The Valve & Actuator Overview is intended to be a general guide. This overview does not replace Installation, Maintenance & Operation manuals (IMOs). Product IMOs should always be used when working with products.
## Product Portfolio

### Wafer-Sphere Valves

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<td>W101-6</td>
<td>IMO-301</td>
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<td>IMO-302</td>
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<td>IMO-303</td>
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<td>IMO-308</td>
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<tr>
<td>Series 860</td>
<td>W104-1</td>
<td>IMO-301</td>
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<tr>
<td>Series 835</td>
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<td>Series K815/K830</td>
<td>W130-1</td>
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<td>IMO-309</td>
</tr>
<tr>
<td>Series K860</td>
<td>W130-1</td>
<td>IMO-319</td>
</tr>
</tbody>
</table>

Please refer to the Metso Business Center for the latest technical documents.
Wafer Style

This guide is for reference only. Refer to product IMO for specific instructions.
Lug Style

Valve Bonnet
Valve Body
Shaft
Seat
Insert
Insert Bolts

This guide is for reference only. Refer to product IMO for specific instructions.
This guide is for reference only. Refer to product IMO for specific instructions.
Lock Nut
Compression Plate
Retainer Ring
Compression Ring
Shaft Seal
Spacer (Chamfer side down)
Valve Bonnet

Graphite
FIRE-TITE®
(Standard)

Direction of Seals (8)

This guide is for reference only. Refer to product IMO for specific instructions.
This guide is for reference only. Refer to product IMO for specific instructions.
Shaft Sealing & Bearing Surfaces

- Shaft Packing Area
- Upper Bearing Area
- Lower Bearing Area

This guide is for reference only. Refer to product IMO for specific instructions.
Seat Removal

- **Remove bolted insert (Lugged style)**
  - Open Valve
  - Unscrew bolts
  - Tap seat/insert from shaft side of valve

- **Remove snap-in insert (Wafer Style)**
  - Open valve
  - Tap seat/insert near cast stop of body

- Remove seat from insert
- Remove body seal from body if applicable
- Clean out any residue in insert grooves
- Clean and polish disc sealing edge
Seat Replacement

**Bolted Insert**
- Close valve
- Install seat into insert
- Install seat/insert assembly into valve body
- Install and torque cap screws per IMO
- Open valve and re-torque screws
- Close Valve

**Snap-in Insert**
- Install insert spring into body groove opposite positive stop
- Slightly open valve
- Position insert/seat assembly at angle to engage spring
- Tap the opposite end of insert with rubber hammer to “pop” insert/seat into place
- Close valve

This guide is for reference only. Refer to product IMO for specific instructions.
Shaft Seal Removal

Remove nuts and compression plate.

Remove C-clip retainer.

Remove compression ring.

Remove old shaft seal (packing) segments. A sharp “pick” may be required. (Do not scratch sealing surfaces on shaft or body bore). Spacer washer does not need to be removed.

This guide is for reference only. Refer to product IMO for specific instructions.
Shaft Seal Replacement

Seal Installation

- Install new shaft seals. (Note V-ring direction.)
- Re-install compression ring, C-clip, compression plate and nuts.
- Close the valve.
- Tighten the nuts evenly until packing is compressed adequately to prevent leakage. It should require tightening the nuts 1-1/2 to 2 turns after they contact the compression plate. (Compression plate should be level.)

This guide is for reference only. Refer to product IMO for specific instructions.
Valve Disassembly

It is good practice to replace the seat, shaft packing and body seal whenever the valve is completely disassembled.

- Remove the seat/insert and open the valve.
- Remove the disc pins by grinding or machining the tack welds off.
- Drive the wedge pins out in the direction away from the positive stop.
- Remove the compression plate and hardware.
- Remove the lower cover plate/gasket if applicable.
Valve Disassembly

- Remove the shaft, being careful not to scratch the sealing edge of the disc.
- Remove the disc and upper and lower thrust bearings.
- Remove the top and bottom shaft bearings.
Valve Assembly

It is good practice to clean all components and inspect for damage to sealing areas of disc, shaft and body bearing areas.

- Light scratches in disc can be polished out with scotch brite cloth.
- Deep scratches may require disc replacement.

- Install shaft bearings into body bores. (Lubricate the shaft and disc bores with grease/oil compatible with media, to ease assembly.)
- Slide the shaft thru the upper bearing and engage thrust bearing. With the 2 pin holes towards the bonnet, place the disc in waterway. Slide the shaft thru the disc bore, thru the lower thrust bearing and into lower shaft bearing.

This guide is for reference only. Refer to product IMO for specific instructions.
Valve Assembly

Orient cut out in shaft with disc pin holes in disc. (Pins should be installed towards the cast positive stop with surface of pins aligning with cut out in shaft.

- Hammer the pins into position. Pins must be within 1/16” of each other. Tack weld pins starting with small end first. (Ground the shaft only per IMO). Clean welds with wire brush.
- Install upper bearing spacer when applicable.
- Install V-ring seals (in proper orientation).
- Install compression ring, retainer ring, compression plate and nuts. (Do not tighten at this time.)
Valve Assembly

- Cycle the valve fully closed and install seat/insert per the “Seat Replacement” section of the IMO.
- With the valve closed, tighten the nuts on the compression plate evenly until the shaft seals are compressed adequately to prevent leakage. It should require tightening the nuts 1-1/2 to 2 turns after they contact the compression plate. (Compression plate should be level.)

