

# SaniForce® Diaphragm Pumps, BV-Series

3A8983A

EN

***Air-operated double-diaphragm (AODD) pumps for sanitary fluid transfer applications. For professional use only.***

## 1050, 1590, and 2150 Models

See page 2 for model information, including approvals.

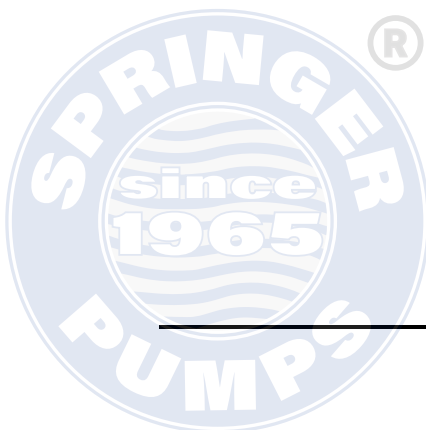
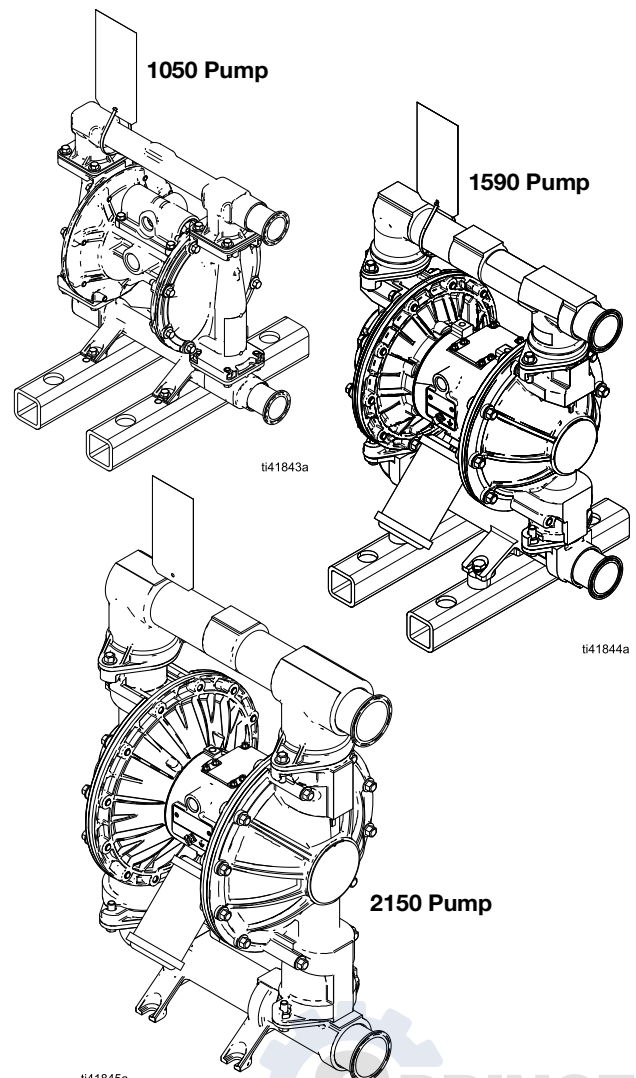
120 psi (0.8 MPa, 8 bar) Maximum Fluid Working Pressure

120 psi (0.8 MPa, 8 bar) Maximum Air Input Pressure



### Important Safety Instructions

Read all warnings and instructions in this manual before using the equipment.  
Save these instructions.



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## Models and Approvals









Pump	Model Part Number	Approvals
1050	26D635	   EC 1935/2004  II 2 GD Ex h IIC 66°C...135°C Gb Ex h IIIC T135°C Db
1590	26D631	
2150	26D634	

ATEX T-code rating depends on the temperature of the fluid being dispensed. Fluid temperature is limited by the materials of the pump interior wetted parts. See **Technical Specifications** for the maximum fluid operating temperature for your specific pump model.

# 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 symbols refer to procedure-specific risks. When these symbols appear in the body of this manual or on warning labels, refer back to these Warnings. Product-specific hazard symbols and warnings not covered in this section may appear throughout the body of this manual where applicable.

 <b>WARNING</b>	
 	<b>EQUIPMENT MISUSE HAZARD</b> Misuse can cause death or serious injury. <ul style="list-style-type: none"> <li>Do not operate the unit when fatigued or under the influence of drugs or alcohol.</li> <li>Do not exceed the maximum working pressure or temperature rating of the lowest rated system component. See <b>Technical Specifications</b> in all equipment manuals.</li> <li>Use fluids and solvents that are compatible with equipment wetted parts. See <b>Technical Specifications</b> in all equipment manuals. Read fluid and solvent manufacturer's warnings. For complete information about your material, request Safety Data Sheets (SDSs) from distributor or retailer.</li> <li>Turn off all equipment and follow the <b>Pressure Relief Procedure</b> when equipment is not in use.</li> <li>Check equipment daily. Repair or replace worn or damaged parts immediately with genuine manufacturer's replacement parts only.</li> <li>Do not alter or modify equipment. Alterations or modifications may void agency approvals and create safety hazards.</li> <li>Make sure all equipment is rated and approved for the environment in which you are using it.</li> <li>Use equipment only for its intended purpose. Call your distributor for information.</li> <li>Route fluid lines and cables away from traffic areas, sharp edges, moving parts, and hot surfaces.</li> <li>Do not kink or over-bend fluid lines, cords, or cables. Do not use fluid lines, cords, or cables to pull equipment.</li> <li>Keep children and animals away from work area.</li> <li>Comply with all applicable safety regulations.</li> </ul>
   	<b>FIRE AND EXPLOSION HAZARD</b> Flammable fumes, such as solvent and paint fumes, in <b>work area</b> can ignite or explode. Paint or solvent flowing through the equipment can cause static sparking. To help prevent fire and explosion: <ul style="list-style-type: none"> <li>Use equipment only in well-ventilated area.</li> <li>Eliminate all ignition sources, such as pilot lights, cigarettes, portable electric lamps, and plastic drop cloths (potential static sparking).</li> <li>Ground all equipment in the work area. See <b>Grounding</b> instructions.</li> <li>Keep work area free of debris, including solvent, rags and gasoline.</li> <li>Do not plug or unplug power cords, or turn power or light switches on or off when flammable fumes are present.</li> <li>Use only conductive, grounded fluid lines.</li> <li><b>Stop operation immediately</b> if static sparking occurs or you feel a shock. Do not use equipment until you identify and correct the problem.</li> <li>Keep a working fire extinguisher in the work area.</li> <li>Route exhaust away from all ignition sources. If diaphragm ruptures, fluid may be exhausted with air.</li> </ul>

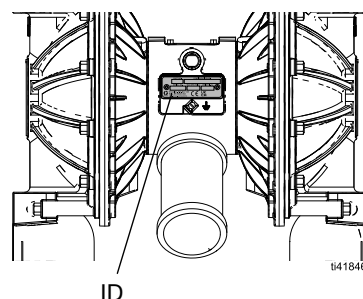
 <b>WARNING</b>	
  	<b>PRESSURIZED EQUIPMENT HAZARD</b> Fluid from the equipment, leaks, or ruptured components can splash in the eyes or on skin and cause serious injury. <ul style="list-style-type: none"> <li>Follow the <b>Pressure Relief Procedure</b> when you stop spraying/dispensing and before cleaning, checking, or servicing equipment.</li> <li>Tighten all fluid connections before operating the equipment.</li> <li>Check fluid lines and connections daily. Replace worn or damaged parts immediately.</li> </ul>
	<b>PRESSURIZED ALUMINUM PARTS HAZARD</b> Use of fluids that are incompatible with aluminum in pressurized equipment can cause serious chemical reaction and equipment rupture. Failure to follow this warning can result in death, serious injury, or property damage. <ul style="list-style-type: none"> <li>Do not use 1,1,1-trichloroethane, methylene chloride, other halogenated hydrocarbon solvents or fluids containing such solvents.</li> <li>Do not use chlorine bleach.</li> <li>Many other fluids may contain chemicals that can react with aluminum. Contact your material supplier for compatibility.</li> </ul>
	<b>TOXIC FLUID OR FUMES HAZARD</b> Toxic fluids or fumes can cause serious injury or death if splashed in the eyes or on skin, inhaled, or swallowed. <ul style="list-style-type: none"> <li>Read Safety Data Sheets (SDSs) to know the specific hazards of the fluids you are using.</li> <li>Route exhaust away from work area. If diaphragm ruptures, fluid may be exhausted into the air.</li> <li>Store hazardous fluid in approved containers, and dispose of it according to applicable guidelines.</li> </ul>
	<b>BURN HAZARD</b> Equipment surfaces and fluid that is heated can become very hot during operation. To avoid severe burns: <ul style="list-style-type: none"> <li>Do not touch hot fluid or equipment.</li> </ul>
	<b>PERSONAL PROTECTIVE EQUIPMENT</b> Wear appropriate protective equipment when in the work area to help prevent serious injury, including eye injury, hearing loss, inhalation of toxic fumes, and burns. Protective equipment includes but is not limited to: <ul style="list-style-type: none"> <li>Protective eyewear, and hearing protection.</li> <li>Respirators, protective clothing, and gloves as recommended by the fluid and solvent manufacturer.</li> </ul>

# Configuration Matrix

Record the model part number and configuration sequence found on your equipment identification plate (ID) to assist you when ordering replacement parts.

**Model Part Number:**

**Configuration Sequence:**



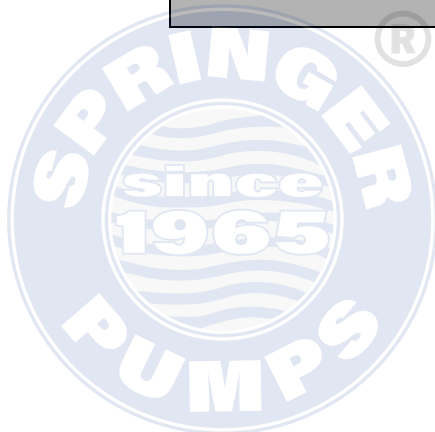
**Sample Configuration Sequence: 1050BVPA01AS16SSCWSPEP**

1050	BV	P	A01A	S16	SS	CW	SP	EP
Pump Model	Wetted Section Material	Drive	Center Section and Air Valve Material	Manifolds	Seats	Checks	Diaphragms	Gaskets

**NOTE:** Some combinations are not possible. Check with your local distributor.

Pump		Wetted Section Material		Drive Type		Center Section and Air Valve Material		Manifolds	
1050	1.5 in. fluid ports	BV	Stainless Steel	P	Pneumatic	A01A	Aluminum	S16	316 Stainless Steel
1590	2 in. fluid ports								
2150	2.5 in. fluid ports								

Seat Material		Checks		Diaphragm Material		Gaskets	
SS	Stainless Steel	CW	Polychloroprene, weighted ball	SP	Santoprene®	EP	EPDM



# Typical Installation

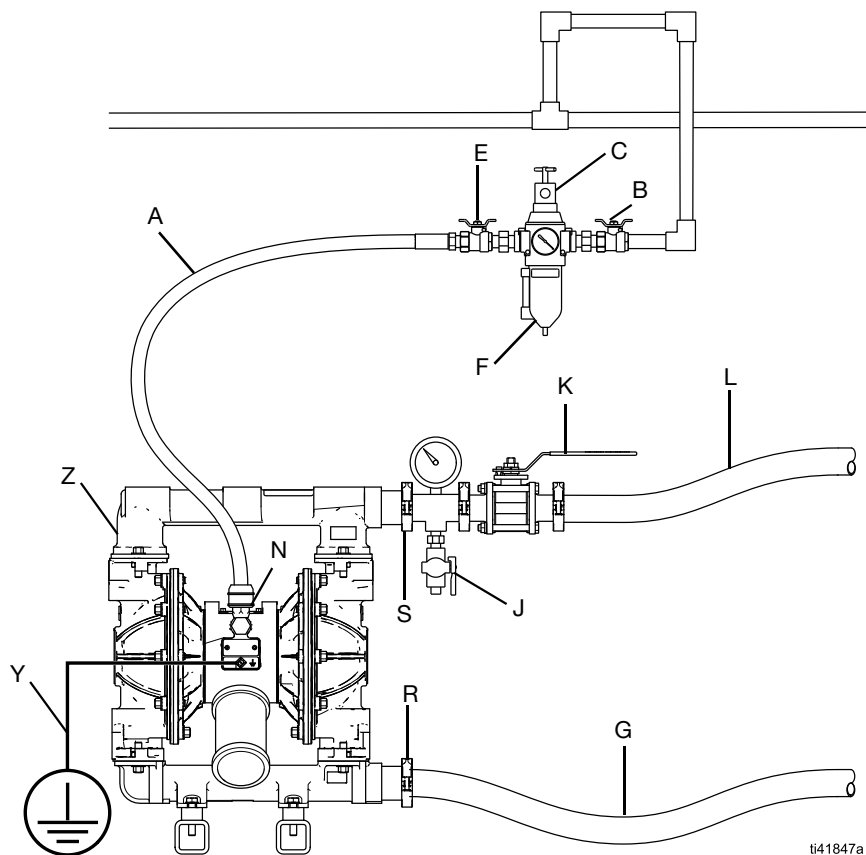
## General Information

A typical installation is shown in FIG. 1. The figure is only a guide for selecting and installing system components. Contact your local distributor for assistance in planning a system to suit your needs.

Always use Genuine Graco Parts and accessories. Be sure all accessories are adequately sized and pressure-rated to meet the requirements of the system.

Reference letters in the text, for example, (A), refer to the callouts in the figures.

## Typical Installation



**FIG. 1: Typical Installation**

### KEY:

- A Air supply line
- B Bleed-type master air valve (for pump) (required, not supplied)
- C Air regulator (required, not supplied)
- E Master air valve (for accessories)
- F Air line filter
- G Flexible, conductive fluid supply line
- J Fluid drain valve (required, not supplied)
- K Fluid shutoff valve
- L Flexible, conductive fluid outlet line
- N\* Air inlet port

- R♦ Fluid inlet port
- S♦ Fluid outlet port
- Y Ground wire
- Z Pump

\* 1/2 in. npt(f) port.

♦ Can be oriented to be on the left or right side. See **Orient Fluid Inlet and Outlet Ports**, page 10.

# Installation

## Before First Use

### Tighten Fasteners

Before using the equipment for the first time, check and torque all fasteners. Follow **Torque Fasteners**, page 36.

After the first day of operation, re-torque the fasteners.

#### NOTICE

To avoid pump damage, do not over-torque the fasteners on the equipment.

### Tighten Connections

Check and tighten all fluid connections before operating the equipment. Replace worn or damaged parts as needed.

#### NOTICE

Firmly tighten all connections to avoid leaks and damage to equipment parts.

### Flush the Equipment

Before using the equipment for the first time, flush the equipment. Follow **Flush the Equipment**, page 15.

The equipment was tested using a food grade lubricant. If a food grade lubricant could contaminate the fluid being dispensed, flush the equipment thoroughly with a sanitizing solution before first use.

## Grounding

<p>The equipment must be grounded to reduce the risk of static sparking. Static sparking can cause fumes to ignite or explode. Grounding provides an escape wire for the electric current. Follow local codes and regulations.</p>				

- **Pump:** Connect a ground wire and clamp to the grounding screw (W). To order a ground wire and clamp, order part number 222011.
1. Loosen the grounding screw (W).
  2. Insert one end of a 12-gauge (1.5 mm<sup>2</sup>) or thicker ground wire behind the grounding screw and tighten the screw securely.
  3. Connect the clamp end of the ground wire to a true earth ground.

