

XL90 Series High-Performance Positioner

GENERAL INFORMATION

This bulletin is designed to assist in installing, calibrating, troubleshooting and performing maintenance as required for the XL90 Series high-performance positioner.

Product users and maintenance personnel should thoroughly read and strictly follow the instructions contained in this bulletin prior to operating the positioner. Any questions concerning this product should be directed to a Flowserve representative.

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

The XL90 high-performance positioner is a two-stage device and is designed for use in control loops where fast response is required. The XL90 positioner is designed to be modular and use the P/P module for 3-15 psi input signal or the NT 3000 Series Transducer Module for 4-20 mA input signal.

The XL90 high-performance positioner is designed as a four-way device, but can easily be converted to a three-way device by plugging one of the output ports.

NOTE: The XL90 high-performance positioner must use the I/P NT 3000 Transducer. The I/P 2000 Transducer is not acceptable for use with the XL90 Series Positioner.

The XL90 positioner can handle supply pressures up to 150 psi; thus, a supply regulator is usually not required. However, *a five micron air filter is required for pneumatic positioners and a coalescing filter is required for I/P positioners.*

NOTE: The air supply should conform to ISA Standard S7.3 (a dew point at least 18° F / -8° C below ambient temperature, particle size below 5 microns, oil content not to exceed one part per million).

The XL90 Series positioner features an adjustable gain of 400-1100:1. The medium gain setting is standard for smaller actuators, while the high gain setting is used on larger actuators (refer to 'Gain Adjustment Procedure' section for further details.)

POSITIONER OPERATION

The positioner schematic (Figure 1) shows an XL90 Series positioner connected for double-acting service on a rotary rack-and-pinion actuator. Tension on the feedback spring provides feedback to the positioner, which varies as the stem position changes. The spring-loading force is applied through the feedback linkage and cam to the positioner's input capsule.

Instrument signal pressure is applied between the diaphragms in the input capsule. Therefore, the input capsule serves as a force-balance member, matching the valve stem position (as measured by tension on the feedback spring) to the instrument signal.

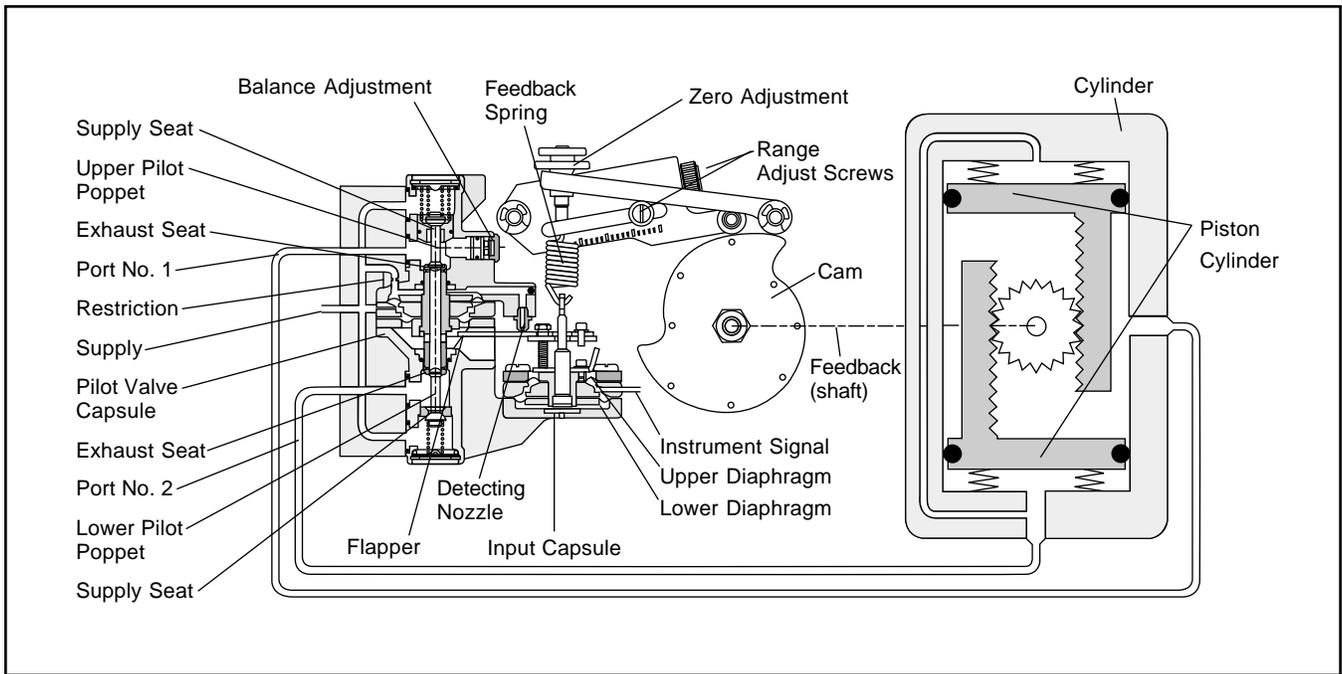


Figure 1: XL90 Positioner Schematic for Air-to-Open

When the opposing forces balance exactly, the system will be in equilibrium and the stem will be in the exact position called for by the instrument signal. If the opposing forces are not in balance, the input capsule will move up or down and, by means of the pilot-valves, will change the output pressures, moving the stem until the tension on the feedback spring exactly opposes the instrument signal pressure.

The sequence of operation is as follows: An increase in instrument signal pressure forces the input capsule downward. Displacement of the capsule in turn moves the flapper away from the detecting nozzle. This allows a larger flow rate through the nozzle, decreasing the pressure exerted on the top of the pilot valve capsule.

Supply air biases the pilot-valve in an upward direction. As the capsule moves up, it will close the exhaust seat of the upper pilot poppet and open the supply seat, which applies increased air pressure to the bottom cylinder port. At the same time, the pilot-valve capsule will open the exhaust seat for the lower pilot poppet; thus, decreasing pressure to the top cylinder port.

This difference in pressure will drive the piston outward, rotate the pinion and stretch the feedback spring until the spring tension exactly opposes the force resulting from the instrument signal pressure. At this point, the flapper will be moved toward the detecting nozzle to restore the pressure above the pilot-valve capsule to its equilibrium value. As a force-balanced condition is approached, the pilot-valve capsule will be forced back to a neutral position where the pilots are neither supplying air to, nor exhausting air from, their respective sides of the piston.

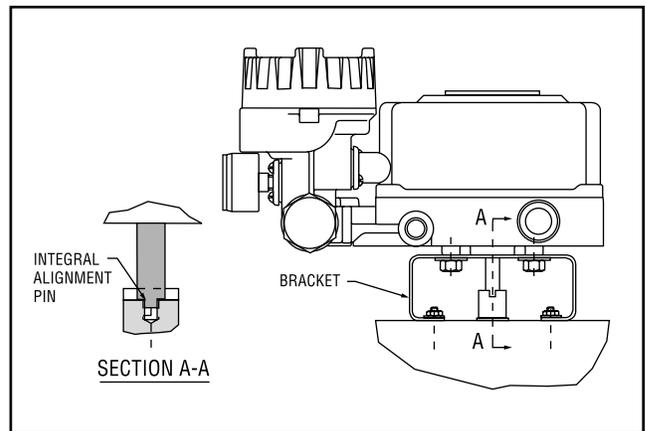


Figure 2: Positioner Mounting with NAMUR shaft

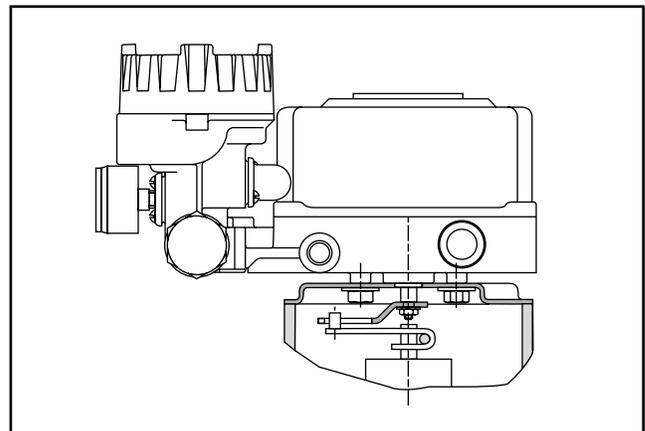


Figure 3: Positioner mounting

A decrease in instrument signal pressure reverses the described actions and causes a proportional inward movement of actuator pistons and a reversal in pinion direction.

