

## 1/2" DIAPHRAGM PUMP 1:1 RATIO (NON-METALLIC)



**READ THIS MANUAL CAREFULLY BEFORE INSTALLING,  
OPERATING OR SERVICING THIS EQUIPMENT.**

It is the responsibility of the employer to place this information in the hands of the operator. Keep for future reference.

### SERVICE KITS

Refer to Model Description Chart to match the pump material options.

637140-4B for fluid section repair (see page 4).

637428 for air section repair (see page 6).

### PUMP DATA

**Model**..... 670093, 670109

**Pump Type**... Non-Metallic Air Operated Double Diaphragm

**Material** ..... see Model Description Chart

**Weight** ..... Polypropylene... 7.2 (3.3 kgs)

**Maximum Air Inlet Pressure** ..... 100 p.s.i.g. (6.9 bar)

**Maximum Material Inlet Pressure**... 10 p.s.i.g. (0.69 bar)

**Maximum Outlet Pressure**..... 100 p.s.i.g. (0.69 bar)

**Displacement / Cycle @ 100 p.s.i.g.**... 0.040 gallons (0.15 L)

**Air Consumption**..... 1 c.f.m. / gallon (approx.)

**Maximum Flow rate** (Ball)..... 13 g.p.m (49.2 l.p.m)

**Maximum Particle size** (Ball)..... 3/32" dia. (2.4 mm)

#### Maximum Temperature Limits

E.P.R. / EPDM .. -60° to 280° F (-51° to 138° C)

Groundable Acetal ..... 10° to 180° F (-12° to 82° C)

Hytrel® ..... -20° to 150° F (-29° to 66° C)

Neoprene .. 0° to 200° F (-18° to 93° C)

Nitrile ..... 10° to 180° F (-12° to 82° C)

Polypropylene ..... 35° to 175° F (2° to 79° C)

Polyurethane ..... 10° to 150° F (-12° to 66° C)

Kynar PVDF® ..... 10° to 200° F (-12° to 93° C)

Santoprene® ..... -40° to 225° F (-40° to 107° C)

PTFE..... 40° to 225° F (4° to 107° C)

Viton® ..... -40° to 350° F (-40° to 170° C)

**Dimensional Data** ..... see page 8

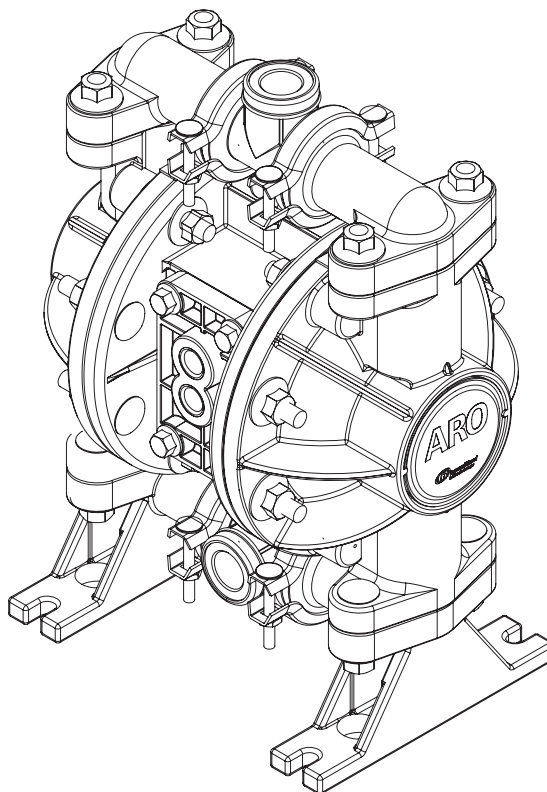


Figure 1

## OPERATING AND SAFETY PRECAUTIONS

READ, UNDERSTAND AND FOLLOW THIS INFORMATION TO AVOID INJURY AND PROPERTY DAMAGE.