This guide is for reference only. Refer to product IMO for specific instructions.
High Cycle Jamesbury® Wafer-Sphere®

Increase the customers maintenance interval two fold in high cycle, clean applications

Features:

- Filled Super PTFE Shaft Seal
- Xtreme
- 316SS/Woven PTFE Shaft Bearing
- PEEK filled PTFE Thrust Bearings
- Excluder Rings

This guide is for reference only. Refer to product IMO for specific instructions.
Super PTFE Shaft Seals

Key Benefits:

- 25% Carbon filled TFM
- Less Compression
- Less Wear
- Longer Cycle Life
- Proven Problem Solver

![Graph showing number of cycles at packing adjustment]

<table>
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<tr>
<th>Number of Cycles at Packing Adjustment</th>
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<tr>
<td>Virgin PTFE</td>
</tr>
<tr>
<td>Super PTFE</td>
</tr>
</tbody>
</table>

This guide is for reference only. Refer to product IMO for specific instructions.
High Cycle Life Thrust Bearings

Key Features:

- PEEK and Carbon Fiber Filled PTFE
- 200 x increase in cycle life over standard bearing
- Prevents damage to disc and body
- Low cost option
- Increases valve and plant reliability
Enhanced Shaft Sealing

LIVE LOADED STANDARD PACKING
(Can Be Retrofit to Std Valve)

DOUBLE-PACKED LIVE LOADED
Monitoring Port Optional

Provide the Customer with Worry Free Control of Emissions

This guide is for reference only. Refer to product IMO for specific instructions.
EXPLODED VIEW
3" – 12" (DN 80 – 300) Wafer and Lugged Style Cryogenic Valves

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<td>47*</td>
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<tr>
<td>64</td>
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<td>77*</td>
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* Parts contained in service kit.
* Quantities vary by valve size and class.

This guide is for reference only. Refer to product IMO for specific instructions.
Cryogenic Seat Design

Snap-in Insert

Bolted Insert

This guide is for reference only. Refer to product IMO for specific instructions.
High-Performance Butterfly Valve

Cryogenic Seat Design

This guide is for reference only. Refer to product IMO for specific instructions.
### Wafer-Sphere Butterfly Valve Trouble Shooting Guide

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<tr>
<th>Problem</th>
<th>Observation / Diagnostics</th>
<th>Corrective Action</th>
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</thead>
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<tr>
<td>Leakage through closed valve</td>
<td>Wrong stop screw adjustment of the actuator</td>
<td>Adjust the stop screw from the closed position</td>
</tr>
<tr>
<td></td>
<td>Faulty zero setting of the positioner</td>
<td>Adjust the positioner</td>
</tr>
<tr>
<td></td>
<td>Damaged seat</td>
<td>Replace seat</td>
</tr>
<tr>
<td></td>
<td>Damaged disc</td>
<td>Check for scratches and, if minor, polish them out; if beyond repair, replace segment</td>
</tr>
<tr>
<td></td>
<td>Disc in a wrong position relative to the actuator</td>
<td>Select the correct keyway (if equipped with one) in the actuator</td>
</tr>
<tr>
<td>Irregular valve movement</td>
<td>Actuator or positioner malfunction</td>
<td>Check the operation of the actuator and positioner</td>
</tr>
<tr>
<td></td>
<td>Process medium accumulated on the disc surface</td>
<td>Clean the disc</td>
</tr>
<tr>
<td></td>
<td>Disc or seat damaged</td>
<td>Replace components as needed</td>
</tr>
<tr>
<td></td>
<td>Crystallizing medium has entered the bearing spaces</td>
<td>Flush the bearing spaces</td>
</tr>
<tr>
<td></td>
<td>Stiction possible between the seat and disc</td>
<td>Options:</td>
</tr>
<tr>
<td></td>
<td>Dynamic Torque</td>
<td>- First check to see if the seats are correct for the application.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Do not increase supply pressure or increase actuator size.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Either back off on the packing nuts, but not enough to cause stem seal leakage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Lap the seat to the disc, possible high points</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check flow conditions to see if they changed.</td>
</tr>
</tbody>
</table>

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## Wafer-Sphere Butterfly Valve Trouble Shooting Guide

