



INSTRUCTIONS

This manual contains important warnings and information.  
**READ AND KEEP FOR REFERENCE.**

*First choice when quality counts.™*

**BULLDOG® HYDRA-CAT®**

## PROPORTIONING PUMPS

*2500 psi (17 MPa, 170 bar)*  
*Maximum Working Pressure*

### MODELS WITH TWO DISPLACEMENT PUMPS

**Model 209028, Series E**  
1:1 Mix Ratio

### MODELS WITH THREE DISPLACEMENT PUMPS

**Model 208958, Series E**  
1–1/4:1 Mix Ratio

**Model 208999, Series E**  
1–1/2:1 Mix Ratio

**Model 209000, Series E**  
2:1 Mix Ratio

**Model 209001, Series E**  
3:1 Mix Ratio

**Model 209002, Series E**  
4:1 Mix Ratio

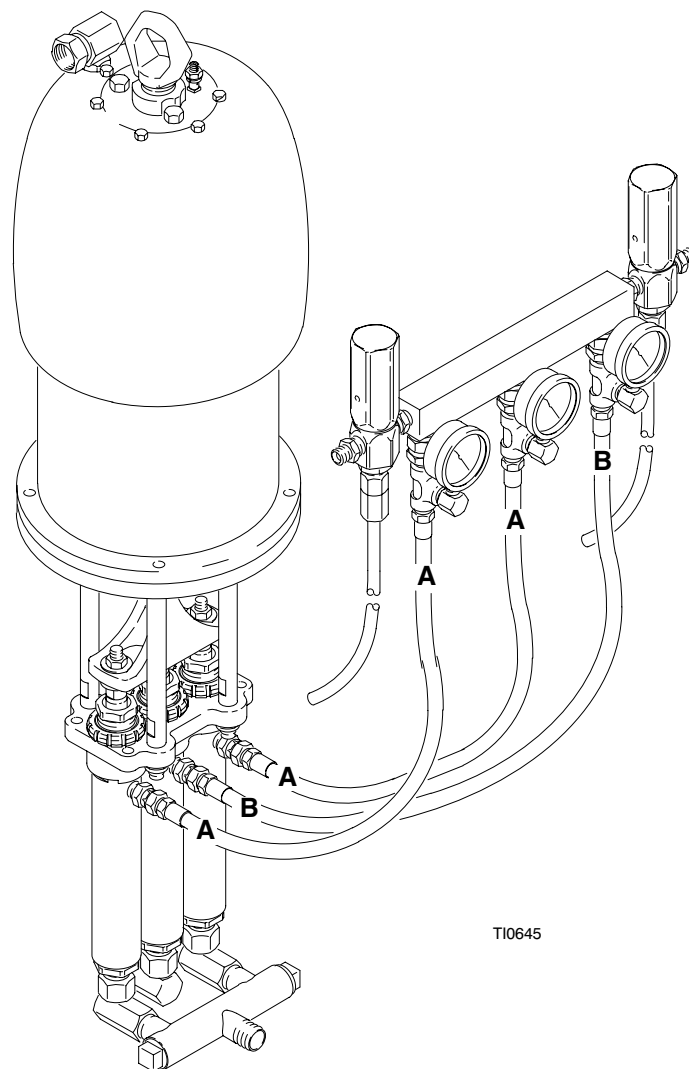
**Model 209003, Series E**  
2–1/2:1 Mix Ratio

### RELIEF VALVE INSTALLATION KITS

Required for safe operation of the pump. Attaches to wall mounting bracket or pump stand and connects relief valves (which relieve fluid pressure if it exceeds preset limit), to displacement pumps.

**209005** Relief Valve Installation Kit  
For two displacement pump models.

**209006** Relief Valve Installation Kit  
For three displacement pump models.



# Table of Contents

Symbols .....	2	Accessories .....	22
Warnings .....	2	Dimensions .....	24
Installation .....	5	Mounting Hole Layout .....	24
Operation .....	10	Technical Data .....	25
Troubleshooting .....	18	Graco Phone Number .....	26
Service .....	20	The Graco Warranty and Disclaimers .....	26

## Symbols

### Warning Symbol



This symbol alerts you to the possibility of serious injury or death if you do not follow the instructions.

### Caution Symbol



This symbol alerts you to the possibility of damage to or destruction of equipment if you do not follow the instructions.

## WARNING



### FIRE AND EXPLOSION HAZARD

Improper grounding, poor ventilation, open flames or sparks can cause a hazardous condition and result in a fire or explosion and serious injury.

- Ground the equipment and the object being sprayed. Refer to **Grounding** on page 9.
- If there is any static sparking or you feel an electric shock while using this equipment, **stop spraying immediately**. Do not use the equipment until you identify and correct the problem.
- Provide fresh air ventilation to avoid the buildup of flammable fumes from solvents or the fluid being sprayed.
- Keep the spray area free of debris, including solvent, rags, and gasoline.
- Electrically disconnect all equipment in the spray area.
- Extinguish all open flames or pilot lights in the spray area.
- Do not smoke in the spray area.
- Do not turn on or off any light switch in the spray area while operating or if fumes are present.
- Do not operate a gasoline engine in the spray area.



### MOVING PARTS HAZARD

Moving parts, such as the air motor piston and the secondary pump lever and connecting rod area, can pinch or amputate your fingers.

- Keep clear of all moving parts when starting or operating the pump.
- Before servicing the equipment, follow the **Pressure Relief Procedure** on page 10 to prevent the equipment from starting unexpectedly.

