

Bimba Model PCS Pneumatic Motion Control System Operating Manual



*Please read this manual carefully before implementing your
Pneumatic Control System.*



General Warnings and Safety Guidelines

Start by Reading These Important Safety Rules



THIS SAFETY ALERT SYMBOL MEANS **CAUTION** — PERSONAL SAFETY, PROPERTY/FIXTURING DAMAGE, OR DANGER FROM ELECTRICAL SHOCK. READ INSTRUCTIONS WITH THIS SYMBOL CAREFULLY.



READ ALL INSTRUCTIONS CAREFULLY BEFORE INSTALLATION. SAVE THIS MANUAL FOR FUTURE REFERENCE.



IF ACTUATOR BECOMES JAMMED, DISCONNECT ALL COMPRESSED AIR CONNECTIONS TO THE ACTUATOR BEFORE ATTEMPTING TO RELEASE OR REMOVE JAMMED ITEM.



IF FULL SYSTEM PRESSURE IS APPLIED WITH A LARGE ERROR SIGNAL PRESENT, THE ACTUATOR WILL ATTEMPT TO INSTANTANEOUSLY MOVE TO THE COMMAND SIGNAL POSITION. THIS COULD POTENTIALLY CAUSE PHYSICAL HARM OR DAMAGE TO APPLICATION TOOLING. ONCE SYSTEM IS INSTALLED, ALWAYS ENSURE THAT THE COMMAND SIGNAL AND FEEDBACK SIGNAL ARE EQUAL AT START UP, OR START SYSTEM UP AT LOW PRESSURE.



This symbol represents boxes that contain helpful hints and recommendations.



This symbol represents boxes that contain important notes, reminders, and items that may need special attention.

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General Overview

The Bimba Pneumatic Control System (PCS) is a closed loop electronic controller with pneumatic valves that can move the rod or shaft of a pneumatic position feedback actuator and hold it in any desired position with accuracy and force. The PCS system is designed for series PFCN, PFCNL, PFC, and PFCL cylinders for linear motion and the Position Feedback Pneu-Turn (PTF) for rotary motion. The PFC should be ordered with the -L option, low friction seals, for the best positioning accuracy and smoothest operation. The standard PTF includes low friction seals.

The standard PCS accepts a 0 to 10 VDC or 4 to 20mA analog command signal, jumper selectable (refer to the illustration on page 11). The command signal defines the position the rod must move to. The rod stops when the feedback voltage from the probe is equal to the command signal.

For example, if the application has a stroke of 10 inches and zero and span adjustments are set for zero to ten inches as well, then a 1 volt change in the command voltage is equal to a 1 inch movement. Similarly, a change in command signal of 0.005 of a volt equals a position change of 0.005 of an inch for the same 10 inch stroke application. If the application has a stroke of 5 inches, a change of 1 volt in the command signal represents a half inch movement. For rotary applications, the convention is similar. If the application has a rotation of 180 degrees, then a 1 volt change in the command signal is equal to 18 degrees of rotation.

The system utilizes the feedback from the actuator to close the control loop. The control loop compares the 0-10 VDC or 4-20mA input command signal to the feedback signal from the actuator. The difference between the command and feedback is referred to as the error term. When the error term is zero, all valves close, trapping air on both sides of the actuator piston. (The error term is considered to be zero when it is within the deadband range. The deadband is defined in the Glossary of Terms section.) This holds the rod at its commanded position. If a force attempts to move the rod or shaft out of the commanded position, the system will react by increasing the restoring force to maintain position. Likewise, if the command signal changes, the system will respond to make the feedback equal the command signal.



The actual accuracy/repeatability of the movements will depend on many factors, including signal noise, load, velocity, supply pressure, supply voltage, and application friction. Refer to the Application Sizing charts for detailed information regarding sizing and suggestions for your application.

Typical Applications

The PCS system is ideal whenever increased flexibility and adaptability is needed in a process; for example, in order to accommodate various size parts and assemblies, or to add control for improved consistency, quality, and productivity. Typical applications are listed below.

Flow Gate

The PCS system can control the position of a flow gate, controlling the rate of product that flows to downstream processes. The position of the gate can be changed to allow more or less product flow depending on the requirements of the process. Sometimes this is controlled manually, resulting in wasted manpower and less control.

Robotic End Effector

The PCS system can control the open position of an end effector for a robotic arm. If the robotic arm is picking and placing differently sized products, the cycle rate can be increased if the open position is automatically adjusted to be only slightly larger than the product itself, reducing the time it takes to grasp the product.

Exhaust Control

The PCS system can control the position of exhaust dampers used in process control systems for increased control in plant emissions, smoke houses, and similar applications.

Labeling

The PCS system can position differently sized parts under a label applicator, allowing the labeling process to continue without any down time for a setup change to adjust for product size.

Animatronics

The PCS system can produce lifelike movements of puppets and figures, such as those used in amusement and entertainment industries. Using an industrial computer or PC, movements can be changed without a hardware change, simplifying new shows and edits.

Glossary of Terms and Formulas

For clarity, please review the definitions below. Descriptions for linear motion actuators (PFCN, PFC, PFCNL, PFCL) are often different from descriptions for rotary actuators (PTF).

ZERO (ZERO Position)

When the PFC rod is fully retracted or the PTF shaft is rotated fully counterclockwise (CCW), it will reach a mechanical stop, due to either a mechanical limit in the application or the actuator's end of stroke or rotation. The PCS' Zero adjustment allows you to adjust the position of the cylinder at 0 VDC control voltage input. Adjustment range is from the fully retracted mechanical limit to approximately 50% of the full actuator stroke or rotation. Refer to the installation section for a description of the adjustment procedure.

SPAN (Full Scale Position)

When the PFC rod is fully extended or the PTF shaft is rotated fully clockwise (CW), it will reach a mechanical stop, due to either a mechanical limit in the application or the actuator's end of stroke or rotation. The PCS' Span adjustment allows you to adjust the position of the cylinder at 10 VDC control voltage input. Adjustment range is from the fully extended mechanical limit to approximately 50% of the full actuator stroke or rotation. Refer to the installation section for a description of the adjustment procedure.



The Zero and Span adjustments can be combined for a total adjustment window of only 50% of total actuator travel, i.e., if the Zero Adjustment is adjusted out to 50% of actuator travel, then the Span Adjustment cannot be adjusted lower than 100%. The effective travel of the actuator in this case would be between 50 and 100%.

Special Note for PTF's with less than 180 degrees of Travel:

Due to the 50% window limitation, the minimum effective electrical rotation for PTF's is 180 degrees of rotation. This is explained further in the PTF application example on Page 21.

MAIN CONTROL (Command or Input Signal)

The Main Control command signal is a variable analog signal, either 0-10 VDC or 4-20 mA depending on the position of jumper JO2 (see the illustration on page 11 for instructions on setting jumpers). The command signal, proportional to the displacement of the actuator, can be supplied by a PLC analog output card or any other low noise signal source. The low end of the range affects the zero position of the actuator and the high end of the range affects the full scale position of the actuator.

The command signal can be translated into actuator displacement with the following formula:

$$CS = (d * R / t) + Z$$

where:

CS = the command signal required to achieve a desired position

d = the displacement the desired position is from the zero position

R = the full range of the command signal

t = full scale travel of the actuator (*Note: for PTF rotary actuators with total rotation less than 180°, always make t = 180*)

Z = the command signal for the zero position

Example 1: A system uses a 0-10 volt command signal, "R" is 10 and "z" is 0. If a position of 2 inches is desired from a 7 inch stroke cylinder, the required Command signal (CS) is $(2 * 10 / 7) + 0$ or 2.857 volts.

Example 2: A system uses a 4-20 mA command signal, "R" is 16 and "z" is 4. If a 30° position is desired from a 90° rotary actuator, the required Command signal (CS) is $(30 * 16 / 180) + 4$ or 6.67 mA.

FEEDBACK SIGNAL

The feedback signal is a voltage signal from the actuator that corresponds to the displacement or rotation of the actuator. The feedback signal range is approximately 0 - 10 VDC.



PTF Note:

The PTF has a fixed electrical rotation span of 340 degrees. This will affect some of the following adjustments and signals for PTF's with full scale rotations of less than 180 degrees.

DEADBAND

The Deadband is a bi-directional band, centered on the commanded position. Once the actuator is within this zone, the error term will be considered zero and all valves will be closed. This deadband is measured in volts and can be adjusted between 0.005 and 0.500 volts. This voltage can be translated to a deadband width with the following formula:

$$w = 1/10V * t$$

Where:

w = deadband width

V = voltage reading from the PCS

t = full scale travel of the actuator (*Note: for PTF rotary actuators with total rotation less than 180°, always make t = 180*)

The full deadband zone is the deadband width above and below the target position.

Example 1: If the deadband is set for 20mV (0.02 of a volt) for a 6 inch stroke cylinder, the width of the deadband zone will be $1/10 * 0.02 * 6$ or ± 0.012 of an inch.

Example 2: If the deadband is set for 20mV (0.02 of a volt) for a 180° actuator, the width of the deadband zone will be $1/10 * 0.02 * 180$ or $\pm 0.72^\circ$.

DECEL RANGE

Once the PCS receives a command signal to move the actuator rod or shaft to a new position, two of the pneumatic valves are opened causing the actuator to move toward the desired position. The Decel Range is an adjustable zone outside the Deadband in which the PCS control begins to slow (decelerate) the actuator rod. The Decel Range enables the PCS system to accurately position the actuator inside the Deadband. The Decel Range is measured in volts and can be adjusted between 0.5 and 13.5 volts. Optimal decel settings vary with the load and application. However, 1.5 volts is a good default setting for PCS models 1, 2, and 3, and 9 to 11 volts usually works well for PCS models 5, 7, and 8.

The following formula will translate the voltage reading into the Decel Range.

$$DR = 0.01485 * V * t$$

Where:

DR = decel range

V = voltage reading from the PCS

t = full scale travel of the actuator (*Note: for PTF rotary actuators with total rotation less than 180°, always make t = 180*)

Example 1: If the Decel Range is set to 5 volts for an 8 inch stroke cylinder, then deceleration will occur for 0.60 inches ($0.0149 * 5 * 8$).

