DPS-1
OPTICAL/DIGITAL ELECTRO-PNEUMATIC VALVE POSITIONER

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NOTE: These positioners are factory set and calibrated prior to shipment. No further adjustment should be necessary, except for response speed once the valve and positioner are put into service.

SPECIFICATIONS

Supply Voltage (Standard)	24VDC or 85-264 VAC or 110-340 VDC
Power Consumption	10 Watts (maximum)
Signal Input Range:	4-20 mA
(Field Selectable)	4-12 mA
	12-20 mA
	0-5 VDC
Loss of Signal: (Field Selectable)	'LOCK', lock in the last position
	'VENT', actuator vents, valve closes
	'LOAD', actuator loads with air, valve opens
Control Action:	Direct/Reverse (switch selectable)
Stroke	1/2" to 3" (13-76 mm), field adjustable
Air Supply:	35-100 psig (2-7 bar), instrument quality
Pneumatic Connections:	1/4 NPT(female)
Gauges:	Optional, supply and output
Output :	0 to 100 psig
Air Consumption:	No Air Consumption at steady state
Input resistance to current loop:	200 Ohms
Input resistance to Voltage I/P	25K Ohms.
Control Position Output:	4-20 mA +/- 2%(maximum load 500 ohms)
Position Sensitivity	+/- 00125" (0.03mm)
Hysteresis:	.1% of Span
Deadband:	Zero
Repeatability:	1% of Span
Mounting Position Effect:	None

Max Output Capacity: (Single Acting or Double Acting) 9 SCFM @ 60 psig(4.25 l/sec @ 4 bar)

Operating Temperature:	32 to 176º F (0 to 80º C)
Storage Temperature:	-4 to 176º F (-20 to 80º C)
Weight:	8 lbs. (3.6 kg)
Enclosure:	Nema 4
Overall Dimensions:	See Figure 1

Introduction

The Leslie positioner Model DPS-1 is a control device that satisfies a wide range of applications. It provides fast, sensitive, and accurate positioning of pneumatic actuators. The positioner receives position feedback from a unique non-contact digital optical sensor. The sensor is housed in a NEMA 4 enclosure.

The positioner provides high volume air for an output at pressures from zero to 100 psig. This pressure will operate an actuator. There are no small orifices to plug or foul. The only air consumption the positioner has is when the it is changing position of the actuator.

OPERATION

The electronic circuit of the positioner compares the setpoint signal received from a controller to the actual stem position. If an error signal is generated, do to a setpoint change, then electrical pulses are sent to one of the two sets of internal solenoid valves for double acting positioners, if the positioner is single acting then the pulses go to one set of solenoids. One solenoid of the pair of solenoids will increase the output air pressure to one side of the actuator and the other will vent the air from the other side of the actuator. Each pulse will increase or decrease the air pressure within the actuator slightly. The greater the error signal, the longer the solenoids are held open and the larger the step increase in actuator air pressure. This increases the speed of the actuator changes. For small errors, the pulse width (time the solenoid is open) is decreased to prevent overshooting. In the event of very large and fast setpoint change a proportional pneumatic response is generated through a secondary large spool valve. The large spool valve causes proportional band changes and the digital solenoids cause small integral band changes. There are adjustable crossover points.

INSTALLATION

The positioner should be mounted on the valve in a manner that will allow access to its internal adjustments. Figure 1 details positioner envelope size. The positioner must be securely mounted with no play permitted. Looseness or play will result in Deadband for the system. The connection arm to the actuator must be rigid, or instability will result. The following procedure should be followed to install the connecting arm.

NOTE: The actuator must be mounted on the valve and set for the approximate valve travel before proceeding with the positioner installation procedure. The positioner is limited to 0.5" to 3" of stroke.

1. Attach the DPS-1 to the actuator with two 5/16"-18 UNC bolts and the spacers provided. Figures 3a and 4a show the typical mounting arrangements.

2. Adjust the two hex jam nuts on the optical sensor arm to the upper-most position.

3. Slide the drive arm as shown in Figure 3b on to the valve stem between the actuator stem and valve stem washer and tighten the valve stem nut finger tight.

4. Lift the optical sensor stem enough to clear the height of the drive arm, slide a Belleville washer onto the optical sensor (cupped toward drive arm), rotate the drive arm and lower the optical sensor stem into the slotted hole on the drive arm.