Installation of XL90 Series Positioner on Actuators

The XL90 can be installed on most sizes of rotary and linear actuators. Actuators can be either double acting or spring return. Cams can be used for direct acting or reverse acting directions. These instructions apply to rotary actuators only. For linear actuator mounting instructions, consult the factory.

NOTE: For retrofitting to an actuator equipped with an APEX positioner, the same bracket and bolting may be used.

NOTE: NAMUR mounting is available with the XL90 positioner. When retrofitting the XL90 positioner to an actuator equipped with another positioner, remove the existing positioner, tubing and associated bolting. See tubing instructions in Connecting XL90 Positioner Ports section.

Mounting Instructions for XL90 with NAMUR Shaft Connection

1. Mount the bracket to the actuator. Finger tighten the bracket bolting.
2. If required, install a coupler on the actuator shaft. Make sure the shaft and coupler are centered. See Figure 2.
3. Verify the orientation of the actuator and coupler flats match the positioner flats on the end of the shaft. Loosen the cam if necessary. (See "Cam Installation" instructions.)
4. Install the positioner onto the bracket. Make sure positioner shaft and coupler are engaged and centered. Finger tighten positioner bolts.
5. Proceed to "Connecting XL90 Positioner Ports."

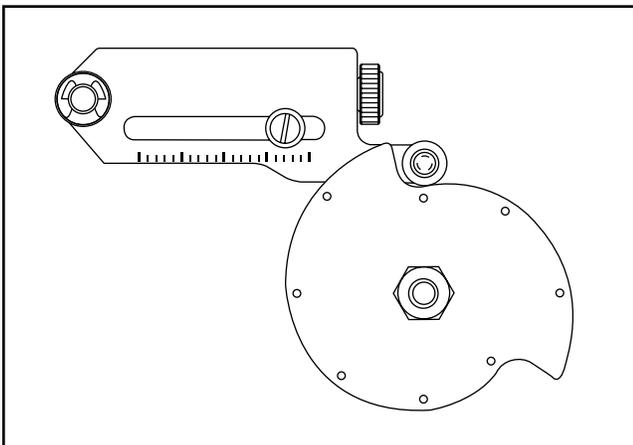


Figure 4: Alignment

Mounting Instructions for XL90 Positioner on Sereg Rotary Actuators

1. Mount the positioner to the transfer case plate in the proper orientation. Tighten the four bolts.
2. Loosen jam nut (see "Cam Installation" instructions).
3. Mount the follower arm, lockwasher and nut on the end of the shaft and tighten nut. Carefully hold the shaft with wrench on shaft flats.
4. With valve in closed position, make sure follower pin lever is mounted parallel to valve lever, flush with end of valve shaft and the nut is tight.
5. Place follower pin (mounted to the lever that is mounted to the valve shaft) into follower arm slot and bolt the transfer case plate in place finger tight only. See Figure 3.
6. Orient the cam to align the "L" shaped line located on the left side of the characteristic curve through the middle of the span arm roller. (See Figure 5.) The valve should be seated when this alignment is done. (See "Cam Installation" instructions). For correct cam characteristic, see Table I.
7. Proceed to "Connecting XL90 Positioner Ports" instructions.

Connecting XL90 Positioner Ports

1. For double acting actuators, connect positioner ports 1 and 2 to the actuator. Port 1 is always connected to the actuator port used to drive the actuator away from its start or fail position (the factory cam setting is full clockwise at minimum input signal).

NOTE: For single acting, spring return actuators, plug output 2

2. Connect supply air to the port marked "SUPPLY"
3. Connect air (for pressure inputs) or instrument tubing or wiring (for 4-20 mA inputs). For current inputs, the terminal is marked (+) and (-) inside the I/P module. The I/P is factory calibrated and should not require adjustment. If adjustments are necessary, see "Calibrating I/P Module Zero and Span Settings" section.

CAUTION: Signal air pressure higher than 30 psi may damage the module gauge and instrument signal capsule; a 3-15 psi instrument signal is recommended on the pneumatic module.

4. Stroke actuator/valve two or three times to align positioner, coupler and actuator. With 50% input (actuator/valve at 45 degrees), tighten all mounting bolts. Stroke actuator/valve again to verify there is no misalignment throughout the stroke.
5. Calibrate valve and adjust cam if necessary. (See "Cam Installation" and "Positioner Calibration" instructions.)

Table I: Cam Characteristic Identification Sereg

Cam Guide											
Sereg Actuator		NR		NX				NL			
Plug Characteristic		MaxFlo Linear		Linear		Equal Percent		Linear		Equal Percent	
Fail Position		Close	Open	Close	Open	Close	Open	Close	Open	Close	Open
Direct Acting Positioner	Linear	A	B	N	M			A	B		
	Equal %	C	E	Q	P	N	M	C	E	A	B
	Equal % Mod			B	A						
Reverse Acting Positioner	Linear	B	A	M	N			B	A		
	Equal %	E	C	P	Q	M	N	E	C	B	A
	Equal % Mod			A	B						

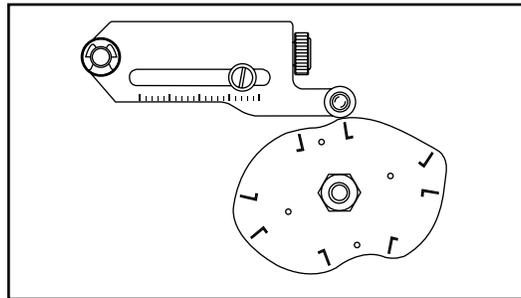


Figure 5: Alignment for Sereg Cams

Cam Removal: Disconnect cam return spring. With a wrench carefully placed on the output shaft (if necessary), loosen and remove the jam nut. Remove pressure from the span arm by pushing it away from the cam. Remove the cam.

Cam Installation:

1. A) For NAMUR shaft end connections make sure shaft is properly aligned with coupler or actuator.
B) For Sereg actuators, make sure follower pin is in follower arm groove.
2. Push span arm away from shaft to avoid pressure on the cam.
3. Place cam over the shaft with the appropriate characteristic facing up and closest to the span arm roller. For Sereg cams, see Table I. For Accord cams, 'D' represents direct-acting and 'R' represents reverse acting.
4. A) For NAMUR shaft end connections, make sure the round mark on the left hand side of the characteristic curve is lined up with the span arm roller bearing. See Figure 4.
B) For Sereg actuators, make sure the line on the left hand side of the characteristic curve is lined up through the middle of the span arm roller bearing. See Figure 5.
5. Tighten jam nut making sure cam does not rotate. Use a flat screwdriver to prevent cam rotation and shaft flats to prevent shaft rotation (if necessary).

6. Connect supply pressure to port marked 'Supply.'
7. Stroke actuator / valve two or three times to align position with actuator. With a 50 percent input signal, tighten all mounting bolts. Stroke actuator to verify proper alignment.

POSITIONER CALIBRATION

Introduction

Valtek positioners are calibrated at the factory; however, due to shipping and handling, it may be necessary to check the calibration before operating the valve. The XL90 positioner can be calibrated to a range of 3-15; two-way split range, 3-9, or 9-15; and three-way split ranging, 3-7, 7-11, 11-15 psi using the standard feedback spring.

WARNING: When stroking the actuator during calibration, keep hands, hair and clothing away from moving parts. Failure to do so may cause serious personal injury.

Note: Positioners and I/Ps are calibrated at the factory. Use mechanical adjustments in positioner for calibration. Zero and span on I/P should not be used to calibrate the valve.

