GENERAL INFORMATION

The following instructions are designed to assist in disassembling, reassembling and troubleshooting Valtek valves equipped with a metal bellows seal. Product users and maintenance personnel should thoroughly review this bulletin in conjunction with Maintenance Instructions 1 (Mark One and Two Control Valves) before installing, operating or performing any maintenance on the valve.

This publication does not contain information on Valtek positioners. Refer to the appropriate Maintenance Instructions for installing, maintaining, troubleshooting, calibrating, and operating Valtek positioners.

Three styles of metal bellows seal exist: Guardian, Guardian II and Formed. Guardian II and Formed bellows are constructed of flat material, which is rolled into a tube and then seam welded. The walls of the tube are then mechanically formed into convolutions. Guardian bellows are constructed from a series of matched pairs of metal discs that are welded together.

To avoid possible injury to personnel or damage to valve parts, WARNING and CAUTION notes must be strictly adhered to. Modifying this product, substituting non-factory or inferior parts, or using maintenance procedures other than outlined could drastically affect performance and be hazardous to personnel and equipment, and may void existing warranties.

GUARDIAN METAL BELLOWS SEAL

Disassembling Guardian Metal Bellows Seal

To disassemble the Guardian metal bellows seal, refer to Figure 1 and proceed as follows:

WARNING: Since toxic or hazardous materials may be present, depressurize the line to atmospheric pressure. Drain all process fluids and decontaminate the valve. Failure to do so can cause serious personal injury. Keep hands, hair and clothing away from moving valve parts at all times. Face and eye protection should be worn; otherwise, serious personal injury may occur.

1. Remove bonnet flange bolts and nuts.
2. Remove the entire actuator/bellows seal assembly, bonnet and bonnet flange by lifting them straight out of the body.

WARNING: The sleeve may stick to the bellows seal and fall from the assembly during removal of the actuator assembly from the body, which could cause damage or possible injury. To remove a sticking sleeve, lightly tap on the sleeve while lifting the actuator assembly.

NOTE: Heavy assemblies may require a hoist. A lifting ring is provided on most actuators for this purpose; otherwise, lift by the yoke legs using lifting straps and a hoist.
3. Remove the sleeve from the body, then the seat retainer and seat ring.

4. Remove the bonnet gasket, seal ring gasket, sleeve gasket and seat gasket.

5. Loosen the actuator stem clamp and remove the packing box bolting.

**WARNING:** If there has been a bellows failure, process fluids may be trapped in the packing box; therefore, be extremely cautious when removing the packing box bolting and packing.

6. Remove the yoke clamps.

7. Remove actuator assembly by turning it off plug stem.

**CAUTION:** Although the valve incorporates an anti-rotation pin, care should be taken not to put excessive torque on the plug stem/bellows assembly. Excessive torque can damage bellows and/or shear the anti-rotation pin.
8. Remove the bonnet flange, then carefully slide the plug/bellows assembly out of the bonnet without stretching the bellows. Be careful not to lose the anti-rotation pin from the plug/bellows assembly. The packing, packing spacer and stem guides can now be removed for inspection or replacement.

Reassembling Guardian Metal Bellows Seal

To reassemble the Guardian metal bellows seal, refer to Figure 1 and proceed as follows:

1. Check metal bellows for signs of wear or damage. If the bellows shows signs of fatigue or cracking, obtain a replacement before reassembling and operating the valve. Make sure all gasket surfaces are clean and free of damage.

2. If the packing has been removed, replace packing, packing spacer and stem guides (refer to Figure 1).

3. Insert the plug stem into the bonnet.

4. Place the bonnet flange on the bonnet.

5. Place the gland flange over the plug stem and the stem clamp on the actuator stem and reinstall the actuator assembly by screwing it onto the plug stem. Three or four plug stem threads should be exposed below the actuator stem to ensure proper seating.

CAUTION: Although the valve incorporates an anti-rotation pin, care should be taken not to put excessive torque on the plug stem/bellows assembly. Excessive torque can damage bellows and/or shear the anti-rotation pin.