5. Center optical sensor stem in the slotted hole on the drive arm and tighten the valve stem nut.

6. Apply dry lubricant to the top and bottom of the drive arm around the slotted hole.

7. If valve is not spring return normally closed, seat the valve plug by applying air to the top of the piston actuator.

8. Slide the remaining Belleville washer onto the optical sensor stem (cupped toward bottom of drive arm) and screw the lock nut onto the stem finger tight.

9. Adjust the lower hex jam nut until it rests on the Belleville washer. Lower the top hex jam nut until it touches the lower jam nut and lock jam nuts together using two wrenches.

10. While holding jam nuts with a wrench, tighten the lock nut until the Belleville washer comes in contact with the drive arm. The optical sensor stem should have a slight side-to-side movement without vertical movement.

11. Remove air pressure from the top of the piston actuator (if previously applied) and connect tubing from upper pipe "T" to top of piston and from lower pipe "T" to the bottom of piston as applicable (single acting or double acting).

As with all pneumatic instruments, dry filtered instrument air should be used with the positioner. For tubing size and location recommendations see table 1. Blow out all the air lines before connecting them to prevent chips and or scale from getting into the positioner. Use pipe compound sparingly, and only on the male threads of the connections. Figure 3a details a typical piping arrangement.

Note: The air lines to and from the positioner and actuator act as a flow control system. As with all control systems the more turns, bends and elbows the piping system has to the slower the response of the system. Keep tubing at recommended sizes. Keep bends and elbow to a minimum and keep tubing lengths to a minimum. Watch for hidden restrictions in tubing fittings, crimped tubing and air leaks

FIELD WIRING

1. After mounting the positioner on the actuator, open the positioner cover by loosening the four captive screws located on the corners of the front of the positioner. The field wiring diagram shown in figure 2 appears on the back of the positioner cover. Power and signal lines should be routed through separate conduits to avoid electrical interference. Shielded wire [with shield grounded only at TB-1 terminal 3 (GRD)], should be used for the setpoint signal coming from the controller.

2. If the signal coming in is mA then connect the positive signal wire to terminal 3 and the negative wire to terminal 4 on TB-2.

3. If the signal coming in is in volts then connect the positive signal wire to terminal 5 and the negative wire to terminal 6 on TB-2.

4. Select the corresponding input signal from pins J1 through J4 (figure 5) and place the jumper across the pins.

5. 24VDC power positive wire is connected to terminal 1 on TB-2. The negative wire will be connected to terminal 2.

NOTE: If the negative of the 24VDC Power is common with the negative of the 4-20mA signal, jumper wire J12 must be removed.

OPTIONAL WIRING

1. 85 to 262 VAC or 110 to 340 VDC can be connected to TB-1 terminals L1, L2 and GND. When powered through TB-1, 24VDC power is disconnected from TB-2, pins 1 and 2.

2. Valve stem position output (4-20MA) is available at TB-2 terminal 7 (positive) and terminal 8 (negative). The maximum load resistance that can be connected across these terminals is 500 ohms. These terminals can be used to connect recorders, alarms, or any other auxiliary devices.

Table 1

Recommended Tubing Size, Length and number of elbows:

Actuator Volume (in3)	Tube Size	Max. Straight Length	Max. Number of Elbows	Aeroflow Actuator
Up to 84	1⁄4	50 ft	Tubing Length/5	P28DA 2” stroke = 56 in3
Up to 84	1⁄4	50 ft	Tubing Length/5	P28DA 3” stroke = 84 in3
84 to 603	3/8	35 ft	Tubing Length/5	P80DA 3” stroke = 234 in3
84 to 603	3/8	35 ft	Tubing Length/5	P200DA 3” stroke = 603 in3
603 to 942	1/2	20 ft	Tubing Length/5	P130DA 4” stroke = 928 in3
603 to 942	1/2	20 ft	Tubing Length/5	P300DA 3” stroke = 942 in3

CAUTION!

Turn the power off before making power connections to TB-1

START UP CALIBRATING AND TUNING

CAUTION!

All of the pneumatic connections must be bubble tight. Check the connections for leaks using a soap solution.

1. Close the flow system stop valves upstream and downstream of the control valve to be calibrated.

2. Open the cover of the DPS-1 by loosening the four captive screws in the corners of the cover.

3. Check the setting of the jumper on pins J1 through J4. It should match the expected input signal to the positioner from the controller. If it does not then change it to match the input signal.

