# Operating and Maintenance Manual

## *Series CBV 2500 Control Ball Valve*

*Series CBV 2500*

NORRISEAL™
A DOVER COMPANY

*Engineered Performance*

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## Series CBV 2500 Control Ball Valve

# INTRODUCTION

**CAUTION!**

*You will see warning boxes like this throughout the manual. Please read and strictly observe these warnings to prevent personal injury or equipment damage. Before you begin the installation, operation or repair of equipment, make sure to completely review and understand the instructions in this manual.*

### Scope

This instruction manual includes installation, operation and maintenance information for Norriseal Series CBV 2500 Control Ball Valves. Please refer to separate manuals for instructions covering controllers and positioners.

### Description

The Series CBV 2500 Control Ball Valve is designed for general-purpose use applications for modulating or on/off service in liquid or gas control. The Series CBV 2500 has a dual-piece body. The Spring/Diaphragm Actuator uses a spring over the diaphragm for both direct (fail closed) and reverse (fail open) settings.

Series CBV 2500 valves are shipped with adjustable packing. Adjustment of packing is described in section 2.5 below.

**CAUTION!**

*Before any disassembly of the valve, all pressures in this device must be relieved. Failure to relieve pressures may result in personal injury or device damage. The resulting uncontrolled venting or spilling of line fluids may cause personal injury, loss of process control or environmental contamination. Note that packing adjustment does not require pressure relief.*

### Valve Identification

The nameplate of the valve is attached to the upper diaphragm housing of each valve. The nameplate lists the serial number, series number and model number, as well as other information applicable to the particular valve assembly, including materials and pressure and temperature limits.

Valve model numbers are 16 characters long (an example of a model number would be: 04W02L4A1T040-XX). For more information on the model numbers, refer to the individual product brochure.

Use Norriseal replacement parts only when servicing valves. Please refer to the serial and model numbers on the nameplate when ordering replacement parts.

**WARNING!**

*Maximum allowable pressures for the valve body and actuator and the maximum allowable temperature for the valve are shown on the nameplate. If pressure to the actuator exceeds these limits, install relief valves or other protection devices.*

**CAUTION!**

*When ordered, the valve configuration and construction materials were selected to meet the specific pressure, temperature, pressure drop and fluid conditions. Since some body/trim materials are limited in their pressure drop and temperature ranges, do not apply any other conditions to the valve without first contacting your Norriseal sales representative.*

## 1.0 Valve Installation and Start-Up

1. Before installing the valve, inspect it for any shipment damage or any debris that may have collected during crating and shipment. Remove the flange protectors from the body end connections.

2. Blow out all pipelines to remove pipe scale, chips, welding slag and other debris. Gasket surfaces should also be free of any debris.

3. Install the valve so that flow is in the direction indicated by the flow direction arrow, which will be on the main body (with the spherical feature) of the valve.

4. Install the valve using good piping practice. For bodies which contain flanges, use a suitable gasket between the body and pipeline. The bodies are rated ANSI 150, 300, or 600 class, as noted on the body casting. Do not install a valve in a system where the working pressures exceed the limitations noted on the body.

5. Where piping is insulated, it is recommended **to not insulate the valve. Insulating the valve will make it difficult to remove the bolts necessary to perform maintenance and repairs on the valve. If valve must be insulated, mask the body and trunnion bolts. Also, do not insulate the actuator bracket nor any parts inside of the actuator bracket.**

6. Connect the instrument air to the actuator or positioner connection. Refer to the nameplate for maximum instrument air pressure. Check for proper valve operation by cycling actuator several times and observing the movement.



