

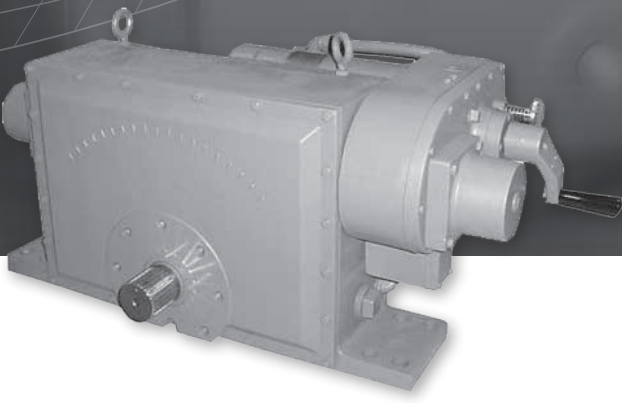
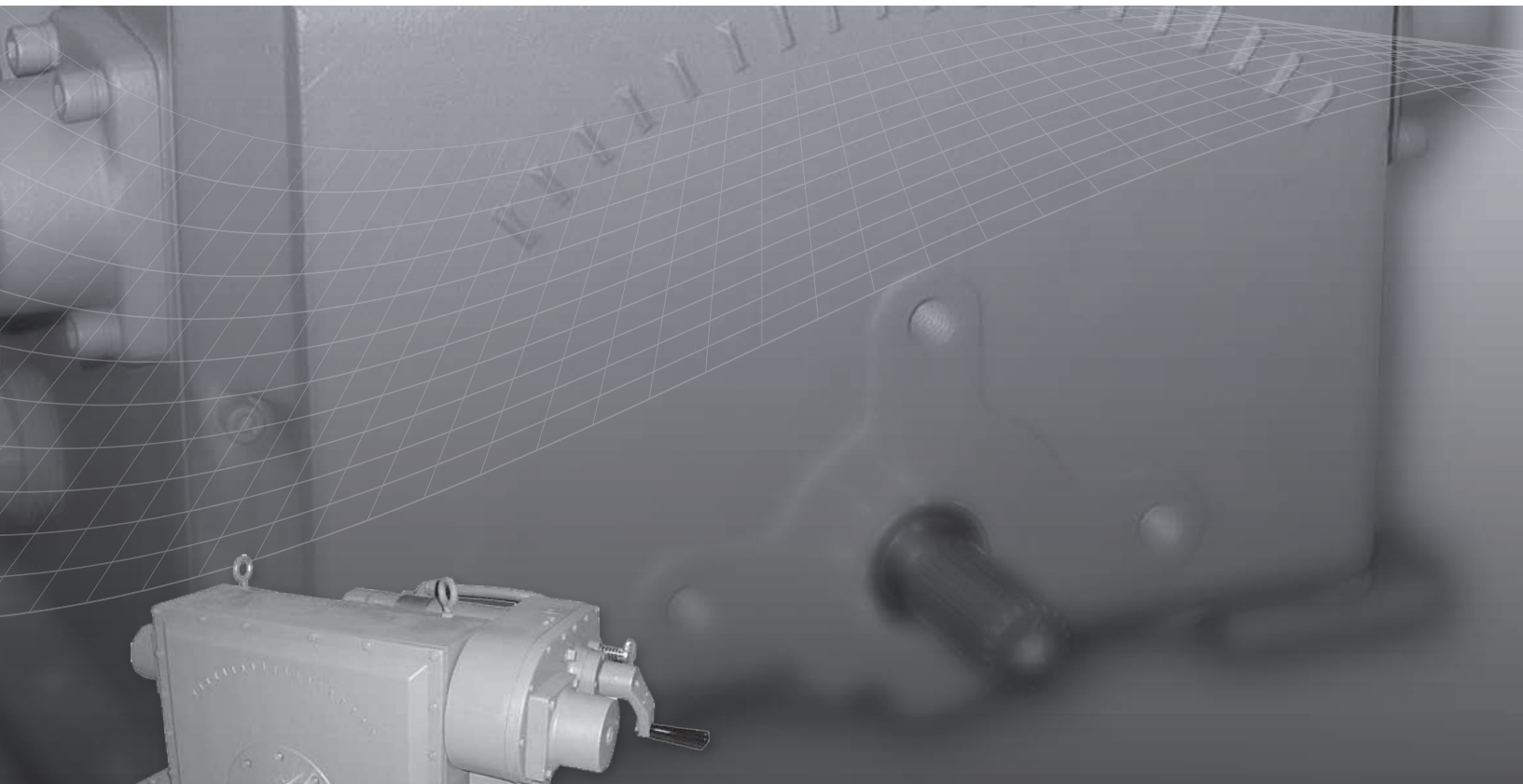
# rotork<sup>®</sup>

## Process Controls



### SM-5300 Series

#### Installation Manual

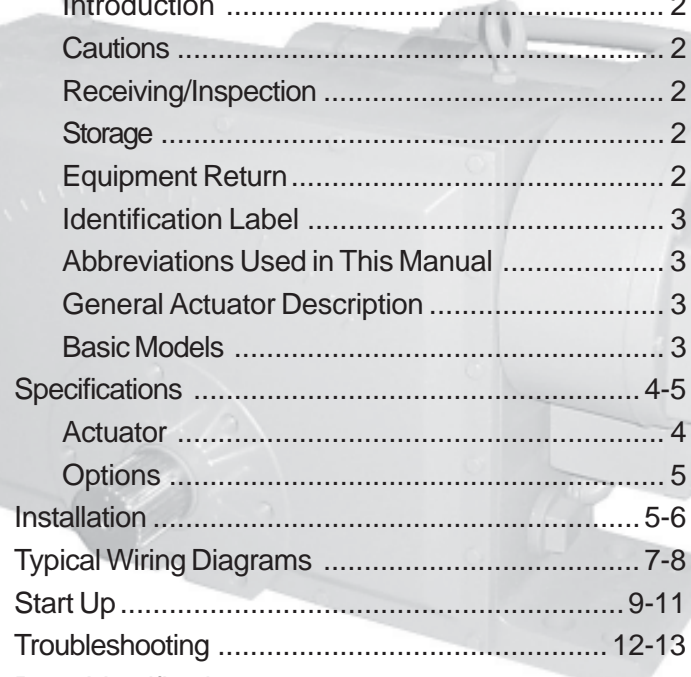


**Rotary Actuators**

**Redefining Flow Control**

## SM-5300 Series Rotary Actuator

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**Failure to properly wire torque/thrust switches will result in actuator damage.**  
*Refer to the specific wiring diagram supplied with your actuator for correct wiring.*

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

# GENERAL INFORMATION

## INTRODUCTION

Rotork Process Controls designs, manufactures, and tests its products to meet national and international standards. For these products to operate within their normal specifications, they must be properly installed and maintained. The following instructions must be followed and integrated with your safety program when installing, using, and maintaining Rotork Process Controls products:

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

If any of the instructions are not understood, contact your Rotork representative for clarification.

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

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

Install equipment as specified in Rotork Process Controls installation instructions and per applicable local and national codes. Connect all products to the proper electrical sources.

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 Rotork Process Controls. Substitutions may result in fire, electrical shock, other hazards, or improper equipment operation.

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



### WARNING

Before installing the actuator, make sure that it is suitable for the intended application. If you are unsure of the suitability of this equipment for your installation, consult Rotork Process Controls prior to proceeding.



### WARNING - SHOCK HAZARD

**Installation and servicing must be performed only by qualified personnel.**



### WARNING - ELECTROSTATIC DISCHARGE

**This electronic control is static-sensitive. To protect the internal components from damage caused by static discharge, never touch the printed circuit cards without being statically protected.**

## RECEIVING INSPECTION

Carefully inspect for shipping damage. Damage to the shipping carton is usually a good indication that it has received rough handling. Report all damage immediately to the freight carrier and Rotork Process Controls.

Verify that the items on the packing list or bill of lading agree with your own.

## STORAGE

If the actuator will not be installed immediately, it should be stored indoors in a clean, dry area where the ambient temperature is not less than -20° F. The actuator should be stored in a non-corrosive environment. The actuator is not sealed to NEMA 4 until the conduit entries are properly connected.

## EQUIPMENT RETURN

**A Returned Goods authorization (RG) number is required to return any equipment for repair.** This must be obtained from Rotork Process Controls. (Telephone: 414/461-9200) The equipment must be shipped, freight prepaid, to the following address after the RG number is issued:

Rotork Process Controls  
5607 West Douglas Avenue  
Milwaukee, Wisconsin 53218  
Attn: Service Department

To facilitate quick return and handling of your equipment, include:

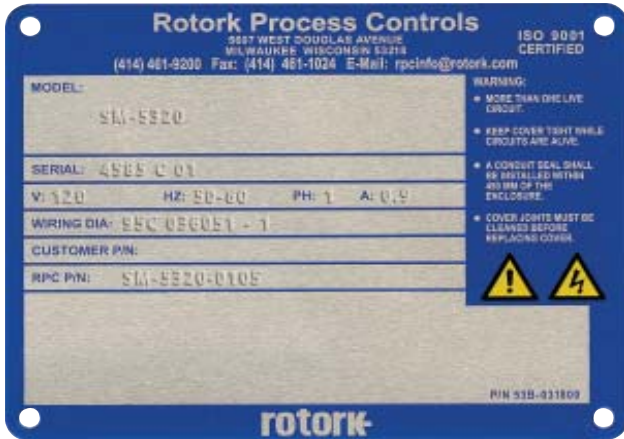
RG Number on outside of box  
Your Company Name, Contact Person, Phone/Fax #  
Address  
Repair Purchase Order Number  
Brief description of the problem

# GENERAL INFORMATION

## 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 NUMBER: SM-5320 Series

SERIAL NUMBER: 4585 C 01

## GENERAL DESCRIPTION, ACTUATOR

The SM-5300 Series are quarter turn, rotary actuators that produce up to 3,200 ft. lbs. (4,339 Nm) of torque, and offer continuous modulating duty up to 4,000 starts per hour. They are designed for up to 90° rotation with bi-directional torque overload protection and have a manual override handcrank. This series of actuators uses a scotch-yoke output gearing design that provides up to 66% more torque at the ends of travel (0° and 90° positions). The SM-5300 Series is ideally suited for dampers, vanes and valve control requiring high torque and exact position control.

All SM-5300 Series actuators are also available with an internal amplifier. These amplifiers are all full-featured ac or dc switching devices designed to seamlessly work with the actuator for closed loop control.

The SM-5100 series includes 120/240 Vac single phase models, 208/240/380/480 Vac three phase models, and 90 Vdc models. Up to six independently adjustable position limit switches are available as options.