Example 2: If the Decel Range is set to 5 volts for a 180° rotary actuator, then deceleration will occur for 13.4° ($0.0149 * 5 * 180$).

CURRENT POSITION

Current Position is a 0 to 10 volt output signal that mirrors the feedback signal from the actuator, fully scalable with the Zero and Span adjustments. In other words, its output will always be 0 to 10 volts no matter how Zero and Span are adjusted. It can be used to monitor the motion of the actuator and the output may be sent to a calibrated display.

AT POSITION (@ POS)

At Position is a digital output signal that is normally open and switches to ground when the actuator is within the Deadband zone. This signal is useful for utilizing a PLC I/O card to receive a signal indicating that the actuator is within the Deadband zone, potentially eliminating the need for an analog input card.



Be cautious when utilizing the @ POS signal. If there is overshoot in the application, the actuator may momentarily go through the Deadband Zone, causing the @ POS signal to momentarily transition back open, before finally stopping in the Deadband Zone.

REPEATABILITY AND STABILITY

It is important to understand the difference between repeatability and stability. A system is considered repeatable if it comes to a stop inside the deadband zone. A system is considered stable if it comes to a stop in the deadband zone time after time with no overshoot. There are different degrees of instability. The first is a system that approaches the commanded position and overshoots it just a little and has to reverse itself before settling to a stop in the deadband zone. This level of instability may be acceptable in many applications. The worst type of instability is oscillation around the deadband zone, never settling to a stop. This level of instability must always be resolved.

MOVEMENT DIRECTIONS

Movements of the actuator may be described as “Increasing” or “Decreasing.” An “Increasing” move is one that moves toward the Full Scale Position. A “Decreasing” move is one that moves toward the Zero position.

Installation Instructions

Before installing your system, refer to the Application Sizing and Rules of Thumb section to ensure your system is sized properly for your application. Use the following steps to successfully install and operate your PCS system. There are a couple of application examples that follow this section which are helpful in gaining a full understanding of the adjustments that will be made.

1. **INSTALL THE BIMBA ACTUATOR**

Install the actuator as you would any other actuator, ensuring that the feedback cable routes away in a careful and protected manner.

2. **MOUNT THE PCS**

Select a mounting location for the PCS not more than 18 inches from the actuator if possible. Positioning accuracy and efficiency improves when the PCS is mounted close to the actuator. Be sure to allow sufficient room for both the pneumatic connections and the electrical connections on opposite sides of the PCS enclosure. Drill four mounting holes (for up to 5/16 diameter mounting bolts) and secure the PCS in position by the enclosure's mounting flanges.

Option-N (No Enclosure)

If Option-N is specified, the PCS system will be shipped with the PCS printed circuit board, a snap track, a valve manifold, and four 25 foot valve cables. The snap track allows for easy mounting inside a larger enclosure box. Mount the snap track in the enclosure and snap the PC Board in place. Mount the valve manifold near the actuator. Be careful to mount the manifold in a place where the valves will not be vulnerable to physical damage.

3. **MAKE THE PNEUMATIC CONNECTIONS**



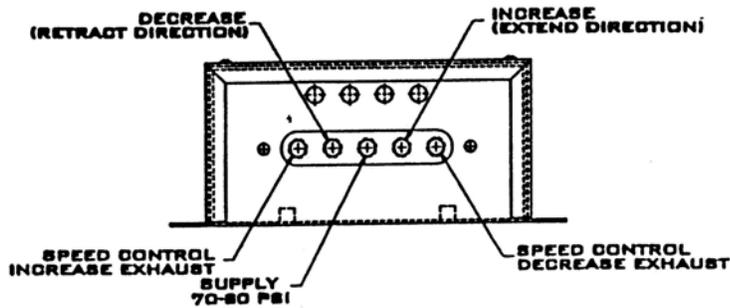
Pressures above 100 psi may damage the PCS control's valves.
Pressures below 70 psi may result in erratic operation.

The supply air must be 70 to 80 psi. Air supply pressure affects system performance, not just force. Air must be filtered to 5 microns and regulated, and the connections *must* be leak free. Leaks of any kind in the plumbing will cause the PCS to adjust to make up for this air loss, creating unnecessary wear on the valves and generating chattering that might be interpreted as a malfunction. All of the pneumatic fittings, tubes, etc., must seal perfectly. For a perfect seal, push-in fittings with O-rings inside perform well. If Teflon tape is employed, care must be taken to ensure that loose pieces don't get into the system. Liquid thread sealants must not be used; they can attack the materials of the transducer. It is also important that tubing used between the PCS valve manifold and the actuator does not expand with pressure. Volume changes, even though slight, will cause the system to work harder. Metal tubing is the best, but nylon is also satisfactory. Do not use very soft, easy to expand tubing like Tygon®.

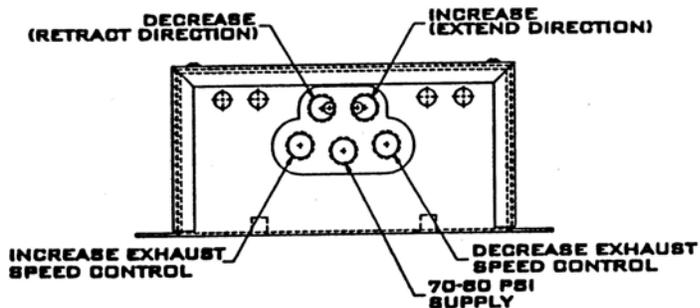
The following table shows recommended tubing sizes. Oversized tubing will degrade positioning repeatability.

Bore Size		Tubing Size
PFC	PTF	
1-1/16" (09)		5/32" OD
1-1/2" (17)	1-1/2" (098/196)	5/32" OD
2" (31)	2" (247/494)	1/4" OD

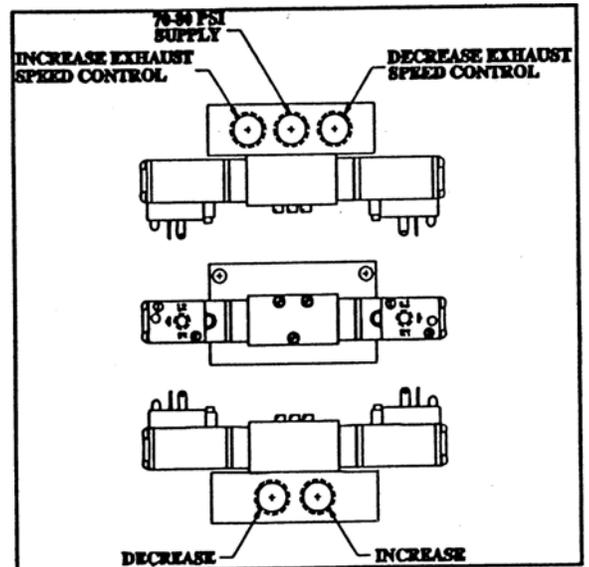
Air line connections are described in the illustrations below. Instructions follow. Also consult the Appendix for air and electrical connections to PFCN, PFC, and PT.



Air hose connections for enclosed controls PCS models 1, 2, 3



Air hose connections for enclosed controls PCS models 5, 7, 8



Air hose connections for option N PCS controls (without enclosures)

- Connect the 70 -80 psi supply air to the center port of the valve manifold.
- Connect the valve manifold retract port (the port directly to the left of the center port when the manifold is facing you) to the rod end of the cylinder.
 - For PTF rotary actuators, connect this to the port on Body "A" for single rack models (left side when the PTF shaft is facing toward you), or connect to bodies "A" and "D" for double rack models (lower left and upper right when the PTF shaft is facing toward you).
- Connect the extend port (the port directly to the right of the center port when the manifold is facing you) to the cap end of the PFC cylinder.
 - For PTF rotary actuators, connect this to the port on Body "B" for single rack models (right side when the shaft is facing toward you), or connect to bodies "B" and "C" for double rack models (upper left and lower right when the shaft is facing toward you).

Do not turn the air supply on at this time.

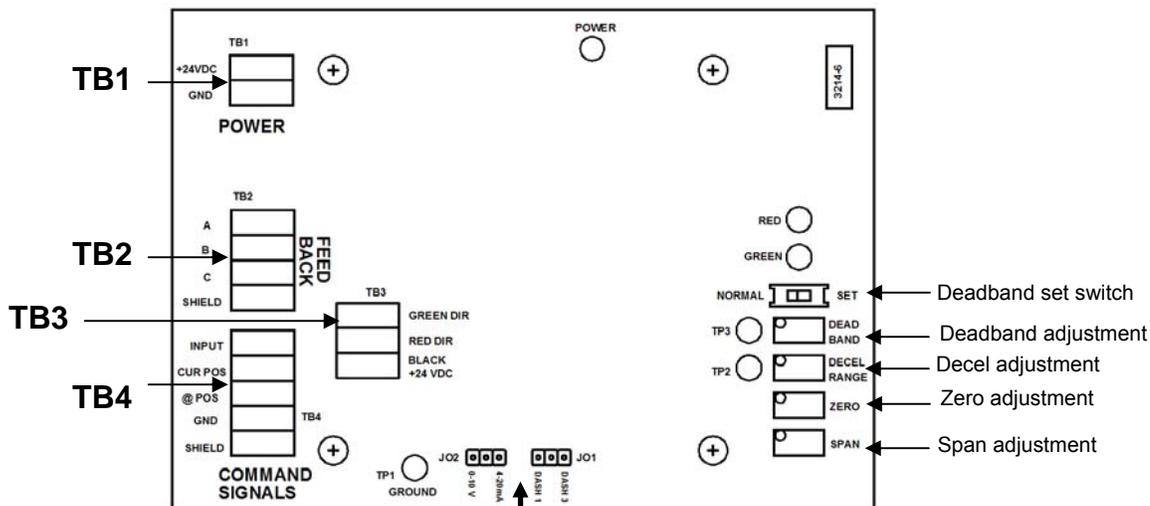


For best positioning results, consider using a precision relieving regulator and an air reservoir with a check valve before the regulator to ensure that there are no pressure drops to the PCS system. You may want to install mufflers into the exhaust ports of the valve manifold (the two outer ports). This will make the system quieter during operation. Do not use mufflers with low flow rates; that may slow the actuator.