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<tr>
<td>Seat Leakage</td>
<td>Dents in the disc edge. (Caused by the disc hitting the insert or the body due to over travel. Usually dented at the 1o'clock to 5 o'clock positions)</td>
<td>Valve rotates counterclockwise to open (viewed from the stem). Check direction of rotation of the valve and topworks. The indicator pointer should be mounted in such a way that the pointer is over the “0” position of the tag when the valve is in the closed position. Reposition the topworks as required.</td>
</tr>
<tr>
<td></td>
<td>Disc not in correct position between lugs in the waterway, buckled or damaged body lugs</td>
<td>The central location of the disc in relation to the body is very important. If the linkage is improperly assembled, it is possible to push the disc downward causing galling of the disc and lug and causing off center seating and leakage. Examine for any evidence of galling and reposition disc if necessary. Loosen coupling on topworks; loosen compression plate and recenter the disc so it is equal – top and bottom. Refer to IMO for correct setup of the linkage. Approximately .010” should be between lugs and disc hub.</td>
</tr>
<tr>
<td></td>
<td>Disc sealing surface damaged</td>
<td>Check media for abrasives. Look for buildup in the pipeline upstream/downstream or on the seat. Contaminants in the media may cause damage to the disc. Of course, mishandling and damage caused prior to installation is excessive, consult factory for alternate disc materials.</td>
</tr>
<tr>
<td></td>
<td>Wear – (smooth shiny surface is required.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disc sealing surface damaged Flat spots on disc</td>
<td>Erosion due to contamination or excessive velocity will be evident at two small segments of the disc. This is where it enters and leaves the seat. Most of this damage will occur at the 3 o’clock and 9 o’clock positions. Check to insure that the line velocity is below 25 fps. Solid matter in the fluid stream can also cause erosion. Relocate valve in the piping system to reduce velocity.</td>
</tr>
<tr>
<td></td>
<td>Disc sealing surface damaged Nicks and dents in the disc where the valve has been improperly installed and cycled hitting the mating flanges or the pipeline</td>
<td>Check for correct flanges – raised, butt weld, etc. Slip on flanges are not acceptable because there is not sufficient flange to compress the insert. Lined or tubing flanges could cause problems. Look for the clearance of the disc in the pipeline and that the valve body has been properly assembled between the mating flanges. The wafer disc has been designed to clear schedule 80 piping.</td>
</tr>
<tr>
<td>Body seal leaks behind the seat can result in downstream leakage</td>
<td>Improper compression of the insert can create a body seal leak. The height of a fully compressed insert in the body should be level or slightly above the body face. Corrosion of the cavity will require different material selection.</td>
<td></td>
</tr>
</tbody>
</table>
# Wafer-Sphere Butterfly Valve Trouble Shooting Guide

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<tbody>
<tr>
<td>Seat Leakage</td>
<td>New seat leaks</td>
<td>Refer to check list for maintenance of valve when installed in a pipeline. Also check if insert set screws are flush and not preventing proper compression. Check to see if insert retention pins are jamming the seat or insert. Proper gasket location and loads are required. Spiral-wound gaskets (flexatallic) are preferred. Consult factory for other recommendations. Note: Once a seat has been installed in a valve, it cannot be used in another valve and it should always be put back in the same position each time.</td>
</tr>
<tr>
<td>Small segments of the seat missing or damaged</td>
<td>Check pressure/ temperature curves. Look for excessive line velocity. 250 psi is the maximum pressure drop allowed. Do not throttle below 10° open. Check for the gaskets protruding out into the pipeline. Occasionally, an improperly cut gasket will be flushed downstream and is trapped between the seat and the disc. Relocate valve as required or use fixed orifice plate to reduce pressure drop.</td>
<td></td>
</tr>
</tbody>
</table>
| Twisted or damaged shaft. |                                                                          | The location of the shaft flats in relation to the disc is critical. The side of the blade should be parallel with the disc profile. The square drive ends should be 45° ±2° to the disc with a milled line on the shaft which is parallel to the disc. Twisting or relative movement of the shaft can be caused by high loads and misapplication could be the problem. The proper shaft material should be checked with the material code and the valve identification.  

NOTE: 316 stainless steel has half the strength of 17-4ph.  
Bending or general deformation of the shaft can be due to water hammer or shock loading. Failed shafts can also be caused by misapplication of the product. Obtain the number of cycles, pressure, closing speed of the valve or application conditions which may have caused the above problems. Note that handles can be used to 150 psi on the 3” – 8” and 100 psi max. on the 10” and 12’. Higher pressures or larger sizes require operators or handwheels.  

NOTE: check the direction of flow vs. shaft location. Refer to catalog. |
| Packing Leaks            | Compression plate has no take-up | The initial height of the compression plate is critical to the proper adjustment of the packing. The clearance above nuts and mating parts should be approx. 3/8’. If there is insufficient clearance, disassemble the compression plate and add more packing rings to maintain the correct height. The stack height can also be off if the packing spacers have been improperly assembled or left out. Damage to the inside of the packing box due to corrosion or mechanical forces can produce a leak. Polish or remachine and repack with oversize packings or higher torque on the compression plate bolts. |

