

INTRODUCTION AND OVERVIEW

This manual contains specific, comprehensive procedures for the installation, operation, and maintenance of the **Williams LD-Series Pneumatic Metering Pumps**.

For user convenience, the manual is divided into four sections:

SECTION 1.0: FUNCTIONAL DESCRIPTION

SECTION 1.0 *contains a physical description, the capabilities, and the operating sequence of the pumps.*

SECTION 2.0: INSTALLATION OF PUMP AND CONTROLLER

SECTION 2.0 *contains specific procedures for installing the pumps and their various components including the controller.*

SECTION 3.0: STARTUP, OPERATION, SHUTDOWN, AND STORAGE

SECTION 3.0 *contains procedures for setup, operation, shutdown, and storage of the pumps.*

SECTION 4.0: MAINTENANCE & TROUBLESHOOTING

SECTION 4.0 *contains procedures for both regular and corrective maintenance.*

SECTION 5.0: LIMITED WARRANTY

SECTION 5.0 *contains information outlining the limited warranty offered with the pump.*

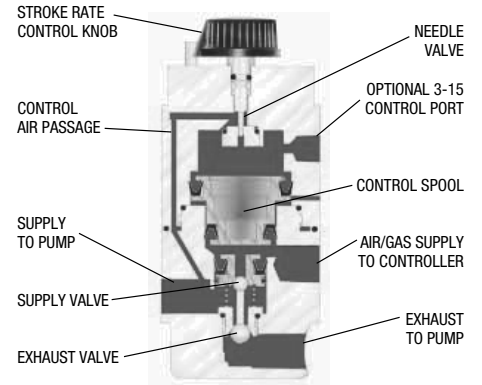
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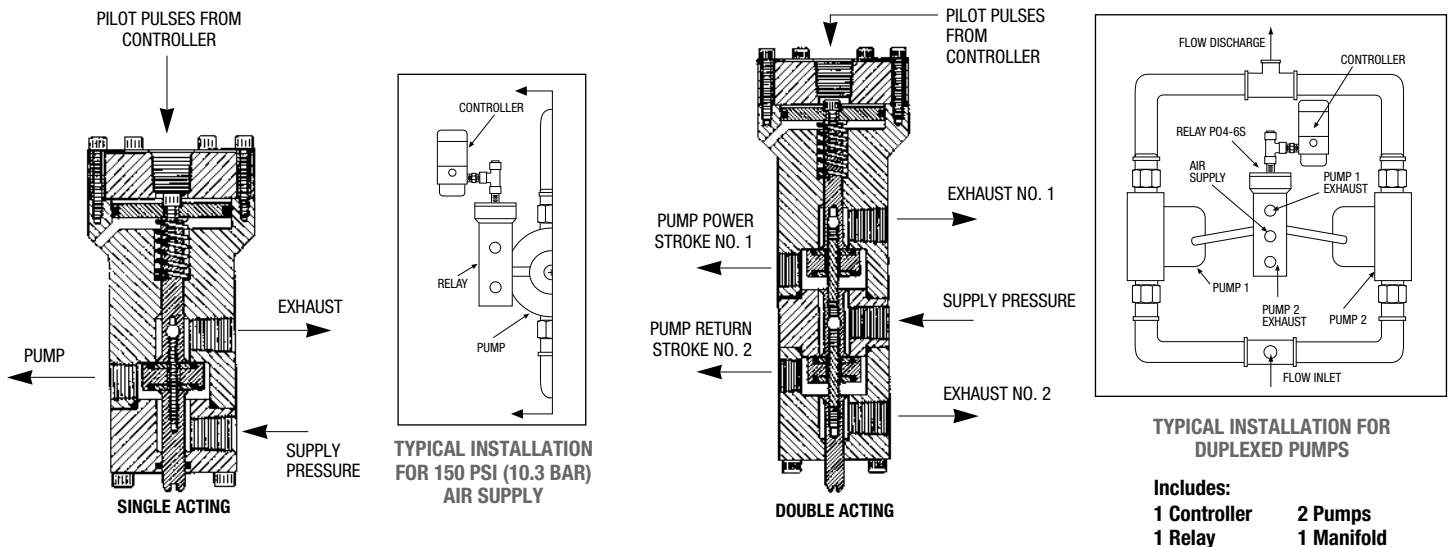
CONTROL METHODS FOR THE PUMP

OSCILLAMATIC® CONTROLLER

Air is supplied at a constant regulated pressure to the CONTROLLER. This air passes through the controller to the pump via the CONTROL SPOOL and SUPPLY VALVE. At the same time, a small volume of air travels up the CONTROL AIR PASSAGE through the NEEDLE VALVE to the top of the CONTROL SPOOL. The NEEDLE VALVE CONTROLS the speed at which the pressure builds on top of the CONTROL SPOOL. As the pressure increases, the CONTROL SPOOL descends, closing the SUPPLY VALVE and opening the EXHAUST VALVE. As the pressure is exhausted from both the pump and the top of the CONTROL SPOOL, the CONTROL SPOOL is then forced upward, starting another cycle. The NEEDLE VALVE ultimately controls the rate at which the OSCILLAMATIC cycles.



CONTROLLER-PNEUMATIC RELAY COMBINATION

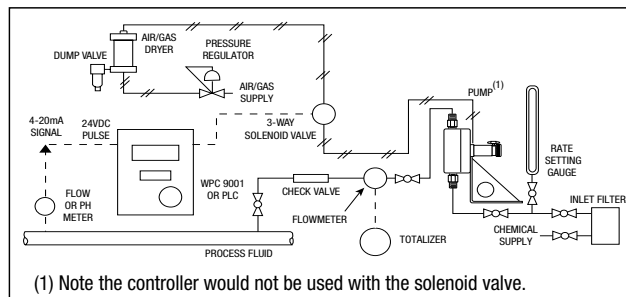


The PNEUMATIC RELAY is a pilot-operated valve designed to provide the higher air or gas flow rates necessary for for higher pressures from 100 to 150 psi. The PNEUMATIC RELAY is actuated by the pulses produced by the OSCILLAMATIC CONTROLLER.

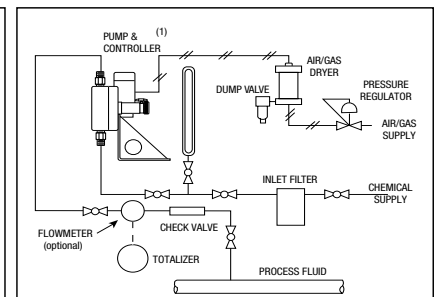
TYPICAL INSTALLATION

SOLENOID VALVES

The pumps can be automated by replacing the CONTROLLER with a 3-way electro-pneumatic SOLENOID VALVE. The SOLENOID VALVE can be cycled in order to achieve the desired pump output. Flow tracking can be accomplished by having a FLOWMETER or PH METER signal interpreted by our WPC9001 or a PLC.