4. Position the "ACTION" switch SW-2 to "DIR" or REV" depending on the required action of the positioner. "Dir" will increase the output to the actuator through the upper port of the positioner when the input signal increases (venting the lower port in double acting). "REV" will increase the output to the actuator through the lower port of the positioner (venting the upper port in double acting).

5. Adjust the regulated air supply to the positioner to the maximum of the actuator. Do not exceed 100 psig.

6. Check that pins J5 and J8 have jumpers on them.

Note: J6 will allow the positioner to run as a standard 4 to 20 mA positioner. If the jumper is on J5 and not J6 then the positioner will put full pressure to the top of the actuator when the input signal reaches 4.00 mA.

INITIAL CALIBRATION PROCEDURE

Calibration is performed using SW-1 with the input jumper on the 4-20mA range (J1). SW-1 has four positions and they are:

Z = Valve Zero (factory set).
S = Valve Span (user adjustable).
MID = Valve Mid-Stroke (factory set to 4-20mA range only).
OP = Operation Mode (responds to external controller signal).

IMPORTANT NOTE: Calibrating the DPS-1 to a 4-20mA (J1) Input range following the procedure presented below automatically calibrates the remaining J2 (4-12mA), J3 (12-20mA), J4 (0-5V) input ranges. Only the Mid-Stroke signal for J2, J3, J4 must be externally introduced in the OP (Operation) position only to verify Mid-Stroke valve position.

1. Set SW-1 to "Z" (zero) position.

2. Turn on the power to the DPS-1. The valve will go to the shut position.

3. Turn the "STK ADJ" (Stroke Adjust) potentiometer (R42) to the fully counter clockwise position. There is no stop on the potentiometer, therefore listen and feel for the clicking sound.

4. Move the switch SW-1 to the "S" (span) position.

5. Adjust the "STK ADJ" (Stroke Adjust) potentiometer (R42) until the valve has opened to the desired stroke.

6. When in the J1 (4-20mA) Input position only (see "Important Note" above for the J2, J3, J4 settings) move SW-1 to the "MID" (Mid-Stroke) position to verify that the valve is actually in the mid-stroke position.

FINE TUNING PROCEDURE

The response speed of the DPS-1 must be fine tuned to the actuator and valve it is mounted on to avoid erratic behavior.

1. Turn the "RESPONSE SPEED" coarse and fine potentiometers to the fully counterclockwise position to obtain the slowest valve movement.

2. Move switch SW-1 to the "Z", "S" and "MID" (valve will reach calibrated mid-stroke position only in the J1, 4-20mA Input setting. J2, J3 and J4 Input positions will not put valve in actual Mid-Stroke and is not a concern in the Fine Tune Procedure).

3. Increase the speed of the valve by turning the "COURSE" potentiometer clockwise. Repeat steps 2 and 3 until the valve becomes unstable. Then slowly turn the "COURSE" potentiometer counter clockwise until the valve becomes stable. Once stable, positioner should slightly overshoot position when repeating step 2.

4. Adjust the "FINE" potentiometer by turning clockwise, repeat step 2 until overshoot has stopped.

5. Positioner is now adjusted for maximum performance.

6. Turn SW-1 to "OP" for normal operation.

NOTE: Always check that the switch SW-1 is in the "OP" position before closing the positioner door.

CAUTION!

Do not adjust potentiometer R1, R43 or R73. These potentiometers should only be adjusted at the factory.

SPECIAL FEATURES:

1. The positioner will hold its last position if the power to the positioner flickers for six seconds or less.
2. Power loss over six seconds will automatically close the valve to reset the positioner electronics before resuming normal operation.
3. Automatic Zero position setting.
4. No interaction between zero and span.
5. Easy to set the positioner for split range (One Jumper).
6. Optional universal power to the positioner, including DC.