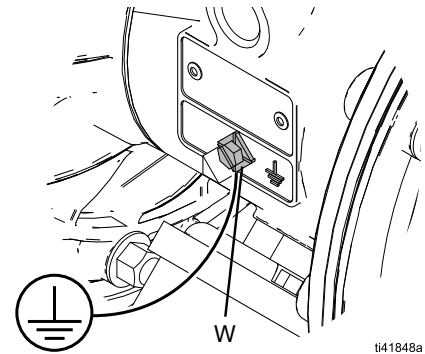


FIG. 2: Ground the Pump

- **Air and fluid lines:** Use only conductive lines with a maximum of 500 ft (150 m) combined line length to ensure grounding continuity. Check electrical resistance of lines. If total resistance to ground exceeds 29 megohms, replace line immediately.
- **Air compressor:** Follow manufacturer's recommendations.
- **Fluid supply container:** Follow local codes and regulations.
- **Solvent pails used when flushing:** Follow local codes and regulations. Use only conductive metal pails, placed on a grounded surface. Do not place the pail on a nonconductive surface, such as paper or cardboard, which interrupts grounding continuity.



## Mount the Pump



The equipment is heavy (see **Technical Specifications** for specific weights). If the equipment must be moved, follow the **Pressure Relief Procedure**, page 12, and have two people lift the equipment by grasping the outlet manifold securely, or use appropriate lifting equipment to lift by the outlet manifold. Never have one person move or lift the equipment.

Rubber Foot Mounting Kit 236452 is available to reduce noise and vibration during operation (*purchase separately*).

1. Ensure that the mounting surface is level and can support the weight of the equipment, lines, and accessories, as well as the stress caused during operation.
2. Mount the equipment on a level surface and secure the equipment to the mounting surface. For all mountings, ensure that the equipment is fastened directly to the mounting surface. See **Dimensions**, page 42, for dimensions of the mounting holes for your equipment.

**NOTE:** For ease of operation and service, mount the equipment so the air valve cover, air inlet, and fluid inlet and outlet ports are easily accessible.

## Ventilate Air Exhaust

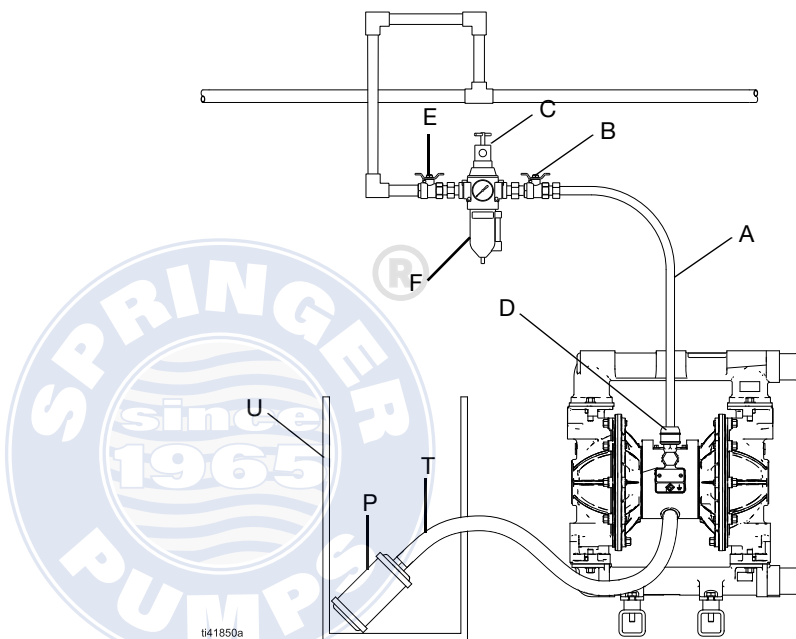


Be sure the system is properly ventilated for your type of installation. Exhaust must be vented to a safe place, away from people, animals, food handling areas, and all sources of ignition when pumping flammable or hazardous fluids. Diaphragm rupture can cause the fluid being pumped to exhaust with the air. Place a grounded container at the end of the air exhaust line to catch the fluid. See FIG. 3.

**NOTE:** The air exhaust port is 3/4 npt(f). Do not restrict the air exhaust port. Excessive exhaust restriction can reduce equipment performance.

To provide a remote exhaust:

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



### KEY:

- A Air supply line
- B Bleed-type master air valve (for pump) (required, not supplied)
- C Air regulator (required, not supplied)
- D Air line quick disconnect
- E Master air valve (for accessories)
- F Air line filter
- P Muffler
- T Conductive air exhaust line
- U Conductive container for air exhaust

**FIG. 3: Air Exhaust Ventilation**

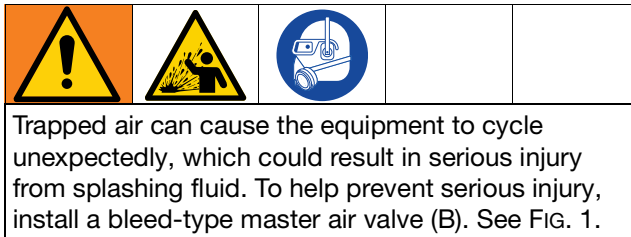


## Install Accessories

Install the following accessories in the order shown in FIG. 1, using adapters as necessary.

### Install Air Line Accessories

- **Bleed-type master air valve (B):** Required in your system to relieve air trapped between it and the air motor when the valve is closed.

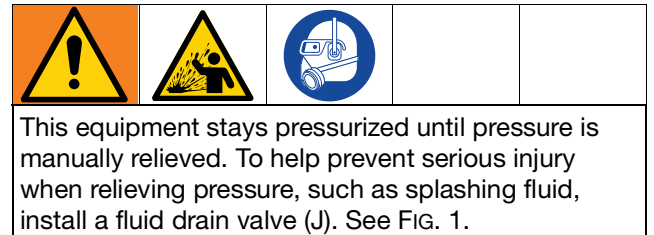


Be sure the valve is easily accessible from the equipment and located downstream from the air regulator.

- **Air regulator (C):** To control pump speed and fluid outlet pressure. Locate it close to the equipment.
  - **Air line filter (F):** Removes harmful dirt and moisture from compressed air supply.
  - **Master bleed-type air valve (E):** Isolates air line accessories for servicing. Locate upstream from all other air line accessories.
1. Install the air line accessories as shown in FIG. 1. Verify that the air line supplying the accessories is grounded.
  2. Install a conductive, flexible air line (A) between the accessories and the air inlet (N). Use a minimum 1/2 in. (13 mm) inner-diameter air line.

## Install Fluid Supply and Outlet Lines

- **Fluid drain valve (J):** Required in your system, relieves fluid pressure in the fluid line.
  - **Fluid pressure relief valve (V):** Relieves fluid pressure in the fluid line. See FIG. 5.
  - **Fluid shutoff valve (K):** Shuts off fluid flow.
1. Install flexible, conductive fluid lines (G and L).
  2. Install a fluid drain valve (J) in the fluid outlet line (L) close to the fluid outlet. See FIG. 1.



3. Install a fluid shutoff valve (K) in the fluid outlet line (L) downstream from the fluid drain valve (J).
4. If needed, install a fluid pressure relief valve (V). See **Fluid Pressure Relief Valve**, page 11.

**NOTE:** For best results, always install the pump as close as possible to the material source. See the **Technical Specifications**, page 45, for maximum suction lift (wet and dry).

### NOTICE

The equipment can be damaged if flexible fluid lines are not used. If hard-plumbed fluid lines are used in the system, use a short length of flexible, conductive fluid line to connect to the equipment.



## Tips to Reduce Cavitation

### NOTICE

Frequent or excessive cavitation can cause serious damage, including pitting and early wear of wetted parts, and may result in reduced efficiency of the equipment. Cavitation damage and reduced efficiency both result in increased operating costs.

Cavitation is the formation and collapse of air pockets in the fluid. Cavitation depends on the vapor pressure of the fluid, the system suction pressure, and the velocity pressure. Viscous fluids are more difficult to pump and more prone to cavitation than non-viscous fluids.

To improve equipment efficiency and reduce the cavitation:

1. **Reduce vapor pressure:** Decrease the temperature of the fluid.
2. **Increase suction pressure:**
  - a. Position the equipment lower than the fluid level in the supply.
  - b. Reduce the number of fittings on the suction lines to reduce friction length.
  - c. Increase the diameter of the suction lines.
  - d. Reduce the fluid inlet pressure. An inlet pressure supply of 3–5 psi (21–35 kPa, 0.2–0.3 bar) is adequate for most materials.

### NOTICE

To avoid pump damage and inefficient operation, do not use a fluid inlet pressure greater than 25 percent of the outlet working pressure.

- e. Increase the Net Positive Suction Head (NPSH). See **Performance Charts**, page 38.
3. **Reduce liquid velocity:** Slow the equipment cyclic rate.

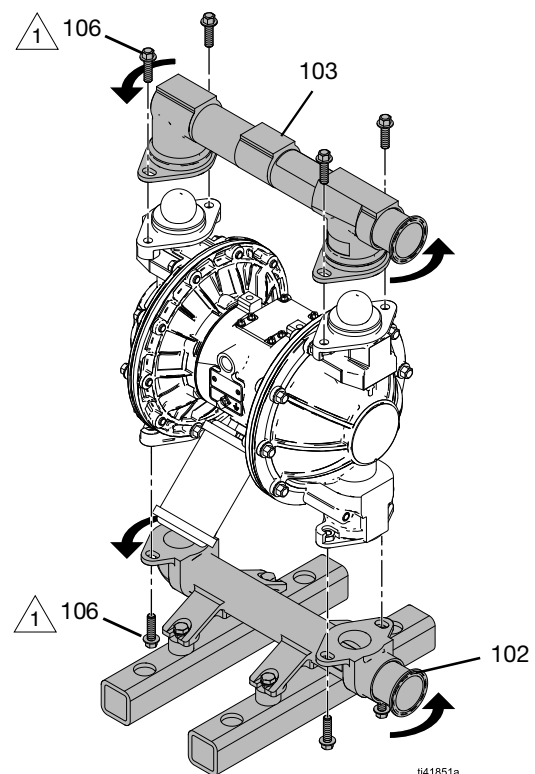
Consider all the previously listed factors in system design. To maintain efficiency, operate the equipment at the lowest speed and pressure setting needed for the required flow.

Contact your local distributor for site-specific suggestions to improve equipment performance and reduce operating costs.

## Orient Fluid Inlet and Outlet Ports

The inlet and outlet fluid port can be rotated. To change the fluid port orientation of the manifold (102, 103):

1. Remove the manifold fasteners (106).
2. Rotate the manifold (102, 103) to the applicable position.
3. Install the manifold fasteners (106) and torque. See **Torque Fasteners**, page 36.



**FIG. 4: Fluid Inlet and Outlet Port Orientation, 1590 model shown**

## Fluid Pressure Relief Valve



Some systems may require installation of a pressure relief valve (V) at the pump outlet to prevent overpressurization and rupture of the pump or fluid lines.

Thermal expansion of fluid in the outlet line can cause overpressurization. Thermal expansion can occur when using long fluid lines exposed to sunlight or ambient heat, or when pumping from a cool to a warm area (for example, from an underground tank).

Overpressurization also can occur if the pump is used to feed fluid to a piston pump, and the intake valve of the piston pump does not close, causing fluid to back up in the outlet line.

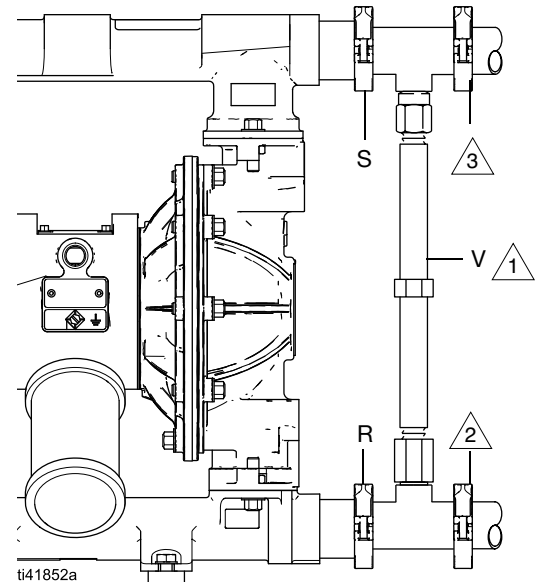
The pressure relief valve reduces the risk of serious injury, including splashing in the eyes or on the skin.

A fluid pressure relief valve is available (purchase separately). See **Kits and Accessories**, starting on page 34.

### KEY:

- R Fluid inlet port
- S Fluid outlet port
- V Fluid pressure relief valve

- 1 Install valve between fluid inlet and outlet ports.
- 2 Connect fluid inlet line here.
- 3 Connect fluid outlet line here.



**FIG. 5: Fluid Pressure Relief Valve**



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# Operation

## Pressure Relief Procedure



Follow the Pressure Relief Procedure whenever you see this symbol.

<p>This equipment stays pressurized until pressure is manually relieved. To help prevent serious injury from pressurized fluid, such as splashing fluid, follow the <b>Pressure Relief Procedure</b> when you stop dispensing and before cleaning, checking, or servicing the equipment.</p>				

1. Close the bleed-type master air valve (B) to shut off the air to the equipment.
2. Open outbound fluid valve to relieve fluid pressure from the equipment.
  - a. **For simple transfer applications**, open either the fluid shutoff valve (K) or the fluid drain valve (J).
  - b. **For circulating applications**, ensure that the fluid shutoff valve (K) is closed and open the fluid drain valve (J).

## Before Each Use

### Tighten Fasteners

Check and tighten all fasteners before operating the equipment. Re-torque as needed. Follow **Torque Fasteners**, page 36.

#### NOTICE

To avoid pump damage, do not over-torque the fasteners on the equipment.

### Tighten Connections

Check and tighten all fluid connections before operating the equipment. Replace worn or damaged parts as needed.

#### NOTICE

Firmly tighten all connections to avoid leaks and damage to equipment parts.

### Flush the Equipment

Flush the equipment before each use. Determine whether to disassemble and clean individual parts or simply flush the equipment with a compatible solvent or sanitizing solution.

To simply flush the equipment with a compatible solvent or sanitizing solution, follow **Start and Adjust the Equipment**, page 13, and **Flush the Equipment**, page 15.

To disassemble and clean individual parts, see the applicable repair procedure. See **Repair**, starting on page 18.



## Start and Adjust the Equipment

1. Confirm that the equipment is properly grounded. See **Grounding**, page 7.
2. Check and tighten all fasteners, air connections, and fluid connections before operating the equipment. Replace worn or damaged parts as needed.

### NOTICE

Firmly tighten all fasteners and connections to avoid air or fluid leaks. To avoid equipment damage, do not over-torque the fasteners on the equipment. See **Torque Fasteners**, page 36.

3. Connect a flexible, conductive fluid supply line (G) from the fluid to be pumped to the fluid inlet port (R).
4. Connect the flexible, conductive fluid outlet line (L) to the fluid outlet port (S) and route the line to the end container.
5. Close the fluid drain valve (J).
6. Turn the air regulator (C) to the lowest air pressure setting and open the bleed-type master air valve (B).

7. If the fluid outlet line (L) has a dispensing device, hold it open while continuing with the following step.
8. To prime the pump, slowly increase air pressure with the air regulator (C) until pump starts to cycle. Do not exceed the maximum operating air pressure listed in the **Technical Specifications**, page 45. Allow the pump to cycle slowly until all air is pushed out of the fluid lines and fluid exits the fluid outlet line (L).

## Shut Down the Equipment



1. Follow **Pressure Relief Procedure**, page 12.
2. Follow **Flush the Equipment**, page 15.



# Maintenance

## Establish a Preventive Maintenance Schedule

### NOTICE

Regularly maintain the equipment to avoid pump damage due to spills, leaks, or diaphragm failure.

Establish a preventive maintenance schedule based on the equipment service history.

## Inspect the Equipment

Regularly inspect the equipment for worn or damaged parts. Replace as needed.

## Torque Fasteners

Regularly check and torque all fasteners. Follow **Torque Fasteners**, page 36.

### NOTICE

To avoid pump damage, do not over-torque the fasteners on the equipment.

## Tighten Connections

Check and tighten all fluid connections before operating the equipment. Replace worn or damaged parts as needed.

