

Instructions/Parts

# Aluminum 3-Inch Air-Operated Diaphragm Pump

3A1449D

EN

*Heavy-duty 3-inch pump with large flow paths for fluid transfer applications. For professional use only.*

**Pump Model 652176**

**See page 2 for description.**

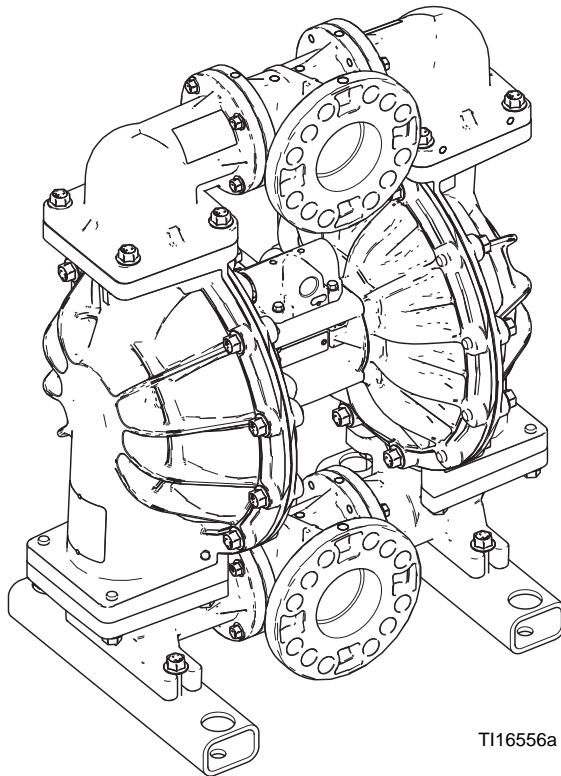
125 psi (0.86 MPa, 8.6 bar) Maximum Working Pressure

125 psi (0.86 MPa, 8.6 bar) Maximum Air Inlet Pressure

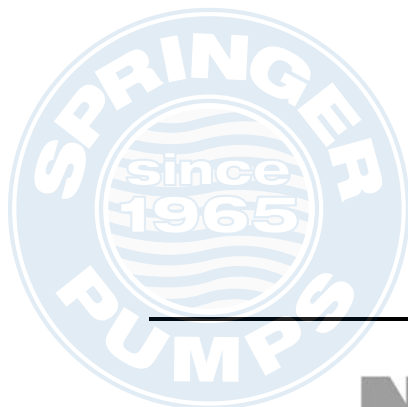


## Important Safety Instructions

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



T116556a



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# Contents

<b>Pump Model</b> .....	<b>2</b>	<b>Maintenance</b> .....	<b>11</b>
<b>Warnings</b> .....	<b>3</b>	Maintenance Schedule .....	11
<b>Installation</b> .....	<b>6</b>	Lubrication .....	11
Overview .....	6	Tighten Threaded Connections .....	11
Tighten Fasteners .....	7	Flushing and Storage .....	11
Mount the Pump .....	7	Torque Instructions .....	12
Ground the System .....	7	<b>Troubleshooting</b> .....	<b>13</b>
Fluid Supply Line .....	8	<b>Repair</b> .....	<b>15</b>
Fluid Outlet Line .....	8	Repair or Replace Air Valve .....	15
Fluid Inlet and Outlet Ports .....	8	Check Valve Repair .....	17
Air Line .....	8	Diaphragms and Center Section .....	18
Air Exhaust Ventilation .....	9	<b>Repair Kits</b> .....	<b>22</b>
<b>Operation</b> .....	<b>10</b>	<b>Dimensions</b> .....	<b>24</b>
Pressure Relief Procedure .....	10	<b>Performance Charts</b> .....	<b>25</b>
Flush the Pump Before First Use .....	10	<b>Technical Data</b> .....	<b>26</b>
Start and Adjust the Pump .....	10	<b>Graco Standard Husky Pump Warranty</b> .....	<b>28</b>
Pump Shutdown .....	10	<b>Graco Information</b> .....	<b>28</b>


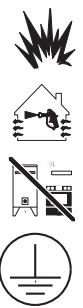

# Pump Model

Part No.	Configuration No.	Fluid Covers and Manifolds	Seats	Check Balls	Diaphragm	Manifold Seals
652176	DNOW-3-PA01EA1TPACTPBN	Aluminum, npt	TPE	Acetal	TPE	Buna-N
















# 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, 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>	
	<p><b>FIRE AND EXPLOSION HAZARD</b></p> <p>Flammable fumes, such as solvent and paint fumes, <b>in work area</b> can ignite or explode. To help prevent fire and explosion:</p> <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 arc).</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>• Ground all equipment in the work area. See <b>Grounding</b> instructions.</li> <li>• Use only grounded hoses.</li> <li>• Hold gun firmly to side of grounded pail when triggering into pail. Do not use pail liners unless they are antistatic or conductive.</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>
	<p><b>PRESSURIZED EQUIPMENT HAZARD</b></p> <p>Fluid from the equipment, leaks, or ruptured components can splash in the eyes or on skin and cause serious injury.</p> <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 hoses, tubes, and couplings daily. Replace worn or damaged parts immediately.</li> </ul>



 <h1 style="margin: 0;">WARNING</h1>	
  	<p><b>EQUIPMENT MISUSE HAZARD</b>                      Misuse can cause death or serious injury.</p> <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 Data</b> in all equipment manuals.</li> <li>• Use fluids and solvents that are compatible with equipment wetted parts. See <b>Technical Data</b> in all equipment manuals. Read fluid and solvent manufacturer's warnings. For complete information about your material, request MSDS from distributor or retailer.</li> <li>• Do not leave the work area while equipment is energized or under pressure.</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 hoses and cables away from traffic areas, sharp edges, moving parts, and hot surfaces.</li> <li>• Do not kink or over bend hoses or use hoses to pull equipment.</li> <li>• Keep children and animals away from work area.</li> <li>• Comply with all applicable safety regulations.</li> </ul>
  	<p><b>THERMAL EXPANSION HAZARD</b>                      Fluids subjected to heat in confined spaces, including hoses, can create a rapid rise in pressure due to the thermal expansion. Over-pressurization can result in equipment rupture and serious injury.</p> <ul style="list-style-type: none"> <li>• Open a valve to relieve the fluid expansion during heating.</li> <li>• Replace hoses proactively at regular intervals based on your operating conditions.</li> </ul>
	<p><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.</p> <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>• Many other fluids may contain chemicals that can react with aluminum. Contact your material supplier for compatibility.</li> </ul>
 	<p><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.</p> <ul style="list-style-type: none"> <li>• Read MSDSs 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>WARNING</b>	
	<p><b>BURN HAZARD</b></p> <p>Equipment surfaces and fluid that's heated can become very hot during operation. To avoid severe burns:</p> <ul style="list-style-type: none"><li>• Do not touch hot fluid or equipment.</li></ul>
	<p><b>PERSONAL PROTECTIVE EQUIPMENT</b></p> <p>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. This equipment includes but is not limited to:</p> <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>



# Installation

## Overview

The Typical Installation shown in FIG. 1 is only a guide for selecting and installing system components. Contact National Oilwell Varco (NOV) for assistance in planning a system to suit your needs.

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

### Key:

#### Accessories/Components Not Supplied

- A Air supply line
- B Bleed-type master air valve (may be required for your pump installation)

- C Air filter/regulator assembly
- D Master air valve (to isolate the filter/regulator for service)
- E Grounded, flexible fluid supply line
- F Fluid drain valve (may be required for your pump installation)
- G Fluid shutoff valve
- H Grounded, flexible fluid outlet line

#### System Components

- J Air inlet port (not visible)
- K Air outlet port and muffler
- L Fluid inlet port
- M Fluid outlet port
- N Ground Screw (see FIG. 3, page 7)
- P Mounting Brackets