EXCESSIVE AIR PRESSURE  
STATIC SPARK



HAZARDOUS MATERIALS  
HAZARDOUS PRESSURE

- ⚠ WARNING** **EXCESSIVE AIR PRESSURE.** Can cause personal injury, pump damage or property damage.
- Do not exceed the maximum inlet air pressure as stated on the pump model plate.
  - Be sure material hoses and other components are able to withstand fluid pressures developed by this pump. Check all hoses for damage or wear. Be certain dispensing device is clean and in proper working condition.
- ⚠ WARNING** **STATIC SPARK.** Can cause explosion resulting in severe injury or death. Ground pump and pumping system.
- Sparks can ignite flammable material and vapors.
  - The pumping system and object being sprayed must be grounded when it is pumping, flushing, recirculating or spraying flammable materials such as paints, solvents, lacquers, etc. or used in a location where surrounding atmosphere is conducive to spontaneous combustion. Ground the dispensing valve or device, containers, hoses and any object to which material is being pumped.
  - Secure pump, connections and all contact points to avoid vibration and generation of contact or static spark.
  - Consult local building codes and electrical codes for specific grounding requirements.
  - After grounding, periodically verify continuity of electrical path to ground. Test with an ohmmeter from each component (e.g., hoses, pump, clamps, container, spray gun, etc.) to ground to insure continuity. Ohmmeter should show 0.1 ohms or less.
  - Submerge the outlet hose end, dispensing valve or device in the material being dispensed if possible. (Avoid free streaming of material being dispensed.)
  - Use hoses incorporating a static wire.
  - Use proper ventilation.
  - Keep inflammables away from heat, open flames and sparks.
  - Keep containers closed when not in use.
- ⚠ WARNING** **Pump exhaust may contain contaminants.** Can cause severe injury. Pipe exhaust away from work area and personnel.
- In the event of a diaphragm rupture, material can be forced out of the diaphragm muffler.
  - Pipe the exhaust to a safe remote location when pumping hazardous or inflammable materials.
  - Use a grounded 3/8" minimum i.d. hose between the pump and the muffler.
- ⚠ WARNING** **HAZARDOUS PRESSURE.** Can result in serious injury or property damage. Do not service or clean pump, hoses or dispensing valve while the system is pressurized.
- Disconnect air supply line and relieve pressure from the system by opening dispensing valve or device and / or carefully and slowly loosening and removing outlet hose or piping from pump.
- ⚠ WARNING** **HAZARDOUS MATERIALS.** Can cause serious injury or property damage. Do not attempt to return a pump to the factory or service center that contains hazardous material. Safe handling practices

must comply with local and national laws and safety code requirements.

- Obtain Material Safety Data Sheets on all materials from the supplier for proper handling instructions.
- ⚠ CAUTION** Verify the chemical compatibility of the pump wetted parts and the substance being pumped, flushed or recirculated. Chemical compatibility may change with temperature and concentration of the chemical(s) within the substances being pumped, flushed or circulated. For specific fluid compatibility, consult the chemical manufacturer.
- ⚠ CAUTION** Maximum temperatures are based on mechanical stress only. Certain chemicals will significantly reduce maximum safe operating temperature. Consult the chemical manufacturer for chemical compatibility and temperature limits. Refer to PUMP DATA on page 1 of this manual.
- ⚠ CAUTION** Be certain all operators of this equipment have been trained for safe working practices, understand it's limitations, and wear safety goggles / equipment when required.
- ⚠ CAUTION** Do not use the pump for the structural support of the piping system. Be certain the system components are properly supported to prevent stress on the pump parts.
- Suction and discharge connections should be flexible connections (such as hose), not rigid piped, and should be compatible with the substance being pumped.
- ⚠ CAUTION** Prevent unnecessary damage to the pump. Do not allow pump to operate when out of material for long periods of time.
- Disconnect air line from pump when system sits idle for long periods of time.
- ⚠ CAUTION** Use only genuine ARO replacement parts to assure compatible pressure rating and longest service life.
- NOTICE** Install the pump in the vertical position. The pump may not prime properly if the balls do not check by gravity upon start-up.
- NOTICE** **RE-TORQUE ALL FASTENERS BEFORE OPERATION.** Creep of housing and gasket materials may cause fasteners to loosen. Re-torque all fasteners to insure against fluid or air leakage.
- NOTICE** Replacement warning labels are available upon request: Static Spark" pn \ 93616-1, Diaphragm Rupture" pn \ 93122.

- ⚠ WARNING** = Hazards or unsafe practices which could result in severe personal injury, death or substantial property damage.
- ⚠ CAUTION** = Hazards or unsafe practices which could result in minor personal injury, product or property damage.
- NOTICE** = Important installation, operation or maintenance information.

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## GENERAL DESCRIPTION

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The ARO diaphragm pump offers high volume delivery even at low air pressure and a broad range of material compatibility options available. Refer to the model and option chart. ARO pumps feature stall resistant design, modular air motor / fluid sections.

Air operated double diaphragm pumps utilize a pressure differential in the air chambers to alternately create suction and positive fluid pressure in the fluid chambers, ball checks insure a positive flow of fluid.

Pump cycling will begin as air pressure is applied and it will continue to pump and keep up with the demand. It will build and maintain line pressure and will stop cycling once maximum line pressure is reached (dispensing device closed) and will resume pumping as needed.

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## AIR AND LUBE REQUIREMENTS

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 **WARNING EXCESSIVE AIR PRESSURE. Can cause pump damage, personal injury or property damage.**

- A filter capable of filtering out particles larger than 50 microns should be used on the air supply. There is no lubrication required other than the "O" ring lubricant which is applied during assembly or repair.
- If lubricated air is present, make sure that it is compatible with the "O" rings and seals in the air motor section of the pump.

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## OPERATING INSTRUCTIONS

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- Always flush the pump with a solvent compatible with the material being pumped if the material being pumped is subject to setting up" when not in use for a period of time.
- Disconnect the air supply from the pump if it is to be inactive for a few hours.
- The outlet material volume is governed not only by the air supply but also by the material supply available at the inlet. The material supply tubing should not be too small or restrictive. Be sure not to use hose which might collapse.
- When the diaphragm pump is used in a forced-feed (flooded inlet) situation, it is recommended that a "Check Valve" be installed at the air inlet.
- Secure the diaphragm pump legs to a suitable surface to insure against damage by vibration.

