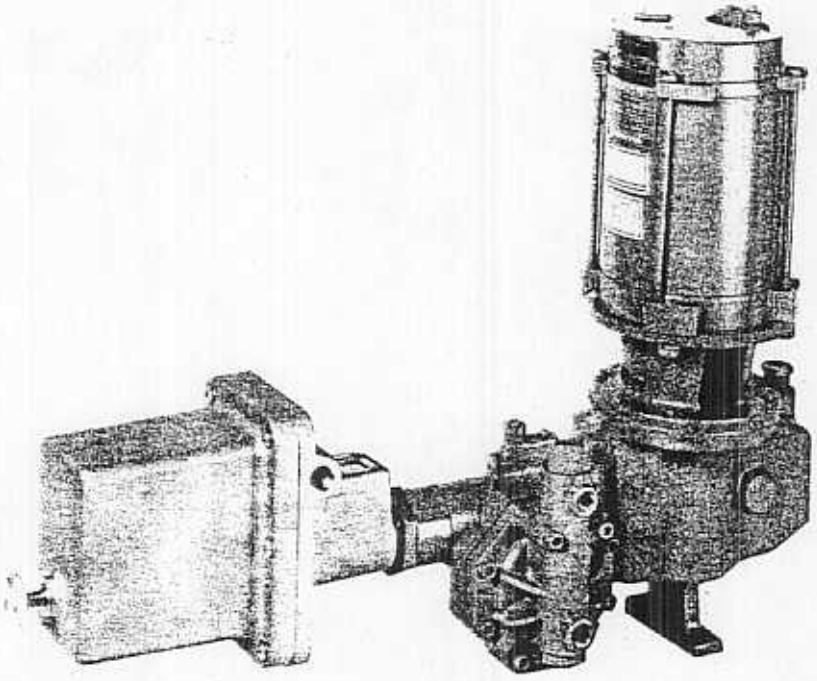
OPERATING & INSTRUCTION MANUAL

for NEPTUNE

ELECTRIC STROKE CONTROL FURNISHED ON SERIES 500 AND 600 DIA-PUMPS



Neptune
CHEMICAL PUMP CO., INC.

Lansdale, Pa. 19446 • Tel: 215-699-8700 • FAX: 215-699-0370

WARNING

BEFORE INSTALLING THE STROKE CONTROLLER-POSITIONER MAKE SURE THAT IT IS SUITABLE FOR THE INTENDED APPLICATION. IF YOU ARE UNSURE OF THE SUITABILITY OF THIS EQUIPMENT FOR YOUR INSTALLATION, CONSULT NEPTUNE CHEMICAL PUMP PRIOR TO PROCEEDING.

WARNING – SHOCK HAZARD

STROKE CONTROLLER-POSITIONER INTENDED FOR INSTALLATION IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC) AND APPROPRIATE LOCAL AND FEDERAL CODES AND SPECIFICATIONS.

INSTALLATION AND SERVICING MUST BE PERFORMED ONLY BY QUALIFIED PERSONNEL.

RACEWAYS CONTAINING ELECTRIC WIRES OR SIGNAL CABLES MUST BE ROUTED AND CONNECTED IN A MANNER THAT CONDENSATION AND MOISTURE CANNOT DRAIN INTO THE STROKE CONTROLLER-POSITIONER.

WARNING – SHOCK HAZARD

PUMP MOTOR DISCONNECT OR POWER SWITCH MAY NOT DE-ENERGIZE STROKE CONTROLLER-POSITIONER. DETERMINE STROKE CONTROLLER-POSITIONER POWER SOURCE AND DISCONNECT POWER BEFORE SERVICING.

DISCONNECT AND USE LOCKOUTS ON BOTH PUMP AND STROKE CONTROLLER-POSITIONER PRIOR TO SERVICING EITHER DEVICE.

WARNING – VIBRATION

STROKE CONTROLLER-POSITIONER IS RIGIDLY MOUNTED ON A MOTORIZED PUMP. RACEWAYS CONTAINING ELECTRIC WIRES OR SIGNAL CABLES SHOULD BE CONNECTED WITH A SECTION OF FLEXIBLE CONDUIT TO ALLOW FOR ANY PIPELINE OR PUMP MOVEMENT AND VIBRATION.

WARNING – HAZARDOUS CHEMICALS

BEFORE SERVICING PUMP OR STROKE CONTROLLER-POSITIONER, CLOSE PUMP ISOLATION VALVES (SHUT OFF CHEMICAL) AND BLEED PRESSURE.

CAUTION – ELECTROSTATIC DISCHARGE

THIS ELECTRONIC CONTROL IS STATIC-SENSITIVE. TO PROTECT THE INTERNAL ELECTRONIC COMPONENTS FROM DAMAGE, NEVER TOUCH THE PRINTED CIRCUIT BOARDS WITHOUT USING ELECTROSTATIC DISCHARGE (ESD) PROCEDURES.

DANGER – FIRE OR EXPLOSION

WHEN INSTALLING AND USING STROKE CONTROL IN A HAZARDOUS AREA:

CONFIRM STROKE CONTROLLER-POSITIONER MODEL, AND ASSOCIATED PUMP MOTOR, ARE APPROVED FOR CLASS, DIVISION AND GROUP OF HAZARDOUS AREA.

INSTALL WIRING, CONDUIT AND CONDUIT SEALS IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE AND OTHER APPROPRIATE CODES AND REGULATIONS. VERIFY SEALING COMPOUND HAS BEEN PROPERLY INSTALLED IN ALL SEALING FITTINGS.

DE-ENERGIZE ALL POWER, SIGNAL AND CONTROL CIRCUITS PRIOR TO REMOVING COVER.

COVER MUST BE PROPERLY INSTALLED AND TIGHTENED PRIOR TO ENERGIZING STROKE CONTROLLER-POSITIONER OR INITIATING CONTROL CIRCUITS AND SIGNALS.

CALIBRATION AND ADJUSTMENTS REQUIRE UNIT BE POWERED AND THE USE OF LIVE SIGNALS. CALIBRATION AND ADJUSTMENTS SHOULD ONLY BE DONE IN A NON-HAZARDOUS AREA.

SERIES EC5000 & EC6000 ELECTRONIC STROKE CONTROL

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SECTION I

NEPTUNE CHEMICAL PUMP CO., INC.

LIMITED WARRANTY

All Neptune products are tested at the factory prior to shipment. Each part used in their construction has been carefully checked for workmanship.

If the Electric Stroke Controller-Positioner is installed properly, Neptune Chemical Pump Co., Inc. warrants to the purchaser of this product for a period of twelve months from the date of first use or eighteen months from shipment, whichever occurs first, this product shall be free of defects in material and/or workmanship, as follows:

1 Neptune Chemical Pump Co., Inc. will replace, at no charge, any part that fails due to a defect in material and/or workmanship during the warranty period, FOB our factory, Lansdale, Pennsylvania. To obtain warranty service, you must forward the defective parts to the factory for examination, freight pre-paid.

2. This warranty period does not cover any product or product part which has been subject to accident, misuse, abuse or negligence. Neptune Chemical Pump Co., Inc. shall only be liable under this warranty if the product is used in the manner intended by the manufacturer as specified in the written instructions furnished with this product.

Any express warranty not provided in this warranty document, and any remedy for breach of contract that, but for this provision, might arise by implication or operation of law, is hereby excluded and disclaimed. Under no circumstances shall Neptune Chemical Pump Company be liable to purchaser or any other person for any charge for labor, repairs, or parts, performed or furnished by others, nor for any incidental consequential damages, whether arising out of breach of warranty, express or implied, a breach of contract or otherwise. Except to the extent prohibited by applicable law, any implied warranty of merchantability and fitness for a particular purpose are expressly limited in duration to the duration of this limited warranty.

Some states do not allow the exclusion or limitation of incidental or consequential damages, or allow limitations on how long any implied warranty lasts, so the above limitations may not apply to you. This warranty gives you specific legal rights, and you may have other rights which may vary from state to state.

IMPORTANT NOTICE – RETURN GOODS AUTHORIZATION

1. All equipment returned to Neptune Chemical Pump Company requires proper Returned Goods Authorization Number (RGA) and tags.

2. If returned goods is a pump, or is to be shipped attached to a pump, drain all oil and chemicals. All chemical contact areas must be thoroughly flushed and neutralized.

3. All equipment which has been in contact with chemicals must be accompanied by a copy of the Chemical Product Material Safety Data Sheet (MSDS).

4. Failure to comply with the above instructions, will result in equipment being returned to sender, freight collect, without service.

PARTS AND REPAIR INSTRUCTIONS

1. Complete model number and serial number of both the Stroke Control AND pump must be provided to insure prompt and accurate parts and repair service.

   Address all inquires and purchase orders for parts and factory repair to :

   Customer Service Department
   Neptune Chemical Pump Company, Inc.
   P.O. Box 247
   Lansdale, PA 19446

   Tel: 215-699-8700
   888-363-7886 (888-3NEPTUNE)

   Fax: 215-699-0370
   800-255-4017

3. Mechanical Stroke Control repairs may be made by purchaser. Refer to Figure 1 for parts identification. Order from Neptune Customer Service by description.

4. Existing Neptune 500 & 600 series manual diaphragm pumps can be upgraded by adding Stroke Control. It is suggested that pump be returned to Neptune for a factory upgrade.

5. If purchaser desires to perform a field pump upgrade by adding Stroke Control, a kit consisting of a Stroke Controller-Positioner and an appropriate pump Connector Rod Assembly will be prepared. Section V of this manual includes required instructions. Prior to ordering consult with Customer Service Department to review required tools and consumables.

6. Electrical repairs are limited to replacing the stepper motor, and factory repairing or replacing the two printed circuit boards. The upper and lower printed circuit boards are interconnected, and are replaced as a single assembly. The Purchaser may send the faulty Printed Circuit Board Assembly to Neptune for evaluation and repair, or replace it with a new assembly. Replacement PC Board Assemblies are shipped with "Factory Settings" (configuration, calibration and adjustments) to match the pump the Stroke Control is mounted on. Stepper motors are not repairable.

7 After April 2003, replacement PC Boards for older Stroke Control units will be newer design digital electronics type. Physically, the newer design PC Board Assembly is directly interchangeable with the older units.

IMPORTANT NOTICE – RETURN GOODS AUTHORIZATION

1. All equipment shipped to Neptune Chemical Pump Company for repair, evaluation or upgrade requires proper Returned Goods Authorization Number (RGA) and tags.

2 If shipped goods are a pump, or is to be shipped attached to a pump, drain all oil and chemicals. All chemical contact areas must be thoroughly flushed and neutralized.

3 All equipment which has been in contact with chemicals must be accompanied by a copy of the Chemical Product Material Safety Data Sheet (MSDS).

