

Sanitary Series FDA-Compliant Diaphragm Pumps

311879F

For use in sanitary applications.

Model FD1 ____ **1040 FDA**

Model FD2 ____ **1590 FDA**

Model FD3 ____ **2150 FDA**

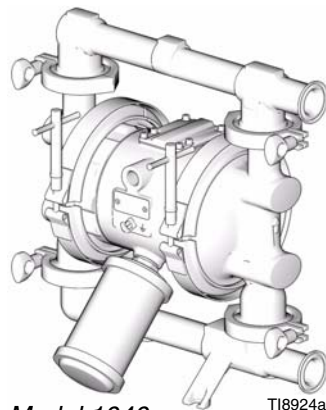
120 psi (0.8 MPa, 8 bar) Maximum Air/Fluid Working Pressure



Important Safety Instructions

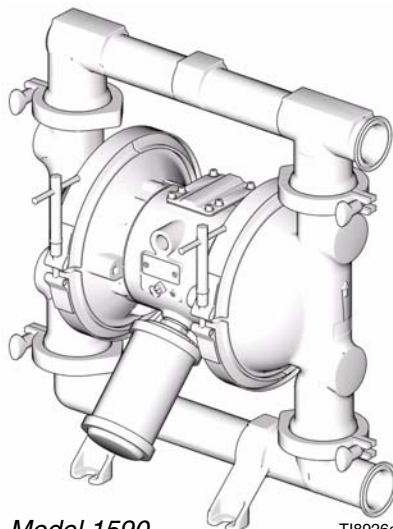
Read all warnings and instructions in this manual.
Save these instructions.

Refer to the appropriate Pump Matrix on page 26, 34, or 42 to determine the model number of your pump.



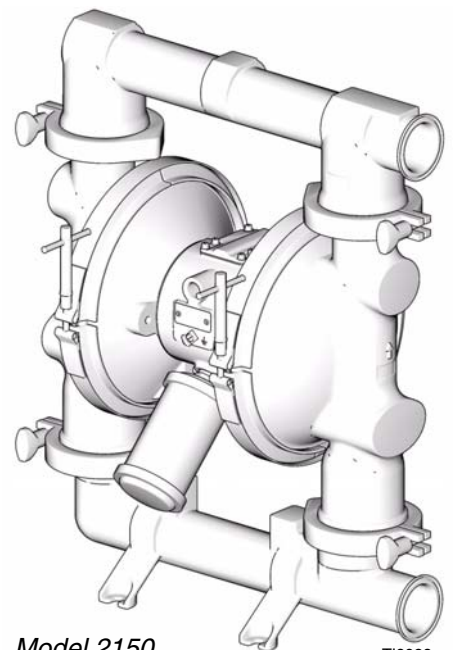
Model 1040

T18924a



Model 1590

T18926a



Model 2150

T18928a

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Certificate of Conformance

Part Number: All FD1, FD2, FD3 models

Description: FDA-Compliant Diaphragm Pump






Materials of
Construction: All fluid contacted materials are FDA-compliant and meet CFR Title 21, Section 177.




Bradley A. Byron

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QMS Management Representative
Graco Inc.

Warnings

The following warnings are for the setup, use, grounding, maintenance, and repair of this equipment. The exclamation point symbol alerts you to a general warning and the hazard symbol refers to procedure-specific risk. Refer back to these warnings. Additional, product-specific warnings may be found throughout the body of this manual where applicable.



 Warning	
	<p>FIRE AND EXPLOSION HAZARD</p> <p>Flammable fumes, such as solvent and paint fumes, in work area can ignite or explode. To help prevent fire and explosion:</p> <ul style="list-style-type: none"> • Use equipment only in well ventilated area. • Eliminate all ignition sources; such as pilot lights, cigarettes, portable electric lamps, and plastic drop cloths (potential static arc). • Keep work area free of debris, including solvent, rags and gasoline. • Do not plug or unplug power cords, or turn power or light switches on or off when flammable fumes are present. • Ground equipment and conductive objects in work area. See Grounding instructions. • Use only grounded hoses. • Hold gun firmly to side of grounded pail when triggering into pail. • If there is static sparking or you feel a shock, stop operation immediately. Do not use equipment until you identify and correct the problem.
	<p>PRESSURIZED EQUIPMENT HAZARD</p> <p>Fluid from the gun/dispense valve, leaks, or ruptured components can splash in the eyes or on skin and cause serious injury.</p> <ul style="list-style-type: none"> • Follow Pressure Relief Procedure in this manual, when you stop operating and before cleaning, checking, or servicing equipment. • Tighten all fluid connections before operating the equipment. • Check hoses, tubes, and couplings daily. Replace worn or damaged parts immediately.
	<p>EQUIPMENT MISUSE HAZARD</p> <p>Misuse can cause death or serious injury.</p> <ul style="list-style-type: none"> • Do not exceed the maximum working pressure or temperature rating of the lowest rated system component. See Technical Data in all equipment manuals. • Use fluids and solvents that are compatible with equipment wetted parts. See Technical Data in all equipment manuals. Read fluid and solvent manufacturer's warnings. • Check equipment daily. Repair or replace worn or damaged parts immediately with genuine Graco replacement parts only. • Do not alter or modify equipment. • For professional use only. • Use equipment only for its intended purpose. Call your Graco distributor for information. • Route hoses and cables away from traffic areas, sharp edges, moving parts, and hot surfaces. • Do not use hoses to pull equipment. • Comply with all applicable safety regulations.
	<p>BURN HAZARD</p> <p>Equipment surfaces and fluids that are heated can become very hot during operation. To avoid severe burns, do not touch hot fluid or equipment. Wait until equipment/fluid has cooled completely.</p>




 Warning	
	<p>TOXIC FLUID OR FUMES HAZARD</p> <p>Toxic fluids or fumes can cause serious injury or death if splashed in the eyes or on skin, inhaled, or swallowed.</p> <ul style="list-style-type: none">• Read MSDS's to know the specific hazards of the fluids you are using.• Store hazardous fluid in approved containers, and dispose of it according to applicable guidelines.
	<p>PERSONAL PROTECTIVE EQUIPMENT</p> <p>You must wear appropriate protective equipment when operating, servicing, or when in the operating area of the equipment to help protect you from serious injury, including eye injury, inhalation of toxic fumes, burns, and hearing loss. This equipment includes but is not limited to:</p> <ul style="list-style-type: none">• Protective eyewear• Clothing and respirator as recommended by the fluid and solvent manufacturer• Gloves• Hearing protection

Installation

General Information

- The typical installations shown in Figs. 2-4 are only guides for selecting and installing system components. Contact your Graco distributor for assistance in planning a system to suit your needs.
- Always use genuine Graco parts and accessories.
- Reference numbers and letters in parentheses refer to the callouts in the figures and the parts lists on pages 28-30, 36-38, and 44-46.

						
<p>The pump is very heavy (see Technical Data on pages 32, 40, and 48 for specific weights). If the pump must be moved, follow the pressure relief procedure on page 11 and have two people to lift the pump by grasping the outlet manifold securely or use appropriate lifting equipment.</p>						



						
<p>Read the TOXIC FLUID OR FUMES HAZARD warnings on page 5.</p> <p>Read the BURN HAZARD warnings on page 4. To reduce the risk of serious injury due to burns, insulate and/or label the pump before pumping fluids above 110°F (43°C).</p>						

Tightening Clamps Before First Use

After you unpack the pump, and before you use it for the first time, check all clamps, and tighten as necessary.

Grounding

To reduce the risk of static sparking, ground the pump and all other equipment used or located in the pumping area. Check your local electrical code for detailed grounding instructions for your area and type of equipment.

						
<p>Read the FIRE AND EXPLOSION HAZARD warnings on page 4.</p>						

- Pump:** Connect a ground wire and clamp as shown in Fig. 1. Loosen the grounding screw (W). Insert one end of a 12 ga (1.5 mm²) minimum ground wire (Y) behind the grounding screw and tighten the screw securely. Connect the clamp end of the ground wire to a true earth ground. Order Part No. 222011 Ground Wire and Clamp.

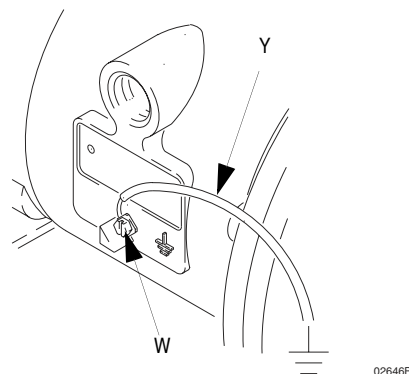


FIG. 1

- Fluid hoses:** Use only grounded hoses with a maximum of 500 ft. (150 m) combined hose length to ensure grounding continuity.
- Air compressor:** Follow the manufacturer's recommendations.
- All solvent pails used when flushing:** Follow the local code. Use only metal pails, which are conductive. Do not place the pail on a non-conductive surface, such as paper or cardboard, which interrupts the grounding continuity.
- Fluid supply container:** Follow the local code.

Mountings

CAUTION

The pump exhaust air may contain contaminants. Ventilate to a remote area if the contaminants could affect your fluid supply. See **Air Exhaust Ventilation** on page 10.

- Be sure the mounting surface can support the weight of the pump, hoses, and accessories, as well as the stress caused during operation.
- For all mountings, be sure the pump is bolted directly to the mounting surface.
- For ease of operation and service, mount the pump so the air valve cover (2), air inlet, and fluid inlet and outlet ports are easily accessible.

Air Line



A bleed-type master air valve (B) is required in the system to relieve air trapped between this valve and the pump. Trapped air can cause the pump to cycle unexpectedly, which could result in serious injury, including splashing in the eyes or on the skin, injury from moving parts, or contamination from hazardous fluids. See FIG. 2.

1. Install the air line accessories as shown in FIG. 2. Mount these accessories on the wall or on a bracket. Be sure the air line supplying the accessories is grounded.
 - a. Install an air regulator (C) and gauge to control the fluid pressure. The fluid outlet pressure will be the same as the setting of the air regulator.
 - b. Locate one bleed-type master air valve (B) close to the pump and use it to relieve trapped air. See the **WARNING** above. Locate the other master air valve (E) upstream from all air line accessories and use it to isolate them during cleaning and repair.
 - c. The air line filter (F) removes harmful dirt and moisture from the compressed air supply.



In the step below, do not connect the quick-disconnect coupler (D) on the air hose to the mating fitting on the pump until you are ready to operate the pump. Connecting the coupler too early can result in unintentional operation of the pump, leading to serious injury from moving parts, splashing fluid in the eyes or on the skin, and contact with hazardous fluids.

2. Install a grounded, flexible air hose (A) between the accessories and the 1/2 npt(f) pump air inlet (N). See Fig. 5. Use a minimum 3/8 in. (9.5 mm) ID air hose. Screw an air line quick disconnect coupler (D) onto the end of the air hose (A), and screw the mating fitting into the pump air inlet snugly.

Fluid Suction Line

1. Use flexible, grounded fluid hoses.
2. For best sealing results, use a standard Tri-Clamp® style sanitary gasket of a flexible material such as EPDM, Buna-N, fluoroelastomer, or silicon.
3. If the fluid inlet pressure to the pump is more than 25% of the outlet working pressure, the ball check valves will not close fast enough, resulting in inefficient pump operation.
4. At inlet fluid pressures greater than 15 psi (0.1 MPa, 1 bar), diaphragm life will be shortened.
5. See the **Technical Data** on pages 32, 40, and 48 for maximum suction lift (wet and dry).

Fluid Outlet Line



A fluid drain valve (J) is required to relieve pressure in the hose if it is plugged. The drain valve reduces the risk of serious injury, including splashing in the eyes or on the skin, or contamination from hazardous fluids when relieving pressure. Install the valve close to the pump fluid outlet. See FIG. 2.

1. Use flexible grounded fluid hoses (L).
2. For best sealing results, use a standard Tri-Clamp® style sanitary gasket of a flexible material such as EPDM, Buna-N, fluoroelastomer, or silicon
3. Install a fluid drain valve (J) near the fluid outlet. See the **WARNING** above, and FIG. 2.
4. Install a shutoff valve (K) in the fluid outlet line.

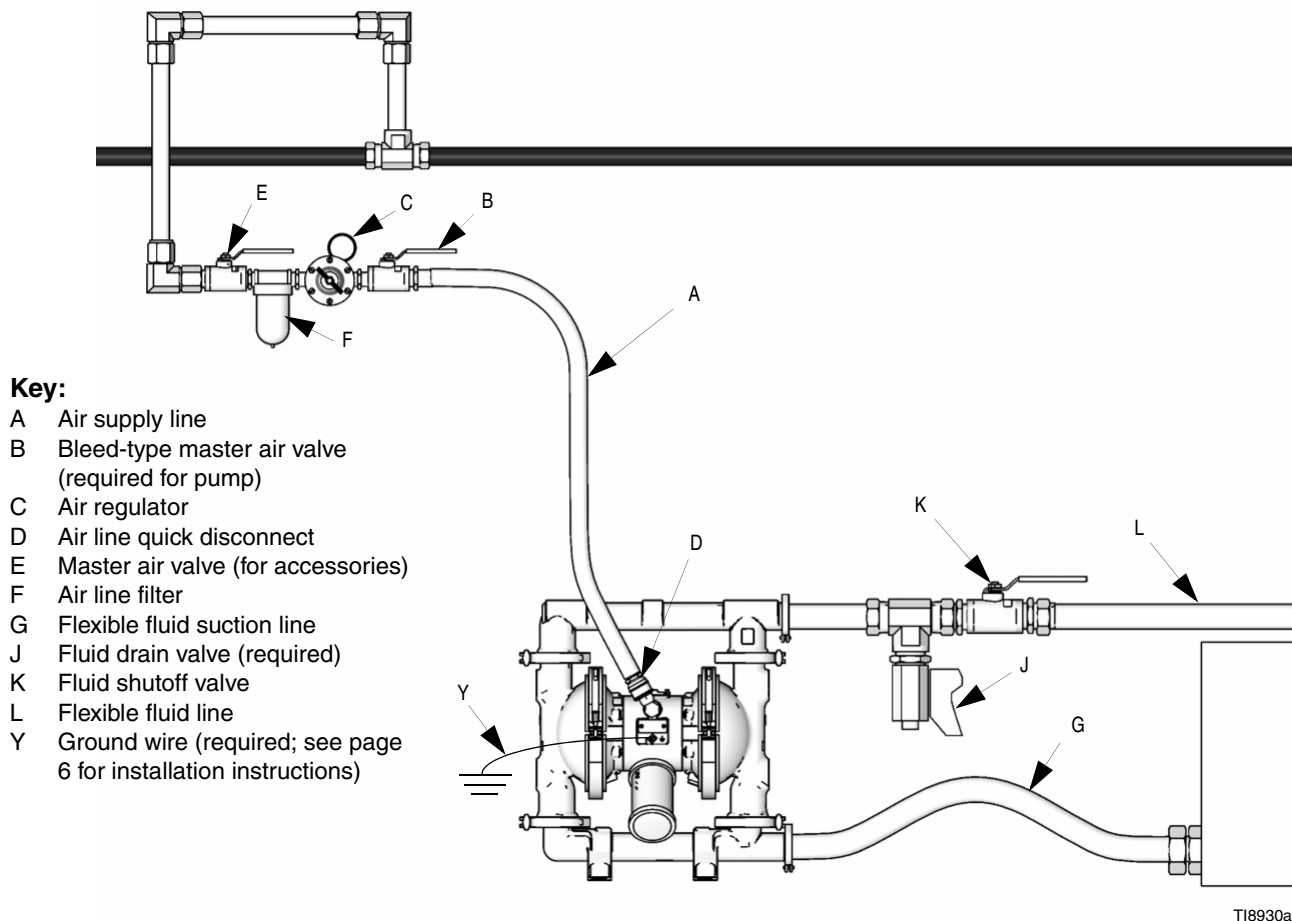


FIG. 2 Typical Floor-Mount Installation


Changing the Orientation of the Fluid Inlet and Outlet Ports

The pump is shipped with the ports facing the same direction. To reverse the orientation of the ports:

1. Remove the clamps holding the inlet and/or outlet manifold to the covers.
2. Reverse the manifold and reattach. Install and tighten clamps snugly.