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## MAINTENANCE

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Provide a clean work surface to protect sensitive internal moving parts from contamination from dirt and foreign matter during service disassembly and reassembly.

- Certain ARO "Smart Parts" are indicated which should be available for fast repair and reduction of down time.
- Service kits are available to service two separate diaphragm pump functions: 1. AIR SECTION, 2. FLUID SECTION. The Fluid Section is divided further to match typical active MATERIAL OPTIONS.
- Provide a clean work surface to protect sensitive internal moving parts from contamination from dirt and foreign matter during service disassembly and reassembly.
- Keep good records of service activity and include pump in preventive maintenance program.

## PARTS LIST / 670093 & 670109 - FLUID SECTION

★ **637140-4B Fluid Section Service Kits** include: Balls, Diaphragms plus "O" ring items: 19, 20, 33 and 93706-1 Key-Lube grease (page 6).

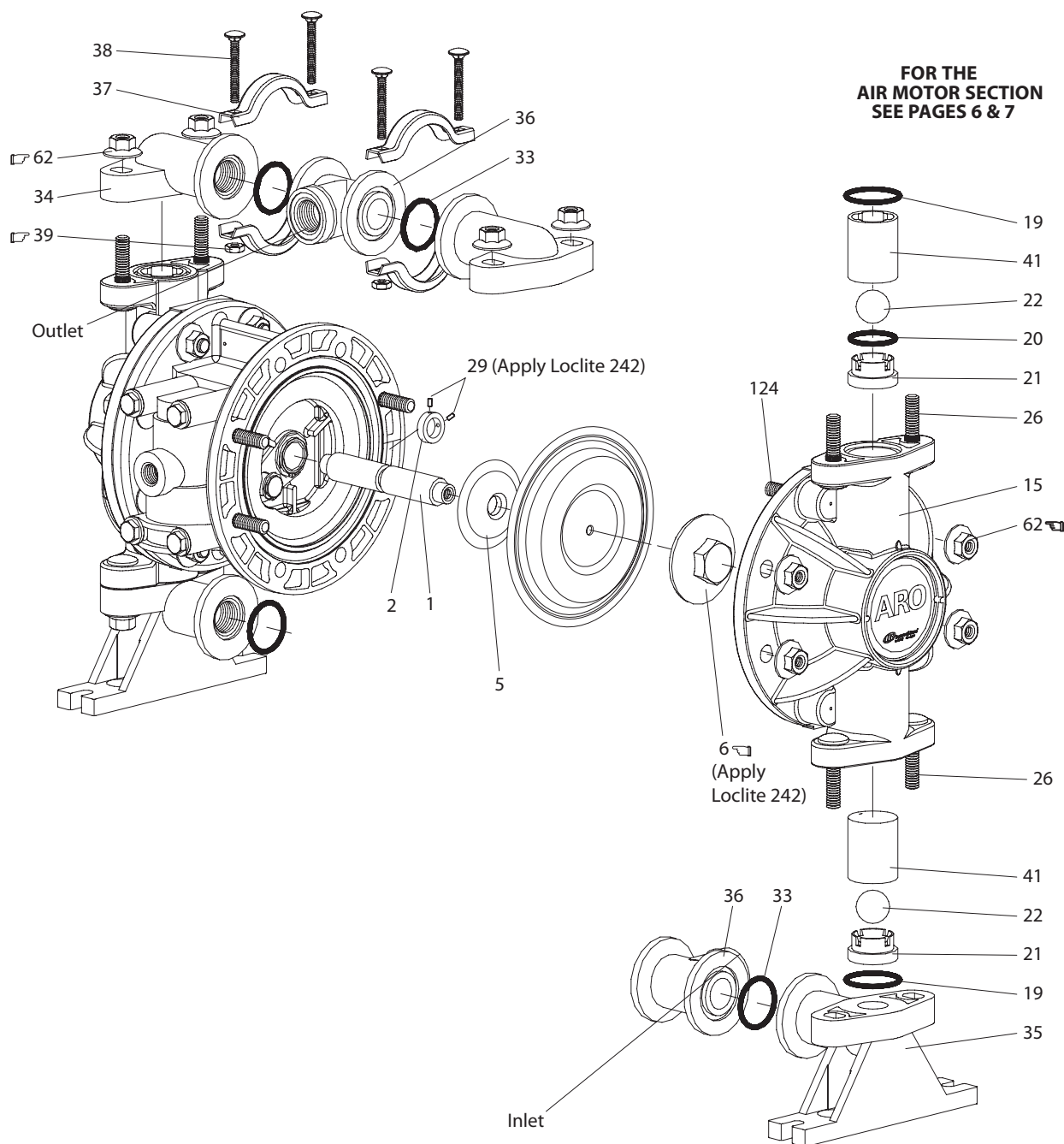
Item	Description (size)	Qty	Part No.	Mtl
<input type="checkbox"/> 1	<b>Rod</b> (for model 670093)	(1)	<b>93084</b>	[SS]
	(for model 670109)	(1)	<b>96379</b>	[SS]
2	<b>Ring</b> (for model 670093)	(1)	<b>97177</b>	[C]
	(for model 670109)	---	---	---
5	<b>Washer</b> (2" o.d.)	(2)	<b>94645</b>	[GFN]
<input type="checkbox"/> 6	<b>Diaphragm Nut</b> (5/16" - 18)	(2)	<b>93103-1</b>	[P]
7	<b>Diaphragm</b>	(2)	<b>93465</b>	[Sp]
15	<b>Fluid Cap</b> (includes 26 & 124)	(2)	<b>93105-1</b>	[P]
19	<b>O" Ring</b> (1-5/16" o.d.)	(4)	<b>93763</b>	[E]
20	<b>O" Ring</b> (1-1/8" o.d.)	(2)	<b>93761</b>	[E]
21	<b>Seat</b>	(4)	<b>93098-10</b>	[P]
22	<b>Ball</b>	(4)	<b>93100-4</b>	[T]
26	<b>Bolt</b> (5/16" - 16 x 1-1/2")	(16)	<b>93109</b>	[SS]
29	<b>Set Screw</b> (for model 670093)	(2)	<b>Y29-132-S</b>	[SS]
	(for model 670109)	---	---	---
33	<b>O" Ring</b> (1-3/16" o.d.)	(4)	<b>93762</b>	[E]
34	<b>Manifold, Outlet</b> (top)	(2)	<b>93102-1</b>	[P]
<input type="checkbox"/> 35	<b>Manifold, Foot</b> (bottom)	(2)	<b>93106-1</b>	[P]
<input type="checkbox"/> 36	<b>Swivel</b>	(2)	<b>93101-1</b>	[P]
<input type="checkbox"/> 37	<b>Clamp</b>	(8)	<b>93099</b>	[SS]
38	<b>Bolt</b> (#10 - 24 x 1-1/2")	(8)	<b>Y84-303-T</b>	[SS]
39	<b>Nut</b> (#10 - 24)	(8)	<b>Y22-10-S</b>	[SS]
41	<b>Ball Cage</b>	(4)	<b>93097-1</b>	[P]
62	<b>Flange Nut</b> (5/16" - 18)	(24)	<b>93886</b>	[SS]
124	<b>Stud</b> (5/16" - 18 x 1-17/32")	(8)	<b>93249</b>	[SS]