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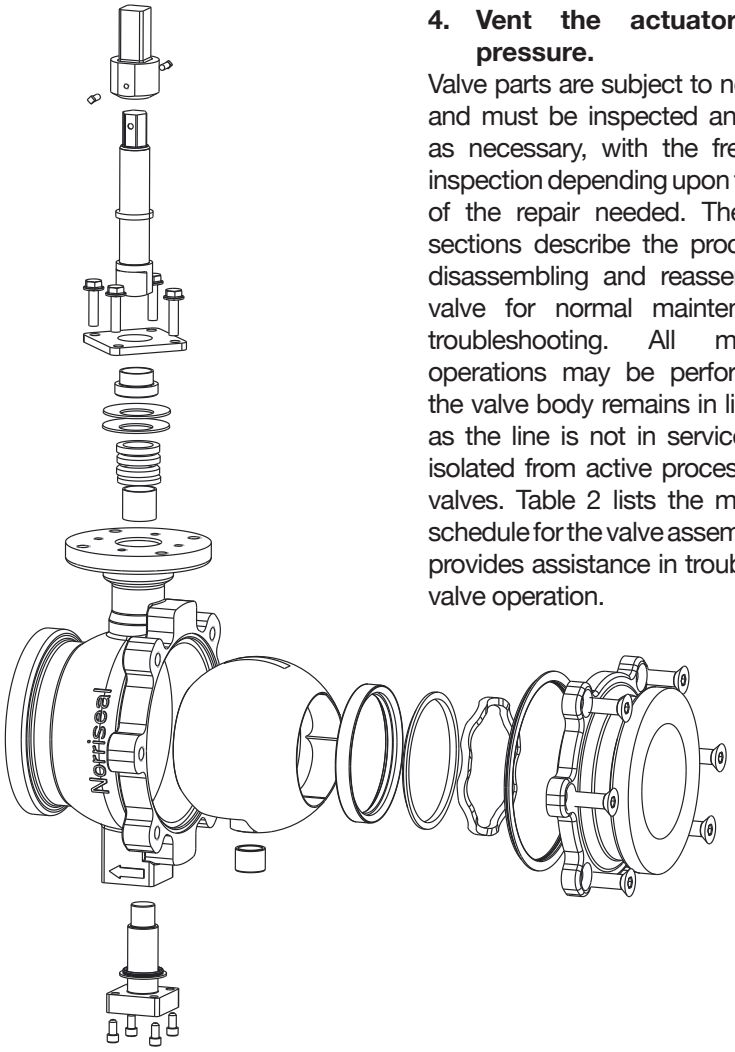
***WARNING!***

*Do not exceed the maximum instrument air pressure stamped on the valve nameplate. Under no circumstances should the actuator loading pressure exceed 55 psi.*

7. Actuator springs and travel limits are pre-set at the factory. Norriseal does not recommend making adjustments to these actuators.




## 2.0 Valve Maintenance

***WARNING!***

*Before attempting any repairs, isolate the control valve from the system and make sure that all pressure is released from the valve body, both up and downstream. Shut off and vent supply and signal air lines to the actuator.*

1. **Isolate the valve from the process.**
2. **Shut off all control and supply lines to the actuator.**
3. **Release the process pressure.**
4. **Vent the actuator loading pressure.**

Valve parts are subject to normal wear and must be inspected and replaced as necessary, with the frequency of inspection depending upon the severity of the repair needed. The following sections describe the procedures for disassembling and reassembling the valve for normal maintenance and troubleshooting. All maintenance operations may be performed while the valve body remains in line, as long as the line is not in service and/or is isolated from active process by block valves. Table 2 lists the maintenance schedule for the valve assembly. Table 5 provides assistance in troubleshooting valve operation.

***TABLE 1***

***SHAFT TORQUES FOR CBV 2500***

| Body Size | Shaft Torque, Dry (ft-lb) | Shaft Torque, Pressurized (ft-lb) |
|---|---|---|
| 3 | 20 | 25 @ 285 psi |
| | 20 | 65 @ 750 psi |
| | 20 | 120 @ 1480 psi |
| 4 | 25 | 85 @ 285 psi |
| | 25 | 120 @ 750 psi |
| | 25 | 170 @ 1480 psi |
| 6 | 35 | 50 @ 285 psi |
| | 35 | 200 @ 750 psi |
| | 35 | 350 @ 1000 psi |