# ⚠ WARNING



## INJECTION HAZARD

Spray from the gun, hose leaks, or ruptured components can inject fluid into your body and cause extremely serious injury, including the need for amputation. Fluid splashed in the eyes or on the skin can also cause serious injury.

- Fluid injected into the skin might look like just a cut, but it is a serious injury. **Get immediate medical attention.**
- Do not point the gun at anyone or at any part of the body.
- Do not put your hand or fingers over the spray tip.
- Do not stop or deflect leaks with your hand, body, glove or rag.
- Do not “blow back” fluid; this is not an air spray system.
- Always have the tip guard and the trigger guard on the spray gun when spraying.
- Check the spray gun diffuser operation weekly. Refer to the gun manual.
- Be sure the gun trigger safety operates before spraying.
- Lock the gun trigger safety when you stop spraying.
- Follow the **Pressure Relief Procedure** on page 10 whenever you: are instructed to relieve pressure; stop spraying; clean, check, or service the equipment; and install or clean the spray tip.
- Tighten all fluid connections before operating the equipment.
- Check the hoses, tubes, and couplings daily. Replace worn, damaged, or loose parts immediately. Permanently coupled hoses cannot be repaired; replace the entire hose.
- Use only Graco approved hoses. Do not remove any spring guard that is used to help protect the hose from rupture caused by kinks or bends near the couplings.



## PLURAL COMPONENT FLUID HAZARD

Before using this equipment, read the fluid manufacturer’s warnings and determine all facts relating to the fluids used, including any of the potential hazards relating to toxic fumes, fires, explosions, reaction times, and exposure of human beings to the individual components or their resultant mixtures.

- Know the specific hazards of the fluid you are using.
- Store hazardous fluid in an approved container. Dispose of hazardous fluid according to all local, state and national guidelines.
- Always wear protective eyewear, gloves, clothing and respirator as recommended by the fluid and solvent manufacturer.
- Graco does not manufacture or supply any of the reactive chemical components that may be used in this equipment and is not responsible for their effects. Graco assumes no responsibility for loss, damage, expense or claims for personal injury or property damage, direct or consequential, arising from the use of such chemical components.

# WARNING



INSTRUCTIONS

## EQUIPMENT MISUSE HAZARD

Equipment misuse can cause the equipment to rupture or malfunction and result in serious injury.

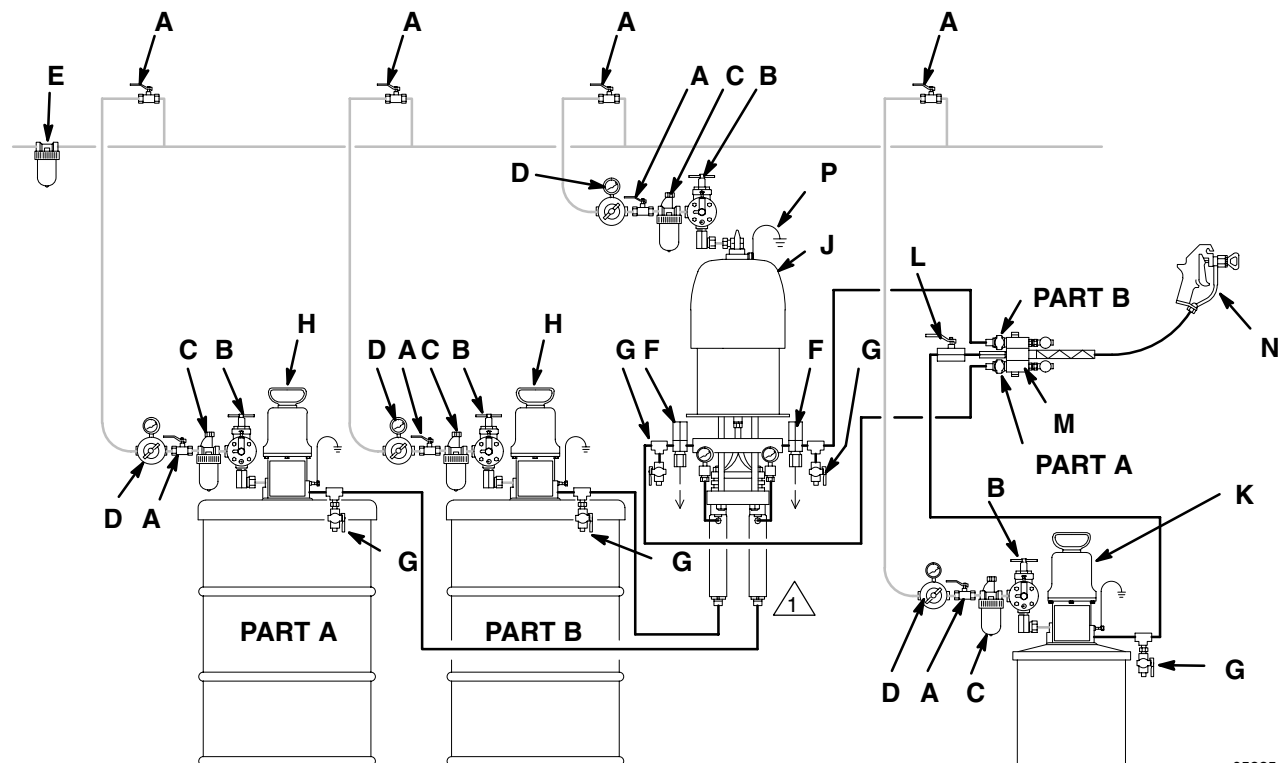
- This equipment is for professional use only.
- Read all instruction manuals, tags, and labels before operating the equipment.
- Use the equipment only for its intended purpose. If you are uncertain about usage, call your Graco distributor.
- Do not alter or modify this equipment. Use only genuine Graco parts and accessories.
- Check equipment daily. Repair or replace worn or damaged parts immediately.
- All system components must meet or exceed the pressure ratings printed on the pressure relief valve. The lever amplification of the secondary pump enables very high fluid pressures to be achieved. A 475 to 575 psi working pressure range relief valve is provided on the secondary side to limit the fluid pressure. Do not tamper with this pressure relief valve or serious injury could result.
- Do not lift pressurized equipment.
- Route hoses away from traffic areas, sharp edges, moving parts, and hot surfaces. Do not expose Graco hoses to temperatures above 82°C (180°F) or below -40°C (-40°F).
- Do not use hoses to pull equipment.
- Use fluids and solvents which are compatible with the equipment wetted parts. Refer to the **Technical Data** section of all equipment manuals. Read the fluid and solvent manufacturer's warnings.
- Fluid hoses must have spring guards on both ends to protect them from rupture caused by kinks or bends near the couplings.
- Wear hearing protection when operating this equipment.
- Comply with all applicable local, state, and national fire, electrical, and safety regulations.

