SPM™ Oil & Gas
A Caterpillar Company

Clapper Check Valves

Operation Instruction and Service Manual

Document P/N: 2A29477
Release Date: 07/08/2021
Revision: E

SPM™ PRODUCT SAFETY GUIDE

WARNING: IMPORTANT SAFETY INFORMATION ENCLOSED. READ THIS OPERATING AND MAINTENANCE INSTRUCTIONS MANUAL BEFORE OPERATING PRODUCT.

WARNING: THIS INFORMATION MUST BE AVAILABLE TO ALL PERSONNEL THAT WILL OPERATE AND MAINTAIN EQUIPMENT. FAILURE TO READ, UNDERSTAND AND FOLLOW THE OPERATING AND MAINTENANCE INSTRUCTIONS MANUAL COULD RESULT IN **SERIOUS BODILY INJURY, DEATH, OR PROPERTY DAMAGE.**

Most SPM™ products generate, control or direct pressurized fluids; therefore, it is critical that those who work with these products be thoroughly trained in their proper application and safe handling. It is also critical that these products be used and maintained properly!!

SPM™ flow products contain elastomeric seals and are not intended to provide proper functionality when exposed to fire.

WARNING: MISUSE, SIDE LOADING, IMPROPER MAINTENANCE, OR DISASSEMBLY UNDER PRESSURE CAN CAUSE SERIOUS BODILY INJURY, DEATH, OR PROPERTY DAMAGE.

The following information is given in good faith and should aid in the safe use of your SPM™ products. This information is not meant to replace existing Company's safety policies or practices.

Personal Responsibilities:

1. When working on SPM™ flow control products, safety glasses, approved safety shoes and hard hat must be worn.
2. Personnel should never hammer on any component when pressure is present. Hammering on any part or component may also cause foreign material or steel slags to become airborne.
3. It is a personal responsibility to use the proper tools when servicing the valve. It is a personal responsibility to be knowledgeable and trained in the use and handling of tools for all maintenance of the valve.
4. Hot surface may be present; it is a person's own responsibility to protect against burn injury.

On Location:

1. Each valve is clearly marked with a maximum pressure rating. This pressure must not be exceeded, or **SERIOUS BODILY INJURY, DEATH, OR PROPERTY DAMAGE MAY OCCUR.**

2. The valve discharge connections should be properly cleaned and lightly oiled before the downstream piping is attached. Any worn, damaged, or missing seals should be replaced.

3. Welding, brazing, or heating any part of the product is prohibited. If accessories must be attached, consult SPM™ Oil & Gas factory prior to installation.

4. A complete visual inspection of the product must be made prior to each use. Any leaking seals, broken bolts, leaking hoses or improperly tightened parts must be remedied prior to using.

5. Any repairs or service (even routine maintenance) performed on the product must be performed by a trained service technician who is qualified to work on high pressure flow control products. All such service and repairs must be supervised by qualified management personnel or returned to SPM™ Oil & Gas for service. **Only SPM™ replacement parts should be utilized**. Failure to do so may result in loss of warranty as well as **SERIOUS BODILY INJURY, DEATH, OR PROPERTY DAMAGE.**

Special Precautions:

1. The modifications to or unauthorized repair of any part of a SPM™ product, or use of components not qualified by SPM™ Oil & Gas , can lead to damage to or failure of equipment and **SERIOUS BODILY INJURY OR DEATH!**

2. All SPM™ threaded components are right hand threaded unless specifically designated otherwise. Any turning counterclockwise will unscrew the assembly. Make sure all threaded components are assembled to the correct torque value.

3. All products should be properly cleaned, greased or oiled after each use and inspected prior to each use.

4. Each integral union connection is clearly marked with a pressure code (i.e. “1502”, 15,000 psi). This pressure must not be exceeded. This code should also be used with mating unions. Improper mating can result in failures. All integral union connections used must match (according to size, pressure rating, etc.). These connections must also match the service of the designated string they are installed in.

5. SPM™ Flow Products are not intended for operation during fire, floods, earthquakes, tornadoes, hurricanes, or other catastrophes, whether natural or man-made. SPM™ recommends immediate depressurization of the equipment, followed by implementation of all customer specific safety protocols.

WARNING: OBSERVE ALL INSTRUCTIONS, CAUTIONS AND WARNINGS AS NOTED IN THIS MANUAL. FAILURE TO DO SO CAN LEAD TO EQUIPMENT DAMAGE AND **SERIOUS BODILY INJURY, DEATH, OR PROPERTY DAMAGE.**

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SECTION I: General Information

This service manual covers:

PART NUMBER	DESCRIPTION	PRESSURE RATING	SERVICE	PART KIT
2A29018	2” Standard Flow, Hammer Union Check Valve	15000	Standard Service	2A29092
2A29024	2” Reverse Flow, Hammer Union Check Valve	15000	Standard Service	2A29092
2A29022	2” Standard Flow, Hammer Union Check Valve	10000	H2S (Sour Gas)	2A29093
2A29026	2” Reverse Flow, Hammer Union Check Valve	10000	H2S (Sour Gas)	2A29093
2A43982	3” Standard Flow, Hammer Union Check Valve EXL	15000	Standard Service	2A44825
2A43980	3” Reverse Flow, Hammer Union Check Valve	15000	Standard Service	2A44825
2A43981	3” Reverse Flow, Hammer Union Check Valve (Viton)	15000	Standard Service	2A45072
2A43974	3” Standard Flow, Safety Iron Check Valve	15000	Standard Service	2A44825
2A43973	3” Standard Flow, Safety Iron Check Valve (Viton)	15000	Standard Service	2A45072
2A28744	4” Standard Flow, Hammer Union Check Valve	10000	Standard Service	2A33163
2A28949	4” Reverse Flow, Hammer Union Check Valve	10000	Standard Service	2A33163
2A28955	4” Standard Flow, Safety Iron Check Valve	10000	Standard Service	2A33163
2A28742	4” Standard Flow, Hammer Union Check Valve	15000	Standard Service	2A33163
2A28945	4” Reverse Flow, Hammer Union Check Valve	15000	Standard Service	2A33163
2A28959	4” Standard Flow, Safety Iron Check Valve	15000	Standard Service	2A33163

Product Description:

The SPM™ clapper style check valves are flow control devices that permit flow in one direction but stop flow in the opposite direction. Generally used in well service applications, the clapper check valve is placed in the treating line to allow flow to the well but isolates any back flow to go upstream in the valve. This provides a safety device at various locations in the flow line and assures that pressure and fluid cannot backup into the manifold area or into the pumps.

SPM™ clapper check valves are manufactured in 2", 3" and 4" sizes. Each size is offered with either SPM™ Safety Iron® or hammer union end connections. In addition, the check valves with hammer union end connections are available in standard or reverse flow. The check valves are available in pressure ranges up to 15,000 psi for well service applications such as acidizing, cementing and fracturing. These valves are designed for fluids that are heavily laden with materials such as proppants, solids and ball sealers.

Severe Duty Characteristics:

The SPM™ severe duty check valve is designed specifically to provide longer life and reliable operation in severe service environments. Ideal for the harsh pumping operations seen in the shale formations; the SD Check Valve utilizes unique design features resulting in improved reliability and performance compared to other check valves currently available to the market.

Utilization of a Threaded Seat:

- Self-locking design prevents seat from becoming loose, due to high vibration of flow line
- Machined from high erosion and high corrosion resistant NACE compliant stainless steel for longer life
- Features O-ring for excellent sealing performance

Enhanced Hanger:

- Flat machined into hanger matches flat machined into body preventing rotation during operation
- Removes hanger pin from assembly requiring fewer component parts

Pressure/Temperature Ratings:

The SPM™ clapper check valves are available in the following configurations:

VALVE SIZE	END CONNECTION	NSCWP (PSI) *	COLOR	TYPE OF SERVICE	TEMP. RANGE
2”	2" 1502 Female x 2" 1502 Male (Standard Flow)	15000	Red	Standard Service	-30°C - 100°C
2”	2" 1502 Male x 2" 1502 Female (Reverse Flow)	15000	Purple	Standard Service	
2”	2" 1502 Safety Iron®	15000	Red	Standard Service	
3”	3" 1502 Female x 3" 1502 Male (Standard Flow)	10000	Sour Gas Green	Sour Gas Service	
3”	3" 1502 Male x 3" 1502 Female (Reverse Flow)	10000	Sour Gas Green	Sour Gas Service	
3”	3" 1502 Female x 3" 1502 Male (Standard Flow)	15000	Red	Standard Service	
3”	3" 1502 Male x 3" 1502 Female (Reverse Flow)	15000	Purple	Standard Service	
3”	3" 1502 Safety Iron®	15000	Red	Standard Service	
4”	4" 1002 Female x 4" 1002 Male (Standard)	10000	Black	Standard Service	
4”	4" 1002 Safety Iron® (Standard)	10000	Black	Standard Service	
4”	4" 1002 Safety Iron® (Reverse)	10000	Yellow	Standard Service	
4”	4" 1502 Female x 4" 1502 Male (Standard)	15000	Red	Standard Service	
4”	4" 1502 Male x 4" 1502 Female (Reverse)	15000	Purple	Standard Service	
4”	4" 1502 Safety Iron®	15000	Red	Standard Service	

Table 1. SPM™ severe duty clapper check valves.