***TABLE 2***

***RECOMMENDED MAINTENANCE SCHEDULE FOR CBV 2500****

| Item | Inspection Schedule |
|---|---|
| Valve Seat | A. Inspect every 9 months, under normal service conditions (low pressure drop and no sand or abrasives in fluid). Inspection can be in the form of a leak test.<br>B. Inspect every 3 months, under service conditions, such as high pressure drop, corrosion, or fluid with sand. Inspection can be in the form of a leak test. |
| Stem Packing | Inspect packing once a year. |
| Actuator | Inspect diaphragm, spring, and stem once a year. |
| Body | The body should last many years under normal conditions. However, under severe conditions of corrosion or erosion from sand in the flowing fluid, high pressure drops, or high fluid velocity, body life may be greatly reduced. Inspect the body each time the valve is disassembled. |
| Seals | Replace gaskets each time valve is disassembled; seal kit available from Norriseal. |

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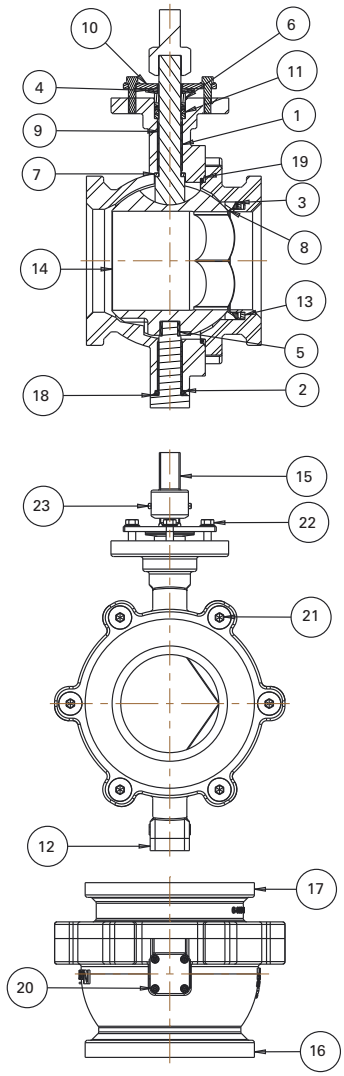


| Items | Dimension | Material | QTY (3”) | QTY (4”) | QTY (6”) |
|---|---|---|---|---|---|
| 1 | Bushing | 3”, 4”: Steel/Bronze/MPTFE; 6”: 316 SS Nitrided | 1 | 1 | 2 |
| 2 | Washer | 302 SS | - | - | 1 |
| 3 | Seat Spacer | 316 SS | 1 | 1 | 1 |
| 4 | Belleville Washer | 17-7PH SS | 2 | 2 | 2 |
| 5 | Bearing | Nitronic 60, Nitrided | 1 | 1 | 1 |
| 6 | Bearing Sleeve | Nitronic 60 | 1 | 1 | 1 |
| 7 | Gasket | MPTFE | 1 | 1 | 1 |
| 8 | Seat | PPS/Carbon/Moly-filled PTFE | 1 | 1 | 1 |
| 9 | Shaft | 17-4PH SS | 1 | 1 | 1 |
| 10 | Spring Plate | 302 SS | 1 | 1 | 1 |
| 11 | Shaft Packing | Graphite/Carbon-filled PTFE | 1 | 1 | 1 |
| 12 | Trunnion | 17-4PH SS | 1 | 1 | 1 |
| 13 | Wave spring | 17-7PH SS | 1 | 1 | 1 |
| 14 | Ball | Ni Plated 410 SS | 1 | 1 | 1 |
| 15 | Shaft Adapter | 440C SS | 1 | 1 | 1 |
| 16 | Body | ASTM A216, GR-LCC | 1 | 1 | 1 |
| 17 | End Body | ASTM A216, GR-LCC | 1 | 1 | 1 |
| 18 | Gasket | Spring Loaded MPTFE | 1 | 1 | 1 |
| 19 | Gasket | Spring Loaded MPTFE | 1 | 1 | 1 |
| 20 | Bolt | Steel | 4 | 4 | 4 |
| 21 | Bolt | Steel | 8 | 6 | 6 |
| 22 | Bolt | Steel | 4 | 4 | 4 |
| 23 | Set Screw | Steel | - | 2 | 2 |

## 2.1 Actuator Disassembly

Norriseal does not recommend disassembling these actuators.