# Installation

These pumps are designed to be part of a Hydra-Cat<sup>®</sup> spray system that will proportion, mix, and spray/dispense two-component fluids. The following two typical installations are only guidelines to setting up a complete Hydra-Cat<sup>®</sup> system. For assistance in designing a system to suit your particular needs, contact your Graco distributor.

- △<sub>1</sub> For pressure feed to proportioning pump, mount fluid pressure gauges at proportioning pump inlets to properly adjust feed pump pressures.

## LIGHT VISCOSITY SYSTEM 5:1 RATIO MAXIMUM RATIO FEED PUMPS



05225

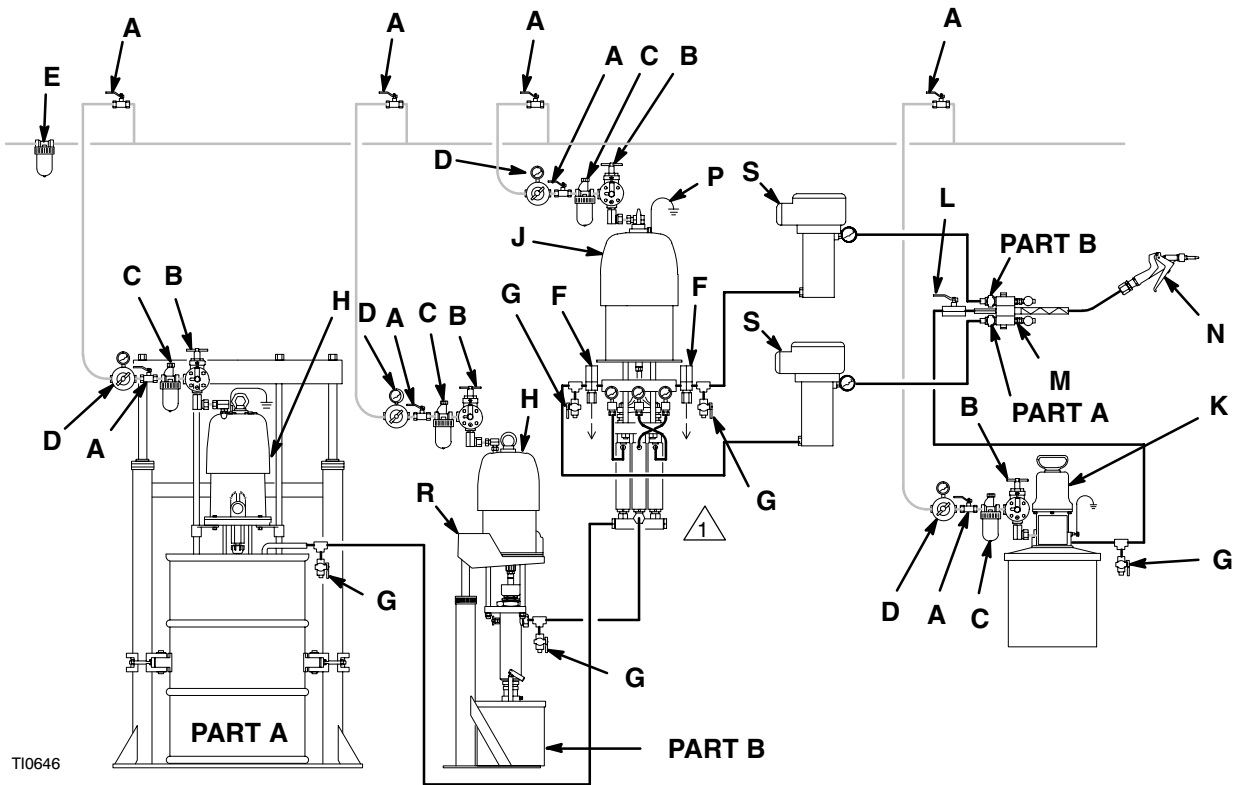
### KEY

A	Bleed-type master air valve	E	Air line filter	K	Solvent pump
B	Pump runaway valve	F	Fluid filter	L	Flushing valve
C	Air line lubricator	G	Fluid drain valve	M	Static mixer
D	Air regulator	H	Feed pump	N	Spray valve
		J	Proportioning pump	P	Ground wire

# Installation

- 1 For pressure feed to proportioning pump, mount fluid pressure gauges at proportioning pump inlets to properly adjust feed pump pressures.