6. Insert the seat gasket, seat ring and seat retainer into the body; then install the sleeve gasket and metal bellows sleeve.

7. Install the seal ring gasket and the bonnet gasket.

8. Retract the plug and carefully lower the bellows/bonnet assembly into the sleeve. Make certain the anti-rotation pin is in place before installing the bellows.

WARNING: Care should be taken not to damage the bellows or plug and seat ring seating surfaces when installing the bellows. Damage to the bellows may cause faulty operation and/or injury to personnel.

9. On air-to-close valves, leave three or four threads exposed. For correct plug engagement on air-to-open valves, make certain the plug does not rotate in the body/bonnet assembly and screw the actuator assembly onto the plug as far as possible.

WARNING: Rotation of the plug while clamped in the body/bonnet assembly will damage the bellows seal, which could cause personal injury.

10. Apply air pressure above the piston to drive it to the bottom of the actuator cylinder. Without rotating the plug, back the actuator assembly off of the plug stem until there is 1/32-inch gap between the bottom of the yoke and bonnet. Then back the actuator assembly off of the plug stem exactly one complete turn. This provides the correct seating force.

11. Apply air below the actuator piston, retracting the plug. Install the yoke clamp.

12. To properly align the seat ring and plug, first bring the bonnet bolting to finger tightness. Apply air above the piston to seat the plug in the seat ring.

NOTE: Step 12 applies only to valves with pneumatic actuators. If an hydraulic or mechanical actuator is used, return the plug to the midstroke position and proceed to tighten.

WARNING: Failure to return the plug to the midstroke position (mechanical or hydraulic actuators only) will cause damage to the actuator and/or the valve during the bonnet tightening sequence. This is due to the inability of most mechanical/hydraulic actuators to accommodate the 1/16-inch back driving during the tightening sequence.

13. With the plug in the extended (or closed) position, tighten two opposing bonnet flange bolts or nuts 1/8-turn (one flat). Tighten each bonnet bolt in this manner until the bonnet, seat, sleeve and seal ring gaskets are compressed and the bonnet, sleeve and body are seated metal-to-metal.

CAUTION: Under tightening may not fully compress the gaskets, which may cause leakage. Over tightening may damage interior parts. Tighten only to the point that metal-to-metal seating occurs.

14. Remove air from the actuator. Adjust the positioner cam and stem clamp according to instructions contained in the appropriate positioner maintenance bulletin. Then adjust the stroke plate to indicate proper air-action (air-to-open valves should be adjusted so the stem clamp points to “closed” on the stroke plate; air-to-close valves should point to “open”).

15. Install the packing box bolting. Packing box bolting should be slightly more than fingertight when Teflon packing is used.

CAUTION: Do not overtighten packing. Over tightened packing can cause high stem friction and excessive packing wear, which may impede stem movement.

16. Stroke the valve and check for smooth, trouble-free operation.
Troubleshooting Guardian Metal Bellows Seals

<table>
<thead>
<tr>
<th>Failure</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
</table>
| Leakage through bonnet or sleeve gaskets | 1. Insufficient compression of bonnet flange  
2. Worn or defective bonnet, sleeve or seat ring gasket | 1. Tighten bonnet flange bolting until leakage stops  
2. Disassemble and replace all gaskets, including seat ring gasket |
| Leakage through packing box or "tell-tale" tap | 1. Failure of metal bellows seal assembly | 1. Disassemble and replace metal bellows seal assembly and all gaskets |
| Valve does not seat or seats too early | 1. Improper actuator stem engagement | 1. Correct stem engagement (refer to step 10 in the “Reassembly” section) |

GUARDIAN II METAL BELLOWS SEAL

Disassembling the Guardian II Metal Bellows Seal

To disassemble the Guardian II metal bellows seal valve, refer to Figures 2 and 3 and proceed as follows:

**WARNING:** Depressurize line to atmospheric pressure, drain all process fluids and decontaminate the valve (if toxic or hazardous materials are present). Special attention should be given to the housing packing area and inside the bellows housing and when disassembling the plug head. Failure to do so can cause serious injury.

