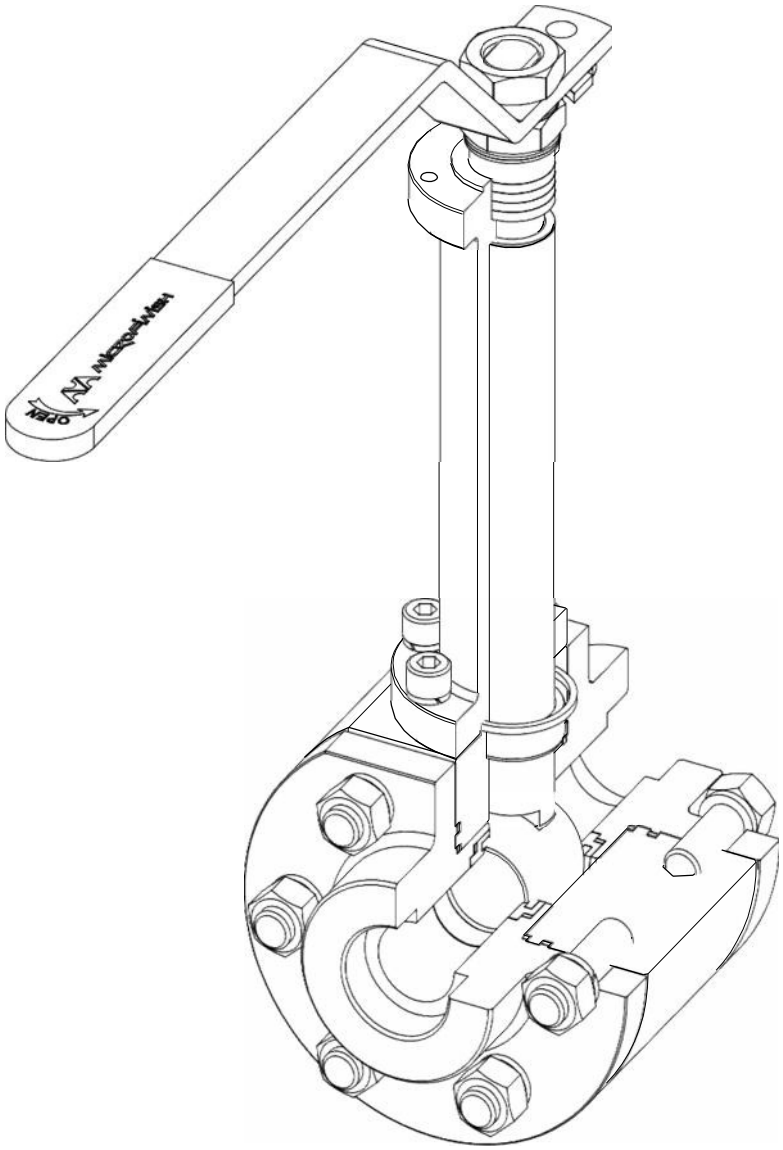
HIGH PRESSURE CRYOGENIC 3PC FLOATING BALL VALVE

Installation, Operation and Maintenance Manual



MICROFINISH VALVES

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Warnings & Safety Instructions

For your safety and protection, it is important that the following precautions be taken prior to working on the valve.

