

Adding live-loaded packing option to Jamesbury™ Wafer-Sphere™ high performance butterfly valve

Installation, maintenance and
operating instructions

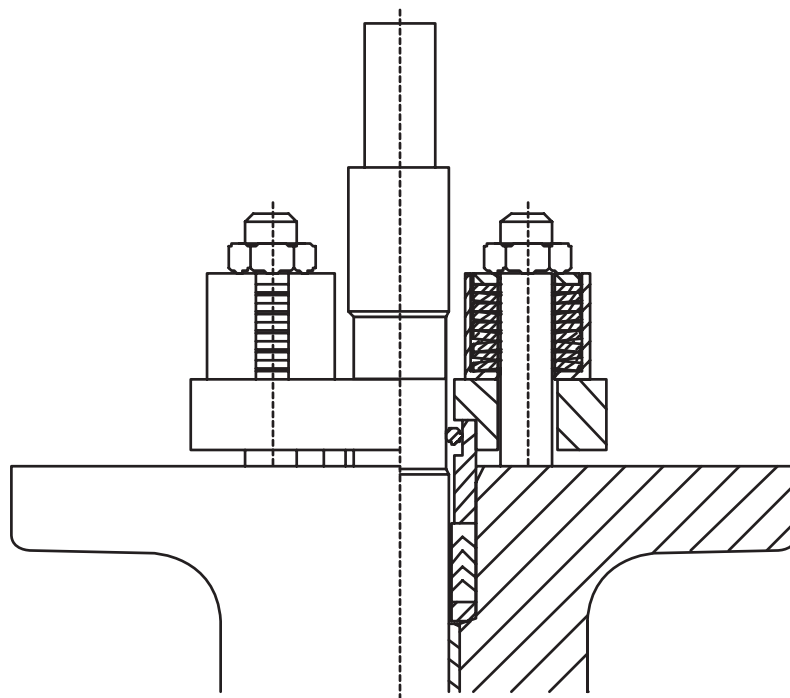


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READ THESE INSTRUCTIONS FIRST!

These instructions provide information about safe handling and operation of the valve.

If you require additional assistance, please contact the manufacturer or manufacturer's representative.

SAVE THESE INSTRUCTIONS!

Addresses and phone numbers are printed on the back cover.

1. GENERAL

1.1 SCOPE OF THE MANUAL

This instruction manual contains important information regarding the installation, operation and maintenance of live loaded packing to the Jamesbury™ Series 815, F815, 818, F818, 830, F830, 838, F838, 860, F860, 868, and F868 Wafer-Sphere™ High Performance Butterfly Valves. See Table 1 for Valve Model. Please read these instructions carefully and save them for future reference.

WARNING:

AS THE USE OF THE VALVE IS APPLICATION SPECIFIC, A NUMBER OF FACTORS SHOULD BE TAKEN INTO ACCOUNT WHEN SELECTING A VALVE FOR A GIVEN APPLICATION. THEREFORE, SOME OF THE SITUATIONS IN WHICH THE VALVES ARE USED ARE OUTSIDE THE SCOPE OF THIS MANUAL. IF YOU HAVE ANY QUESTIONS CONCERNING THE USE, APPLICATION OR COMPATIBILITY OF THE VALVE WITH THE INTENDED SERVICE, CONTACT VALMET FOR MORE INFORMATION.

WARNING:

SAFETY FIRST! FOR YOUR OWN SAFETY, ASK THE FOLLOWING QUESTIONS BEFORE REMOVING THE VALVE FROM THE LINE, AND BEFORE ANY DISASSEMBLY.