* Non-Shock Cold Working Pressure

*****CAUTION*****
SINCE CHECK VALVES MAY BE REPAINTED IN DIFFERENT COLORS FOR VARIOUS APPLICATIONS, DO NOT USE FACTORY COLOR AS PRIMARY MEANS OF IDENTIFICATION

VALVE SIZE	NSCWP (PSI)	BORE	FLOW RATE	
			GPM	BPM
2”	15000	1.75	315	7.5
3”	15000	2.75	778	18.5
4”	10000	3.75	1446	34.4
4”	15000	3.75	1446	34.4

Table 2: Recommended Flow Rates (Flow rate based on 42 fps)

SECTION II: Installation and Operation

The following information is given in good faith and should aid in the safe use of your SPM™ products. This information is not meant to replace any existing Company's safety policies or practices, which should be strictly followed.

The SPM™ Clapper Check Valve should be installed in the line where a flow control device is necessary to stop flow in one direction (See Fig. 1). For complete fluid shut-off, an isolation valve (such as a SPM™ plug valve) should be installed in series with the clapper check valve.

Before assembly into a fluid line, check the direction of flow indicated by the arrow on the body and make sure the valve is properly oriented in the line. **Improperly directed check valves will shut off fluid flow and can result in SERIOUS INJURY OR DEATH.**

The valve should be mounted in a flat, horizontal position, as shown in Fig. 1, to allow for gravity to close the clapper when there is no flow. The clapper will close by itself, reseat and seal when sufficient backpressure is encountered. If a flat, horizontal installation is not possible, contact your SPM™ representative about using a SPM™ dart style check valve instead. Dart check valves utilize a spring to close and can be oriented in any position.

The clapper check valve is specifically designed to be used with liquid frac, acidizing, and cementing fluids. On jobs where nitrogen is introduced into the frac line, the clapper check valve should be used only in the co-mingled fluid. A dart style check valve is required for the nitrogen line.

SPM™ recommends avoiding mounting the check valve directly to a series of swivels off the discharge flange of a frac pump. This application may result in increased turbulence within the valve, resulting in a decrease in the life of the internal kit components. The preferred approach will require the addition of a 24” pipe between the inlet of the check valve, and the outlet of the swivels. This will allow for stabilization of the turbulent fluid from the swivels, prior to entering the check valve.

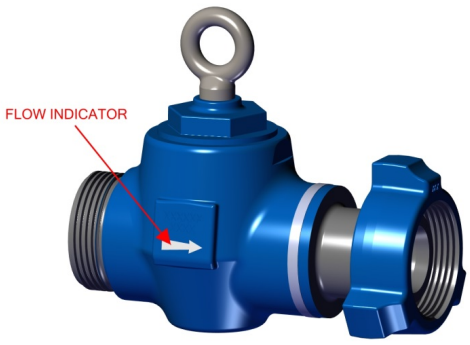


Figure 1:
Check Valve indicating Flow Indicator

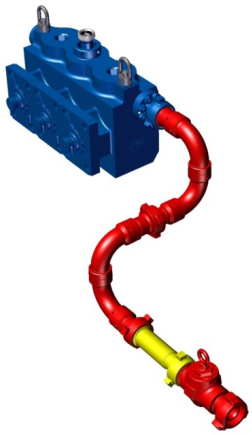


Figure 2:
Spacer pipe installed between check valve and swivel

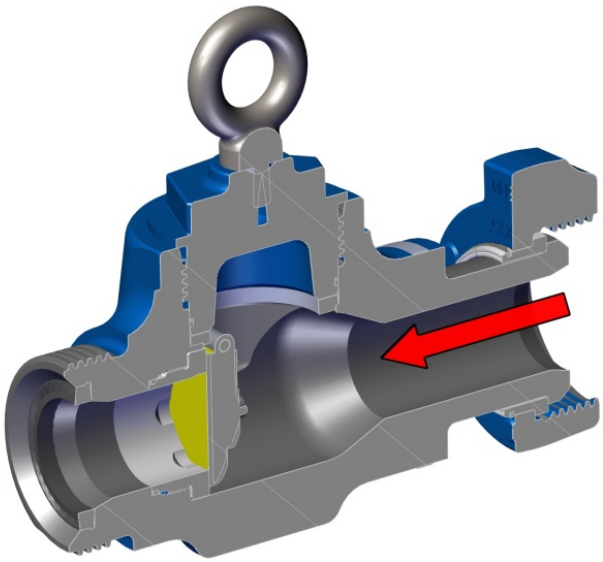
*****CAUTION*****

CARE MUST BE TAKEN WHEN INSTALLING THE CLAPPER STYLE CHECK VALVE SO THAT A HAMMER NEVER STRIKES THE VALVE BODY. THE BODY IS NOT INTENDED FOR SEVERE FORCES, SUCH AS A HAMMER BLOW, AND THERE IS THE DANGER THAT THE VALVE COULD CRACK UNDER SUCH CIRCUMSTANCES.

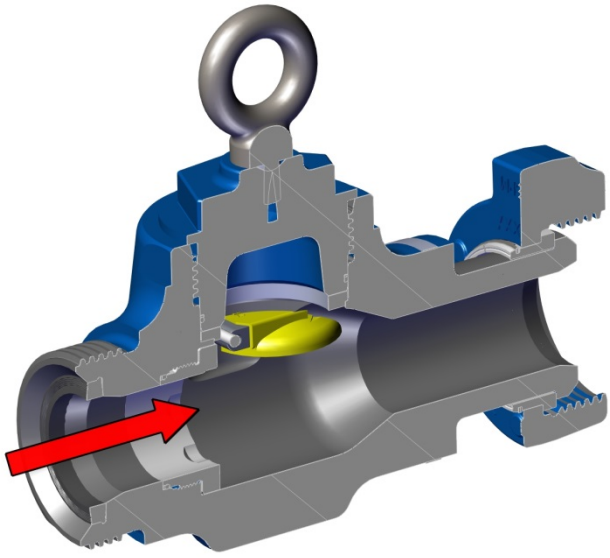
Materials used in the SPM™ standard service clapper check valves are designed for high strength. They are susceptible to stress corrosion and do not conform to NACE for use in sour gas (H2S) environments. Only use SPM™ Sour Gas Service Clapper Check Valves for H2S service.

Whenever clapper style check valves are installed on portable equipment, such as trucks or trailers, the operator must ensure that the truck or trailer is positioned correctly in a flat horizontal position.

Do not attempt to work on or repair any equipment isolated by the clapper check valve while the check valve has energized fluid behind it. Before any service is performed on the check valve, make sure there is no pressure in the line.



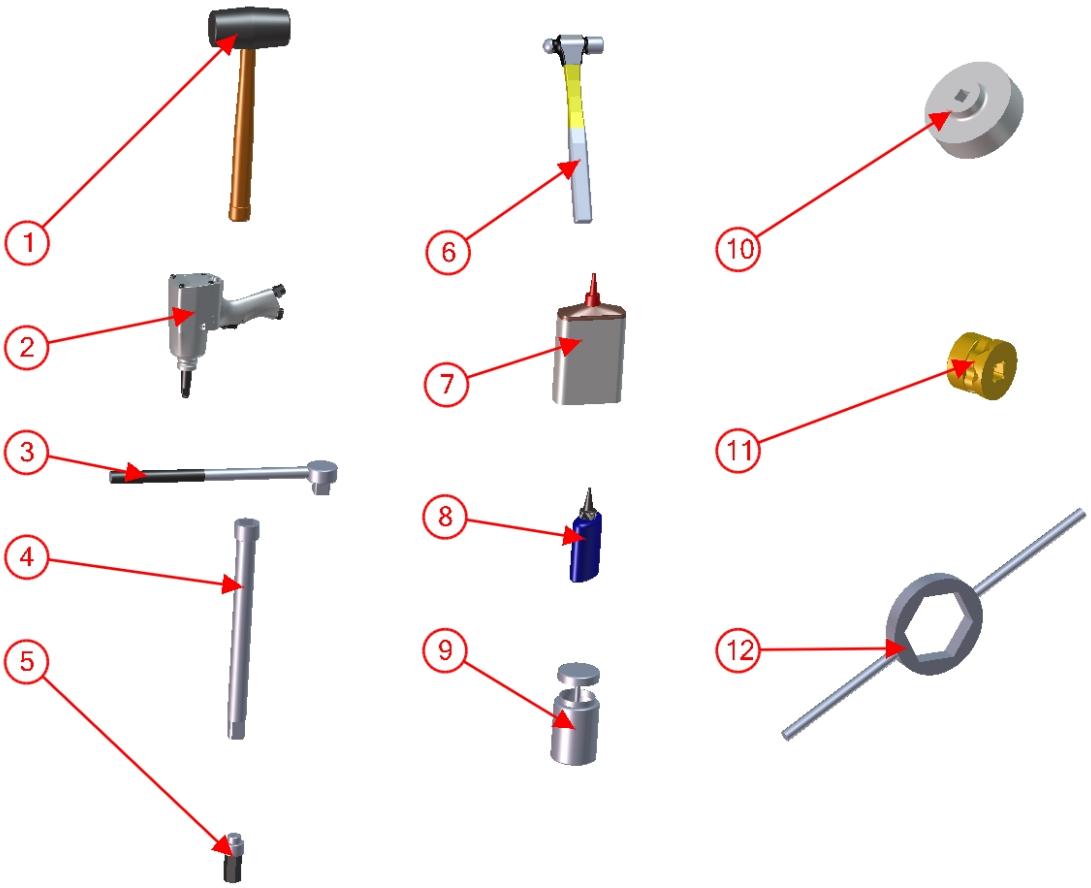
Flow in the opposite direction (CLAPPER CLOSED)



Flow in the standard direction (CLAPPER OPEN)

SECTION III: Maintenance and Repair

Required Tools:



ID NUMBER	DESCRIPTION
1	Rubber Hammer
2	Impact Wrench
3	Ratchet Wrench
4	Extension Arm
5	Socket (1”)
6	Hammer
7	Super Lube or approved equivalent
8	Loctite
9	Anti-Seize
10	2” Cap Removal tool (Pneumatic) - 2P41672
	3” Cap Removal tool (Pneumatic) - 2P41671
11	3” Seat Removal tool - 2A42646
	4” Seat Removal tool - 2A42879
12	2” Cap Removal tool (Manual) - 2P30665
	3” Cap Removal tool (Manual) - 2P30666

Maintenance Requirements:

The well-designed SPM™ clapper check valves with severe duty components provide long term, reliable performance for the user. Like any device, however, they do require routine inspection and servicing to guarantee that they are fully functional.