TROUBLESHOOTING

If...	Then...
The control valve operates in the opposite direction.	Check the position of SW-2 “DIR” or “REV” switch. Check the tubing connections.
The positioner does not operate at all.	Check the power connections to the positioner.
The positioner does not respond to the input signal.	Check that SW-1 is in “OP” position. Check pins J1 through J4 for proper selection of input signal
The control valve does not respond to the positioner output	Check the filter/regulator supplying air to the positioner. Make sure that the output pressure is at least 5 to 10 psig higher than the pressure required to stroke the valve. Check the operation of the actuator Check for tubing leaks.
The system cycles	Packing too tight on the valve stem. Valve stem is sticking. Check that the valve is operating in its rated flow (usually 10 to 90% open). Check with soapy water, all of the pneumatic connections from the positioner to the actuator for leaks Check that the controller operating signal is not cycling. Check the drive arm for looseness or bending.

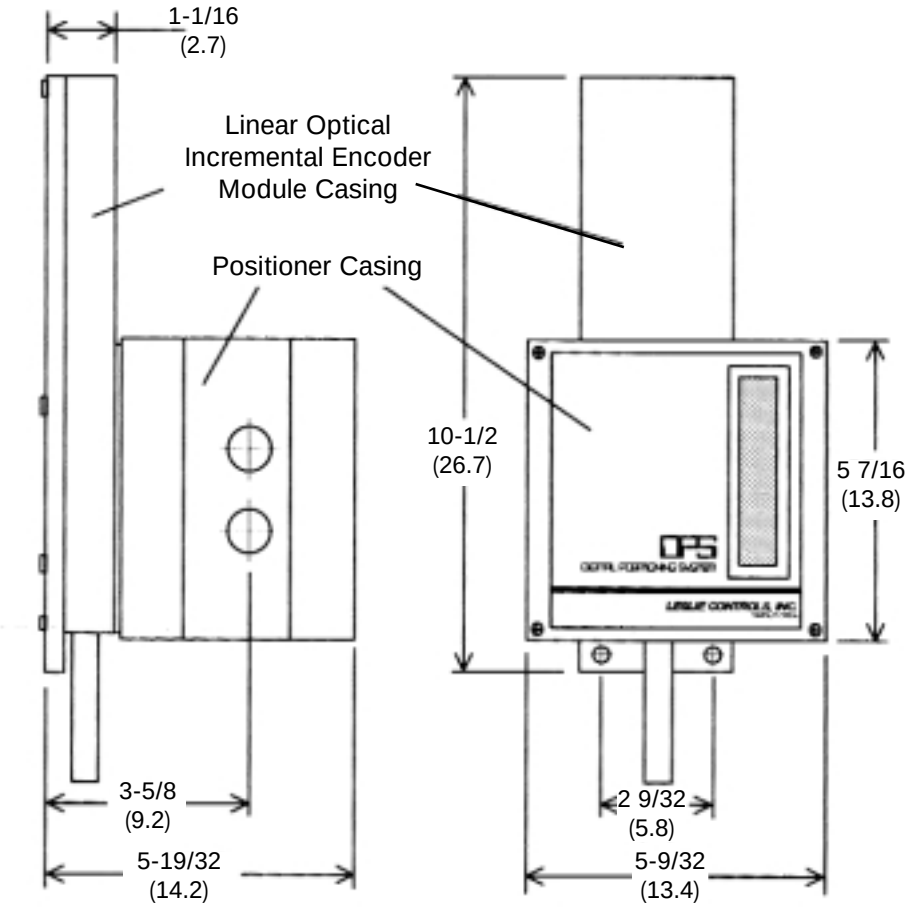

Figure 1
Overall Dimensions
inches
(mm)