For calibration, proceed as follows:

1. For 3-15 or 3-9 psi range, loosen by hand the zero adjustment locking knob and adjust zero adjust-

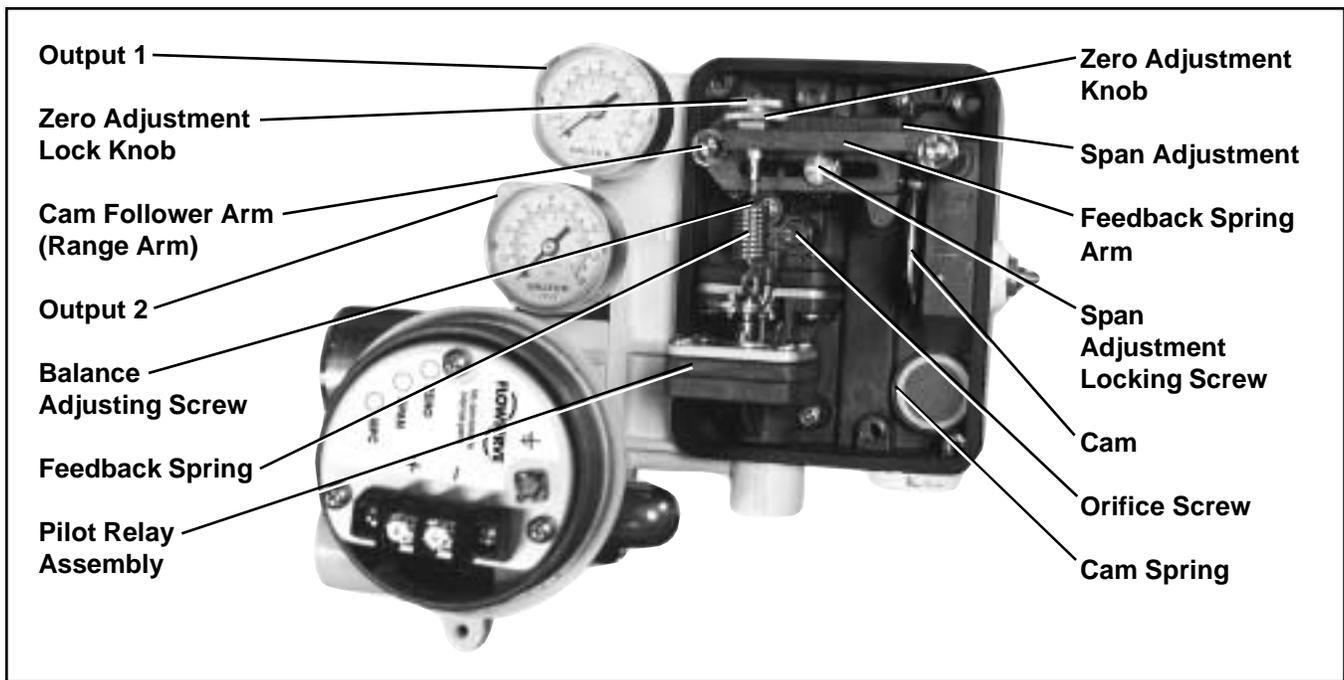


Figure 6: Positioner Adjustments

- ment knob until valve begins to stroke with more than 3 psi signal (for 9-15 psi range adjust to 9 psi).
- 2. Loosen range adjustment locking screw no more than $\frac{1}{8}$ turn.
- 3. With a phillips screwdriver adjust the span adjustment so valve is at full stroke with more than 15 psi for 3-15 or 9-15 psi range (adjust to 9 psi for 3-9 psi range).
- 4. Return to 3 psi (or 9 psi for 9-15 psi range) and check the zero. Repeat steps 1-4 if necessary.
- 5. Tighten zero adjustment lock knob and span adjustment lock knob.
- 6. Use the same procedure for three-way split range.
- 7. Connect Cam return spring. See Figure 6.

Positioner Balance Adjustment

CAUTION: Balance pressure is 75 percent of the supply pressure and is the average pressure of output ports 1 and 2. Balance is preset at factory. However, if this adjustment becomes necessary, carefully make the adjustment slowly, letting out the positioner. Check to make sure balance pressure is correct.

Balance adjustment is set at the factory and should not need adjustment. Balance adjustment (output pressure level) permits the equilibrium pressure in both sides of the actuator piston to be raised or lowered. The average actuator pressure level of output 1 and 2 is approxi-

mately 75 percent of supply pressure. For single-acting actuators, the balance pressure should be left at the factory setting. If it is necessary to adjust the output pressure level, follow the procedure outlined:

- 1. If output pressure level is low, before adjusting, check for leaks in tubing connections between positioner and actuator and check supply pressure.
- 2. Make certain there is no process force or pressure in the valve (Valve should be removed or isolated from the process.)
- 3. On positioners without gauges, connect gauges to 'output 1' and 'output 2' lines.
- 4. Remove rubber cap over balance adjustment. (See Figure 6.)
- 5. Apply full actuator operating pressure to positioner supply port.
- 6. Set input signal to midscale (9 psi for 3-15 psi span). Output pressure level cannot be adjusted with actuator against valve seat or travel stops. Allow actuator pressure to stabilize.
- 7. Observe pressure gauges. If reading is not correct, turn balance adjustment screw about $\frac{1}{8}$ turn at a time and wait about 20-30 seconds for pressure to stabilize (counterclockwise to increase pressure). Continue until output pressure level of the higher pressure gauge is approximately 80 percent of supply.
- 8. Replace rubber cap over balance adjustment screw.



Figure 7: Close-up of Gain Adjustment

Gain Adjustment Procedure

The unique gain adjustment on the XL90 positioner provides a means to increase or decrease responsiveness of the valve / actuator / positioner system. Increasing gain makes the valve more responsive and faster, while decreasing gain makes the system less sensitive and slower to respond (with increased damping).

The gain is infinitely adjustable between its highest and lowest settings. For convenience, three marks indicate (H) high, (M) medium and (L) low gain. Most sizes of actuators will respond well to a (M) setting. Unique actuator / valve configurations may require a gain adjustment at the factory or in the field.

1. Before adjusting the gain, place controller on manual and isolate the valve from the process.
2. Turn off supply air to control valve actuator.
3. Using a $\frac{5}{64}$ -inch allen wrench, *loosen both upper and lower lock screws* about one half turn. Do not loosen the spacer nut. (See Figure 8.)
4. By grasping adjust lever, carefully rotate gain adjust assembly to desired position.

CAUTION: To avoid damaging gain adjust connecting spring mechanism. Make sure both upper and lower gain adjust plates rotate together. When they are rotated to the new position, the connecting spring should be perpendicular to the plates.

5. When the gain is set to the desired position, firmly tighten both lock-down screws.
6. Turn on supply pressure. Check actuator respon-

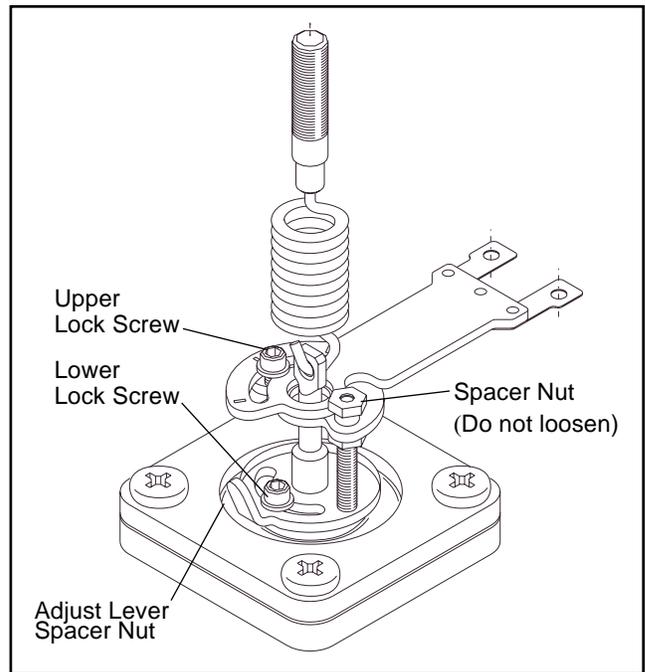


Figure 8: Gain Adjustment

siveness by providing a step signal to positioner. When gain is set as desired, check valve zero and span calibration and re-calibrate if needed.