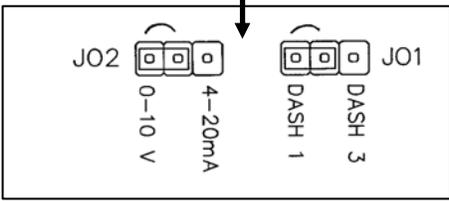
4. CONNECT THE POWER CABLE

Standard Enclosure

Carefully remove the enclosure cover. Use a two conductor cable, 22 gage minimum, with an outside diameter between 0.114 and 0.250 inch. Pass the cable through the bulkhead strain relief and connect to the **POWER** terminal block (TB1) on the PCS circuit board (refer to illustration below). If a shield wire is used, twist the Ground wire and the Shield wire together and connect to the Ground terminal (do not terminate the other side of the shield).



You may adjust the jumper on JO2 for 0-10V (left and center terminals connected) or 4-20 mA (right and center terminals connected) operation.



Do NOT change the jumper JO1. This adapts the board for use as PCS-4 through PCS-8 operation. Different valves must be installed as well.

Set jumper J02 for 4-20 mA or 0-10 V control voltage input in accordance with the illustration above. Refer to Appendix A for air and electrical connections to PFCN, PFC, and PT.

Option N

Connect a two conductor, 22 gage minimum shielded cable to the **POWER** terminal block (TB1) on the PCS circuit board. Twist the ground and shield wire together and connect to the Ground terminal (do not terminate the other side of the shield).

Option Q

Connect the Quick Connect power cable (2 meter model PCS-CBL-PWR or 5 meter Model PCS-CBL-PWR-X) to power. Connect the other end of the cable using the following color codes: **+24 VDC-Brown**, **Ground-Blue**, the other wires are not used.

Quick Connect Wire Color Codes					
Power cable PCS-CBL-PWR			Command Cable PCS-CBL-CMD		
Color	Pin	Description	Color	Pin	Description
Brown	1	Positive	Brown	1	Input
White	2	N/C	White	2	@ Position
Blue	3	Negative	Blue	3	Ground
Black	4	N/C	Black	4	Current Position
Green/Yellow	5	N/C	Gray	5	N/C
			Pink	6	N/C



Do **not** allow the supply voltage to vary outside of the 23.5 to 24.5 voltage specification, as this will degrade system response and performance significantly.

5. CONNECT THE FEEDBACK CABLE



For PFCN only, power to the probe **MUST** come from 24 VDC supplied to the PCS control, and NOT the 10 VDC that the PCS produces from terminal A of TB2.

For PFCN only, If the Q (quick connect) option was selected, the lead from the connector to terminal A of TB2 must be removed and the lead reinserted into the +24VDC terminal of TB1.

For PFCN only, always insert a jumper between TB1 ground and TB2 terminal C.

See **PFCN ELECTRICAL AND PNEUMATIC CONNECTIONS** illustration in **APPENDIX A**.

Standard Enclosure

Connect the feedback cable from the actuator to the PCS. The OD of the cable **must** be between 0.114 inch and 0.250 inch. If the actuator is equipped with a plug connector, utilize accessory cable C5 or C5X. If the actuator has a pigtail lead, attach a longer cable between the actuator and the PCS observing the color standards shown in the table below. Pass the cable through the bulkhead strain relief and connect the individual wires to terminal block TB2 on the PCS board.

Wire Function From Feedback Device	Wire Color 3 Pin Connector (C5 or C5X)	Wire Color Pigtail Lead	PCS Terminal Block TB2
Input (Excitation Voltage)	Blue	Red	A
Feedback Signal	Brown	White	B
Ground	Black	Black	C
Shield	Shield	N/A	Shield



Accessory cable C5/C5X is required for PFC's with the plug connector option (Option-P quick connect option), and for PTF's on which a connector is standard).

Option-N

Connect the shielded feedback cable to terminal block TB2 on the PCS PC Board, allowing for proper strain relief. Follow the same wire color designation defined in the table from the previous section.



Be sure to use a shielded cable, or noise will couple to the feedback signal creating noise in the system resulting in poor operation of the system.

Option-Q

Connect the Quick Connect feedback cable (2 meter Model PCS-CBL-FBK or 5 meter Model PCS-CBL-FBK-X) between the PCS and the actuator. *The Quick Connect Option, Option-P, must be ordered with the PFC for mating cable to work. The Quick Connect plug connector is standard on the PTF.*

6. CONNECT THE COMMAND SIGNAL CABLE

Standard Enclosure

Connect the Command Signal Cable from the Main Control to the PCS. This cable should be a 4-conductor, twisted-shielded cable, 22 gage minimum. A 2-conductor cable can be used if @ Position and Current Position signals are not utilized. The cable's outside diameter *must* be between 0.114 and 0.250 inch. Pass the cable through the remaining bulkhead strain relief and connect the individual wires to PCS Terminal Block TB4 on the PC Board as follows:

Input (Command Signal) A positive analog input signal to the PCS control of 0-10 VDC or 4-20mA which defines the desired position of the PFC rod or PTF shaft..

Current Position A positive analog output voltage (0-10 VDC) from the PCS which corresponds to the current position of the PFC rod or PTF shaft.

@ Position A digital output signal that is normally open and switches to ground when the actuator is within the Deadband zone (Current Position equals Command Signal).

Ground This is the power return path and must connect to both the Main Control and the PCS control ground connections.

Shield Connect only to the PCS. It *should not be* connected to the Main Control end of the cable.

Option-N

Connect the individual wires from the Command Cable to PCS Terminal Block TB4 on the PC Board per above. Provide the proper strain relief.

Option-Q

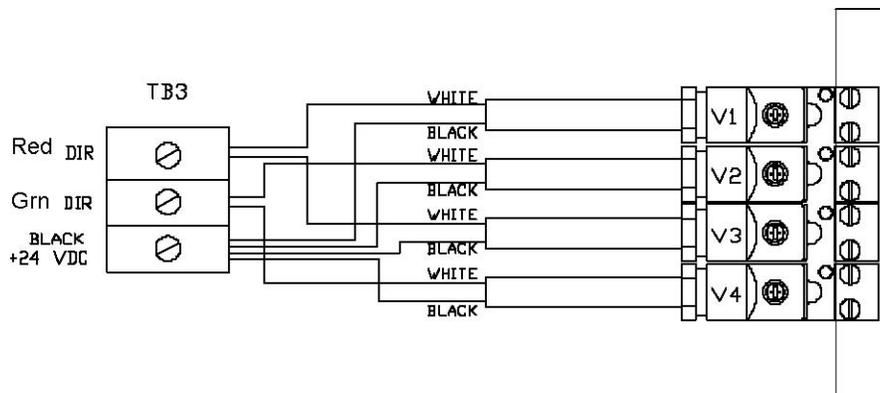
Connect the quick connect command cable (2 meter Model PCS-CBL-CMD or 5 meter Model PCS-CBL-CMD-X) connector end of the cable to the enclosure box command signal connector (this is the 6 pin connector, the connector is keyed and can only be plugged into the correct connector). Connect the other end of the cable using the following color codes: **Input-Brown**, **Current Position-Black**, **@ Pos-White**, **Ground-Blue**. The other wires are not used. See definitions above in the Standard Enclosure section.

7. Perform the following step for OPTION N Only. CONNECT VALVE CABLES TO PCS PC BOARD

Connect per the following

- Connect all 4 Black wires from the valves to **TB3 BLACK +24 VDC**.
- Connect the 2 white wires from Valves V1 and V3 to **TB3 RED DIR**. (Decreasing Direction)
- Connect the 2 white wires from Valves V2 and V4 to **TB3 GRN DIR**. (Increasing Direction)

The following diagram below shows the location of the valves, when looking down at them.



8. CHECK ALL ELECTRICAL AND PNEUMATIC CONNECTIONS

Make sure all pneumatic connections to the actuator and PCS are correct and leak free. Double check all electrical connections at the actuator, the PCS, the power supply and the Main Control. If all electrical connections are correct, carefully tighten the captive plastic nut on the strain relief fittings. Do not install the control enclosure cover yet.

9. APPLY 24 VDC POWER

With the actuator mounted in final position and the PCS or snap track mounted in its final position, apply the 24 VDC power to the PCS. The cylinder should not move since it does not yet have any pneumatic pressure. **You may hear clicking noises and/or have a Green or Red LED on, which is normal.**



Measure the voltage with a digital voltmeter at Terminal Block TB1 on the PCS PC Board. The voltage must be between 23.5 VDC and 24.5 VDC for the system to function properly.

10. **APPLY PNEUMATIC PRESSURE**

Ensure the actuator is clear of all obstacles. Apply a low pneumatic pressure (20 psi). The actuator should attempt to move. If no command signal is applied to the PCS, the cylinder will attempt to assume its zero position. Once the cylinder has moved and stopped, raise the pressure to the normal operating pressure (70 to 80 psi). If the actuator does not move, it may already be at the zero position.



CAUTION!

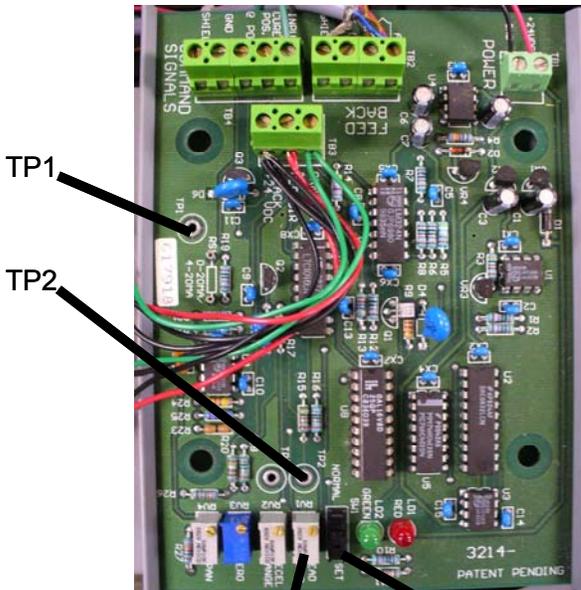
If full system pressure is applied with a large error signal present, the actuator will attempt to instantaneously move to the command signal position. This could potentially cause physical harm or damage to application tooling. Once system is installed, always ensure that the command signal and feedback signal are equal at start up or start system up at low pressure.