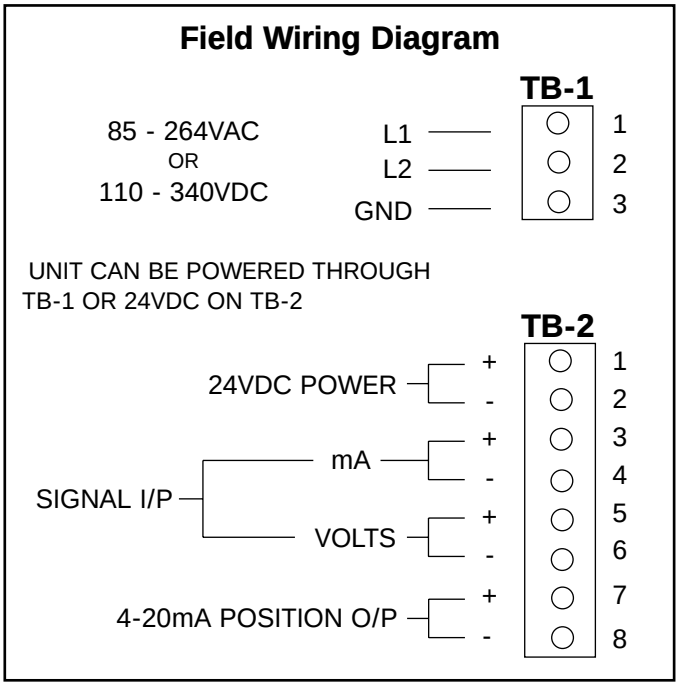

Figure 2

Figure 3a: Typical Positioner Mounting on Yoke

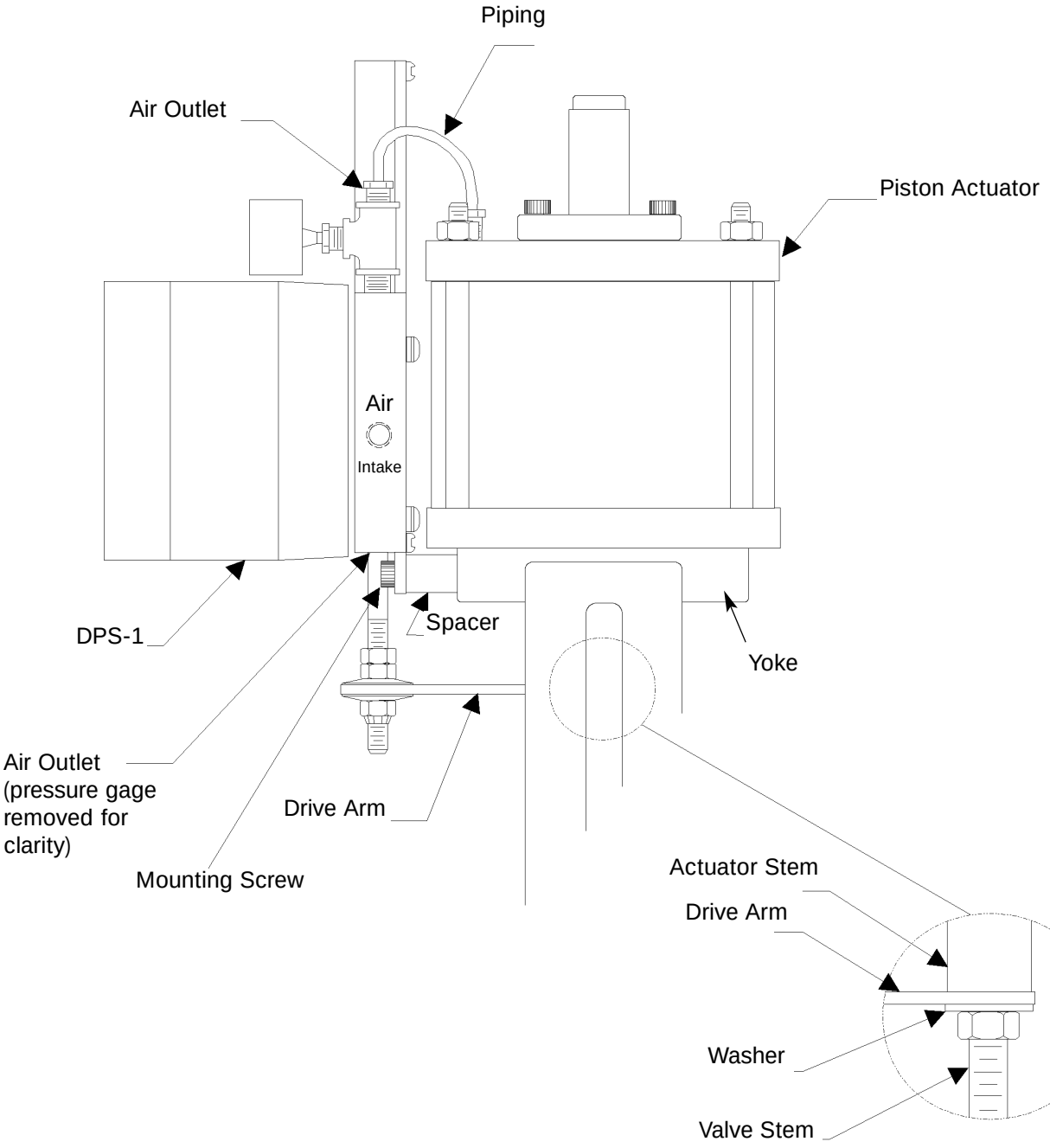

Figure 3b: Attachment of Drive Arm to Valve Stem

