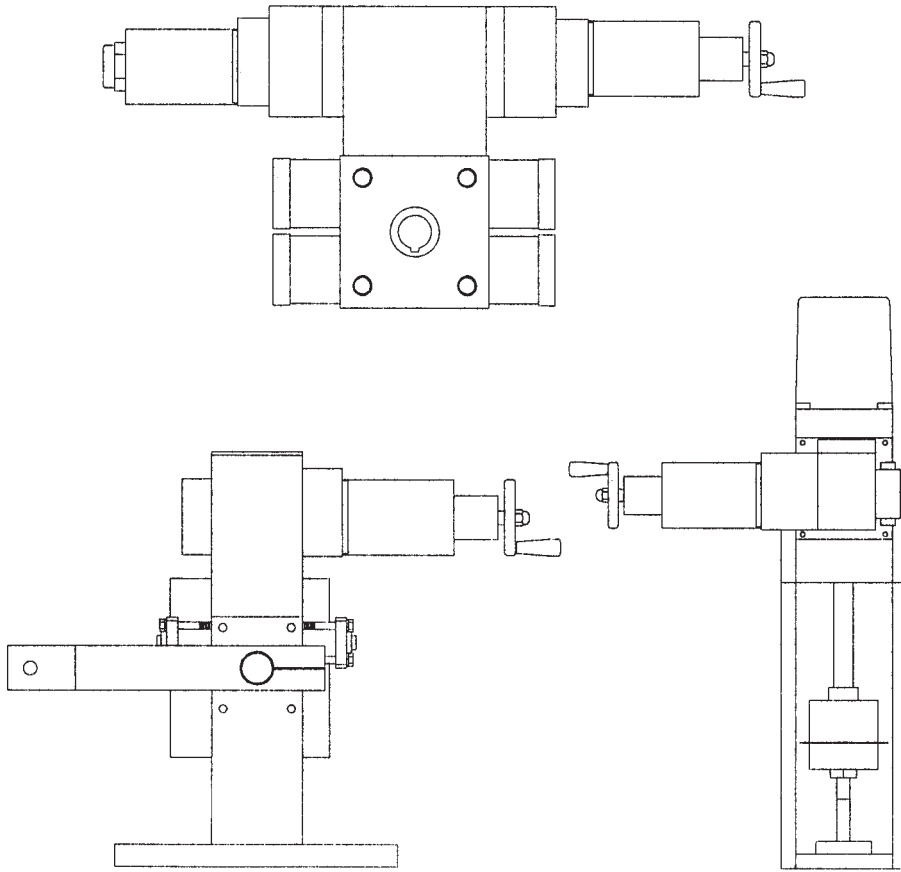




REXA Electrahydraulic Actuators & Drives



***Xpac Process Control Actuators
Trouble Shooting and Repair Manual***

KOSO AMERICA, INC.

7/03 Rev.-1

KOSO AMERICA

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ACKNOWLEDGEMENTS

The efforts of many professionals went into the writing, editing, and production of this manual. KOSO America wishes to extend our thanks and a "JOB WELL DONE!"

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1.1 Introduction

The importance of customer service and product quality cannot be overemphasized at REXA. The Troubleshooting and Repair Manual is one of our efforts to provide this superior support. Our goal, however, is for this manual not to be used.

In practice, many applications can subject REXA actuators and drives to severe service conditions and demanding operational requirements. Should the need arise, this Manual can provide to you the knowledge and experience of a REXA service engineer.

Section 2 is structured to allow a straightforward pinpointing of most problems. The repair procedures are described in the referenced paragraphs of Section 3.

Although the primary purpose of this manual is to keep you on line; it is also an excellent training tool. Appendix B is an explanation of the function and interaction of the major components of REXA's electrohydraulic technology. With this understanding, Section 3 can now be

thoroughly read to gain the feel of hands on experience.

The structure of this manual assumes that the actuator in question has been operating in a satisfactory manner for a period of time. The instructions and directions for startup are contained in the REXA Installation and Operation Manual which is normally shipped with the unit.

Do not hesitate to contact REXA for assistance, but please have available the serial number, model and setup parameters.

1.2 Important Comments from the Factory

While working on the actuator, insure that electric power to the unit is off. When power is applied, the actuator may go into "auto" mode and begin moving. Failure to anticipate inadvertent motion may result in damage to the installation or injury to personnel.

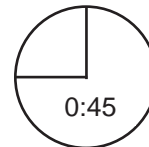
Because hazardous voltage levels are present in the control box and at the actuator, only qualified service and installation personnel should install or adjust the device. This hazardous voltage symbol is displayed in the manual whenever a warning about hazardous voltage is required.



Each procedure in Section 3 has a level of difficulty rating between one and three, level one being a simple, common sense task, and level three being a somewhat more involved procedure.



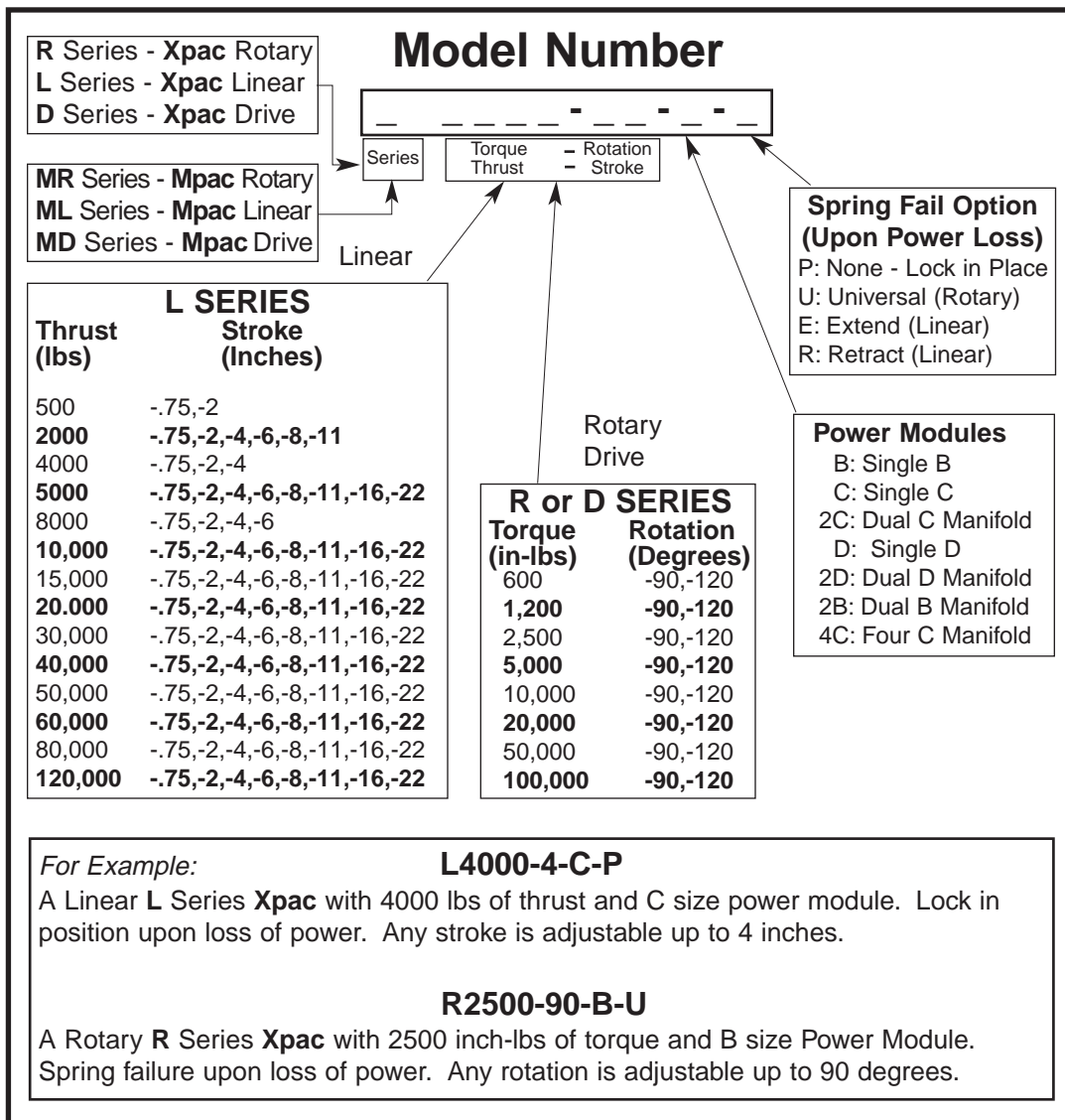
Along with the level of difficulty rating, an approximate time to complete the task is given. The time should be close to your actual time if all parts and tools needed are readily available.



1.3 Model Numbering System

To a technician experienced with REXA products, the model number would provide a physical description of the mechanical portion of

the actuator. The mechanical layout, power modules and failure mode is described in this simple straightforward system.



2 What is The Problem?

Determine which of the statements listed below most closely describes the problem that you are encountering. Please refer to the flowcharts to diagnose the problem.

The Display is Showing an "E-dr"	2.1
The Display is Showing an "E-Fb"	2.2
The Display is Showing an "E-St"; Actuator is Not Moving and the Motor is Stalling*	2.3
The Display is Showing an "E-St"; Actuator is Not Moving, But the Motor is Turning*	2.4
The Display is Showing an "E-St"; Actuator is Not Moving and the Motor is Not Turning*	2.5
The Display is Showing an "E-St"; Elastic Coupling Will Not Compress	2.6
The Display is Showing an "E-CS"	2.7
Everything is Dead-No Lights, No Movement	2.8
Actuator Moves to Wrong Position	2.9
Actuator Still Operates, but there is an Oil Leak.....	2.10
The Oil Indicator is Low, But No Oil is Visible.....	2.11
On Power Down, Unit Does Not Move into Fail Position	2.12
Actuator "Drifts" Away From the Applied Load.....	2.13
The Display is Showing an "E-PS"	2.14

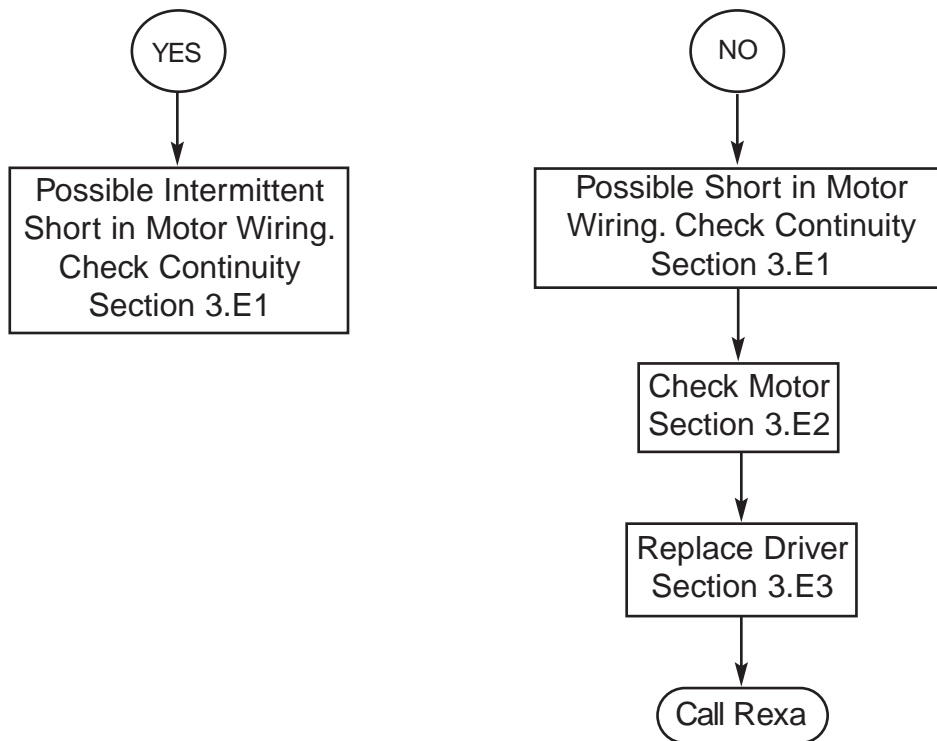
If you do not see a description which corresponds to your problem, contact REXA.

* Remove the handwheel or the rear motor nut to observe the outboard motor shaft, Section 3.

Flowchart 2.1

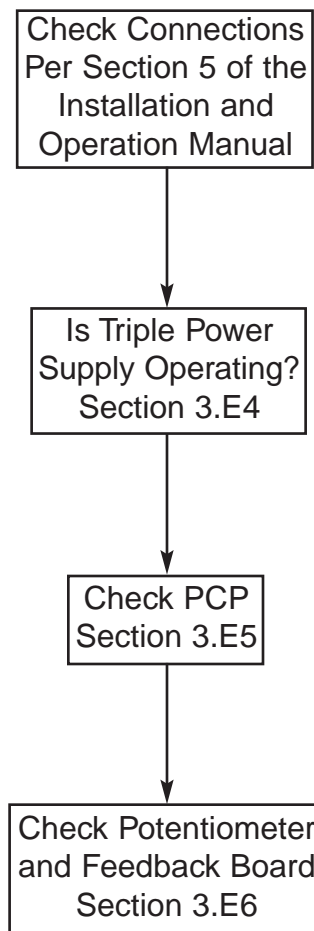
Display E-dr - Motor Moves in Wrong Direction

In Local Mode (Flashing P) Repeatedly Push the Same "UP" or "DOWN" Button and Observe Motion. Does the Actuator Always Move in the Same Direction?



Flowchart 2.2

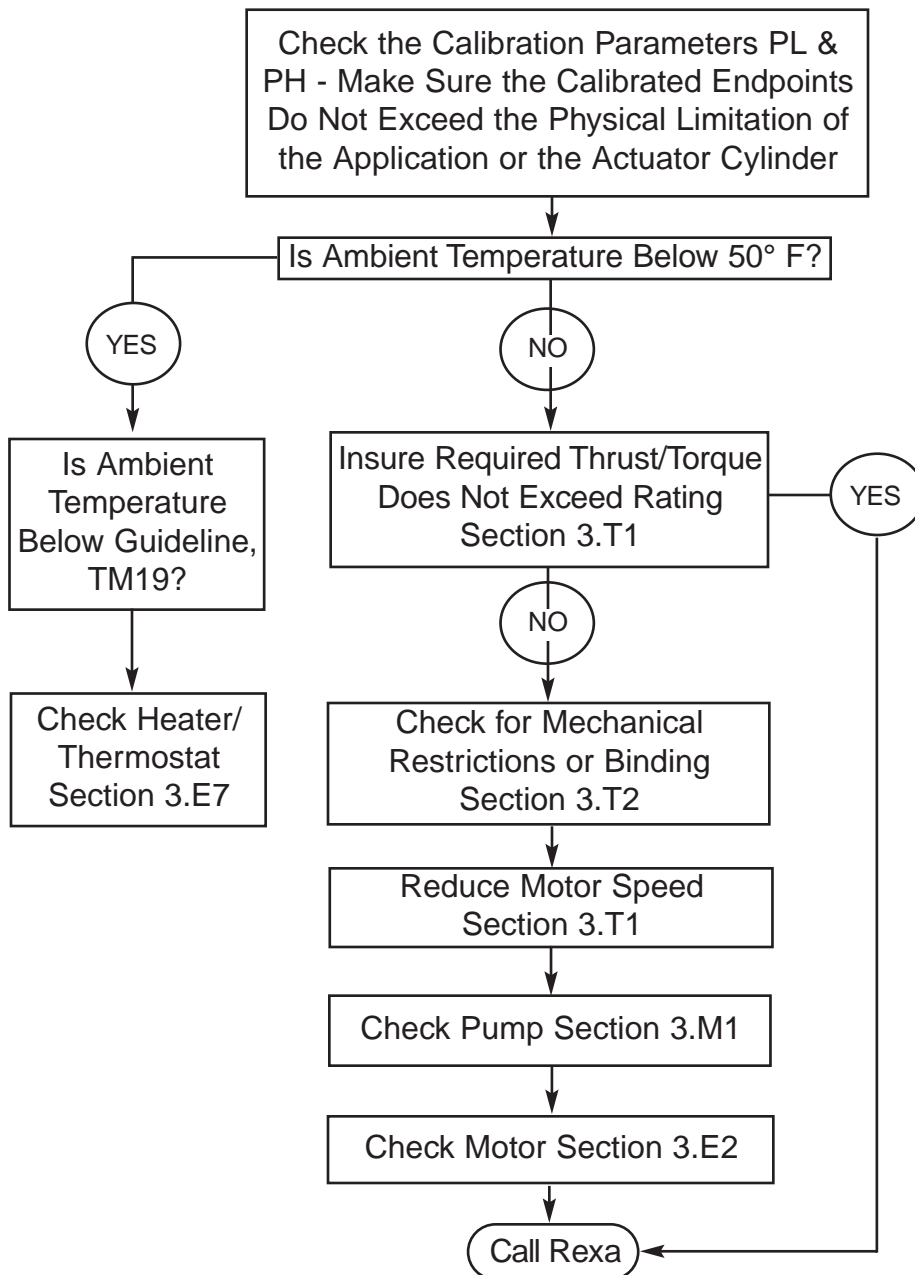
Display E-Fb - Loss of Feedback



Flowchart 2.3

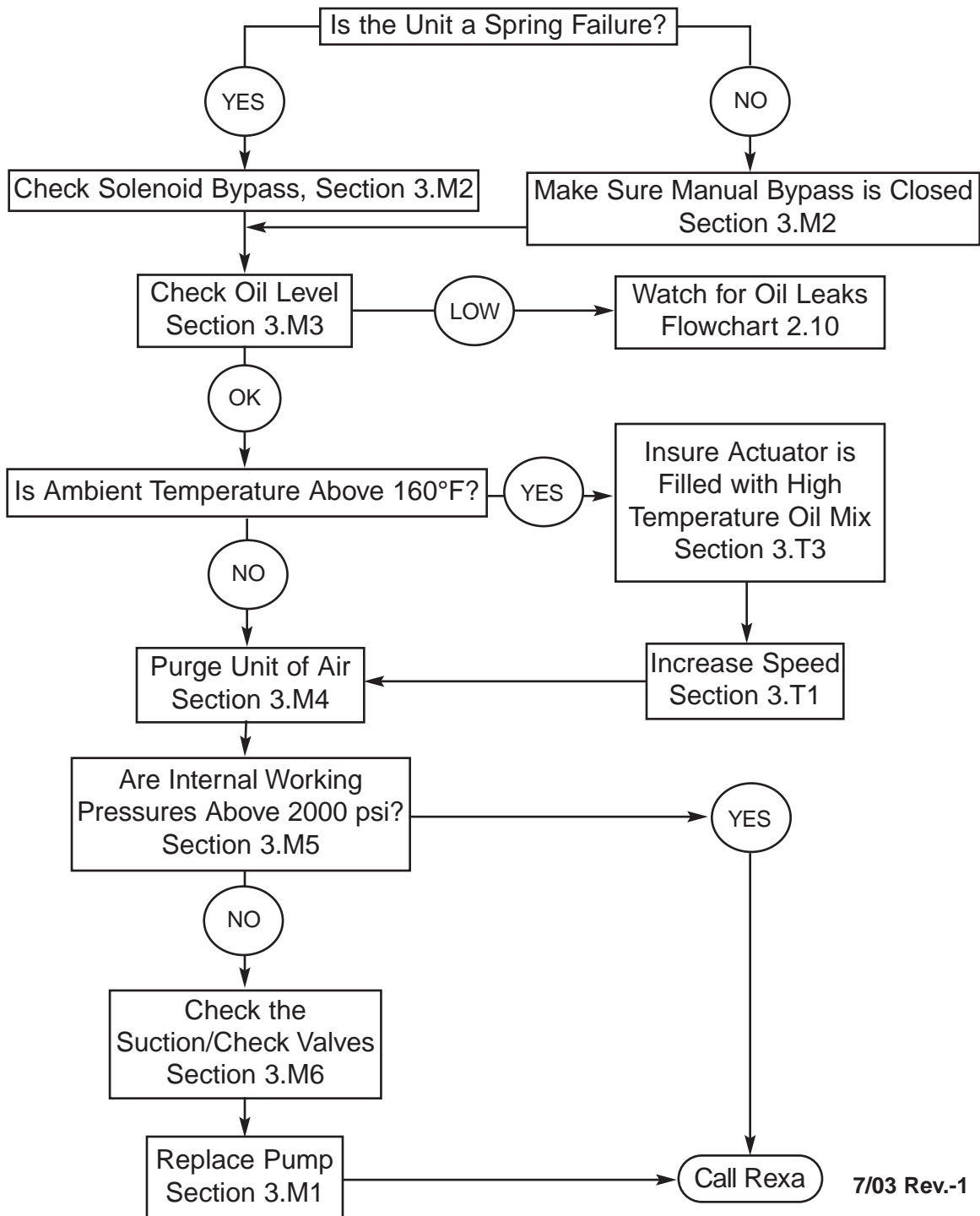
Display E-St - Actuator Not Moving, Motor is Stalling

(Motor Begins Turning and Then Stops While Emitting a High-Pitched Sound)