## ABBREVIATIONS USED IN THIS MANUAL

A .....	Ampere
AC .....	Alternating Current
° C .....	Degrees Celsius
CW .....	Clockwise
CCW .....	Counterclockwise
DC .....	Direct Current
° F .....	Degrees Fahrenheit
G .....	Earth Ground
Hz .....	Hertz
in. lbs. ....	Inch Pounds
kg .....	Kilogram
L .....	Line (power supply)
lbs. ....	Pounds Force
LVDT .....	Linear Variable Differential Transformer
mA .....	Milliamp
mfd .....	Microfarad
mm .....	Millimeters
N .....	Newton (force)
NEMA .....	National Electrical Manufacturing Association
Nm .....	Newton Meter
NPT .....	National Pipe Thread
PH .....	Phase
PL .....	Position Limit Switch
RPM .....	Revolutions per Minute
SEC .....	Second
TL .....	Torque Limit Switch
V .....	Volts
VA .....	Volt Amps
Vac .....	Volts ac
Vdc .....	Volts dc
VR .....	Variable Resistance
W .....	Watt

## BASIC MODELS

**SM-5320** models are single phase ac, three wire, plug reversible units. **SM-5310** models are three phase ac, reversible units.

Both of these models are also available with internal or remote mounted servo amplifiers that features loss of signal detection for current command signal inputs and can be calibrated to allow the actuator to lock-in-place or drive to a preset position should the command signal drop below 3.8mA. Also included is a dynamic brake circuit to increase positioning accuracy and a loop-powered, 4 to 20mA position transmitter.

**SM-5360 models** are 90 Vdc proportional control units. These models are also available with an internal or remote mounted AD-7830 or AD-9120 servo amplifier.

# SM-5300 Series Specifications

**Rotation:** Up to 90°

**Modulation Rate:** AC: 2,000 starts/hour.  
*Minimum position change of 1%*  
 DC: 4,000 starts/hour.  
*Minimum position change of 1%*

**Temperature:** -40°F to 150°F (-40°C to 65°C).

**Environment Ratings:** NEMA Type 4 (IP65) or Explosion Proof, Class I, Division 1, Groups C & D. Class II, Division 1, Groups E, F & G.

**Weight:** Approximately 350 lbs. (158 kg).

**Enclosure Materials:** Cast aluminum alloy.

**Lubrication Type:** Grease, permanently lubricated.

**Gearing:** Spur type.

**Hold on Loss of Power:** Self-locking. Optional brake allows improved positioning response.

**Mounting:** Any position.

**Torque Limiting:** Bi-Directional, disables motor in one direction when torque rating is exceeded.

**Output Shaft:** 2.69-2.695 in. (68.33-68.45 mm) diameter with 30 tooth spline.

**Anti-Condensation Heater:** 120 or 240 Vac, 30 Watt with thermostat set for 110°F (43.3°C).

**Position Feedback:** 1000 ohm potentiometer. Optional contactless feedback available.

**Field Wiring:** To barrier type terminal blocks.

**Integral Thermal Protection/Single Phase AC Motor:** Standard thermal overload protection at 130°C, self resetting.

**End-of-Travel Position Limit Switches:** 20 amp, 250 Vac

Actuator Model	Input Power Volts/Phase/Hz	Current (Amps)		Amplifier Model		* Time/Torque sec./ft. lbs. (Nm)
		Run	Stall	Inernal	Remote	
<b>SM-5310</b>	208/3/50-60	2.9	14.5	AD-8900	AD-8900	23/1600 (2170) 47/1600 (2170) 47/3200 (4339)
	240/3/50-60	2.5	12.5			
	380/3/50	2.2	13.5			
	480/3/50-60	1.2	6.2			
<b>SM-5320</b>	120/1/50-60	10	12	AD-8130	AD-8230	23/1600 (2170) 47/1600 (2170) 47/3200 (4339)
	240/1/50-60	5	6			
<b>SM-5360</b>	90 Vdc	9.5	N/A	NA	AD-7830 or AD-9120	23/1600 (2170) 47/1600 (2170) 47/3200 (4339)
	120/1/50-60			AD-7830	NA	
	208/1/50-60			or		
	240/1/50-60			AD-9120		

\*Multiply these shift times by 1.2 for 50 Hz operation of AC models. All travel times are nominal for 90° of movement.



## OPTION SPECIFICATIONS

**Servo Amplifiers:** All servo amplifiers include a field-adjustable command signal monitor that can be set for lock-in-place, or drive to a pre-set position if the current command signal is lost. They also have a dynamic brake circuit which helps increase positioning accuracy of the loop by minimizing motor coast. These amplifiers are also equipped with a 4-20mA isolated two wire, loop-powered transmitter.

**Local Auto/Manual, INC/OFF/DEC Toggle Switches:** Actuator-mounted switches for control of Auto/Manual and INCREASE/OFF/DECREASE. These are available as toggle switches or NEMA style rotary switches.

**Output Shaft:** 2.75 in. (69.85 mm) diameter with 0.625 inch square (15.87 mm) keyway.

**30 Tooth Splined Drive Arm:** Reversible for ½ tooth positioning.

**Linkage Kit:** Includes two clevises, two adjustment rods with lock nuts, two pipe adapters, two pins for clevises.

**Auxiliary Position Limit Switches:** (two or four): 20 amps, 250 Vac maximum, or 5 amps at 28 Vdc.

**Transmitter Position Feedback:** 4 to 20mA, isolated two wire loop-powered type. Tracks actuator position. Requires separate power.

**Local Position Indicator:** Reversible indicator to show open or close in either direction.

**Local Control:** Actuator mounted NEMA 4 rated switches for control of AUTO/MANUAL and INCREASE/OFF/DECREASE. These are available as toggle switches or NEMA-style rotary switches.

**LVDT Contactless Feedback:** Characterized feedback assembly directly replaces the standard linear feedback potentiometer.

## Installation

### MOUNTING

The outline and mounting dimensions for a standard unit are shown on page 23 of this manual. The rear cover opposite output shaft must have clearance so that it may be removed for adjustments and interconnect wiring. When the actuator is directly coupled to a drive shaft, it is recommended that a flexible no backlash type coupling be used. The output shaft is also available with a splined output for standard lever arms and linkage drive to the driven load. The unit may be mounted on the standard foot mount, or a flange mount. Mounting may be in any position convenient to the driven load.

When mounting the unit, be sure that no excessive axial or side loading is applied to the output shaft. The limit switches and position feedback are connected through gearing to the output shaft of the actuator which should be positively secured to the driven load shaft so that no slippage can occur which would cause misalignment or damage.

When manual override is required, as in the event of a power failure, the crank is engaged by operating the auto-manual selector lever at the top of the actuator. The crank may then be turned in the proper direction for the de-

sired output shaft rotation. If during manual operation, electric power is applied to the actuator, the selector lever will return to the “auto” position and the actuator will respond to the power command. The shift from “manual” to “auto” disengages the manual crank, which cannot be power driven, thereby protecting the operator.

Care, however, should be taken when driving a load to recognize that excessive output torque may be developed by forcing the handcrank. A mechanical telltail-indicator shaft adjacent to the crank indicates over-torquing. The telltail-indicator shaft will either protrude or recede depending on the direction of over-torquing. Discontinue cranking on over-torque warning.

The motor, limit switch and feedback area of the actuator depends upon the cover to maintain the NEMA 4 rating. This cover should be removed only when actual work is being done in that area and reinstalled immediately thereafter.

This actuator contains no internal mechanical stops. If it is allowed to run outside of the initial factory alignment of the limit switches, a realignment of switches and feedback might be required. However, no internal damage will have occurred.

# Installation

## INSTALLATION WIRING

Typical wiring diagrams are shown on pages 7-8. **Actual wiring should follow the print supplied with the actuator.**

The wiring diagram shows the fundamental connections for the standard three-wire reversible single-phase motor, and the standard permanent magnet dc motor. These units show an arrangement with torque switches, limit switches, feedback potentiometers, and a heater. To meet special requirements, certain items shown may not be supplied. **In all instances the wiring diagram appropriate to the equipment will be supplied with each unit.**

A barrier type terminal strip is located under the rear cover opposite the output shaft. Two conduit entries are located in the side of the unit to accommodate standard 1 inch N.P.T. and inch N.P.T. fittings.

**CAUTION: On standard single-phase wiring, the position limit switches and the torque switches are wired directly in the motor circuit and protect it at the extremes of travel or at torque cutout. Three phase AC or DC units must have these torque and position limit switches wired into the controlling device to cause end of travel or torque shutdown. Care must be taken in wiring these to the controlling device so that the appropriate direction of control is turned off when that direction's limit switch is actuated. If care is not taken in phasing the equipment, damage may occur to the actuator or driven load. Also, inductive devices, such as lights and solenoids, must not be paralleled across motor terminals 1 and 2 or 1 and 3 as this will upset the motor capacitor phase shift and motor torque will be lost.**

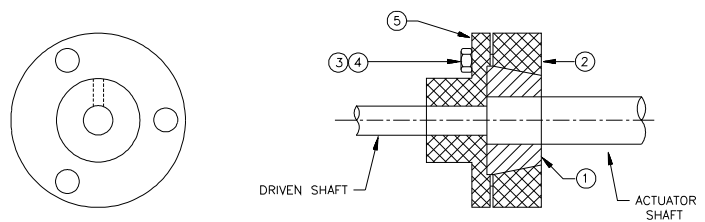
- All wiring must be done in accordance with prevailing codes by qualified personnel.
- Fusing must be installed in line power, and should be of the slow blow type.
- Wiring should be routed to the actuator through the two conduit openings. Generally, one conduit will contain input power and earth ground wires. The other conduit would then contain low level input and output signal wiring. It is required that all low level signal wiring be a shielded type with the shield grounded at source common.
- After installation, it is required that all conduits be sealed to prevent water damage and to maintain NEMA 4 enclosure and applicable dust ignition ratings.

## ROTORK PROCESS CONTROLS SUPPLIED (OPTIONAL) COUPLING (Field Installed)

Jordan Controls has designed a three piece "wedge-lock" coupling which can be adjusted to align the driven device to the actuator output shaft with no concern as to keyway alignment of the shaft on the drive device in relation to the spline on the actuator output shaft.

### ADJUSTMENT

1. Slide coupling (5) onto driven shaft.
2. Slide coupling cone (1) and cup (2) onto actuator shaft.



3. Mount actuator with the two shafts in line and the shaft ends about inch (3 mm) apart.
4. Turn the shaft of the driven device to the close position.
5. Run the actuator to the close limit switch.
6. Lock coupling (5) to the driven shaft by pinning or other suitable method.
7. Slide cone (1) to fit flat in recess of coupling (5).
8. Install three bolts and lockwasher (3) and (4) and tighten. (20-30 ft. lbs.)
9. Operate the actuator in the open direction and back to the close direction until the close limit switch stops the actuator.
10. If the driven shaft does not move to the exact close position you want, loosen the three bolts and turn the driven shaft. Tighten the bolts. (20-30 ft. lbs.)