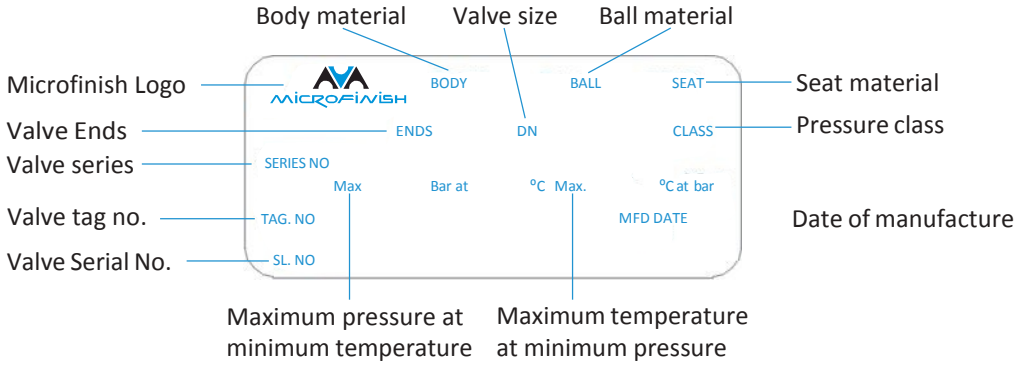
- It is the prime responsibility of the end user to determine the appropriate compatible material of construction and the product ratings for the intended service.
- User should ensure that valve pressure and temperature limits (as specified on nameplate) do not exceeded.
- The valve should be used in a well-designed, adequately supported piping system such that it will not be subjected to undue forces or hydraulic shocks during service.
- Valve surface temperature may become extremely cold due to the operating condition; prevent any type of direct contact with the valve that may cause harm or injury.
- The valves are not designed to operate during or after earthquakes or under fatigue conditions. It is the responsibility of the owner to determine if fatigue conditions exist.
- Isolate the valve that exhibits any sign of leakage, do not try to either operate it, repair or replace it.
- Read the entire IOM carefully and make sure everything is clear, for doubts consult Microfinish engineering team.

Note: The drawings and images in this manual are for reference only.

1. Introduction

Microfinish cryogenic ball valves are designed and manufactured for long lasting, trouble free, service.
This Installation, Operating & Maintenance manual covers the instructions required for safe use of Microfinish cryogenic ball valve.

Check the valve nameplate for the identification of materials.



Storage

Prior to storage, inspect the valve for shipping damage. The valves are packed individually in a hermetically sealed plastic bag filled with dry nitrogen. It is recommended to keep the valve in its bag and in a clean and protective environment until ready for use. Keep all protective packaging, flange covers and end caps attached to the valves during storage.

Long term storage

Valves intended for long term storage (over 6 months), shall be kept as shipped, protected against humidity, moisture, dust, dirt, sand, mud, salt spray, and seawater. Manual ball valves will remain in the open position during the period of storage. Actuated valves (fail to close position) remain in closed position; (fail to open position) remain in open during this time.

Prior to Installation

Operate the valve at least two cycles prior to installation. Verify smooth operation, if valve stored exceeds 6 months in a long term storage, it is advisable to check and re-tighten the body fasteners as per the torque table 2, and the pattern defined in figure 4.

Flush the pipeline, and verify it is cleared of impurities such as sand, grit, welding splatters, or any particles that might damage the ball surface or valve internals.

2. Installation

2.1. General

2.1.1. Microfinish cryogenic ball valves are unidirectional; valve installation shall be in the direction indicated by the arrow mark attached to the body and bonnet (Refer Figure1). The arrow indicates the High pressure (HP) side, at its tail, and the low pressure (LP) side, at the arrow head. The arrow direction does not always indicate the normal direction of cryogen flow; on the contrary, in most applications the valve should be installed with the arrow pointing in the opposite to the normal direction of cryogen flow. To clarify this issue, the high pressure side should be specified when the flow stops and the valve is in its closed position; **Although it may seem trivial, Microfinish has found this to be a very common error in industry which causes double the work, a waste of raw materials, and even a safety concern.**

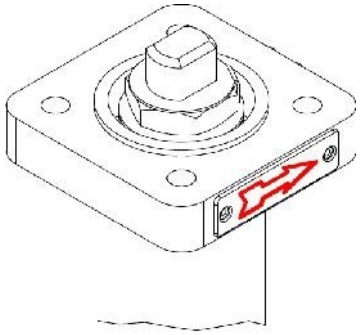


Figure 1. Arrow plate – Doesn't always indicates the direction of the flow

2.1.2. The function of the bonnet of a cryogenic valve is to allow proper heat transfer, and a steep temperature gradient along the bonnet's length between cryogenic temperatures as low as -269°C / -452°F and a temperature of around -10°C / 14°F at the cryogenic ISO toppad. This feature allows the soft parts of the valve gland packing to remain ductile. According to BS 6364 standard a 10 inch (250 mm) cryogenic bonnet shall be installed in the vertical position or inclined up to 45° from the vertical axis as shown in figure 2. For confined spaces and systems characterized by high vibration, Microfinish offers a 6 inch (150 mm) bonnet. A cryogenic valve with 6 inch (150 mm) bonnet not compliant with BS 6364. A cryogenic valve with 6 inch bonnet shall be installed only in the vertical position.

