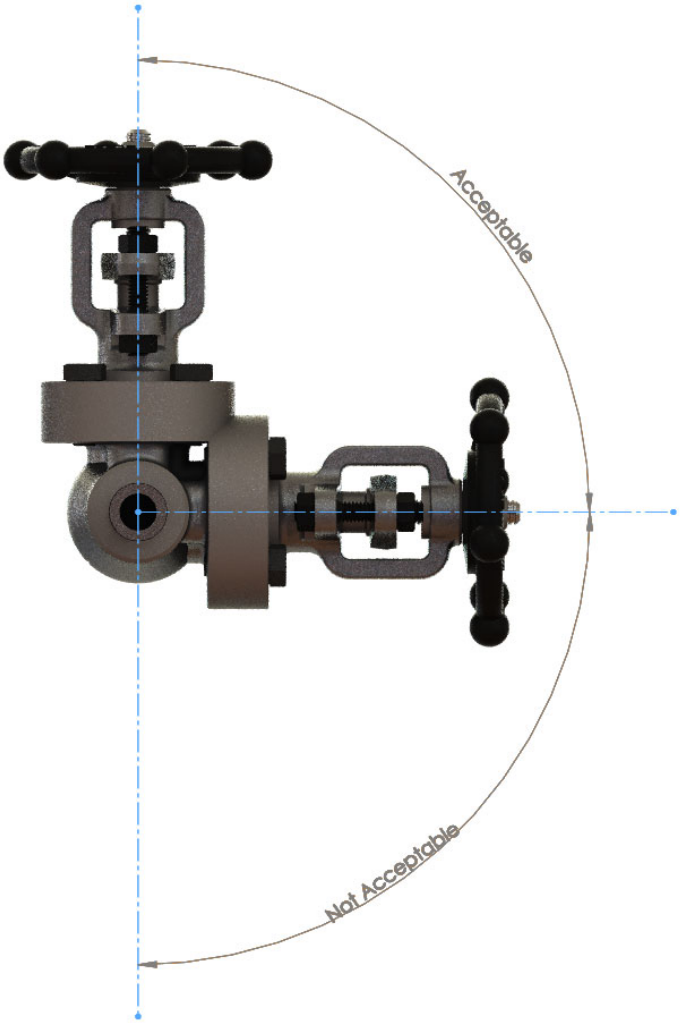
Note – Only spring loaded ball check valves, spring loaded piston check valves, and swing check valves may be installed in vertical runs of pipe. Flow must be upward.

Figure 3 - Check Valve Positions

Horizontal Line



Vertical Line



Maximum Rotation

Figure 4 - Gate and Globe Valve Positioning

5.0. Valve Operation

All Bonney Forge gate and globe valves have "open" and "closed" marked on the hand wheels along with directional arrow. Gate and globe valves may be opened by turning the hand wheel counterclockwise and closed by turning clockwise. The hand wheels are designed such that reasonable effort exerted by the operators is sufficient to operate the valve. Whenever possible, open and close the valve slowly. This is particularly important in piping systems containing liquids where rapid valve closure (alone or in combination with other factors) could lead to the possibility of an undesirable pressure surge ("water hammer") in the piping system.

NOTICE	After the valve has been opened fully, rotate the hand wheel 1/4 turn toward the closed position so the valve will not remain in the full back seated position. Allowing the stem to remain in the full back seated position may mask an unsatisfactory condition of the stem packing[1].

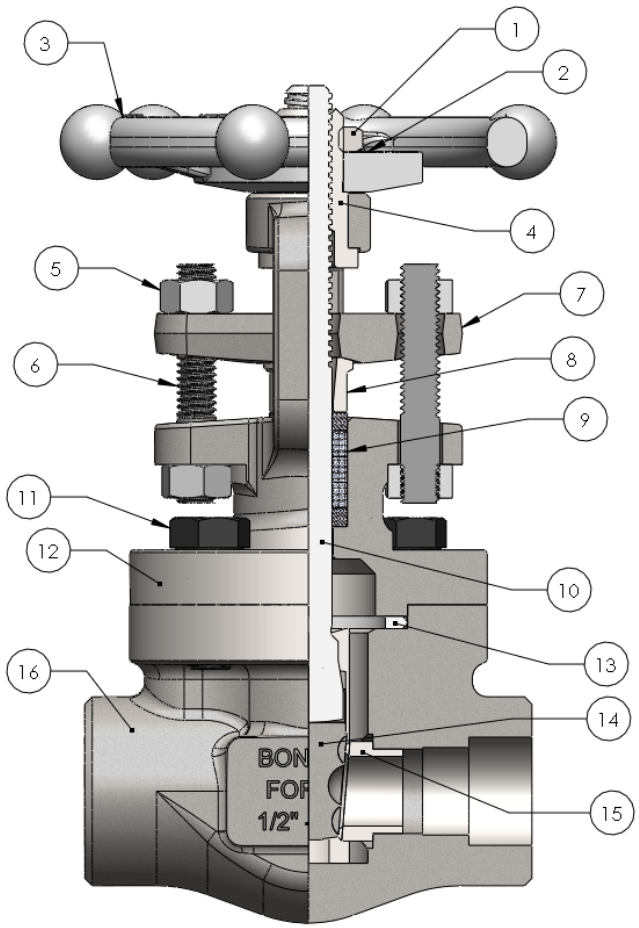
NOTICE	Never use a cheater bar on the hand wheel to stop leakage since this force can damage the stem and valve seats. Foreign materials may be trapped between the seats, which can permanently damage the seat.

Cold valves located on steam or hot fluid lines may leak slightly through the stem packing for a short time during startup. Do **not** immediately tighten the packing gland or nuts. Rather, allow the valve to heat up to its operating temperature. The leakage will generally stop within a few minutes. If leakage persists, consult the maintenance section of this manual. Sections 5.1 through 5.4 will help in the understanding of basic operation of common valves.

[1] Sentence extracted from MSS SP-92, with permission of the publisher, the Manufacturers Standardization Society.

5.1. Gate Valve

A typical outside screw and yoke (OS&Y) gate valve of bolted bonnet design is shown in Figure 5; an exploded view is shown in Appendix A. Flow through the gate valve is stopped by forcing the wedge (14) between the two seats (15). These seats (15) are pressed into the valve body (16) and are of a removable design. The end of the stem (10) fits into the slots on top of the wedge (14) which allows sufficient wedge movement for effective seating with the seat rings (15). The wedge (14) is guided through its entire travel by guides in the body (16). The stuffing box is located in the bonnet (12) and filled with packing rings (9). The packing (9) is compressed in the stuffing box and around the stem (10) by the packing gland (8) and the gland flange (7) which are forced down against the packing (9) by two adjustable gland studs (6) and stud nuts (5). The valve stem (10) threads are engaged with the yoke sleeve (4) and the yoke sleeve (4) is held in place with the hand wheel nut (1). The valve is opened by a counterclockwise rotation of the hand wheel (3).



ITEM	DESCRIPTION
1	HANDWHEEL NUT
2	NAME PLATE
3	HANDWHEEL
4	YOKE SLEEVE
5	GLAND NUT
6	GLAND BOLT STUDS
7	GLAND FLANGE
8	PACKING GLAND
9	PACKING
10	STEM
11	BOLTS
12	BONNET
13	GASKET
14	WEDGE
15	SEAT
16	BODY

Figure 5 - Typical Gate Valve (Bolted Bonnet Design)

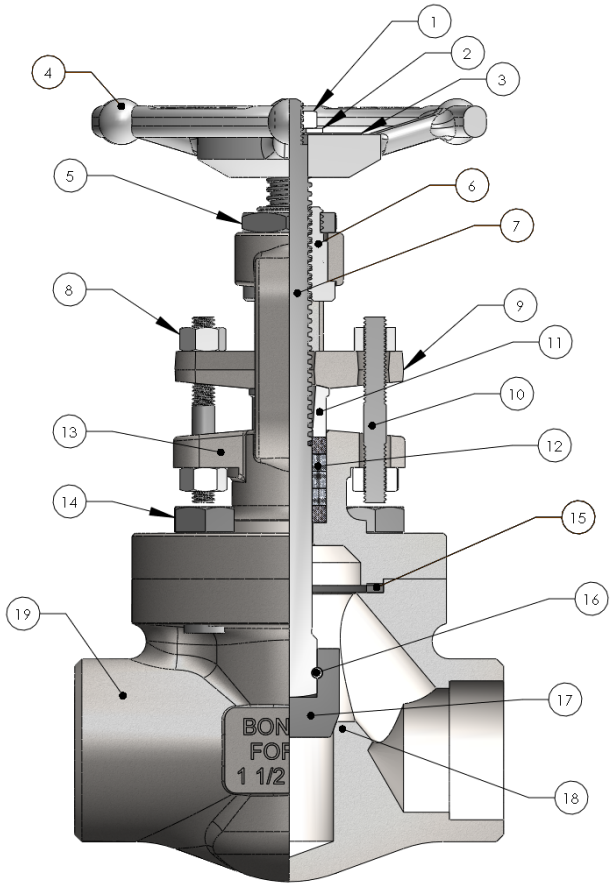
5.2. Globe Valve

A typical outside screw and yoke (OS&Y) globe valve of bolted bonnet design is shown in Figure 6; an exploded view is shown in Appendix B. The design of the globe valve is very similar to that of a gate valve and its operating characteristics are basically the same. The main difference being that, rather than a wedge, the globe valve employs a disc (17) as a means of controlling the flow. The disc (17) is connected to the stem (7) by means of a disc connecting ring (16). Another difference is that globe valves generally contain an integral seat (18) (renewable seats are also an option).

