Jordan CONTROLS

IM-0529 Rev. D
DATE: May 19, 1997
BY: Engineering Dept.

MV-1100/AD-8100 SERIES ELECTRIC SLIDING STEM VALVE OPERATORS

Jordan Controls, Inc. • 5607 West Douglas Avenue • Milwaukee Wisconsin 53218
Phone: 414/461-9200 • Fax: 414/461-1024 • E-Mail: jordan@jordancontrols.com • Website: www.jordancontrols.com

I. Description

A. General

The MV-1100/AD-8100 series actuator utilizes a three wire 120 or 240 Vac permanent split phase, capacitor run motor to operate a rotary spur gear train which is converted to linear motion with a 3/8 - 12 ACME SCREW and NUT combination. the actuator has a maximum stroke of .75 inch and a maximum thrust of 300 pounds. The actuator is permanently lubricated, may be mounted in any position, and is designed to "SOFT SEAT" the valve to which it is mounted Incorporated in the actuator are two spur gear train assemblies. The first is the power output which consists of either three or four stages of hardened gearing to drive the ACME SCREW. There are two combinations of the three stage gearing and two of the four stage gearing. To identify the gearing we have designated gearing codes of 3H, 3L, 4H and 4L. (See capacities and shift times chart.) The selection of theses gears determine both the maximum thrust and the shift rate of the actuator. Along with the power gearing is the feedback gearing which is driven from the ACME SCREW shaft. The feedback gearing determines the maximum stroke of the unit.

Position end of travel independently adjustable limit switches are driven by the feedback gearing along with a 1000 ohm precision potentiometer. The switches are set to limit the stroke within the maximum travel range and the potentiometer is used to generate a position feedback signal which is fed to the AD-8100 series amplifier. A tandem feedback potentiometer may be used to supply one signal to the AD-8100 amplifier and another for customer external use. One of these potentiometer's might be used to drive an optional 4 to 20 mA transmitter for feedback indication.

The MV-1100/AD-8100 series actuator has a built-in AD-8100 series control amplifier. This amplifier is mounted inside the actuator and pre-wired to the internals of the unit. when this amplifier is supplied as a part of the package, the customer needs only to connect the Power Input Source and a 4 to 20 mA dc command signal to the actuator. This simplifies customer wiring and eliminates many field installation problems, such as mounting amplifier in different locations and providing interconnect wiring.

In the chart on the following page explains the power gear code used, shift rates and thrust capacities of the actuator. The only difference between the model numbers is the type of motor used in the actuator. From the chart we can obtain four different shift rates of 2, 5, 9, and 18 seconds per .25 inch of stroke and four different thrust capacities of 50, 100, 200 and 300 pounds.

MV-1100/AD-8100 CAPACITIES & SHIFT TIMES

MODEL	GEAR CODE	.25" STROKE	.50" STROKE	.75" STROKE	MAX. CAPACITY
MV-1110 MV-1170	4L	18 SEC	36 SEC	54 SEC	300 LBS
MV-1110 MV-1170	4H	9 SEC	19 SEC	28 SEC	200 LBS
MV-1110 MV-1170	3L	5 SEC	9 SEC	14 SEC	100 LBS
MV-1110 MV-1170	3H	2 SEC	5 SEC	7 SEC	50 LBS
MV-1120	4H	9 SEC	19 SEC	28 SEC	300 LBS
MV-1120	3L	5 SEC	9 SEC	14 SEC	200 LBS
MV-1120	3H	2 SEC	5 SEC	7 SEC	100 LBS

MV-1110 . . . . . 50 % duty cycle, 1200 starts or 250 plug Rev/Hr; 120 Vac Motor
MV-1170 . . . . . 50 % duty cycle, 1200 starts or 250 plug Rev/Hr; 240 Vac Motor
MV-1120 . . . . . 50 % duty cycle, 60 starts or 10 plug Rev/Hr; 120 Vac Motor
** Duty cycles are at 100% rated load and maximum ambient temperature

B. Specifications

Model: MV-1110/AD-8110 120 Vac 50/60 Hz
MV-1120/AD-8110 120 Vac 50/60 Hz
MV-1170/AD-8120 240 Vac 50/60 Hz
Housing: NEMA 4 and 7 C, D; 9 E, F, G. - Indoors & Outdoors
Stroke: .75 in. (19mm) max
Thrust: 300 lb_f (136 kg_f) max
Mass: 12 lbs (5.5 kg) without valve
Duty Cycle: MV-1110/AD-8110
50 % 1200 starts or 250 plug Reversals/hour
MV-1170/AD-8120
50 % 1200 starts or 250 plug Reversals/hour
MV-1120/AD-8110
50 % 60 starts or 10 plug Reversals/hour
(duty cycles are at 100% rated load & maximum ambient)
Ambient: 0° to 65° C (32° to 150° F)
-40° to 65° C (-40° to 150° F) w/heater
to 85° R.H.