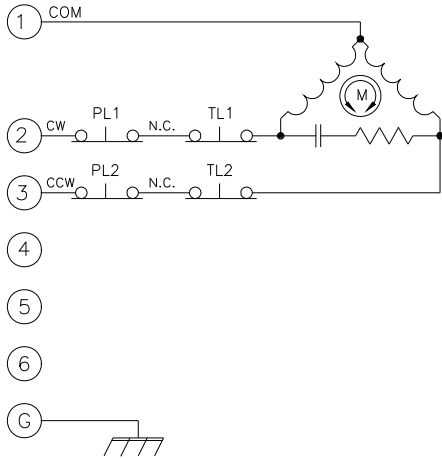
**NOTE: Keep the coupling parts clean while assembling.**

See page 21 of this manual for Jordan supplied linkage components information.

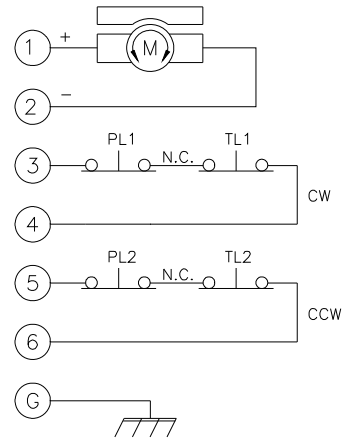
# Typical Wiring Diagrams

## ACTUATOR WITHOUT AN INTERNAL AMPLIFIER

**SM-5320 (120/240 Vac)**



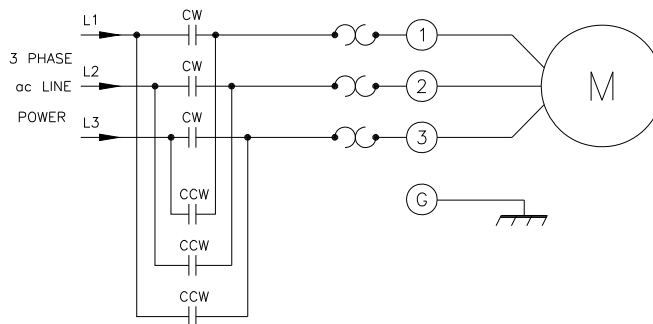
**SM-5360 (90 Vdc)**



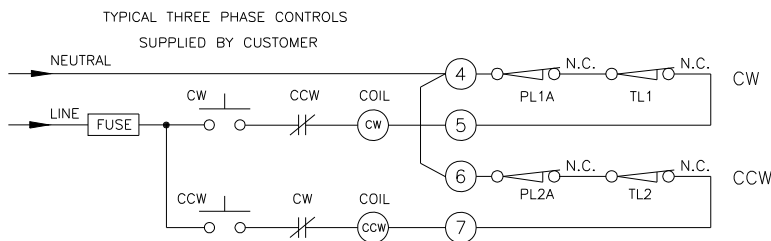
Actuator Action	AC Power Applied to Terminals		DC Power Applied to Terminals	
	1 & 2	1 & 3	1(+) & 2(-)	1(-) & 2(+)
Viewing Output Shaft	CCW	CW	CW	CCW

- Notes:**
1. The torque limit switches are factory set to trip if the rating of the actuator is exceeded.
  2. Shielded wire is required for position feedback signal wiring.

## SM-5310 SERIES ACTUATOR



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



- Notes:**
1. Optional remote three phase reversing starter shown.
  2. Caution: Care must be taken in properly phasing position and torque limit switches with respect to clockwise and counterclockwise positioning.



# Start Up

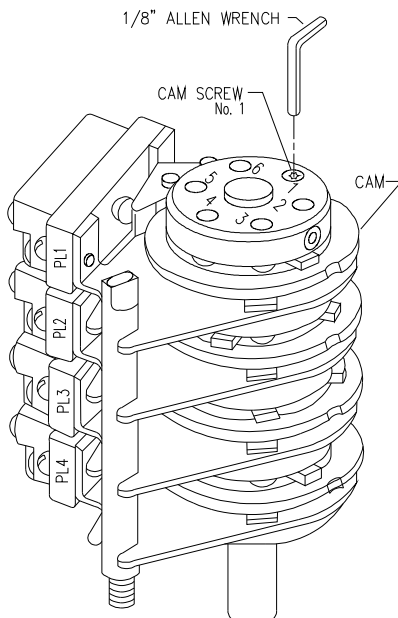
## ACTUATORS WITHOUT SERVO AMPLIFIERS

### A. POSITION LIMIT SWITCH ADJUSTMENT (Ref. Fig. 1)

#### NOTE:

The actuator is shipped in its mid-travel position.

1. Referring to your wiring diagram, apply motor power and drive the actuator in the CW output shaft direction (looking at the shaft), until PL1 trips and stops the actuator. This is the CW limit switch setting and starting point for final switch adjustment.
2. Move the controlled equipment to the same starting point and couple the actuator output shaft to the driven shaft.
3. Apply motor power to rotate the output shaft CCW about 5 degrees, allowing PL1 switch to reset.
4. Apply motor power to rotate the output shaft CW until PL1 trips, turning off the motor. If the driven device is not at the desired position:
  - a. Remove motor power.
  - b. Using an 1/8 inch, long shaft allen wrench, loosen Cam Screw #1 about 1/4 turn.
  - c. Rotate Cam #1 CCW to allow the actuator to run further in the CW direction or rotate the cam CW to turn the actuator off sooner. (Cam #1 will turn off the motor for CW output shaft rotation, when the switch roller lever moves to the high side of the cam with the cam rotating CW.)
  - d. Position the Cam as desired and while holding in place, tighten screw #1 with moderate force to adequately clamp the cam in place.  
**DO NOT OVER TIGHTEN.**



5. Apply motor power to drive the actuator to the desired CCW position or until PL2 trips and stops the motor. If the driven device is not at the desired position:
  - a. Remove motor power.
  - b. Loosen Cam Screw #2 about a turn.
  - c. Rotate Cam #2 CW to increase the actuator's total travel range or CCW to decrease the travel range.
  - d. Hold the cam in place and tighten screw #2.
6. Electrically operate the actuator to its CW limit and back to the CCW limit to check switch settings. Readjust Cam #1 or #2 as needed.
7. Switches 3 through 6 (optional) are adjusted by loosening their respective cam screws and rotating the cam. They may be set anywhere within the range of PL1 or PL2.
8. If the unit is equipped with a feedback device and switches PL1 or PL2 were readjusted, proceed with the proper feedback alignment prior to any further adjustments or operation of the actuator.

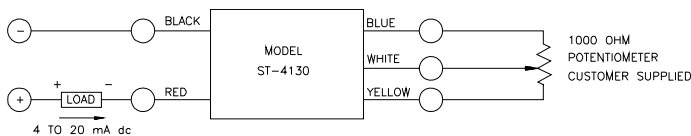
### B. POTENTIOMETER ADJUSTMENT

1. Run the actuator to the center of travel. Loosen the three panhead screws, securing the potentiometer body, and rotate it to its center (50%) of travel position. An ohmmeter will be required for this adjustment. Tighten the three screws.
2. Run the actuator to the zero or minimum travel limit. With the actuator running, monitor the potentiometer with an ohmmeter to ensure the potentiometer deadband is not crossed.
3. If your system requires a low resistance starting point, loosen the three screws and rotate the potentiometer body for the required starting resistance. This is usually 20 to 50 ohms (measured from the potentiometer wiper arm to the zero end of the potentiometer).

### C. 4 to 20mA TRANSMITTER OPTION ADJUSTMENT

The ST-4130 (1000 ohm-input, 4 to 20 mA output) two wire transmitter modulates the current on a direct current supply proportional to the input resistance. It is powered by a 12.0 to 36.0 Vdc regulated power supply line which is modulated from 4 to 20 mA proportional to the resistance of the input.

For the unit to function optimally, the 4mA end of the feedback potentiometer must be pre-set to 50 ohms.



1. Position the actuator to the desired 4mA setting.
2. With potentiometer resistance at 50 ohms, adjust ELEVATION for 4.0mA output.
3. Position the actuator to the desired 20mA setting.
4. Adjust RANGE for 20mA output.
5. Repeat steps 1 through 4 until desired accuracy is achieved.
6. To reverse the 4 and 20mA output, interchange the BLUE and YELLOW wires and return to step 1.

#### D. ACTUATOR WITH INTERNAL AD-8230 SERVO AMPLIFIER

Switch and feedback potentiometer alignment is accomplished in the same manner as actuator without amplifiers, except motor power is supplied from the amplifier. Varying the command signal input to the amplifier will allow reversal of the rotation of the actuator output shaft to run to the minimum/maximum switch settings. If the actuator does not run to the limit switch, but stops short, the amplifier has nulled and adjustments of span, elevation, loss of signal, or feedback potentiometer may be required. Refer to IM-0607 for information on the AD-8130 amplifier.

#### E. ACTUATOR WITH INTERNAL AD-7830 SERVO AMPLIFIER

Switch and feedback potentiometer alignment is accomplished in the same manner as actuator without amplifiers, except motor power is supplied from the amplifier. Varying the command signal input to the amplifier will allow reversal of the rotation of the actuator output shaft to run to the minimum/maximum switch settings. If the actuator does not run to the limit switch, but stops short, the amplifier has nulled and adjustments of span, elevation, loss of signal, or feedback potentiometer may be required. Refer to IM-0606 for information on the AD-7830 amplifier.

#### F. ACTUATOR WITH INTERNAL AD-7830 SERVO AMPLIFIER

Switch and feedback potentiometer alignment is accomplished in the same manner as actuator without amplifiers, except motor power is supplied from the amplifier. Varying the command signal input to the amplifier will allow reversal of the rotation of the actuator output shaft to run to the minimum/maximum switch settings. If the actuator does not run to the limit switch, but stops short, the amplifier has nulled and adjustments of span, elevation, loss of signal, or feedback potentiometer may be required. Refer to IM-0620 for information on the AD-8900 amplifier.

#### G. ACTUATOR WITH INTERNAL AD-9120 SERVO AMPLIFIER

Switch and feedback potentiometer alignment is accomplished in the same manner as actuator without amplifiers, except motor power is supplied from the amplifier. Varying the command signal input to the amplifier will allow reversal of the rotation of the actuator output shaft to run to the minimum/maximum switch settings. If the actuator does not run to the limit switch, but stops short, the amplifier has nulled and adjustments of span, elevation, loss of signal, or feedback potentiometer may be required. Refer to IM-0626 for information on the AD-9120 amplifier.

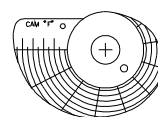
#### H. CHARACTERIZED CAM ADJUSTMENT (OPTION)

The characterized feedback assembly is an option which directly replaces the standard linear feedback potentiometer.