Hammer union ends should be cleaned and lightly oiled prior to each use. Hammer union seals should be checked and replaced when worn or damaged.

For Safety Iron® products care must be taken to ensure that threads on bolts & clamps, and all mating surfaces are lubricated, free of burrs, dents, gouges and dirt. Typical maintenance would include properly cleaning, greasing, or oiling the product after each use. Consult the Safety Iron® Instructions and Safety Manual for further information regarding maintenance, inspection, and replacements of parts.

There are wear surfaces on this device and elastomer seals that require maintenance. For the valve to operate properly and safely, these items must be kept in good condition. Inspection and servicing should be conducted in accordance with your service program. In general, the more severe the usage, the more often the maintenance should occur. It is recommended that a flow rate in excess of 42 feet per second be avoided. Rates above this will cause more rapid wear and erosion.

Inspection/Repair:

Check valves require maintenance. It is impossible to visually inspect components from the outside. Consequently, the valves should be disassembled and inspected often (at least every 90 days). Any signs of pitting or washing on the body and components require replacement. Clapper assemblies should be replaced regularly (approx. every 90 days or sooner depending the type and amount of use). Clapper valve seats should be checked for wear. If such evidence exists, contact your nearest service center for valve seat replacement. Clapper check valve caps should be inspected for damage, deterioration or washing. Use only SPM™ OEM parts when repairing units.

Any check valve that has been exposed to high shock loads (i.e. overpressure, sandoffs, etc.) should be removed from service until ultrasonic checks and pressure testing can be performed. Valves used in areas of high acid concentrations require special attention to inspection and maintenance.

NOTE: Some end users prefer to use ported caps to allow the installation of needle valves in the cap for bleed off. SPM™ opposes that process and recommends installing an integral tee and torture plug valve in line with the check valve (for bleed off purposes). WELDING, BRAZING OR HEATING CHECK VALVES IS PROHIBITED, MATERIAL DAMAGE WILL OCCUR.

Pressure Testing

SPM™ pressure tests all clapper style check valves prior to shipping. Every valve is vessel tested to 150% of its rating to ensure safety and reliability.

Field Testing:

When pressure testing, the pressure should be applied to the total body as well as the check system side. Pressure testing should be done with cold water. Personnel should wear proper safety equipment and avoid any area of danger while pressure is present. Prior to any pressure testing, all air must be evacuated from the system. Failure to do so could result in **PERSONAL INJURY OR DEATH!**

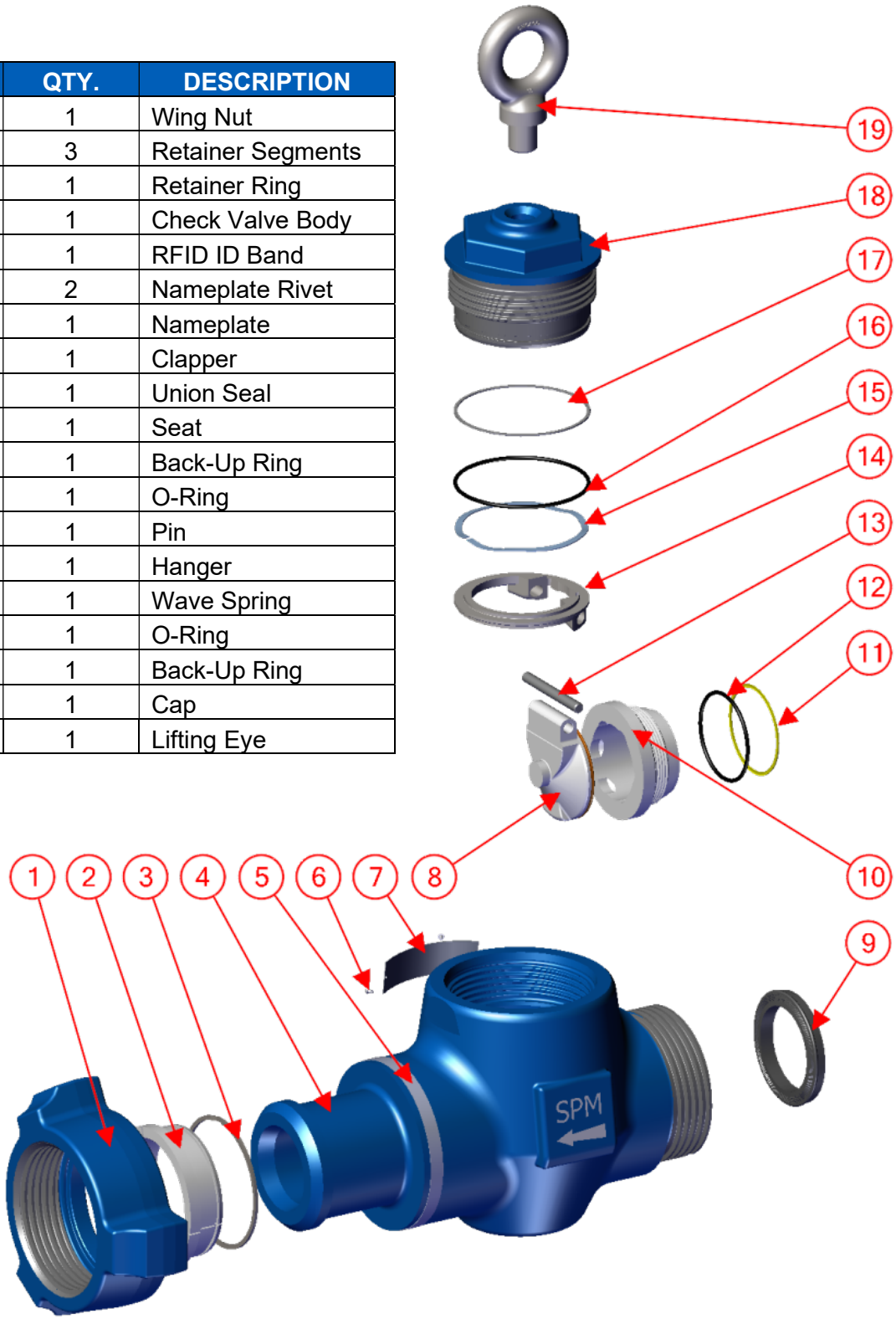
Pressure testing (and ultrasonic test) should be performed every 6 months or more frequently if service is "severe" or "low temperature". It is necessary to test each valve for leaks after they are refurbished. To test for leaks:

Fill the valve with liquid (Water)

With the valve near working pressure, carefully examine for leaks. If no leaks are observed, the valve is now ready for service.

