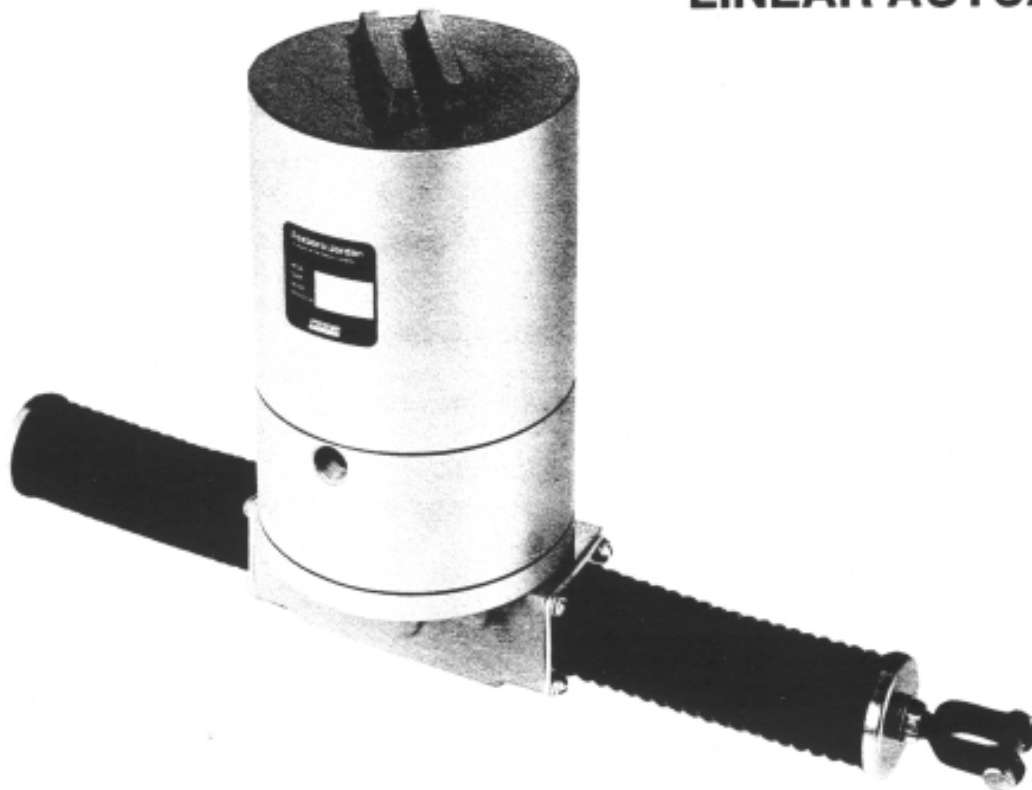




# Jordan Controls, Inc.

## Instruction Manual

## LA-1500 SERIES LINEAR ACTUATOR



### MODELS

LA-1510	LA-1540	LA-1570	LA-1510/AD-8210	LA-1550/AD-8220
LA-1520	LA-1550	LA-1580	LA-1520/AD-8210	LA-1570/AD-8220
LA-1530	LA-1560	LA-1590	LA-1530/AD-8210	LA-1590/AD-8220

*Due to wide variations in the terminal numbering of actuator products, actual wiring of this device should follow the print supplied with the unit.*

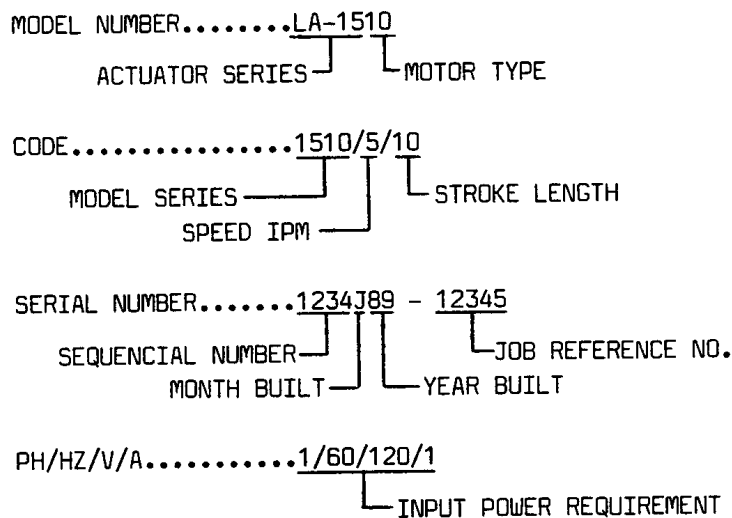
# PRODUCT IDENTIFICATION

## IDENTIFICATION LABEL

An identification label is attached to each actuator cover. The serial number is also stamped on the aluminum housing, directly above the conduit entry. When ordering parts, requesting information or service assistance, please provide all of the label information.

### EXAMPLE:

MODEL        LA-1510  
CODE        1510/5/10  
SERIAL      1234J89 - 12345  
PH/HZ/V/A   1/60/120/1



PH = PHASE  
HZ = HERTZ  
V = VOLTAGE  
A = AMPERES

NOTE: model number for actuators with built-in amplifier.

MODEL NUMBER.....LA-1510/AD-8210  
  └── MODEL NUMBER OF ──┤  
  └── BUILT-IN AMPLIFIER ──┘

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**\*\* GENERAL INSTRUCTIONS \*\***

Foxboro/Jordan designs, manufactures, and tests its products to meet many national and international standards. However, for these products to operate within their normal specifications, you must properly install, use, and maintain these products. The following instructions must be adhered to and intergrated with your safety program when installing, using and maintaining Foxboro/Jordan products.

Read and save all instructions prior to installing, operating and servicing the product.

If you do not understand any of the instructions, contact your Foxboro Jordan representative for clarification.

Follow all warnings, cautions, and instructions marked on and supplied with the product.

Inform and educate your personnel in the proper installation, operation, and maintenance of the product.

Install your equipment as specified on Foxboro/Jordan installation instructions and per applicable local/national codes. Connect all products to the proper electrical sources.

Handle, move, and install each product using the appropriate number of personnel and moving devices/equipment (dolly, forklift, crane, etc.). Failure to do so could cause serious personal injury.

To ensure proper performance, use qualified personnel to install, operate, update, tune, and maintain the product.

When replacement parts are required, ensure that the qualified service technician uses replacement parts specified by Foxboro/Jordan. Unauthorized substitutions may result in fire, electrical shock, other hazards, or improper equipment operation.

Ensure all actuator protective covers are in place, except when maintenance is being performed by qualified personnel, to prevent electrical shock, personal injury, or damage to the actuator.

**\*\* CAUTION \*\***

Before beginning actuator installation, make sure the actuator supplied is suitable for the intended application with respect to environmental conditions and the voltage/frequency of available line power. If you are unsure of the suitability of this equipment for your installation, consult Foxboro/Jordan prior to proceeding.

**\*\* WARNING - SHOCK HAZARD \*\***

Installation and servicing must be performed only by qualified personnel. De-energize all sources of power BEFORE removing actuator cover. KEEP COVER TIGHT WHEN CIRCUITS ARE ALIVE. Failure to follow these precautions may result in serious injury or death.

DESCRIPTION

The LA-1500 series linear actuators are self contained bi-directional electrically operated devices with a maximum thrust rating of 500 lbs. An electric motor drives a spur gear train which is coupled thru a pinion gear to a gear rack converting rotary motion to linear movement. The drive motor may be either AC or DC. The unit may contain position feedback, limit switches, motor brake, heater and thermostat, manual handcrank, a built-in amplifier, rack covers (bellows) and clevis ends. The positioning range with selected feedback gear ratios and proper length gear rack will control the rack travel from 3/4" to 21 inches of stroke. The actuator may be mounted in any position. The power and feedback gearing is totally enclosed and permanently lubricated. The gear rack may be enclosed using bellows. The actuator housing may be NEMA 12 Inside Industrial, NEMA 4 Watertight or Explosionproof rated for Class I, Div. 1, Groups C, D and Dust-ignitionproof Class II, Div. 1, Groups E, F, G Hazardous Location.

<u>BASIC MODEL</u>	<u>MOTOR USED</u> (ac motors are single phase, permanent split capacitor, plug reversible) (dc motors are permanent magnet)
LA-1510	120 V ac, modulating duty, run current .44 A, stall .65 A
LA-1510/AD-8210	LA-1510 above with built-in amplifier
LA-1520	120 V ac, intermittent duty, run current 2.5 A, stall 2.9 A
LA-1520/AD-8210	LA-1520 above with built-in amplifier
LA-1530	120 V ac, modulating duty, run current .9 A, stall 1.2 A
LA-1530/AD-8210	LA-1530 above with built-in amplifier
LA-1540	24 V dc (PM), run current 1.7 A, max. cont. duty 1.9 A
LA-1550	240 V ac, intermittent duty, run current .45 A, stall .5 A
LA-1550/AD-8220	LA-1550 above with built-in amplifier
LA-1560	90 V dc (PM), run current .4 A, max. cont. duty .5 A
LA-1570	240 V ac, modulating duty, run current .27 A, stall .4 A
LA-1570/AD-8220	LA-1570 above with built-in amplifier
LA-1580	24 V dc (PM) with tach, run current 5.2 A, max. cont. duty 6.25 A
LA-1590	240 V ac, intermittent duty, run current 1.1 A, stall 1.6 A
LA-1590/AD-8220	LA-1590 above with built-in amplifier

ACTUATOR SPEED/THRUST

MODEL	LA-1510 LA-1570	LA-1520 LA-1590	LA-1530 LA-1550	LA-1540 LA-1560	LA-1580
1	2	1	3	3	500
5	6	5	9	11	500
9	13	9	19	24	500
16	19	16	31	38	500
31	44	31	63	78	500
56	75	56	110	140	500
88	120	88	175	220	500
110	150	110	230	280	500
	36	300	100	80	150

SPEED (inches/min) / THRUST (lb)

## PHYSICAL INSTALLATION

### Actuator Characteristics

- The actuator is permanently lubricated, it is not oil or grease filled and may be mounted in any desired plane.
- The actuator weighs approximately 25 lbs. The mass of the actuator varies, depending upon the configuration of options selected and the length of stroke.
- The actuators output rack is made of stainless steel and the housing is aluminum.
- The actuator is a very efficient design and the output rack may coast or be back-driven by the load if the actuator is not supplied with the optional motor brake.

### Mounting Brackets

- When designing mounting brackets and considering mounting locations, allow adequate clearance from the top of the actuator cover to any obstructions such as brick walls or steel structures that could interfere with cover removal.
- Allow for clearance on the back end of the output rack.
- If the actuator is supplied with a manual handcrank, allow for operator access.
- The standard LA-1500 series actuators are designed to be mounted with four, 5/16-18 Grade 5 (or better) mounting bolts. The mounting holes on the bottom of the rack block are tapped 3/4 inch deep and the bolts selected should engage a minimum of 6 full threads (5/16").
- Care should be taken not to use bolt lengths that are too long which will bottom in the tapped holes. This will cause a loose mount and applying excessive torque to further tighten the bolts may damage the aluminum threads or shear the bolts.

### Coupling the Output Rack

- For maximum actuator life and efficiency, avoid side loading caused by incorrect shaft alignment. The use of the Clevis Option is recommended.
- Each end of the output rack is tapped 7/8" deep with a 1/2-13 thread.
- The output rack is not intended to support an overhung load.

### INSTALLATION DIMENSIONS - INCHES

HOUSING TYPE	MODEL	A				B				C
		Options 1,3,5,6	Options 1,4,6	Options 2,3,5,6	Options 2,4,6	Options 1,3,5,6	Options 1,4,6	Options 2,3,5,6	Options 2,4,6	
Nema 12	LA-1510,70	5.25	7.99	N/A	N/A	10.70	13.44	N/A	N/A	2.86
	LA-1530,50	6.25	7.99	N/A	N/A	11.70	13.44	N/A	N/A	2.86
	LA-1520,40,60,90	6.25	9.24	N/A	N/A	11.70	14.69	N/A	N/A	2.86
	LA-1580	6.25	N/A	N/A	N/A	11.70	N/A	N/A	N/A	2.86
Nema 4	LA-1510,30,50,70	6.88	8.00	10.00	11.12	13.01	14.13	16.13	17.25	3.20
	LA-1520,90	6.88	9.44	10.00	11.12	13.01	15.58	16.13	17.25	3.20
	LA-1540,60	6.88	9.44	N/A	N/A	13.01	15.58	N/A	N/A	3.20
	LA-1580	6.88	N/A	N/A	N/A	13.01	N/A	N/A	N/A	3.20
Explosionproof	LA-1500 ALL	6.88*	N/A	10.00*	N/A	13.01*	N/A	16.13*	N/A	3.20