Input Command Signal: 4 to 20 mA dc
Response Time: Less than 250 milliseconds
Sensitivity: ±.1 mA to ±1.5 mA step command (adjustable w/ deadband)
Dynamic Brake Period: 130 milliseconds
Loss of Command Signal Monitor: Jumper selectable
A. Lock in place
B. Run to Preset Position
Loss of Command Set Point: Fixed at approximately 3.4 mA
Other Adjustments: HI & LO trim pots (for actuator alignment to command signal)
Connectors:
TB1 6 position pins — Molex 2695 series
crimping tool — Molex HTR 2262A
TB2 7 pin pins — Molex 2139 series
crimping tool — Molex 2478 series
Molex HTR 2262A

II. Theory of Operation

A. Mechanics

A single phase, reversible, three wire, permanent split capacitor motor produces torque at the motor pinion gear. This torque is increased (with a corresponding decrease in speed) through three or four stages of spur gearing. The final output shaft is supported with bronze bushings and thrust needle bearings. This rotary output shaft protrudes through the gearbox housing and provides an acme power thread.

Running along the thread is a drive nut (manufactured of a low friction, long wearing, self lubricating, plastic material) which allows the high torque, low speed rotary shaft output to be converted to linear thrust and also prevents the unit from backdriving when the motor is de-energized. The drive nut is retained from turning by a shoulder screw which projects radially from the nut and rides in a precision machined groove. In addition to preventing the drive nut from rotating, the shoulder screw provides a direct indication of linear movement. The drive nut is housed in a cast aluminum housing which provides a means of mating a valve to the actuator. Located in the opposite end of the drive nut is a pre-loaded compression spring and a drive nut coupling which is threaded to mate up to the valve stem. The spring and drive nut coupling are retained by a snap ring and are protected from the contaminants by a sea. This spring provides "soft seating"of the valve: with the valve in the fully closed position the spring is further compressed .030 which guarantees a positive seating force with the drive nut positioned with reasonable accuracy. the housing is gasketed to the gearbox housing and features a gasketed "lexan" window over the position indicator (shoulder screw) and a seal around the O.D. of the drive nut. Also, a fine pitch gear is affixed to the rotary output shaft which provides feedback indication and limit switches.

B. Electronics

The AD-8100 series amplifier is used for closed loop systems controlling ac reversible motors and actuators. a 4 to 20 mA current loop command is used to provide a voltage across a 200 ohm shunt. This command voltage is compared to a feedback voltage from a potentiometer (driven off the final output shaft) and the difference is the error voltage. The sign and magnitude of the error voltage is used to determine the direction and if in the deadband region. The error voltage is compared to an adjustable deadband voltage and determines whether to stop energizing the motor or not. If the error voltage approaches the edge of the deadband region, dynamic braking occurs. Dynamic braking causes both windings to become energized for less than 130 ms before turning both windings off. This reduces coasting of the motor and increases the accuracy of closed loop system. Optoisolator drive triads for high isolation between input signal and output line voltage.

A loss of signal circuit is used to monitor the command signal. A fixed set point voltage gets compared to the command signal and, in turn, controls the loss of signal circuit. If the command signal is less than 4 mA, the actuator will lock in place or run to a preset position and LED 3 turns on depending on the loss of signal set jumper setting. For lock - in place setting, the feedback voltage is just compared to itself, creating a null condition. For run to "preset" position, the command signal becomes an adjustable potentiometer signal on the amplifier. The customer adjust the "preset" pot to the desired actuator position.

II. Installation

A. Storage

If the actuator will not be installed immediately, it should be stored in a clean, dry area where the ambient temperature is not less than 20°F. The actuator should not be stored in a corrosive environment.

B. Wiring and Fusing

All installation wiring shall meet the National Electrical Standards, as well as any state and/or local standards which may apply. Shielded wiring is recommended for all command and feedback wiring. connect shielded wire to terminal #9. ***DO NOT*** connect chassis ground to shield ground. For the rest of wiring, refer to the Jordan Controls print sent with actuator or refer to page 14 for a general print.

Fusing is not provided in the MV-1100/AD-8100 series, and must be installed in line. Fuse to a current valve slightly higher than the driven load. (slow-blow fuse)

C. Customer Valve Mounting Procedure

*NOTE: **The MV-1100/AD-8110 series actuator has been preset to your stroke requirement.***

1. Using 4-20 mA Command Signal, run the actuator to the fully extended position (Valve should be closed.)

2. Insert the valve through the hole in the linear thrust assembly housing. Drop body nut and packing nut over valve stem but do no but do not thread on.

*NOTE: **a) Most valves are mounted with a body nut supplied with the valve, or***
b) Some valves will require removal of the stem packing nut to allow removal of the body nut.

3. Run two hex nuts onto the valve stem as far as possible and "jam" to provide the means of rotating the valve stem.

4. Using an open end wrench, begin to carefully thread the valve stem into the drive nut coupling. Thread and tighten the valve body nut and packing nut.

5. Continue to thread valve stem into drive nut coupling using an open end wrench on the nut coupling "flats" to resist rotation until the nut coupling is moved toward the actuator .030". Check with straightedge. See chart on page 3.

6. Run actuator full open and return to the fully closed position. Recheck with straightedge. Readjust and repeat if necessary.

*NOTE: **If valve does not open fully, check for proper limit switch settings, valve stem interference or feedback trim pots on AD-8100. Shorten valve stem if it touches the rotary output shaft when valve approaches the full open position. Adjust limit switches and feedback trim pots for proper valve stroke length.***

7. Apply thread sealant to valve stem/nut coupling to create watertight seal. Loosen jam nuts and run up against nut coupling.

8. The valve mounting is now complete and the valve is "soft-seated" at the rated output thrust.

9. Reverse above procedure to remove valve.

D. Start up & Calibration

The procedure for calibration is discussed on page 5 . If MV-1100/AD-8100 does not respond correctly to a command signal or is erratic, refer to the Troubleshooting section on page . If the loss of signal mode is not to be used, set jumper to Lock-In-Place.