1. **WHAT'S IN THE LINE?** BE SURE YOU KNOW WHAT FLUID IS IN THE LINE. IF THERE IS ANY DOUBT, DOUBLE-CHECK WITH THE PROPER SUPERVISOR.
2. **ARE YOU PROTECTED?** WEAR ANY PROTECTIVE CLOTHING AND EQUIPMENT NORMALLY REQUIRED TO AVOID INJURY FROM THE PARTICULAR FLUID IN THE LINE.
3. **IS THE LINE DEPRESSURIZED?** DEPRESSURIZE THE LINE AND DRAIN THE SYSTEM FLUID. THE WAFER-SPHERE™ BUTTERFLY VALVE OFFSET SHAFT CREATES GREATER DISC AREA ON ONE SIDE OF THE SHAFT. THIS MEANS THAT A WAFER-SPHERE™ BUTTERFLY VALVE TENDS TO OPEN WHEN PRESSURIZED ON THE INSERT SIDE WITHOUT A HANDLE OR AN ACTUATOR ON THE VALVE.
4. **IS THE VALVE CLOSED?** BEFORE YOU INSTALL A WAFER-SPHERE™ BUTTERFLY VALVE IN, OR REMOVE IT FROM THE LINE, FULLY CLOSE THE VALVE. THE WAFER-SPHERE™ BUTTERFLY VALVE MUST BE REMOVED FROM THE LINE IN THE CLOSED POSITION TO PREVENT MECHANICAL DAMAGE TO THE DISC SEALING EDGE. THE BLADE DRIVE FLATS ON TOP OF THE SHAFT WILL INDICATE THE POSITION OF THE DISC (SEE FIGURES 3 AND 4).

1.2 VALVE MARKINGS

The valve has an identification plate attached to the valve bonnet (see Figure 1).

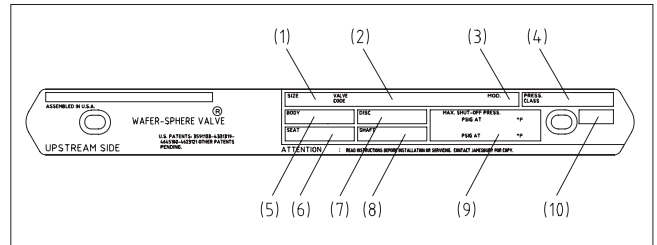


Figure 1. Identification plate

Identification plate markings:

1. Size
2. Valve catalog code
3. Model
4. Pressure
5. Body Material
6. Seat Material
7. Disc Material
8. Shaft Material
9. Maximum/minimum shut-off pressure/temperature
10. Assembly date

1.3 SAFETY PRECAUTIONS

WARNING:

DO NOT EXCEED THE VALVE PERFORMANCE LIMITATIONS!

EXCEEDING THE PRESSURE OR TEMPERATURE LIMITATIONS MARKED ON THE VALVE IDENTIFICATION PLATE MAY CAUSE DAMAGE AND LEAD TO UNCONTROLLED PRESSURE RELEASE. DAMAGE OR PERSONAL INJURY MAY RESULT.

WARNING:

SEAT AND BODY RATINGS!

THE PRACTICAL AND SAFE USE OF THIS PRODUCT IS DETERMINED BY BOTH THE MAXIMUM/MINIMUM SHUTOFF RATINGS LISTED ON THE IDENTIFICATION PLATE. THE RATINGS ARE DEPENDENT ON VALVE TYPE AND SIZE, MATERIALS, AND TEMPERATURE. DO NOT EXCEED THESE RATINGS!

WARNING:**DO NOT DISMANTLE THE VALVE OR REMOVE IT FROM THE PIPELINE WHILE THE VALVE IS PRESSURIZED!**

Dismantling or removing a pressurized valve will result in uncontrolled pressure release. Always isolate the relevant part of the pipeline, release the pressure from the valve and remove the medium before dismantling the valve.

Be aware of the type of medium involved. Protect people and the environment from any harmful or poisonous substances. Make sure that no medium can enter the pipeline during valve maintenance. Failure to do this may result in damage or personal injury.

WARNING:**BEWARE OF THE DISC MOVEMENT!**

KEEP HANDS, OTHER PARTS OF THE BODY, TOOLS AND OTHER OBJECTS OUT OF THE OPEN FLOW PORT. LEAVE NO FOREIGN OBJECTS INSIDE THE PIPELINE. WHEN THE VALVE IS ACTUATED, THE DISC FUNCTIONS AS A CUTTING DEVICE. DISCONNECT ANY PNEUMATIC SUPPLY LINES, ANY ELECTRICAL POWER SOURCES AND MAKE SURE SPRINGS IN SPRING-RETURN ACTUATORS ARE IN THE FULL EXTENDED/RELAXED STATE BEFORE PERFORMING ANY VALVE MAINTENANCE. FAILURE TO DO THIS MAY RESULT IN DAMAGE OR PERSONAL INJURY!