Because of the body's labyrinth design, the globe valve causes a larger pressure drop than a gate valve. Because of this, the globe valve is an excellent device for regulation of flow in the moderate to full flow range.

NOTICE Globe valves shall not be throttle at less than 20% open. Throttling at less than 20% can cause flow-induced vibration capable of damaging the valve.

NOTICE Globe valves should be installed only in the direction of flow indicated by the arrow stamped on the body.



ITEM	DESCRIPTION
1	HANDWHEEL NUT
2	WASHER
3	NAMEPLATE
4	HANDWHEEL
5	YOKE NUT
6	YOKE SLEEVE
7	STEM
8	GLAND NUT
9	GLAND FLANGE
10	GLAND BOLT STUD
11	PACKING GLAND
12	PACKING
13	BONNET
14	BOLTS
15	GASKET
16	WIRE CONNECTION
17	DISC
18	INTEGRAL SEAT
19	BODY

Figure 6 - Typical Globe Valve (Bolted Bonnet Design)

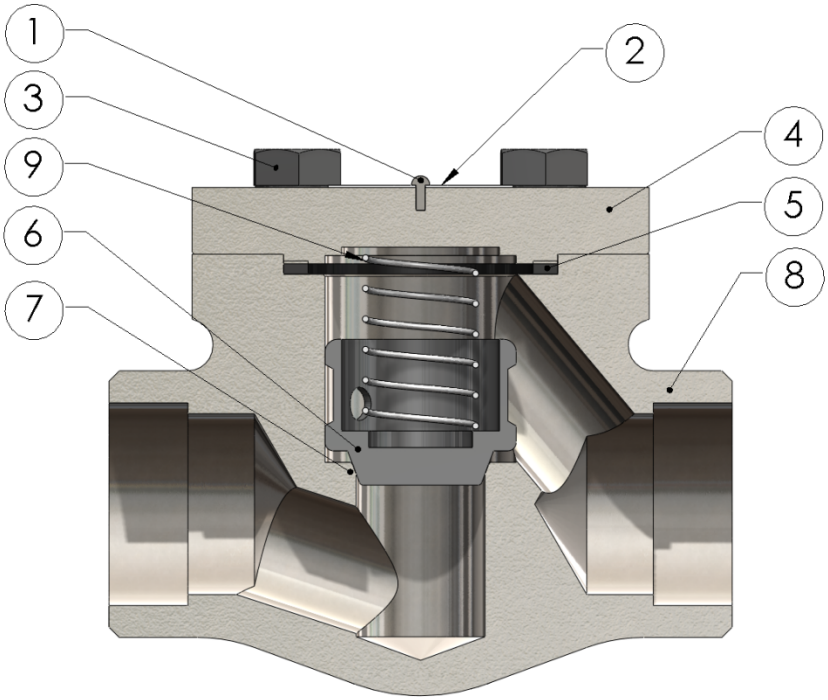
5.3. Piston Check/Ball Check Valve

A typical bolted bonnet piston check and ball check valve are shown in Figure 7; an exploded view is shown in Appendix C. The bodies (8) of the piston check valve and the ball check valve are of the same labyrinth design as that of the globe valve. The barrier to flow is a free moving piston (6) that is guided by the body (8) or a free moving ball (10) that is guided by the bonnet (4). The piston check and ball check valve also have an integral seat (7) (renewable seats also an option), against which either the piston (6) or the ball (10) seat to provide stoppage of flow. The piston (6) or ball (10) drop into the seat (7) by gravity during no-flow conditions and open by fluid pressure on the upstream side (from underneath the piston (6) or ball(10)). Reversal of fluid flow forces the piston (6) or ball (10) back into the seat (7) which stops the flow.

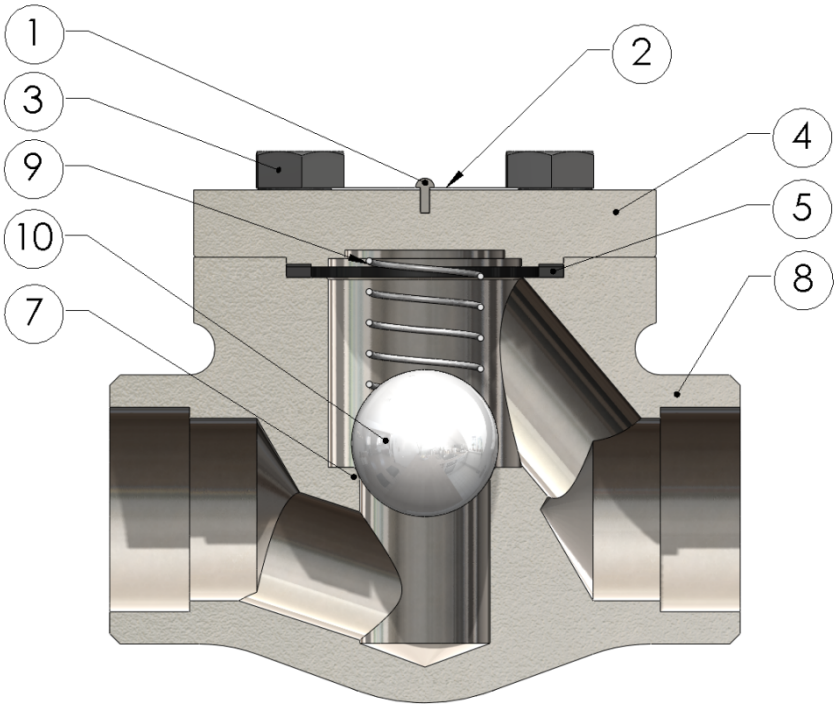
The piston and ball check valves are designed for horizontal service; however, these valves can be equipped with an internal spring (9) which allows the valve to be used in vertical up service, as shown in Figure 3.

NOTICE A check valve should not be used as a primary means of isolation for any application because a check valve may not provide a leak-tight seal (no through leakage). Only gate or globe valves should be used for isolation.

NOTICE Check valves can be installed only in the direction of flow indicated by the arrow stamped on the body.



Piston Check



Ball Check

ITEM	DESCRIPTION
1	RIVET
2	NAMEPLATE
3	BOLTS
4	BONNET
5	GASKET
6	PISTON
7	INTEGRAL SEAT
8	BODY
9	SPRING*
10	BALL

* THE SPRING WILL BE SUPPLIED ON REQUEST

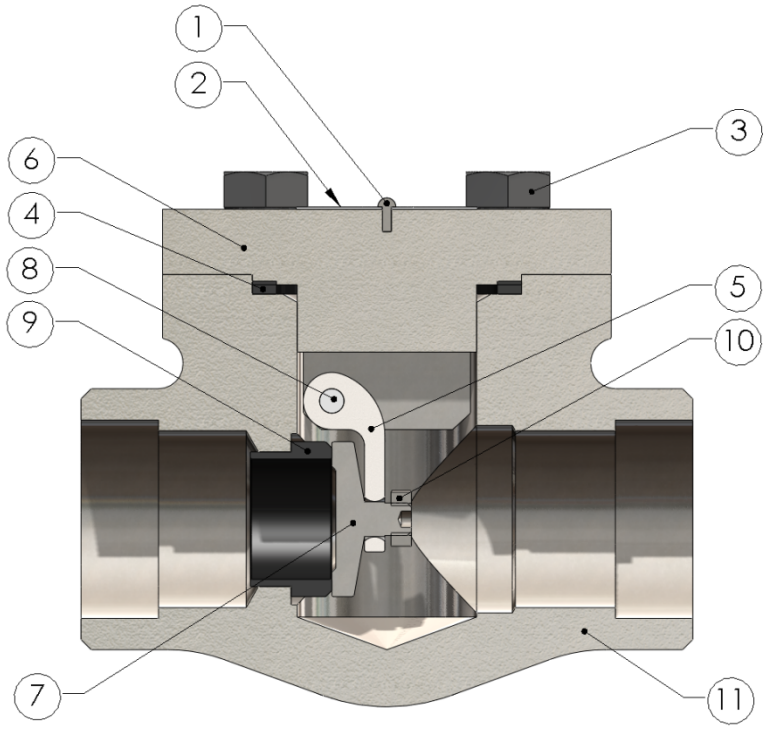
Figure 7 - Typical Piston/Ball Check Valve (Bolted Bonnet Design)

5.4. Swing Check Valve

A typical bolted bonnet swing check valve is shown in Figure 8; an exploded view is shown in Appendix D. The swing check valve is a straight-through flow check valve equipped with a disc (7) which rests against the seat (9) under no-flow conditions. The seat (9) is pressed into the valve body (11) and is of the removable design. A hinge (5) supports the disc (7) from a hinge pin (8) which is set in the valve bonnet (6). The supporting hinge (5) allows the disc (7) to swing freely away from the seat (9) because of the flow pressure being exerted upon the disc's upstream side. A reversal of fluid flow exerts pressure on the downstream side of the disc (7) forcing it against the seat (9) and stopping the flow.