4 Failure to comply with the above instructions, will result in equipment being returned to sender, freight collect, without service.

SECTION II

PRODUCT SPECIFICATIONS

Electrical

Line Voltage: 120/240 VAC ±10% (Switch Selectable)
Frequency: 50/60 Hertz
Power: 18 VA

Command Signal Inputs: (Switch Selectable)
4-20 mADC, 4-12 mADC, 12-20 mADC (Input Impedance 200 ohms)
0-5 VDC, 0-10 VDC (Input Impedance 410K ohms)
Incremental Dry Contact Closures

Command Signal Adjustability:

Direct or Reverse Acting –	(Factory Setting – Direct)
Zero and Span Positions -	(Factory Setting – 0% & 100%)
Limits, Lower and Upper -	(Factory Setting – 0% & 100%)
Deadband -	(Factory Setting - 1%)

Loss of Command Signal (Current Signal Only): If signal is below 3.2 mADC, or above 20.7 mADC, output shaft position will be determined by one of two pre-selected signal loss modes.
Lock In Place (at last position)
Pre-configured Position (Factory Setting 0%)

Loss of Power – Output shaft will Lock In Place. Output shaft position can be changed using Manual Handwheel.

Position Feedback Outputs:
Isolated 4-20 mADC, loop powered with 12–36 VDC external power supply.
Limit Switches (adjustable over stroke range): Open transistor low level logic (40 mA max at 40 VDC).

Servo Motor Current Limit: Automatic

Terminals: Spring clamp barrier type, 22 – 14 AWG (0.33 – 2.1 mm^2) wire.

Conduit Entry: two 1/2" NPTI

Recommended Overcurrent Protection:
120 VAC Power - 1/2 Amp
220 VAC Power – 1/4 Amp

Mechanical

Stroke: (Output Shaft linear travel)
EC 5000 Series (500 Pumps): 0.714" (18.14 mm)
EC 6000 Series (600 Pumps): 1.428" (36.27 mm)

Shaft Motion: Extend or retract on command Signal (adjustable)

Speed: 0.25 in/sec (6.35 mm/sec)

Thrust: 10 lbf. (44.5 N)

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

Humidity: 50% maximum at 104°F (40°C)

continued

Mechanical Specifications continued

Altitude: Up to 3280 ft (1000 m) above mean sea level.

Environmental Rating: See chart below.

Weight: 12 pounds (5.4 kg.)

Housing: Cast Aluminum with gasketed window for stroke Position Indicator.

Handwheel, Manual Operation: Push to engage, spring return on release.

Performance:

Permanently Lubricated
Positioning Accuracy: 1.5%
Duty Cycle: Unrestricted Modulating Duty
Maintenance: None required (remove cover and inspect yearly)

Model Number Classification:

MODEL	MATING PUMP	ENVIRONMENTAL RATING
EC 5000	Series 500 dia-Pump	NEMA 4, IP65 Class I, Div. I, Group C & D Class II, Div. I, Group E, F & G
EC 5004	Series 500 dia-Pump	NEMA 4, IP 65
EC 6000	Series 600 dia-Pump	NEMA 4, IP65 Class I, Div. I, Group C & D Class II, Div. I, Group E, F & G
EC 6004	Series 600 dia-Pump	NEMA 4, IP 65

Correct installation, operation and servicing of Stroke Controller-Positioner, and associated pump, in Hazardous Areas is entirely the responsibility of the user.

The Neptune model ER 1000 Remote Control Station is available for control strategies requiring a REMOTE-LOCAL Analog Transfer Station. The ER 1000 is housed in a NEMA 1 panel-mounted enclosure and includes a digital display and a 24 VDC loop power supply for use with the stroke controller Feedback Signal.

INTRODUCTION

The Neptune EC 5000 & EC 6000 Electronic Stroke Controller-Positioners are bi-directional, AC powered, digital electronic linear actuators with built-in servo amplifiers. The Stroke Controller-Positioner is mounted on a Neptune 500 series or 600 series hydraulic diaphragm type chemical metering pump. Pump capacity is controlled by the controller's brushless stepper motor which is directly connected to the pump control rod.

The Stroke Controller can be configured to accept a variety of analog or incremental contact command signal (control signal) inputs. The command input signal is compared to a feedback signal from a linear potentiometer directly connected to the drive shaft. The polarity and magnitude of the command-feedback error is compared to the deadband setting to determine if stepper motor should operate, and in which direction. Isolated analog feedback and solid state limit switch outputs are provided for customer use. Available adjustments include Zero, Span, Travel Limits, Deadband, Loss of Command Signal logic and Direct versus Reverse Control Action. A manual override mechanism allows operation when AC power is disconnected or lost.

Mechanically, the stepper motor produces torque which is directly transmitted to a bearing supported shaft with an acme power thread profile on one end. Running along the thread is a screw nut (manufactured from a low friction, long wearing, self-lubricating material) which allows the motor output to be converted to linear thrust. Design provides smooth, accurate positioning with positive position lock when motor is de-energized. The screw nut and output screw shaft are prevented from turning by a shoulder screw projected radially from the nut-shaft assembly which rides in a precision machined groove. The shoulder screw is visible through a gasketed window and provides a visible indication of linear movement and position. The shoulder screw manipulates the feedback shaft which provides direct position feedback to the linear potentiometer used to generate the above referenced feedback signal.

The stepper motor, nut-sleeve assembly and all electronics are housed in a cast aluminum housing. The sealed output shaft has a threaded hole for attaching the pump's connector-control rod assembly. A mounting nut positions the housing when mating it to the pump.

The stepper motor, nut-sleeve assembly and all electronics are identical for all models. Individual model numbers identify the housing's environmental rating, indicator scale and the configuration required to adapt it to a particular pump model.