### NOTICE

Firmly tighten all connections to avoid leaks and damage to equipment parts.

## Lubricate the Equipment

The equipment is lubricated at the factory. It is designed to require no further lubrication for the life of the equipment. There is no need to add an inline lubricator under normal operating conditions.

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

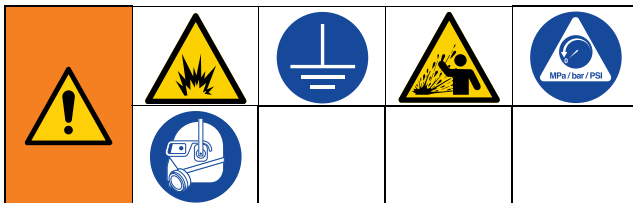
### NOTICE

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





## Flush the Equipment



To avoid fire and explosion, always ground equipment and waste container. To avoid static sparking and injury from splashing, always flush at the lowest possible pressure.

- Flush before changing fluid materials, before fluid can dry or freeze in the equipment, at the end of the day, before storing, and before repairing equipment.
  - Flush at the lowest pressure possible. Check and tighten all fasteners and fluid connections. Replace worn or damaged parts as needed.
  - Flush with a solvent that is compatible with the fluid being dispensed and the equipment wetted parts.
  - Flushing schedule will vary based on particular uses.
  - Always cycle the equipment during the entire flushing process.
1. Perform the **Pressure Relief Procedure**, page 12.
  2. Insert the suction end of the supply line (G) into a compatible solvent.
  3. Open the air regulator (C) to supply low pressure air to the equipment.
  4. Run the equipment for enough time to thoroughly clean the equipment and lines.
  5. Close the air regulator (C).
  6. Remove the suction end of the supply line (G) from the compatible solvent and drain the equipment.

## Store the Equipment



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

1. Follow **Pressure Relief Procedure**, page 12.
2. Follow **Flush the Equipment**, page 15.

### NOTICE

Store the equipment at 32°F (0°C) or higher. Exposure to extreme low temperatures may result in damage to plastic parts.

## Recycling and Disposal

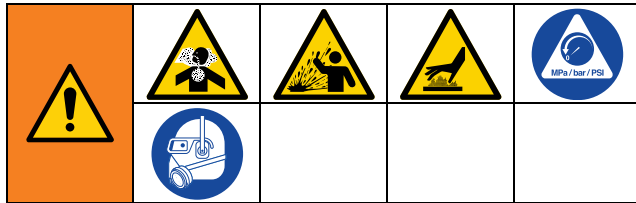
### End of Product Life

At the end of the product's useful life, dismantle and recycle it in a responsible manner.

- Perform the **Pressure Relief Procedure**, page 12.
- Drain and dispose of fluids according to applicable regulations. Refer to the material manufacturer's Safety Data Sheet.
- Deliver remaining product to a recycling facility.



# Troubleshooting



1. Follow **Pressure Relief Procedure**, page 12, before checking or repairing the equipment.
2. Check all possible problems and causes before disassembling equipment.

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 page 18.
Pump will not cycle, or cycles once and stops.	Air valve is stuck or dirty.	Disassemble and clean air valve. See pages 22–26. 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 the fluid pressure relief valve. See page 11.
	Dispensing valve clogged.	Relieve pressure and clear valve.
Reduced pump performance.	Clogged suction line.	Inspect; clear.
	Sticky or leaking balls (301).	Clean or replace. See page 18.
	Diaphragm ruptured.	Replace. See page 19.
	Restricted exhaust.	Remove restriction.
Air bubbles in fluid.	Suction line is loose	Tighten.
	Diaphragm ruptured.	Replace. See page 19.
	Loose inlet manifold (102), damaged seal between manifold and seat (201), damaged o-rings (202).	Tighten manifold fasteners (106) or replace seats (201) or o-rings (202). See page 18.
	Loose diaphragm shaft fastener (107).	Tighten or replace. See page 19.
	Damaged o-ring (108).	Replace. See page 19.
Fluid in exhaust air.	Diaphragm ruptured.	Replace. See page 19.
	Loose diaphragm shaft fastener (107).	Tighten or replace. See page 19.
	Damaged o-ring (108).	Replace. See page 19.
Pump exhausts excessive air at stall.	Worn air section parts.	Repair or replace. See pages 22–26.
	Worn shaft seals (402).	Replace. See page 19.

Problem	Cause	Solution
Pump leaks air externally.	Loose, worn, or damaged air section parts.	Tighten fasteners on air section. See pages 22–26.
		Repair or replace parts. See pages 22–26.
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 fasteners (106) or replace seats (201) or o-rings (202). See page 18.



# Repair

Repair kits available (purchase separately). Use all parts in the kits for best results. See **Parts**, starting on page 28.

## Repair the Check Valve

### Tools Required:

- Torque wrench
- O-ring pick
- **For 1050 Pumps:** 10 mm socket wrench
- **For 1590 and 2150 Pumps:** 13 mm socket wrench

Repair kits are available (purchase separately). Use all parts in the kit for best results. See **Kits and Accessories**, starting on page 34.

Service the check valves as follows.  
See FIG. 6.

### Remove the Check Valves



To avoid severe burns, do not touch hot fluid or hot equipment.

1. Perform the **Pressure Relief Procedure**, page 12.
2. Disconnect all air and fluid lines from the equipment.
3. Remove fasteners (106) from manifolds (102, 103). Remove manifolds from fluid covers (101).

**NOTE:** Use care while removing manifolds to avoid damage to check valve components.

4. Remove balls (301), seats (201), and o-rings (202).
5. Clean and inspect for wear or damage. Replace as needed.

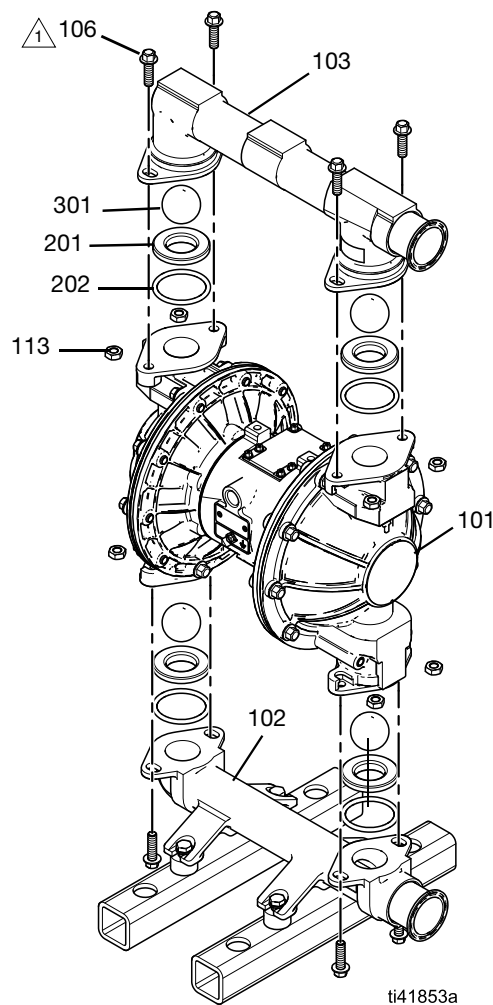
**NOTE:** To ensure proper seating, always replace all seat and check valve components when performing check valve repairs.

### Install the Check Valves

1. Install the o-rings (202), seats (201), and balls (301). See FIG. 6.

**NOTE:** Ensure that the check valves and seating areas are clean.

2. Align manifolds (102, 103) with fluid covers (101).
3. Insert fasteners (106) and torque. See **Torque Fasteners**, page 36.
4. Reconnect air and fluid lines to equipment.



1. Apply medium-strength (blue) thread locker to the threads and torque. See **Torque Fasteners**, page 36.

**FIG. 6: Check Valve Section**

## Repair the Diaphragm

### Tools Required:

- Torque wrench
- 13 mm socket wrench
- 15 mm socket wrench
- 1 in. socket wrench
- 19 mm open-end wrench
- O-ring pick
- Lithium-base grease

Repair kits are available (purchase separately). Use all parts in the kit for best results. See **Kits and Accessories**, starting on page 34.

Service the diaphragms as follows. See FIG. 7–FIG. 9.

### Remove the Diaphragms



To avoid severe burns, do not touch hot fluid or hot equipment.

1. Perform the **Pressure Relief Procedure**, page 12.
2. Disconnect all air and fluid lines from the equipment.
3. Perform **Remove the Check Valves**, page 18.
4. Remove fasteners (106, 106b) from fluid covers (101). Remove fluid covers from air covers (23).
5. Use an applicable wrench to loosen the diaphragm shaft fasteners (107). Do not remove the fastener.
6. Remove one diaphragm assembly (401). See FIG. 7.
7. Remove the other diaphragm assembly (401) with the shaft (24). See FIG. 9.
8. Disassemble the diaphragm plates (104, 105), diaphragms (401), packing o-rings (108), and fastener (107).
9. Clean and inspect for wear or damage. Replace as needed.

### Install the Diaphragms

1. Assemble the diaphragm plates (104, 105), packing o-ring (108), and diaphragm (401) onto the diaphragm shaft fastener (107). See FIG. 9.

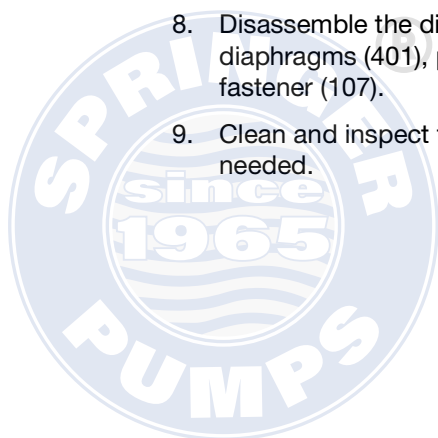
**NOTE:** Install diaphragms (401) with the side marked **AIR SIDE** facing toward the center housing (1). See FIG. 8.

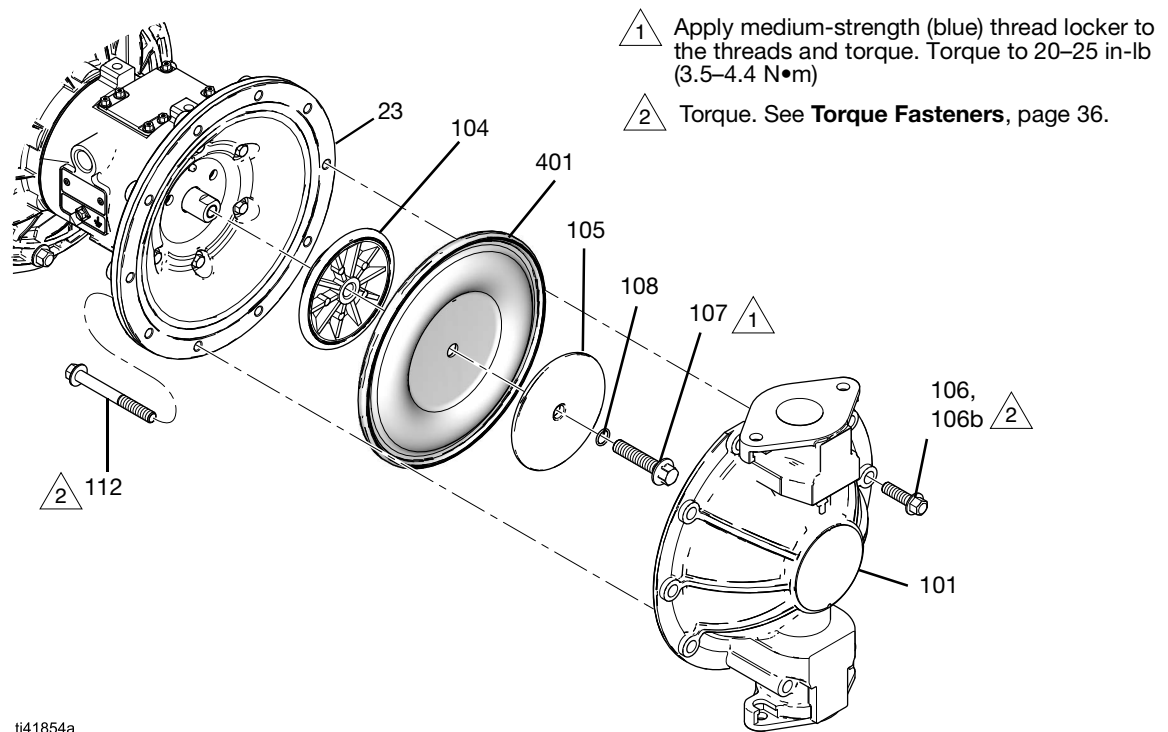
2. Screw the diaphragm assembly onto one side of the shaft (24). Torque to 20–25 in-lb (3.5–4.4 N•m).
3. Grease the length of the shaft (24) and slide through the center housing (1).
4. Repeat steps 1–2 for the other diaphragm assembly.
5. Apply medium-strength (blue) thread locker to the threads of the fluid cover fasteners (106, 106b).

### NOTICE

After reassembly, allow the thread locker to cure for 12 hours, or per manufacturer's instructions, prior to operating the equipment. Damage to the equipment will occur if the diaphragm shaft fastener loosens.

6. Align fluid covers (101) with center housing (1) and insert fluid cover fasteners (106, 106b). Torque the fasteners (106, 106b). See **Torque Fasteners**, page 36.
7. Perform **Install the Check Valves**, page 18.
8. Reconnect air and fluid lines to equipment.

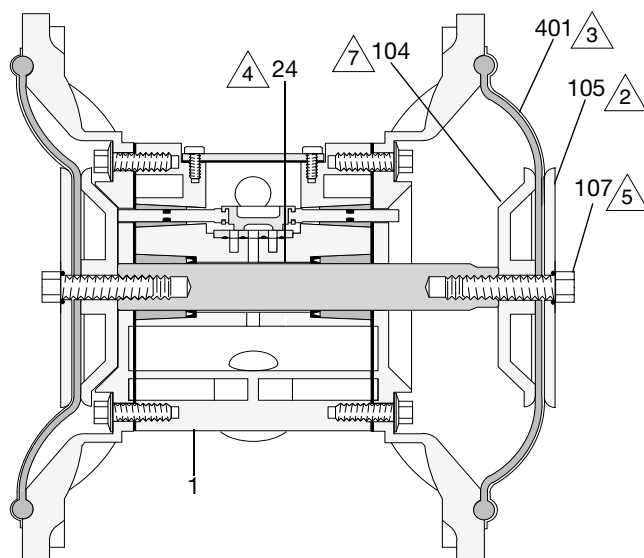




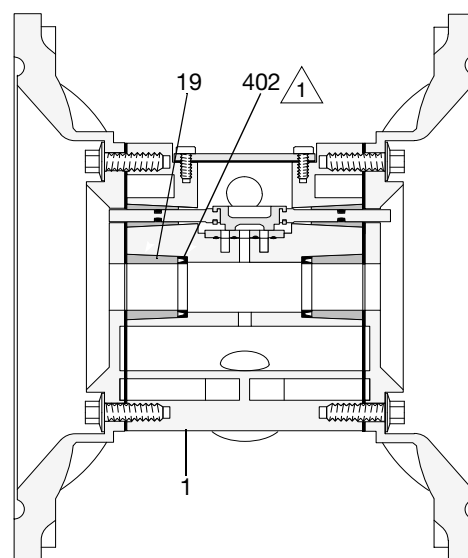
**FIG. 7: Diaphragm Section, 1590 model shown**



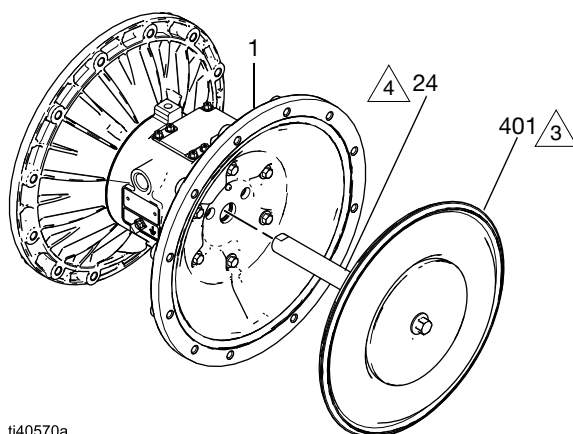




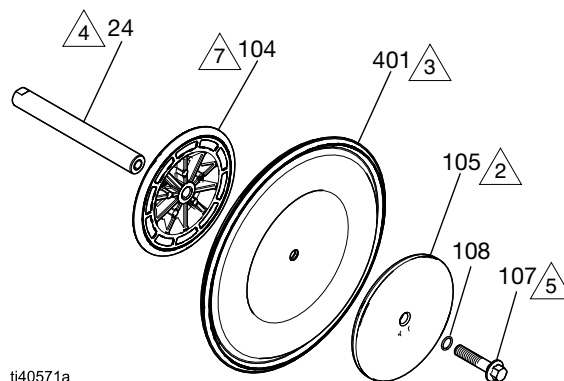
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**Cutaway View, with diaphragms**

03982A

**Cutaway View, diaphragms removed****FIG. 8: Diaphragm Section, Cutaway Views**

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ti40571a

- 1 Lips face out of housing (1).
- 2 Rounded side faces diaphragm (401).
- 3 AIR SIDE must face center housing (1).
- 4 Grease.
- 5 Apply medium-strength (blue) thread locker. Torque to 20–25 ft-lb (27–34 N•m) at 100 rpm maximum.
- 7 Recessed side faces diaphragm (401).