## 2.2 Complete Valve Disassembly

1. Prior to removal of the actuator, note the location of the ball upon removal. Ball must be in the same position when the actuator is reattached.
2. Orient the valve such that the main body half holding the ball, shaft and trunnion are facing a work surface. Remove the flat head bolts holding the two body halves together.
3. Lift the end body half off the main body half. The seat, seat spacer, and wave spring are located inside this end body. Remove body gasket and discard. Gently remove seat, being careful not to gouge the body slot, and discard.
4. Move the ball to the open position. Slide some protective netting underneath the ball to protect it from damage when removing trunnion.
5. Remove trunnion bolts. Pull trunnion out of its bore in the main body. Remove the trunnion gasket and discard.
6. Remove the ball by gently tilting the bottom of the ball out, rotating the ball about the shaft in the slot. Be careful not to



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damage the surface of the ball, store in safe place.

7. Remove the stem:

   a. For 3" valves, gently tap the stem into the main body until it protrudes out through the trunnion bore. Be careful not to damage out the OD of the shaft.

   b. For 4" and 6" valves, remove the set screws holding the shaft adapter on, and remove the shaft adapter. Then gently tap the stem into the main body until it is free to be removed out the ball pocket of the body.

8. Remove the spring plate bolts, spring plate, Belleville washers and bearing sleeve.

9. Remove packing either by use of the packing removal tool, by use of a plastic tipped hook, or other means. Discard the packing.

10. Remove the shaft gasket from the body if it did not come out with the shaft using a plastic tipped hook.

## 2.3 Component Inspection/ Repair

1. Visually inspect the seat and ball for signs of erosion, pitting, scratches and other damages. A magnifying glass may be helpful here.

2. Determine the severity of the damage. In general, it is advisable to replace the seat each time the valve is disassembled.

3. If the only observation on the ball is residue from the seat, it may be removed with rubbing alcohol. The ball may then be polished back to an 8 u-in surface finish. Do not remove any more than .001" DIA of material as the ball OD is a tightly controlled feature. Special care must be taken to prevent damage to the surface of the ball.

4. If the shaft has been removed, examine the stem for pitting, scratches or any other damage. If any damage cannot be removed by polishing the shaft, replace the shaft.

5. Remove any rust or other residue from the end body groove that holds the seat. Polish the outer wall of the seat groove back to 63 u-in surface finish if necessary. Be careful not to remove more than .003" DIA of material, as this is a sealing surface for the seat. If groove damage cannot be removed by polishing, replace the end body.

## 2.4 Inspection/Adjustment of Teflon V-Ring Packing

1. Through the opening in the actuator bracket, check the relative location of the top surface of the spring plate and the top surface of the bearing sleeve (visible through the center hole in the spring plate).

2. If the tops of these two parts are at the same level, the packing is fully adjusted and no changes are required.

3. If the packing has relaxed, the top edge of the bearing sleeve will have slipped below the top of the spring plate, and the packing will need to be adjusted.

4. Using a box end wrench, tighten the 4 flanged hex head spring plate bolts, no more than a quarter turn at a time, until the plate and sleeve surfaces are at the same level. It is critical that the spring plate remain parallel to the bracket mounting surface of the body to ensure symmetric loading on the shaft, bearing, and packing.

## 2.5 Replacement of Teflon V-Ring Packing

1. Isolate the valve from the system so that no pressure is acting on the valve.

2. Open the valve to the full open position.

3. Remove the actuator and actuator mounting bracket.

4. Remove the spring plate bolts, remove the spring plate, Belleville washers, and bearing sleeve. This will expose the packing stack.

5. Remove each component of the packing stack with Norriseal packing removing tool. Insert barbed end over shaft until it touches the packing stack. Hit tool with a rubber mallet, then quickly twist the tool in the CCW direction. The barbed ends should hook the packing component and it may be pulled out. Repeat this until the entire packing stack is removed.