Key:

- N 1/2 npt(f) air inlet port
P Muffler (air exhaust port is 3/4 npt(f))
R Fluid inlet port
S Fluid outlet port
113 Manifold clamps
3 Air valve screws

 Torque to
28-30 in-lb
(3.2-3.7 N•m)

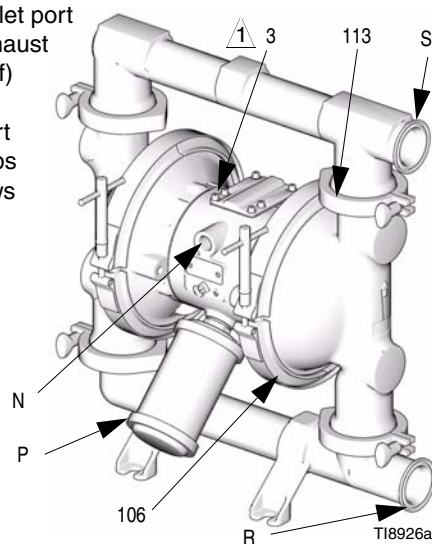





FIG. 3

Air Exhaust Ventilation

						
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Read the **FIRE AND EXPLOSION HAZARD** and **TOXIC FLUID OR FUMES HAZARD** warnings on page 5 before operating this pump.

Be sure the system is properly ventilated for your type of installation. When pumping flammable or hazardous fluids, you must vent the exhaust to a safe place, away from people, animals, food handling areas, and all sources of ignition.

Diaphragm failure will cause the fluid being pumped to exhaust with the air. Place an appropriate container at the end of the air exhaust line to catch the fluid. See FIG. 4.

The air exhaust port is 3/4 npt(f). Do not restrict the air exhaust port. Excessive exhaust restriction can cause erratic pump operation.

To provide a remote exhaust:

1. Remove the muffler (P) from the pump air exhaust port.
2. Install a grounded air exhaust hose (T) and connect the muffler (P) to the other end of the hose. The minimum size for the air exhaust hose is 3/4 in. (19 mm) ID. If a hose longer than 15 ft (4.57 m) is required, use a larger diameter hose. Avoid sharp bends or kinks in the hose.
3. Place a container (U) at the end of the air exhaust line to catch fluid in case a diaphragm ruptures. See FIG. 4.

Key:

- A Air supply line
- B Bleed-type master air valve (required for pump)
- C Air regulator
- D Air line quick disconnect
- E Master air valve (for accessories)
- F Air line filter
- P Muffler
- T Grounded air exhaust hose
- U Container for remote air exhaust

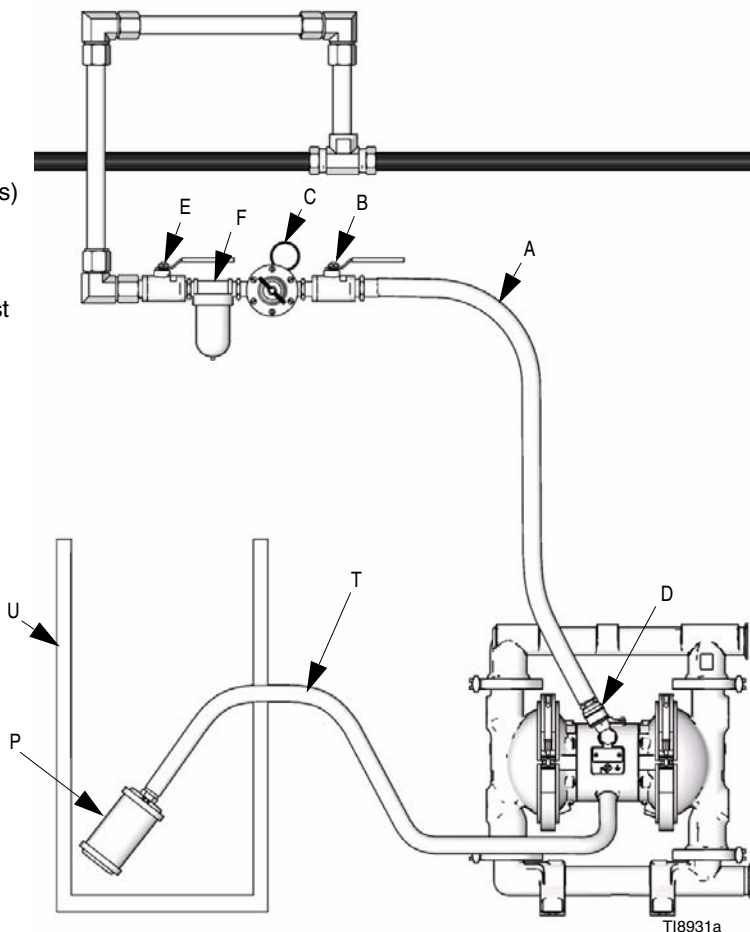




FIG. 4 Venting Exhaust Air

Operation




Pressure Relief Procedure

						
<p>Read the PRESSURIZED EQUIPMENT HAZARD warnings on page 4.</p> <p>The equipment stays pressurized until pressure is manually relieved. To reduce the risk of serious injury from pressurized fluid or splashing fluid, follow this procedure whenever you:</p> <ul style="list-style-type: none"> are instructed to relieve pressure stop pumping check, clean or service any system equipment 						

1. Shut off the air to the pump.
2. Open the dispensing valve, if used.
3. Open the fluid drain valve to relieve fluid pressure, having a container ready to catch the drainage.


Sanitize the Pump Before First Use

It is the user's responsibility to properly sanitize the pump before first use. It is up to the user whether this will include disassembling and cleaning individual parts or simply flushing pump with a sanitizing solution. As necessary, follow the steps under **Starting and Adjusting the Pump** below, under the **Service** section on page 16, or under **Flushing** on page 13.

						
<p>Read the TOXIC FLUID OR FUMES HAZARD warnings on page 5. Never move or lift a pump under pressure. If dropped, the fluid section may rupture. Always follow the Pressure Relief Procedure before lifting the pump.</p>						

Starting and Adjusting the Pump

1. Be sure the pump is properly grounded. Refer to **Grounding** on page 4.
2. Check connections to be sure they are tight. Tighten fluid inlet and outlet connections securely.
3. Place the suction tube (if used) in fluid to be pumped.

 If fluid inlet pressure to the pump is more than 25% of outlet working pressure, the ball check valves will not close fast enough, resulting in inefficient pump operation.

4. Place the end of fluid hose (L) into an appropriate container.
5. Close the fluid drain valve (J).
6. Back out the air regulator (C) knob, and open all bleed-type master air valves (B, E).
7. If the fluid hose has a dispensing device, hold it open while continuing with the following step.
8. Slowly increase air pressure with the air regulator (C) until the pump starts to cycle. Allow the pump to cycle slowly until all air is pushed out of the lines and the pump is primed.

Pump Shutdown

						
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At the end of the work shift, relieve pressure.



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Maintenance



Lubrication

The air valve is designed to operate unlubricated, however if lubrication is desired, every 500 hours of operation (or monthly) remove the hose from the pump air inlet and add two drops of machine oil to the air inlet.

CAUTION

Do not over-lubricate the pump. Oil is exhausted through the muffler and could contaminate your fluid supply or other equipment. Excessive lubrication can also cause the pump to malfunction.

Flushing

						
To reduce the risk of serious injury, whenever you are instructed to relieve pressure, always follow the Pressure Relief Procedure on page 11.						

Insert suction tube into cleaning solution. Open air regulator to supply low pressure air to the pump. Run the pump long enough to thoroughly clean the pump and hoses. Close the air regulator. Remove the suction tube from the cleaning solution and drain pump. Place suction tube in the fluid to be pumped.

Flush the pump often enough to prevent the fluid you are pumping from drying or freezing in the pump and damaging it. Flushing schedule will be based on what the pump is being used for. Use a compatible cleaning solution and always cycle the pump during the entire flushing process.

Always flush the pump and relieve the pressure before storing it for any length of time.



Tightening Connections

Before each use, check all hoses for wear or damage, and replace as necessary. Check to be sure all connections are tight and leak-free.

Preventive Maintenance Schedule

Establish a preventive maintenance schedule, based on the pump's service history. This is especially important for prevention of spills or leakage due to diaphragm failure.

Troubleshooting

To reduce the risk of serious injury, whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 11.

- Relieve the pressure before checking or servicing the equipment.
- Check all possible problems and causes before disassembling the pump.

PROBLEM	CAUSE	SOLUTION
Pump cycles at stall or fails to hold pressure at stall.	Worn check valve balls (301), seats (201) or o-rings (202).	Replace. See 18.
Pump will not cycle, or cycles once and stops.	Air valve is stuck or dirty.	Disassemble and clean air valve. See page 16. Use filtered air.
	Check valve ball (301) severely worn and wedged in seat (201) or manifold (102 or 103).	Replace ball and seat. See page 18.
	Check valve ball (301) is wedged into seat (201), due to overpressurization.	Install Pressure Relief Valve (see page 10).
	Dispensing valve clogged.	Relieve pressure and clear valve.
Pump operates erratically.	Clogged suction line.	Inspect; clear.
	Sticky or leaking balls (301).	Clean or replace. See page 18.
	Diaphragm ruptured.	Replace. See pages 19-21.
	Restricted exhaust.	Remove restriction.
Air bubbles in fluid.	Suction line is loose.	Tighten.
	Diaphragm ruptured.	Replace. See pages 19-21.
	Loose inlet manifold (102), damaged seal between manifold and seat (201), damaged o-rings (202).	Tighten manifold clamps (113), or replace seats (201) or o-rings (202). See page 18.
	Loose diaphragm shaft bolt (107).	Tighten or replace (pages 19-21).
	Damaged o-ring (108).	Replace. See pages 19-21.
Chattering - noisy operation.	Check valve balls do not seat properly/cleanly due to imbalance between fluid inlet and outlet line sizing. Noise is accentuated with light viscosity fluids.	Reduce size/diameter of inlet line relative to outlet line. Outlet line size should not exceed pump size.

PROBLEM	CAUSE	SOLUTION
Leak in inlet or outlet sanitary fitting.	Loose sanitary clamp.	Tighten clamp.
	Damaged or worn gasket.	Replace gasket.
	Misalignment of inlet/outlet hose or pipe.	Use flexible hoses at pump inlet and outlet.
	Gasket does not seal.	Use a standard sanitary gasket of flexible material such as EPDM, Buna-N, fluoroelastomer, or silicon.
Fluid in exhaust air.	Diaphragm ruptured.	Replace. See pages 19-21.
	Loose diaphragm shaft bolt (107).	Tighten or replace. See pages 19-21.
	Damaged o-ring (108).	Replace. See pages 19-21.
Pump exhausts excessive air at stall.	Worn air valve block (7), o-ring (6), plate (8), pilot block (18), u-cups (10), or pilot pin o-rings (17).	Repair or replace. See page 16.
	Worn shaft seals (402).	Replace. See pages 19-21.
Pump leaks air externally.	Air valve cover (2) or air valve cover screws (3) are loose.	Tighten screws. See page 16.
	Air valve gasket (4) or air cover gasket (22) is damaged.	Inspect; replace. See pages 16, 22-23.
	Air cover screws (25) are loose.	Tighten screws. See pages 22-23.
Pump leaks fluid externally from ball check valves.	Loose manifolds (102, 103), damaged seal between manifold and seat (201), damaged o-rings (202).	Tighten manifold clamps (113), or replace seats (201) or o-rings (202). See page 18.

Service

Repairing the Air Valve

Tool Required

- Torque wrench
- Torx (T20) screwdriver or 7 mm (9/32 in.) socket wrench
- Needle-nose pliers
- O-ring pick
- Lithium base grease



Air Valve Repair Kit 255061 is available. Parts included in the kit are marked with a symbol, for example (4†). Use all the parts in the kit for the best results.

Disassembly



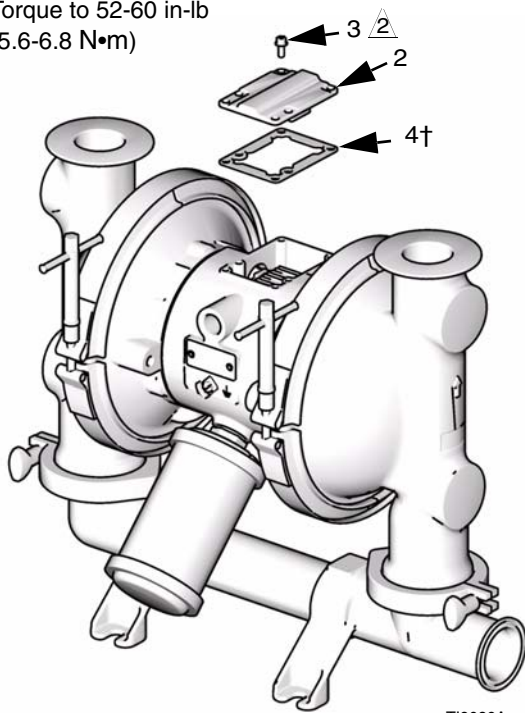
To reduce the risk of serious injury, whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 11.

1. Relieve the pressure.
2. With a Torx (T20) screwdriver or 7 mm (9/32 in.) socket wrench, remove the six screws (3), air valve cover (2), and gasket (4). See FIG. 5.
3. Move the valve carriage (5) to the center position and pull it out of the cavity. Remove the valve block (7) and o-ring (6) from the carriage. Using a needle-nose pliers, pull the pilot block (18) straight up and out of the cavity. See FIG. 6.
4. Pull the two actuator pistons (11) out of the bearings (12). Remove the u-cup packings (10) from the pistons. Pull the pilot pins (16) out of the bearings (15). Remove the o-rings (17) from the pilot pins. See FIG. 7.
5. Inspect the valve plate (8) in place. If damaged, use a Torx (T20) screwdriver or 7 mm (9/32 in.) socket wrench to remove the three screws (3). Remove the valve plate (8). See FIG. 8.
6. Inspect the bearings (12, 15) in place. See FIG. 7. The bearings are tapered and, if damaged, must be removed from the outside. This requires disassembly of the fluid section. See page 24.
7. Clean all parts and inspect for wear or damage. Replace as needed. Reassemble.