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<tbody>
<tr>
<td>Flange Face or Body Joint Leakage</td>
<td>Gaskets are leaking</td>
<td>Check for proper flange loading using the blot torques shown in the IMO. Proper minimum gasket loads of approx. 2/3 of the recommended flange tightening is required for the seat to effectively work. Extra thick rubber gasket or gaskets that do not adequately cover the insert can yield leaky valves. Distortion of the flanges due to improper welding procedures can cause leakage. Hard gasket materials require correspondingly higher flange faces. Consult factory for recommendation if normal assembly techniques do not work.</td>
</tr>
<tr>
<td></td>
<td>Flanges not parallel or in straight line. Gaskets crushed unevenly</td>
<td>Flanges must be flat and parallel with the valve when installed. (see IMO for proper flange type). Check pipe supports for proper alignment. When installing the valve, make sure the flanges are tightened in their proper sequence of alternating bolts. Install additional pipe hanger as required to get pipe straight.</td>
</tr>
<tr>
<td></td>
<td>Leak from pipe plug</td>
<td>Improper torque of the pipe plugs could result in leakage. Teflon tape or TFE pipe compound is required for the 316SS valves. Vacuum valves are modified with welding of the pipe plug to prevent in leakage at very high vacuums.</td>
</tr>
<tr>
<td>Movement Of Disc</td>
<td>Relative movement between disc and shaft</td>
<td>With the shaft properly held, use a rubber mallet or a piece of wood and see if there is any relative movement between the disc and shaft. This could indicate pins that are not tight, crushed, or improperly welded pins. Install new pins and weld on the small end this draws in the pin for tighter fit.</td>
</tr>
</tbody>
</table>
|                              | Crushed pins                           | During extremely high shocks, the disc can cause compression of the pin resulting in disc movement. First check for relative motion between the disc and shaft. Record service conditions and look for physical obstruction which prevents disc rotation. Possible problems: misapplication, shock loading, rotation wrong way, foreign objects in line, hitting of pipeline, or wrong material pins. Look for corrosion or evidence that the improper pins have been installed. This is particularly important in stainless valves where a less corrosion resistance 17-4 pin could inadvertently be used.  
It is very important to realize that a 316 pin will take approx. ½ the load of the 17-4 pin and proper application of the product is critical. Reinstall new pins. |
|                              | Movement of disc under high loads      | Check linkage adjustment and tightness, and actuator torque output. Topworks may not be set correctly, or there may be too much angular play in the actuator driving mechanism. (See IMO for setup and required torques.) |
# Product Portfolio
## Ball Valves

### Documents Available

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<th>Valve Series</th>
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<td>IMO-214, IMO-220, IMO-270, IMO-271, IMO-281, IMO-299</td>
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<tr>
<td>Series 4000</td>
<td>B105-1</td>
<td>IMO-203, IMO-210, IMO-220</td>
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</table>

Please refer to the Metso Business Center for the latest technical documents.
Series 7000/9000
Uni-Body Flanged Ball Valves

This guide is for reference only. Refer to product IMO for specific instructions.
Small Flanged Ball Valve

- Handle Nut
- Shake Proof Washer
- Hex Head Cap Screw
- Disc Spring
- Compression Plate
- Socket Head Cap Screw
- Spacer
- Stem Seal
- Bonnet of Valve
- Insert End of Valve
- Stem Bearing
- Secondary Stem Seal
- Stem Bearing
- Stem
- Ball
- Seat
- Body Seal
- Insert

This guide is for reference only. Refer to product IMO for specific instructions.
Valve Disassembly

Comply fully with the steps in the “WARNING” section of the appropriate IMO.

- Open and close valve and leave in closed position.
- Remove handle nut, lock-washer and handle.
- Remove hex head cap screws, disc springs and compression plate.
- Unscrew and remove insert.
- Remove and discard the old body seal. (May include support ring used with graphite seal.)
Seat Removal

- With the ball in the closed position, remove ball and seats. (A piece of wood or plastic rod may be used to unseat the parts from the opposite side. Be careful not to damage ball surface.)

- Press stem into body and remove from insert end.

- Carefully pry out the stem seal and stem bearing to avoid damage to the bearing surfaces.
This guide is for reference only. Refer to product IMO for specific instructions.
Valve Assembly

Inspect all parts to ensure sealing surfaces are in good condition and properly cleaned.

- Position body with insert or cap side up.
- Insert the seat into the body with flat side down (per IMO).
- Place the stem bearing or FIRE-TITE stem bearings on stem.
- Insert the stem with the bearings into the body and up thru the stem bore.
- Holding the stem in place, install the stem seal and compression plate.
- Place the disc springs, if applicable, onto the hex head cap screws (note disc spring orientation in IMO). Install the screws thru the compression plate and hand tighten.
Valve Assembly

- While pressing the stem from inside the body, tighten the screws to the required torque in IMO. (Compression plate should be parallel to valve bonnet.)
- Align the stem to the ball slot and insert the ball.
- Insert the second seat with flat side up.
- Insert body seal. (Insert metallic support ring in front of graphite body seal where applicable.)
- Screw insert into body and torque per IMO.
- Install handle, lock-washer and handle nut and tighten to torque listed in IMO.
- Cycle valve slowly to ensure smooth operation.

This guide is for reference only. Refer to product IMO for specific instructions.
Split Body Valve Disassembly

- Handle Nut
- Handle
- Retainer Ring
- Indicator Stop
- Handle Stop
- Packing Nut
- Compression Plate
- Stem Packing
- Valve Bonnet
- Body
- Seat
- Ball
- Sec Stem Seal
- Stem Bearing
- Stem Bearing
- Stem
- Body Gasket
- Body Cap

This guide is for reference only. Refer to product IMO for specific instructions.
Split Body Valve Disassembly

Comply fully with the steps in the “WARNING” section of the appropriate IMO.

