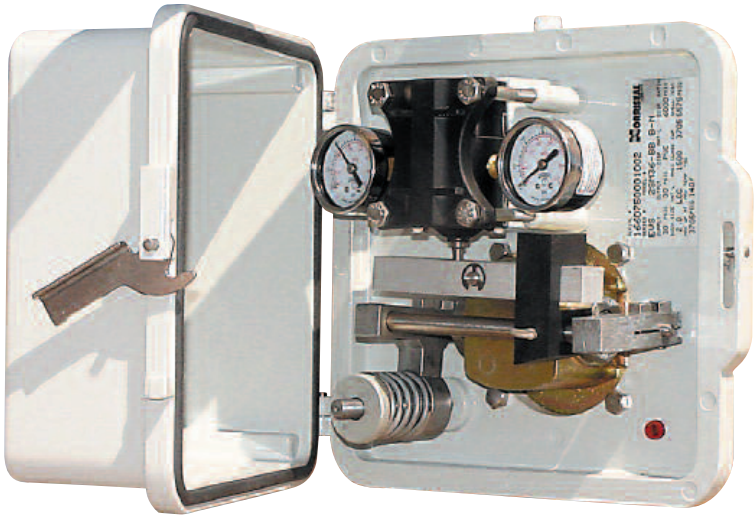
Operating and Maintenance Manual

Series EVS Liquid Level Control



Series EVS Liquid Level control

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INTRODUCTION

CAUTION!

Before installing, operating or repairing this equipment completely review and understand the instructions in this manual. All CAUTION and WARNING notes must be strictly observed to prevent serious injury or equipment malfunction.

Scope

This manual includes installation, operation and maintenance information for the Norriseal EVS Liquid Level Controllers.

Description

The EVS Liquid Level Controller (LLC) is designed for general-purpose use in liquid level and interface control applications. It uses the patented Norriseal Envirosave™ direct-acting, on/off (snap) pneumatic pilot. The LLC body is back-mounted on the case. Pilot action can be reversed and modulating (throttle) service is optionally available.

The standard EVS Liquid Level Controller is equipped with a 1.88" x 12" PVC displacer that can be attached for either horizontal or vertical service. Optional displacer materials, lengths and diameters can be supplied by Norriseal to accommodate a wide range of control applications.

Controller Identification

Controller model numbers are typically 12 positions long (ex: 2SM36-BBDB-N). Refer to the product brochure for specific information on the controller nomenclature.

A nameplate attached to the inside of the case includes the controller model and serial number. Also included is information pertinent to the controller assembly (i.e. - supply and output pressures, displacer material and rating, body size and material, ANSI class and pressure, and temperature limits.)

CAUTION!

Before disassembly or maintenance, 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 process fluids may cause personal injury, loss of process control or environmental contamination.

WARNING!

Maximum allowable pressures for the level controller body and the maximum allowable pressure at the maximum temperature for the level controller are shown on the nameplate mounted in the case. If pressure to the level controller is capable of exceeding these limits, install relief valves or other over-pressure protection devices in the pressure lines.

CAUTION!

When ordered, the displacer material and configuration were selected to meet particular pressure, temperature and fluid conditions. Bodies and displacers are limited in their operating pressure and temperature ranges as well as their ability to resist corrosion. Do not apply any other conditions to the controller without first contacting your Norriseal sales office or your sales representative.

Principal of Operation

Force Balance Principal

The operation of the EVS Liquid Level Controller is based on the Force Balance Principal. A spring balances the weight of a displacement-type sensor. As liquid rises around the displacer, the amount of force available to the pilot is proportional to the weight of the displaced liquid. The available force is transmitted to the pilot thrust pin through a lever and fulcrum. The higher the level, the greater the available force to the pilot.

The control is direct-acting (rising level increases pilot output) when the fulcrum is on the right of the pivot pin (refer to Figure 1).