**FIG. 9: Diaphragm Section, Shaft Assembly, 1590 model shown**

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## Repair the Air Valve for 1050 Pumps

### Tools Required:

- Torque wrench
- 10 mm hex wrench
- Lithium-base grease

Repair kits are available (purchase separately). Use all parts in the kit for best results. See **Kits and Accessories**, starting on page 34.

Service the air valve as follows. See FIG. 10–FIG. 13.

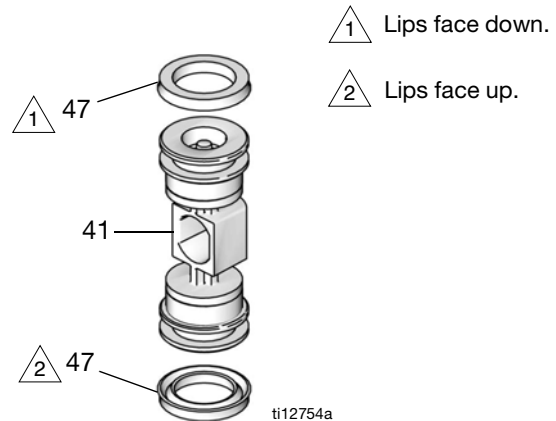
### Disassemble the Air Valve for 1050 Pumps



1. Perform the **Pressure Relief Procedure**, page 12.
2. Disconnect all air and fluid lines from the equipment.
3. Remove the fasteners (33) from the air valve housing (40).
4. Remove the air valve housing (40) from the center section (1).
5. Remove the valve plate (44), cup assembly (51, 52, 53), spring (50), and detent assembly (42).
6. Pull the cup (52) off of the base (51).
7. Remove the o-ring (53) from the cup.
8. Remove the retaining ring (49) from each end of the air valve housing (40).
9. Use the piston (41) to push the end caps (46) out of the ends of the air valve housing (40).
10. Remove end cap o-rings (45).
11. Remove the u-cup seals (47) from each end of the piston (41), then remove the piston.
12. Remove the detent cam (43) from the air valve housing (40).
13. Clean and inspect for wear or damage. Replace as needed.

### Install the Air Valve for 1050 Pumps

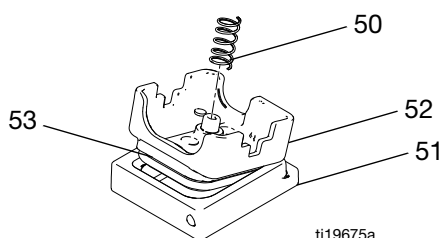
1. Grease the detent cam (43).
2. Install the detent cam (43) into housing (40).
3. Grease the u-cups (47).
4. Install the u-cups (47) on the piston (41). Ensure the lips of the u-cups (47) face toward the center of the piston (41).



**FIG. 10: Air valve u-cup installation**

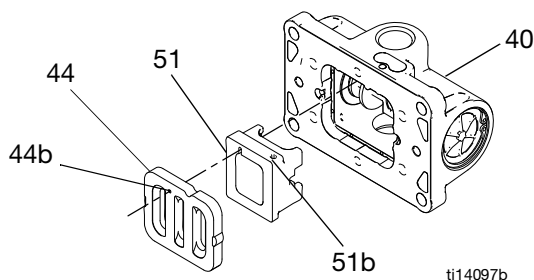
5. Grease both ends of the piston (41).
  6. Install the piston (41) in the housing (40), with the flat side toward the cup (51).
- NOTE:** Be careful not to tear the u-cups (47) when sliding the piston (41) into the housing (40).
7. Install a retaining ring (49) on each end of the housing (40) to hold the end caps in place.
  8. Grease and install the detent assembly (42) into the piston (41).
  9. Install the o-ring (53) on the cup (52).
  10. Apply a light film of grease to the outside surface of the o-ring (53) and the inside mating surface of the base (51).
  11. Orient the end of the base (51) with the magnet (51b) toward the end of the cup (52) with the larger cutout. Engage the opposite end of the parts. Leave the end with the magnet free.
  12. Tilt the base (51) toward the cup (52) and fully engage the parts. Ensure that the o-ring (53) remains in place.
  13. Install the spring (50) onto the protrusion on the cup (52).

14. Align the magnet (51b) in the base (51) with the air inlet (40b) of the housing (40) and install the cup (52) assembly.



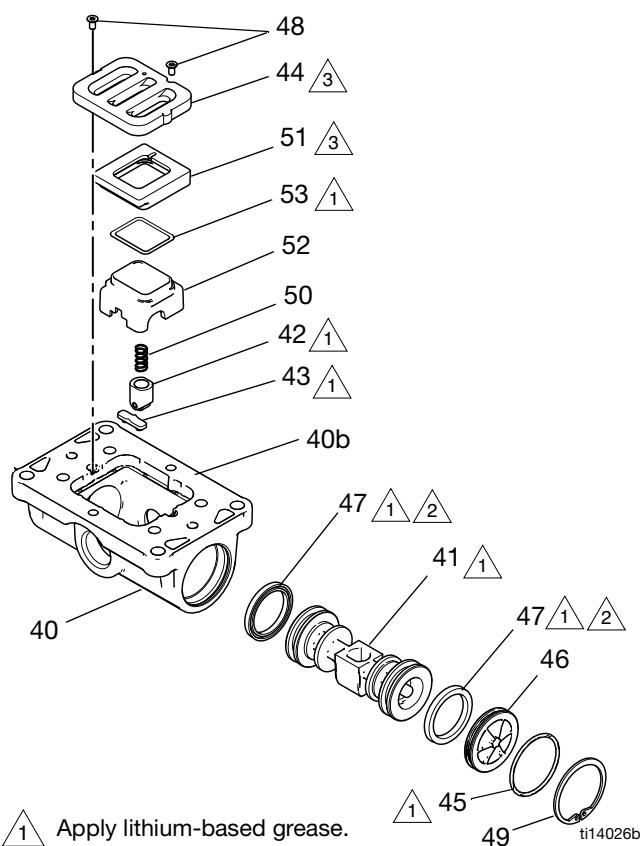
**FIG. 11: Base assembly**

15. Grease the cup (52) side and install the valve plate (44).
16. Align the small hole (44b) in the plate with the air inlet (40b).
17. Install the fasteners (48). Securely tighten.



**FIG. 12: Air valve cup and plate installation**

18. Align the air valve housing (40) to the center section (1) and secure in place with fasteners (33). Torque fasteners (33) to 80 in-lb (9.0 N•m).
19. Reconnect the equipment to air and fluid lines.



1 Apply lithium-based grease.

2 U-cup lips must face piston.

3 Apply lithium-based grease to contact surface.

**FIG. 13: Air valve assembly, 1050 pumps**



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## Repair the Air Valve for 1590 and 2150 Pumps

### Tools Required:

- Torque wrench
- 13 mm socket wrench
- Needle-nose pliers
- O-ring pick
- Lithium-base grease

Repair kits are available (purchase separately). Use all parts in the kit for best results. See **Kits and Accessories**, starting on page 34.

Service the air valve as follows. See FIG. 14–FIG. 17.

### Disassemble the Air Valve for 1590 and 2150 Pumps

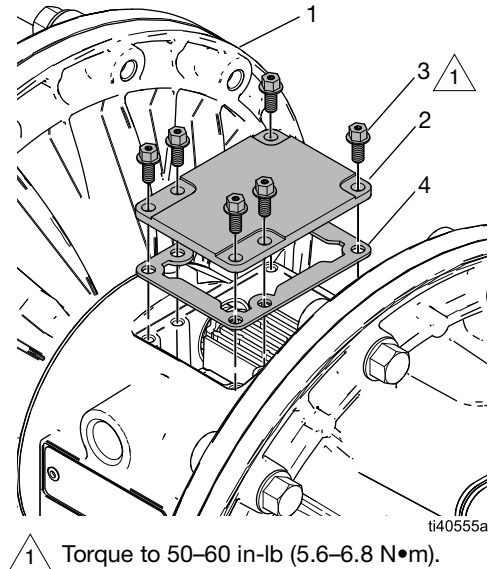


1. Perform the **Pressure Relief Procedure**, page 12.
2. Disconnect all air and fluid lines from the equipment.
3. Use an applicable screwdriver or wrench to remove the fasteners (3) from the valve cover (2) on the center housing (1). Remove valve cover (2) and gasket (4) from center housing (1).
4. Move the valve carriage (5) to the center position and pull it out of the cavity.
5. Remove the valve block (7) and o-ring (6) from the carriage.
6. Use a needle-nose pliers to pull the pilot block (18) straight up and out of the cavity. See FIG. 15.
7. Pull the actuator pistons (11) out of the bearings (12). See FIG. 16.
8. Remove the u-cup packings (10) from the pistons. Pull the pilot pins (16) out of the bearings (15).
9. Remove the o-rings (17) from the pilot pins.
10. Inspect the valve plate (8). If damaged, use an applicable screwdriver or wrench to remove the fasteners (3). Remove the valve plate (8) and seal (9). See FIG. 17.

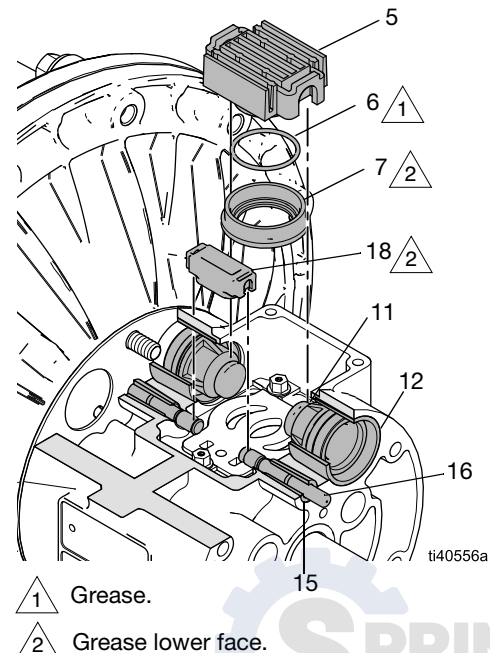
11. Inspect the bearings (12, 15). If damaged, follow **Replace the Bearing and Air Gasket**, page 26.

**NOTE:** Do not remove undamaged bearings.

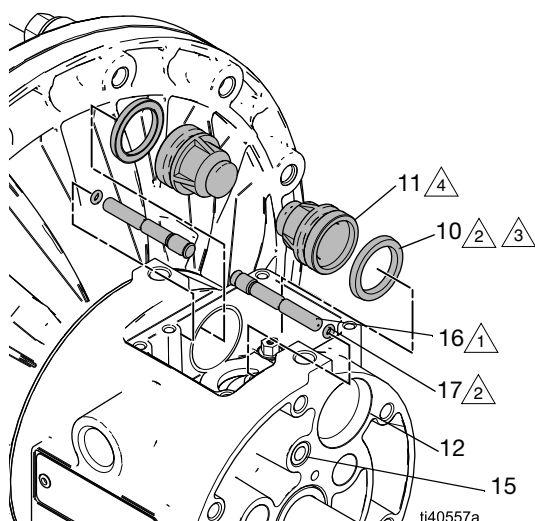
12. Clean and inspect for wear or damage. Replace as needed.



**FIG. 14: Air Valve Access**

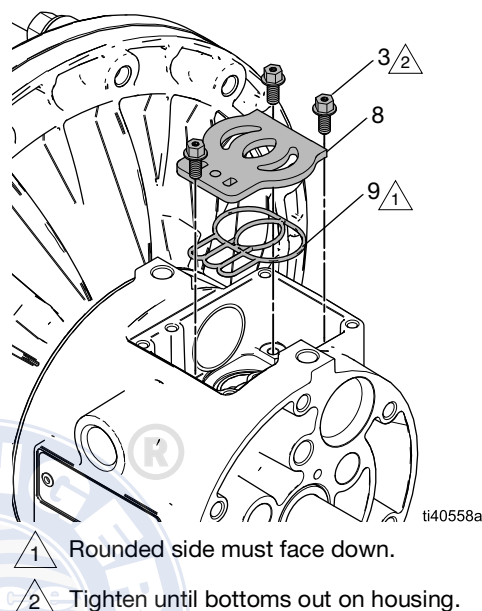


**FIG. 15: Air Valve Carriage**



- 1 Insert narrow end first.
- 2 Grease.
- 3 Lips face narrow end of piston (11).
- 4 Insert wide end first.

**FIG. 16: Air Valve Pistons**



**FIG. 17: Air Valve Plate**

## Install the Air Valve for 1590 and 2150 Pumps

1. If bearings (12, 15) were removed, install new bearings. See **Replace the Bearing and Air Gasket**, page 26.
2. Install the valve plate seal (9) into the groove at the bottom of the valve cavity. Ensure the rounded side of the seal faces down into the groove. See FIG. 17.
3. Install the valve plate (8) in the cavity. The plate is reversible, so either side can face up.
4. Use an applicable screwdriver or wrench to install the fasteners (3). Tighten until the fasteners bottom out on the housing. See FIG. 9.
5. Install an o-ring (17) on each pilot pin (16). Grease the pins and o-rings.
6. Insert the pilot pins (16) into the bearings (15), narrow end first. See FIG. 16.
7. Install a u-cup packing (10) on each actuator piston (11). Ensure the lips of the packings face the narrow end of the pistons. See FIG. 16.
8. Lubricate the u-cup packings (10) and actuator pistons (11). Reach inside the cavity and insert the actuator pistons into the bearings (12), wide end first. Leave the narrow end of the pistons exposed. See FIG. 16.
9. 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. 15.
10. Grease the o-ring (6) and install it in the valve block (7). See FIG. 15.
11. Push the valve block (7) onto the valve carriage (5). Grease the lower face of the valve block. See FIG. 15.
12. Install the valve carriage (5) so its tabs slip into the grooves on the narrow end of the actuator pistons (11). See FIG. 15.
13. Align the valve gasket (4) and cover (2) with the center housing (1) holes.
14. Insert fasteners (3). Torque to 50–60 in-lb (5.6–6.8 N•m). See FIG. 14.
15. Reconnect the equipment to air and fluid lines.



## Replace the Bearing and Air Gasket

### Tools Required:

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

Service the bearing and air gasket as follows. See FIG. 18–FIG. 19.

### Remove the Bearing and Air Gasket



To avoid severe burns, do not touch hot fluid or hot equipment.