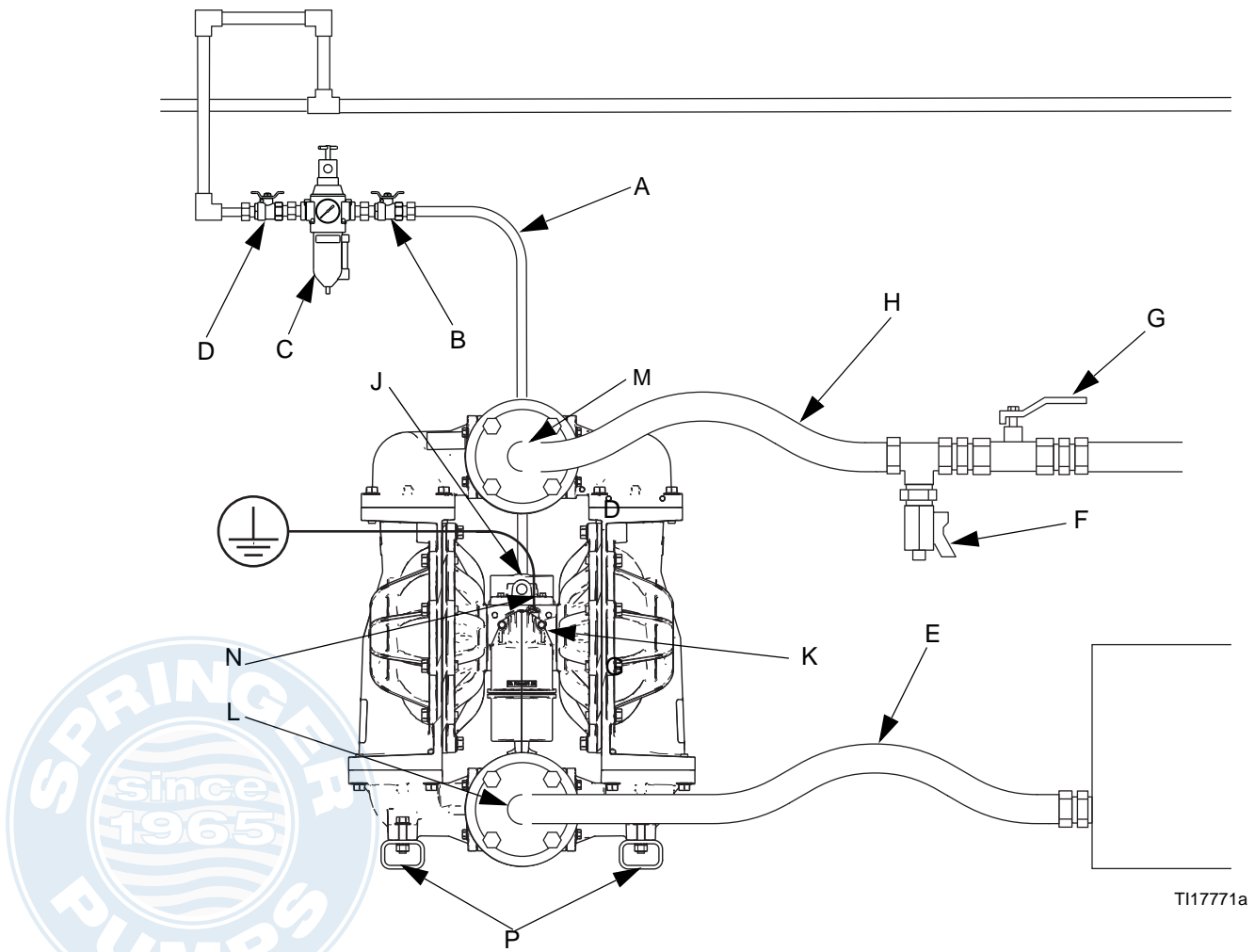


FIG. 1. Typical Installation

## Tighten Fasteners

Before mounting and using the pump for the first time, check and retorque all external fasteners. Follow **Torque Instructions**, page 12, or see the torque tag on your pump. After the first day of operation retorque the fasteners.

## Mount the Pump

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To avoid serious injury or death from toxic fluid or fumes:

- Ventilate to a remote area. The pump exhaust air may contain contaminants. See **Air Exhaust Ventilation** on page 9.
- Never move or lift a pump under pressure. If dropped, the fluid section may rupture. Always follow the **Pressure Relief Procedure** on page 10 before moving or lifting the pump.

1. Verify that the bolts holding the pump feet to the brackets are tight. Torque to 55-60 ft-lb (75-81 N•m).
2. Secure the brackets to the floor. Do not mount on any other surface. The pump must be mounted upright.

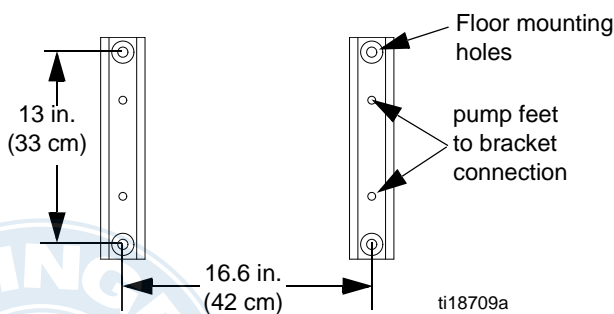


FIG. 2. Mounting Diagram

3. Make sure the surface is flat and that the pump does not wobble.
4. For ease of operation and service, mount the pump so air valve, air inlet, fluid inlet, and fluid outlet ports are easily accessible.

## Ground the System

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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.

- Aluminum pumps have a ground screw. **Always** ground the entire fluid system as described below.
- Follow your local fire codes.

**Pump:** See FIG. 3. Loosen the ground screw (N). Insert one end of a 12 ga. minimum ground wire behind the ground screw and tighten the screw securely. Connect the clamp end of the ground wire to a true earth ground. A ground wire and clamp, Part 238909, is available.

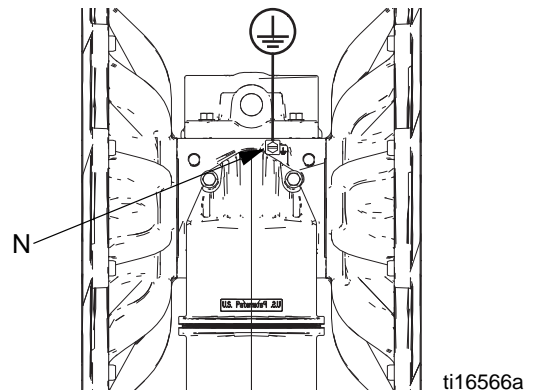


FIG. 3. Ground screw and wire

**Air and fluid hoses:** Use only grounded hoses with a maximum of 500 ft (150 m) combined hose length to ensure grounding continuity.

**Air compressor:** Follow manufacturer's recommendations.

**Fluid supply container:** Follow local code.

**Solvent containers used when flushing:** Follow local code. Use only conductive metal containers, placed on a grounded surface. Do not place the container on a nonconductive surface, such as paper or cardboard, which interrupts grounding continuity.

Check your system electrical continuity after the initial installation, and then set up a regular schedule for checking continuity to be sure proper grounding is maintained.

## Fluid Supply Line

1. Use grounded, flexible fluid hoses (E). See **Ground the System**, page 7.
2. If the inlet fluid 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. Excessive inlet fluid pressure also will shorten diaphragm life. Approximately 3-5 psi (0.02-0.03 MPa, 0.21-0.34 bar) should be adequate for most materials.
3. For maximum suction lift (wet and dry), see **Technical Data**, page 26. For best results, always install the pump as close as possible to the material source. Minimize suction requirements to maximize pump performance.

## Fluid Outlet Line

1. Use grounded, flexible fluid hoses (H). See **Ground the System**, page 7.
2. Install a fluid drain valve (F) near the fluid outlet.
3. Install a shutoff valve (G) in the fluid outlet line.

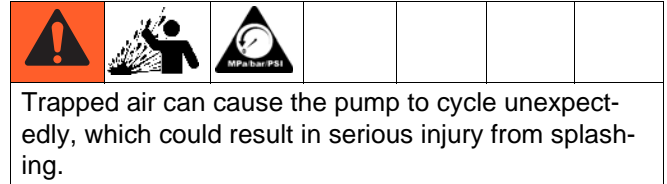
## Fluid Inlet and Outlet Ports

The fluid inlet and outlet manifolds each have a 3 in. ANSI/DIN center flange with 3 in.-8 npt internal threads.

**NOTE:** Remove and reverse the center manifold(s) to change the orientation of inlet or outlet port(s). Follow **Torque Instructions** on page 12.

## Air Line





1. Install an air regulator and gauge (C) to control the fluid pressure. The fluid stall pressure will be the same as the setting of the air regulator.
2. Locate a bleed-type master air valve (B) close to the pump and use it to relieve trapped air. Be sure the valve is easily accessible from the pump and located downstream from the regulator.



3. Locate another master air valve (D) upstream from all air line accessories and use it to isolate them during cleaning and repair.
4. An air line filter (C) removes harmful dirt and moisture from the compressed air supply.
5. Install a grounded, flexible air hose (A) between the accessories and the 3/4 npt(f) pump air inlet.