7. Return valve to service.

Calibrating I/P Module Zero and Span Settings

NOTE: Although calibration can be accomplished using output pressure gauge on I/P module, its accuracy is ± 3 percent. The standard gauge should be removed only for calibration and more accu-

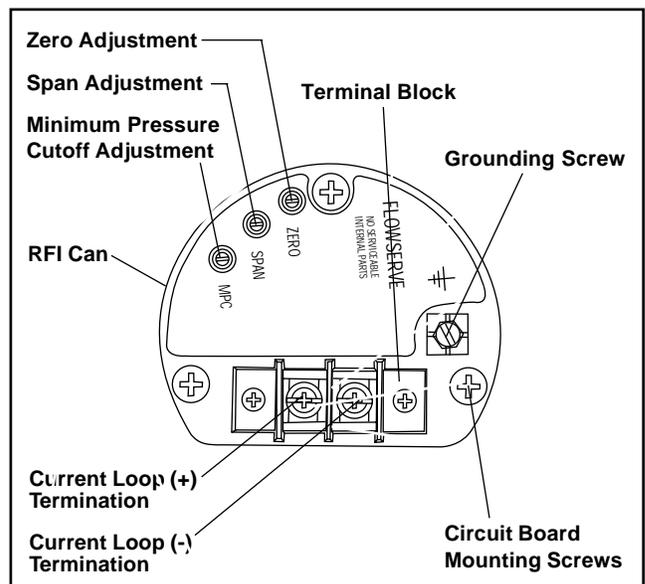


Figure 9: NT 3000 Circuit Board Module
(housing cover removed)

rate calibration equipment of ± 0.1 percent of span should be used. The pressure gauge port is 1/8-inch NPT. Calibration manifolds are available from the factory (Part No. 97370).

1. Connect I/P module to a supply pressure between 30 to 150 psi.
2. Remove I/P module housing cover. (See Figure 9.)

WARNING: Be certain power to I/P module is disconnected before removing housing cover in explosive atmospheres; otherwise personal injury may occur.

3. Before adjusting the zero and span, be certain the MPC feature is disabled. Refer to Step 7 in the 'Adjusting the Minimum Pressure Cutoff Feature' section.
4. Connect a current source to terminal block on circuit board.

NOTE: The zero and span adjustments are multi-turn potentiometers (pots) and have no stops on the ends of their travel; however, they have a slip clutch to prevent damage from over-adjustment. The pots also make a clicking noise when they have reached adjustment limits.

5. Apply a 4.0 mA signal to the input. Locate and adjust zero trim pot to achieve a 3.0 psi output. The output will increase with clockwise rotation of the zero trim pot. If calibrating an I/P module with a 10-50 mA input signal, apply a 10.0 mA signal to input.
6. Increase input signal to 20.0 mA (50 mA for 10-50 mA units). Locate and adjust span trim pot to achieve a 15.0 psi output. The output will increase with clockwise rotation of the span.
7. Recheck zero setting by repeating Step 5. The span adjustment may affect zero setting.
8. Repeat Steps 5, 6 and 7 until proper adjustments are obtained.

Adjusting Minimum Pressure Cutoff Feature

The XL90 positioner with I/P Transducer has a 'Minimum Pressure Cutoff' (MPC) feature, which allows the user to set the positioner. When the input signal falls below a user-adjustable current, the pressure output falls rapidly to approximately 1.7 psi, causing the valve to move to the failure position. This feature is generally used when the service requires a tight shut off or to prevent throttling near the valve seat. To adjust this feature, refer to Figure 9 and perform the following:

NOTE: The following procedure applies only when the minimum pressure cutoff feature will be used.

NOTE: The zero and span settings of both the positioner and I/P transducer should be verified as accurate before the minimum pressure cutoff feature is enabled and adjusted.

1. Connect the I/P module to a 30 to 150 psi air supply pressure.
2. Remove the I/P module housing cover.
WARNING: Be certain power to the I/P module is disconnected before removing the housing cover in explosive atmospheres; otherwise personal injury may occur.
3. Connect an adjustable current source to the terminal block on the circuit board. Apply the desired input signal to the positioner at which the output pressure is to fall to approximately 1.7 psi. This signal can range from factory setting of 3.7 to 8 mA.
4. Turn the minimum pressure cutoff pot clockwise until the output pressure drops off.
5. Fine-tune the pressure drop-off point by increasing the input signal and then decreasing it through the desired shut-off signal. Observe the signal value at which the pressure drops off. If the pressure drops off at a lower mA signal than desired, turn the MPC pot counterclockwise. If the pressure drops off at a higher signal than desired, turn the tight shut-off screw clockwise.
6. Repeat Step 5 until the pressure drops off at the desired input signal.
7. To disable the MPC feature turn the minimum pressure cutoff pot (marked "MPC") 20 turns counterclockwise or until it makes a clicking noise.

Positioner Maintenance

NOTE: Refer to NT 3000 IOM for I/P module maintenance instructions.

For proper maintenance, proceed as follows:

1. Maintain a clean air supply, free of dust, oil and water. A coalescing air filter for I/P is required to ensure a clean air supply. Check and maintain filter regularly.
2. Make sure all arms and levers move freely.
3. Check for loose parts.
4. Be sure there are no leaks in the air supply tubing, fittings or connections.
5. Refer to the troubleshooting chart on page 12 in case of problems.

Pilot Relay Disassembly and Reassembly

The pilot relay is available as a complete unit and can be easily replaced (See Steps 2 and 18.) Before attempting to correct any problem with the pilot relay assembly, obtain a positioner repair kit that contains the soft goods most commonly required.

NOTE: Numbers in parentheses correspond to the numbers in Figure 16.