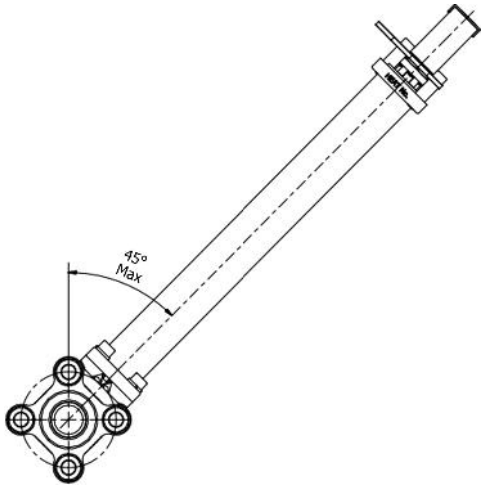


Figure 2. Valve tilting limitations

2.1.3. Support the pipeline properly and eliminate strain of the valve due to hydraulic forces and/or pipeline weight.

2.2. Screwed end valve

2.2.1. Valves with screwed ends should be treated as a single unit and should not be dismantled when installing to the pipeline.
2.2.2. Keep the valve in the fully open position.
2.2.3. Clean both mating parts before assembly.
2.2.4. Ensure pipe threads are matching with the valve threads.
2.2.5. Apply adhesives on the male thread to keep leak tight joint and connect the two parts.

2.3. In-line welding of valve with extended pups

2.3.1. Keep the valve in "full open" position.
2.3.2. Clean both mating parts before assembly.
2.3.3. Welding of valves shall be performed by a qualified welder according to the ASME Boiler Construction Code Section IX.
2.3.4. Align the valve to pipeline, ensuring proper fit to minimize pipe load, and maintain the 2 to 3mm gap co-axially.
2.3.5. Use an internal welding backing ring where practical.
2.3.6. While welding, do not allow the temperature of valve body seat area to exceed 120°C (248°F) to prevent seat or seal damage. Use a temperature stick and a wet cloth wrapped around the center section to prevent overheating.
2.3.7. Do not allow rapid application of excess welding material.
2.3.8. Complete the welding operation and clean the pipeline and valve parts by flushing or pigging to remove all impurities left during the installation and welding process.
2.3.9. Do not to rotate the valve to the closed position before flushing the pipeline.

3. Operation

3.1. Icing of internal parts will damage the valve functionality, flush the valve and pipeline with Nitrogen or Helium (service dependent), and prevent air, moist, or any elements that may freeze during operation, from the cryogenic valve flow bore and pipeline.
3.2. To operate the Microfinish cryogenic ball valve turn the stem 90˚clockwise to close and 90˚ counter clockwise to open.
3.3. Manually operated valves, the position of the lever aligned with the valve/pipeline axis indicates valve open position; position of the lever perpendicular to the valve/pipeline axis indicates valve close position.
3.4. Do not leave the valve in the partial open position.
3.5. The valve is intended for on-off service only; it should not be used for throttling services.
3.6. Valve should be "fully opened" or "fully closed" to prevent damage to the seat and ball.
3.7. Avoid side load on the valve stem.

4. Maintenance

4.1. Flush the valve and pipeline with nitrogen, whilst preventing the introduction of air, moisture or water into the cryogenic valves and pipelines, as this will freeze the valve and render in inoperable.
4.2. Regular maintenance or lubrication is not required for cryogenic ball valve.
4.3. If a body seal leak develops tighten the valve bolting to the torque figure in Table 2; if the body seal leak continues, replace the body seal with new one.
4.4. If stem leak develops, tighten the gland nut to the torque figure in Table 1; if the stem leak continues, replace the stem packing with new one.
4.5. **Stem packing replacement:** Prior to replacing the stem packing, verify that the valve is not pressurized. Remove all accessories including actuator to give access to the stem packing. After loosening and removing the gland nut, the stem packing can be removed by means of a hooked wire.