Reassembly

1. If you replaced the bearings (12, 15), reinstall as explained on page 24. Reassemble the fluid section.
2. Install the valve plate (8) in the cavity, seal down. Install the three screws (3), using a Torx (T20) screwdriver or 7 mm (9/32 in.) socket wrench. Tighten until the screws bottom out on the housing. See FIG. 8.
3. Install an o-ring (17†) on each pilot pin (16). Grease the pins and o-rings. Insert the pins into the bearings (15), **narrow** end first. See FIG. 7.
4. Install a u-cup packing (10†) on each actuator piston (11), so the lips of the packings face the **narrow** end of the pistons. See FIG. 7.
5. Lubricate the u-cup packings (10†) and actuator pistons (11). Insert the actuator pistons in the bearings (12), **wide** end first. Leave the narrow end of the pistons exposed. See FIG. 7.
6. Grease the lower face of the pilot block (18†) and install so its tabs snap into the grooves on the ends of the pilot pins (16). See FIG. 6.
7. Grease the o-ring (6†) and install it in the valve block (7†). Push the block onto the valve carriage (5). Grease the lower face of the valve block. See FIG. 6.
8. Install the valve carriage (5) so its tabs slip into the grooves on the narrow end of the actuator pistons (11). See FIG. 6.
9. Align the valve gasket (4†) and cover (2) with the six holes in the center housing (1). Secure with six screws (3†), using a Torx (T20) screwdriver or 7 mm (9/32 in.) socket wrench. Torque to 52-60 in-lb (5.6-6.8 N•m). See FIG. 5.

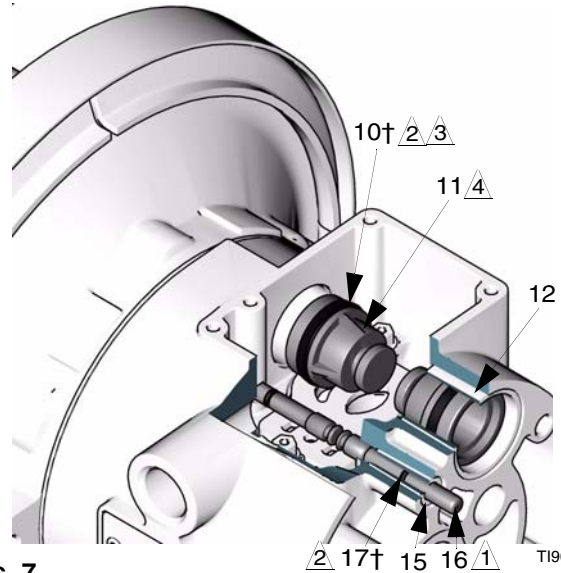
- 2 Torque to 52-60 in-lb
(5.6-6.8 N•m)



TI9086A

FIG. 5

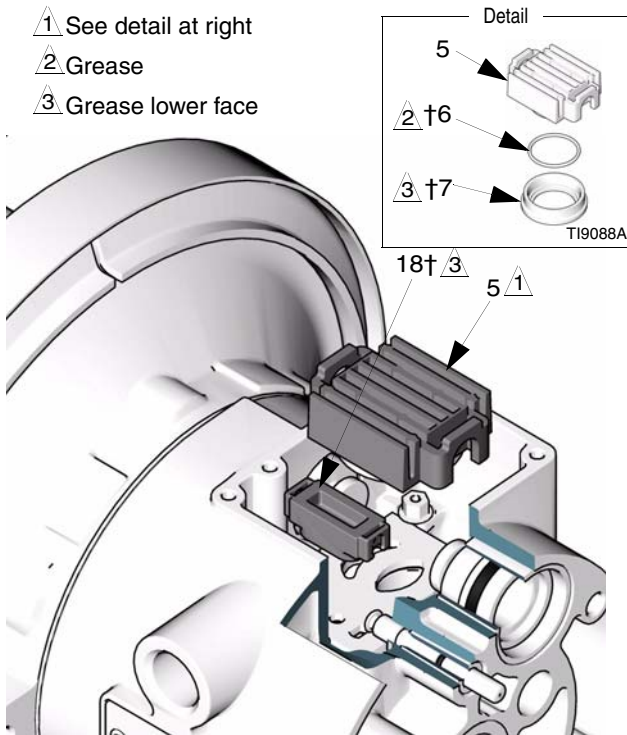
- 1 Insert narrow end first
2 Grease
3 Install with lips facing narrow end of piston (11)
4 Insert wide end first



TI9089A

FIG. 7

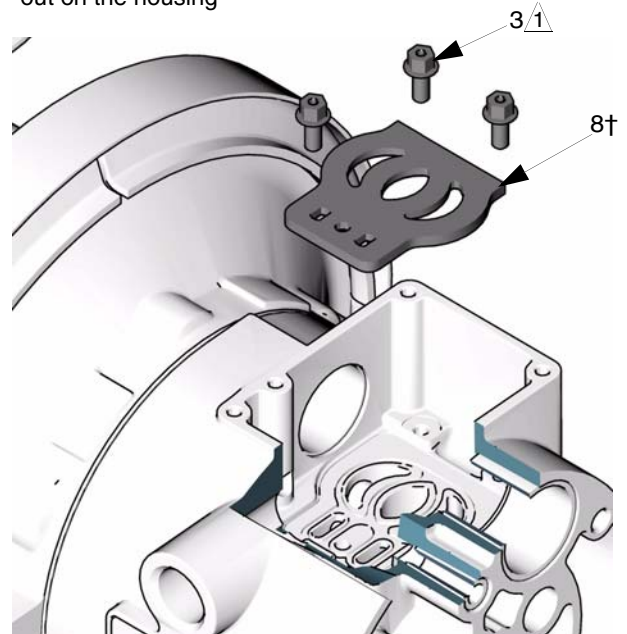
- 1 See detail at right
2 Grease
3 Grease lower face



TI9087A

FIG. 6

- 1 Tighten screws until they bottom out on the housing



TI9090A

FIG. 8

Ball Check Valve Repair

Tools Required

- O-ring pick

Disassembly

- A Fluid Section Repair Kit is available. Refer to the Repair Kit Matrix parts section for the appropriate pump size so that the correct kit for your pump is ordered. Parts included in the kit are marked with an asterisk, for example (202*). Use all the parts in the kit for the best results.
- To ensure proper seating of the balls (301), always inspect the seats (201) when replacing the balls. Replace seats as necessary if seating surface shows evidence of wear. Also, replace the o-rings (202) as necessary. PTFE o-rings should be replaced every time manifolds are removed.

To reduce the risk of serious injury, whenever you are instructed to relieve pressure, always follow the Pressure Relief Procedure on page 11.						

1. Relieve the pressure. Disconnect all hoses.
2. Remove the pump from its mounting.
3. Remove the clamps (106) holding the outlet manifold (103) to the fluid covers (101). See FIG. 9.
4. Remove the o-rings (202), seats (201), and balls (301) from the manifold (103).
5. Turn the pump over and remove the inlet manifold (102). Remove the o-rings (202), seats (201), and balls (301) from the fluid covers (101).

Reassembly

1. Clean all parts and inspect for wear or damage. Replace parts as needed.
2. Reassemble in the reverse order, following all notes in FIG. 9. Be sure the ball checks and manifolds are assembled **exactly** as shown. The arrows (A) on the fluid covers (101) **must** point toward the outlet manifold (103).

- 1 Arrow (A) must point toward outlet manifold (103)
- 2 Radiused seating surface must face the ball (301). Large chamfer on O.D. must face o-ring.

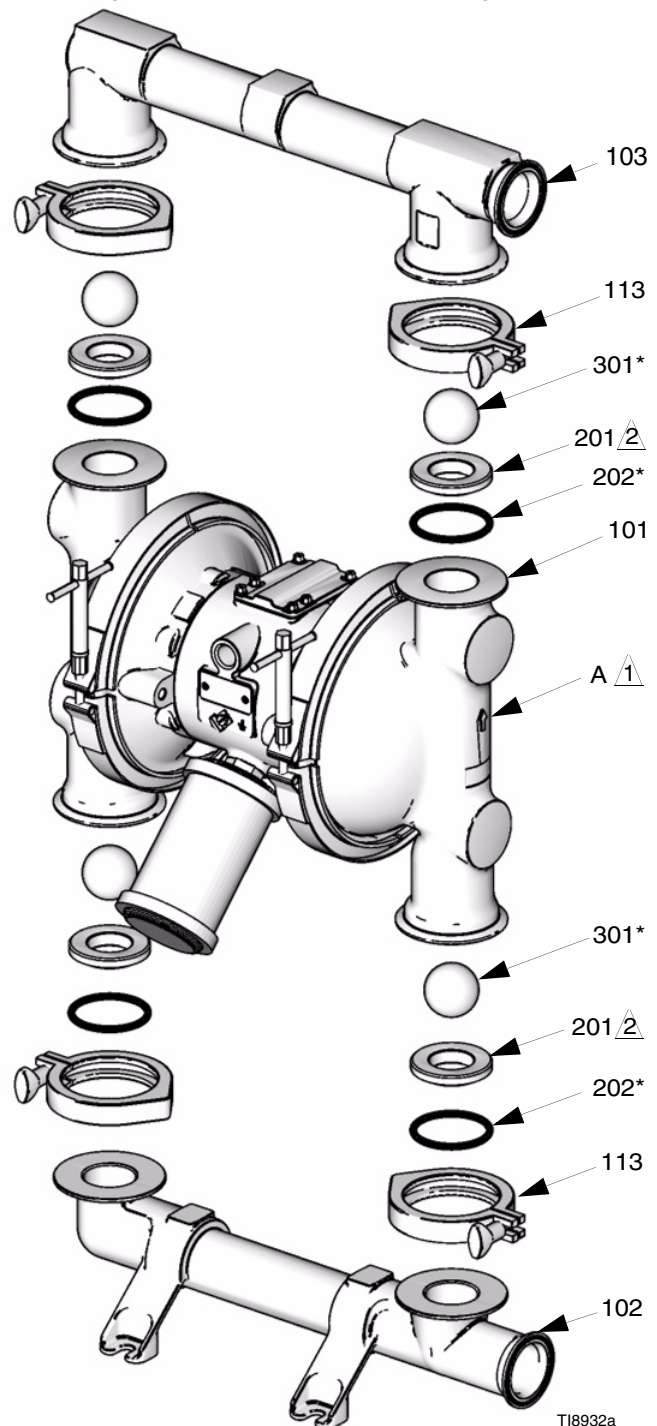



FIG. 9


Standard Diaphragm Repair



 If your pump uses heavy-duty diaphragms, see page 22.

Tools Required

- Torque wrench
- 15 mm socket wrench
- 19 mm open end wrench
- O-ring pick
- Lithium-base grease

Disassembly

 A Fluid Section Repair Kit is available. Refer to page 27, 35, or 43 to order the correct kit for your pump. Parts included in the kit are marked with an asterisk, for example (401*). Use all the parts in the kit for the best results.

						
To reduce the risk of serious injury, whenever you are instructed to relieve pressure, always follow the Pressure Relief Procedure on page 11.						

1. Relieve the pressure.
2. Remove the manifolds and disassemble the ball check valves as explained on page 18.
3. Remove the clamps (106) holding the fluid covers (101) to the air covers (23). Pull the fluid covers (101) off the pump. See FIG. 10.

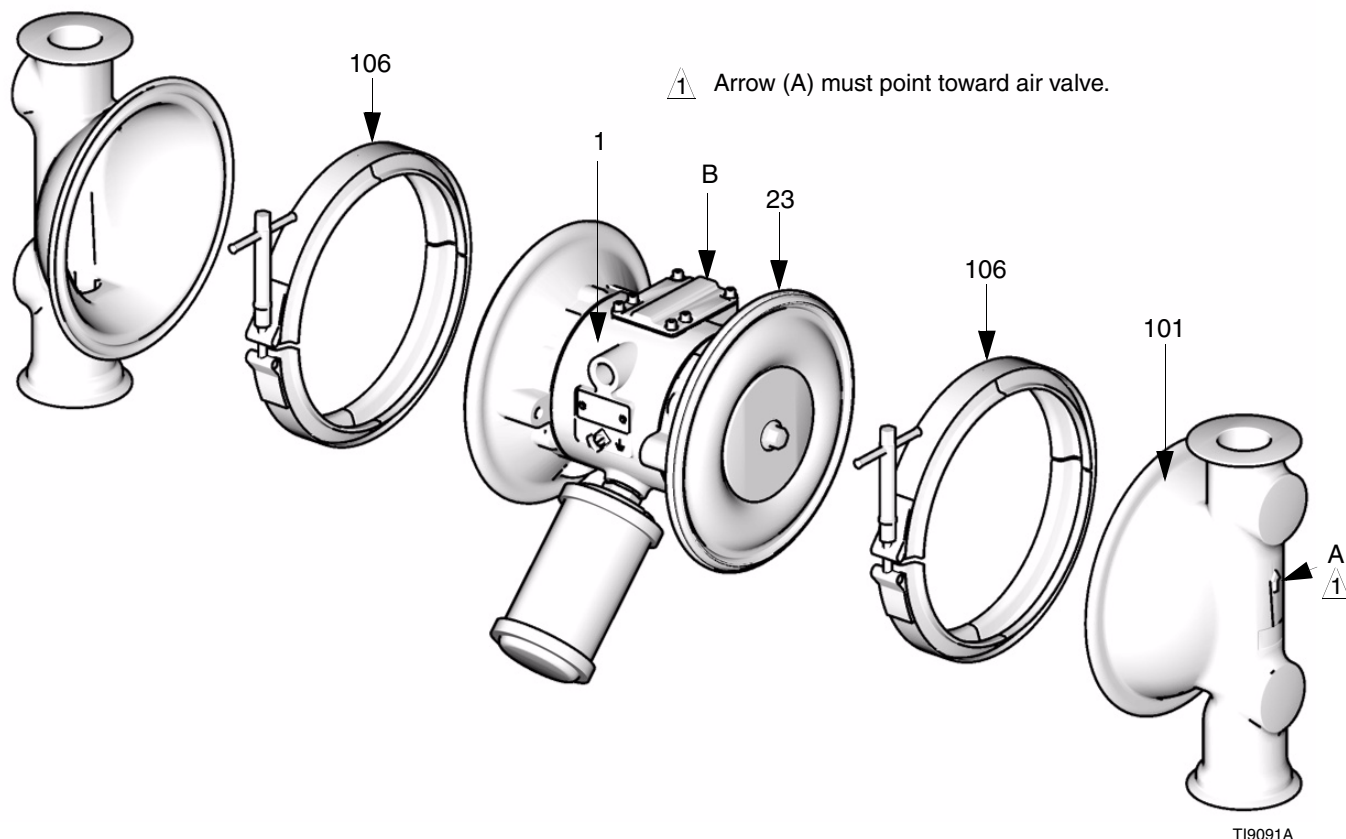


FIG. 10

4. Loosen but do not remove the diaphragm shaft bolts (107), using a 15 mm socket wrench on both bolts. See FIG. 11.
5. Unscrew one bolt from the diaphragm shaft (24) and remove the o-ring (108), fluid side diaphragm plate (105), diaphragm (403), backer (401) used only on PTFE models, and air side diaphragm plate (104). See FIG. 11.
6. Pull the other diaphragm assembly and the diaphragm shaft (24) out of the center housing (1). Hold the shaft flats with a 19 mm open end wrench, and remove the bolt (107) from the shaft. Disassemble the remaining diaphragm assembly.
7. Inspect the diaphragm shaft (24) for wear or scratches. If it is damaged, inspect the bearings (19) in place. If the bearings are damaged, refer to page 24.
8. Reach into the center housing (1) with an o-ring pick and hook the u-cup packings (402), then pull them out of the housing. This can be done with the bearings (19) in place.
9. Clean all parts and inspect for wear or damage. Replace parts as needed.
- d. On PTFE models only, install the backer (401*) on the bolt. Make certain the side marked AIR SIDE faces the center housing (1).
- e. Install the air side diaphragm plate (104) so the rounded side faces the diaphragm (401). This plate is stamped with its part number.
- f. Apply medium-strength (blue) Loctite® or equivalent to the bolt (107) threads. Screw the bolt into the shaft (24) hand tight.
3. Grease the length and ends of the diaphragm shaft (24), and slide it through the housing (1).
4. Assemble the other diaphragm assembly to the shaft as explained in step 2.
5. Hold one shaft bolt (107) with a wrench and torque the other bolt to 60-70 ft-lb (81-95 N•m) at 100 rpm maximum.
6. Align the fluid covers (101) and the center housing (1) so the arrows (A) on the covers face the same direction as the air valve (B). Secure covers with the clamps. See FIG. 10.
7. Reassemble the ball check valves and manifolds as explained on page 18.