WARNING:**WHEN HANDLING THE VALVE OR VALVE/ACTUATOR ASSEMBLY, TAKE ITS WEIGHT INTO ACCOUNT!**

Never lift the valve or valve/actuator assembly by the actuator, positioner, limit switch or their piping. Place lifting devices securely around the valve body. Failure to follow these instructions may result in damage or personal injury from falling parts.

Please consult separate document: instructions for lifting Valmet products. (See Valmet document id: 10LIFT70EN.PDF).

CAUTION:**BEWARE OF NOISE EMISSIONS!**

The valve may produce noise in the pipeline. The noise level depends on the application. Observe the relevant work environment regulations on noise emission. This can be measured or calculated using Neles Nelprof software.

CAUTION:**BEWARE OF A VERY COLD OR HOT VALVE!**

The valve body may be very cold or very hot during use. Protect yourself against cold injuries or burns.

NOTE:

Do not turn the disc more than 90° as this could damage the seat. The valve is so constructed that the disc operates only between 0-90°.

WARNING:

IF THE VALVE DOES NOT HAVE EITHER A FULLY OPERATIONAL ACTUATOR OR A HANDLE, DO NOT PRESSURIZE THE VALVE. UNRESTRAINED DISC MAY OPEN OR CLOSE DUE TO PIPELINE PRESSURE.

ATEX/EX SAFETY

CAUTION:

Potential electrostatic hazard, ensure the protection (grounding, etc.) in the process.

CAUTION:

The actual surface temperature of valve is depended on the process temperature. The protection from high or low temperature must be considered by the end user before valve is put into service.

CAUTION:

Ensure the general process and worker protection from static electricity in the facilities.

Note! Within series there is possibility to Category 2, Category 3 and non-ATEX valve.

2. INTRODUCTION

Wafer-Sphere™ High Performance Butterfly Valve live-loaded packing conversion kits are designed to decrease the need for packing adjustment and to meet evolving emissions standards. Kits include disc springs, washers, housings, replacement locknuts and a compression ring or plate. Other soft parts, including packing and seats are available separately.

3. TRANSPORTATION AND STORAGE

Check the valve and the accompanying devices for any damage that may have occurred during transport.

Store the valve carefully. Storage indoors in a dry place is recommended.

Do not remove the flow port protectors until installing the valve.

Move the valve to its intended location just before installation.

The valve is usually delivered in the closed position.

If the valve(s) are to be stored for a long duration, follow the recommendations of IMO-S1.

4. LIVE-LOADING INSTALLATION

WARNING:

Observe the safety precautions mentioned in Section 1.3 before maintenance!

CAUTION:

When handling the valve or the valve package as a whole, be mindful of the weight of the valve or the entire package.

WARNING:

For safety reasons the live-loading components **MUST** always be installed according to Section 4.

WARNING:

FOR YOUR SAFETY IT IS IMPORTANT THE FOLLOWING PRECAUTIONS BE TAKEN PRIOR TO REMOVAL OF THE VALVE FROM THE PIPELINE OR BEFORE ANY DISASSEMBLY:

1. Wear any protective clothing or equipment normally required when working with the fluid involved.
2. Depressurize the pipeline by placing the valve in the open position and draining the pipeline.

After removal and before any disassembly, cycle the valve again several times

NOTE:

When sending goods to the manufacturer for repair, do not disassemble them. Clean the valve carefully and flush the valve internals. For safety reasons, inform the manufacturer of the type of medium used in the valve (include material safety datasheets (MSDS)).

NOTE:

In order to ensure safe and effective operation, always use original spare parts to make sure that the valve functions as intended.

NOTE:

For safety reasons, replace pressure retaining bolting if the threads are damaged, have been heated, stretched or corroded.

WARNING:

Do not dismantle the valve or remove it from pipeline while the valve is pressurized.