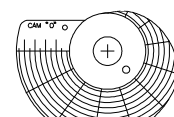
Prior to adjusting the cam, the end of travel limit switches must be set and the proper cam installed for your particular system requirements on the characterized cam shaft. Four different cams are supplied with each characterized assembly. The cams are printed on both sides and may be flipped over to reverse the characterization action in relation to the output shaft rotation.

The cams are each printed with a letter "O", "F", or "B" which indicate the cam type. Three of the cams are shaped to correspond to X=2, 1, and 0.5 respectively in the equation:

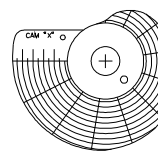
$$\% \text{ amplifier input} = (\% \text{ shaft rotation})^x$$



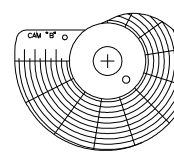
CAM F  
SQUARE (X = 2)



CAM O  
LINEAR (X = 1)



CAM X  
SQUARE ROOT (X = 0.5)



CAM B  
MAXIMUM (CUT AS NEEDED)

The fourth cam is used for any value of x between 0.5 and 2 and must be cut by the user. For details on cutting this cam, see "To Shape Feedback Cam".

- a. Run the actuator to the zero or minimum position limit. While running, observe the direction of character cam rotation.
- b. Is the cam rotating in the direction of 100-0 for your system requirement? If not, remove the thumb screw and flip the cam over. Tighten the screw.
- c. Have you selected the proper cam for the system requirement? If not, remove the thumb screw and change the cam, installing the cam the same as in (b) above. (Green or Black side up.)
- d. Loosen three screws and remove the cam assembly.
- e. Rotate the cam until the zero on the cam is in line with the center line of the potentiometer or LVDT shaft.
- f. Potentiometers need no further adjustment.
- g. LVDT contactless feedback may require fine zeroing.
  - i. Apply power to the LVDT and monitor the output with a volt meter.
  - ii. Loosen the two body clamp screws and slide the body of the LVDT to obtain zero output.
  - iii. Tighten the body clamp screws.
  - iv. If a finer adjustment is desired, loosen the nut on the LVDT shaft and turn the shaft slightly one way or the other and tighten the nut.

## TO SHAPE FEEDBACK CAM

With characterized feedback, one of the four cams supplied (cam B), is partially shaped. For installation, it must be cut to its final shape by the user. This cam is used if none of the other three cams produces the desired input-output relationship where:

$$\% \text{ amplifier input} = (\% \text{ shaft position})X$$

Two typical conditions where the user might want to use the fourth cam are:

1. In equation above, if the value of X is not equal to 0.5 or 2.
2. In equation, if the value of X is equal to 0.5 or 2, and if upper shaft position is not equal to 100% (90°), and/or lower shaft position is not equal to 5% (0°).

To lay out the cam shape for the desired input-output relationship, it is necessary to determine outputs (rise in cam), for various inputs (amount of cam rotation). The rise in the cam corresponds to % of maximum output range and the amount of cam rotation corresponds to % input signal to amplifier.

1. Lay out on graph paper, axes and maximum and minimum slopes as shown in figure 2. (Maximum slope is 25 units rise per 10% shaft rotation; minimum slope is 5 units per 10% rotation.)

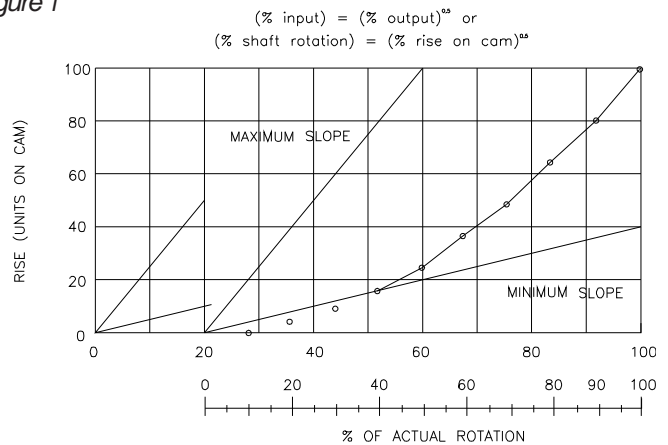
2. If either upper or lower shaft position is not at 0 or 100% (0° or 90°) respectively, lay out additional x-axis scale as shown in figure 3 on page 13. Use both sets of values when plotting cam shape in step 3.
3. Calculate outputs (rise in cam) for 5% or 10% increments in input for entire input scan (actual cam rotation). NOTE: only output values that fall within maximum and minimum slope lines can be used.
4. Plot these values on cam. Scribe smooth line between points and grind cam to this shape.

Refer to example for typical cam calculations and layout.

## TYPICAL FEEDBACK CAM CALCULATIONS

EXAMPLE: Assume X in (input/output equation) = 0.5, and that upper and lower shaft positions are at 100% and 20% (90° and 18°), same as center illustration of Figure 3.

Figure 1



Input % of actual rotation	Output	
	location on cam	% rise on cam
0	20%	0
10	28	1*
20	36	4*
30	44	9*
40	52	16
50	60	25
60	68	36
70	76	49
80	84	64
90	92	81
100	100	100

Note: These values fall outside of minimum slope on graph.

Figure 2

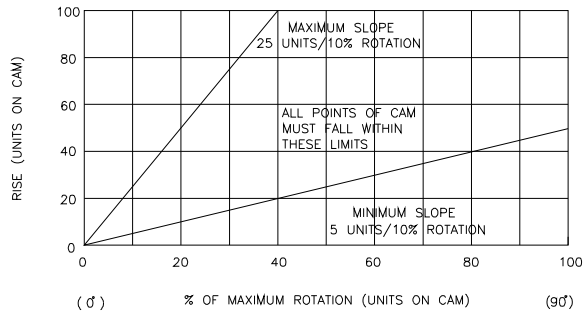
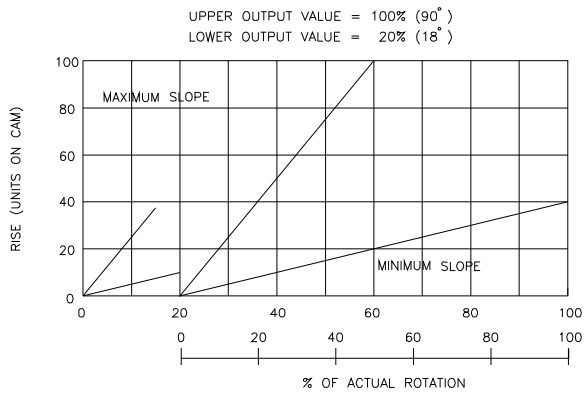
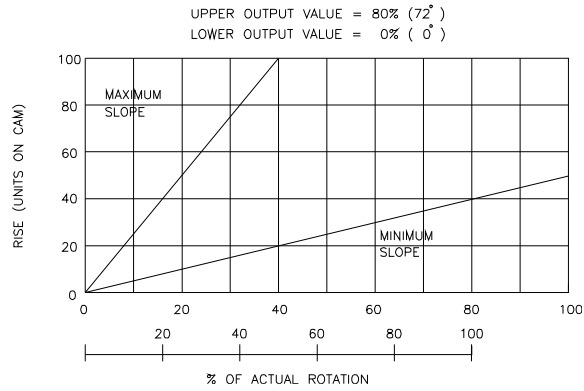
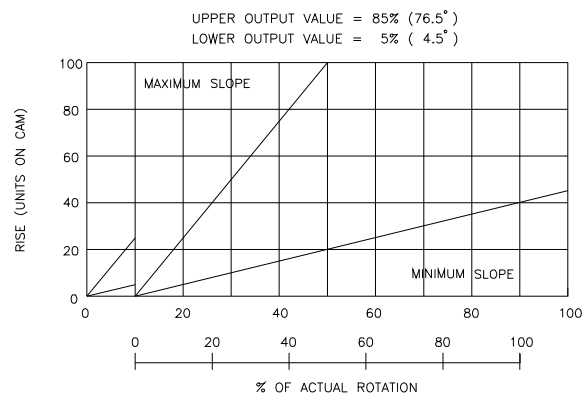


Figure 3

Illustrations below show an 80% ( $72^\circ$ ) shaft rotation span.



IF LOWER SHAFT POSITION IS NOT EQUAL TO 0% ( $0^\circ$ )  
REDRAW SLOPE LIMITS TO GO THROUGH ACTUAL  
STARTING ROTATION POINT, AS SHOWN ABOVE.



IF LOWER SHAFT POSITION IS NOT EQUAL TO 0% ( $0^\circ$ )  
REDRAW SLOPE LIMITS TO GO THROUGH ACTUAL  
STARTING ROTATION POINT, AS SHOWN ABOVE.

# Troubleshooting Guide

TROUBLE	POSSIBLE CAUSE	REMEDY
Motor does not operate	a. No power to actuator	a. Check source, fuses, wiring
	b. Motor overheated and internal thermal switch tripped (single phase AC motors only)	b. Let motor cool and determine why overheating occurred (such as, excessive duty cycle or ambient temperature)
	c. Motor burned out	c. Replace motor and determine cause of failure
	d. Motor drag brake improperly adjusted	d. Adjust as detailed on page 20
	e. Motor drag brake defective	e. Replace drag brake
	f. Both end of travel switches open or one open and one defective	f. Adjust switch settings or replace defective switch
	g. Actuator output shaft stalled	g. Check drive load for mechanical jam and correct cause
	h. Defective motor run capacitor	h. Replace capacitor (AC models)
	i. Load exceeds actuator torque rating	i. Reduce load or replace actuator with one with appropriate torque rating
	j. Power applied to CW & CCW rotation at same time	j. Correct power input problem
	k. Amplifier defective	k. Replace amplifier
	l. Amplifier is in Loss of Signal	l. Check command signal to verify signal greater than 3.8 mA is present
	m. Amplifier deadband is too wide	m. Reduce deadband setting
Motor hums but does not run	a. Power applied to CW & CCW rotation at the same time	a. Correct power input problem
	b. Damaged power gearing	b. Repair gearing
	c. Defective motor run capacitor	c. Replace capacitor
	d. Motor drag brake	d. Adjust or replace as required
Motor runs, output shaft does not rotate	a. Defective power gearing	a. Repair gearing
Motor does not shut off at limit switch	a. Switch wired wrong or is defective	a. Correct wiring or replace switch
	b. Motor phased incorrectly	b. Correct wiring
Actuator backdrives when power is removed	a. Motor drag brake improperly adjusted	a. Adjust as detailed on page 20
	b. Motor drag brake defective	b. Replace drag brake
Handcrank does not move output shaft	a. Power still on	a. Remove power
	b. Load is jammed and motor drag brake slips	b. Remove jammed load
	c. Drag brake missing or improperly adjusted.	c. Replace drag brake