Reassembly

1. Install the shaft u-cup packings (402*) so the lips face **out** of the housing (1). Lubricate the packings. See FIG. 11.
2. Install the diaphragm assembly on one end of the shaft (24) as follows:
 - a. Install the o-ring (108*) on the shaft bolt (107).
 - b. Install the fluid side diaphragm plate (105) on the bolt so the rounded side faces the diaphragm (401).



The fluid side diaphragm plate (105) is stainless steel. This plate **is not** stamped with its part number. Be sure to install this plate on the fluid side of the diaphragm.

- c. Install the diaphragm (403*). Make certain the side marked AIR SIDE faces the center housing (1).

Cutaway view, with
diaphragms in place

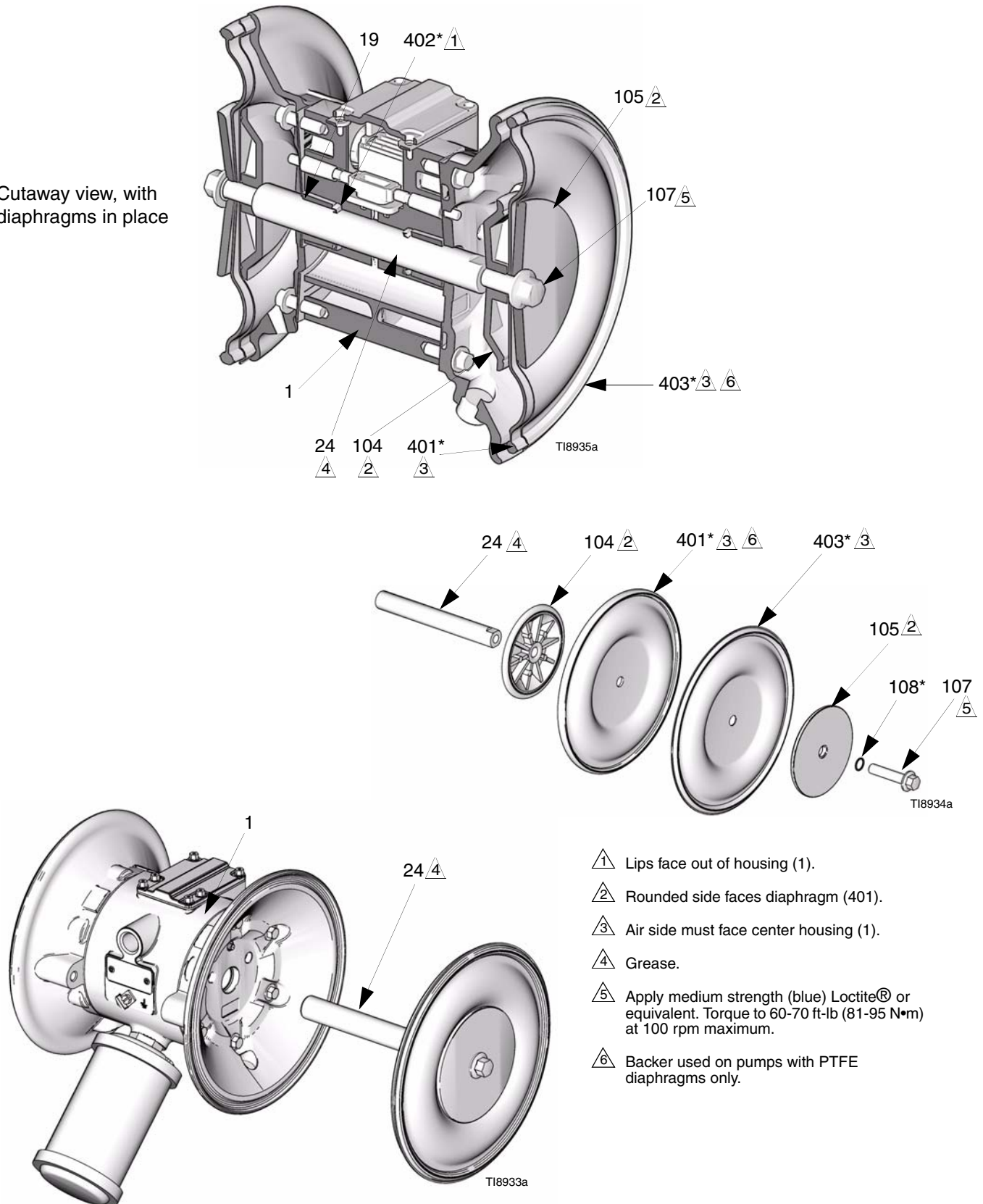


FIG. 11

Heavy-Duty Diaphragm Repair



If your pump uses standard diaphragms, see page 19.

Tools Required

- Torque wrench
- 19 mm open end wrench
- O-ring pick
- Lithium-base grease

Disassembly



A Fluid Section Repair Kit is available. Refer to page 27, 35, or 43 to order the correct kit for your pump. Parts included in the kit are marked with an asterisk, for example (401*). Use all the parts in the kit for the best results.



To reduce the risk of serious injury, whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 11.

1. Relieve the pressure.
2. Remove the manifolds and disassemble the ball check valves as explained on page 18.
3. Remove the clamps (106) holding the fluid covers (101) to the air covers (23). Pull the fluid covers (101) off the pump. See FIG. 12.
4. Once the fluid covers are removed, the diaphragm on the side of the pump which was last pressurized with air will be separated from the center section/air cover. This allows you to grip the diaphragms.
5. Diaphragms are assembled handtight. To loosen, grip both diaphragms securely around the outer edge and rotate counterclockwise. One diaphragm assembly will come free and the other will remain attached to the shaft. Remove the freed diaphragm (403) and air side plate (104).
6. Pull the opposite diaphragm assembly and shaft (24) out of the center housing (1). Hold the shaft flats with a 19 mm open end wrench and remove the diaphragm and air side plate from the shaft.
7. Inspect the diaphragm shaft (24) for wear or scratches. If it is damaged, inspect the bearings (19)

in place. If the bearings are damaged, refer to page 24.

8. Reach into the center housing (1) with an o-ring pick and hook the u-cup packings (402), then pull them out of the housing. This can be done with the bearings (19) in place.
9. Clean all parts and inspect for wear or damage. Replace parts as needed.

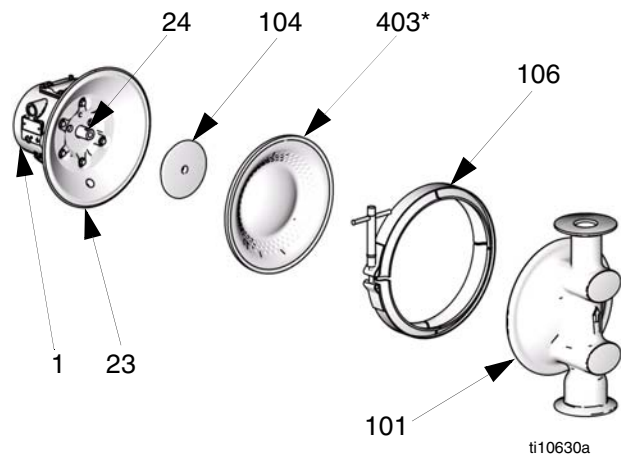
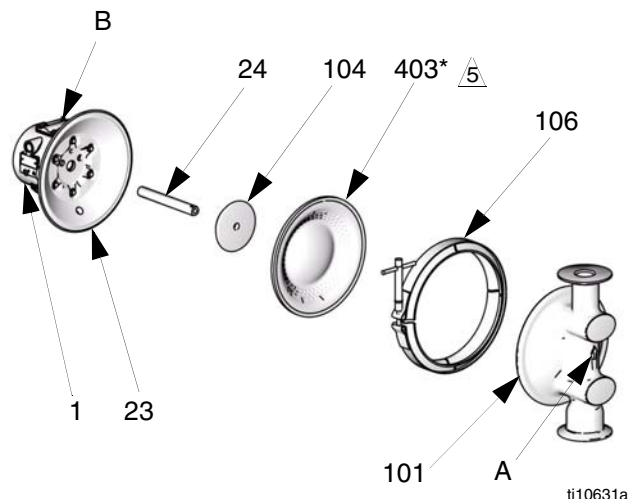


FIG. 12

Reassembly

1. Install the shaft u-cup packings (402*) so the lips face **out** of the housing (1). Lubricate the packings. See FIG. 13.
2. Assemble the air side plate (104) onto the diaphragm (403). The wide, radiused side of the plate must face the diaphragm. Apply medium-strength (blue) Loctite® or equivalent to the threads of the diaphragm assembly. Screw the assembly into the shaft (24) hand tight.
3. Grease the length and ends of the diaphragm shaft (24). Determine the orientation of the air valve by checking which side the pilot pins (16) protrude farthest (see FIG. 14). This side will be supplied with air first. Insert the shaft/diaphragm assembly into this side of the pump. Assemble the fluid cover (101) and clamp (106) so the arrow (A) on the cover faces the same direction as the air valve (B). Securely tighten the clamp.
4. Assemble the other diaphragm assembly to the shaft as explained in step 2. This diaphragm will be lifted off the air cover at this point.
5. Set the other fluid cover (101) in place on the diaphragm, so the arrow (A) on the cover faces the same direction as the air valve (B). Supply the pump with low pressure air (less than 7 psi [.05 MPa, 0.5 bar]). The diaphragm will very slowly pull onto the air cover (23). You can support the movement with your hand by gently pushing on the fluid cover (101).




 Apply medium strength (blue) Loctite® or equivalent to bolt (not shown).

FIG. 13

CAUTION

Do not deform the diaphragm manually. The diaphragm needs uniform pressure to deform properly.

6. Assemble the fluid cover (101) and clamp (106) so the arrow (A) on the cover faces the same direction as the air valve (B). Securely tighten the clamp.
7. Reassemble the ball check valves and manifolds as explained on page 18.

Bearing and Air Gasket Removal

Tools Required

- Torque wrench
- 10 mm socket wrench
- Bearing puller
- O-ring pick
- Press, or block and mallet

Disassembly



Do not remove undamaged bearings.



To reduce the risk of serious injury, whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 11.

1. Relieve the pressure.
2. Remove the manifolds and disassemble the ball check valves as explained on page 18.
3. Remove the fluid covers and diaphragm assemblies as explained on page 19.
4. Disassemble the air valve as explained on page 16.
5. Using a 10 mm socket wrench, remove the screws (25) holding the air covers (23) to the center housing (1). See FIG. 14.
6. Remove the air cover gaskets (22). Always replace the gaskets with new ones.
7. Use a bearing puller to remove the diaphragm shaft bearings (19), air valve bearings (12) or pilot pin bearings (15). Do not remove undamaged bearings.
8. If you removed the diaphragm shaft bearings (19) reach into the center housing (1) with an o-ring pick and hook the u-cup packings (402), then pull them out of the housing. Inspect the packings. See FIG. 11.
2. The bearings (12, 15, and 19) are tapered and can only be installed one way. Insert the bearings into the center housing (1), **tapered end first**. Using a press or a block and rubber mallet, press-fit the bearing so it is flush with the surface of the center housing.
3. Reassemble the air valve as explained on page 16.
4. Align the new air cover gasket (22) so the pilot pin (16) protruding from the center housing (1) fits through the proper hole (H) in the gasket.
5. Align the air cover (23) so the pilot pin (16) fits in the middle hole (M) of the three small holes near the center of the cover. Install the screws (25), handtight. Apply medium-strength (blue) Loctite® or equivalent to the threads of the screws (25). See FIG. 14. Using a 10 mm socket wrench, torque the screws oppositely and evenly to 130-150 in-lb (15-17 N•m).
6. Install the diaphragm assemblies and fluid covers as explained on page 19.
7. Reassemble the ball check valves and manifolds as explained on page 18.



If you are removing only the diaphragm shaft bearing (19), skip step 4.

Reassembly

1. If removed, install the shaft u-cup packings (402*) so the lips face **out** of the housing (1). See FIG. 11.

- 1 Insert bearings tapered end first
- 2 Press-fit bearings flush with surface of center housing (1)
- 3 Apply medium strength (blue) Loctite® or equivalent.
Torque to 130-150 in-lb (15-17 N•m)

Detail of air valve bearings

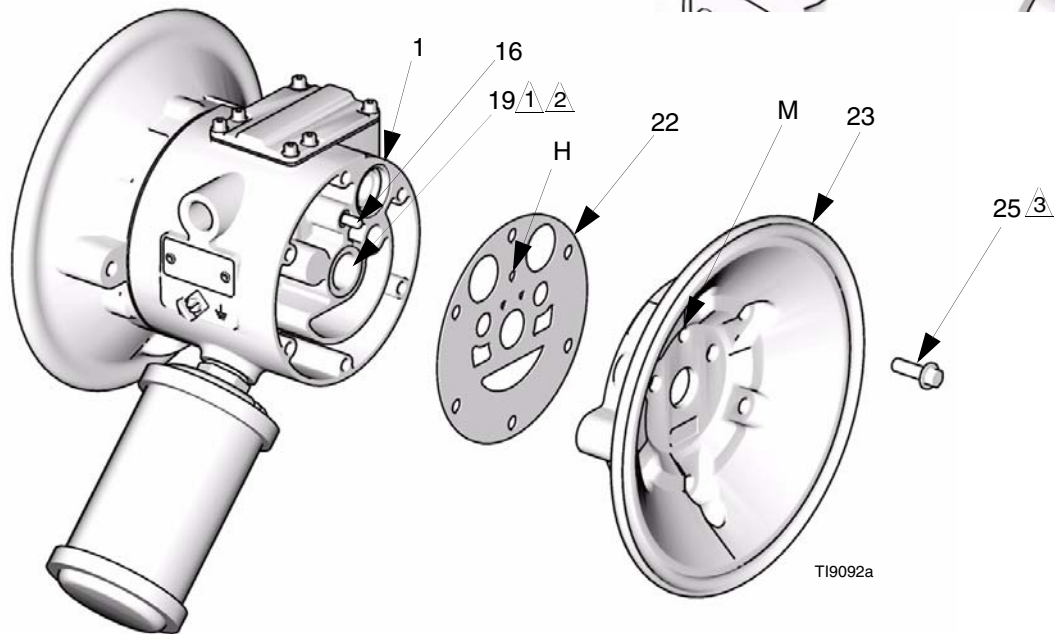
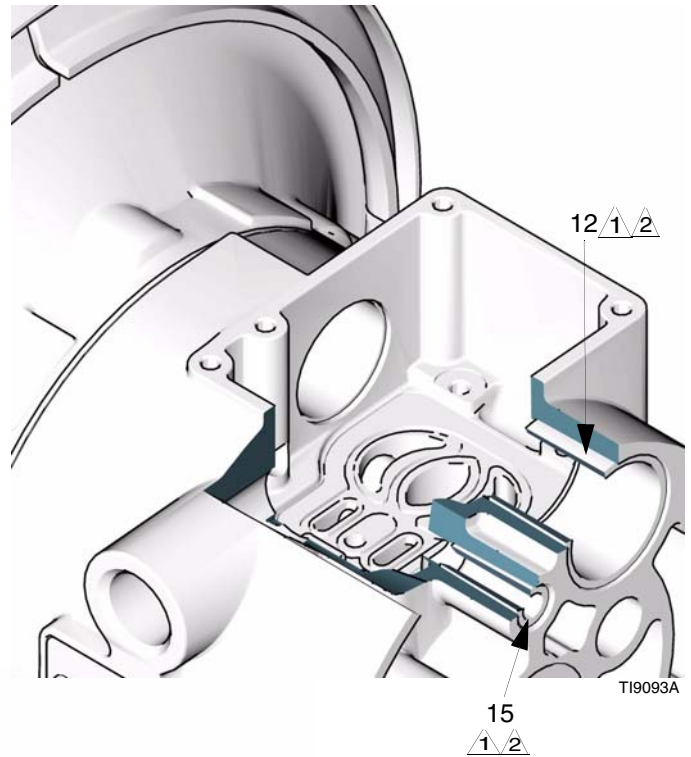


FIG. 14

Pump Matrix - 1040

1040 FDA-Compliant Stainless Steel Sanitary Pumps

Your Model No. is marked on the pump's serial plate. To determine the Model No. of your pump from the following matrix, select the six digits which describe your pump, working from left to right. The first three digits are always FD1, designating 1040 SST FDA-compliant pumps. The remaining three digits define the materials of construction. For example, a 1040 FDA pump with

PTFE o-rings, stainless steel seats, PTFE balls, and PTFE diaphragms is Model **FD1111**. To order replacement parts, refer to the part lists on pages 29-30.