1. Remove the feedback spring (47) and rotate the span and zero arms (40, 46) out of the way.

2. Remove four screws (33) holding the pilot relay to positioner base (1). Remove relay from positioner.
3. Remove the nut (25) connecting the flapper assembly (21) to the signal capsule.
4. Remove four screws (32) holding the two halves of the pilot relay assembly together. Carefully pull the relay assembly halves apart, making sure the flapper assembly (21) slides off the flapper adjustment screw (19) without damaging the signal diaphragm assembly (16). Pull the relay diaphragm assembly (13) out of the other half of the relay body (9).
5. With the relay assembly in two sections, remove two screws (22) holding flapper assembly (21) to the relay diaphragm assembly (13). Remove flapper.
6. Remove diaphragm retaining plate (15) from relay diaphragm assembly (13) and relay plate (14).
7. Replace relay diaphragm assembly (13) with one from the positioner repair kit. Place the relay plate (14) between the new diaphragms, making sure the $\frac{1}{16}$ -inch diameter holes between the relay plate (14) and the diaphragm line up. Position diaphragm retaining plate (15) on relay diaphragm assembly with rounded inner diameter edge against diaphragm.
8. Attach flapper assembly (21) onto relay diaphragm assembly (13) using two screws (22) with a locking adhesive on the threads. The flapper assembly should extend away from the $\frac{1}{16}$ -inch diameter hole through the relay plate. Make sure lettering on flapper assembly is facing away from diaphragm.
9. With relay halves still apart, remove relay tube O-rings (8) from upper and lower bodies (9, 7) and replace them with new O-rings (found in the positioner O-ring repair kit).
10. Remove rubber cap (35) and balance adjust screw cap (36) from upper relay body (9). Remove O-ring (38) from balance adjust screw and install new O-ring.
11. To remove and clean poppets (28), remove the retaining rings (31), poppet covers (27), O-rings (30), and poppet springs (29) found at the end of each housing. After removing poppets, inspect them for dirt buildup or damage to seating surfaces.
12. The upper relay body (9) has a movable seat ring (34) which is adjusted with the balance adjust screw (36). This seat is removed by pushing it out with a soft instrument such as a wooden dowel. Be careful not to damage seating surface. Remove O-ring (37) from seat ring.
13. Lubricate and replace O-ring (37) on movable seat ring (34). Carefully reinstall seat ring into upper relay body (9), being careful not to damage seating surface or O-rings.
14. Reinstall poppets (28), poppet springs (29), Seat Spring O-rings (30), and poppet covers (27) before installing retaining rings (31).
15. If signal diaphragm assembly (16) is damaged, proceed as follows: With relay halves still apart, remove four screws (32) holding signal diaphragm assembly (16) to the pilot relay assembly. Remove locking screw (23), washer (24), adjustable gain lower plate (26), and diaphragm plate. Remove signal diaphragm assembly (15) and remove relay plate (14) from between the diaphragms. Place relay plate (14) between the diaphragms on the new assembly, *taking care to align the $\frac{1}{16}$ -inch diameter holes between the diaphragms and the relay plate (14)*. Replace diaphragm plate (15), adjustable gain lower plate (26), washer (24), and locking screw, but do not tighten. Replace four screws (32) that hold signal diaphragm assembly together.
16. Pack O-ring grease into the O-ring groove and lightly lubricate the outside of the relay tube on diaphragm relay assembly. (13) Make sure small end holes on the side of the tube do not get plugged with grease. Insert the relay diaphragm assembly (13) as assembled in steps 7 and 8 into the lower relay half. Carefully align the flapper over the adjustable gain screw (19) and replace and tighten the nut (25).
17. Fasten the two halves of the relay together using four long screws (32). *Make sure the $\frac{1}{16}$ -inch diameter holes in the relay diaphragm assembly (13) and the upper relay body (9) line up.* Set gain to desired setting and tighten locking screws (23, 25). See gain adjustment procedure.
18. *Replace screen (110) and O-rings (8,12) found on the back of the pilot relay before reinstalling the pilot relay on the base of the positioner with four screws (33).* Clean out any debris lodged in screen or replace with a new one.
19. Replace span arm and zero arm (40, 46) and feedback spring (47).

Installation, Operation and Maintenance of UltraSwitch position indicators

For detailed information, refer to the following Accord controls bulletins:

- PS0008, PS0009, PS0031, PS0032, PS0033, PS0034, PS0037 and PS0050

Troubleshooting XL90 Positioners

Failure	Probable Cause	Corrective Action
Valve won't stroke, no excessive air is exhausting from positioner	<ol style="list-style-type: none"> 1. Tubing to wrong ports 2. Cam action reversed 3. Lever is stuck 4. Low air supply 5. Relay tube stuck 6. Balance adjust screw not adjusted correctly 7. I/P module filter plugged 8. I/P module failure 9. I/P mounting bolts loose 10. I/P pressure signal blocked 	<ol style="list-style-type: none"> 1. Re-tube to correct ports (see 'Installation' section) 2. Refer to 'Installation' section and reverse cam 3. Work with lever arm until it turns freely 4. Increase air supply to recommended value 5. Disassemble relay assembly and work relay tube free. Lightly lubricate if necessary 6. Adjust balance pressure with adjusting screw 7. Remove I/P module and replace filter 8. Replace I/P module 9. Tighten mounting bolts 10. Remove I/P module and clear passageway; replace O-ring if necessary
Valve won't stroke, excessive air exhausting from positioner	<ol style="list-style-type: none"> 1. A diaphragm in relay assembly burst 2. One of the poppets is stuck 3. Internal control valve problem 4. Damaged relay O-rings on relay tube 5. Blocked passageways in relay 	<ol style="list-style-type: none"> 1. Replace relay assembly or replace diaphragms 2. Remove relay assembly/poppet cover; free stuck poppet 3. Refer to instructions or check for actuator tubing leaks 4. Disassemble relay and replace O-rings 5. Disassemble relay and check small holes under diaphragms; clean if clogged
Actuator goes to full signal position regardless of signal	<ol style="list-style-type: none"> 1. Broken feedback spring 2. Linkage is disconnected or stuck 3. Orifice is clogged by water, oil or dust in air supply 4. Bent flapper, damaged nozzle 5. I/P module failure 6. Clogged orifice screen 	<ol style="list-style-type: none"> 1. Replace feedback spring 2. Check and tighten bolts/nuts in linkage. Make sure linkage does not hang up; grease pin that rides in follower arm slot 3. Remove orifice screw and carefully clean orifice hole 4. Straighten flapper or replace damaged parts 5. Replace I/P module 6. Remove relay and clean or replace orifice screen
Calibration shifts	<ol style="list-style-type: none"> 1. Loose positioner mounting 2. Loose linkage 3. Loose zero adjustment locking knobs 4. Wear of arms or pins 5. I/P mounting bolts loose 6. Stroke has changed in valve 	<ol style="list-style-type: none"> 1. Remove cover and check three screws holding positioner to bracket; check two bolts holding bracket to yoke 2. Tighten nuts and bolts on linkage and stem clamp 3. Tighten zero adjustment locking knob; re-calibrate if necessary 4. Replace worn arms, pins; grease appropriately 5. Tighten I/P mounting bolts 6. Refer to valve maintenance instructions
Excessive air consumption (other than normal exhaust)	<ol style="list-style-type: none"> 1. Air leakage from manifold rings between relay and base 2. Air leakage from tubing 3. Leaky cylinder piston O-rings 4. Air leakage from relay 	<ol style="list-style-type: none"> 1. Tighten screws holding relay assembly together and/or replace O-rings 2. Tighten or replace tubing fittings 3. Replace O-rings in cylinder 4. Disassemble relay and check and replace dynamic O-rings next to tube if necessary
Actuator strokes very slowly in one direction only	<ol style="list-style-type: none"> 1. Connection between signal capsule and flapper misadjusted 2. Tubing to cylinder is restricted 3. Balance pressure low 	<ol style="list-style-type: none"> 1. Adjust gain according to Figure 8 or until actuator strokes approximately equal speed in both directions. Verify alignment of upper and lower gain plates. Make sure spacer nut is tightened 2. Inspect tubing/fittings for restrictions and replace if necessary 3. Adjust balance pressure according to page 5
Erratic operation	<ol style="list-style-type: none"> 1. Dirt buildup on relay poppets or seats 2. Dirt buildup on relay tube 3. Clogged ports / passageways in relay 4. Faulty I/P module 5. Clogged orifice screw 6. Mechanical binding in linkage or internal galling in valve 7. Clogged orifice screen 	<ol style="list-style-type: none"> 1. Disassemble; clean poppets and seats; add air or change filter 2. Disassemble; clean relay and lightly lubricate; replace O-rings if necessary; add air filter or change filter 3. Disassemble, inspect and clean all ports and passageways 4. Replace the I/P module 5. Remove orifice screw and carefully clean orifice 6. Tighten linkage or refer to valve maintenance instructions 7. Remove relay and clean or replace orifice screen
Excessive overshoot	<ol style="list-style-type: none"> 1. Restricted air flow to positioner 2. Balance pressure not set correctly 3. Gain is set too high 	<ol style="list-style-type: none"> 1. Adjust air supply as needed 2. Adjust balance pressure according to page 5. 3. Lower gain mechanism until overshoot is minimized