Ensure that the valve is not pressurized and the pipeline is empty. Ensure that the medium cannot flow into the section where servicing is to take place. Support the valve carefully with a hoist. Place ropes carefully and unscrew the pipe flange bolts. Ensure that the ropes are positioned correctly.

Numbers in () refer to items shown in Figures 4A, 4B, 5, & 6.

Please pay close attention to the following instructions when installing live-loaded packing conversion kits in your valves.

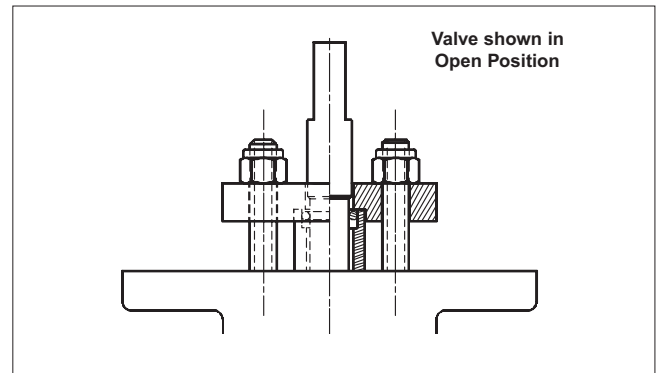


Figure 2. Standard valve

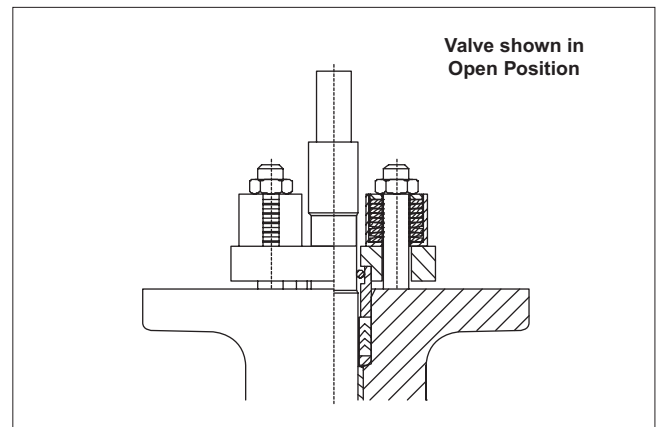


Figure 3. Valve with conversion kit

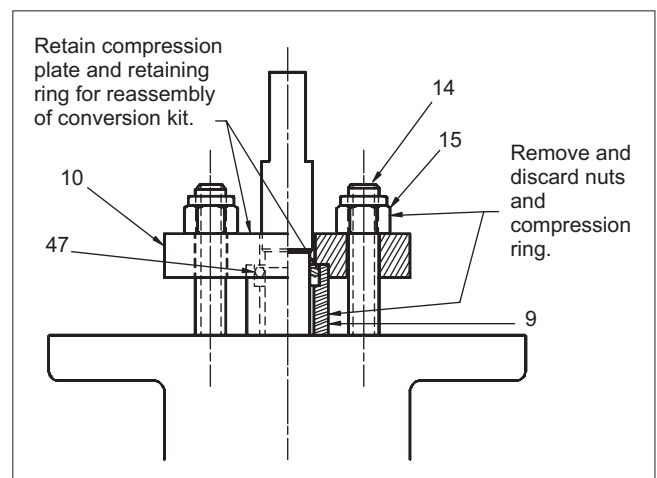


Figure 4A. Standard valve

-
- Replace existing hex nuts with new hex jam nuts supplied in kit.
(See Item 7 in **LIVE-LOADING INSTALLATION** Section.)
- Replace existing compression ring with new shorter live load compression ring supplied in kit.

NOTE: If new packing is required refer to the **SHAFT SEAL REPLACEMENT** Section of IMO-302, 303, 308 or 322.

IMO-302	Series 860 (14"-24") Model A
IMO-303	Series 830 (18"-48") Model A
IMO-308	Series 815 & 830 (2-1/2" - 24") Model C
IMO-322	Series 860 (3"-12") Model C

- NOTE:** If the compression plate sits too high to install the live-loading kit it may be necessary to precompress the shaft seals. In that case, remove the live-loading kit and install the locknuts (15). Tighten the locknuts down onto the compression plate to accomplish the precompression. Remove the locknuts and install the live-loading kit.