FlowTracking Controller Configuration



Standard Pneumatic Controller Configuration

SECTION 1.0: FUNCTIONAL DESCRIPTION

1.1 PHYSICAL DESCRIPTION

1.1.1 Mark X Oscillamatic® Controller (35-100 psi)

The controller consists of an upper and a lower chamber, separated by a sliding spool. A capillary tube, controlled by a needle valve, transfers the supply air/gas from the lower to the upper chamber. When the spool is in its highest position, a pilot plug closes a vent and opens the supply air/gas to the pump. When the spool is in its lowest position, the pilot plug prevents the supply air/gas from entering the pump, and opens the air/gas vent to let it exhaust the pump. The spool then returns to its highest position to repeat the cycle.

1.1.2 Mark XII Oscillamatic® Controller (30 - 100 psi)

The Mark XII Controller operates on the same operating principal as the Mark X Controller. The Mark XII has the same chambers which are separated with flexible diaphragms rather than sliding seals. See paragraph 1.1.1. above for a description of operation.

1.1.3 Pump

The pneumatic diaphragm metering pump (DWG. 1) consists of a liquid chamber and an air chamber separated by a diaphragm. In the liquid chamber, the suction (inlet) and discharge (outlet) ports have check valves that control the direction of the fluid flow. A pipe nipple connects the controller to the pump air chamber. In the air chamber, the air/gas power supply from the controller enters and exhausts through the pipe nipple connector. When the controller exhausts the air/gas supply, the fluid suction pressure and the return spring force the diaphragm backwards. The diaphragm stops when the end of the diaphragm stem, which is attached to the air chamber side of the diaphragm, collides with the end of the stroke adjuster.

1.2 CAPABILITIES

1.2.1 Controller

1.2.1.1 Air/Gas Supply

The Controller will operate with air or virtually any gas, such as nitrogen or natural gas, that is dry and clean. No oilers. No oxygen.

WARNING: TO PREVENT INJURY WHEN YOU USE A FLAMMABLE GAS SUCH AS NATURAL GAS, MAKE SURE THAT YOU VENT IT SAFELY.

CAUTION: If you think the gas might damage the standard viton seals in either the pump or the controller, contact your distributor or Williams Instrument for advice.

1.2.1.2 Air/Gas Supply Pressure:

A regulator always must be used to control the air/gas power supply. The controller will operate with supply pressures up to 100 psig (6.9 bar). With supply pressures over 100 psig (6.9 bar), it is essential to use a pressure regulator between the supply and the controller to prevent the higher pressures from accidentally damaging the controller. If you need to operate at supply pressures over 125 psig (8.62 bar), contact your distributor or Williams Instrument for information on how to apply our pneumatic relay.

* The process pressure is the pressure of the stream or reservoir into which the metering pump is discharging.

1.2.2 Pumps

1.2.2.1 Viscosities

The pumps will provide catalog performance on fluids with viscosities up to 6000 SSU (Saybolt Second Universal) or 1280 CP (Centipoise). Although the pumps can operate on higher viscosity fluids, there will be a reduction in catalog performance.

1.2.2.2 Suction Lift

Suction lift reduces maximum pumping volume. The maximum suction lift without flow loss that each pump can handle is: 60 inches (1524 mm) (all models)

A foot valve is recommended in the supply line of the suction check valve.

CONTROLLER COMPARISON

MODELS	SUPPLY PRESSURE	BODY MATERIAL	STROKES (SPM)	ELASTOMER OPTIONS	SPOOL STYLE
MK XIIA	30-100 PSI (2.0-6.9 Bar)	316 ss	1 - 45	Neoprene, Buna N, Viton®	Diaphragm
MK X	35-100 PSI (2.4-6.9 Bar)	316 ss	1 - 45	Buna/TFE, Viton®/TFE	U-Cup

SPECIFICATIONS TABLE

Models	Diaphragm Size (Inch)	Maximum Volume GPH / LPH	Maximum Discharge Pressure *		Air to Fluid Pressure	Strokes Per Minute (SPM)	Volume Per Stroke (cc)	Standard Diaphragm Material (STD)	Maximum Air Supply		Max. Air Usage At Max. Volume		Approx. Shipping Weight	
			Simplex	PSI					Bar	PSI	Bar	SCF/D	SCM/D	Lbs.
LD100-316-TFE	1	0.75 / 2.8	80	5.52	100.80	1-45	1.0	TFE	100	6.9	20	0.64	7.0	3.1
LD200-316-TFE	2	10.0 / 37.8	98	6.76	100.96	1-45	14.0	TFE	100	6.9	255	5.78	9.12	4.1
LD400-316-TFE	4	45.0 / 170.3	93	6.41	100.93	1-45	63.0	TFE	100	6.9	1200	27.30	17.25	7.8
LD100-TFE-TFE	1	0.75 / 2.8	75	5.17	100.75	1-45	1.0	TFE	100	6.9	20	0.64	6.0	2.7
LD200-TFE-TFE	2	10.0 / 37.8	93	6.41	100.93	1-45	14.0	TFE	100	6.9	255	5.78	7.25	3.2
LD400-TFE-TFE	4	45.0 / 170.3	90	6.20	100.90	1-45	63.0	TFE	100	6.9	1200	27.30	11.5	5.2

NOTE: * with 100 PSI Air Supply Max.

The controller and relay combination using 150 psig air can only be used with the all 316ss pumps.

1.2.2.3 Operating Temperature Range

The range of operating temperature depends on the pump and diaphragm material. The recommended range with our standard PTFE diaphragm is:

LIQUID END MATERIAL	TEMPERATURE RANGE
316 SS	+40°F to 185°F
PTFE	+40°F to 185°F

Contact your distributor or Williams Instrument if you need further information on the operating temperature range.

1.2.2.4 Metered Fluids

The pumps can work with many kinds of acids, caustics, solvents, and slurries depending on the pump materials. Contact your distributor or Williams Instrument for the correct pump material to use with a particular fluid.

1.4 GENERAL OPERATING SEQUENCE

1.4.1 Oscillamatic® Controller

The spool spring forces the spool upward to its highest position and unseats the top of the pilot plug from the upper seat. The exhaust spring forces the pilot plug upward and seats it on the lower seat. This blocks the air/gas exhaust port.

When high pressure air/gas enters the supply port, it passes around and through the spool and past the open upper seat to the motor cylinder port.

High pressure air/gas passes through the control passage in the controller, past the valve stem, and into the valve body upper chamber which causes pressure to build up in the chamber. Because the surface area of the upper U-cup diaphragm is much larger than that of the middle U-cup diaphragm, the downward force on the spool is greater than the upward force. This pressure pushes the spool down until the pilot plug seats itself on the upper valve seat, shutting off the air/gas supply. As the spool continues to move down, it pushes the pilot plug until the plug is unseated from the lower valve seat and allows the air/gas to exhaust through the lower valve from both the motor cylinder and the valve body volume chamber.

When the pressure in the chamber is low enough, the spool spring starts pushing the spool upward. The exhaust spring pushes the pilot plug upward, and the controller returns to its initial position.

1.4.2 Pump Motor (Air Chamber)

Air/gas and the diaphragm return spring force the diaphragm to move alternately into and out of the pump liquid chamber.