OPTIONAL ULTRADOME ASSEMBLY

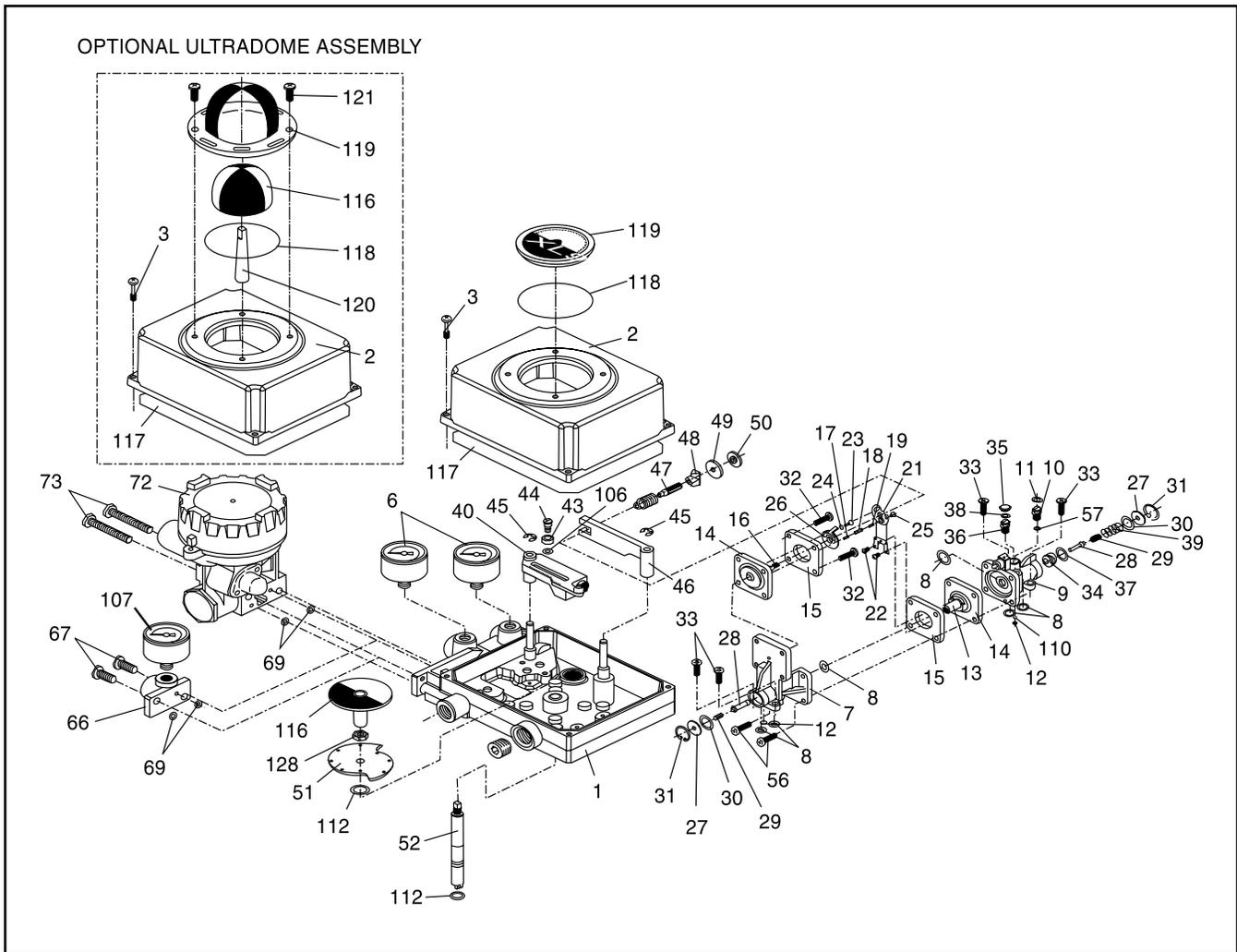


Figure 16: XL90 Positioner — Exploded View — Accord Cam

- | | | | |
|------------------------------|--------------------------------|---------------------------|------------------------|
| 1 Base assembly | 20 Nut | 37 O-ring | 57 O-ring |
| 2 Cover | 21 Adjustable gain upper plate | 38 O-ring | 66 Pneumatic adapter |
| 3 Screw | 22 Pan head screw | 39 Adjustable seat spring | 67 Screw |
| 6 Pressure gauge 0-160 psi | 23 Socket screw | 40 Span arm | 69 O-ring |
| 7 Bottom relay assembly | 24 Washer | 43 Pivot bushing | 72 I/P module |
| 8 O-ring | 25 Spacer nut | 44 Pivot screw | 73 Screws |
| 9 Upper relay assembly | 26 Adjustable gain lower plate | 45 Snap ring | 106 Washer |
| 10 Orifice screw | 27 Poppet cover | 46 Zero arm | 107 Signal gauge |
| 11 O-ring | 28 Poppet | 47 Feedback spring | 110 Orifice screen |
| 12 O-ring | 29 Poppet spring | 48 Pivot block | 112 Snap ring |
| 13 Relay diaphragm assembly | 30 O-ring | 49 Adjust zero knob | 116 Rotor or indicator |
| 14 Relay plate | 31 Retaining ring | 50 Zero locking knob | 117 O-ring |
| 15 Diaphragm retaining plate | 32 Screw | 51 Return spring | 118 O-ring |
| 16 Signal diaphragm assembly | 33 Screw | 52 Cam shaft | 119 Dome |
| 17 Set screw | 34 Adjustable seat | 53 Cam | 120 Adapter shaft |
| 18 Spring | 35 Rubber cap | 55 Nut | 121 Screw |
| 19 Set screw | 36 Balance adjust screw | 56 Screw | 128 Jam nut |

All of the above parts are in stock and can be purchased in a spare parts kit. For selecting and ordering the appropriate kit or a new positioner, contact your Flowserve representative or the factory.