1. Loosen the actuator stem clamp.
2. Remove the packing box bolting.
3. Remove the yoke clamps.
4. Remove the actuator by turning it completely off the bellows seal stem and bellows seal housing.

**CAUTION:** Although the valve incorporates an anti-rotation pin, care should be taken not to put excessive torque on the plug stem/bellows assembly. Excessive torque can damage bellows and/or shear the anti-rotation pin. Flats on plug stem should only be used to prevent stem from rotating while removing actuator or installing plug heads.

**CAUTION:** Heavy actuators may require a hoist. A lifting ring is provided on most actuators for this purpose; otherwise, lift by the yoke legs using lifting straps and the hoist.

5. Remove the bonnet flange bolts or nuts.
6. Remove entire bellows seal assembly, plus the bonnet and plug, by lifting them straight out of body.

**WARNING:** If there has been a bellows failure, process fluid may be trapped in the bellows seal housing; therefore, be extremely cautious when disassembling the valve and bellows assembly.

7. Disassemble the bellows assembly by first removing the plug head. Begin by grinding the tack welds off where the plug head meets the plug stem. Next, securely hold the plug stem by the flats, being careful not to damage the threads or gall the shaft. Using a wrench on the plug head flats, turn the plug head off the stem.
8. Remove the metal bellows assembly by carefully pulling it out of the housing.
9. Pull the stem guide housing off the bellows assembly. Jack screw holes are provided, if needed.
10. Remove the bellows housing gasket from the bellows housing.
11. Inspect lower stem guide for galling or wear. If replacement is required, use a dowel and arbor to press out the soft guide and guide retainer in the case of soft guides. When hard guides are used, the entire guide will be pressed out in one piece.
12. Remove the seat ring, seat retainer, seat ring gasket, and bonnet gasket from the body. Refer to Maintenance Instructions 1 for further details.

Reassembling the Guardian II Metal Bellows Seal

To reassemble the Guardian II metal bellows seal valve, refer to Figures 2 and 3 and proceed as follows:

1. If bellows failure has been determined, properly discard the old assembly and obtain a new one. Inspect all parts for wear and replace. All gaskets must be replaced.
2. Replace the lower stem guide into the stem guide housing. With soft guides, insert the Teflon® liner into the guide retainer and then press this assembly into the guide housing. With hard guides, press the solid guide into the guide housing. (An arbor is required to press in these parts.)
3. Install the stem guide housing over the stem and into the lower flange of bellows assembly. Jack screw threads should be facing outward.
Figure 2: Guardian II Metal Bellows Seal with Integral Flange Design

Note: Item numbers correspond directly to the valve’s bill of material. Refer to bill of material for specific numbers.
4. Place the upper end of the stem into a vice using the stem flats to hold in place. Use caution to not damage the stem or its threads. Thread the plug head into the bellows stem using a wrench on the flats of the head. (Torque 1/2 through 2-inch valves to 540 in-lbs, and 3-inch valves to 2500 in-lbs.)

5. At the inside corner where the plug head meets the plug stem, tack weld the head to the stem with two 1/8-inch welds 180 degrees apart.

6. Install a new seat ring gasket, seat ring, seat retainer and new bellows assembly gasket into valve body.

7. Insert the bellows assembly into the valve body, being careful to not damage the plug head.

8. Insert a new bellows housing gasket onto the bellows assembly. Next, carefully lower the bellows housing over the bellows assembly and onto the valve body and bonnet flange studs. Be certain the tell-tale tap is located opposite of the positioner.

9. Install the bonnet flange nuts and tighten finger-tight.

10. Insert the packing spacer, lantern ring, new packing and upper stem guide into the packing box.

11. Turn the actuator back onto the bellows stem, without turning the stem inside the bellows seal housing. Be certain the gland flange and bonnet flange are in place before engaging the bellows stem and actuator stem threads. Leave approximately three to five bellows stem threads exposed or until a 1/8-inch gap remains between the yoke bottom and bonnet. With air-to-open valves, retract the stem by applying air pressure to the bottom of the actuator. This will allow the yoke clamp and gland flange bolting to be attached and tightened firmly. The packing box nuts should be just over finger tight.