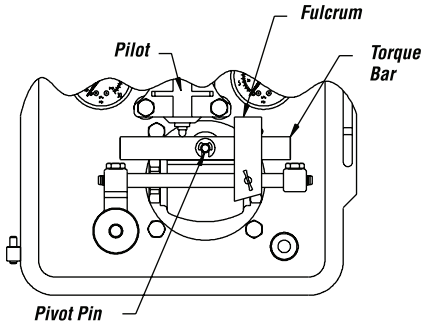

Figure 1 — Direct-Acting Controller

The control can be made reverse-acting (rising level decreases pilot output) by moving the fulcrum to the left of the pivot pin (refer to Figure 2).

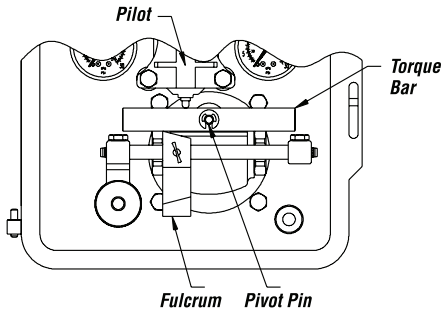

Figure 2 — Reverse-Acting Controller

Dump Span

A snap pilot provides on/off action of output pressure that can be set anywhere within the displacer length. The differential between on and off (known as the "dump span") is set by positioning the fulcrum along the

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torque bar (refer to Figure 3).

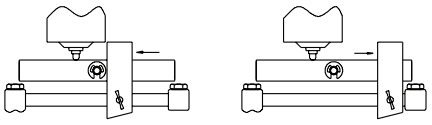

Figure 3 — Adjusting Dump Span and Proportional Band

Proportional Band

The term Proportional Band is most commonly associated with throttling pilots. It is the ratio of used displacer length to total length of the displacer. (ex: If a 6" level change will develop a 3-15 psi output signal with a 12" long vertical displacer, the level controller is said to have 50% proportional band.)

Level Adjustment

The spring is used to balance the weight of the displacer. As the level increases, the apparent weight of the displacer decreases. The spring tension increases and is transmitted to the pilot thrust pin through the lever and fulcrum.

Increasing tension on the spring lowers the sensed level. Decreasing tension on the spring raises the level required to produce the toggle force.

Interface

Spring compression can be sufficiently reduced so that a hydrocarbon liquid can rise above the displacer without transmitting enough force to the pilot to produce an output. If properly adjusted, water (with higher specific gravity) can then rise on the displacer, changing its weight, and produce an output. This wide range of control makes liquid interface sensing possible.

Pilot Operation

As described in "Principal of Operation," force from the balance spring is transmitted via the lever and fulcrum to the thrust pin of the pilot.

Envirosave™ (Snap) Pilot (Figure 4)

This patented* pilot has two elastomer seats that ensure zero leakage. The upper seat (D) is sealed by the ball (A). The upper seat controls supply air and holds the ball in the closed position. Upward mechanical force on the thrust pin (B) overcomes the supply air pressure holding the ball to the seat. The ball snaps upward and supply air flows out of the output port (H). The lower port is sealed by the spherical end of the thrust pin preventing supply air from escaping.

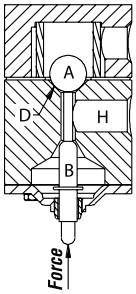

Figure 4 — Snap Pilot

As the upward force on the thrust pin decreases, supply air pressure overcomes the upward force. The ball once again seals the supply air and simultaneously opens the lower exhaust port, venting gas from the control valve actuator.

Throttle Pilot (Figure 5)

The throttle pilot also has two seats to admit supply gas and exhaust the actuator gas. A diaphragm (E) is used to sense pressure/force feedback and a spring assists closing pressure on the thrust pin. The throttle pilot is operationally similar to the snap pilot, except that the output pressure is proportional to the mechanical force applied to the thrust pin (C). As the thrust pin force changes, the pilot seeks to maintain equilibrium by either decreasing (exhausting) output loading pressure or increasing output loading pressure. Supply air does not flow when the loading pressures of the pilot are balanced.