6. Clean the packing box and all metal parts.

7. Lubricate the packing components with Dow-Corning #111 Silicon grease.



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8. Install the new packing and parts in the following sequence:

    a. Lower male packing retainer with "V" pointing away from body

    b. Male "V" packing ring (the "V" rings with the "V" pointed downward toward the body)

    c. Upper female packing retainer with the "V" toward the packing

9. Replace the bearing sleeve, Belleville washers, and spring plate.

10. Tighten the spring plate bolts, half a turn each at a time, until the upper surfaces of the bearing sleeve and the spring plate are even. Pay close attention to keep the spring plate parallel to the body surface mating to the actuator bracket.

## 2.6 Packing Lubrication

Norriseal recommends the use of Dow-Corning #111 Silicon, Norriseal part number 416744.

## 2.7 Valve Reassembly

Note: Use all new gaskets, packing, and seat for re-assembly, available in the seal kit from Norriseal.

1. Clean all gasket surfaces, including the body, bonnet and guide.

2. A modest coat of lubricant, Dow-Corning #111 Silicon grease (DC-111), shall be used on all the gaskets, packing, seat, and sealing pockets in bodies to aid ease of assembly and support sealing.

3. Apply the body gasket to the main body. Be careful not to fold the gasket sealing lips over.

4. Insert the packing stack into the body bore, open sides of V's pointing toward the center of the body.

5. Apply bearing sleeve, Belleville washers, and spring plate over the packing stack. Secure loosely with the spring plate bolts. DO NOT TIGHTEN. (New hardware kit available from Norriseal if needed.)

6. Apply the shaft gasket to the shaft. Insert the shaft:

    a. For 3" valves, insert the shaft into the trunnion bore, and gently tap it into place using a piece of nylon barstock. Be careful not to scratch the bores as the shaft is inserted. Insert until the shaft will not move any further.

    b. For 4" and 6" valves, locate the shaft in the ball pocket of the body and gently insert it into the shaft bore. Gently tap it into place using a piece of nylon barstock. Be careful not to scratch the bore as the shaft is inserted. Insert until the shaft will not move any further. Add shaft adapter to shaft, secure with thread locking set screws.

7. Remove the bearing sleeve, Belleville washers, spring plate and spring plate bolts assembled loosely in step 5. Apply bearing grease to shaft where the bearing sleeve contacts the shaft. Reinstall the bearing sleeve, Belleville washers, spring plate and spring plate bolts (finger tight with the plate parallel with the body surface mating to the actuator bracket.

8. Tighten the spring plate bolts, half a turn each at a time, until the upper surfaces of the bearing sleeve and the spring plate are even. Pay close attention to keep the spring plate parallel to the body surface mating to the actuator bracket. This applies uniform loading to the packing.

9. Orient the shaft so that the rounded paddle is pointing in the flow direction of the valve.

10. Apply the trunnion gasket to the main body. Be careful not to fold the gasket sealing lips over.

11. Pre-position the trunnion in preparation of ball insertion. Insert the trunnion such that the tip is just short of protruding into the ball pocket of the body.

12. Drape plastic netting across the ball pocket in the body to safeguard damaging the ball when inserting it into the body. The plastic netting must be thin enough not to get pinched after the ball is inserted, approximately .025"-.050" thick.

13. Apply bearing grease to tip of trunnion and ID of ball hole.

14. Insert the ball by grasping the v-notch side of the hole, pivoting the ball away from the trunnion approximately 45°, and inserting the shaft paddle into ball slot all the way in. Slowly rotate the ball about the paddle/groove and when the hole in the bottom of the ball is in line with the trunnion, insert the trunnion into the ball



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hole. There should be a small .010" gap between the trunnion and the body, due to the gasket.

15. Thread in the trunnion bolts. (New hardware kit available from Norriseal if needed.)

16. Remove the netting used to protect the ball. Rotate the ball inside the pocket and verify that the ball travel stops at full open and fully closed.

17. Lubricate the outer surface of the seat groove in the end body with DC-111.

18. Install the wave spring into the end body sealing groove.

19. Install the seat spacer atop the wave spring, such that the flat face of the spacer mates to the wave spring.

20. Install the seat atop the seat spacer into the end body groove. The fit with the groove should be snug. Be careful to apply the 30° angled edge of the seat facing the 30° angled edge of the seat spacer.