NOTICE A check valve should not be used as a primary means of isolation for any application because a check valve may not provide a leak-tight seal (no through leakage). Only gate or globe valves should be used for isolation.

NOTICE Swing check valves are designed for horizontal flow but may also be used for vertical flow in the upward direction. See Figure 3 for details.



ITEM	DESCRIPTION
1	RIVET
2	NAMEPLATE
3	B/B BOLTS
4	B/B GASKET
5	HINGE
6	BONNET
7	DISC
8	HINGE PIN
9	SEAT
10	DISC NUT
11	BODY

Figure 8 - Typical Swing Check Valve (Bolted Bonnet Design)

6.0. Maintenance

Bonney Forge valves are made from selected materials to give long and trouble free service when properly installed in the correct applications. Proper care and maintenance in the field can contribute to extended performance of the valve.

The general maintenance operation on Bonney Forge valves usually consists of lubrication of the yoke sleeve and stem threads and adjustment of the packing gland. Should other repairs be required, Sections 6.2. through 6.10. are provided to be used as a guide in the repairs.

6.1. List of Tools for Maintenance and Repair

Standard wrenches and tools are suitable for servicing the valves as follows:

- Set of open end, box end, crescent, and socket wrenches, and torque wrench to adjust/remove: bonnet bolts, gland bolt nuts, and handwheel nuts.
- Standard packing tools or blunt hooks to remove stem packing.
- Combination oilstone and lapping compounds, coarse and fine grit, to lap and polish.
- Emory cloth, coarse and fine grit, for removing scratches and polishing gasket surface area.
- Pipe and spanner wrenches for installation.
- Hammers, blunt chisels, tapered drift pins for seat removal and replacement.
- Other devices and fixtures as stated throughout the instruction manual.

6.2. Preventative Maintenance

Maintenance programs vary greatly from application to application, dependent on factors such as operational frequency, service conditions, external environment, etc. The end user should establish a routine maintenance program to extend the life of the valve and minimize downtime for repair. Table 1 suggests actions to include in a preventive maintenance program. These actions and performance frequencies are to be used as a guide only in establishing an individual maintenance program.

INSPECTION	FREQUENCY
Inspect exterior of valve for cleanliness and signs of corrosion or leakage	Monthly
Inspect stem packing for signs of leakage	Monthly
Inspect body-bonnet flange connection for signs of gasket leakage	Monthly
Perform a complete valve cycle (open-close or close-open)	Every 6 Months
Inspect stem packing torque and adjust per Table 3	Every 6 Months
Lubricate valve stem threads. Examine stem threads for cleanliness	Every 6 Months or 100 Cycles (whichever occurs first)
Lubricate valve yoke sleeve	Every 6 Months or 100 Cycles (whichever occurs first)

Table 1 - Preventive Maintenance Schedule

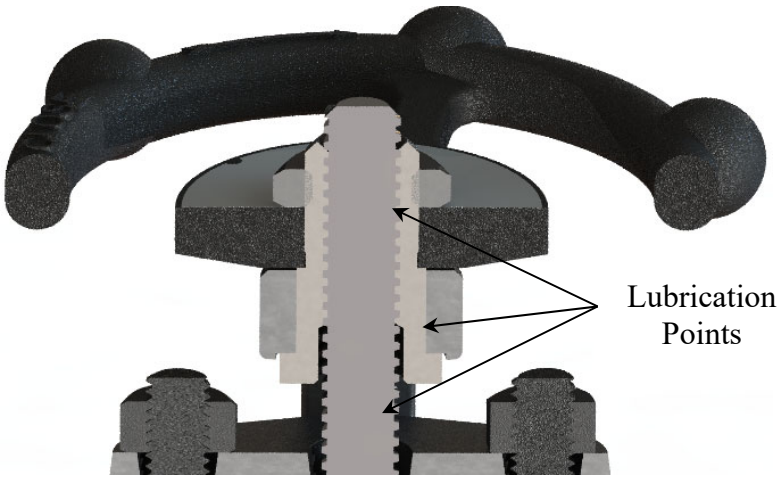
6.3. Valve Lubrication

The valve stem and yoke sleeve should be lubricated periodically based on cycle and service conditions, but not less than that shown in Table 1. Maintaining the stem and yoke sleeve adequately lubricated helps to ensure smooth valve operation and helps prevent premature component wear, particularly the yoke sleeve flange. Additionally, exposed stem threads should be kept clean.

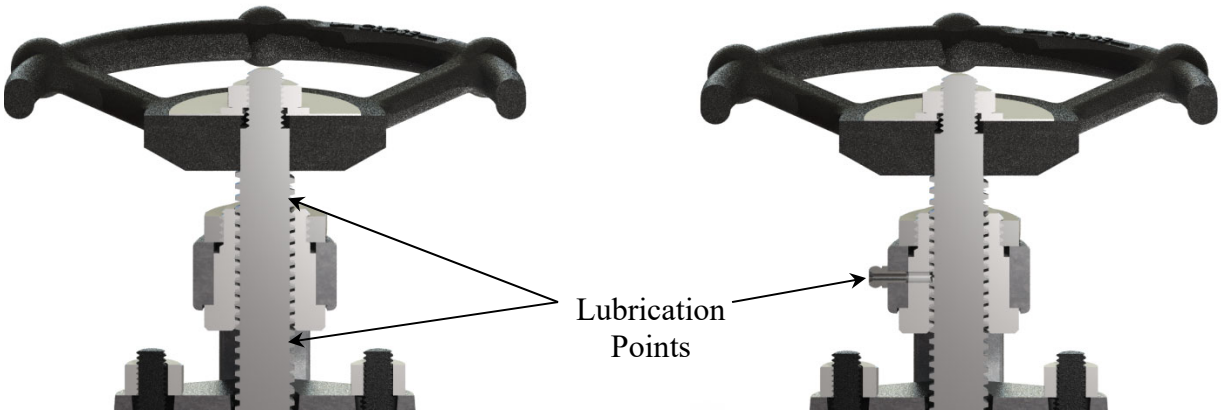
NOTICE	When the valve is installed in dirty environments, the use of dry lubricants is recommended, because tacky lubricants on exposed stem threads can attract abrasive particles.

Bonney Forge recommends using a quality high temperature lubricant on all gate and globe valves. See Section 6.3.2 for recommended lubricants.

6.3.1. Points of Lubrication



Gate Valve – Top Works



Globe Valve – Top Works
(No Grease Fitting)

Globe Valve – Top Works
(Single Grease Fitting)

Figure 9 - Gate and Globe Valve Points of Lubrication

Gate Valves, O.S.&Y Design (Figure 9)

Bonney Forge gate valves have two (2) points of lubrication, the stem/yoke sleeve threads and the yoke sleeve flange/yoke bearing ring area. Lubricate these areas as follows:

- Open the valve to half stroke.
- Brush lubricant onto the stem as it protrudes through the hand wheel, and on the stem under the yoke.
- Run the valve through a complete "open-close" cycle, the stem/yoke sleeve are now lubricated.
- Next, open the valve slightly (about 1/8 turn, the hand wheel will have some slop as the yoke sleeve is not engaged with the stem), this will cause the yoke sleeve to drop slightly creating a small clearance between the yoke sleeve and the yoke.
- Liberally brush lubricant into the small opening.
- Close the valve. This will distribute lubricant to the bearing ring interface of the yoke sleeve and yoke.

Globe Valves, O.S.&Y Design (Figure 9)

Bonney Forge globe valves have one point of lubrication, the stem/yoke sleeve threads. Lubricate as follows:

- For Bonney Forge globe valves with a grease fitting, lubricate through the fitting.
- For Bonney Forge globe valves without a grease fitting, open the valve to half stroke.
- Brush lubricant on the stem threads above and below the yoke nut.
- Run a complete "open-close" cycle, the stem/yoke are now lubricated.

6.3.2. Recommended Stem and Yoke Sleeve Lubricants

Bonney Forge valves are supplied with the stem threads and yoke sleeve lubricated with AGIP MU EP 2 type lubricant or equivalent. Table 2 lists some stem lubricants which are equivalent to the AGIP product. Bonney Forge recommends using one of these lubricants or one with equivalent properties/characteristics for stem thread and yoke sleeve lubrication.

LUBRICANT	MANUFACTURER	REMARKS
AGIP MU EP 2	AGIP	OEM
Mobilux EP 2	Mobil	
Spheerol EPL 2	Castrol	
Ronex MP	Exxon	
Alvania EP 2	Shell	
Jet-Lube Extreme	Jet-Lube	High Temp
Maconsynth HT 1050	Macon Research SAS	High Temp

Table 2 - Recommended Lubricants

6.4. Stem Packing (Eco-Seal®)

Beginning in 2013, Bonney Forge Forged Steel Valves are supplied with low emission (Low E) Eco-Seal® Packing as a standard. The packing is designed and tested to API 622 2nd Edition (1510 mechanical and 5 thermal cycles) in a test fixture and both gate and globe valves to meet below 50 ppm fugitive emissions applications. The following maintenance instructions are applicable to Bonney Forge Low E valves. For non-Low E valves, please consult the June 2010 version of the Bonney Forge Forged Steel Valve IOM for stem packing instructions.