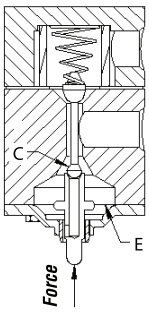

Figure 5 — Throttle Pilot

1.0 Level Controller Installation and Start-up

CAUTION!

When making connection to the vessel, observe all safety requirements of the area where the work is being done. Be especially careful of pressure vessels.

1. After unpacking the controller, inspect the unit for any shipping damage. Shipping damage claims must be filed with the carrier who handled the package(s). Remove any foreign material that may have collected during crating and shipment. Remove the thread protectors from the body end connection.
2. Insure that screwed surfaces on both the controller and the vessel are free of foreign materials.
3. The controller normally ships in four pieces: the controller body/case, the displacer, the displacer arm and the swivel. Therefore, some assembly is required. Insert the displacer arm into the opening in the controller body. Carefully align and screw the arm into the body shaft. For vertical installation, screw the swivel onto the free end of the displacer arm. Screw the displacer onto the free end of the swivel. For horizontal applications, screw the displacer (no swivel used) directly onto the free end of the displacer arm.
4. Install the controller using good piping practice. Use TFE tape or

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pipe thread sealant.

CAUTION!

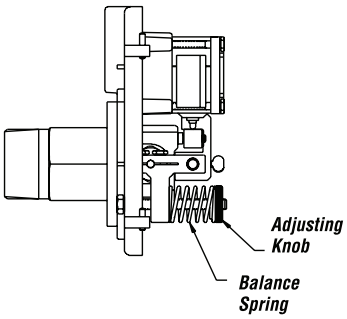
The bodies are rated ANSI 1500 class. Do not install in a system where the working pressures can exceed those marked on the nameplate.

5. Connect instrument air to the supply connection on the controller. Connect the control valve signal line to the output connection. The supply and output connections are clearly marked.
6. Open the case and rock the torque bar by hand to verify the displacer arm moves freely and is NOT resting against the vessel nozzle or other obstruction. The arm must be reasonably centered in the connection opening, parallel to the ground.

1.1 Level Adjustment

NOTE: All controllers are factory set for average level and sensitivity.

1. To decrease the level (increase compression on the balance spring), turn the adjusting knob on top of the balance spring CLOCKWISE. To increase the level (decrease compression on the balance spring), turn the knob on top of the balance spring COUNTER CLOCKWISE.



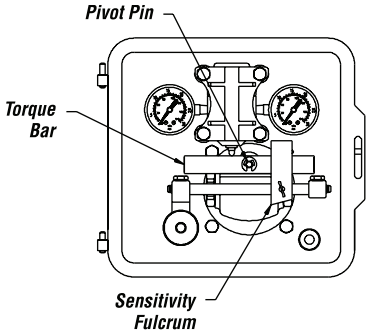


Figure 6 — How to Make Level Adjustments

2. Adjust the proportional band (dump span) by first loosening the thumbscrew on the sensitivity fulcrum. Slide the fulcrum along the fulcrum bar toward the pivot pin to INCREASE proportional band and DECREASE SENSITIVITY. Slide the fulcrum along the fulcrum bar away from the pivot pin to DECREASE proportional band and INCREASE SENSITIVITY. Tighten the thumbscrew on the sensitivity fulcrum when the proper span is selected.

1.2 Liquid Level Interface

NOTE: All controllers are factory set for average level and sensitivity.

1. Set the sensitivity fulcrum ½ inch from the pivot pin. Reduce the spring tension slowly by turning the adjusting knob COUNTER CLOCKWISE, and let the UPPER fluid rise to submerge the displacer. Fine tune it after the displacer is fully submerged in the UPPER fluid by slowly increasing spring tension (turning adjusting knob CLOCKWISE) until an output signal is obtained. Then back the tension off slowly (turning the adjusting knob COUNTER CLOCKWISE) until the output signal pressure returns to zero.
2. Let the lower fluid rise until the desired interface level is reached. Fine tune it by slowly increasing the spring tension (turning the adjusting knob CLOCKWISE) until an output signal is obtained. Then back the tension off the balance spring slowly (turning the adjusting knob COUNTER CLOCKWISE) until the output signal pressure returns to zero.
3. If you want a shorter dump span, move the fulcrum father away from the pivot pin and repeat the above procedure.