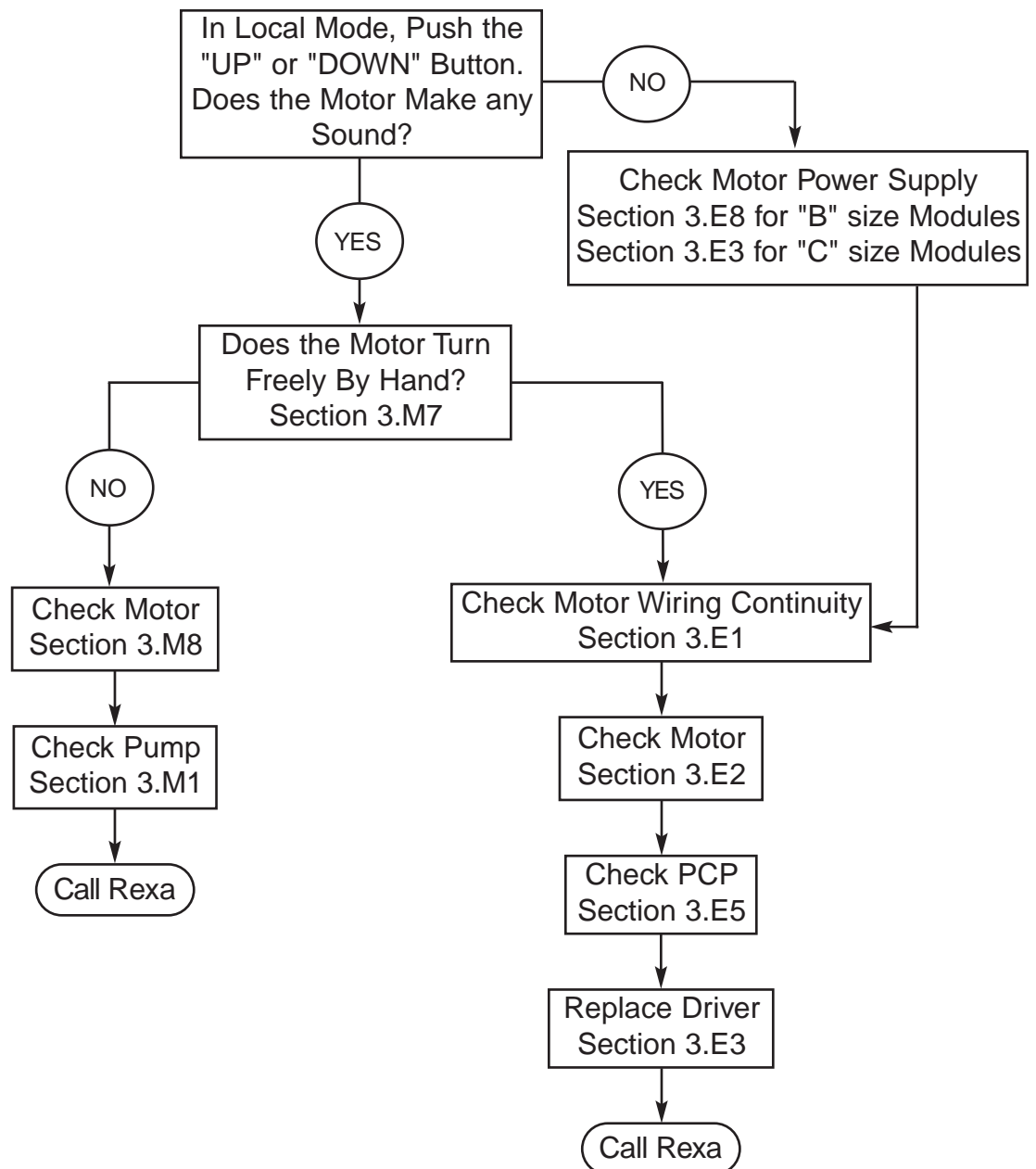
Flowchart 2.4

Display E-St - Actuator Will Not Move, But The Motor is Turning



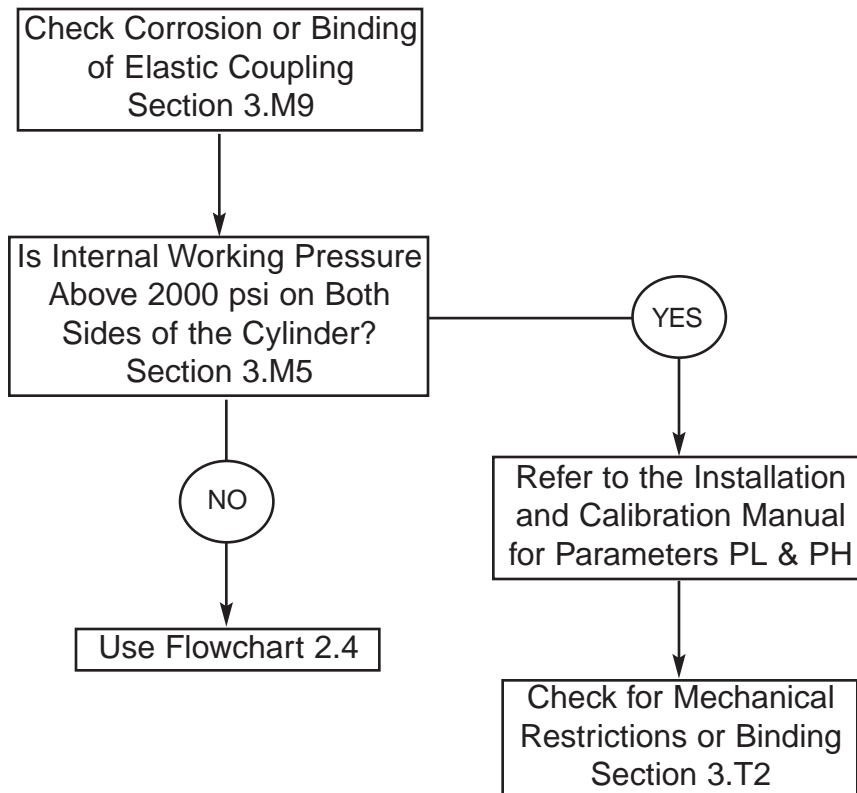
Flowchart 2.5

Display E-St - Actuator is Not Moving And the Motor is Not Turning



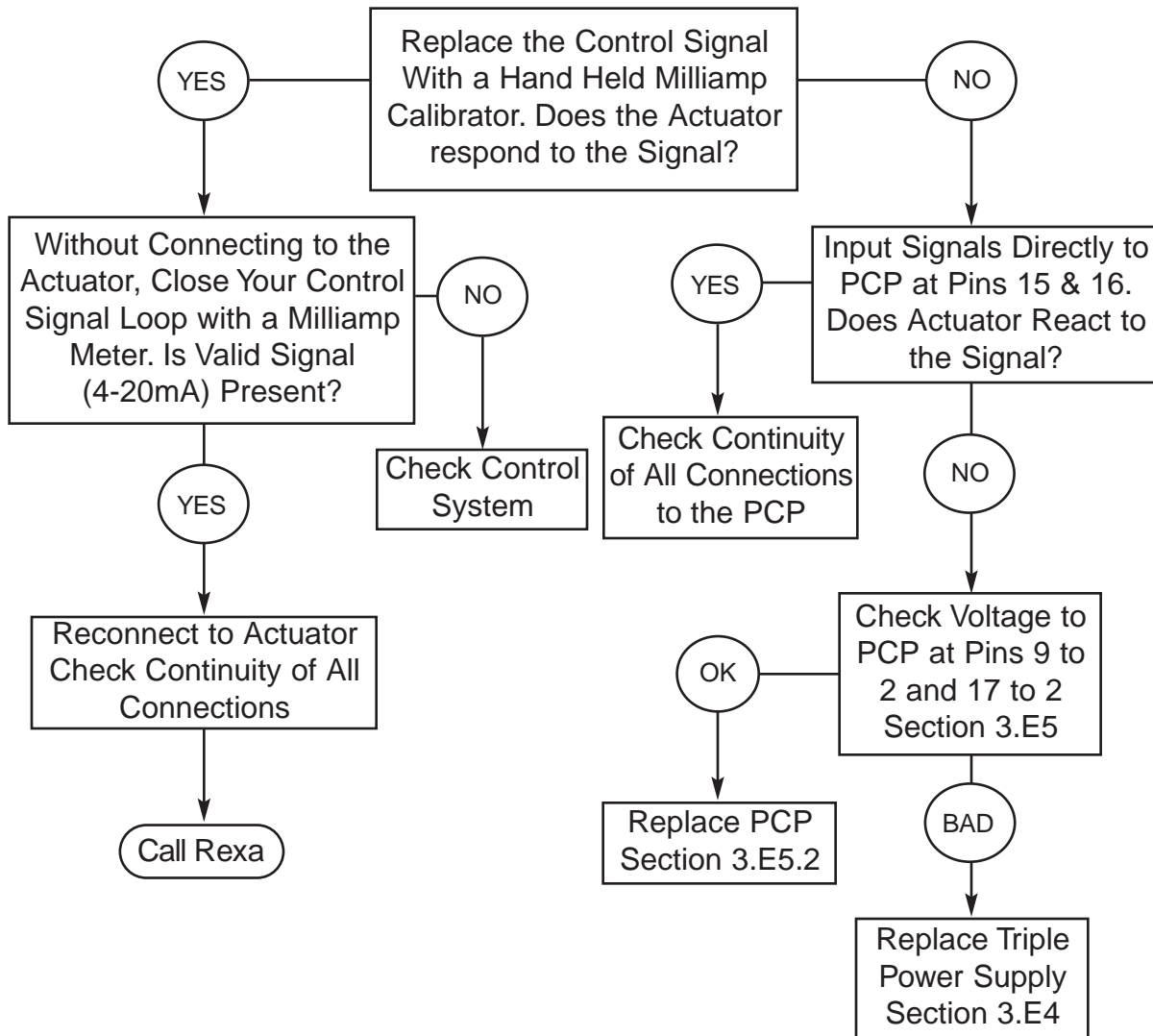
Flowchart 2.6

Display E-St - The Elastic Coupling Will Not Compress

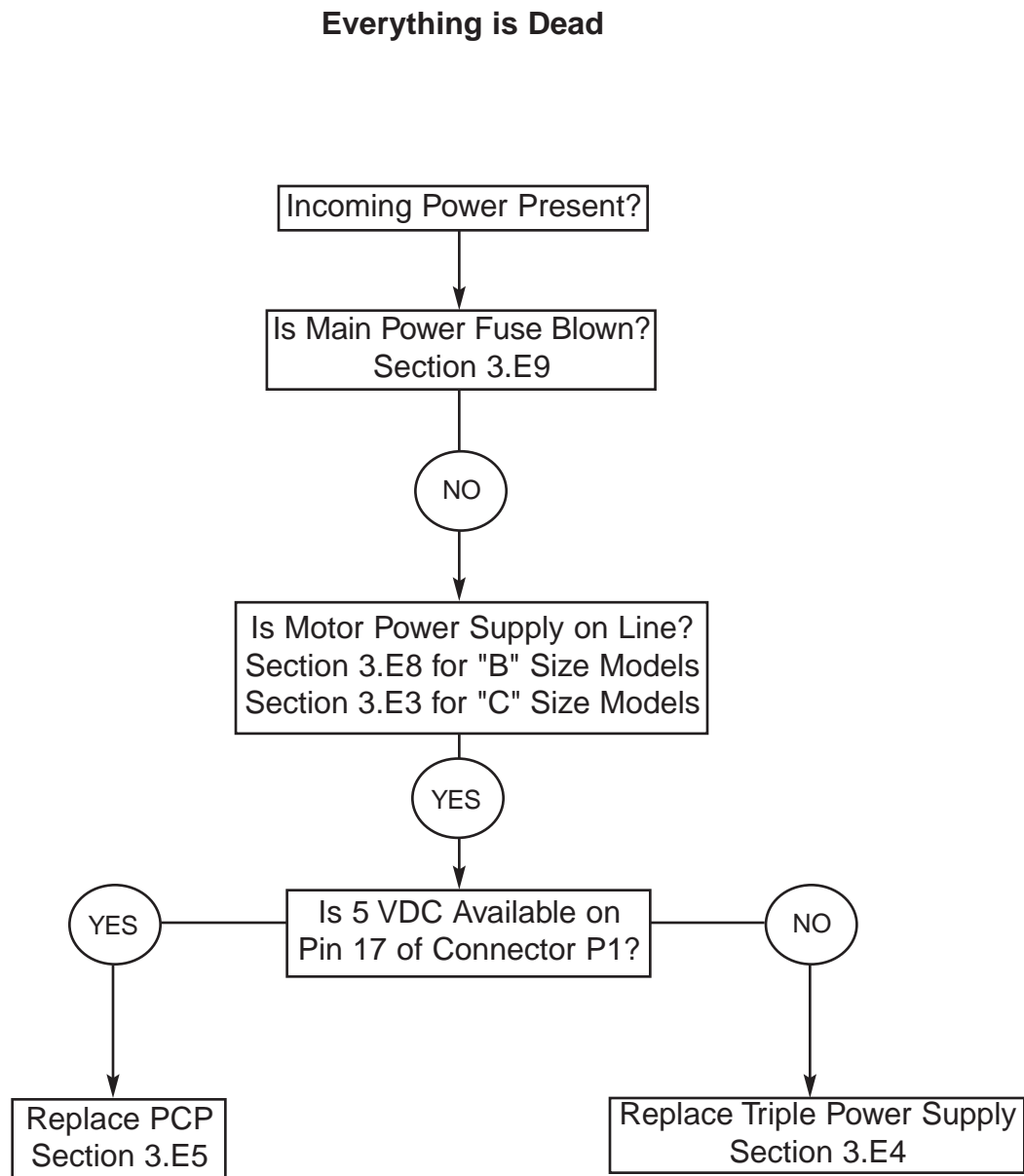


Flowchart 2.7

Display E-CS - Loss Of Control Signal

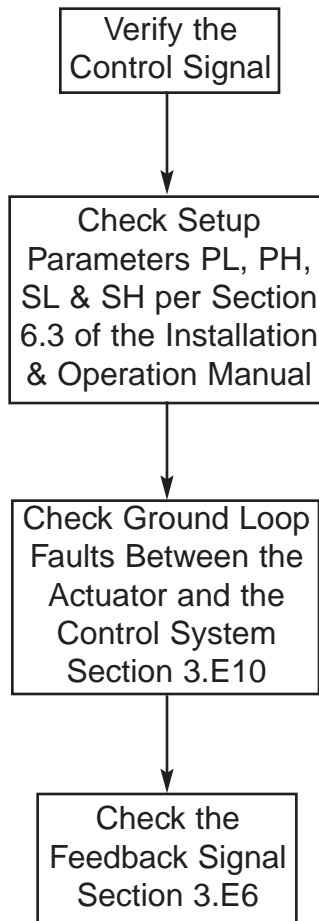


Flowchart 2.8



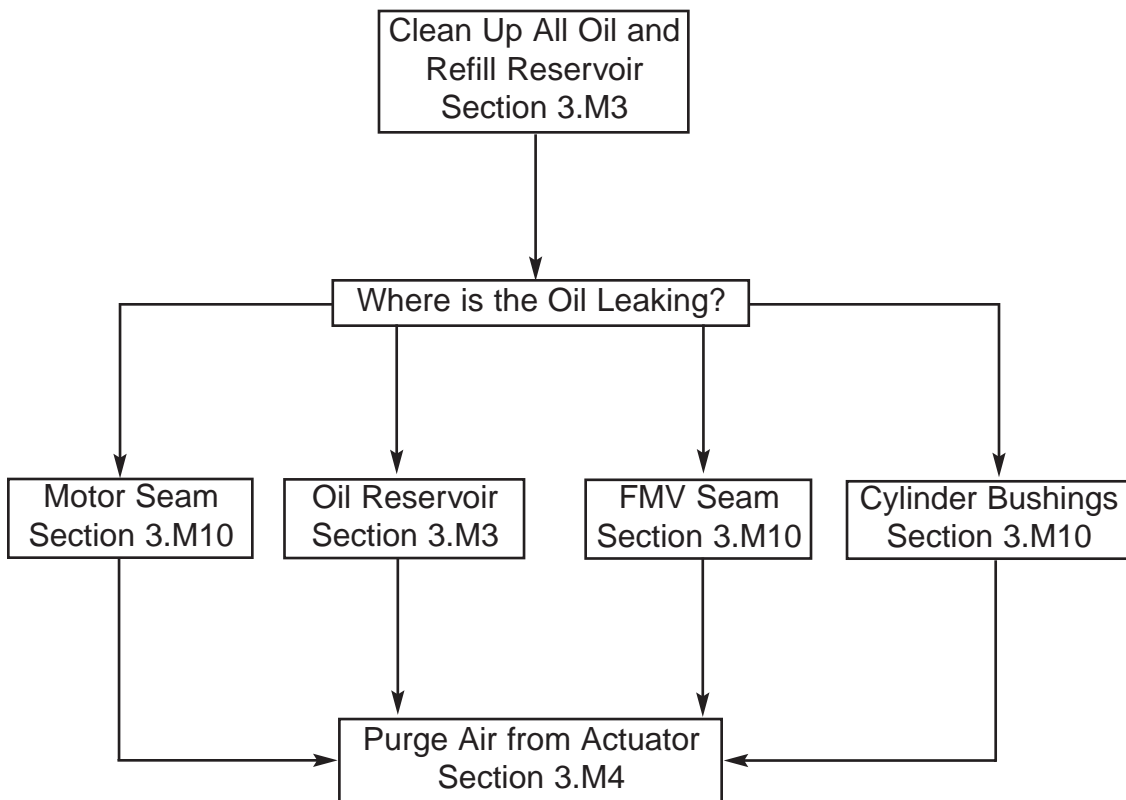
Flowchart 2.9

The Actuator Moves to the Wrong Position



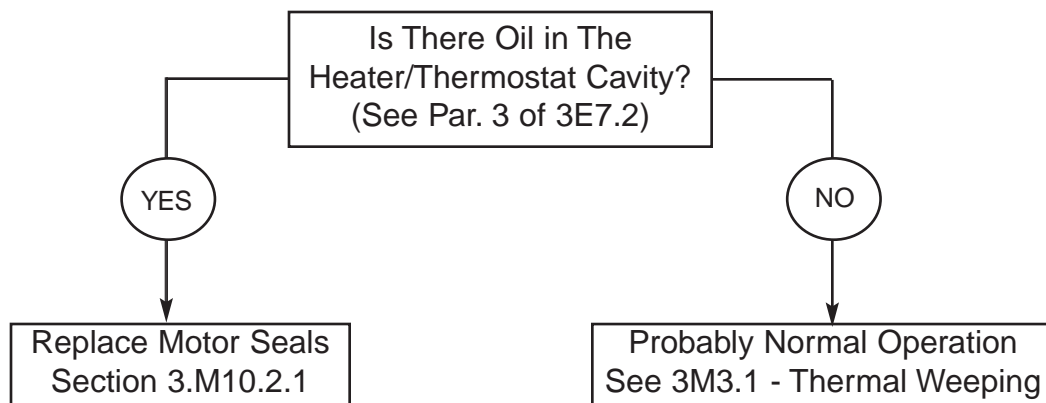
Flowchart 2.10

The Actuator is Still Operating, But There is an Oil Leak



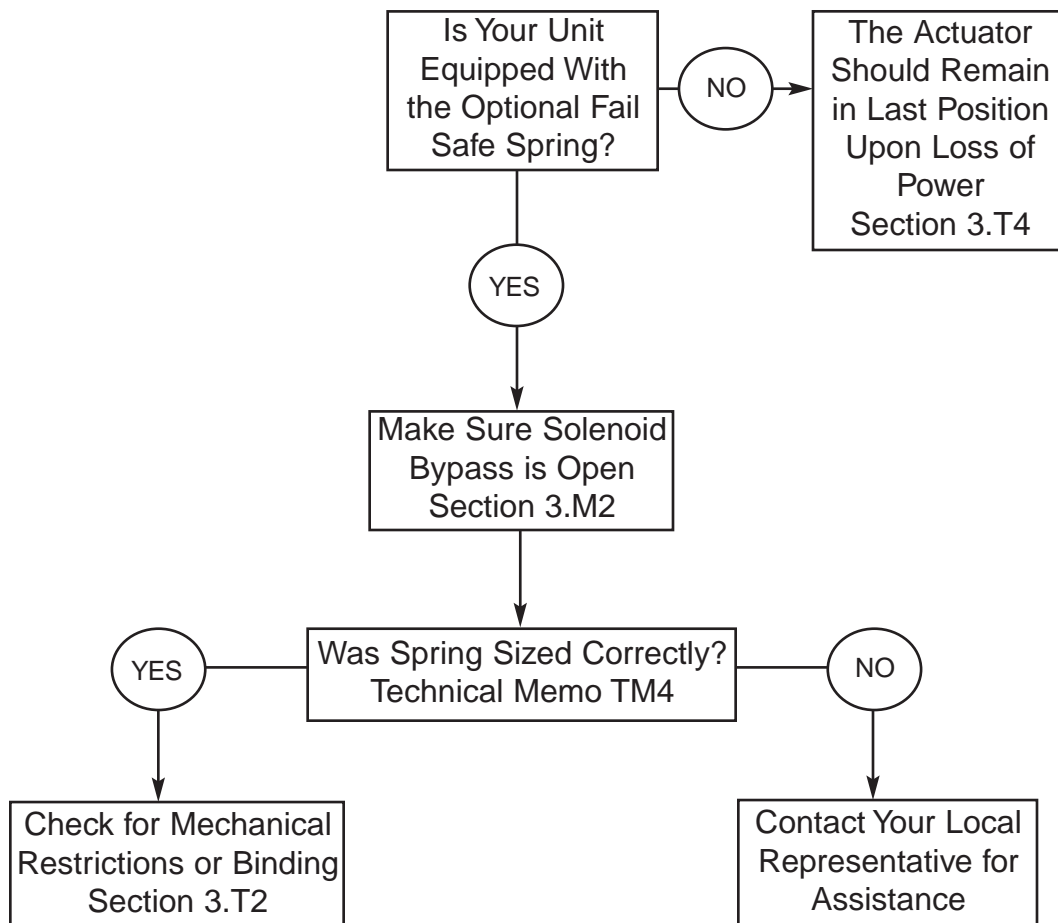
Flowchart 2.11

Oil Indicator is Low, But No Oil is Visible



Flowchart 2.12

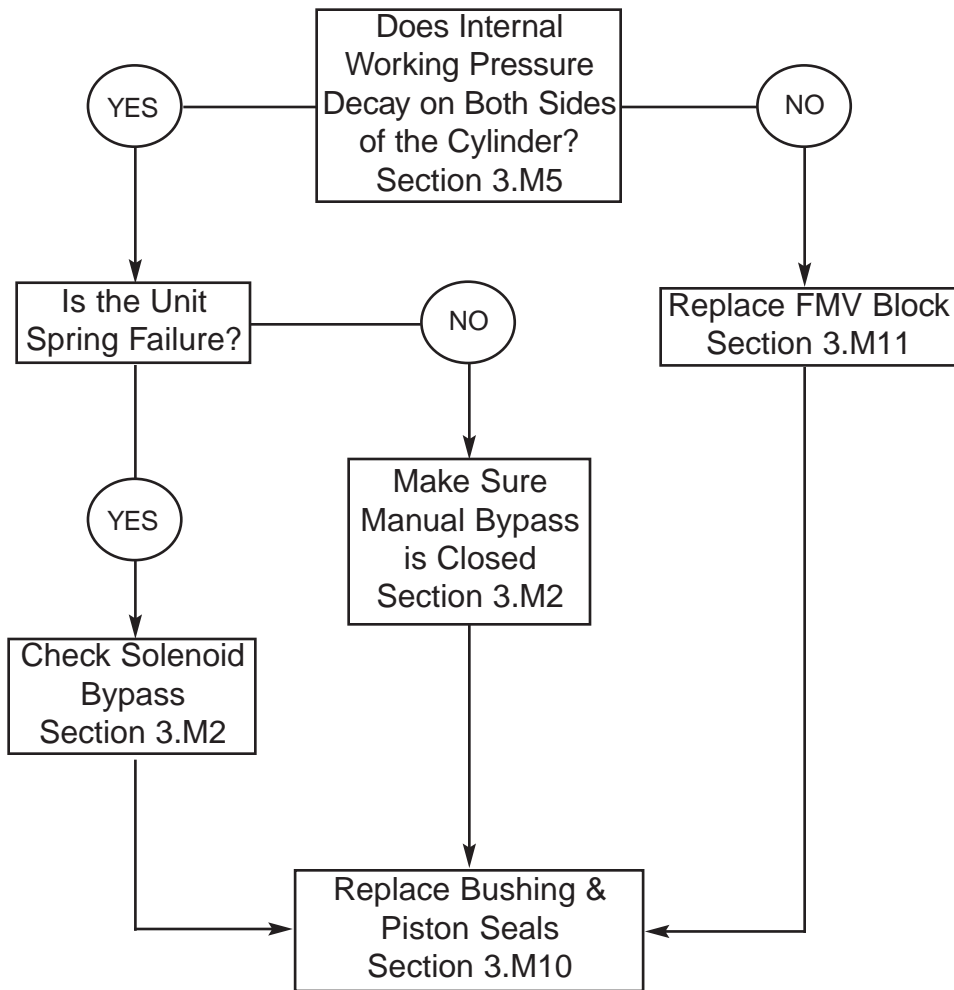
On Power Down, the Unit Does Not Move to the Fail Position



Flowchart 2.13

Actuator "Drifts" Away From the Applied Load

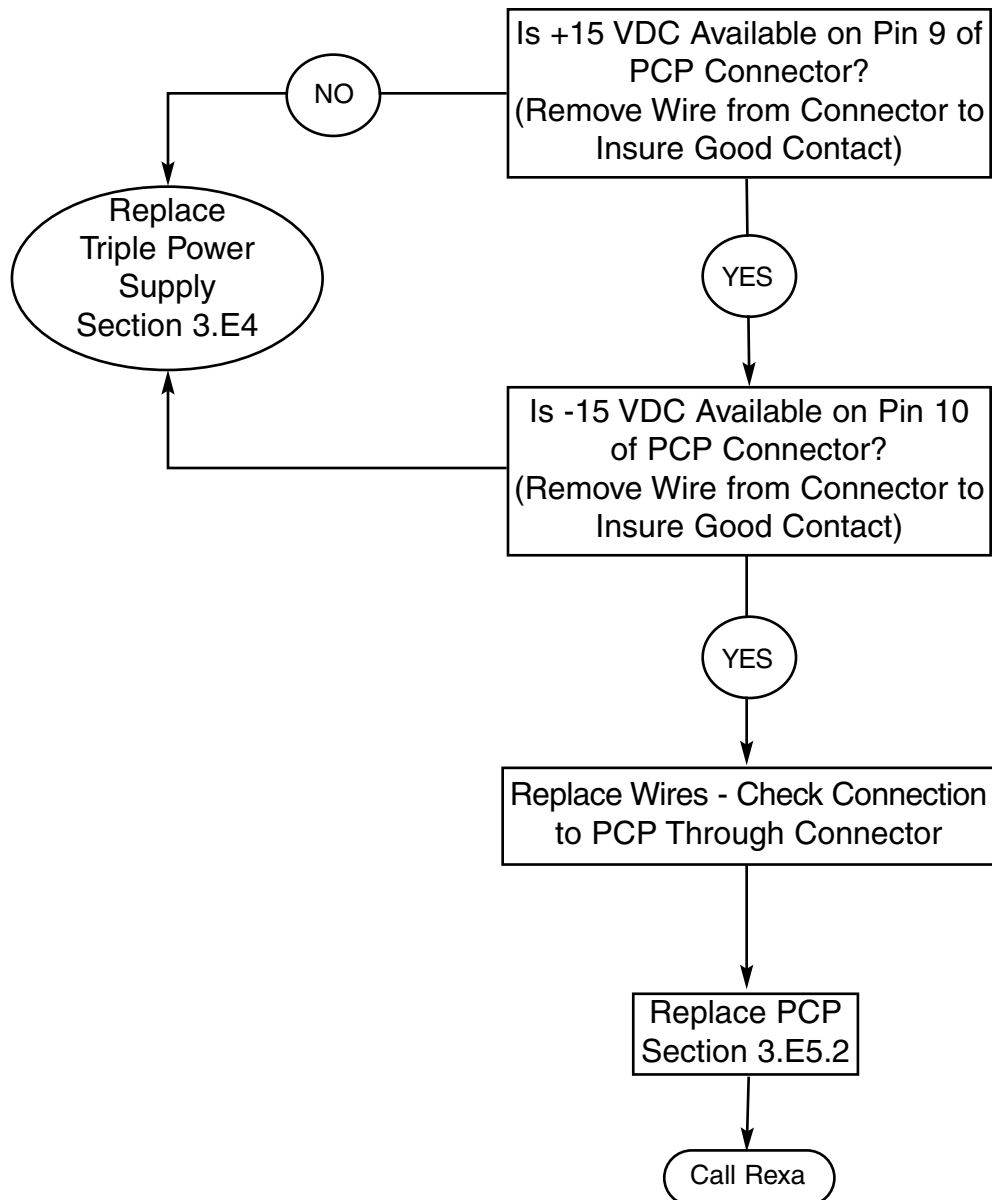
When "drift" occurs, the actuator stem will move slowly in the direction of the applied load. This change in position is sensed by the feedback circuit and corrected when it exceeds the deadband setting. Continual motor cycling in this mode may decrease the life of the actuator.



Flowchart 2.14

Display E-PS - Loss of +15 VDC or -15 VDC from PCP

(Refer to Section 3.E5)



3 Index to Analysis and Repair

Each index subject contains general information, analysis and repair. Appropriate drawings which are found in Appendix C are referenced in the header.

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Wiring Continuity.....	3.E1
Stepper Motor (Electrical).....	3.E2
Motor Driver	3.E3
Triple Voltage Power Supply ...	3.E4
Central Processing Unit.....	3.E5
Actuator Feedback Circuit.....	3.E6
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3.E1 Wiring Continuity, Power and Feedback Cables

(Drawings: M95913, M95914, M95915, M95939 & M95940)

General

The Rexa actuator uses a two cable system for standard actuators. If more than one power module is used, then an additional power cable will be needed for each module. In any case, only one feedback cable is necessary.

Power Cable

The power cable consists of 4 individually shielded, 18AWG, twisted pairs (Photo 1). This cable is used for:

1. Connection of stepper motor driver to stepper motor (Green/Black, Red/Black Pairs)



Photo 1

2. 110vac to heater/thermostat (White/Black Pair)
3. 105Vdc to spring fail solenoid (Optional) (Blue/Black Pair)

If motor phase wires are crossed or they are intermittent (loose connection), an E-1 Error will occur. Insure that all connections are correct and secure.

Feedback Cable

This is an 18AWG, 3 conductor, solidly shielded cable (Photo 2). It is used for:

1. +15VDC supply to feedback PCB in the actuator (Red Wire)
2. 4-20 mA feedback to control box (White, Black Wires)

Any miswiring of the feedback cable will cause the position display to remain constant during actuator motion or an E-2 error to occur. Insure all connections are correct and secure.

3.E1 Wiring Continuity, Power and Feedback Cables

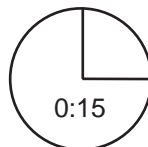
(Drawings: M95913, M95914, M95915, M95939 & M95940)



Photo 2

connector P3 back to the stepper motor driver circuit board. Should any of these connections be open or intermittent, the cable connecting the driver to the mother board is seated improperly. Also, visually inspect the connector P3 and the driver PCB for any burn marks, as this may be the cause of the problem.

3.E1.1 Analysis



1. Verify that wiring is correct using Section 3 of the Installation and Calibration Manual.
2. Visually inspect both ends of cable for cut wires, short circuits, or loose connections.
3. Using your digital multimeter, check the continuity of each wire. Check the continuity of the motor phase wires from the

3.E2 STEPPER MOTOR - ELECTRICAL

Applies to Both "B" and "C" Size Actuators
(Drawings: M03105, M03110, M0311)

General

A stepper motor is energized with digital (electrical) pulses and will move to any number of steps (or detent positions) in strict accordance with the digital pulse provided. In other words, a step motor is an electromagnetic incremental actuator which converts digital pulse inputs into angular indexed motion (Bodine Electric Company, catalog S-11, p. 38). The digital pulses are applied to two winding or phases of the motor, thus switching the windings in sequence. Each pulse defines a discrete position of the motor shaft.

The stepper motor transfers the electrical energy into rotary motion to the hydraulic gear pump. Two sizes of motors are commonly available:

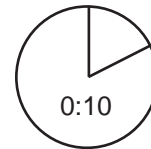
B size; 120 watts (Shown on the left in Photo 3).

C size; 500 watts (Shown on the right of Photo 3).



Photo 3

3.E2.1 Analysis



A defective stepper motor can cause E-1 (wrong direction error) or E-3 (stall detection error). If there is suspicion of a defective motor, the motor can be checked by measuring the resistance of its windings. With an Ohm meter, measure the resistance across A and \bar{A} and measure B and \bar{B} where these connections terminate in the actuator. The resistance you should see is approximately 0.3 ohm across each phase for the motor to operate correctly. If the resistance is much less (< 0.1 ohm) or more (> 0.6 ohm), the motor is defective and should be replaced.

3.E2.2 Repair

Replace motor per Section 3.M8.2.

3E.3 STEPPER MOTOR DRIVER

(Drawings: M95917 & M95939 - "B" size; M95937 & M95940 - "C" size)

General

The stepper motor driver is an electronics package that converts step and direction inputs, from the CPU, to motor winding currents to control the two-phase bipolar stepper motor. The B-Pump driver switches 48 vdc pulses at 3 amperes per winding while the C-Pump driver switches 160 vdc at 6 amps per winding. The stepper motor driver also accepts an "Enable" signal from the CPU, thus Enabling and disabling the drivers output. The B-Pump enable signal is active Low while C-Pump Enable signal is active High.

3.E3.1-B Analysis "B" Size



The B size stepper motor driver is located in the control box on the left hand side wall. It is easily identified by its aluminum back plate, and its 2" x 3" PCB with Gray capacitor. (Photo 4).

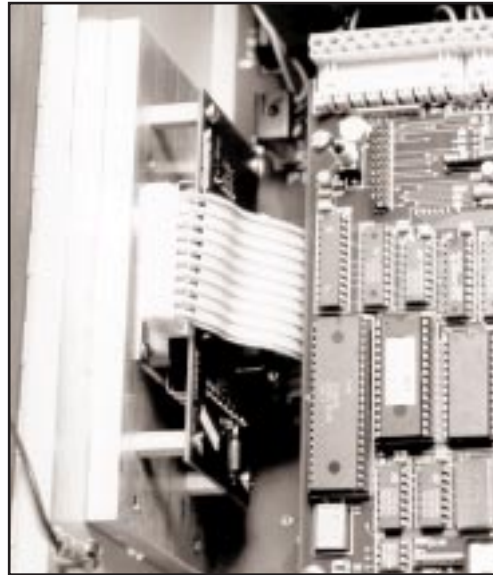


Photo 4

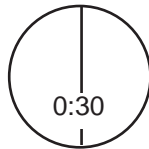
The B stepper motor driver, when defective, could possibly be the cause of an E-1 (wrong direction) or E-3 (Actuator Stall) errors. To determine a problem with the driver, you will need an oscilloscope to see the output pulses of each motor phase winding. Under normal operation, the output should be a 48 vdc square wave pulse with its frequency proportional to the speed setting in Parameter 1.

In most cases, it is easier to replace the driver after eliminating all other likely cases of E-1 and E-3 Errors.

3E.3 STEPPER MOTOR DRIVER

(Drawings: M95917 & M95939 - "B" size; M95937 & M95940 - "C" size)

3.E3.2-B Repair



Remove the driver from the enclosure. Replace with a new driver. To insure proper heat transfer between the driver heat sink and enclosure, coat the base with a heat transfer compound.

Parts Required: "B" Driver

To replace a defective driver, unplug the gray ribbon cable from the driver circuit board. Remove the four, 10-32 buttonhead socket screws which fasten the driver heatsink to the side of the electronics enclosure (Photo 5).



Photo 5

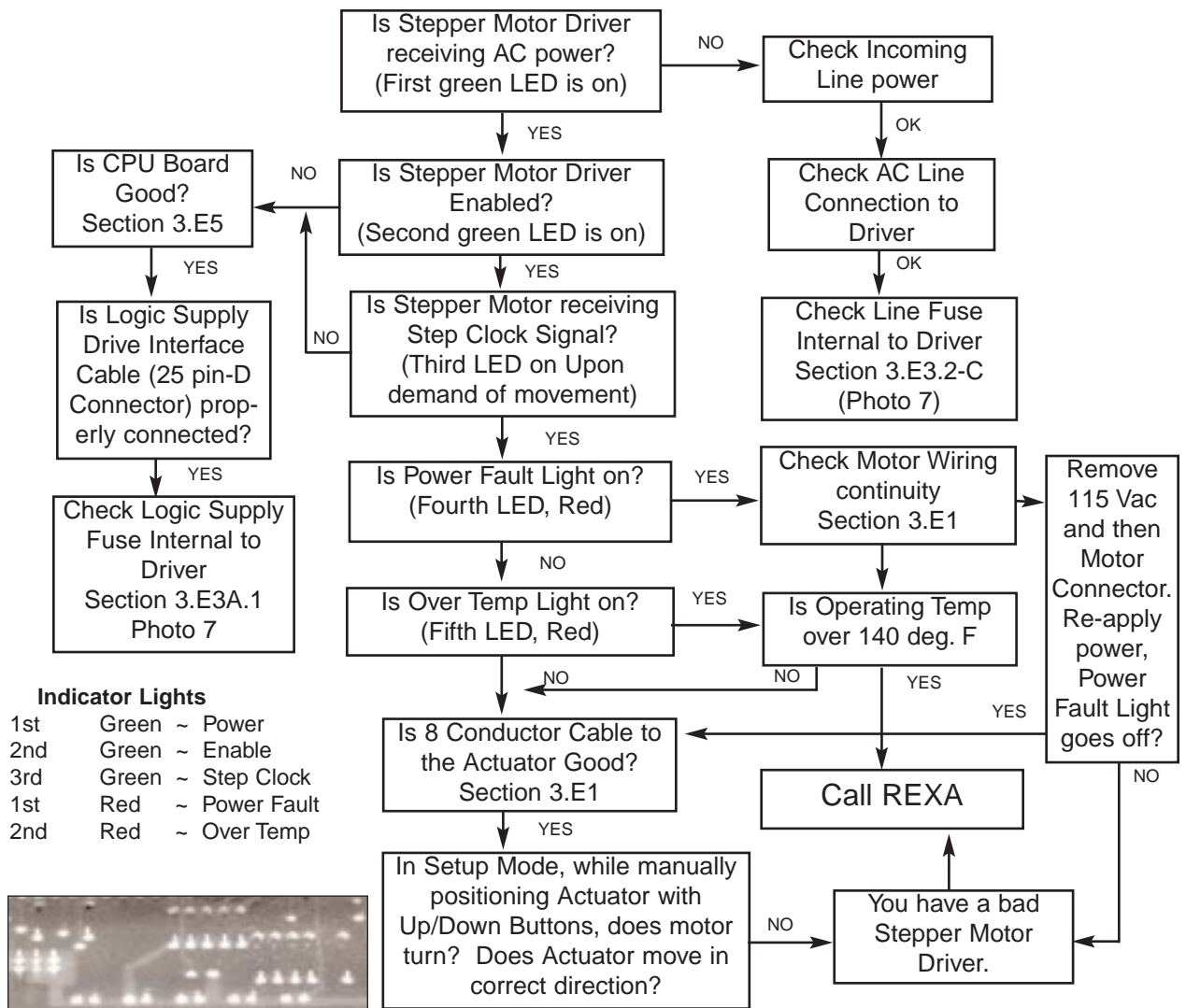
3.E3.1-C ANALYSIS

"C" Size



The "C" size stepper motor driver is located in the control box. It is easily identified by its five indicating LED's, 3 Green, 2 Red.

The stepper motor driver uses logic signals from the CPU to switch 160 vdc (Internal to the driver) to the stepper motor. To isolate a problem in the motor driver circuit, use the following chart.



- Indicator Lights**
- 1st Green ~ Power
 - 2nd Green ~ Enable
 - 3rd Green ~ Step Clock
 - 1st Red ~ Power Fault
 - 2nd Red ~ Over Temp

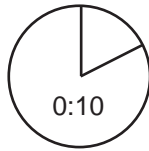


Photo 6

3.E3.1-C REPAIR "C" Size Stepper Motor Driver

(Drawings: M95917 & M95939 - "B" size; M95937 & M95940 - "C" size)

3.E.2-C Repair



Replace open fuses as follows:

- F1 Bussman MDS 20Amp
- F2 Bussman MDL 1/2 Amp

Replacing Fuses

If an open fuse is suspected, replace the fuse as follows:



1. Remove electric power from the control box.
2. Wait 3 minutes to allow charge on capacitors, Internal to Driver, to Dissipate.
3. Check the fuses, F1& F2, located by J1 115Vac connector (Photo 7).

NOTE: If Stepper Motor Driver does not operate, or fuse failure occurs again, you have a faulty driver.

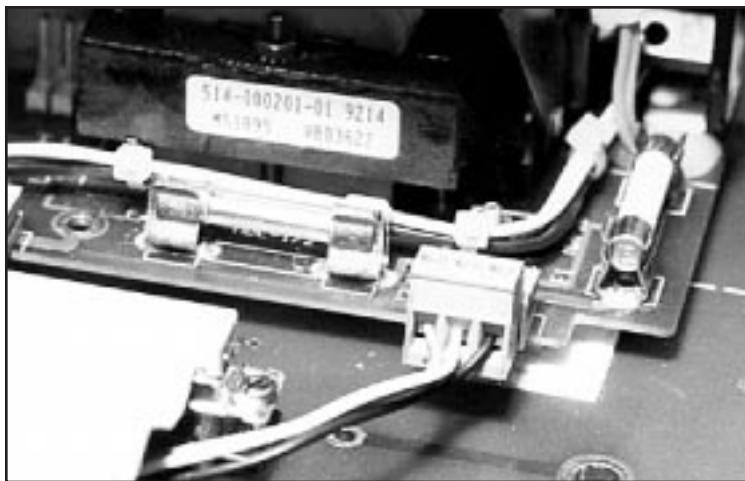


Photo 7

3.E4 Triple Voltage Power Supply
Applicable to Both "B" and "C" Size Actuators
 (Drawings: M95917, M95937, M95939 & M95940)

General

This regulated power supply is used specifically to provide the DC voltages needed by the CPU Board and the feedback circuit.

The unit itself is soldered to the motherboard and is located directly underneath the CPU Board (Photo 8).

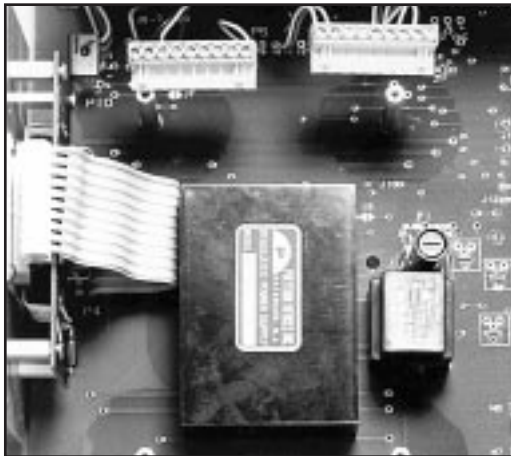
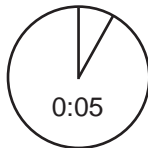


Photo 8

3.E4.1 Analysis



1. Locate the 18 position gray connector at the top of the CPU Board (The connector positions are numbered from left to right). (Photo 9)

2. Using a DC Voltmeter, and the chart following, verify the voltage level outputs going to the CPU Board.

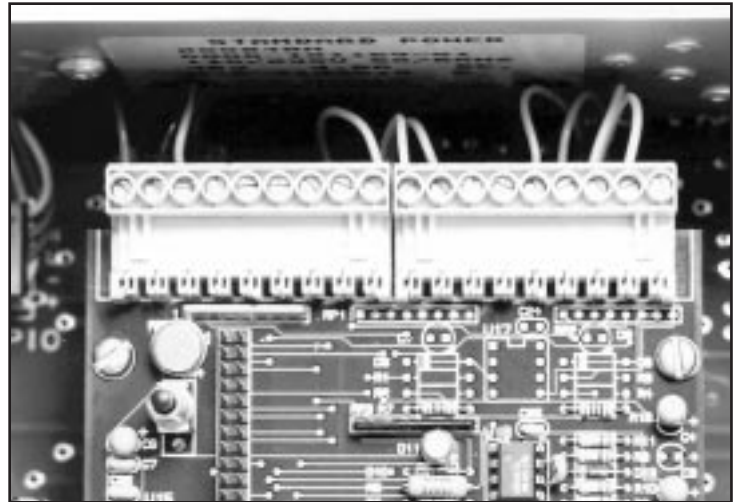


Photo 9

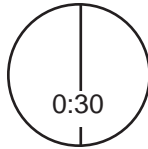
Gray Connector Position	Voltage Should Be	Color of Wire at Position
2	Common Ground	Black
9	+15 vdc - .02%	Orange
10	-15 vdc ± .02%	Yellow
17	+5 vdc ± .05%	White

If any of these voltages are incorrect, the triple power supply must be replaced.

3.E4 Triple Voltage Power Supply

Applicable to Both "B" and "C" Size Actuators
(Drawings: M95917, M95937, M95939 & M95940)

3.E4.2 REPAIR



Parts Required:

Triple Power Supply

Remove the motherboard from the electronics enclosure per section 3.E11.

Remove the CPU Board from the motherboard per section 3.E5.2.

To replace the triple power supply, remove the two, 4-40 pan head screws from the solder side of the motherboard which fasten to the supply (Photo 10). Using a soldering iron and desoldering tool, remove the solder from each pin of the supply. Try to remove as much solder as possible, to avoid any damage to the solder pads of the motherboard when removing. Replace with a new supply, solder and fasten with 4-40 screws. Replace CPU and motherboard.

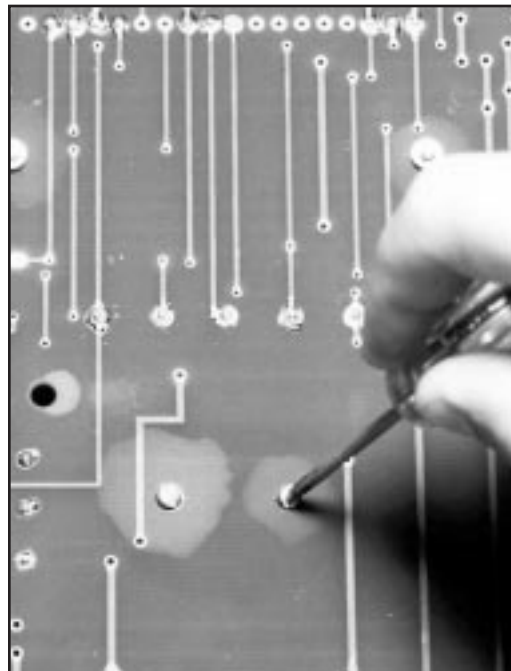


Photo 10

3.E5 Central Processing Unit (CPU Board)

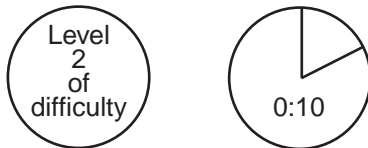
(Drawings: M95917, M95937, M95939 & M95940)

General

This component of the actuator is located in the center of the control box (Photo 11). It is a microprocessor based (Intel 8051) circuit that includes a 12 bit (A/D) converter, a non-volatile memory for storing the set up parameters, the LED display, and keypad.

All programming of the CPU Board is done by using the three button keypad. A complete explanation of the set-up parameters can be found in Section 5 of the Installation and Calibration Manual. The CPU is specifically designed to receive power, control, and feedback signals from the actuator, then output the needed logic signals to the stepper motor driver.