6.4.1. Maintenance Conditions for Fugitive Emissions Performance

Bonney Forge recommends the following conditions of valve use to ensure Low E performance throughout the service life:

1. Follow all instructions as written within the supplied Bonney Forge valve shipping tags and/or Bonney Forge IOM manual and fit for service.
2. Store the valve in accordance with Section 2.2.
3. Follow the Preventative Maintenance schedule in Table 1. This includes performing inspection of the valve for visible damage, keeping the valve stem free of scratches or corrosion, and inspecting for stem leakage.
4. Protect and handle the valves properly during plant construction and transportation. This includes the protection of exposed stems and the glands of valves when painting and sandblasting.
5. Verify the packing gland torque is correct in accordance with Table 3 to maintain valve performance and reduce the potential for leaks above allowable limits.

6.4.2. Stem Packing Bolting Torque

Leakage through the stuffing box does not always indicate a defective valve, but may simply indicate that the stem packing is not fully compressed. Re-tightening of the gland bolts under normal conditions will stop the leakage. The gland bolts should be tightened to maintain a straight and level gland flange and only to the extent needed to stop the leakage. Table 3 can be used as a guide for tightening of the gland nuts.

NOTICE Excessive tightening of the gland flange may cause difficult operation of the valve and possible damage to the stem. Do not exceed the torques listed in Table 3.

PACKING CODE	PACKING TORQUE			REMARKS
	ft-lbs	in-lbs	N-m	
BH2	2.9	35	3.9	See Appendix E to determine the packing style used in each valve.
BH3	3.2	38	4.3	
BH4	3.2	38	4.3	
BH5	3.8	46	5.2	
BH6/A	8.7	104	11.7	
BH8	19.9	239	27	
BY5/A	9.3	112	12.6	
2B3	4.6	55	6.2	
2B4/A	9.3	112	12.6	
2B5	9.6	115	13	
2B8	25.9	311	35.1	

Table 3 - Gland Bolt Torque (Low Emission Packing)

6.4.3. Stem Packing Repair

⚠WARNING	Repacking of the valve is not recommended while the valve is pressurized or in service because any leakage could cause serious injury to maintenance personnel.

If leakage is detected 100 ppm above background, repair is to be done in accordance with 40 CFR 61.242-7. The first attempt at repair should involve retightening of the gland bolts using the torques provided in Table 3. If leakage cannot be reduced below the allowable limits by tightening the gland bolts, packing replacement is required. Table 4 lists an acceptable replacement packing to achieve low emission performance.

PACKING STYLE	MANUFACTURER	REMARKS
EDP-15	Nippon Pillar	Flexible Graphite, Certified Low E
EDP-19	Nippon Pillar	PTFE, Certified Low E

Table 4 – Approved/Recommended Replacement Packing (Certified Low E Packing)

The following steps may be utilized for the replacement of the valve packing:

a) For packing extraction, remove the gland nuts and studs.

b) Lift the gland flange/follower and gland out of the stuffing box.

c) Remove old packing:

- Use correct size extraction tool (see Figure 10). **Care shall be taken to avoid scratching the stem or stuffing box surfaces.**
- Eco-Seal® packing has solid seal ring that must be cut for removal. Any remains of existing Eco-Seal® packing must be removed from the stuffing box and stem.

d) Clean the stem and stuffing box and perform visual inspection for damage.

e) Install new packing rings, one at a time, with the 45-degree diagonal cut in each ring rotated ¼ to ½ turn away from the cut in the ring previously installed (see Figure 11).

f) Each ring should be firmly compressed into position before the next ring is added. Rings should fit snugly into the stuffing box; the ends of a packing ring must not overlap or remain open when fitted into the stuffing box.

g) Install the gland and the gland flange/follower, install the gland studs and nuts. **Bolting lubrication is highly recommended to achieve adequate packing load.** Tighten the nuts a few turns at a time to maintain a straight and level gland flange using the applicable torque in Table 3.

h) Actuate the valve through a minimum of three (3) complete cycles ending with the valve in the closed position. Verify the torque provided for the valve being re-packed.

Figure 10 - Extraction of Valve Packing

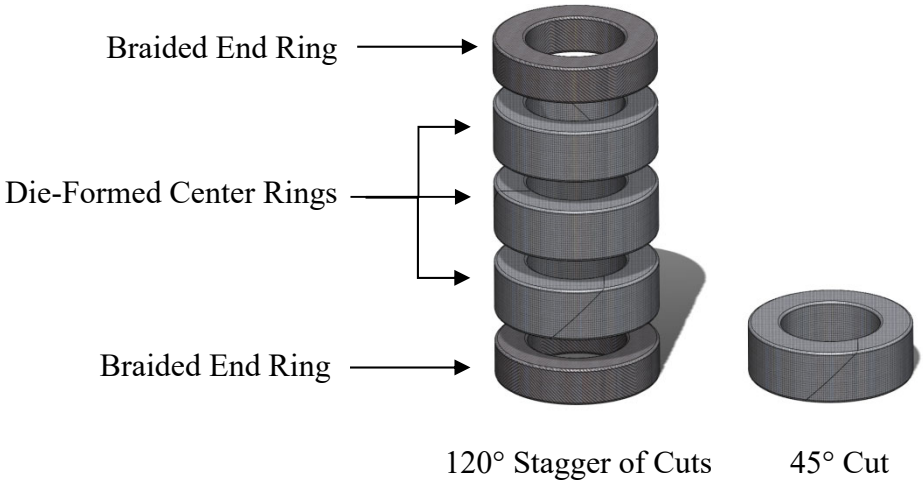


Figure 11 - Typical Low-Emission Replacement Packing Ring Configuration

6.5. Body-Bonnet Disassembly

NOTICE	Disassembling the valve will void the Bonney Forge standard valve warranty. Please consult Bonney Forge prior to disassembling if the valve is under warranty.

Complete body-bonnet disassembly procedures are listed below and should be used when performing the maintenance described in Sections 6.7 through 6.10. Bonney Forge recommends that disassembly be limited only to the extent required to provide corrective work.

a) Isolate and depressurize the system.

b) Operate the valve to its full open position.

c) Match mark the body and bonnet flanges to maintain their relation.

d) For bolted bonnet type valves:

   1) Remove the body-to-bonnet bolts in a crossover pattern to prevent cocking of the bonnet which could cause the remaining bolts to jam. See Figure 12

   2) Lift up the entire bonnet assembly, taking care not to damage the wedge or disc.

      i) For gate valves, match mark the wedge and body to maintain their relation upon reassembly. It is important to match mark the wedge so that the same wedge and seat face are in contact upon reassembly.

e) For welded bonnet type valves, Bonney Forge recommends that an approved modification shop be used for disassembly.

6.6. Body-Bonnet Assembly

Complete body-bonnet assembly procedures are listed below and should be used when performing the maintenance described in Sections 6.7 through 6.10.

a) Inspect the bonnet bolting to ensure that it is not damaged. Any damaged bolting should be immediately replaced.

b) Make sure both the body and bonnet gasket faces are smooth and clean. For bolted bonnet valves, insert a new gasket onto the body gasket seating surface.

c) Place the entire bonnet assembly onto the valve body, taking care not to damage the wedge or disc. Attention shall be given to the location marks on the body, body flanges, and the wedge.

NOTICE To prevent the disc or wedge from being driven into the seat(s) during tightening of the bonnet bolts, make sure the valve is a few turns open.

d) For bolted bonnet type valves:

1) Install the bonnet bolts, initially tightening by hand to ensure threads are properly engaged.

2) Slightly torque all bolts uniformly using a crossover sequence to prevent uneven gasket loading, bolt damage, and to facilitate smoother assembly. See Figure 12.

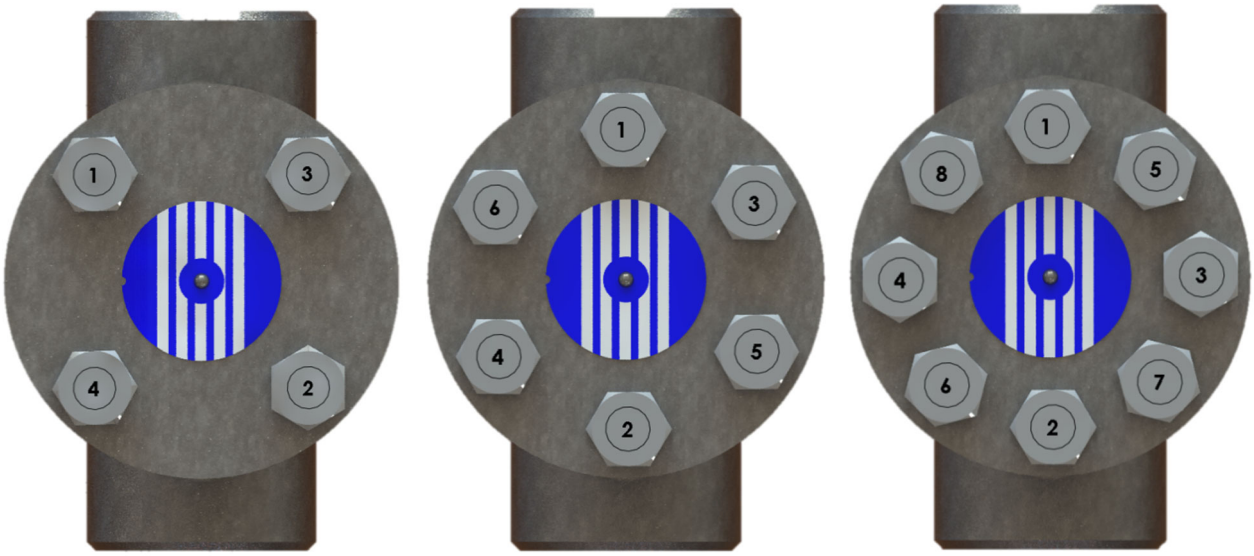
3) Repeat Step (2) using additional torque until the body and bonnet flanges come into contact and the bonnet bolt torques are in accordance with Table 5.

e) For welded bonnet type valves, Bonney Forge recommends that an approved modification shop be used for assembly and welding.

f) Test the valve as required, and place the valve back into service.