12. For air-to-close valves, skip this step and go to step 13. For air-to-open valves, check for proper plug seating as follows: When proper seating occurs, the bonnet flange will be forced up against the finger tight bonnet bolting with such force that it will be impossible to wiggle the flange. If proper seating does not occur, the bonnet flange can be wiggled with light hand force. Should this occur, place air under the actuator piston and retract the actuator to approximate mid-stroke position. Remove the yoke clamp and gland flange bolting and turn the actuator off the bellows stem one additional thread and repeat the above seating procedure. When the bonnet flange becomes tight against the finger-tight body bolting, plug is properly seated. If necessary, repeat above procedure until proper seating occurs. Re-attach and tighten the yoke clamp and gland flange bolting.

13. Move the plug to the extended (or closed) position. Begin tightening the bonnet flange bolting in a manner that will keep the bonnet flange square/parallel with the body. Tighten the first bolt 1/8-turn,
then tighten the bolt directly opposite 1/4-turn and so on around the flange. Firmly tighten all bolts evenly and completely to compress the bonnet gasket and to seat the bonnet. Torque the bonnet bolts to the suggested torque values in Table I.

14. Apply air over the piston to seat the plug. For all throttling valves, adjust the stem clamp so that with full instrument signal to the positioner the full signal scribe line on the positioner cam points to the center of the cam roller bearing.

Tighten the stem clamp bolting. Proper tightness is important since this adjustment secures the actuator stem to the bellows stem. Adjust the stroke plate so that the stem clamp points to the “closed” position.

15. If the valve has been taken out of the line, make sure the flow arrow indicates proper flow direction upon reinstallation.

### Table I: Suggested Bonnet Bolting Torque Values (ft-lbs, +10 percent)

<table>
<thead>
<tr>
<th>Bolt Size (inches)</th>
<th>Bolt/Stud Material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>5/8</td>
<td>80</td>
</tr>
<tr>
<td>3/4</td>
<td>140</td>
</tr>
<tr>
<td>1</td>
<td>350</td>
</tr>
<tr>
<td>11/8</td>
<td>510</td>
</tr>
<tr>
<td>11/4</td>
<td>730</td>
</tr>
<tr>
<td>13/8</td>
<td>990</td>
</tr>
</tbody>
</table>

**Troubleshooting Guardian II Metal Bellows Seals**

<table>
<thead>
<tr>
<th>Failure</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage through bellows assembly gasket</td>
<td>1. Insufficient compression of bonnet gasket 2. Worn or defective bonnet gasket</td>
<td>1. Tighten bonnet flange bolting until leakage stops 2. Disassemble and replace bonnet gasket</td>
</tr>
<tr>
<td>Leakage through packing box or “tell-tale” tap</td>
<td>1. Failure of metal bellows seal assembly</td>
<td>1. Disassemble and replace metal bellows seal assembly and all gaskets</td>
</tr>
<tr>
<td>Valve does not seat or seats too early</td>
<td>1. Loose stem locknut on bellows stem 2. Improper actuator stem engagement</td>
<td>1. Disassemble, tighten stem locknut 2. Correct stem engagement (refer to steps 9 thru 12 in the “Reassembly” section)</td>
</tr>
<tr>
<td>Leakage through bellows assembly gasket</td>
<td>1. Insufficient compression of gaskets 2. Worn or defective housing, bellows assembly or seat ring gasket</td>
<td>1. Tighten bonnet flange bolting until leakage stops 2. Disassemble and replace all gaskets, including seat ring gasket</td>
</tr>
</tbody>
</table>

**FORMED METAL BELLOWS SEAL**

**Disassembling Formed Metal Bellows Seal**

To disassemble the formed metal bellows seal, refer to Figures 4 and 5 and proceed as follows:

**WARNING:** Depressurize line to atmospheric pressure, drain all process fluids and decontaminate the valve (if toxic or hazardous materials are present). Failure to do so can cause serious injury.