## Air Exhaust Ventilation

					
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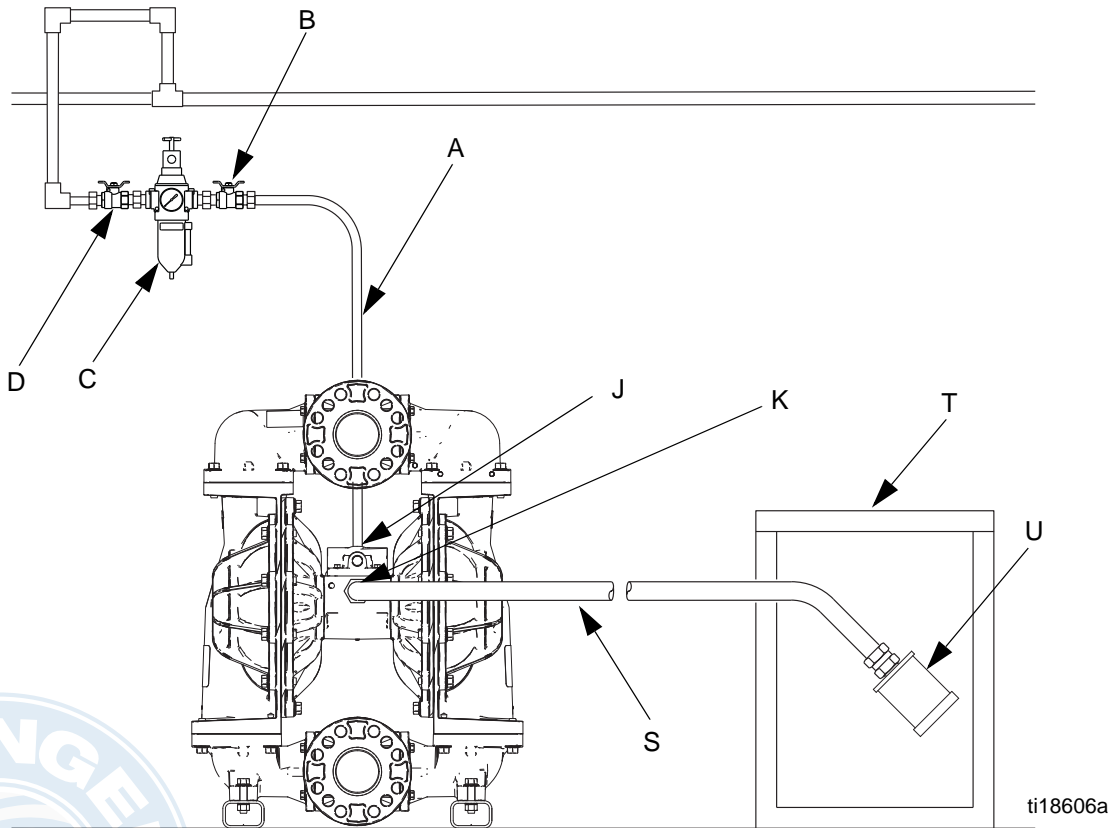
If pumping flammable or toxic fluids, you must vent the exhaust away from people, animals, food handling areas, and all sources of ignition. Follow all applicable codes.

**NOTICE**

The air exhaust port is 1 npt. Do not restrict the air exhaust port. Excessive exhaust restriction can cause erratic pump operation and poor diaphragm life.

### To provide a remote exhaust:

1. Remove the muffler (U) from the pump air exhaust port (K).
2. Install a grounded air exhaust hose (S) and connect the muffler (U) to the other end of the hose. Use muffler PN 111897, sold separately. The minimum size for the air exhaust hose is 1 in. (25 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 (T) at the end of the air exhaust line to catch fluid in case a diaphragm ruptures. If the diaphragm ruptures, the fluid being pumped will exhaust with the air.



**Key:**

- |  |                                    |
|--|------------------------------------|
| A Air supply line  | J Air inlet port (not visible)     |
| B Bleed-type master air valve (may be required for your pump installation) | K Air outlet port                  |
| C Air filter/regulator assembly  | S Grounded air exhaust hose        |
| D Master air valve (for accessories)                                       | T Container for remote air exhaust |
|  | U Muffler                          |

**FIG. 4. Vent exhaust air**

# Operation

## Pressure Relief Procedure



Follow the Pressure Relief Procedure whenever you see this symbol.



This equipment stays pressurized until pressure is relieved manually. To help prevent serious injury from pressurized fluid, such as splashing in the eyes or on skin, follow the Pressure Relief Procedure whenever you stop pumping and before you clean, check, or service the equipment.

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

## Flush the Pump Before First Use

The pump was tested in water. If water could contaminate the fluid you are pumping, flush the pump thoroughly with a compatible solvent. See **Flushing and Storage**, page 11.

## Start and Adjust the Pump

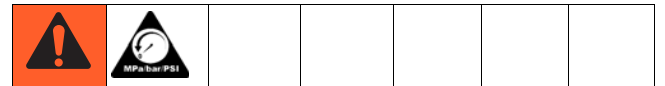
1. Be sure the pump is properly grounded. Refer to **Ground the System** on page 7.
2. Check fittings to be sure they are tight. Use a compatible liquid thread sealant on male threads. Tighten fluid inlet and outlet fittings securely.
3. Place the suction tube (if used) in fluid to be pumped.

**NOTE:** 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.

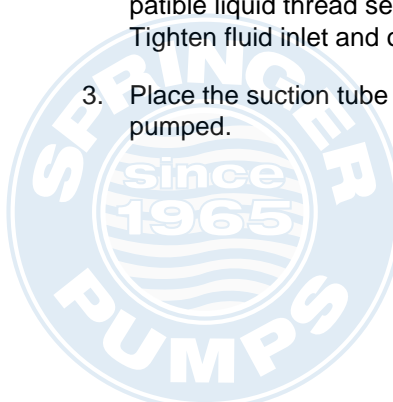
<b>NOTICE</b>
Excessive fluid inlet pressure can reduce diaphragm life.

4. Place the end of the fluid hose into an appropriate container.
  5. Close the fluid drain valve (F).
  6. Back out the air regulator knob (C), and open all bleed-type master air valves (B, D).
  7. If the fluid hose has a dispensing device, hold it open.
  8. Slowly increase air pressure with the air regulator until the pump just starts to cycle. Allow the pump to cycle slowly until all air is pushed out of the lines and the pump is primed.
- NOTE:** Use lowest possible air pressure to prime, just enough to cycle the pump. If the pump does not prime as expected, turn air pressure **DOWN**.
9. If you are flushing, run the pump long enough to thoroughly clean the pump and hoses.
  10. Close the bleed-type master air valve (B).

## Pump Shutdown



At the end of the work shift and before you check, adjust, clean or repair the system, follow the **Pressure Relief Procedure**, page 10.



# Maintenance

## Maintenance Schedule

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

## Lubrication

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

## Tighten Threaded Connections

Before each use, check all hoses for wear or damage and replace as necessary. Check to be sure all threaded connections are tight and leak-free. Check mounting bolts. Check fasteners. Tighten or retorque as necessary. Although pump use varies, a general guideline is to retorque fasteners every two months. See **Torque Instructions**, page 12.

## Flushing and Storage



- Flush before fluid can dry in the equipment, at the end of the day, before storing, and before repairing equipment.
- Flush at the lowest pressure possible. Check connectors for leaks and tighten as necessary.
- Flush with a fluid that is compatible with the fluid being dispensed and the equipment wetted parts.
- Always flush the pump and relieve the pressure before storing it for any length of time.

**NOTICE**

Flush the pump often enough to prevent the fluid you are pumping from drying or freezing in the pump and damaging it. Use a compatible solvent.



## Torque Instructions

If fluid cover or manifold fasteners have been loosened, it is important to torque them using the following procedure to improve sealing.

**NOTE:** Always completely torque fluid covers, then torque the manifold pieces together, then torque the assembled manifolds to the fluid covers.

Start all fluid cover screws a few turns. Then turn down each screw just until head contacts cover. Then turn each screw by 1/2 turn or less working in a crisscross pattern to specified torque. Repeat for manifolds.

**Fluid cover fasteners:**

55-60 ft-lb (75-81 N•m)

**Manifold fasteners:**

Refs 1-8: 11-21 ft-lb (15-28 N•m)

Refs 9-16: 55-60 ft-lb (75-81 N•m)

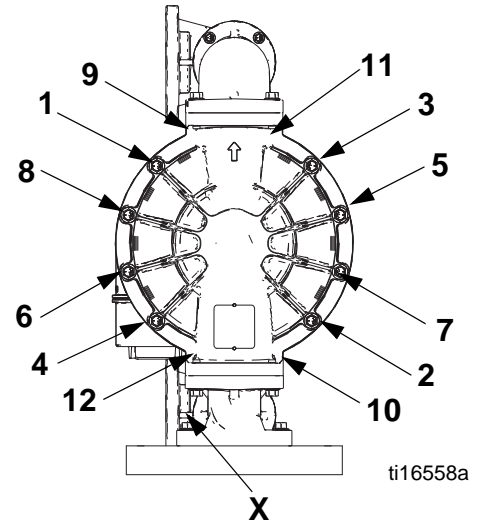
Retorque the air valve fasteners in a crisscross pattern to specified torque.