3.E5.1 Analysis



During normal operation, the input and output (I/O) signals to the CPU are shown in Chart E5.A. If problems are occurring, then these specific I/Os should be addressed:

Flowchart 2.2

Connector Position 9, +15vdc
 Connector Position 14, +Act.
 Feedback

Flowchart 2.7

Connector Position 9, +15vdc
 Connector Position 15 & 16,
 Control Signal
 Connector Position 17, +5vdc

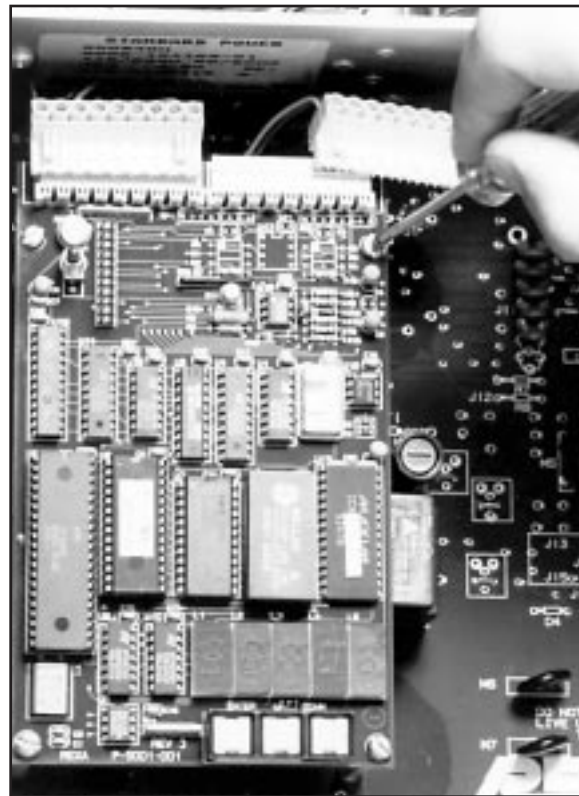


Photo 11

Flowchart 2.8

Connector Position 9, +15vdc
 Connector Position 10, -15vdc
 Connector Position 17, +5vdc

E5.A Central Processing Unit

(Drawings: M95917, M95937, M95939 & M95940)

Connector Positions are Numbered Left to Right

Is Signal an "input" to or "output" from the CPU	CPU Connector Position	Name of Signal	Color of Wire at Position	Measuring Reference to Pos. 2 - (Common), You Should See...
output	1	Stepper Motor Driver Enable	Brown	"B" Size Units: Voltage Level change from a high state to a low state when directional button is depressed. "C" Size Units: Voltage Level change from a low state to a high state when directional button is depressed.
n/a	2	Common/FB-	Black	n/a
output	3	Stepper Motor Direction	Red	Voltage Level Change When Alternately Depressing Up/Down Buttons
input	9	+15vdc	Orange	+15vdc \pm .02%
input	10	-15vdc	Yellow	-15vdc \pm .02%
output	11	Step Clock	Green	Frequency reading in KHZ corresponding with the speed setting (Parameter !). An oscilloscope is required to obtain a meaningful reading.
input	14	Actuator Feedback+	Blue	A milliamp signal between 4 and 20mA. It should vary linearly with actuator motion.
input	15	Control Signal+	Violet	This signal is the incoming control signal.
input	16	Control Signal-	Gray	n/a
input	17	+5vdc	White	+5vdc \pm .05%

3.E5 Central Processing Unit (CPU Board)

(Drawings: M95917, M95937, M95939 & M95940)

3.E5.2 Repair



Parts Required: CPU

Now that you are certain that the CPU Board is defective, it must be replaced. Follow the steps below to do so.



1. Write down the setup parameters currently entered into the CPU (Photo 12).
2. Remove electric power from unit.
3. Using an integrated circuit extractor, carefully remove the software eeprom chip (Photo 13). (It is identified by a sticker with a version number on it).
4. Unplug the two piece, 18 position gray connector from the CPU Board.
5. Remove the 4 panhead screws at the four corners of the CPU Board (Photo 11).
6. Replace with new board, and reverse the above steps.
7. The new CPU Board will require the input of the setup parameters per Section 4 and 5 of the Installation and Calibration Manual. Variations in reading between the original and new CPU should be expected for parameters 2, 3, 4 and 5.



Photo 12

3.E5 Central Processing Unit (CPU Board)

(Drawings: M95917, M95937, M95939 & M95940)

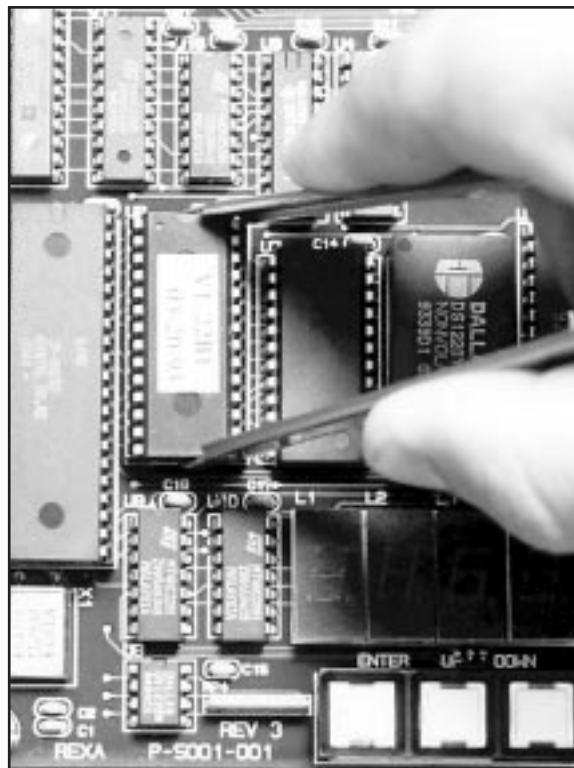


Photo 13

3.E6 Actuator Feedback Circuit

Applies to Both "B" and "C" Size Actuators

(Drawings: M95914 & M95915)

General

In order for the microprocessor to determine the position of the actuator, a closed-loop, 4-20mA feedback circuit is used.

In the actuator hydraulic cylinder, a potentiometer is directly connected to the output piston rod.

A voltage coming from the triple power supply (+15vdc) is applied to the feedback PCB integral voltage regulator. This is now a 0-10vdc output signal that is directly propor-

tional to the actuator position. For electrical noise immunity and for greater transmission distances, the 0-10vdc signal is converted to 4-20mA by the feedback PCB located under the potentiometer cover (Photo 14).

3.E6.1 Analysis



If the LED screen on the CPU displays all zeros, an E-2 Error, a P___ L or P___ H the feedback circuit may be defective.

Under the potentiometer cover at the actuator, measure for the presence of +15vdc on the feedback board (Photo 15). Using a volt meter, measure between the purple wire (+15vdc) and gray wire (Logic ground.) If 15 volts is not present, re-check wiring connections and triple power supply.

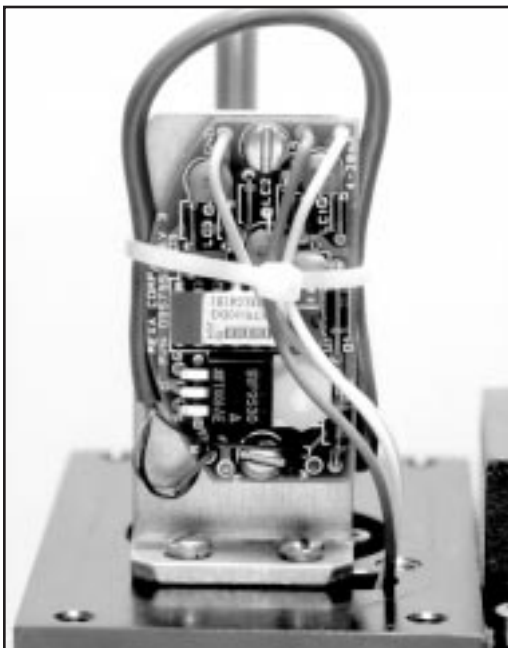


Photo 14

3.E6 Actuator Feedback Circuit

Applies to Both "B" and "C" Size Actuators

(Drawings: M95914 & M95915)

If 15 volts is present disconnect the yellow/white connection in the junction box at the actuator. Place an ammeter in series with the two wires (Photo 16). While stroking the actuator from one end to the other, is 4-20mA signal present? If yes, recheck connections and CPU. If yes and feedback is greater than 21 mA, replace feedback board.

If no, feedback PCB needs replacement. If problem still exists, replace potentiometer.



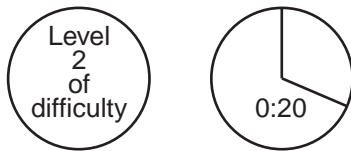
Photo 15

3.E6 Actuator Feedback Circuit

Applies to Both "B" and "C" Size Actuators

(Drawings: M95914 & M95915)

3.E6.3 Repair Feedback



Parts Required:

Feedback Board Assembly

If it is determined that the feedback PCB must be replaced, follow the steps outlined below:

NOTE: Use the supplied pictures to assist you in the replacement of the Feedback Potentiometer.

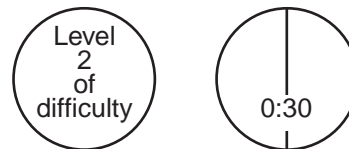
3.E6.3.1 Feedback Board and Potentiometer Disassembly and Replacement



Photo 16

Feedback Board Replacement

1. Disconnect the incoming power.
2. Remove all wires from the connector, making note of their positions.
3. Remove the two nylon screws that secure the circuit board to the mounting plate.
4. Reinstall the new circuit board in the reverse order and reconnect the wires.



Parts Required:

Potentiometer

If it is determined that the feedback PCB is operating, and the potentiometer is defective, follow the steps outlined below for potentiometer replacement;

1. Remove electric power from the unit.
2. Locate feedback potentiometer cover for your unit.
3. Remove cover and record the wire colors and their positions on the feedback PCB.
4. Disconnect the potentiometer wires at the feedback PCB
5. Disconnect the potentiometer wires from feedback PCB.



3.E6 Actuator Feedback Circuit

Applies to Both "B" and "C" Size Actuators

(Drawings: M95914 & M95915)

6A. Linear Potentiometer

Replacement Procedure:

- a. Remove the 1/4-20 socket-head shoulder cap screw which fastens the feedback takeoff arm to the shaft the cylinder. Be careful not to misplace the curved spring washer under the takeoff arm, it will be loose.
- b. Remove the 4-40 hex nut from the shaft of the potentiometer.
- c. Remove the retaining ring which holds the potentiometer in place.
- d. Replace the potentiometer and re-assemble.
- e. Connect the wires to the feedback board and secure them (Photo 17).



Photo 17

6B. Rotary Potentiometer

Replacement Procedure:

- a. Put the electronics into the "SETUP" mode, scroll down to either "PL" or "PH", depending on which end of the travel you are at. If you are somewhere in the middle either may be selected. Now hit the "ENTER" button. Record the reading of the PCP/CPU before disconnecting power. If no reading is present move the actuator to either the full open or full closed position. A record of this number should have been recorded on the data sheet inside the electronics enclosure.
- b. Disconnect the incoming power.
- c. Unscrew the cover of the feedback housing to expose the potentiometer.
- d. Disconnect the three wires coming from the potentiometer, making note of their position by color.
- e. Loosen the upper set screw on the potentiometer shaft coupling.

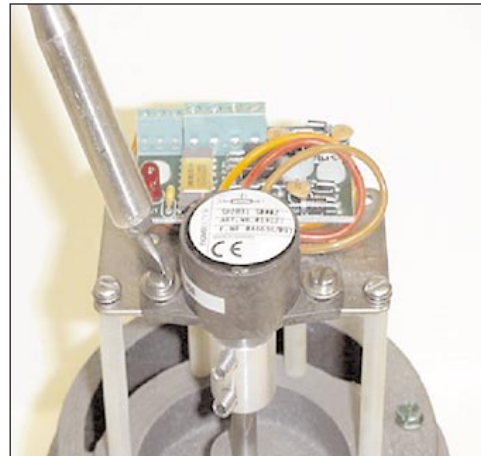


3.E6 Actuator Feedback Circuit

Applies to Both "B" and "C" Size Actuators

(Drawings: M95914 & M95915)

- f. Remove the two screws holding the potentiometer to the mounting plate and remove the old potentiometer.
- g. Reinstall a new potentiometer by reversing the above procedures. Trim the potentiometer wires to length as required, routing them as illustrated in the photograph, insert into the connector and tighten securely. Tighten the upper set screw on the coupling.



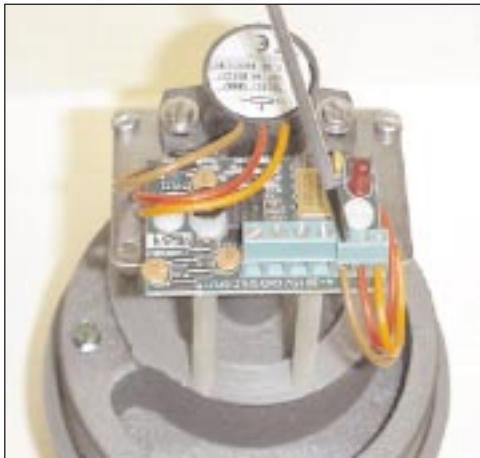
Potentiometer Screw

Calibration



1. Loosen the lower set screw on the potentiometer shaft coupling.
2. Reconnect power to the actuator. Go to either "PL" or "PH", whichever you used in step A.1 above, and hit "ENTER". You should now see a reading on the PCP/CPU display.
3. Rotate the shaft coupling so that the display reading is the same as when the unit was powered down (or matches the recorded number off the data sheet) and tighten the lower set screw. This may take a few tries because of slight shifting when the screw is tightened. The unit should now operate close to how it did with the old potentiometer.
4. Resetting of PL and PH should now be done to ensure accuracy of the full open and full closed positions. This procedure is outlined in the Installation and Operation manual.
5. Reinstall the housing cover and put the unit back into service.

3.E6 Actuator Feedback Circuit
Applies to Both "B" and "C" Size Actuators
(Drawings: M95914 & M95915)



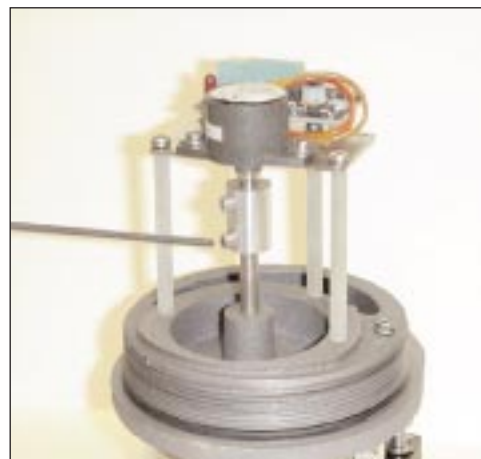
Wire Connections



Upper Set Screw



Wire Routing



Lower Set Screw

3.E7 Heater/Thermostat

Applies to Both "B" and "C" Size Actuators

(Drawings: M03105)

General

To maintain the viscosity of the oil, each unit has a cartridge heater controlled by a thermostat (Photo 19). The thermostat will turn the heater on at 60°F and off at 80°F.

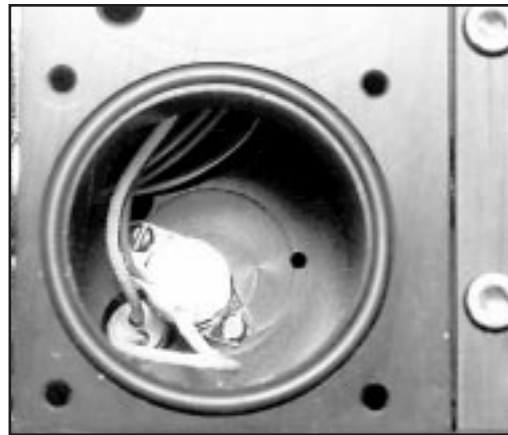
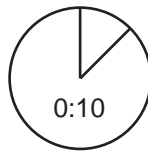


Photo 19

3.E7.1 Analysis



The operation of the heater can be checked by either:

- A. Feeling the Pump/Motor Standoff: This is the block of metal that is bolted to the stepper motor. At ambient temperatures less than 60°F it should feel slightly warm to the touch.

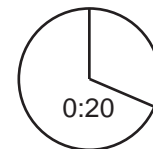


- B. Measuring the Current to the Heater:

If the thermostat is closed (temperature below 60°F) and the heater is on, you should measure approximately 1 Amp in series between position 15 (Heater 110vac Line) and the black wire in the white/black pair of the large 8 conductor cable going to the actuator (Photo 20).

3.E7.2

Repair



Parts Required:

Heater/Thermostat Assembly
Heat Transfer Compound

If all wiring connections appear to be good, the temperature is below 60°F, and the heater is not on, follow these steps for replacement.

1. Remove electric power from unit.
2. Open the electrical junction box and disconnect the brown teflon and brown cloth wires from the white/black pair of wires coming



3.E7 Heater/Thermostat

Applies to Both "B" and "C" Size Actuators

(Drawings: M03105)

from the large 8 conductor cable.

3. Remove the four 10-32 socket head cap screws from the heater/thermostat compartment cover (Photo 21).
4. Unscrew the two 4-40 pan head screws that secure the thermostat down.
5. Pull the two disconnected heater/thermostat wires down from the electrical junction box.
6. Now grasp the heater by the wires and remove from unit.
7. Coat the new cartridge heater and back of thermostat with heat transfer compound and install.

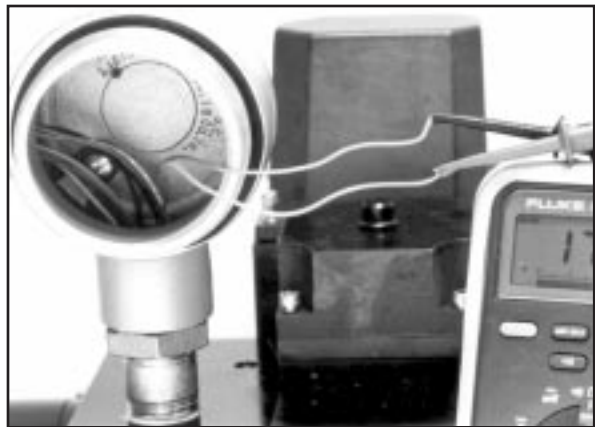


Photo 20

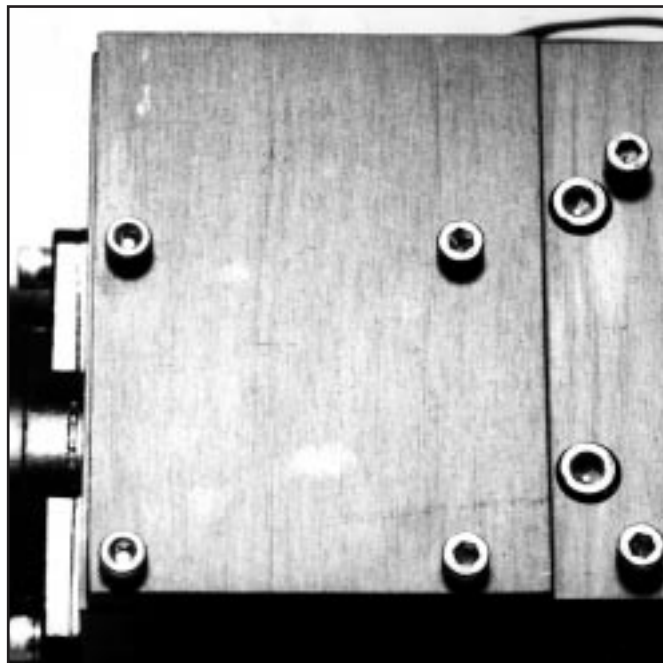


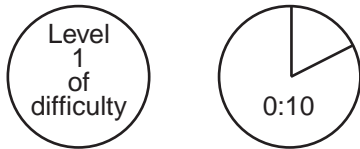
Photo 21

3.E8 "B" Motor Power Supply
Applies to "B" Size Power Modules Only
 (Drawings: M95917 & M95939)

General

This is a non-regulated power supply used to provide 45-55 vdc (Photo 22), at 4 Amps to the "B" size stepper motor driver.

3.E8.1 Analysis



Follow this flowchart to isolate a problem with the 48 vdc power circuit.

3.E8.2 Repair

Parts Required:

Motor Power Supply
 See Section 3.E11 for replacement.



Photo 22

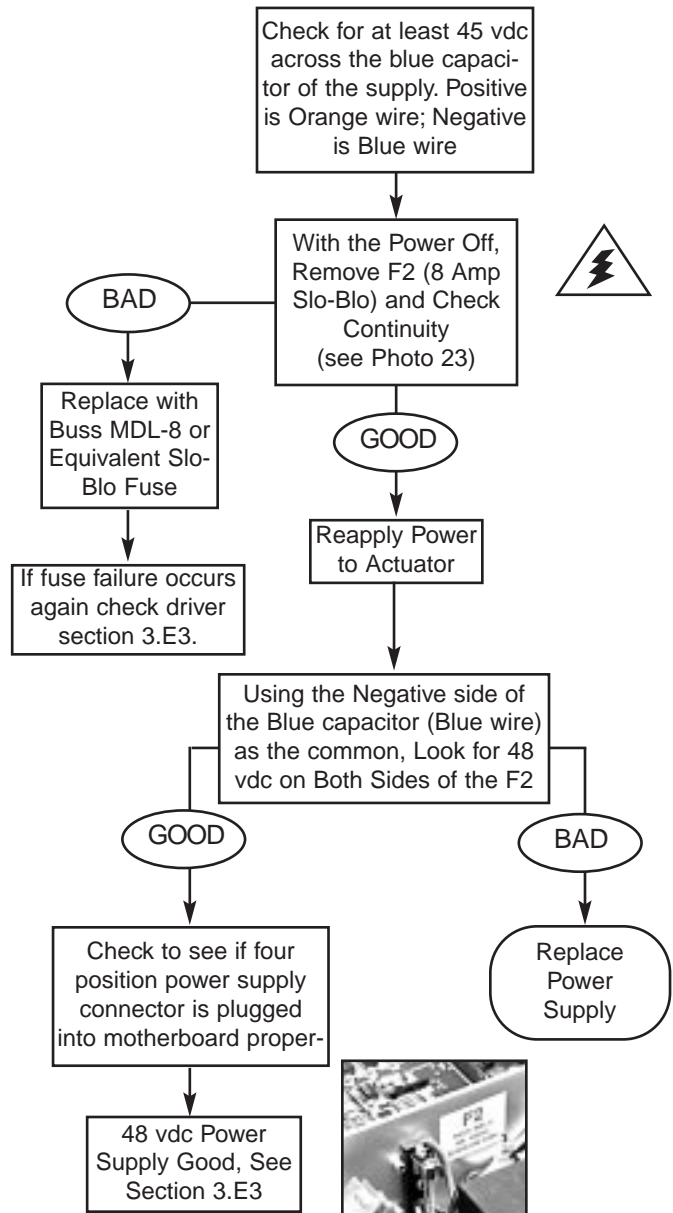


Photo 23

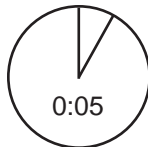
3.E9 Main Fuse

(Drawings: M95917 & M95939)

General

The main fuse protects the electronic circuitry from overload conditions at the incoming power line.

3.E9.1 Analysis



1. Remove electric power from the unit.
2. Locate the main fuse (F1) on the motherboard between the CPU board and the 24 pin connector. (Photo 24)
3. Remove the fuse from the fuse holder.
4. Test Fuse Continuity
5. If the fuse is an open circuit, replace with new fuse.

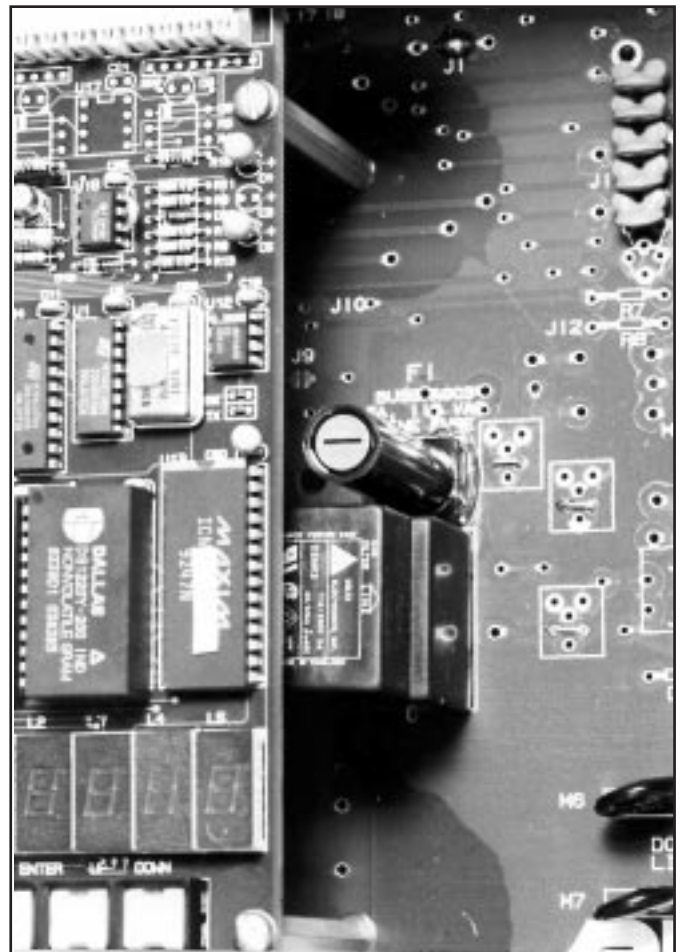


Photo 24

If fuse continues to fail, check the Triple Power Supply Section 3.E4. and Ground Faults, Section 3.E10.

3.E10 Ground Faults

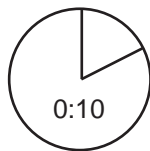
(Drawings: M95917, M95937, M95939, & M95940)

General

A ground fault is essentially a current short circuit to earth ground. This situation is dangerous to both personnel and equipment. All Rexa equipment is subjected to a dielectric test of 1200VRMS between the primary circuit and earth ground. Although only fault free equipment is shipped from the factory, the actuator should be rechecked after installation to verify that a fault has not been inadvertently introduced during installation or shipment.

3. Any fault found must be corrected to prevent personal injury and equipment malfunction. For safety reasons, REXA recommends that all power line feeds contain a third earth ground conductor.

3.E10.1 Analysis



1. Disconnect electric power from the unit.
2. Measure the resistance between earth ground and 115 VAC, PIN#12. This value must be an open circuit for safe operation.

3.E11-B Removing the Motherboard for Servicing

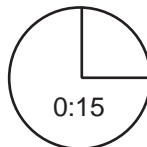
Applies to "B" Size Units Only

(Drawing: M95917)

General

The motherboard is the large green circuit board (12" x 10") that acts as the mounting base of all the electronic components. The motherboard is the main interface between actuator and electronics as well as external power, control signal and electronics. If you have a known bad component on the motherboard, follow the procedure below for removal.

3.E11.1-B Removal



1. Remove electric power to the unit.
2. Disconnect the wires at the 24 position green connector (Photo 25).
3. Remove the four stepper motor driver fastening screws, along with the white nylon washers (Photo 5). These are located on the left side of the control box. Remove the motor driver complete with card.
4. Remove the CPU from the assembly per section 3.E.5.2 and put aside.

5. Next, unscrew the earth ground from the lug at the bottom of the control box (Photo 26). Remove the four, 10-32 socket head screws which fasten the 48 vdc power supply to the enclosures (Photo 27).
6. Remove the four 10-32 screws located on each corner and pull the entire motherboard from the control box.
7. Replace with new motherboard. Assemble by first replacing the motor power supply, then driver and finally the CPU board.

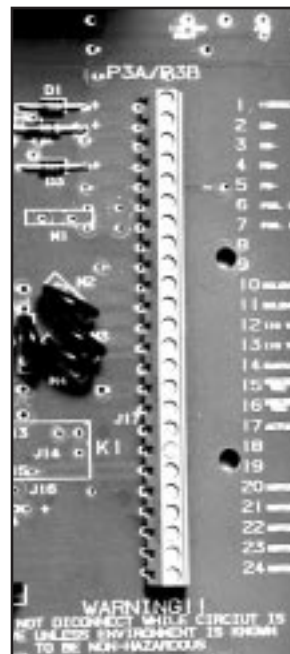


Photo 25

3.E11 Removing the Motherboard for Servicing

Applies to "B" Size Units Only

(Drawing: M95917)

3.E11.2-B Repair

The motherboard is mainly a base to all components. If a problem with the board does exist, it is easier and recommended to replace it. However, if a repair is attempted please use the following cautions:



1. Perform all repairs without electric power applied.
2. When soldering or desoldering, be careful not to damage any of the solder pads on the motherboard.
3. When re-assembling, be sure there is no hardware remaining loose in the enclosure.
4. Re-check all connections to be sure they are correct.



Photo 27



Photo 26

3.E11-C Removing the Motherboard for Servicing

Applies to "C" Size Units Only, Single Power Module

(Drawing: M95937)

3.E11.1-C Removal



1. Remove electric power to the unit.

CAUTION: *Wait three minutes to allow capacitors in the driver to discharge.*

2. Disconnect the wires at the 24 position green connector.
3. Remove the five driver fastening screws, along with their white nylon washers. These are located on the top side of the control box (Photo 28).



Photo 28

4. Remove the motor driver.
5. Remove CPU Board per Section 3.E5.2 and put aside.
6. Next, unscrew the earth ground wire from the lug at the top left corner of the control box (Photo 29).
7. Remove the four 10-32 screws located on each corner and pull the entire motherboard from the control box.
8. Replace with new motherboard. Re-assembly by first replacing the Stepper Motor Driver then the CPU Board.

3.E11.2-C Repair

The motherboard is mainly a base to all components. If a problem with the board does exist, it is easier and recommended to replace it. However, if a repair is attempted please use the following cautions:

1. Perform all repairs without electric power applied.
2. When soldering or desoldering, be careful not to damage any of the solder pads on the motherboard.
3. When re-assembling, be sure there is no hardware remaining loose in the enclosure.
4. Re-check all connections to be sure they are correct.

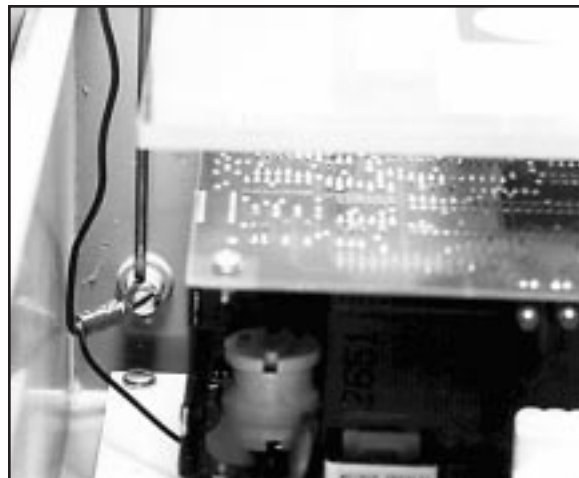


Photo 29

3.M1 Pump

(Drawings: M03110, M03111, M03099 & M03105)

General

This is a reversible precision gear pump (Photo 30), driven by the motor to provide fluid at high pressure to either side of the cylinder piston depending upon the direction of motion.

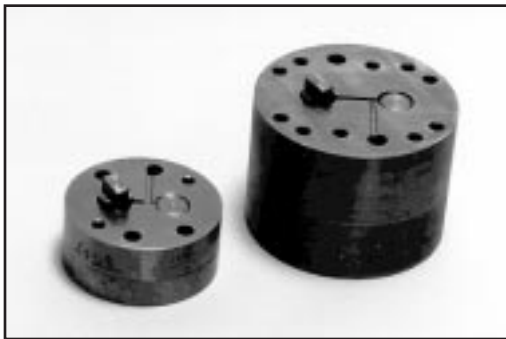


Photo 30

4. Without pulling the motor wires, tilt the motor to expose the motor shaft (Photo 31).
5. Insert a 3/16" socket key or large standard screwdriver into the pump/motor coupling and turn the pump (Photo 32).
6. The pump should be free to turn.
7. To replace motor, see Section 3.M8.2.

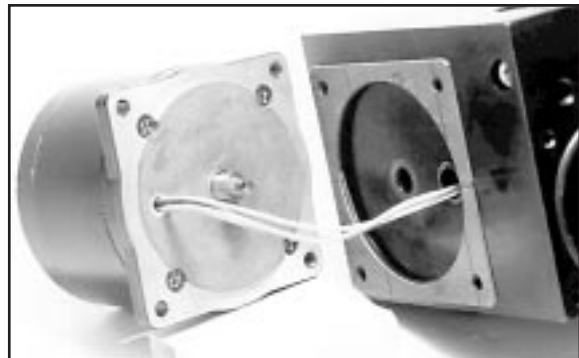
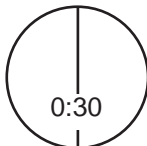


Photo 31

3.M1.1 Analysis



To determine if the pump is free from binding, take the following steps:

1. Remove electric power from unit.
2. Open the bypass valve.
3. Remove the four socket head cap screws at the corners of the motor face flange.

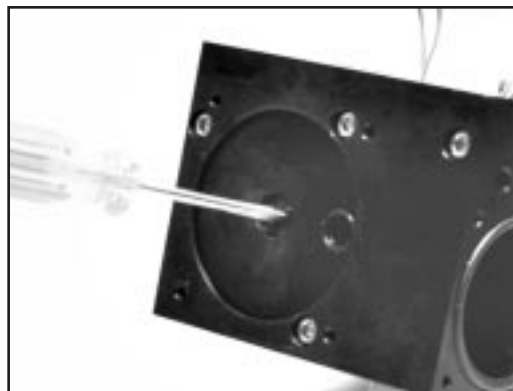
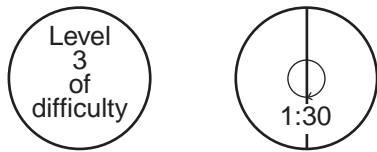


Photo 32

3.M1 Pump

(Drawings: M03110, M03111, M03099 & M03105)

3.M1.2 Repair



Parts Required:

Pump

Power Module Seal Kit

1. To install the new pump, the motor should be disconnected at the junction box and removed from the unit.
2. The feedback wires and the solenoid wires (if present) should be disconnected at the junction box.
3. Remove the four socket head cap screws which hold the pump standoff to the manifold and reservoir (Photo 33).
4. Remove the standoff carefully to avoid stripping the wires as they are pulled from the junction box. Also the pump manifold interface is through pressure tubes sealed by O-rings. These tubes will slip out of either the pump or the manifold. See drawing M03105 in Appendix D for location of pressure tubes.
5. Remove the socket head cap screws which hold the pump to the pump standoff (2 on B pump, 4 on C pump). See Drawing M03105 in Appendix D for location of the pump (Photo 34).

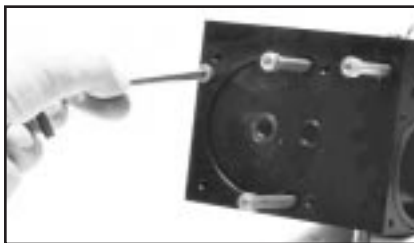


Photo 33

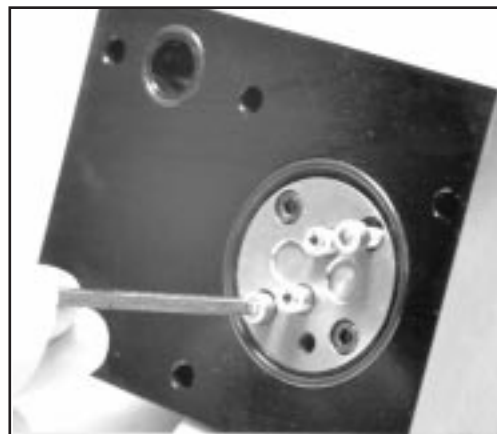


Photo 34

3.M1 Pump

(Drawings: M03110, M03111, M03099 & M03105)

6. The pump should slip out of the standoff cavity. It is not economical to repair this part. NOTE: During reassemble, replace all softgoods (O-rings & seals).
7. The new pump should then be secured into the standoff cavity with the socket head cap screws. Be sure to fully engage the pump shaft into the pump coupling before securing in place with the cap screws.
8. Check that the pump is free to rotate by inserting a 3/16" socket key or large standard screwdriver into the pump/motor coupling and turning the pump.
9. Reassemble pump standoff to the manifold and reservoir. The connector tubes should be inserted into the pump and then aligned with the manifold for reassembly. Lubricate the O-Rings (petroleum jelly or oil) before assembly. Care should be taken when inserting the wires to avoid stripping or pinching.
10. Install the motor shaft seal into its cavity in the standoff with the O-Ring side of the seal away from the motor. (Photo 66); see seal illustration Section 3.M10.
11. Reassemble the motor to the standoff with care to engage the pump shaft with the coupling and to insert the motor wires into the standoff to avoid component damage.
12. Guide all the wires back to the junction box and reconnect.
13. Bleed air from the actuator and refill with the proper hydraulic fluid (see Section 3.M4).
14. The unit should be ready to test and then put back on line.