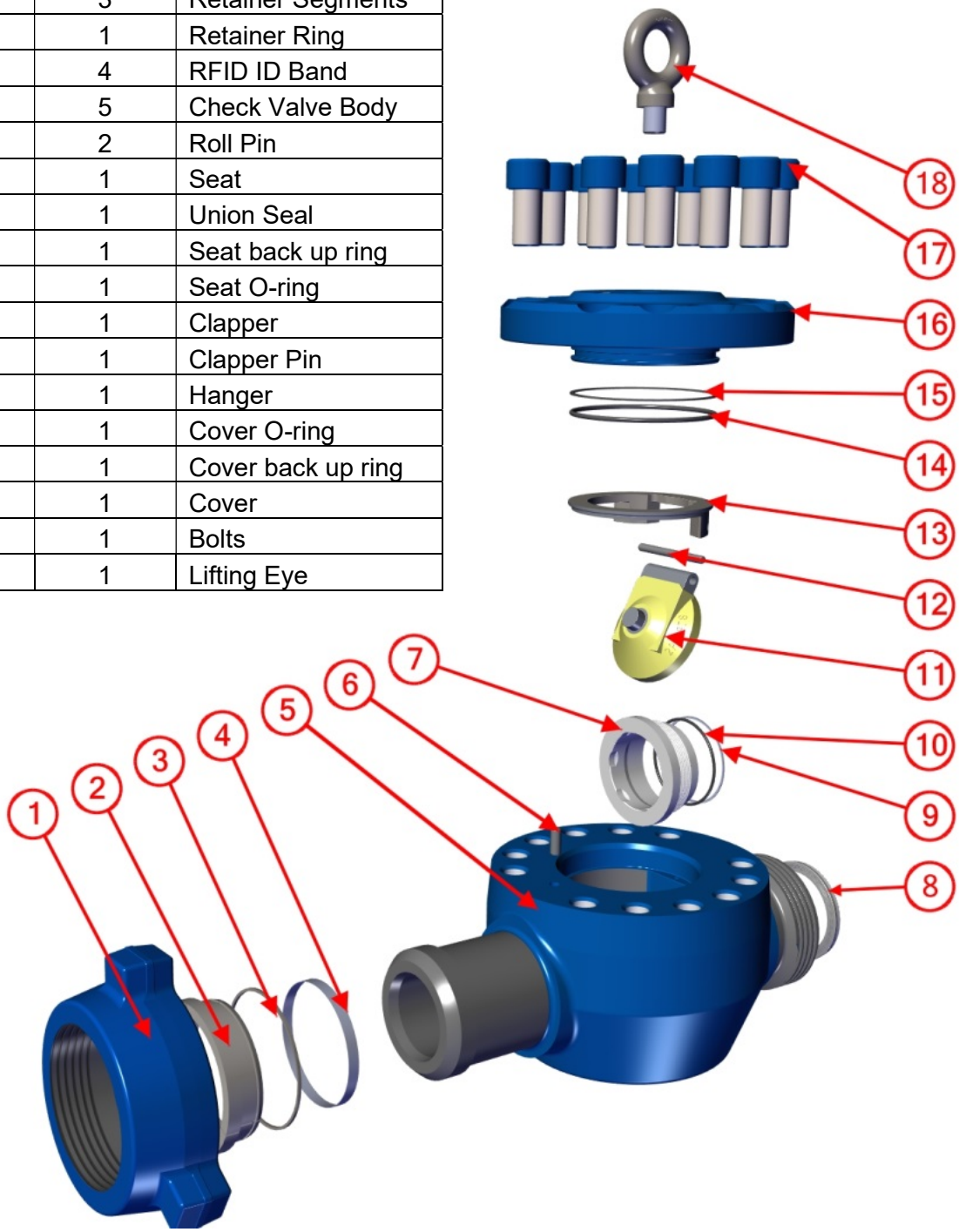
3” Check Valve – Exploded View

BOM ID	QTY.	DESCRIPTION
1	1	Wing Nut
2	3	Retainer Segments
3	1	Retainer Ring
4	1	Check Valve Body
5	1	RFID ID Band
6	2	Nameplate Rivet
7	1	Nameplate
8	1	Clapper
9	1	Union Seal
10	1	Seat
11	1	Back-Up Ring
12	1	O-Ring
13	1	Pin
14	1	Hanger
15	1	Wave Spring
16	1	O-Ring
17	1	Back-Up Ring
18	1	Cap
19	1	Lifting Eye



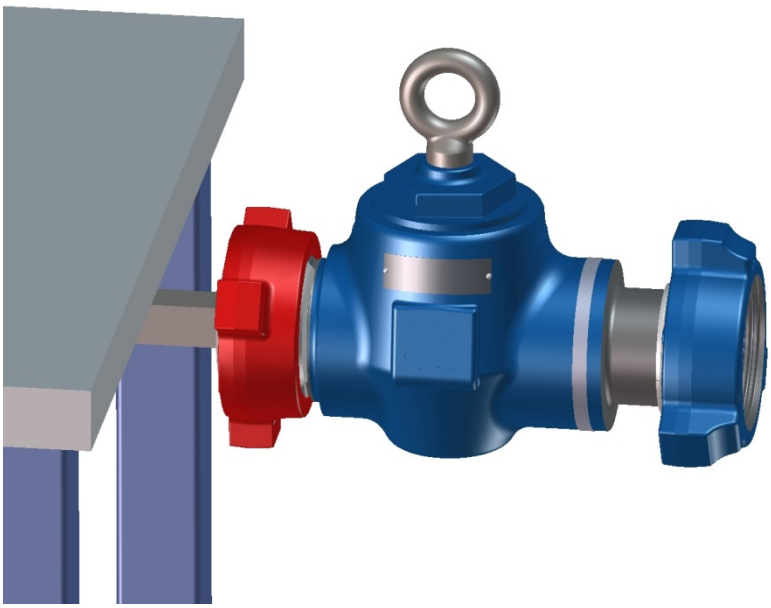
4” Check Valve – Exploded View

BOM ID	QTY.	DESCRIPTION
1	1	Wing Nut
2	3	Retainer Segments
3	1	Retainer Ring
4	4	RFID ID Band
5	5	Check Valve Body
6	2	Roll Pin
7	1	Seat
8	1	Union Seal
9	1	Seat back up ring
10	1	Seat O-ring
11	1	Clapper
12	1	Clapper Pin
13	1	Hanger
14	1	Cover O-ring
15	1	Cover back up ring
16	1	Cover
17	1	Bolts
18	1	Lifting Eye

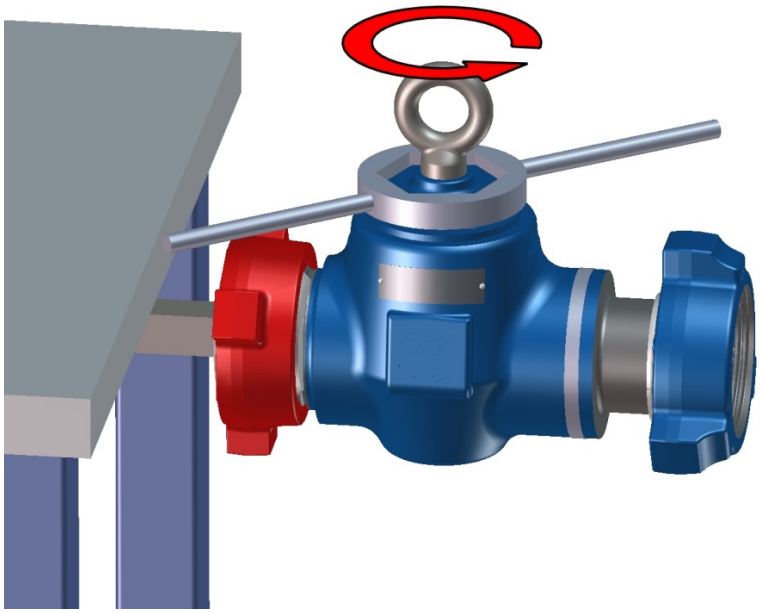


2” & 3” Disassembly:

1. Secure the valve in an upright position by clamping the valve body (4) in a vise.



2. Using a large pipe wrench start to unscrew valve cap, (18) from the body (4) by turning counterclockwise. Use hammer if necessary. Remove cap seal (16) and seal backup (17) from cap (18) .



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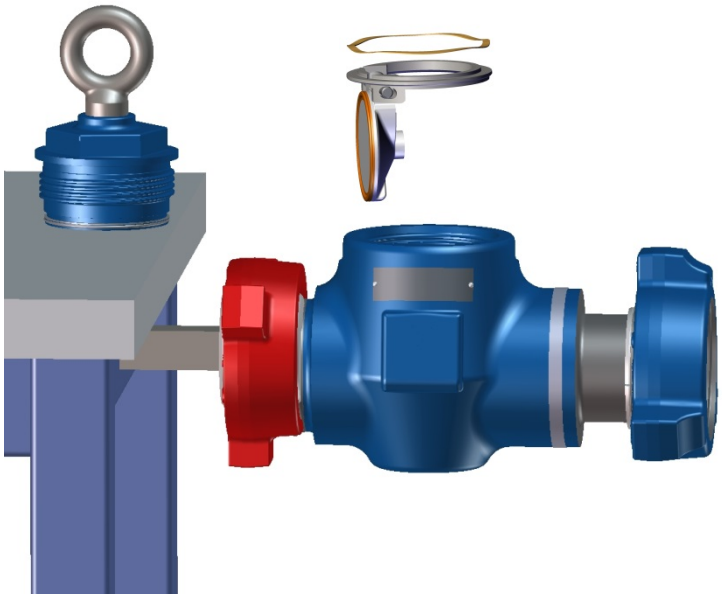
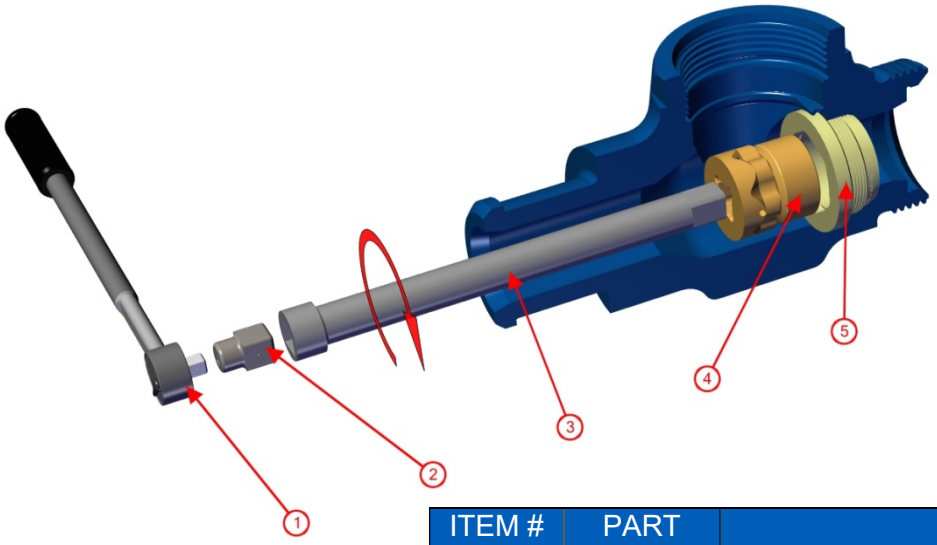
3. Remove the wave spring (15), hanger (14), clapper (8), and clapper pin (13).