**Air Valve fasteners**

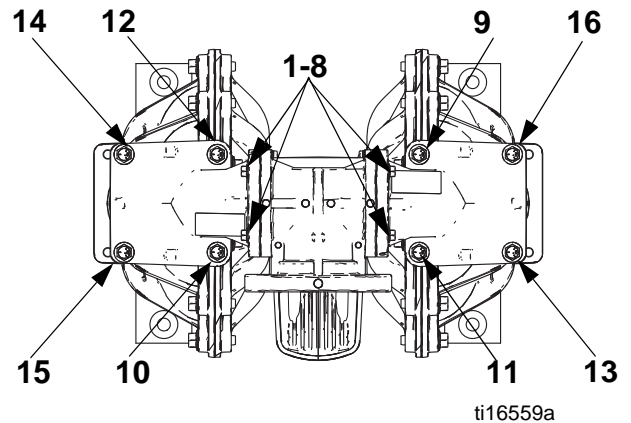
75-85 in-lb (8.5-9.6 N•m)

Also check and tighten the bolts (X) holding the manifold feet to the mounting brackets.

Fluid Cover Screws



Inlet and Outlet Manifold Screws



Air Valve Screws

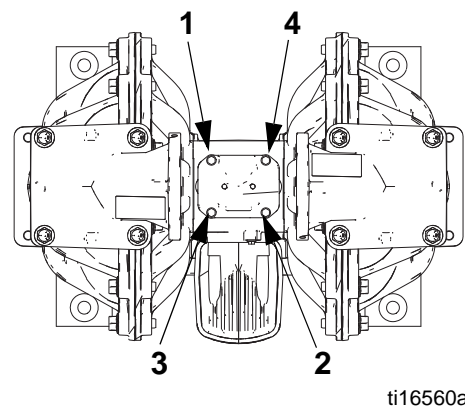


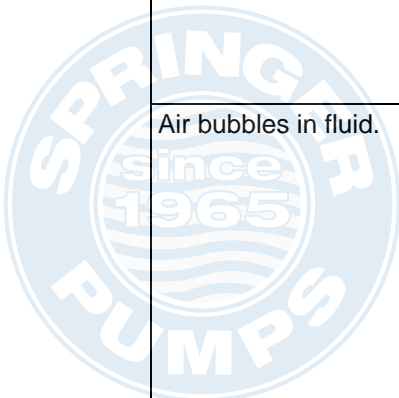
FIG. 5. Torque instructions



# Troubleshooting



Problem	Cause	Solution
Pump cycles but will not prime.	Pump is running too fast, causing cavitation before prime.	Reduce air inlet pressure.
	Check valve ball severely worn or wedged in seat or manifold.	Replace ball and seat. See page 17.
	Seat severely worn.	Replace ball and seat. See page 17.
	Outlet or inlet clogged.	Unclog.
	Inlet or outlet valve closed.	Open.
	Inlet fittings or manifolds loose.	Tighten.
	Manifold o-rings damaged.	Replace o-rings. See page 17.
Pump cycles at stall or fails to hold pressure at stall.	Worn check valve balls or seats.	Replace. See page 17.
Pump will not cycle, or cycles once and stops.	Air valve is stuck or dirty.	Disassemble and clean air valve. See page 15. Use filtered air.
	Check valve ball severely worn and wedged in seat or manifold.	Replace ball and seat. See page 17.
	Pilot valve worn, damaged, or plugged.	Replace pilot valve. See page 18.
	Air valve gasket damaged.	Replace gasket. See page 15.
	Dispensing valve clogged.	Relieve pressure and clear valve.
Pump operates erratically.	Clogged suction line.	Inspect; clear.
	Sticky or leaking check valve balls.	Clean or replace. See page 17.
	Diaphragm ruptured.	Replace. See page 18.
	Restricted exhaust.	Remove restriction.
	Pilot valves damaged or worn.	Replace pilot valves. See page 18.
	Air valve damaged.	Replace air valve. See page 15.
	Air valve gasket damaged.	Replace air valve gasket. See page 15.
	Air supply erratic.	Repair air supply.
	Exhaust muffler icing.	Use drier air supply.
Air bubbles in fluid.	Suction line is loose.	Tighten.
	Diaphragm ruptured.	Replace. See page 18.
	Loose manifolds, damaged seats or manifold o-rings.	Tighten manifold bolts or replace seats or o-rings. See page 17.
	Diaphragm shaft bolt o-ring damaged.	Replace o-ring.
	Pump cavitation.	Reduce pump speed or suction lift.
	Loose diaphragm shaft bolt.	Tighten.



<b>Problem</b>	<b>Cause</b>	<b>Solution</b>
Exhaust air contains fluid being pumped.	Diaphragm ruptured.	Replace. See page 18.
	Loose diaphragm shaft bolt.	Tighten or replace. See page 18.
	Diaphragm shaft bolt o-ring damaged.	Replace o-ring. See page 18.
Moisture in exhaust air.	High inlet air humidity.	Use drier air supply.
Pump exhausts excessive air at stall.	Worn air valve cup or plate.	Replace cup and plate. See page 15.
	Damaged air valve gasket.	Replace gasket. See page 15.
	Damaged pilot valve.	Replace pilot valves. See page 18.
	Worn shaft seals or bearings.	Replace shaft seals or bearings. See page 18.
Pump leaks air externally.	Air valve or fluid cover screws loose.	Tighten.
	Diaphragm damaged.	Replace diaphragm. See page 18.
	Air valve gasket damaged.	Replace gasket. See page 15.
	Air cover gasket damaged.	Replace gasket. See page 18.
Pump leaks fluid externally from joints.	Loose manifold screws or fluid cover screws.	Tighten manifold screws or fluid cover screws. See page 17.
	Manifold o-rings worn out.	Replace o-rings. See page 17.



# Repair

## Repair or Replace Air Valve



### Replace Complete Air Valve

1. Stop the pump. Relieve the pressure. See **Pressure Relief Procedure**, page 10.
2. Disconnect the air line to the motor.
3. Remove screws (104). Remove the air valve and gasket (113).
4. To repair the air valve, go to **Disassemble the Air Valve**, in next section. To install a replacement air valve, continue with step 5.
5. Align the new air valve gasket (113\*) on the center housing, then attach the air valve. See **Torque Instructions**, page 12.
6. Reconnect the air line to the motor.

### Replace Seals or Rebuild Air Valve

**NOTE:** Repair kits are available (see page 22). Air Valve Seal Kit parts are marked with a †. Air Valve Repair Kit parts are marked with a ◆. Air Valve End Cap Kit parts are marked with a ⌘.

#### Disassemble the Air Valve

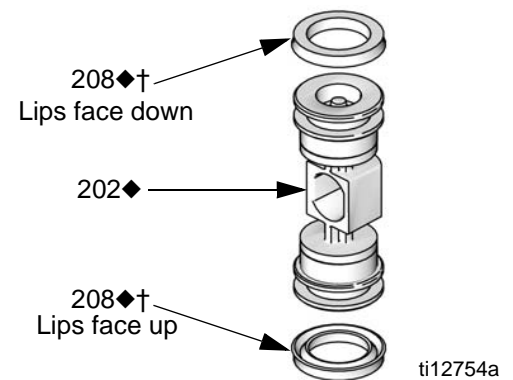
1. Perform steps 1-3 under **Replace Complete Air Valve**, page 15.
2. See FIG. 8. Use a T8 Torx screwdriver to remove two screws (209). Remove the valve plate (205), cup assembly (212-214), spring (211), and detent assembly (203).
3. Pull the cup (213) off of the base (212). Remove the o-ring (214) from the cup.
4. See FIG. 8. Remove the retaining ring (210) from each end of the air valve. Use the piston (202) to push the end cap (207) out of one end. Remove the u-cup seal (208). Pull the piston out the end and remove the other u-cup seal (208). Remove the other end cap (207) and the end cap o-rings (206).

5. Remove the detent cam (204) from the air valve housing (201).

#### Reassemble the Air Valve

**NOTE:** Apply lithium-based grease whenever instructed to grease. Order PN 111920.

1. Use all parts in the repair kit. Clean other parts and inspect for damage. Replace as needed.
2. Grease the detent cam (204◆) and install into housing (201).
3. Grease the u-cups (208◆†) and install on the piston with lips facing toward the center of the piston.



**FIG. 6. Air valve u-cup installation**

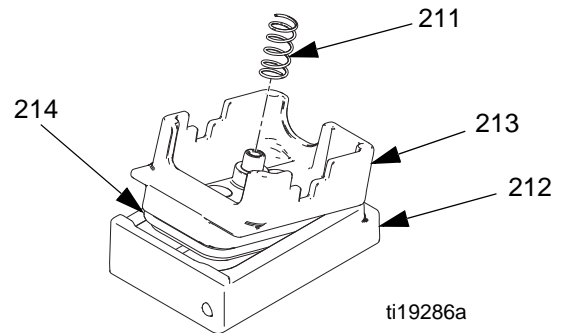
4. Grease both ends of the piston (202◆) and the housing bore. Install the piston in the housing (201), with the flat side toward the cup (213◆). Be careful not to tear u-cups (208◆†) when sliding piston into housing.
5. Grease new o-rings (206◆†⌘) and install on the end caps (207⌘). Install the end caps into the housing.
6. Install a retaining ring (210⌘) on each end to hold end caps in place.