### MATERIAL CODE

[B]	Nitrile
[C]	Carbon steel
[D]	Acetal
[E]	E.P.R.
[F]	Fluoraz
[GA]	Groundable Acetal
[GFN]	Glass Filled Nylon
[H]	Hytrel
[N]	Neoprene
[P]	Polypropylene
[PK]	Pure Kynar
[Sp]	Santoprene
[SS]	Stainless Steel
[T]	PTFE
[U]	Polyurethane
[V]	Viton

☐ "Smart parts", keep these items on hand in addition to the service kits for fast repair and reduction of down time.

COLOR CODE		
Material	Diaphragm Color	Ball Color
Acetal	N/A	Orange
Nitrile	Red (-)	Red (•)
E.P.R.	Blue (-)	Blue (•)
Hytrel	Cream	N/A
Neoprene	Green (-)	Green (•)
Santoprene	Tan	Tan
PTFE	White	White
Polyurethane	Clear	Red
Viton	Yellow (-)	Yellow (•)
	(-) Stripe	(•) Dot



FOR THE  
AIR MOTOR SECTION  
SEE PAGES 6 & 7

#### TORQUE REQUIREMENTS

NOTE: DO NOT OVERTIGHTEN FASTENERS.

- (6) Diaphragm nut, 95 - 105 in. lbs (10.7 - 11.9 Nm).
- (62) Fluid cap / manifold nuts, 50 - 60 in. lbs (5.6 - 6.8 Nm), / alternately and evenly, then re-torque after initial run-in.
- (39) Nuts, 20 - 25 in. lbs (2.3 - 2.8 Nm) then re-torque.

#### LUBRICATION / SEALANTS

Apply Lubriplate (94276) to all "O" rings, "U" cups and mating parts.

Figure 2



## PARTS LIST / 670093 & 670109 - AIR MOTOR SECTION

✓ Indicates parts included in 637428 Air Section Repair Kit.