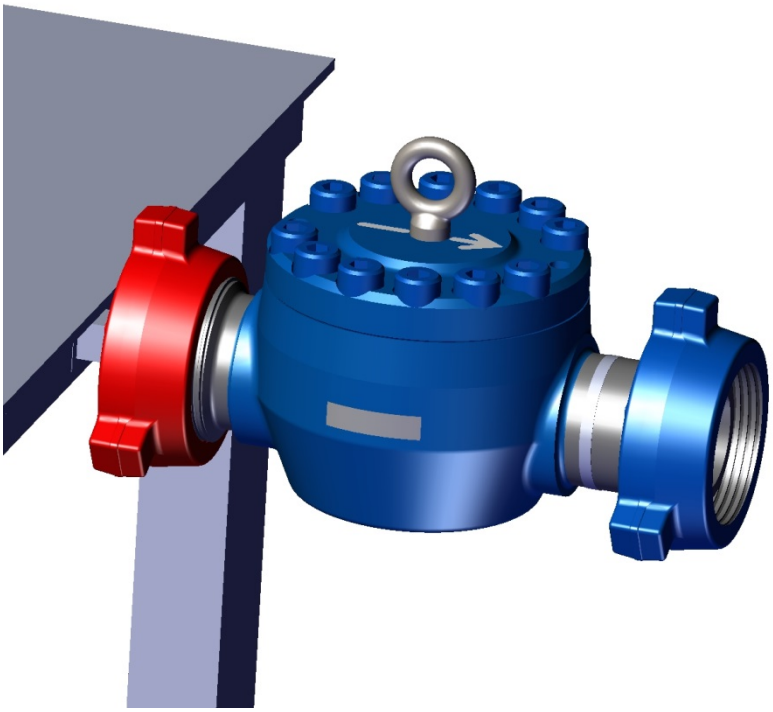
4. Use tools a shown below to remove the check valve seat. Once the seat ⑧ is removed, remove the seat O-ring ⑩ and back up seal ⑪. The valve is now completely disassembled.



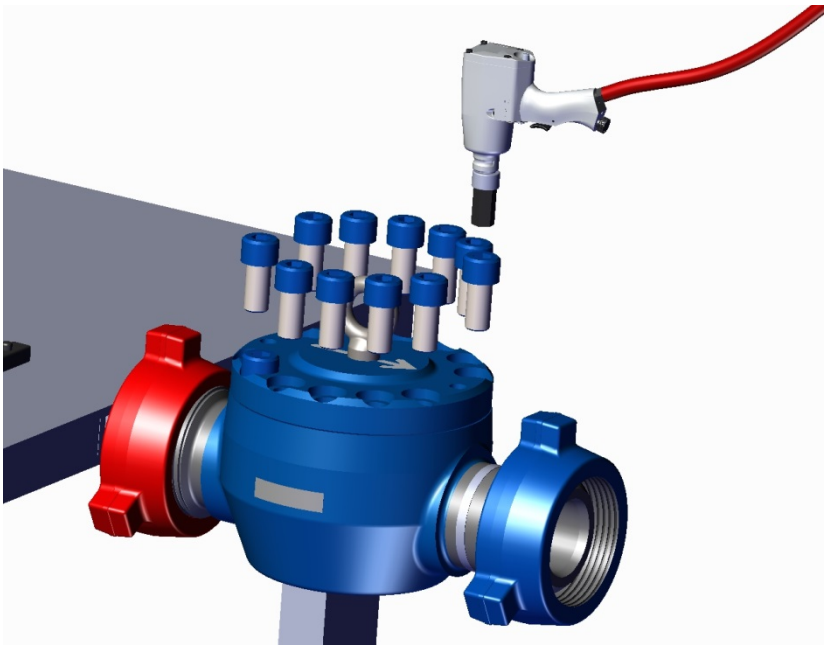
ITEM #	PART NUMBER	DESCRIPTION
1		¾” Drive Pneumatic Impact Wrench (Dis-assembly)
		¾” Drive Hand Socket Wrench (Assembly)
2		1” Male to ¾” Female Socket Adapter
3	P42674	1” x 17” Drive Extension
4	2A42646	3” Seat Socket
5	2A42728	Enhanced Seat Kit (Buna)
	2A42729	Enhanced Seat Kit (Viton)

4” Disassembly:

1. Secure the valve in an upright position by clamping the valve body into a vise or a table with a union connection.



2. Use an impact with ¾” socket or a 3/4" Allen Wrench with 12" leg and hammer to loosen the 10 or 12 SHCS bolts from the body.



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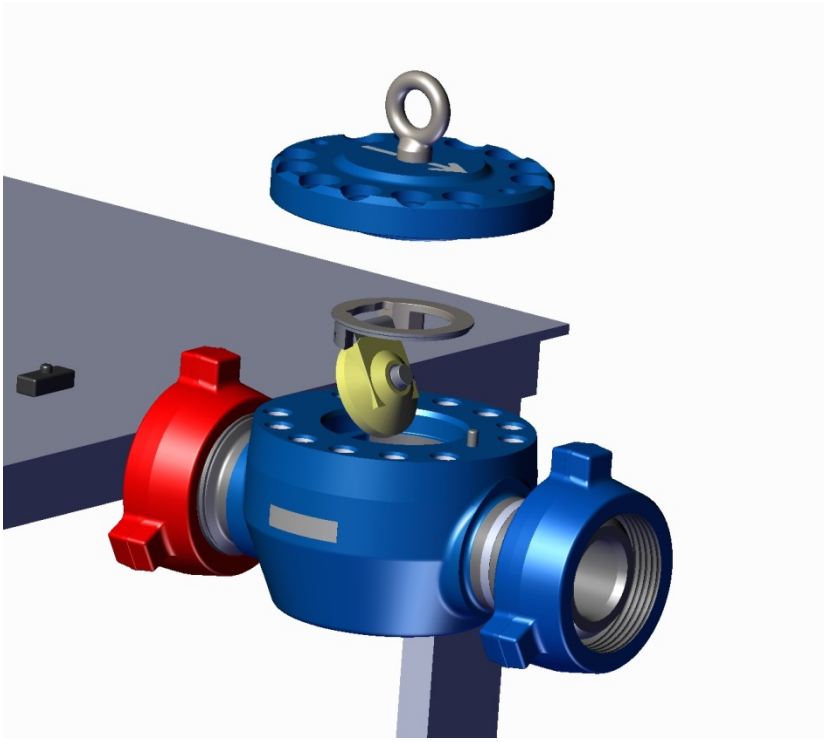
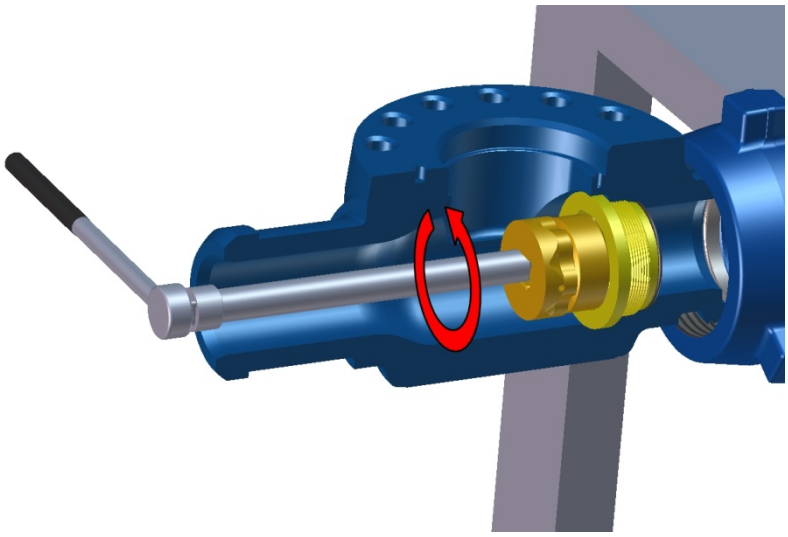
3. Remove Cap cover by lifting with eyelid. Remove the Clapper/Hanger/Pin sub assembly from body