4.6. Stem packing adjustment:

a. Microfinish valves allows an externally adjustable stem seal in the event of stem leak.
b. Operate the valve once.
c. Loosen the Gland Nut / Chuck Nut for two turns.
d. Operate the valve three full cycles.
e. Tighten the Gland Nut / Chuck Nut as per **Table-1** column **"X".**
f. Loosen the Gland Nut / Chuck Nut.
g. Operate the valve three full cycles.
h. Retighten the Gland Nut / Check Nut as per **Table-1** column **"Y".**
i. Operate the valve three full cycles.
j. Record the torque.
k. If the first action has not stopped the leak, repeat steps "d" to "j". If the leakage has not stopped, replace the stem packing with a new set.

Table 1. Stem nut tightening torque (Nm)

Valve size	Series	Stem nut size	GRAPHITE		PTFE	
			X	Y		
DN15	C89F3, C90F3, F89F3, F90F3	M12x1.75	15	7	13	5
DN20	C89R3, C90R3, F89R3, F90R3					
DN20	C89F3, C90F3, F89F3, F90F3	M12x1.75	15	7	13	5
DN25	C89R3, C90R3, F89R3, F90R3					
DN25	C89F3, C90F3, F89F3, F90F3	M18x2	19	11	17	11
DN32	C89R3, C90R3, F89R3, F90R3					
DN32	C89F3, C90F3, F89F3, F90F3	M20x2	22	19	20	15
DN40	C89R3, C90R3, F89R3, F90R3					
DN40	C89F3, C90F3, F89F3, F90F3	M27x2	29	19	27	18
DN50	C89R3, C90R3, F89R3, F90R3					

The gland nut is secured from opening by a locking strip. Push down the tabs away from the nut with a flathead screwdriver, allow the gland nut a free rotation and reset of the stem seal. After tightening the stem packing secure the locking strip by pushing back the tabs toward the stem nut flats.

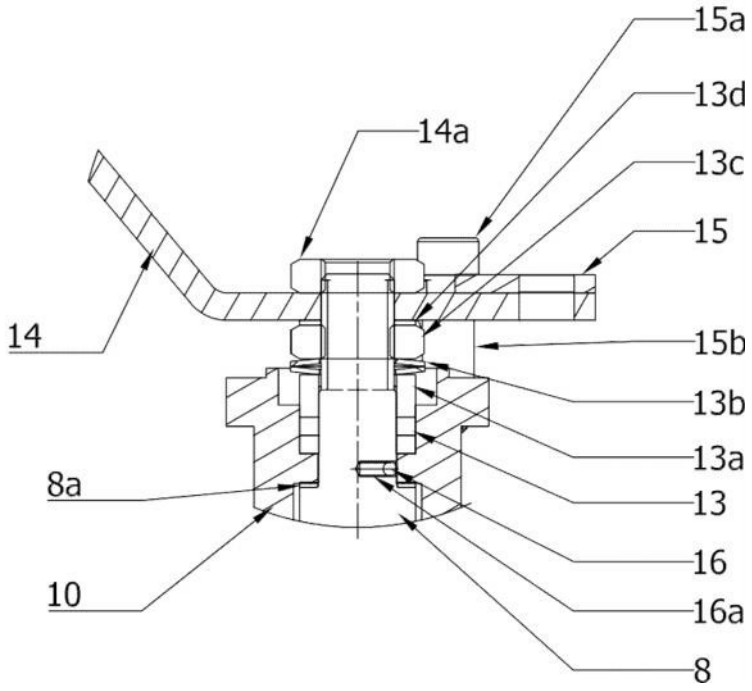


Figure 3. Stem seal arrangement

Item no.	Part description
8	Stem
8a	Stem thrust washer
10	Bonnet
13	Stem seal
13a	Gland
13b	Disc spring
13c	Stem nut
13d	Nut lock clip
14	Handle
14a	Handle nut
15	Locking disc
15a	Locking disc bolt
15b	Locking disc bush
16	Antistatic ball
16a	Antistatic spring

5. Disassembly

For your safety and protection, it is important that the following precautions will be taken prior to removing the valve from service, or before any disassembly of the valve.

5.1. Disassembly from pipe line

5.1.1. Keep hands out, since remotely actuated valves could close at any time.
5.1.2. Disconnect all auxiliary piping of jackets and pneumatic or electric connection.
5.1.3. Wear an eye shield, protective clothing, gloves and footwear.
5.1.4. When necessary keep water available nearby and/or fire extinguisher.
5.1.5. De-pressurize the line and drain the system.
5.1.6. Keep the valve in the fully open position.
5.1.7. Remove the valve and place it on a level surface.