MAXIMUM BODY-BONNET BOLT TORQUE					
US CUSTOMARY	METRIC	ALL MATERIALS WITH MIN YIELD STRESS @ ROOM TEMP > 60ksi (> 400MPa) Ex. B7		ALL MATERIALS WITH MIN YIELD STRESS @ ROOM TEMP ≤ 60ksi (≤ 400MPa) Ex. B8/B8M Class 1	
		Ft-Lb	N-m	Ft-Lb	N-m
3/8 UNC	M10	20	30	11	16
1/2 UNC	M12	50	70	27	37
9/16 UNC	M14	70	95	38	50
5/8 UNC	M16	100	140	50	70
3/4 UNC	M20	170	230	90	125
7/8 UNC	M22	270	370	145	200
1 UNC	M24	400	550	215	300

Table 5 - Body-Bonnet Bolt Torque Table



Tighten/Loosen Bolts in Numerical Order

Figure 12 - Body-Bonnet Bolt Torque Sequence

6.7. Gasket Replacement (Bolted Bonnet Valves Only)

a) Examine the gasket seating surface of the body and the bonnet for evidence of wear, damage, or deterioration. Discard the old gasket.

b) Replace or repair all damaged parts, then clean seating surfaces to remove all rust, gasket residue, and other debris.

c) Polish gasket seating surfaces using a fine emery cloth.

d) Remove any radial scratches or other damage, taking care that the emery cloth does not remain in the valve.

NOTICE	To ensure a proper seal, the gasket seating surface should have a finish between 63 and 125 µin Ra.

e) Clean the surface to remove all polishing residue.

f) Install a new gasket and re-assemble the valve according to Section 6.6. **Bolting lubrication is highly recommended to achieve adequate gasket load.** Gasket sealing compound should not be used when installing the new gasket.

6.8. Gate Valve Seating Surfaces: Repair and Replacement

The valve and seat ring design and method of seat ring installation are such that the valve must be removed from the line when seat ring replacement is necessary. Bonney Forge recommends that the valve be replaced or returned to the factory for seat ring replacement.

6.9. Globe & Check Valve Seating Surfaces: Repair and Replacement

These valves are available with either threaded-in seat rings or an integral seat, both of which may be repaired (threaded in seats shall be replaced) while the valve is in line.

6.9.1. Seat Surface Repair

When surface damage is minor, the seats may be repaired by using a lapping operation.

- Globe valves require a guide fixture to maintain alignment during the lapping operation. The guide fixture can be made to fit into the gasket area of the body as shown in Figure 13.
- The section of the fixture extending into the body is to be made 1/64" smaller than the body bore.
- A hole in the center of the fixture is required for the stem; this hole should be 1/64" larger than the shank of the valve stem or outside diameter of the spacer (see Figure 13).

NOTICE	The globe valve stem/disc assembly may be used in the lapping operation. However, due to its loose disc design, it is necessary to prevent the disc from rotating on the stem. This can be accomplished by preparing a fixture as shown in Figure 13. The valve handwheel can then be reattached to the stem and used as a convenient handle when re-lapping the seats.

NOTICE	Applying too much pressure to the seat ring may damage the seat and/or valve.

The lapping operation can be performed as follows:

a) Place a small quantity of lapping compound between the seat and disc surface.

b) With the lapping compound in place, between the mating surfaces, the disc should be reciprocally rotated: the strokes should be light, and the disc should be lifted frequently and turned to a new position, circularly around the valve body, so the lapping will take place over a new area.

c) Continue lapping until all defects are removed; apply a final finish with a fine lapping compound.

NOTICE	After lapping, it is recommended that the surface of the seat and disc be checked for proper contact using marking blue. Coat the seats with marking blue, and tightly screw the disc into the seats. Unscrew the disc, and examine to make sure there is continuous contact between the sealing surfaces of the disc and body seat.

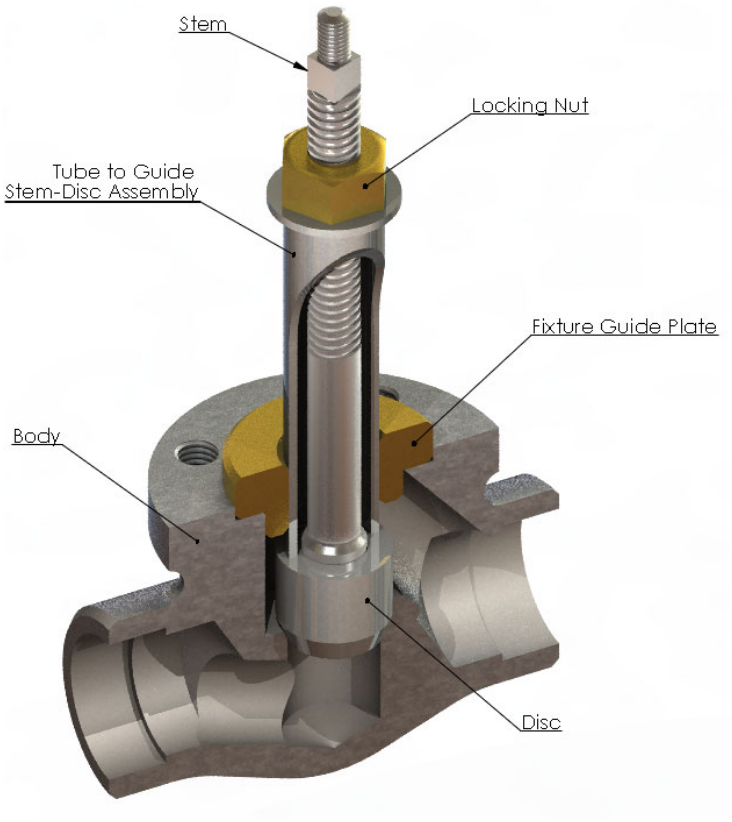


Figure 13 - Fixture for Globe & Piston/Ball Check Valve Seat Surface Repair

The disc of the globe valve may also require refinishing. When defects are found on the stem/disc assembly seating surface, it is recommended to refinish the stem/disc assembly using a lathe.

a) Place the stem/disc assembly onto the lathe spindle and place the chuck around the disc, without taking the assembly apart.

b) Hold the disc using a four jaw chuck so that the large outside diameter and seating surface run true.

c) Polish the seating surface with a fine emery cloth.

NOTICE	Check valves do not require lapping fixtures as the bore of the valve body serves as a guide. On ball check valves the rolling action of the ball retains seating surfaces in good condition until ball size or ball guide is worn and replacement parts are needed.

6.9.2. Seat Ring Replacement (Threaded)

Valves having renewable (threaded-in) seats may have the seat ring replaced while the valve is in the line. The inside area of the seat ring has a hexagonal shape, into which a hexagonal shape tool may be inserted. The seat ring may then be removed by un-threading the seat in a counterclockwise direction. The seat threads in the valve body should be carefully inspected to make sure they are in useable condition.

NOTICE	When installing new renewable seats, the seal should be verified using marking blue. Coat the seats with marking blue, and tightly screw the disc into the seats. Unscrew the disc, and examine to make sure there is continuous contact between the sealing surfaces of the disc and body seat.

6.10. Swing Check Valve Seating Surfaces: Repair and Replacement

The valve and seat ring design and method of seat ring installation are such that the valve must be removed from the line when seat ring replacement is necessary. Bonney Forge recommends that the valve be replaced or returned to the factory for seat ring replacement.

7.0. Motor-Operated Valves

Bonney Forge gate and globe valves are capable of being equipped with an actuator, which allows for remote operation of valves. A motor-operated valve consists of the valve, actuator, and a mounting plate with brackets for support. The brackets are typically welded to the valve, and the actuator is bolted to the mounting plate.