When the controller sends the supply air/gas into the motor chamber through the nipple connector, the air/gas pressure on the diaphragm overcomes the combined force of the process fluid pressure on the diaphragm and the diaphragm return spring. The pressure moves the diaphragm into the pump liquid chamber. When the external controller exhausts the air/gas, the diaphragm return spring pulls the diaphragm out of the pump liquid chamber.

1.4.3 Pump (Liquid Chamber)

The pump operating cycle consists of two parts: discharge and suction. Discharge occurs when the diaphragm moves into the pump liquid chamber, decreasing the fluid chamber's volume, and raising the pressure of the fluid in the chamber. This higher pressure closes the suction check valve and opens the discharge check valve, sending the fluid into the discharge line. The suction part of the cycle occurs when the diaphragm moves out of the pump chamber, increasing the chamber volume and lowering the pressure of the fluid in the liquid chamber. This lower pressure opens the suction check valve and closes the discharge check valve, sending fluid from the suction line into the pump liquid chamber.

SECTION 2.0: INSTALLATION OF PUMP AND CONTROLLER

2.1 GENERAL REQUIREMENTS

2.1.1

Always install a pressure regulator with pressure gauge in the air/gas supply line.

2.1.2 Recommendations

For the most efficient use of your pump, we also recommend:

2.1.2.1

A dryer and a dump valve in the air/gas supply line to remove any moisture in the supply gas.

2.1.2.2

Isolation valves (ball type) on the inlet (suction) and discharge sides of the pump and on the air/gas supply line to ease maintenance.

2.1.2.3

A check valve where the pump discharge line joins the main process line, to prevent process fluid back flow. The check valve can be a free-floating ball-type that does not contain a spring, or a 5 to 10 psi spring-loaded type.

2.1.2.4

A pump rate setting gauge installed on the suction side of the pump can be used in setting the pump output volume.

2.2 PUMP LOCATION

2.2.1

Install the pump in an upright position with the outlet/discharge check valve directly above the inlet/suction check valve.

Because the valves have no springs, the pump will not work as well in any other position.

2.2.2

We recommend that you mount the pump on the stand supplied whenever possible. The pump check valves may be damaged if you support the pump with only the process piping. Damage will occur if you are using the TFE plastic pump fluid sections, which have plastic check valves. You can safely mount the 316 SS pump with 316 SS check valves on the process piping.

2.2.3

We recommend that you locate the supply reservoir at the same level as the inlet valve (flooded suction). A reservoir located above the inlet valve (net positive suction head) will let fluid flow freely through the pump if the process pressure is less than the inlet head. A reservoir below the inlet valve (suction lift) could reduce the pump output.

2.2.4

To control net positive suction head, we recommend that you install a relief valve in the discharge side of the pump. Use a

valve whose relief pressure is only 1 or 2 psi (0.07 or 0.15 bar) greater than the net positive suction head, or raise the end of the discharge line so it is higher than the liquid level in the tank.

2.2.5

For suction lift conditions, install a “foot” valve at the bottom of the suction line. Also keep the suction line size equal to the inside diameter of the suction check valve.

2.2.6

When you place the pump in position, leave ample space around the pump to allow easy access to all components during maintenance.

2.3 SUCTION/DISCHARGE PIPING

2.3.1

To attach the pump to the inlet/outlet piping, use the following pipe sizes:

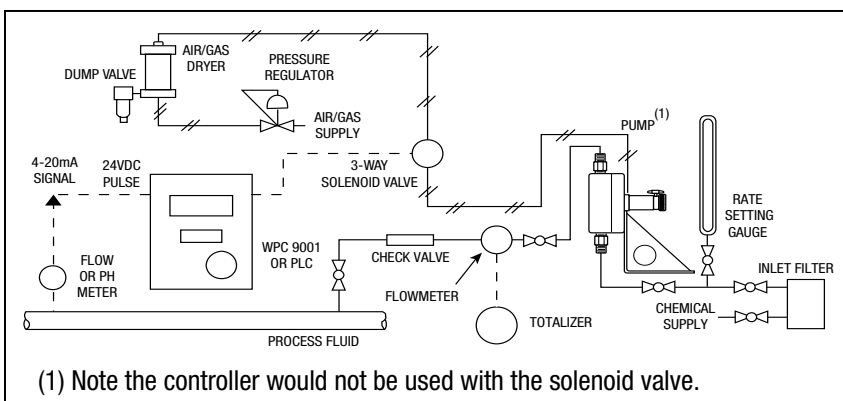
- LD100 series: 1/4" NPS Nominal pipe size; wall schedule to fit pressure
- LD200 series: 1/2" NPS Nominal pipe size; wall schedule to fit pressure
- LD400 series: 3/4" NPS Nominal pipe size; wall schedule to fit pressure

2.3.2

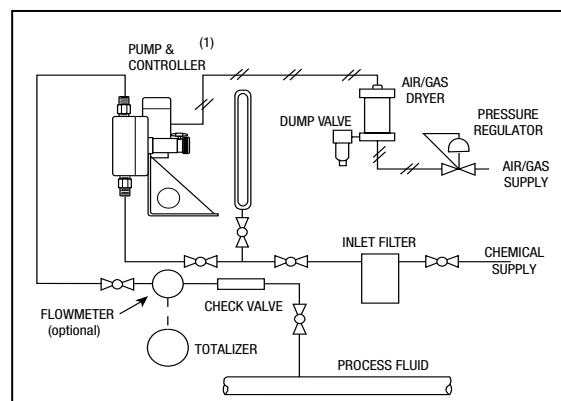
Wrap all pipe threads with Teflon tape or coat them with thread sealant compound (paste) to prevent leaks.

CAUTION: Do not let any tape extend beyond the end of the pipe threads. It could tear off and jam the pump.

TYPICAL INSTALLATION

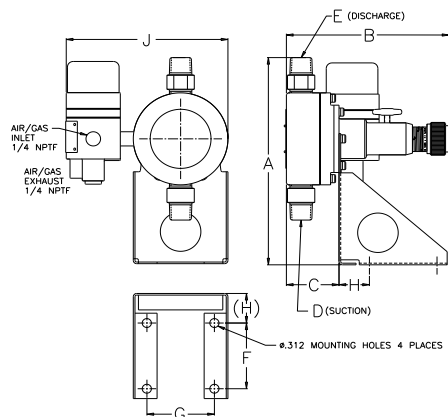


FlowTracking Controller Configuration



Standard Pneumatic Controller Configuration

DIMENSIONS



MODEL	A	B	C	D	E	F	G	H	J
LD100-TFE	7.10	5.88	1.66	1/4"NPTM	1/4"NPTM	2.50	2.50	1.13	5.53
LD100-316	7.35	5.72	1.52	1/4"NPTM	1/4"NPTM	2.50	2.50	1.13	5.53
LD200-TFE	7.75	6.45	1.25	1/2" NPTM	1/2" NPTM	2.50	2.50	1.13	6.10
LD200-316	7.85	6.12	1.90	1/2" NPTM	1/2" NPTM	2.50	2.50	1.13	6.10
LD400-TFE	10.32	8.32	2.72	3/4" NPTM	3/4" NPTM	2.50	2.50	1.50	8.00
LD400-316	10.60	8.12	2.45	3/4" NPTM	3/4" NPTM	2.50	2.50	1.50	8.00

2.3.3

Recommended: Install a strainer no larger than 100 microns before the inlet check valve to avoid damaging the check valves. Install a line check valve at the point of liquid injection to maintain a filled discharge line.