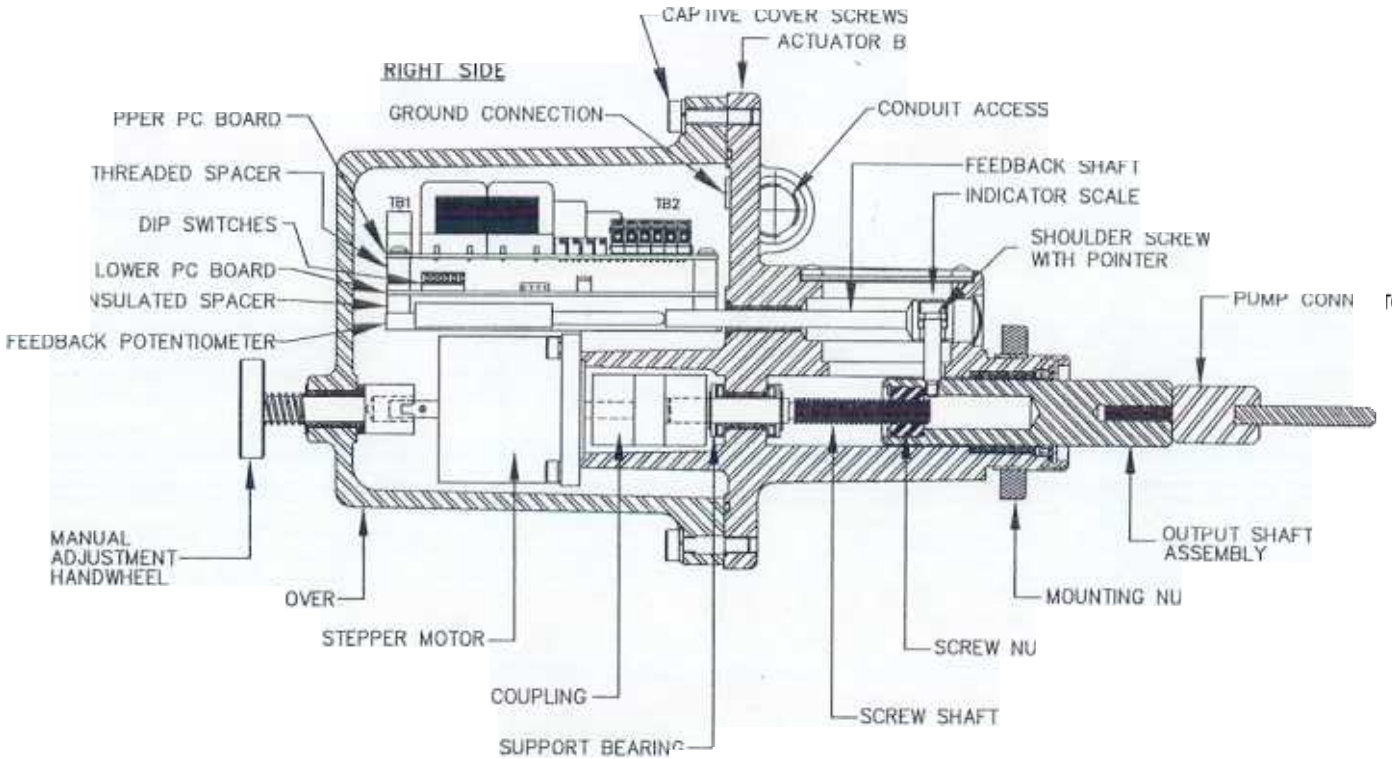


FIGURE 1. MAJOR COMPONENT IDENTIFICATION

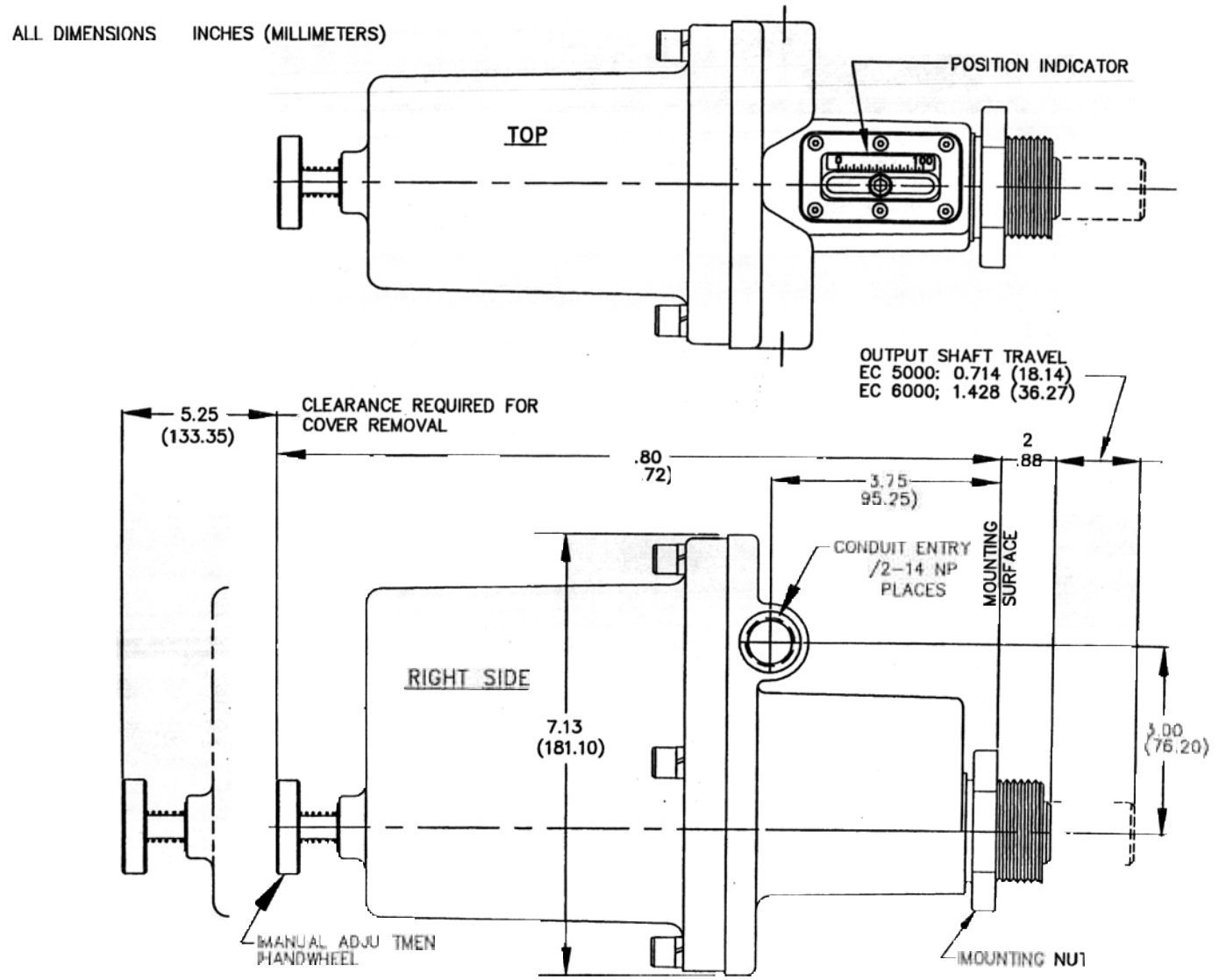
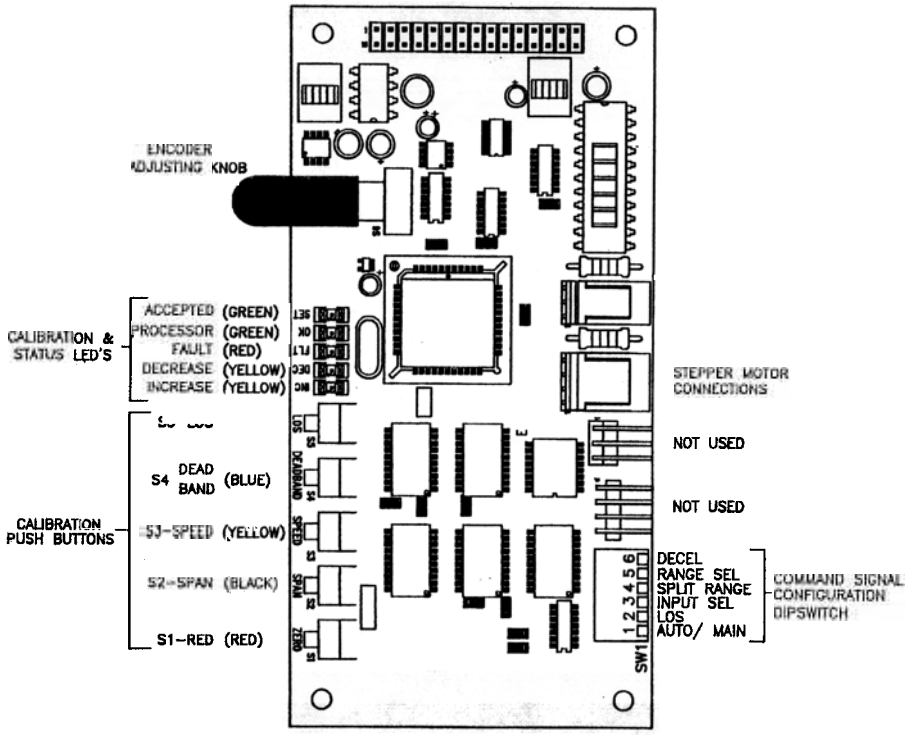


FIGURE 2 OUTLINE DIMENSIONS

CONFIGURATION & CALIBRATION



FIGUPE 3B LOWER PC BOARD

CUSTOMER CONNECTIONS

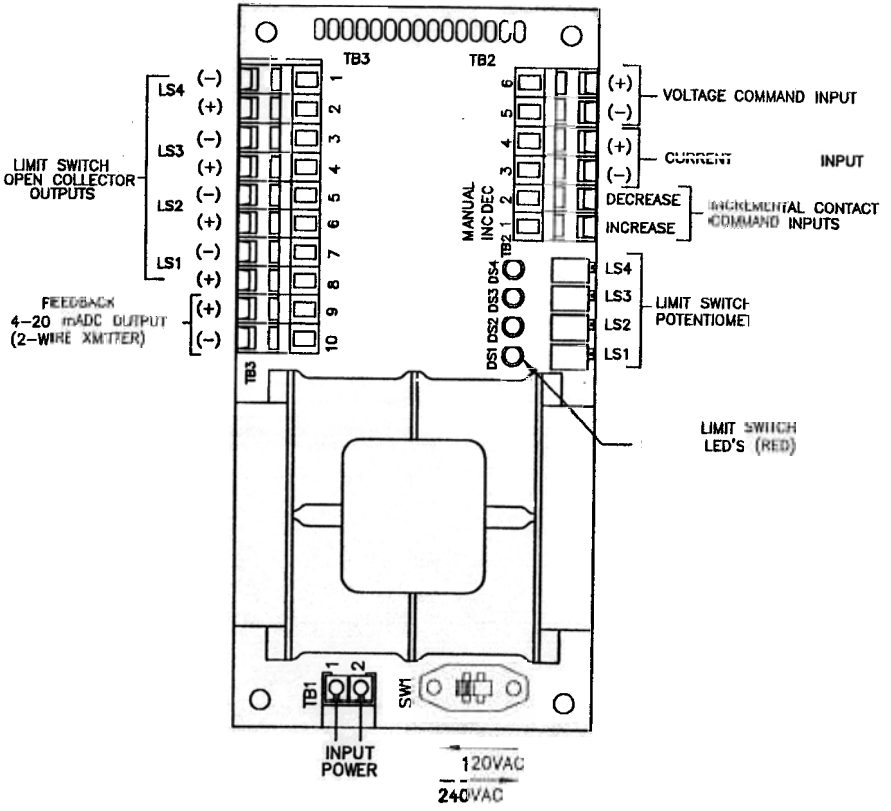


FIGURE 3A UPPER PC BOARD

FIGURE 3A & 3B

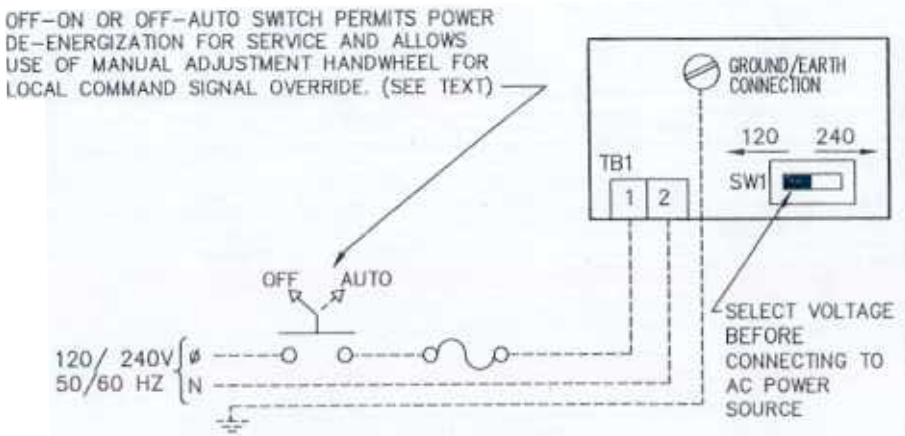


FIGURE 4A AC WIRING

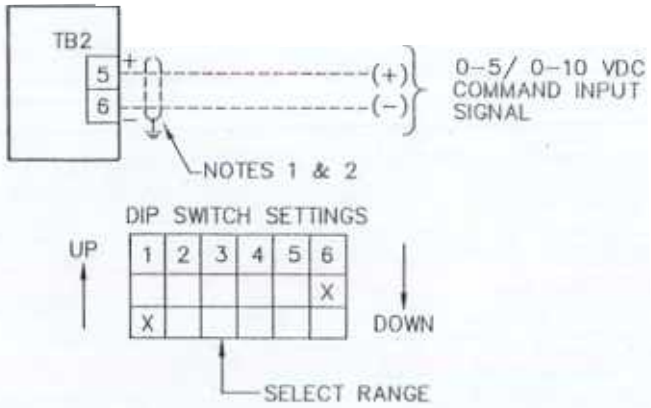


FIGURE 4C VOLTAGE COMMAND INPUT SIGNAL

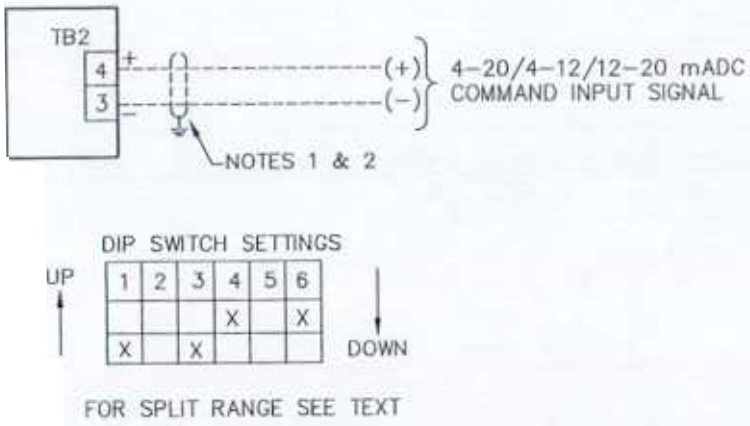


FIGURE 4B CURRENT COMMAND INPUT SIGNAL

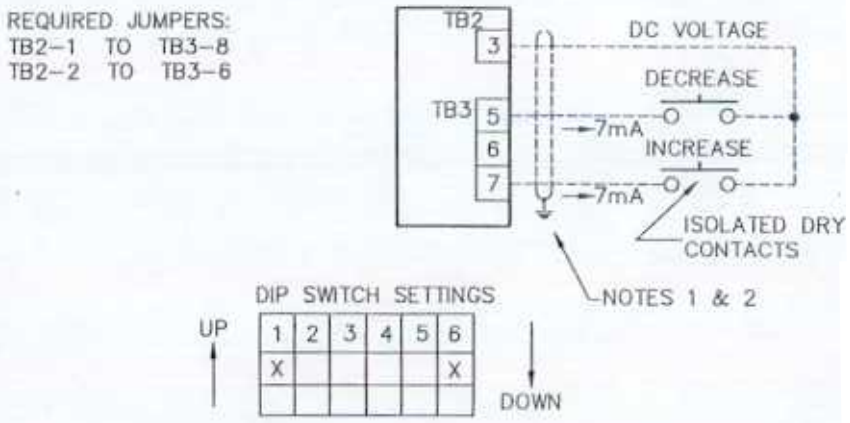


FIGURE 4D INCREMENTAL CONTACT COMMAND INPUT

NOTES:
1. ANALOG SIGNALS AND LOW LEVEL DC WIRING SHOULD BE SEPARATED FROM AC WIRING AND NOT RUN IN THE SAME CONDUIT OR WIREWAY.
2. USE SHIELDED, TWISTED INSTRUMENT CABLE TO WIRE SIGNALS.
3. DE–ENEREGIZE STROKE CONTROL TO CHANGE DIP SWITCH SETTINGS.