1. Remove the bonnet flange bolts or nuts.
2. Remove the entire actuator/bellows seal assembly, plus the bonnet and plug, by lifting them straight out of the body.

**CAUTION:** Heavy assemblies may require a hoist. A lifting ring is provided on most actuators for this purpose; otherwise, lift by the yoke legs using lifting straps and the hoist.

3. Loosen the actuator stem clamp.
4. Remove the packing box bolting.
5. Remove the yoke clamps.
6. Remove the actuator by turning it completely off the bellows seal bonnet and bellows seal stem.

**CAUTION:** Although the valve incorporates an anti-rotation pin, care should be taken not to put excessive torque on the plug stem/bellows assembly. Excessive torque can damage bellows and/or shear the anti-rotation pin.

7. Remove the bolting from the upper housing clamps or flanges.

**WARNING:** If there has been a bellows failure, process fluid may be trapped in the bellows seal bonnet; therefore, be extremely cautious when removing the upper housing bolting.
8. Remove the upper housing clamps or flanges (if separable) and slide the bellows seal bonnet off the bellows seal stem. Care should be taken not to lose the anti-rotation pin from the upper seal. The packing, packing spacer, and stem guides can now be removed for inspection or replacement.

9. Remove the bolting from the lower housing clamps or flanges. Remove the clamps or flanges (if separable) from the assembly.

**WARNING:** Toxic process fluid may be trapped inside the bellows housing. Although previously decontaminated, care should be taken to prevent exposure to toxic residues.

10. Slide the body bonnet down until it makes contact with the plug head, exposing the stem locknut between the body bonnet and bellows seal stem. Using a wrench on the flats, loosen the stem locknut.

11. Screw the plug stem out of the bellows seal stem and separate the bonnet and plug from the metal bellows assembly. Remove the bonnet spring guide retainer and guide for inspection or replacement.

12. Remove the metal bellows assembly by carefully pulling the assembly through the housing.

13. Remove both upper seal ring gaskets from the upper seal ring.

14. Remove the lower housing gasket from the housing.

15. Remove the seat ring, seat retainer, seat ring gasket, and bonnet gasket from the body. Refer to Maintenance Instructions 1 for further details.

### Reassembling Formed Metal Bellows Seal

To reassemble the formed metal bellows seal, refer to Figures 4 and 5 and proceed as follows:

1. Check the metal bellows for signs of wear or damage. If the bellows shows signs of fatigue or cracking, obtain a replacement before reassembling and operating the valve.

2. Install new upper seal gasket “A” in the recessed area of the upper (or larger) end of the bellows seal housing.

3. Insert the metal bellows seal assembly into the housing, making sure the upper seal ring gasket properly engages the upper seal ring.

4. Install the lower guide and spring guide retainer in the body bonnet.

5. Place the lower housing gasket into the recessed gasket surface on the lower (or smaller) end of the housing.

6. Slide the plug stem through the body bonnet.

7. Make sure the separable flanges and half rings are positioned on the housing and bonnet. The bonnet flange should also be positioned on the bonnet.

8. Install the stem locknut on the plug stem. Screw the plug stem into the bellows seal stem. Proper engagement of the plug stem is achieved when there is approximately 1/6-inch of space in the slot above the anti-rotation pin when the plug is fully extended or in the seated position (refer to Figure 5). To determine the correct location of the extended plug, fit the bonnet and housing loosely together using the lower housing clamps or flanges. Screw the plug clockwise into the bellows stem until the 1/8-inch clearance is achieved above the anti-rotation pin. When in the fully extended position, measure the distance from the back of the plug head to the bottom of the bonnet. This distance should correspond to the stroke of the valve plus 1/16-inch. These measurements are found in Table II. If adjustment is needed, turn the plug head so that the plug stem screws in or out of the bellows seal stem until the proper measurement is reached. Double check to be sure the 1/8-inch clearance still remains.

9. Remove the lower housing clamp or flange bolting and pull the bonnet and housing apart, exposing the plug stem. Tighten the locknut firmly against the bellows seal stem, using two wrenches: one on the nut and the other on the bellows seal stem flats.