2.4 AIR/GAS SUPPLY

2.4.1

Attach the controller to the air/gas power supply regulator with 1/4" NPT piping or tubing.

2.4.2

Wrap the pipe threads with Teflon tape or coat them with thread sealant compound(paste), making sure you do not let any tape extend beyond the end of the pipe threads because it could tear off and jam the controller.

2.4.3

If you need to use a relay with the controller, or if you use a solenoid valve instead of the controller, please refer to typical installation diagram above, or contact your distributor or Williams Instrument directly for information on such installations.

SECTION 3.0: STARTUP, OPERATION, AND SHUTDOWN

While the procedures for startup, operation and shutdown/storage are easy to perform, following them carefully and correctly will improve the performance and increase the life of your pump.

3.1 STARTUP

3.1.1 Air/Gas Supply

3.1.1.1

Make sure that the primary air/gas supply — a compressor, a tank of gas, or other resource— is turned OFF.

3.1.1.2

Set the pressure regulator to ZERO pressure.

3.1.2 Controller & Pumps

3.1.2.1

Rotate the stroke rate knob on the controller clockwise(CW) to ZERO on the stroke rate reference scale.

3.1.2.2

Turn ON the main air/gas supply to the regulator and adjust the regulator to pressure 20 to 40 psi above the pump discharge pressure.

NOTE: 40 psi above the discharge pressure will ensure full capacity of the pump.

Refer to the performance charts on the following page for the exact air/gas pressure.

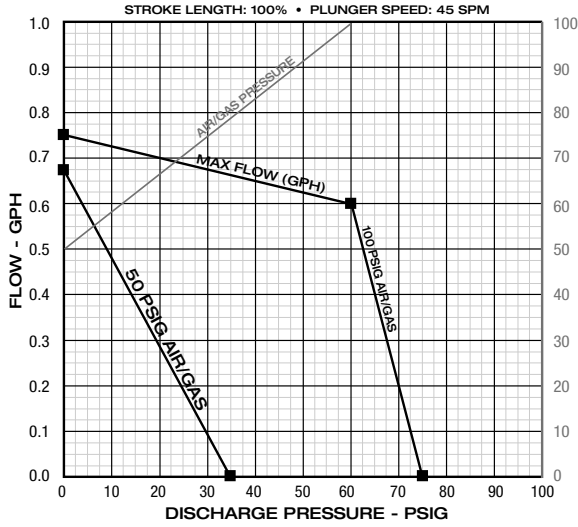
3.1.2.3

Use the controller's rate adjustment and the pump's stroke length adjustment to obtain the desired flow rate for your application. Use a pump rate setting gauge to set the flow or use a graduated flask or beaker to time the flow rate with a stop watch. (Refer to Section 1.3, Specifications Table, on page 4 for maximum pump performance.)

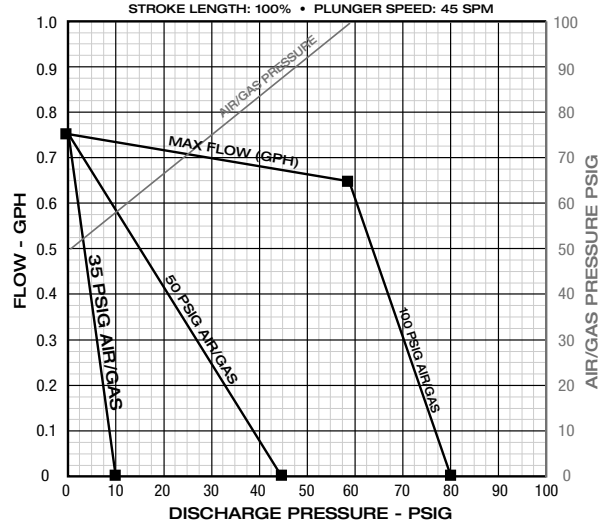
3.1.2.4

The controller is preset at the factory to provide 45 strokes per minute maximum. This value will fall on the 100 mark, since the scale is only used for a reference. However, at ZERO on the scale the controller will have little or no output to the pump. The controller can be adjusted as necessary to another maximum value.