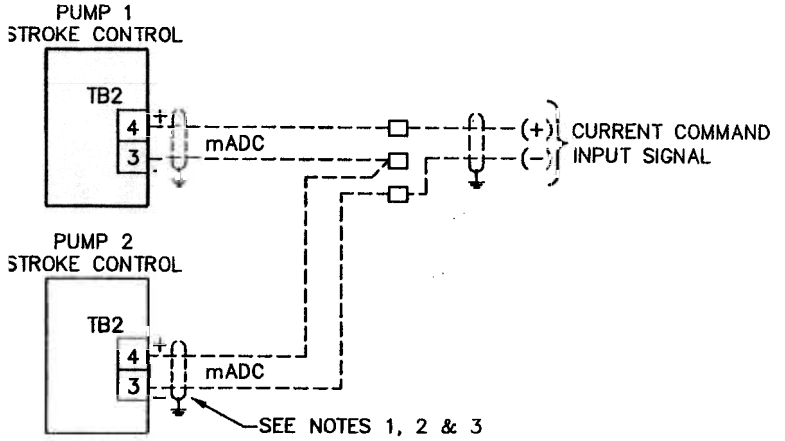
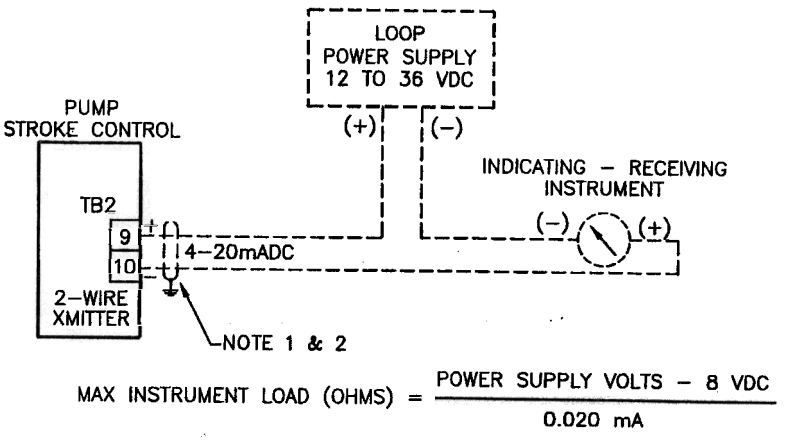


FIGURE 5A SERIES WIRING – CURRENT INPUT



$$\text{MAX INSTRUMENT LOAD (OHMS)} = \frac{\text{POWER SUPPLY VOLTS} - 8\ \text{VDC}}{0.020\ \text{mA}}$$

FIGURE 5C FEEDBACK OUTPUT

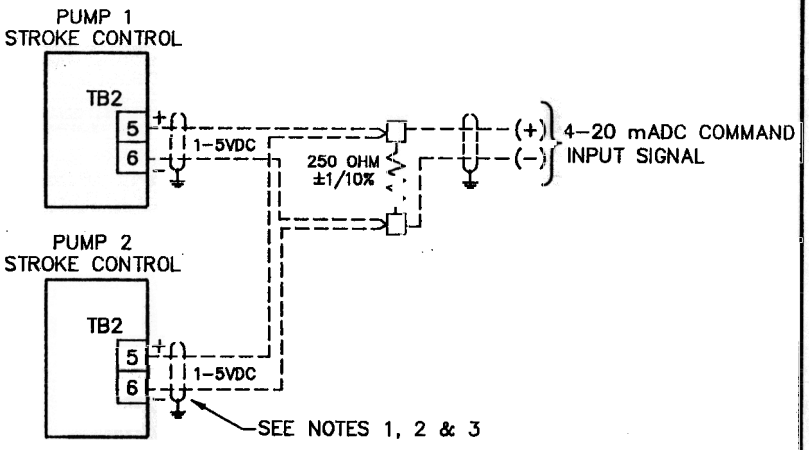


FIGURE 5B PARALLEL WIRING – CURRENT INPUT

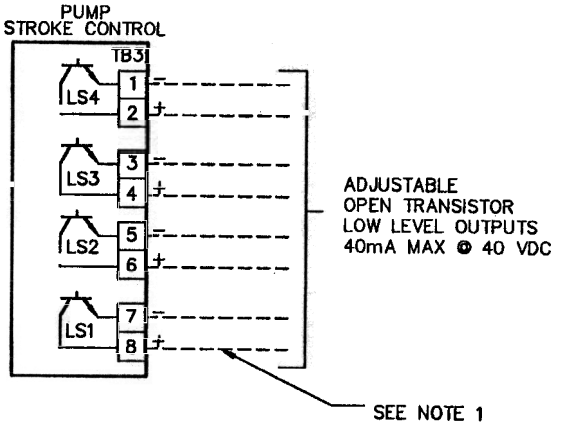


FIGURE 5D LIMIT SWITCH OUTPUTS

NOTES:

1. ANALOG SIGNALS AND LOW LEVEL DC WIRING SHOULD BE SEPERATED FROM AC WIRING AND NOT RUN IN THE SAME CONDUIT OR WIREWAY.
2. USE SHIELDED, TWISTED INSTRUMENT CABLE TO CONNECT SIGNALS.
3. SEE FIGURE 4B FOR REQUIRED DIP SWITCH SETTINGS.

SECTION III

INSTALLATION

1.0 GENERAL

1.1 EC 5000 and EC 6000 Electronic Stroke Controller-Positioners are normally shipped mounted on, and configured for, the pump with which it will be used. Unless the customer order specifically instructs otherwise, the stroke controller will be shipped with standard "Factory Settings". Configuration is discussed in paragraph 3 of this Section. Calibration and Adjustments are discussed in paragraph 4.

1.2 Refer to Section IV for instructions on retrofitting an existing pump with an EC 5000 or EC 6000 Stroke Control-Positioner.

1.3 This manual will use the conventions of Left, Right, Top, Bottom, Front and Rear as if the reader were directly facing, and slightly above, the Manual Adjustment Handwheel. (The window to view the position indicator is at the "rear" of the Stroke Controller).

1.4 This Manual will refer to configuration, calibrations, and adjustments for Direct Action control logic (increase in Command Signal increases pump output). Converting to Reverse Action logic is discussed in paragraph 4.8.

1.5 The inside front cover of this manual lists hazards and dangers associated with Stroke Control installation, use and servicing. This listing should be reviewed prior to initial installation and periodically thereafter.

WIRING

WARNING! All wiring should be done in accordance with the National Electric Code (NEC) and appropriate Local, State And National codes and specifications. Installation and servicing should only be accomplished by qualified personnel.

WARNING! Verify pump power is disconnected (de-energized) and Locked Out.

2.1 PUMP INSTALLATION: Refer to separate pump Operating and Instruction manual for pump installation. Complete the installation of all pump process piping and wiring.

2.2 REMOVE COVER: Loosen the six captive screws to remove Stroke Controller-Positioner cover.

2.6 CONDUIT: The Stroke Controller-Positioner has two 1/2"-14 NPT conduit entrances toward the rear of the housing – see Figure 2. It is recommended the left conduit entrance be used for AC power wires, and the right for low level and signal wiring. Conduit runs should be routed so that moisture and condensation cannot drain into housing.

2.7 AC POWER: Input Power conductors connect to TB1 which is a blue colored, two point terminal board located on the front of the upper PC board – see Figures 3A & 4A. TB1 has spring-clamp type terminals with front tabs which are pushed down to insert wires. Maximum wire size is 14 AWG (2.1 mm^2). Conductor insulation strip length is 0.22" (5.6 mm).

Terminal 1 of TB1 is for AC Line, terminal 2 is for Neutral.

A slide switch, SW1 is located to the immediate right of TB1 to select operating voltage. The left position of SW1 is for 120 VAC, the right position is for 240 VAC.

The earth ground connection is a green ground screw located inside the housing, to the rear of the two PC Boards, between the two conduit entrances.

Overcurrent protection should be supplied in the Line conductor of the Incoming Power – see Figure 4A. Recommended is 1/2 amp fusing for 120 VAC power, and 1/4 amps for 240 VAC power.

An OFF-ON or OFF-AUTO switch is recommended in the Line conductor of the Incoming Power - see figure 4A. Switch would disconnect AC power for service or to use the Manual Handwheel to override a remote command signal.
If a manual handwheel adjustment is attempted with the power connected, the analog command signal will return the stroke controller to its pre-adjustment position.
If manual handwheel adjustment is attempted after interrupting the analog signal, the Loss of Signal configuration logic may interfere with the handwheel adjustment.

2.8 INPUT & OUTPUT SIGNALS: Low level and signal cable conductors connect to TB2 or TB3. Both terminal boards are gray in color. Terminals are spring-clamp type and require the use of a small blade type screw driver or an insertion tool – see Figure 6. Terminals are suitable for a conductor range of 22 AWG (0.33 mm²) to 14 AWG (2.1 mm²). Conductor insulation strip length is 0.22" (5.6 mm).

2.8.1 TB2 is used for Command Input signals. It is located on the right side of the upper PC Board – see Figure 3A.

TB3 is used for Feedback Output signals. It is on the left side of the upper PC Board – see Figure 3A.