2.0 Level Controller Maintenance

Use only Norriseal replacement parts when servicing level controllers. Please refer to the model and serial numbers when ordering replacement parts.

WARNING!

Before attempting any repairs, isolate the controller from the system and make sure that all pressure is released from the controller body. Shut off and vent the supply and output (signal air) lines to the controller.

1. Isolate the controller from the process.
2. Shut off and vent the supply and output (signal air) lines to the controller.
3. Release the process pressure.

Controller parts will rarely need to be repaired. However, should repair be necessary, the following sections

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describe how to disassemble and re-assemble the controller.

2.1 Level Controller Preventive Maintenance

1. O-rings and main-shaft bearings last for many years. If a leak occurs, Norriseal has O-ring Seal Kits (LSK) available.
2. Controllers used in high-paraffin service or interface control with a horizontal displacer should be removed and inspected after their initial three months of service. Check for debris buildup inside the controller body that might interfere with displacer arm movement. Future inspections can be gauged by how much buildup occurred in the initial three months of service.

2.2 Level Controller Disassembly

NOTE: These instructions do not apply to the pilot or body. Refer to 2.4 for removal/ replacement of the pilot. Refer to 2.6 for body removal.

1. Remove the balance spring, spring retainer and the spring adjustment cap screw.
2. Remove the retaining ring from the torque bar. Slide the torque bar off the pivot pin. Remove and discard Teflon® back-up ring. ***NOTE:*** *DO NOT attempt to remove the pivot pin. It is press-fit into the body and is not meant to be removed.*
3. Remove the spring retainer stud.
4. Loosen the two cap screws holding the level-adjusting bar and slide it off the right end of the fulcrum bar and shaft end.
5. Remove the sensitivity fulcrum and fulcrum bar together by pulling the assembly from the level-adjusting bar with spring.
6. Loosen the two cap screws holding the level-adjusting bar with spring and slide it off the left end of the shaft.

2.3 Level Controller Re-assembly

1. Slide the level-adjusting bar with spring onto the left end of the shaft and snug the two cap screws. Do not completely tighten at this time.
2. Install the spring retainer stud.
3. Replace the sensitivity fulcrum and fulcrum bar together by pushing the assembly into the level-adjusting bar with spring. Slide the level-adjusting bar onto the right end of the shaft and onto the fulcrum bar. Snug, *but do not tighten*, the two cap screws that secure the bar to the shaft.
4. Center the displacer arm in the body opening. It may be helpful to put a temporary spacer under the displacer arm to hold it in place.
5. Temporarily slide the sensitivity fulcrum fully to the right. Position the fulcrum bar so that it is parallel with the bottom edge of the case. Tighten the two cap screws on the level-adjusting bar with spring and the two cap screws on the level-adjusting bar.
6. Replace the Teflon® back-up ring, torque bar and then the retaining ring that secures them to the pivot pin. ***NOTE:*** *The torque bar must move freely.*
7. Install the spring adjustment cap screw, balance spring and spring retainer.

2.4 Level Pilot Removal/Replacement

WARNING!

Before attempting any repairs, isolate the controller from the system and make sure that all pressure is released from the controller body. Shut-off and vent supply and output (signal air) lines to the controller.

1. The pilot is held in place by four cap screws in the pilot clamp. Remove these four cap screws and lift the pilot from the case.
2. If necessary, replace the pilot. Use only genuine Norriseal parts.
3. Re-install the pilot by reversing steps 1 & 2 above. It may appear that the pilot gasket does not need replacing, but replacement is recommended.

2.5 Level Controller Pilot Action Conversion

EVS Controllers are normally shipped from the factory set for Direct Action. The following procedure converts the unit from Direct to Reverse Action.