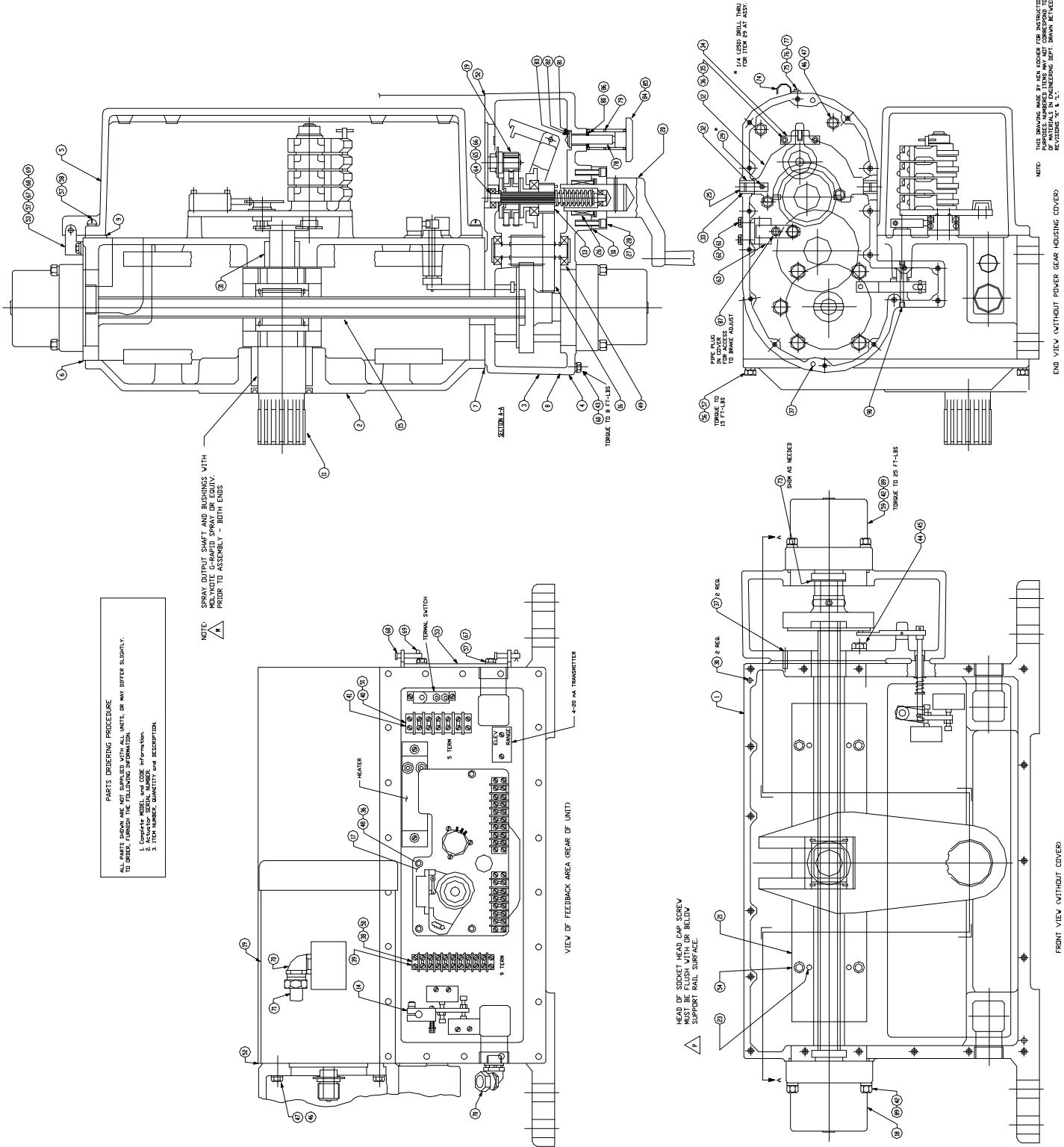
# Troubleshooting Guide

Motor runs, but only one way	a. Power not applied for other direction	a. Correct power problem
	b. Power always applied to one direction and electrically stalls when applied for opposite direction	b. Correct power problem
	c. Open limit switch for other direction	c. Adjust or replace limit switch as required
	d. Actuator is torqued out	d. Determine obstruction and correct
	e. Motor has an open winding	e. Replace motor
	f. Motor and feedback potentiometer are out of phase	f. Reverse potentiometer end leads
	g. Amplifier is defective	g. Replace amplifier
Poor response to command signal changes	a. Amplifier deadband is too wide	a. Reduce deadband setting
	b. Amplifier is defective	b. Replace amplifier
	c. Excessive noise on command signal	c. Reduce noise. Also ensure that command signal wiring is shielded with shield grounded at source common only.
	d. Defective feedback potentiometer	d. Replace potentiometer
Actuator oscillates at setpoint	a. Amplifier deadband is too narrow	a. Increase deadband setting
	b. Amplifier is defective	b. Replace amplifier
	c. Excessive noise on command signal	c. Reduce noise. Also ensure that command signal wiring is shielded with shield grounded at source common only.
Pot feedback signal not always present during actuator rotation	a. Pot not aligned with end of travel extremes and is being driven through dead region	a. Align pot to range of actuator
	b. Pot signal is erratic or nonexistent	b. Replace pot
Pot signal does not change as actuator operates	a. Defective pot	a. Replace pot
	b. Feedback gear not turning pot shaft	b. Check gearing engagement and set screw in gear hub
Pot signal is reversed for output shaft rotation	a. Pot is wired wrong	a. Reverse wiring from ends of pot at actuator terminal block
Output shaft rotates wrong direction for CW and CCW input power	a. Wiring to actuator incorrect	a. Correct field wiring
	b. Wiring from motor to terminals or switches is reversed	b. Correct internal actuator wiring
4-20 mA customer feedback missing or non-linear	a. External wiring error	a. Refer to IM-0607
	b. Power supply fault	b. Refer to IM-0607
	c. Shunt resistance too light	c. Refer to IM-0607

# Parts Identification

**PARTS ORDERING PROCEDURE**  
 ALL PARTS SHOWN ARE NOT SHOWN WITH ALL UNITS, OR MAY DIFFER SLIGHTLY  
 TO ORDER, FURNISH THE FOLLOWING INFORMATION:  
 1. COMPLETE MODEL AND CODE INFORMATION.  
 2. PART NUMBER, QUANTITY and DESCRIPTION.  
 3. ITEM NUMBER, QUANTITY and DESCRIPTION.

NOTE: SPRAY OUPUT SHAFT AND BUSINGS WITH  
 MELYNITE G-RAPID SPRAY OR EQUIV.  
 PRIOR TO ASSEMBLY - BOTH ENDS.



NOTE: THIS DRAWING MADE BY GEN. MODEL FOR INSTRUCTION MANUAL.  
 PARTS IDENTIFICATION AND PART NUMBER INFORMATION  
 OF MATERIALS IN DRAWING NOT SHOWN BELOW.  
 REVISIONS "A" & "B".