Low level and signal wiring should be separated, and run in separate conduit from AC wiring. Signal wiring should be instrument grade twisted, shielded cable. Ground cable shield(s) in only one location.

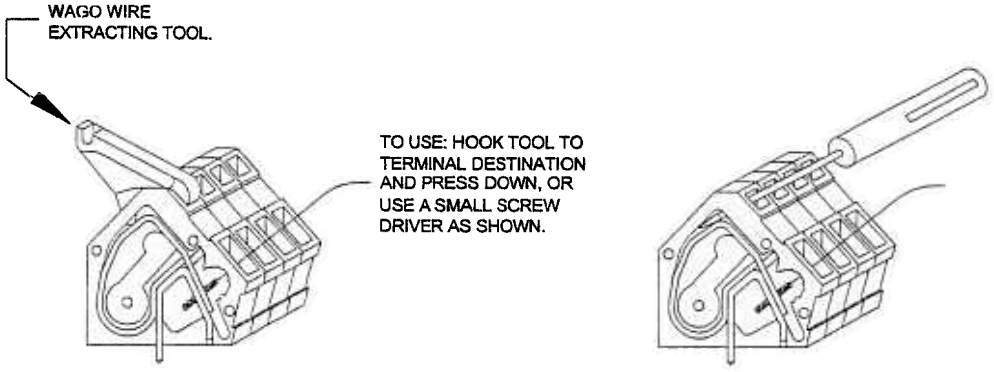


FIGURE 6 – TERMINAL INSTRUCTIONS

1010-CONN

CONFIGURATION

WARNING! De-energize (disconnect) pump. De-energize all power, signal and control circuits from Stroke Controller-Positioner before removing cover.

CAUTION! Operating configuration switches with Stroke Controller-Positioner energized can damage electronic circuits.

CAUTION! Electronic components and circuits are static sensitive. Do not touch printed circuit boards without using Electrostatic Discharge (ESD) procedures.

3.1 FACTORY CONFIGURATION SETTINGS:

Input Power -	120 VAC
Command Signal -	4-20mADC or 0-5 VDC
Loss of Signal -	Lock in Place
Split Range -	Disabled

3.2 INPUT POWER: Slide Switch SW1 selects the Line (Operating) power. Left position is for 120 VAC, right position is for 240 VAC. Slide Switch SW1 is located to the tight of Power Terminal Board TB1 on the front of the Upper PC Board – see Figure 3A.

3.3 COMMAND SIGNAL: Dip Switch SW1 selects Command Signal options. Dip Switch SW1 is a six switch assembly located on the front-right of the Lower PC Board – see Figure 3B.

COMMAND SIGNAL CONFIGURATION - Dip Switch SW1

SWITCH	SWITCH POSITION	FUNCTION	CONNECTION DIAGRAM
1	DOWN (ON) *	AUTO – ANALOG INPUT	FIGURE 4B or 4C
1	UP (OFF)	MANUAL – CONTACT INPUT	FIGURE 4D
2	DOWN (ON) *	LOSS OF SIGNAL – LOCK IN PLACE	
2	UP (OFF)	LOSS OF SIGNAL – GO TO PRESET	
3	DOWN (ON) *	4-20 mADC / 0-5 VDC	FIGURE 4B or 4C
3	UP (OFF)	0-10 VDC	FIGURE 4C
4	DOWN (ON)	SPLIT RANGE - ENABLED	
4	UP (OFF) *	SPLIT RANGE – DISABLED	
5	DOWN (ON)	12-20 mADC SPLIT RANGE	FIGURE 4B
5	UP (OFF) *	4-12 mADC SPLIT RANGE	FIGURE 4B
6	DOWN (ON)	not applicable	
6	UP (OFF) *	LINEAR ACTUATION	

* FACTORY SETTINGS

3.4 ANALOG (AUTO) COMMAND: Inputs can be DC current or DC voltage. Voltage signals are more subject to signal degradation from electrical interference and to signal error or loss due to wire resistance versus distance from the signal source. See paragraph 2.8.3 for a discussion signal cable installation.

3.5 CONTACT CLOSURE (MANUAL) COMMAND: Manual control requires two isolated dry contacts or pushbuttons. DC interrogation voltage is provided by the Stroke Controller. Contacts or pushbuttons must be located within a 50 foot wire run length. Minimum cable conductor size is 16 AWG (1.3 mm^2).

3.6 LOSS OF COMMAND SIGNAL: Loss of Signal (LOS) monitoring only pertains to analog current signals. If the command signal is lost, or shorted out, the user can select to have Stroke Controller-Positioner "park" at its last position, or travel to a preset position. Adjustments required to establish the Loss of Signal Preset is covered in paragraph 4.9.

3.7 SPLIT RANGE COMMAND Signals requires re-calibration of High Command, Low Command, Zero and Span as directed in paragraphs 4.4 through 4.7.

3.8 SHARED COMMAND SIGNALS: Two or more Stroke Controller-Positioners can be controlled from a single analog current signal. Shared Command Signals can be wired in "Series" or in "Parallel". Both wiring strategies have limitations and disadvantages.

3.8.1 SERIES WIRING of multiple Stroke Controller-Positioners is illustrated in Figure 5A. Only active Stroke Controller-Positioner need be energized. This circuit is frequently used where one of the pumps is an inactive "Stand-By". The maximum quantity of Stroke Controller-Positioners that can be wired "in series" is a function of the remote signal source, its power supply and the possible presence of other loop instrumentation. If evaluating loop capacity using resistance, add 200 ohms for each Stroke Controller-Positioner. If evaluating loop capacity using voltage, add 4 volts for each Stroke Controller-Positioner.

3.8.2 PARALLEL WIRING of multiple Stroke Controller-Positioners using a precision resistor is illustrated in Figure 5B. The 250 ohm precision resistor converts the analog current signal to 1-5 VDC. The maximum quantity of Stroke Controller-Positioners that can be wired "in parallel" is a function of desired input signal accuracy. In addition to precision resistor tolerance, the parallel impedance (410K ohms) of each Stroke Controller-Positioner contributes a small error the "equivalent resistance" of the precision resistor.

3.8.3 PARALLEL WIRING Command voltage inputs requires calibrating the Zero and span adjustments to match the voltage signal - see paragraphs 4.5 and 4.7. Also see paragraph 2.8.3 and 3.4 for DC Signal wiring considerations.

4.0 CALIBRATION AND ADJUSTMENTS

WARNING! Calibration and adjustments require powering the Stroke Controller-Positioner with the cover removed. Adjustments should be made by an experienced instrument technician in a laboratory setting. Calibration and adjustments should NEVER be made in a Hazardous Area or in a damp / wet location.

CAUTION! Operating configuration switches with Stroke Controller-Positioner energized can damage electronic circuits.

CAUTION! Electronic components and circuits are static sensitive. Do not touch printed circuit boards without using Electrostatic Discharge (ESD) procedures.

4.1 FACTORY SETTINGS:

Direct Acting -	Increase in Command Signal increases pump output
Low Command Value -	4 mADC
High Command Value -	20 mADC
ZERO (Low /0%) -	Output shaft fully retracted, zero pump output
SPAN (High /100%) 500 pump-	Shaft extended 0.714" (18.14 mm), 100% pump output
SPAN (High /100%) 600 pump -	Shaft extended 1.428" (36.27 mm), 100% pump output
Loss of Signal Preset -	0%
Deadband -	± 1%
Feedback Output, 4 mADC –	0% (Shaft fully extracted)
Feedback Output, 20 mADC -	100% (Shaft Extended)
Analog Command Limits -	0% & 100% - see paragraph 4.13
Contact Command Limits -	0% & 100% - see paragraph 4.14
Limit Switches -	see paragraph 4.15

4.2 REQUIRED TOOLS:

Small Screwdriver
Analog Signal Generator
Milliammeter (Feedback Output measurement)
Power Supply, 12-36 VDC (Feedback output adjustment)

4.2 LOCATION OF ADJUSTMENTS:

Signal and Position calibrations – Lower PC Board, left side – see Figure 4B

Adjustments require depressing color coded pushbuttons (S1 to S5) while turning the adjusting knob of the Encoder (common adjustment potentiometer).

Function identifying LED's are positioned between the pushbuttons and the Encoder knob.

INC – yellow LED illuminated during shaft movement toward High Setpoint.
DEC – yellow LED illuminated during shaft movement toward Low Setpoint.
FAULT – red LED illuminated IF current Command Signal is lost (LOS)
µOK – green LED flashes when microprocessor is operating.
ACCEPTED – green LED illuminates when Command Signal level calibration accepted.

Limit Switches – Upper PC board, right side – see Figure 4A.

Adjustments require turning dedicated potentiometers. Individual red LED's indicate Limit Switch State.

4.3 LOW COMMAND: Connect a simulated Command Signal from signal generator to the appropriate terminals (see Figure 4B or 4C). Set simulated Command Signal to its Lowest Level (e.g. 4 mA or 0 VDC). Apply AC Power to the Stroke Controller (green LED tagged "OK" will flash). Depress and hold the red ZERO (S1) and white LOS (S5) pushbuttons until green ACCEPTED LED illuminates (approximately 2 seconds).

4.4 ZERO (LOW SETPOINT): With simulated Command Signal set at its lowest level, depress and hold the red ZERO (S1) pushbutton, and observing the Position Indicator, turn Encoder knob clockwise to extend the output shaft, or counterclockwise to retract shaft. Move output shaft to desired position.

4.5 HIGH COMMAND: Set simulated Command Signal to highest level (e.g. 20 mA, 5 VDC or 10 VDC). With Stroke Controller powered, depress and hold the black SPAN (S2) and white LOS (S5) pushbuttons until green ACCEPTED LED illuminates.

4.6 SPAN (HIGH SETPOINT): With simulated Command Signal set at its highest level, depress and hold the black SPAN (S2) pushbutton, and observing the Position Indicator, turn Encoder knob clockwise to extend the output shaft, or counterclockwise to retract shaft. Move output shaft to desired position.

4.7 DIRECT ACTION: A Command Signal increase *extends* output shaft and *increases* pump output. Output shaft is retracted at Low Setpoint, and extended at High Setpoint (Factory Setting).

REVERSE ACTION: A Command Signal increase *retracts* output shaft and *decreases* pump output. Adjust Low Setpoint (paragraph 4.5 above) to correspond to an extended output shaft position shaft. Adjust Low Setpoint to correspond to a retracted output shaft position.

4.8 LOSS OF SIGNAL PRESET: To change the Factory Setting, depress and hold the white LOS (S5) pushbutton, and observing the Position Indicator, turn the Encoder knob clockwise to extend the output shaft, or counterclockwise to retract shaft. Move output shaft to desired LOS Preset position. NOTE: To activate this setting, Dip Switch 2 must be in the UP (OFF) position – see paragraph 3.3.