*The digits in the matrix **do not** correspond to the reference numbers in the parts drawings and parts lists.*

FDA- Compliant Diaphragm Pump	1040 Stainless Steel Air Motor	Stainless Steel Fluid Section	Seats and O-rings	Balls	Diaphragms
FD1 - All 1040 Stainless Steel FDA-Compliant pumps.			1 (316 SST with PTFE o-rings)	1 (PTFE)	1 (PTFE)
			2 (316 SST with EPDM o-rings)	2 (Santoprene®)	2 (Santoprene®)
				3 (Neoprene with SST core)	3 (PTFE Heavy-Duty)

Available Configurations

- **FD1111**
- **FD1122**
- **FD1211**
- **FD1222**
- **FD1113**
- **FD1213**
- **FD1132**
- **FD1232**

Repair Kit Matrix - 1040

For 1040 Stainless Steel Sanitary Pumps

Repair Kits may be ordered separately. To repair the air valve, order **Part No. 255061** (see page 28). Parts included in the Air Valve Repair Kit are marked with a symbol in the parts list, for example (4†).

To repair your pump, select the six digits which describe your pump from the following matrix, working from left to right. The first three digits are always FK1. The remain-

ing three digits define the materials of construction.

Parts included in the kit are marked with an asterisk in the parts list, for example (201*). For example, if your pump has stainless steel seats, PTFE o-rings, PTFE balls, and PTFE diaphragms, order Repair Kit **FK1111**.

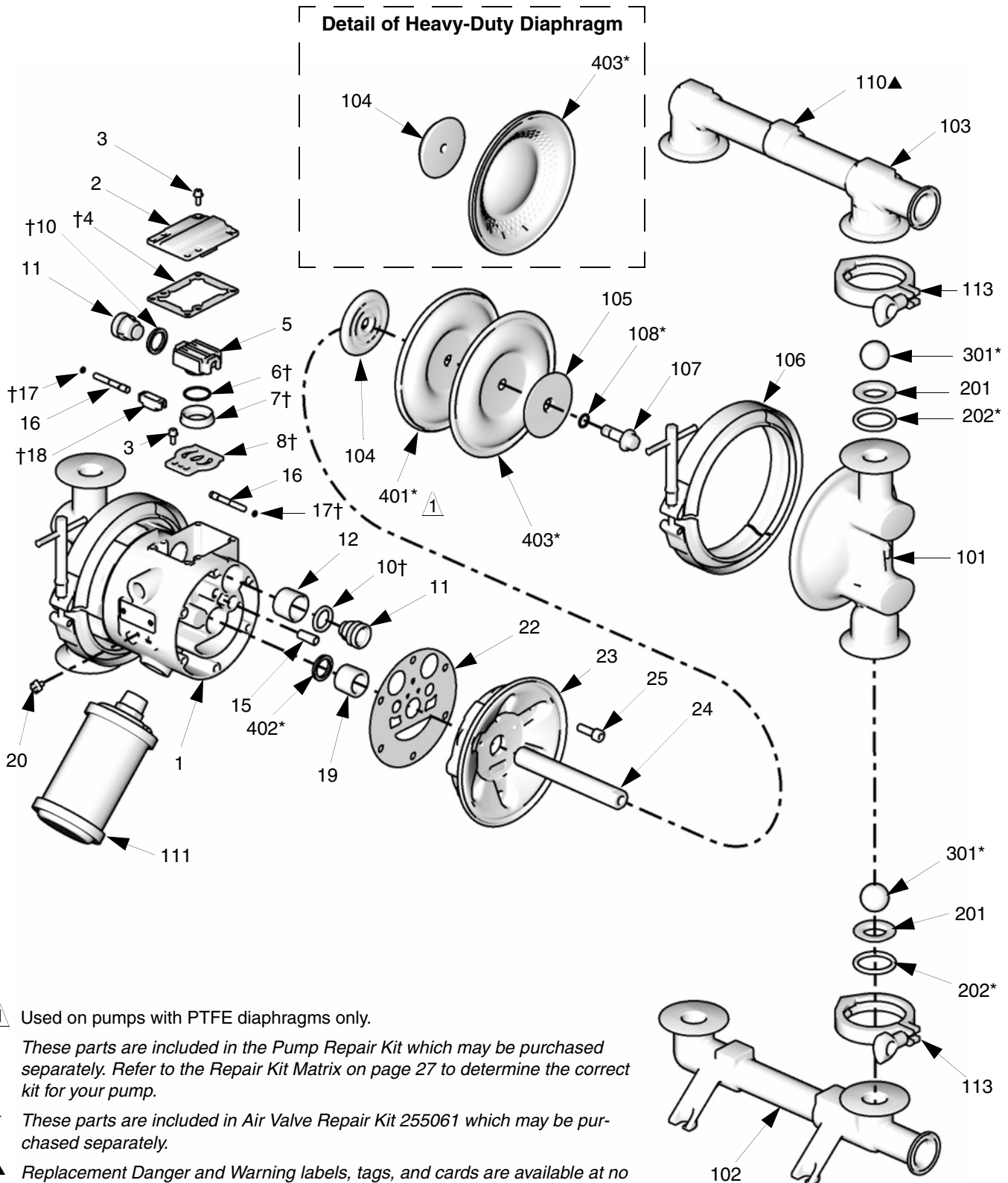
*The digits in the matrix **do not** correspond to the reference numbers in the parts drawings and parts lists.*

Diaphragm Pump	Null	Pump Size	Seats and O-rings	Balls	Diaphragms
FK1 for all 1040 SST FDA-Compliant Pumps.			1 (316 SST with PTFE o-rings)	1 (PTFE) white	1 (PTFE) white
			2 (316 SST with EPDM o-rings)	2 (Santoprene®) blue	2 (Santoprene®) blue
				3 (Neoprene with SST core)	3 (PTFE Heavy-Duty)

Available Configurations

- FK1111
- FK1122
- FK1211
- FK1222
- FK1113
- FK1213
- FK1132
- FK1232

Parts - 1040



TI10634a

Air Motor Parts List (Matrix Column 2)

Ref.	Part No.	Description	Qty
1	15K009	HOUSING, center; SST	1
2	15A735	COVER, air valve; SST	1
3	116344	SCREW, mach, hex flange hd; M5 x 0.8; 12 mm (0.47 in.)	9
4†	188618	GASKET, cover	1
5	188855	CARRIAGE; aluminum	1
6†	108730	O-RING; nitrile	1
7†	188616	BLOCK, air valve; acetal	1
8†	15H178	PLATE, air valve; SST	1
10†	112181	PACKING, u-cup; nitrile	2
11	188612	PISTON, actuator; acetal	2
12	188613	BEARING, piston; acetal	2
15	188611	BEARING, pin; acetal	2
16	188610	PIN, pilot; SST	2
17†	157628	O-RING; buna-N	2
18†	188614	BLOCK, pilot; acetal	1
19	188609	BEARING, shaft; acetal	2
20	116344	SCREW, grounding	1
22	188603	GASKET, air cover; foam	2
23	15G667	COVER, air, SST	2
24	188608	SHAFT, diaphragm; SST	1
25	112178	SCREW; M8 x 1.25; 25 mm (1 in.); stainless steel	12

† These parts are included in Air Valve Repair kit 255061 which may be purchased separately.

Fluid Section Parts List (Matrix Column 3)

Ref.	Part No.	Description	Qty
101	277262	COVER, fluid; SST	2
102	277265	MANIFOLD, inlet; SST	1
103	277266	MANIFOLD, outlet; SST	1
106	15G698	CLAMP, diaphragm	2
110▲	188621	LABEL, warning	1
111	15G332	MUFFLER	1
113	620223	CLAMPS, sanitary	4

* These parts are included in the Pump Repair Kit which may be purchased separately. Refer to the Repair Kit Matrix on page 27 to determine the correct kit for your pump.

▲Replacement Danger and Warning labels, tags, and cards are available at no cost.

Seat Parts List (Matrix Column 4)

Digit	Ref.	Part No.	Description	Qty
1	201	15H824	SEAT; 316 SST	4
	202*	15J280	O-RING; PTFE	4
2	201	15H824	SEAT; 316 SST	4
	202*	15H827	O-RING; EPDM	4

Ball Parts List (Matrix Column 5)

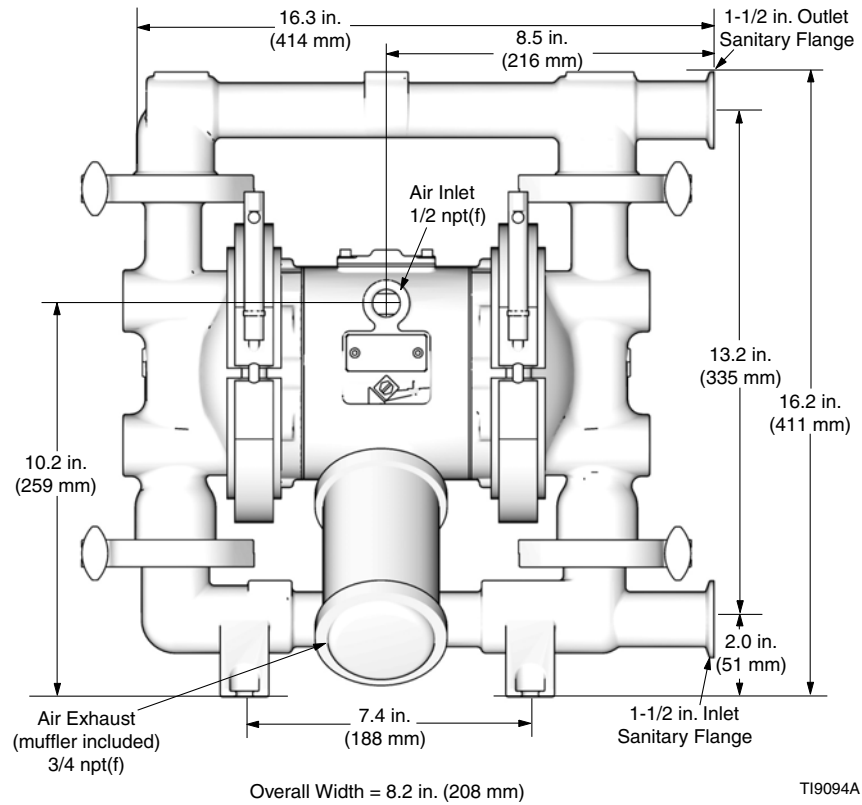
Digit	Ref.	Part No.	Description	Qty
1	301*	112088	BALL; PTFE	4
2	301*	112092	BALL; Santoprene®	4
3	301*	15H832	BALL; neoprene/SST core	4

Diaphragm Parts List (Matrix Column 6)

Digit	Ref.	Part No.	Description	Qty
1	401*		DIAPHRAGM; backer; EPDM	2
	402*	112181	PACKING; u-cup; nitrile	2
	403*	188605	DIAPHRAGM; PTFE	2
	104	188607	PLATE, air side; aluminum	2
	105	15C039	PLATE, fluid side; SST	2
	107	189044	BOLT; M12 x 1.75; 35 mm (1.38 in.); SST	2
	108*	104319	O-RING; PTFE	2
2	402*	112181	PACKING; u-cup; nitrile	2
	403*	188857	DIAPHRAGM; Santoprene	2
	104	188607	PLATE, air side; aluminum	2
	105	15C039	PLATE, fluid side; SST	2
	107	189044	BOLT; M12 x 1.75; 35 mm (1.38 in.); SST	2
3	108*	104319	O-RING; PTFE	2
	289224 Kit, heavy-duty diaphragm, PTFE; includes 403 and 104			
	402*	112181	PACKING; u-cup; nitrile	2
	403*	253626	DIAPHRAGM; Heavy-Duty; PTFE; includes two diaphragms and two packings (402)	1
	104	15H809	PLATE, air side; aluminum	2

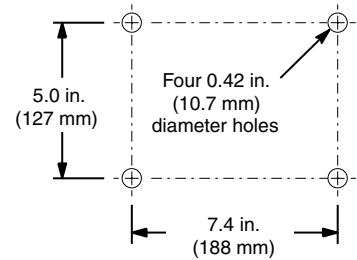
* These parts are included in the Pump Repair Kit which may be purchased separately. Refer to the Repair Kit Matrix on page 27 to determine the correct kit for your pump.

Dimensional Drawing - 1040



TI9094A

Pump Mounting Hole Pattern



1040 FDA

Technical Data - 1040

Maximum fluid working pressure	120 psi (0.8 MPa, 8 bar)
Air pressure operating range	20-120 psi (0.14-0.8 MPa, 1.4-8 bar)
Maximum air consumption	50 scfm
Air consumption at 70 psi/20 gpm	18 scfm (see chart)
Maximum free-flow delivery	41 gpm (159 l/min)
Maximum pump speed	256 cpm
* Gallons (Liters) per cycle	0.16 (0.57)
Maximum suction lift	29 ft (8.83 m) wet, 16 ft (4.87 m) dry
Maximum size pumpable solids	1/8 in. (3.2 mm)
** Maximum Noise Level at 100 psi, full flow	92 dBa
** Sound Power Level	100 dBa
** Noise Level at 70 psi and 50 cpm	73 dBa

Maximum fluid operating temperature is based on the following maximum diaphragm, ball, and seat temperature ratings.	PTFE 220°F (104.4°C)
	Santoprene® 180°F (82.2°C)
	EPDM 275°F (135°C)
	Neoprene 200°F (93°C)
	Stainless steel 250°F (121.1°C)

Air inlet size	0.5 in. npt(f)
Fluid inlet size	1.5 in. sanitary flange
Fluid outlet size	1.5 in. sanitary flange

Wetted parts

***All fluid contact materials are FDA-compliant and meet the United States Code of Federal Regulations (CFR) Title 21, Section 177.

Wetted materials on all models	316 SST
Wetted material depending on model	EPDM, Neoprene, PTFE, Santoprene®

CAUTION:

Santoprene® may be used only with non-fatty, non-oily foods or alcohols up to 15%.

Non-wetted external parts	300 series stainless steel, polyester (labels), LDPE foam (gasket)
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Weight

All models	55 lb. (24.9 kg)
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Santoprene® is a registered trademark of the Monsanto Co.