- NOTE:** Do not over-tighten or unequally tighten the locknuts, as this may damage the compression plate, and/or shaft seals, as well as reduce the cycle life of the shaft seal.

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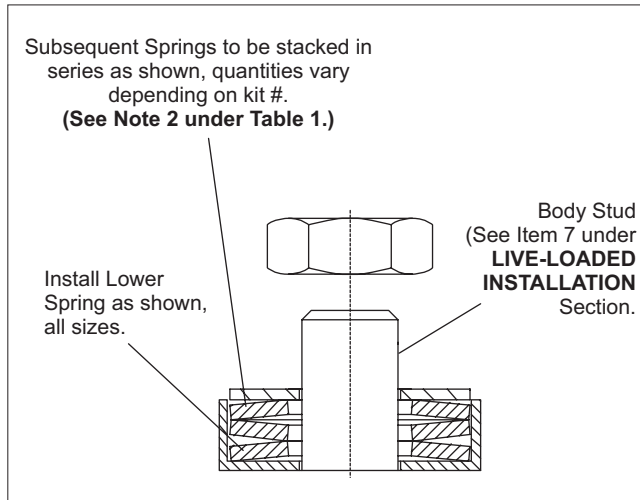


Figure 5 Disc spring stack assembly

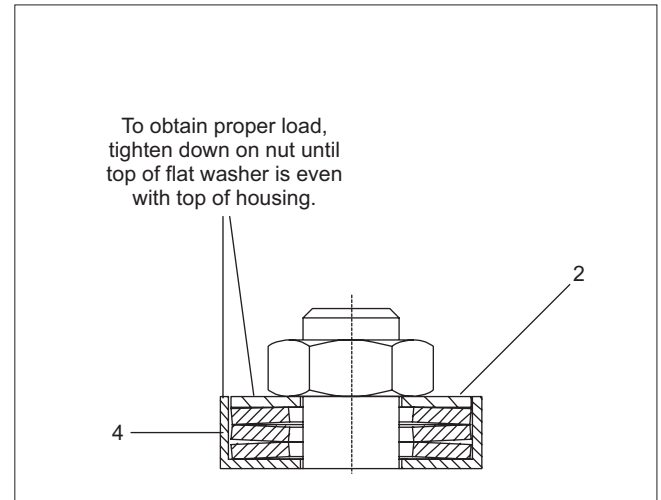


Figure 6 Disc spring stack detail shown installed

Table 1														
Wafer-Sphere Live-Loaded Packing Conversion Kits														
	Type 815	Model	Type 830	Model	Type 860	Model	Type F815	Model	Type F830	Model	Type F830	Model	Type F860	Model
2-1/2" (DN 65)	RKW-510	(C)	RKW-510	(C)	N/A		RKW-742	(C)	RKW-742	(C)	N/A		N/A	
3" (DN 80)	RKW-510	(C)	RKW-510	(C)	RKW-510	(C)	RKW-742	(C)	RKW-742	(C)	N/A		RKW-742	(C)
4" (DN 100)	RKW-510	(C)	RKW-510	(C)	RKW-512	(C)	RKW-742	(C)	RKW-742	(C)	N/A		RKW-744	(C)
5" (DN 125)	RKW-510	(C)	RKW-510	(C)	N/A		RKW-742	(C)	RKW-742	(C)	N/A		N/A	
6" (DN 150)	RKW-511	(C)	RKW-512	(C)	RKW-513	(C)	RKW-743	(C)	RKW-744	(C)	RKW-793	(A)	RKW-745	(C)
8" (DN 200)	RKW-512	(C)	RKW-513	(C)	RKW-515	(C)	RKW-744	(C)	RKW-745	(C)	RKW-794	(A)	RKW-747	(C)
10" (DN 250)	RKW-513	(C)	RKW-514	(C)	RKW-680	(C)	RKW-745	(C)	RKW-746	(C)	RKW-795	(A)	RKW-748	(C)
12" (DN 300)	RKW-514	(C)	RKW-515	(C)	RKW-681	(C)	RKW-746	(C)	RKW-747	(C)	RKW-796	(A)	RKW-749	(C)
14" (DN 350)	RKW-515	(C)	RKW-753	(C)			RKW-747	(C)	RKW-754	(C)	RKW-850	(A)		
16" (DN 400)	RKW-680	(C)	RKW-681	(C)			RKW-748	(C)	RKW-749	(C)				
18" (DN 450)	RKW-753	(C)	RKW-682	(C)			RKW-754	(C)	RKW-750	(C)				
20" (DN 500)	RKW-681	(C)	RKW-683	(C)			RKW-749	(C)	RKW-751	(C)				
24" (DN 600)	RKW-682	(C)	RKW-684	(C)			RKW-750	(C)	RKW-752	(C)				
30" (DN 750)	RKW-683	(C)	RKW-774	(C)			RKW-751	(C)	RKW-776	(C)				
36" (DN 900)	RKW-684	(C)					RKW-752	(C)						