The range of the MV-1100/AD-8100 series is dependent on either the limit switches or the HI & LO trim pots (VR2 & VR3) on the amplifier. Set the limit switches for your maximum stroke length, and the HI & LO trim pots just inside the range of the limit switches. Refer to the "Actuator Alignment" procedure on page 11 for further information.

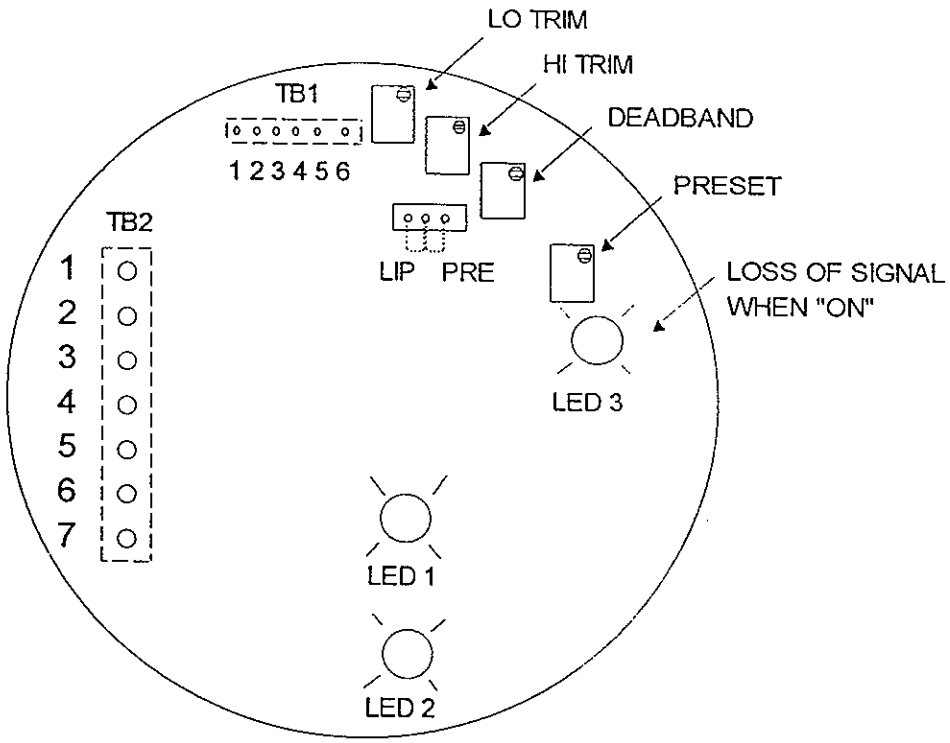
E. Changing Wires

If the wires in connectors TB1 and TB2 are to be removed for any reason, proceed as follows:

Using a small pointed object (awl or x-acto knife blade), press the small tab inside the opening of the connector housing. Pull out wire and bend tab back out carefully. Continue procedure until wire(s) are out and reinsert back into connector housing, noting tab on termination should go into slot. If not, pull wire back out and carefully pry tab away from the body of termination and reinsert.

F. Reversing Direction for Increasing Command

The MV-1100/AD-8100 is set up for increasing command = open valve. If an increasing command is to close the valve, simply change wires at the harness connect to AD-8100. Reverse wires at TB1-4 & 6 and TB2-6 &7, referring to section E (Changing Wires).