Loctite® is a registered trademark of the Loctite Corporation.

* *Displacement per cycle may vary based on suction condition, discharge head, air pressure, and fluid type.*

** *Noise levels measured with the pump mounted to a solid surface. Sound power measured per ISO Standard 9614-1.*

*** *The pump user must verify that the construction materials meet their specific application requirements.*

Performance Chart - 1040

Test Conditions: Pump tested in water with inlet submerged

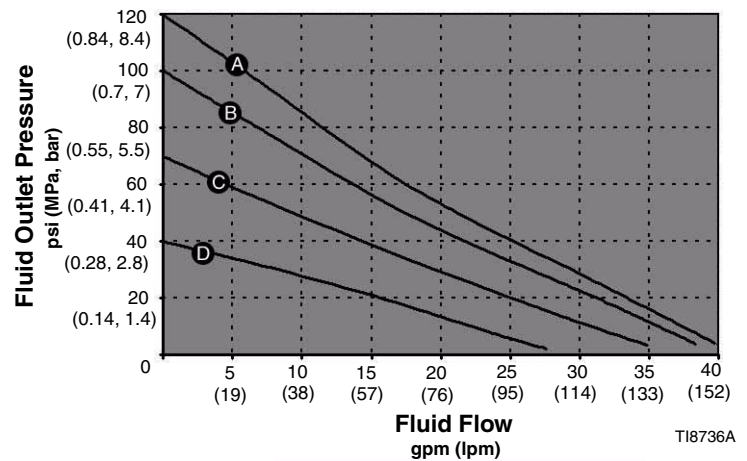
Fluid Pressure Curves

- A** at 120 psi (0.7 MPa, 7 bar) operating air pressure
- B** at 100 psi (0.7 MPa, 7 bar) operating air pressure
- C** at 70 psi (0.48 MPa, 4.8 bar) operating air pressure
- D** at 40 psi (0.28 MPa, 2.8 bar) operating air pressure

To find Fluid Outlet Pressure

(psi/MPa/bar) at a specific fluid flow (gpm/lpm) and operating air pressure (psi/MPa/bar):

1. Locate fluid flow rate along bottom of chart.
2. Follow vertical line up to intersection with selected operating air pressure curve.
3. Follow left to scale to read fluid outlet pressure.



AIR PRESSURES	
(A) =	@ 120 psi (8.4 bar, 0.84 MPa)
(B) =	@ 100 psi (7.0 bar, 0.7 MPa)
(C) =	@ 70 psi (4.8 bar, 0.5 MPa)
(D) =	@ 40 psi (2.8 bar, 0.3 MPa)

TI8742A

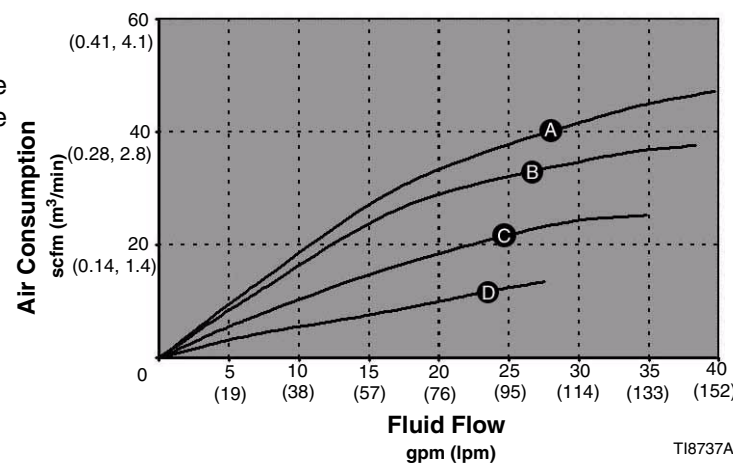
Air Consumption Curves

- A** at 120 psi (0.7 MPa, 7 bar) operating air pressure
- B** at 100 psi (0.7 MPa, 7 bar) operating air pressure
- C** at 70 psi (0.48 MPa, 4.8 bar) operating air pressure
- D** at 40 psi (0.28 MPa, 2.8 bar) operating air pressure

To find Pump Air Consumption

(scfm or m³/min) at a specific fluid flow (gpm/lpm) and operating air pressure (psi/MPa/bar):

1. Locate fluid flow rate along bottom of chart.
2. Read vertical line up to intersection with selected operating air pressure curve.
3. Follow left to scale to read air consumption.



AIR PRESSURES	
(A) =	@ 120 psi (8.4 bar, 0.84 MPa)
(B) =	@ 100 psi (7.0 bar, 0.7 MPa)
(C) =	@ 70 psi (4.8 bar, 0.5 MPa)
(D) =	@ 40 psi (2.8 bar, 0.3 MPa)

TI8742A

Pump Matrix - 1590

1590 FDA-Compliant Stainless Steel Sanitary Pumps

Your Model No. is marked on the pump's serial plate. To determine the Model No. of your pump from the following matrix, select the six digits which describe your pump, working from left to right. The first three digits are always FD2, designating 1590 SST FDA compliant diaphragm pumps. The remaining three digits define the materials of construction. For example, a 1590 FDA

pump with a stainless steel motor, stainless steel fluid section, stainless steel seats, PTFE o-rings, PTFE balls, and PTFE diaphragms is Model No. **FD2111**. To order replacement parts, refer to the part lists on pages 37-38.

*The digits in the matrix **do not** correspond to the reference numbers in the parts drawings and parts lists.*

FDA-Compliant Diaphragm Pump	1590 Stainless Steel Air Motor	Stainless Steel Fluid Section	Seats and O-rings	Balls	Diaphragms
FD2 - All 1590 Stainless Steel FDA-Compliant Pumps			1 (316 SST with PTFE o-rings)	1 (PTFE)	1 (PTFE)
			2 (316 SST with EPDM o-rings)	2 (Santoprene®)	2 (Santoprene®)
				3 (Neoprene with SST core)	3 (PTFE Heavy-Duty)

Available Configurations

- **FD2111**
- **FD2122**
- **FD2211**
- **FD2222**
- **FD2113**
- **FD2213**
- **FD2132**
- **FD2232**

Repair Kit Matrix - 1590

For 1590 Stainless Steel Sanitary Pumps

Repair Kits may be ordered separately. To repair the air valve, order **Part No. 255061** (see page 28). Parts included in the Air Valve Repair Kit are marked with a symbol in the parts list, for example (4†).

To repair your pump, select the six digits which describe your pump from the following matrix, working from left to right. The first three digits are always FK2. The remaining three digits define the materials of construction.

Parts included in the kit are marked with an asterisk in the parts list, for example (201*). For example, if your pump has stainless steel seats, PTFE o-rings, PTFE balls, and PTFE diaphragms, order Repair Kit **FK2111**.

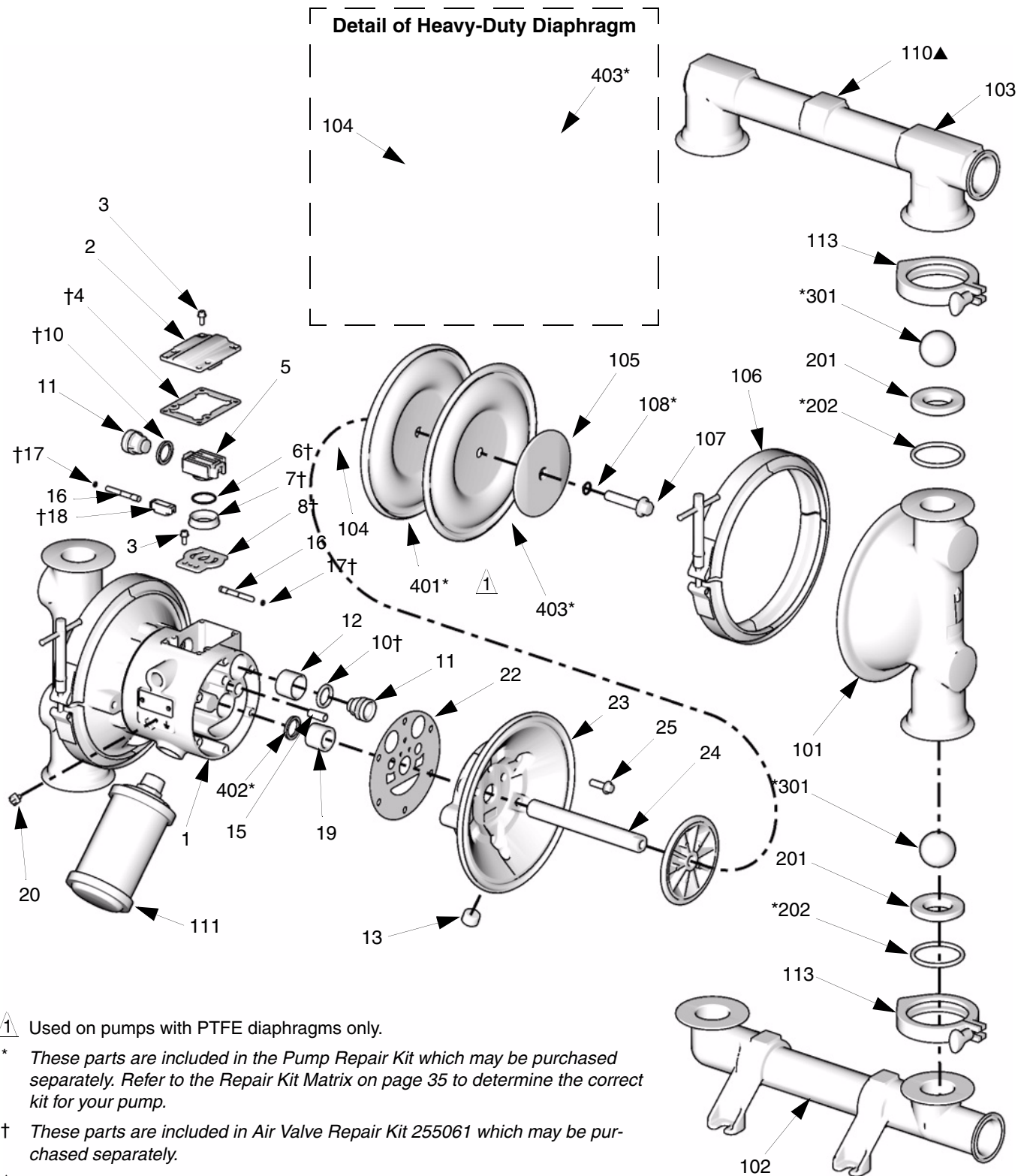
*The digits in the matrix **do not** correspond to the reference numbers in the parts drawings and parts lists.*

Diaphragm Pump	Null	Pump Size	Seats and O-rings	Balls	Diaphragms
FK2 - All 1590 SST FDA-Compliant Pumps			1 (316 SST with PTFE o-rings)	1 (PTFE) white	1 (PTFE) white
			2 (316 SST with EPDM o-rings)	2 (Santoprene®) blue	2 (Santoprene®) blue
				3 (Neoprene with SST core)	3 (PTFE Heavy-Duty)

Available Configurations

- **FK2111**
- **FK2122**
- **FK2211**
- **FK2222**
- **FK2113**
- **FK2213**
- **FK2132**
- **FK2232**

Parts - 1590



TI8927b

Air Motor Parts List (Matrix Column 2)

Ref.	Part No.	Description	Qty
1	15K009	HOUSING, center; SST	1
2	15A735	COVER, air valve; SST	1
3	116344	SCREW, mach, hex flange hd; M5 x 0.8; 12 mm (0.47 in.)	9
4†	188618	GASKET, cover;	1
5	188855	CARRIAGE; aluminum	1
6†	108730	O-RING; nitrile	1
7†	188616	BLOCK, air valve; acetal	1
8†	15H178	PLATE, air valve; SST	1
10†	112181	PACKING, u-cup; nitrile	2
11	188612	PISTON, actuator; acetal	2
12	188613	BEARING, piston; acetal	2
13	103778	PLUG, pipe	2
15	188611	BEARING, pin; acetal	2
16	188610	PIN, pilot; SST	2
17†	157628	O-RING; buna-N	2
18†	188614	BLOCK, pilot; acetal	1
19	188609	BEARING, shaft; acetal	2
20	116344	SCREW, grounding	1
22	188603	GASKET, air cover; foam	2
23	15G668	COVER, air; SST	2
24	189245	SHAFT, diaphragm; SST	1
25	112178	SCREW; M8 x 1.25; 25 mm (1 in.); stainless steel	12

† These parts are included in Air Valve Repair Kit 255061 which may be purchased separately.

Fluid Section Parts List (Matrix Column 3)

Digit	Ref.	Part No.	Description	Qty
S	101	277263	COVER, fluid; SST	2
	102	277267	MANIFOLD, inlet; SST	1
	103	277268	MANIFOLD, outlet; SST	1
	106	15G699	CLAMP, diaphragm	2
	110▲	188621	LABEL, warning	1
	111	15G332	MUFFLER	1
	113	15D475	CLAMP, sanitary	4

Seat Parts List (Matrix Column 4)

Digit	Ref.	Part No.	Description	Qty
1	201	15H825	SEAT; 316 stainless steel	4
	202*	15H830	O-RING; PTFE	4
2	201	15H825	SEAT; 316 stainless steel	4
	202*	15H828	O-RING; EPDM	4

* These parts are included in the Pump Repair Kit which may be purchased separately. Refer to the Repair Kit Matrix on page 35 to determine the correct kit for your pump.

▲ Replacement Danger and Warning labels, tags and cards are available at no cost.