NOTE: When the sensitivity fulcrum is to the right of the pivot pin, the unit is set for Direct Action (Figure 1). When the sensitivity fulcrum is to the left of the pivot pin, the unit is set for Reverse Action (Figure 7). It may be necessary to relax the tension from the balance spring to freely move the fulcrum.

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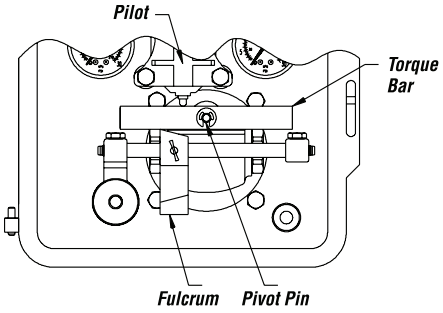

Figure 7 — Reverse-Acting Controller

1. Remove the thumbscrew from the front of the sensitivity fulcrum.
2. Grasp the top of the sensitivity fulcrum and pull it out and downward to completely rotate the fulcrum on the fulcrum bar. Slide the sensitivity fulcrum to the left side of the fulcrum bar and replace the thumbscrew to lock the fulcrum in its new inverted position.
3. If necessary, re-adjust the tension on the balance spring to establish the desired switch point.

2.6 Level Controller Body Disassembly

1. Disassemble the controller by following the disassembly instructions in paragraph 2.2 above.
2. Remove the two bearing blocks (1 ¼ inch wrench) and the shaft. Remove and discard the O-rings and Teflon® back-up rings in the body, on the shaft, and in the bearing blocks.
3. Remove the four cap screws holding the case to the body. The gasket should be discarded. Do not attempt to reuse the gasket.

2.7 Level Controller Body Re-assembly

1. Install the case/ body gasket and mount the case to the body with four cap screws. Tighten the screws to 6 ft-lbs.
2. Using new O-rings, install the large O-ring over the threads of the bearing block. Install the new Teflon® back-up rings in each bearing block by pressing them in to place with a 5/16th inch diameter rod.
3. Replace one bearing block on either side of the body. ***NOTE:*** *Light oil applied to the O-rings will assist in the assembly.*
4. Insert the shaft into the body and firmly seat in the bearing.
5. Replace the remaining bearing block on the body and tighten.
6. Reassemble the controller (per paragraph 2.3).

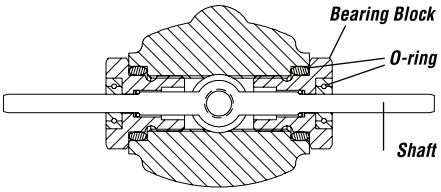

Figure 8 — End-on Cutaway of Controller Body

3.0 Repair Kits

Norriseal provides repair kits for use in controller maintenance. Contact your Norriseal sales office or your sales representative for more information.

CAUTION!

If the bearing blocks are removed from the body for any reason, the back-up rings and O-rings must be re-packed (pressed into place). It is recommended that new back-up rings and new O-rings be used.