- Grease and install the detent assembly (203♦) into the piston. Install the o-ring (214♦) on the cup (213♦). Apply a light film of grease to the outside surface of the o-ring and the inside mating surface of the base (212♦).

Orient the end of the base that has a magnet toward the end of the cup that has the larger cutout. Engage the opposite end of the parts. Leave the end with the magnet free. Tilt the base toward the cup and fully engage the parts, using care so that the o-ring remains in place. Install the spring (211♦) onto the protrusion on the cup. Align the magnet in the base with the air inlet and install the cup assembly.

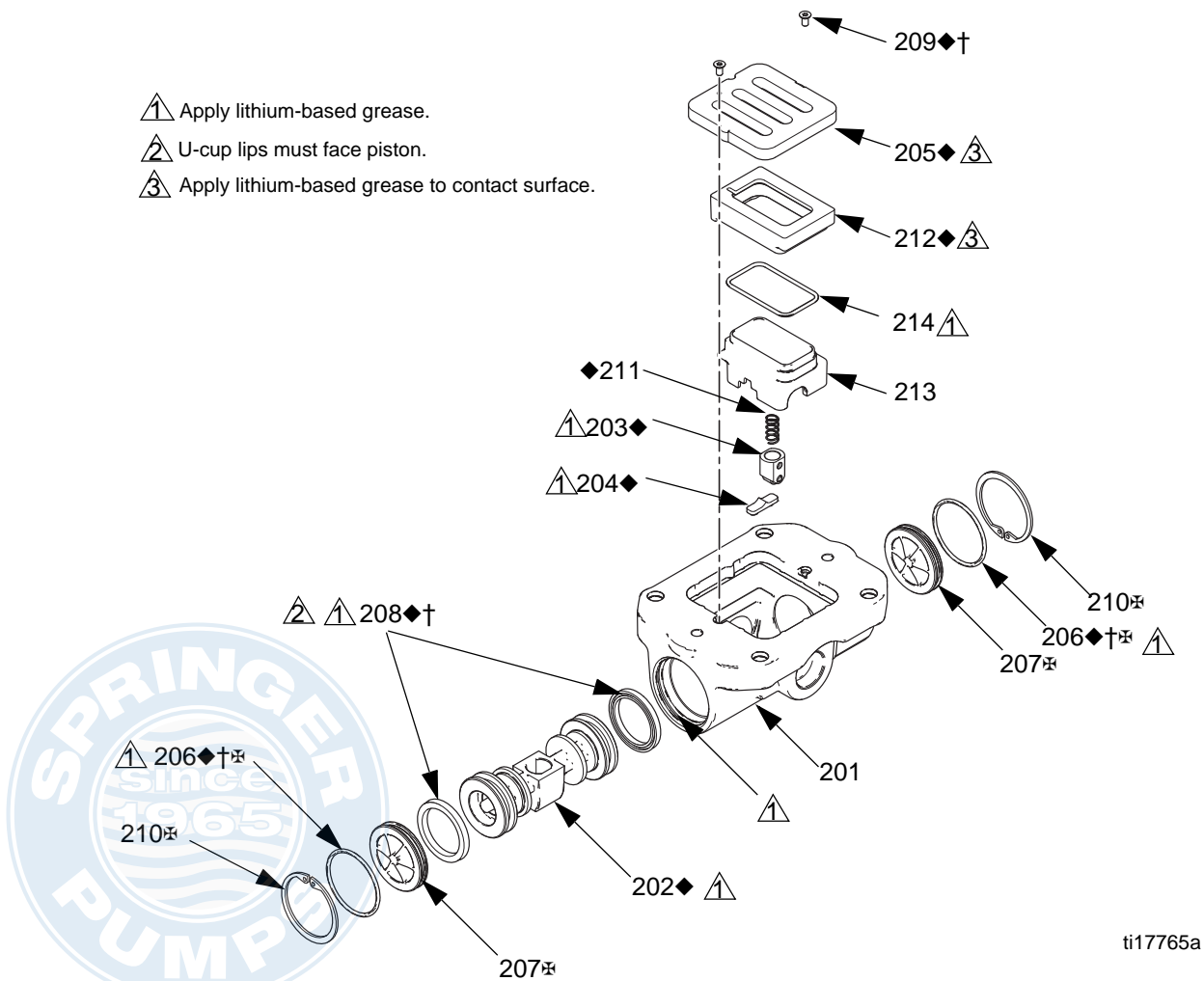
- Grease the cup side and install the valve plate (205♦). Align the small hole in the plate with the air inlet. Tighten the screws (209♦†) to hold it in place.



**FIG. 7. Cup assembly**

- Reassemble gasket and air valve onto pump housing. Grease the screws prior to assembly to prevent galling. See **Torque Instructions**, page 12.

- ▲ Apply lithium-based grease.
- ▲ U-cup lips must face piston.
- ▲ Apply lithium-based grease to contact surface.



**FIG. 8. Air valve assembly**



# Check Valve Repair



**NOTE:** See page 22 to order kits for new check valve balls and seats. Fastener kits also are available.

**NOTE:** To ensure proper seating of the check balls, always replace the seats when replacing the balls.

## Disassembly

1. Follow the **Pressure Relief Procedure** on page 10. Disconnect all hoses.

**NOTE:** The pump is heavy. Always use two people to lift or move it.

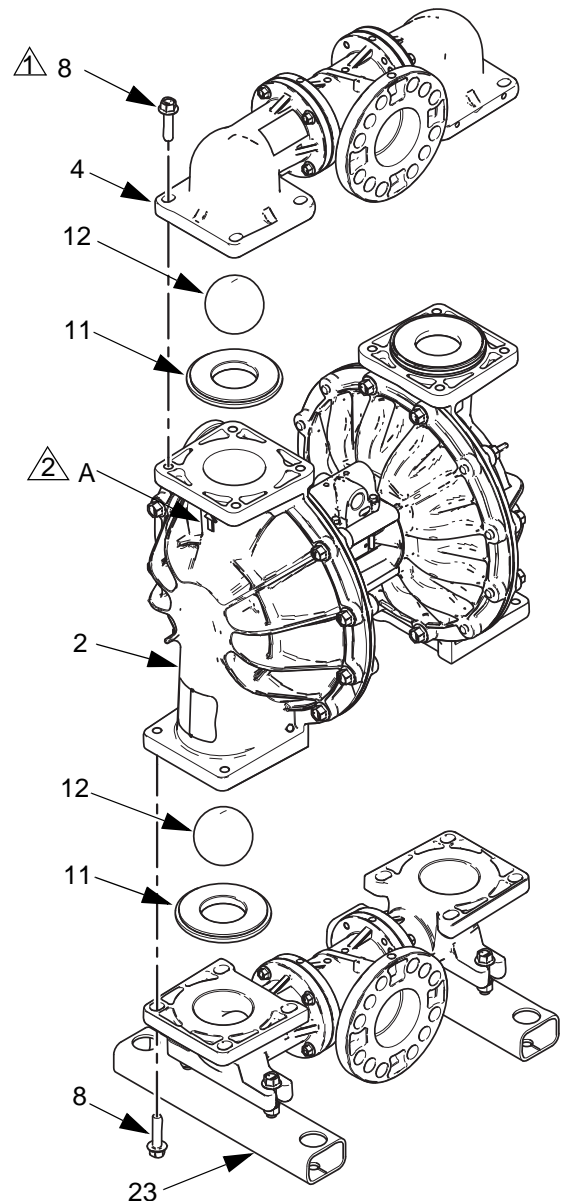
2. Remove the pump from its mounting.
3. Use a 3/4 in. (19 mm) socket wrench to remove the outlet elbow fasteners (8), then remove the manifold assembly. See FIG. 9.
4. Remove the seats (11) and balls (12).
5. Turn the pump over and remove the inlet manifold. The mounting brackets will remain attached.
6. Remove the seats (11) and balls (12).

## 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. Put the inlet manifold on first. Be sure the ball checks (11-12) and manifolds are assembled **exactly** as shown. The arrows (A) on the fluid covers **must** point toward the outlet manifold.

Torque to 55-60 ft-lb (75-81 N•m). See **Torque Instructions**, page 12.

Arrow (A) must point toward outlet manifold.



ti19217a

**FIG. 9. Ball check valve assembly**



## Diaphragms and Center Section



### Disassembly

**NOTE:** See page 22 to order a replacement diaphragm kit for your pump. A Center Rebuild Kit also is available. See page 22. Parts included in the Center Rebuild Kit are marked with an \*. For best results, use all kit parts.

1. Follow the **Pressure Relief Procedure** on page 10.
2. Remove the manifolds and disassemble the ball check valves as explained on page 17.