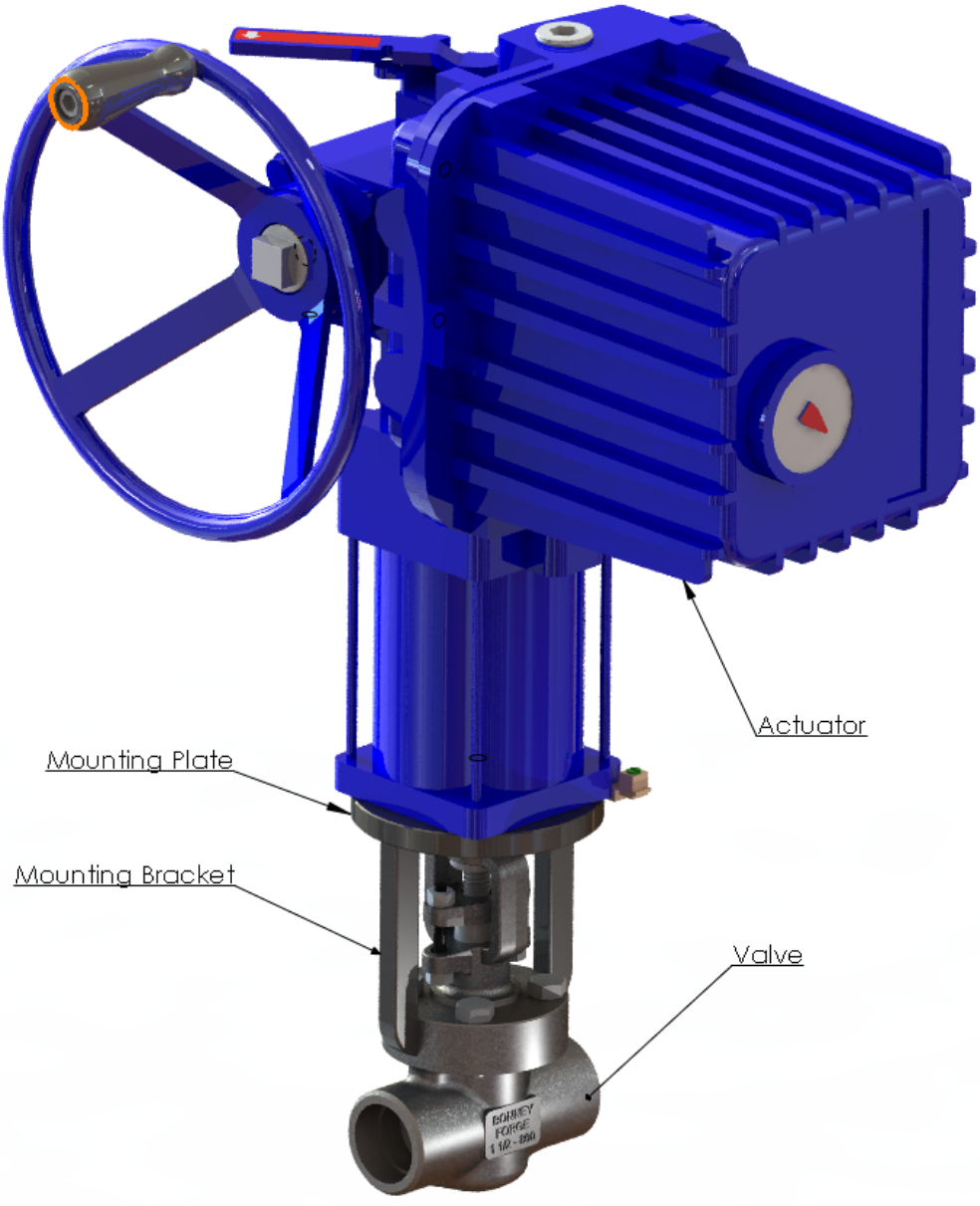


Figure 14 - Components of a Motor-Operated Valve

Bonney Forge recommends the following precautions be followed strictly to ensure the proper setup, installation, and maintenance of motor-operated valves.

- Install mounting plates and support brackets on all motor-operated valves. Support brackets should be welded to the valve body or bonnet.
- Lubricate stems at the actuator drive bushing following the guidance in Section 6.2 Preventative Maintenance schedule and Section 6.3 Stem Lubrication instruction.
- Ensure that the settings are set by a certified actuation service provider. Bonney Forge will provide a stem torque form upon request, which provides stem torque limits for the valve.
- Perform test cycles prior to installation to verify the actuator settings are correct.
- If installing the motor-operated valve with the actuator in any orientation other than directly above the bonnet, the actuator must have additional support added to remove the bending load from the stem.

NOTICE Actuator settings will be factory sealed. Any actuator adjustments performed without using a Bonney Forge authorized service provider will void the valve warranty.

⚠ CAUTION Packing leakage and stem damage can result from an unsupported actuator.

Figure 15 - Supporting a Motor-Operated Valve

8.0. Spare Parts

Spare parts generally consist of stuffing box packing and body-bonnet gaskets for all Bonney Forge forged steel valves. Packing and gaskets are typically available from inventory for Bonney Forge standard valves.

When ordering spare parts, please have the following information available (found on valve nameplate): size, figure number, item number, and material. When possible, the original purchase order and purchase date can help identify the parts, especially those used on special order valves.

9.0. Troubleshooting Guide

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Leakage through stem packing	1. Gland nuts are loose 2. Improper packing installation 3. Insufficient packing in stuffing box 4. Stem is damaged	1. Tighten gland nuts per Section 6.4. 2. Replace packing per Section 6.4. 3. Add packing per Section 6.4. 4. Repair or replace stem or replace valve.
Leakage through body-bonnet flange	1. Bonnet bolts are loose 2. Gasket is damaged	1. Tighten bolts per Section 6.6 and Table 4. 2. Replace gasket per Section 6.7.
Seat Leakage	1. Valve is not fully closed 2. Dirt or debris between sealing surfaces. 3. Sealing surface is damaged	1. Close valve fully. 2. Open valve to flush or clean sealing surfaces. 3. If possible, repair sealing surface per Section 6.8, 6.9, or 6.10.
Difficult to operate	1. Over-tightened packing 2. Stem threads lack lubrication 3. Dirt or debris on stem threads 4. Stem or stem threads are bent	1. Tighten gland nuts per Section 6.4. 2. Lubricate stem threads per Section 6.3. 3. Remove dirt or debris from threads; lubricate as needed 4. Repair or replace stem or valve as required.