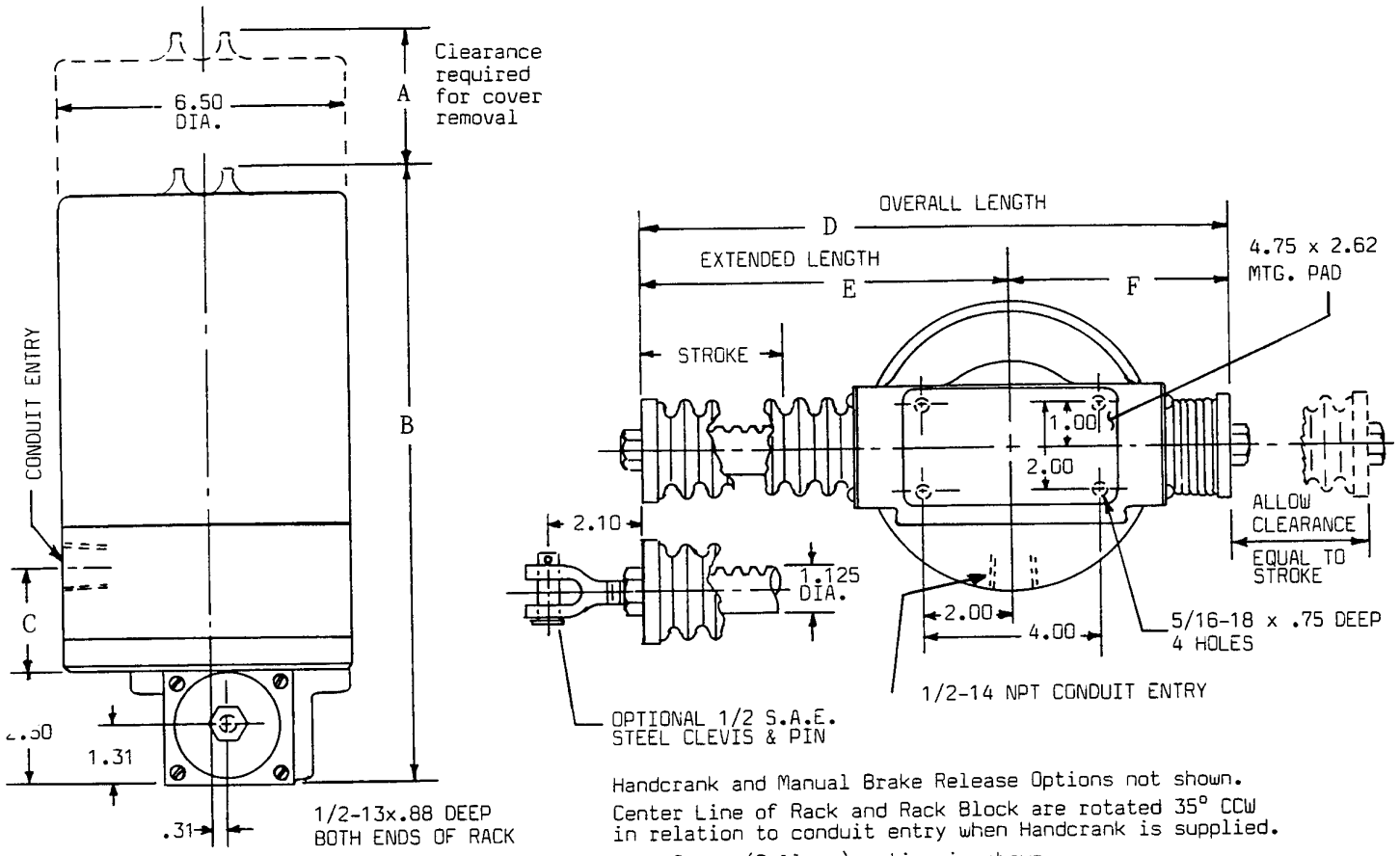
#### OPTIONS

- |   |                          |                        |
|---|--------------------------|------------------------|
| 1 -- Without built-in AD-8200 Amplifier | 3 -- Without Motor Brake | 5 -- Without Handcrank |
| 2 -- With built-in AD-8200 Amplifier    | 4 -- With Motor Brake    | 6 -- With Handcrank    |

\* ---- Explosionproof Units are not available with Handcrank Option #6.

N/A = Not Available.

INSTALLATION DIMENSIONS  
(NOMINAL)  
INCHES



Handcrank and Manual Brake Release Options not shown.  
Center Line of Rack and Rack Block are rotated 35° CCW  
in relation to conduit entry when Handcrank is supplied.  
Rack Cover (Bellows) option is shown.

RACK LENGTH DIMENSIONS

STROKE INCHES	WITH RACK COVERS			WITHOUT RACK COVERS		
	D	E	F	D	E	F
.75 to 3.00	15.08	9.04	6.04	10.25	6.62	3.62
3.00 to 6.00	20.08	13.04	7.04	13.25	9.62	3.62
6.00 to 9.00	25.08	17.04	8.04	16.25	12.62	3.62
9.00 to 12.00	30.08	21.04	9.04	19.25	15.62	3.62
12.00 to 15.00	35.08	25.04	10.04	22.25	18.62	3.62
15.00 to 21.00	45.08	33.04	12.04	28.25	24.62	3.62

## FIELD WIRING

### \*\* WARNING - SHOCK HAZARD \*\*

Installation and servicing must be performed only by qualified personnel.

De-energize all sources of power BEFORE removing the actuator cover. KEEP COVER TIGHT WHEN CIRCUITS ARE ALIVE. Voltages hazardous to your health are applied to these actuators. Failure to follow these precautions may result in serious injury or death.

EXPLOSIONPROOF and DUST-IGNITIONPROOF ACTUATORS are not explosionproof or dust-ignitionproof until final installation is complete. "Hazardous location enclosures must be installed in accordance with The National Electric Code requirements as well as state and local codes".

WATERTIGHT ACTUATORS are not watertight until final installation is complete with conduit entry sealed and actuator cover in place.

### \*\* CAUTION \*\*

All ac powered actuators contain single phase, 3 wire, permanent split capacitor motors. Motor power is applied across the motor common winding wire and one of the directional input wires. The capacitor creates a phase shift to the other motor directional input wire. This allows the motor to run and develop torque. With external input power applied to one winding, the opposite winding (energized by the capacitor) will have a voltage on it which is greater than the applied voltage while the motor is running. The voltage will be approximately 150 V ac for 120 V ac units and 300 V ac for 240 V ac units. Because of this characteristic the actuator directional input wires must never be connected in parallel from one actuator to another. No inductive or resistive load can be connected in parallel with the directional inputs. When operating more than one actuator from a common source, the use of isolated contacts between each actuator is required. Wiring ac actuators in parallel without isolation will cause one of the actuators to operate at a reduced torque when an end of travel limit switch in the other actuator is opened. The actuator with the opened switch may continue to run, receiving power to the direction winding with the closed switch, by way of the power supplied from the actuator that has not reached its limit switch.

END OF TRAVEL LIMIT SWITCHES built into single phase, ac motor driven units are factory wired in series with the proper motor directional winding. When a switch is tripped (opened), motor power will be removed from the winding and the motor will stop.

END OF TRAVEL LIMIT SWITCHES built into dc motor driven units are wired to the field wiring terminals and will only stop the motor when they are properly phased and wired to your motor control circuit.

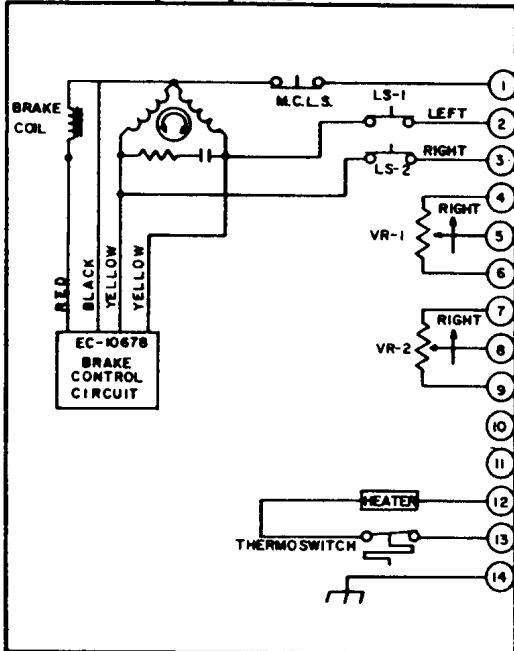
FUSING IS NOT PROVIDED WITHIN THE ACTUATOR. Line fusing must be provided by the customer. Fuse rating should not exceed 5 amperes and fuses should be motor type.

All installation must be in accordance with The National Electric Code requirements as well as state and local codes.



# AC ACTUATOR WIRING

LA-1510, 1520, 1530  
LA-1550, 1570, 1590



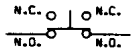
"YOUR ACTUATOR MAY OR MAY NOT BE WIRED AS SHOWN"

**NOTES:**

- 1) The LA-1510, 1520 and 1530 use 120 V ac input power. The LA-1550, 1570 and 1590 use 240 V ac input power.
- 2) Voltage applied across terminals 1 and 3 will result in rack movement to the right (as viewed from the mounting face with the rack teeth down). Voltage applied across terminals 1 and 2 will result in rack movement to the left.
- 3) When the optional Motor Brake is supplied, an electro-mechanical brake and brake circuit (EC-10678) will be wired as shown. The brake releases whenever the motor is energized.
- 4) Rack movement to the right results in decreasing resistance as measured across terminals 4 and 5 when feedback pot VR-1 is supplied and decreasing resistance across terminals 7 and 8 when feedback pot VR-2 is supplied.
- 5) When facing rack mounting face with rack teeth down, LS-2 is factory set to trip at the maximum extended position to the right. From this point, the rack retracts moving to the left and LS-1 is factory set to trip at the customer specified stroke length. Switches are shown at mid-travel.

Single Turn Feedback Ass'y:

LS-1 is operated by a white cam. LS-2 is operated by a red cam. LS-1 and LS-2 are wired with the N.O. contacts as shown.



- 6) M.C.L.S. indicates the Manual Crank Limit Switch. The switch is only supplied on units with the Manual Handcrank option. The switch is normally closed. When the Manual Handcrank is engaged, the circuit to the motor is opened.

Optional Heater Circuit:

The heater is powered thru the thermoswitch. The switch closes at 90°F and opens at 110°F. 120 V ac units use a 30 WATT heater and 240 V ac units use a 75 WATT heater.

Optional Transmitter:

The ST-4130, 4 to 20mA TRANSMITTER wired as shown will result in a DECREASING SIGNAL for rack movement to the right. Operation of the TRANSMITTER requires an EXTERNAL DC POWER SUPPLY with an output in the range of 12.5 Vdc (MIN) to 36.0 Vdc (MAX) and a LOAD connected in series with one lead from the power supply.

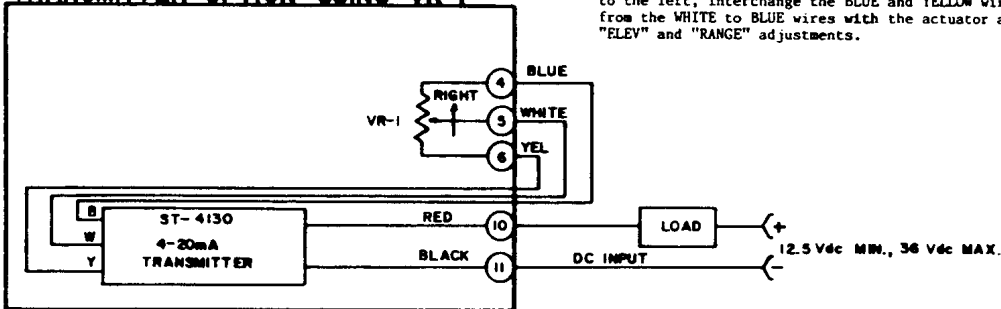
$$\text{POWER SUPPLY VOLTAGE} - 12V = \text{LOAD RESISTANCE MAX.} \cdot 0.020A$$

Connect Power Supply polarity as shown.

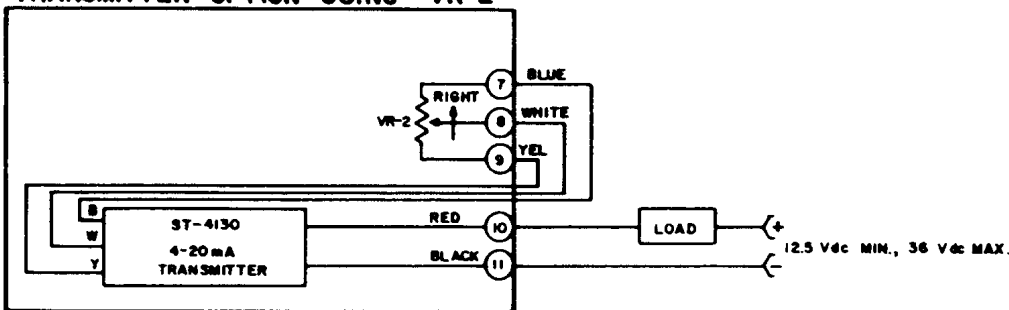
With the actuator rack at its RIGHT (EXTENDED) end of travel, adjust VR-1 or VR-2 (the one being used), for 50 ohms from the WHITE to BLUE wires. Adjust "ELEVATION" on the TRANSMITTER for 4.00mA output. With the actuator rack at its LEFT (RETRACTED) end of travel, adjust "RANGE" on the TRANSMITTER for 20.0mA output. Repeat the "ELEV" and "RANGE" adjustments.

To reverse the TRANSMITTER OUTPUT and cause the signal to DECREASE for rack movement to the left, interchange the BLUE and YELLOW wires. Adjust VR-1 or VR-2 for 50 ohms from the WHITE to BLUE wires with the actuator at its left end of travel. Perform "ELEV" and "RANGE" adjustments.

**TRANSMITTER OPTION USING VR-1**

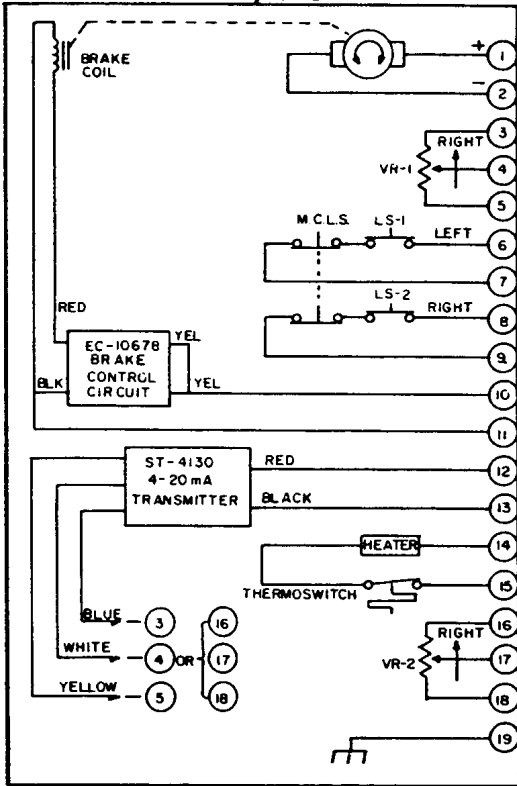


**TRANSMITTER OPTION USING VR-2**



# DC ACTUATOR WIRING

LA-1540, 1560



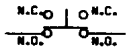
"YOUR ACTUATOR MAY OR MAY NOT BE WIRED AS SHOWN"

**NOTES:**

- 1) The LA-1540 uses 24 V dc motor input power. The LA-1560 uses 90 V dc motor input power.
- 2) Voltage applied to terminals 1 and 2 with the polarity shown will result in rack movement to the right (as viewed from the mounting face with rack teeth down). Reversing the polarity reverses the direction.
- 3) When an optional Motor Brake is supplied, an electro-mechanical brake and a brake circuit (EC-10678) will be wired as shown. 120 V ac must be applied across terminals 10 and 11 to release the brake whenever the motor is energized.
- 4) Rack movement to the right results in decreasing resistance as measured across terminals 3 and 4 when feedback pot VR-1 is supplied and decreasing resistance across terminals 16 and 17 when feedback pot VR-2 is supplied.
- 5) When facing rack mounting face with the rack teeth down, LS-2 is factory set to trip at the maximum extended position to the right. From this point, the rack retracts moving to the left and LS-1 is factory set to trip at the customer specified stroke length. Switches are shown at mid-travel.