**NOTE:** You may wish to remove the inner fluid cover bolts as you remove each manifold, for convenience.

3. Remove fluid covers and disassemble diaphragms.
  - a. Orient the pump so one of the fluid covers faces up. Use a 3/4 in. (19 mm) socket wrench to remove the fluid cover screws, then pull the fluid cover (2) up off the pump. Turn the pump over and remove the other fluid cover.
  - b. Turn the pump on its side. Hold one diaphragm shaft bolt (17) with a wrench, then use a 15/16 socket to remove the other bolt. Remove all parts of the diaphragm assembly. See FIG. 10.
  - c. Disassemble the other diaphragm assembly.
4. Use an o-ring pick to remove the u-cup packings (101) from the center housing. Bearings (109) can remain in place.
5. If necessary, use a socket wrench to remove the pilot valves (110).

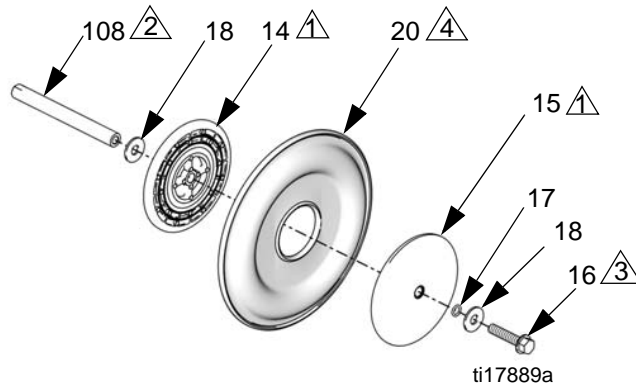
### Air Covers

Remove air covers only if a serious air leak suggests that the gaskets need to be replaced.

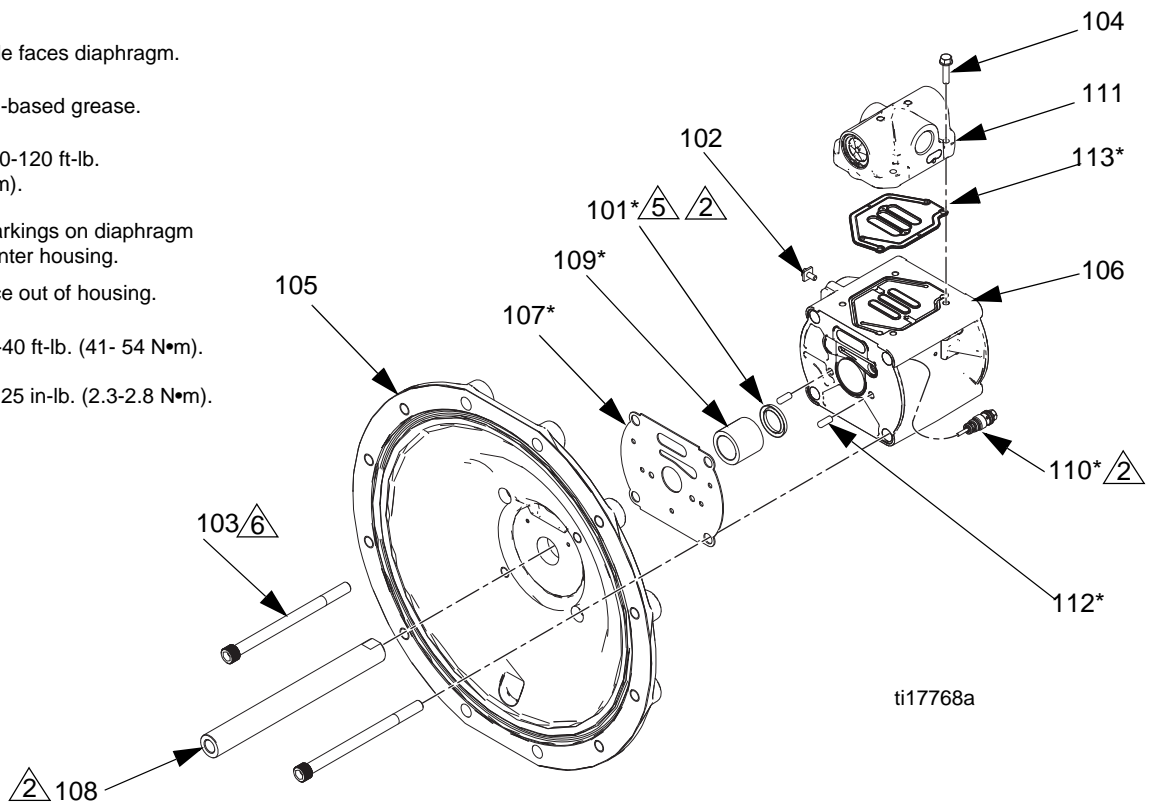
1. Remove pilot valves (110).
2. Use a 3/8 allen wrench to remove two bolts (103), then remove one air cover (105). Repeat for the other air cover.
3. Remove the gasket (107).
4. Inspect the diaphragm shaft (108) for wear or scratches. If it is damaged, inspect the bearings (109) in place. If they are damaged, use a bearing puller to remove them.

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





- ▲ 1 Rounded side faces diaphragm.
- ▲ 2 Apply lithium-based grease.
- ▲ 3 Torque to 100-120 ft-lb. (136-163 N•m).
- ▲ 4 AIR SIDE markings on diaphragm must face center housing.
- ▲ 5 Lips must face out of housing.
- ▲ 6 Torque to 30-40 ft-lb. (41- 54 N•m).
- ▲ 7 Torque to 20-25 in-lb. (2.3-2.8 N•m).



**Fig. 10. Diaphragm and Center Section**



## Reassembly

Follow all notes in FIG. 10. These notes contain **important** information.

**NOTE:** Apply lithium-based grease whenever instructed to grease. Order PN 111920.



1. Clean all parts and inspect for wear or damage. Replace parts as needed.

**NOTICE**

Unwanted pressurized air due to worn seals can lead to reduced diaphragm life.

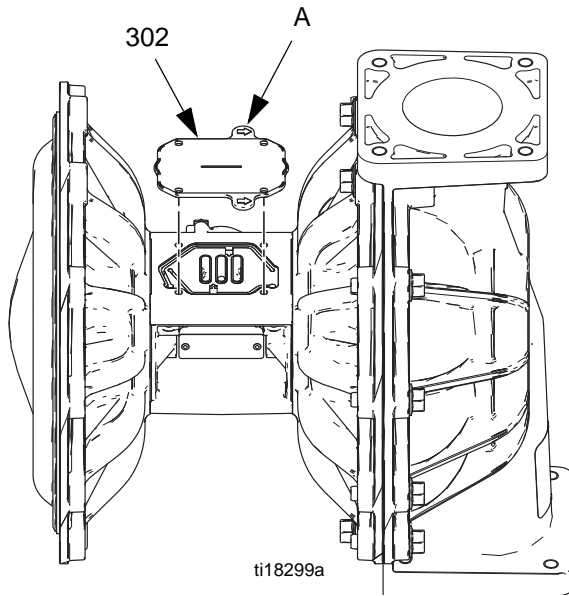
2. Grease and install the diaphragm shaft u-cup packings (101\*) so the lips face **out** of the housing.
3. If removed, insert the new bearings (109\*) into the center housing. Use a press or a block and rubber mallet to press-fit the bearing so it is flush with the surface of the center housing.
4. Assemble air covers, if removed:
  - a. Put one air cover on the bench. Install the alignment pins (112\*) and a new gasket (107\*).
  - b. Carefully place the center section on the air cover.
  - c. Install second set of alignment pins (112\*) in the center section. Lower the second air cover onto the center housing.
  - d. Apply medium-strength (blue) thread locker on the bolts (103). Torque to 30-40 ft-lb (41-54 N•m). Turn the pump over on the bench and install and torque the other two bolts.
5. Grease and install the pilot valves (110\*). Torque to 20-25 in.-lb (2.3-2.8 N•m). Do not over-torque.
6. Reassemble diaphragms.
  - a. Install the washer (18) and o-ring (17) on the shaft bolt (16).
  - b. Assemble the fluid side plate (15), the diaphragm (20), the air side diaphragm plate (14), and the washer (18) on the bolt exactly as shown in FIG. 10.

- c. Apply medium-strength (blue) Loctite or equivalent to the bolt (16) threads. Screw the bolt into the shaft hand tight.
  - d. Grease the shaft u-cups (101\*) and the length and ends of the diaphragm shaft (108\*). Slide the shaft into the housing.
  - e. Repeat Steps a-c for the other diaphragm assembly.
  - f. Hold one shaft bolt with a wrench and torque the other bolt to 100-120 ft-lb (136-163 N•m) at 100 rpm maximum. Do not over-torque.
7. Reattach the first fluid cover (2). Arrow (A) must point toward the air valve. See **Torque Instructions**, page 12.
  8. Reattach the second fluid cover.

						
To reduce the risk of serious injury, do not put your fingers or hand between the air cover and the diaphragm.						

To ensure proper seating and help attain expected diaphragm life, attach the second fluid cover with air pressure on the pump.