DEADBAND: This adjustment establishes servo sensitivity. It is recommended that the Factory Setting of 1% NOT be adjusted. If output shaft oscillates (yellow and green lights turn on and off rapidly) adjustment is too sensitive for Command Signal. To decrease sensitivity (increase deadband) depress and hold the blue DEADBAND (S4) pushbutton and turn the Encoder knob clockwise until oscillation stops.

SPEED: Speed is factory adjusted to match the pumps required thrust (force). Speed is not field adjustable.

FEEDBACK TRANSMITTER: The Feedback Transmitter is a 2-wire transmitter that produces an increasing signal as output shaft moves toward SPAN position, and a decreasing signal as shaft moves toward ZERO position. Transmitter resistance is 400 ohms (8 VDC voltage drop at 20 mADC output). Output is isolated from all Stroke Control electronics. To calibrate the transmitter, a loop power supply and milliammeter are wired as shown in Figure 5C. Connect a simulated Command Signal and apply AC Power to the Stroke Controller.

4.11.1 FEEDBACK ZERO (4mADC): Connect a simulated Command Signal from signal generator to the appropriate terminals (see Figure 4B or 4C). Set simulated Command signal to its lowest level (e.g. 4 mADC or 0 VDC). Allow output shaft to travel to desired ZERO position. Depress and hold red ZERO (S1) and white LOS (S5) pushbuttons until green ACCEPTED LED illuminates. Continue to depress pushbuttons, and observing milliammeter, rotate Encoder knob clockwise to increase 4 mA point, or counterclockwise to decrease 4 mA point.

FEEDBACK SPAN (20mADC): Set simulated signal to its highest level (e.g. 20 mADC, 5 VDC or 10 VDC). Allow output shaft to travel to desired SPAN position. Depress and hold black SPAN (S2) and white LOS (S5) pushbuttons until green ACCEPTED LED illuminates. Continue to depress pushbuttons, and observing milliammeter, rotate Encoder knob clockwise to increase 20 mA point, or counterclockwise to decrease 20 mA point.

RESTORE FACTORY DEFAULTS: Factory calibration and adjustment settings can be restored by simultaneously depressing switches S3 (yellow), S4 (blue) and S5 (white) until green ACCEPTED LED illuminates (approximately 2 seconds). Note: Restoration does not affect Limit Switch potentiometer adjustments and Configuration Switch settings (Paragraphs 3.1 through 3.7).

4.12.1 600 PUMP RESTORATION – ADDITIONAL INSTRUCTIONS: Restoration returns Stroke Controller-Positioner to calibration and adjustment Factory Settings appropriate for 500 pumps. After restoration, SPAN (Paragraph 4.7) and Feedback SPAN (Paragraph 4.11.2) will require additional adjustment to compensate for additional 600 pump output shaft travel.

4.13 LIMIT SWITCH OUTPUTS: Four open collector Limit Switch outputs (LS1 to LS4) are available for customer use. Limit Switch output rating is 40 mA (max) at 40 VDC. Limit Switches can be set to be ON, or OFF, anywhere within the ZERO and SPAN setpoints. Limit switches are adjusted with individual trim potentiometers located on the right side of the Upper PC Board – see Figure 3A. Status of each Limit Switch is indicated by a red LED (DS1 to DS4) located adjacent to its trim pot. LED is illuminated when associated limit switch is ON (conducting).

4.13.1 LIMIT SWITCH WIRING: Wiring connections are show in Figure 5D. If Command Signal Limits are being used (paragraphs 4.13 & 4.14), LS1 and LS2 will not be available for field monitoring of shaft positions.

4.13.2 LIMIT SWITCH ADJUSTMENT: Connect a simulated Command Signal from signal generator to the appropriate terminals (see Figure 4B or 4C). Set simulated command signal to desired level or desired shaft position. Clockwise rotation of the corresponding trim pot will cause LS1 or LS3 to go ON and LS2 or LS4 to go OFF.

4.13.3 VERIFY LIMIT SWITCH SETTINGS: Use simulated command signal to exercise Stroke Controller-Positioner though it's full travel range. It is suggested this be repeated several times.

4.14 ANALOG COMMAND SIGNAL LIMITS: Limit Switches LS1 and LS2 can be jumpered into the analog Command circuit to create adjustable end of travel limits for the output shaft. (Establishes minimum, or maximum pump output). Limit switches are adjusted to repress the analog command signal when the output shaft reaches desired limits. LED's for LS1 and LS2 are OFF when in the operating range. When the limits are reached, shaft travel is inhibited, and the appropriate LED is illuminated.
Required jumpers:

TB2-1 to TB3-8
TB2-2 to TB3-6
TB2-3 to TB3-5
TB3-7 to TB3-5 Suggested jumper wire size 20 AWG (0.52 mm²).

4.14.1 LOW ANALOG COMMAND LIMIT ADJUSTMENT: Low travel limits are established using the potentiometer and LED (DS1) associated with LS1 – see Figure 3A. Set simulated command signal to desired low limit. Allow the output shaft to travel to desired low limit position. Slowly turn LS1 potentiometer clockwise until DS1 is just illuminated. On decreasing command signal, output shaft will not retract past this point (minimum pump output).
If when initially adjusting the output shaft, DS1 illuminates prior to reaching the desired low limit, turn the LS1 potentiometer counterclockwise to retract the shaft to the desired low limit.

4.14.2 HIGH ANALOG COMMAND LIMIT ADJUSTMENT: High (maximum) travel limits are established using the potentiometer and LED (DS2) associated with LS2 – see Figure 3A. Set simulated command signal to desired high limit. Allow the output shaft to travel to desired high limit position. Slowly turn LS2 potentiometer counterclockwise until DS2 is just illuminated. On increasing command signal, output shaft will not extend past this point (maximum pump output).
If when initially adjusting the output shaft, DS2 illuminates prior to reaching the desired high limit, turn the LS2 potentiometer clockwise to extend the shaft to the desired high limit.

4.15 CONTACT COMMAND LIMITS: Wiring for remote incremental control using remote contacts is shown in Figure 4D. Distance and wire limitations are defined in Paragraph 3.5. Limit Switches LS1 and LS2 are wired in series with the remote command contacts to create adjustable travel limits for the output shaft (Establishes maximum and minimum pump outputs). LED's for LS1 and LS2 are illuminated when output shaft is within the operating range. When the limits are reached, travel is inhibited and the appropriate LED is de-energized.
Required jumpers:

TB2-1 to TB3-8
TB2-2 to TB3-6 Suggested jumper wire size 20 AWG (0.52 mm²).

4.15.1 LOW CONTACT COMMAND LIMIT ADJUSTMENT: Low (minimum) travel limits are established using the potentiometer and LED (DS2) associated with LS2 – see Figure 3A. Use a temporary jumper between terminals TB2-2 and TB2-3 to retract the output shaft toward desired low limit position. (To extend shaft, place a temporary jumper between TB2-1 and TB2-3). Slowly turn the LS2 potentiometer counterclockwise until LED (DS2) is first illuminated, or turn potentiometer clockwise until the DS2 is initially de-energizes. On decreasing command contact closures, output shaft will not retract past this point (minimum pump output).

4.15.2 HIGH CONTACT COMMAND LIMIT ADJUSTMENT: High (maximum) travel limits are established using the potentiometer and LED (DS1) associated with LS1 – see Figure 3A. Use a temporary jumper between terminals TB2-1 AND TB2-3 to extend the output shaft toward desired high limit position. (To retract shaft, place a temporary jumper between TB2-2 and TB2-3). Slowly turn the LS1 potentiometer clockwise until LED (DS1) is first illuminated, or turn potentiometer counterclockwise until the DS1 is initially de-energizes. On increasing command contact closures, output shaft will not extend past this point (maximum pump output).

SECTION IV

5.0 REPLACING PRINTED CIRCUIT BOARDS

WARNING! Examination, repair or replacement of Stroke Control components requires removal of cover. Repair, calibration and adjustments should NEVER be made in a Hazardous Area or in a damp / wet location. Servicing should be by an experienced instrument technician in a laboratory setting.

WARNING! De-energize (disconnect) pump. De-energize all power, signal and control circuits from Stroke Controller-Positioner before removing cover.

CAUTION! Electronic components and circuits are static sensitive. Do not touch printed circuit boards without using Electrostatic Discharge (ESD) procedures.

5.1 ELECTRONICS PACKAGE: Stroke Control electronics, terminals, power supply, and feedback transmitter are each contained on one of two PC Boards. The upper and lower PC Boards are interconnected and are replaced or repaired as a single assembly. After April 2003, non-repairable older design analog PC Boards are replaced with newer digital electronic PC Boards. Newer digital design PC Boards are dimensionally interchangeable with identical mounting holes. Locations of field wiring terminals match the older design. New design digital PC Boards can be identified by observing that the Configuration Dip Switch Assembly on the right-front of the Lower PC-Board (see Figure 3B) has 6 switches (versus 8 for the older design).

5.2 DISCONNECT FIELD WIRING: Tag and disconnect all field wiring. Insulate (wirenut or tape) all exposed field wire conductors.

5.3 REMOVE UPPER PC BOARD: Record settings of configuration dip switches (right-front of Lower PC Board) and AC Power Slide Switch (SW1 on upper PC Board). Remove four screws and washers from Upper PC Board. Lift Upper PC Board perpendicularly away from Lower PC Board (unplugging a multi-pin connector) and remove it. Save all mounting hardware.

5.4 REMOVE LOWER PC BOARD: Unscrew and remove four metal threaded spacers and washers. Remove Lower PC Board and four insulated spacers (see Figure 1). Locate stepper motor connectors on right side of PC Board (see Figure 3B). Gently lift upper tab on PC Board's connector and pull out mating connector containing four stepper motor wires. Save all mounting hardware and insulated spacers.

5.5 REPLACEMENT PC BOARDS: Identify upper and lower PC Boards (see Figures 3A & 3B).

REPLACE LOWER PC BOARD: Observe Feedback Potentiometer is attached to lower side of PC Board. Position board so shafts of Feedback Potentiometer and Feedback shaft intersect (see Figure 1). Replace hardware removed in paragraph 5.4 (above). Reconnect Stepper Motor.

REPLACE UPPER PC BOARD: Observe mating multi-pin connectors at rear of upper and lower PC Boards. Carefully plug Upper PC Board into lower board. Replace hardware removed in paragraph 5.3 (above).

CONFIGURATION: Replacement PC Boards were shipped with Factory Configuration Settings defined in Paragraph 3.1. Paragraphs 3.2 to 3.8 describe configuration customization to match actual field requirements. NOTE: Individual Dip Switch functions on older design Analog PC Boards do NOT match those of the newer digital PC Boards.