Single Turn Feedback Ass'y:

LS-1 is operated by a white cam. LS-2 is operated by a red cam. LS-1 and LS-2 are wired with the N.O. contacts as shown.



- 6) M.C.L.S. indicates the Manual Crank Limit Switch. The switch is only supplied on units with the Manual Handcrank option. The switch is normally closed. When the Manual Handcrank is engaged, the switch is opened. Provision must be made in the customer wiring to interrupt the motor circuit when the Handcrank is engaged.
- 7) Optional Heater Circuit:  
The heater is powered thru the thermoswitch. The switch closes at 90°F and opens at 110°F. 120 V ac power is applied across terminals 14 and 15. The heater is 30 WATTS.
- 8) Optional Transmitter:  
The ST-4130, 4 to 20mA TRANSMITTER wired as shown to either VR-1 or VR-2 will result in a DECREASING SIGNAL for rack movement to the right. Operation of the TRANSMITTER requires an EXTERNAL DC POWER SUPPLY with an output in the range of 12.5 Vdc (MIN) to 36.0 Vdc (MAX) and a LOAD connected in series with one lead from the power supply.

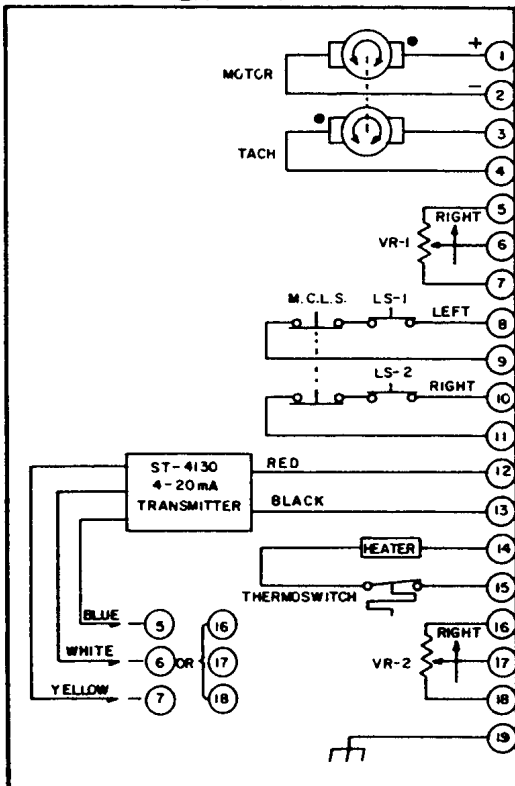
POWER SUPPLY VOLTAGE - 12V = LOAD RESISTANCE MAX.  
.020A

Connect Power Supply polarity as shown.

With the actuator rack at its RIGHT (EXTENDED) end of travel, adjust VR-1 or VR-2 (the one being used), for 50 ohms from the WHITE to BLUE wires. Adjust "ELEVATION" on the TRANSMITTER for 4.00mA output. With the actuator rack at its LEFT (RETRACTED) end of travel, adjust "RANGE" on the TRANSMITTER for 20.0mA output. Repeat the "ELEV" and "RANGE" adjustments.

To reverse the TRANSMITTER OUTPUT and cause the signal to DECREASE for rack movement to the left, interchange the BLUE and YELLOW wires. Adjust VR-1 or VR-2 for 50 ohms from the WHITE to BLUE wires with the actuator at its left end of travel. Perform "ELEV" and "RANGE" adjustments.

LA-1580



**NOTES:**

- 1) The LA-1580 uses 24 V dc input power to the motor armature.
- 2) The motor has a built-in tachometer.
- 3) Voltage applied to terminals 1 and 2 with the polarity shown will result in rack movement to the right (as viewed from the mounting face with rack teeth down). Rack movement to the right results in tachometer output of terminal 4 positive with respect to terminal 3. Reversing the polarity at terminals 1 and 2 will reverse the rack travel and the tachometer output polarity at terminals 3 and 4.
- 4) Rack movement to the right results in decreasing resistance as measures across terminals 5 and 6 when feedback pot VR-1 is supplied and decreasing resistance across terminals 16 and 17 when feedback pot VR-2 is supplied.
- 5) For Limit Switches, Heater and Transmitter see notes 5 thru 8 above.

START-UP  
Actuators without built-in AD-8200 Series Amplifier

NOTE: The actuator has been factory calibrated for the stroke specified by the customer and only minor adjustments should be needed to match it to the controlled equipment. Refer to the installation print supplied with the actuator. The alignment is written with the extended direction being to the right when looking at the mounting face of the actuator with the rack teeth facing down. The rack is usually symmetrically located in the rack block and either end of the rack may be used to drive the load. If you use the opposite end, substitute the proper terminal numbers in the following procedure.

FINAL ALIGNMENT CONSISTS OF:

- A) Setting the end of travel limit switches for the range of the driven unit without running the actuator into any type of mechanical stops.
- B) Aligning the feedback potentiometer (pot) to the range of the actuator set by the end of travel limit switches.
- C) Calibrating the 4 to 20 mA transmitter (if used).

ACTUATOR ALIGNMENT ac UNITS

- 1) If the actuator has been mounted and coupled to the controlled equipment, remove the coupling between the actuator rack and the driven device.
- 2) Move the driven device to the position it is to be when the actuator is at its full extended stroke length. This will be the starting point.
- 3) Remove the actuator cover to gain access to the limit switches, feedback pot and terminals.
- 4) Apply power across terminals 1 and 3 to drive the actuator to its extended position. When the actuator is at position, LS-2 should trip stopping the actuator.
- 5) With both units at this starting point and the proper mounting bracket dimensions, the actuator rack can be coupled to the driven device. DO NOT OVERRIDE THE LIMIT SWITCH TO FURTHER EXTEND THE RACK. Actuators with rack covers are limited by the stretch and compression of the bellows. Actuators without rack covers must not be stroked so as to allow the end of the rack to enter into the rack block bushing.

If the actuator rack will not couple to your unit correct the mounting dimensions on your bracket.

- 6) With the actuator rack coupled to the driven unit it is necessary to check the "Extend" limit switch setting to insure it trips before a mechanical stop (if the driven unit has one) is reached. THE ACTUATOR MUST NEVER BE DRIVEN INTO A MECHANICAL STOP. To check the switch setting, apply power across terminals 1 and 2 and allow the actuator to retract far enough to re-set the extend limit switch. Remove power from terminal 2 and apply it to terminal 3. While the actuator is running to the extend position, observe the trip point of the limit switch. Remove power immediately if it appears the actuator will reach a mechanical stop prior to the switch tripping.

If only a very small amount of adjustment is needed (less than 1/8"), loosen 3 truss head screws (item 11 on page 11) and rotate the limit switch frame until the switch just trips. Tighten the 3 screws.

If a large amount of adjustment is needed, check your mounting bracket dimensions.

- 7) If the actuator is equipped with a feedback pot (VR-1), measure the resistance from terminal 5 to terminal 4, with the actuator at the extended limit. Loosen the pot body nut (shown on page 18, Fig. 2) and rotate the body of the pot for a resistance reading of 5% of the total pot value. Tighten the nut. Units supplied with tandem pots (VR-1 and VR-2) have both pots coupled together and adjusting VR-1 adjusts VR-2 at the same time.
- 8) Monitor the feedback pot (if supplied) from terminal 5 to terminal 6. Apply power to drive the actuator to the desired retracted position. Do not drive into a mechanical stop and do not drive the pot to less than 5% of its value at the actuator end of travel. Adjust the cam for limit switch LS-1 to trip at the retract end of travel.
- 9) If the actuator is supplied with a 4 to 20 mA transmitter, refer to the appropriate wiring diagram (supplied with the actuator) for transmitter calibration (or pages 8 and 9).

The procedure described creates a zero (0%) reference for external amplifier control or position monitoring with a meter station with zero being the actuator extended position and 100% travel being the actuator retract position. If actuator retract is to be the zero reference, adjust VR-1 for a 5% resistance reading from terminals 5 to 6 with the actuator at the retract limit switch. The standard potentiometer value used is 1000 ohms and 5% of it is 50 ohms.

Failure to properly reference the pot could result in no control or alignment capability with external amplifier or improper reading of actuator position with meter station.

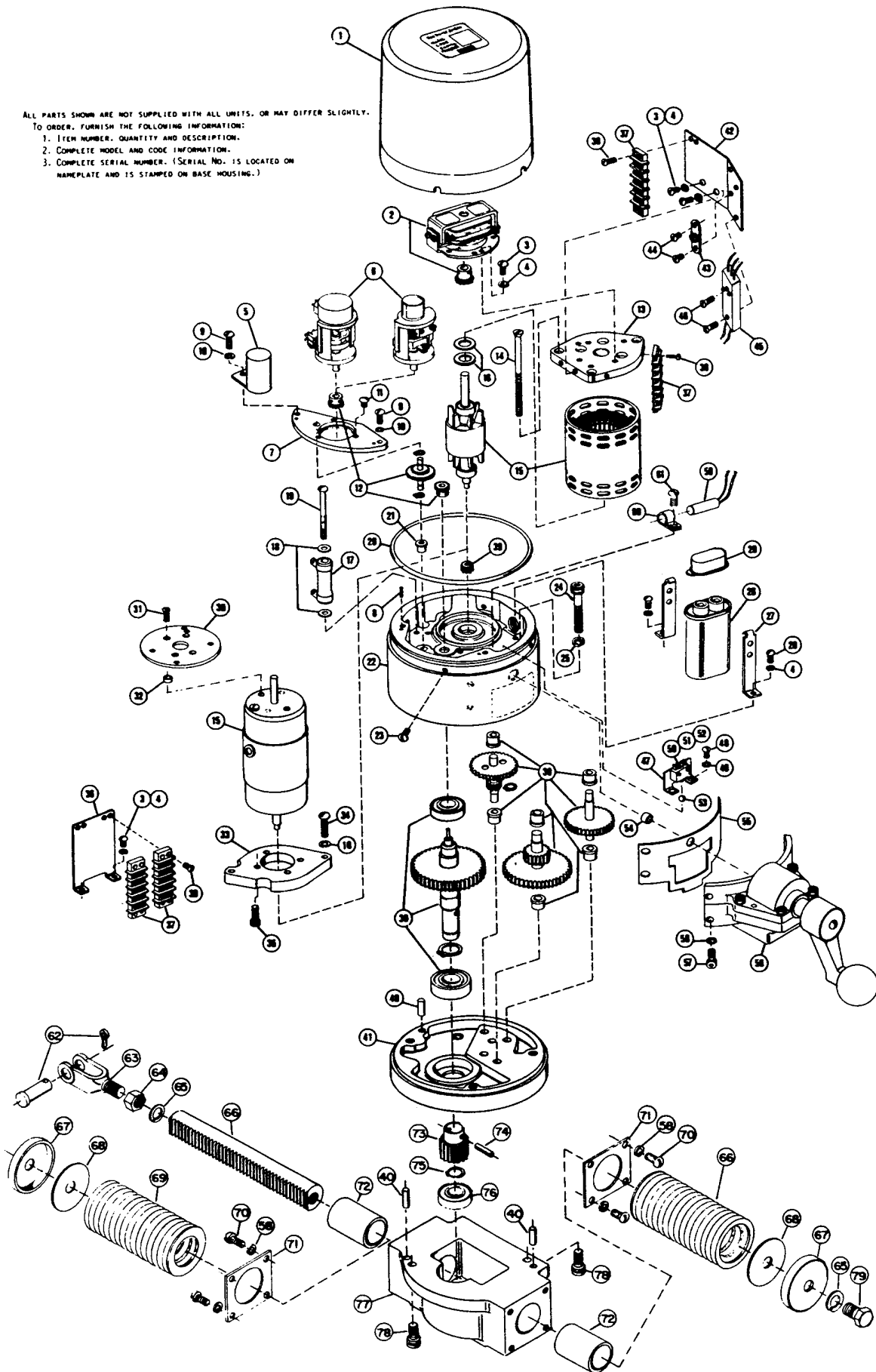
ACTUATOR ALIGNMENT dc UNITS

The alignment of a dc actuator is similar to that of the ac actuator with a few exceptions.

- 1) The input power is applied across terminals 1 and 2. The polarity of the input power determines the actuator output rack direction of movement.
- 2) The end of travel position limit switches are not wired in series with the motor and must be field wired to your motor control circuit and phased properly to turn off motor power when the proper switch is "tripped".
- 3) If the actuator is supplied with a motor brake, power must be supplied from an external source to the motor brake terminals. When motor power is applied, brake power must also be applied.
- 4) The terminal numbers for the components in the dc actuator are different than the terminal numbers in an ac actuator.
- 5) The operation and phase control of the limit switch circuit should be checked with the actuator near its center of travel, to prevent damage of the controlled unit or the actuator. Improper phasing of the limit switch circuit will cause the actuator motor to receive power and run when the switch is supposed to stop it.

# PARTS ORDER PROCEDURE

ALL PARTS SHOWN ARE NOT SUPPLIED WITH ALL UNITS, OR MAY DIFFER SLIGHTLY.  
TO ORDER, FURNISH THE FOLLOWING INFORMATION:  
1. ITEM NUMBER, QUANTITY AND DESCRIPTION.  
2. COMPLETE MODEL AND CODE INFORMATION.  
3. COMPLETE SERIAL NUMBER. (SERIAL NO. IS LOCATED ON  
NAMEPLATE AND IS STAMPED ON BASE HOUSING.)