**NOTE:** Do not remove undamaged bearings.

1. Perform the **Pressure Relief Procedure**, page 12.
2. Remove the manifolds and disassemble the check valves. See **Repair the Check Valve**, page 18.
3. Remove the fluid covers and diaphragm assemblies. See **Repair the Diaphragm**, page 19.
4. If necessary, disassemble the air valves. See **Repair the Air Valve for 1050 Pumps**, page 22, or **Repair the Air Valve for 1590 and 2150 Pumps**, page 24.

**NOTE:** It is not necessary to remove the air valves if only removing the diaphragm shaft bearing (19).

5. Use an applicable wrench to remove the fasteners (25) holding the air covers (23) to the center housing (1).
6. Remove the air cover gaskets (22). Always replace with new gaskets.
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 the diaphragm shaft bearings (19) were removed, reach into the center housing (1) with an o-ring pick to hook the u-cup packings (402). Remove u-cup packings from the housing.
9. Inspect parts for wear or damage. Replace as necessary.

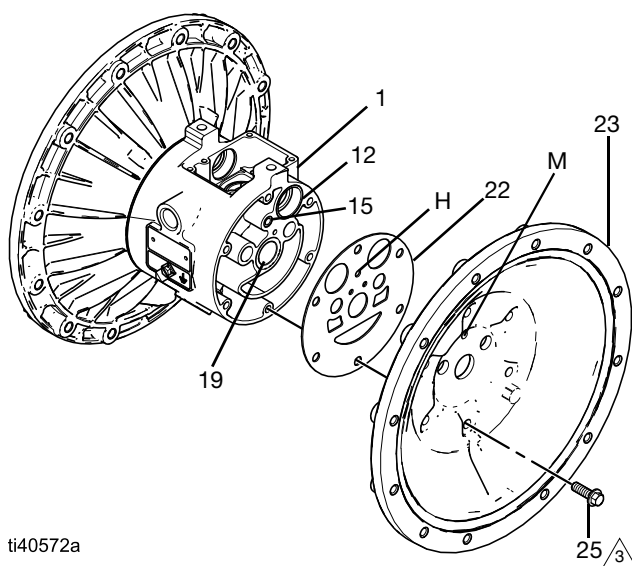
### Install the Bearing and Air Gasket

1. If removed, install the shaft u-cup packings (402). Ensure the lips face out of the housing (1).
2. The bearings (19, 12, and 15) are tapered and can only be installed one way. Insert the bearings into the center housing (1), tapered end first. Use a press or a block and rubber mallet to press-fit the bearing. Ensure the bearing is flush with the surface of the center housing.
3. If necessary, reassemble the air valve. See **Repair the Air Valve for 1050 Pumps**, page 22, or **Repair the Air Valve for 1590 and 2150 Pumps**, page 24.
4. Align the new air cover gasket (22) on the pilot pin (16) protruding from the center housing (1). Ensure the pin 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 fasteners (25) and hand-tighten.
6. Use an applicable wrench to torque the fasteners (25) to 120–150 in-lb (14–17 N•m).
7. Install the diaphragm assemblies and fluid covers. See **Install the Diaphragms**, page 19.
8. Reassemble the check valves and manifolds. See **Install the Check Valves**, page 18.

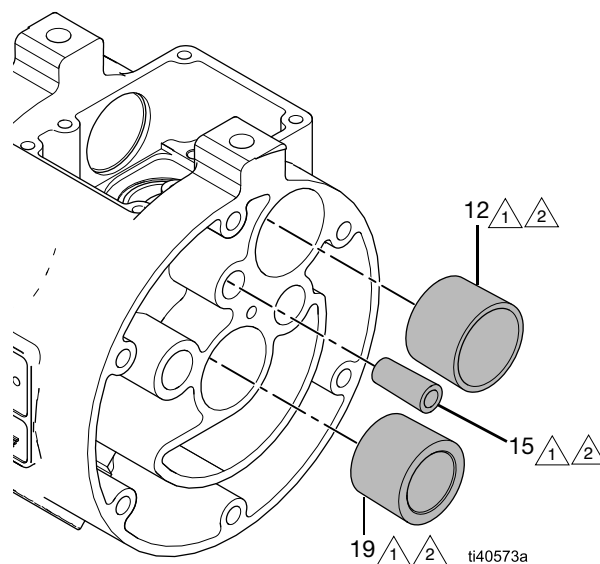




- 1 Insert bearings tapered end first.
- 2 Press-fit bearings flush with surface of center housing (1)
- 3 Apply medium-strength (blue) thread locker to the threads. Torque to 120–150 in-lb (14–17 N•m).



**FIG. 18: Bearing and Air Gasket**

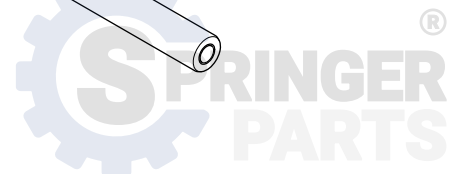
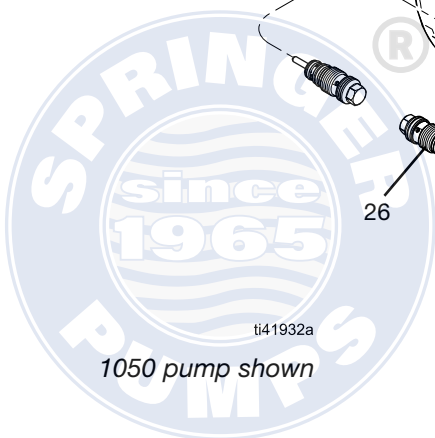
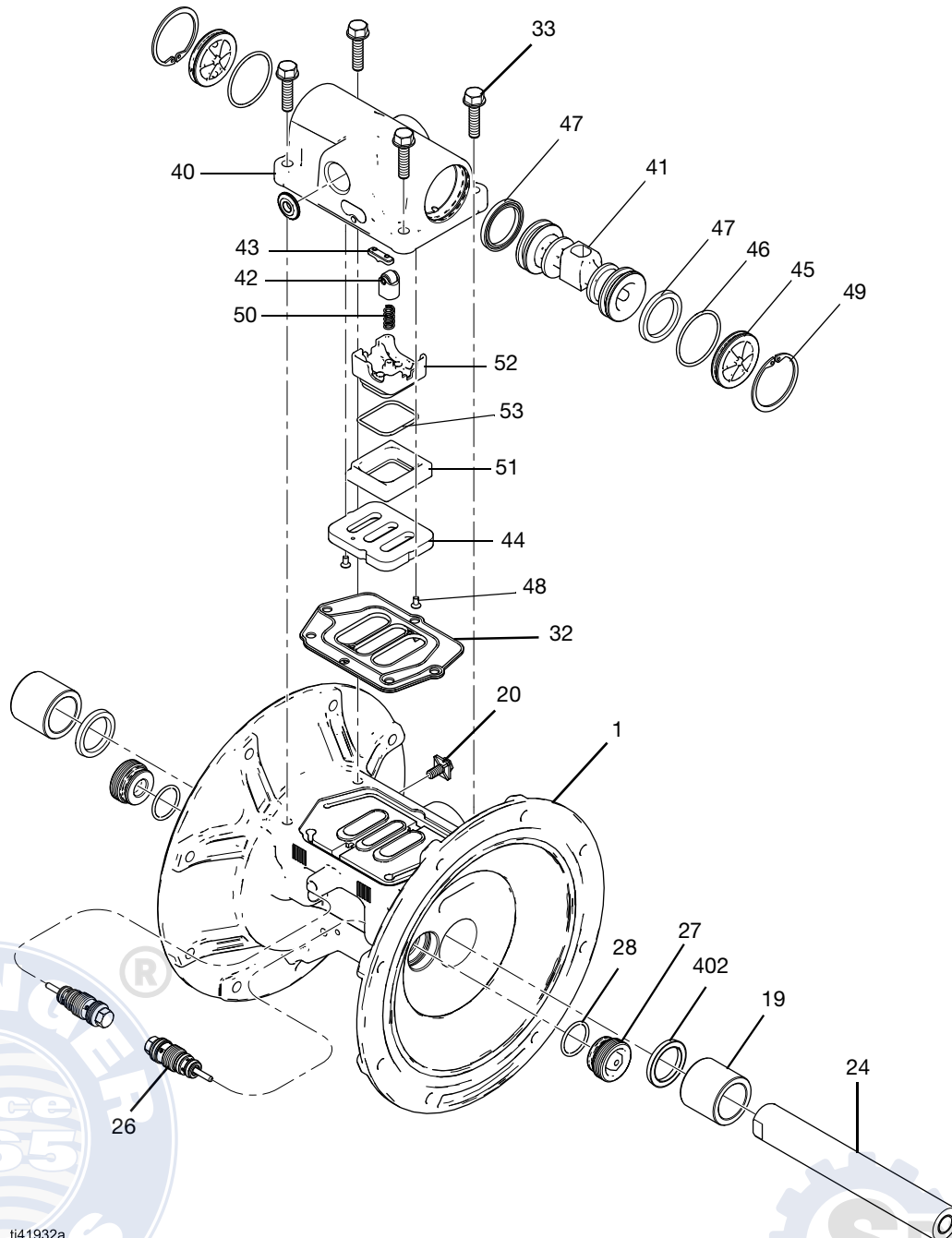


**FIG. 19: Detail of Air Valve Bearings**



## Parts

### Center Section and Air Section Parts for 1050 Pumps



## Center Section and Air Section Parts List for 1050 Pumps

Ref.	Part No.	Description	Qty.
1	18F321*	HOUSING, center	1
19	---*	BEARING, shaft	2
20	116343	SCREW, grounding	1
24	15R677	SHAFT, diaphragm	1
26	---*	VALVE, pilot	2
27	---*	CARTRIDGES, pilot valve receiver	2
28	---*	O-RING, receiver cartridge	2
32	---*	GASKET, air valve	1
33	---*	FASTENER, M6 x 25, stainless steel	4
40	---	HOUSING, air valve	1
41	---*	PISTON	1
42	---*	DETENT PISTON ASSEMBLY	1
43	---*	CAM, detent	1
44	---*	PLATE, air valve	1
45	---*	O-RING	2

46	---*	CAP, end	2
47	---*	U-CUP	2
48	---*	SCREW	2
49	---*	RETAINING RING	2
50	---*	DETENT SPRING	1
51	---*	BASE, cup	1
52	---*	CUP	1
53	---*	O-RING, cup	1
402	112181*	PACKING, u-cup	2

--- Not available or not available separately.

\* See **Kits and Accessories**, page 34.



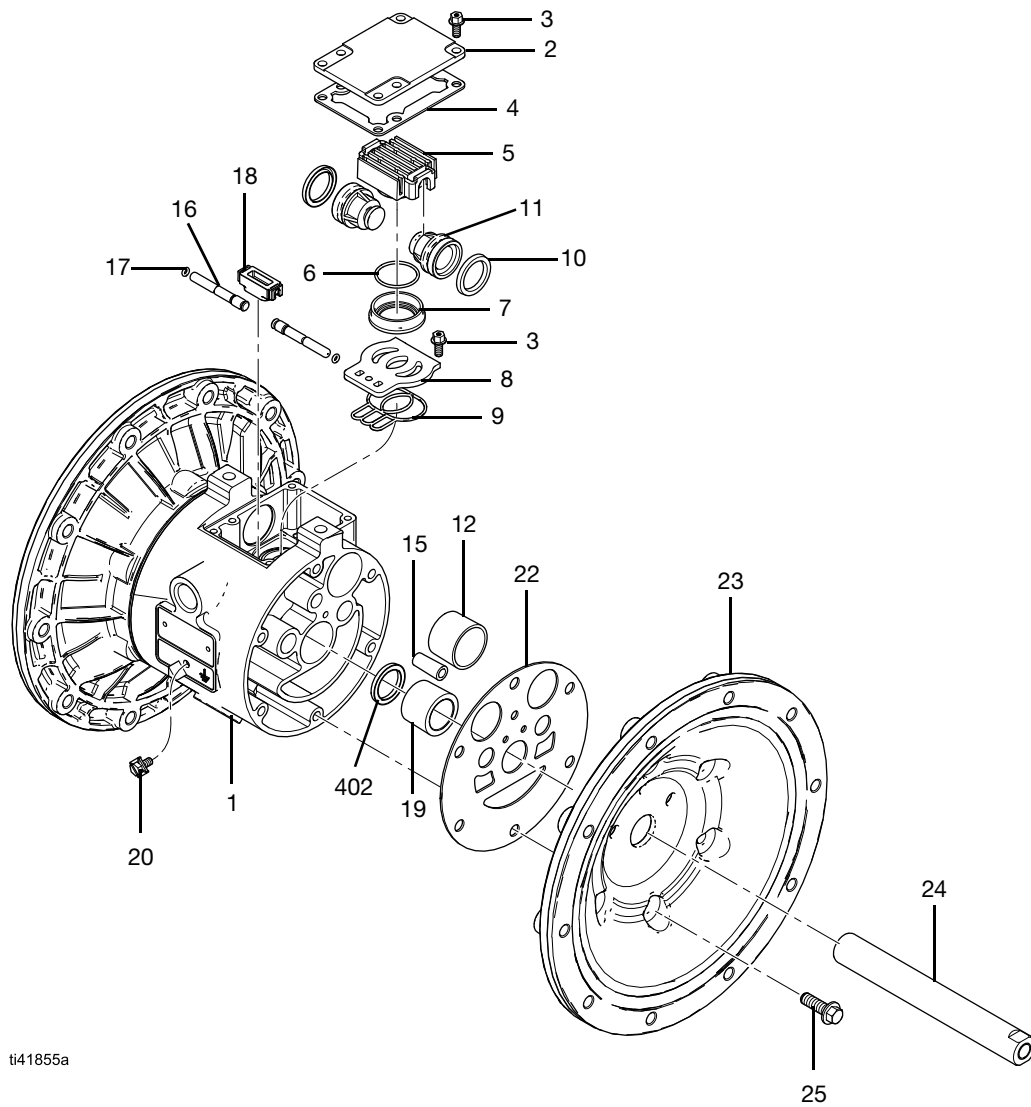
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## Center Section and Air Section Parts for 1590 and 2150 Pumps



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1590 pump shown



### Center Section and Air Section Parts List for 1590 and 2150 Pumps

Ref.	Part No.	Description	Qty.
1	188838	HOUSING, center	1
2	188854	COVER, air valve	1
3	116344	FASTENER	9
4	---*	GASKET, cover	1
5	188855	CARRIAGE	1
6	---*	O-RING	1
7	---*	BLOCK, air valve	1
8	188615	PLATE, air valve	1
9	---*	SEAL, valve plate	1
10	---*	PACKING, u-cup	2
11	188612	PISTON, actuator	2
12	188613	BEARING, piston	2
15	188611	BEARING, pin	2
16	188610	PIN, pilot	2
17	---*	O-RING; Buna-N	2
18	---*	BLOCK, pilot	1
19	188609	BEARING, shaft	2

20	116343	SCREW, grounding	1
22	188603	GASKET, air cover	2
23		COVER, air	2
	189400	for 1590 pumps	
	189300	for 2150 pumps	
24		SHAFT, diaphragm	1
	189245	for 1590 pumps	
	189304	for 2150 pumps	
25		FASTENER	12
	115643	for 1590 pumps; M8 x 1.25; 25 mm (1 in.), aluminum	
		for 2150 pumps; M8 x 1.25; 25 mm (1 in.), aluminum	
	112178	FASTENER; M8 x 1.25; 25 mm (1 in.), stainless steel	
402	112181	PACKING, u-cup	1

--- Not available or not available separately.

\* See **Kits and Accessories**, page 34.