Item	Description (size)	Qty	Part No.	[Mtl]
101	Center Body	(1)	96461	[PPG]
103R	Cover (right side)	(1)	96091	[D]
103L	Cover (left side)	(1)	96351	[D]
118	Actuator Pin	(2)	94874-1	[SS]
121	Washer	(2)	96092	[D]
123	Screw (#4 - 20 x 1/2")	(8)	96093	[SS]
128	Plug (#10 - 32 x 5/32")	(2)	59632-1	[Ny]
129	Exhaust Cover (for model 670093)	(1)	67443	[PPG]
	(for model 670109)	(1)	67367	[PPG]
130	Gasket (for model 670093)	(1)	93107	[SY]
	(for model 670109)	---	---	---
✓ 132	Air Manifold Gasket	(1)	96214-1	[B]
134	Flange Bolt (1/4" - 20 x 4-1/4")	(4)	96465	[SS]
135	Porting Plate	(1)	96382	[PPG]
✓ 144	"U" Cup Packing (3/16" x 1" o.d.)	(2)	Y187-48	[B]

### MATERIAL CODE

[B] = Nitrile	[PPG] = Glass filled Polypropylene
[C] = Carbon Steel	[SS] = Stainless Steel
[D] = Acetal	[SY] = Syn Seal
[Ny] = Nylon	[U] = Polyurethane

### DIAPHRAGM PUMP SERVICE

#### GENERAL SERVICE NOTES:

- Inspect and replace old parts with new parts as necessary. Look for deep scratches on metallic surfaces, and nicks or cuts in "O" rings.
- Tools needed to complete disassembly and repair:
  - 7/8" socket or wrench, 1/2" socket or wrench, 3/8" socket or wrench, 3/8" Allen wrench, T-10 Torx screwdriver, torque wrench (measuring inch pounds), "O" ring pick.

### FLUID SECTION DISASSEMBLY

- Remove (34) top manifold / (36) swivel assembly.
- Remove (19) "O" rings, (21) seats and (22) balls.
- Remove (35) bottom manifolds / (36) swivel assembly.
- Remove (19) "O" rings, (21) seats and (22) balls.
- Remove (15) fluid caps.
- Remove (6) diaphragm nut and (5) washer.
- Remove (29) set screws.
- Remove (1) connecting rod from air motor sliding off (2) ring.
- Carefully remove remaining (6) diaphragm nut and (5) washer from (1) connecting rod. Do not mar surface of connecting rod.

### FLUID SECTION REASSEMBLY

- Reassemble in reverse order.
- Lubricate (1) connecting rod with Lubriplate or equivalent "O" ring lubricant.
- Connecting rod (1) should be installed using 96571 bullet, included in service kit.
- Install (5) washers with i.d. chamfer toward diaphragm.
- When replacing PTFE diaphragms, install the 93465 Santoprene diaphragm behind the PTFE diaphragm.

Item	Description (size)	Qty	Part No.	[Mtl]
	Pilot Piston (includes 168 and 169)	(1)	67382	[D]
168	"O" Ring (1/16" x 7/16" o.d.)	(2)	96459	[U]
169	"U" Cup Packing (1/8" x 5/8" o.d.)	(1)	96384	[U]
170	Spool Bushing	(1)	96090	[D]
✓ 171	"O" Ring (1/16" x 13/16" o.d.)	(2)	Y325-17	[B]
✓ 173	"O" Ring (3/32" x 7/8" o.d.)	(2)	Y325-115	[B]
✓ 174	"O" Ring (3/32" x 11/32" o.d.)	(2)	Y325-105	[B]
✓ 200	Porting Gasket	(1)	96364	[B]
232	"O" Ring (1/16" x 3/8" o.d.)	(4)	Y325-10	[B]
233	Sensor (for model 670093)	(1)	97175	
	(for model 670109)	---	---	
✓	Lubriplate FML-2 grease	(1)	94276	
	Lubriplate Grease Packets (10)		637308	

### AIR MOTOR SECTION SERVICE

- Air Motor Section service is continued from Fluid Section repair.

### AIR MOTOR SECTION DISASSEMBLY

- Remove (123) screws, releasing (103) covers, (121) washers, (118) actuator pins and (167) pilot piston.
- Remove (170) spool bushing and inspect inner bore of bushing for damage.
- Unthread (134) bolts, releasing (129) muffler assembly.
- Pull (135) porting plate and (132 and 200) gaskets from (101) center body.

### AIR MOTOR SECTION REASSEMBLY

- Clean and lubricate parts not being replaced from service kit
- Assemble (171) "O" rings to (170) bushing and assemble bushing into (101) center body.
- Lubricate and assemble (167) pilot piston assembly into (170) bushing.
- Assemble (173 and 174) "O" rings and (121) washers to (103) covers, then insert (118) actuator pins through assembly.
- Assemble (144) "U" cups (note the lip direction) and (103) covers to (101) center body, securing with (123) screws. NOTE: Tighten (123) screws to 4 -6 in. lbs (0.45 -0.68 Nm).
- Assemble (132 and 200) gaskets, (135) porting plate and (129) muffler assembly to (101) center body, securing with (134) bolts. NOTE: Tighten (134) bolts to 15-20 in. lbs (1.7-2.3 Nm).