5.2. Disassembly of the cryogenic floating ball valves

5.2.1. Flush the valve and remove any residuals from within.
5.2.2. Support the valve on a plat form.
5.2.3. Remove all accessories if fitted and also adapter, lever or gear operator.
5.2.4. Unscrew the body-end connection studs, separate the body, and end piece.
5.2.5. Remove the seats, ball, and body seals, and place them on a clean surface.
5.2.6. Discard the used body seals.
5.2.7. Unscrew the cryogenic bonnet from the body, and discard the body-bonnet seal.
5.2.8. Remove the gland nut, disc springs, locking plate, and gland.
5.2.9. Pull down the stem outside of the bonnet; verify that the stem thrust washer is also removed.
5.2.10. Remove the stem seal from the bonnet top, without scoring the metallic sealing surfaces surrounding it.
5.2.11. Keep all disassembled metallic parts on a clean surface and discard the soft part.

6. Assembly

CAUTION !
Follow the safety rules and regulations to avoid personal injury or equipment damage

6.1. Use only Microfinish original spare parts.
6.2. Assembly of Oxygen service valve shall be held in an oil free zone.
6.3. Wear clean working clothes and latex gloves throughout the complete process.
6.4. Cover the working table with clean plastic sheet.
6.5. Before assembling the valve, examine all parts and replace any worn or damaged item.
6.6. Clean all parts carefully with Isopropyl Alcohol-IPA and keep them on the cleaned working area.
6.7. Lubrication is not required for Cryogenic ball valve for internals.
6.8. Smear small amount of BAM approved grease on body fasteners only.
6.9. For valve assembly, follow the disassembly steps (paragraph 5) in a reverse order.
6.10. Tighten the body bolts to the torque figures (Table 2) according to tightening pattern illustrated in figure 4.
6.11. Keep the valve in the open position for flushing purpose.

Table 2. Body bolts tightening torque

Valve size	Series	Thread size x pitch	Tightening torque for lubricated fastener	
			Nm	lbf.in
DN15	C90F3	M10x1.5	30 – 33	266 – 292
DN20	C90R3			
DN20	C90F3	M12x1.75	51 – 54	451 – 478
DN25	C90R3			
DN25	C90F3	M12x1.75	51 – 54	451 – 478
DN32	C90R3			
DN32	C90F3	M12x1.75	51 – 54	451 – 478
DN40	C90R3			
DN40	C90F3	M16x2	83 – 87	735 – 770
DN50	C90R3			

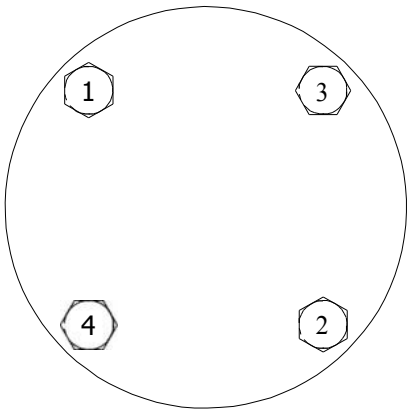
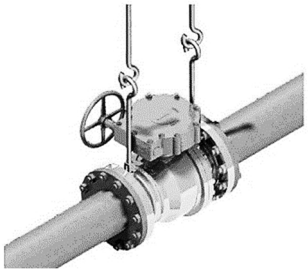