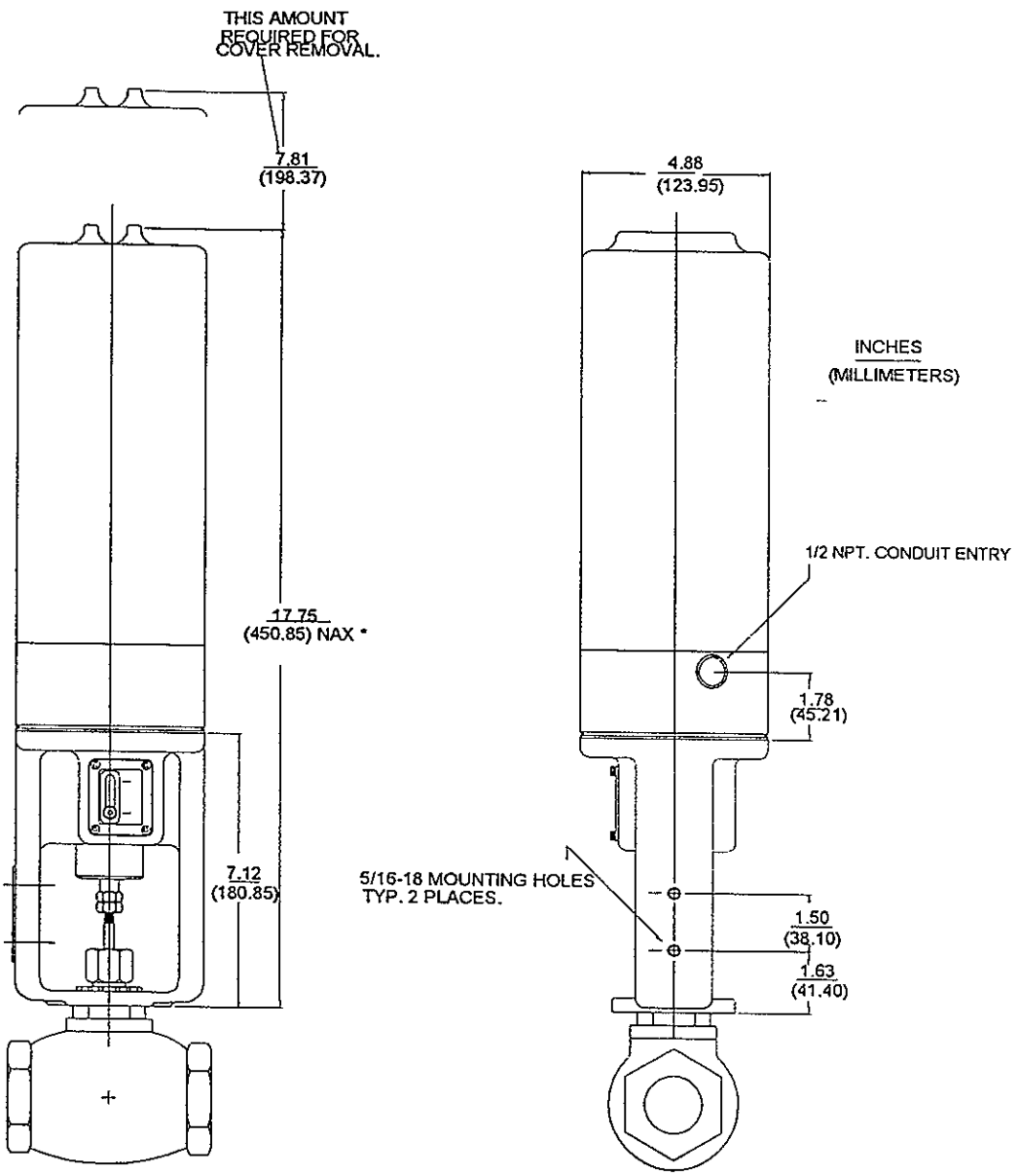


NOTES: With increasing command signal, LED 2 should be "ON"
With decreasing command signal LED 1 should be "ON"
Adjust "LO TRIM" with command at 4.0 mA for actuator position.
Adjust "HI TRIM" with command at 20.0 mA for actuator position.
Adjust "DEADBAND" for positioning accuracy and actuator stability.
Select Jumper for "LIP" or "PRESET" (LIP is Lock-In-Place)
Remove Command Signal:
If "LIP" was selected, actuator should Lock-In-Place
If "PRESET" was selected, adjust "PRESET" pot for actuator position.
Restore Command Signal and check response and adjustments.

IV. Troubleshooting Guide

PROBLEM	POSSIBLE CAUSE	SOLUTION
Valve won't position	1) No power applied to electric actuator 2) No command signal applied 3) In loss of signal mode 4) Deadband window too wide 5) Valve jammed 6) Actuator not properly sized for valve used 7) Valve operator assembly jammed or not aligned w/ electric actuator 8) Defective amplifier	1) Apply power; check wiring to AD-8100 2) Apply command signal; check wiring on AD-8100 3) Increase command signal to 4-20 mA 4) Decrease deadband (VR4 CCW) 5) Repair or replace valve 6) Recalculate valve thrust required & change actuator to proper gear ratio 7) Align or repair 8) Repair or replace amplifier
Valve won't seat or drive fully closed	1) Close position limit switch not set with .030" deflection of valve operator coupling & valve seated 2) Valve seat defective or dirt in valve 3) Broken gearing in electric actuator	1) Adjust close position limit switch; adjust "LO" trim pot (VR3) to near seat position 2) Repair seat position 3) Repair gearing
Electric motor runs but valve doesn't move	1) Broken gear in electric actuator 2) Traveling nut on valve operator assembly bad	1) Repair 2) Replace
No control over direction of valve	1) Feedback & motor rotation "out of phase" 2) Feedback pot broken 3) Broken feedback gear 4) Command signal input wires reversed	1) Swap outside wires of feedback pot; or swap motor leads at TB2 2) Replace 3) Replace 4) Rewire input leads
Electrical actuator hunts, oscillates around position setting (both LEDS stay on)	1) Deadband window too narrow 2) Command signal too noisy	1) Widen deadband window (VR4 CW) 2) Reduce noise; widen deadband window
Electric actuator will not run w/power applied (no valve)	1) Defective motor 2) Defective motor run capacitor 3) Gears jammed or broken 4) Limit Switches open 5) Deadband window too wide 6) Defective amplifier	1) Replace 2) Replace 3) Repair 4) Adjust or replace 5) Narrow window (VR4 CCW) 6) Repair or replace
No signal from feedback potentiometer	1) Feedback Pot not wired or incorrectly wired 2) Feedback Pot broken 3) Signal monitor device defective	1) Rewire 2) Replace 3) Repair or Replace

* Maximum dimension shown actual dimension will be less depending on valve mounting requirement .