11. **SET THE “DEADBAND”**

The Deadband should initially be set according to the Application Sizing Chart. Move switch SW1 on the PC Board from the **NORMAL** to the **SET** position. (see illustration on page 11 and the photo below). Set the digital voltmeter to DC volts and measure the voltage between the Ground Reference Point (TP1) and TP2 on the printed circuit board. Adjust the Deadband setting to the recommended minimum voltage setting shown in the Application Sizing Chart.



After the Deadband is set, the SW1 Switch must be returned back to the Normal position or the PCS will not function.



TP1
TP2
Deadband SW1
DEADBAND ADJUSTMENT



Span Zero LED's
SPAND AND ZERO ADJUSTMENTS

12. COMMAND THE BIMBA ACTUATOR TO ITS ZERO POSITION

We will command the PCS to move to different positions by adjusting the command signal input to TB4. First command the PFC cylinder or the PTF rotary actuator to retract to the zero position by setting the analog command input signal to 0 volts or 4 mA, depending on the setting of jumper J01. Either the cylinder will move to its hard stop (either internal or external) or it will move to a point short of that stop.



Note: Improve performance by *not* using the actuator end of stroke limit as a hard stop. (Eliminates any potential stiction between the actuator piston and the end cap, as well as improves the positioning capability at end of stroke or rotation). This can be accomplished by implementing mechanical hard stops in the application fixturing or by using command signals greater than the set zero position or less than full scale.

13. PRELIMINARY “ZERO” ADJUSTMENT

PFC and PFCN cylinders and PTF rotary actuators greater than 180 degrees of rotation (See below for PTF’s less than 180 degrees)

Adjust the Zero setting so that it coincides with the desired retracted or rotational position hard stop. First note the two red and green LEDs on the PCS printed circuit board. If the PCS wants to move the actuator towards the actuator zero position, but cannot due to a mechanical limitation, the red LED will stay on continuously flicker. Look at the LEDs and make the adjustments described in one of the two following paragraphs.

If the Red LED is On - (The Zero setting is currently set beyond the desired retracted or rotational position). Adjust the Zero potentiometer CCW slowly, until the red LED goes off. (If the zero potentiometer was adjusted too far and the actuator moved away from zero, adjust the Zero potentiometer CW just enough to move the actuator back to the zero position. If adjusted too far, the red LED will come back on). Both LEDs should be off when set correctly. This ends the preliminary Zero adjustment.

If Both LEDs are Off - (The Zero setting is currently set somewhere in mid-stroke.) Slowly adjust the Zero potentiometer CW to move the actuator toward the zero position. The red LED will flicker while being adjusted. When the actuator hits the zero position, the red LED will continue to flicker even when the adjustment is no longer being turned. Now adjust the Zero CCW just enough to turn off the red LED. Both LEDs should be off when set correctly. This ends the preliminary Zero adjustment.



Note: If the system does not move at all, go back and check all of your connections. For Option-N models, be sure the valve cables are connected properly. If the wires are reversed, the actuator may move opposite of the intended direction. (i.e., zero will move the actuator to its full scale position. If the actuator does this, reverse the white wires from the valve cables.)

Also - If the LED's occasionally pulse on, it may indicate a slight leak in the system. The system will work OK with a slight leak, but you may want to eliminate the leak so the system operates at maximum efficiency

PTF rotary actuators less than 180 degrees of rotation

Considering all feedback potentiometers used on PTF rotary actuators have an electrical rotation angle of 340 degrees, and that the Zero and Span adjustments can only be adjusted down to a 50% window of total electrical span, PTF rotary actuators less than 180 degrees of rotation will not be able to use the full scale span of the analog command input signal, and will be treated by the Main Control as though they are 180 degree units.

PTF's less than 180 degrees of rotation are shipped with the feedback potentiometer's electrical zero set to the PTF's rotational zero position, so when the zero analog command input signal is applied to the PCS input, the PTF should be very close to the zero rotational position when the zero adjustment is fully CW. Now follow the steps below.

If the Red LED is On - (The Zero setting is currently set beyond the desired retracted or rotational position). Adjust the Zero potentiometer CCW slowly, until the red LED goes off. This should only be a minor adjustment. If the zero potentiometer needed many turns of adjustment, the PTF feedback potentiometer located on the back of the PTF may be set incorrectly, and may prohibit the Span adjustment from being made properly. We will address this in the Span adjustment section if necessary. (If the zero potentiometer was adjusted too far and the actuator moved away from zero, adjust the Zero potentiometer CW just enough to move the actuator back to the zero position. If adjusted too far, the red LED will come back on). Both LEDs should be off when set correctly. This ends the preliminary Zero adjustment.

If Both LEDs are Off - (The Zero setting is currently set somewhere in mid-stroke.) Slowly adjust the Zero potentiometer CW to move the actuator rod or towards the zero position. The red LED will flicker while being adjusted. When the actuator hits the zero position, the red LED will continue to flicker even when the adjustment is no longer being turned. Now adjust the Zero CCW just enough to turn off the red LED. Both LEDs should be off when set correctly. This ends the preliminary Zero adjustment.

14. PRELIMINARY “SPAN” ADJUSTMENT

PFC cylinders and PTF rotary actuators greater than 180 degrees of rotation (See below for PTF’s less than 180 degrees)

Use the Span adjustment to set the intended fully extended position to be the same as the full scale (maximum) analog command input signal. Using the Main Control (or equivalent), command the actuator to go to the analog command input signal full scale position. (Set the analog command input signal to 10 volts, or 20 mA depending on the PCS Model.) Look at the LEDs and make the adjustments described in one of the appropriate following paragraphs.

If the Green LED is on or continuously flickering - (Span is currently set beyond the extended hard stop.) Slowly adjust the Span potentiometer CW, until the green LED goes off. (If the Span potentiometer was adjusted too far and the actuator moved, adjust the Span potentiometer CCW just enough to move the actuator back to the full scale position. If adjusted too far, the Green LED will come back on). Both LEDs should be off when set correctly. This ends the preliminary Span adjustment.

If neither LED is on - (Span is currently set somewhere in mid-stroke.) Slowly adjust the Span potentiometer CCW to move the actuator rod or shaft toward the full scale position. When the actuator hits the full scale position, the green LED will continue to flicker even when the adjustment is no longer being turned. Now adjust the Span CW just enough to turn off the green LED. Both LEDs should be off when set correctly. This ends the Preliminary Span adjustment.

PTF rotary actuators less than 180 degrees of rotation

Using the command signal (CS) formula defined in the Main Control section of the Glossary, calculate the full scale analog command signal setting the **d** parameter = full rotation of your actuator, and setting the **t** parameter = 180 degrees.

For Example:

The calculation for a 45 degree PTF with Voltage input would be:

$$\mathbf{CS = 45 \times (10/180) + 0 = 2.50 \text{ VDC Full Scale Analog Command Input Signal}}$$

And the calculation for a 45 degree PTF with a 4-20mA input would be:

$$\mathbf{CS = 45 \times (16/180) + 4 = 8 \text{ mA Full Scale Analog Command Input Signal}}$$

Now set the analog command input signal to the calculated full scale command signal for your PTF rotation (i.e., 2.50 volts for a 45 degree unit with voltage command input signal) and perform one of the following adjustments:

If the Green LED is on or continuously flickering - (Span is currently set beyond the extended hard stop.) Slowly adjust the Span potentiometer CW, until the green

LED goes off. (If the Span potentiometer was adjusted too far and the actuator moved, adjust the Span potentiometer CCW just enough to move the actuator back to the full scale position. If adjusted too far, the Green LED will come back on). Both LEDs should be off when set correctly. This ends the preliminary Span adjustment.

If neither LED is on - (Span is currently set somewhere in mid-stroke.) Slowly adjust the Span potentiometer CCW to move the actuator rod or shaft toward the full scale position. When the actuator hits the full scale position, the green LED will continue to flicker even when the adjustment is no longer being turned. Now adjust the Span CW just enough to turn off the green LED. Both LEDs should be off when set correctly. This ends the Preliminary Span adjustment.

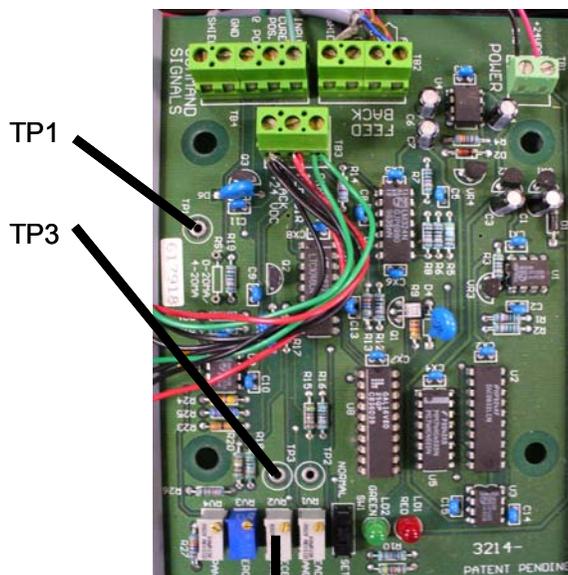
15. **FINAL “ZERO” AND “SPAN” ADJUSTMENT**

The Zero and Span adjustments may need to be fine tuned. This is accomplished by setting the Main control to the zero position signal (0 volts, 0 mA, or 4 mA) and repeating Step 12, being careful to make very small adjustments, as the setting should already be very close. Now recheck Step 13 and make any small adjustment that may be necessary.