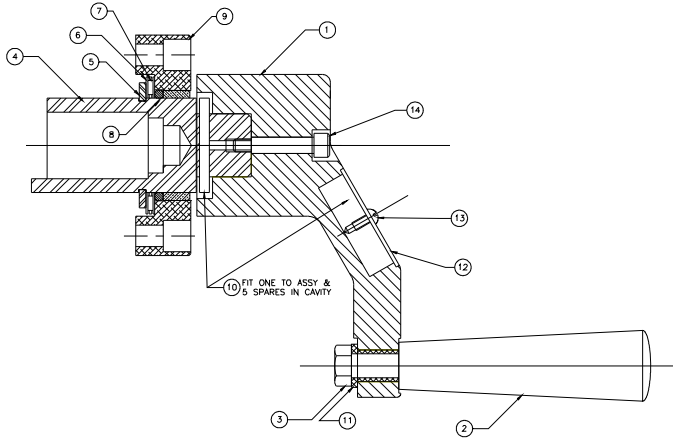
END VIEW WITHOUT POWER GEAR HOUSING COVER

FRONT VIEW WITHOUT COVER

# Parts Identification

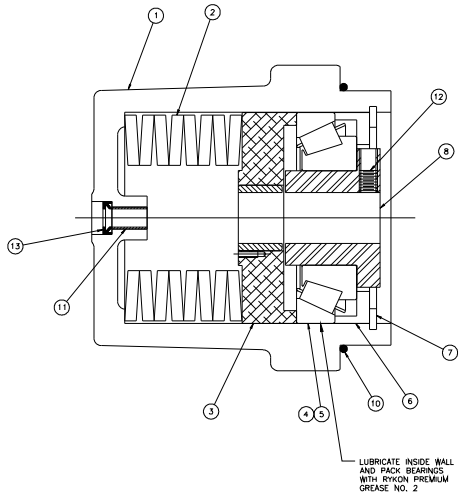
Item	Description	Part No.	Qty.	Item	Description	Part No.	Qty.
1	Main Housing	60E-013921-001	1	46	Hex. Hd. Screw, 3/8-16 x 1.26 Lg.	54A-015081-125	8
2	Front Cover Assembly	68C-022776-001	1	47	Lockwasher, 3/8 Std.	56A-015230-002	8
3	Power Gear Housing	60E-022774-001	1	48	Soc. Hd. Screw, 1/4-20 x .75 Lg.	54A-015060-075	4
4	Power Gear Housing Cover	60E-022805-001	1	49	Ball Bearing	17B-003813-012	2
5	Feedback Cover	60D-013534-001	1	50	Term Block Insulator	32A-014121-001	1
6	Gasket, Front Cover	13C-013366-001	1	51	Term Block Insulator	32A-014122-001	1
7	Gasket, Main Housing to Power Gear Housing	13C-013925-001	1	52	Gasket, Motor to Power Gear Housing	13B-013890-001	1
8	Gasket, Power Gear Housing Cover	13D-013924-001	1	53	Hinge Bracket	61B-024765-001	1
9	Gasket, Feedback Cover	13C-013927-001	1	54	Soc. Hd. Screw, 3/8-16 x .88 Lg.	54A-015080-088	4
10	Gasket, Hand Crank Cap	13A-014001-001	1	55			
11	Drive Shaft Assembly	68C-021085-xxx	1	56	Hex. Hd. Screw, 5/16-18 x 1.25 Lg.	54A-015071-125	15
12	Clutch Yoke Assembly	68C-013959-001	1	57	Lockwasher, 5/16 Std.	56A-015220-002	43
13	Clutch Assembly	68C-022794-xxx	1	58	Rd. Hd. Screw, 5/16-18 x 1.0 Lg.	54A-015073-100	22
14	Torque Limit Switch Assembly	68D-019379-001	1	59	Screw Thrust Housing Assembly	68C-014509-xxx	1
15	Screw Shaft Assembly	68B-019356-001	1	60	Lockwasher, 1/4 Std.	56A-015210-002	17
16	Intermediate Gear Assembly	68B-019352-001	1	61	Stat-O-Seal Washer	56A-022752-007	2
17	Feedback Plate Assembly	Consult Factory	1	62	Hex. Hd. Screw, 5/16-18 x 1.0 Lg.	54A-015071-100	2
18	Screw Thrust Housing Assembly	68C-014509-xxx	1	63	Drag Brake Assembly	68B-017723-002	1
19	Motor, Pinion, & Release Assembly	68B-019315-xxx	1	64	Thrustwasher	56B-004107-011	1
20	Hand Crank Assembly	68C-015452-001	1	65	Bearing	17B-002813-011	1
21	Support Rail	61B-011794-001	2	66	Retaining Ring, 5000-112	58B-014184-112	1
22	End Block	61A-011796-001	2	67	Hex. Hd. Screw, 5/16-18 x .75 Lg.	54A-015071-075	2
23	Dowel Pin, .250 Dia. X 1.0 Lg.	57A-015226-100	4	68	Clevis Pin	74A-017486-005	2
24	Hex. Hd. Screw, 3/2-16 x 1.0 Lg.	54A-015081-100	4	69	Cotter Pin, 3/32 Dia. X .75 Lg.	58B-024244-067	2
25	Yoke Shaft	62A-022566-001	1	70	1/2" x 90E Elbow, Appleton #ST9050	58B-024244-082	2
26	Needle Bearing	17A-013947-001	1	71	Liquatite Tubing 1/2" x 18" Lg.	58B-024244-113	1
27	Soc. Hd. Screw, 5/16-18 x 1.0 Lg.	54A-015070-100	4	72	Pipe Plug, Steel 2" (not shown, Conduit)	52A-024353-003	2
28	Lockwasher, Hi Collar 5/16	56A-015221-001	4	73	Shim Washer	13A-014549-001	AR
29	Rollpin, .250 Dia. X 1.0 Lg.	57A-015215-100	1	74	Thinwall Clamp, Gardner 3/4"		1
30	Dowel Pin, .250 Dia. X .50 Lg.	57A-015226-050	2	75	Rd. Hd. Screw, 10-24 x .50 Lg.	54A-015043-050	1
31	Bearing (Main Housing)	18B-003814-066	1	76	Lockwasher #10 Std.	56A-015200-002	1
32	Bearing (Yoke Shaft)	18B-SP1988-012	2	77	Flatwasher #10	56A-015202-001	1
33	"O" Ring, .38 ID x .500 OD	74B-010957-012	1	78	Clutch Latching Shaft	62A-022400-001	1
34	Latch Plate	61A-014003-001	1	79	Spring	20A-017916-001	1
35	Soc. Hd. Screw, 1/4-20 x .50 Lg.	54A-015060-050	2	80	Seal Adaptor Bushing	61A-019023-001	1
36	Lockwasher, Hi Collar 1/4"	56A-015211-001	6	81	Rubber Washer	07A-016974-001	1
37	Dowel Pin, .250 Dia. X .75 Lg.	57A-015226-075	4	82	Washer	74A-017915-001	1
38	Terminal Block 9 Pin	43B-003888-309	1	83	Retaining Ring 5100-50	58B-014183-050	1
39	Rd. Hd. Screw, 8-32 x .63 Lg.	54A-015033-063	4	84	Knob	61A-017764-001	1
40	Terminal Block, 5 Pin	43B-003888-505	1	85	Set Screw, 10-24 x .19 Lg.	54A-019695-019	1
41	Rd. Hd. Screw, 10-24 x .63 Lg.	54A-015043-063	4	86	Seal	19B-003815-017	1
42	Hex. Hd. Screw, 3/8-16 x 2.25 Lg.	54A-015081-225	8	87	Pipe Plug, 3/4-14 NPT	52A-024353-006	1
43	Hex. Hd. Screw, 1/4-20 x 1.5 Lg.	54A-015061-150	17	88	Zerust Vapor Capsule (not shown)	74A-023169-001	1
44	Hex. Hd. Screw, 1/2-13 x 1.38 Lg.	54A-015101-138	5	89	Stat-O-Seal	56A-022752-008	8
45	Lockwasher, 1/2" std.	56A-015250-002	5	90	Pipe Plug, 1/16 Hex. Soc.	58B-024244-176	2

# Handcrank Assembly



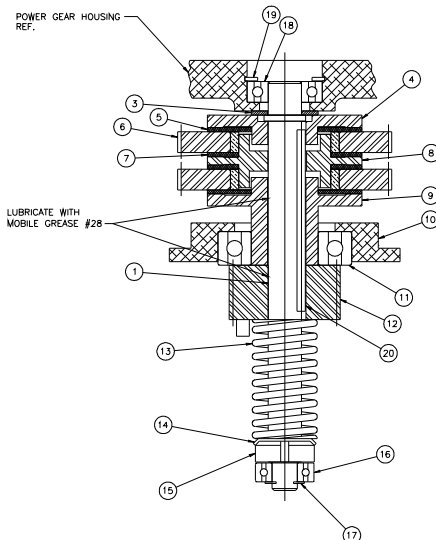
1	Hand Crank .....	60B-014514-001
1	Hand Crank (Painted) .....	60B-014514-002
2	Handle .....	74A-014614-001
3	Screw, Hex. Hd. 3/8-16 x 1.50 Lg. ....	54A-015081-150
4	Manual Override Shaft .....	61A-013950-001
5	Ret. Ring - #5160-150 .....	58B-014186-150
6	Thrust Race .....	17A-013949-001
7	Needle Thrust Bearing .....	17A-013948-001
8	"O" Ring, 1.50 I.D. x 1.75 O.D. ....	74B-010957-222
9	Cap Assembly .....	68A-015364-001
9	Cap Assembly (Painted) .....	68A-015364-002
10	Shear Pin (Single Shear) .....	61A-014553-001
11	Bushing .....	18B-SP1988-065

# Screw Thrust Housing Assembly



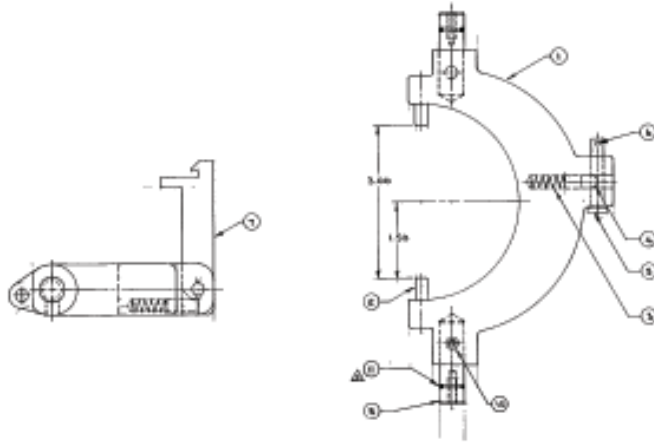
1	Screw Thrust Housing .....	60C-014508-001
1	Screw Thrust Housing W/Hole .....	60C-014508-002
2	Bellville Washer .....	56B-010462-006
2	Bellville Washer .....	56B-010462-005
3	Spacer .....	61A-011778-001
3	Spacer .....	61A-011778-002
3	Spacer .....	61A-011778-003
3	Spacer .....	61A-011778-004
4	Roller Bearing Cone (Steep Angle) .....	17B-014239-001
5	Roller Bearing Cup (Steep Angle) .....	17B-014239-002
6	Spacer .....	61A-012516-001
7	Ret. Ring Truarc #N5000-362 .....	58B-014184-362
8	Thrust Sleeve .....	61A-011799-001
9	Bushing, .878 I.D. x 1.003 O.D. x 750 Lg. ....	18B-003814-019
10	"O" Rings 4-3/8 I.D. x 4-5/8 O.D. ....	74B-010957-245
3	Spacer .....	61A-011778-007
3	Spacer .....	61A-011778-009
11	Bushing .....	18B-003814-016
12	5/16-18 Setscrew x 3.8 Lg. ....	54A-015077-038
3	Spacer .....	61A-011778-008
8	Thrust Sleeve .....	61A-011799-002
9	Bushing .....	61A-016668-001

# Clutch Assembly



1	Clutch Shaft .....	62A-013940-001
2	Ret. Ring 5100-50 .....	58B-014183-050
3	Key, .125 Sq. x 2.87 Lg. S.S. #303 .....	61A-014885-001
4	Clutch Disc .....	61A-013941-001
5	Friction Disc (See Note) .....	61A-013942-001
6	Clutch Gear, 62T-20P-20E P.A. (36 Sec.) ...	16A-013943-001
6	Clutch Gear, 49T-20P-20E P.A. (18 Sec.) ...	16A-013943-002
7	Gear Idler Drum .....	61A-013944-001
8	Clutch Drum .....	61A-013945-001
9	Clutch Pinion .....	16A-013946-001
10	1" x 2" MD Spring .....	20A-012340-001
11	Lockwasher .....	74A-014545-002
12	Bearing .....	17B-003813-025
13	Ret. Ring 5100-37 .....	58B-014183-037
19	Thrust Washer .....	56B-004107-011
20	Bearing (Ref.) .....	17B-003813-011
21	Ret. Ring (Ref.) 5000-112 .....	58B-014184-112
22	Ball Bearing .....	17B-003813-031
23	Throwout Slider .....	61A-010932-001
25	Locknut .....	74A-014545-001