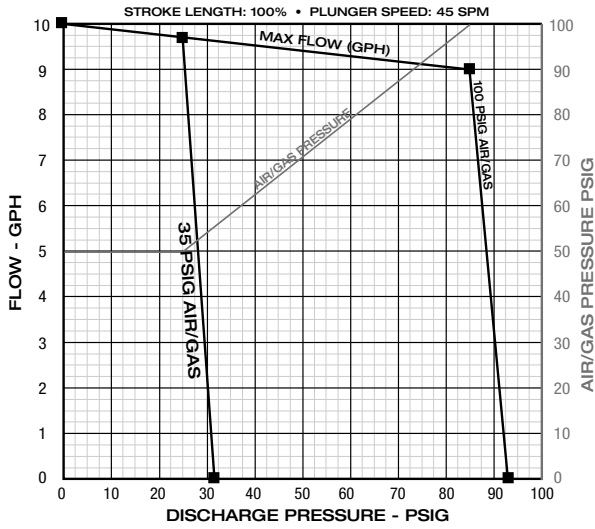
PERFORMANCE CHARTS



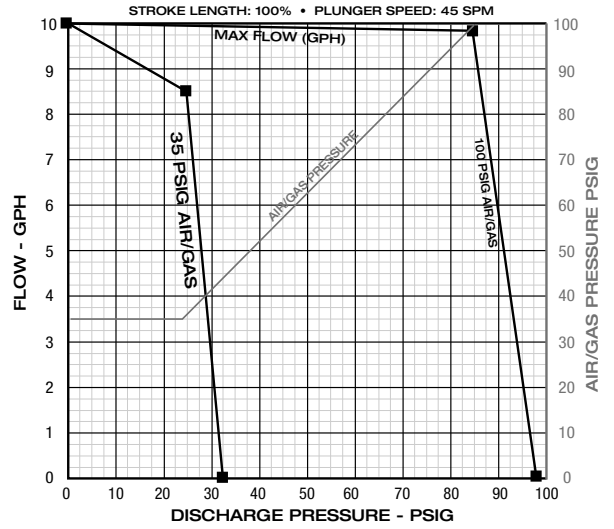
LD100-TFE-TFE



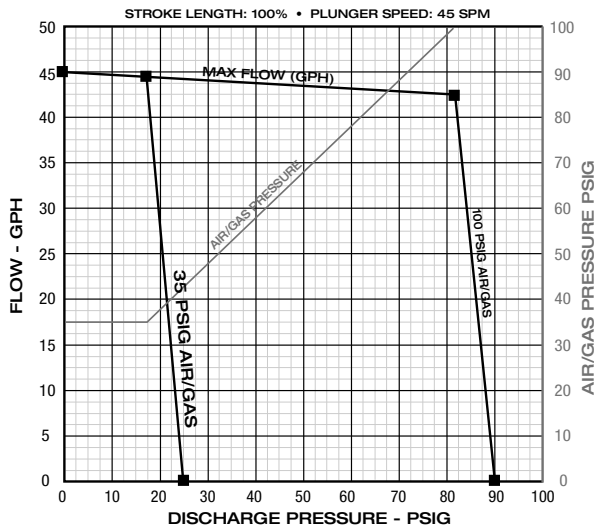
LD100-316-TFE



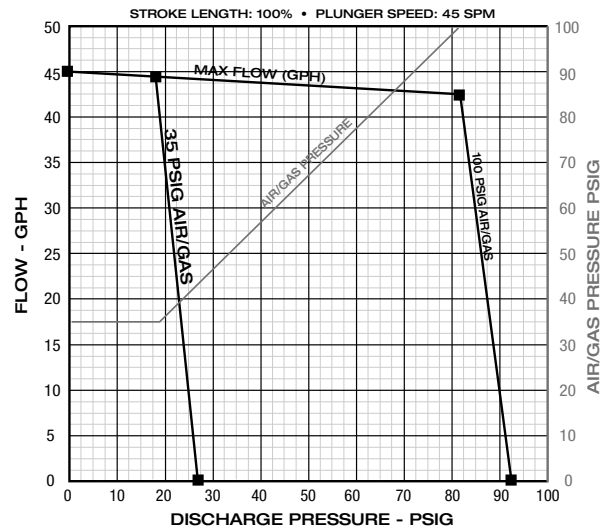
LD200-TFE-TFE



LD200-316-TFE



LD400-TFE-TFE



LD400-316-TFE

3.1.2.5

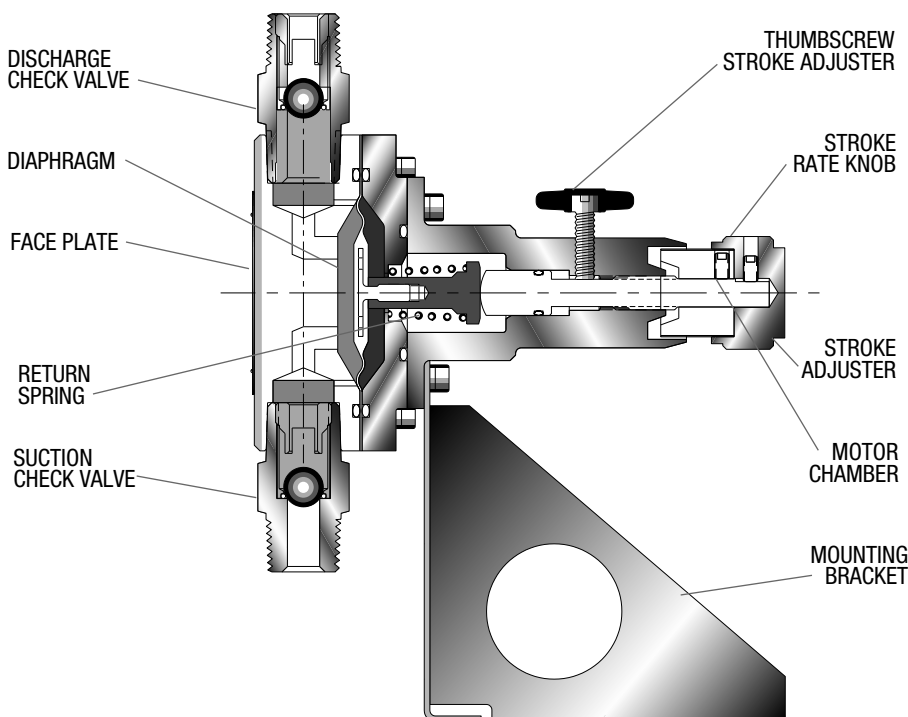
To adjust the controller stroke rate knob, loosen the set screw and remove the knob and spring. Adjust the valve stem with your fingers to the desired rate. Turn the stem clockwise (CW) to decrease the stroke rate or counterclockwise (CCW) to increase the rate. Attach and set the knob at the desired position on the scale or at the 100 mark. To do so, install spring and knob on stem. Press down on the knob until spring pressure is felt, tighten set screw and reseal with latex paint.

3.1.2.6

The pump's stroke length adjuster scale is factory set so that a ZERO reading equals zero stroke length. To calibrate the scale:

- Turn the stroke length adjuster knob CW until it bottoms the diaphragm inside the pump.
- Loosen the Allen screw (3/32" hex) on the end of the knob. Remove the knob.
- Rotate the cylinder until ZERO on the scale lines up with the scale indicator Vee notch on the pump body.
- Retighten set screw and replace knob.
- Tighten Allen screw against flat on shaft.

The stroke length can now be selected from zero to 100% in 10% increments.

**3.1.2.7**

After the desired setting has been made, the wing thumb screw can be used to lock the adjustment. For extreme vibration conditions the black plastic wing can be broken off and a 5/32 hex wrench may be used to further tighten screw.

NOTE: The stroke length is not proportional to pump flow. Controller rate is proportional to flow.

3.2 OPERATION

Open all service valves. Apply air to controller. Confirm air pressure. Shortly after the pump begins to operate, the metered liquid should begin to flow through the pump. The pump is self priming. If the supply reservoir is below the inlet valve (suction lift) and a foot valve is in the suction line, it will take a few seconds for the liquid flow to begin. Without a foot valve, it will take longer for the flow to start. Once you have set the speed and stroke according to the procedure above, operation of both the controller and pump is automatic and continuous at the stroke rate as long as the pressure regulator maintains a constant air/gas supply pressure.

3.2.1

Set the stroke rate knob to a mark on the scale that will produce the flow rate close to what you want on the controller. A good average speed is 25 - 35 SPM. Measure the flow. Repeat and adjust as necessary. Lock stroke length with thumb screw.

NOTE: The Stroke Rate Scale on the controller is only a reference. At the ZERO setting on the scale the pump will not stroke, but as the knob is rotated toward 100, the rate will increase to maximum of 45 strokes per minute. Since the scale is meant as a reference, you must time the exhaust of the controller in order to accurately set the stroke rate. Record this value and stroke length.

3.2.2

For best accuracy, count the number of pump strokes in a one minute interval. A short quick way is to count the strokes in 15 second intervals and multiply by 4.

3.3 SHUTDOWN/STORAGE

3.3.1

Set the pressure regulator to ZERO and turn the air/gas supply to the OFF position.

3.3.2.

If you want to store the pump, flush out the pump chamber with a solvent or water, and blow dry with compressed air.

CAUTION: To avoid damaging the pump when you clean it, make sure you use a solvent compatible with the metered fluid that will not damage the diaphragm in the pump. For a recommended solvent, contact your distributor or Williams Instrument.

3.3.3

You may leave the pump and controller assembled. Be sure to store them in a dry, protected place.

SECTION 4.0 MAINTENANCE

This section provides procedures for disassembly and reassembly of the controller and the pump as well as those for preventive and corrective maintenance. Easy to perform, these procedures are essential to the reliability, durability, and performance for your pump.

4.1 DISASSEMBLY AND ASSEMBLY

When you remove air/gas or process fluid piping, be sure to cover the open ports in both the controller and the pump to keep out dirt.