This completes the final Zero and Span adjustments.

16. **“DECCEL” RANGE ADJUSTMENT**

Low Decel settings provide fastest speeds. High Decel settings provide the most stability for high loads. If deadband is set too low for the load, the rod will overshoot and undershoot the target position, oscillating before settling to a stop. The default setting is 1.5 volts. But it can be varied from 0.5 to 13.5 volts. To adjust the Deceleration Range, rotate the DECEL potentiometer as shown in the photo below and monitor the voltage between TP1 and TP3.



Decel

DECCEL ADJUSTMENT

Note: Decel and Deadband adjustments are iterative, and optimum settings depend upon the application and load. Set the deadband as low as possible for the greatest positioning accuracy. Set the Decel as low as possible for the greatest speed. As load inertia increases, the actuator might oscillate (buzz) around the ending position before coming to a complete stop at the commanded position. If this happens, simply increase the Deadband or Decel settings, or both, for the smoothest, fastest, most accurate positioning.



CAUTION! *If the DECEL and Deadband adjustments are set too low, the system may be unstable when subjected to large transient loads (loads that are 75% of maximum actuator capability). Check by applying an instantaneous force against the actuator (i.e., push hard and release quickly). If the system is not stable, increase the DECEL range or the Deadband. An unstable system could potentially cause personal harm or damage to products or machinery.*

To optimize the Decel setting, command the actuator to make several long and short motions, in both increasing and decreasing directions. Watch the LEDs carefully as the actuator slows to a stop.

Moves in the Increasing Direction (Towards Full Scale)

The green LED will be on while the actuator is moving in the increasing direction. As the actuator tries to stop at its commanded position, the red LED may come on or flicker. If so, the Decel Range is too small because the actuator had to backup before stopping in the Deadband zone. On the other hand, if the actuator seems to take a long time to stop at its commanded position and the red LED never comes on, then the Decel Range is too big.

Moves in the Decreasing Direction (Towards Zero)

The red LED will be on while moving in the decreasing direction. As the actuator tries to stop at its commanded position, the green LED may come on or flicker. If so, the Decel Range is too small. On the other hand, if the actuator seems to take a long time to stop at its commanded position and the green LED never comes on, then the Decel Range is too big. This iterative adjustment can be used to optimize the PCS for your specific application.



Note: *If the DECEL adjustment cannot stabilize the system at the selected Deadband setting, flow controls may be inserted into both exhaust ports of the PCS system to reduce the velocity of the actuator. NEVER install flow controls in the actuator ports. Flow controls can be adjusted to reduce velocity until stable controlled motion is achieved. If velocity cannot be reduced in the application, then increase the Deadband instead. Start with the Flow Controls in the fully open position, then adjust them as needed.*

17. APPLICATION EXAMPLES

PFC Example

Suppose we have just finished the installation procedure for a Bimba PFC Cylinder with 10 inches of stroke, and are using a 0-10 VDC input command signal. There is a retracted hard stop at 1.5 inches of cylinder stroke and an extended hard stop at the 9.0 inches of cylinder stroke. Therefore:

- After adjusting the Span setting, 10 volts is equivalent to 9.0 inches of cylinder rod extension.
- After adjusting the Zero setting, 1.5 inches of cylinder rod extension will equal 0 volts.

Therefore, 0 to 10 volts covers the 7.5 inch (9.0" - 1.5") range of motion

Using the Formula shown in the Glossary Yields:

To command the PFC to go to a position that is 2.0 inches extended from the retracted hard stop, the command signal would be calculated as follows:

$$\text{CS} = 2 \times 10/7.5 + 0 = 2.667 \text{ VDC Command Input Signal}$$

If a 4-20 mA signal is used, the command input signal would be calculated as follows:

$$\text{CS} = 2 \times 16/7.5 + 4 = 8.267 \text{ mA Command Input Signal}$$

PTF Example

Suppose we have just finished the installation procedure for a Bimba PTF Rotary actuator with 200 degrees of rotation, and a 0-10 VDC command input signal. There is a zero rotational hard stop at 10 degrees of rotation and a full scale rotational hard stop at 190 degrees of rotation. Therefore:

- After adjusting the Span setting, 10 volts is equivalent to 190 degrees of rotation
- After adjusting the Zero setting, 10 degrees of rotation will equal 0 volts.

Therefore, 0 to 10 volts covers 180 degrees (190 - 10) of motion.

To command the actuator shaft to rotate to a position that is 45 degrees rotated from the zero hard stop, the command voltage would be calculated as follows:

$$\text{CS} = 45 \times 10/180 + 0 = 2.50 \text{ VDC Input Command Signal}$$

If a 4-20 mA input command signal is used, the command input would be calculated as follows:

$$\text{CS} = 45 \times 16/180 + 4 = 8 \text{ mA Command Input Signal}$$

SPECIFICATIONS

Description	Specification
Zero Adjustment	50% of Total Full Scale Output between both adjustments
Span Adjustment	
DECEL Adjustment	Approximately 0.5 to 13.5 volts
Deadband Adjustment	Approximately 0.005 to 0.500 Volts
@ Position	Discrete signal that Sinks to Ground when Within Deadband zone. 20mA Maximum.
Current Position	0 to 10 VDC signal, 1M ohm input impedance required for input device.
Operation at Power Loss	All valves close at power loss.
Input Supply Voltage	23.5 to 24.5 VDC, 1 amp
Operating Pressure	70 to 80 psig
Air Requirement	Regulated and Filtered to 5 micron
Operational Temperature Range	0 to 100 degrees F (Electronics\PC Board)
Reverse Polarity Protected	
Overvoltage Protected	

APPLICATION SIZING and "RULES OF THUMB

PFC Cylinder/PCS Valve System Matching and Sizing Recommendations*

Bore Size	PCS Model	Stroke Range	Maximum Payload	Average Velocity	Maximum External Friction	Zero Friction Deadband **	½ Maximum Friction Deadband	Maximum Friction Deadband	Minimum Step
PFC-09 (1-1/16")	PCS-1	2" to 7"	1 lb	2.75 in/sec	zero	+/- 50mV	NA	NA	0.080"
PFC-09 (1 1/16")	PCS-1	8" to 24"	30 pounds	4.00 in/sec	5 pounds	+/- 40mV	+/- 80mV	+/- 160mV	0.20 - 0.39"
PFC-17 (1-1/2")	PCS-1	1" to 3"	2 lbs	2.50 in/sec	zero	+/- 25mV	NA	NA	0.040"
PFC-17 (1 1/2")	PCS-2	4" to 24"	50 pounds	5.50 in/sec	10 pounds	+/- 20mV	+/- 40mV	+/- 80mV	2 times Deadband
PFC-31 (2")	PCS-2	1" to 2"	4 lbs	2.75 in/sec	zero	+/- 50mV	NA	NA	0.020"
PFC-31 (2")	PCS-3	3" to 24"	90 pounds	6.50 in/sec	20 pounds	+/- 15mV	+/- 30mV	+/- 60mV	2 times Deadband

**If your application requires lower velocities or payloads, you may be able to reduce the minimum recommended deadband setting, or if your deadband requirements can accommodate a large range, you may be able to increase your payload higher than the recommended values.*

***Note: Use the Formulas in the Glossary to convert the Minimum Deadband shown in the table to displacement.*

Assumptions used for Sizing Values recommended above:

- Values shown above are with no overshoot. If overshoot is acceptable for your application, the Deadband may possibly be less than specified above. However, be sure your system cannot go unstable. Refer to Caution statement on page 20.
- PFC cylinder with Option L is used. (Option L has very low friction seals. The standard PFC utilizes a rod wiper which increases friction significantly, which will have adverse effects on positioning capabilities).

- 80 psi air supply.
- Minimum of 23.5 VDC provided to the PCS.
- Clean Command Signal for Main Control. (<5mV noise/ripple)
- Leak free system (The system will actually perform well with some system leakage, however, the best performance is with no leakage).
- Short (<18 inches), hard air lines (nylon) between the valves and the actuator.
- No backlash in the system.
- Horizontally guided load. The system can handle vertical or inclined loads and still meet the minimum deadband specified above, however, the velocity may be effected by up to 40%.



Typical “Rules of Thumb”:

- Deviations from the recommended parameters, such as air pressure, power supply voltage, external friction, etc, will negatively effect system performance. However, the system may still perform adequately for your application.
- Applications with loads less than 10% of actuator capacity and strokes greater than 4 inches will yield better repeatability than the minimum Deadband shown in the sizing table above.
- Reducing actuator velocity by use of Flow Controls may enable the Deadband to be adjusted tighter for a given application. *The Flow Controls must be inserted into the exhaust ports of the valve manifold, **NOT** in the actuator.*
- Oversizing the actuator for a given application typically yields better repeatability.
- Generically, following are relative influences on velocity:
 - As Mass increases, Velocity decreases (up to 20%)
 - As Friction increases, Velocity decreases (up to 20%)
 - As Pressure decreases, Velocity decreases (up to 20%)
- Increased Friction decreases repeatability. Maximum external friction should not exceed 20% of the maximum rated payload. Any external friction in the application will degrade system performance. Ensure the system is aligned properly to any guiding systems. Misalignment will cause external application friction.
- A borderline solution can be effective through any/all of the following:
 - sacrificing performance in one area for another,
 - limiting velocity with external flow controls,
 - diligently employing the rules of thumb, located in the Bag of Tricks portion of this report,
 - employing a small central portion of a longer probe,
 - using a larger bore cylinder.
- The PCS system is not best suited for applications where accurate velocity control is needed by controlling the rate of command signal change. Flow controls can be used if lower velocities are required.



Do not allow the PCS valves to stay on for prolonged time periods unless the valves are well ventilated, as they may overheat potentially causing damage to the valves.

Troubleshooting

The following information is helpful if you experience difficulties setting up your Pneumatic Control System. A problem may be associated with one or a combination of causes, including a malfunction of your Main Control (PLC), system adjustments, application parameters, or system inputs (air supply, electrical power, command signal, etc.).