PARTS LIST  
(ALL MODELS)

ITEM	DESCRIPTION	PART NUMBER	QTY	ITEM	DESCRIPTION	PART NUMBER	QTY
1	Cover	See Page 13	1	34	10-24x1.00 Rd Hd Screw	54A-015043-100	2
2	Motor Brake		1	35	DC Motor Mounting Screws		
	(Without Manual Release)				M5x10MM for mtg to plate	58B-024244-024	4
	LA-1510,20,30	22B-009033-001			M5x15MM for mtg to housing	58B-024244-029	4
	LA-1550,70,90	22B-009033-003			LA-1580 10-32x1.00 long	54A-015050-100	2
	LA-1540,60	61A-021147-001		36	Terminal Bracket	13B-024486-001	1
	(With Manual Release)			37	Terminal Block 6 Pin	43B-003888-106	2
	LA-1510,20,30	68B-017132-001			Terminal Block 7 Pin	43B-003888-107	
	LA-1550,70,90	68B-017132-003			Terminal Block 8 Pin	43B-003888-108	
	LA-1540,60	68B-017132-006		38	6-32x.38 Rd Hd Screw	54A-015023-038	8
3	8-32x.31 Rd Hd Screw	54A-015033-031	6	39	Power Gearing & Bearings	See Page 15 & 16	
4	#8 Lockwasher	56A-015190-002	8	40	.250x.88 Dowel Pin	57A-015226-088	3
5	Brake Control Circuit	70A-022661-001	1	41	Gear Housing Cover	See Page 14	1
6	Pot/Limit Switch Assy	See Page 18	1	42	Accessory Mtg Bracket	13B-024555-001	1
7	Feedback Mounting Plate	61A-SM2542-001	1	43	Thermal Switch	74A-023565-001	1
8	.093 x .50 Dowel Pin	57A-015176-050	2	44	6-32x.19 Rd Hd Screw	54A-015023-019	2
9	10-24x.50 Rd Hd Screw	54A-015043-050	2	45	4 to 20 mA Transmitter	70A-019948-001	1
10	#10 Lockwasher	56A-015200-001	4	46	6-32x.75 Rd Hd Screw	54A-015023-075	2
11	8-32x.25 Truss Hd Screw	54A-015032-025	3	47	Switch Bracket	12A-015384-001	1
12	Feedback Gearing	See Page 17		48	6-32x.38 Fil Hd Screw	54A-015183-038	2
13	Motor Top	61B-012753-001	1	49	#6 Lockwasher	56A-015180-002	2
	Top use with brake release	61B-017133-001		50	Switch SPDT	46B-004053-405	1
14	Motor Screws 10-24 Thread		3		Switch DPDT	46B-004053-414	
	LA-1510,70 4.00 long	54A-015044-400		51	2-56x.38 Rd Hd Screw	54A-015003-038	2
	LA-1520,30,50 5.00 long	54A-015044-500		52	#2 Lockwasher	56A-015180-002	2
	LA-1590 5.50 long	54A-015044-550		53	.250 Dia. Steel Ball	74A-014865-001	1
15	Motor	See Page 13	1	54	Bushing	18B-003814-055	1
16	Belleville Washer	56A-005479-003	2	55	Gasket	13B-015482-001	1
17	Resistor		1	56	Handcrank Assembly	68D-022196-001	1
	LA-1510,30,50,70,90	33B-003852-205		57	1/4-20x.75 Soc Hd Screw	54A-015060-075	4
	LA-1520	33B-003852-305		58	1/4" Lockwasher	56A-015210-001	12
18	Fiber Washer	56B-005479-003	2	59	Heater 120 V ac 30 Watt	74A-016946-001	1
19	Screw, 10-24 Thread		1		Heater 240 V ac 75 Watt	74A-016946-002	
	LA-1510,30,50,70,90 2.5"	54A-015043-250		60	Clamp for 120 V Heater	74A-016947-001	1
	LA-1520 4.5"	54A-015043-450			Clamp for 240 V Heater	74A-016947-002	
20	O'Ring			61	8-32x.38 Rd Hd Screw	54A-015033-038	1
	NEMA 12 Units	74B-004108-001	1	62	Clevis Pin with Cotter Pin	74B-005526-001	1
	NEMA 4 & Explosionproof	74B-010957-163	2	63	Clevis	74A-200008-001	1
21	Bushing	18B-SP1988-001	1	64	1/2-13 Jam Nut	55A-015109-001	1
22	Gear Housing	See Page 14	1	65	1/2" Lockwasher	56A-015250-002	2
23	10-24x.25 Rd Hd Screw	54A-015043-025	4	66	Rack	See Page 16	1
24	5/16-18x2.25 Soc Hd Screw	54A-015070-225	3	67	Bellows End Cup	13A-004716-002	2
25	5/16 Hi Collar Lockwasher	56A-015221-001	3	68	Bellows Support Disc	13A-001265-003	2
26	Capacitor	See Page 13	1	69	Bellows	See Page 16	2
27	Capacitor Bracket	See Page 13	2	70	1/4-20x.62 Rd Hd Screw	54A-015063-063	8
28	Bracket Screws	See Page 13	2	71	Bellows Clamp Plate	13A-200019-001	1
29	Boot	24B-004066-110	1	72	Bushing	18B-003814-018	2
30	Brake Mounting Plate	61A-021327-001	1	73	Pinion Gear	16A-200006-001	1
31	4-40x.75 Flat Hd Screw	58B-024244-013	4	74	3/16 x 1.0 Roll Pin	57A-015205-100	1
32	Spacer	61B-SP1324-100	4	75	Retaining Ring 5100-62	58B-014183-062	1
33	DC Motor Mounting Plate (not used if motor has a brake on it)	60B-020716-001	1	76	Bearing	17B-003813-010	1
				77	Rack Block	60C-200003-001	1
				78	5/16-18x.75 Soc Hd Screw	54A-015070-075	2
				79	1/2-13x.75 Hex Hd Screw	54A-015101-075	1

COVER SELECTION ITEM 1

NEMA 12 UNITS  
WITHOUT MOTOR BRAKE RELEASE

MODEL	PART NUMBER
LA-1510,70 LA-1520,30,40,50,60,80,90	11B-SM1197-002 11B-SM1197-005

NEMA 12 UNITS  
WITH MOTOR BRAKE RELEASE

MODEL	PART NUMBER
LA-1510,70 LA-1520 LA-1530,50 LA-1540,60 LA-1590	68C-017138-004 68C-017138-007 68C-017138-002 68C-017138-010 68C-017138-008

NEMA 4 and EXPLOSIONPROOF UNITS  
WITHOUT MOTOR BRAKE RELEASE  
WITHOUT BUILT-IN AD-8200 AMPLIFIER

MODEL	PART NUMBER
LA-1500 ALL	60B-001573-001

NEMA 4 and EXPLOSIONPROOF UNITS  
WITHOUT MOTOR BRAKE RELEASE  
WITH BUILT-IN AD-8200 AMPLIFIER

MODEL	PART NUMBER
LA-1500 ALL	60C-024806-001

NEMA 4 UNITS  
WITH MOTOR BRAKE RELEASE  
WITHOUT BUILT-IN AD-8200 AMPLIFIER

MODEL	PART NUMBER
LA-1510,70 LA-1520 LA-1530,50 LA-1540,60 LA-1590	68C-017138-003 68C-017138-005 68C-017138-001 68C-017138-009 68C-017138-006

NEMA 4 UNITS  
WITH MOTOR BRAKE RELEASE  
WITH BUILT-IN AD-8200 AMPLIFIER

MODEL	PART NUMBER
LA-1510,70 LA-1520 LA-1530,50 LA-1590	68C-025134-001 68C-025134-002 68C-025134-003 68C-025134-004

MOTOR SELECTION ITEM 15

ACTUATOR CONFIGURATION	NO MOTOR BRAKE NO HANDCRANK	WITH MOTOR BRAKE NO HANDCRANK	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK
MODEL				
LA-1510	61B-021200-002	23B-020702-001	61B-021200-002	23B-020702-001
LA-1520	61B-021200-004	23B-011999-002	61B-021200-004	23B-011999-002
LA-1530	61B-021200-003	23B-020700-001	61B-021200-003	23B-020700-001
LA-1540	61B-021694-001	61B-021089-002	61B-021694-001	61B-021089-003
LA-1550	61B-021200-005	61B-021240-001	61B-021200-005	61B-021240-001
LA-1560	61B-021694-002	61B-021089-001	61B-021694-002	61B-021089-004
LA-1570	61B-021200-001	23B-020701-001	61B-021200-001	61B-020701-001
LA-1580	23B-012722-001	NOT AVAILABLE	23B-012722-001	NOT AVAILABLE
LA-1590	61B-021200-006	23B-018106-002	61B-021200-006	23B-018106-002

CAPACITOR and MOUNTING HARDWARE SELECTION ITEMS 26, 27 and 28

MODEL	CAPACITOR DESCRIPTION	CAPACITOR PART NUMBER	CAPACITOR MTG. BRACKET	MOUNTING SCREWS DESCRIPTION	SCREW PART NUMBER
LA-1510	5uf, 330 Vac	24B-004066-027	24B-004066-103	8-32 x .88 long	54A-015033-088
LA-1520	30uf, 236 Vac	24B-004066-039	24B-004066-111	8-32 x 2.75 long	54A-015033-275
LA-1530	10uf, 330 Vac	24B-004066-028	24B-004066-103	8-32 x 2.50 long	54A-015033-250
LA-1550	3uf, 440 Vac	24B-004066-042	24B-004066-103	8-32 x 1.00 long	54A-015033-100
LA-1570	1.5uf, 440 Vac	24B-004066-043	24B-004066-103	8-32 x .50 long	54A-015033-050
LA-1590	7.5uf, 440 Vac	24B-004066-035	24B-004066-111	8-32 x 1.50 long	54A-015033-150

GEAR HOUSING and GEAR HOUSING COVER SELECTION ITEMS 22 and 41

NEMA 12 GEAR HOUSING (ITEM 22)

ACTUATOR CONFIGURATION	NO MOTOR BRAKE NO HANDCRANK	WITH MOTOR BRAKE NO HANDCRANK	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	COVER (ITEM 41)
ACTUATOR MODEL					
LA-1510, 20, 30, 50, 70, 90	600-005914-001	600-005914-001	600-015375-001	600-015375-001	60C-005916-001
LA-1540, 60	600-005914-001	600-021360-001	600-015375-001	600-015375-004	60C-005916-001
LA-1580	60C-017188-001	60C-017188-002	60C-017188-002	NOTE #2	60C-005916-001

NEMA 12

ACTUATOR CONFIGURATION	UNITS WITH 2A GEARING		UNITS WITH 2B GEARING		COVER (ITEM 41)
	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	
ACTUATOR MODEL					
LA-1510, 20, 30, 50, 70, 90	60C-022077-001	60C-022077-001	60C-022078-001	60C-022077-002	60C-022078-002
LA-1540, 60	60C-022077-001	60C-022077-005	60C-022078-001	60C-022077-002	60C-022078-002
LA-1580	60C-022077-009	NOTE #2	60C-022078-001	60C-022077-010	60C-022078-002

NEMA 4 and EXPLOSIONPROOF HOUSING (ITEM 22)

ACTUATOR CONFIGURATION	NO MOTOR BRAKE NO HANDCRANK	WITH MOTOR BRAKE NO HANDCRANK	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	COVER (ITEM 41)
ACTUATOR MODEL					
LA-1510, 20, 30, 50, 70, 90	600-018267-001	600-018267-001	600-016586-001	600-016586-001	60C-018268-001
LA-1540, 60	600-018267-001	600-021091-001	600-016586-001	600-016586-006	60C-018268-001
LA-1580	600-018279-001	NOTE #2	600-016586-007	NOTE #2	60C-018268-001

NEMA 4

ACTUATOR CONFIGURATION	UNITS WITH 2A GEARING		UNITS WITH 2B GEARING		COVER (ITEM 41)
	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	
ACTUATOR MODEL					
LA-1510, 20, 30, 50, 70, 90	60C-022077-003	60C-022077-003	60C-022078-003	60C-022077-004	60C-022078-004
LA-1540, 60	60C-022077-003	60C-022077-007	60C-022078-003	60C-022077-004	60C-022078-004
LA-1580	60C-022077-011	NOTE #2	60C-022078-003	60C-022077-012	60C-022078-004