- Open and close valve and leave in closed position.
- Remove handle (screw, handle, retainer ring, spring and indicator stop).
- Remove hex nuts, stop bushings and compression plate.
- Mark joint flanges to assure correct body/cap orientation.
- Unscrew all body/cap hex nuts and remove the body cap.
- Remove the old body seal.
Seat Removal

- With the ball in the closed position, remove ball and seats. (A piece of wood or plastic rod may be used to unseat the parts from the opposite side. Be careful not to damage ball surface.)

This guide is for reference only. Refer to product IMO for specific instructions.
Stem and Stem Seal Removal

- Press stem into body and remove from insert end.
- Carefully pry out the stem seal and stem bearing to avoid damage to the bearing surfaces.

This guide is for reference only. Refer to product IMO for specific instructions.
Series 4000 Mod. “B”
Ball Valves

This guide is for reference only. Refer to product IMO for specific instructions.
Series 4000 Valves

Nuts (4)

Body Seals

Seat

Body

Seat

Body Seals

Cap

Body Bolts (4)

Handle

This guide is for reference only. Refer to product IMO for specific instructions.
Valve Disassembly

Comply fully with the steps in the “WARNING” section of the appropriate IMO.

- Open and close valve and leave in closed position.
- Remove handle nut, lock-washer and handle.
- Remove hex nuts, stop spacers and compression plate.
- Unscrew and remove all body/cap hex nuts and the body caps.
- Carefully pry out body seal from end caps and stem seal & bearing to avoid damage to the sealing surfaces.

This guide is for reference only. Refer to product IMO for specific instructions.
Seat Removal

✓ Comply fully with the steps in the “WARNING” section of the appropriate IMO.

☐ With the ball in the closed position, remove ball and seats. (A piece of wood or plastic rod may be used to unseat the parts from the opposite side. Be careful not to damage ball surface.)
Stem and Stem Seal Removal

- Handle Nut
- Shake Proof Washer
- Disc Springs
- Stem Seal
- Handle
- Hex Head Cap Screw
- Compression Plate
- Socket Head Cap Screw
- Spacer
- Body
- Sec Stem Seal
- Stem Bearing
- Stem

- Press stem into body and remove.

- Carefully pry out the stem seal and stem bearing to avoid damage to the bearing surfaces.

This guide is for reference only. Refer to product IMO for specific instructions.
Valve Assembly

- Insert stem bearing, second stem seal and another stem bearing into stem bore.
- Insert stem.
- Install stem seal and compression plate.
- Place disc springs on studs and hand tighten.
- Install ball & seats, body bolts and torque per IMO.

This guide is for reference only. Refer to product IMO for specific instructions.
Packing Orientation

Orientation of V-Ring Packing (Item 69)

Seats Must Be in This Position at Assembly
Seat and Disc Spring Orientation

Seats should be in this position at assembly

Proper Disc Spring Orientation

This guide is for reference only. Refer to product IMO for specific instructions.
This guide is for reference only. Refer to product IMO for specific instructions.
Product Portfolio

Valv-Powr Actuators

Documents Available

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</tr>
<tr>
<td></td>
<td>A111-4</td>
<td></td>
</tr>
</tbody>
</table>
Valv-Powr VPVL Pneumatic Actuator
Technical Data – VPVL Actuator

- **Operating Media**
  - Dry or Lubricated Air
  - Non-Corrosive Gas
  - Light Hydraulic Oil

- **Air Supply**
  - 116 psi (8 bar) maximum

- **Temperature**
  - -60° to 302°F (-50° to 150°C)

This guide is for reference only. Refer to product IMO for specific instructions.
VPVL Pneumatic Spring Return (shown) & Double-Acting Rack & Pinion Compact Actuator

- Position Indicator
- Stop Cap Screws & Nuts
- Octi-Cam (Stop Arrangement)
- Piston
- O-Ring (Piston)
- Bearing (Piston Head)
- Spring (Cartridge)
- Drive Shaft
- End Cap
- Cap Screw (End Cap)

- O-Ring (End Cap)
- Piston Guide
- Plug (Transfer Port)
- Bearing (Pinion Top)
- O-Ring (Pinion Top)
- Bearing (Pinion Bottom)
- O-Ring (Pinion Bottom)

This guide is for reference only. Refer to product IMO for specific instructions.
Air supplied to Port 2 forces pistons apart and toward end positions with exhaust air exiting at Port 4 (a counterclockwise rotation is obtained).

Air supplied to Port 4 forces pistons toward center with exhaust air exiting at Port 2 (a clockwise rotation is obtained).

**REVERSE ROTATION**
Upon request, the pistons can be inverted to obtain a clockwise rotation when the air pressure is applied to Port 2.
Air supplied to Port 2 forces pistons apart and toward end position, compressing springs. Exhaust air exits at Port 4 (a counterclockwise rotation is obtained).