Try the following suggestions to isolate and solve the problem. If the problem persists or cannot be rectified, contact your local distributor or our **Technical Assistance Center at 800-44-BIMBA**. Our website (www.bimba.com) contains the latest information regarding product updates, so it may be helpful to check there for the latest product support information.

The Actuator Does Not Move

- Problem: Air Supply is not connected or turned on.
Solution: Connect the Air Supply and turn it on. Ensure it has the proper air pressure (75 psi recommended).
- Problem: Power supply is not connected properly or turned on.
Solution: Verify that the power supply is connected properly (*with the correct polarity*) or turn it on. Use a digital voltmeter to verify that 24 VDC is present on the PCS PC board.
- Problem: The actuator air lines are reversed.
Solution: Check installation diagram to ensure proper connection. Connect lines to proper ports if necessary.
- Problem: Dip Switch SW1 (Deadband adjustment) is in the Set position.
Solution: Move Dip Switch SW1 to the Normal position.
- Problem: No feedback signal from the actuator.
Solution: Verify proper connection of the feedback cable to the PCS using Figure 2. If the connection is correct, use a digital voltmeter and verify that there is 10 VDC present across the PCS Sensor terminals A and C. If 10 VDC is not present, there is a problem with the PCS Sensor excitation circuit and will need repaired. If the 10 VDC is present, check to see if there is voltage present between Sensor terminals B and C (this is the actuator feedback, which should vary from approximately 0 VDC when the actuator is in the zero position and to approximately 10 VDC when the actuator is positioned near full scale). If this signal is not present, or doesn't change when the actuator is moved (disconnect the air supply and move by hand if necessary), there may be a problem with the actuator. At this point, call your local distributor or Bimba's Technical Assistance Center for additional assistance.
- Problem: No command signal from the Main Control.
Solution: Ensure that the connections between the Main Control and the PCS are connected according to Figure 2 (Use correct polarity). Also, verify that the Main Control is sending a command signal. This can be accomplished with a volt meter (for a 0-10 VDC command signal) or an ammeter (for 4-20mA or 0-20mA command signals). Check the signal on the PCS terminal.

- Problem: The change in command signal is too small.
Solution: Ensure that the change in command signal is large enough to cause the actuator to move outside of the deadband. If the change in signal is too small (smaller than the adjusted deadband), the actuator will not respond.
- Problem: The Zero adjustment is too high and/or Span adjustment is too low.
Solution: Refer to the Installation Section of the manual that pertains to the Zero and Span Adjustments and make the proper adjustments.
-

The Actuator is not Repeatable or Stable

- Problem: PCS system parameters are not adjusted properly.
Solution: Follow the Installation instructions to make the appropriate system adjustments for your application parameters, ensuring that the deadband and decel adjustments are adjusted according to the application requirements. Improper adjustments may cause actuator overshoot (deadband is too small), non-repeatability (deadband is too big), sluggishness or instability.
- Problem: The actuator and PCS system are not sized properly.
Solution: Refer to the Application Sizing Chart in the PCS catalog to ensure the actuator and PCS system are sized properly for the application requirements.
- Problem: Noisy Command Signal.
Solution: Provide an analog 0-10 VDC command signal that has less than 5 mV of ripple. Employ proper wiring techniques to ensure signal noise is kept to a minimum (use shielded cables, proper grounding methods, etc.)
- Problem: The Electrical Power Supply is supplying less than the required 23.5 VDC.
Solution: Utilize a DC power supply that can supply the minimum 23.5 VDC required by the PCS. At voltages less than 23.5 VDC, the system performance will degrade.
- Problem: Inadequately sized air line between the actuator and PCS valves.
Solution: Application testing yielded best results with 0.093 I.D. air line tube for 1-1/16" and 1-1/2" bore actuators and 0.170 I.D. air line tube for 2" bore actuators. Smaller or larger I.D. tubing may result in less position repeatability.
- Problem: Air lines between the actuator and PCS valves are too soft or compliant.
Solution: Avoid using soft easy to expand air tubing. Use harder tubing such as nylon or metal.
- Problem: Air lines between the actuator and PCS valves are too long.
Solution: Longer air lines cause the system to be less accurate. Always use the shortest air lines as possible (< 18"). The system will work with longer lines, but may not be stable or responsive enough for application requirements. Option N allows you to mount the valves close to the actuator with the PCS electronics mounted separately.
- Problem: Air Supply pressure is too low (Below 70 psi)
Solution: Turn air supply up to at least 70 psi. If the air supply experiences pressure drops due to excess air demand in the building's air supply system, an air reservoir may be required.

- Problem: Excessive air leak in the actuator or PCS system.
 Solution: Find and fix the leak. External fitting leaks are relatively easy to find. Use a solution, such as Leak Tech, to identify leaks in fittings, couplings, and rod seal (if linear actuator). Check for leaks in the actuator seals.
- Problem: PCS valves are contaminated.
 Solution: Unfiltered air (>5 microns) can cause the valves to become contaminated causing them to leak. Use a filter that is rated for <5 micron particles. Thread tape can also cause leaks in the valve if the tape becomes loose and enters the system. It is recommended that a solid or liquid thread seal be used.
- Problem: The actuator feedback potentiometer is malfunctioning.
 Solution: Replace the feedback potentiometer. See respective catalogs for part number information.
- Problem: Actuator seals are worn or contaminated.
 Solution: For PFC applications, order an RPFC (Cylinder with no probe) and replace existing cylinder (You may use the existing probe if it is still in working order).
 For PTF applications, order a seal repair kit (Part numbers are in the PTF catalog) and replace the worn or contaminated seals.
- Problem: Excess friction is being exerted by application components.
 Solution: Reduce the friction to levels outlined in the installation section of the manual. External friction may change as system components wear over time. Misalignment between the actuator and guiding system may cause binding and increase friction to unacceptable levels.
- Problem: Varying loads in application.
 Solution: Stabilize the load variation. If loads cannot be stabilized, the deadband may need increased to improve performance.
- Problem: Excessive velocity due to flow control misadjustment.
 Solution: Some applications require flow controls to limit velocity in order to attain required repeatability. The flow controls may have been adjusted after initial settings were made. Re-adjust to proper settings.

The Actuator Moves Slower than Sizing Chart Indicates

- Problem: Inadequately sized air line between the actuator and PCS valves (tube diameter is too small).
 Solution: Application testing yielded best results with 0.093 I.D. air line tube for 1-1/16" and 1-1/2" bore actuators and 0.170 I.D. air line tube for 2" bore actuators. Smaller or larger I.D. tubing may result in less position repeatability.
- Problem: The actuator and PCS system are not sized properly.
 Solution: Refer to the Application Sizing Chart in the PCS catalog to ensure the actuator and PCS system are sized properly for the application requirements.

- Problem:** Air lines between the actuator and PCS valves are too long.
Solution: Longer air lines cause the system to be less accurate or respond slower. Always use the shortest possible lines as possible (<18"). The system will work with longer lines, but may not be repeatable enough for application requirements. Option N allows you to mount the valves close to the actuator with the PCS electronics mounted separately.
- Problem:** Air Supply pressure is too low (below 70 psi).
Solution: Turn air supply up to at least 70 psi. Low air pressure can cause the actuator to slow down. If the air supply experiences pressure drops due to excess air demand in the building's air supply system, an air reservoir may be required.
- Problem:** The Electrical Power Supply is supplying less than the required 23.5 VDC.
Solution: Utilize a DC power supply that can supply the minimum 23.5 VDC required by the PCS. At voltages less than 23.5 VDC, the system performance will degrade.
- Problem:** Decreased velocity due to flow control misadjustment.
Solution: Some applications require flow controls to limit velocity in order to attain required repeatability. The flow controls may have been adjusted after initial settings were made. Re-adjust to proper settings.
- Problem:** Excess friction is being exerted by application components.
Solution: Reduce the friction to levels outlined in the installation section of the manual.
- Problem:** PCS system parameters are not adjusted properly.
Solution: Follow the Installation instructions to make the appropriate system adjustments for your application parameters, ensuring that the deadband
Some applications require flow controls to limit velocity in order to attain required repeatability. The flow controls may have been adjusted after initial settings were made. Re-adjust to proper settings and decel adjustments are adjusted according to the application requirements. An unnecessarily wide deceleration zone will result in lower average velocities.

Poor Positioning on the First Cycle

- Problem: Air pressure may have been lost during idle time, either through leaks or disconnect of the air supply.
- Solution: If extended periods of non-operation are normal, the application will require a start-up routine for the initial cycle. This will stabilize pressures in the actuator.
-

Repeatability/Stability/Responsiveness changes over time

- Problem: Input pressure has changed.
- Solution: Changes in input pressure will effect actuator performance. Lower pressure will typically reduce repeatability and increased pressure will typically improve repeatability.
- Problem: External friction changed due to component wear or changes.
- Solution: Re-adjust system parameters based on new frictional characteristics, or restore friction to initial values (i.e., lubricate bearing surfaces, replace worn components, etc.)
- Problem: If flow controls are utilized in the system, the initial setting has changed.
- Solution: Re-adjust flow controls to initial setting. It may be helpful to lock the flow control adjustment with the provided lock nut or thread lock.
- Problem: Improper actuator lubrication.
- Solution: Lubricate actuator with recommended lubrication. See actuator catalog for recommendations.
-

The Red or Green LED will not turn off

- Problem: The Red LED will not turn off.
- Solution: The PCS electrical zero is set beyond the mechanical zero. Adjust the PCS zero setting to correspond with the mechanical zero. If a mechanical stop was added or changed after the initial zero adjustment was made, it will need to be re-adjusted.
- Problem: The Green LED will not turn off.
- Solution: The PCS electrical full scale is set beyond the mechanical stop. Adjust the PCS span adjustment to correspond with the mechanical stop. If a mechanical stop was added or changed after the initial span adjustment was made, it will need to be re-adjusted.

The PCS system always makes a popping noise, even when in position

- Problem: There are air leaks between the valves and the actuator.
- Solution: Fix any leaks between the valve and the actuator. The PCS system will compensate for leaks in the system. The popping noise is the valves actuating to maintain position.
- Problem: The command signal may be generating excess noise.