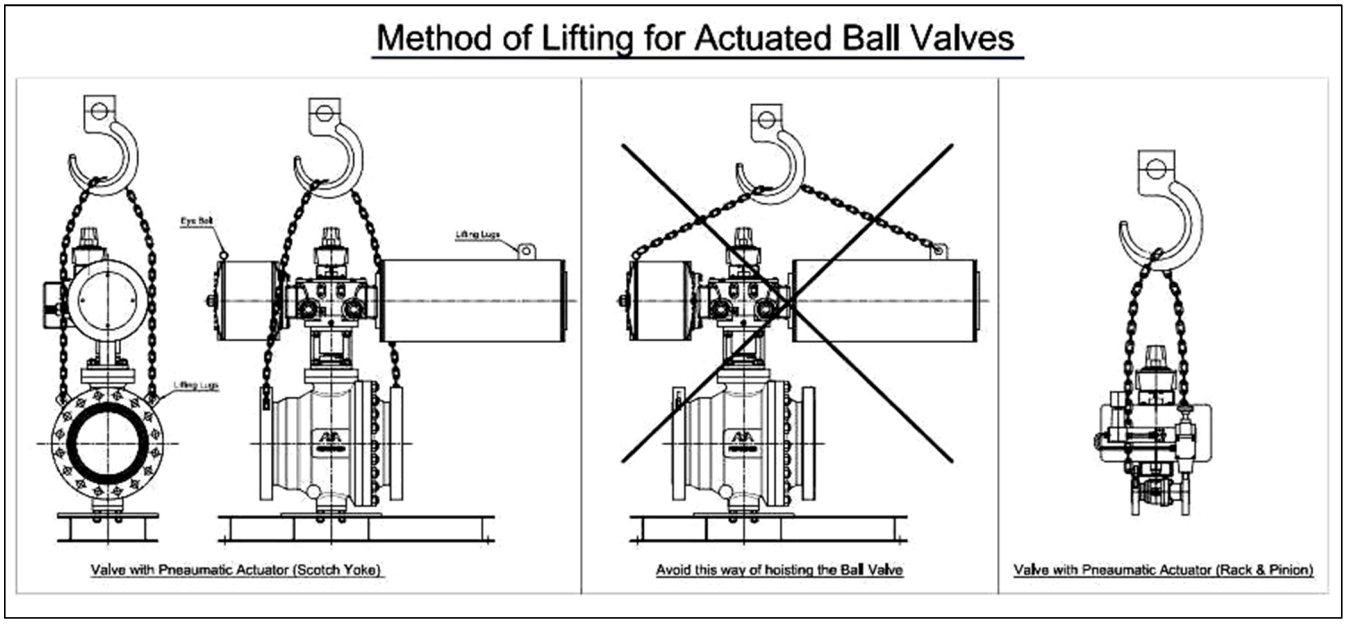
Figure 4. Fastener tightening sequence

7. Lifting instructions

Lifting plates are provided for valve weighing 25 KG and above unless otherwise specified by the customer. Lifting plates are verified for suitability through design calculations with respect to valve weight along with the operator assembly and accessories. Lifting sketches and handling instructions for safe lifting operation for valves weighing more than 25 KG is as shown in the below figures. The safe working Limit (SWL) of each lifting point is marked on the lifting plate Lifting plates are to be affixed to the valve flange for valves weighing 25 KG and above by balancing with respect to center of gravity of the valve along with the valve accessories if any.

	
Way of Hosting the Ball Valve	**Avoid this way of Hosting the Ball Valve**
	
Way of Hosting the Ball Valve	**Avoid this way of Hosting the Ball Valve**
	
Valve ready for Disassembling supported on Platform	**Way of supporting the Ball Valve**
	
Way of supporting the Ball Valve	**Way of supporting the Ball Valve**

➢ Method of Lifting for Actuated Ball Valves



➢ Instruction for lifting the valve assembly

Valve shall be lifted using the lifting lugs provided on the valve. Eye bolts provided on theactuator shall not be used for lifting the entire valve – actuator assembly. Eye bolting actuator shall be used only for lifting the actuator during maintenance if any.

Along with the lifting lugs provided on the valve, eye bolts provided on the actuator mayalso be used for balancing if needed while lifting.

While lifting the valve assembly care should be taken to see that the tubing and accessoriesmounted on the valve and actuator are not damaged.