THIS AMOUNT REQUIRED FOR COVER REMOVAL.
7.81
(198.37)
17.75
(450.85) NAX *
7.12
(180.85)
4.88
(123.95)
INCHES
(MILLIMETERS)
1/2 NPT. CONDUIT ENTRY
1.78
(45.21)
5/16-18 MOUNTING HOLES
TYP. 2 PLACES.
1.50
(38.10)
1.63
(41.40)

V. Actuator Alignment

A. General (with gearbox removed from linear thrust assembly and all field wires disconnected)

*NOTE: **This procedure is set up assuming 4 mA = valve "closed". If electric actuator is to be set up for 4 mA = valve "open", refer to section entitle Reversing Direction page 8.***

1. Apply power to electric actuator. Set command Signal to 4 mA. The MV-1100/AD-8100's output shaft will rotate clockwise until the CW limit switch is tripped. Remove ac power and check with an ohmmeter, across pins of TB1-5 & 6. Resistance should be 50 ohms ±10%. If not, adjust limit switch and LO trim (VR3) to get resistance of feedback potentiometer to approximately 50 ohms

2. With a pen or pencil mark the face of the actuator and the output shaft. this will be the starting position to count the number of output shaft turns for a preliminary setting of the counterclockwise or valve "open" position limit switch. At this time it is beneficial to know the stroke length of the stem on the valve to be positioned. The drive screw in the valve operator assembly requires three turns to stroke a valve stem .25 inches. The maximum stroke of the valve operator is .75 inches which represents nine turns of the actuator output shaft. The chart below can be used to determine the output shaft revolutions for any stroke from 0 through .75 inch.

All revolutions add 1/3 of a revolution if valve is "soft-seated"

Actuator output shaft revolutions	Valve stroke (inches)
0	0
1	.08"
2	.17"
3	.25"
4	.33"
5	.42"
6	.50"
7	.58"
8	.67"
9	.75"

Apply ac power, run MV-1100/AD-8100 to "open" position (Command to 20 mA) and count the number of shaft revolutions. Adjust the "open" limit switch (CCW) and "HI" trim pot to stop the MV-1100/AD-8100 at the number of revolutions selected. The final resistance read at fully "open" position should fall between 650 and 950 ohms for a 1000 ohm potentiometer. If resistance does not end up within this range, recheck step 1. Failure to fall within these ranges could indicate a defective potentiometer, incorrect gearing or improper alignment.

3. Change the Command Signal to 4.0 mA. The actuator output shaft should rotate clockwise until the close switch trips, and the potentiometer resistance across terminals 4 and 5 of TB1 should again be about 50 ohms. Change the Command Signal to 20 mA. With the actuator again running counterclockwise, recount the number of revolutions until the open switch stops the actuator. Leave the actuator in this position and disconnect the power.

B. Alignment - Gearbox to Linear Thrust Assembly

1. Run actuator to full clockwise position (looking at rotary output shaft) - valve closed.

2. Lubricate rotary output shaft threads with AMOCO-RYKON PREMIUM GREASE No. 2.

3. While supporting linear thrust assembly carefully thread rotary output shaft into drive nut (be careful not to strip threads in plastic drive nut.)

4. Continue to rotate linear thrust assembly until indicator is aligned with closed position on indicator label and install two 5/16" soc. head cap screws and lockwashers.

5. Assembly is now complete. Run actuator fully open and return to fully closed to verify proper operation.

6. Install valve per Customer Valve Mounting Procedure.

C. 4-20 mA Transmitter Alignment (Requires tandem potentiometer & EC-10649 4-20 mA transmitter)

1. Potentiometer & Switch Alignment

Follow the feedback alignment for the actuator on page 9. when adjusting the potentiometer for 50 ohms at the valve "closed" position, remove the blue and yellow wires from terminals 4 and 6. The potentiometer should now be set for 50 ohms between terminals 4 and 5. If the transmitter signal is to increase as the valve opens, the potentiometer should be adjusted for 50 ohms between 5 and 6, with the actuator at the full "open" position.

2. Calibration

For the unit to function properly the 4.0 mA end of the feedback potentiometer must be preset to 50 ohms. This will insure linearity across the active region of the feedback potentiometer. both the RANGE and ELEVATION adjustments interact. The ELEVATION sets the 4 mA point and the RANGE sets the 20 mA point.

1. Position the actuator to the valve "closed" position.
2. Adjust ELEVATION for 4 mA.
3. Position the actuator to the valve "open" position.
4. Adjust RANGE to 20 mA.
5. Repeat all steps until no further adjustment is necessary, as RANGE and ELEVATION do interact.
6. To reverse the 4-20 mA output, interchange the blue and yellow transmitter wires and adjust ELEVATION with the valve "open" and RANGE with the valve "closed"

VI. Replacement Procedures

A. Lubrication

The gearbox and linear thrust assembly are permanently lubricated with AMOCO-RYKON PREMIUM GREASE No. 2. Lubrication is only required if the unit is disassembled for repair, at which time all parts must be completely and thoroughly cleaned.

B. Disassembly for Repair

The gearbox and linear thrust assembly are serviced as separate items. To disassemble the unit, the following steps must be performed:

1. Disconnect all power.
2. Remove valve from actuator (see Customer Valve Mounting Procedure).
3. Remove the gearbox from the linear thrust assembly by removeing the two 5/16 " socket head cap screws and carefully rotating the linear thrust assembly counterclockwise. Support linear thrust assembly while rotating.

C. Feedback Assembly

1. Remove three screw which hold the feedback assembly to base housing.
2. Remove the feedback assembly from the housing by lifting straight out.
3. A gear will positioned on the shaft of the feedback assembly. It is held in place with two set screws. Not the location of the gear on the shaft.
4. Loosen the set screws, remove the gear, and transfer it to the new feedback assembly; positioning it to the same location as it was on the original feedback assembly.
5. Insert the assembly in the housing, being sure the gear is properly mashed with its mating gear.
6. Install the three screw removed in step 1.
7. Using a 25 watt solder iron, transfer the wires from the original feedback assembly to the new one; one at a time to insure proper wiring.
8. Align the feedback following the alignment procedure on page 9.