3.M2 Cylinder Bypass System

(Drawing: M03103, M03110 & M03111)

General

The bypass system allows controlled equalization of hydraulic pressure on both sides of the cylinder. There are two ways in which the cylinder can be bypassed.

1. Manual

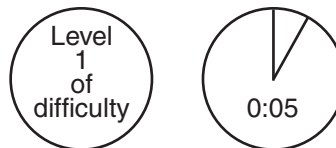
This is most likely to be used when the actuator is being purged of air. The actual bypass valve is located on the top of the power module and is identified by a 3/16" hex head. Manual bypass valves are found in the standard fail in place Rexa actuator. Refer to Section 3.M4 on purging air from the unit. During normal operation, this valve should be snug (Section 3.M2.2.1).

2. Solenoid

This is an optional solenoid which is specified for spring failure upon loss of power. When electric power is interrupted to the actuator, the normally open solenoid is de-energized, causing the bypass valve to open, and allowing the spring to move the actuator to the desired failure position.

3.M2.1 Analysis

3.M2.1.1 Manual Bypass



The manual bypass is a fairly simple two-piece design that should not fail (Photo 35). Basically, just make sure that the 3/16" hex head is snug. Do NOT over-tighten. If the actuator continues to remain inoperative, eliminate all other failure options before replacing the bypass plug.

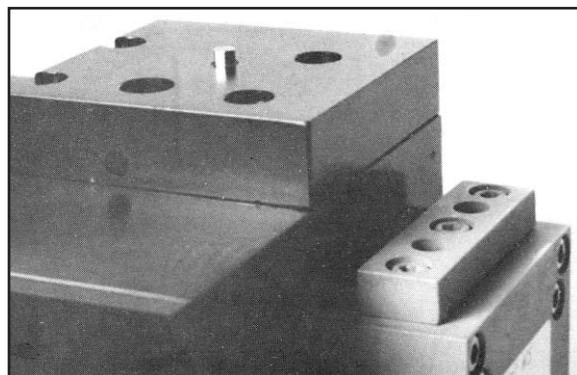
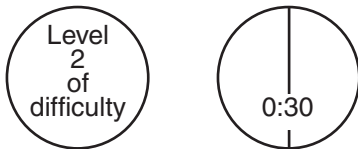


Photo 35

3.M2 Cylinder Bypass System

(Drawing: M03103, M03110 & M03111)

3.M2.1.2 Solenoid Bypass



ELECTRICAL

A manual pushbutton override for the solenoid is located on the top cover (Photo 36).

While applying force to the button, attempt to operate the actuator. If operation is normal, then solenoid failure may have occurred.



1. Remove electric power from unit.
2. Open the actuator junction box and disconnect the solenoid (the two blue wires).
3. The coil resistance across these wires should read as follows:

125 vdc-NEMA 4; 550-675 ohms

24 vdc-NEMA 4; 25-35 ohms

125 vdc-CLI, DIV 2; 165-185 ohms

B-pump, CL. 1, Div. 2, 120/240 vac main power: 60 vdc solenoid, 165-185 ohm coil resistance

B-pump, NEMA 4, 120/240 vac main power: 125 vdc solenoid 550-675 ohm coil resistance

B-pump Cl. 1, Div. 2 & NEMA 4, 24 vdc main power: 24 vdc solenoid, 23-35 ohm coil resistance

C, ½D, D and 2D, all classifications and power inputs: 125 vdc solenoid, 550-675 ohm coil resistance

Replace the solenoid if readings are outside of this range (Photo 36).



Photo 36

3.M2 Cylinder Bypass System

(Drawing: M03103, M03110 & M03111)

MECHANICAL

If operation of the manual pushbutton does not allow normal operation, then there may be a mechanical misalignment.



1. Remove electric power from the unit.
2. Remove the solenoid cover by unscrewing the four 10-32 socket head screws (be careful not to lose the large Buna-N O-ring from underneath the cover).
3. Now lift up the brass colored, circular top of the solenoid (Photo 37).
4. Reapply electric power to the unit.
5. Now insert a 3/16" socket key Allen wrench down the center of the solenoid base. While pushing down firmly to manually close the

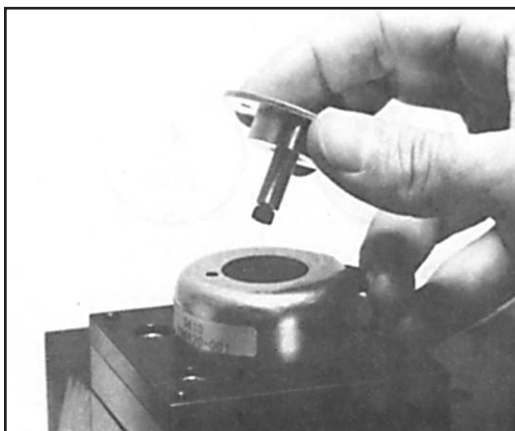


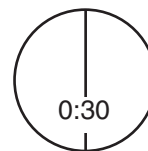
Photo 37

bypass valve, push the up/down buttons and look for movement of the actuator (the bypass valve's stroke is approximately 1/8"). (Photo 38)

Movement of the actuator indicates that the problem is the adjustment of the solenoid plunger.

3.M2.2 Repair

3.M2.2.1 Manual ByPass Valve Replacement



1. Remove electric power from the unit. Remove process forces from the unit, and equalize the cylinder pressure by opening the bypass valve.

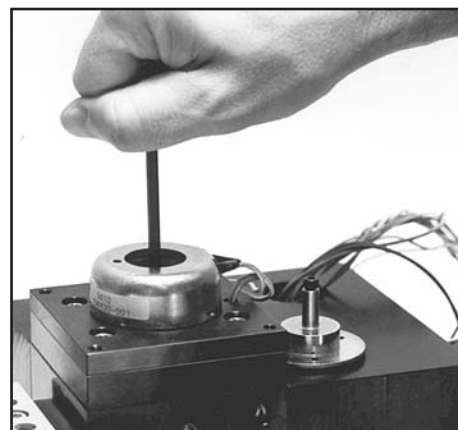


Photo 38

3.M2 Cylinder Bypass System

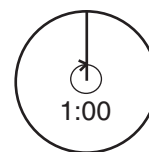
(Drawing: M03103, M03110 & M03111)

2. Remove the four 1/4-20 SHCS from the manual bypass plate. Some oil may flow from the unit at this time.
3. Unscrew the bypass valve plug from the plate and inspect both parts for damage. Replace one or both parts as needed. Replace all O-rings. Inspect the power module bypass seat surface for damage (Photo 39).
4. Apply petroleum jelly to the O-ring on the bypass valve stem and screw it completely into the plate.
5. Re-attach the manual bypass plate to the power module with the four 1/4-20 SHCS. A small amount of petroleum jelly may be applied to the O-rings to keep them in place during assembly.
6. Screw the 3/16" hex head in until the plug just touches the seat, then add 1/4 turn to seal the valve (If the bypass plug has previously been seated, use 1/8 turn to seal the valve).
7. The unit is ready to test now. If the bypass is still leaking, add 1/8 turn to the 3/16" hex. If at this point the actuator is still drifting, review the cylinder piston seals (3.M10) and the Flow Matching Valves (3.M11).



Photo 39

3.M2.2.2 Solenoid ByPass Valve Replacement



Parts Required:

Solenoid S/A
Solenoid ByPass Valve Plug
Power Module Seal Kit

3.M2 Cylinder Bypass System

(Drawing: M03103, M03110 & M03111)



1. Remove process forces from the unit. Remove electric power from the unit; this will cause the solenoid to open the bypass valve and equalize the cylinder pressure.
2. Remove the four 1/4-20 SHCS from the solenoid cover. Remove the four 1/4-20 SHCS from the solenoid mounting plate.
2. Re-attach the solenoid mounting plate with the four 1/4-20 SHCS. Insert the solenoid plunger into the housing. There should be a thin metal disk separating the solenoid plunger from the housing.
3. Push the solenoid plunger into the housing. Measure the spacing between the plunger flange and the housing using a feeler gauge (Photo 41). The spacing should be .015". Adjust the spacing as needed by turning the screw on the end of the plunger (Photo 42).

SOLENOID REPLACEMENT

1. If the solenoid needs replacing, unscrew the two #8 nuts and cut the solenoid leads close to the solenoid. Attach the new Solenoid S/A using a threadlocker, and solder the leads from the solenoid to the two blue leads using heat-shrink tubing (Photo 40).

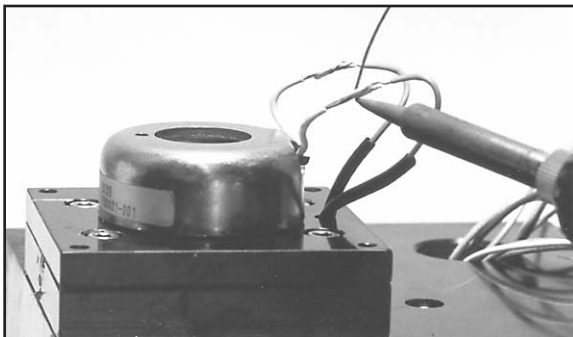


Photo 40

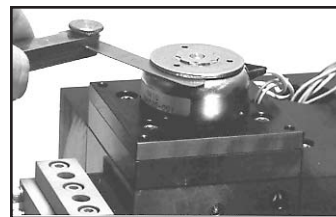


Photo 41



Photo 42

3.M2 Cylinder Bypass System

(Drawing: M03103, M03110 & M03111)

4. Re-attach the solenoid cover with the four 1/4-20 SHCS. The exterior solenoid button on the cover should be able to move .015"-020". This is achieved by adjusting the SHCS under the button (Photo 43). Typically backing the screw off 7/8 of a turn from seated is satisfactory.

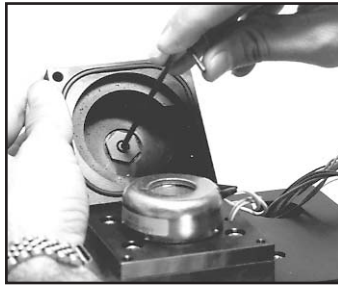


Photo 43

5. Test the Solenoid Bypass Valve by putting the control signal to other than the fail position and attach the power and re-attaching it while the cylinder is moving (the spring will move the cylinder during loss of power). In both tests, the Bypass Valve should engage immediately and the cylinder should move in the direction of the control signal.
6. The Bypass Valve should also be tested for "cylinder drift". Load the elastic coupling and observe for drift. If this test or that in #5 fails, readjustment of the solenoid may be necessary, or the problem may lie elsewhere.

SOLENOID BYPASS VALVE REPLACEMENT

1. Remove the four 1/4-20 SHCS from the Solenoid Bypass Plate. Some oil may flow from the unit at this time.
2. Remove the Bypass Valve from the plate and inspect both parts and the spring for damage. Replace any parts as needed. Replace all O-rings. Inspect the power module bypass seat surface for damage. If damage is found at the seat area, call REXA.
3. Apply petroleum jelly to the Bypass Valve and O-rings and assemble into the Solenoid Bypass Plate.
4. Re-attach the Solenoid Bypass Plate to the power module with the four 1/4-20 SHCS.
5. Re-attach the Solenoid Mounting Plate and Solenoid Cover calibrating the assembly as specified in the "Solenoid Replacement" section above.
6. Test the Solenoid Bypass Valve as specified in the "Solenoid Replacement" section above.

3.M3 Oil Reservoir

(Drawings: M03110, M03111 & M03103)

General

The oil reservoir is located on the back right hand side of the actuator. It is identified by a 1/2" diameter indicator protruding from the cover (Photo 44). When the reservoir is full of oil, this indicator will extend approximately 3/4". It should be refilled if it retracts to below 1/4".



Photo 44

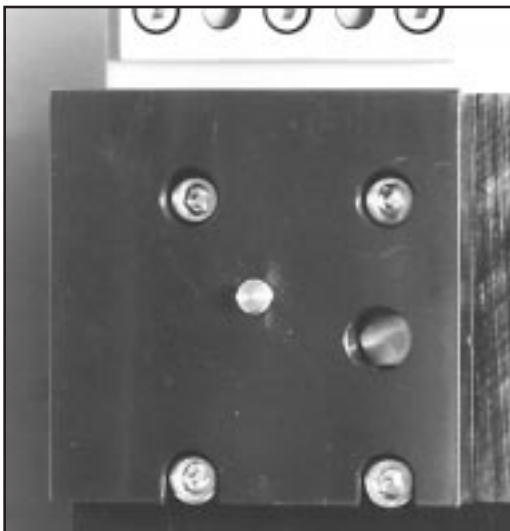


Photo 45

On the top side of the hydraulic power module, there is a reservoir pressure relief valve (Photo 45). This valve limits the pressure in the oil reservoir to 50psi. Any excess oil or air will be vented out through the Reservoir Pressure Relief Valve when it is in an upward position. Refer to Section 1 of the Installation and Calibration Manual for oil fill instructions.

3M3.1 Analysis

See attached chart (Fig. 3.M3.A).

THERMAL WEeping

After refilling the oil reservoir or when the actuator is exposed to an increase in temperature, the reservoir pressure relief valve may weep oil (Photo 46). This weeping is normal, and should stop once the temperature has stabilized.

If the reservoir pressure relief valve continues to weep after temperature has stabilized, and the unit is not moving, check the sealing and relief O-rings on the pressure relief valve.

3.M3 Oil Reservoir

(Drawings: M03110, M03111 & M03103)

3.M3.1		3.M3.2
Analysis	Signifies	Repair
Oil Leaking from Around Oil Reservoir Indicator	<ol style="list-style-type: none"> 1. Reservoir Piston Seal is Worn. 2. Reservoir Indicator seal is worn or not seated properly. 	<ol style="list-style-type: none"> 1. Drain the reservoir by opening the fill valve (Photo 47). 2. Remove Reservoir Cover by unscrewing the four 10-32 Allen Head Cap Screws. <i>Use Caution Not to Lose the Compressed Spring Located Underneath the Cover (Photo 48).</i> 3. Next, pull the Reservoir Piston out of the unit. 4. Inspect the Piston Seal and replace if necessary (Photo 49). 5. Also inspect the Inside Bore of the Reservoir for nicks and scratches. 6. Check that the buttonhead screw is tight and that the indicator shaft is secure. 7. If buttonhead screw is loose, remove screw and inspect O-Ring under the indicator shaft. Replace O-Ring if necessary and reinsert screw into shaft using a thread locking compound.
Oil Flows from the Relief Valve During Actuator Movement or with no movement	<p>Thermal Weeping (Normal operation - See Analysis 3.M3.1)</p> <p>Suction Check Valves Stuck (see Section 3.M6)</p> <p>Relief Valve Seals</p>	<ol style="list-style-type: none"> 1. Secure the reservoir piston from moving by attaching a C-clamp to the oil level indicator (Photo 50). 2. Remove the cylinder bypass plate (see section 3.M2.2 Par 2 & 3). 3. Remove the reservoir relief valve by screwing it counterclockwise (Photo 51). 4. Inspect the two O-rings for damage and replace the relief valve if necessary. 5. Reinstall the reservoir pressure relief valve. 6. Reinstall the cylinder bypass system (see section 3.M2).

Figure 3.M3.A

3.M3 Oil Reservoir

(Drawings: M03110, M03111 & M03103)

SUCTION CHECK VALVES

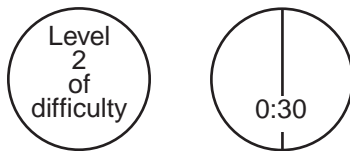
A flow of oil from the relief valve during actuator motion may indicate a leaking suction check valve. Please refer to section 3.M6.



Photo 47

3M3.2 Repair

See attached chart (Fig. 3.M3.A).



Parts Required:

Pressure Relief Valve
Power Module Seal Kit

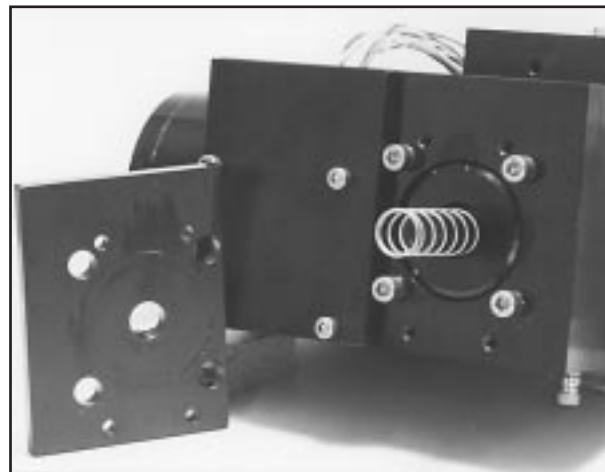


Photo 48

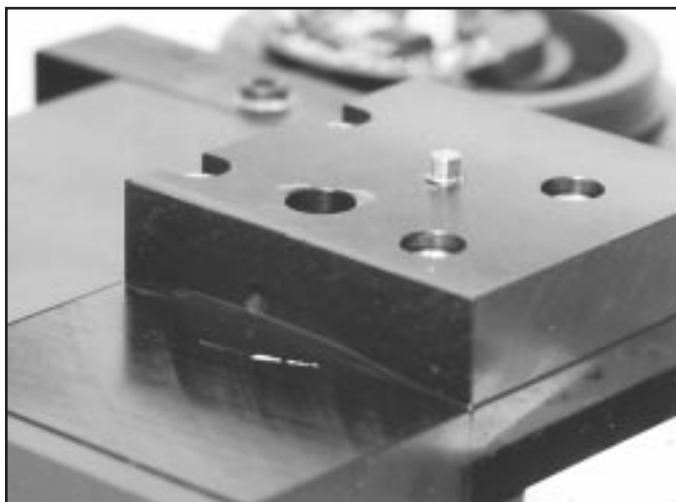


Photo 46

3.M3 Oil Reservoir

(Drawings: M03110, M03111 & M03103)

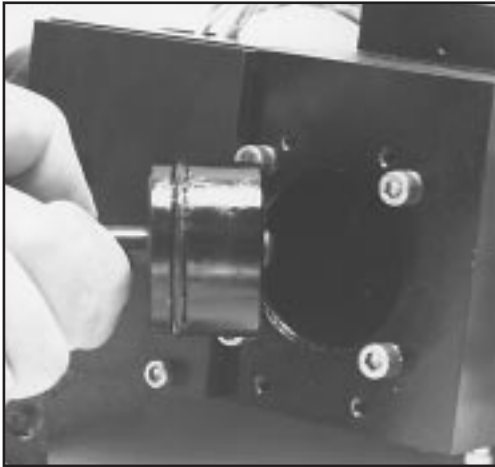


Photo 49

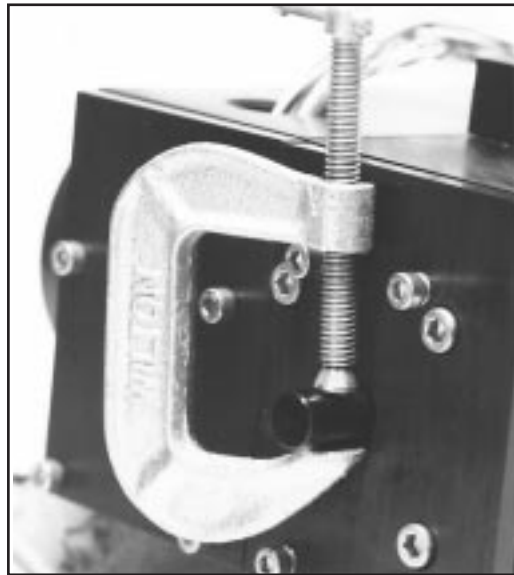


Photo 50



Photo 51

3.M4 Air Purging the Actuator

(Drawings: M03106, M03110 & M03111)

General

All electrohydraulic actuators are self contained and pressure sealed from the environment. Under normal operation, air, moisture and other contaminants cannot intrude into the hydraulic circuit. Certain repair and replacement procedures may introduce unwanted air.

3.M4.1 Analysis

Some of the advantages of hydraulic operation is derived from the incompressibility of the fluid. This produces an immediate response to position changes, high resolution without oscillation and an insensitivity to external load changes. An actuator with air in the hydraulic system will exhibit sluggish or spongy operation and not reach its peak performance. Any time that the hydraulic boundary (O-ring) is broken, the actuator should be purged of unwanted air.



Photo 52

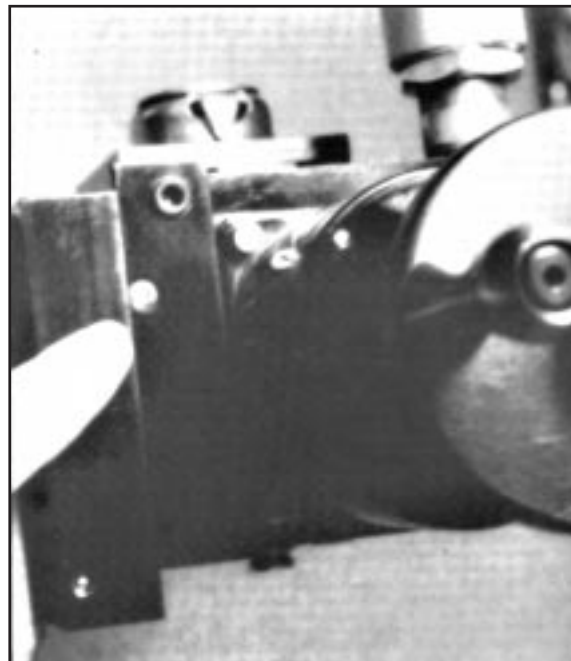


Photo 53

3.M4 Air Purging the Actuator

(Drawings: M03106, M03110 & M03111)

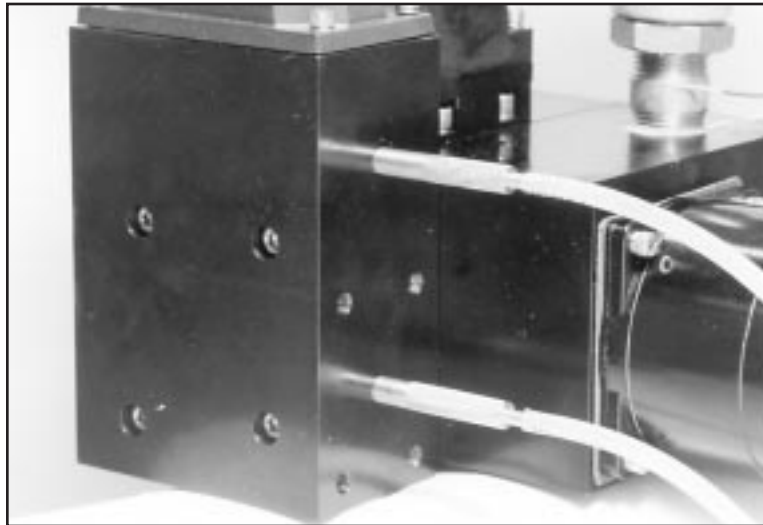
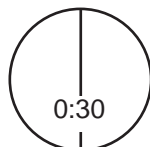


Photo 54

3.M4.2 Repair



Parts Required:

None

1. If possible, drive the actuator to its fully extended position (linear), or fully clockwise (rotary).
2. Equalize the pressure on both sides of the cylinder. Open the bypass valve by either loosening the 3/16" hexhead located on top of the power module (Photo 46); or if a solenoid

bypass valve is being used disconnect the leads at the terminal strip of the PCP.

(CAUTION: Electric power should be removed from the unit before disconnecting the solenoid leads. Electric power should then be re-connected to continue the air purge procedure).



3. Remove the two 10-32 button head bleed screws from the cylinder on linear units, (Photo 52) or from the adapter plate on rotary units (Photo 53). Special adapter fittings (Part No. K03277) are available from Rexa for attaching 1/4" plastic tubing to bleed screw ports to divert oil bleed from the system into a container (Photo 54).

3.M4 Air Purging the Actuator

(Drawings: M03106, M03110 & M03111)

Using clear plastic hose attached to the adapters allows air bubbles to be viewed easily.

4. Orient the actuator so that the bleed screws are not facing downward.
5. Attach the oil fill gun to the reservoir fill plug.
6. Run the pump in setup manual mode (at a speed setting of 30 or less) for about 5 seconds repeatedly in each direction.
7. Any air in the system will be expelled through the purge ports by this repeated cycling of the pump in each direction. As air is purged, the reservoir will supply oil to the system. Insure that during the purging procedure, the reservoir is not allowed to run out of oil by keeping close watch on the oil level indicator, and filling as needed.
8. When no more air is seen in the oil exiting through the bleed ports, disconnect the tubing (if used) and reinstall the bleed screws being careful not to over tighten them.
9. Re-tighten the bypass valve, or re-apply power to the solenoid.
(CAUTION: Electric Power should be removed from the unit before re-connecting the solenoid.)
10. Stroke the actuator back and forth a few times and refill the oil reservoir as needed.
11. Move the actuator to each end of the cylinder and "Burp" (purge) any air by momentarily opening the appropriate bleed screw.



3.M5 Hydraulic Pressure Check

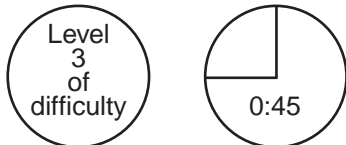
(Drawings: M03110, M0311, & M03106)

General

If the Rexa actuator fails to move under load, it is possible that there is an internal leak or the pump is producing inadequate pressure. Use the pressure gauge adapters and the steps below to help diagnose an internal pressure problem.

3.M5.1 Analysis

A set of pressure gauge adapters (Rexa Part No. K03278) are needed to perform this procedure.



1. Position the actuator to an unloaded point of travel by opening the bypass valve on fail in place units or by disconnecting the electric power on spring fail units.
2. Remove the two 10-32 button head bleed screws from the cylinder on linear units (Photo 52) or from the adapter plate on rotary units (Photo 53).
3. Using the adapter, attach two

5000 PSI gauges to the purge ports (Photo 55).

4. Close the manual bypass on fail in place units or reconnect the electric power on spring fail units.
5. In setup manual mode, run the actuator at a speed setting of 70 in one direction and record the difference in readings from both of the gauges. In most cases, the largest differential will occur at the cylinder end points when the motor stalls.
6. Do the same in the other direction.
7. The differential pressures for both directions must be at least 2000 psi for all Rexa actuators.

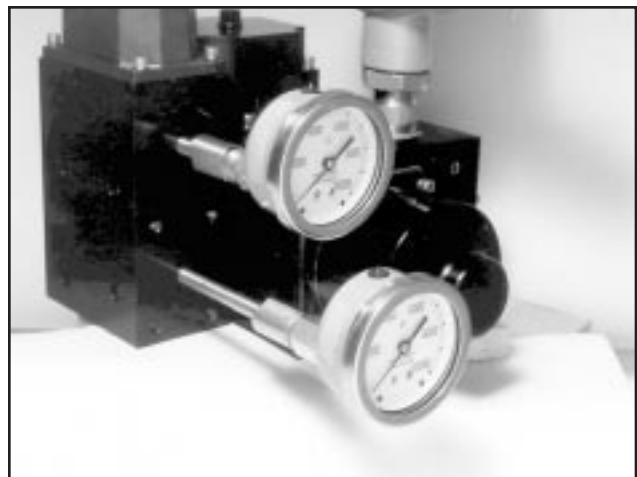


Photo 55

3.M6 Suction / Check (S/C) Valves

(Drawing: M03103)

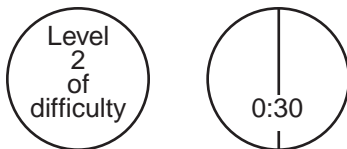
General

Suction check valves isolate the reservoir from high pressure fluid yet allow any required make up oil to be drawn into the system (Photo 56). These valves are located in the reservoir.



Photo 56

3.M6.1 Analysis



1. Drain the reservoir by depressing the pneumatic style ("Schrader") fill valve while pushing in the reservoir indicator (Photo 47).
2. Remove reservoir cover by unscrewing the four 10-32 socket cap screws. Use caution not to lose the compressed spring located underneath the cover (Photo 48).

3. Pull the reservoir piston out of the unit (Photo 49).
4. With a 1/8" socket key, gently push the ball in the center of each check valve. The ball should be able to be pushed and spring returned to the seat (approximately 3/16") without sticking (Photo 57).
5. Run the actuator in both directions and observe to see if oil leaks past either valve (Photo 58).
6. If leakage is observed, replace the valves.

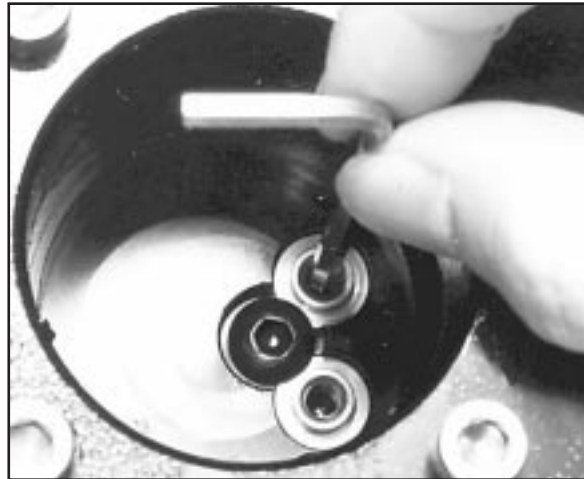
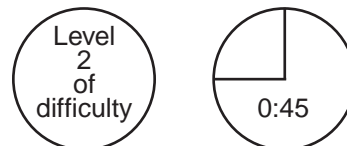


Photo 57

3.M6.2 Repair



3.M6 Suction / Check (S/C) Valves

(Drawing: M03103)

Parts Required:

S/C Valve Kit

1. Remove the 1/4-20 button head screw located between the two suction check valves (Photo 58).
2. Thread a 10-32 screw into each S/C valve and pull straight out. Remove the existing springs and ball. If the S/C valve is not threaded for removal, clamp a good pair of needle nose pliers onto the edge.
3. Insert the spring and ball into the suction check valve cavity. If the spring and ball will not stay in the cavity, coat the ball with petroleum jelly so that it will stick to the valve body. Apply petroleum jelly to the S/C O-ring and insert into the cavity. The valves must be inserted straight to avoid damaging the O-ring.



Photo 58

3.M7 Drive Train

(Drawing: M03105)

General

The drive train (motor, pump/motor coupling and pump) must be free to rotate in both directions by hand.

3.M7.1 Analysis



1. Disconnect electric power from the actuator or place the actuator into setup mode. Try using the handwheel to move the unit (Photo 59). If a handwheel is unavailable, then unscrew the cap on the back of the motor to expose the motor shaft (Photo 60). A wrench can be used to turn the shaft.
2. The motor, coupling and pump should turn reasonably free with a slight detent feel.

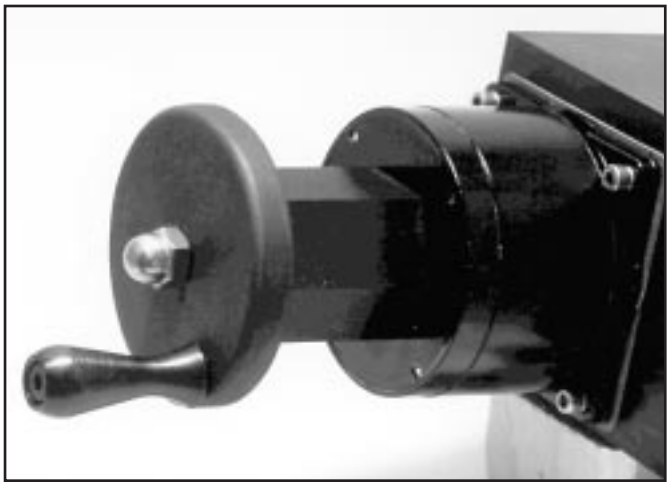


Photo 59

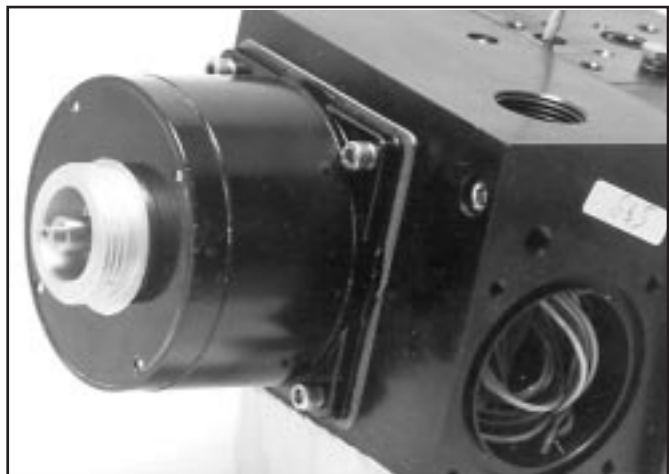


Photo 60

3.M8 Stepping Motor - Mechanical

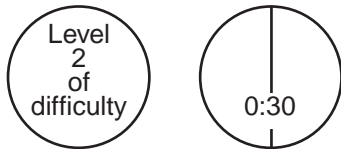
(Drawings: M03110, M03111, & M03105)

General

The stepping motor transfers the electrical pulses from the driver into rotary motion.

The stepping motor is directly coupled to a reversible hydraulic gear pump. The motor rotates only when a change in actuator position is required.

3.M8.1 Analysis



If the actuator motor does not turn, follow the steps below:

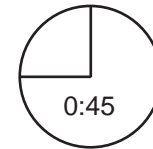


1. Remove electric power from the unit.
2. Disconnect the motor from the standoff by removing the four cap screws from the motor face flange.
3. Without pulling the motor wires, tilt the motor out of the pump/motor coupling (Photo 31).
4. Turn the motor shaft with the handwheel or wrench. The

motor should turn with a mild detent feel.

5. If the motor will not turn, it must be replaced.
6. If the motor turns freely, then check the pump as described in Section 3.M1.

3M8.2 Repair



Motor Replacement

Parts Required:

Stepper Motor Motor Seal

1. Remove electric power from the unit.
2. Open the actuator junction box and disconnect the motor wires (Green/Black pair and Red/Black pair on the cable side).
3. Remove the four 10-32 SHCS from the thermostat cavity cover and remove the cover.
4. Remove the four 10-32 SHCS from the motor face flange.



3.M8 Stepping Motor - Mechanical

(Drawings: M03110, M03111, & M03105)

5. Carefully remove the motor from the actuator while guiding the motor wires from the actuator junction box, through the thermostat cavity and out of the actuator.
6. If the motor seal comes away from the actuator or is on the motor shaft, reinsert it into the actuator (see 3.M10.2.1). If the motor wire hole O-ring seal comes away from the actuator, reinsert it into the actuator. These parts should be replaced if there is any indication of damage.
7. Install the new motor onto the actuator. Guide the motor wires into the motor wire hole, through the thermostat cavity and into the actuator junction box. Take extra precaution to insure that insulation is not stripped from the motor wires. Wipe all excess oil from the mounting area. Insert the motor shaft into the pump cavity and rotate the shaft until it mates properly with the pump coupling.
8. Replace the four 10-32 Socket Head Cap Screws into the motor face flange.
9. Check that the motor and pump turn freely with a mild detent feel.
10. Reconnect the motor wires to the cable and replace the wire nuts.

3.M9 Elastic Couplings

General

The elastic coupling is used to apply a controlled load at the seated position with linear (L series) actuators. The elastic coupling is attached to the actuator between the stem and the drive device. Most valves are down seating and require a compression coupling.