Solution: Provide an analog 0-10 VDC command signal that has less than 5 mV of ripple. Employ proper wiring techniques to ensure signal noise is kept to a minimum (use shielded cables, proper grounding methods, etc.)

Problem: The actuator feedback has excess signal noise.
Solution: Ensure that the feedback signal is free from electrical noise. Electro-Magnetic Interference (EMI) can couple to the feedback signal. Employ shielded cable between the actuator and the PCS system.

Problem: The valves are contaminated.
Solution: The valves need rebuilt or replaced. Teflon tape or line contamination can cause valve leaks if allowed to enter the valve. Use a liquid thread sealant and a filtration system that is rated for 5 microns.

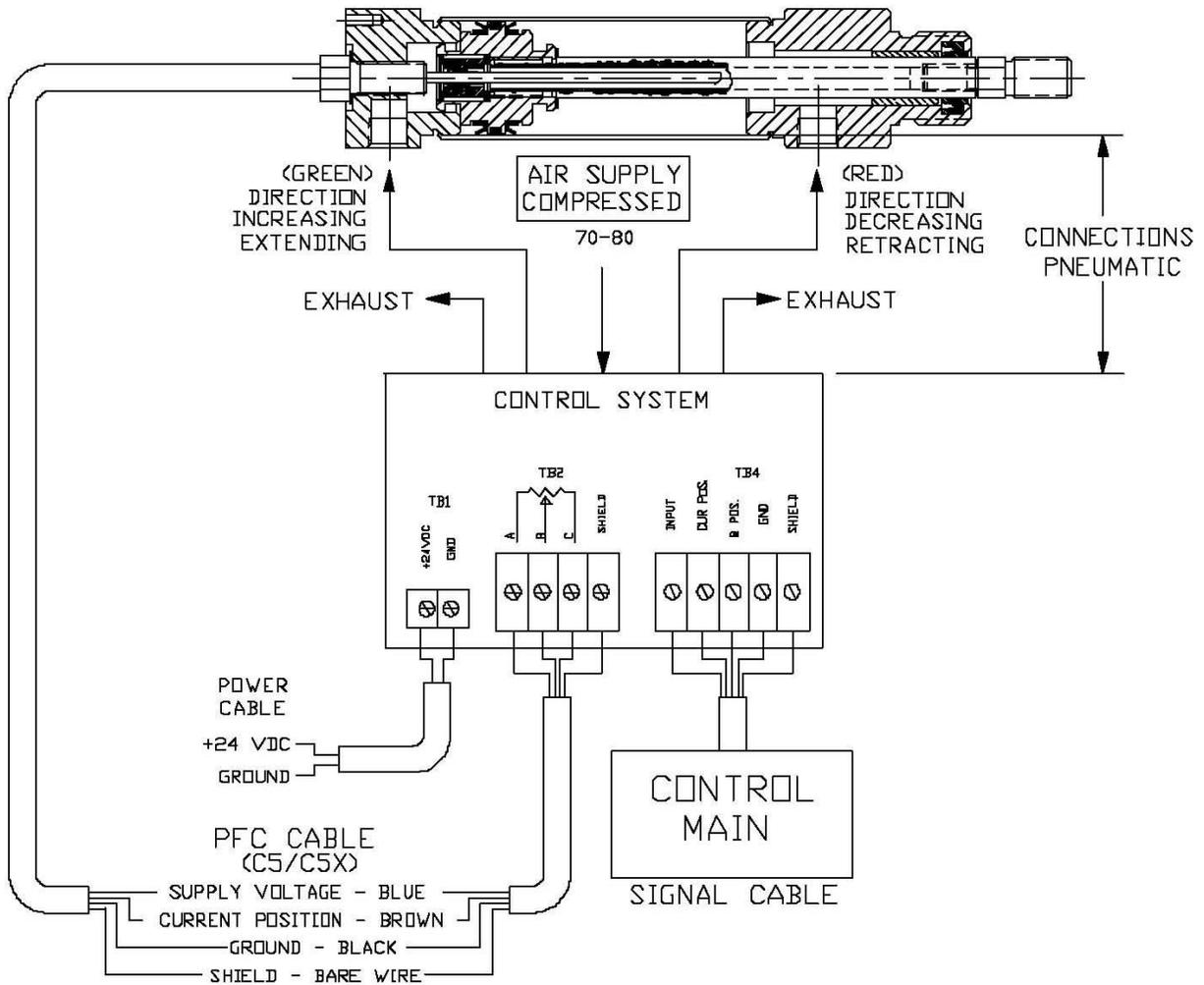
Problem: Possibly Nothing.
Solution: The actuators and valves are built to minimize leakage, but not to totally eliminate it. If a stable positioned actuator drifts toward the edge of the system deadband, the PCS will pulse to maintain position. If the deadband is set very narrow, this correction will be more frequent.

Frequently Asked Questions

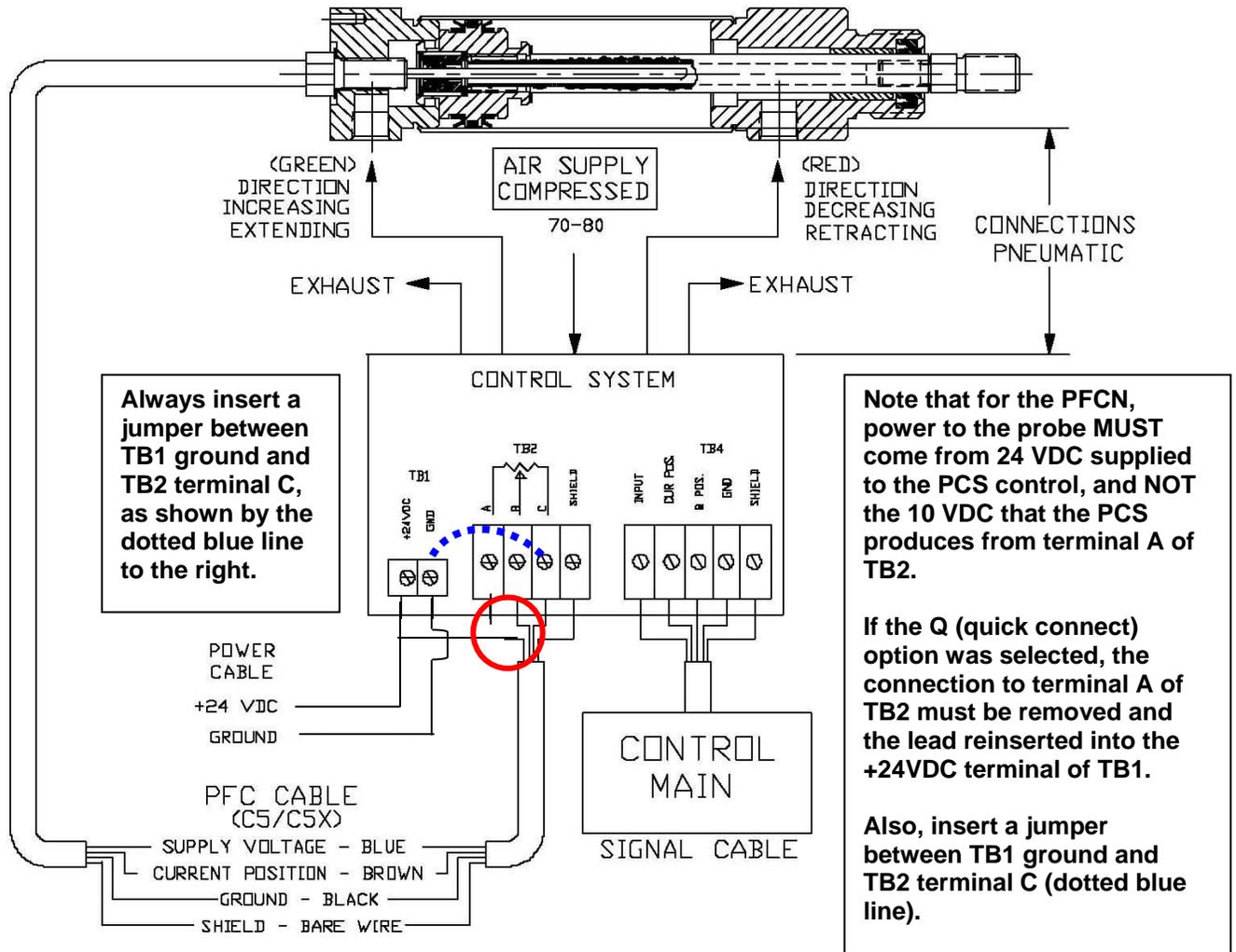
Question: Are there Default Settings for the Deadband, Zero, Span, and Decel settings?
Answer: While there are no perfect default settings, the following are used as the default factory settings.

- Deadband 0.020 VDC (20mV). Check between TP1 and TP2 with SW1 switched in the Set position.
- Decel 1.5 VDC. Check between TP1 and TP3.
- Zero is set to its minimum value (fully CW).
- Span is set to its minimum value (fully CW).