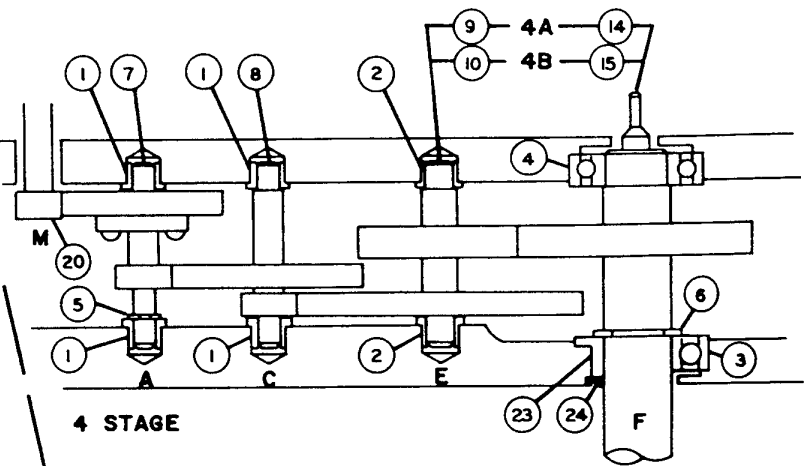
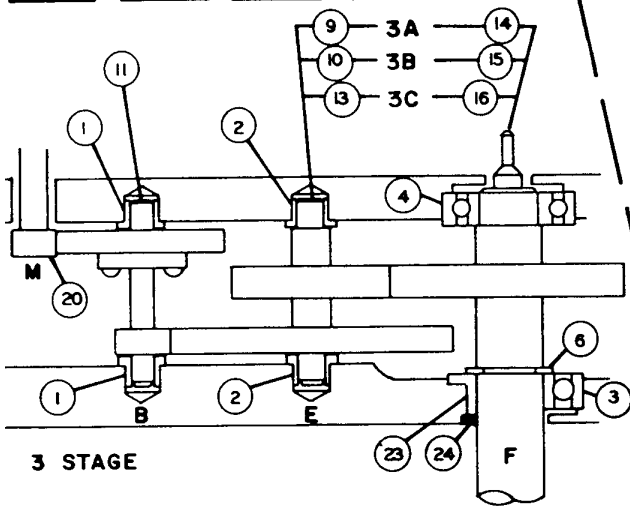
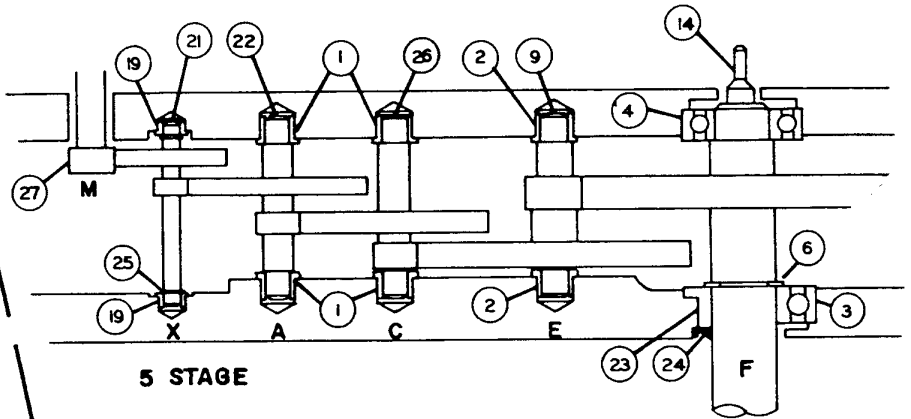
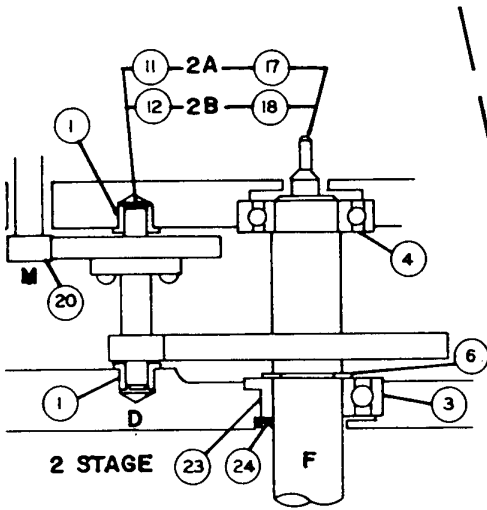
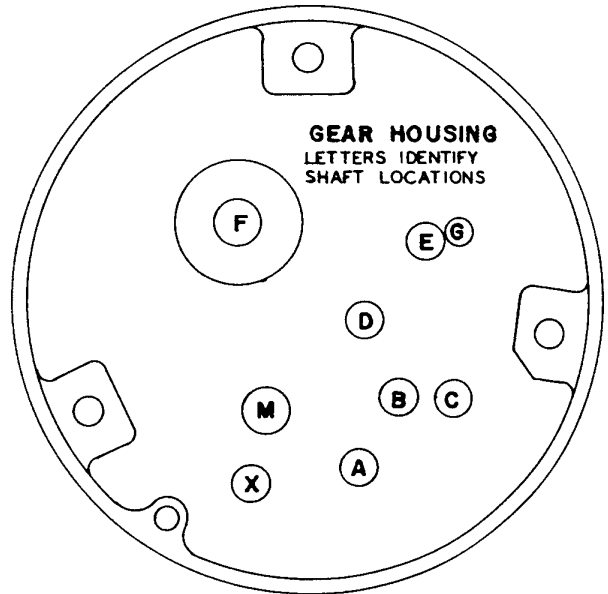
NOTES: #1 FOR LA-1500 ACTUATORS WITH 2A or 2B POWER GEARING and HANDCRANK OPTION, REFER TO PROPER CHART.

#2 LA-1580 IS NOT AVAILABLE WITH MOTOR BRAKE

#3 EXPLOSIONPROOF UNITS ARE NOT AVAILABLE WITH HANDCRANK OPTION.

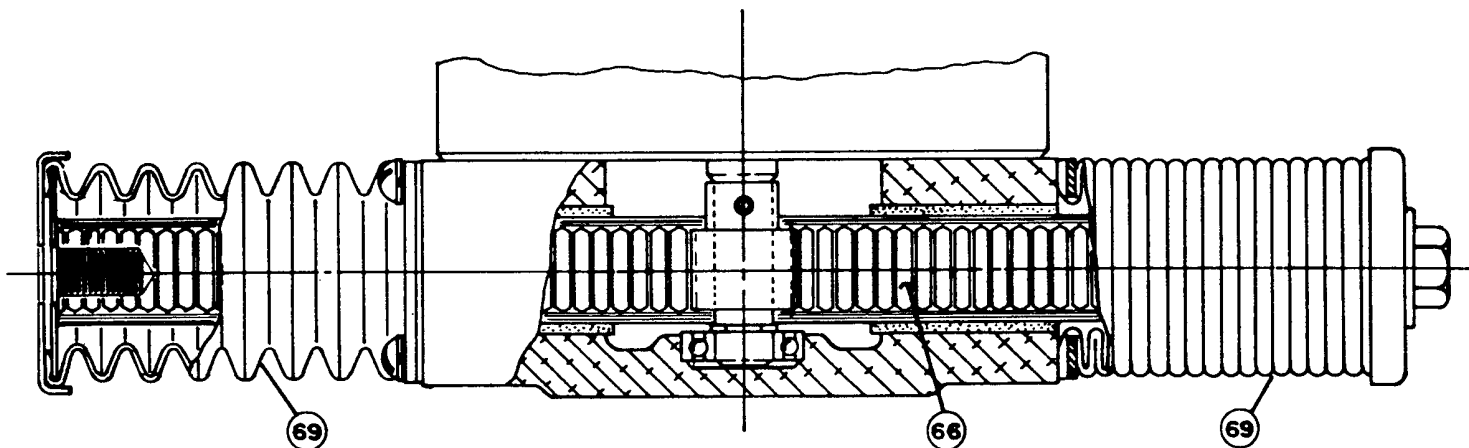
# LA-1500 SERIES POWER GEARING VARIATIONS AND LOCATIONS

LA-1510 LA-1530 LA-1550 LA-1570	LA-1520 LA-1590	LA-1540 LA-1560	LA-1580	POWER GEARING STAGES
I.P.M.				
1	2	3	3	5A
5	6	9	11	4A
9	13	19	24	4B
16	19	31	38	3A
31	44	63	78	3B
56	75	110	140	3C
88	120	175	220	2A
110	150	230	280	2B





# RACK and BELLOWS ASSEMBLY



RACK AND BELLOWS SELECTION ( ITEMS 66 AND 69 )

STROKE INCHES	RACK FOR USE WITH BELLOWS		RACK FOR USE WITHOUT BELLOWS		BELLOWS (RACK COVERS)	
	PART NUMBER	RACK LENGTH INCHES	PART NUMBER	RACK LENGTH INCHES	PART NUMBER	NUMBER OF CONVOLUTIONS
3	61B-004953-030	15.08	61B-004952-030	10.25	75B-004954-030	14 1/2
6	61B-004953-060	20.08	61B-004952-060	13.25	75B-004954-060	21 1/2
9	61B-004953-090	25.08	61B-004952-090	16.25	75B-004954-090	28 1/2
12	61B-004953-120	30.08	61B-004952-120	19.25	75B-004954-120	35 1/2
15	61B-004953-150	35.08	61B-004952-150	22.25	75B-004954-150	42 1/2
21	61B-004953-210	45.08	61B-004952-210	28.25	75B-004954-210	56 1/2

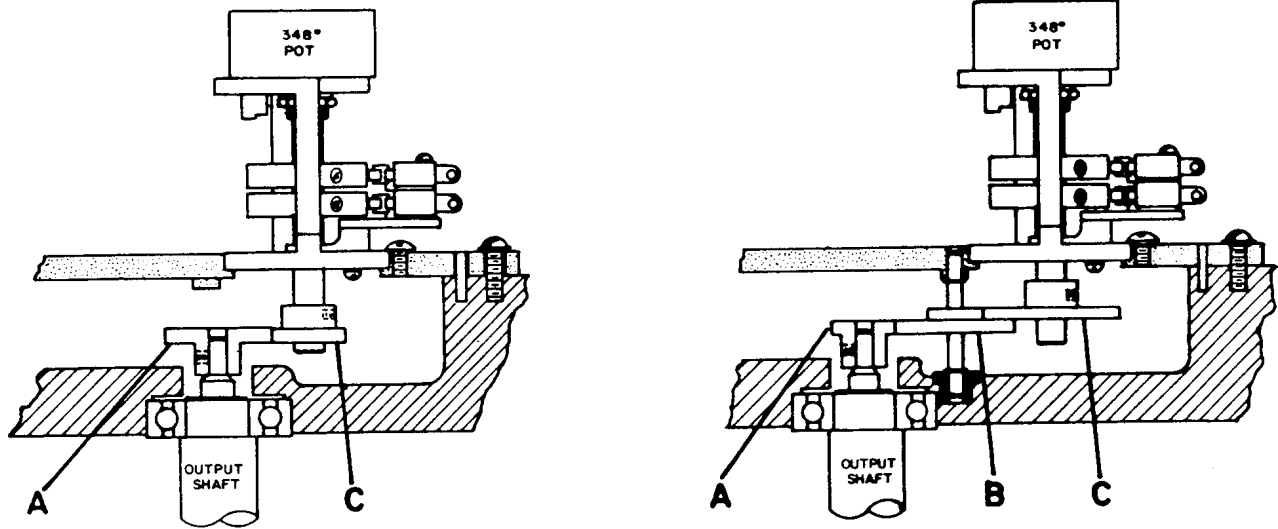
## POWER GEARING PARTS LIST

### LA-1500 SERIES

ITEM	DESCRIPTION	NEMA 12 INSIDE INDUSTRIAL HOUSING		NEMA 4 WATERTIGHT and EXPLOSIONPROOF HOUSING	
		PART NUMBER	PART NUMBER	PART NUMBER	PART NUMBER
1	Bushing	18B-SP1988-006	18B-SP1988-006	18B-SP1988-006	18B-SP1988-006
2	Bushing	18B-SP1988-007	18B-SP1988-007	18B-SP1988-007	18B-SP1988-007
3	Bearing	17B-003813-012	17B-003813-012	17B-003813-010	17B-003813-010
4	Bearing	17B-003813-010	17B-003813-010	17B-003813-010	17B-003813-010
5	C'Ring 5100-25	58B-014183-025	58B-014183-025	58B-014183-025	58B-014183-025
6	C'Ring 5100-75	58B-014183-075	58B-014183-075	58B-014183-075	58B-014183-075
7	Gear Assembly	65A-022648-001	65A-022648-001	65A-022648-001	65A-022648-001
8	Gear Assembly	65A-022649-001	65A-022649-001	65A-022649-001	65A-022649-001
9	Gear Assembly	65A-SP3265-001	65A-SP3265-001	65A-SP3265-001	65A-SP3265-001
10	Gear Assembly	65A-SP3265-002	65A-SP3265-002	65A-SP3265-002	65A-SP3265-002
11	Gear Assembly	65A-200485-003	65A-200485-003	65A-200485-003	65A-200485-003
12	Gear Assembly	65A-200485-001	65A-200485-001	65A-200485-001	65A-200485-001
13	Gear Assembly	65A-SP3265-003	65A-SP3265-003	65A-SP3265-003	65A-SP3265-003
14	Output Shaft Assembly	65A-005901-005	65A-005901-005	65A-005901-006	65A-005901-006
15	Output Shaft Assembly	65A-005902-005	65A-005902-005	65A-005902-006	65A-005902-006
16	Output Shaft Assembly	65A-005903-005	65A-005903-005	65A-005903-006	65A-005903-006
17	Output Shaft Assembly	65A-005899-005	65A-005899-005	65A-005899-006	65A-005899-006
18	Output Shaft Assembly	65A-005900-005	65A-005900-005	65A-005900-006	65A-005900-006
19	Bushing	18B-SP1988-011	18B-SP1988-011	18B-SP1988-011	18B-SP1988-011
20	Motor Pinion	16B-003806-003	16B-003806-003	16B-003806-003	16B-003806-003
21	Gear Assembly	65A-016312-001	65A-016312-001	65A-016312-001	65A-016312-001
22	Gear Assembly	65A-016313-001	65A-016313-001	65A-016313-001	65A-016313-001
23	Bushing	18B-SP1988-017	18B-SP1988-017	18B-SP1988-017	18B-SP1988-017
24	Seal	19B-003815-019	19B-003815-019	19B-003815-019	19B-003815-019
25	C'Ring 5100-18	58B-014183-018	58B-014183-018	58B-014183-018	58B-014183-018
26	Gear Assembly	65A-200488-001	65A-200488-001	65A-200488-001	65A-200488-001
27	Motor Pinion	16B-003804-011	16B-003804-011	16B-003804-011	16B-003804-011
28	Gear Assembly (NOTE #1)	65A-022076-001	65A-022076-001	65A-022076-001	65A-022076-001
29	Bushing (NOTE #1)	18B-SP1988-011	18B-SP1988-011	18B-SP1988-011	18B-SP1988-011

NOTE #1  
Gear Assy (item 28) and Bushings (item 29) not shown, are used in hole C when actuator is built with 2A or 2B gearing and a handcrank.