3.M9.1 Identification

Rexa offers two types of compression elastic couplings. One has an open frame construction. See figure 9-1. The second type has a closed frame construction. See figure 9-2.



Figure 9-1

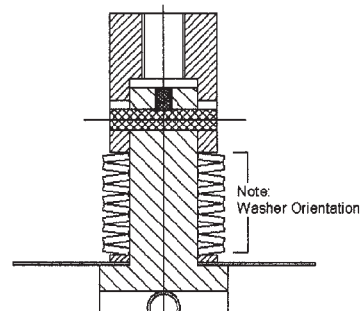
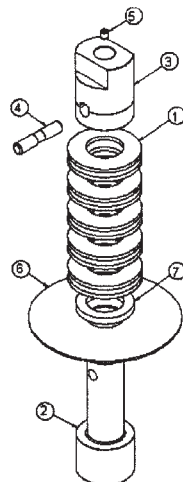


Figure 9-2

3.M9.2 Open Spring Compression Load Type Elastic Coupling

Figure 9-3

PARTS LIST		
ITEM	QTY	DESCRIPTION
1	10	SPRING WASHERS
2	1	SPRING STOP
3	1	ACTUATOR STEM ADAPTER
4	1	LOAD PIN
5	1	# 8 - 32 SET SCREW
6	1	STROKE INDICATOR
7	1	SPACER



3.M9 Elastic Couplings

NOTE:

Replacement of elastic coupling will require removing the unit from service. Tag and lockout the unit for repair in accordance with local procedures.

Elastic Coupling Replacement Procedure.

1. Remove any external loads from the actuator. Both pressure gauges should read zero.
2. Remove the elastic coupling from the valve stem and actuator shaft by unthreading it from each end.
3. Remove the set screw (5) located in the thread hole of the actuator stem adapter (3).
4. Compress the elastic coupling until the load pin (4) moves to the center of the hole in the actuator stem adapter (3). This removes the internal spring load from the load pin (4).
5. Push the load pin (4) out.
6. Slowly release the pressure on the coupling and note the arrangement of the spring washers (1).
7. Replace or modify components as necessary.
8. Reassemble by placing the stroke indicator (6), spacer (7), spring washer (1) stack and actuator stem adapter (3) over the spring stop (2).
9. Line up the spring stop (2) hole with the actuator stem adapter (3) slot. Compress the spring washers (1) until the hole and slot line up.
10. Insert the load pin (4) into the hole. Make sure the flat on the pin is facing the set screw hole.
11. Slowly release the pressure on the spring washers (1).
12. Install the set screw using a thread lock.

3.M9 Elastic Couplings

3.M9.3 Closed Spring Compression Load Type Elastic Coupling

NOTE:

Replacement of elastic coupling will require removing the unit from service. Tag and lockout the unit for repair in accordance with local procedures.

Elastic Coupling Replacement Procedure.

1. Remove any external loads from the actuator. The pressure gauges both should read zero.
2. Remove the elastic coupling from the valve stem and actuator shaft by unthreading it from each end.
3. Compress the elastic coupling until the seating indicator starts to move.
4. Remove the set screw located in the thread hole of the actuator stem adapter. Similar to step 3 of the open frame type.
5. Slowly release the pressure on the coupling. and note the arrangement of the spring washers.
6. Remove the top plate. Do not lose the seating indicator and spring which is under the plate.
7. Remove the cylindrical wall and note the arrangement of the spring washers.
8. Replace or modify components as necessary.
9. Reassemble by placing the stroke indicator, spring washer stack, cylindrical wall and actuator stem adapter over the valve step adapter.
10. Place the seating indicator and spring on the actuator shaft adapter and fit the cover plate on so that the seating indicator slides into the hole. Rotate the top plate so that the indicator is not beside the wrench flats on the actuator shaft.
11. Compress the elastic coupling until all the parts fit together and the seating indicator starts to move.
12. Install the set screw using a thread lock.

3.M9 Elastic Couplings

3.M9.4 Closed Spring Tension Load Type Elastic Coupling

NOTE:

Replacement of elastic coupling will require removing the unit from service. Tag and lockout the unit for repair in accordance with local procedures.

General

The tension load elastic coupling is very similar to the compression elastic coupling. The main difference is in how the disk springs and the actuator adapter shaft interact. In a compression elastic coupling the actuator shaft adapter typically compresses the disk springs from the top. In a tension elastic coupling they are compressed from the bottom.

Elastic Coupling Replacement Procedure.

Repair and replacement procedures are similar to those in the closed spring compression load type coupling. For details please reference that section.

3.M10 Oil Leaks

(Drawings: M03106, M03110 & M03111)

General

External oil leaks are rare, but they can be insidious. Mating seams, indentations and other surface discontinuities make the source of a leak difficult to discern. Depending upon the source and magnitude of the leak, the actuator may operate normally, erratically or not at all.

3.M10.1 Analysis

If the origin of the leak is unknown, wipe the unit down with a dry rag and refill with oil if necessary. Run the unit back and forth and observe cylinder bushings, the seams between the blocks that comprise the power module, etc.

3.M10.1.1 Seam Leaks

Seam leaks are usually caused by a failed O-ring between sub-assem-

blies. Verify the location of the seam that is leaking.

3.M10.1.2 Leaks at Cylinder Bushings

Seals between sliding surfaces such as the piston ring can be subject to wear. Misalignment between the actuator and driven device will cause accelerated wear.

If the cylinder bushings appear to be leaking where the piston exits the cylinder (linear units only), it could be an alignment problem between the piston and the valve stem (see Section 3.T2). Side loading will wear the sides of the bushings, piston seal, and O-rings. When checking for bushing leaks, also check the top bushing located under the feedback cover.

3.M10.1.3 Leaks at Piston Seal

If the shaft appears to be drifting, this may indicate that the piston seal is damaged. The scope of this manual only includes the linear cylinders. Piston Seal leaks can occur if the shaft is side loaded or foreign matter is present in the oil that will degrade the piston seal and possibly the cylinder bore.



Photo 64

3.M10 Oil Leaks

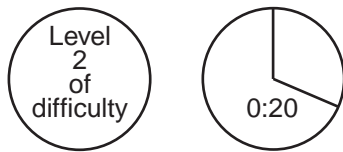
(Drawings: M03106, M03110 & M03111)

3.M10.2 Repair

In most cases an oil leak is corrected by replacement of the damaged O-ring. Since identification of the damaged O-ring is sometimes difficult, it is recommended that all visible seals be replaced.

the bad seal and replace with a new one (Photo 65 & Photo 66).*

3.M10.2.1 Seam Leaks



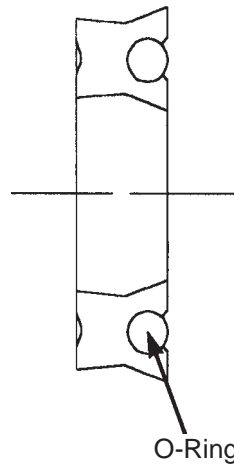
Motor
(Oil is leaking between Motor and Pump Block)

Parts Required



Power Module Seal Kit

1. Remove electric line power from the unit.
2. Remove wire connections to the four motor wires (refer to Section 3 of the Installation and Calibration Manual).
3. Remove the four socket head cap screws on the corners of the motor.
4. Without pulling the motor wires down the 3/4" nipple, remove



* Note: The side of this seal with the O-ring goes toward the actuator and away from the motor. Also, in order for the motor to be installed, the seal must be recessed in the pump stand-off block before attempting to reinstall the motor (Photo 66).

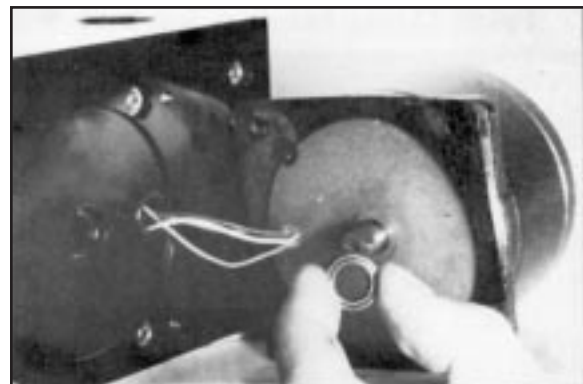


Photo 65

3.M10 Oil Leaks

(Drawings: M03110 & M03111)

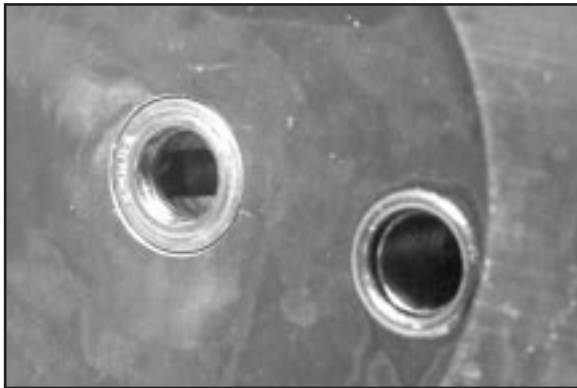
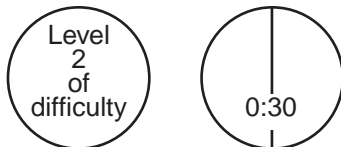


Photo 66

FMV Seam



1. Remove electric power from the unit.
2. Equalize the cylinder pressure in non-spring fail units (Spring fail units should equalize upon removing the electric power). Do this by opening the manual bypass.
3. Remove the F.M.V. by removing the eight 10-32 SHCS.
4. Inspect the actuator surface for possible causes of leaks. Contact REXA if surface is damaged.

5. Replace the 10 O-ring seals. The FMV should be replaced if there is damage to the surface.

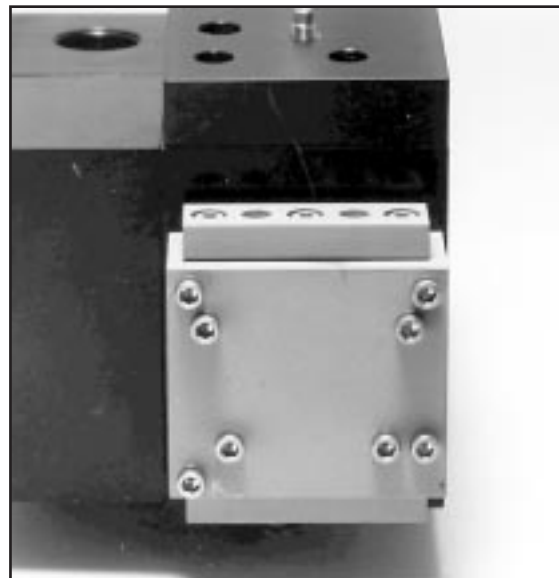
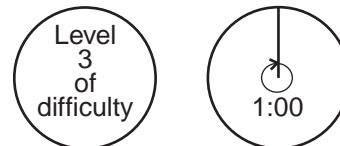


Photo 67

3.M10.2.2 Cylinder Bushing Seals



1. Remove electric power from the unit.
2. Equalize the cylinder pressure in non-spring fail units (Spring fail units should equalize upon removing electric power). Do this by opening the manual bypass.

3.M10 Oil Leaks

(Drawings: M03110, & M03111)

3. Remove the unit from the driven device so that the cylinder shaft can be over extended.
4. If the unit is a spring fail, then remove the spring assembly. Take measurements to aid in reassembling.
5. Remove the cylinder feedback cover. Disconnect the feedback arm from the cylinder shaft and potentiometer. The anti-rotation rod will have to be removed.
6. Remove the seal retainer from the leaking bushing.
7. Remove the retaining ring from the leaking bushing with a small screw driver.
8. Using a rubber mallet, drive the cylinder shaft in the direction towards the leaky bushing. The bushing will be forced out with this action.
9. Once the bushing is out, inspect it for seal degradation and side wear. Inspect the seating surface within the cylinder for possible causes of leaks.
10. Remove the O-rings and other seals from the bushing and replace with new ones. Replace the bushing if it is damaged.
11. Lubricate and reinstall the bushing into the cylinder. Replace the retainer ring and seal retainer using thread locker on the screws.
12. Reassemble the feedback assembly using thread locker on all threaded parts.
13. The unit must be purged of air after reassembling of the cylinder (see section 3.M4).
14. Reassemble the spring fail assembly if one exists.
15. Install unit and check the setup parameters.

3.M10.2.3 Cylinder Piston Seal

1. Remove electric power from the unit.
2. Equalize the cylinder pressure in non-spring fail units (Spring fail units should equalize upon removing electric power). Do this by opening the manual bypass.
3. Follow the operations 3 through 8 of the procedures for Cylinder Bushing Seal replacement.
4. At this point the Shaft/Piston Assembly should slip out of the cylinder body.
5. Inspect the cylinder bore and shaft for wear or scratches.



3.M10 Oil Leaks

(Drawings: M03110, & M03111)

6. Remove the piston seal. Do not scratch or otherwise damage the seal seating surface. Replace with new piston seal.
7. There is a seal between the piston and shaft that may need to be replaced. Remove the snap ring holding the piston in place. Remove the split rings and piston from the shaft. Carefully remove the O-ring from the shaft and inspect for damage.
8. Re-install the Piston/Shaft Assembly into the cylinder. Follow the operations 11 through 15 of the procedures for Cylinder Bushing Seals replacement.

3.M11 Flow Matching Valve (FMV) Module

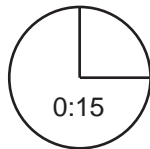
(Drawings: M03110, M03111, & M03099)

General

This module is responsible for allowing the Rexa actuator to lock in its last position without continuous operation of the pump and motor.

See Appendix B for an in-depth theory of operation on the FMV module.

3.M11.2 Repair



Parts Required:

Power Module Seal Kit FMV Block

There are no serviceable parts within the flow match valve. The entire block must be replaced.



1. Remove electric power from the unit.
2. Open bypass valve on fail in place units (Photo 35).
3. To keep the reservoir from emptying, attach a C-clamp to the oil level indicator in a manner which will prevent the indicator

from retracting into reservoir block (Photo 50).

4. Now remove the eight 10-32 socket head cap screws from the FMV module (Photo 68). A small bleed of oil from the manifold block is normal. This will continue until the pressure in the reservoir is relieved by the C-clamp (Photo 32).
5. Replace all O-rings and install the new FMV module. This module can only be installed one way.
6. Refer to Section 3.M4 to purge any air and refill unit with oil.



Photo 68

3.M12 REXA Linear Cylinder

General

The current linear block cylinder line consists of five models. These models equate to force outputs of 500 lb, 1 200 lb, 2 000 lb, 4 000 lb and 10 000 lb. Each of these models comes in different length stroke options typically 2", 4" and 6". To identify the model/size of your cylinder reference the model number. The first digit will be an L signifying it is a linear stroke. The next three to five digits before the dash is the thrust output. For more details on the part numbering system reference the section on Model numbering in the trouble shooting and repair manual. You can also confirm the output by measuring the shank diameter and reference the table below.

Shank Diameter	Cylinder Size
9/16"	L500
7/8"	L1200
9/16"	L2000
1"	L4000
1-5/16"	L10000

3.M12.1 Cylinder Removal Procedure for All Rexa Block Cylinders

NOTE:

Tagout and lockout the unit for repair in accordance with local procedures. Repair of the linear cylinder will require removing the unit from service.

Due to the large number of custom applications of REXA actuators, this manual does not show the exact steps to separate the power module but rather the general procedure that should be followed.

1. Remove any external loads or springs attached to the unit before attempting any service. In some cases the power will be needed to remove these loads. **Note:** *Failure to remove loads on the actuator properly can result in injury or death.*
2. Clamp the reservoir indicator to prevent oil from draining out of

3.M12 REXA Linear Cylinder

- the power module when disconnecting tubing.
3. Clean the module thoroughly. It is important that no contaminants enter the internals of the actuator.
 4. Remove the power module from the cylinder.
 5. Remove the cylinder from it's mounting.

3.M12 REXA Linear Cylinder

3.M12.2 L500, L1200 and L2000 Cylinder Rebuild Procedure for ¾ Inch, 2 Inch, 4 Inch and 6 Inch Stroke Units

Parts Required:

L500 Cylinder Seal Kit P/N: K01749

L1200 Cylinder Seal Kit P/N: K08551

L2000 Cylinder Seal Kit P/N: K01751

A. Feedback Removal.

PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	CYLINDER BODY
2	1	POTENTIOMETER
3	1	FEEDBACK ARM
4	1	CIRCUIT BOARD BRACKET
5	1	#10-32 SHLDR SCR
6	1	HEX NUT STD #4-40 (SS)
7	2	#6-32 SHCS
8	1	FEEDBACK COVER
9	1	O-RING VITON -150
10	1	CURCUIT BOARD ASSEMBLY
11	2	NYLON #8-32 x .31 SCR
12	2	NYLON SPACER
13	3	SPRING WASHER
14	6	#10 LOCK WASHER
15	4	SHCS #10-32 x .75
16	1	RETAINING RING
17	1	ANTI ROTATION ROD

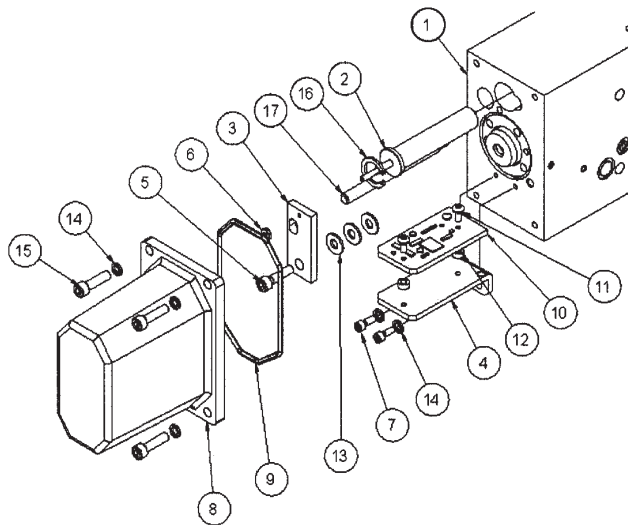


Figure 3-1

3.M12 REXA Linear Cylinder

Disassembly

1. Refer to figure 3-1 and remove the four #10-32 screws (15) and lock washers (14).
2. Remove the feedback cover (8) and O-ring (9). The O-ring can be thrown out once the replacement is identified from the rebuild kit.
3. Remove the two #6-32 SHCS (7) and lock washers (14) to remove the circuit board bracket (4).
4. Remove the shoulder screw (5) and hex nut (6). Remove the 3 spring washers (13). Holding the potentiometer (2) rod unscrew the feedback arm (3).
5. Remove the retaining ring (16), anti-rotation rod (17) and the potentiometer (2).
6. Jump to bushing rebuild Section B to continue disassembly.

Reassembly

1. Slide the potentiometer (2) into the pot hole in the cylinder (1) insuring the cable slides into it's slot. Snap the retaining ring (16) into the ring groove above the pot.
2. Screw the feed back arm (3) onto the potentiometer (2). Thread the hex nut (6) on. Anytime the pot is removed you will need to adjust the pot height.
3. Align the 3 spring washers (13) to the end of the shank. Spin the take off arm (3) over the spring washers (13) and line up the holes. Install the shoulder screw (5).
4. Screw in the anti rotation rod (17).
5. Align the circuit board bracket (4) with it's mounting hole on the cylinder and install the two SHCS (7) and lock washer (14).
6. Install a new o-ring (9) into the cover (8). Petroleum jelly can be used to hold the o-ring from falling out.

3.M12 REXA Linear Cylinder

B. Bushing Rebuild.

PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	CYLINDER
2	2	BUSHING RETAINER
3	2	BUSHING
4	4	BUSHING SEAL
5	2	BUSHING O-RING
6	2	ROD WIPER
7	4	NYLON TIPPED SET SCREW

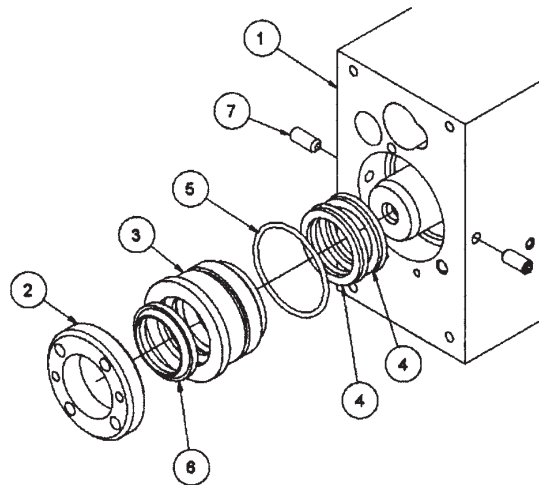


Figure 3-2

CAUTION:

While assembling and disassembling the cylinder, use caution due to oil discharging from unprotected ports.

Disassembly

1. **NOTE:** *To prevent damage, use a dead blow hammer or soft face mallet. Stroke the cylinder by striking it with a dead blow hammer from end to end with the open SAE ports over an oil drain bucket. Read caution above.*
2. Refer to figure 3-2 and remove the two set screws (7).
3. Using a spanner wrench remove the bushing retainer (2).
4. **NOTE:** *To prevent damage, use a dead blow hammer or soft face mallet. Hammer the opposite end of the shaft to force the bushing (3) out.*
5. Use a pick to remove the rod wiper (6), o-ring (5) and the two rod seals (4). These items can be throw out once the replacement parts are located from the rebuild kit.

3.M12 REXA Linear Cylinder

6. Repeat steps 2-5 on the opposite end. **NOTE:** *If there is a spacer sleeve on the piston rod it needs to be reassembled on the same side or damage and improper operation may result.*

Cleaning and Inspection

1. Clean the bushings (3) in solvent and dry.
2. Inspect the bushing (3) bore for damage. If any visual marks can be felt by the touch in the bushing (3) bore then the bushing (3) will need to be replaced.
3. Continue to section C to complete disassembly.

Reassembly

1. Install the new rod wiper (6) with the pointed edge out. Install the new o-ring (5) into the o-ring groove on the outside of the bushing (3).
2. Install the new rod seals (4) into the seal grooves. The o-ring side must face the cylinder body. Installing these backwards will cause the seals to fail.
3. Coat the o-ring (5) and seals (4&6) with petroleum jelly for lubrication during installation.
4. Slide the bushing (3) into the cylinder body (1).
5. Use a removable medium grade thread lock on the bushing retainer (2) and screw it into the cylinder body. Tighten with spanner wrench.
6. Slide the piston assembly into the cylinder bore insure the orientation of the output end. **NOTE:** *To prevent damage, use a dead blow hammer or soft face mallet.* Hammer the assembly in if necessary.
7. Use a thread lock and install the two set screws (7) into the cylinder body. Turn the screws 1 ¼ turns once you feel the nylon bottom.
8. Repeat steps 1 through 6 for the opposite end of the cylinder.
9. Continue back to the feedback reassembly Section A to complete the rebuild.

3.M12 REXA Linear Cylinder

C. Shank Rebuild.

CAUTION:

While assembling and disassembling the cylinder, use caution due to oil discharging from unprotected ports.

PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	SHAFT
2	4	SPLIT RING
3	1	PISTON
4	2	PISTON SEAL
5	1	SPLIT RING RETAINER
6	1	RETAINING RING
7	1	SHANK O-RING

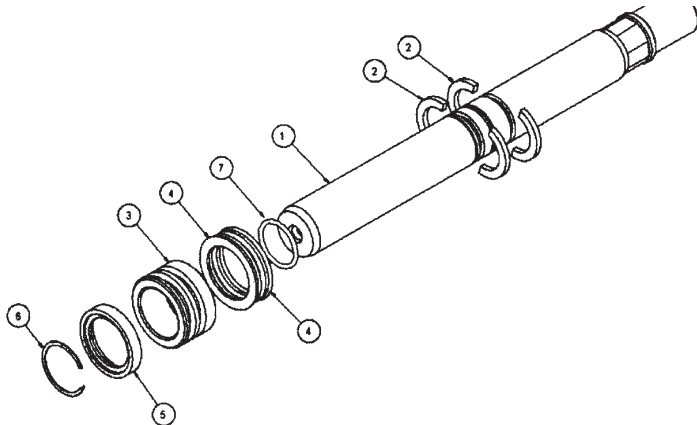


Figure 3-3

Disassembly

1. Refer to figure 3-3 and remove the retaining ring (6). Care must be taken not to scratch the shaft finish.
2. Slide the split ring retainer (5) off exposing the first set of split rings (2).
3. Separate the split rings (2) and slide the piston disk (3) off. The second set of split rings (2) should now fall off.
4. Remove the o-ring (7) from the piston shank (1) and both piston seals (4) from the piston disk (3). These three items can be thrown out once you have located the new replacements from your rebuild kit.

Inspect and Clean

1. Clean the piston shaft (2), piston (3), split ring retainer (4), split rings (5) and the retaining rings (6) in solvent and dry. Insure no residue or contaminants remain.

3.M12 REXA Linear Cylinder

2. Inspect the piston shaft (1) for scratches. If you can detect scratches by running your finger nail around the shaft (1) then the shaft (1) will need to be replaced. Reference parts list in figure 3-3 when ordering replacement parts.
3. Inspect the piston disk (3) for any burrs around the outer surface that would scratch into the cylinder bore. If burrs are found replace the piston disk.
4. Clean the cylinder bore in solvent and dry. Be very cautious not to get contaminants into the ports. If any contaminants get into the system they could cause drifting problems.
5. Inspect the bore for wear or scratches. If the anodizing has worn through or any scuff marks can be felt replace the cylinder body. Reference figure 3-1 for part numbers. Insure any new cylinders have ball plugs installed before reassembly.

Reassembly

1. Slide the new o-ring (7) into the o-ring groove of the shank (1). O-ring groove is located between the two identical split ring grooves. Coat the o-ring (7) with petroleum jelly to lubricate.
2. Slide the new piston seals (4) into the piston disk (3). Note the o-ring side of the seals must face away from each other. Improper orientation will cause the seals to leak.
3. Install one set of split rings (2) into the lower split ring slot of the shank (1).
4. Slide the piston (3) on from the top insuring the counter bore fits over the split ring (2).
5. Install the second set of split rings (2) into the upper slot on the shank (1).
6. Slide the split ring retainer (5) over the second set of split rings (2). Note the split ring retailer can only go on one way and should set flush to the piston disk (3).
7. Install the retaining ring (6).
8. Coat the new piston seals (4) with petroleum jelly to lubricate. Continue back to the bushing rebuild reassembly Section B to continue the rebuild.

3.M12 REXA Linear Cylinder

3.M12.3 L4000 Cylinder Rebuild Procedure for 3/4 Inch, 2 Inch and 4 Inch Stroke Units

Parts Required:

Cylinder Seal Kit P/N: K01752

B. Feedback Removal

Parts List		
ITEM	QTY	DESCRIPTION
1	1	L4000 Cylinder 4"
2	1	Potentiometer
3	1	Retaining Ring
4	3	Curved Spring Washer
5	1	Feedback takeoff arm
6	1	#4-40 Hex Nut STD SS
7	1	SH Shoulder Screw (#10-24)
8	1	Rod - Anti Rotation Rod
9	1	Bracket, Circuit Board Mounting
10	2	Nylon Spacer
11	1	Circuit Board Assembly
12	2	Nylon #6-32 x .31 Screw
13	1	SBHCS 1/4-20 x .5 SS
14	1	L4000 Cover
15	4	1/4 - 20 x .75 SHCS SS
16	4	1/4 Hi Collar Lockwasher
17	1	O-Ring -156 Viton

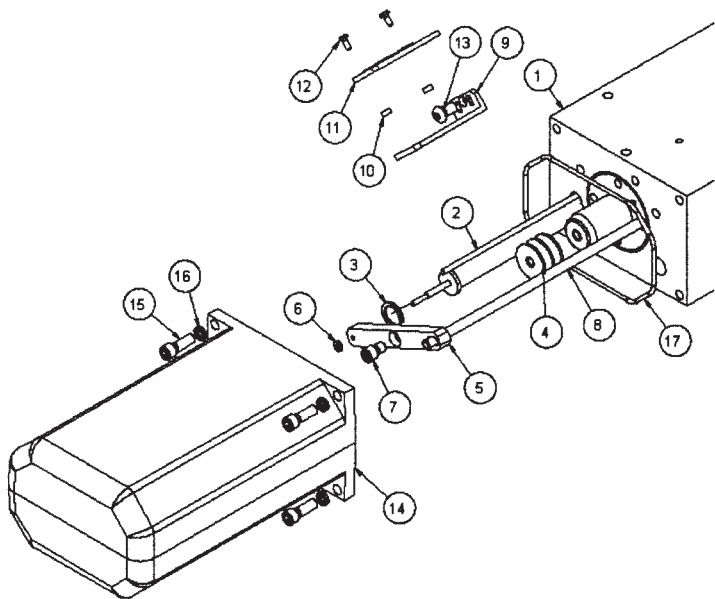


Figure 3-4

Disassembly

1. Refer to figure 3-4 and remove the four #1/4-20 screws (15) and lock washers (16).
2. Remove the feedback cover (14) and o-ring (17). The o-ring can be thrown out once the replacement is identified from the rebuild kit.
3. Remove the 1/4-20 SHCS (13) to remove the circuit board bracket (9).

3.M12 REXA Linear Cylinder

4. Remove the shoulder screw (7) and hex nut (6). Remove the 3 spring washers (4). Holding the potentiometer (2) rod unscrew the feedback arm (5).
5. Remove the retaining ring (3), anti rotation rod (8) and the potentiometer (2).
6. Jump to bushing rebuild Section B to continue disassembly.

Reassembly

1. Slide the potentiometer (2) into the pot hole in the cylinder (1) insuring the cable slides into it's slot. Snap the retaining ring (3) into the ring groove above the pot.
2. Screw the feed back arm (5) onto the potentiometer (2). Thread the hex nut (6) on. Anytime the pot is removed you will need to adjust the pot height.
3. Align the 3 spring washers (4) to the end of the shank. Spin the take off arm (5) over the spring washers (4) and line up the holes. Install the shoulder screw (7).
4. Screw in the anti rotation rod (8).
5. Align the circuit board bracket (9) with it's mounting hole on the cylinder and install the SHCS (13).
6. Install a new o-ring (17) into the cover (14). Petroleum jelly can be used to hold the o-ring from falling out.

3.M12 REXA Linear Cylinder

B. Bushing Rebuild.

Parts List		
ITEM	QTY	DESCRIPTION
1	1	L4000 Cylinder Body
2	2	Bushing Retainer
3	2	L4000 Cylinder Bushing
4	2	O-Ring 1.987 .103 Viton-136
5	4	1" Dia Rod Seal
6	2	1" Rod Wiper
7	4	1/4-20 Nylon Tipped Set Screw

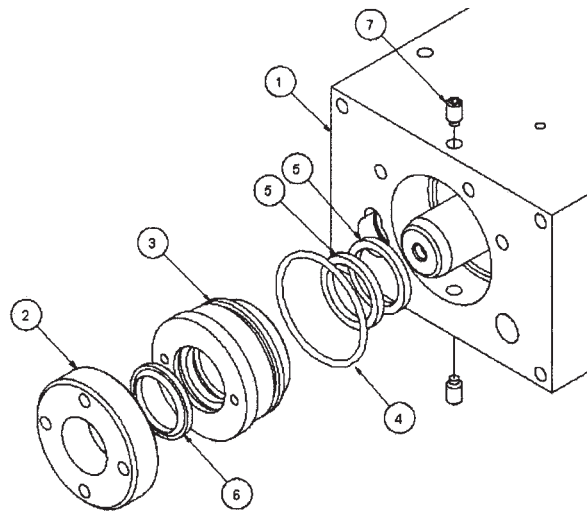


Figure 3-5

CAUTION:

While assembling and disassembling the cylinder, use caution due to oil discharging from unprotected ports.

Disassembly

1. **NOTE:** To prevent damage, use a dead blow hammer or soft face mallet. Stroke the cylinder by striking it with a dead blow hammer from end to end with the open SAE ports over an oil drain bucket. Read caution above.
2. Refer to figure 3-5 and remove the two set screws (7).
3. Using a spanner wrench remove the bushing retainer (2).
4. **NOTE:** To prevent damage, use a dead blow hammer or soft face mallet. Hammer the opposite end of the shaft to force the bushing (3) out.
5. Use a pick to remove the rod wiper (6), o-ring (4) and the two rod seals (5). These items can be throw out once the replacement

3.M12 REXA Linear Cylinder

parts are located from the rebuild kit.

6. Repeat steps 2-5 on the opposite end. **NOTE:** *If there is a spacer sleeve on the piston rod it needs to be reassembled on the same side or damage and improper operation may result.*

Cleaning and Inspection

1. Clean the bushings (3) in solvent and dry.
2. Inspect the bushing (3) bore for damage. If any visual marks can be felt by the touch in the bushing (3) bore then the bushing (3) will need to be replaced.
3. Continue to section C to complete disassembly.

Reassembly

1. Install the new rod wiper (6) with the pointed edge out. Install the new o-ring (4) into the o-ring groove on the outside of the bushing (3).
2. Install the new rod seals (5) into the seal grooves. The o-ring side must face the cylinder body. Installing these backwards will cause the seals to fail.
3. Coat the o-ring (4) and seals (5&6) with petroleum jelly for lubrication during installation.
4. Slide the bushing (3) into the cylinder body (1).
5. Use a thread lock on the bushing retainer (2) and screw it into the cylinder body. Tighten with spanner wrench.
6. Use a thread lock and install the two set screws (7) into the cylinder body. Turn the screws 1 turn once you feel the nylon bottom.
7. Slide the piston assembly into the cylinder bore insure the orientation of the output end. **NOTE:** *To prevent damage, use a dead blow hammer or soft face mallet.* Hammer the assembly in if necessary.
8. Repeat steps 1 through 6 for the opposite end of the cylinder.
9. Continue back to the feedback reassembly Section A to complete the rebuild.

3.M12 REXA Linear Cylinder

B. Shank Rebuild.

CAUTION:

While assembling and disassembling the cylinder, use caution due to oil discharging from unprotected ports.

Parts List		
ITEM	QTY	DESCRIPTION
1	1	L4000 Piston Shank
2	4	L4000 Split Ring
3	1	L4000 Piston Disk
4	2	Piston Seal L4000
5	1	L4000 Split Ring Retainer
6	1	Retaining Ring
7	1	O-Ring

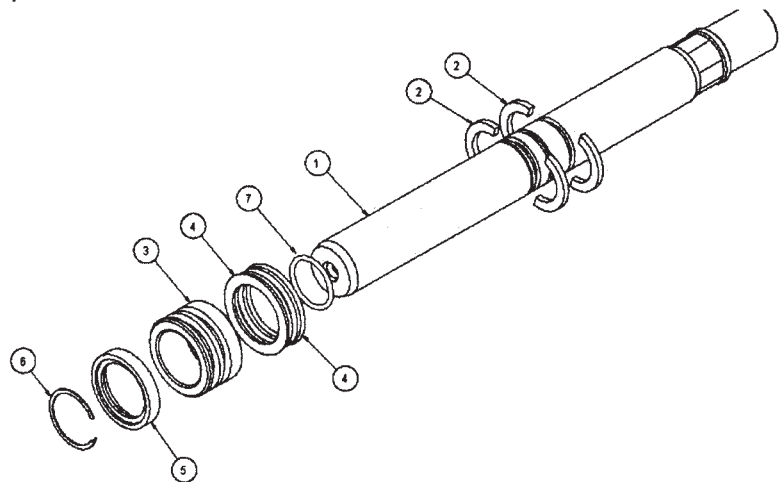


Figure 3-6

Disassembly

1. Refer to figure 3-6 and remove the retaining ring (6). Care must be taken not to scratch the shaft finish.
2. Slide the split ring retainer (5) off exposing the first set of split rings (2).
3. Separate the split rings (2) and slide the piston disk (3) off. The second set of split rings (2) should now fall off.
4. Remove the o-ring (7) from the piston shank (1) and both piston seals (4) from the piston disk (3). These three items can be thrown out once you have located the new replacements from your rebuild kit.