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Table 1 Trouble Shooting

Symptom	*Probable Cause(s)*	*Corrective Action(s)*
1. The pilot output pressure gauge indicates output pressure signal when the fluid level is below the displacer on the direct acting controller OR when the fluid level is above the displacer on a reverse-acting controller.	• The balance spring is too compressed and puts too much pressure on the torque bar. • The displacer arm is set too low or the displacer is hitting something inside the vessel.	• Back-off the spring retainer until the output pressure signal goes off. Re-check when the fluid level rises (direct-acting) or falls (reverse-acting). • Check the displacer arm by moving the leveling adjusting bar up and down. If the adjusting bar will move in only one direction, this indicates the displacer arm is riding at either the top or bottom of the vessel connection. If it moves too freely, the displacer has become disconnected from the displacer arm. Re-center the displacer arm in the vessel connection.
2. The pilot output pressure gauge indicates no output pressure signal when the fluid level is above the displacer on a direct-acting controller OR when the fluid level is below the displacer on a reverse acting controller.	• The balance spring is insufficiently compressed and doesn't put enough pressure on the torque bar. • The displacer arm is set too high or the displacer is hitting something inside the vessel.	• Compress the spring retainer until an output pressure signal is indicated on the output pressure gauge. Re-check it when the fluid level falls (direct-acting) or rises (reverse-acting). • Check the displacer arm by moving the leveling adjusting bar up and down. If the adjusting bar will move in only one direction, this indicates the displacer arm is riding at either the top or bottom of the vessel connection. If it moves too freely, the displacer has become disconnected from the displacer arm. Re-center the displacer arm in the vessel connection.
3. The controller does not repeat at the same fluid level after each dump and sometimes fails to either dump or shut-off. (The torque bar does not bounce back fast when depressed and appears to be hard to move.)	• Paraffin or debris has built up inside the level control body.	• Remove the controller from service and clean out the body with a solvent.
4. A pneumatic pilot bleeds air continuously.	• There is foreign matter under the ball on a snap control pilot or under the peanut on a throttle control pilot. ***OR*** • The tru-arc ring on the snap pilot thrust pin may have been disconnected.	• Remove the pilot (following instructions in paragraph 2.4). Remove the two cap screws from the bottom of the pilot. Clean the pilot thoroughly. If it is a snap pilot, make sure the dimension between the tru-arc ring and the bottom of the pin is ¾ inch. If not, gently tap the tru-arc ring into the proper location. Reassemble the pilot.
5. On the interface control, the vessel occasionally loses all fluid or the vessel overflows, especially with temperature change. The displacer arm is free and the displacer is not hitting inside the vessel.	• The displacer is not big enough to handle the interface differential. Close specific gravity of two fluids and a temperature change can cause this problem.	• Provide the exact specific or API gravities of both fluids to Norriseal Engineering for exact sizing of the displacer that should be used.

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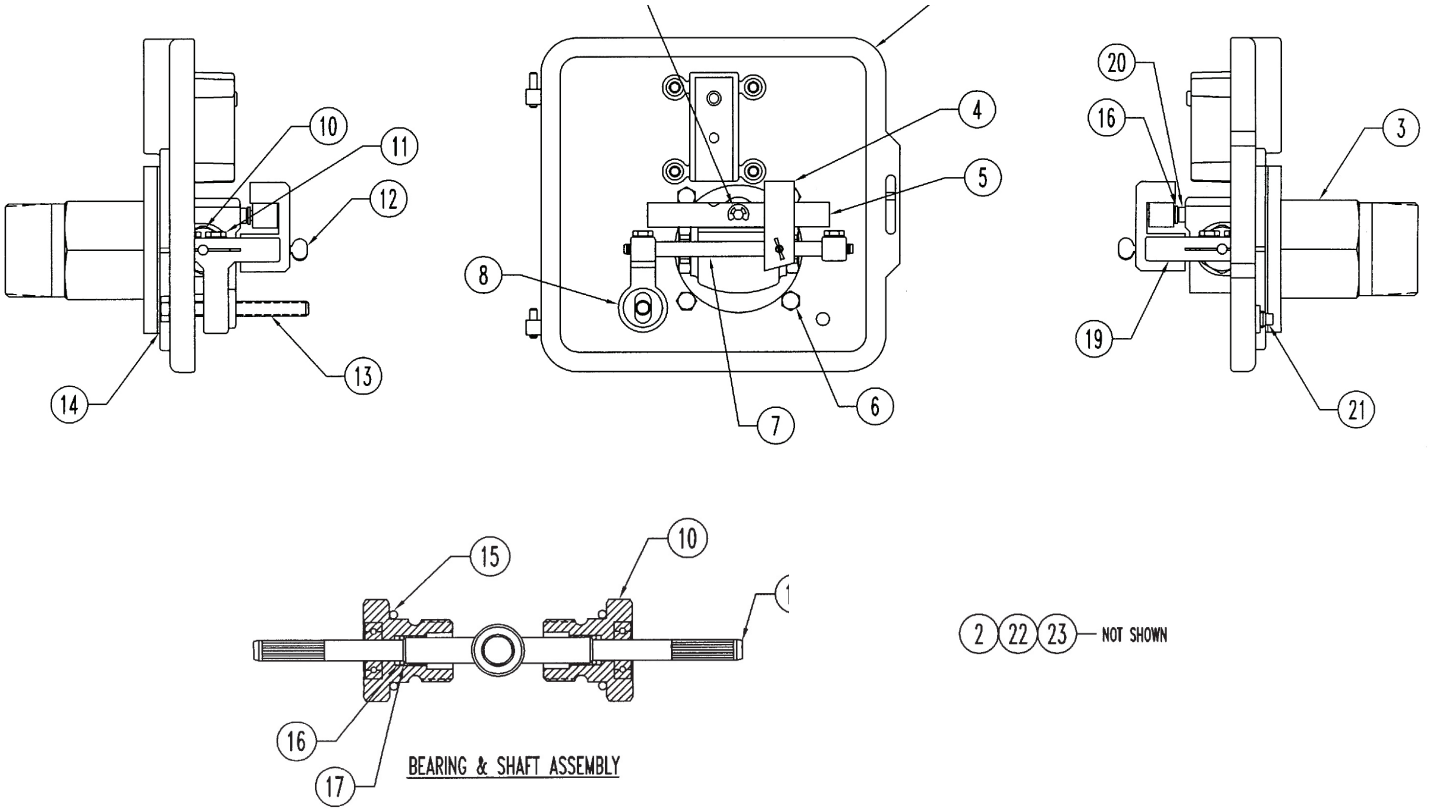