21. Invert the end body and apply it to the main body. Seat the body gasket by tapping the body downward, leaving only wave spring preload holding the bodies apart. Orient the end body such that the gap is even all around the bodies.

22. Thread in the flat head hex body bolts: (New hardware kit available from Norriseal if needed.)

    a. Finger tighten all bolts without compressing the spring preload gap at all.

    b. Select a bolt and tighten it 1 turn. Tighten all the bolts 1 turn using a criss-cross pattern.

    c. Repeat step b until all the bolts have all secured the bodies tightly to themselves.

    d. Torque the bolts to the appropriate torque, using a criss-cross pattern.

23. Prepare valve for reattachment to the actuator by setting the ball orientation the same as it was when it came apart (step 2.2).

**TABLE 3**

***Final Bolt Torques for Carbon Steel Bodies (all values are in Foot-Pounds)***

| Valve Size | Bolt Location | | |
|---|---|---|---|
| | BODY | TRUNNION | BRACKET |
| 3 | 31 ft-lb | 8 ft-lb | 17 ft-lb |
| 4 | 75 ft-lb | 8 ft-lb | 49 ft-lb |
| 6 | 150 ft-lb | 8 ft-lb | 75 ft-lb |

**TABLE 3B**

***Final Bolt Torques for Stainless Steel Bodies (all values are in Foot-Pounds)***

| Valve Size | Bolt Location | | |
|---|---|---|---|
| | BODY | TRUNNION | BRACKET |
| 3 | 23 ft-lb | 6 ft-lb | 13 ft-lb |
| 4 | 56 ft-lb | 6 ft-lb | 37 ft-lb |
| 6 | 112 ft-lb | 6 ft-lb | 56 ft-lb |

## 3.0 Repair Kits

Norriseal provides two repair kits for use in valve maintenance: a valve seal kit and a hardware kit.



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**TABLE 4**

***Trouble Diagnosis***

| TROUBLE | SYMPTOM POSSIBLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| Valve will not cycle when instrument air is applied to the actuator. | 1. Broken valve shaft or actuator stem.<br>2. Diaphragm ruptured or torn.<br>3. Diaphragm plate connection at top may be loose.<br>4. Actuator vent plugged. | 1. Replace shaft/stem.<br>2. Remove upper diaphragm housing. Inspect the diaphragm and replace if necessary.<br>3. Remove upper diaphragm housing. Inspect the plate-to-stem connection and tighten if loose.<br>4. Clean out vent fitting. |
| Excessive trim leakage with valve closed. | 1. Insufficient shut-off force from actuator.<br>2. Seat contact surfaces may be worn or damaged. | 1. Fail open actuator: Increase supply pressure to actuator. ***DO NOT exceed 55 psi supply pressure.***<br>2. Inspect critical surfaces of seat and ball. If severely worn or damaged, replace seat and/or polish ball. |
| Fluid leakage from top of valve. | 1. Stem packing is worn or loose. | 1. Adjust packing per step 2.5.<br>2. If adjustment does not stop leak, packing must be replaced per step 2.6. |
| Fluid leakage from body joint. | 1. Some or all body bolts may be loose.<br>2. Body gasket may be worn or damaged. | 1. Check bolts, tighten if necessary.<br>2. Inspect gasket, replace if necessary. |
| Instrument air leaks from outer edge of diaphragm housings. | 1. Cap screws securing upper and lower housings may be loose. | 1. Inspect cap screws, tighten as necessary. |
| Instrument air leaks from actuator vent connection located in upper housing of reverse actuator or lower housing of direct actuator. | 1. Diaphragm may be torn or ruptured, allowing air to leak through. | 1. Disassemble upper and lower housing and inspect diaphragm. Replace if damaged. |
| Valve stem movement is sticky or jerky. | 1. Valve shaft or actuator stem may be bent or misaligned.<br>2. Insufficient lubricant between sliding surfaces. | 1. Disassemble valve and/or actuator to inspect shaft/stem. Replace if bent or otherwise damaged.<br>2. Lubricate all sliding surfaces. |



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***Notes:***



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