4.1.1 Required Tools

(Tools differ according to the pump model.)

- Adjustable Wrench: 15"
- Adjustable Wrench: 8"
- Vise with soft jaws and vee notch
- Hex Wrenches: 3/32", 5/32", 1/4", 3/8", and 1/2"
- Blade Screwdriver: 1/8"
- MK-X Screwdriver (Part No. WIC-TOOL-I) with 1/4" Hex Socket Drive containing special lower seat spanner tool
- Open End Wrenches

4.1.2 Controllers

4.1.2.1 Mark XII Controller Disassembly

Refer to the Mark XII Controller Parts List. To disassemble, do the following:

4.1.2.1.1

Remove red cap. (Fig. 1)



Fig. 1

4.1.2.1.2

The Mark XII has (4) four socket head cap screws holding the controller together. Use

a 5/32" hex wrench to remove. Separate upper valve body from the lower section. (Fig. 2 & 3)



Fig. 2



Fig. 3

4.1.2.1.3

Lift off the upper body and diaphragm. Lift out the inner diaphragm assembly. Set aside. (Fig. 4 & 5)



Fig. 4



Fig. 5

4.1.2.1.4

Lift out the spool spring. (Fig. 6)

4.1.2.1.5

Turn lower controller body upside down. Use a 3/16" hex wrench to unscrew

bottom plug. Remove the bottom plug, lower spring and pilot plug. (Fig. 7 & 8)



Fig. 6



Fig. 7



Fig. 8

4.1.2.1.6

Return controller body as before and unscrew lower seat with a 3/16" hex wrench. Remove lower seat. (Fig. 9 & 10)



Fig. 9

4.1.2.1.7

To disassemble the inner diaphragm and spool assembly, first remove outer sleeve and mid ring by sliding past the diaphragms towards the upper seat. (Fig. 11, 12 & 13) Use a small screw driver or hex wrench placed through the inner



Fig. 10



Fig. 14



Fig. 17



Fig. 11



Fig. 15



Fig. 18



Fig. 12



Fig. 16



Fig. 19



Fig. 13

spacer holes and with a 9/16" wrench unscrew the upper seat and lower diaphragm. (Fig. 14) Place the top diaphragm stop (and inner sleeve with screw driver/hex wrench) into a soft jaw vice with a vee notch. Lightly clamp top diaphragm stop. Unscrew inner sleeve. (Fig. 15) Remove the mid diaphragm from the top diaphragm stop. (Fig. 16) Remove the lower diaphragm from the upper seat. (Fig. 18)

4.1.2.1.8

Clean all metal parts. Inspect and or replace all three diaphragms. To reassemble, push the mid diaphragm onto the top diaphragm stop. Push the lower diaphragm onto the upper seat. Thread the inner spacer onto these (2) two diaphragm assemblies. With a screw driver and 9/10" wrench, tighten securely, but *not* enough to pucker the diaphragms. Install the mid ring, counter bore first, onto the diaphragm assembly past the lower diaphragm and then past the mid diaphragm. Some maneuvering of the diaphragms will be needed. Install the outer sleeve by sliding past the lower diaphragm. Insure the narrow seat on the sleeve goes against the mid diaphragm and the wider seat is against the lower diaphragm. Some maneuvering of the lower diaphragm will also be needed. The inner assembly is now complete. (Fig. 17 & 19)

4.1.2.1.9

To install the inner assembly into the lower controller body, be sure to reinstall the lower seat and spool spring. Make sure the capillary holes in the upper diaphragm, the mid ring and the mid diaphragm are in line with the capillary hole of the lower body. Use a small awl or hex wrench to thread together. Install (1) one of the (4) body screws from the under side through the loose parts and through the top diaphragm. Now remove the awl and place on top of the assembly the upper controller body. Insure its capillary hole is inline with the others. Loosely thread together the (1) one body screw. Install remaining (3) three screws and torque all to 28 - 32 inch pounds.

4.1.2.2 Mark X Controller Disassembly

Refer to the MK-X Controller Parts List. To disassemble the controller, do the following:

4.1.2.2.1

Clamp the lower end of the controller body in a bench vise. (Fig. 20) Use soft jaws to hold controller. Remove red cap.

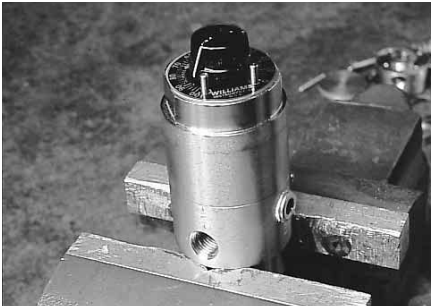


Fig. 20

4.1.2.2.2

Use an adjustable wrench on the flats at the top of the valve body assembly; unscrew and pull off the upper valve body assembly. (Fig.21)

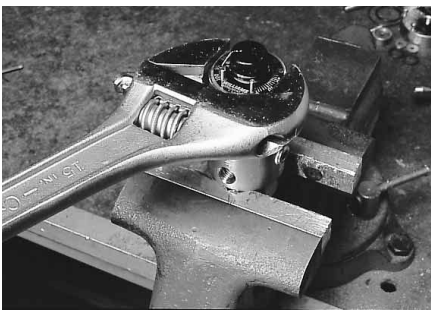


Fig. 21

4.1.2.2.3

Lift out the spool, with the three attached U-cups and the spool alignment O-ring. (Fig.22)



Fig. 22

4.1.2.2.4

Lift out the spool spring. (Fig.23)



Fig. 23

4.1.2.2.5

Using the proper spanner-type blade screwdriver (Part No. WIC-TOOL-1) for the MK-X, unscrew the lower seat and remove. (Fig.24 & 25)



Fig. 24



Fig. 25

4.1.2.2.6

Lift out the pilot plug and exhaust spring. (Fig. 26)



Fig. 26

4.1.2.2.7

Remove the body O-ring that isolates the control passage. (Fig. 27)
Clean all parts. Inspect. Replace all damage parts, seals and o-rings.
To reassemble the controller, reverse the



Fig. 27

above procedure. Also, when necessary, refer to Section 2.0: Installation of Pump and Controller.

4.1.3 Pump

Refer to the appropriate pump parts list and drawing. For all pumps, first remove the controller and pipe nipple. The check valve removal can be done more easily after the face plate is removed from the pump.

Check Valve Wrench size	316SS Models	TFE Models
LD 100 - 9/16"	9/16"	5/8"
LD 200 - 3/4"	7/8"	1 1/16"
LD 400 - 7/8"	1 1/8"	1 1/4"

To disassemble your pump, follow the applicable procedure below:

4.1.3.1 LD 100 Series

NOTE: Photos shown are of the LD200-316 Model. The LD100-316 model is similar in construction.