- a. Place the supplied tool (302) where the air valve gasket (113) normally goes. Arrow (A) must face toward the fluid cover that is already attached.



**Fig. 11. Diaphragm Installation Tool**

b. Reattach the air valve.

- c. Supply the pump with low pressure air, just enough to move the diaphragm. For standard diaphragms, use about 10 psi (0.07 MPa, 0.7 bar); for overmolded diaphragms use about 20 psi (0.14 MPa, 1.4 bar). Shop air may be used. The diaphragm will shift so the second fluid cover will seat properly. Keep air pressure on until the second fluid cover is attached.
- d. Attach the second fluid cover (2). See **Torque Instructions**, page 12.
- e. Remove the air valve and the tool (302), replace the gasket (113), and reattach the air valve. See **Torque Instructions**, page 12.

**NOTE:** If you are replacing the diaphragms but not the air valve, you still must remove the air valve, and replace the gasket with the tool so the air valve can be used for proper installation of the second fluid cover. Remember to remove the tool and replace the gasket when finished.



## Repair Kits

### Kit 24K955, Center Rebuild (\*)

Kit includes:

- 2 center shaft u-cups (101)
- 4 screws, M6 x 25 (104)
- 2 air cover gaskets (107)
- 1 center shaft (108)
- 2 center shaft bearings (109)
- 2 pilot valve assemblies (110)
- 4 dowel pins (112)
- 1 air valve gasket (113)
- 1 grease packet

### Kit 24K948, Air Valve Seals (†)

Kit includes:

- 2 end cap o-rings (206)
- 2 piston u-cups (208)
- 2 screws, M3 (209)
- 1 air valve gasket (113)
- 1 grease packet
- 1 solenoid release button o-ring (not shown), used only with optional DataTrak kit.

### Kit 24K954, Air Valve Repair (◆)

Kit includes:

- 1 air valve piston (202)
- 1 detent piston assembly (203)
- 1 detent cam (204)
- 1 air valve plate (205)
- 2 end cap o-rings (206)
- 2 piston u-cups (208)
- 2 screws, M3 (209)
- 1 detent spring (211)
- 1 air cup base (212)
- 1 air cup (213)
- 1 air cup o-ring (214)
- 1 solenoid release button o-ring (not shown), used only with optional DataTrak kit.
- 1 air valve gasket (113)
- 1 grease packet

### Kit 24D734, Air Valve End Caps (⊕)

Kit includes:

- 2 end caps (207)
- 2 retaining rings (210)
- 2 o-rings (206)

### Kit 24K947, Complete Air Valve Replacement

Kit includes:

- 1 air valve assembly (1b)
- 1 air valve gasket
- 4 screws (109)

### Kit 24K932, TPE Seats

Kit includes:

- 4 seats (10)

### Kit 24K937, Acetal Check Balls

Kit Includes:

- 4 balls (11)

### Kit 24K901, TPE Diaphragms

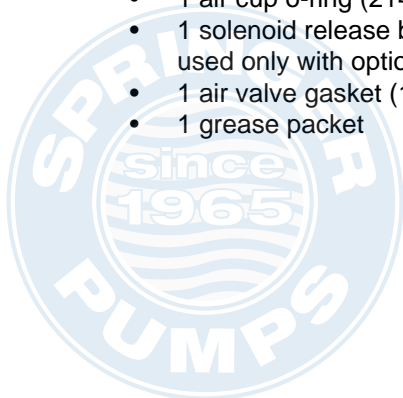
Kit includes:

- 2 diaphragms (20), TPE
- 2 o-rings (17) for the bolt
- 1 diaphragm install tool
- 1 anaerobic sealant packet

### Kit 24P932, Muffler, Ice-Resistant

Kit includes:

- 1 muffler
- 1 o-ring
- 1 retaining washer
- 2 screws, plastite, #10-14 x 1.25 in., for pumps with plastic center sections
- 2 screws, M6-1 x 30 mm, for pumps with metal center sections



### Kit 24K906, Fluid Plate

Kit includes:

- 1 fluid side diaphragm plate (15)
- 1 o-ring (301)
- 1 washer (18)
- 1 bolt (304)

### Kit 24K975, Air Plate

Kit includes:

- 1 air side diaphragm plate (14)
- 1 washer (18)
- 1 o-ring (17)

### Shaft and Bearing Kits

Kit 24K950 includes:

- 1 center shaft (104)
- 2 center shaft bearings (105)
- 2 center shaft u-cups (106)
- 1 grease packet

Kit 24K951 includes:

- 2 center shaft bearings (105)
- 2 center shaft u-cups (106)
- 1 grease packet

### Kit 24K946, Pilot Valves

Kit includes:

- 2 pilot valves (101)
- 1 grease packet

### Kit 24K952, Fluid Cover Fasteners

Kit includes:

- 12 bolts, hex head with flange, 1/2-13 x 1.25 in., stainless steel

### Kit 24K953, Manifold Fasteners

Kit includes:

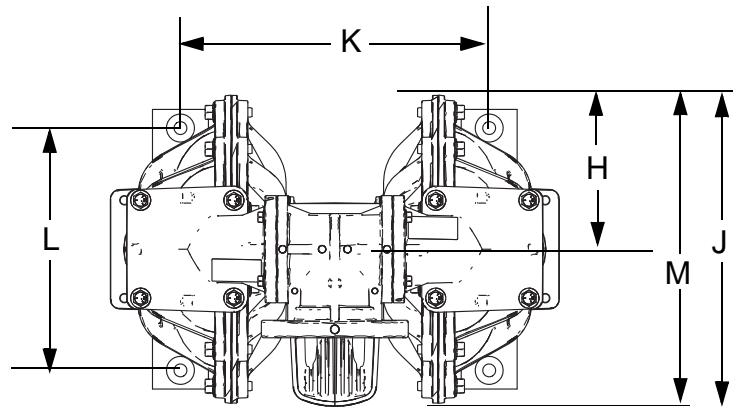
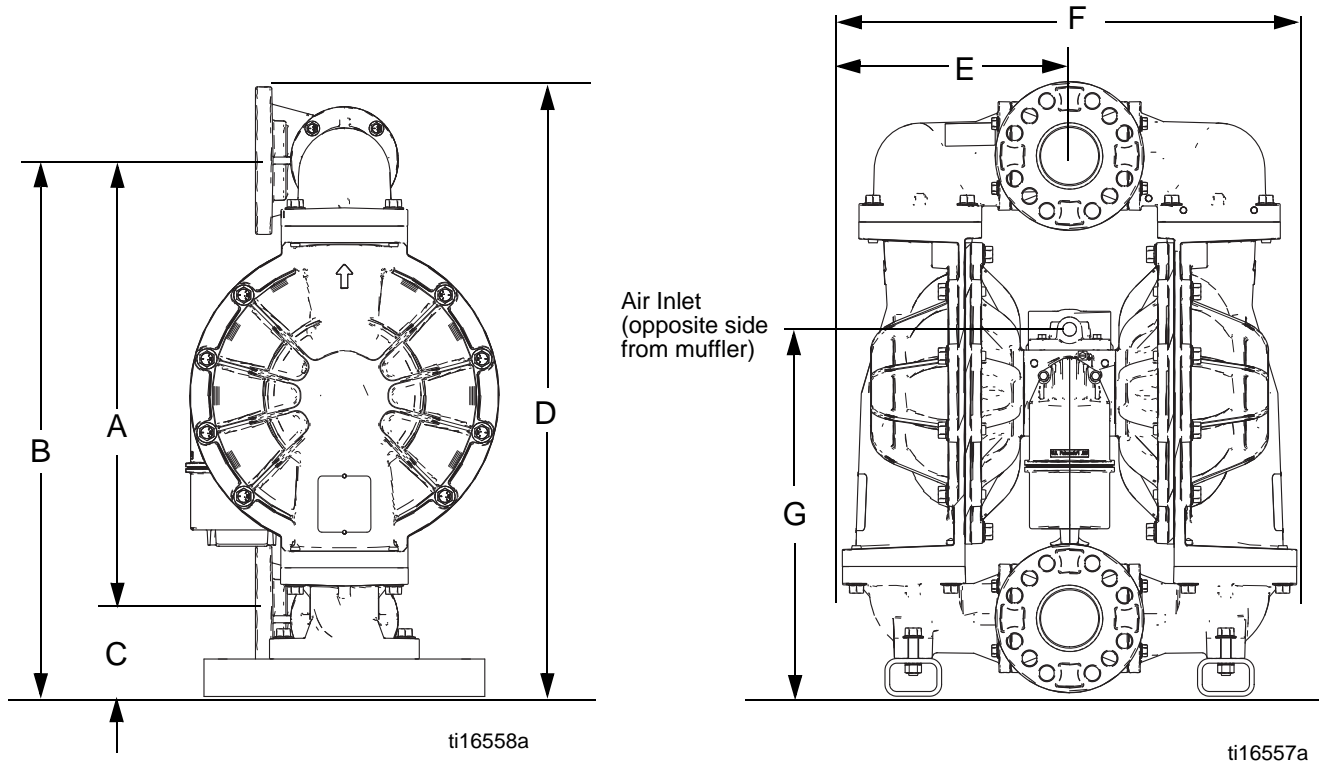
- 8 bolts, hex head with flange, 3/8-16 x 1.25 in., stainless steel