Notes:

1. Apply a thread lubricant to studs prior to installing hex jam nuts supplied in kits to prevent galling.
2. Spring stacks in each housing contain an odd number of disc springs. Refer to appropriate kit number for specific quantities. Springs must be stacked as shown in (Figure 6).

PARTS LIST QUANTITY						
ITEM	PART NAME	2-1/2" -6" 815/F815 2-1/2" -5" 830/F830 3" 860/F860	8" -14" 815/F815 6" -12" 830/F830 4" -8" 860/F860"	16" -24" 815/F815 14" -18" 830/F830 10" -12" 860/F860	30" -36" 815/F815 20" -24" 830/F830"	30" 830/F830
1	Hex Jam Nut	2	2	-	-	-
2	Flat Washer	2	2	2	2	2
3	*Disc Spring	18	14	6	10	14
4	Spring Housing	2	2	2	2	2
5	Compression Ring	1	1	1	1	1
6	Tag	1	1	1	1	1

* The conversion kits used on the Fire-Tite™ valves are supplied with Inconel® disc springs.

8. GENERAL SAFETY WARNINGS AND DISCLAIMERS

General safety warnings

Lifting

1. Always use a lifting plan created by a qualified person to lift this equipment. Lifting guidance is provided in this IMO (Installation, Maintenance and Operation manual) to assist in lifting plan development. Think about the center of gravity (CG) of the equipment being lifted. Make sure the CG is always under the central lifting point.
2. Valves may be equipped with lifting threads on the body or on the flanges. These are intended to be used with the lifting plan.
3. Use only correct and approved lifting devices. Ensure that lifting devices and straps are securely attached to the equipment prior to lifting.
4. Check, that lifting devices are not damaged and in good condition with a valid check stamp prior to use.
5. Workers must be trained for lifting and handling valves.
6. Never lift an assembly by the instrumentation (solenoid, positioner, limit switch, etc.) or by the instrumentation piping. Straps and lifting devices should be fitted to prevent damage to instrumentation and instrumentation piping. Failure to follow the lifting guidance provided may result in damage and personal injury from falling objects.

Work activities on the valve

1. Wear your personal safety equipment. Personal safety equipment includes but is not limited to protective shoes, protective clothing, safety glasses, helmet, hearing protection and working gloves.
2. Always follow the local safety instructions in addition to the Valmet instructions. If Valmet instructions conflict with local safety instructions, stop work and contact Valmet for more information.
3. Before beginning service on the equipment, make sure that the actuator is disconnected from any kind of power source (pneumatic, hydraulic, and/or electric), and no stored energy is applied on the actuator (compressed spring, compressed air volumes, etc.). Do not attempt to remove a spring return actuator unless the stop screw is carrying the spring force.
4. Make sure that there is a LOTOTO (Lock Out / Tag Out / Try Out) procedure in place for the system in which the valve is installed and strictly follow it.
5. Always make sure that the pipeline is depressurized and in ambient temperature condition before maintenance work is started.
6. Keep hands and other body parts out of the flow port when the valve is being serviced and the actuator is connected to the valve. There is a high risk of serious injury to hands and/or fingers due to malfunction if the valve suddenly starts to operate.
7. Beware of Trim (Disc, Ball or Plug) movement even when the valve is disassembled. Trim may move simply due to the weight of the part or change in position of the valve. Keep hands or other body parts away from locations where they may be injured by movement of the trim. Do not leave objects near or in the valve port which may fall in and need to be retrieved.