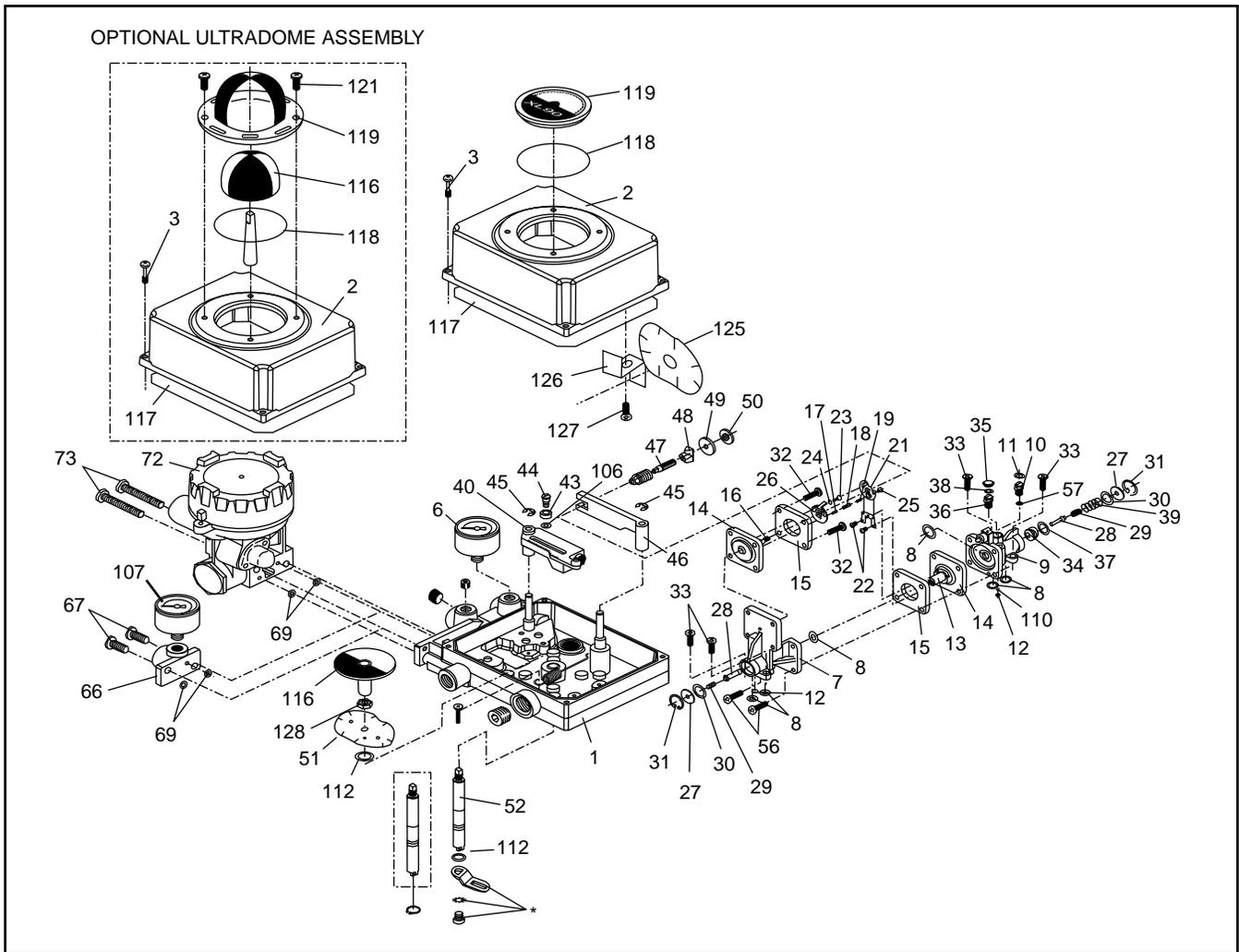


Figure 17: XL90 Positioner — Exploded View — Sereg Cam

- | | | | |
|------------------------------|--------------------------------|---------------------------|-------------------------|
| 1 Base assembly | 21 Adjustable gain upper plate | 39 Adjustable seat spring | 67 Screw |
| 2 Cover | 22 Pan head screw | 40 Span arm | 69 O-ring |
| 3 Screw | 23 Socket screw | 43 Pivot bushing | 72 I/P module |
| 6 Pressure gauge 0-160 psi | 24 Washer | 44 Pivot screw | 73 Screws |
| 7 Bottom relay assembly | 25 Spacer nut | 45 Snap ring | 106 Washer |
| 8 O-ring | 26 Adjustable gain lower plate | 46 Zero arm | 107 Signal guage |
| 9 Upper relay assembly | 27 Poppet cover | 47 Feedback spring | 110 Orifice Screen |
| 10 Orifice screw | 28 Poppet | 48 Pivot block | 112 Snap ring |
| 11 O-ring | 29 Poppet spring | 49 Adjust zero knob | 116 Snap ring |
| 12 O-ring | 30 O-ring | 50 Zero locking knob | 117 O-ring |
| 13 Relay diaphragm assembly | 31 Retaining ring | 51 Return spring | 118 O-ring |
| 14 Relay plate | 32 Screw | 52 Cam shaft | 119 Dome |
| 15 Diaphragm retaining plate | 33 Screw | 53 Cam | 120 Adapter shaft |
| 16 Signal diaphragm assembly | 34 Adjustable seat | 55 Nut | 121 Screw |
| 17 Set screw | 35 Rubber cap | 56 Screw | 125 Cam, reverse acting |
| 18 Spring | 36 Balance adjust screw | 57 O-ring | 126 Clamp |
| 19 Set screw | 37 O-ring | 66 Pneumatic adapter | 127 Screw |
| 20 Nut | 38 O-ring | | 128 Jam nut |

All of the above parts are in stock and can be purchased in a spare parts kit. For selecting and ordering the appropriate kit or a new positioner, contact your Flowserve representative or the factory. *Consult factory for parts.

PREFIX (see note 5)	MB Automax Manufacture - Black Epoxy
	MW Automax Manufacture - White Food Grade Epoxy
	AB Accord Manufacture - Black Epoxy
	AW Accord Manufacture - White Food Grade Epoxy
	SW Sereg Manufacture - White Epoxy
	VW Valtek Manufacture - White Epoxy
 INPUT MODEL	 90 Pneumatic Input 3-15 psi
	91 Electro-Pneumatic Input 4-20mA—General Purpose NT3000
FM/CSA	92 Electro-Pneumatic Input 4-20mA—Explosion Proof and Intrins. Safe NT3000)
Cenelec	93 Electro-Pneumatic Input 4-20mA—EExd (Explosion Proof) NT3000
Cenelec	94 Electro-Pneumatic Input 4-20mA—EExia & EExib (Intrinsically Safe)NT3000
 INDICATION	 1 Flat Lens with Green Indicator (Standard)
	U Ultradome with Green Indicator
	T Cover for top-mounted Namur UltraSwitch (includes UltraSwitch mounting kit)
 GAGES	 2 3 Stainless Steel Gages with Brass Fitting (Standard)
	3 2 Stainless Steel Gage with Brass Fitting (Standard)
	4 3 Stainless Steel Gages
	5 2 Stainless Steel Gage
	6 No Gages
 TEMPERATURE	 7 Standard Temperature (Buna-N soft goods)
	8 Extended Temperature (Fluorosilicone soft goods)
 CAM	 A Accord Linear Cam
	B Accord 30, 45, 60, & 90 Degree Linear Cam
	C Accord Linear, Square, Square Root (Damper) Cam
	D Accord 0-60 Degree Cam (Butterfly Valves)
	E Sereg Linear and =% Cam - Diaphragm Actuator
	F Valtek Linear Cam - Piston Actuator
 CONDUIT THREAD CONNECTION	 P 1/2" NPT (Standard)
	R M20 Threads
<i>ADD OPTIONS AS NEEDED (See notes 1-4 below)</i>	
ANALOG OUTPUTS	F 4-20 mA Transmitter
- or -	
INTERNAL LIMIT SWITCHES	J 2-SPDT Mechanical Switches with High Resolution Cams
	K 2-SPDT Mechanical Switches
	M 2-SPST Proximity Switches
	N 2-SPDT Proximity Switches
	Q 2-Non-Incendive Reed Switches
	R 2-Intrinsically Safe Solid State Proximity Switches

Notes: 1. Internal limit switches and an internal transmitter cannot be used simultaneously.
 2. When options F, J, K, M, N, or Q are used with an I/P transducer, input model number 91 must be used.
 3. When option R is used with an I/P transducer, input model numbers 92 or 94 must be used.
 4. Internal limit switches or an internal transmitter cannot be used in an explosion proof environment. As an alternative, the explosion proof UltraSwitch may be mounted on top of the positioner. (Use option T.)
 5. Namur shaft end connections are standard for Automax and Accord positioners, Double "D" shaft end connections are standard for Sereg and Valtek positioners. Contact factory for exceptions to this standard.

General Spare Part Kits

Standard O-ring Kit — Part No. 10078576

Item No.	Description	Quantity
8	Relay/base O-ring and relay tube O-ring	6
11	Orifice screw O-ring	1
12	Relay/base O-ring	2
30	Relay retainer O-ring	2
37	Adjustable seat O-ring	1
38	Adjustable screw O-ring	1
57	Orifice face O-ring	1
69	Input signal O-ring	2
117	Cover O-ring	1

Standard Diaphragm Kit — Part No. 10078578

Item No.	Description	Quantity
13	Relay diaphragm assembly (Includes item No. 78, 79, 80, 81, 82, 83)	1
16	Signal diaphragm assembly (Includes item No. 78, 79, 80, 83, 85, 86)	1

Standard Relay Kit — Part No. 10066907

Item No.	Description	Quantity
69	Relay assembly (Includes item Nos. 8-39, 56, 57, 70, 72, 73, 74, 76, 77)	1
8	O-ring	4
33	Pan head screw	4

Shaft Kit, Double D End Connection — Part No. 10099939

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
108	Jam Nut	1
54	Lock Washer	1
55	Nut	1

Ext. Temp. Relay Kit — Part No. 10076180

Item No.	Description	Quantity
69	Relay assembly (Includes item Nos. 8-39, 56, 57, 70, 72, 73, 74, 76, 77)	1
8	O-ring	4
33	Pan head screw	4

Ext. Temp. O-ring Kit — Part No. 10078577

Item No.	Description	Quantity
8	Relay/base O-ring and relay tube O-ring	6
11	Orifice screw O-ring	1
12	Relay/base O-ring	2
30	Relay retainer O-ring	2
37	Adjustable seat O-ring	1
38	Adjustable screw O-ring	1
57	Orifice face O-ring	1
69	Input signal O-ring	2