8. Troubleshooting

Sl.No.	Malfunction	Possible cause	Remedial action
1	In line leak	1. Damage of seat due to presence of foreign particles. 2. Damage of seat in weld end valves due to improper precautions. 3. Damage of seat at high temperature. 4. Improper closing of actuator operated valves. 5. Damage of seat due to rust at body of seat retainer.	Dismantle, clean & replace by new seats. Follow right steps/instructions as per this IOM manual. Check for suitability of seat material and design. Ensure correct closing of actuator. Dismantle, clean & reassemble/replace.
2	Stem seal leak	1. Loosening of stem nut or locking bolt. 2. Damage/wear of stem seal/stem thrust washer. 3. Misalignment of actuator, bracket & stem.	Tighten the stem nut & locking bolts. Replace the stem seal/stem thrust washer. Ensure correct alignment.
3	Body seal leak	1. Improper tightening of Body bolting. 2. Improper precautions in case of weld end valves. 3. Misalignment of pipeline mating flanges.	Ensure proper tightening of Body bolting. Follow right steps/instructions as per this IOM manual. Ensure correct alignment of flanges.
4	High torque operation	1. High temperature fluid handled. 2. Highly viscous fluid handled. 3. Insufficient air supply pressure in case of pneumatic operated valves. 4. Reducing of lever length by user due to less space. 5. Pipeline flange pressure in case of single piece valves.	Check for suitability of material and design. Check for suitability of material and design. Ensure sufficient air pressure. Use lever of correct length. Face the seat or seat seal to relieve extra pressure.
5	Jerky operation	1. Presence of foreign particles at seat contact area. 2. Peeling of plating of Ball in case of metal seated valves. 3. Insufficient air supply pressure in case of pneumatic operated valves.	Dismantle, Clean & Reassemble. Check for service condition/replace. Ensure sufficient air pressure.

9.SIL

Under normal operating conditions, the Microfinish valve should be inspected for proper functioning and signs of deterioration every six months. Under severe operating conditions, inspection shall be taken place more frequently.

Severe operating conditions can be defined as:

- Operating temperature less than -49˚ C.
- Operating temperature higher than +230˚ C.
- Flow velocity higher than 5 m/sec for liquids, and 200 m/sec for gases.
- Acidic media PH < 5 or Alkaline media PH > 9.

For fail to open ESD System Microfinish recommend a partial stroke test once in 12 months to confirm the proper functioning of the system.

For fail to close ESD System it is necessary to plan system shut down; de-energize the system and inspect the functioning of the valve.

It is essential to record date, time, name and signature of the responsible engineer, air pressure on site, time to close the valve, time to open the valve.

Microfinish recommends inspecting the valve wall thickness every time the valve is maintained. When the valve body thickness is eroded, corroded, or mechanically removed by 1 mm (combined corrosion and erosion allowance for the valve wall thickness) the valve should no longer be used.