General disclaimers

Receiving, handling and unpacking.

1. Respect the safety warnings above!
2. Valves are critical components for pipelines to control high pressure fluids and must therefore be handled with care.
3. Store valves and equipment in a dry and protected area until the equipment is installed.
4. Do not exceed the maximum storage temperatures given in the IMO (installation, maintenance, and operating instructions).
5. Keep the original packaging on the valve as long as possible to avoid environmental contamination by dust, water, dirt, etc.
6. Remove the valve endcaps just before mounting into the pipeline.
7. **FOR YOUR SAFETY IT IS IMPORTANT TO FOLLOW THESE PRECAUTIONS BEFORE REMOVAL OF THE VALVE FROM THE PIPELINE OR ANY DISASSEMBLY:**
 - Be sure you know what flow medium is in the pipeline. If there is any doubt, confirm with the proper supervisor.
 - Wear any personal protective equipment (PPE) required for working with the flow medium involved in addition to any other PPE normally required.
 - Depressurize the pipeline, bring to ambient temperature, and drain the pipeline flow medium.
 - Cycle the valve to relieve any residual pressure in the body cavity.
 - After removal but before disassembly, cycle the valve again until no evidence of trapped pressure remains.
 - The valves with offset shaft (Butterfly, eccentric rotary plug) have greater trim area on one side of the shaft. This will cause the valve to open when pressurized from the preferred direction without a locking handle or an actuator installed.
 - **WARNING: DO NOT PRESSURIZE THE ECCENTRIC VALVE WITHOUT A HANDLE OR AN ACTUATOR MOUNTED ON IT!**
 - **WARNING: DO NOT REMOVE A HANDLE OR AN ACTUATOR FROM AN ECCENTRIC VALVE WHILE PRESSURIZED!**
 - Before installing the eccentric valve in or remove it from the pipeline, cycle the valve closed. Eccentric valves must be in the closed position to bring the trim within the face to face of the valve. Failure to follow these instructions will cause damage to the valve and may result in personal injury.

Operating

8. The identification plate (ID-plate, type plate, nameplate, or engraved markings) on the valve gives the information of max. process conditions to the valve.
9. (For soft seats) The practical and safe use of this product is determined by both the temperature and pressure ratings of the seat and body. Read the identification plate and check both ratings. This product is available with a variety of seat materials. Some seat materials have pressure ratings that are lower than the body ratings. All body and seat ratings are dependent on the valve type, size and material of the body and seat. Never exceed the marked rating.