## Clutch Yoke Assembly

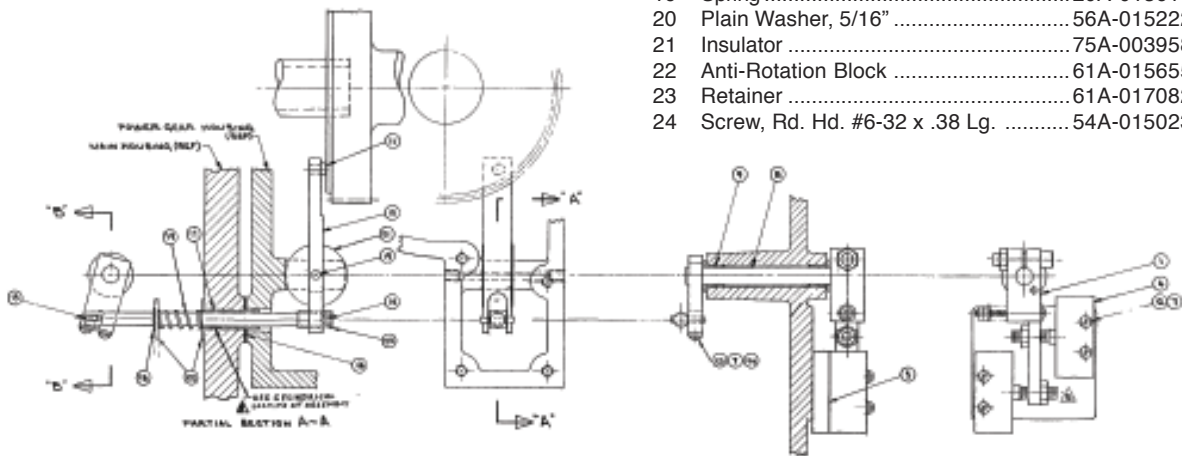


- |    |                                      |                |
|----|--------------------------------------|----------------|
| 1  | Clutch Yoke .....                    | 60C-013958-001 |
| 2  | Dowel Pin, .250 x 1.00 Lg. ....      | 57A-015226-100 |
| 3  | Spring .....                         | 20A-012337-001 |
| 4  | Latch Pin .....                      | 61A-011664-001 |
| 5  | Clevis Pin .....                     | 75A-014771-001 |
| 6  | Cotter Pin, 3/32 Dia. X 1/2 Lg. .... |                |
| 7  | Manual Crank Latch .....             | 61A-013960-001 |
| 8  | Yoke Shaft .....                     | 62A-013961-001 |
| 10 | Roll Pin 1/4 Dia x 1" Lg. ....       | 57A-015215-100 |

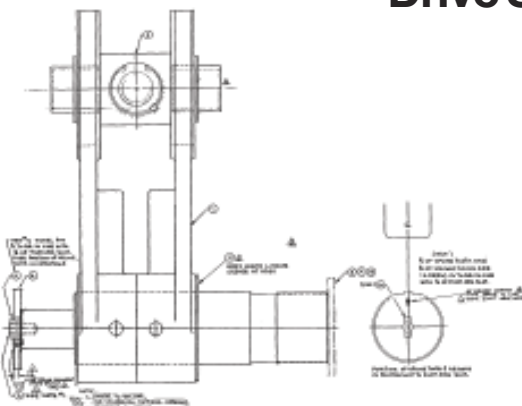
## Torque Limit Switch Assembly

- |   |   |                |
|---|---|----------------|
| 1 | Switch Actuating Arm Assembly .....     | 68B-013573-001 |
| 2 | 1/4-20 x 1" Lg. Soc. Hd. Cap. Scr. .... | 54A-015060-100 |
| 3 | 1/4-20 Jam Nut .....                    | 55A-015069-001 |
| 4 | Limit Switch .....                      | 46A-010016-001 |
| 4 | Limit Switch (Hi Pressure) .....        | 46A-010016-003 |
| 5 | Spacer Block .....                      | 61A-014626-001 |
| 6 | #6-32 x 1.38 Lg. Rd. Hd. Screw .....    | 54A-015023-138 |
| 7 | #6 Lockwasher .....                     | 56A-015180-002 |
| 8 | Arm & Shaft Assembly .....              | 68A-014015-001 |

- |    |  |                |
|----|--|----------------|
| 9  | Bushing .....                          | 18B-SP1988-015 |
| 10 | Lever .....                            | 61A-014007-001 |
| 11 | Button .....                           | 61A-014552-001 |
| 13 | Sliding Shaft Assembly .....           | 68A-014554-001 |
| 14 | .125 Dia. X .75 Lg. Roll Pin .....     | 57A-015185-075 |
| 15 | .188 Dia. X 1-1/4" Lg. Dowel Pin ..... | 57A-015206-125 |
| 16 | Gasket .....                           | 13A-013928-001 |
| 17 | Sleeve Bearing .....                   | 18B-003814-030 |
| 18 | Ret. Ring-Truarc 5100-31 .....         | 58B-014183-031 |
| 19 | Spring .....                           | 20A-013616-001 |
| 20 | Plain Washer, 5/16" .....              | 56A-015222-001 |
| 21 | Insulator .....                        | 75A-003958-001 |
| 22 | Anti-Rotation Block .....              | 61A-015655-001 |
| 23 | Retainer .....                         | 61A-017082-001 |
| 24 | Screw, Rd. Hd. #6-32 x .38 Lg. ....    | 54A-015023-038 |



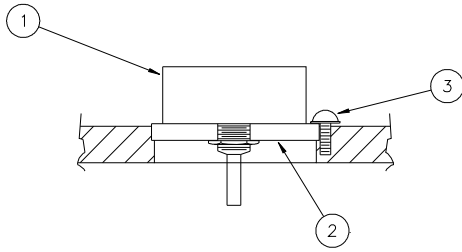
## Drive Shaft Assembly



- |    |   |                |
|----|---|----------------|
| 1  | Nut Carrier .....                         | 60B-013985-001 |
| 2  | Ret. Ring 5000-237 .....                  | 58B-014184-237 |
| 3  | Drive Nut .....                           | 61A-014432-001 |
| 4  | Key, .250 Sq. x 3.00 Lg. ....             | 61B-010954-496 |
| 5  | Nut Spacer .....                          | 61A-013986-001 |
| 7  | Output Shaft (Position Tran.) Splined ... | 62A-016731-001 |
| 7  | Output Shaft-splined .....                | 62B-013983-001 |
| 7  | Output Shaft-Key .....                    | 62B-013984-001 |
| 8  | Pivot Arm .....                           | 60B-014446-001 |
| 10 | Dowel Pin, .500 Dia. x 2.00 Lg. ....      | 57A-015266-200 |
| 12 | Bearing .....                             | 61A-014540-001 |
| 13 | Spacer .....                              | 13A-014541-001 |
| 14 | Bearing Retainer .....                    | 61A-014542-001 |
| 15 | 1/4-20 x 1/2 Lg. Rd. Hd. Screw .....      | 54A-015063-050 |
| 16 | 1/4 Lockwasher .....                      | 56A-015210-002 |

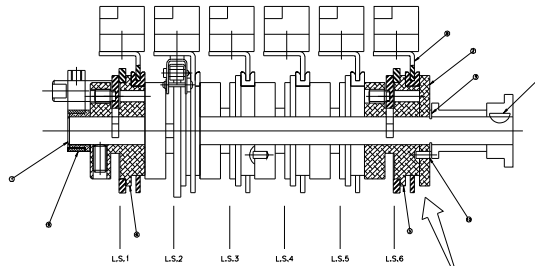
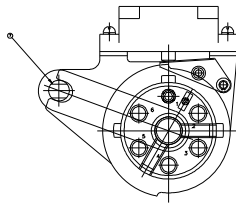


## Standard Feedback - Potentiometers

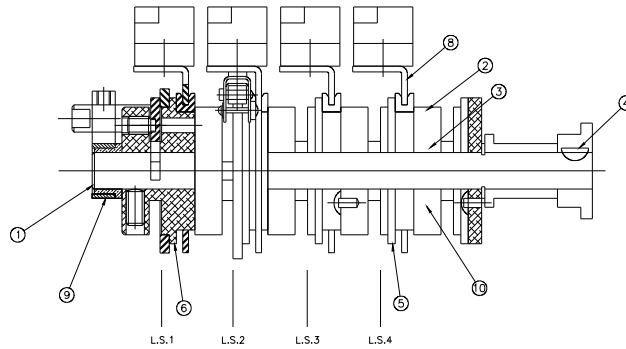
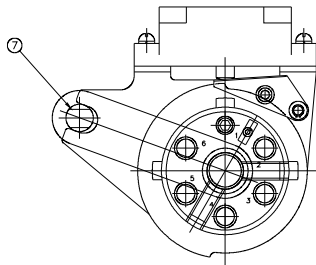


- 1 Precision One Turn, 1K ..... 34B-003956-043
- 2 Disc, Adapter (Precision) ..... 61A-SM3304-003
- 3 Screw, Truss Hd., 8-32 x 0.25 Lg. .... 54A-015032-025

## Limit Switch Assembly



NOTE:  
WHEN SPACER FOR LVDT IS REQUIRED,  
LOCATE IN THIS POSITION.



# Maintenance

## LUBRICATION

Under normal service conditions the motor, gearing, bearings, and parts are all pre-lubricated and should not require periodic maintenance. If for any reason the unit is disassembled in the field, all oilite bushings should be resaturated with an SAE-10, non-detergent oil and all gearing heavily coated with Amoco Rykon Premium Grease #2 or equivalent grease. Care should be taken to ensure that no foreign material is allowed to become combined with the grease in the gear train, which will cause premature failure. Keep gearbox clean and dry.

## DRAG BRAKE ADJUSTMENT

The drag brake serves two functions: a) to prevent actuator from backdriving at maximum rated torque; and b) to allow the motor shaft to slip when handcranking and the output shaft load is in excess of rated torque.

The drag brake was factory set and should not need readjustment. If it does need adjustment:

1. Apply an overhung load, equal to the maximum torque rating to the output shaft.
2. Loosen drag brake jam nut until the motor shaft starts to backdrive.
3. Tighten the drag brake jam nut just enough to prevent backdriving.
4. While handcranking against the load, increase the load until motor backdriving occurs.

## TORQUE LIMIT SWITCH ALIGNMENT

The torque limit switches are factory set and field adjustment is not advised unless proper test equipment is available. If adjustment must be done, use the following procedure:

1. Load the output shaft with a known load which matches the torque rating of the actuator in an opposing direction for the switch being adjusted.
2. Apply power to the motor and run the actuator to drive the opposing load.
3. Increase the load by 5% to 10% and adjust the set screw (140C) to trip the torque switch.
4. Remove the 5% to 10% increase of load and the switch should reset.
5. Load the actuator in the opposite direction and set the other switch in the same manner.

***NOTE: When looking at the torque limit switch assembly as it is mounted in the actuator, the switch on the top of the assembly controls the CW torque and the switch on the bottom controls the CCW torque. The torque should be set near equal for both directions.***

***When the actuator is driven into a torque condition in the CW direction (looking at the output shaft), the handcrank handle will move slightly outward. For CCW direction the handle will pull slightly inward.***

# Maintenance

## MOTOR REPLACEMENT

1. Disconnect all power to the actuator.
2. Remove screws, washers and rear cover.
3. Disconnect actuator output shaft from driven device and remove actuator from mount.
4. Remove bolts, washers, and front gear case cover. Note location of all gearing.
5. Remove motor pinion.
6. Remove brake assembly from top of motor.
7. Disconnect motor wires - note colors.
8. Remove motor.
9. Reverse the procedure to install new motor. (Clean and regrease all gearing, check bushings and bearings, lubricate bushings with SAE-10, non-detergent oil.)
10. Reinstall the actuator.

## POWER GEARING REPLACEMENT

1. Perform steps 1,3 & 4 of Motor Replacement.
2. Remove defective gear(s) and replace with new.
3. Ensure all gearing and oilite bushings are properly lubricated as detailed above.
4. Install front cover and Reinstall actuator.