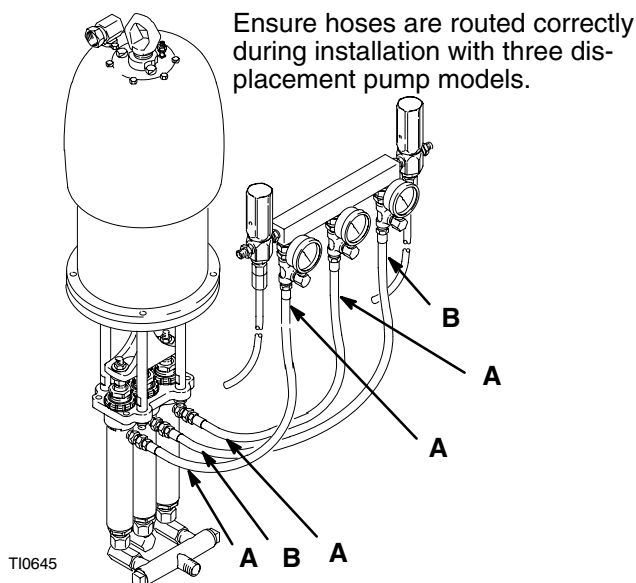
## HEAVY VISCOSITY HEATED SYSTEM 10:1 RATIO MAXIMUM RATIO FEED PUMPS



### KEY

A	Bleed-type master air valve	F	Fluid filter	M	Static mixer
B	Pump runaway valve	G	Fluid drain valve	N	Spray valve
C	Air line lubricator	H	Feed pump	P	Ground wire
D	Air regulator	J	Proportioning pump	R	Air powered ram
E	Air line filter	K	Solvent pump	S	Fluid heater
		L	Flushing valve		

# Installation



**NOTE:** See page 22 for accessories mentioned in this section.

In the following instructions, the base fluid will always be called part A and the catalyst will be called part B. With three displacement pump models, always use the two outer displacement pumps to supply part A and the middle displacement pump to supply part B.

Mount pump to suit the type of installation planned. Accessory wall mounting bracket is shown on page 22, pump dimensional drawing and mounting hole layout are shown on page 24. When mounting pump on wall, be sure the wall is strong enough to support the pump and other equipment, plus any stress developed when equipment is operating. Drill three 3/16 in. diameter holes in mounting bracket as shown on page 24. Using screws (43 or 56), screw manifold (49 or 62) onto bracket.

Connect part A inlet hose to 3/4 npt inlet of manifold on three displacement pump models, or to 3/4 npt inlet of left hand displacement pump on two displacement pump models. Connect part B inlet hose to 3/4 npt swivel union inlet of center displacement pump models.

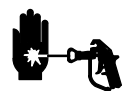
## System Accessories

Install the accessories in the order shown in the **Typical installations** on pages 5 and 6. Working upstream from the pump inlet, install a pump runaway valve (B) to shut off the air to the pump if the pump accelerates beyond the pre-adjusted setting. A pump which runs too fast can be seriously damaged.

Next, install an air line lubricator (C) for automatic air motor lubrication, a bleed-type master air valve (A) to relieve air trapped between the valve and the pump, an air regulator (D) to control pump speed, and an air filter (E) to remove harmful dirt and moisture from the compressed air supply.

Install a fluid drain valve (G) at each fluid outlet to relieve pressure in the system. Be sure the valve is pointed downward.

## ⚠ WARNING



### INJECTION HAZARD

Two accessories, the bleed-type master air valve (A) and the fluid drain valve (G) are required for your system to reduce the risk of serious injury from moving parts, fluid injection, or splashing when shutting off the pump.

The bleed-type air valve relieves air trapped between the valve and the pump, after the pump is shut off. Trapped air can cause the pump to cycle unexpectedly and result in serious injury if you are adjusting or repairing the pump.

The fluid drain valve helps relieve fluid pressure in the displacement pump, hose and gun when shutting off the pump. Triggering the gun to relieve pressure may not be sufficient, especially if there is a clog in the hose, gun/dispensing valve, or tip/nozzle.

Install and connect feed pumps, solvent pump, mixer, etc. See **Typical installations** on pages 5 and 6 and separate component instructions.

## Feed Systems

Material supply must be pressure fed into each proportioning cylinder. If materials require heating they can be heated in the supply feed as well as the outbound side of the pumps. Material supply is critical to proper proportioner operation. Material must fill the proportioner cylinders on their upstroke totally to eliminate a “diving” of the cylinders on the top change-over. This “diving” will also be seen as a pressure drop at the change over. This will cause an off ratio condition.

Ensure your feed systems are designed to supply twice the volume used by each component. This supply pump pressure should never exceed 25% of the proportioner output pressure.

**Example:** 4:1 proportioner. 2.0 gpm output, 1000 psi.

4:1 ratio at 2.0 gpm = 1.5gpm of “A” component and 1/2 (.5) gpm of component “B”.

- “A” feed pump needs to have a 4 gpm capacity at a max of 250psi.
- “B” feed pump needs to be at least 1 gpm at 250 psi max.