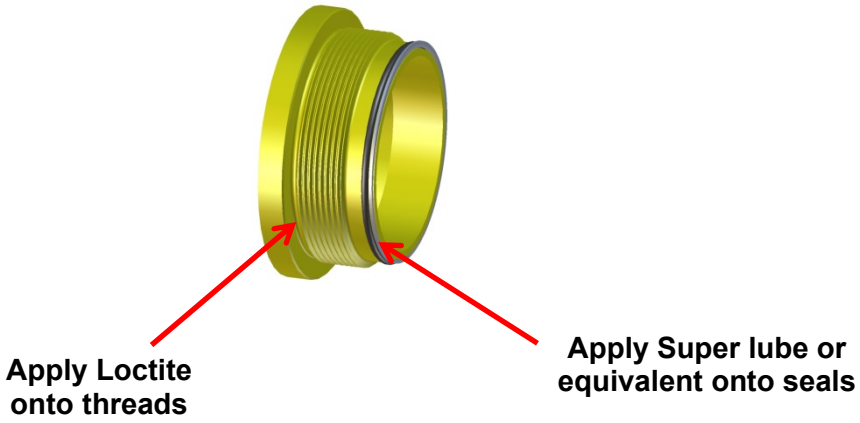


4. Use SPM™ seat removal tool 2A42646 with breaker bar and socket extension to remove seat as shown.

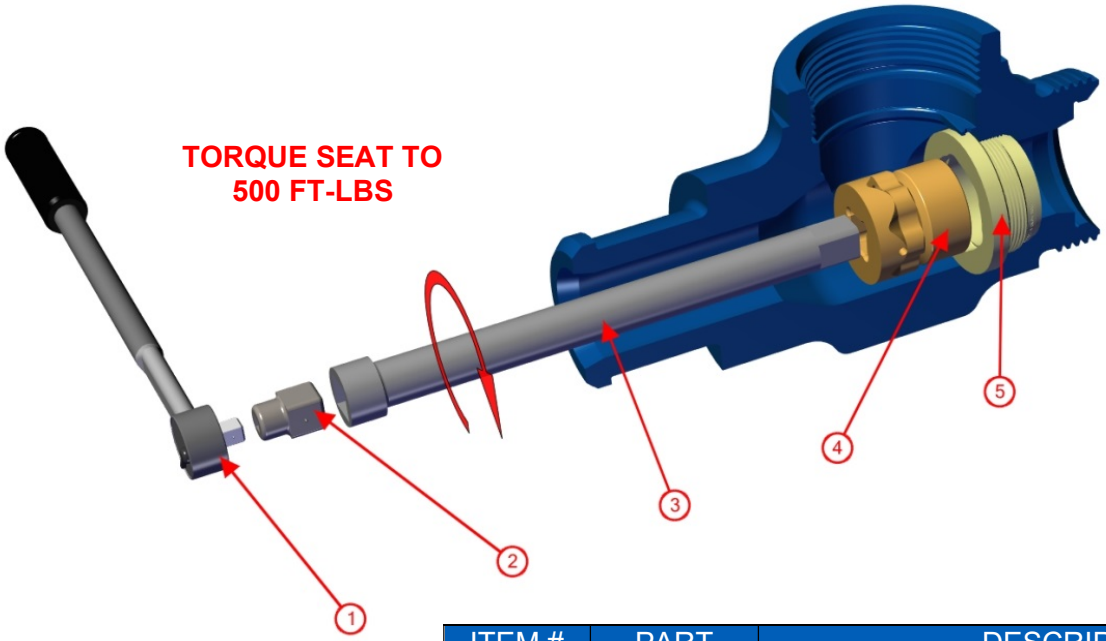


3” Assembly:

1. Secure the valve in an upright position by clamping the valve body into a vise or a table with a union connection. Install the backup ring and O-ring onto seat. Apply Super lube or equivalent onto the seals. Apply a thin coat of Loctite onto the threads of the seat.



2. Use seat removal tool as shown below to install seat.



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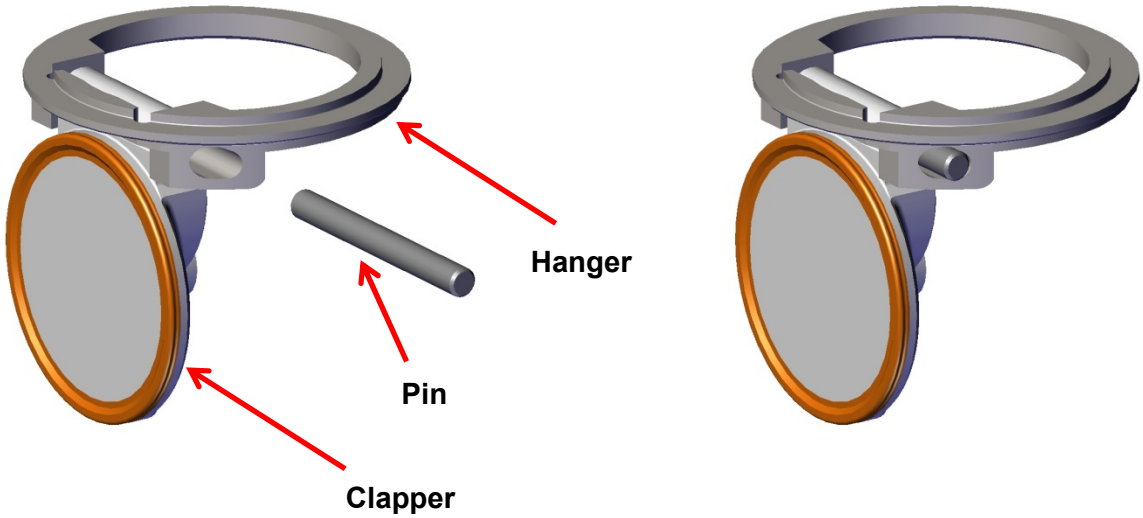
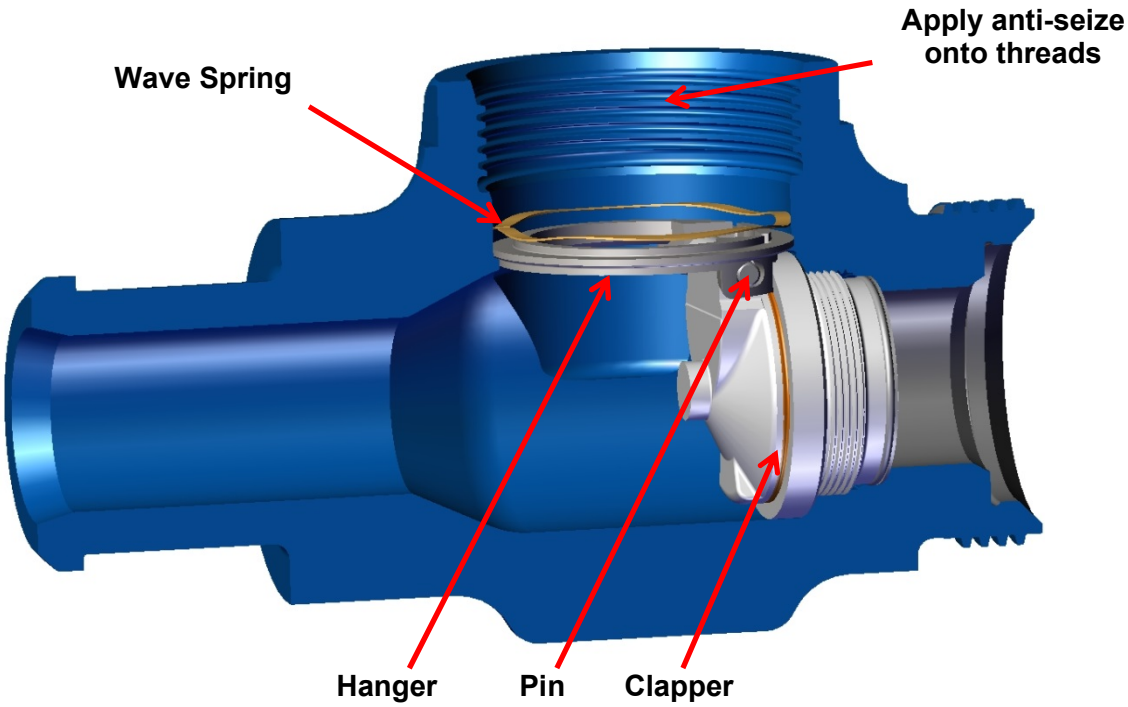
4	2A42646	3” Seat Socket
5	2A42728	Enhanced Seat Kit (Buna)
	2A42729	Enhanced Seat Kit (Viton)

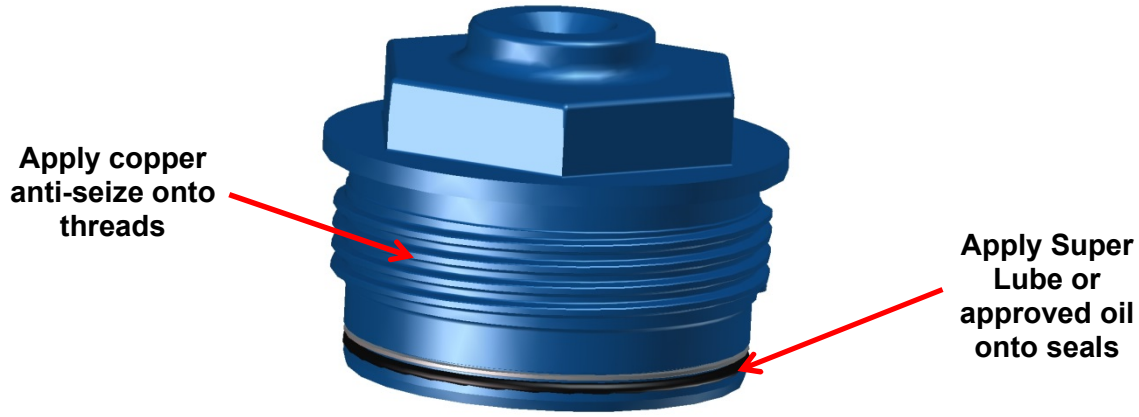
3. Insert Pin into Clapper and Hanger



4. Insert Clapper/Hanger/Pin sub assembly and wave spring into body as shown. Visually inspect threads and clean them. Apply thin coat of anti-seize onto threads

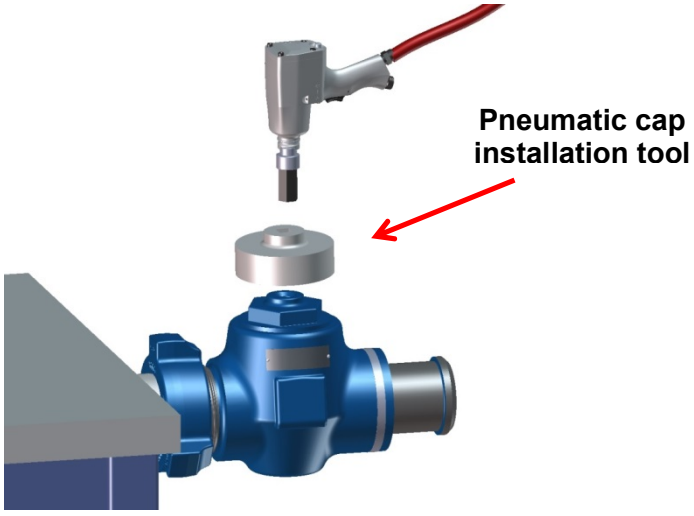


5. Install lifting eye onto cap. Install back up and O-ring onto cap as shown. Apply super lube or equivalent onto seals and anti-seize onto threads.