10. The housing can now be bolted to the bonnet using the lower housing clamps or flanges. At this point, the bolting should be finger-tight.

**NOTE:** Be certain the anti-rotation pin is still in place before proceeding to step 11.

11. After placing upper seal gasket “B” on the upper seal ring, insert the bellows seal bonnet over the bellows seal/plug assembly and onto the upper seal ring.

12. If the packing has been removed for replacement, replace the packing, packing spacer, and guides in the correct order in the bellows seal bonnet by referring to Figure 4. For non-standard packing configurations, refer to Maintenance Instructions 1.

13. Position the upper housing clamps or flanges and bolt them together. Bolting should be finger-tight.

14. Before turning the actuator back onto the bellows seal stem, be certain the stem clamp and gland flange are in place.

15. For correct stem engagement on air-to-open valves, turn the actuator stem onto the bellows seal stem until about 1/16-inch of space is left between the bottom of the yoke and the shoulder of the bellows seal bonnet. Apply air pressure under the piston to drive it up approximately 1/4-inch. This will seat the yoke on the bellows seal bonnet and provide the proper clearance between the piston and the top of the yoke.
Figure 4: Formed Metal Bellows Seal with Separable Flange Design

Note: Item numbers correspond directly to the valve's bill of material. Refer to bill of material for specific numbers.
Figure 5: Plug Thread Adjustment

(Refer to Step 8 in "Reassembly" Section)

Bellows Seal Assembly

Anti-rotation Pin

Spring Guide Retainer should compress approximately 1/8-inch

Plug Stem Jam Nut

Bellows Seal Plug

Stroke + 1/16-inch
1-inch to less stroke stroke +1/32-inch

(See Table II)
Table II:  
Extended Plug to Bonnet Dimensions  
(refer to Figure 5)

<table>
<thead>
<tr>
<th>Valve Size (inches)</th>
<th>Stroke (inches)</th>
<th>Distance Between Extended Plug and Bonnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2, 3/4, 1</td>
<td>1.00</td>
<td>1.03</td>
</tr>
<tr>
<td>1 1/2, 2</td>
<td>1.50</td>
<td>1.56</td>
</tr>
<tr>
<td>3, 4, 6 (class 150)</td>
<td>2.50</td>
<td>2.56</td>
</tr>
</tbody>
</table>

16. For correct stem engagement on air-to-close valves, a check valve must be used to lock air into the top of the actuator. This puts the actuator stem in the extended position. Turn the actuator stem onto the bellows seal stem until about 1/16-inch of space is left between the bottom of the yoke and the shoulder of the bellows seal bonnet. Carefully exhaust the check valve and the yoke will come into contact with the bonnet. This will provide the proper clearance between the piston and the top of the yoke.

17. Attach the yoke clamps.

18. Using new seat and bonnet gaskets, replace the seat ring and seat retainer in the body.

19. Install the entire actuator/bellows seal subassembly into the valve body. Tighten the bonnet flange bolting finger-tight.

20. Apply air pressure over the piston while exhausting the other side to seat the valve. Tighten two opposing bonnet flange bolts or nuts 1/8-turn (one flat). Tighten each bonnet bolt in this manner until the bonnet bottoms metal-to-metal in the body. This can easily be felt through the wrench.

21. Release the air in the cylinder. Firmly tighten the upper and lower housing clamps or flanges by tightening two opposing bolts, so that even pressure on the gasket and proper alignment of the housing and body bonnet are maintained.

22. Adjust the stem clamp to the correct position according to the air action (air-to-open valves should be adjusted so that the stem clamp points to “closed” on the stroke indicator plate; air-to-close valves should point to “open”).

23. Attach the packing box bolting and tighten the packing box nuts to slightly over finger-tight. **CAUTION:** Do not overtighten packing. This can cause excessive packing wear and stem friction which may impede stem movement.

24. Stroke the valve and check for smooth operation.
Valtek will continue to provide its customers with the best possible products and service available. Should you have any questions about these provisions or about Valtek’s products in general, contact your local Valtek representative or the factory directly for assistance.

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