Review your feed systems with your Graco Distributor.

# Installation

Assemble installation kit as shown in Fig. 1 and 2. Attach manifold to mounting bracket as shown, using

screws provided in installation kit. Connect fluid supply hoses to 3/8 npt(m) fluid outlets of relief valves.

## 209005 Relief Valve Kit

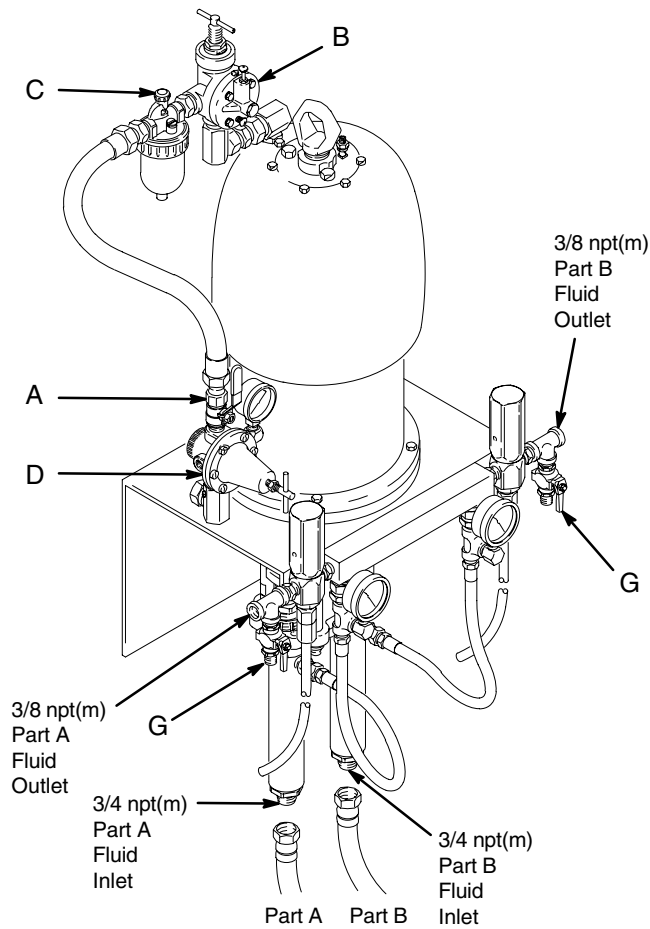


Fig. 1

05227

## 209006 Relief Valve Kit

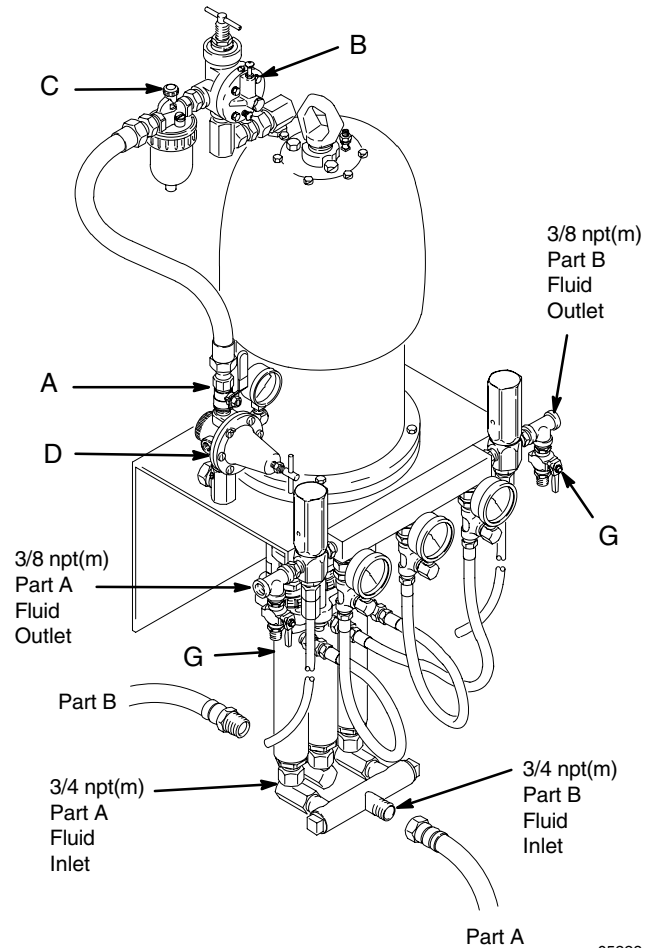


Fig. 2

05228



# Installation

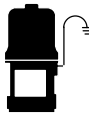
## Grounding

### WARNING



#### FIRE AND EXPLOSION HAZARD

Static electricity is created by the high velocity flow of fluid through the pump and hose. If your system is not properly grounded, sparking may occur and the system may become hazardous.



To reduce the risk of static sparking which can result in a fire or explosion and cause serious injury, follow these recommendations for providing electrical continuity throughout your system.

Also read the WARNING section, **FIRE AND EXPLOSION HAZARD** on page 2.