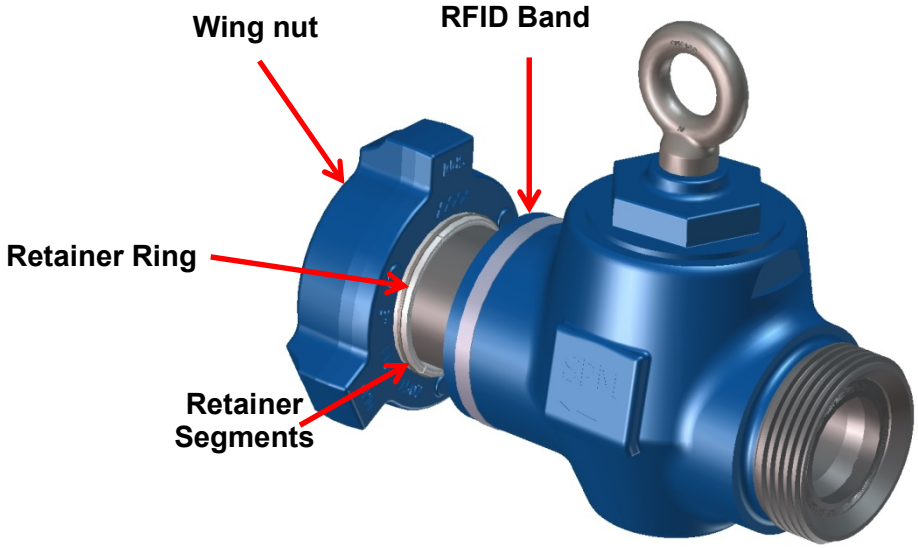
6. Use SPM™ pneumatic cap installation tool (2" 2P41672, 3" 2P41671) to tighten the cap onto the body. Utilize a torque wrench to verify torque of cap per the guidelines referenced below:

2" & 3" CHECK VALVE TORQUE REQUIREMENTS
Field Repair Applications *Torque cap to 625 ft-lbs per Bulletin 1758*
Service Center Repair/Re-kitting *Torque cap to a minimum of 875 ft-lbs. per Eng-234*
New Manufacturing *Torque cap to minimum of 875 ft-lbs. per Eng-233*



Note: The preferred minimum torque value for the cap is 875 ft-lbs. However, testing has confirmed that this value may be challenging to achieve during field repairs in which proper fixtures may not be available. Due to this, field repair applications may incorporate the lower torque value referenced above.

7. Install retainer segments, retainer ring, RFID and wing nut



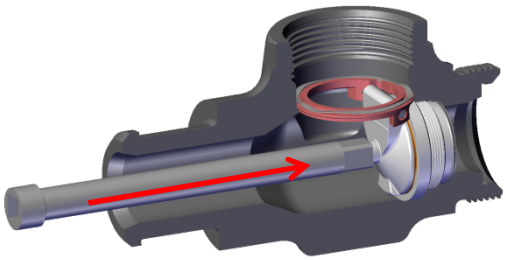
8. For pressure testing purposes only. (3” Check Valve Only)

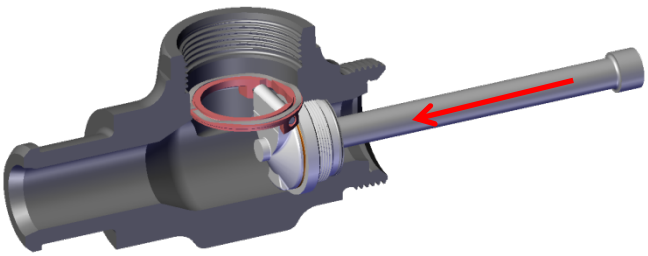
After installation of the EXL check valve kit, it is beneficial to ensure the hanger and clapper assembly is properly aligned for correct sealing performance. This is best accomplished by striking the closed face of the clapper with several firm blows using a suitable extension bar. This will create sufficient torque on the hanger to achieve slight rotational adjustments as required. Note that this procedure is not applicable for circumstances in which the valve is already installed in the flowline.

In field applications the high fluid easily overcomes the small friction from the wave spring, allowing the clapper to shift and align.

The manual manipulation of the clapper is only beneficial during hydrostatic testing applications in which the small volume of fluid entering the valve is insufficient to build enough pressure to shift and align the clapper.

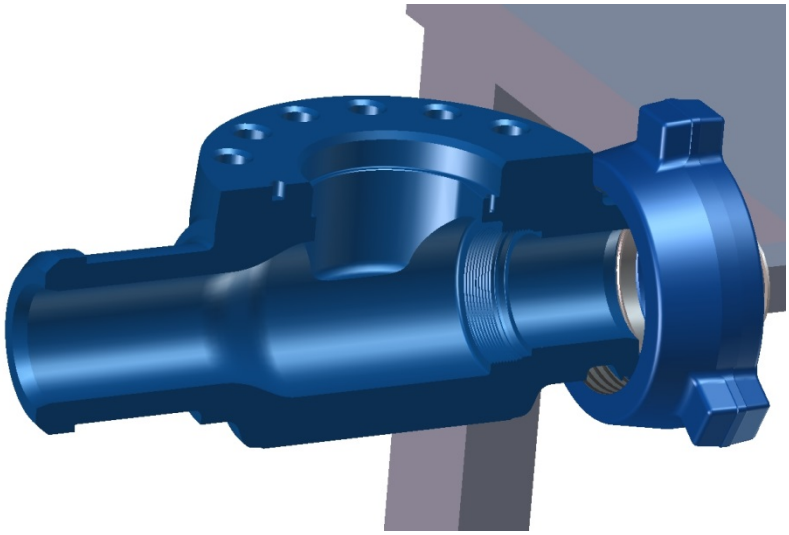
Inspect bore to verify the clapper is in the CLOSED position. Use extension bar and hammer to tap clapper as shown below (as applicable). Repeat in opposite direction to ensure the clapper is installed correctly (as applicable).

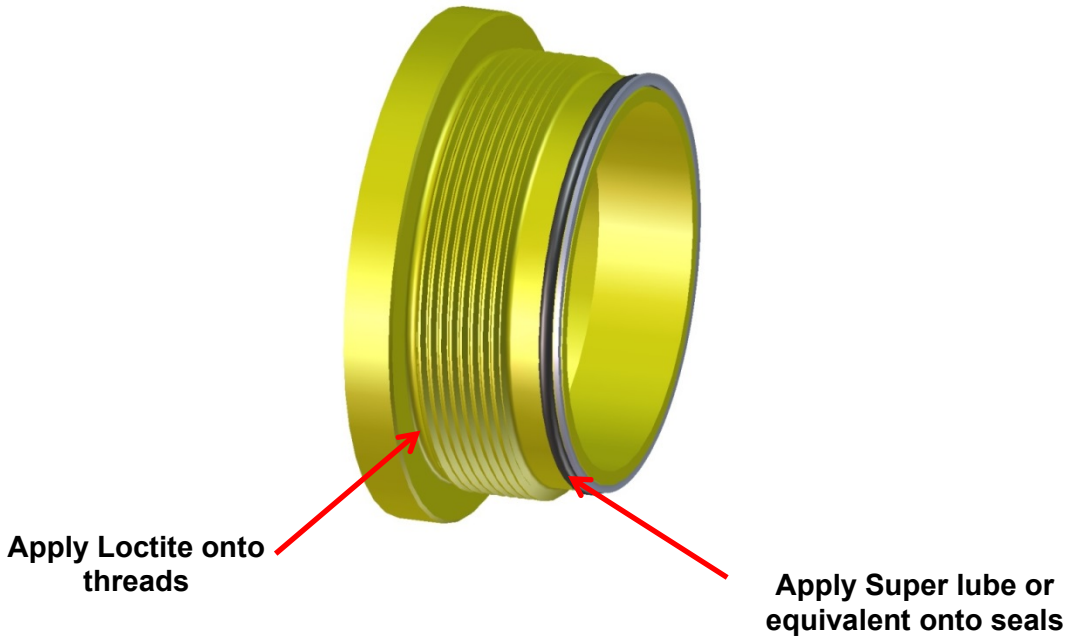




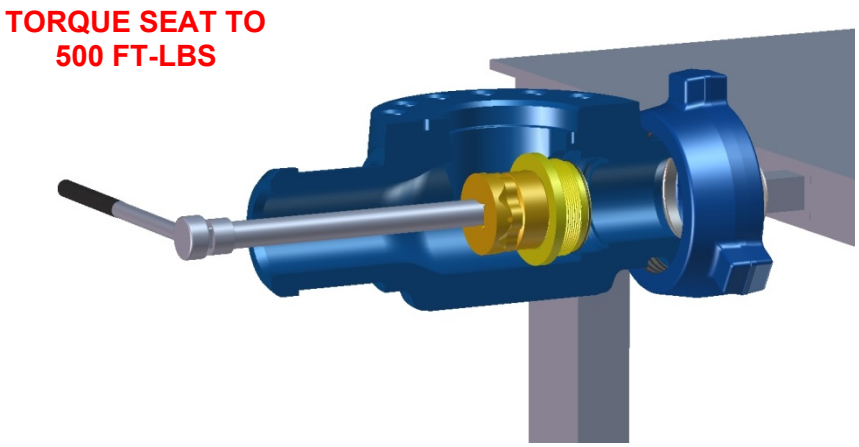
4” Assembly

1. Secure the valve in an upright position by clamping the valve body into a vise or a table with a union connection. Install the backup ring and O ring onto seat. Apply Super lube or equivalent onto the seals. Apply a thin coat of Loctite onto the threads of the seat.