Inspect and Clean

1. Clean the piston shaft (2), piston (3), split ring retainer (4), split rings (5) and the retaining rings (6) in solvent and dry.

3.M12 REXA Linear Cylinder

- Insure no residue or contaminants remain.
2. Inspect the piston shaft (1) for scratches. If you can detect scratches by running your finger nail around the shaft (1) then the shaft (1) will need to be replaced. Reference parts list in figure 3-4 when ordering replacement parts.
 3. Inspect the piston disk (3) for any burs around the outer surface that would scratch into the cylinder bore. If burs are found replace the piston disk.
 4. Clean the cylinder bore in solvent and dry. Be very cautious not to get contaminants into the ports. If any contaminates get into the system they could cause drifting problems.
 5. Inspect the bore for wear or scratches. If the anodizing has worn through or any scuff marks can be felt replace the cylinder body. Reference figure 3-4 for part numbers. Insure any new cylinders have ball plugs installed before reassembly.

Reassembly

1. Slide the new o-ring (7) into the o-ring groove of the shank (1). Coat the o-ring (7) with petroleum jelly to lubricate.
2. Slide the new piston seals (4) into the piston disk (3). Note the o-ring side of the seals must face away from each other. Improper orientation will cause the seals to leak.
3. Install one set of split rings (2) into the lower split ring slot of the shank (1).
4. Slide the piston (3) on from the top insuring the counter bore fits over the split ring (2).
5. Install the second set of split rings (2) into the upper slot on the shank (1).
6. Slide the split ring retainer (5) over the second set of split rings (2). Note the split ring retailer can only go on one way and should set flush to the piston disk (3).
7. Install the retaining ring (6).
8. Coat the new piston seals (4) with petroleum jelly to lubricate. Continue back to the bushing rebuild reassembly and feedback reassembly to complete the rebuild.

3.M12 REXA Linear Cylinder

3M12.4 L10000 Cylinder Rebuild Procedure for 2 Inch and 6 Inch Stroke Units

Parts Required:
Cylinder Seal Kit P/N: K05069

A. Feedback removal.

PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	L10000 CYLINDER
2	1	POTENTIOMETER
3	1	BRACKET, CIRCUIT BOARD
4	1	SHOULDER SCREW #10-24
5	1	#8 LOCK WASHER
6	1	PAN HEAD #6-32 SCREW
7	1	O-RING -159
8	1	COVER
8	4	1/4 LOCK WASHER
10	4	1/4 - 20 SHCS
11	1	RETAINING RING
12	1	#4-40 HEX NUT
13	3	SPRING WASHER
14	2	NYLON SPACER
15	2	NYLON #6-32 SCREW
16	2	TAKE OFF ARM
17	1	ANTI ROTATION ROD

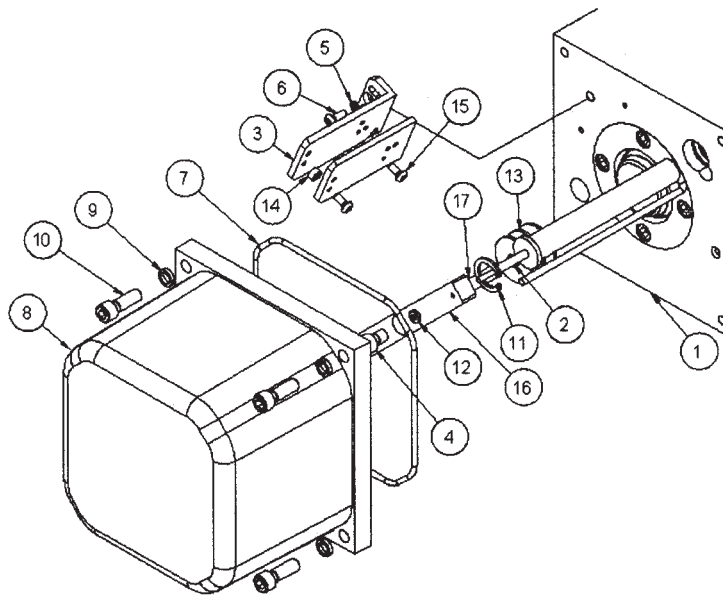


Figure 3-7

Disassembly

1. Refer to figure 3-7 and remove the four 1/4-20 screws (10) and lock washers (9).
2. Remove the cover (8) and O-ring (7). The O-ring can be thrown out once the replacement is identified from the rebuild kit.
3. Remove the pan head screw (6) and lock washer (5) to remove the circuit board bracket (3).
4. Remove the shoulder screw (4) and hex nut (12). Remove the 3 spring washers (13). Holding the potentiometer (2) rod unscrew

3.M12 REXA Linear Cylinder

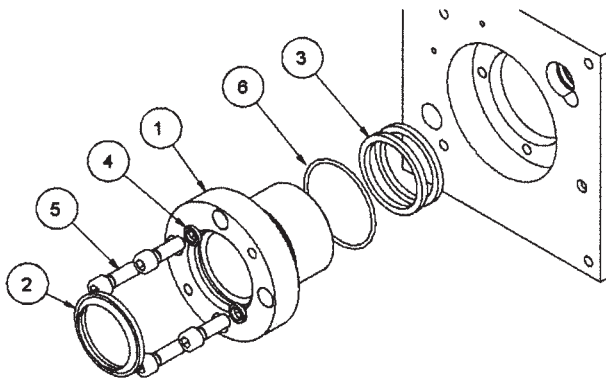
- the take off arm (16).
5. Remove the retaining ring (11), anti rotation rod (17) and the potentiometer (2).
 6. Continue to bushing rebuild to continue disassembly.

Reassembly

1. Slide the potentiometer (2) into the pot hole in the cylinder (1) insuring the cable slides into its slot. Snap the retaining ring (11) into the ring groove above the pot.
2. Screw the take off arm (16) onto the potentiometer (2). Thread the hex nut (12) on. Anytime the pot is removed you will need to adjust the pot height.
3. Align the 3 spring washers (13) to the end of the shank. Spin the take off arm (16) over the spring washers (13) and line up the holes. Install the shoulder screw (4).
4. Screw in the anti rotation rod (17).
5. Align the circuit board bracket (3) with its mounting hole on the cylinder and install the pan head screw (6) and lock washer (5).
6. Install a new o-ring (7) into the cover (8). Petroleum jelly can be used to hold the o-ring from falling out.

3.M12 REXA Linear Cylinder

B. Top Bushing Rebuild.



PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	L10000 BUSHING
2	2	ROD WIPER
3	4	SEAL
4	4	1/4 LOCK WASHER
5	4	.250-20 SHCS
6	1	O-RING VITON -030

Figure 3-8

CAUTION:

While assembling and disassembling the cylinder, use caution due to oil discharging from unprotected ports.

Disassembly

1. **NOTE:** To prevent damage, use a dead blow hammer or soft face mallet. Stroke the cylinder by striking it with a dead blow hammer from end to end with the open SAE ports over an oil drain bucket. Read caution above.
2. Refer to figure 3-8 and remove the four 1/4-20 screws (5) and four lock washers (4).
3. Screw two of the 1/4-20 screws (5) into the threaded holes of the bushing (1) to force it out.
4. Use a pick to remove the rod wiper (2), o-ring (6) and the two rod seals (3). These items can be thrown out once the replacement parts are located from the rebuild kit.

Cleaning and Inspection

1. Clean the bushing in solvent and dry.
2. Inspect the bushing bore for damage. If any visual marks can be

3.M12 REXA Linear Cylinder

felt by touch in the bushing (1) bore, the bushing (1) will need to be replaced.

3. Continue to section C to complete disassembly.

Reassembly

1. Install the new rod wiper (2) with the pointed edge out. Install the new o-ring (6) into the o-ring groove on the outside of the bushing (1).
2. Install the new rod seals (3) into the seal grooves. The o-ring side must face the cylinder body. Installing these backwards will cause the seals to fail.
3. Coat the o-ring and seals with petroleum jelly for lubrication during installation.
4. After the end cap and shaft sections have been completed slide the bushing over the shank and into place. Insure that the screw holes line up. Install the four 1/4-20 screws (5) and four lock washers (4). Use a thread lock on the screws and torque to **100 lb-in.**
5. Slide the piston assembly into the cylinder bore. **NOTE:** *To prevent damage, use a dead blow hammer or soft face mallet.* Hammer the assembly in if necessary. Note the orientation of the shank's output end goes in last.
6. Continue back to the end cap rebuild reassembly Section C to continue the rebuild.

3.M12 REXA Linear Cylinder

PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	L10000 END CAP
2	2	ROD WIPER
3	4	ROD SEAL
4	8	1/2 LOCK WASHER
5	8	#1/2 -13 SHCS
6	1	O-RING VITON-047
7	1	O-RING VITON, #040

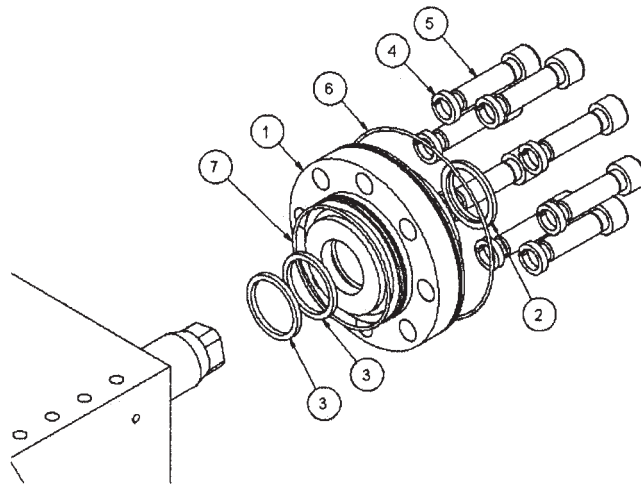


Figure 3-9

C. End Cap Rebuild.

CAUTION:

While assembling and disassembling the cylinder, use caution due to oil discharging from unprotected ports.

Disassembly

1. Refer to figure 3-9 and remove the eight 1/2-13 screws (5) and eight lock washers (4).
2. **NOTE:** *To prevent damage, use a dead blow hammer or soft face mallet.* Hammer on the opposite end of the shaft to drive the end cap (1) out. The Shaft assembly should also come out; reference section D shaft rebuild section for rebuild. **NOTE:** *If there is a spacer sleeve on the piston rod it needs to be reassembled on the same side or damage and improper operation may result.*
3. Use a pick to remove the rod wiper (2), o-ring (6), o-ring (7) and the two rod seals (3). These items can be throw out once the replacement parts are located from the rebuild kit.

3.M12 REXA Linear Cylinder

Cleaning and Inspection

1. Clean the end cap in solvent and dry.
2. Inspect the end cap (1) for damage. If any visual marks can be felt by touch in the end cap (1) bore, then end cap (1) will need to be replaced.
3. Continue to section D Piston shank rebuild before reassembly.

Reassembly

1. Install the new rod wiper (2) with the pointed edge out. Install the new o-rings (6 & 7) into the appropriate o-ring grooves.
2. Install the new rod seals (3) into the seal grooves. The o-ring side must face the cylinder body. Installing these backwards will cause the seals to fail.
3. Coat the o-ring and seals with petroleum jelly for lubrication during installation. Slide the end cap over the piston rod and back into the cylinder. Use two of the 1/2-13 screws (5) with out washers to pull it back into place.
4. Install the eight 1/2-13 screws (5) and eight lock washers (4). Use a thread lock on the screws and torque to **65 lb-ft**.
5. Continue back to the feedback rebuild reassembly Section A to finish the rebuild.

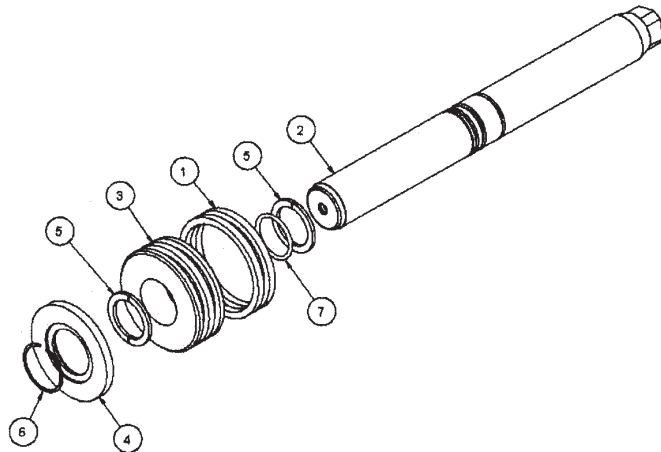
3.M12 REXA Linear Cylinder

D. Shank Rebuild

CAUTION:

While assembling and disassembling the cylinder, use caution due to oil dis-

PARTS LIST		
ITEM	QTY	DESCRIPTION
1	2	PISTON SEAL
2	1	SHANK - L10000
3	1	PISTON L10000 DISK
4	1	SPLIT RING RETAINER
5	2	SPLIT RING
6	1	RETAINING RING
7	1	O-RING VITON-122



charging from unprotected ports.

Figure 3-10

Disassembly

1. Refer to figure 3-10 and remove the retaining ring (6). Care must be taken not to scratch the shaft finish.
2. Slide the split ring retainer (4) off exposing the first set of split rings (5).
3. Separate the split rings (5) and slide the piston disk (3) off. The second set of split rings should now fall off.
4. Remove the o-ring (7) from the piston shank (2) and both piston seals (1) from the piston disk (3). These three items can be thrown out once you have located the new replacements from your rebuild kit.

Inspect and Clean

1. Clean the piston shaft (2), piston (3), split ring retainer (4), split rings (5) and the retaining rings (6) in solvent and dry. Insure no residue or contaminants remain.

3.M12 REXA Linear Cylinder

2. Inspect the piston shaft (2) for scratches. If you can detect scratches by running your finger nail around the shaft (2), then the shaft (2) will need to be replaced. Reference parts list in figure 3-10 when ordering replacement parts. The overall length of a two inch shank is approximately 11-3/4 inches and the length of a 6 inch shank is approximately 19-3/4 inches.
3. Inspect the piston disk (3) for any burrs around the outer surface that would scratch into the cylinder bore. If burrs are found replace the piston disk.
4. Clean the cylinder bore in solvent and dry. Be very cautious not to get contaminants into the ports. If any contaminants get into the system, they could cause drifting problems.
5. Inspect the bore for wear or scratches. If the anodizing has worn through or any scuff marks can be felt replace the cylinder body. Reference figure 3-7 for part numbers. Insure the new cylinder has ball plugs installed before reassembly.

Reassembly

1. Slide the new o-ring (7) into the o-ring groove of the shank (2). Coat the o-ring (7) with petroleum jelly to lubricate.
2. Slide the new piston seals (1) into the piston disk (3).
Note: *the o-ring side of the seals must face away from each other. Improper orientation will cause the seals to leak.*
3. Install one set of split rings (5) into the lower split ring slot of the shank (2).
4. Slide the piston (3) on from the top insuring the counter bore fits over the split ring (5).
5. Install the second set of split rings (5) into the upper slot on the shank (2).
6. Slide the split ring retainer over (4) the second set of split rings (5).
Note: *the split ring retailer can only go on one way and should set flush to the piston disk (3).*
7. Install the retaining ring (6).
8. Coat the new piston seals (1) with petroleum jelly to lubricate.
9. Continue back to end cap rebuild reassembly, top bushing rebuild

3.M13 Commercial Linear Cylinders

General

The CYLINDER consists of a double rod end through shaft cylinder. There are two bushings with seals and wiper, shank, piston disk, piston seals and cylinder body. The sizes range from 2 000-10 000 lb greater than 4" stroke and greater than 10 000 lb with almost any stroke size required.

NOTE: Use the supplied drawing and pictures to assist you in the repair of the actuator. The numbers listed in parenthesis are the part numbers listed in Figure 1.

3.M13.1 Assembly and Disassembly Procedures

NOTE: Tagout and lockout the unit for repair in accordance with local procedures. Repair of the cylinder will require removing the unit from service.

A. Seals Replacement

CAUTION: While assembling and disassembling the cylinder, use caution due to oil discharging from unprotected ports.

1. Clamp the reservoir piston to prevent oil from discharging from power module when removing. Remove tubing feeding the cylinder.
2. Remove the fasteners holding the feedback arm to the cylinder shaft. Remove all plates, fasteners and legs as necessary to free the cylinder from the assembly. Remove the cylinder from the unit.
3. Loosen and remove the four tie rod nuts (23).
4. Remove the retainer plate (27).
5. Note: Special tools for gland removal can be ordered from Parker Cylinders. Remove the bronze gland (14) on the retainer plate (27) by unscrewing counter clockwise.
6. Remove the cap assembly (7).
7. Remove the piston and piston rod assembly (57,17,60).
8. Remove the cylinder body (15).
9. Remove the head assembly (1). Tie rods may be left installed in the retainer.
10. Remove the seals from the piston disk (17) and inspect

3.M13 Commercial Linear Cylinders

the disk for wear and damage. Replace as necessary.

11. Inspect the cylinder body (15) for wear and damage. Replace as necessary.
12. Remove the seals (40, 41 & 43) from the glands (14) and inspect the glands for wear and damage. Replace as necessary.
13. Remove and discard the following o-rings: two gland to head seals (45) and two cylinder body end seals (47). Inspect the o-ring seating surface for damage. Replace as necessary.

NOTE: *Lubricate all surfaces, seal and o-rings with oil prior to assembly.*

14. Place one new set of piston lipseal (42) and back-up washer (44) on one side of the piston disk with the open ends toward the shaft end.
15. Slide the piston disk assembly (57,17, 60) into the cylinder body (14). Slide the piston disk assembly to the end of the body to expose the seal groove with no seals. Do not slide the piston disk assembly all the way out of the cylinder body.
16. Place the other new piston lipseal (42) and back-up washer (44) on the piston disk. Slide the piston disk assembly (57, 17, 60) back into the cylinder body (15).
17. With both glands, install new wiper seal (40), gland lipseal (41) and gland backup washer (43) into the gland.
18. Install new cylinder body end seal o-ring (47) into head (1) and cap (7). Also install new gland to head seal (45).
19. Install gland (14) to retainer (27). Ensure that the gland is installed only two turns. If required, install tie rods to retainer so that the tie rod ends are flush to the retainer.
20. Install head (1) to retainer (27). Slip the cylinder body (15) with piston disk assembly (57, 17, 60) over the tie rods (19) and onto the head.
21. Install cap (7) to cylinder body (15).
22. Install retainer plate (27) to cap (7).
23. Thread tie rod nuts onto the tie rods. Torque tie rod nuts (23) in accordance with Table 1.
24. Tighten gland (14) so that the top of the gland to the retainer is 0.25".
25. Install power module, tubing and feedback items. Install unit to valve.



Fig A1: Retainer Plate
(step A.4, A.19, A.20, A.27)



Fig A2: Tools for gland removal and installation. (step A.5, A.24)



Fig A2: Parker tool for gland removal and installation. (step A.5, A.24)

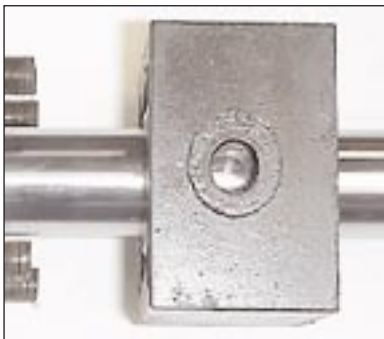


Fig A4: Cap/Head Assembly
(step A.6, A.9, A.18, A.20)



Fig A5: Piston Rod Assembly
(step A.7, A.18)



Fig A6: Cylinder Body
(step A.8, A.18)



Fig A7: Piston Disk Assembly
(step A.10, A.14)



Fig A8: Piston disk with one set of seals into cylinder (step A.15)



Fig A9: Piston disk ready for second set of seals (step A.16)



Fig A10: Gland and Seals
(step A.12, A.15)



Fig A11: Head/Cap Seals
(step A.13, A.16)



Fig A12: Head/Cap Seals
(step A.13, A.16)

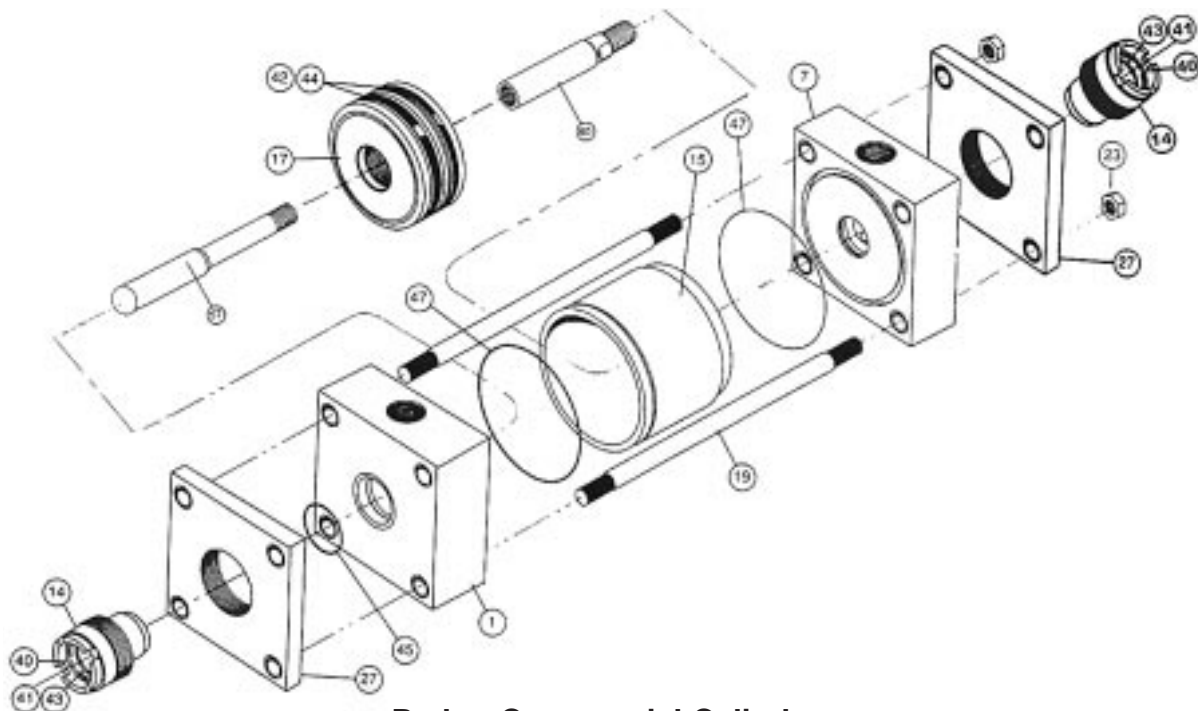
3.M13 Commercial Linear Cylinders

Table 1—TORQUE (lb-ft)

Size	Cylinder Bore	Rod Size	Tie Rod (lb-ft)
L2 000	1.5"	1"	18
L5 000	2.5"	1.75"	45
L10 000	3.25"	2"	120
L15 000	4"	2.5"	131
L20 000	4"	1.75"	131
L40 000	6"	3"	528
L60 000	7"	3"	800
L80 000	8"	3.5"	1168

Figure 1—PARTS LIST

ITEM NO.	DESCRIPTION	QTY	ITEM NO.	DESCRIPTION	QTY
1	HEAD, PORTED, NON CUSHIONED	1	41	LIPSEAL, GLAND	2
7	CAP, PORTED, NON CUSHIONED	1	42	LIPSEAL, PISTON	2
14	GLAND	2	43	BACKUP WASHER, GLAND	2
15	CYLINDER BODY	1	44	BACKUP WASHER, PISTON	2
17	PISTON BODY, LIPSEAL TYPE	1	45	O-RING, GLAND TO HEAD SEAL	2
19	TIE ROD	4	47	O-RING, CYLINDER BODY END SEAL	
23	TIE ROD NUT	4	57	PISTON ROD	1
27	RETAINER	2	60	PISTON ROD EXTENSION	1
40	WIPER SEAL, GLAND	2			



Parker Commercial Cylinder

3.M14 Rotary Cylinders

General

The actuator consists of a pinion and one or two racks located within the housing. Pressurization of alternate cylinder port(s) result in shaft rotation. The gear chamber is filled with a Moly grease containing a minimum Molybdenum Disulfide (MSO₂) content of 3%. In the event that maintenance is required, the following steps should be used as a guide:

NOTE: Use the supplied drawing and pictures to assist you in the repair of the actuator. The numbers listed in parenthesis are the part numbers listed in Figure 1.

3.M14.1 Assembly and Disassembly Procedures

NOTE: Tagout and lockout the unit for repair in accordance with local procedures. Repair of the rotary actuator will require removing the unit from service.

A. Inspection & Replacement of End Cap Seals (9)

1. Remove the tie rod nuts/bolts (10) from the tie rods (13).
2. Pull end cap (11) free from the cylinder tube (12).
3. Inspect and/or replace end cap o-ring (9). Lubricate the seal and end cap with 5W-50 oil before re-installing.
4. Replace end cap(s) (11) on cylinder tube (12) and assemble tie rod nuts (10) to tie rods (13).
5. Torque the tie rod nuts/bolts per the Torque Table.



Fig A1: Tie Rod nuts/bolts
(Step A1)



Fig A2: End Cap o-ring (Step A3.)

3.M14 Rotary Cylinders

B. Inspection & Replacement of Wear Rings (4), Piston Seals (5) and Cylinder O-Ring (8).

1. Perform steps A1 and A2.
2. For 50 000 lb-in and greater models:
 - a) Remove Rack bolt (7).
 - b) Screw two threaded rods into the tapped holes in piston (16) and pull free from cylinder tube (12).
3. For models less than 50 000 lb-in:
 - a) Pull cylinder tube (12) free from housing (2).
 - b) Remove Rack bolt (7).
4. Inspect piston (16) and replace piston seal (5).
5. Inspect and/or replace wear ring (4), (used on R2 500 lb-in and above actuators only).
6. Inspect and/or replace Cylinder o-ring (8).
7. Place cylinder tube (12) over rack and press in housing (2).
8. Slide piston (16) with piston seal and wear rings assembled onto it, into the cylinder tube (12), until it contacts the rack (17).
9. **CAUTION:** *Nylon slug (6) is designed to prevent rack bolt from vibrating loose during operation; replace as required.* Replace rack bolt (7) and torque per the Torque Table.
10. Replace end cap (11) and tie rod nuts (10), torque per the Torque Table.



Fig B1: Rack Bolt
(Step B.2.a/B.3.b)



Fig B2: Cylinder Tube
(Step B.2.b/B.3.a)

3.M14 Rotary Cylinders



Fig B3: Piston
(Step B.4)



Fig B4: Cylinder O-Ring
(Step B.6)

C. Inspection and Replacement of Pinion and Bearing Retainer O-Rings

1. **CAUTION:** Make match marks to re-establish the correct timing. Failure to loosen the lock screw will damage the threads on the bearing retainer. Loosen lock screw (19).
2. Using a spanner wrench, remove the bearing retainer (25) by turning counter-clockwise. Remove the bearing retainer o-ring (24).
3. Remove upper bearing (22), pinion (23) and lower bearing (22).
4. Inspect and/or replace pinion o-ring (1) located at the "front" or blindside of the housing (2).
5. Reinstall lower bearing (22), pinion (23) making sure match marks line up, and upper bearing.
6. Inspect and/or replace bearing retainer o-ring (24).
7. Apply Moly grease to bearing retainer threads (25) and reinstall into housing (2).
8. Torque bearing retainer (25) per the Torque Table.
9. Install and tighten locking screw per the Torque Table.

3.M14 Rotary Cylinders



Fig C1: Match Marking
(Step C1)

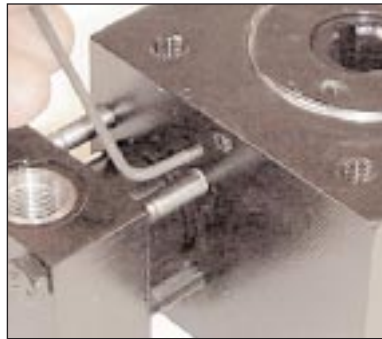


Fig C2: Locking Screw
(Step C1)



Fig C3: Bearing Retainer
(Step C2)



Fig C4: Bearing Retainer O-Ring
(Step C2)



Fig C5: Upper Bearing
(Step C2)



Fig C6: Pinion
(Step C3)

D. Complete Disassembly of Cylinder

1. Perform steps B1 through B3.
2. Perform steps C1 through C3.
3. **CAUTION:** Make match marks to re-establish the correct timing. Push the rack (17) from either end to remove from housing.

E. Reassembly of Cylinder

1. Perform C4 through C9. Refill gear chamber with Moly Grease.
2. Perform B4 through B10.

3.M14 Rotary Cylinders

TORQUE TABLE (lb-ft)

Size	Tie Rod Nut (10)	Rack Bolt (7)	Bearing Retainer (25)	Locking Screw (19)
R600/R1 200	6	3	15	2
R2 500/R5 000	15	15	30	4
R10 000/R20 000	30	40	100	4
R50 000/R100 000	130	130	250	15
R200 000/R400 000	525	360	500	15

(Figure 1) PARTS LIST

ITEM NO	DESCRIPTION	QUANTITY		ITEM NO	DESCRIPTION	QUANTITY	
		SINGLE RACK	DOUBLE RACK			SINGLE RACK	DOUBLE RACK
1*	O-RING PINION	2	2	13	TIE ROD	8	16
2	HOUSING	1	1	14*	O-RING, RACKBOLT	2	4
3	RACK BEARING	1	2	15*	BACK-UP RING, RACK BOLT	2	4
4*	WEAR RING	2	4	16	PISTON	2	4
5*	PISTON SEAL	2	4	17	RACK	1	2
5a†	BACK-UP RING	2	4	18	RELIEF VALVE	1	1
6	NYLOK SLUG	2	4	19	LOCKING SCREW	1	1
7	RACK BOLT	2	4	20	DRIVE SCREW	4	4
8*	O-RING CYLINDER	2	4	21	NAME PLATE	1	1
9*	O-RING END CAP	2	4	22	BEARING	2	2
10	TIE ROD NUT	8	16	23	PINION	1	1
11	END CAP	2	4	24*	O-RING, BEARING RETAINER	1	1
12	CYLINDER TUBE	2	4	25	BEARING RETAINER	1	1

* Denotes items supplied with seal kit

† Applies to Viton o-rings only.

3.M14 Rotary Cylinders

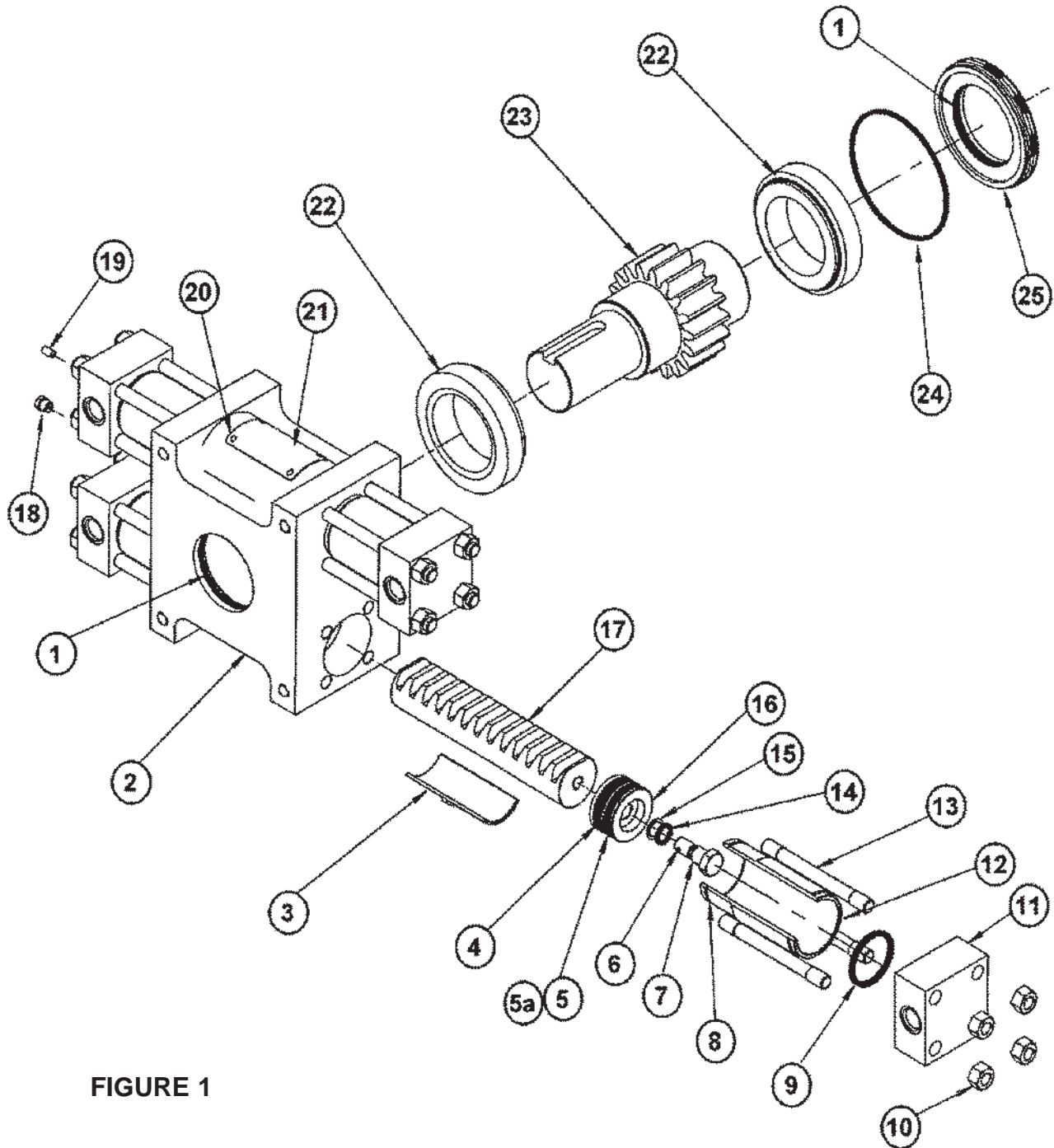


FIGURE 1

NOTE:
THIS EXPLODED VIEW IS OF A TYPICAL PARKER CYLINDER.

3.T1 Thrust/Torque

General

The most important concern in actuator sizing is adequate knowledge of the application. Factors such as pressure drop, size, packing friction and valve type affect the required output. These conditions may change with time or temperature. As an independent actuator supplier, REXA's general policy is to take a conservative approach to actuator selection. It is better to err on the side of safety than to provide a product that is too small for the job.

All REXA actuators are thoroughly tested to exceed their rated thrust or torque specifications. The output is determined by either direct mechanical means (load or spring) or an implied load developed from the pump test. Two application specific conditions will reduce rated output: ambient temperature and speed of operation. These two factors are interrelated as shown on the attached graph (Figure T1.A).