4.1.3.1.1

Use a 5/32" hex wrench to remove the six screws and washers that fasten the back plate, spring housing and pump stand. Separate the pump stand and spring housing from the back plate and face plate. (Fig. 28, 29, 30)



Fig. 28



Fig. 29

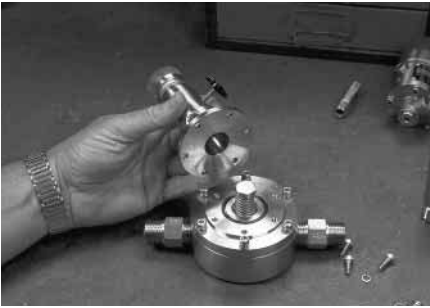


Fig. 30

NOTE: The LD100-TFE model has a backup ring that the screws are installed into.

4.1.3.1.2

To disassemble the diaphragm from the back plate, replace the back plate and diaphragm to face plate and loosely replace the cap screws. Use the 5/8" wrench to unscrew the spring retainer. (Fig.31)



Fig. 31

CAUTION: The spring is loaded and the retainer must be removed with caution. (Fig.32)



Fig. 32

4.1.3.1.3

Disassemble the back plate and diaphragm from the face plate by removing the loosely installed six screws. Remove the three O-rings. The Teflon coated O-ring is in the face plate. (Fig. 33)

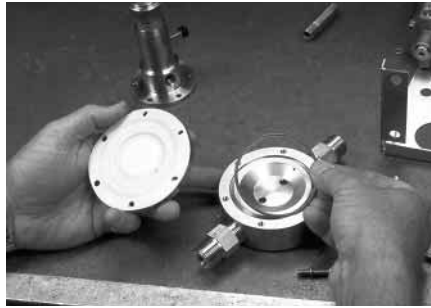


Fig. 33

4.1.3.1.4

Use the 3/32" hex wrench to loosen the set screw that holds the stroke adjuster knob. Pull off the knob. (Fig.34)



Fig. 34

4.1.3.1.5

Use the 3/32" hex wrench to loosen the cylinder set screw. (Fig. 35)



Fig. 35

4.1.3.1.6

To remove the stroke adjuster screw from the spring chamber: remove the thumb screw from the side of the chamber. Return the stroke adjuster knob to the end of the screw. (Fig. 36) The knob set screw should engage the flat on the screw. If not,



Fig. 36

lightly tighten. Turn knob counter clockwise until knob stops. Remove knob from screw and complete the removal of the stroke adjuster screw from the spring chamber. Remove O-ring seals from the screw. (Fig. 37 & 38)



Fig. 37



Fig. 38

4.1.3.1.7

If you did not previously remove the check valves, do so at this time by using the preferred crescent wrench. For assistance, clamp the face plate in a soft jaw vise. (Fig. 39)

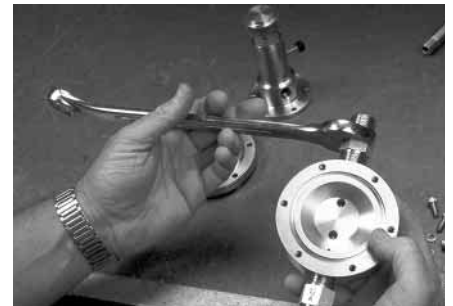


Fig. 39



Fig. 40

4.1.3.1.8 When rebuilding check valves

4.1.3.1.8.1

Clamp check valve in a soft jaw vise and use a 3/16" hex wrench to unscrew the retainer. (Fig. 40)

4.1.3.1.8.2

Remove the ball and sleeve with Teflon seat. Inspect for damage. (Fig. 41)

4.1.3.1.8.3

Remove the Teflon O-ring and replace all damaged parts. (Fig. 41)



Fig. 41

4.1.3.1.8.4

For the LD 100 - TFE model, inspect the seat area for damage. Replace if damaged or imbedded with dirt. Inspect check valve sealing ring. (Fig. 42)



Fig. 42

4.1.3.1.8.5

When reassembling, note the flow direction arrow on the check valves. The suction check valve points into the pump. The discharge arrow points away from the pump.

4.1.3.2 LD 200 Series

Use the 5/32" hex wrench to remove the six screws that fasten the spring chamber and pump stand from the back plate. Separate the components. (Fig. 28, 29 & 30)

4.1.3.2.2

To disassemble the spring retainer screw from the diaphragm, place the back plate

and face plate assembly, name plate side down. Using a 5/8" wrench, unscrew the spring retainer screw. (Fig. 31)

CAUTION: The spring is loaded and the retainer must be removed with caution. Remove the spring retainer screw and diaphragm return spring. (Fig. 32)

4.1.3.2.3

Disassembly of the back plate and diaphragm from the face plate requires removal of the (6) six screws. Use the 5/32" hex wrench. Separate the components. Remove (3) O-rings. The coated O-ring is removed from the face plate. (Fig. 33)

NOTE: The LD 200-TFE has a Backup Ring that the screws are installed into.

4.1.3.2.4

Use the 3/32" hex wrench to loosen the set screw that holds the stroke adjuster knob. Pull off the knob. (Fig. 34)

4.1.3.2.5

Use the 3/32" hex wrench to loosen the cylinder set screw. (Fig. 35)

4.1.3.2.6

To remove the stroke adjuster screw from the spring chamber, follow the instructions of paragraph 4.1.3.1.6.

4.1.3.2.7

If you did not previously remove the check valves, do so at this time by using a 7/8" wrench. For assistance, clamp the face plate in a soft jaw vise. (Fig. 39)

4.1.3.2.8 When rebuilding check valves

4.1.3.2.8.1

Clamp the check valve in the soft jaw vise and use a 3/8" hex wrench to unscrew the retainer. (Fig. 40)

4.1.3.2.8.2

Remove the ball sleeve with Teflon O-ring and inspect ball and seat area for damage. Replace the Teflon O-ring and all damaged parts. (Fig. 41)

4.1.3.2.8.3

For the LD 200 - TFE models, use the 3/8" hex wrench to remove the retainer. Inspect seat area for damage or imbedded dirt. Replace as necessary. (Fig. 42 & 43)

4.1.3.2.8.4

When reassembling check valves back on to the pump, note the flow direction arrow on the check valves. The suction check valve arrow points into the pump. The discharge arrow points away from the pump.

4.1.3.3 LD 400 Series

NOTE: Photos shown are of the LD200-316 model. The LD400-316 is similar in construction.

4.1.3.3.1

Use the 5/32" Allen wrench to remove the (6) six screws that fasten the spring chamber and pump stand to the back plate. Separate the components. (Fig. 28, 29, 30)

4.1.3.3.2

Place the back plate and face plate assembly, name plate side down. Using a 3/4" wrench, unscrew the spring retainer screw. (Fig. 31)

CAUTION: The spring is loaded and the retainer must be removed with caution. Remove the spring retainer and diaphragm return spring. (Fig. 32)

4.1.3.3.3

Use the 5/32" hex wrench to remove the (8) eight screws that fasten the back plate to the face plate. Separate the components. Remove the (3) three O-rings. The coated O-ring is removed from the face plate. (Fig. 33)

NOTE: The LD400-TFE Model has a Backup Ring that the screws are installed into.

4.1.3.3.4

To disassemble the stroke adjuster mechanism, remove the wing thumb screw.