CALIBRATION AND ADJUSTMENTS: Replacement PC Boards were shipped with Factory Settings defined in Paragraph 4.1. (If the pump model number was not provided with order, factory Settings will be for a 500 pump). Paragraphs 4.2 to 4.15 describe how to make calibration and adjustment changes to match actual field requirements.

SECTION V

6.0 RETROFITTING EXISTING NEPTUNE DIAPHRAGM PUMPS

WARNING! Do not perform pump retrofit in a Hazardous Area or a damp / wet location.

WARNING! Verify pump power is disconnected (de-energized) and Locked-Out.

WARNING! Close isolation valves (shut off process fluid). Bleed Pressure. Drain all oil and process fluids.

6.1 FACTORY RETROFIT: Existing manual Neptune diaphragm pumps can be upgraded with an Electric Stroke Control. It is suggested the pump be returned to Neptune Customer Service for the retrofit.

6.2 FIELD RETROFIT: If a field retrofit is planned, the appropriate instructions should be reviewed for required manuals, tools, connector rod assembly, replacement gaskets and consumables (e.g. hydraulic oil, Loctite). The process should be analyzed to see if a precise determination of the pump ZERO setting is required.

6.3 CLEARANCE: Examine pump location for clearances to install Stroke Controller-Positioner. If Stroke-Positioner is to be installed with pump remaining in pipeline, verify clearances required for draining oil and process fluids.

7.0 RETROFITTING SERIES 481, 500 & 560 DIAPHRAGM PUMPS

7.1 PUMP MODIFICATION: Refer to illustrations in the Series 500 or 560 Pump Operating & Instruction Manual for parts identification and other information referenced in the instructions. Individual parts are identified by "Figure Numbers" (F/N). Manual includes tables that cross reference Figure Numbers to part descriptions and Neptune Part Numbers (P/N). Replacement parts are ordered by their Part Number (P/N). Note: Control Rod Assemblies for Series 481, 500 & 560 pumps are not interchangeable. Correct control rod Assembly will be included with a Stroke Controller-Positioner purchased for retrofit.

7.1.1 Remove gear box drain plug F/N 510 from gear box F/N 500 and allow hydraulic oil to drain completely from the gear box. Replace the drain plug.

Remove two slotted head screws F/N 521 from pump body F/N 513 allowing the indicator plate F/N 520 to hang loosely.

Turn control knob F/N 524 counterclockwise until the threads disengage from the sealing nut F/N 526. Pull he control knob and attached metering rod from the pump body.

With an 11/16" 6-point socket wrench, remove the sealing nut.

Parts 520, 521, 524, and 526 are no longer needed.

7.1.6 The sealing plate F/N 518 remains in position within the pump body.

7.1.7 Screw adapter P/N 002705 into the pump body and tighten securely against the seal plate.
NOTE: A small hole is drilled in the side of the adapter. This hole must face down to allow any oil leakage to drain out of the adapter. Shims are provided to position he adapter. If, when the adapter is tightened the hole is not between 5 o'clock and 7 o'clock, unscrew the adapter and add shims between the adapter and the sealing plate to reposition the drip hole.

The control rod is supplied attached to the connector, P/N 002707. Apply 1 drop of low strength (blue) Loctite to the threads on the connector P/N 002707. Screw the connector completely into the threaded rod projecting from the nose of the Electric Stroke Control. Allow the Loctite to set.

7.2 MOUNT ELECTRIC STROKE CONTROL: The Stroke Controller-Positioner is installed as a unit. Do not disassemble or remove the cover from the unit.

If the output shaft of Stroke Controller-Positioner is not in the ZERO position (output shaft fully retracted) turn the Manual Adjustment Handwheel clockwise until the shaft is fully retracted (see Figure 2).

Turn the large Mounting Nut on the nose of the Stroke Controller-Positioner so that there is 1/4" between the face of the nut and the face of the stroke control unit (see Figure 2).

7.2.3 Coat the tip of the control rod F/N 515 with STP, or heavy machine oil, to allow it to slip easily into the sealing plate O-ring.

Center the control rod in the sealing plate and, using hand pressure on the back of the control housing, push the control rod through the O-ring in the sealing plate. This operation is best undertaken with two people, one to position the Stroke Controller-Positioner and the other to apply the pressure.

Engage the threads on the Stroke Controller-Positioner with the threads in the adapter. Screw the Stroke Controller-Positioner into the adapter until the jam nut contacts the pump body.

7.2.6 Orient the Stroke Controller-Positioner with the nameplate and viewing window up and parallel to the pump mounting surface.

Tighten the Mounting Nut securely against the pump body.

7.3 PREPARE PUMP: Fill the pump gear box with hydraulic oil P/N 002372 for 481 and 500 pumps and P/N 106549 for 510 and above pumps.

Using the scale on the top of the stroke control unit and the Manual Adjustment Handwheel on the back of the Stroke Controller-Positioner, follow the pump Start-up Procedure, in the Pump Operating & Instruction Manual.

7.3.2 The pump is now ready to be returned to service. Follow start-up procedure as if starting a new pump. Refer to Section II of this manual for instructions on Wiring the Electric Stroke Control Unit. Refer to Section III of this manual for information on Configuration, Calibration and Adjusting the Electric Stroke Control Unit.

7.4 SETTING EXACT ZERO: This optional step calibrates a measured pump output against the analog Command Control Signal. Process control scheme should be analyzed to determine if Exact Zero calibration is required.

7.4.1 DISCUSSION: Exact Zero can be set in field. The pump output must operate against a back pressure equal to that found in normal operation. Water is an acceptable calibration fluid if its viscosity and density that matches the process fluid. Do not use the actual process fluid if it is a hazardous chemical.

7.4.2 REQUIRED EQUIPMENT:

- Small Screwdriver
- Analog Signal Generator
- Valve (on pump discharge)
- Calibrated Measuring Cylinder (on pump suction)
- Pipe Stand with Drain

7.4.3 Review Warnings at the beginning of Operating Manual and at the beginning of this section.

7.4.4 Remove cover from Stroke Controller-Positioner.

7.4.5 Connect Analog Signal Generator to the appropriate Command Input terminals (see Figure 3A).

7.4.6 Energize Stroke Controller-Positioner. Start pump motor. Increase simulated Command Input Signal.

7.4.7 Start pumping by opening discharge valve.

Confirm back pressure duplicates normal operation.

Slowly reduce simulated Command Signal to zero (e.g. 4 mADC / 0 VDC). Observe the Measuring Cylinder and adjust LOW SET POINT by depressing the red ZERO (S1) pushbutton and rotating the Encoder knob to adjust ZERO (LOW SETPOINT) - Reference Paragraph 4.3 and Figure 3B. Adjust encoder to a position where a slight clockwise Encoder adjustment would just start pumping and a slight counterclockwise adjustment will hold the liquid steady. This is the Exact Zero Set Point.

7.4.10 Increase simulated Command Signal and observe increased pumping. Decrease simulated Command Signal to zero (e.g. 4 mADC / 0 VDC). Use the Measuring Cylinder to verify pump has stopped pumping. Make a slow minor manipulation of the Encoder knob while depressing the red ZERO (S1) pushbutton to confirm the setting made in paragraph 7.4.9.

Increase simulated Command Signal to 100% (e.g. 20 mADC / 5 VDC). Confirm Stroke Control Position Indicator reads 100%. If it needs adjustment, depress and hold the black SPAN (S2) pushbutton and rotating the Encoder knob to adjust SPAN (HIGH SETPOINT) - Reference Paragraph 4.3 and Figure 3B. Clockwise adjustment will extend the shaft, counterclockwise retract the shaft. HIGH SET POINT can be further adjusted by measuring and adjusting pump output against a specific process required output .

8.0 RETROFITTING SERIES 600 DIAPHRAGM PUMPS

81 PUMP MODIFICATION: Refer to illustrations in the Series 600 Pump Operating & Instruction Manual for parts identification and other information referenced in the instructions. Individual parts are identified by "Figure Numbers" (F/N). Manual includes tables that cross reference Figure Numbers to part descriptions and Neptune Part Numbers (P/N). Replacement parts are ordered by their Part Number (P/N). Note: Control Rod Assemblies differ for the various Series 600 models. Correct control rod Assembly will be included with a Stroke Controller-Positioner purchased for retrofit.

Remove gear box drain plug F/N 0130 from gear box F/N 0101 and allow hydraulic oil to drain completely from the gear box. Replace the drain plug.

8.1.2 Remove two slotted head screws F/N 0142 from pump body F/N 1401 allowing the indicator plate F/N 0118 to hang loosely.

8.1.3 Turn control knob F/N 0117 counterclockwise until the threads disengage from the sealing plate retainer F/N 0116. Pull the control knob and attached control rod from the pump body.

8.1.4 Remove the sealing plate retainer by removing the four (4) socket head cap screws F/N 0144. Pull the sealing nut retainer out of the pump body.

Parts 0116, 0117, 0118, and 0143 are no longer needed.

8.1.6 The sealing plate F/N 1407 remains in position within the pump body.

8.1.7 Slide adapter F/N 002706 into pump body and secure with the 4 socket head cap screws F/N 0144.

The control rod is supplied as an assembly attached to the connector, P/N 002708. Apply 1 drop of low strength (blue) Loctite the threads on the connector P/N 002708. Screw the connector completely into the threaded rod projecting from the nose of the Electric Stroke Control. Allow the Loctite to set.

8.2 MOUNT ELECTRIC STROKE CONTROL: The Stroke Controller-Positioner is installed as a unit. Do not disassemble or remove the cover from the unit.

If the output shaft of the Controller-Positioner is not in the ZERO position (output shaft fully retracted) turn the Manual Adjustment Handwheel clockwise until the shaft is fully retracted – see Figure 1.

Turn the large Mounting Nut on the nose of the Stroke Controller-Positioner so that there is 1/4" between the face of the nut and the face of the stroke control unit (See Figure 2).

8.2.3 Coat the tip of the control rod with STP, or heavy machine oil, to allow it to slip easily into the sealing plate O-ring.

8.2.4 Center the control rod in the sealing plate and, using hand pressure on the back of the control housing, push the control rod through the O-ring in the sealing plate. This operation is best undertaken with two people, one to position the Stroke Controller-Positioner and the other to apply pressure.

8.2.5 Engage the threads on the Stroke Controller-Positioner with the threads in the adapter. Screw the Stroke Controller-Positioner into the adapter until the jam nut contacts the pump body.

Orient the Stroke Controller-Positioner with the nameplate and viewing window up and parallel to the pump mounting service.

Tighten the Mounting Nut securely against the pump body.