In general, the REXA power modules will develop their nominal pressure (2000 PSI) over a tremendous range of temperatures (-20 to 140 degrees Fahrenheit) and

speed settings (30% to 80%). It is only in the extreme where output drops below the ratings. Depending on the situation, REXA has available different remedies to insure adequate output for the application. For instance, excessive ambient temperature will thin out the hydraulic oil and thus reduce pump pressure. The output can be increased by using a higher viscosity oil (see section T.3), increasing the speed of rotation or selecting a larger actuator.

The thrust or torque rating of Rexa actuators is based upon a differential oil pressure of 2000 psi acting across the cylinder piston. The actual usable thrust or torque is modified in spring return actuators. See Charts T1.B and T1.C for available output values of linear and rotary actuators respectively.

Fail In Place Actuators

Fail in place actuators have the full output ratings available in both directions of motion.

Spring Return Actuators

Spring return actuators have the rated output minus the spring load .

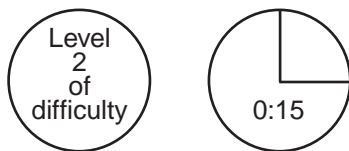
3.T1 Thrust/Torque

available in the direction opposing the spring and the rated output plus the spring load in the direction of the spring load. Upon power failure only the spring load is available.

3.T1.1 Analysis

Refer to section 3.M5 to determine the actual differential pressure across the piston. If the differential pressure exceeds 2000 PSI, then the actuator is producing its rated output. Contact the supplier of the driven device to determine the required output.

3.T1.2 Repair



Parts Required:

None

Flowchart 2.3

Motor Stalling- Reduce speed (ambient temperature is less than 120 degree fahrenheit).

The torque output of the motor peaks at approximately 50% speed and decreases at lower or higher settings. An increase in actuator output can be obtained by adjusting the speed towards the peak of the motor torque.

Flowchart 2.4

Motor Not Stalling - Increase speed (ambient temperature is greater than 120 degree Fahrenheit).

A turning motor and insufficient pressure output will usually indicate a too low oil viscosity (thin). In these cases, a higher speed setting will enhance the actuator output. See section T3 for additional information concerning oil viscosity.

Chart T1.B Linear Thrust

Fail-In-Place

<u>Model</u>	<u>Available Thrust (lbs)</u>
L500	500
L1000	1000
L2000	2000
L4000	4000

Spring Return

See Technical Memo TM4 for an indepth discussion of available spring outputs and the relationship to valves.

<u>Model</u>	Maximum Spring Thrust (standard spring - lbs) spring extended			Gross Hydraulic * Thrust (lbs)
	<u>2 in Stroke</u>	<u>4 in Stroke</u>	<u>6 in Stroke</u>	
L500	220	175	85	500
L1000	365	305	150	1000
L2000	600	480	265	2000
L4000	680	590	N/A	4000
L8000	750	3500	2500	8000

Spring extended thrusts may be reduced for a particular application. Please reference the initial spring force indicated on the original actuator specifications.

* Gross hydraulic thrust is increased or decreased by the spring force.

Chart 1.C Rotary

Fail-In-Place

<u>Model</u>	<u>Available Torque (in-lbs)</u>
R1000	1000
R2500	2500
R8000	8000
R15000	15000
R35000	35000

Spring Return

See Technical Memo TM4 for an indepth discussion of available spring outputs and the relationship to valves.

<u>Model</u>	Maximun Spring Torque (standard spring in-lbs) <u>Spring Extended</u>	Gross Hydraulic * Torque (in-LBS)
R1000	400	1000
R2500	1000	2500
R8000	3200	8000
R15000	6000	15000
R35000	14000	35000

Spring extended torques may be reduced for a particular application. Please reference the initial spring force indicated on the original actuator specifications.

* Gross hydraulic torque is increased or decreased by the spring torque.

Chart T1.A

TYPICAL TEMPERATURE VERSUS SPEED

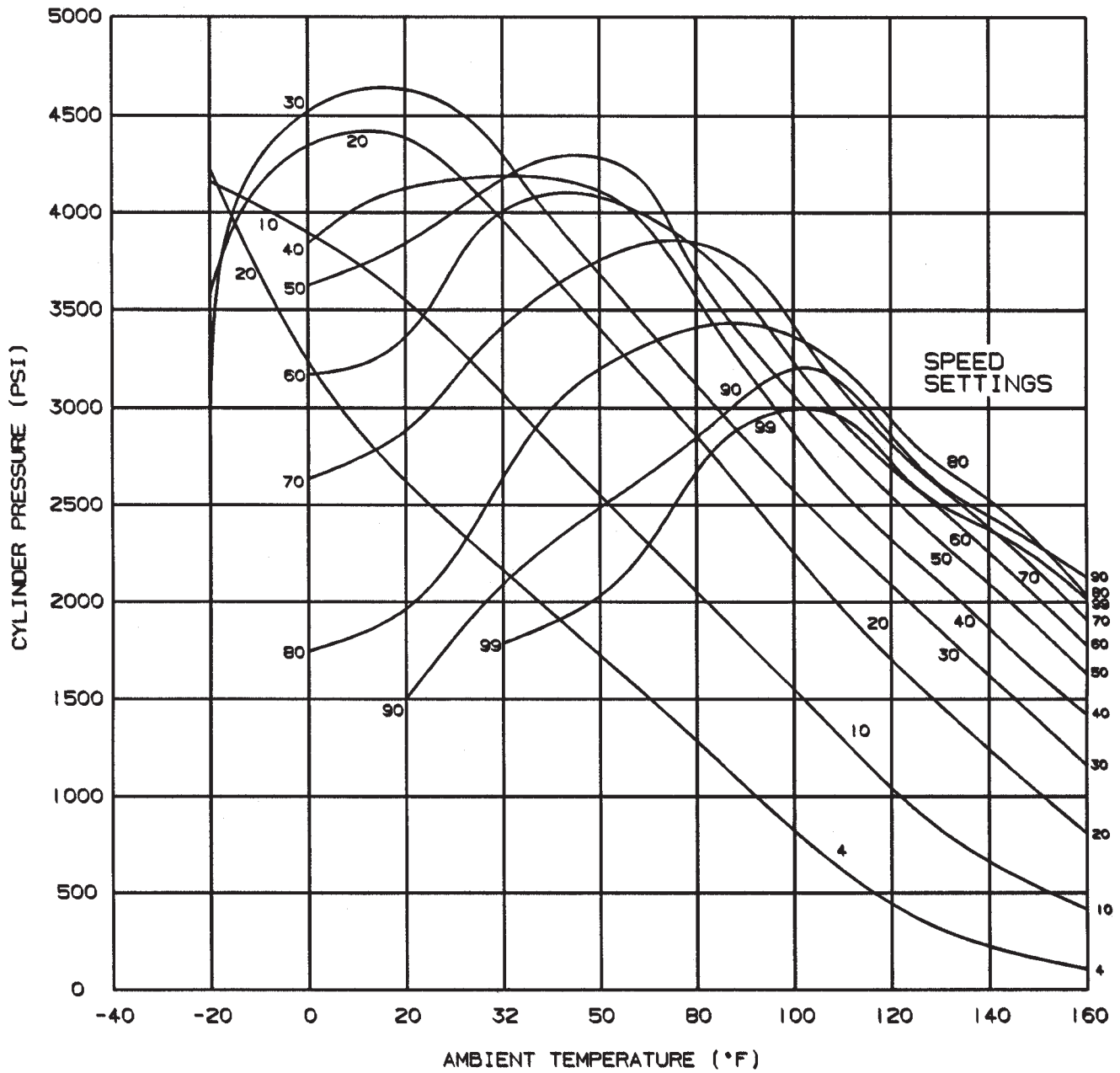


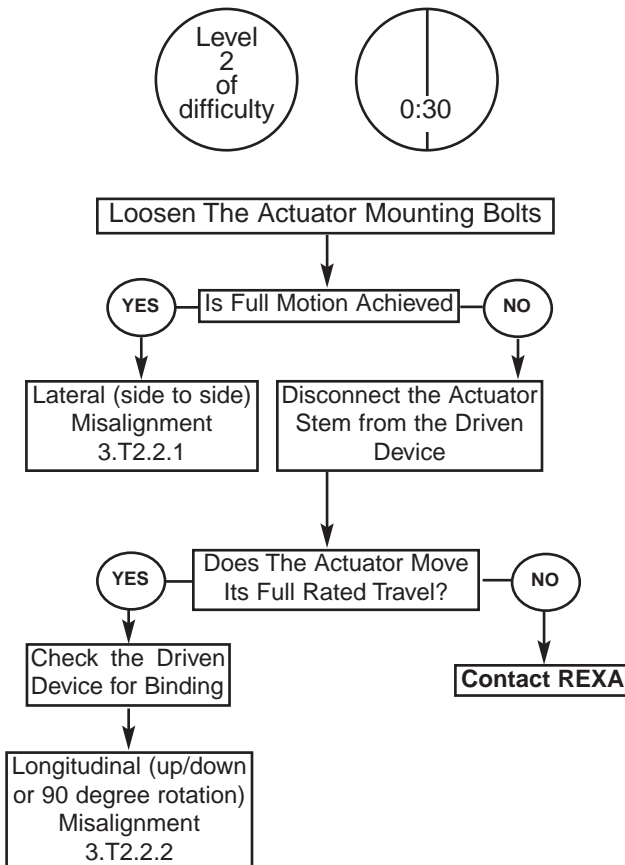
FIGURE T1.A

3.T2 Mechanical Restriction/Binding

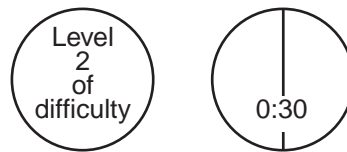
General

Most mechanical restrictions are an application or mounting related problem. Any binding will be indicated by erratic motion, slower speed or restriction of travel. The problem could lie in the actuator, the device being driven or misalignment between the two.

3.T2.1 Analysis



3.T2.2 Repair



3T2.2.1 Lateral (side to side) Misalignment

Parts Required:

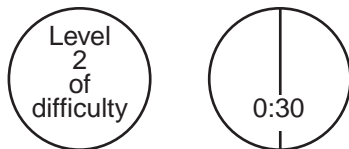
None

Any noticeable bending of the actuator stem or driven device (valve) stem should be immediately corrected. Not only is operation impaired, but damage to the actuator seals and bushing or the valve packing and stem may occur.

In most cases, lateral alignment is corrected by stroking the actuator with the mounting or mating connection in a loosened condition. This will allow the connection to self-align. If there is insufficient clearance, then the appropriate bore diameters must be increased.

3.T2 Mechanical Restriction/Binding

3.T2.2.2 Longitudinal (up/down or < 90 deg. rotation) Misalignment



Linear

Parts Required:

None

Failure to reach full stroke is caused by a mechanical limitation within the actuator or driven device. Incorrect yoke leg lengths or thread engagement in the stem coupling may reduce the travel. In most cases, the required adjustment is small and can simply be made by changing the length of thread engagement of the stem coupling. Further adjustment can only be made by changing the length of the yoke legs.

Rotary (< 90 deg. Rotation)

Parts Required

None

Failure to reach full 90 degree rotation is usually not binding, but rather an installation problem. With the actuator separated from the driven device, rotate the driven device to the closed position. Move the actuator in the same direction until the end of rotary piston travel is reached. Rotate the actuator 2 to 4 degrees from the end point and reconnect the actuator. The spline to the hydraulic cylinder will allow mating every 5 deg. (+/- 2.5 degrees). Locate the stem in the spline that is closest. Calibrate the actuator per the instruction in the Operation and Calibration Manual.

3.T3 Oil Mixture

General

Oil is used as the means to transfer rotary motion into mechanical thrust or torque. Because oil is essentially incompressible Rexa actuators exhibit high stiffness and therefore can precisely position large loads. The viscosity of the oil is essential to the operation of the actuator. If the oil is heated the viscosity decreases until at some elevated temperature the viscosity or oil thickness becomes too low for the gear pump to produce the necessary output pressure. Conversely if the oil is cooled, the viscosity increases until the pressure required to pump the thickened oil stalls the pump motor. For this reason the specific oil used is temperature range dependent.

Average Ambient Temperature Range

For a temperature range of 0° F to 140° F Rexa uses Castrol GTX 20W-50 grade motor oil and an internal 120 watt heater which activates at 60° F and deactivates at 80° F.

Below Average Temperatures

For a temperature range of -40° F to 140° F Rexa still uses Castrol GTX 20W-50 grade motor oil and the internal 120 watt heater which activates at 60° F. However, Rexa recommends insulating the actuator with at least 1.0 inch thick insulating material. On units with extended thrust or strokes an additional heating element at the cylinder may be required.

Above Average Temperatures

For a temperature range which is continually elevated above 140° F to the maximum temperature rating, Rexa recommends a 50/50 mixture of STP and Castrol GTX 20W-50 grade motor oil.

Extreme Temperature / Operating Conditions

For conditions or requirements which do not fit within the previous categories, please consult the factory.

3.T4 Failure Mode

General

The failure modes of REXA actuators are divided into two categories. The first is due to loss of control signal while the second is due to loss of power.

Failure Due to Loss of Control Signal

The failure mode due to loss of control signal is programmable as Parameter 7 in the Setup Mode as described in the Operation and Calibration Manual. Within Parameter 7 there are four options. Option 1 is to fail in place. Option 2 is to fail to the low signal position. Option 3 is to fail to the high signal position. Option 4 is to ignore the control signal failure and take no action. With Options 1, 2 or 3, a control signal of less than 2.5 mA is interpreted as failed.

Failure Due to Loss of Power

The failure mode due to loss of power can be any one of three options. These are to fail in place, to fail in the stem extended or clockwise position depending on linear or rotary motion, or to fail in the stem retracted or counter clock-

wise position. The desired mode of failure due to loss of power must be chosen at the time the actuator is ordered since construction is specific to each option.

An actuator with a failure position, extended or retracted on linear units and clockwise or counter clockwise on rotary units, is constructed with an external spring element to provide the motive force upon loss of power. If there is no spring, the actuator will remain in place upon power loss.

Index to Appendices

Appendix A

List of Recommended Tools

Appendix B

Returning an Actuator for Repair

Appendix C

Mechanical Drawings and Circuit Schematics

Appendix A List of Recommended Tools

1. Digital Multimeter - Fluke Model 85 or Equivalent
2. Allen Wrenches - Standard and Metric
3. Pliers
4. Adjustable Wrench
5. Combination Wrenches
6. Wire Cutters
7. Needle Nose Pliers
8. Screwdrivers - Slotted and Phillips
9. Channel Lock Pliers
10. Soldering Equipment
11. Vaseline

Appendix B Returning the Actuator for Repair

This section contains information on how to return a faulty actuator for repair or replacement.

B.1 Return Procedure

1. Call Rexa at (508) 584-1199 during regular business hours to get a Returned Materials Authorization Number (RMA#).

Note: Do not attempt to return materials or other equipment without a valid RMA#. Returns received without a valid RMA# are not accepted and are returned to sender.

2. Rexa is not responsible or liable for damage resulting from improper packaging or shipment.
3. Ship the actuator to:

KOSO AMERICA, INC.
4 Manley Street
W. Bridgewater, MA 02379
Attn: Repair Dept., RMA#_____

4. Rexa will determine the failure and cost to repair. No work will be performed without your authorization. A minimum charge for diagnostic evaluation will apply.

Appendix C

Electrical Drawings and Circuit Schematics

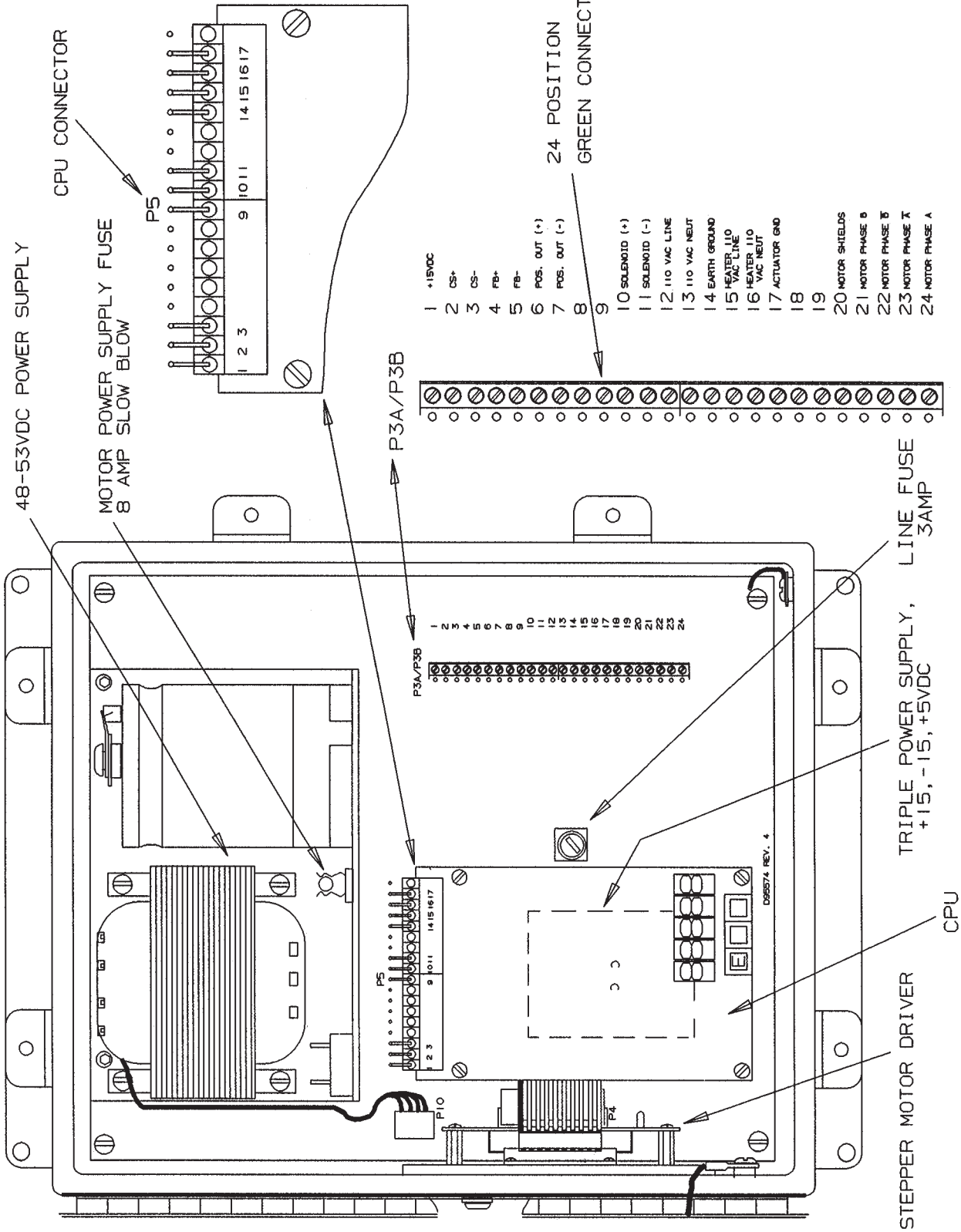
M95917	Position Control Processor (PCP) for B Power Module
M95939	Interconnection Schematics for B Electronics
M95937	Position Control Processor (PCP) for C Power Module
M95940	Interconnection Schematics for C Electronics
M95915	Feedback Wiring - Rotary Cylinder

Mechanical Drawings

M03110	Linear Actuator S/A
M03111	Rotary Actuator S/A
M03099	Power Module S/A
M03105	Pump Standoff S/A
M03103	Manifold S/A
M03107	Rotary Cylinder S/A
M03100	Elastic Coupling S/A

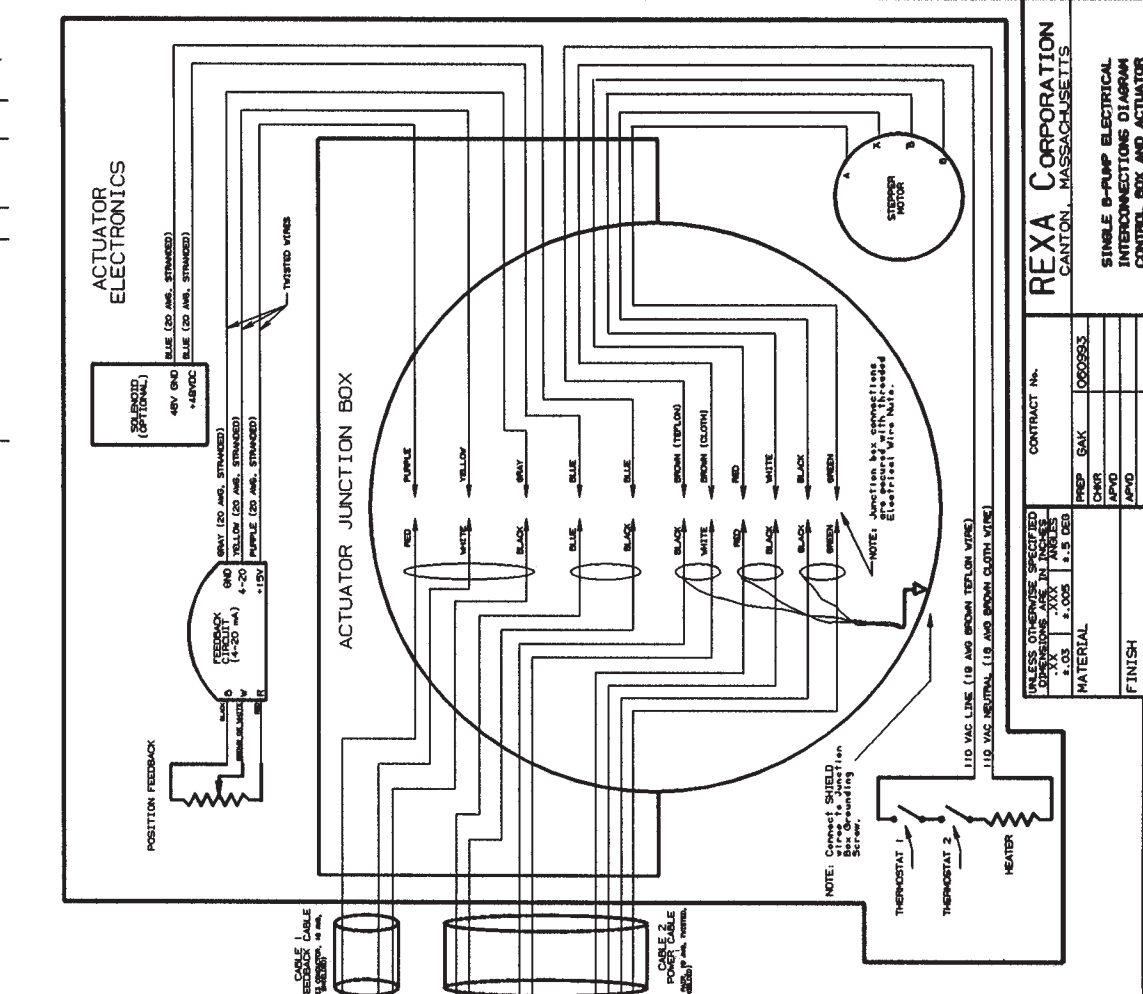
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REXA CORPORATION
B-PUMP ELECTRONICS
M95917 SCALE=NONE 3-94 REV.



REVISIONS

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DESCRIPTION	REV	DATE	BY	APPROVED



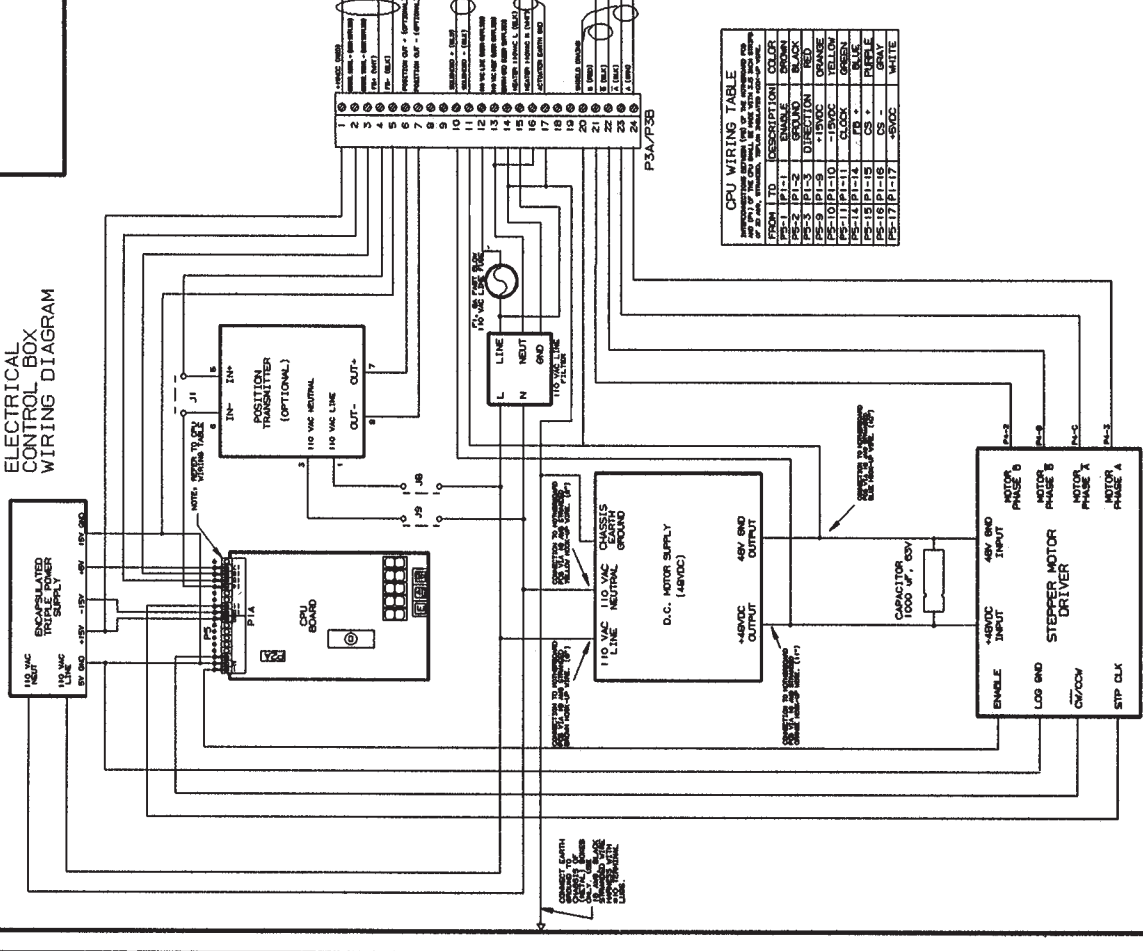
CPU WIRING TABLE

FOR CPU OF THIS AND OTHER MODELS, SEE WIRE WITH 2.5 MM DIA. STRIPS

FUNCTION	WIRE COLOR
ENABLE	BLACK
DIR	BROWN
STEP	RED
STOP	YELLOW
PHASE A	GREEN
PHASE B	BLUE
PHASE X	GRAY
PHASE Y	WHITE

REVISIONS

DISPOSITION	1. REV. NO.	2. SCRAP	3. USE AS IS	4. RECORD CHANGE
DESCRIPTION	REV	DATE	BY	APPROVED



REXA CORPORATION
CANTON, MASSACHUSETTS

CONTRACT No. 0000983

PREP GAK
CHKR APVD
APVD

MATERIAL

FINISH

MACHINE SURFACE 63

UNLESS OTHERWISE SPECIFIED
MATERIALS SHALL BE TO THE FOLLOWING STANDARDS:
ASTM A 306
ASTM A 307
ASTM A 308
ASTM A 309
ASTM A 310
ASTM A 311
ASTM A 312
ASTM A 313
ASTM A 314
ASTM A 315
ASTM A 316
ASTM A 317
ASTM A 318
ASTM A 319
ASTM A 320
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ASTM A 327
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ASTM A 399
ASTM A 400

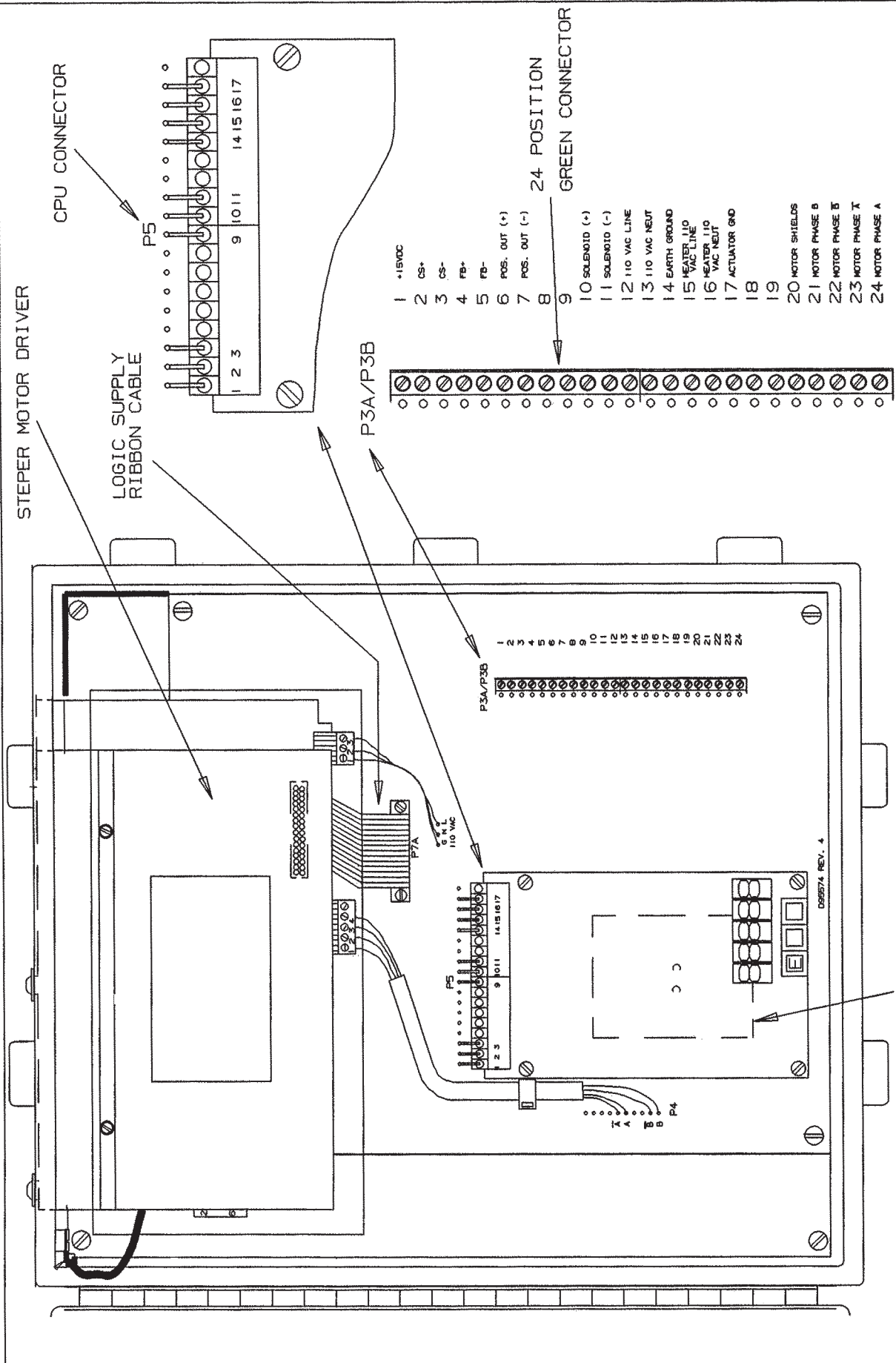
SIZE D NUMBER M95939 REV 1 SHEET

SCALE NONE

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C-PUMP ELECTRONICS
M95937 SCALE=NONE 3-94 REV.