**NOTE:** Replacement Warning Label 188621 and Warning Tag 16F337 are available at no cost.





# Dimensions



ti16559a

<b>A</b>	24.50 in. (62.2 cm)
<b>B</b>	28.63 in. (72.7 cm)
<b>C</b>	4.13 in. (10.5 cm)
<b>D</b>	32.56 in. (82.7 cm)
<b>E</b>	12.04 in. (30.6 cm)
<b>F</b>	24.08 in. (61.2 cm)

<b>G</b>	19.70 in. (50.0 cm)
<b>H</b>	8.25 in. (21.0 cm)
<b>J</b>	18.8 in. (47.8 cm)
<b>K</b>	16.56 in. (42.1 cm)
<b>L</b>	13.00 in. (33.0 cm)
<b>M</b>	16.5 in. (41.9 cm)

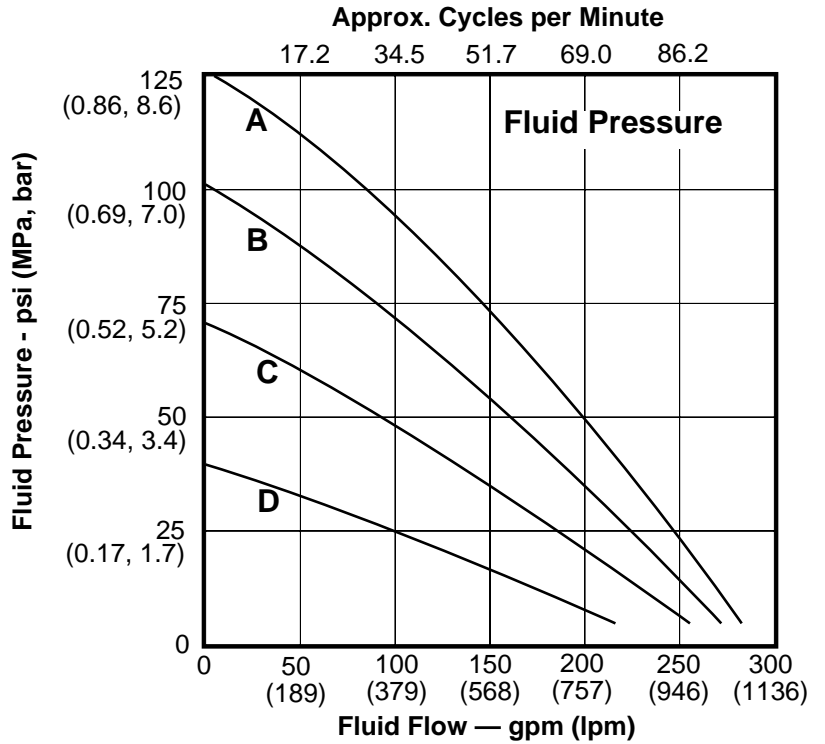


# Performance Charts

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

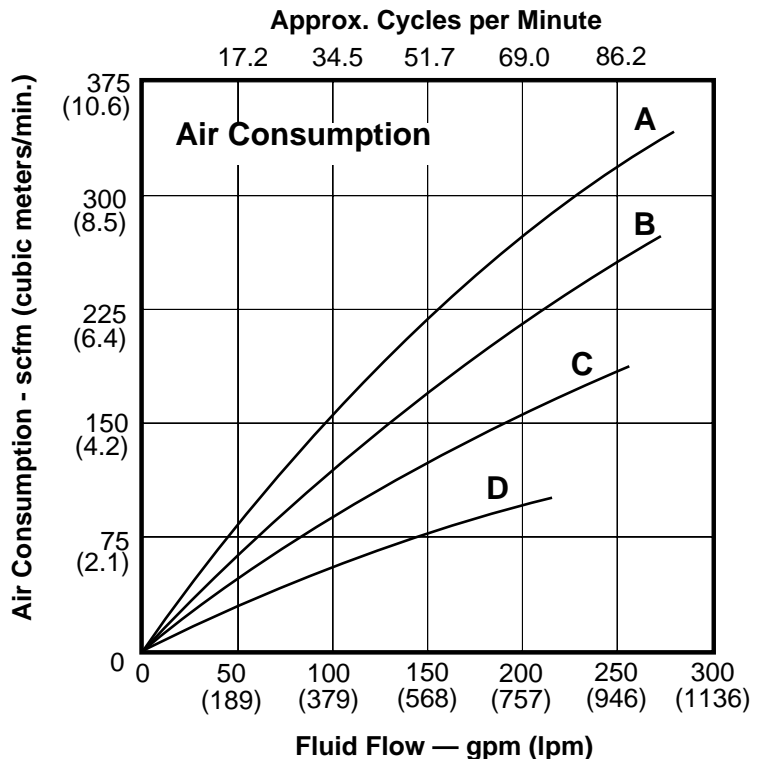
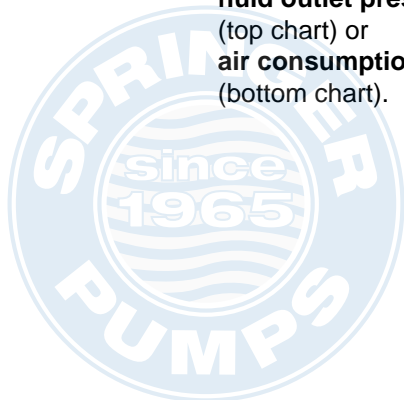
### Operating Air Pressure

- A**  
125 psi (0.83 MPa, 8.3 bar)
- B**  
100 psi (0.7 MPa, 7.0 bar)
- C**  
70 psi (0.48 MPa, 4.8 bar)
- D**  
40 psi (0.28 MPa, 2.8 bar)



### How to Read the Charts

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** (top chart) or **air consumption** (bottom chart).



# Technical Data

NOV 3300		
	US	Metric
Maximum fluid working pressure	125 psi	8.6 bar, 0.86 MPa
Air pressure operating range	20-125 psi	0.14-0.86 MPa, 1.4-8.6 bar
Air consumption	90 scfm at 70 psi, 100 gpm	2.5 m <sup>3</sup> /min at 4.8 bar, 379 lpm
Maximum air consumption	335 scfm	9.5 m <sup>3</sup> /min
Recommended cycle rate for continuous duty	20 cycles per minute	
Recommended cycle rate for circulation systems	20 cycles per minute	
Maximum size pumpable solids	1/2 in.	13 mm
Fluid flow per cycle**	2.9 gal	11.0 l
Wetted parts	Acetal, Aluminum, Buna-N, coated carbon steel, TPE	
Non-Wetted external parts	aluminum, coated carbon steel	
Weight	150 lb	68 kg
Fluid temperature range	32°-150°F	0° to 66°C
<b>Noise (dBa)***</b>		
Sound Power	99.1 at 50 psi and 50 cpm, 106.1 at 125 psi and full flow	99.1 at 3.4 bar and 50 cpm 106.1 at 8.6 bar and full flow
Sound Pressure	91.5 at 50 psi and 50 cpm 98.2 at 125 psi and full flow	91.5 at 3.4 bar and 50 cpm 98.2 at 8.6 bar and full flow
<b>Maximum free-flow delivery*</b>		
Standard diaphragms	300 gpm at 125 psi	1135 lpm at 8.6 bar
Standard diaphragms	280 gpm at 100 psi	1059 lpm at 7 bar
<b>Maximum Pump Speed*</b>		
Standard diaphragms	103 cpm at 125 psi	103 cpm at 8.6 bar
Standard diaphragms	97 cpm at 100 psi	97 cpm at 7 bar
<b>Maximum suction lift (varies widely based on ball/seat selection and wear, operating speed, material properties, and other variables)*</b>		
Dry	8 ft.	2.4 meters
Wet	28 ft.	8.5 meters
<b>Inlet/Outlet Sizes</b>		
Fluid inlet	3 in.-8 npt or 3 in.-11 bspt with 3 in. ANSI/DIN flange	
Air Inlet	3/4 in. npt(f)	
Air Exhaust	1 in. npt	
<b>Notes</b>		
* Maximum values with water as media at ambient temperature. Water level is approximately 3 feet above pump inlet.		
** Startup pressures and displacement per cycle may vary based on suction condition, discharge head, air pressure, and fluid type.		
*** Sound power measured per ISO-9614-2. Sound pressure was tested 3.28 ft (1 m) from equipment.		



# Graco Standard Husky Pump 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 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 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 (6) 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 the latest information about Graco products, visit [www.graco.com](http://www.graco.com).

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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