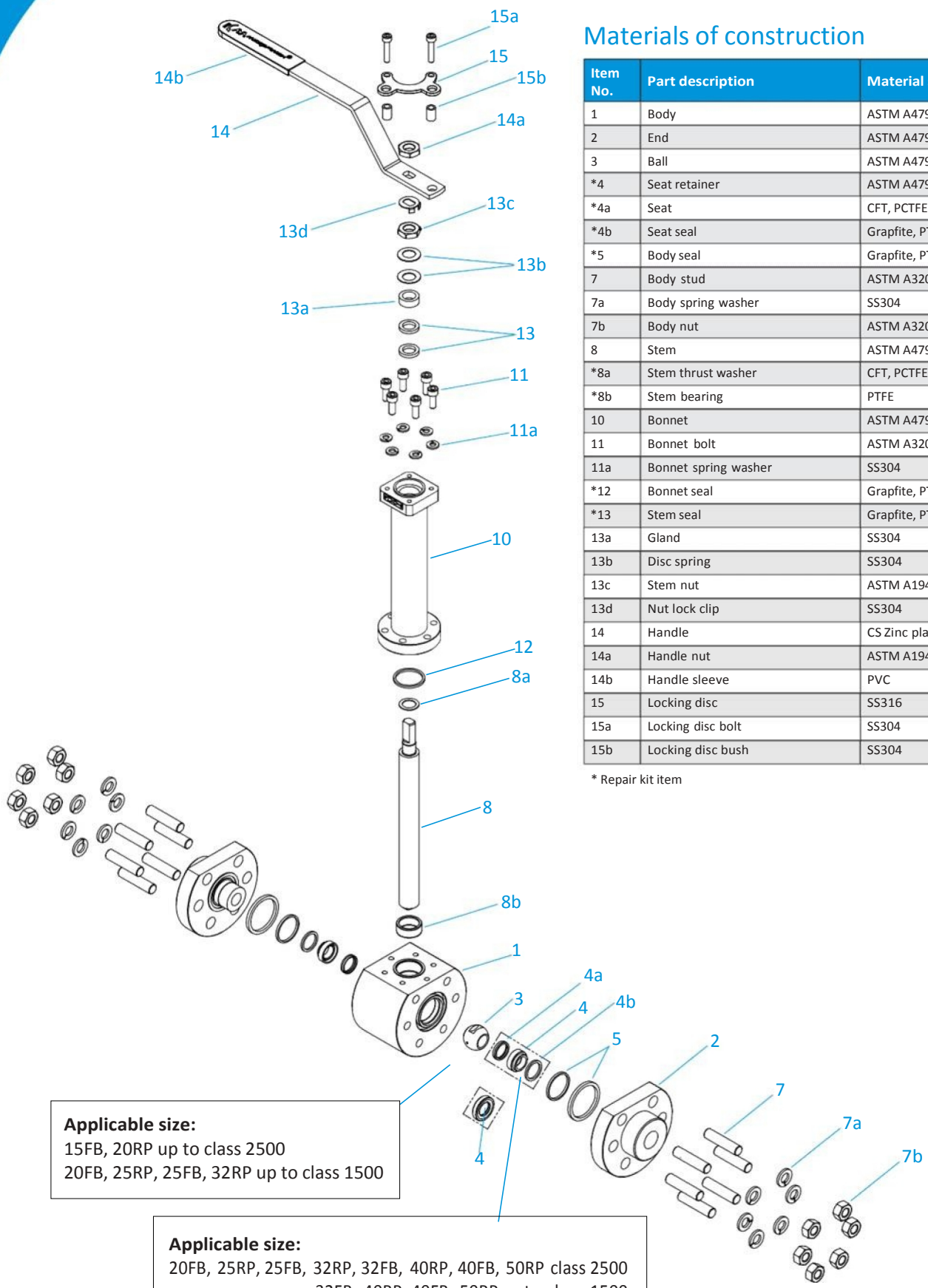
When Microfinish valve has been repaired or any maintenance was performed.

Any failures affecting functional safety should be reported to the Microfinish factory.

User should consult the Microfinish factory to obtain the product assessment, and other associated statistical data to satisfy SIL level.

Valve exploded view: Cryogenic floating ball valve

Full or reduced bore, three piece, flanged, threaded or welded end connection



Materials of construction

Item No.	Part description	Material specification
1	Body	ASTM A479 Gr. SS316
2	End	ASTM A479 Gr. SS316
3	Ball	ASTM A479 Gr. SS316
*4	Seat retainer	ASTM A479 Gr. SS316
*4a	Seat	CFT, PCTFE
*4b	Seat seal	Grapfite, PTFE
*5	Body seal	Grapfite, PTFE
7	Body stud	ASTM A320 B8M Class 2
7a	Body spring washer	SS304
7b	Body nut	ASTM A320 Gr. 8M
8	Stem	ASTM A479 Gr. SS316, Nitronic XM19
*8a	Stem thrust washer	CFT, PCTFE
*8b	Stem bearing	PTFE
10	Bonnet	ASTM A479 Gr. SS316
11	Bonnet bolt	ASTM A320 B8M Class 2
11a	Bonnet spring washer	SS304
*12	Bonnet seal	Grapfite, PTFE
*13	Stem seal	Grapfite, PTFE
13a	Gland	SS304
13b	Disc spring	SS304
13c	Stem nut	ASTM A194 Gr. 8
13d	Nut lock clip	SS304
14	Handle	CS Zinc plated
14a	Handle nut	ASTM A194 Gr. 8
14b	Handle sleeve	PVC
15	Locking disc	SS316
15a	Locking disc bolt	SS304
15b	Locking disc bush	SS304

* Repair kit item

Applicable size:
15FB, 20RP up to class 2500
20FB, 25RP, 25FB, 32RP up to class 1500

Applicable size:
20FB, 25RP, 25FB, 32RP, 32FB, 40RP, 40FB, 50RP class 2500
32FB, 40RP, 40FB, 50RPup to class 1500

Figure 5. Full bore Cryogenic floating ball valve, three piece design

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