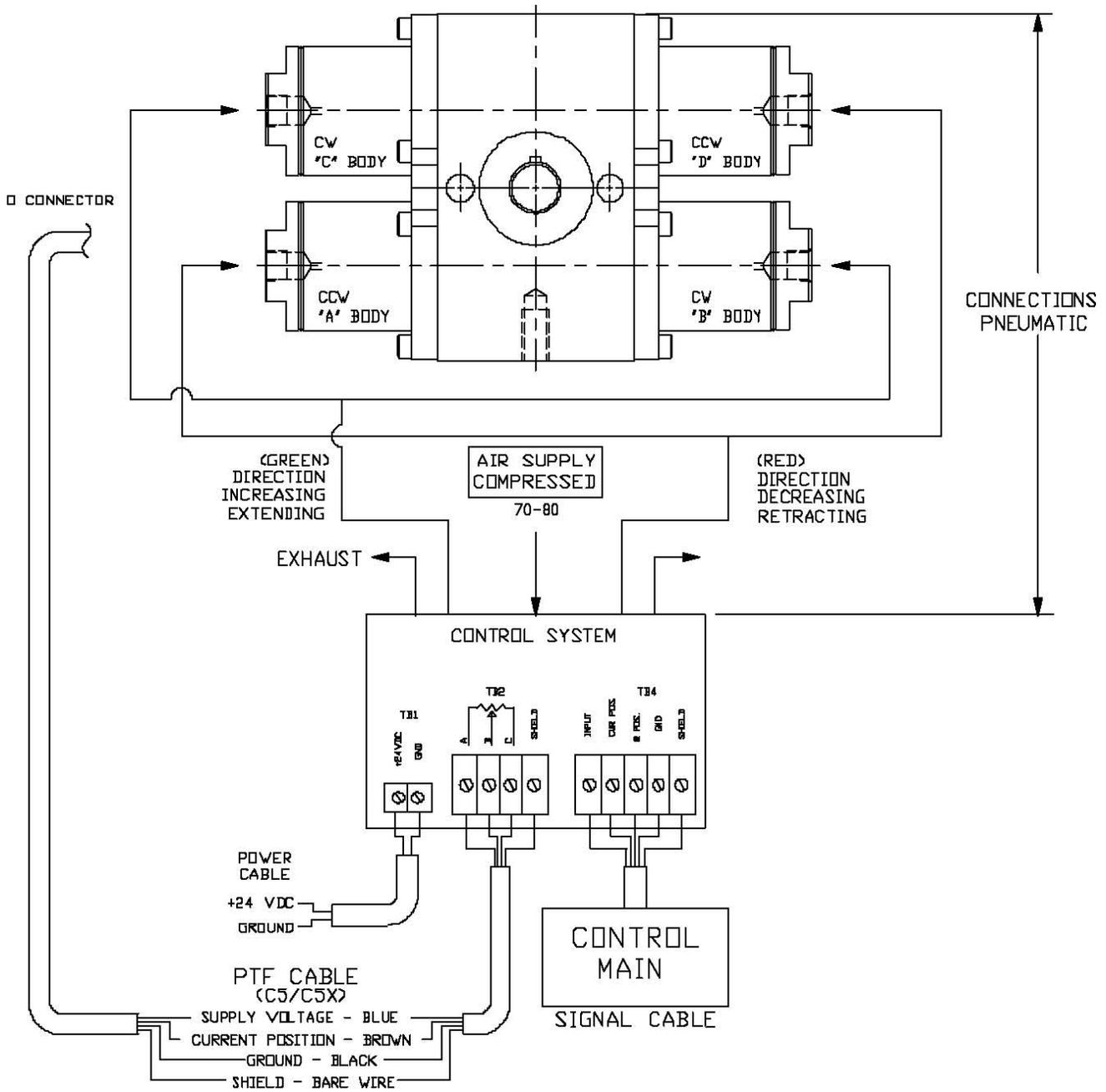
APPENDIX A



PFC ELECTRICAL AND PNEUMATIC CONNECTIONS



PFCN ELECTRICAL AND PNEUMATIC CONNECTIONS



PT ELECTRICAL AND PNEUMATIC CONNECTIONS

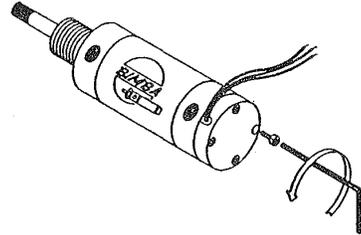
Note: For Single Rack Models, Use Only Bodies "A" and "B."

APPENDIX B

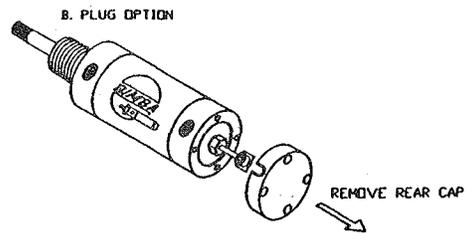
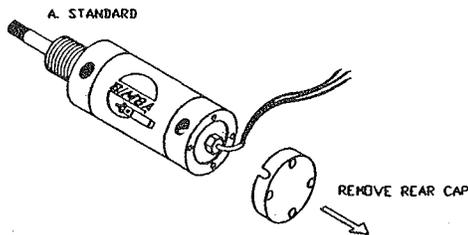
PFC Probe Replacement Instructions

- Using the correct allen wrench identified in the table below, remove the four socket head cap screws on the rear of the cylinder.

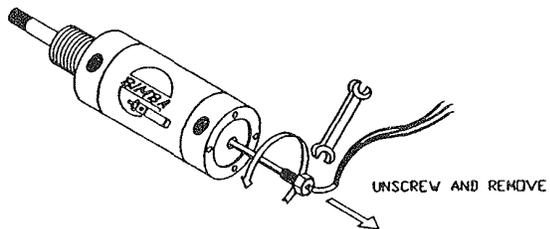
Bore	Wrench
09	3/32
17	3/32
31	5/32
50	3/16
70	1/4



- Remove the rear cap. If a plug connector is installed in the rear cap, slide it out.

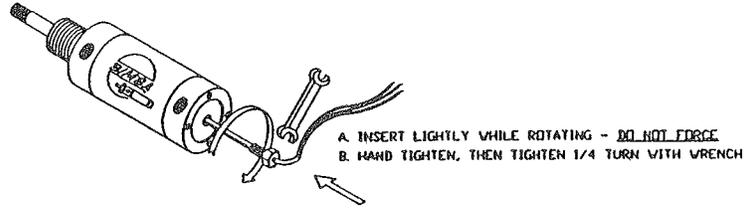


- Using a 3/8 inch wrench, carefully unscrew the exposed delrin nut (the back end of the probe). When all the threads are free, pull the probe out of the cylinder.

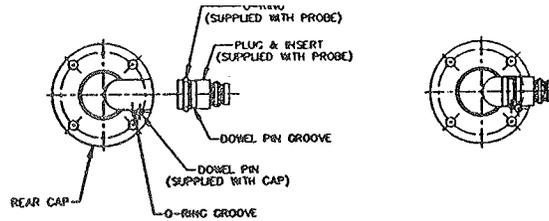


Examine the condition of the probe. If debris from the application's environment or from dirty air lines covers the probe, the wiper and rod inside the cylinder are most likely contaminated as well, and replacing the entire cylinder is recommended. If only a new probe is installed, its life will be shortened.

- Gently insert the replacement probe into the cylinder, rotating it until it slides through the hole in the piston. **DO NOT FORCE THE PROBE INTO THE CYLINDER.** It should slide in freely with minimal friction. Hand tighten until O-ring is seated, then rotate **ONLY 1/4 turn** until with the 1/4 inch wrench. **APPLYING TOO MUCH TORQUE WILL DAMAGE THE PROBE.**

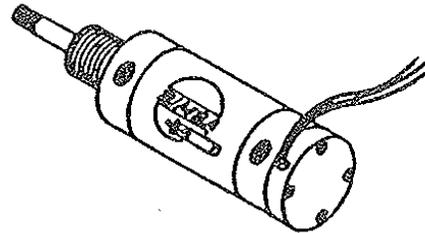


- If there is a plug connector, slide it into the area in the rear cap.



- Replace the rear cap and four cap screws using the torque in the table below.

Bore	Torque (in-lbs.)
09	7
17	10
31	35
50	90
70	150



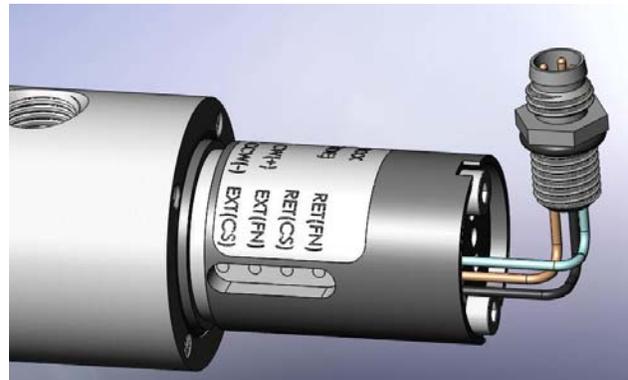
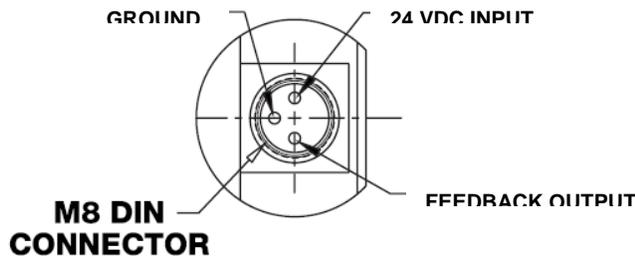
APPENDIX C

PFCN Probe Adjustment and Replacement Instructions

Probe Adjustment

Probe output calibration is normally not required. Every PFCN is calibrated at the factory for 0 to 10 V DC output fully retracted to fully extended. If readjustment is necessary in your application, follow the instructions below:

1. Install the PFCN in your application. Remove the rear end cap exposing the probe and four adjustment screws.
2. Apply 24 VDC power to the probe and monitor the feedback voltage. Connector pin identification is shown in the illustration below.
3. Position the actuator to full retract at 80 psi. Adjust the output as close to zero as possible using the coarse adjustment “RET(CS),” and then the fine adjustment “RET(FN).”
4. Position the actuator to full extend at 80 psi. Adjust the output to 10 V DC using the coarse adjustment “EXT(CS),” and then the fine adjustment “EXT(FN).”



Probe Replacement

The PFCN probe is not a wear part and normally will not need replacement. If replacement is necessary, follow the instructions below:

1. Using an allen wrench, remove the four socket head cap screws on the rear of the cylinder.
2. Remove the rear cap. Carefully detach the plastic connector that secures the M8 DIN connector to the probe terminals.
3. Remove the two long screws that secure the probe in the cylinder. Then pull the probe out of the cylinder.
4. Gently insert the replacement probe into the cylinder, rotating it until its through holes align with the screw holes in the cylinder. Tighten the screws, then reattach the end cap.



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