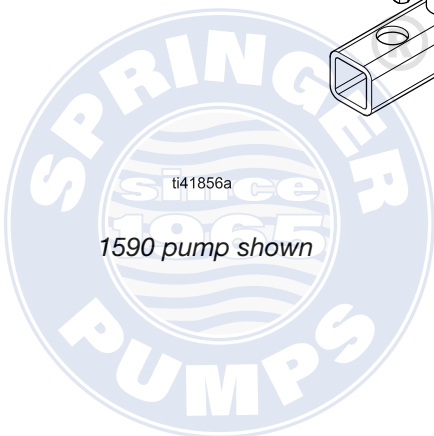
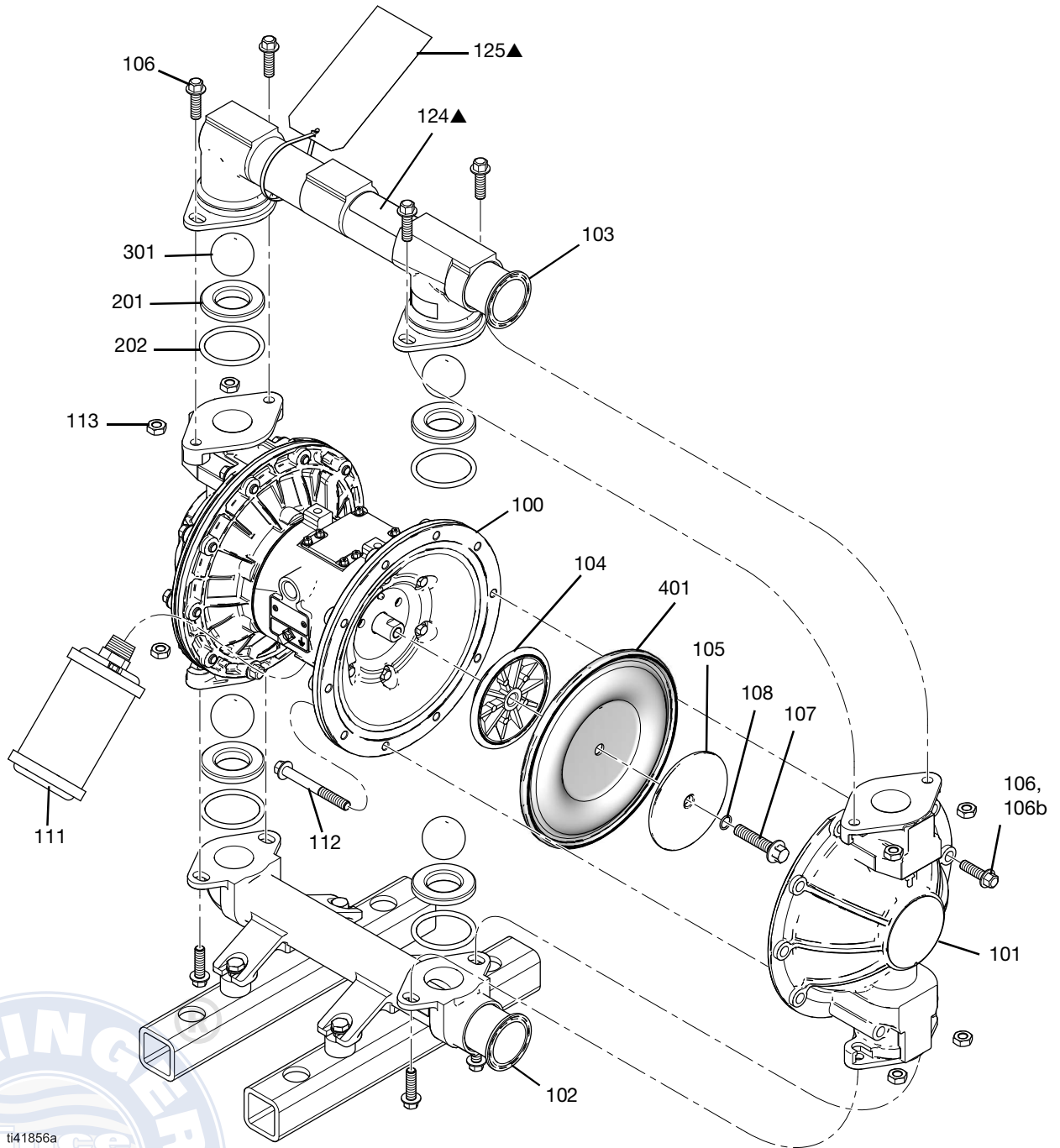
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## Fluid Section Parts





## Fluid Section Parts List

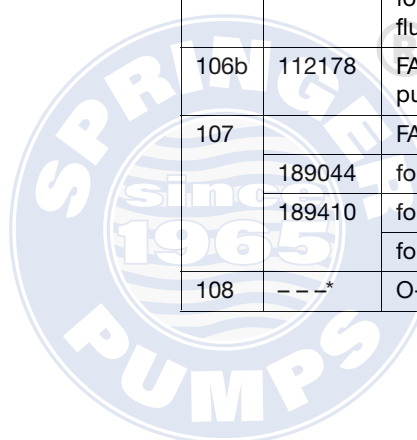
Ref.	Part/Kit	Description	Qty.
100		MOTOR, assembly	1
	20A734	for 1050 pumps	
	237372	for 1590 pumps	
	237360	for 2150 pumps	
101		COVER, fluid	2
	277929	for 1050 pumps	
	194169	for 1590 pumps	
	194279	for 2150 pumps	
102		MANIFOLD, inlet	1
	25U949	for 1050 pumps	
	24U888	for 1590 pumps	
	20B147	for 2150 pumps	
103		MANIFOLD, outlet	1
	20B206	for 1050 pumps	
	20B146	for 1590 pumps	
	20B148	for 2150 pumps	
104		PLATE, air side	2
	15R689	for 1050 pumps	
	15K448	for 1590 pumps	
	189298	for 2150 pumps	
105		PLATE, fluid side	2
	15X356	for 1050 pumps	
	189843	for 1590 pumps	
	189299	for 2150 pumps	
106		FASTENER	
	15Y149	for 1050 pumps; for manifold only; M8 x 1.25	16
	112416	for 1590 pumps; for manifold and fluid cover; M10 x 1.50	24
		for 2150 pumps; for manifold and fluid cover; M10 x 1.50	
106b	112178	FASTENER; fluid cover; for 1050 pumps only; M8 x 1.25	16
107		FASTENER	2
	189044	for 1050 pumps; M12 x 1.75	
	189410	for 1590 pumps; M12 x 1.75	
		for 2150 pumps; M12 x 1.75	
108	---	O-RING	2

111		MUFFLER	1
	24D642	for 1050 pumps	
	102656	for 1590 pumps for 2150 pumps	
112		FASTENER	
	---	for 1050 pumps	
	115645	for 1590 pumps; M10 x 1.50	
	112417	for 2150 pumps; M10 x 1.50	8
113		NUT, hex	
	112257	for 1050 pumps	
	114862	for 1590 pumps for 2150 pumps	
124▲	188621	LABEL, safety, warning	1
125▲		TAG, re-torque	1
	15Y997	for 1050 pumps	
	15H975	for 1590 pumps	
	15J142	for 2150 pumps	
201		SEAT	4
	---	for 1050 pumps	
	---	for 1590 pumps	
	---	for 2150 pumps	
202		O-RING	
	---	for 1050 pumps	
	---	for 1590 pumps	
	---	for 2150 pumps	4
301		BALL	4
	---	for 1050 pumps	
	---	for 1590 pumps	
	---	for 2150 pumps	
401		DIAPHRAGM	2
	---	for 1050 pumps	
	---	for 1590 pumps	
	---	for 2150 pumps	

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

--- Not available or not available separately.

\* See **Kits and Accessories**, page 34.



# Kits and Accessories

To define material codes and reference numbers, see **Configuration Matrix**, page 5, and **Parts**, starting on page 28.

## Part Kits

Part kits are available (purchase separately).

### Seat Kits

Pump	Kit No.	Includes Refs.	Description	Qty.
1050	24B637	201	SEAT	4
	24B655	202	O-RING	12
1590	26B430	201	SEAT	4
	26B256	202	O-RING	12
2150	26C568	201	SEAT	4
	26B355	202	O-RING	4

### Check Valve Kits

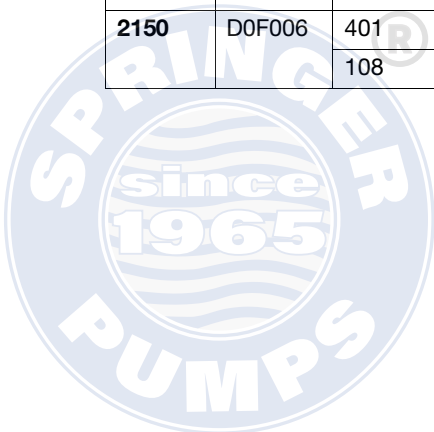
Pump	Kit No.	Includes Refs.	Description	Qty.
1050	24B644	202	O-RING	8
		301	BALL	4
1590	26B431	301	BALL	4
2150	D0F0H0	301	BALL	4

### Diaphragm Kits

Pump	Kit No.	Includes Refs.	Description	Qty.
1050	25B628	401	DIAPHRAGM	2
		108	O-RING	2
1590	D0B006	401	DIAPHRAGM	2
		108	O-RING	2
2150	D0F006	401	DIAPHRAGM	2
		108	O-RING	2

### Air Valve Repair Kits

Pump	Kit No.	Includes Refs.	Description	Qty.
1050	24B768	41	PISTON	1
		42	DETENT PISTON ASSEMBLY	1
		43	CAM, detent	1
		44	PLATE	1
		45	O-RING	2
		47	U-CUP	2
		48	SCREW	2
		50	DETENT SPRING	1
		51	BASE, cup	1
		52	CUP	1
		53	O-RING, cup	1
1590 2150	236273	4	GASKET, cover	1
		6	O-RING	1
		7	BLOCK, air valve	1
		9	SEAL, valve plate	1
		10	PACKING, u-cup	2
		17	O-RING; Buna-N	2
		18	BLOCK, pilot	1



### Center Section Rebuild Kits

Pump	Kit No.	Includes Refs.	Description	Qty.
1050	24B621	26	VALVE	2
		27	CARTRIDGES	2
		28	O-RING	2
		24	SHAFT	1
		19	BEARING	2
		402	U-CUP	2
		32	GASKET	1
		33	FASTENER	4
1590	---	---	---	—
2150	---	---	---	—

### Center Housing Kits

Pump	Kit No.	Includes Refs.	Description	Qty.
1050	24X345	19	BEARING	2
		402	U-CUP	2
		1	HOUSING	1
1590	---	---	---	—
2150	---	---	---	—

### Air Valve Seals Kits

Pump	Kit No.	Includes Refs.	Description	Qty.
1050	24B769	45	O-RING	2
		47	U-CUP	2
		48	SCREW	2
1590	---	---	---	—
2150	---	---	---	—

### Air Valve End Cap Kits

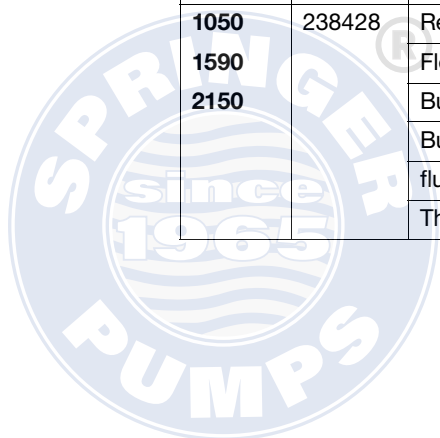
Pump	Kit No.	Includes Refs.	Description	Qty.
1050	24A361	45	O-RING	2
		46	CAP, end	2
		49	RETAINING RING	2
1590	---	---	---	—
2150	---	---	---	—

## Accessory Kits

Accessory kits are available (purchase separately).

### Fluid Pressure Relief Valve Kits

Pump	Kit No.	Includes	Qty.
1050	238428	Relief valve	1
1590		Flexible tube	1
2150		Bushing, 3/4 npt(m) x 3/8 npt(f)	2
		Bushing, 1.0 npt(m) x 3/8 npt(f)	2
		fluid line adapter	2
		Thread sealant	1



# Torque Fasteners

## Torque Instructions

To ensure proper sealing, torque fasteners using the following procedure.

1. Start all fasteners a few turns.
2. Follow the torque sequence to turn down each fastener until each fastener is slightly under the specified torque. See **Torque Sequence**, page 36.
3. Follow the torque sequence to turn each fastener by 1/2 turn or less until each fastener is at the specified torque. See **Torque Sequence**, page 36.

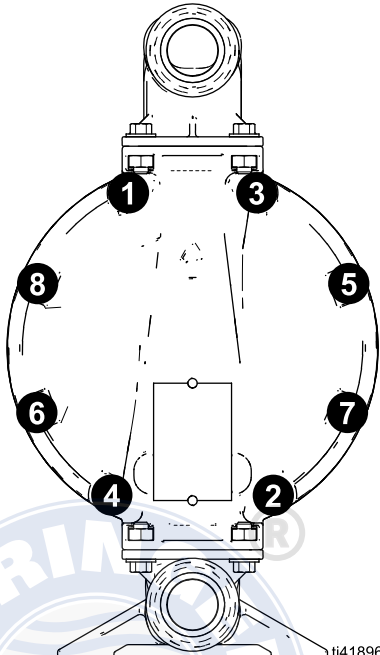
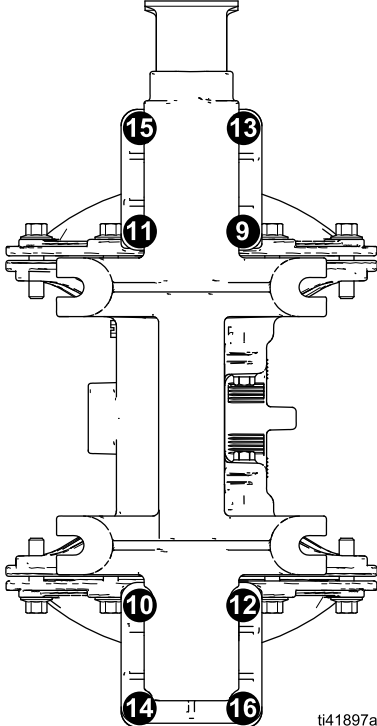
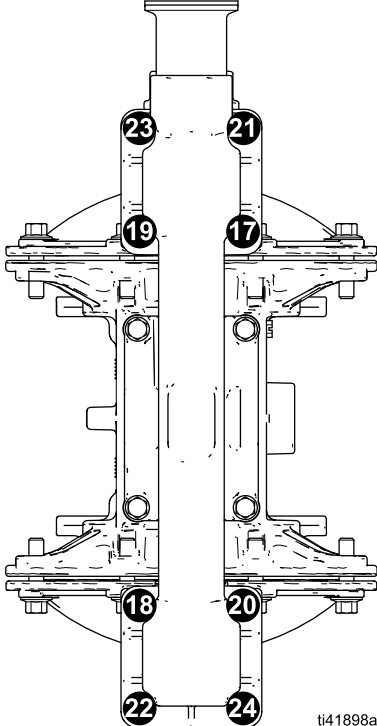
## Torque Sequence

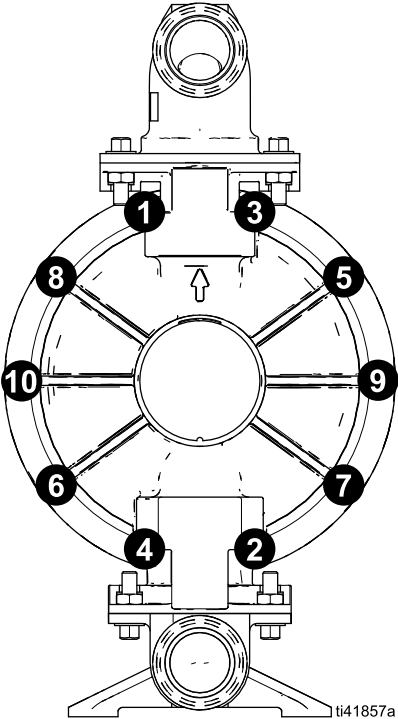
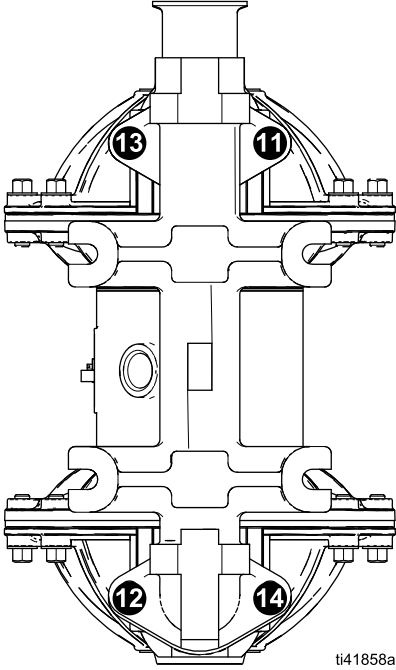
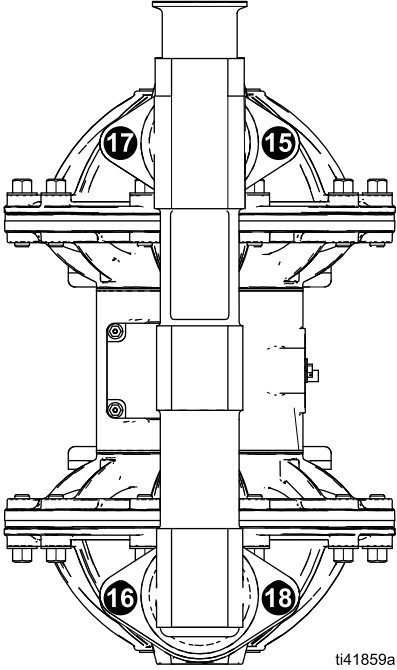
Fully torque all fasteners on the fluid covers before torquing the fasteners on the manifolds.