D. Feedback Potentiometer

NOTE: The potentiometer used with a multi-turn feedback assembly is a 10 turn potentiometer with built-in stops at each end. Incorrect mechanical orientation of the potentiometer shaft or setting of the limit switches can cause the potentiometer shaft to be driven into the stops, breaking the potentiometer internally.

D. Feedback Potentiometer

1. Remove three screws which hole the feedback assembly to the housing.
2. Remove the feedback assembly from the housing by lifting straight out. A gear will be positioned on the shaft of the feedback assembly.
3. While holding the feedback frame in one hand, turn the feedback shaft clockwise until the lower limit switch is activated. The aluminum multi-turn screw has two set screws through it's side; one holds this lower shaft in position, and the other holds the potentiometer shaft, loosen the set screw nearest the potentiometer.

*NOTE: **In some instances a broken feedback potentiometer will not allow you to turn the feedback shaft. In that instance, loosen the set screw nearest the potentiometer first so the shaft may be rotated, or loosen the potentiometer body nut and allow the entire potentiometer to rotate.***

4. With the upper set screw loosened, loosen the potentiometer body nut and let it slide down the shaft until it lays on top of the multi-turn screw. Lift the potentiometer off the frame.
5. Turn the shaft of the new potentiometer to its full clockwise end stop, and back the shaft off of the top 1/2 turn counterclockwise.
6. While pulling downward on gear with the multi-turn screw held against the bottom boss of the frame, rotate gear clockwise until the lower limit switch just trips.
7. Holding the mechanism in this position, insert the new potentiometer into the frame with the lockwasher and nut in place. Tighten the set screw to hold the potentiometer shaft to the multi-turn screw, and without rotating the body of the potentiometer or shaft, spin the body nut onto the potentiometer bushing and snug it up.
8. Using a 25 watt solder iron, transfer the wires from the old potentiometer to the new one; one at a time to insure proper wiring.
9. Turn gear counter clockwise until either the upper limit switch trips, or the counterclockwise end stop of the potentiometer is just touched. If everything was done properly, the switch will trip first leaving at lease 1/2 turn on the potentiometer shaft before the end stop in the potentiometer is touched. There may be as many as 3 1/2 turns left on the potentiometer after the switch is tripped. If the potentiometer end stop is touched before the switch trips, the switches and potentiometer must be mechanically readjusted before proceeding any further. Failure to do so will cause potentiometer damage to occur during operation.
10. With the preceding procedure accomplished, insert the feedback assembly into the housing with the feedback mechanism turned to approximately its mid-travel position. Install screws.
11. Refer to page 9 for final alignment.

E. Limit Switches

1. Limit switches are held in position wit two screws. Remove the screws to replace a switch and transfer the wires fro the old screw to the new one; one at a time using a 25 watt solder iron.
2. Minor re-alignment of the switch settings may be required, refer page 9 for the alignment instructions.

F. Motor

1. Remove all power from actuator.
2. Remove the amplifier's three mounting screws and lift amplifier away from actuator.
3. Remove the motor mounting screws.
4. Remove the old motor from the housing, leave the wires connected, and install the new motor. Tighten the screws evenly to insure motor alignment with the first stage power gear. If the motor is not mounted straight, bearing binding will occur.
5. Using a 25 watt solder iron, transfer the two soldered wires one at a time, remove common motor lead from TB2 and install new motor lead into connector.
6. Install amplifier to mount, apply power and check proper rotation and operation.

G. AD-8100 Amplifier

1. Disconnect harnesses from AD-8100 amplifier (noting orientation).
2. Remove three mounting screws and associated hardware.
3. Reverse procedure for installation of AD-8100 amplifier.

H. Gearbox

Access to the gears is obtained by removal of two cap screws and standoff.

1. With the gearbox removed from the linear thrust assembly and power disconnected, remove the AD-8100 amplifier and the two cap screws and standoff from the gearbox housing.
2. Holding the output shaft in place, remove the gear case cover.
3. Replace any worn or broken parts.
4. Bushing replacement is accomplished by using a machinist thread tap and handle, threading into the bushing hole and bottoming the tap, allowing the bushing to walk up the tap.
5. When inserting bushings use a properly sized mandrill while pressing the bushing into the housing or cover, sizing the bushing bore at the same time. (Failure to "size" the new bushing will hinder the operation of the rebuild actuator.) Page17 shows suggested mandrill sizes for the different bushings used.
6. With the housing and cover completely cleaned put a few drops of SAE-10 non-detergent oil on each bushing. Do not use detergent oil, as it is not compatible with the combination of stainless steel shafts in bronze bushings.
7. Clean and insert all gears, replace and damaged or worn parts. Be sure all retaining rings are in grooves of shafts.
8. Insert the gears one at a time; starting with the first stage and checking for proper gear mesh.
9. After all gears are inserted into the housing and checked for proper mesh, coat the gears with AMOCO-RYKON PREMIUM GREASE No. 2 or equivalent. DO NOT pack the gear case - only a light coating is needed.
10. Slide the gear case cover over the output shaft and align it with the housing on the dowel pin. Do not force the cover on. with the cover in place, insert the two cap screws and standoff, and install the AD-8100 amplifier.
11. Apply power to the actuator (terminals 1 and 2) and check for proper operation.