Ball Parts List (Matrix Column 5)

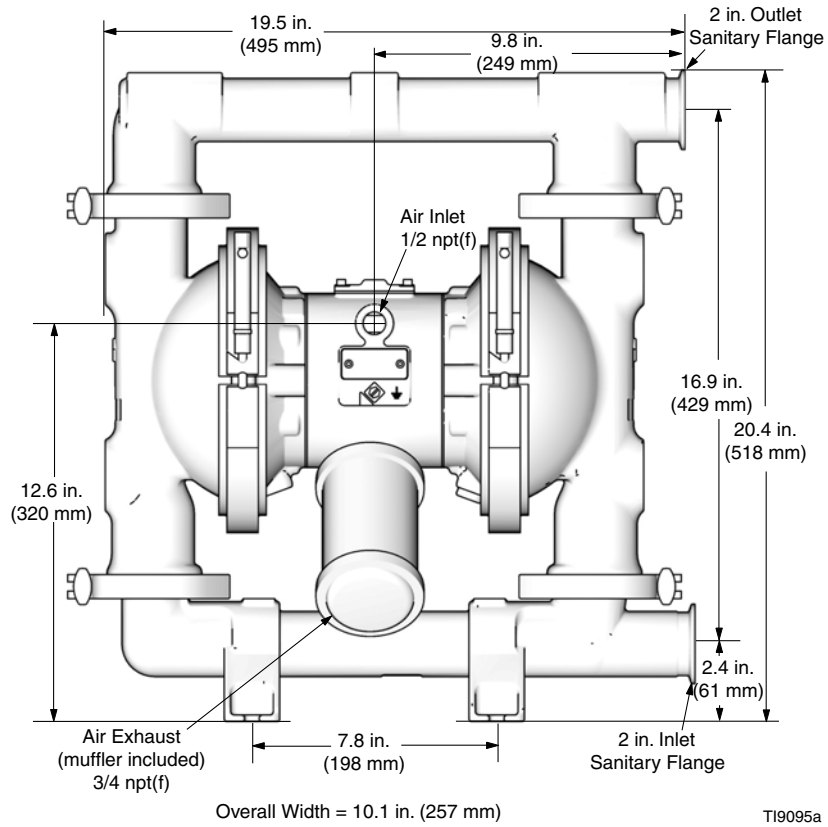
Digit	Ref.	Part No.	Description	Qty
1	301*	112419	BALL; PTFE	4
2	301*	112421	BALL; Santoprene®	4
3	301*	15H833	BALL; neoprene/SST core	4

Diaphragm Parts List (Matrix Column 6)

Digit	Ref.	Part No.	Description	Qty
1	401*		DIAPHRAGM; backer; EPDM	2
	402*	112181	PACKING; u-cup; nitrile	2
	403*	15K312	DIAPHRAGM; PTFE	2
	104	15K448	PLATE, air side; aluminum	2
	105	189309	PLATE, fluid side; SST	2
	107	189410	BOLT; M12 x 1.75; 35 mm (1.38 in.); SST	2
	108*	104319	O-RING; PTFE	2
2	402*	112181	PACKING; u-cup; nitrile	2
	403*	189426	DIAPHRAGM; Santoprene®	2
	104	15K448	PLATE, air side; aluminum	2
	105	189309	PLATE, fluid side; SST	2
	107	189410	BOLT; M12 x 1.75; 35 mm (1.38 in.); SST	2
	108*	104319	O-RING; PTFE	2
3	289225 Kit, heavy-duty diaphragm, PTFE; includes 403 and 104			
	402*	112181	PACKING; u-cup; nitrile	2
	403*	253627	DIAPHRAGM; Heavy-Duty; PTFE; includes two diaphragms and two packings (402)	1
	104	15H810	PLATE, air side; aluminum	2

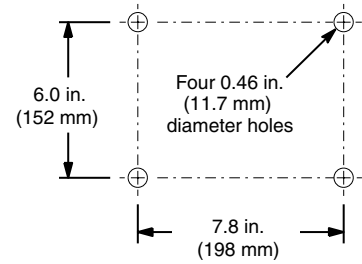
* These parts are included in the Pump Repair Kit which may be purchased separately. Refer to the Repair Kit Matrix on page 35 to determine the correct kit for your pump.

Dimensional Drawing - 1590



TI9095a

Pump Mounting Hole Pattern



1590 FDA

Technical Data - 1590

Maximum fluid working pressure	120 psi (0.8 MPa, 8 bar)
Air pressure operating range	20-120 psi (0.14-0.8 MPa, 1.4-8 bar)
Maximum air consumption	130 scfm
Air consumption at 70 psi/50 gpm	42 scfm (see chart)
Maximum free-flow delivery	100 gpm (379 l/min)
Maximum pump speed	200 cpm
* Gallons (Liters) per cycle	0.5 (1.9)
Maximum suction lift	29 ft (8.83 m) wet, 14 ft (4.26 m) dry
Maximum size pumpable solids	3/16 in. (4.8 mm)
** Maximum Noise Level at 100 psi, full flow	88 dBa
** Sound Power Level	95 dBa
** Noise Level at 70 psi and 50 cpm.	79 dBa

Maximum fluid operating temperature is based on the following maximum diaphragm, ball, and seat temperature ratings.	PTFE 220°F (104.4°C)
	Santoprene® 180°F (82.2°C)
	Neoprene 200°F (93°C)
	EPDM 275°F (135°C)
	Stainless steel 250°F (121.1°C)

Air inlet size	0.5 in. npt(f)
Fluid inlet size	2.0 in. Sanitary flange
Fluid outlet size	2.0 in. Sanitary flange

Wetted parts

***All fluid contact materials are FDA-compliant and meet the United States Code of Federal Regulations (CFR) Title 21, Section 177.

Wetted materials on all models	316 SST
Wetted material depending on model	EPDM, Neoprene, PTFE, Santoprene®

CAUTION:

Santoprene® may be used only with non-fatty, non-oily foods or alcohols up to 15%.

Non-wetted external parts	300 series stainless steel, polyester (labels), LDPE foam (gasket)
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Weight

All models	89 lb (40.3 kg)
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Santoprene® is a registered trademark of the Monsanto Co.

Loctite® is a registered trademark of the Loctite Corporation.

* *Displacement per cycle may vary based on suction condition, discharge head, air pressure, and fluid type.*

** *Noise levels measured with the pump mounted to a solid surface. Sound power measured per ISO Standard 9614-1.*

*** *The pump user must verify that the construction materials meet their specific application requirements.*

Performance Chart - 1590

Test Conditions: Pump tested in water with inlet submerged

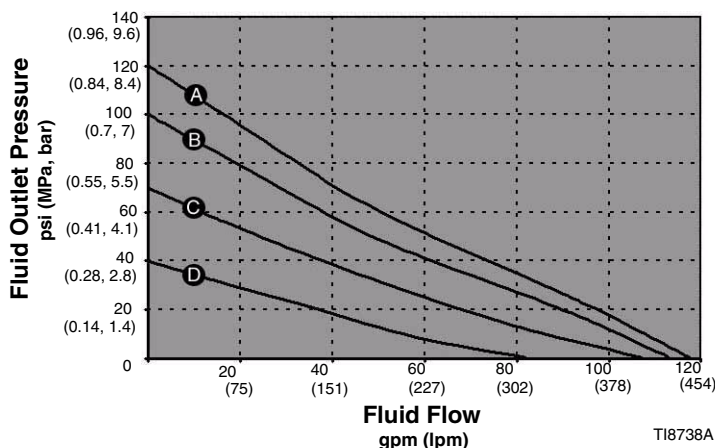
Fluid Pressure Curves

- A** at 120 psi (0.7 MPa, 7 bar) operating air pressure
- B** at 100 psi (0.7 MPa, 7 bar) operating air pressure
- C** at 70 psi (0.48 MPa, 4.8 bar) operating air pressure
- D** at 40 psi (0.28 MPa, 2.8 bar) operating air pressure

To find Fluid Outlet Pressure

(psi/MPa/bar) at a specific fluid flow (gpm/lpm) and operating air pressure (psi/MPa/bar):

1. Locate fluid flow rate along bottom of chart.
2. Follow vertical line up to intersection with selected operating air pressure curve.
3. Follow left to scale to read fluid outlet pressure.



TI8738A

AIR PRESSURES	
(A) =	@ 120 psi (8.4 bar, 0.84 MPa)
(B) =	@ 100 psi (7.0 bar, 0.7 MPa)
(C) =	@ 70 psi (4.8 bar, 0.5 MPa)
(D) =	@ 40 psi (2.8 bar, 0.3 MPa)

TI8742A

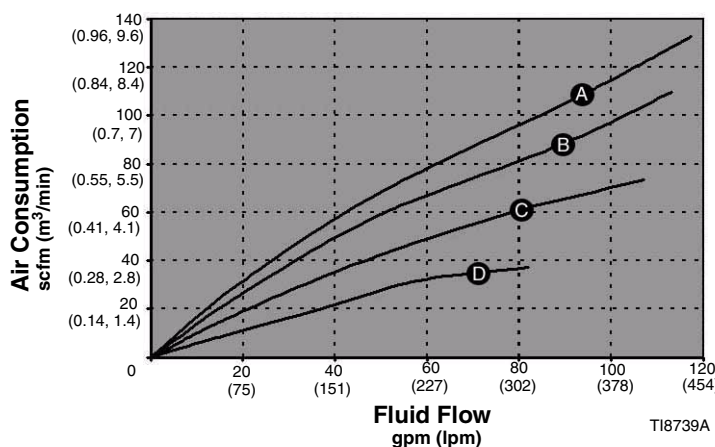
Air Consumption Curves

- A** at 120 psi (0.7 MPa, 7 bar) operating air pressure
- B** at 100 psi (0.7 MPa, 7 bar) operating air pressure
- C** at 70 psi (0.48 MPa, 4.8 bar) operating air pressure
- D** at 40 psi (0.28 MPa, 2.8 bar) operating air pressure

To find Pump Air Pressure

(scfm or m³/min) at a specific fluid flow (gpm/lpm) and operating air pressure (psi/MPa/bar):

1. Locate fluid flow rate along bottom of chart.
2. Read vertical line up to intersection with selected operating air pressure.
3. Follow left to scale to read air consumption.



TI8739A

AIR PRESSURES	
(A) =	@ 120 psi (8.4 bar, 0.84 MPa)
(B) =	@ 100 psi (7.0 bar, 0.7 MPa)
(C) =	@ 70 psi (4.8 bar, 0.5 MPa)
(D) =	@ 40 psi (2.8 bar, 0.3 MPa)

TI8742A

Pump Matrix - 2150

2150 FDA-Compliant Stainless Steel Sanitary Pumps

Your Model No. is marked on the pump's serial plate. To determine the Model No. of your pump from the following matrix, select the six digits which describe your pump, working from left to right. The first three digits are always FD3, designating 2150 SST FDA compliant diaphragm pumps. The remaining three digits define the materials of construction. For example, a pump with an

aluminum air motor, stainless steel fluid section, stainless steel seats, PTFE o-rings, PTFE balls, and PTFE diaphragms is Model No. **FD3111**. To order replacement parts, refer to the part lists on pages 45-46.

*The digits in the matrix **do not** correspond to the reference numbers in the parts drawings and parts lists.*

FDA-Compliant Diaphragm Pump	2150 Stainless Steel Air Motor	Stainless Steel Fluid Section	Seats and O-rings	Balls	Diaphragms
FD3 - All 2150 SST FDA-Compliant Pumps			1 (316 SST with PTFE o-rings)	1 (PTFE)	1 (PTFE)
			2 (316 SST with EPDM o-rings)	2 (Santoprene®)	2 (Santoprene®)
				3 (Neoprene with SST core)	3 (PTFE Heavy-Duty)

Available Configurations

- FD3111
- FD3122
- FD3211
- FD3222
- FD3113
- FD3213
- FD3132
- FD3232

Repair Kit Matrix - 2150

For 2150 Stainless Steel Sanitary Pumps

Repair Kits may be ordered separately. To repair the air valve, order **Part No. 255061** (see page 28). Parts included in the Air Valve Repair Kit are marked with a symbol in the parts list, for example (4†).

To repair your pump, select the six digits which describe your pump from the following matrix, working from left to right. The first three digits are always FD3. The remaining three digits define the materials of construction.

Parts included in the kit are marked with an asterisk in the parts list, for example (201*). For example, if your pump has stainless steel seats, PTFE o-rings, PTFE balls, and PTFE diaphragms, order Repair Kit **FK3111**.

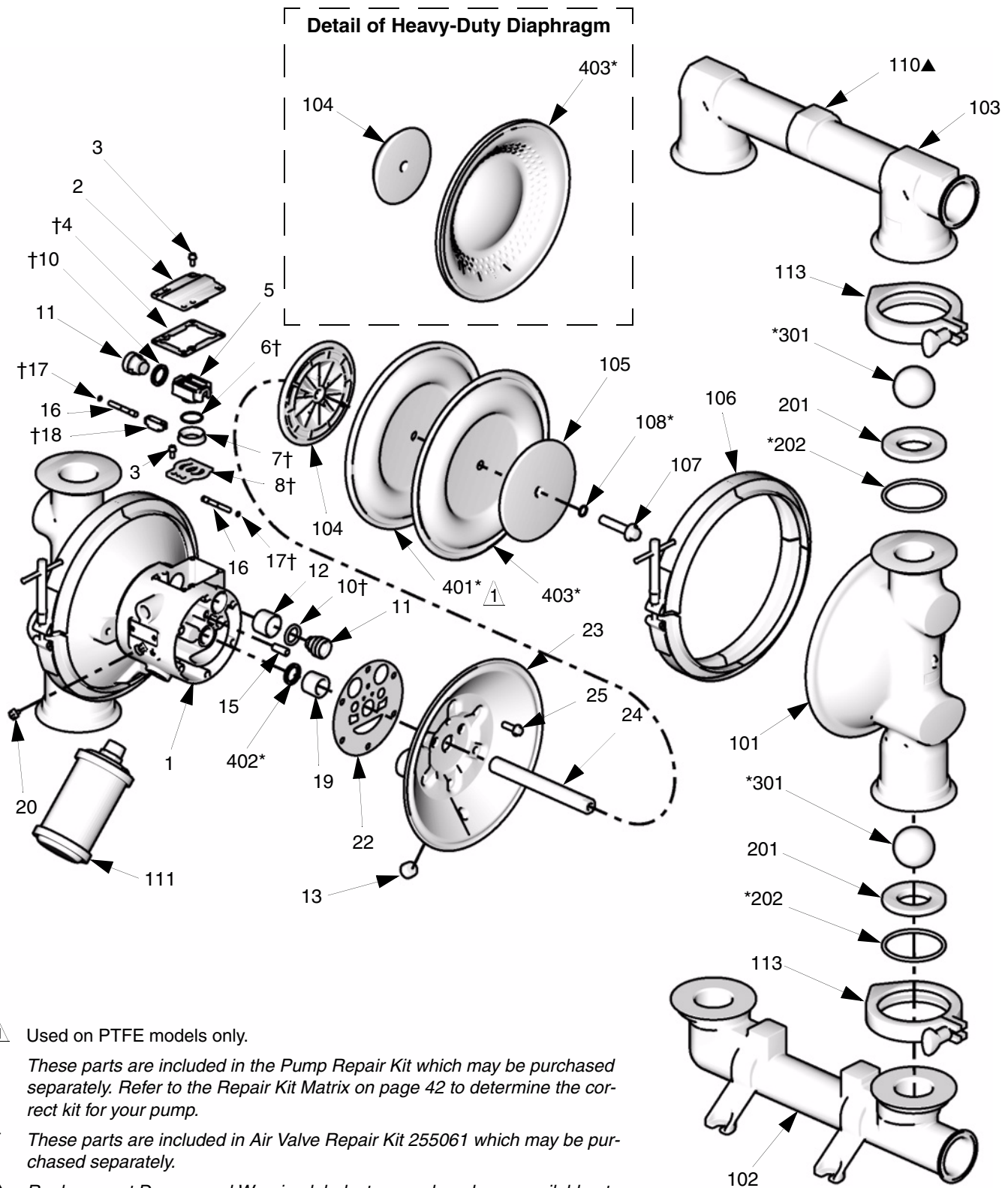
*The digits in the matrix **do not** correspond to the reference numbers in the parts drawings and parts lists.*

Diaphragm Pump	Null	Pump Size	Seats and O-rings	Balls	Diaphragms
FK3 - All 2150 SST Sanitary Pumps			1 (316 SST with PTFE o-rings)	1 (PTFE) white	1 (PTFE) white
			2 (316 SST with EPDM o-rings)	2 (Santoprene®) blue	2 (Santoprene®) blue
				3 (Neoprene with SST core)	3 (PTFE Heavy-Duty)

Available Configurations

- FK3111
- FK3122
- FK3211
- FK3222
- FK3113
- FK3213
- FK3132
- FK3232

Parts - 2150



T18929b

Air Motor Parts List (Matrix Column 2)

Ref.	Part No.	Description	Qty
1	15K009	HOUSING, center; SST	1
2	15A735	COVER, air valve; SST	1
3	116344	SCREW, mach, hex flange hd; M5 x 0.8; 12 mm (0.47 in.)	9
4†	188618	GASKET, cover	1
5	188855	CARRIAGE; aluminum	1
6†	108730	O-RING; nitrile	1
7†	188616	BLOCK, air valve; acetal	1
8†	15H178	PLATE, air valve; SST	1
10†	112181	PACKING, u-cup; nitrile	4
11	188612	PISTON, actuator; acetal	2
12	188613	BEARING, piston; acetal	2
13‡	103778	PLUG, pipe	2
15	188611	BEARING, pin; acetal	2
16	188610	PIN, pilot; SST	2
17†	157628	O-RING; buna-N	2
18†	188614	BLOCK, pilot; acetal	1
19	188609	BEARING, shaft; acetal	2
20	116344	SCREW, grounding	1
22	188603	GASKET, air cover; foam	2
23	15H859	COVER, air; SST	2
24	189304	SHAFT, diaphragm; SST	1
25	112178	SCREW; M8 x 1.25; 25 mm (1 in.); stainless steel	12

† These parts are included in Air Valve Repair Kit 255061 which may be purchased separately.