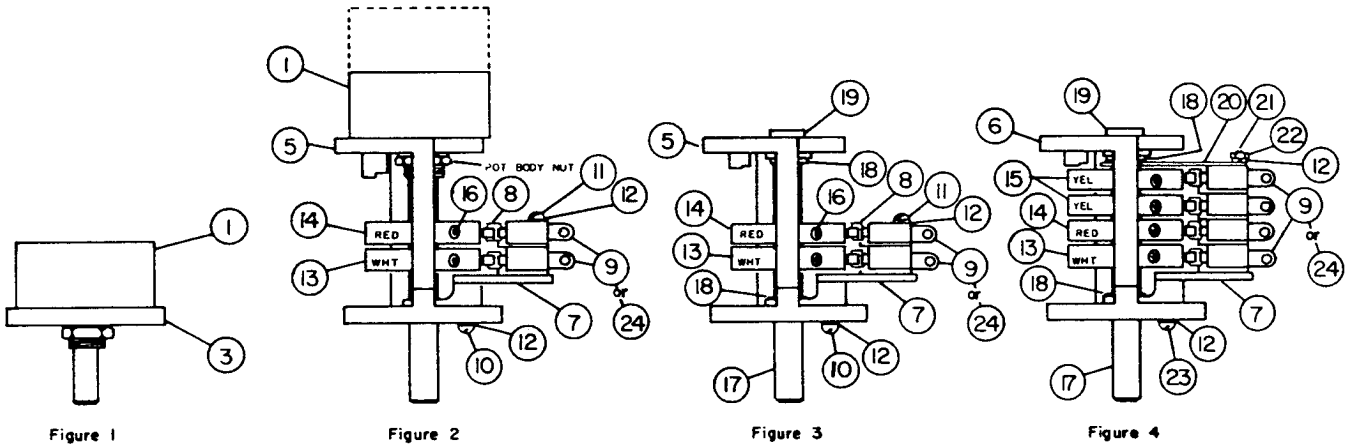
# POTENTIOMETER AND LIMIT SWITCH GEARING



STROKE INCHES FROM (MIN) TO (MAX)		FEEDBACK GEAR RATIO	GEARS (NO. OF TEETH)			GEAR A	PART NUMBER GEAR ASSY B	GEAR C	LIMIT SWITCH RESET
			A	B	C				
.63"	.94"	.346:1	60	52-90	36	16B-003811-058	65A-007127-001	16B-003811-036	.030"
1.23"	1.85"	.647:1	62	---	42	16B-003811-062	---	16B-003811-039	.035"
1.82"	2.73"	1.000:1	52	---	52	16B-003811-049	---	16B-003811-051	.048"
2.39"	3.58"	1.311:1	45	---	59	16B-003811-042	---	16B-003811-057	.070"
4.95"	7.42"	2.714:1	28	---	76	16B-003811-023	---	16B-003811-077	.130"
7.17"	10.75"	3.934:1	36	76-44	82	16B-003811-033	65A-007127-002	16B-003811-082	.218"
9.62"	14.43"	5.277:1	36	76-36	90	16B-003811-033	65A-007127-003	16B-003811-091	.305"
12.28"	18.42"	6.739:1	34	78-32	94	16B-003811-030	65A-007127-004	16B-003811-095	.350"
18.47"	27.71"	10.136:1	26	86-31	95	16B-003811-019	65A-007127-005	16B-003811-097	.523"

- NOTES:
- When a 348° electrical rotation feedback potentiometer is used:  
The (MIN) stroke uses 60% of the pot.  
The (MAX) stroke uses 90% of the pot.
  - Limit Switch Reset:  
The maximum movement required of the actuator output rack to reset the end of travel position limit switch after it has been tripped.

# POTENTIOMETER AND LIMIT SWITCH ASSEMBLIES



## COMPLETE ASSEMBLY

FIGURE	DESCRIPTION	PART NUMBER
1	1K Pot and Mounting Disc	68A-007162-003
	10K Pot and Mounting Disc	68A-007162-004
2	1K Pot, 2 Switches (SPDT)	68B-018200-001
	1K Pot, 3 Switches (SPDT)	68B-018200-002
	1K Pot, 4 Switches (SPDT)	68B-018200-003
	1K Pot, 2 Switches (DPDT)	68B-018200-004
	1K/1K Tandem Pot, 2 Switches (SPDT)	68B-018200-009
	10K Pot, 2 Switches (SPDT)	68B-018200-017
3	No Pot, 2 Switches (SPDT)	68B-018200-006
	No Pot, 2 Switches (DPDT)	68B-018200-038
4	No Pot, 3 Switches (SPDT)	68B-018200-007
	No Pot, 4 Switches (SPDT)	68B-018200-008

NOTE:  
DUE TO THE MANY CONFIGURATIONS POSSIBLE NOT ALL ARE LISTED.  
ONLY STANDARD POTENTIOMETER VALUES ARE LISTED.  
CONSULT FACTORY FOR OTHER COMBINATIONS.

## ITEMIZED PARTS LIST

ITEM	DESCRIPTION	PART NUMBER
1	Potentiometer, 1 Turn, 1K	34C-015848-001
	Potentiometer, 1 Turn, Tandem, 1K/1K	34B-003956-026
3	Potentiometer, 1 Turn, 10K	34C-021779-001
	Pot Mounting Disc	61A-SM3304-001
5	Mounting Frame	14C-008600-001
6	Mounting Frame (4 switch only)	61A-009180-001
7	Switch Mounting Plate	13A-010187-001
8	Switch Lever	46B-004053-406
9	Limit Switch (SPDT)	46B-004053-405
10	2-56 x .50 lg. Rd. Hd. Screw	54A-015003-050
11	2-56 x .62 lg. Rd. Hd. Screw	54A-015003-062
12	#2 Starwasher	56A-015160-002
13	Cam (white)	14B-SM2341-001
14	Cam (red)	14B-SM2341-004
15	Cam (yellow)	14B-SM2341-007
16	8-32 x .38 lg. Set Screw	54A-015037-038
17	Shaft (units without potentiometer)	62A-005942-001
18	E'Ring 5133-25	58A-024086-001
19	Bushing	18B-SP1988-005
20	Switch Support Plate (3 and 4 sw units)	61A-014663-001
21	2-56 x .88 lg. Thrd. Stock (3 sw units)	54A-015088-001
22	2-56 x 1.19 lg. Thrd. Stock (4 sw units)	54A-015539-119
	2-56 Hex Nut	55A-015008-001
23	2-56 x .31 lg. Rd. Hd. Screw (4 sw units)	54A-015033-031
24	Limit Switch (DPDT)	46B-004053-414

TROUBLE-SHOOTING  
LA-1500 ACTUATOR WITHOUT BUILT-IN AMPLIFIER

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Motor won't run in either direction	<ol style="list-style-type: none"> <li>1. Power not applied from source.</li> <li>2. Motor overheated and internal thermal switch tripped.</li> <li>3. Motor is burnt out.</li> <li>4. Motor brake not releasing.</li> <li>5. Both end of travel switches open or one open and one defective.</li> <li>6. Actuator output rack stalled.</li> <li>7. Manual handcrank engaged or handcrank switch M.C.L.S. is open.</li> <li>8. Defective motor run capacitor.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check source, fuses, wiring.</li> <li>2. Let motor cool, determine why overheating occurred.</li> <li>3. Replace motor and determine what caused burn out.</li> <li>4. Check brake and brake circuit.</li> <li>5. Adjust switch settings or replace defective switch.</li> <li>6. Check load on output rack.</li> <li>7. Disengage handcrank to close switch.</li> <li>8. Replace capacitor.</li> </ol>
Motor hums but does not run.	<ol style="list-style-type: none"> <li>1. Actuator output rack stalled.</li> <li>2. Power applied to both directions of movement at same time.</li> <li>3. Jammed, damaged power gearing.</li> <li>4. Motor brake not releasing.</li> <li>5. Defective motor run capacitor.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check load on output rack.</li> <li>2. Apply power to only one direction of movement at a time.</li> <li>3. Repair gearing.</li> <li>4. Check brake and brake circuit.</li> <li>5. Replace capacitor.</li> </ol>
Motor runs only one way.	<ol style="list-style-type: none"> <li>1. Power not applied for other direction.</li> <li>2. Power always applied to one direction and electrically stalls when applied for opposite direction.</li> <li>3. Open limit switch for other direction.</li> <li>4. Open motor winding.</li> </ol>	<ol style="list-style-type: none"> <li>1. Correct power problem.</li> <li>2. Correct power problem.</li> <li>3. Reset switch adjustment or replace.</li> <li>4. Replace motor.</li> </ol>
Motor runs, output rack does not move.	<ol style="list-style-type: none"> <li>1. Broken or worn power gearing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Repair power gearing.</li> </ol>
Motor does not shut off at limit switch.	<ol style="list-style-type: none"> <li>1. Switch defective or wired wrong.</li> <li>2. Actuator is coasting thru switch cam dwell area and switch is resetting.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace switch or correct wiring.</li> <li>2. Change power gearing to slower speed. Add motor brake and brake circuit.</li> </ol>
Motor brake does not hold motor shaft.	<ol style="list-style-type: none"> <li>1. Brake disc worn.</li> <li>2. Set screws in brake hub are loose.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust brake air gap.</li> <li>2. Remove brake and tighten set screws.</li> </ol>
Motor brake does not release.	<ol style="list-style-type: none"> <li>1. Defective brake control circuit.</li> <li>2. No brake air gap.</li> <li>3. Defective brake coil.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace control circuit.</li> <li>2. Adjust air gap.</li> <li>3. Replace entire brake.</li> </ol>
Pot feedback signal not present at some position of actuator output rack.	<ol style="list-style-type: none"> <li>1. Pot not aligned with end of travel switches and is being driven thru dead region.</li> <li>2. Pot signal is erratic or pot broken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Align pot to range of actuator.</li> <li>2. Replace pot.</li> </ol>
Pot signal does not change as output rack moves.	<ol style="list-style-type: none"> <li>1. Broken or burnt out pot.</li> <li>2. Feedback gear not turning pot shaft.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace pot.</li> <li>2. Check gearing engagement and set screws in gear hub.</li> </ol>
Pot signal is reversed for output rack movement.	<ol style="list-style-type: none"> <li>1. Pot is wired to wrong terminals.</li> </ol>	<ol style="list-style-type: none"> <li>1. Reverse wiring from ends of pot at actuator terminal block.</li> </ol>
Output rack moves wrong direction for LEFT and RIGHT input power.	<ol style="list-style-type: none"> <li>1. Wiring to actuator incorrect.</li> <li>2. Wiring from motor to terminals or switches is backward.</li> </ol>	<ol style="list-style-type: none"> <li>1. Correct field wiring.</li> <li>2. Correct internal actuator wiring.</li> </ol>
Water droplets inside motor area of actuator.	<ol style="list-style-type: none"> <li>1. Condensation caused by temperature variations and humidity.</li> <li>2. Water entering actuator.</li> </ol>	<ol style="list-style-type: none"> <li>1. Add heater and thermostat circuit or keep existing circuit energized.</li> <li>2. Keep cover tight, check conduit entry.</li> </ol>

## AD-8200 SERIES (BUILT-IN) AMPLIFIER

### DESCRIPTION:

The built-in AD-8200 Series Amplifiers are used to control the actuator output rack position, in relation to the CUSTOMER SUPPLIED 4 to 20 mA COMMAND SIGNAL.

The amplifier requires two input signals. One signal is from the CUSTOMER SUPPLIED 4 to 20 mA COMMAND SIGNAL and the other is the FEEDBACK SIGNAL from the actuator.

The 4 to 20 mA COMMAND SIGNAL is converted to a .8 V dc to 4.0 V dc signal at the amplifiers input, by use of a 200 ohm shunt resistor. The FEEDBACK SIGNAL is obtained from a 1000 ohm potentiometer built into the actuator. The potentiometer has a dc voltage applied to it from the amplifier. The voltage applied to the potentiometer is adjustable with the HI-TRIM and LO-TRIM adjustments located on the amplifier circuit board. The feedback potentiometer is gear driven from the actuator output shaft and the voltage derived from it changes as the output shaft turns and moves the rack. The LO-TRIM is used to adjust the minimum signal from the feedback potentiometer to a level of .8 V dc and the HI-TRIM is used to adjust the maximum signal from the feedback potentiometer to a level of 4.0 V dc. When properly adjusted for the range of the actuator output rack, the feedback signal and the command signal will be equal at the minimum and maximum voltage levels and the actuator output rack will follow the command signal in a linear fashion.

If the two signals are equal, the amplifier's output circuit is "OFF" and both light emitting diodes (LED 1 and LED 2) on the amplifier will be "OFF". When the COMMAND SIGNAL is greater than the FEEDBACK SIGNAL, LED 2 will be turned "ON" and power from the amplifier will drive the actuator rack in the "LEFT" direction. When the COMMAND SIGNAL is less than the FEEDBACK SIGNAL, LED 1 will be turned "ON" and power from the amplifier will drive the actuator rack in the "RIGHT" direction. The actuator motor will run until the FEEDBACK SIGNAL is equal to the COMMAND SIGNAL (within the amplifier DEADBAND setting) and the LED turns "OFF" or until an end of travel limit switch is tripped in the actuator. If a limit switch is tripped and the LED is "ON", the HI and LO trim adjustments are not properly adjusted. The DEADBAND adjustment on the amplifier is used to adjust the amplifier's sensitivity to the difference of the COMMAND and FEEDBACK SIGNALS. It must be adjusted to stabilize the AMPLIFIER/ACTUATOR loop, in final installation with the CUSTOMER COMMAND SIGNAL.

A DYNAMIC BRAKE CIRCUIT is built into the amplifier. The function of this circuit is selected with a jumper for "ON" or "OFF" by the customer. When the jumper is in the "OFF" position the circuit is not used. When the jumper is in the "ON" position, the circuit causes both motor directional outputs to be turned "ON" for a period of 130 ms whenever the amplifier nulls. This electrically stalls the motor by applying power to both the INCREASE and DECREASE windings at the same time to prevent motor coasting. The use of the DYNAMIC BRAKE CIRCUIT depends upon the number of actuator positioning changes per hour, as each time the circuit is energized heat will be generated within the motor. Excessive motor heat will cause the thermal overload in the motor to shut off the motor. The overload will reset automatically when the motor windings cool down.

The amplifier has a built-in LOSS OF SIGNAL (LOS) detection circuit. This circuit monitors the 4 to 20 mA COMMAND SIGNAL. Loss of signal may be either a broken wire or a "low command signal". The detection level is adjustable from 0 to 7 mA with the "LOS" pot on the amplifier. When in "LOS", a jumper on the amplifier is selected to cause the actuator to "RUN TO HI LIMIT" "LOCK IN PLACE" or "RUN TO LOW LIMIT". Adjusting the "LOS" pot for a signal detection level above 4 mA will not allow normal signal control at 4.0 mA. The "LOS" pot is normally adjusted for a 3.6 mA trip point.

If the actuator has a built-in motor brake, the brake coil is energized from the amplifier each time one of the LEDS turn "ON" to drive the motor. When the LED turns "OFF" the motor brake friction disc stops the motor. This is not the same function as "DYNAMIC BRAKING" previously described. When the actuator is supplied with a motor brake, the DYNAMIC BRAKE CIRCUIT JUMPER should be selected to the "OFF" position.