ITEM	DESCRIPTION	MATERIAL	STOCK NUMBER	QTY.
1	CASE CASTING LLC EVS	ALUMINUM	626516-EVS-0003	1
2	COVER CASTING EVS	ALUMINUM	626515-EVS-0002	1
3	BODY 2.00 EVS ANSI 1500	LCC	626514-EVS-0001	1
4	FULCRUM SENSITIVITY F/EVS	NYLON	626520-EVS-0007	1
5	BAR TORQUE F/EVS	ALUMINUM	428747-EVS-0012	1
6	SCREW CAP HEX .250-28UNF X .75 LG	18-8 SST	416167	4
7	BAR FULCRUM F/EVS	316 SST	428671-EVS-0011	1
8	RAW CASTING BAR ADJUSTING LEVEL F/SPRING	ALUMINUM	626517-EVS-0004	1
9	RING RETAINING	316 SST	626522	1
10	BLOCK BEARING W/SST BEARING	316 SST	418447-1001-694	2
11	SCREW CAP HEX .250-28UNF X .63 LG	18-8 SST	415870	4
12	SCREW THUMB 10-32UNC X .50 LG	18-8 SST	415222-1001-1316	1
13	SCREW CAP HEX ALL THREAD .375-24UNC X 3.50 LG	18-8 SST	626525	1
14	GASKET CASE/BODY F/EVS	NEOPRENE	626521-EVS-0009	1
15	O RING	VITON A	416013-210	2
16	RING BACKUP SPIRAL	TFE	415029	3
17	O RING	VITON GF	626281-010	2
18	SHAFT F/EVS	316 SST	626519-EVS-0006	1
19	RAW CASTING BAR ADJUCTING LEVEL F/EVS	ALUMINUM	626518-EVS-0005	1
20	POST PIVOT .250 X 1.62 LG F/EVS	316 SST	428670-EVS-0008	1
21	PLUG BREATHER .125NPT SQUARE HEAD	POLYETHYLENE	426111-1005-199	1
22	NAMEPLATE INSTRUCTION F/EVS	316 SST	626583-EVS-0013	1
23	GASKET PILOT/CASE F/EVS	VITON GF	626524-EVS-0010	1

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