Table 6 - Troubleshooting Guide

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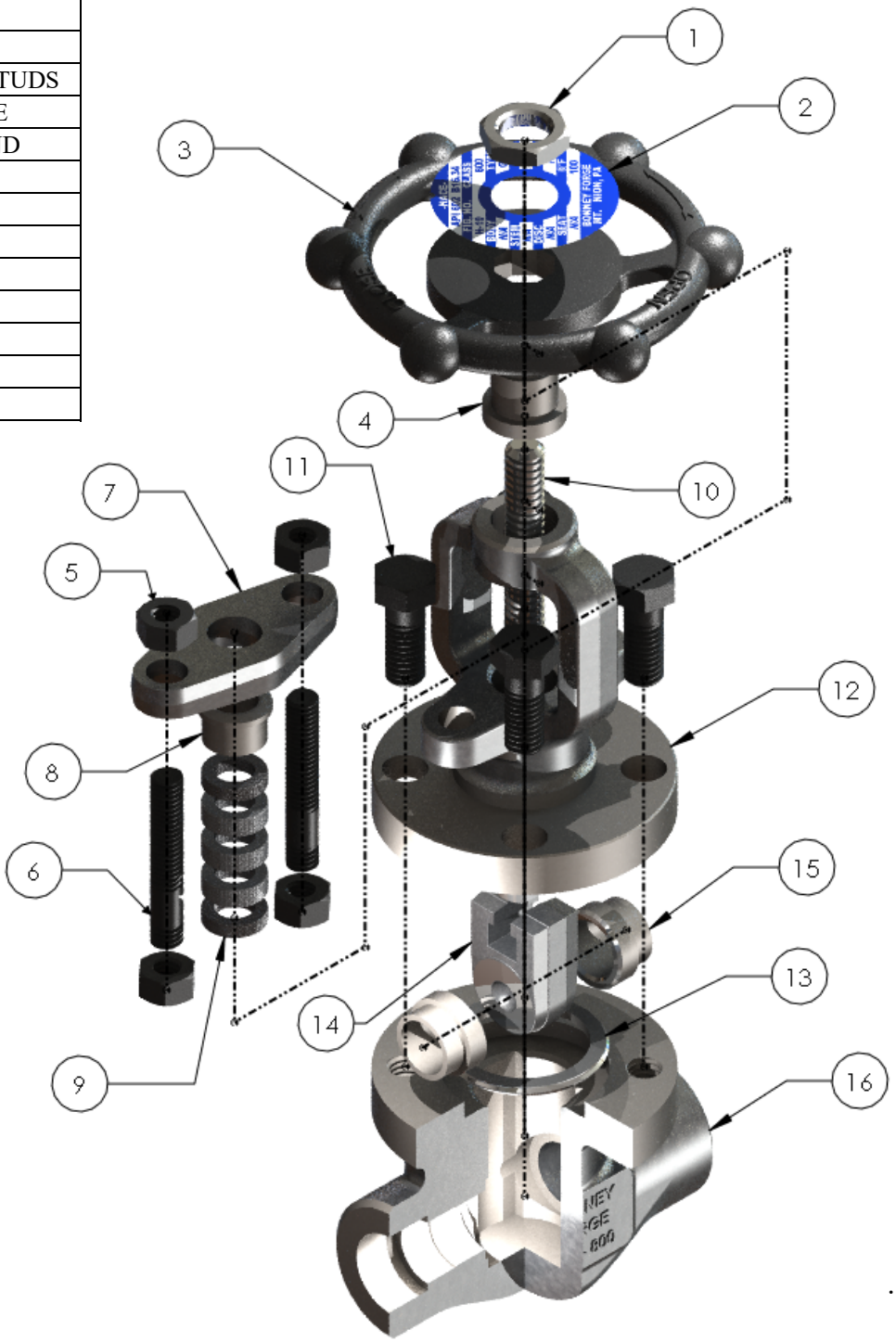
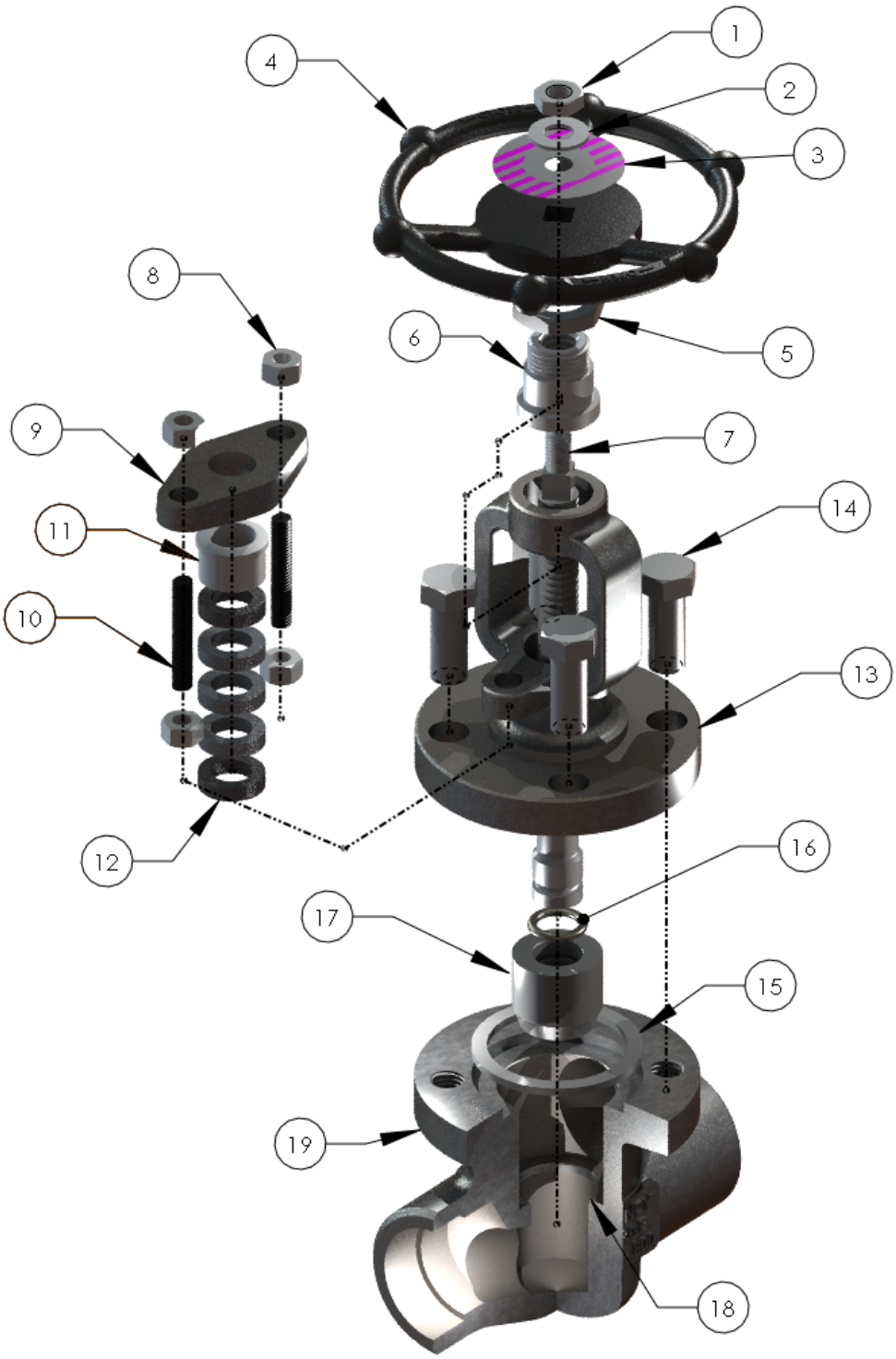
NO.	DESCRIPTION
1	HANDWHEEL NUT
2	NAME PLATE
3	HANDWHEEL
4	YOKE SLEEVE
5	GLAND NUT
6	GLAND BOLT STUDS
7	GLAND FLANGE
8	PACKING GLAND
9	PACKING
10	STEM
11	BOLTS
12	BONNET
13	GASKET
14	WEDGE
15	SEAT
16	BODY

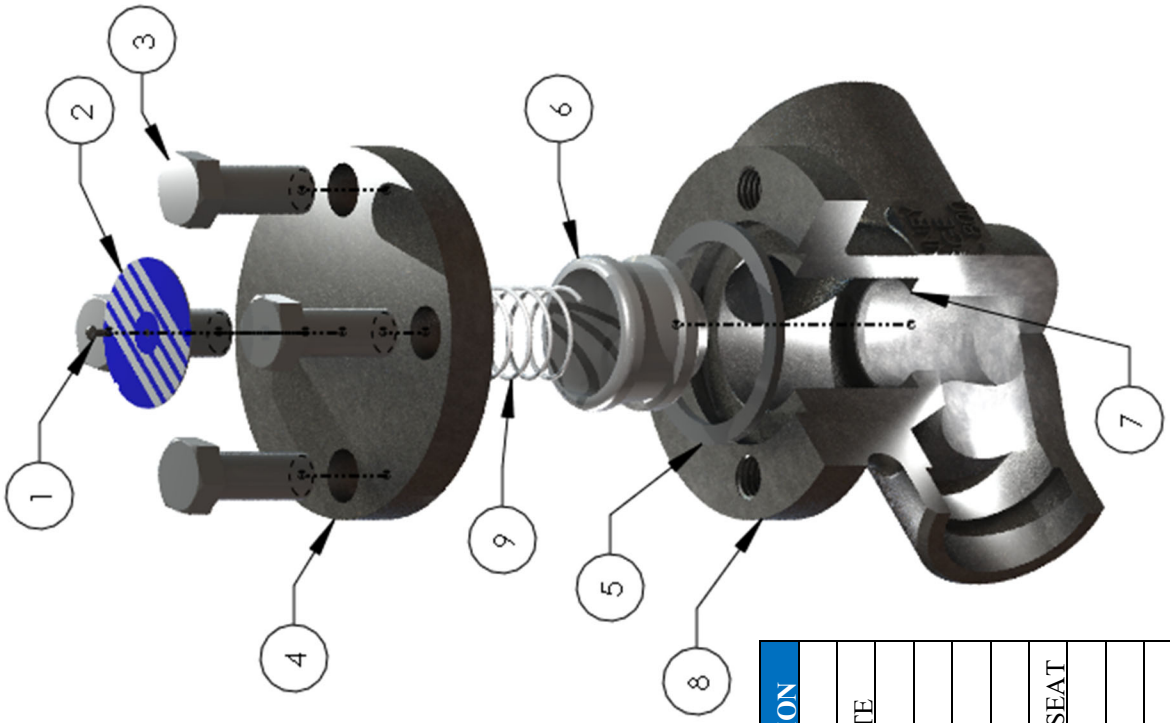


Appendix A - Exploded View Typical Gate Valve (Bolted Bonnet Design)

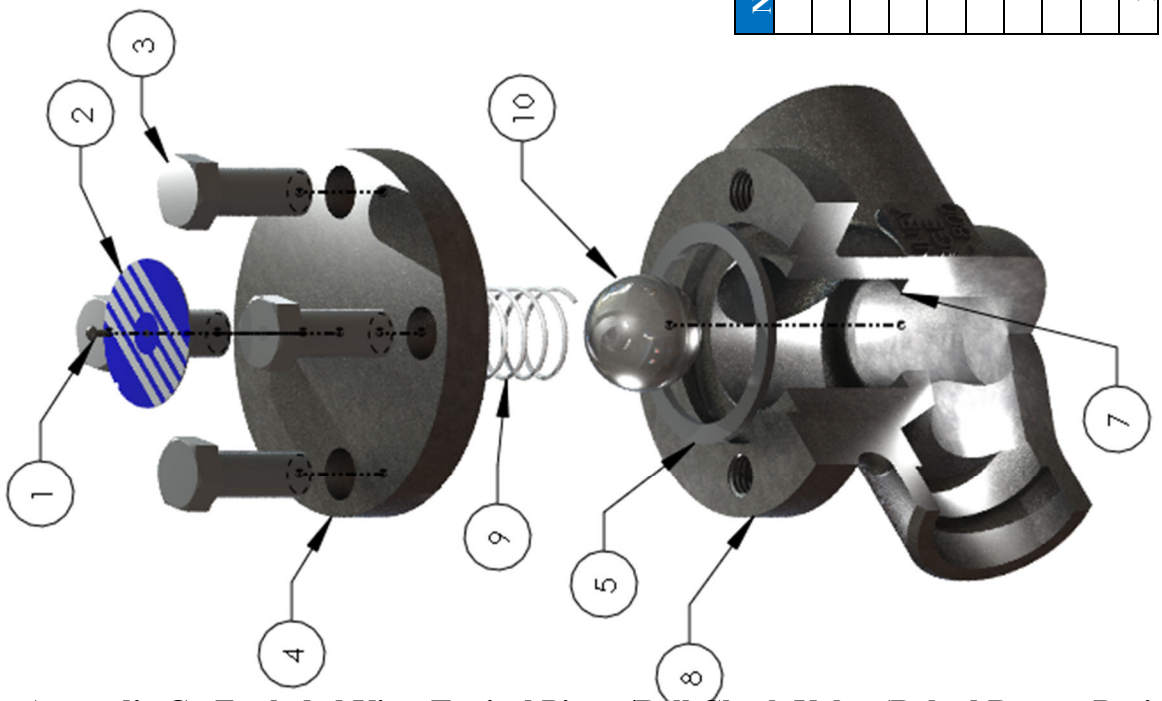
NO.	DESCRIPTION
1	HANDWHEEL NUT
2	WASHER
3	NAME PLATE
4	HANDWHEEL
5	YOKE NUT
6	YOKE SLEEVE
7	STEM
8	GLAND NUT
9	GLAND FLANGE
10	GLAND BOLT STUD
11	PACKING GLAND
12	PACKING
13	BONNET
14	BOLTS
15	GASKET
16	WIRE CONNECTION
17	DISC
18	INTEGRAL SEAT
19	BODY