1. *Pump:* Loosen the grounding lug locknut (A) and washer. Insert one end of a 12 ga (1.5 m<sup>2</sup>) minimum ground wire (B) into the slot in the lug (C). Tighten the locknut securely. See Fig. 3. Connect the other end of the ground wire to a true earth ground. Order a Grounding Wire and Clamp, P/N 237569, (25 feet (7.6 m) long, 12 ga.).
2. *Air and fluid hoses:* Use only electrically conductive hoses with a maximum of 500 feet (150 m) combined hose length to ensure grounding continuity.
3. *Air compressor:* follow the air compressor manufacturer's recommendations.
4. *Spray gun or dispensing valve:* Obtain grounding through connection to a properly grounded fluid hose and pump.
5. *Fluid supply container:* according to your local code.
6. *Object being sprayed:* according to local code.
7. *All solvent pails* used when flushing, according to local code. **Use only metal pails** which are conductive, placed on a positively grounded surface. Do not place the pail on a non-conductive surface, such as paper or cardboard, which interrupts the grounding continuity.
8. *To maintain grounding continuity when flushing or relieving pressure,* always hold a metal part of the gun or dispensing valve firmly to the side of a grounded metal pail, then trigger the gun.

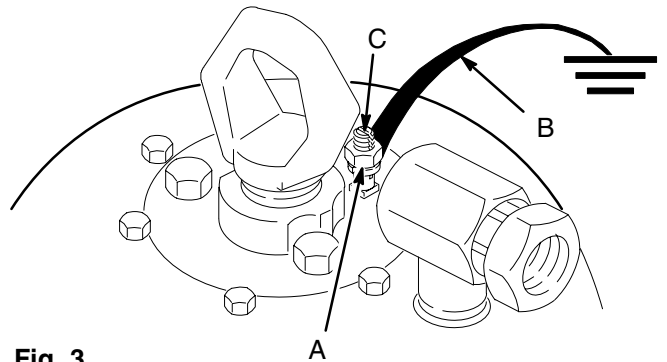


Fig. 3

# Operation

## WARNING



Some of the chemicals used with proportioning equipment are hazardous to handle. Be sure you are completely familiar with the fluids you are using. Read and follow the fluid manufacturer's instructions carefully.

When spraying reactive fluids, wear the proper protective clothing, eye protection, gloves, and clean air breathing apparatus as prescribed by the fluid manufacturer's recommendations, O.S.H.A. regulations and approved by N.O.I.S.H. for chemicals being handled.

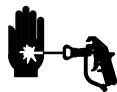
## WARNING



All system components must meet or exceed the pressure rating printed on the pressure relief valve. The lever amplification of the secondary pump enables very high fluid pressures to be achieved. A relief valve is provided on the secondary side to limit the fluid pressure. Do not tamper with this pressure relief valve or serious injury could result.

## Pressure Relief Procedure

### WARNING



#### INJECTION HAZARD

The system pressure must be manually relieved to prevent the system from starting or spraying accidentally. Fluid under high pressure can be injected through the skin and cause serious injury. To reduce the risk of an injury from injection, splashing fluid, or moving parts, follow the **Pressure Relief Procedure** whenever you:

- are instructed to relieve the pressure,
- shut off the pump,
- stop spraying,
- check or service any of the system equipment,
- or install or clean the spray tips.

1. Lock the gun/dispensing valve trigger safety.
2. Shut off the air supply to all the pumps.
3. Close the bleed-type master air valve (required).
4. Unlock the gun/dispensing valve trigger safety.
5. Hold a metal part of the gun/dispensing valve firmly to the side of a grounded metal pail. Trigger the gun/dispensing valve into the pail to relieve pressure.
6. Lock the gun/dispensing valve trigger safety.
7. Open the fluid drain valves (required), having a container ready to catch the drainage.
8. Leave the fluid drain valves open until ready to spray/dispense again.

If you suspect that the spray tip or nozzle or the hose is completely clogged or that pressure has not been fully relieved after following the steps above, follow this procedure: Very slowly loosen the tip guard retaining nut or hose end coupling and relieve pressure gradually, then loosen completely. Now clear the obstruction.

# Operation

## Fill the Throat Packing Nuts

Keep the displacement pumps' throat packing nuts filled with Graco Throat Seal Liquid (TSL) to help prevent fluid from drying on the displacement rod and damaging the pump packings. See **Accessories**.

## Flush the Pump

The equipment was factory tested in light oil, which was left in to protect the parts. Before using the equipment to mix and dispense fluid, flush as follows:

Place each pump intake into a separate 5 gallon, grounded pail, containing about 3 gallons (12 liters) of mineral spirits solvent.

Holding a metal part of the gun/dispensing valve firmly to the side of a grounded metal pail, trigger the gun/dispensing valve, open the mixer inlet valves, and completely close all the air regulators (turn handle counterclockwise until spring tension is released).

Turn on the air supply to the feed pumps, and slowly open the air regulators until the pumps start. Let the pumps run slowly until clean solvent is coming from the gun/dispensing valve. Then release the trigger, set the safety latch, and shut off the air supply to the pumps.

Repeat the flushing procedure using a solvent compatible with the fluid you are going to use. When clean solvent is coming out of the gun/dispensing valve, remove the solvent supply from the feed pumps intakes. Slowly run the pump to push all the solvent out of the lines, then stop the pumps.

Set the air pressure to the solvent pump at about 60 psi (0.4 MPa, 4 bar). Slowly open the air shutoff valve to the pump, and let the pump prime and stall against pressure. Open the mixer solvent valve briefly to be sure the solvent will be supplied when it is needed.

## WARNING

Always close the air supply valve to the pump before opening the drain valves to relieve system pressure. This will reduce the risk of excessive pressure buildup in the opposite component hose and fittings.