Figure 4a: Typical Positioner Mounting on Piston Actuator

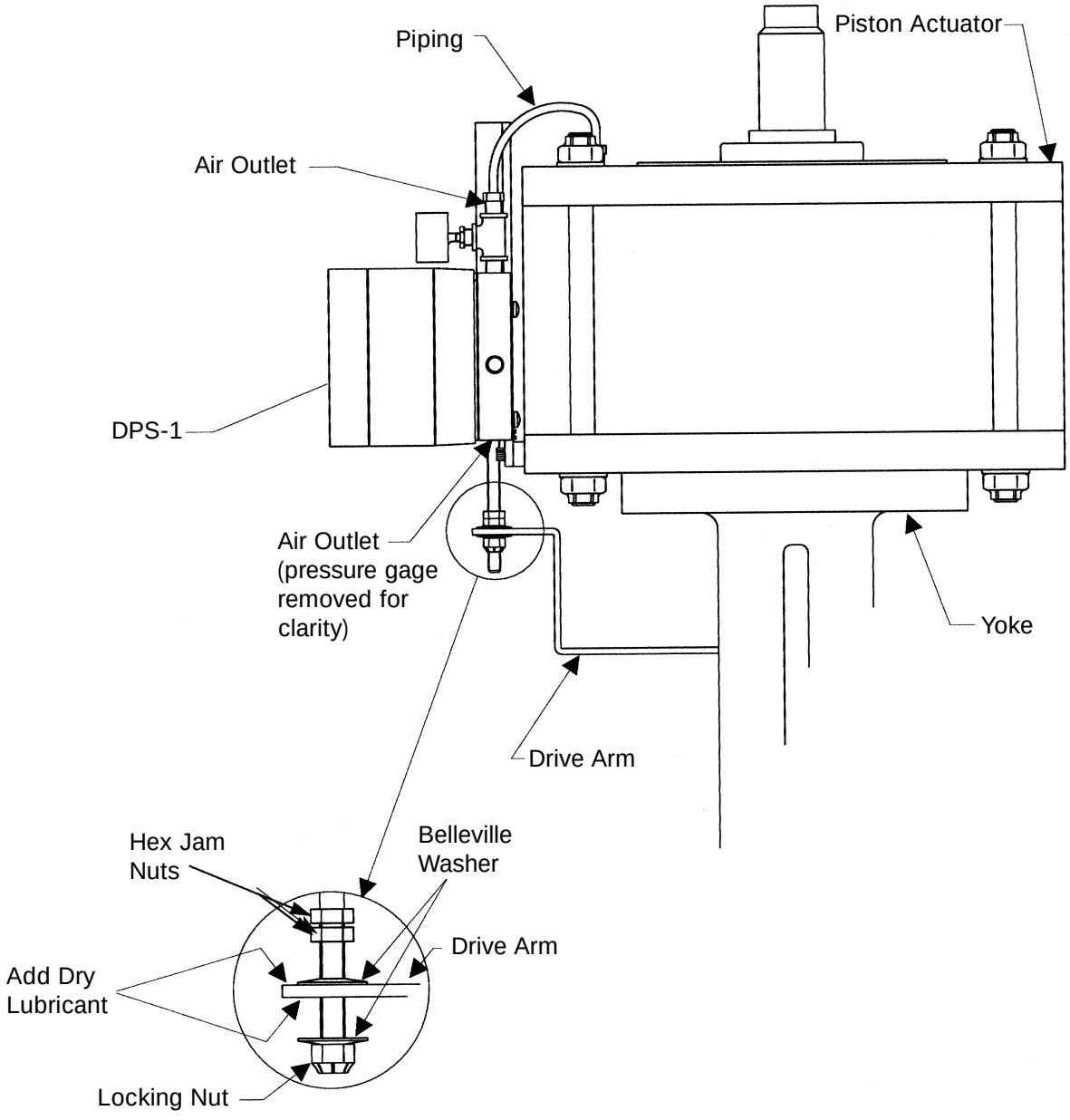

Figure 4b: Positioner/Drive Arm

FIGURE 5: PC BOARD LAYOUT