Follow **Torque Instructions**, page 36.

### NOTICE

To avoid pump damage, do not over-torque the fasteners on the equipment.

Torque Sequence for 1050 Pumps		
Fluid Covers	Manifolds	
For 1050 Pumps: Torque to 90 in-lb (16 N•m)	For 1050 Pumps: Torque to 90 in-lb (16 N•m)	
 ti41896a	 ti41897a	 ti41898a

Torque Sequence for 1590 and 2150 Pumps		
Fluid Covers	Manifolds	
For 1590 and 2150 Pumps: Torque to 190–220 in-lb (33–39 N•m)	For 1590 and 2150 Pumps: Torque to 120–150 in-lb (21–26 N•m)	
 ti41857a	 ti41858a	 ti41859a



## Performance Charts

**To find Fluid Outlet Pressure** (psi/bar/MPa) at a specific fluid flow (gpm/lpm) and operating air pressure (psi/bar/MPa):

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

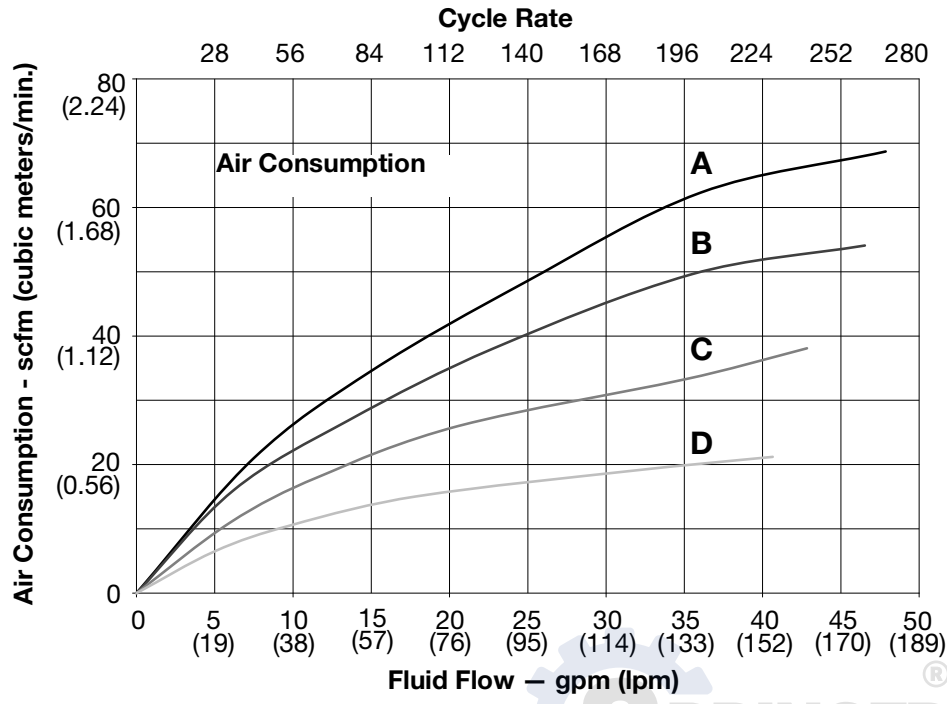
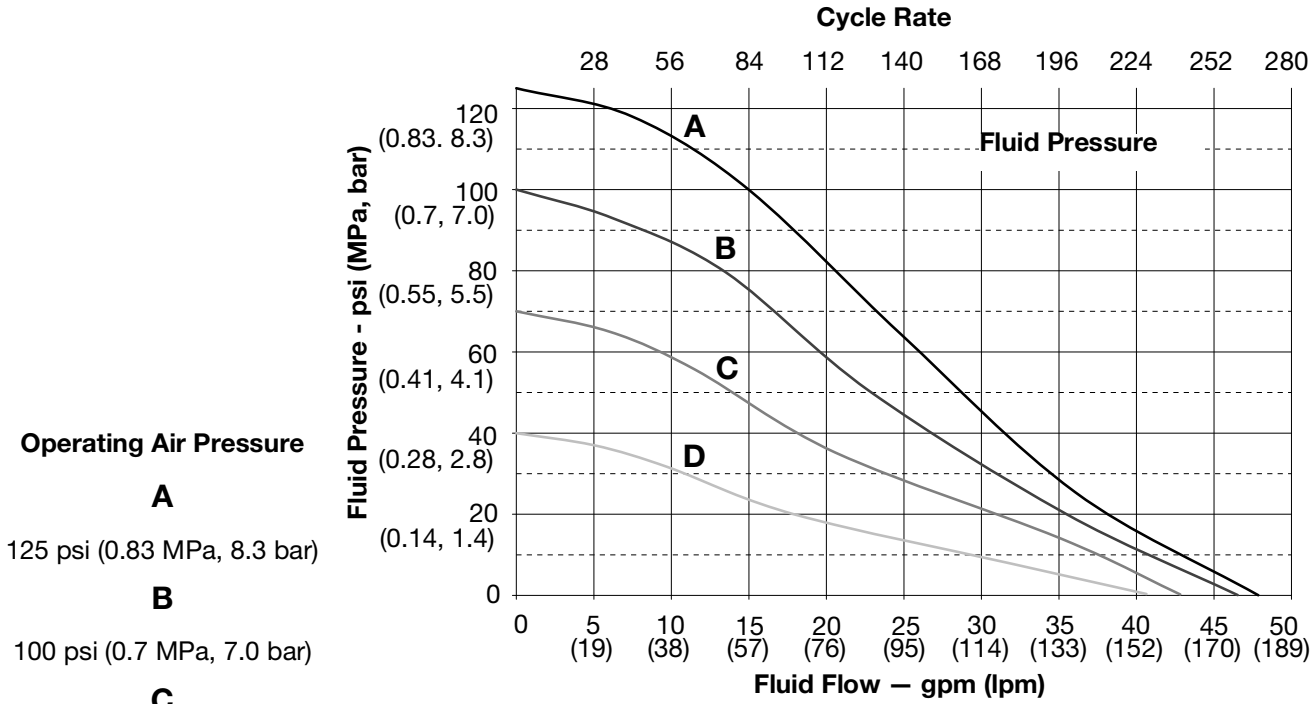
**To find Air Consumption** (scfm or m<sup>3</sup>/min) at a specific fluid flow (gpm/lpm) and air pressure (psi/bar/MPa):

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



# Performance Charts for 1050 Pumps

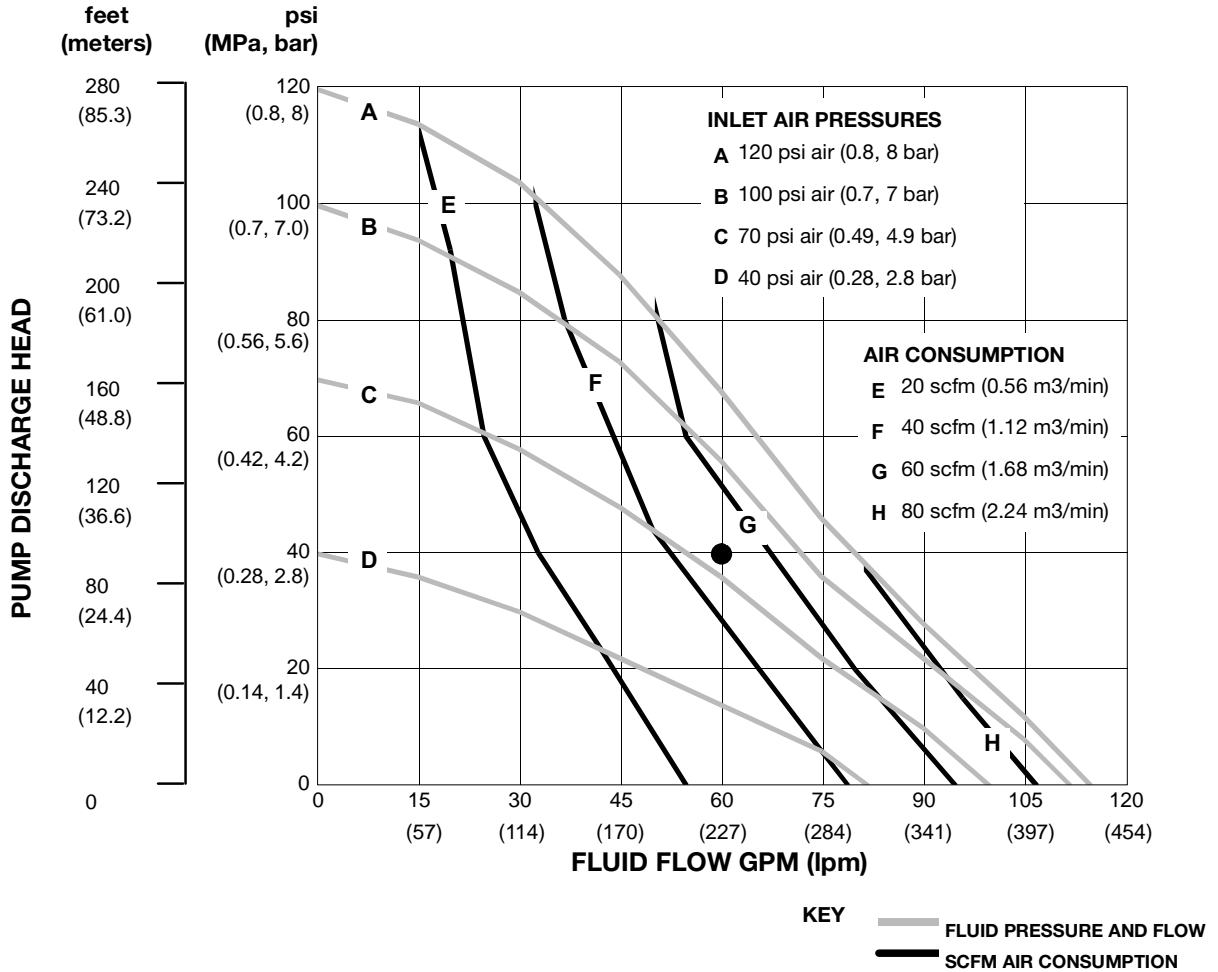
**Test Conditions:** Pump tested in water with inlet submerged.





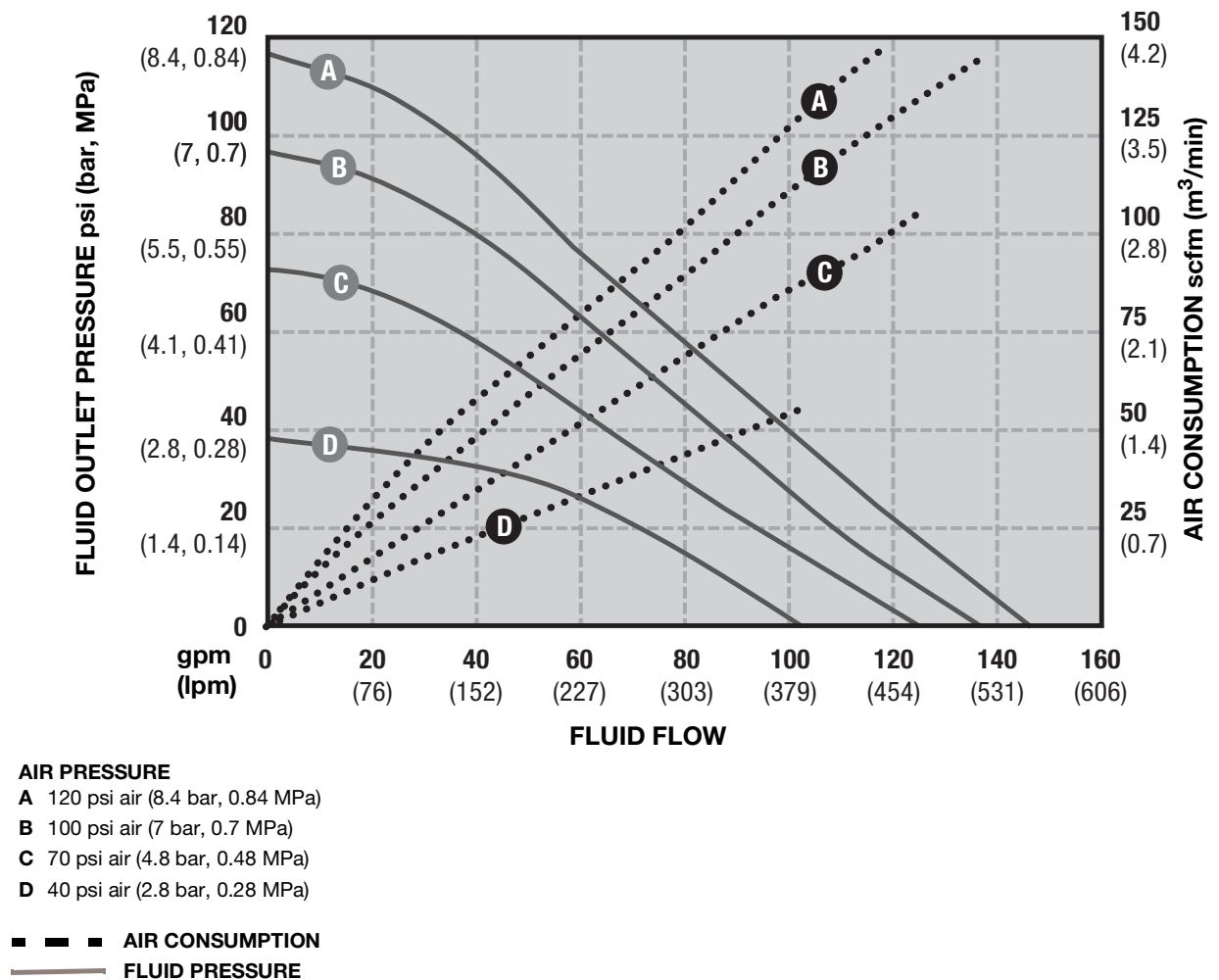
## Performance Chart for 1590 Pumps

**Test Conditions:** Pump tested in water with inlet submerged.



## Performance Chart for 2150 Pumps

**Test Conditions:** Pump tested in water with inlet submerged.



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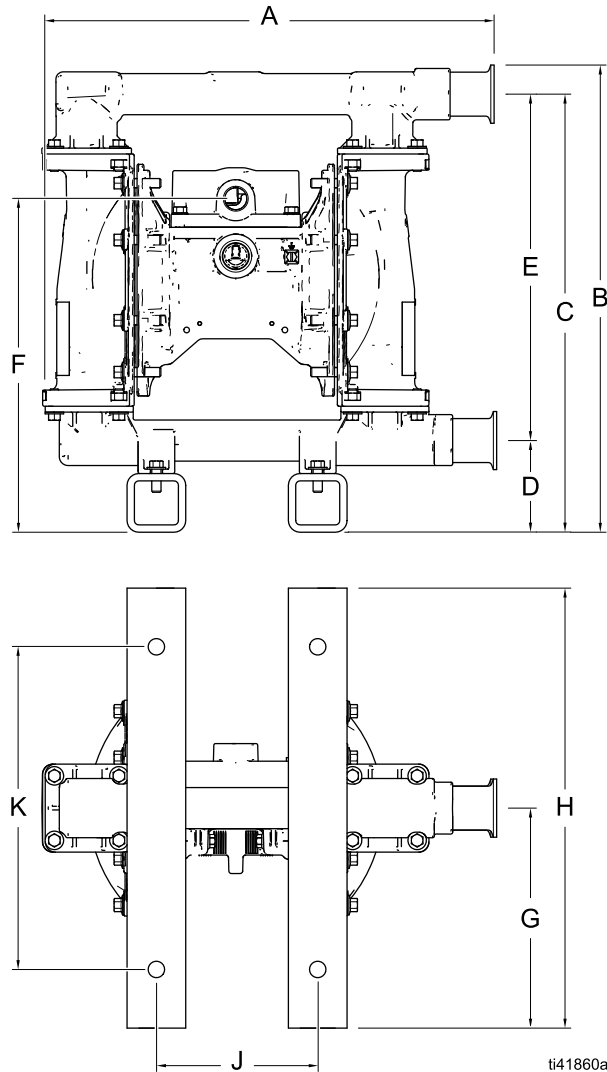
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# Dimensions