## POSITION LIMIT SWITCH REPLACEMENT

1. Disconnect all power to the actuator.
2. Remove rear cover.
3. Remove two screws and washers from appropriate switch on assembly.
4. Install new switch and transfer wires from old switch one at a time.
5. No realignment should be necessary.

## FEEDBACK POTENTIOMETER REPLACEMENT

### A. One Turn Linear Potentiometer

1. Disconnect all power to the actuator.
2. Remove screws, washers, and rear cover.
3. Remove three screws holding potentiometer and disc to housing.
4. Pull potentiometer and disc out of housing.
5. Measure location of gear from mounting disc to farthest face of gear and note measurement.
6. Loosen set screws and remove gear.
7. Remove nut and washer holding potentiometer to disc.
8. Cut shaft of new potentiometer to same length as old.
9. Mount new potentiometer on disc, tighten potentiometer nut, install gear to measured dimension from step 5.
10. Install assembly in housing and tighten screws.
11. Using a 25 watt solder iron, remove wires from old potentiometer one at a time and solder to corresponding terminals on new potentiometer.
12. Align potentiometer and install cover.

### B. Characterized Potentiometer

1. Disconnect power and remove rear cover.
2. Remove three screws and pull potentiometer off of pins.
3. Install new potentiometer and tighten screws.
4. Using a 25 watt solder iron, remove wires from old potentiometer one at a time and solder to corresponding terminals on new potentiometer.

**CAUTION - DO NOT USE EXCESSIVE HEAT WHEN SOLDERING.**

5. Align potentiometer and install cover.

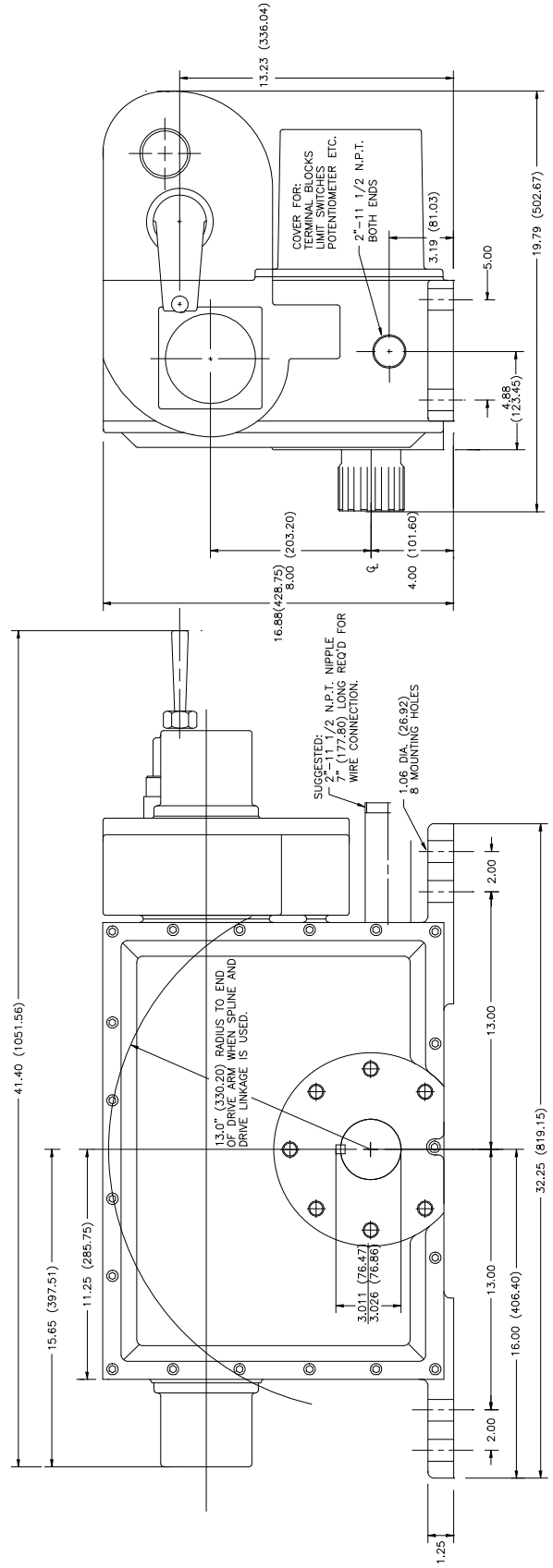
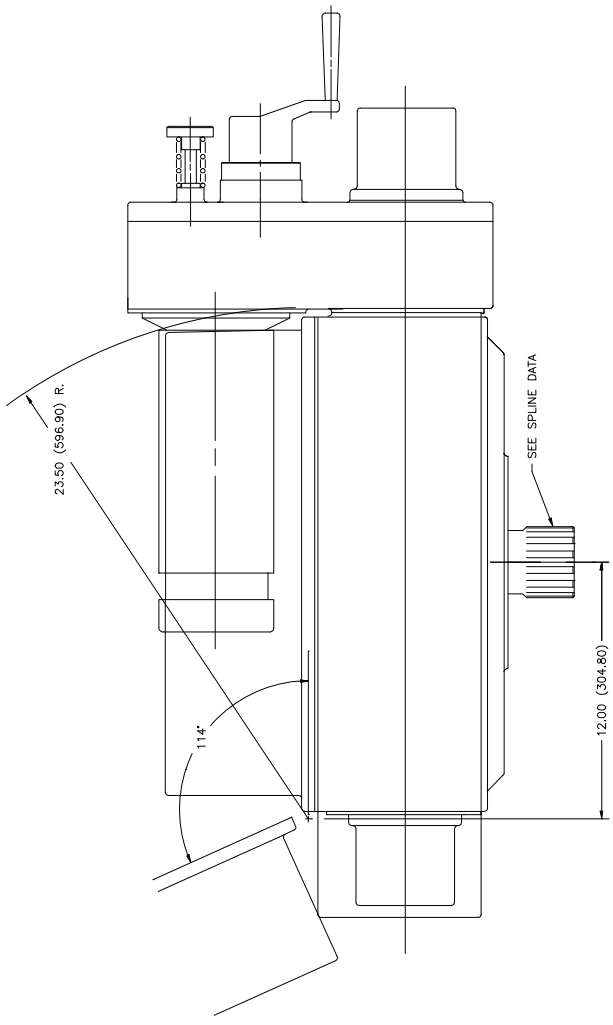
### C. LVDT Assembly Replacement

1. Same as Characterized Potentiometer replacement above.
2. Align LVDT body for zero output (see alignment procedure, characterized cam adjustment on page 12, step G).

# Major Dimensions

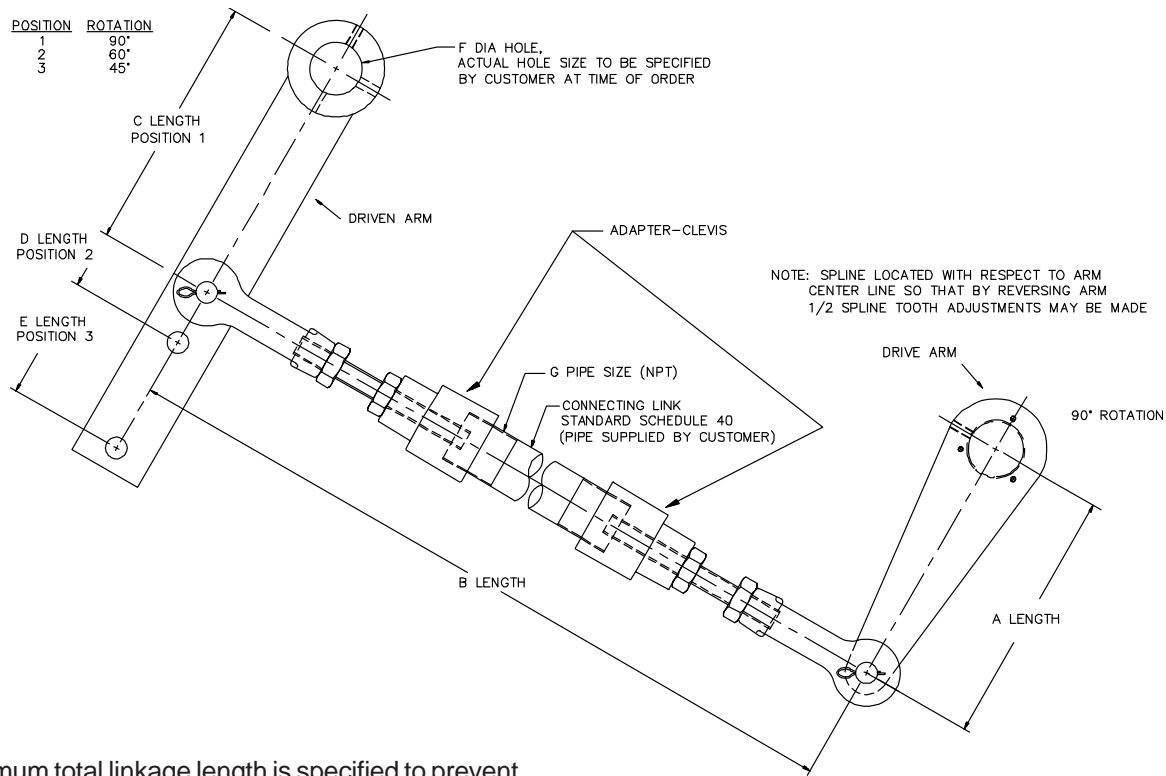
SPLINE DATA:	CHORD	OUTS. DIA.	ROOT DIA.	NO. OF TEETH
SPLINE NO.	919-970	2.690-2.695	2.573-2.578	30
	2625-30M-4	(23.34-23.37)	(65.33-65.48)	

DIMENSIONS IN INCHES (MILLIMETERS)



These dimensions are subject to change without notice and should not be used for preparation of drawings or fabrication of installation mounting. Current installation dimension drawings are available on request.

# SM-5000 SERIES DRIVE ARM AND LINKAGE OPTIONS



**Notes:**

1. Maximum total linkage length is specified to prevent buckling under compressive load.
2. Adjustable drive arms are also available to allow "A" length to vary from 6 to 10 inches (152 to 254 mm). In this case, the adapter-clevis has rod ball ends with lubricating fittings.
3. Special drive arm lengths are available to meet application requirements.

"A" LENGTH in. (mm) (See Note 3)	"B" LENGTH ft. (m)	"C" LENGTH in. (mm)	"D" LENGTH in. (mm)	"E" LENGTH in. (mm)	"F" DIA HOLE min.-max. in. (mm)	"G" PIPESIZE
10 (254)	18 (5.5)	10 (254)	12.25 (311)	17 (432)	0.75 - 1.5 (19 - 38.1)	1 - 1/4 (NPT)

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 IM-0462 2/1/2011

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