## PARTS LIST / 670093 & 670109 - AIR MOTOR SECTION

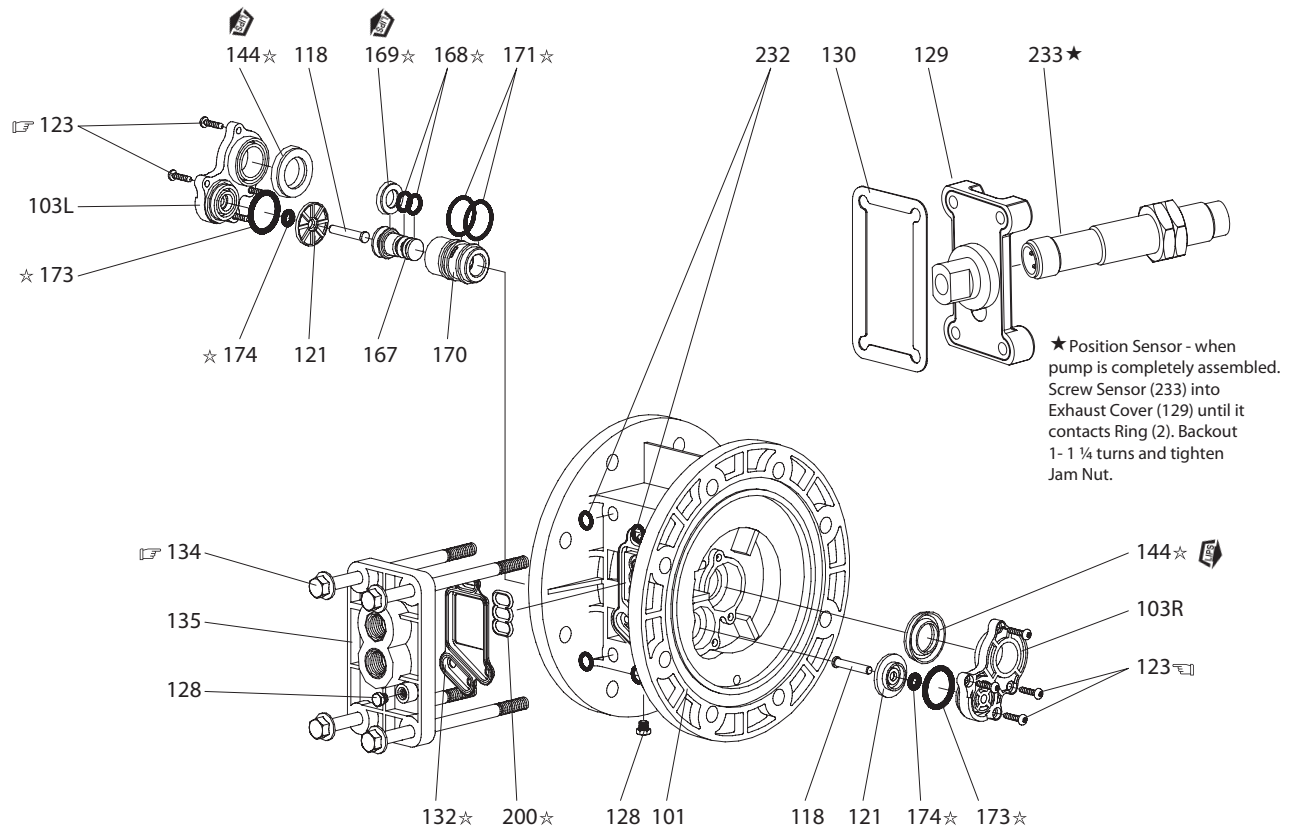


Figure 4

### TORQUE REQUIREMENTS

**NOTE: DO NOT OVERTIGHTEN FASTENERS.**

(134) Torque to 15- 20 in. lbs (1.7 - 2.3 Nm), wait 10 minutes, then re-torque to 15 - 20 in. lbs (1.7 - 2.3 Nm).

(123) Torque to 4 - 6 in. lbs (0.45 - 0.68 Nm).

### LUBRICATION / SEALANTS

★ Apply Lubriplate (94276) to all "O" rings, "U" cups and mating parts.

## TROUBLE SHOOTING

### Product discharged from air exhaust.

- Check for diaphragm rupture.
- Check tightness of (6) diaphragm nut.

### Air Bubbles in product discharge.

- Check connections of suction plumbing.
- Check "O" rings between intake manifold and fluid caps.
- Check tightness of (6) diaphragm nut.