4.1.3.3.5

Use the 3/32" hex wrench to loosen the set screw that holds the stroke adjuster knob. Pull off the knob. (Fig. 34)

4.1.3.3.6

Use the 3/32" hex wrench to loosen the cylinder set screw.

4.1.3.3.7

To remove the stroke adjuster screw from the spring chamber, follow the instructions in paragraph 4.1.3.1.6.

4.1.3.3.8

If you did not previously remove the check valves, do so at this time by using the 1 1/8" wrench. For assistance, clamp the face plate in a soft jaw vise. (Fig. 39)

4.1.3.3.9 When Rebuilding Check Valve**4.1.3.3.9.1**

For the LD 400 - 316 model, clamp the check valve in the soft jaw vise. With a 1/2" hex wrench remove the retainer ball and sleeve. Inspect the ball and Teflon O-ring for damage. Replace the Teflon O-ring and all damaged parts. (Fig. 40 & 41)

4.1.3.3.9.2

For the LD400-TFE models, use the 1/2" hex wrench to remove the retainer. Inspect the seat area for damage or imbedded dirt. Replace parts as necessary. (Fig. 42 & 43)

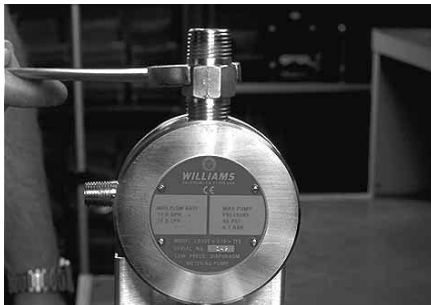


Fig. 43

4.1.3.3.9.3

When reassembling, note the flow direction arrow on the check valves. The suction check valve points into the pump. The discharge arrow points away from the pump. To reassemble your pump, reverse the applicable disassembly procedures.

4.2 PREVENTIVE MAINTENANCE

4.2.1 Periodic Maintenance Schedule**4.2.1.1**

At least every 6 months, inspect the pump diaphragm. If it is cracked, rough, or discolored, replace it.

4.2.1.2

At least every 12 months, disassemble and inspect the pump inlet and outlet check valves.

4.2.1.3

At least every 12 months, inspect the pump diaphragm return spring. If it is cracked, chipped, or flaking, replace it.

4.2.1.4

At least every 12 months, replace the MK X controller spool U-cups. If a MK XII is used, replace the three diaphragms.

4.2.2 Cleaning and Lubrication

When pump is disassembled, clean all interior and exterior surfaces with a good quality solvent, and blow dry with high pressure air.

CAUTION: Make sure to use a solvent for cleaning that is correct for the process fluid and will not damage the seals in your pump. Contact your distributor or Williams Instrument for a recommended solvent.

Use silicone grease to lubricate all seals, O-rings and other surfaces that create a seal or have sliding contact with another surface. Request our G321M1 or G321M4 (1 oz. or 4 oz. container) for this purpose.

SECTION 5.0 LIMITED WARRANTY

WILLIAM INSTRUMENT, INC. will repair or replace any pump due to defects in material or workmanship for a period of up to twelve months from the date of shipment. Product failure due to any other reason including, but not limited to misuse, negligence, accident, normal wear and usage, or improper installation and operation, will not be remedied under this warranty. This warranty is valid only if the repairs are performed by WILLIAMS INSTRUMENT, INC. and returned to the factory for inspection (freight prepaid) within the warranty period. No claim for labor or consequential damages will be allowed.

4.3 CORRECTIVE MAINTENANCE TROUBLESHOOTING TABLE

PROBLEM	POSSIBLE CAUSES	ACTION
• Controller not oscillating	• Foreign material, dirt, heavy oil in controller	• Disassemble controller and clean
	• No air/gas supply	• Connect pressure gauge to pressure regulator to verify required supply pressure
	• Supply pressure too high or too low	• Reset regulator to proper pressure
	• Too much pressure drop in air/gas line	• Increase connecting tube size or clean air lines. If problem persists, increase air supply piping to the pump
	• Stroke rate valve open too much	• Disconnect air/gas supply. Rotate stroke rate knob CCW to peg. Wait 5 seconds. Rotate knob CW until it stops. DO NOT FORCE!
	• Leak between pump body and controller body	• Loosen, then re-tighten the connection between pump valve body and controller body
	• Continuous air flow from controller exhaust port (pilot plug not seating properly)	• Inspect and replace damaged pilot plug • Replace damaged diaphragm
	• Air flowing from the equalizer hole on the side of the controller body	• Inspect and replace ruptured or improperly seated U-cups or diaphragms
• No pump discharge	• Controller may be stalled	• Vent air/gas supply to atmospheric pressure
	• Suction or discharge check valves not seating	• Clean or replace check valves. Add 25 micron filter on suction line to prevent recurrence
	• Suction or discharge line clogged or stopped	• Inspect line for clogged valve
• Diaphragm not flexing	• Air entering suction line	• Tighten fittings. Inspect and replace damaged fittings
	• Broken diaphragm return spring	• Replace spring
	• Air/gas supply pressure too low to overcome process line pressure	• Increase supply pressure to 100 psig maximum
	• Discharge line clogged	• Clear discharge line
• Low pump output	• Air/gas supply to controller too low	• Inspect for clogs. If none, increase size or decrease length of supply line
	• Suction lift condition	• Change tank elevation to get flooded suction (See 2.2.3)
	• Diaphragm ripped or punctured	• Replace diaphragm
• Low pump discharge	• Faulty suction check valve	• Add foot valve at end of suction line (See 2.2.5) • Increase suction line diameter
	• Blocked suction filter	• Clean or replace filter element
	• Supply and discharge lines too small	• Install correct tubing size
	• Diaphragm damaged	• Replace diaphragm
	• Diaphragm return spring broken	• Replace spring
	• Erratic controller operation	• Rebuild and clean controller. Add air
	• Leaky or contaminated check valves	• Rebuild or replace damaged parts
• Improper chemical supply	• Make certain the top of the chemical supply tank is vented to atmosphere or pressurized	

LD PUMP REPAIR KITS

PUMP MODEL	REPAIR KIT	DIAPHRAGM KIT	MK XIIA KIT	MK X KIT *
LD100-316-TFE	RKLD100-316-TFE	DKLD100-TFE	OS72 – (N,BR,V)	OS62BR/TFE
LD100-TFE-TFE	RKLD100-TFE-TFE	DKLD100-TFE	OS72 – (N,BR,V)	OS62BR/TFE
LD200-316-TFE	RKLD200-316-TFE	DKLD200-TFE	OS72 – (N,BR,V)	OS62BR/TFE
LD200-TFE-TFE	RKLD200-TFE-TFE	DKLD200-TFE	OS72 – (N,BR,V)	OS62BR/TFE
LD400-316-TFE	RKLD400-316-TFE	DKLD400-TFE	OS72 – (N,BR,V)	OS62BR/TFE
LD400-TFE-TFE	RKLD400-TFE-TFE	DKLD400-TFE	OS72 – (N,BR,V)	OS62BR/TFE

*MK X Controller repair kits also available in Viton (Part No. = OS52V/TFE)
 MK XIIA Controller repair kit available in Neoprene (N), Buna N (BR), Viton (V)



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