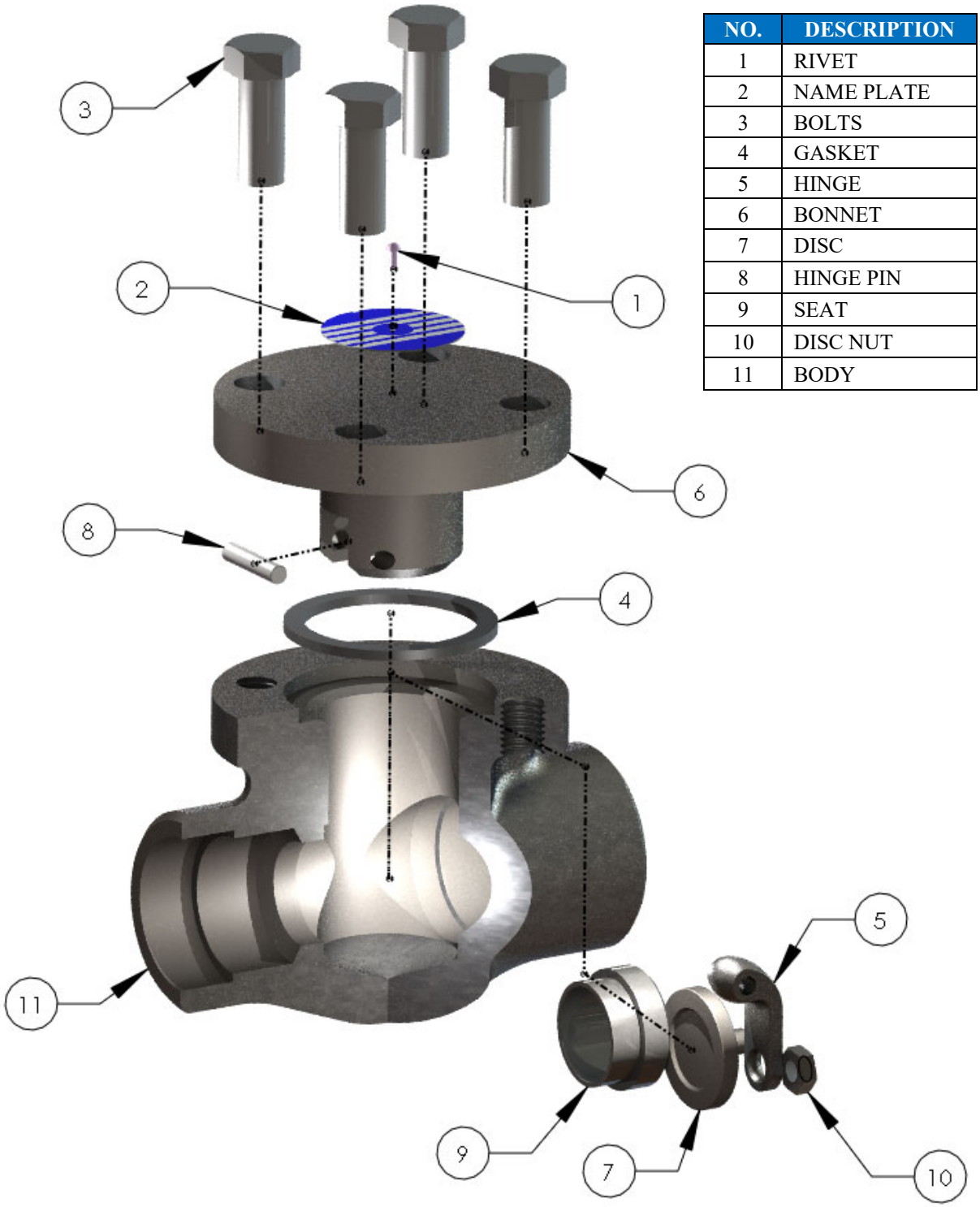
Appendix B - Exploded View Typical Globe Valve (Bolted Bonnet Design)



NO.	DESCRIPTION
1	RIVET
2	NAME PLATE
3	BOLTS
4	BONNET
5	GASKET
6	PISTON
7	INTEGRAL SEAT
8	BODY
9	SPRING
10	BALL



Appendix C - Exploded View Typical Piston/Ball Check Valve (Bolted Bonnet Design)



NO.	DESCRIPTION
1	RIVET
2	NAME PLATE
3	BOLTS
4	GASKET
5	HINGE
6	BONNET
7	DISC
8	HINGE PIN
9	SEAT
10	DISC NUT
11	BODY

Appendix D - Exploded View Typical Swing Check Valve (Bolted Bonnet Design)

GATE VALVES									
FIGURE NUMBER	SIZES								
	1/4"	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	3"
H	BH2	BH2	BH2	BH4	BH5	BH6/A	BY5/A	BH8	
HL			BH2	BH2	BH4		BH6/A	BY5/A	
9H			BH5	BH6/A	2B4/A		2B5	2B8	
9HL			BH3	BH5	BH6/A		2B5	BH8	
W	BH2	BH2				BH6/A			
WL			BH2	BH2	BH4		BH6/A	BY5/A	
9WL			BH3		BH6/A		2B5	BH8	
25W			2B3	2B4/A	2B5		2B5	2B8	
15F				BH6/A	2B4/A		BH8		
L1			BH2	BH2	BH4		BH6/A	BY5/A	BH8
L3			BH2	BH2	BH4		BH6/A	BY5/A	
L6			BH2	BH2	BH4		BH6/A	BY5/A	
CL			BH2	BH2	BH4			BY5/A	
SHWL			BH2	BH2	BH4		BH6/A	BY5/A	
1SHWL							BH6/A	BY5/A	
3SHWL			BH2	BH2	BH4		BH6/A	BY5/A	
6SHWL				BH2			BH6/A	BY5/A	
ML			BH2	BH2	BH4		BH6/A	BY5/A	
MFL			BH2	BH2	BH4		BH6/A	BY5/A	
9MFL			BH3	BH5	BH6/A				
VLL			BH2	BH2	BH4		BH6/A	BY5/A	
VOLL			BH2	BH2	BH4		BH6/A	BY5/A	
9VOLL			BH3	BH5	BH6/A				

GLOBE VALVES								
FIGURE NUMBER	SIZES							
	1/4"	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
H	BH3	BH3					BY5/A	
HL			BH3	BH3	BH5	BY5/A		BY7
9HL			BH3	BH5	2B4/A	2B5		BH8
W	BH3							
WL			BH3	BH3	BH5	BY5/A		BY7
9WL				BH5				
25W			2B3	2B4/A	2B5	2B5		2B8
Y			BH3	BH5	BY5/A	BY7		BH8
1690Y			BH5	2B4/A	2B4/A	BH8		2B8
2680Y			2B3	2B4/A	2B5	2B5		2B8
L1			BH3	BH3	BH5	BY5/A		BY7
L3			BH3	BH3	BH5	BY5/A		BY7
L6			BH3	BH3	BH5	BY5/A		BY7
SHWL				BH3	BH5	BY5/A		BY7

Appendix E – Packing Styles By Figure Number and Valve Size

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Bonney Forge has made every attempt to ensure that the information contained in this Installation, Operation, and Maintenance manual is correct. This manual is provided for informative purposes and to provide general guidance in regards to installation, operation, and maintenance of Bonney Forge forged steel valves. Therefore, the material contained herein does not constitute a guarantee of satisfactory results by reliance thereon, nor shall it be construed as a product warranty or guarantee. It is ultimately the purchaser's/user's responsibility for the proper installation, operation, and maintenance of Bonney Forge valves.

Bonney Forge reserves the right to change designs, materials, or specifications without notice. Questions regarding these provisions, or regarding material contained in this manual, shall be directed to Bonney Forge at the following address:

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