Loss of air pressure allows springs to force pistons toward center position with exhaust air exiting at Port 2 (a clockwise rotation is obtained).
VPVL – Spring Orientation for VPVL051

Spring Configuration for VPVL051

<table>
<thead>
<tr>
<th></th>
<th>Side A</th>
<th>Side B</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR4/5</td>
<td>#1 Green</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>#2 Black</td>
<td>#3 Red</td>
</tr>
<tr>
<td>SR6</td>
<td>#1 Green</td>
<td>#1 Green</td>
</tr>
<tr>
<td></td>
<td>#3 Red</td>
<td>#3 Red</td>
</tr>
</tbody>
</table>

This guide is for reference only. Refer to product IMO for specific instructions.
VPVL – Spring Orientation for VPVL100-800

Spring Configuration for VPVL100 - VPVL800

This guide is for reference only. Refer to product IMO for specific instructions.
VPVL Actuator

Disassembly

- Follow cautions in IMO-553.
- Remove position indicator, stop screws & end caps.
- For spring return actuators, remove springs.
- Back out the 2 stops, but don’t remove. Rotate drive shaft until pistons are released. Remove pistons.
- Remove spring clip, thrust bearing and thrust washer.
- Press drive shaft down into body.
- Remove inner thrust bearing & Octi-Cam. Remove drive shaft.

Assembly

- Inspect and clean components not being replaced, reverse disassembly order.
- Use lubricants from list in IMO 553.
- For spring return, follow pattern in IMO 553.

DANGER OF PERSONAL INJURY

This guide is for reference only. Refer to product IMO for specific instructions.
### Pneumatic Actuator Trouble Shooting Guide

<table>
<thead>
<tr>
<th>Problem</th>
<th>Items to Check</th>
</tr>
</thead>
</table>
| When energizing the solenoid, actuator does not function | air supply to the solenoid  
electricity being available to the solenoid  
open circuit in the solenoid  
clogged valve ports in the solenoid  
magnitude of air pressure  
solenoid not properly piped to the actuator  
water frozen in the solenoid |
| Air reaches actuator, but unit will not cycle | air supply port of the operator may be plugged  
fittings on outside of operator may be leaking  
piston seals, driver seals or diaphragm may be leaking  
disengaged or broken internal components  
broken driver  
jammed valve (i.e. log in valve foreign material, galled stem, misaligned linkage) |
| Actuator functions, but valve does not move | disengaged actuator driver  
loose, worn or broken coupling  
valve stem is broken |
| Leaking diaphragm on new installation | was actuator dropped  
was air supply in excess of 65 psi during startup |
| Leaky diaphragm | Has jackscrew been damaged  
Does diaphragm have a lot of cycles on it |
| Actuator does not come to stop at proper position | Stop adjusting screws defective or not set properly  
Loose bracket or coupling between valve and actuator  
Positioner out of calibration |
<table>
<thead>
<tr>
<th>Problem</th>
<th>Items to Check</th>
</tr>
</thead>
</table>
| Valve will not seal properly | Closing stop screw of the actuator not properly set  
| | Loose linkage components  
| | Insufficient air to actuator  
| | Piston, driver or diaphragm seals are leaking |
| Pneumatic actuator and positioner unit will not fully open or closed | (The problems which effect on/off systems will also effect control units as well)  
| | Improperly calibrated control range or zero point on positioner or controller  
| | Loose positioner feedback linkage internal or external to positioner  
| | Stop screws incorrectly adjusted  
| | Manual override not fully backed out  
| | Instrument signal wires crossed |
| Unit cycles full stroke, but cannot be controlled | Air lines between positioner and actuator are crossed  
| | Positioner cam (NE, NP), etc., set-up wrong, check IMO. ND9 use LUI or FieldCare to check problem |
| Unit is not stable (positioner hunting) | Loose linkage  
| | Improper balancing adjustment in (NE & NP) positioner (refer to IMO for correction)  
| | ND9000 check the LUI and adjust the performance level 'PERF' from A-Aggressive – through – E Maximum stability. Check IMO for other methods to fine tune the positioner. |
Product Portfolio

Quadra-Powr Actuators

Documents Available

<table>
<thead>
<tr>
<th>Actuator Series</th>
<th>Bulletin</th>
<th>IMO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series QPX</td>
<td>A110-4</td>
<td>IMO-215</td>
</tr>
</tbody>
</table>

Please refer to the Metso Business Center for the latest technical documents.
QPX Actuator

This guide is for reference only. Refer to product IMO for specific instructions.
Diaphragm Replacement

- If tension exists on screws, the spring package is not properly contained. Stop disassembly, retighten nuts and return actuator to factory.

- Back off diaphragm casing nuts until flush with the end of hex head cap screw. Do not remove completely. Diaphragm casing should be loose to the touch.

- Remove casing, hex cap screw, retaining washer and diaphragm.
Disassembly

- Disassemble cover by removing six (4 DNQPX1) socket cap screws.

- Tap with plastic hammer, if necessary, to free the cover.

This guide is for reference only. Refer to product IMO for specific instructions.
Disassembly

- After assembling the new diaphragm, apply air pressure to remove the driver arm preload by partially stroking the actuator.

- Remove socket shoulder screw that holds clevis to driver arm. Apply heat to lower arm to loosen loctite adhesive.

- Slowly increase pressure until driver arm moves off stop screw. Remove shoulder screw.

- Relieve all pressure slowly until clevis stops against spring retainer.
Spring Cartridge Replacement

- Remove cap screws, diaphragm, diaphragm casing and spring cartridge.
- Do not attempt to disassemble spring package.