## START-UP

### Actuators with built-in AD-8200 Series Amplifier

The ACTUATOR/AMPLIFIER combination has been factory calibrated and only minor adjustments will need to be made during installation.

#### INITIAL INSTALLATION CALIBRATION

- 1) If the actuator has been mounted and coupled to the controlled equipment, remove the coupling from the actuator output rack to the driven unit.
- 2) Apply a COMMAND SIGNAL that can be varied from 0 to 20 mA and adjust it for 12 mA.
- 3) Apply INPUT POWER. A light emitting diode (LED) on the amplifier will turn "ON" and the actuator output rack will be moved to mid-travel. Upon positioning to this set point, the LED will turn "OFF" and the output rack will stop.
- 4) Set the COMMAND SIGNAL to 4.00 mA. The actuator output rack will move in the "DECREASE" (RIGHT) direction until LED 1 turns "OFF" or the "RIGHT" END OF TRAVEL LIMIT SWITCH (in the actuator) is tripped. Adjust "LO TRIM" (on the amplifier) to just turn "OFF" LED 1 before the limit switch trips. If the switch trips before LED 1 turns "OFF", adjust "LO TRIM" to turn LED 1 "OFF" with the switch tripped.
- 5) Determine the amount of rack movement needed for travel of the driven unit.
- 6) Use a ruler or scale to measure the stroke length and slowly give the amplifier an increasing signal. The rack will move to the LEFT. When the rack travel corresponds to the stroke required for the driven unit, adjust the "LEFT" END OF TRAVEL LIMIT SWITCH to just trip.
- 7) Set the COMMAND SIGNAL to 20.00 mA.
- 8) Adjust "HI TRIM" on the amplifier to just turn "OFF" LED 2 before the switch trips.
- 9) Repeat the "LO" and "HI TRIM" adjustments until the actuator stops at each end of travel, just before the end of travel switches are tripped and the LEDs turn "OFF".
- 10) Set the COMMAND SIGNAL to 4.00 mA and allow the actuator to stop running.
- 11) With the actuator and the driven unit at the 4.00 mA position, couple the units.
- 12) Adjust the COMMAND SIGNAL to various settings between 4 and 20 mA and adjust the "DEADBAND" potentiometer (on the amplifier) for best response without having the actuator oscillate at set points.
- 13) Repeat the "LO" and "HI TRIM" adjustments after "DEADBAND" is adjusted.
- 14) Select the "LOS" jumper for the desired function - RUN HI, LOCK-IN-PLACE or RUN LO.
- 15) Adjust the COMMAND SIGNAL to 3.6 mA. The "LOS" function selected should occur. If it doesn't, adjust "LOS TRIM" to trip at 3.6 mA.

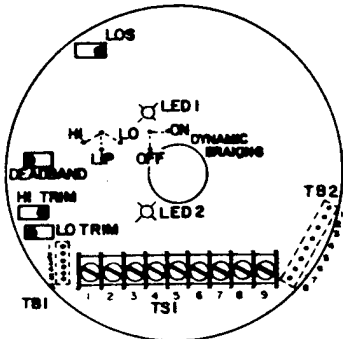
#### REVERSING THE ACTUATOR DIRECTION WITH RESPECT TO AN INCREASING COMMAND SIGNAL

Refer to NOTE 2 on PAGE 22 for internal wiring changes. Perform above calibration, keeping in mind that the "DECREASE" switch is now the "LEFT" END OF TRAVEL SWITCH and "INCREASE" is now the "RIGHT" END OF TRAVEL SWITCH.

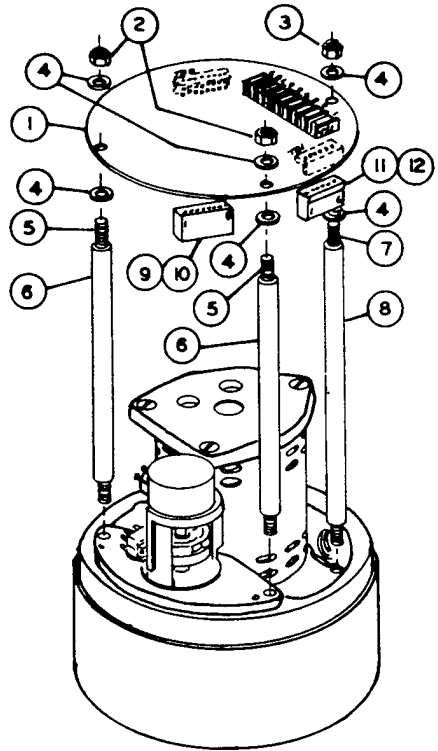
#### CALIBRATION IF LIMIT SWITCHES HAVE BEEN ALTERED or POTENTIOMETER REPLACED

- 1) If an INCREASING COMMAND SIGNAL is rack movement to the "LEFT".
  - A) Start with the rack at it's "RIGHT" most position.
  - B) Remove plug TB-1 from the amplifier and loosen pot nut holding feedback pot VR-1.
  - C) Rotate the pot body until 50 ohms is measured from PIN 1 to PIN 3 of TB-1.
  - D) Tighten the pot nut and adjust LS-2 (RIGHT) to trip at this point.
  - E) Insert plug TB-1 on the amplifier and perform INITIAL INSTALLATION CALIBRATION.
- 2) If an INCREASING COMMAND SIGNAL is rack movement to the "RIGHT".
  - A) Start with the rack at it's "LEFT" most position.
  - B) Perform steps B thru E above changing step D to read LS-1 (LEFT).

# ACTUATOR WITH BUILT-IN AMPLIFIER



LITER	DESCRIPTION	PART NUMBER	QTY
1	AMPLIFIER AD-8210 (120 Vac) AD-8220 (240 Vac)	70A-023905-001 70A-023905-002	1
2	10-24 ESNA Nut	58B-024244-206	2
3	8-32 ESNA Nut	58B-024244-203	1
4	Fiber Washer	56B-005479-003	6
5	10-24x6.93 long stud	61A-025129-001	2
6	Spacer 5.911 long	61A-025128-001	2
7	8-32x8.06 long stud	61A-025130-001	1
8	Spacer 7.281 long	61A-025128-003	1
9	Connector 8 Pin	45B-019344-108	1
10	Crimp Terminals	45B-019344-201	8
11	Connector 6 Pin	45B-023445-006	1
12	Crimp Terminals	45B-023445-101	6



## NOTES:

- 1) The LA-1510,20,30/AD-8210 require 120 Vac INPUT POWER. The LA-1550,70,90/AD-8220 require 240 Vac INPUT POWER.

### FUSING IS NOT PROVIDED WITHIN THE ACTUATOR/AMPLIFIER:

Fuse the INPUT POWER LINE for a value slightly higher than the units rating. In most cases a 2 AMP SLO-BLO fuse will be the proper size.

- 2) AN INCREASING COMMAND SIGNAL will result in actuator rack movement to the LEFT. (as viewed from the rack block mounting face with the rack teeth down).  
If it is desired that an INCREASING COMMAND SIGNAL result in rack movement RIGHT, it will be necessary to interchange the MOTOR DIRECTION WIRES to PINS 2 and 3 in the PLUG of TB-2 and also the POTENTIOMETER WIRES to PINS 2 and 3 in the PLUG of TB-1. After reversing the wires and with LIMIT SWITCH LS-1 just tripped, remove PLUG TB-1 from the AMPLIFIER, loosen the pot bushing nut and rotate the body of VR-1 until 50 ohms is read from PIN 1 to PIN 3 of PLUG TB-1. Tighten the pot nut and insert the plug into the amplifier connector.
- 3) CALIBRATION: Refer to AMPLIFIER/ACTUATOR CALIBRATION.
- 4) When VR-2 is supplied for FEEDBACK (for customer use), resistance as measured between FIELD WIRING TERMINALS 1 and 2 will be INCREASING as the actuator rack moves to the LEFT.
- 5) OPTIONAL TRANSMITTER:  
The ST-4130 4 to 20mA TRANSMITTER wired as shown will result in an INCREASING SIGNAL for actuator rack movement to the LEFT. Operation of the TRANSMITTER requires an EXTERNAL DC POWER SUPPLY with an output in the range of 12.5 Vdc (MIN) to 36.0 Vdc (MAX) and a LOAD connected in series with one lead from the power supply.

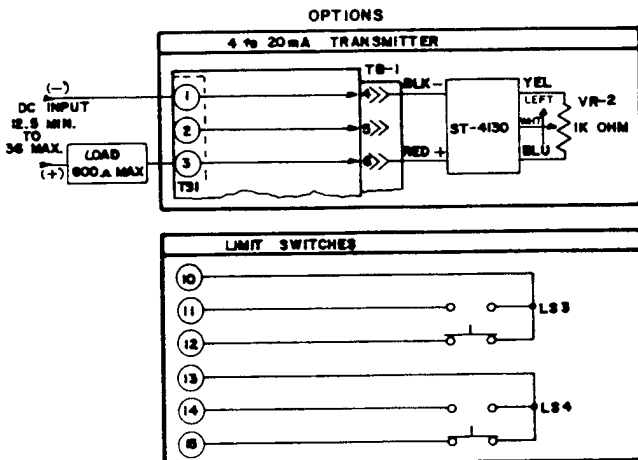
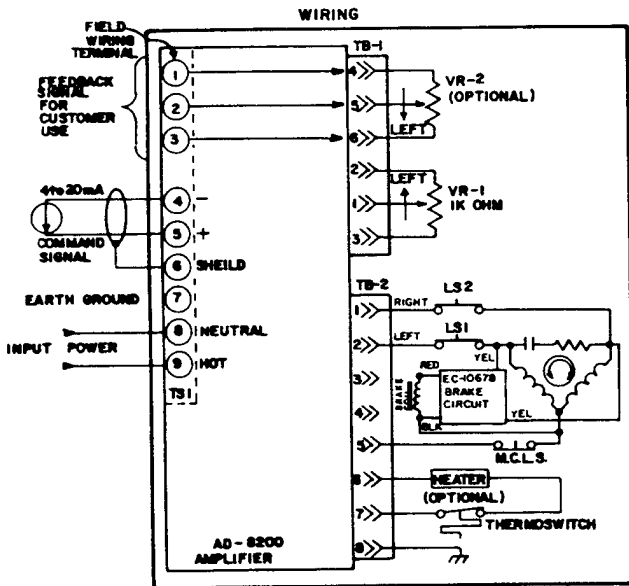
POWER SUPPLY VOLTAGE - 12V .020A

Connect (-) to FIELD WIRING TERMINAL 1 and (+) to FIELD WIRING TERMINAL 3.

With the actuator rack at it's RIGHT end of travel, adjust VR-2 pot body for 50 ohms from the WHITE to BLUE pot wires. Adjust "ELEVATION" on the TRANSMITTER for 4.00mA output. With the actuator rack at the LEFT end of travel, adjust "RANGE" for 20.0mA output. Repeat the "ELEV" and "RANGE" ADJUSTMENTS.

To reverse the TRANSMITTER OUTPUT and cause the signal to increase for rack movement to the RIGHT, interchange the BLUE and YELLOW wires at the pot terminals. Adjust the body of the pot for 50 ohms across the WHITE and BLUE wires with the rack at it's LEFT end of travel. Adjust "ELEV" for 4.00mA output. With the rack at the RIGHT end of travel, adjust "RANGE" for 20.0mA output.

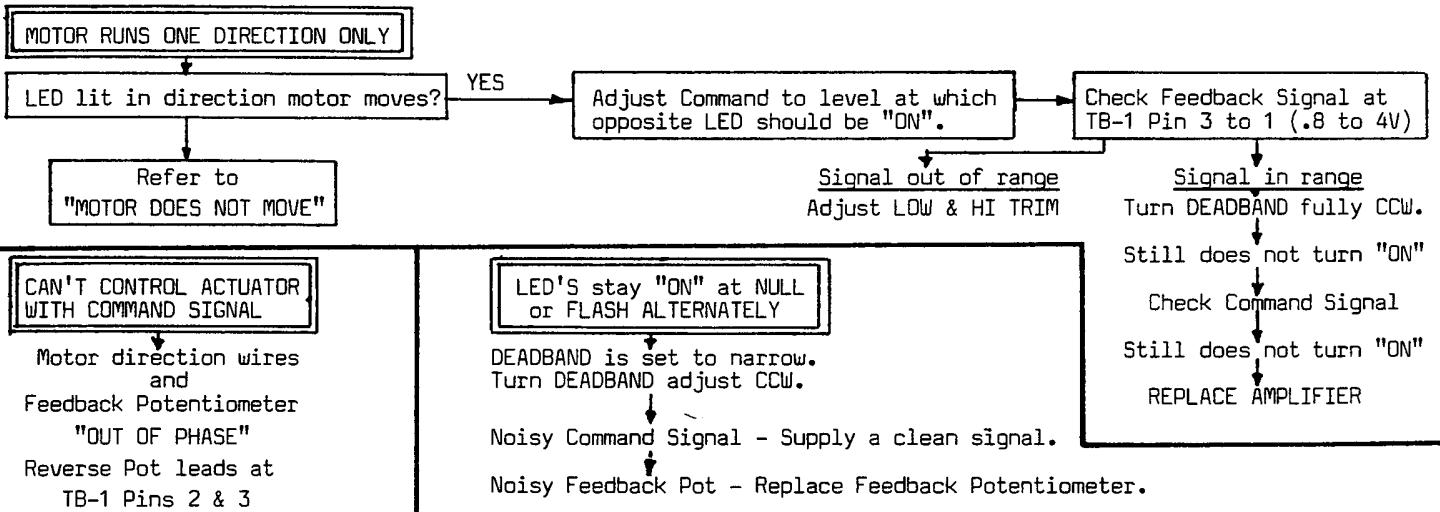
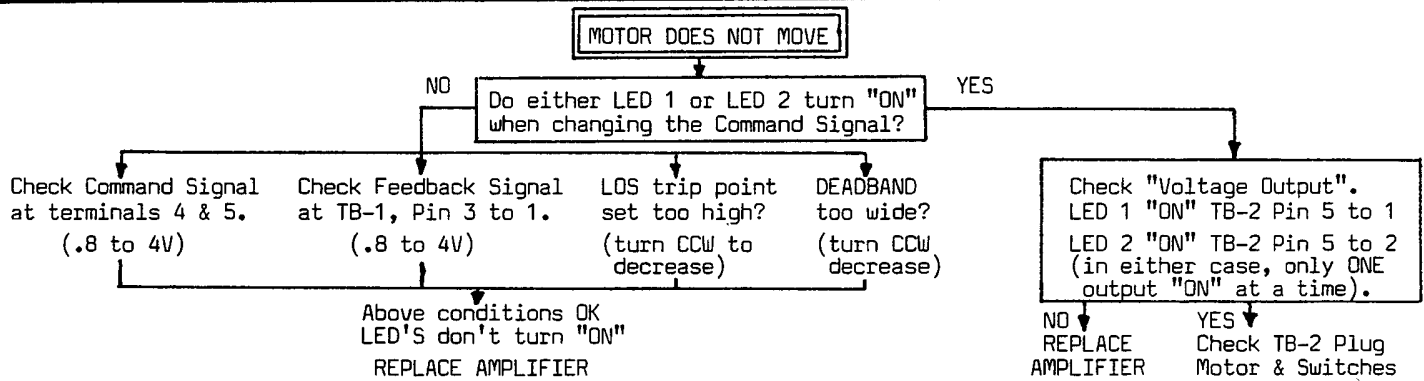
- 6) Shielded wiring is recommended for all incoming COMMAND and FEEDBACK SIGNAL wiring. Connect the shield to TERMINAL 6.
- 7) OPTIONAL LIMIT SWITCHES LS-3 and LS-4 may be adjusted with the YELLOW CAMS to trip anywhere within the range of the actuators end of travel limits.
- 8) SWITCH M.C.L.S. (MANUAL CRANK LIMIT SWITCH) is only used on units equipped with the MANUAL HANDCRANK OPTION. The switch is normally closed and when the handcrank is engaged the motor power circuit is opened.
- 9) OPTIONAL HEATER and THERMOSWITCH:  
The HEATER is powered thru the THERMOSWITCH from the AMPLIFIERS LINE POWER. The THERMOSWITCH is CLOSED at 90°F and OPENS at 110°F. 120 Vac units use a 30 WATT HEATER and 240 Vac units use a 75 WATT HEATER.
- 10) Refer to IM-0530 for further information on the AD-8200 SERIES AMPLIFIER.