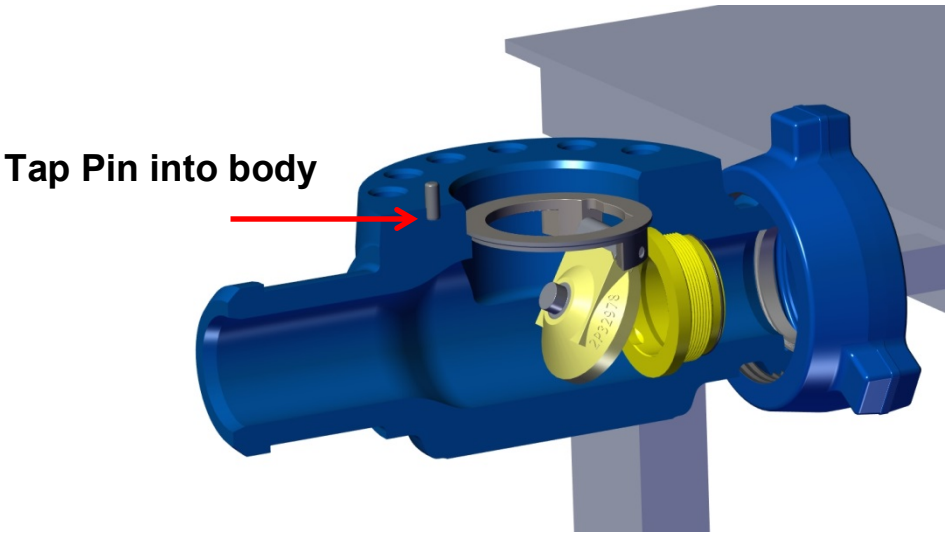
2. Use seat removal tool as shown below to install seat.



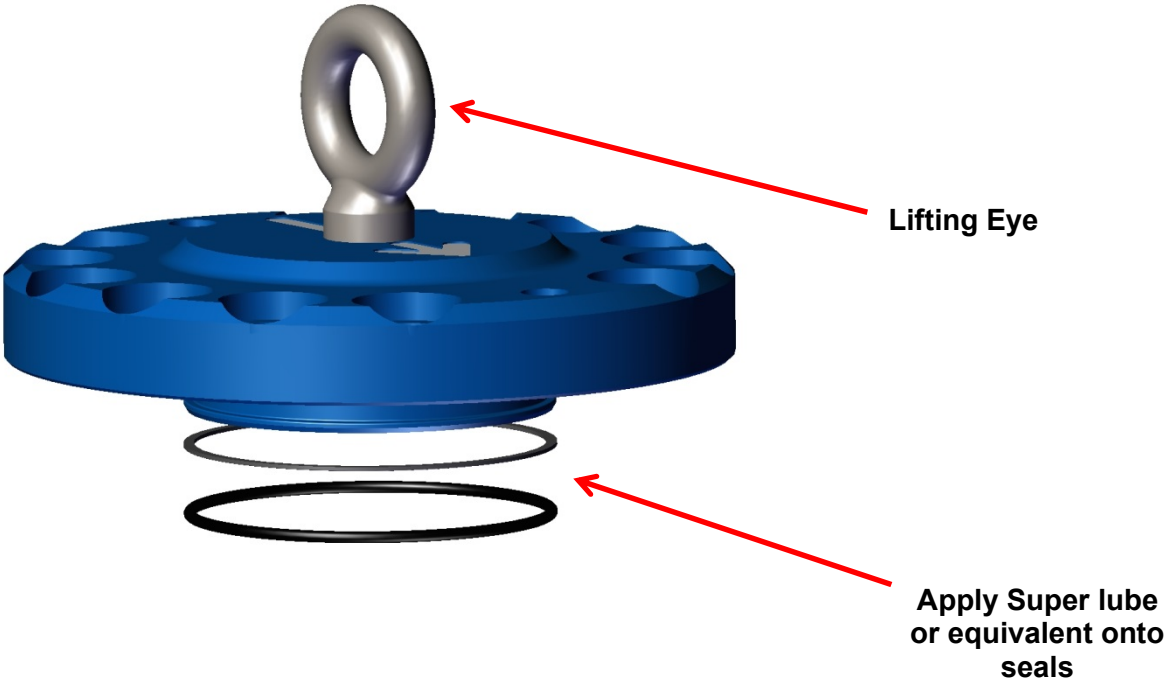
3. Insert Pin into Clapper and Hanger

4. Insert Clapper/Hanger/Pin sub assembly into body as shown. Visually inspect clean threads. Apply thin coat of anti-seize onto threads

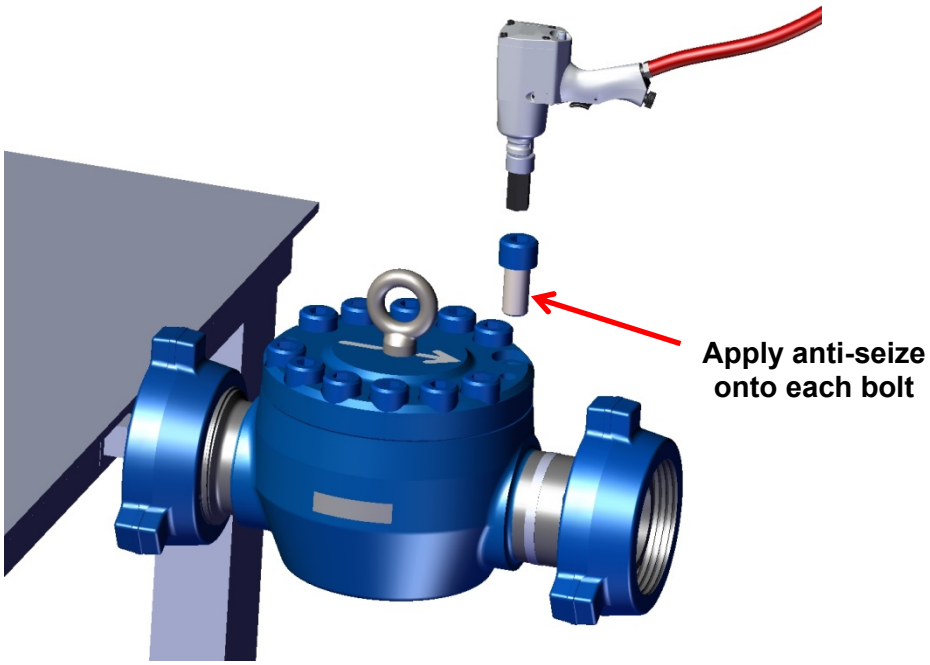
   Tap Pin into position with hammer as shown below.



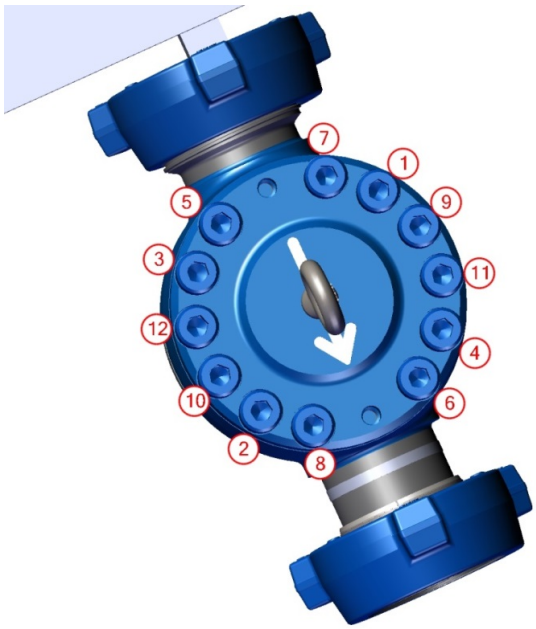
5. Install back up and O-ring onto cap as shown. Apply super lube or equivalent onto seals. Install lifting eye



6. **Ensure that the Cap's arrow is pointing the direction of flow when the Check valve is opened in normal flow operations.** Apply Anti-seize to each bolt and engage a few threads by hand.



7. Use Impact and socket to tighten each bolt in a cross-torque method. Follow the numbered pattern as shown below. Utilize a torque wrench to verify torque of cap to a minimum value of 450-550 ft-lbs.



Troubleshooting Guide:

	ISSUE		ROOT CAUSE		SOLUTION
1	Valve leaks between cap and valve body.		a) Damaged cap seal or damaged seal & seal backup. b) Cap seal or seal & seal backup installed incorrectly.		a) Replace damaged seals. b) Reinstall seals correctly.
2	Valve leaks from clapper seal area (Valve does not seal or prevent back flow)		a) Clapper not seating correctly or clapper seal area is damaged.		a) Inspect clapper. If acceptable, reinstall correctly. If not acceptable, replace and install new clapper correctly. b) Remove valve from service. Replace with new valve assembly. c) Remove valve cap and clapper. Examine seal area on valve body and clapper. Remove all debris. Reassemble.
3	Severe clapper chatter when flowing nitrogen		a) Wrong type of check valve is being used. Clapper check valve is mounted in nitrogen line prior to co-mingling the fluids. This produces clapper action instability.		a) Switch to Dart style check valves and move Clapper style check valves out of the path of full force Nitrogen.

SECTION IV: Service and Support

Service Center Order Information:

SPM™ Oil and Gas stocks a large inventory of genuine original equipment replacement parts. In order to expedite a parts order and avoid any delays, please provide the following information with your order:

- The part number and description (refer to drawings and parts lists in this section) of each item ordered.
- The quantity of each part, kit, or assembly ordered.
- The model number and serial number.
- Your purchase order number.
- Specify method of shipment, complete shipping address, complete billing address and telephone number at the destination of the shipment.

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