### Pump blows air out main exhaust when stalled on either stroke.

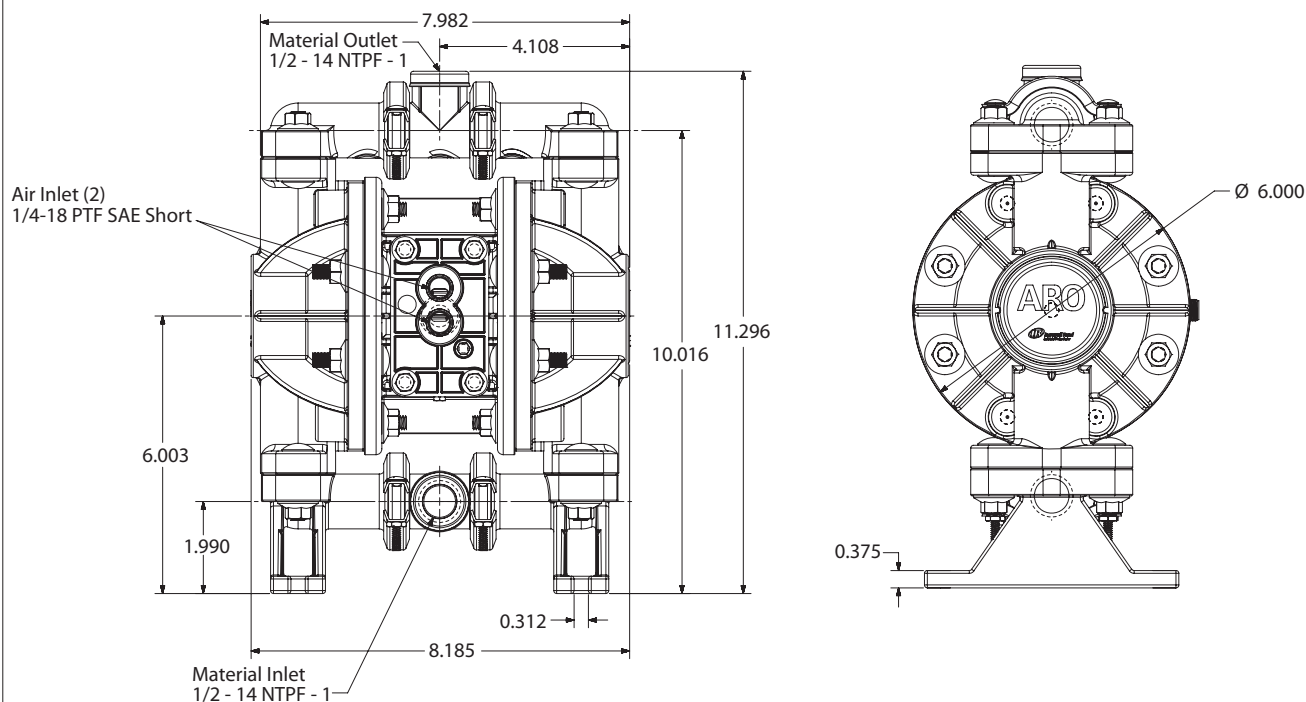
- Check (169) "U" cup on (167) pilot piston.

### Low output volume.

- Check air supply.
- Check for plugged outlet hose.
- For the pump to prime itself, it must be mounted in the vertical position so that the balls will check by gravity.
- Check for pump cavitation - suction pipe should be sized at least as large as the inlet thread diameter of the pump for proper flow if high viscosity fluids are being pumped. Suction hose must be non-collapsible type, capable of pulling a high vacuum.
- Check all joints on intake manifolds and suction connections, These must be airtight.
- Inspect the pump for solid objects lodged in the diaphragm chamber or the seat area.

## DIMENSIONAL DATA

Dimensions shown are for reference only, they are shown in inches and millimeters (mm).



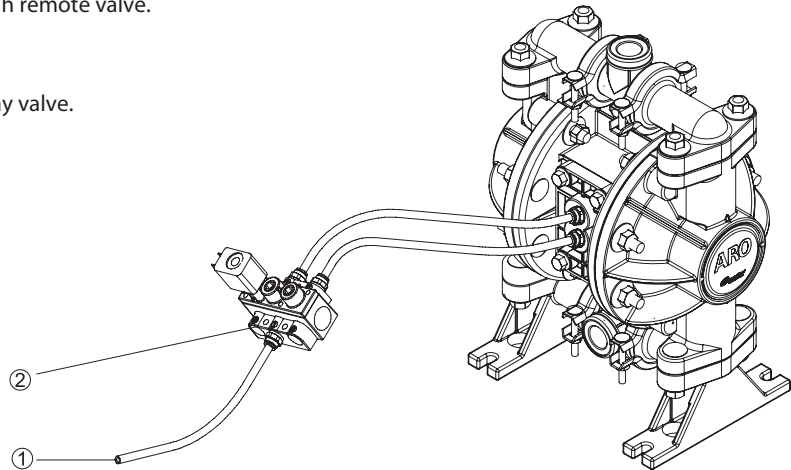


## REMOTE HOOK-UP CONNECTIONS

### TYPICAL BASIC REMOTE HOOK-UP (#10 - 32 PORTS ON PUMP ARE PLUGGED)

NOTE: Pump charges and exhausts through remote valve.

- ① Supply air.
- ② Spring return - solenoid actuated 4-way valve.