I. Linear Thrust Assembly (with gearbox and valve removed)

1. Remove "Lexan" inspection window and gasket.
2. Remove indicator (shoulder screw).
3. Slide drive nut out of housing. Remove seal from housing.
4. Remove seal from drive nut.
5. With arbor press (with up to 300 lb capacity) or equivalent, press nut coupling until snap ring can be easily removed. Slowly release pressure. Remove spring and spacer (if present).

Caution: Compression spring inside drive nut is precompressed.

6. Clean and inspect parts. Replace if necessary. Replace all seals and gaskets.
7. Reverse above procedures to reassemble. Lubricate drive nut/ housing interface. (AMOCO-RYKON PREMIUM GREASE No. 2)

VII. Suggested Spare Parts

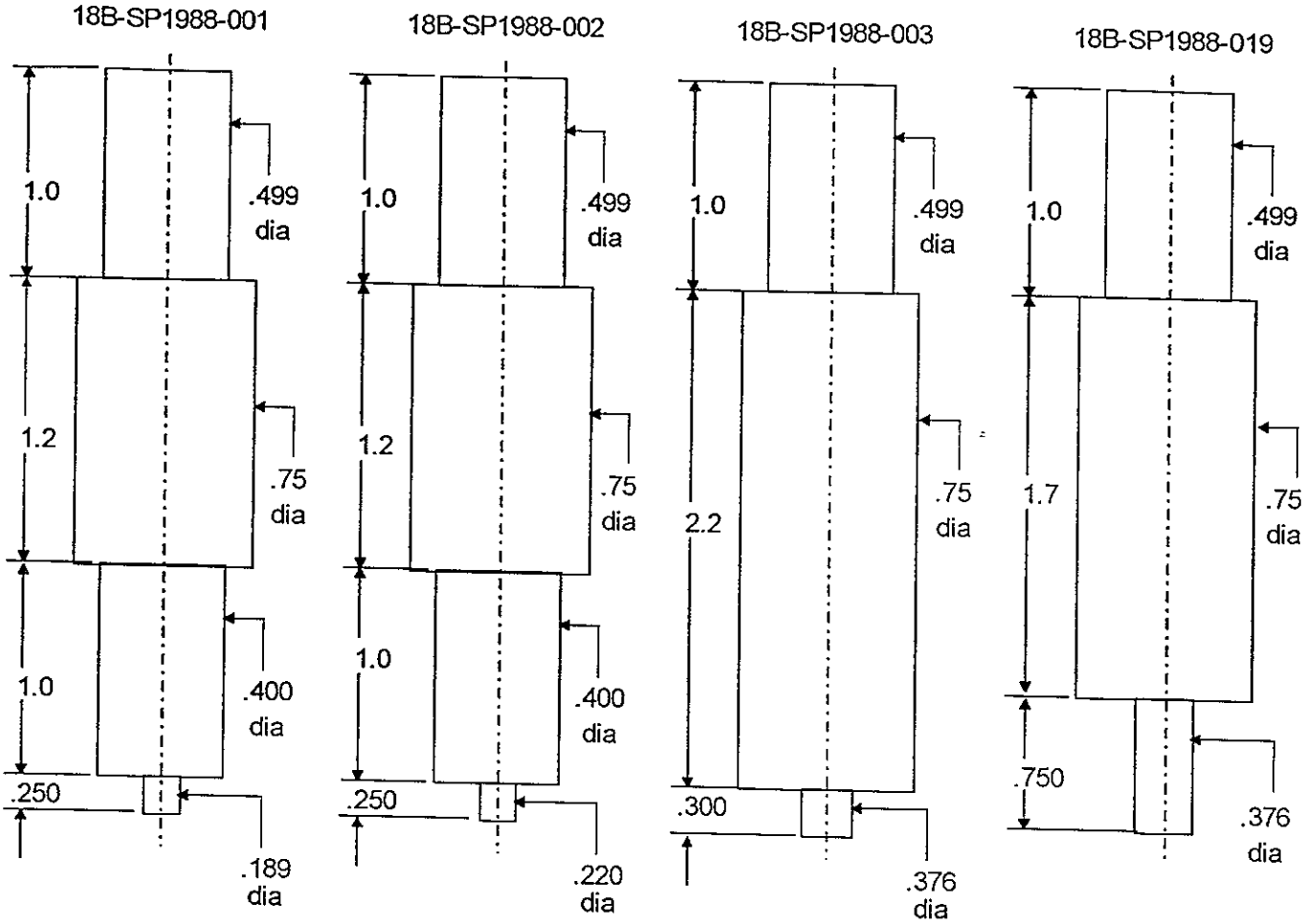
For Electric Actuator

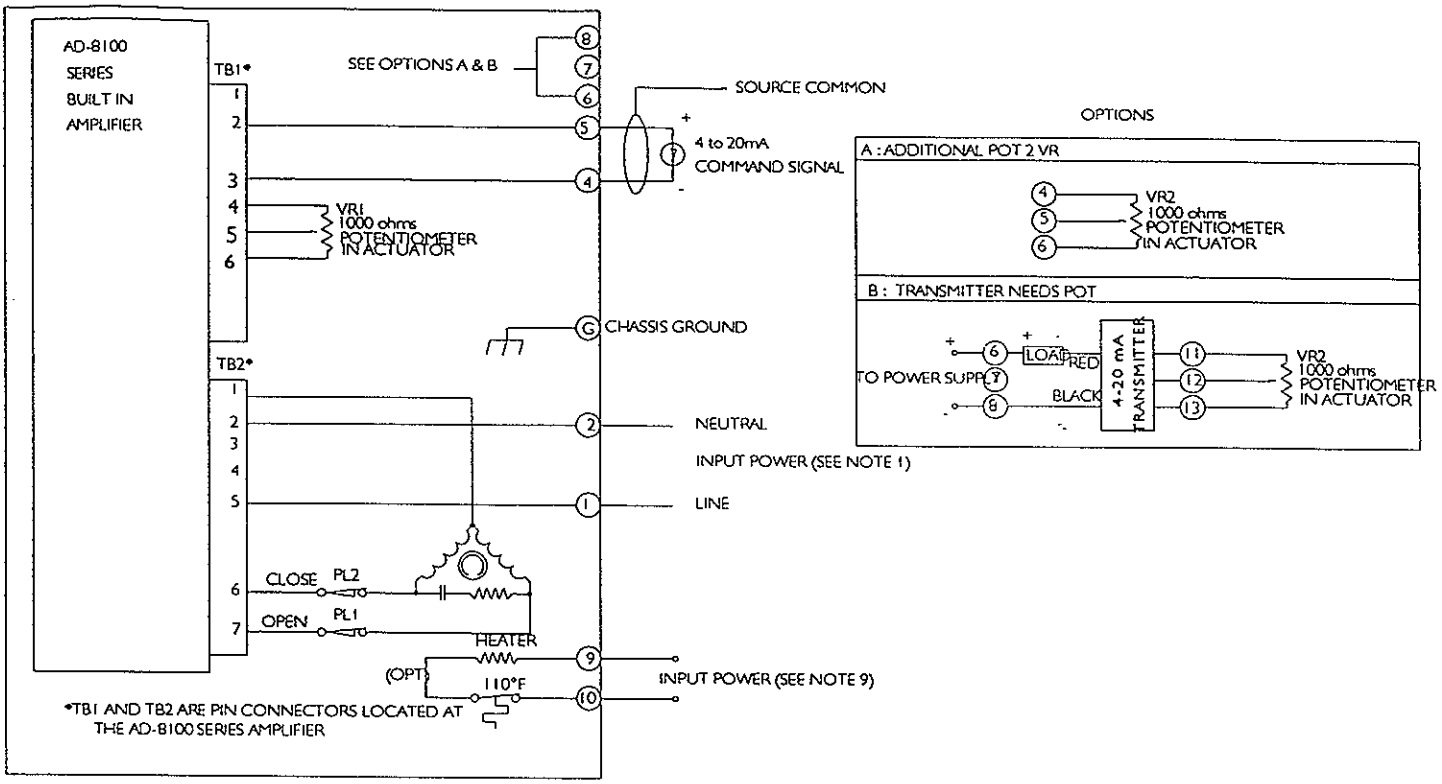
1. Motor
2. Potentiometer
3. Limit Switches
4. Limit Switch Actuator
5. Power Gears
6. Feedback Gears
7. Terminal Strip
8. Motor Capacitor
9. O-Rings
10. Bushings
11. Seal
12. Thrust Bearings
13. Integral Amplifier

For Linear Thrust Assembly

1. Drive Nut
2. Indicator Cover Gasket
3. Gearbox Gasket
4. Drive Nut Seal
5. Drive Nut Coupling Seal

IX. Suggested Mandrills for Pressing Bushings





NOTES:

1. The MV-1110/AD-8100 and the MV-1120/AD-8110 require 120 Vac input power. The MV-1170/AD-8120 requires 240 Vac input power.
2. An INCREASING COMMAND SIGNAL will result in the valve opening.
3. Limit switch PL1 operates at the "open" end of travel, PL2 operates at the "closed" end. Both switches are shown at mid travel (not operated).