Fluid Section Parts List (Matrix Column 3)

Ref.	Part No.	Description	Qty
101	277264	COVER, fluid; SST	2
102	277269	MANIFOLD, inlet; SST	1
103	277270	MANIFOLD, outlet; SST	1
106	15H513	CLAMP, sanitary, dia-phragm	2
110▲	188621	LABEL, warning	1
111	15G332	MUFFLER	1
113	510490	CLAMP, sanitary	4

Seat Parts List (Matrix Column 4)

Digit	Ref.	Part No.	Description	Qty
1	201	15H826	SEAT; 316 SST	4
	202*	15H831	O-RING; PTFE	4
2	201	15H826	SEAT; 316 SST	4
	202*	15H829	O-RING; EPDM	4

* These parts are included in the Pump Repair Kit which may be purchased separately. Refer to the Repair Kit Matrix on page 42 to determine the correct kit for your pump.

▲Replacement Danger and Warning labels, tags and cards are available at no cost.

Ball Parts List (Matrix Column 5)

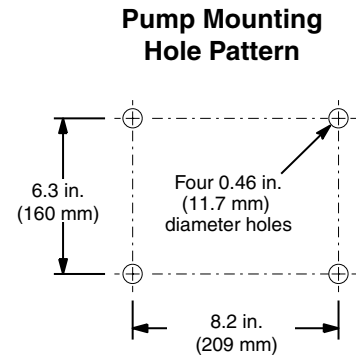
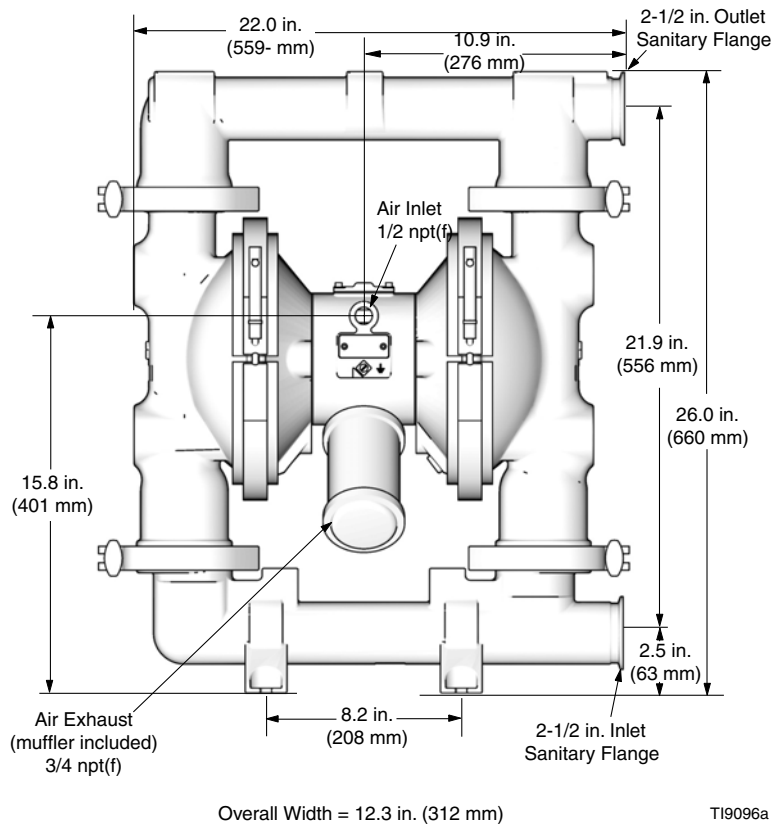
Digit	Ref.	Part No.	Description	Qty
1	301*	112359	BALL; PTFE	4
2	301*	112361	BALL; Santoprene®	4
3	301*	15H834	BALL; neoprene/SST core	4

Diaphragm Parts List (Matrix Column 6)

Digit	Ref.	Part No.	Description	Qty
1	401*		DIAPHRAGM; backer; EPDM	2
	402*	112181	PACKING; u-cup; nitrile	2
	403*	15K313	DIAPHRAGM; PTFE	2
	104	189298	PLATE, air side; aluminum	2
	105	189299	PLATE, fluid side; SST	2
	107	189410	BOLT; M12 x 1.75; 55 mm (2.16 in.); SST	2
	108*	104319	O-RING; PTFE	2
2	402*	112181	PACKING; u-cup; nitrile	2
	403*	189296	DIAPHRAGM; Santoprene®	2
	104	189298	PLATE, air side; aluminum	2
	105	189299	PLATE, fluid side; SST	2
	107	189410	BOLT; M12 x 1.75; 55 mm (2.16 in.); SST	2
	108*	104319	O-RING; PTFE	2
3	289226 Kit, heavy-duty diaphragm, PTFE; includes 403 and 104			
	402*	112181	PACKING; u-cup; nitrile	2
	403*	253628	DIAPHRAGM; Heavy-Duty; PTFE; includes two diaphragms and two packings (402)	1
	104	15H811	PLATE, air side; aluminum	2

* These parts are included in the Pump Repair Kit which may be purchased separately. Refer to the Repair Kit Matrix on page 42 to determine the correct kit for your pump.

Dimensional Drawing - 2150



2150 FDA

Technical Data - 2150

Maximum fluid working pressure	120 psi (0.8 MPa, 8 bar)
Air pressure operating range	20-120 psi (0.14-0.8 MPa, 1.4-8 bar)
Maximum air consumption	175 scfm
Air consumption at 70 psi/80 gpm	70 scfm (see chart)
Maximum free-flow delivery	160 gpm (568 lpm)
Maximum pump speed	165 cpm
* Gallons (Liters) per cycle	0.97 (3.67)
Maximum suction lift	29 ft (8.83 m) wet, 16 ft (4.87 m) dry
Maximum size pumpable solids	1/4 in. (6.3 mm)
** Maximum Noise Level at 100 psi, full flow	95 dBa
** Sound Power Level	102 dBa
** Noise Level at 70 psi and 50 cpm	84 dBa

Maximum fluid operating temperature is based on the following maximum diaphragm, ball, and seat temperature ratings.	PTFE 220°F (104.4°C)
	Santoprene® 180°F (82.2°C)
	Neoprene 200°F (93°C)
	EPDM 275°F (135°C)
	Stainless steel 250°F (121.1°C)

Air inlet size	0.5 in. npt(f)
Fluid inlet size	2.5 in. sanitary flange
Fluid outlet size	2.5 in. sanitary flange

Wetted parts

***All fluid contact materials are FDA-compliant and meet the United States Code of Federal Regulations (CFR) Title 21, Section 177.

Wetted materials on all models	316 SST
Wetted material depending on model	EPDM, Neoprene, PTFE, Santoprene®

CAUTION:

Santoprene® may be used only with non-fatty, non-oily foods or alcohols up to 15%.

Non-wetted external parts	300 series stainless steel, polyester (labels),
	LDPE foam (gasket)

Weight

All models	147 lb (66.7 kg)
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Santoprene® is a registered trademark of the Monsanto Co.

Loctite® is a registered trademark of the Loctite Corporation.

* *Displacement per cycle may vary based on suction condition, discharge head, air pressure, and fluid type.*

** *Noise levels measured with the pump mounted to a solid surface. Sound power measured per ISO Standard 9614-1.*

*** *The pump user must verify that the construction materials meet their specific application requirements.*

Performance Chart - 2150

Test Conditions: Pump tested in water with inlet submerged

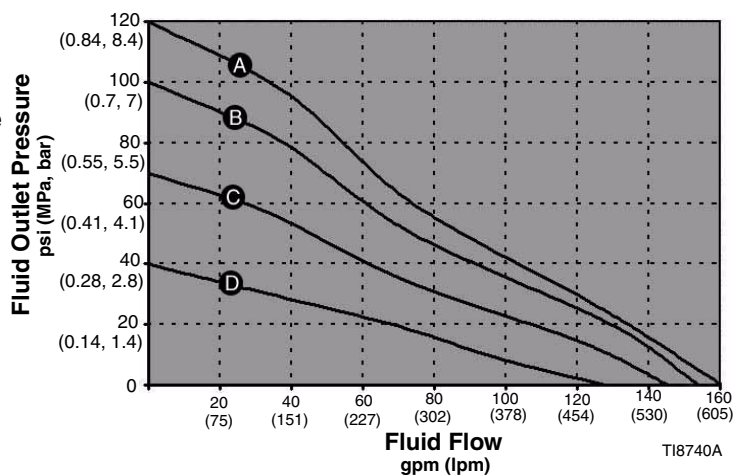
Fluid Pressure Curves

- A** at 120 psi (0.7 MPa, 7 bar) operating air pressure
- B** at 100 psi (0.7 MPa, 7 bar) operating air pressure
- C** at 70 psi (0.48 MPa, 4.8 bar) operating air pressure
- D** at 40 psi (0.28 MPa, 2.8 bar) operating air pressure

To find Fluid Outlet Pressure

(psi/MPa/bar) at a specific fluid flow (gpm/lpm) and operating air pressure (psi/MPa/bar):

1. Locate fluid flow rate along bottom of chart.
2. Follow vertical line up to intersection with selected operating air pressure curve.
3. Follow left to scale to read fluid outlet pressure.



AIR PRESSURES	
A	= @ 120 psi (8.4 bar, 0.84 MPa)
B	= @ 100 psi (7.0 bar, 0.7 MPa)
C	= @ 70 psi (4.8 bar, 0.5 MPa)
D	= @ 40 psi (2.8 bar, 0.3 MPa)

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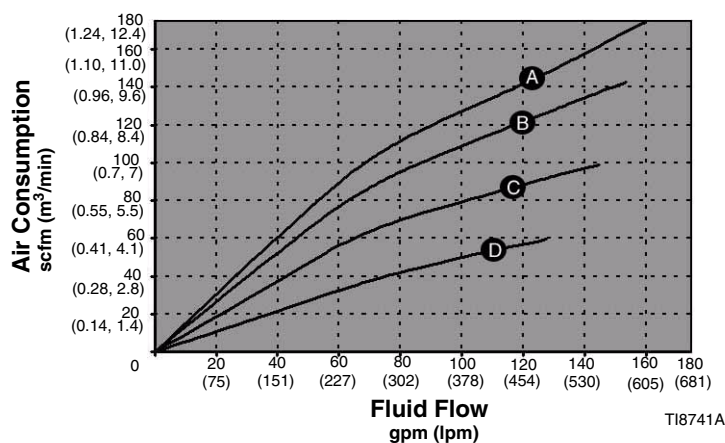
Air Consumption Curves

- A** at 120 psi (0.7 MPa, 7 bar) operating air pressure
- B** at 100 psi (0.7 MPa, 7 bar) operating air pressure
- C** at 70 psi (0.48 MPa, 4.8 bar) operating air pressure
- D** at 40 psi (0.28 MPa, 2.8 bar) operating air pressure

To find Pump Air Consumption

(scfm or m³/min) at a specific fluid flow (gpm/lpm) and operating air pressure (psi/MPa/bar):

1. Locate fluid flow rate along bottom of chart.
2. Read vertical line up to intersection with selected operating air pressure curve.
3. Follow left to scale to read air consumption.



AIR PRESSURES	
A	= @ 120 psi (8.4 bar, 0.84 MPa)
B	= @ 100 psi (7.0 bar, 0.7 MPa)
C	= @ 70 psi (4.8 bar, 0.5 MPa)
D	= @ 40 psi (2.8 bar, 0.3 MPa)

TI8742A

Graco Warranties

Graco Standard Pump Warranty

Graco warrants all equipment manufactured by Graco and bearing its name to be free from defects in material and workmanship on the date of sale to the original purchaser for use. With the exception of any special, extended, or limited warranty published by Graco, Graco will, for a period of five years from the date of sale, repair or replace any part of the equipment determined by Graco to be defective. This warranty applies only when the equipment is installed, operated and maintained in accordance with Graco's written recommendations.

This warranty does not cover, and Graco shall not be liable for general wear and tear, or any malfunction, damage or wear caused by faulty installation, misapplication, abrasion, corrosion, inadequate or improper maintenance, negligence, accident, tampering, or substitution of non-Graco component parts. Nor shall Graco be liable for malfunction, damage or wear caused by the incompatibility of Graco equipment with structures, accessories, equipment or materials not supplied by Graco, or the improper design, manufacture, installation, operation or maintenance of structures, accessories, equipment or materials not supplied by Graco.

This warranty is conditioned upon the prepaid return of the equipment claimed to be defective to an authorized Graco distributor for verification of the claimed defect. If the claimed defect is verified, Graco will repair or replace free of charge any defective parts. The equipment will be returned to the original purchaser transportation prepaid. If inspection of the equipment does not disclose any defect in material or workmanship, repairs will be made at a reasonable charge, which charges may include the costs of parts, labor, and transportation.

THIS WARRANTY IS EXCLUSIVE, AND IS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

Graco's sole obligation and the buyer's sole remedy for any breach of warranty shall be as set forth above. The buyer agrees that no other remedy (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property, or any other incidental or consequential loss) shall be available. Any action for breach of warranty must be brought within six years of the date of sale.

Graco makes no warranty, and disclaims all implied warranties of merchantability and fitness for a particular purpose in connection with accessories, equipment, materials or components sold but not manufactured by Graco. These items sold, but not manufactured by Graco (such as electric motors, switches, hose, etc.), are subject to the warranty, if any, of their manufacturer. Graco will provide purchaser with reasonable assistance in making any claim for breach of these warranties.

In no event will Graco be liable for indirect, incidental, special or consequential damages resulting from Graco supplying equipment hereunder, or the furnishing, performance, or use of any products or other goods sold hereto, whether due to a breach of contract, breach of warranty, the negligence of Graco, or otherwise.

FOR GRACO CANADA CUSTOMERS

The parties acknowledge that they have required that the present document, as well as all documents, notices and legal proceedings entered into, given or instituted pursuant hereto or relating directly or indirectly hereto, be drawn up in English. Les parties reconnaissent avoir convenu que la rédaction du présente document sera en Anglais, ainsi que tous documents, avis et procédures judiciaires exécutés, donnés ou intentés, à la suite de ou en rapport, directement ou indirectement, avec les procédures concernées.

Extended Product Warranty

Graco warrants all 205, 307, 515, 716, 1040, 1590, 2150, 3150, and 3275 air valve center sections to be free from defects in material and workmanship for a period of fifteen years from date installed in service by the original purchaser. Normal wear of items such as packings or seals are not considered to be defects in material and workmanship.

Five years	Graco will provide parts and labor.
Six to Fifteen years	Graco will replace defective parts only.

Graco Information

TO PLACE AN ORDER, contact your Graco distributor, or call to identify the nearest distributor.

1-800-328-0211 Toll Free

612-623-6921

612-378-3505 Fax

*All written and visual data contained in this document reflects the latest product information available at the time of publication.
Graco reserves the right to make changes at any time without notice.*

This manual contains English. MM 311879

Graco Headquarters: Minneapolis

International Offices: Belgium, China, Japan, Korea

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