DANGER OF PERSONAL INJURY

This guide is for reference only. Refer to product IMO for specific instructions.
Driver Arm Seal and Bearing Replacement

- Press replacement bearings into body and cap. (Cap not shown.)
Driver Arm Seal and Bearing Replacement

- Press clevis bearing into clevis.
- Apply grease to inside of bearings of driver arm. No grease should be applied to the clevis.
Cover Replacement

- Replace cover and torque bolts per IMO instructions.
<table>
<thead>
<tr>
<th>Problem</th>
<th>Observation / Diagnostics</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage through closed valve</td>
<td>Wrong stop screw adjustment of the actuator</td>
<td>Adjust the stop screw from the closed position</td>
</tr>
<tr>
<td></td>
<td>Faulty zero setting of the positioner</td>
<td>Adjust the positioner</td>
</tr>
<tr>
<td></td>
<td>Broken Spring</td>
<td>Check actuator stroke limit (90°)</td>
</tr>
<tr>
<td></td>
<td>Actuator in fail open or closed position</td>
<td>Check the actuator for fail open or close, flip actuator if incorrect orientation.</td>
</tr>
<tr>
<td></td>
<td>Segment in a wrong position relative to the actuator</td>
<td>Select the correct keyway in the actuator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check actuator internal driver arm maybe worn</td>
</tr>
<tr>
<td>Irregular valve movement</td>
<td>Actuator or positioner malfunction</td>
<td>Check the operation of the actuator and positioner</td>
</tr>
<tr>
<td></td>
<td>Process medium accumulated on the segment surface</td>
<td>Clean the segment/ball</td>
</tr>
<tr>
<td></td>
<td>Segment or seat damaged</td>
<td>Replace components as needed</td>
</tr>
<tr>
<td></td>
<td>Crystallizing medium has entered the bearing spaces</td>
<td>Flush the bearing spaces</td>
</tr>
<tr>
<td></td>
<td>Stiction possible between the seat and segment/ball</td>
<td>Options:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>First check to see if the seats are correct for the application</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Either back off on the packing nuts but not enough to cause stem seal leakage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lap the seat to the segment, possible high points</td>
</tr>
<tr>
<td></td>
<td>Broken actuator spring</td>
<td>Check spring in actuator</td>
</tr>
<tr>
<td></td>
<td>Actuator blow-by</td>
<td>Check to see if there is any air on spring end</td>
</tr>
<tr>
<td></td>
<td>Not enough air supply</td>
<td>Check air supply pressure or increase actuator size.</td>
</tr>
</tbody>
</table>
Product Portfolio

B-Series Actuators

Please refer to the Metso Business Center for the latest technical documents.
B-Series Pneumatic Actuator

This guide is for reference only. Refer to product IMO for specific instructions.
Technical Data – B-Series Actuator

- **Temperature**
  - -40° to 250°F (-40° to 120°C)

- **Air Supply Maximum**
  - B1J – 120 psi (8 bar)
  - B1C – 120 or 145 psi (8 or 10 bar)
B-Series Actuator Spring Return (shown) & Double Acting Pneumatic Actuator
# B-Series Actuator Spring Return & Double Acting

## Pneumatic Actuator Parts Listing

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Housing</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Cover</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Lever arm</td>
</tr>
<tr>
<td>3A</td>
<td>1</td>
<td>Antistatic ring</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>Connection arm and bearings</td>
</tr>
<tr>
<td>4A</td>
<td>1</td>
<td>Antistatic ring</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Bearing unit</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Cylinder base</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Pointer cover</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Cylinder</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Piston</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Piston rod</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>Spring</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>Spring plate</td>
</tr>
<tr>
<td>12A</td>
<td>1</td>
<td>Protection bushing</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Ring</td>
</tr>
<tr>
<td>14</td>
<td>2</td>
<td>Lock ring</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>Hexagon nut</td>
</tr>
<tr>
<td>16</td>
<td>1</td>
<td>O-ring</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>O-ring</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td>O-ring</td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>O-ring</td>
</tr>
<tr>
<td>20</td>
<td>2</td>
<td>Bearing</td>
</tr>
<tr>
<td>21</td>
<td>2</td>
<td>Bearing</td>
</tr>
<tr>
<td>22</td>
<td>1</td>
<td>Bearing</td>
</tr>
<tr>
<td>23</td>
<td>2</td>
<td>Bearing</td>
</tr>
<tr>
<td>24</td>
<td>3</td>
<td>Piston seal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>2</td>
<td>Bushing</td>
</tr>
<tr>
<td>26</td>
<td>1</td>
<td>Stop screw</td>
</tr>
<tr>
<td>27</td>
<td>1</td>
<td>Stop screw</td>
</tr>
<tr>
<td>29</td>
<td>1</td>
<td>Screw</td>
</tr>
<tr>
<td>30</td>
<td>4</td>
<td>Screw</td>
</tr>
<tr>
<td>31</td>
<td>8, 12</td>
<td>Screw</td>
</tr>
<tr>
<td>32</td>
<td>2</td>
<td>Screw</td>
</tr>
<tr>
<td>33</td>
<td>1</td>
<td>Nut</td>
</tr>
<tr>
<td>33A</td>
<td>1</td>
<td>O-ring</td>
</tr>
<tr>
<td>34</td>
<td>1</td>
<td>Nut</td>
</tr>
<tr>
<td>35</td>
<td>1</td>
<td>Lock nut</td>
</tr>
<tr>
<td>36</td>
<td>2</td>
<td>Lock ring</td>
</tr>
<tr>
<td>37</td>
<td>2</td>
<td>Support ring</td>
</tr>
<tr>
<td>39</td>
<td>1</td>
<td>ID plate</td>
</tr>
<tr>
<td>40</td>
<td>1</td>
<td>Filter</td>
</tr>
<tr>
<td>41</td>
<td>4</td>
<td>Plug</td>
</tr>
<tr>
<td>42</td>
<td>1</td>
<td>Plug</td>
</tr>
<tr>
<td>43</td>
<td>1</td>
<td>Warning plate</td>
</tr>
<tr>
<td>44</td>
<td>1</td>
<td>Cylinder end</td>
</tr>
<tr>
<td>58</td>
<td>1</td>
<td>Pressure outlet valve</td>
</tr>
<tr>
<td>61</td>
<td>1</td>
<td>Direction arrow</td>
</tr>
<tr>
<td>62</td>
<td>1</td>
<td>Screw</td>
</tr>
</tbody>
</table>