Ext. Temp. Diaphragm Kit - Part No. 10078580

Item No.	Description	Quantity
13	Relay diaphragm assembly (Includes item No. 78, 79, 80, 81, 82, 83)	1
16	Signal diaphragm assembly (Includes item No. 78, 79, 80, 83, 85, 86)	1

Cover Kit, Ultradome, White — Part No. 10101034

Item No.	Description	Quantity
2	Cover	1
3	Screw	4
117	O-ring	1
119	Dome	1
122	Sticker, Rotor	1
120	Adapter Shaft	1
121	Screw	4
118	O-ring	1
116	Rotor	1

Cover Kit, Ultradome, Black — Part No. 10101049

Item No.	Description	Quantity
2	Cover	1
3	Screw	4
117	O-ring	1
119	Dome	1
122	Sticker, Rotor	1
120	Adapter Shaft	1
121	Screw	4
118	O-ring	1
116	Rotor	1

**Shaft Kit, NAMUR End Connection —
Part No. 1009944**

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1

Feedback Spring Kit — Part No. 10066924

Item No.	Description	Quantity
47	Feedback spring assembly (Includes item Nos. 103, 104)	1
48	Pivot block	1
49	Adjustment knob	1
50	Lock knob	1

Manufacturer-specific Spare Part Kits

Sereg Cam Kit — Part No. 10115721

Item No.	Description	Quantity
51	Direct Acting Cam	1
125	Reverse Acting Cam	1
126	Cam Cover Clip	1
127	Screw	1
130	Cam Spring	1
131	Screw	1
132	Sticker, Cam	1

**Cover Kit, Lens, White, Sereg —
Part No. 10115895**

Item No.	Description	Quantity
2	Cover	1
3	Screw	4
117	O-ring	1
119	Sereg Lens	1
116	Indicator	1
118	O-ring	1

**Cover Kit, Lens, Black, Accord —
Part No. 10115898**

Item No.	Description	Quantity
2	Cover	1
3	Screw	4
117	O-ring	1
119	Accord Lens	1
116	Indicator	1
118	O-ring	1

**Cover Kit, Lens, White, Valtek —
Part No. 10115720**

Item No.	Description	Quantity
2	Cover	1
3	Screw	4
117	O-ring	1
119	Valtek Lens	1
116	Indicator	1
118	O-ring	1

**Cover Kit, Lens, Black, Automax —
Part No. 10115899**

Item No.	Description	Quantity
2	Cover	1
3	Screw	4
117	O-ring	1
119	Automax Lens	1
116	Indicator	1
118	O-ring	1

Electronic Spare Part Kits

WARNING: INTERNAL ELECTRONIC KITS CANNOT BE USED IN APPLICATIONS REQUIRING EXPLOSION-PROOF COMPONENTS.

As an alternative, the explosion-proof UltraSwitch position indicator may be mounted to the top of the positioner. Consult your local Flowserve representative for ordering information.

**Transmitter Kit, 4-20mA Output, Double D Shaft
End Connection — Part No. 10115900**

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
54	Lock Washer	1
55	Nut	1
130	Electronics Kit (Includes shaft gear, circuit board and mounting screws)	1

Transmitter Kit, 4-20mA Output, NAMUR Shaft End Connection — Part No. 10115905

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
130	Electronics Kit (Includes shaft gear, circuit board and mounting screws)	1

Mechanical Limit Switch Kit, NAMUR Shaft End Connection — Part No. 10115910

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
130	Electronics Kit (Includes shaft cams, spring, circuit board and mounting spacers and screws)	1

High Resolution Mechanical Limit Switch Kit, Double D Shaft End Connection — Part No. 10115906

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
54	Lock Washer	1
55	Nut	1
130	Electronics Kit (Includes shaft cams, spring, circuit board and mounting spacers and screws)	1

Proximity Limit Switch Kit, SPST, Double D Shaft End Connection — Part No. 10115914

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
54	Lock Washer	1
55	Nut	1
130	Electronics Kit (Includes shaft cams, magnets, spring, circuit board and mounting spacers and screws)	1

High Resolution Mechanical Limit Switch Kit, NAMUR Shaft End Connection — Part No. 10115907

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
130	Electronics Kit (Includes shaft cams, spring, circuit board and mounting spacers and screws)	1

Proximity Limit Switch Kit, SPST, NAMUR Shaft End Connection — Part No. 10115915

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
130	Electronics Kit (Includes shaft cams, magnets spring, circuit board and mounting spacers and screws)	1

Mechanical Limit Switch Kit, Double D Shaft End Connection — Part No. 10115909

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
54	Lock Washer	1
55	Nut	1
130	Electronics Kit (Includes shaft cams, spring, circuit board and mounting spacers and screws)	1

Proximity Limit Switch Kit, SPDT, Double D Shaft End Connection — Part No. 10115916

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
54	Lock Washer	1
55	Nut	1
130	Electronics Kit (Includes shaft cams, magnets, spring, circuit board and mounting spacers and screws)	1

**Intrinsically Safe Proximity Limit Switch Kit,
NAMUR Shaft End Connection —
Part No. 10115920**

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
130	Electronics Kit (Includes shaft cams, magnets spring, circuit board and mounting spacers and screws)	1

**Intrinsically Safe Proximity Limit Switch Kit,
Double D Shaft End Connection —
Part No. 10115919**

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
54	Lock Washer	1
55	Nut	1
130	Electronics Kit (Includes shaft cams, magnets, spring, circuit board and mounting spacers and screws)	1

**Proximity Limit Switch Kit, SPDT, NAMUR Shaft
End Connection — Part No. 10115917**

Item No.	Description	Quantity
52	Cam Shaft	1
112	Retaining Ring	2
128	Jam Nut	1
130	Electronics Kit (Includes shaft cams, magnets spring, circuit board and mounting spacers and screws)	1

Flowserve Corporation has established industry leadership in the design and manufacture of its products. When properly selected, this Flowserve product is designed to perform its intended function safely during its useful life. However, the purchaser or user of Flowserve products should be aware that Flowserve products might be used in numerous applications under a wide variety of industrial service conditions. Although Flowserve can (and often does) provide general guidelines, it cannot provide specific data and warnings for all possible applications. The purchaser/user must therefore assume the ultimate responsibility for the proper sizing and selection, installation, operation and maintenance of Flowserve products. The purchaser/user should read and understand the Installation Operation Maintenance (IOM) instructions included with the product, and train its employees and contractors in the safe use of Flowserve products in connection with the specific application.

While the information and specifications presented in this literature are believed to be accurate, they are supplied for informative purposes only and should not be considered certified or as a guarantee of satisfactory results by reliance thereon. Nothing contained herein is to be construed as a warranty or guarantee, express or implied, regarding any matter with respect to this product. Because Flowserve is continually improving and upgrading its product design, the specifications, dimensions and information contained herein are subject to change without notice. Should any question arise concerning these provisions, the purchaser/user should contact Flowserve Corporation at any of its worldwide operations or offices.

For more information, contact:

For more information about Flowserve and its products, contact www.flowserve.com or call USA 972 443 6500



Regional Headquarters

Quick Response Centers

1350 N. Mt. Springs Prkwy.
Springville, UT 84663
Phone 801 489 8611
Facsimile 801 489 3719

5114 Railroad Street
Deer Park, TX 77536 USA
Phone 281 479 9500
Facsimile 281 479 8511

12 Tuas Avenue 20
Republic of Singapore 638824
Phone (65) 862 3332
Facsimile (65) 862 4940

104 Chelsea Parkway
Boothwyn, PA 19061 USA
Phone 610 497 8600
Facsimile 610 497 6680

12, av. du Québec, B.P. 645
91965, Courtaboeuf Cedex, France
Phone (33 1) 60 92 32 51
Facsimile (33 1) 60 92 32 99

1300 Parkway View Drive
Pittsburgh, PA 15205 USA
Phone 412 787 8803
Facsimile 412 787 1944

Flowserve and Valtek are registered trademarks of Flowserve Corporation.