4. When VR2 (Option A) is supplied for customer use, resistance measured between terminals 6 & 7 will be decreasing as the valve is closing.
5. When 4-20 mA feedback is supplied for customer use, the customer must provide a DC Supply to power the circuit 12.0 Vdc min. and 36 Vdc max as shown in option B.
   The maximum resistance is calculated as follows:
   $$\frac{\text{Supply voltage - 8 V}}{.020\ \text{A}} = \text{Max. load in ohms}$$
   The signal will be decreasing as the valve is closing.
6. CALIBRATION: 1. Set Command Signal to minimum (4 mA)
   2. Adjust "Low Trim" pot on the amplifier so the amplifier nulls when the valve is closed.
   3. Set Command signal to maximum (20.0 mA)
   4. Adjust "Hi Trim" pot on the amplifier so it nulls when the valve is fully open.
   5. Repeat the "Low" and "Hi" adjustments until the valve closed and open positions are satisfied.
   6. These adjustments will interact. Adjust "Deadband" for positioning accuracy and stability.
   7. Select the Loss of Signal Jumper for either Lock-In-Place or run to PreSet Position.
   8. Remove Command Signal, if using PreSet Position, adjust "PreSet" pot for desired position.
7. Shielded wiring is recommended for all Command and Feedback signal wiring.
8. Chassis Ground is identified by a green screw on base of housing. *Do Not* connect shield wiring to Ground.
9. Separate input power is required for heater. Heater input voltage is determined by the customer at the time of the order. See nameplate for input voltage.