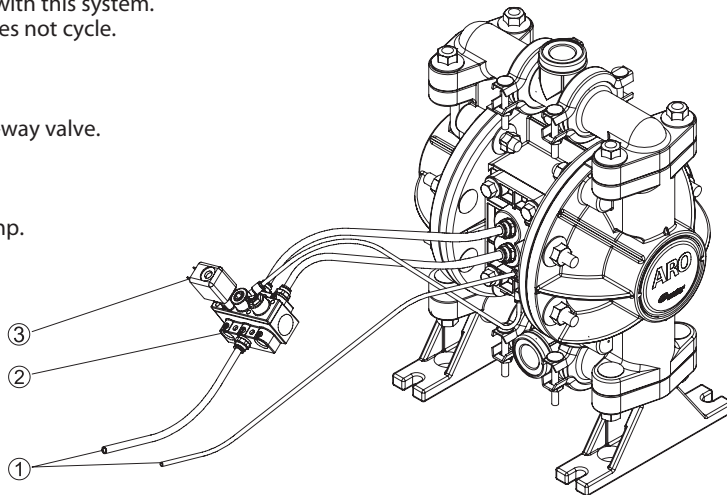


**Figure 6**

### TYPICAL REMOTE HOOK-UP WITH POSITIVE FEEDBACK SIGNAL

NOTE: Pump may not be short-stroked with this system.  
Valve will not run when pump does not cycle.

- ① Supply air.
- ② Air pilot return - solenoid actuated 4-way valve.
- ③ PLC / Controller signal.
- ④ Pneumatic feedback signal from pump.

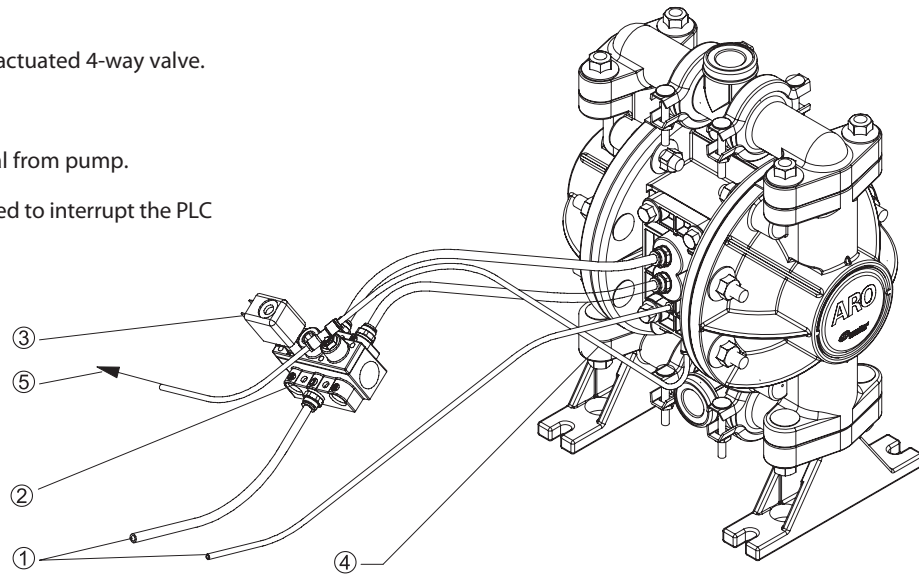


**Figure 7**

## REMOTE HOOK-UP CONNECTIONS

### TYPICAL REMOTE HOOK-UP WITH ENHANCED POSITIVE FEEDBACK SIGNAL CAPABILITY

- ① Supply air.
- ② Air pilot return - solenoid actuated 4-way valve.
- ③ PLC / Controller signal.
- ④ Pneumatic feedback signal from pump.
- ⑤ Pneumatic echo can be used to interrupt the PLC signal and set alarm.

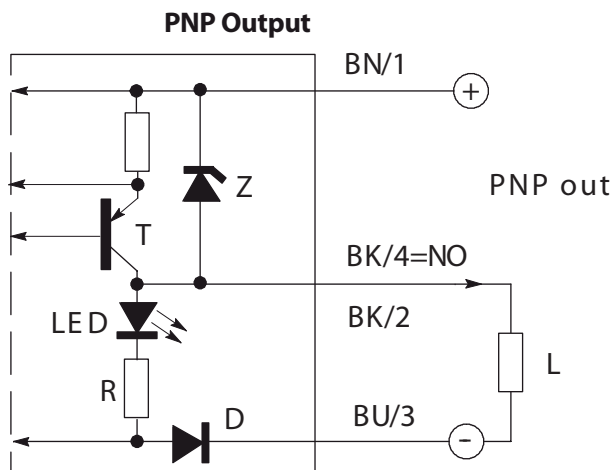


NOTE: Pump may not be short-stroked with this system.  
Pneumatic-to-electric signal can send alarm to operating system.

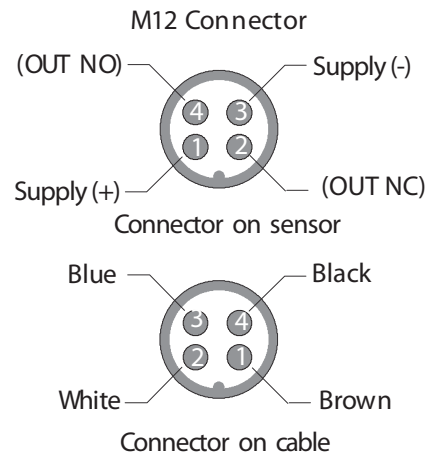
Figure 8

### Inductive Proximity Sensor M-12 DC

#### Wiring Diagram



#### Connector



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**Notes**

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