**TROUBLE-SHOOTING  
ACTUATOR WITH AD-8200 BUILT-IN AMPLIFIER**

FUNCTION TO TEST	MEASUREMENT TO BE MADE	CORRECTION TO MAKE
INPUT POWER "ON".	Line voltage at terminals 8 to 9.	Check INPUT POWER source.
Command set to 12.0 mA	2.4 Vdc, terminal 4 (-), terminal 5 (+)	Check Command signal and resistor R23 (200 ohms) on amplifier.
Feedback Power Supply	TB-1 Pin 3 (-), to Pin 2 (+) should read 15 Vdc or less depending on settings of LOW and HI TRIM pots on amp.	Read nothing -- Replace amplifier. Read 15 Vdc -- Check pot VR-1 in actuator and plug connections.
Feedback Pot Signal	TB-1 Pin 3 to Pin 1 Should read signal input from VR-1 The signal changes as actuator is running.	No signal or erratic Check pot VR-1 in actuator and plug.
Decrease the Command Signal to cause LED 1 to turn "ON" then increase to turn "OFF".	With LED 1 "ON" measure Voltage Output TB-2 Pin 5 to Pin 1. *LED 1 "OFF" read 0 volts out.	If output does not turn "ON" and "OFF", replace amplifier.
Increase the Command Signal to cause LED 2 to turn "ON" then decrease to turn "OFF".	With LED 2 "ON" measure Voltage Output TB-2 Pin 5 to Pin 2. *LED 2 "OFF" read 0 volts out.	If output does not turn "ON" and "OFF", replace amplifier.

\* With motor running, a voltage greater than "Voltage Output" will be present. -- caused by Motor/Capacitor phase shift.





## MAINTENANCE and PARTS REPLACEMENT

### \*\* WARNING - SHOCK HAZARD \*\*

Maintenance must be performed only by qualified personnel.  
Voltages hazardous to your health are applied to these actuators.  
De-energize all sources of power before removing actuator cover.  
Failure to follow these precautions may result in serious injury or death.

#### LUBRICATION

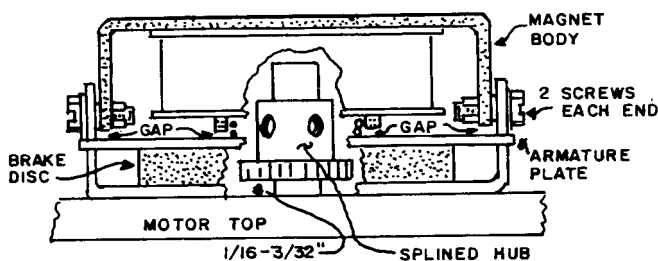
The gearing is permanently lubricated with AMOCO-RYKON PREMIUM GREASE #2 or equal. Re-lubrication is only required during repairs to the power gearing

The bronze bushings are lubricated with a few drops of SAE 10 or 20 NON-DETERGENT oil, re-lubricate when repairs are made.

#### MOTOR BRAKE REPLACEMENT

Refer to page 11

- 1) Remove 2 screws and lockwashers (3 & 4).
- 2) Remove brake ass'y (2) from top of motor (13).
- 3) The brake hub is held to the motor shaft with 2 set screws. Loosen the set screws and remove the brake hub from the motor shaft.
- 4) Place the new brake hub on the motor shaft with the spline toward the motor top, positioning the hub 1/16 to 3/32" from the motor top. Tighten the set screws.
- 5) Place the new brake ass'y over the hub, engaging the brake disc with the spline hub.
- 6) Rotate the brake ass'y to align the mounting holes and secure with screws and lockwashers.
- 7) Remove the old brake coil wires at their terminations and connect the new wires.
- 8) Measure the brake gap using feeler gages and adjust if required.



When air gap between magnet body and armature plate exceeds .025" reset to .010".

Loosen 4 screws holding magnet body in place. Insert feeler gages between magnet body and armature plate. Push magnet body down against feeler gages and tighten 4 screws. Remove feeler gages and check brake operation.

#### MOTOR REPLACEMENT ac MOTORS

- 1) If the actuator has a built-in amplifier as shown on page 22, remove the amplifier. Refer to page 11.
- 2) Remove the motor brake (2) if supplied.
- 3) Remove 3 screws (14), motor top (13), Belleville washers (16) and motor stator (15).
- 4) Pull the rotor with pinion gear out of housing.
- 5) Insert new rotor with pinion gear into housing.
- 6) Install new stator with the thermal overload (on one end of the windings) outward, away from the housing. This may be opposite of the way the old stator was mounted. Care must be taken to prevent nicking or cutting the windings when guiding the stator over the rotor.
- 7) Place the Belleville washers (16) on top of the rotor bearing with the first washer "cupped" down to touch the outer race of the bearing and the second washer "cupped" upward.
- 8) Position the motor top over the motor, install the motor mounting screws and tighten evenly. The rotor must rotate freely.
- 9) Remove old motor wires and wire the new motor. The motor wire colors may or may not match the old motor. If the old motor was mounted with the thermal overload opposite of the new, the motor direction leads must be reversed as compared to the original wiring.
- 10) Install any other parts that were removed and test the actuator.

#### MOTOR REPLACEMENT dc MOTORS

- 1) IF THE MOTOR IS MOUNTED WITH ADAPTOR PLATE ( 33).
  - A) Remove 2 screws and lockwashers (34 & 10).
  - B) Remove motor with adaptor plate from housing.
  - C) Remove screws (35) holding motor to plate.
  - D) Mount new motor with pinion gear attached to its shaft, insert and tighten screws (35).
  - E) Mount motor and adaptor to housing with screws and lockwashers (34 & 10), tighten evenly.
  - F) Remove old motor wires and connect new wires.
  - G) Install any other parts removed and test.
- 2) IF MOTOR IS NOT MOUNTED USING ADAPTOR PLATE (33).
  - A) Remove feedback ass'y and feedback gearing.
  - B) Remove rack block ass'y, c'ring, roll pin and pinion gear from output shaft.
  - C) Remove housing screws and lockwashers (24 & 25)
  - D) Remove gear housing cover (41).
  - E) Remove motor mounting screws (35) from inside of actuator housing.
  - F) Install new motor with pinion gear attached and Tighten screws (35) evenly.
  - G) Remove old motor wires, connect new wires.
  - H) Install all other parts which were removed.
  - I) Test actuator and align feedback for range.

## FEEDBACK GEARING REPLACEMENT

Refer to page 11

- 1) Remove 2 screws and lockwashers (9 & 10) holding mounting plate (7) to housing (22).
- 2) Carefully lift mounting plate (7) off of the locating dowel pins (8).
- 3) Refer to page 17. Depending upon the gear ratio, the feedback gearing will consist of only gears A and C or it will include gear assembly B.
- 4) Gear A is attached to the output shaft tip with either 2 set screws in its hub or it is pressed onto the tip and loctite is used to bond it. If loctite is used and removal is required, the gear will be destroyed. To remove it, apply heat and carefully pull the gear off without bending the shaft tip. If the gear is held with set screws, loosen them to remove the gear.
- 5) Gear C is held to the pot/switch shaft using 2 set screws in its hub. Loosen them to remove the gear.
- 6) Gear ass'y B consists of two gears pressed onto a shaft with retaining rings on each end to position it in the housing. If replacing this assembly, replace the complete assembly, do not attempt to salvage a gear or the shaft.
- 7) If the gear ratio is being changed and gear B is being added, a bushing must be installed in the housing (item 21 on page 12).
- 8) Changing the gear ratio to add or delete gear assembly B will change the rotation of the potentiometer/limit switch assembly in relation to the actuator rack direction of travel. This will require re-wiring of the limit switches and potentiometer for proper direction of travel. Failure to re-wire will result in switches not shutting off motor power when they are tripped and reverse phasing of the potentiometer signal.
- 9) Install the gearing and check for proper gear mesh. The gears should have at least 90% face width engagement. Lightly grease the gears. Test and align the actuator.

## POTENTIOMETER/LIMIT SWITCH ASSEMBLY REPLACEMENT

Refer to page 11

- 1) Remove 3 truss head screws (11).
- 2) Lift the feedback ass'y off the mounting plate.
- 3) A gear is attached to the shaft on the bottom of the ass'y. Measure the distance from the bottom of the disc or frame to the outer face of the gear. Loosen 2 set screws in the gear hub and remove the gear from the shaft.
- 4) Place the gear on the new ass'y to the dimension measured above and tighten the set screws.
- 5) Insert the ass'y into the mounting plate, check the gear mesh and install 3 truss head screws.
- 6) Using a 25 watt solder iron, transfer the wires from the old ass'y to the new, one at a time to prevent wiring errors.
- 7) Test and align the actuator.

## LIMIT SWITCH REPLACEMENT

Refer to page 18

Switches are mounted with screws, remove the screws, remove the switch, mount the new switch, transfer the wires from the old switch to the new.

Check the cam action with the switch and switch lever for proper operation.

Check the switch alignment for ends of travel.

## POTENTIOMETER REPLACEMENT

- 1) Perform POTENTIOMETER/LIMIT SWITCH ASSEMBLY REPLACEMENT steps 1, 2 and 3.
- 2) Refer to page 18. The assembly will look like one of those shown. Perform step 3A or 3B.
- 3A) BUILT AS SHOWN IN Fig. 1
  - A) Remove the pot body nut and lockwasher.
  - B) Separate the potentiometer from the disc.
  - C) Measure the length of the old pot shaft.
  - D) Carefully cut the shaft of the new pot to the length of the old and de-burr the shaft.
  - E) Mount the pot to the disc using the new nut and lockwasher supplied.
  - F) Perform steps 4 thru 7 of POTENTIOMETER/LIMIT SWITCH ASSEMBLY REPLACEMENT.
- 3B) BUILT AS SHOWN IN Fig. 2
  - A) Loosen set screws holding the cams to the pot shaft. Observe the relation of the set screws to that of the dwell in the cams. The cams must be installed properly to allow access to the set screws in final adjustment.
  - B) Loosen the pot body nut and remove the pot from the frame. Replace the cams if needed.
  - C) Insert the new pot into the top of the frame, guiding the shaft thru the lockwasher, pot nut, cams and bottom hole of the frame.
  - D) Tighten the pot nut and perform steps 4 thru 7 of POT/LIMIT SWITCH ASSEMBLY REPLACEMENT.

## POWER GEARING REPLACEMENT

Refer to page 11

- 1) Perform steps 1,2,3,4 and 6 of FEEDBACK GEARING REPLACEMENT.
- 2) Remove 2 screws (78) from bottom of rack block.
- 3) Remove rack block assembly, located with 2 dowel pins (40) from gear case cover (41).
- 4) Remove c'ring (75), roll pin (74) and gear (73) from the output shaft.
- 5) Remove 3 screws (24) and lockwashers (25) holding gear case cover (41) to housing (22).
- 6) Remove gear case cover (41) located with dowel pin (40) from housing (22).
- 7) Refer to pages 15 and 16 for gearing variations, locations and part numbers.
- 8) Clean all gears and gear housing. Inspect and replace any worn or damaged bearings or gears.
- 9) Lubricate bushings with a few drops of SAE 10 or 20 NON-DETERGENT oil.
- 10) Install gearing in proper locations of housing and lightly grease gear teeth with AMOCO-RYKON PREMIUM GREASE #2 or equal.
- 11) Slide gear case cover (41) over the output shaft and push in place using dowel pin (40) to locate.
- 12) Install screws (24) with lockwashers (25).
- 13) Install gear (73), roll pin (74) and c'ring (75) onto the output shaft. If the output shaft was replaced, drill a new 3/16" dia. hole thru the hub of the gear and the output shaft.
- 14) Install the rack block assembly with the rack near the center of travel.
- 15) Install the feedback gearing and feedback ass'y.
- 16) If the power gear ratio was changed, the internal actuator wiring of the motor, limit switches and potentiometer may need to be reversed as going from an odd number of gear stages to an even number will reverse the direction of the rack movement.
- 17) Perform calibration adjustments.



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