## Startup and Priming

Install full containers of part A and part B at the fluid inlets of the appropriate feed pumps. Refer to the **Typical Installations** on pages 5 and 6. Disconnect the dispensing hose from the mixer outlet and place a grounded metal waste container under the outlet.

Open the air supply valves to the pumps and increase the air pressure just enough to keep the pumps running. After all the air has been purged and the system is completely primed, close the mixer fluid valves.

Open the solvent flushing valve on the mixer and keep it open until all the mixed fluid is flushed out and clean solvent is coming from the outlet. Then close the mixer solvent and air valves.

# Operation

## Using Your Proportioning Pump System

When the system is primed and operating, check the fluid outlet pressure gauges. Check the gauges frequently while using the system. Always make a note of the pressures indicated. These notes will help to analyze any problems that may occur since a change in displacement pump performance will be indicated by a change in pressure gauge readings.

**NOTE:** A pressure drop does occur during pump stroke changeover.

Set the air pressure to the proportioning pump to obtain the fluid pressure you require. Refer to the **Proportioning Pump Chart** on page 16 for the fluid to air pressure ratio.

Set the air pressure to the feed pumps at a pressure that will not give more than 250 psi (1.8 MPa, 18 bar) at their fluid outlets. Pressures greater than 250 psi (1.8 MPa, 18 bar) may prevent the proportioning pump inlet ball checks from seating properly.

### **WARNING**



To reduce the risk of serious injury, including fluid injection, splashing in the eyes or on the skin, and property damage, never exceed the maximum air and fluid working pressure of the lowest rated component in your system. See page 10.

Reconnect the fluid dispensing hose to the mixer. Make sure the gun/dispensing valve is not triggered. Open the air valve to the mixer air motor. Open the mixer fluid valves. Point the gun/dispensing valve into a grounded metal waste container and trigger the gun/dispensing valve to purge air out of the dispensing lines. After all air has been purged from the lines, release the trigger and set the safety. The pumps will start and stop as the gun/dispensing valve is triggered and released.

### **WARNING**

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 10.

To shut the system down, shut off the air to all the pumps, trigger the gun/dispensing valve into a grounded metal waste container, and open the fluid drain valves to relieve pressure. Close the mixer valves. Flush all the mixed fluid out of the mixer, hoses, and dispensing equipment. Refer to separate mixer instructions for flushing procedure. Relieve the pressure after flushing.

# Operation

## Care of the Pump

Never allow the fluid supply containers to run dry of the fluid being pumped. A dry container allows air to be pumped into the system and causes incorrect proportioning. Also, one dry pump will quickly accelerate to a high speed, possibly damaging itself and the displacement pump(s) because it causes a pressure rise in the other pump. If a supply container is dry, stop the pump immediately, refill the container, and prime the system. Be sure to eliminate all the air from the system.

**NOTE:** The pump runaway valve recommended in the **Installation** section will shut off the air supply to the pump if the pump accelerates beyond the pre-adjusted setting.



## WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 10.

Keep the throat packing nuts filled with TSL, and check the tightness of the packing nut weekly. The packing nut should be tight enough to prevent leakage; no tighter. Too tight an adjustment will cause the packings to bind or wear prematurely and leak. Relieve the pressure before adjusting the packing nut.

Observe the pot life limit. Flush the mixed fluid out of the mixer, dispensing lines and equipment before it hardens. Flush the complete system, when necessary to prevent the fluids from hardening in the equipment and hoses. Check the fluid manufacturer's instructions for fluid shelf life, and flush the entire system before this time is reached. Flush the system with a compatible solvent as explained on page 11.

You should use a nitrogen regulator kit to protect the fluid in the supply containers from moisture that can crystallize the fluid and cause the ball checks to malfunction. See **Accessories**.

With heavy fluids, flushing solvents could channel through the fluid, leaving a coating of fluid on the inside of the hoses. Disconnect the hoses and clean the fluid out with a rag and wire or a ramrod type cleaner, or use a solvent and air purge to agitate the solvent, and flush until the mixer, hose and gun/dispensing valve are clean.

# Operation

## Checking the Mix Ratio

### WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 10.

If the mixed fluid does not cure or harden properly, check the ratio of part A to part B. To check the ratio, relieve the pressure, flush the mixed fluid out of the mixer, dispensing lines and equipment, then proceed as follows:

**NOTE:** The pump must be operating in order to accurately check the proportioning ratio of the pumps. The outlet pressures at the pumps must be maintained at a minimum level of 4 times that of the inlet pressures. When the mixer manifold or other dispensing valve is removed to check the mix ratio, a flow restrictor will be needed to simulate the pressure conditions during normal operation. The preferred flow restrictor is a small diameter, 1/16 in. ID, 12 in. (13 mm) long steel tube, coupled to the fluid supply hoses. A needle-type flow control valve could also be used. Contact your Graco distributor for assistance in selecting the proper type of flow restrictor for your application.

1. Disconnect the fluid hoses from the mixer inlet valves, taking note of which hose was connected to which valve. Then place the hose ends into a waste container. Set two graduated cylinders of the same size next to the waste container. See Fig. 4.
2. Set the air pressure to the pumps at normal operating pressure. Then open the air shut off valves to the feed pumps and proportioning pump.
3. When the fluids are flowing freely, at exactly the same time, move the hoses over the cylinders – part A hose over one cylinder and part B hose over the other.

4. When you have a large enough sample, move both hoses back into the waste containers, at exactly the same time. Then shut off the air to all the pumps.
5. Compare part A volume to part B volume. If the ratio is not correct, refer to the **Troubleshooting Chart** on page 18 for further information on how to correct the ratio.
6. Connect the fluid hoses back to the mixer inlet valves.