8.3 PREPARE PUMP: Fill the pump gear box with 4 quarts of hydraulic oil, (two P/N 002372) containers. Refer to Series 600 Pump Instruction Manual.

8.3.1 Using the scale on the top of the stroke control unit and the manual control knob on the back of the unit, follow the pump Start-up-Procedure, in the Pump Manual.

8.3.2 The pump is now ready to be returned to service. Follow start-up procedure as if starting a new pump. Refer to Section II of this manual for instructions on Wiring the Electric Stroke Control Unit. Refer to Section III of this manual for information on Configuration, Calibration and Adjusting the Electric Stroke Control Unit.

8.4 SETTING EXACT ZERO: This optional step calibrates a measured pump output against the analog Command Control Signal. Process control scheme should be analyzed to determine if Exact Zero calibration is required.

8.4.1 DISCUSSION: Exact Zero can be set in field. The pump output must operate against a back pressure equal to that found in normal operation. Water is an acceptable calibration fluid if its viscosity and density that matches the process fluid. Do not use the actual process fluid if it is a hazardous chemical.

8.4.2 REQUIRED EQUIPMENT:

- Small Screwdriver
- Analog Signal Generator
- Valve (on pump discharge)
- Calibrated Measuring Cylinder (on pump suction)
- Pipe Stand with Drain

8.4.3 Review Warnings at the beginning of Operating Manual and at the beginning of this section.

8.4.4 Remove cover from Stroke Controller-Positioner.

8.4.5 Connect Analog Signal Generator to the appropriate Command Input terminals (see Figure 3A).

8.4.6 Energize Stroke Controller-Positioner. Start pump motor. Increase simulated Command Input Signal.

8.4.7 Start pumping by opening discharge valve.

8.4.8 Confirm back pressure duplicates normal operation.

8.4.9 Slowly reduce simulated Command Signal to zero (e.g. 4 mADC / 0 VDC). Observe the Measuring Cylinder and adjust LOW SET POINT by depressing the red ZERO (S1) pushbutton and rotating the Encoder knob to adjust ZERO (LOW SETPOINT) - Reference Paragraph 4.3 and Figure 3B. Adjust encoder to a position where a slight clockwise Encoder adjustment would just start pumping and a slight counterclockwise adjustment will hold the liquid steady. This is the Exact Zero Set Point.

8.4.10 Increase simulated Command Signal and observe increased pumping. Decrease simulated Command Signal to zero (e.g. 4 mADC / 0 VDC). Use the Measuring Cylinder to verify pump has stopped pumping. Make a slow minor manipulation of the Encoder knob while depressing the red ZERO (S1) pushbutton to confirm the setting made in paragraph 7.4.9.

8.4.11 Increase simulated Command Signal to 100% (e.g. 20 mADC / 5 VDC). Confirm Stroke Control Position Indicator reads 100%. If it needs adjustment, depress and hold the black SPAN (S2) pushbutton and rotating the Encoder knob to adjust SPAN (HIGH SETPOINT) - Reference Paragraph 4.3 and Figure 3B. Clockwise adjustment will extend the shaft, counterclockwise retract the shaft. HIGH SET POINT can be further adjusted by measuring and adjusting pump output against a specific process required output .

SECTION VI

DIAGNOSIS AND TROUBLESHOOTING

WARNING! Diagnosis and troubleshooting requires powering the Stroke Controller-Positioner with the cover removed. Diagnosis and troubleshooting should be performed by an experienced instrument technician in a laboratory setting. Diagnosis and troubleshooting should NEVER be made in a Hazardous Area or in a damp / wet location.

CAUTION! Operating configuration switches with Stroke Controller-Positioner energized can damage electronic circuits.

CAUTION! Electronic components and circuits are static sensitive. Do not touch printed circuit boards without using Electrostatic Discharge (ESD) procedures.

9.0 DIAGNOSIS: "Problems" may be electronic, mechanical, communication, configuration, calibration, a "pump" or process difficulty, or a fault in a remote customer owned device. Initial diagnostic efforts are directed to determining the origin of the fault.

9.1 DIAGNOSTIC AIDS: LED's in the Stroke Controller-Positioner indicate microprocessor (μ) operation, output shaft movement, output shaft position / limits and loss of analog current Command Signal (see Figure 3B and Paragraphs 4.2 & 4.13 to 4.15.2). A mechanically coupled Position Indicator shows output shaft movement and position (see Figures 1 & 2). A typical installation will have pump motor status lights, process pressure gauges etc.

9.1.1 INSTRUMENTATION: Suggested is a multi-meter to monitor power and control signals, plus a signal generator to produce simulated Command Signals.

MECHANICAL: With power to pump and Stroke Controller-Positioner disconnected (turned OFF), push and turn the Manual Adjustment Handwheel (see Figure 2) through the full range of travel. Rotation of the handwheel should be somewhat still but smooth with a slight "cogging" feel. There should not be any binding or tight spots. Do not turn the knob to move the pump output shaft beyond the 100% limit indicated on the Position Indicator scale.

9.2.1 MECHANICAL BINDING: If binding does exist, remove the Stroke Controller-Positioner from the pump (refer to Section V). Rotate the Manual Adjustment Handwheel. If binding is no longer present consult pump manual.

9.3 CONFIGURATION: Disconnect (turn OFF) AC power to Pump and Stroke Controller-Positioner. Visually check the settings of the power and Command Signal configuration switches (see Paragraphs 3.0 to 3.7).

QUICK TEST: Temporarily disconnect Command and feedback signals. Set Dip Switch 1 & 3 DOWN (ON) – see Figure 3B and Paragraph 3.3.1. Restore power to Stroke Controller-Positioner. Observe green LED tagged "μOK" is flashing and the red LED tagged FAULT is ON (left side of Lower PC Board – see Figure 3B). Disconnect (Turn OFF) AC power to Stroke Controller-Positioner. Apply a simulated 4-20 mADC signal from the signal generator to terminals TB2-4 (+) and TB2-3 (-) – See Figure 3A. Restore power. Red FAULT LED should be OFF. Vary simulated Command Signal, Output shaft should extend / retract and INCREASE or DECREASE LED should illuminate while shaft is in motion.

9.4 CALIBRATION TEST: Restore Factory Default calibration (see Paragraph 4.12). Repeat Quick Test (above). Re-calibrate if needed (see Paragraphs 4.0 to 4.15.2).

9.5 ANALOG LIMITS: Disconnect jumpers between TB2 and TB3 (see Paragraph 4.14). Repeat Quick Test above. Limit switch LED's on LS1 and LS2 should be OFF in the operating range. Replace jumpers and re-adjust Limit Switch potentiometers (see Paragraphs 4.14 to 4.14.2).

9.6 TROUBLESHOOTING GUIDE:

SYMPTOM	PROBLEM	ACTION
µOK (microprocessor) LED Not Illuminated	1. Power Failure	1a. Restore AC Power 1b. Check AC Power Level
	2. Incorrect Power (SW1) Setting	2. Check SW1 (Figure 3A & 4A)
	3. PC Board Failure	3. Consult Neptune
LOS (Fault) LED Illuminated	1. No current Command Signal	1a. Check Signal with Milliammeter 1b. Check Wiring (Figure 4B) 1c. Signal Source Not a 4-Wire Transmitter 1d. Simulate Input with Signal Generator
	2. Incorrect Dip Switch Setting	2. See Paragraphs 3.3 & 3.3.1
	3. PC Board Failure	3. Consult Neptune
Does Not Respond - Analog Input Command Signal	1. Power Failure	1. Check µOK LED (see above)
	2. Mechanical Binding	2. See Paragraph 9.2
	3. No Analog Command Signal	3. Check LOS (Fault) LED (see above)
	4. Incorrect Configuration	4. See Paragraphs 3.3 & 3.3.1
	5. Incorrect Calibration	5. See Paragraphs 4.3 to 4.6
	6. Limit Jumpers miswired	6. See Paragraph 4.14
	7. Limit Switch Adjustments	7a. LS1 & LS2 *Not* Illuminated? (Para 4.14) 7b. See Paragraph 4.14.1 & 4.14.2
	8. Stepper Motor Failure	8a. Stepper Motor Connected to Lower PC Board? 8b. Consult Neptune
	9. PC Board Failure	9. Consult Neptune
Does Not Respond – Incremental Contact Command	1. Power Failure	1. Check µOK LED (see above)
	2. Mechanical Binding	2. See Paragraph 9.2
	3. Improper Signal Source	3. Not *Dry Incremental* Contacts
	4. Incorrect Configuration	4. See Paragraphs 3.3 & 3.3.1
	5. Incorrect Calibration	5. See paragraphs 4.15.1 to 4.15.2
	6. Incorrect Wiring	6. See Figure 4D
	7. Wire Size Too Small	7. See Paragraph 3.5
	8. Source Distance Too Far	8. See Paragraph 3.5
	9. Limit Switch Adjustment	9a. LS1 & LS2 LED's illuminated? (Para 4.15) 9b. See paragraphs 4.15.1 to 4.15.2
	10. Stepper Motor Failure	10a. Stepper Motor Connected to Lower PC Board? 10b. Consult Neptune
	11. PC Board failure	11. Consult Neptune
Output Shaft Oscillates	1. Deadband Too Small	1. Adjust Deadband (see Paragraph 4.9)
	2. Interference on Command Signal	2a. Reroute Command Signal 2b. Add Filters at Signal Source 2c. Isolate Command Signal
Output Shaft will not go to High Setpoint /100%	1. Analog Command Signal Strength	1a. Loop Resistance Too High for Signal Source 1b. Series Wiring Issue – see Paragraph 3.8.1 1c. Loop Power Supply Too Small 1d. Incorrect Series Wiring – see Figure 5A
	2. Voltage Command Signal Strength	2a. Signal Source Output Not Calibrated 2b Signal Source Distance Too Long (voltage loss) 2b. Wire Size too Small for DC Signal (voltage loss) 2d. Parallel Wiring Issue – see Paragraph 3.8.1 2e. Incorrect Parallel Wiring – see Figure 5B
	3. Incorrect Configuration	3. See Paragraphs 3.3 & 3.3.1
	4. Incorrect Calibration	4. See Paragraphs 4.5, 4.6 & 3.8.3
	5. Limit Switch Wiring	5. See Paragraph 4.14 or 4.15
	6. Limit Switch Adjustment	6. See Paragraphs 4.14.1, 4.14.2 or 4.15.1, 4.15.2
Feedback Analog Output Not Working	1. Power Failure	1. Check µOK LED (see above)
	2. Incorrect Calibration	2. See Paragraphs 4.11.1 to 4.11.2
	3. No Loop DC Power	3. See Paragraph 4.11 & Figure 5C
	4. Incorrect Wiring	4. See Figure 5C