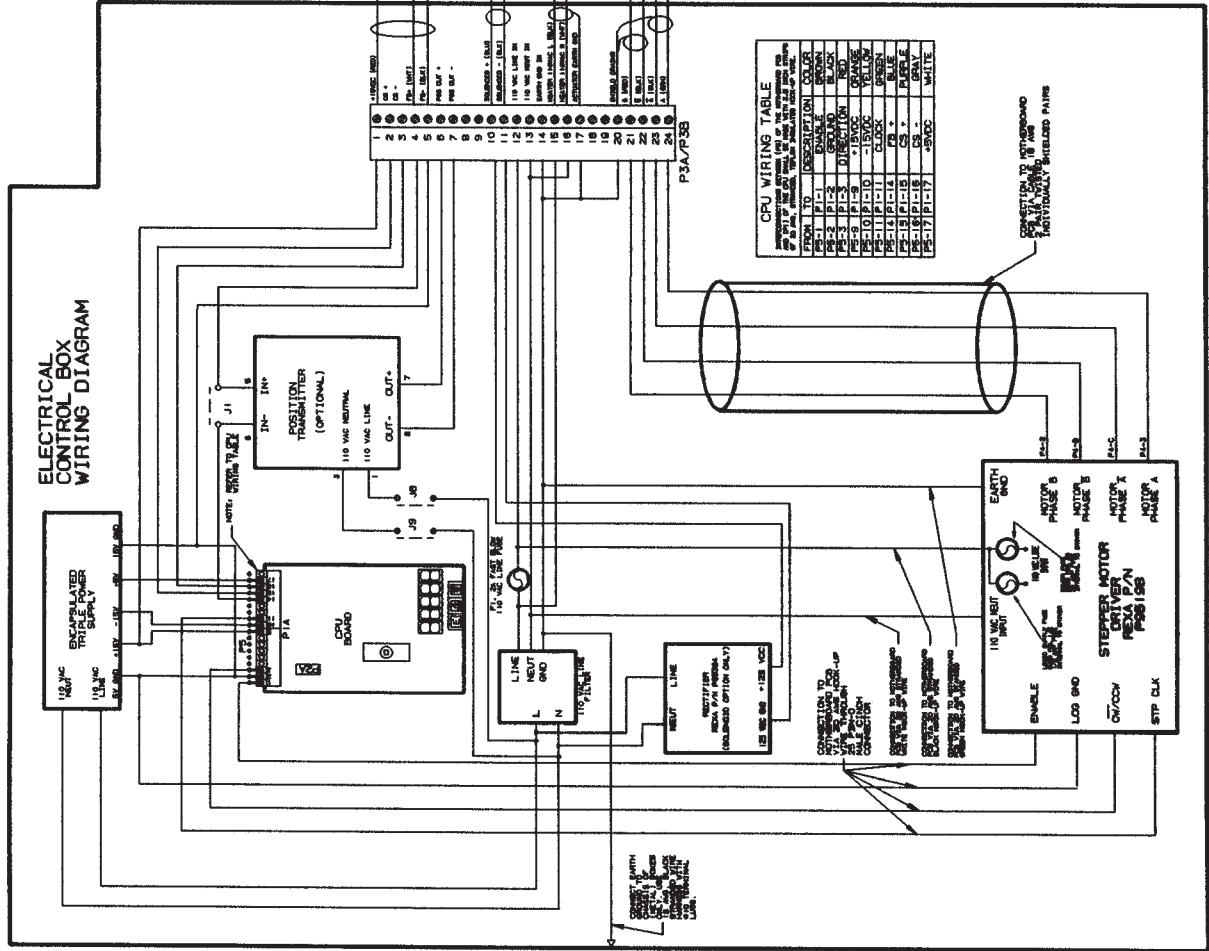


TRIPLE POWER SUPPLY,
+15, -15, +5VDC

REVISIONS

DISPOSITION	REVISION	DESCRIPTION	REV	DATE	APPROVED

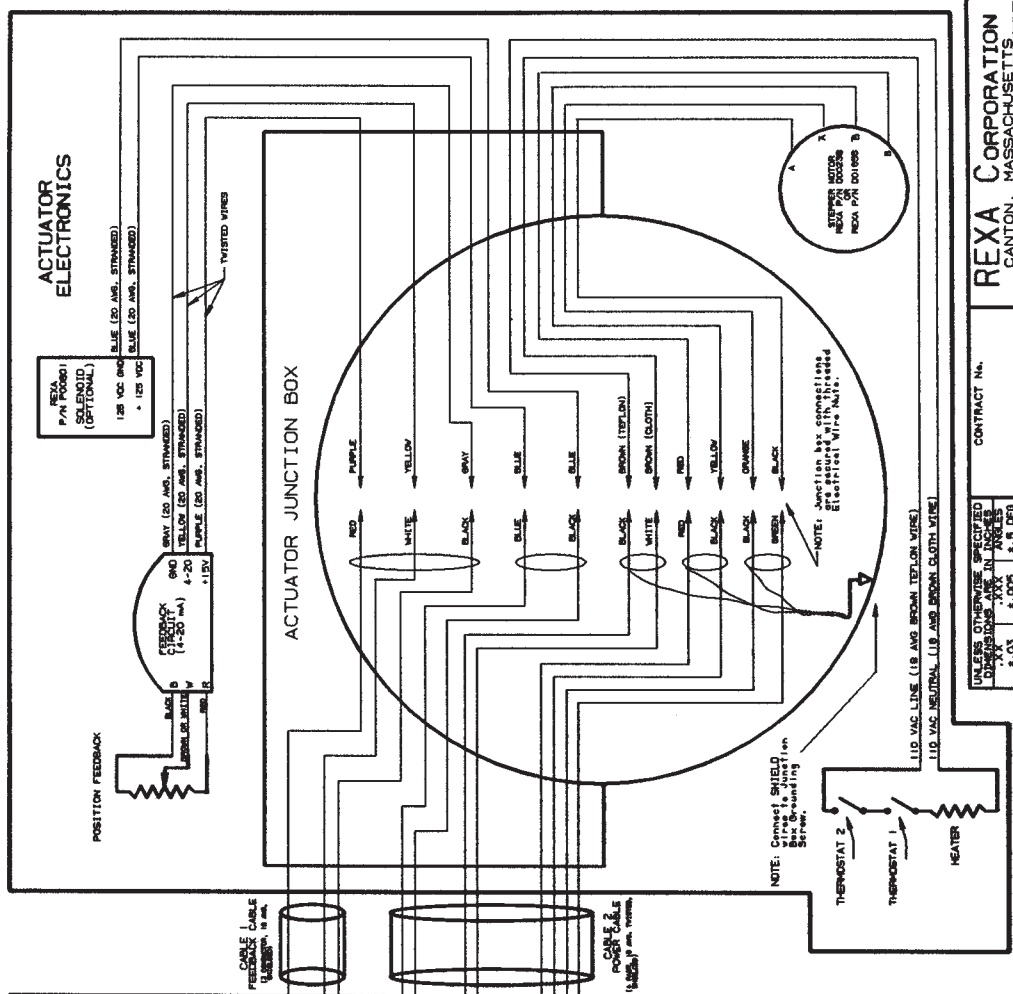
ELECTRICAL CONTROL BOX WIRING DIAGRAM



CPU WIRING TABLE

FROM TO DESCRIPTION COLOR

PC-1	PC-1	ENABLE	BROWN
PC-2	PC-2	STOP	BLACK
PC-3	PC-3	STOP	BLACK
PC-4	PC-4	STOP	BLACK
PC-5	PC-5	STOP	BLACK
PC-6	PC-6	STOP	BLACK
PC-7	PC-7	STOP	BLACK
PC-8	PC-8	STOP	BLACK
PC-9	PC-9	STOP	BLACK
PC-10	PC-10	STOP	BLACK
PC-11	PC-11	STOP	BLACK
PC-12	PC-12	STOP	BLACK
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PC-44	PC-44	STOP	BLACK
PC-45	PC-45	STOP	BLACK
PC-46	PC-46	STOP	BLACK
PC-47	PC-47	STOP	BLACK
PC-48	PC-48	STOP	BLACK
PC-49	PC-49	STOP	BLACK
PC-50	PC-50	STOP	BLACK



REXA CORPORATION
CANTON, MASSACHUSETTS

CONTRACT No. 080993

MATERIAL: PREP. GAUK, CURE, LAPD, LAPD

FINISH: MACHINE SURFACE 63

SCALE: NONE

SIZE: D NUMBER M95940 REV

SHEET

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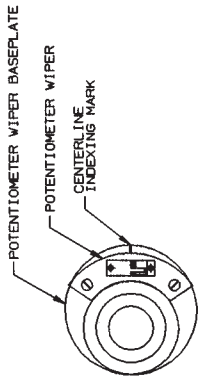
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FINISH: MACHINE SURFACE 63

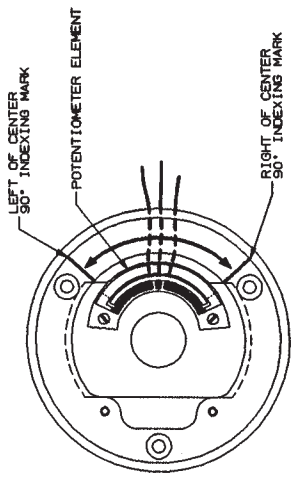
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REVISIONS

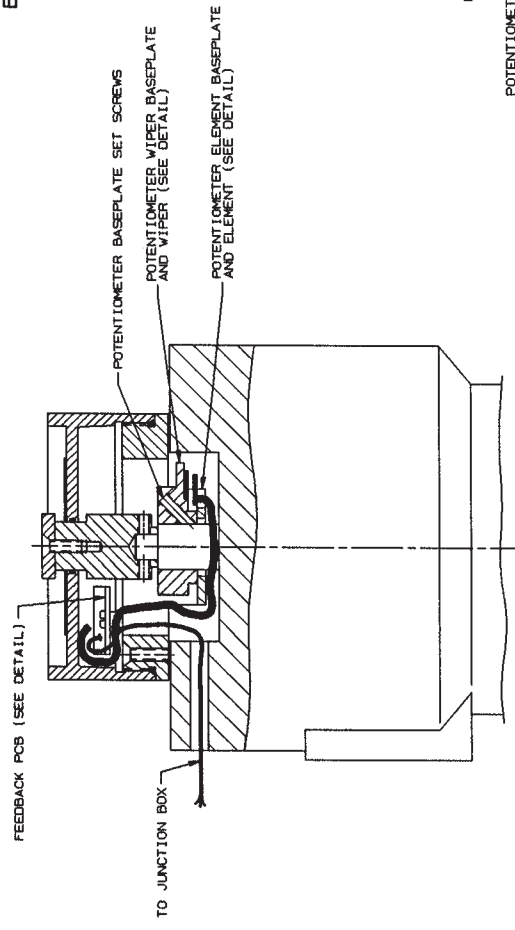
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		DESCRIPTION			DATE	



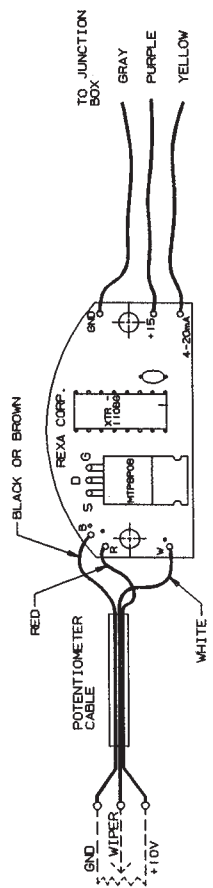
POTENTIOMETER WIPER BASEPLATE DETAIL



POTENTIOMETER ELEMENT AND FEEDBACK PCB BASEPLATE DETAIL



ROTARY CYLINDER



FEEDBACK PCB DETAIL

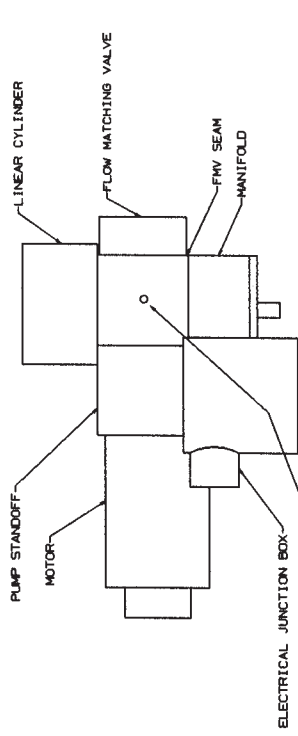
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MATERIAL		CHKR	
FINISH		APVD	
MACHINE SURFACE 63		APVD	

REXA CORPORATION CANTON, MASSACHUSETTS	
ROTARY CYLINDER WIRING	
SIZE B	NUMBER M95915
SCALE NONE	REV
	SHEET

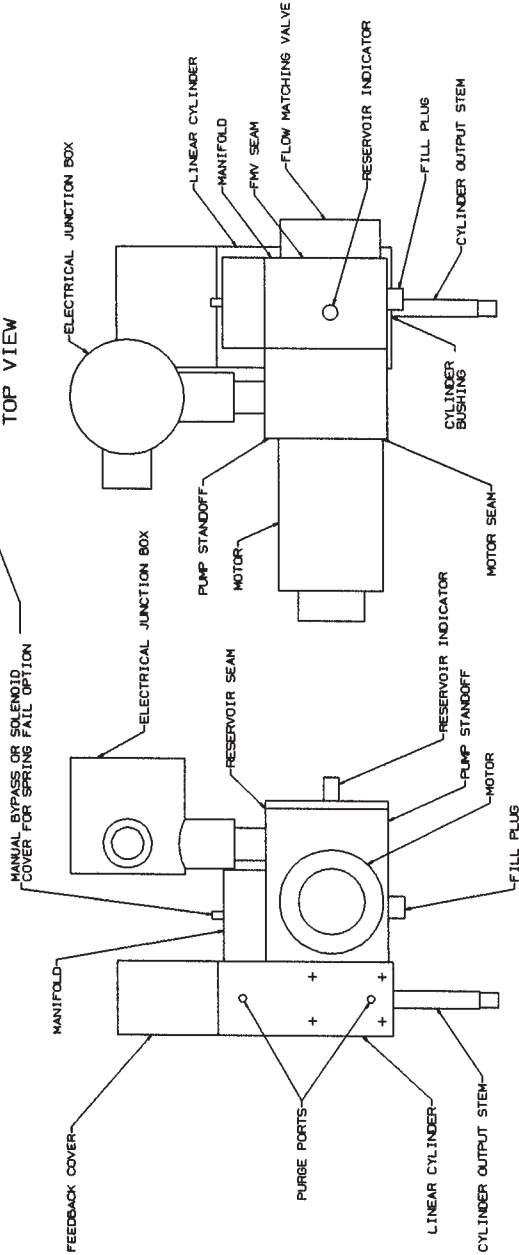
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REVISIONS

REV	DISPOSITION	1. REVISE	2. SCRAP	3. USE AS IS	4. RECORD CHANGE	
	DESCRIPTION	TECH	NO	DISP	DATE	APVD



TOP VIEW



FRONT VIEW

SIDE VIEW

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES 1/16" 1/8" 3/16" 1/4" 3/8" 1/2" 5/8" 3/4" 7/8" 1" 1 1/8" 1 1/4" 1 1/2" 1 3/4" 2" 2 1/4" 2 1/2" 3" 3 1/2" 4" 4 1/2" 5" 5 1/2" 6" 6 1/2" 7" 7 1/2" 8" 8 1/2" 9" 9 1/2" 10" 1 1/4" 1 3/8" 1 1/2" 1 5/8" 1 3/4" 1 7/8" 2" 2 1/8" 2 1/4" 2 1/2" 2 3/4" 2 7/8" 3" 3 1/8" 3 1/4" 3 1/2" 3 3/4" 3 7/8" 4" 4 1/8" 4 1/4" 4 1/2" 4 3/4" 4 7/8" 5" 5 1/8" 5 1/4" 5 1/2" 5 3/4" 5 7/8" 6" 6 1/8" 6 1/4" 6 1/2" 6 3/4" 6 7/8" 7" 7 1/8" 7 1/4" 7 1/2" 7 3/4" 7 7/8" 8" 8 1/8" 8 1/4" 8 1/2" 8 3/4" 8 7/8" 9" 9 1/8" 9 1/4" 9 1/2" 9 3/4" 9 7/8" 10" 10 1/8" 10 1/4" 10 1/2" 10 3/4" 10 7/8" 11" 11 1/8" 11 1/4" 11 1/2" 11 3/4" 11 7/8" 12" 12 1/8" 12 1/4" 12 1/2" 12 3/4" 12 7/8" 13" 13 1/8" 13 1/4" 13 1/2" 13 3/4" 13 7/8" 14" 14 1/8" 14 1/4" 14 1/2" 14 3/4" 14 7/8" 15" 15 1/8" 15 1/4" 15 1/2" 15 3/4" 15 7/8" 16" 16 1/8" 16 1/4" 16 1/2" 16 3/4" 16 7/8" 17" 17 1/8" 17 1/4" 17 1/2" 17 3/4" 17 7/8" 18" 18 1/8" 18 1/4" 18 1/2" 18 3/4" 18 7/8" 19" 19 1/8" 19 1/4" 19 1/2" 19 3/4" 19 7/8" 20"		CONTRACT No.	050593
MATERIAL	PREP	CHKR	APVD
FINISH	CHKR	APVD	APVD
MACHINE SURFACE 63	MATERIAL		
FINISH			

REXA CORPORATION
 CANTON, MASSACHUSETTS

LINEAR ACTUATOR S/A

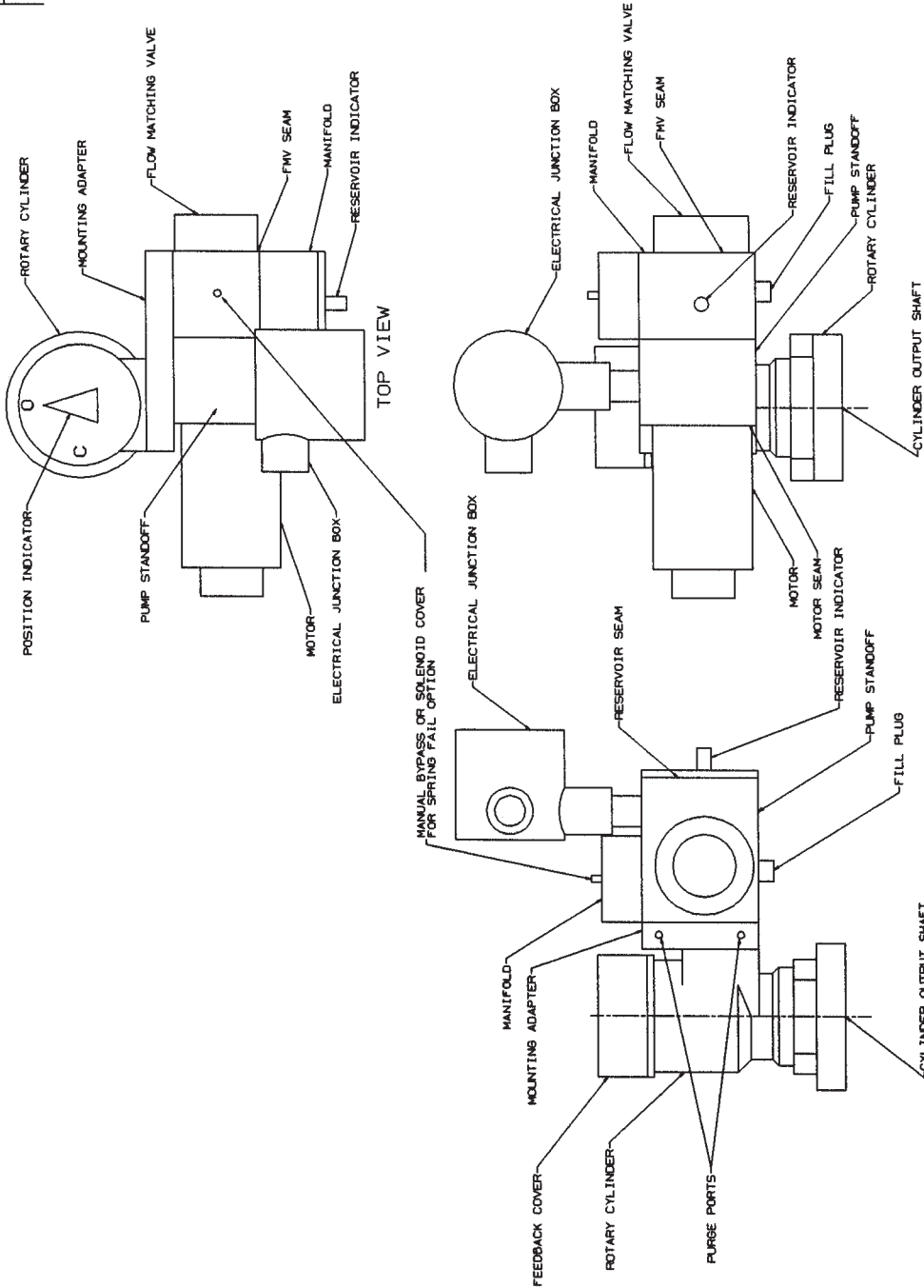
SIZE B NUMBER M03110 REV

SCALE NONE SHEET

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REVISIONS

REV	DESCRIPTION	ECN NO	DISP.	DATE	APPRO
1.	REWORK				
2.	SCRAP				
3.	USE AS IS				
4.	RECORD CHANGE				



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES XX ±.03 ±.005 ±.5 DEB		CONTRACT No.	
MATERIAL		PREP	GR2553
FINISH		QMR	
MACHINE SURFACE 63/		APD	

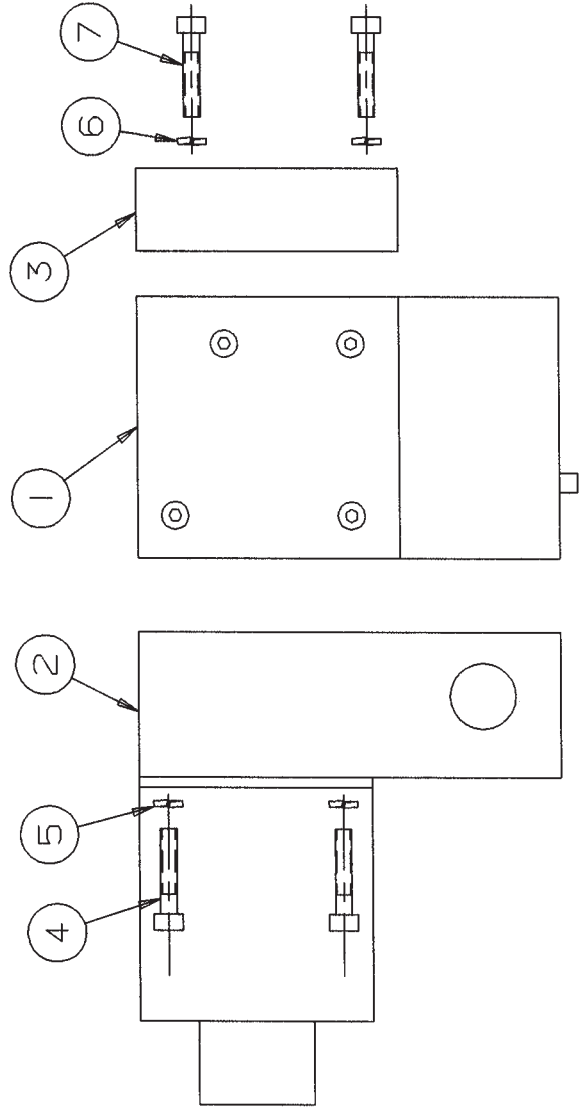
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REXA CORPORATION CANTON, MASSACHUSETTS	
ROTARY CYLINDER S/A	
SIZE B	NUMBER M03111
SCALE NONE	REV
	SHEET

REVISIONS

REV	DESCRIPTION	ECN NO	DISP.	DATE	APVD

DISPOSITION: 1. REWORK 2. SCRAP 3. USE AS IS 4. RECORD CHANGE



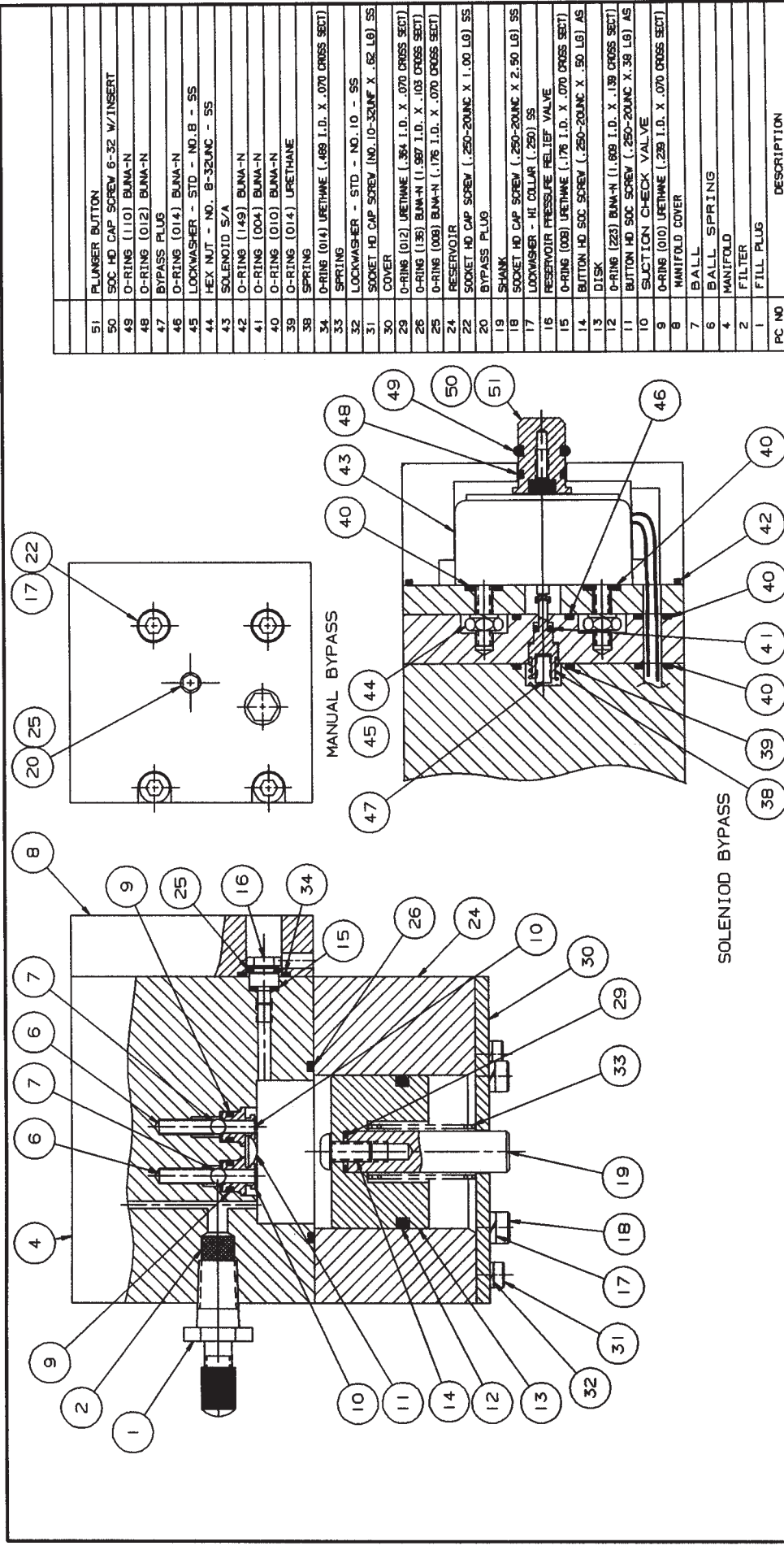
PC NO	DESCRIPTION
1	MANIFOLD S/A - M03103
2	PUMP STANDOFF S/A - M03105
3	FLOW MATCHING VALVE S/A
4	SOC HD CAP SCREW (.250-20UNC X 3.00 LG) SS
5	LOCKWASHER - HI COLLAR - 1/4" - SS
6	LOCKWASHER - HI COLLAR - NO.10 - SS
7	SOC HD CAP SCREW (NO.10-32UNF X 1.50 LG) SS

CONTRACT No.	REXA CORPORATION CANTON, MASSACHUSETTS	DESCRIPTION
FREP	GAK 1050393	POWER MODULE S/A
CHKR		
APVD		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES .XX .XXX ANGLES ±.03 ±.005 ±.5 DB		
MATERIAL		
FINISH		
MACHINE SURFACE		✓

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SCALE	NONE	NUMBER	M03099	REV	

1 SHEET



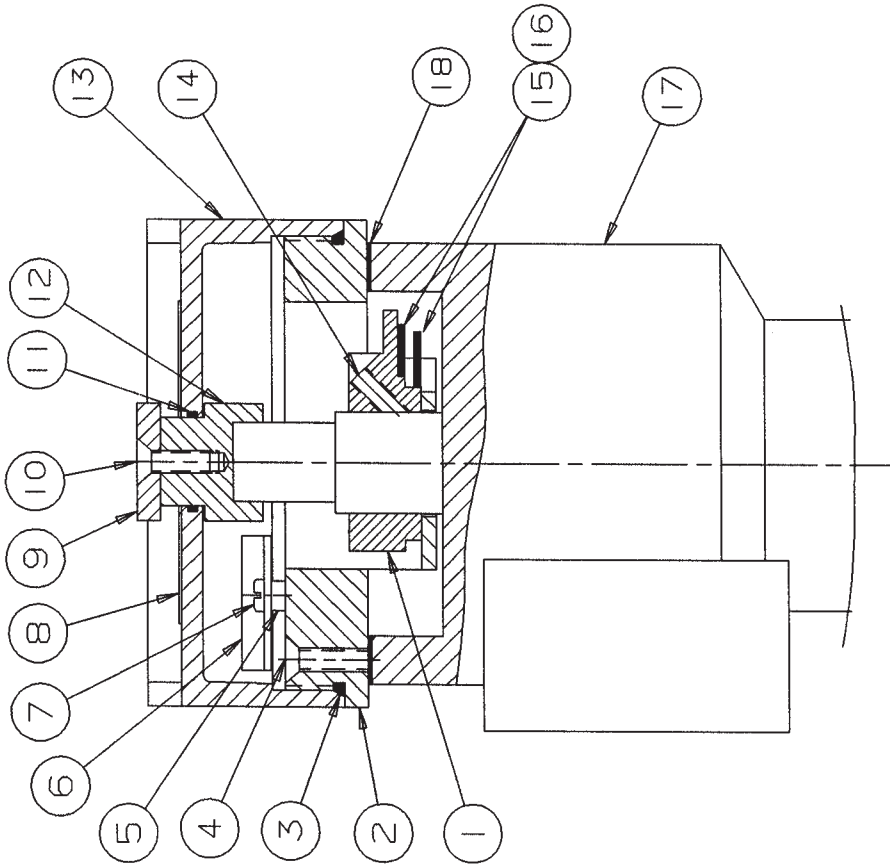
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D	F	F	F	F	F
±.03	±.015	±.005	±.005	±.005	±.005
1) BREAK ALL SHARP EDGES .015		PREP OAK		050493	
2) O-RING GROOVES 65 FITS OR BETTER		CHKR			
3) INSIDE CORNER RADI TO BE .030 MAX		APVD			
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		MACHINE SURFACE		✓	
REXA CORPORATION CANTON, MASSACHUSETTS					
MANIFOLD S/A					
SIZE B	NUMBER	M03103		REV	
SCALE	NONE	SHEET			

PC NO	DESCRIPTION
51	PLUNGER BUTTON
50	SOCKET HD CAP SCREW (6-32 W/INSERT)
49	O-RING (110) Buna-N
48	O-RING (012) Buna-N
47	BYPASS PLUG
46	O-RING (014) Buna-N
45	LOCKWASHER - STD - NO. B - SS
44	HEX NUT - NO. B-32UNC - SS
43	SOLENOID S/A
42	O-RING (149) Buna-N
41	O-RING (004) Buna-N
40	O-RING (010) Buna-N
39	O-RING (014) URETHANE
38	SPRING
34	O-RING (014) URETHANE (.489 I.D. X .070 CROSS SECT)
33	SPRING
32	LOCKWASHER - STD - NO. 10 - SS
31	SOCKET HD CAP SCREW (NO. 10-32UNF X .62 L6) SS
30	COVER
29	O-RING (012) URETHANE (.364 I.D. X .070 CROSS SECT)
26	O-RING (136) Buna-N (1.987 I.D. X .103 CROSS SECT)
25	O-RING (008) Buna-N (.176 I.D. X .070 CROSS SECT)
24	RESERVOIR
22	SOCKET HD CAP SCREW (.250-20UNC X 1.00 L6) SS
20	BYPASS PLUG
19	SHANK
18	SOCKET HD CAP SCREW (.250-20UNC X 2.50 L6) SS
17	LOCKWASHER - HI COLLAR (.250) SS
16	RESERVOIR PRESSURE RELIEF VALVE
15	O-RING (008) URETHANE (.176 I.D. X .070 CROSS SECT)
14	BUTTON HD SOC SCREW (.250-20UNC X .50 L6) AS
13	DISK
12	O-RING (223) Buna-N (1.609 I.D. X .139 CROSS SECT)
11	BUTTON HD SOC SCREW (.250-20UNC X .39 L6) AS
10	SUCTION CHECK VALVE
9	O-RING (010) URETHANE (.229 I.D. X .070 CROSS SECT)
8	MANIFOLD COVER
7	BALL
6	BALL SPRING
4	MANIFOLD
2	FILTER
1	FILL PLUG

REVISIONS

DISPOSITION: 1. REWORK 2. SCRAP 3. USE AS IS 4. RECORD CHANGE

REV	DESCRIPTION	DISP.	DATE	APPROVED



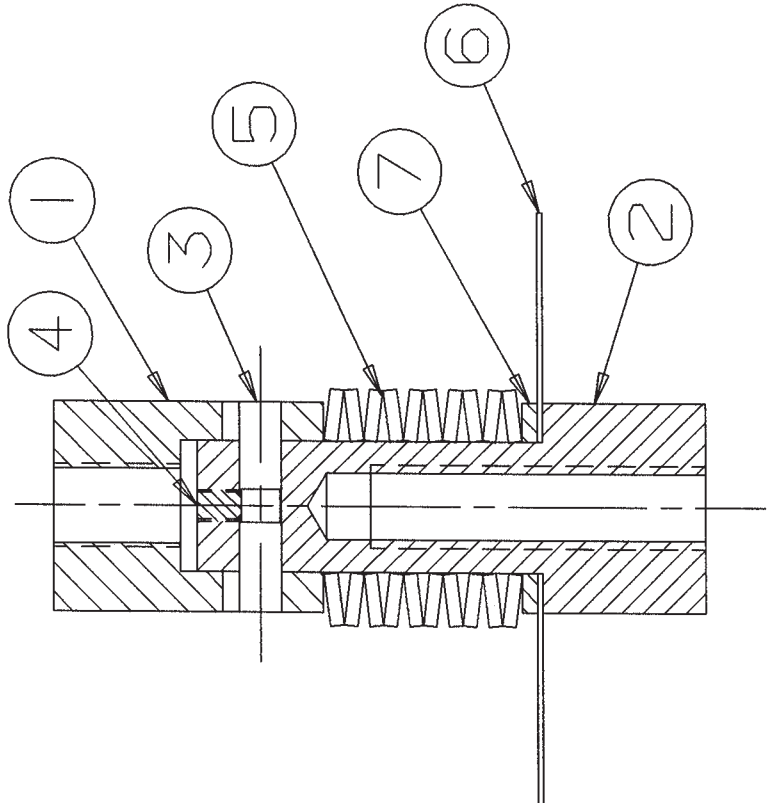
18	GASKET
17	ROTARY CYLINDER
16	SLOTTED FLAT HD. SCREW (NO. 2-56UNC X .19 LONG) SS
15	POTENTIOMETER S/A
14	SET SCREW - CUP POINT (NO. 10-32UNF X .31 LONG) AS
13	COVER
12	SHAFT EXTENSION
11	O-RING (O18) BUNA-N (.739 I.D. X .070 CROSS SECT.)
10	SOCKET FLT. HD. SCREW (NO. 10-32UNF X .62 LONG) SS
9	INDICATOR ARROW
8	POSITION INDICATOR
7	PAN HD. SCREW - SLOTTED (NO. 6-32UNC X .50 LONG) SS
6	CIRCUIT BOARD S/A
5	SPACER - NYLON (.25 O.D. X .140 I.D. X .125 LONG)
4	SOCKET FLT. HD. SCREW (M5 X 0.8 X 30 LONG) AS
3	O-RING (153) BUNA-N (3.487 I.D. X .103 CROSS SECT.)
2	BASE PLATE - POT. & CIRCUIT BOARD
1	BASE PLATE - POT. WIPER
PC NO	DESCRIPTION

UNLESS OTHERWISE SPECIFIED		CONTRACT No.	
DIMENSIONS ARE IN INCHES		REXA CORPORATION CANTON, MASSACHUSETTS	
X	.XX	PREP	GAK 050593
Y	.XX	CHKR	
Z	.XX	APVD	
ANGLE	°	APVD	
TOLERANCE			
MATERIAL			
FINISH			
MACHINE SURFACE	✓		
<p>1) BREAK ALL SHARP EDGES .015</p> <p>2) O-RING GROOVES 63 FINISH OR BETTER</p> <p>3) INSIDE CORNER RADIUS TO BE .030 MAX</p> <p>THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF REXA CORPORATION. IT IS CONFIDENTIAL AND MUST NOT BE MADE PUBLIC OR COPIED AND IS SUBJECT TO RETURN UPON DEMAND.</p>			
SIZE	B	NUMBER	M03107
SCALE		SHEET	

REVISIONS

DISPOSITION= 1.REWORK 2.SCRAP 3.USE AS IS 4.RECORD CHANGE

REV	DESCRIPTION	DISP.	DATE	APPROVED



PC NO	DESCRIPTION
7	SPACER
6	STROKE INDICATOR DISK
5	DISC SPRING
4	SOCKET SET SCREW
3	LOAD PIN
2	SPRING STOP
1	ACTUATOR STEM ADAPTER

<p>REXA CORPORATION CANTON, MASSACHUSETTS</p>		CONTRACT No.	
		PREP GAK	050393
UNLESS OTHERWISE SPECIFIED		DIMENSIONS ARE IN INCHES	
1) BREAK ALL SHARP EDGES .015		X .XX	.XXX
2) O-RING GROOVES .63 FINISH OR BETTER		±.03	±.015 ±.005 ±2°
3) INSIDE CORNER RADIUS TO BE .030 MAX		MATERIAL	
THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF REXA CORPORATION. IT IS CONFIDENTIAL AND MUST NOT BE MADE PUBLIC OR COPIED AND IS SUBJECT TO RETURN UPON DEMAND.		FINISH	
		MACHINE SURFACE ✓	
SIZE A		NUMBER	MO3100
SCALE		NONE	SHEET

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7/03 Rev.-1