10. Temperatures and pressures must never exceed values marked on the valve. Exceeding these values may cause uncontrolled release of pressure and process medium. Damage or personal injury may result.
11. The operating torque of the valve may rise over time due to wear, particles or other damage of the seat. Never exceed the actuator torque preset values (air supply, position). Application of excessive torque may cause damage to the valve.
12. Valmet valves typically are designed to be used in atmospheric conditions. Do not use valves under external pressurized conditions unless specifically designed and explicitly marked for this service.
13. Avoid Pressure shocks or water hammer. Systems with high pressure valves should be equipped with a bypass to reduce the differential pressure before opening the valve to avoid pressure shock.
14. Avoid thermal shock. High temperature, Low temperature and cryogenic valves should be operated in a way that limits the rate of increase or decrease in temperature. The valve should be thermally stabilized before being pressurized.
15. Materials of the valve are carefully selected for the process conditions. Changes to the process media can have a major impact on function and safety of the valve. Always confirm the materials are suitable for the service prior to installation.
16. As the use of the valve is application specific, several factors should be considered when selecting a valve for a given application. Therefore, some situations in which the valves are used are outside the scope of this manual.
17. It is the end user's responsibility to confirm compatibility of the valve materials with the intended service, however if you have questions concerning the use, application, or compatibility of the valve for the intended service, contact Valmet for more information.
18. Never use a valve with enriched or pure oxygen if the valve is not explicitly designed and cleaned for oxygen. Selected materials and design have a major impact on the safety to operate the valve with oxygen.
19. Valves intended for use in or with explosive atmospheres must be equipped with a grounding device and marked according ATEX (or equivalent international standards).
20. Manual handles are available for specific butterfly valve sizes and maximum line pressures. Do not operate a valve with a handle or wrench outside the size and pressure limits stated in the IMO. High line pressure may create a large enough force to pull the handle from the operator's hands. Damage or personal injury may result.
25. Always check the position of the valve before starting maintenance work. Follow the Lock out /tag out (LOTO) rules at the site before starting any maintenance activity.
 - See IMO for the correct stem position.
 - Consider that the positioner may give the wrong signals.
26. Sealing materials (soft sealing parts) should be changed when the valve is in maintenance. Always use original equipment manufacturers (OEM) spare parts to ensure proper performance of the repaired valve.
27. All pressure containing parts must be inspected visually for damage or corrosion. Damaged parts must be replaced.
28. Valve pressure retaining parts and all internals must be inspected for corrosion or erosion which may result in reduced wall thickness on pressure retaining parts. Damaged pressure retaining parts must be replaced with original equipment manufacturer's (OEM) replacement parts or repaired to factory specifications by an authorized Valmet service partner in order to maintain the warranty.
29. Do not use sharp tools, grinding machines, or files to work on functional surfaces such as sealing, seating or bearing surfaces as this can damage these surfaces.
30. Check the condition of sealing surfaces on the seats, trim (disc, ball, plug, etc.), body and body cap. Replace parts if there are significant wear, scratches, or damage.
31. Check the wear of bearings and bearing contact surfaces on the shaft and replace damaged parts if necessary.
32. Do not weld on pressure retaining parts without an ASME and PED qualified procedure and personnel.
33. Pressure retaining parts of valves in high temperature applications must be carefully examined for the effects of material creep and fatigue.
34. Make sure that the valve is positioned in the correct flow direction into the pipeline.
35. If the valves are marked to be suitable for explosive atmospheres, the correct function of the discharging device must be tested before returning to service.
36. Always work in a clean environment. Avoid getting particles inside the valve due to machining, grinding, or welding nearby.
37. Never store a valve in maintenance without flow port protection.
38. When pressure testing valve seats, never exceed the maximum operating pressure of the system or the maximum shut-off pressure marked on the valve identification plate.
39. Actuator mounting and unmounting:
 - Before installing the actuator on to the valve, be sure the actuator is properly indicating the valve position. Failure to assemble these to indicate correct valve position may result in damage or personal injury.
 - When installing or removing a linkage kit, best practice is to remove the entire linkage assembly, including couplings which may fall off the valve during lifting or when position changes.
 - Mounting sets have been designed to support the weight of the Valmet actuator and recommended accessories either as is or with additional actuator support. Use of the linkage to support additional equipment or additional weight such as people, ladders, etc. may result in equipment damage or personal injury.

Maintenance

21. Respect the safety warnings above!
22. Plan service and maintenance actions, that spare parts, lifting devices and service personnel is available.
23. Maintain the valve within the recommended minimum maintenance intervals or within the recommended maximum operating cycles.
24. Always make sure that the valve and the pipeline is depressurized before starting any kind of maintenance work at a valve.

40. The valve should be installed between flanges using appropriate gaskets and fasteners that are compatible with the application, and in compliance with applicable piping codes and standards. Center the gaskets carefully when fitting the valve between the flanges. Do not attempt to correct pipeline misalignment by means of the flange bolting.
41. Repairs on valves for special service like Oxygen, Chlorine, and Peroxide, have special requirements.
- Parts must be cleaned appropriate to the service and protected from contamination prior to assembly.
 - Assembly areas and tools must be clean and dry to prevent contamination of the parts during assembly.
 - Test equipment must be clean and dry to prevent contamination during testing. This includes the test equipment internals that may allow particles or other contamination into the test medium during the test.
 - Lubrication shall be used only if specifically required in the instructions. Where lubrication is required, the lubricant must be approved for the service by the end user.

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