## Dimensions for 1050 Pumps

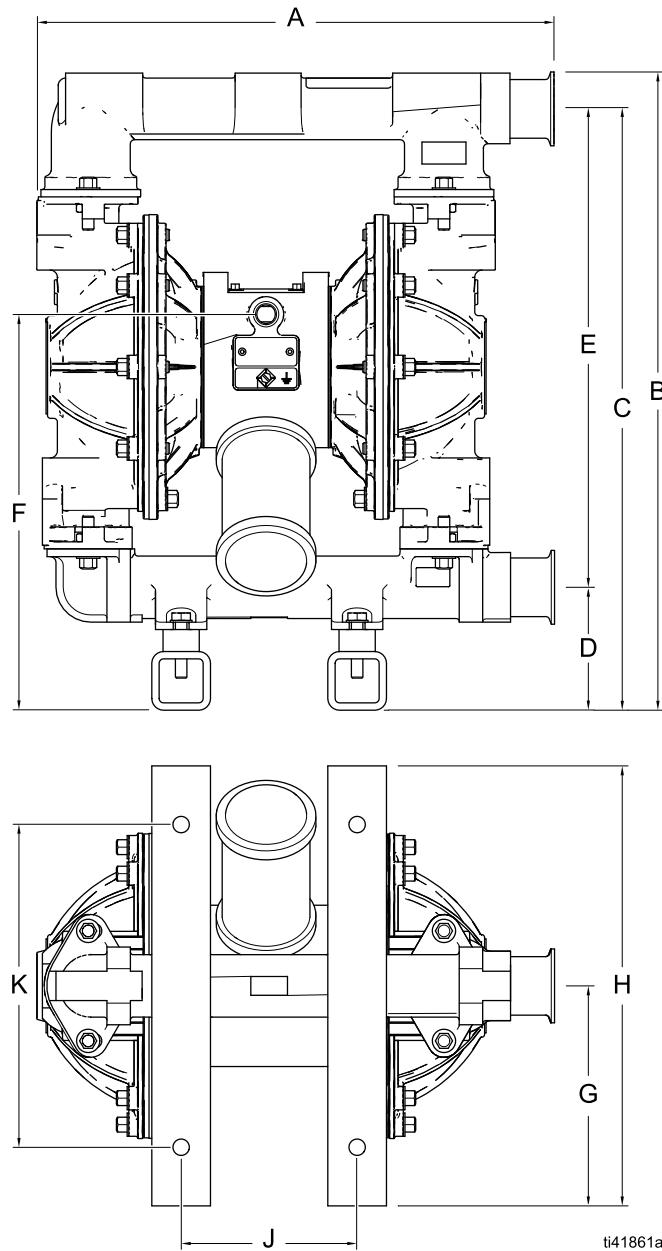


**Dimensions for 1050 Pumps**

	A	B	C	D	E	F	G*	H*	J	K*
in.	51.48	15.93	14.94	3.13	11.81	11.37	8.13	15.00	5.50	11.00
mm	393.19	404.60	379.47	79.50	299.97	288.80	206.50	381.00	139.70	279.40

\* Dimensions can vary by up to 1/4 in. (6.3 mm) depending on the diaphragm material fitted in the equipment.

## Dimensions for 1590 Pumps

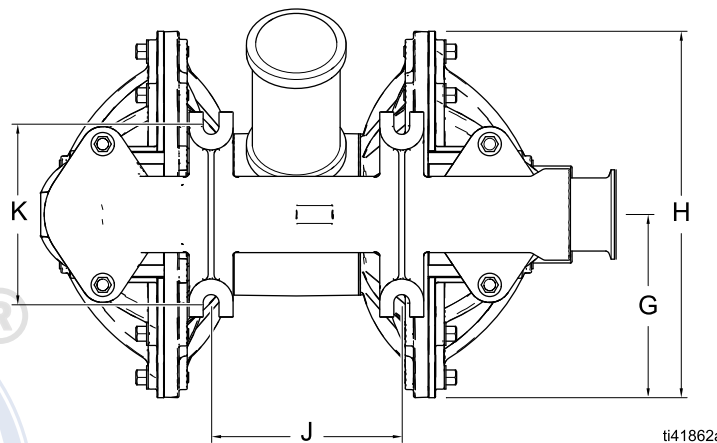
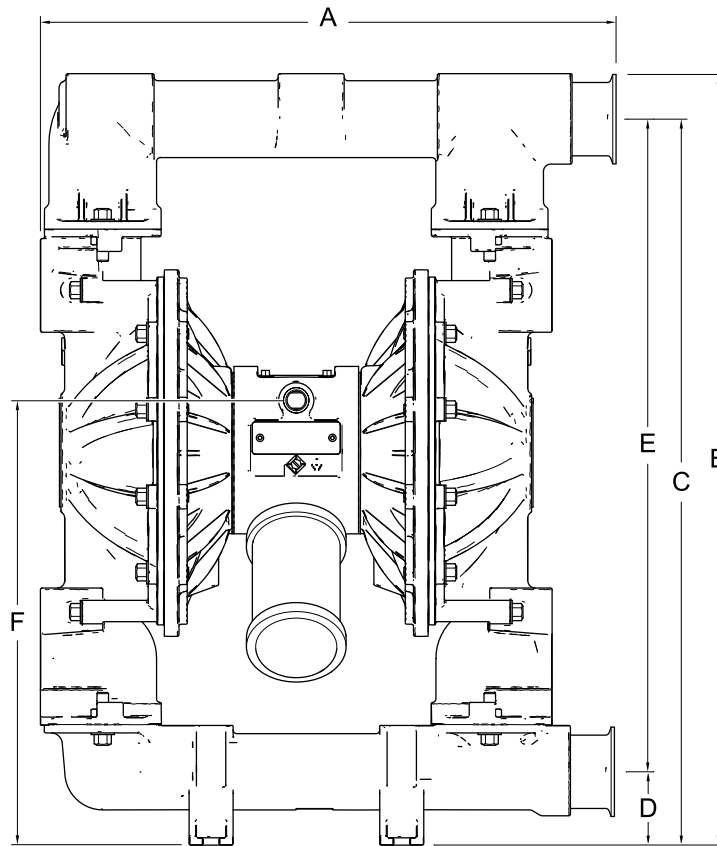


**Dimensions for 1590 Pumps**

	A	B	C	D	E	F	G*	H*	J	K*
in.	17.63	21.76	20.50	4.19	16.31	13.50	7.50	15.00	6.00	11.00
mm	447.80	552.70	520.70	106.43	414.27	342.90	190.50	381.00	152.40	279.40

\* Dimensions can vary by up to 1/4 in. (6.3 mm) depending on the diaphragm material fitted in the equipment.

## Dimensions for 2150 Pumps



ti41862a

**Dimensions for 2150 Pumps**

	A	B	C	D	E	F	G*	H*	J	K*
in.	19.60	26.27	24.75	2.50	22.25	15.17	6.25	12.50	6.50	6.00
mm	497.80	667.26	628.65	63.50	565.15	385.32	158.75	317.50	165.10	152.40

\* Dimensions can vary by up to 1/4 in. (6.3 mm) depending on the diaphragm material fitted in the equipment.

# Technical Specifications

## Technical Specifications for 1050 Pumps

SaniForce Diaphragm Pumps, BV-Series, 1050 Pumps		
	US	Metric
Maximum fluid working pressure	120 psi	0.83 MPa, 8.27 bar
Air pressure operating range*	20–120 psi	0.14–0.83 MPa, 1.38–8.27 bar
Maximum air consumption	50 scfm	1.42 m <sup>3</sup> /minute
Air consumption at 70 psi/20 gpm	18 scfm	0.51 m <sup>3</sup> /minute
Maximum free-flow delivery	41 gpm	155.2 lpm
Maximum pump speed	256 cycles per minute	
Maximum size pumpable solids	1/8 in.	3.2 mm
Environmental temperature range	–4° to 140°F	–20° to 60°C
Maximum suction lift		
Dry	16 ft	4.87 meters
Wet	29 ft	8.83 meters
Fluid flow per cycle*		
Standard Diaphragms	0.16 gallon	0.57 liters
Noise (dBa) <sup>‡</sup>		
Maximum sound pressure	92 dBa at 100 psi (0.69 MPa, 6.9 bar), full flow	
Inlet/Outlet Sizes		
Air inlet size	1/2 in. npt(f)	
Air exhaust port size	3/4 npt(f)	
Fluid inlet/outlet size	1.5 in. tri-clamp	
Materials of Construction		
Wetted materials on all models	Stainless Steel	
Weight		
1050 Pumps	60.4 lb	27.4 kg
Notes		
* Startup pressures and displacement per cycle may vary based on suction condition, discharge head, air pressure, and fluid type.		
‡ Sound pressure measured 3.28 feet (1 meter) from equipment. Sound power measured per ISO-9614-1.		
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## Technical Specifications for 1590 Pumps

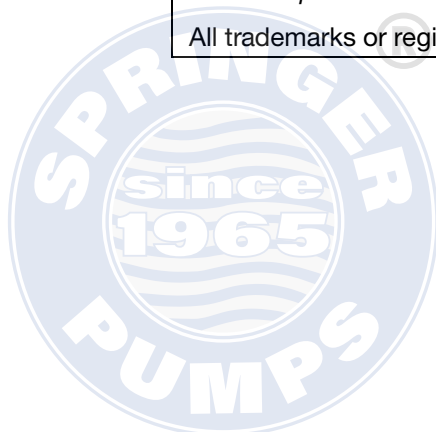
SaniForce Diaphragm Pumps, BV-Series, 1590 Pumps		
	US	Metric
Maximum fluid working pressure	120 psi	0.83 MPa, 8.27 bar
Air pressure operating range*	20–120 psi	0.14–0.83 MPa, 1.38–8.27 bar
Maximum air consumption	125 scfm	3.54 m³/minute
Air consumption at 70 psi/60 gpm	50 scfm	1.42 m³/minute
Maximum free-flow delivery	100 gpm	378.5 lpm
Maximum pump speed	200 cycles per minute	
Maximum size pumpable solids	3/16 in.	4.8 mm
Environmental temperature range	–4° to 140°F	–20° to 60°C
Maximum suction lift		
Dry	18 ft	5.48 meters
Wet		
Fluid flow per cycle*		
Standard Diaphragms	0.5 gallon	1.9 liters
Noise (dBa)†		
Maximum sound pressure	94 dBa at 100 psi (0.69 MPa, 6.9 bar), full flow	
Inlet/Outlet Sizes		
Air inlet size	1/2 in. npt(f)	
Air exhaust port size	3/4 npt(f)	
Fluid inlet/outlet size	2 in. tri-clamp	
Materials of Construction		
Wetted materials on all models	Stainless Steel	
Weight		
1590 Pumps	111 lb	50.3 kg
Notes		
* Startup pressures and displacement per cycle may vary based on suction condition, discharge head, air pressure, and fluid type.		
† Sound pressure measured 3.28 feet (1 meter) from equipment. Sound power measured per ISO-9614-1.		
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## Technical Specifications for 2150 Pumps

SaniForce Diaphragm Pumps, BV-Series, 2150 Pumps		
	US	Metric
Maximum fluid working pressure	120 psi	0.83 MPa, 8.27 bar
Air pressure operating range*	20–120 psi	0.14–0.83 MPa, 1.38–8.27 bar
Maximum air consumption	175 scfm	4.95 m <sup>3</sup> /minute
Air consumption at 70 psi/60 gpm	60 scfm	1.70 m <sup>3</sup> /minute
Maximum free-flow delivery	150 gpm	568 lpm
Maximum pump speed	145 cycles per minute	
Maximum size pumpable solids	1/4 in.	6.3 mm
Environmental temperature range	–4° to 140°F	–20° to 60°C
Maximum suction lift		
Dry	18 ft	5.48 meters
Wet		
Fluid flow per cycle*		
Standard Diaphragms	1.03 gallon	3.90 liters
Noise (dBa) <sup>‡</sup>		
Maximum sound pressure	90 dBa at 100 psi (0.69 MPa, 6.9 bar), full flow	
Inlet/Outlet Sizes		
Air inlet size	1/2 in. npt(f)	
Air exhaust port size	3/4 npt(f)	
Fluid inlet/outlet size	2.5 in. tri-clamp	
Materials of Construction		
Wetted materials on all models	Stainless Steel	
Weight		
2150 Pumps	162 lb	73.4 kg
Notes		
* Startup pressures and displacement per cycle may vary based on suction condition, discharge head, air pressure, and fluid type.		
‡ Sound pressure measured 3.28 feet (1 meter) from equipment. Sound power measured per ISO-9614-1.		
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## Fluid Temperature Range

### NOTICE

Temperature limits are based on mechanical stress only. Certain chemicals will further limit the fluid temperature range. Stay within the temperature range of the most-restricted wetted component. Operating at a fluid temperature that is too high or too low for the components of your equipment may cause equipment damage.

Diaphragm, Check, or Seat Material	Fluid Temperature Range	
	Fahrenheit	Celsius
PTFE	–40° to 180°	–40° to 82°
Santoprene	–40° to 180°	–40° to 82°
Polychloroprene	14° to 176°	–10° to 80°

## California Proposition 65

### CALIFORNIA RESIDENTS

 **WARNING:** Cancer and reproductive harm – [www.P65warnings.ca.gov](http://www.P65warnings.ca.gov).





# Graco Standard Warranty

Graco warrants all equipment referenced in this document which is 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 twelve months 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 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 two (2) 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.

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For patent information, see [www.graco.com/patents](http://www.graco.com/patents).

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

**Phone:** 612-623-6921 or **Toll Free:** 1-800-328-0211, **Fax:** 612-378-3505

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Original instructions. This manual contains English. MM 3A8983

**Graco Headquarters:** Minneapolis

**International Offices:** Belgium, China, Japan, Korea

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