*This guide is for reference only. Refer to product IMO for specific instructions.*
B-Series Actuator – Replacement of Piston Seal

Disassembly

- Follow Cautions in IMO.
- Remove cylinder end slide stop screw (26), cylinder end (44), housing cover (2).
- Unscrew the bearing screw (29) and the cylinder fastening screws (31) from the cylinder base (6).

**Do not take apart spring cartridge**

- Remove the cylinder with the piston.
- Remove the O-rings.
- Slide the piston out of the cylinder.
- Remove the old seals (24), o-rings (18), piston rod seal (16), and bearing (22).
- Clean the seal space.
B-Series Actuator – Replacement of Piston Seal

Assembly

- Lubricate seal space and new o-ring.
- Install the o-ring (18) located under the piston seals.
- Place piston seals (24) around the piston.
- Hammer or press the piston into the cylinder through the tie ring.
- Install new o-rings (19).
- Replace cylinder end and install cylinder with piston.
- Apply bearing unit screw (29).
- Fasten the housing cover temporarily so the secondary shaft bearings function but the linkage can be seen.
- Operate the actuator to check function.

DANGER OF PERSONAL INJURY
B-Series Actuator – Replacement of Linkage Bearings and O-rings

DANGER OF PERSONAL INJURY

Disassembly

• Follow Cautions in IMO.
• Remove cylinder end slide stop screw (26), housing cover (2).
• Open bearing unit (5) fastening screw (29).
• Turn lever arm (3) to detach bearing unit from piston rod (10) and remove linkage.
• Remove lock rings (36) and support rings (37).
• Remove connection arms (4), ring (4A).
• Remove lever arm bearings (23), o-rings (17), and the grounding spring (3A).
B-Series Actuator – Replacement of Linkage Bearings and O-rings

DANGER OF PERSONAL INJURY

Assembly

• Install the grounding ring (3A), lever bearings (23) and the o-rings (17).
• Assemble the linkage and install in the housing.
• Operate the actuator to check that it is moving properly.
## B-Series Actuator Trouble Shooting Guide

<table>
<thead>
<tr>
<th>Problem</th>
<th>Observation / Diagnostics</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregular or slow operation</td>
<td>Low supply pressure</td>
<td>• Verify that supply pressure complies with minimum torque required by valve.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check that supply air pipes are large enough.</td>
</tr>
<tr>
<td></td>
<td>Positioner Fault</td>
<td>Check positioner operation.</td>
</tr>
<tr>
<td></td>
<td>Valve Fault</td>
<td>Check that valve functions properly without actuator.</td>
</tr>
<tr>
<td></td>
<td>Incorrect actuator rating</td>
<td>Contact manufacturer to check rating.</td>
</tr>
<tr>
<td></td>
<td>Leak in piston or piston rod seal</td>
<td>Replace seals. (see IMO)</td>
</tr>
<tr>
<td></td>
<td>Cylinder damaged by impurities</td>
<td>• Note installation position recommendation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace cylinder if damaged.</td>
</tr>
<tr>
<td></td>
<td>Worn-out actuator bearings</td>
<td>Check bearings (see IMO)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace bearings when necessary. If operating density is high, bearings and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>piston seals must be replaced regularly: max 500,000 operations.</td>
</tr>
<tr>
<td></td>
<td>Linkage corroded in harsh, humid conditions</td>
<td>• Clean linkage and replace bearings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• When necessary, lubricate housing or fill with grease regularly (see IMO).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If water occurs in housing, an outlet hole (Ø 5mm) can be bored in lower part</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of housing.</td>
</tr>
<tr>
<td></td>
<td>Bearing unit fastening screw loose</td>
<td>Tighten screw. Seal e.g. with Loctite 225.</td>
</tr>
<tr>
<td></td>
<td>Backlash in joint between actuator and valve</td>
<td>Replace parts as necessary.</td>
</tr>
</tbody>
</table>

**This guide is for reference only. Refer to product IMO for specific instructions.**