### CAUTION

Be sure to connect the hoses back to the same valves they had originally been connected to. The mixer could be damaged by reversing them.

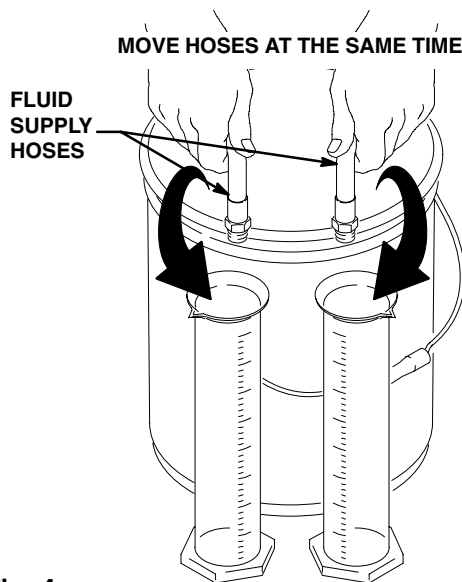


Fig. 4

05229

# Operation

## Changing the Mix Ratio on the Three Displacement Pump Models

### WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 10.

To change the fluid ratio of the proportioning pump, the displacement pumps must be changed. Refer to the **Proportioning Pump Chart** on page 16. Completely flush the system and pump out the solvent. Shut off the air to the pumps and relieve the pressure. Then proceed as follows:

### CAUTION

If you are changing to a different type of fluid, completely clean all the equipment and hoses, making sure that no fluid remains in any part of the system.

1. Disconnect the three fluid riser hoses from the fluid pumps' outlets.

2. Unscrew the three unions (9) from the intakes of the displacement pumps and remove the manifold (20).
3. Remove the two retaining nuts (6) from the two outer pumps' displacement rods (E). Screw the fluid pump retaining rings (15) off the fluid pumps (use a screwdriver and hammer to loosen). See Fig. 5.
4. Pull the two outer pumps down out of the retaining plate (12). Remove the washers from the displacement rods.
5. Using a wrench on the flats of the center pump's displacement rod, screw the rod out of the yoke (13). See Fig. 5. Then remove the center pump and remove the washer from its displacement rod.
6. Refer to the **Proportioning Pump Chart** on page 16 for mix ratios for different combinations as instructed in the **Service** Section. Install the center pump first, then the two outside pumps.
7. Screw the unions (9) securely onto the intakes of the fluid pumps. Flush the system, then start up as explained on page 11.

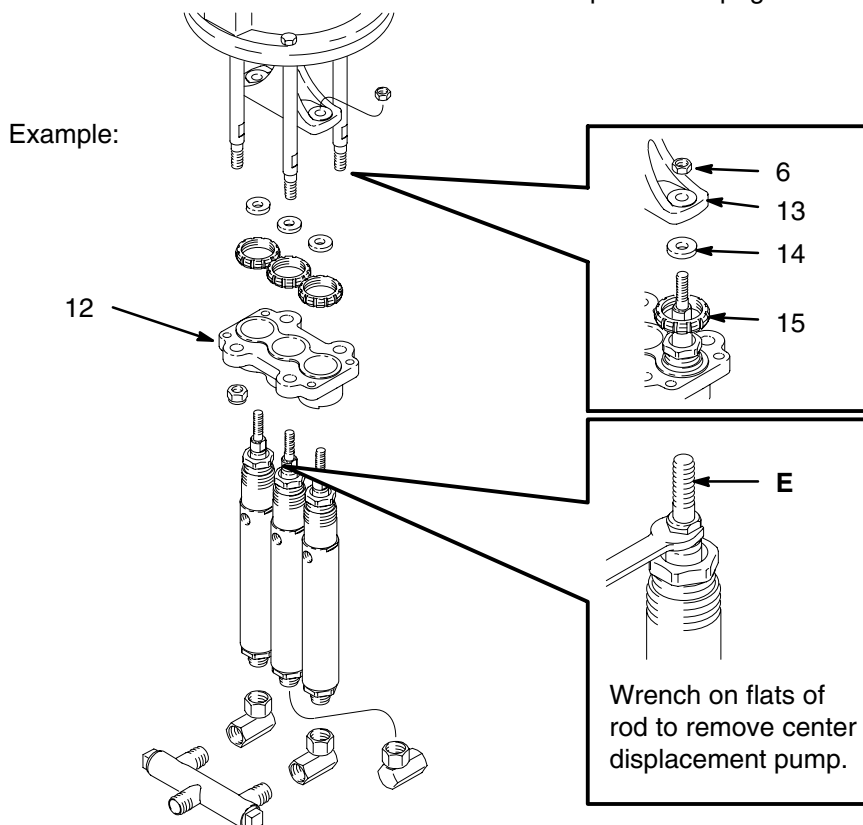


Fig. 5

05230

# Operation

## Proportioning Pump Chart

Displacement pump combinations for mix ratio, pressure ratio and volume per cycle for each model.

### CAUTION

With three displacement pump models, the outer two displacement pumps must be identical models to balance forces and avoid damaging the pumps.

Mix	Part A	Part B	Part A	Pressure Ratio (fluid to air)	Volume per Cycle Gallon (liter)	Fluid Pressure Developed psi (MPa, bar) at incoming air pressure of psi (MPa, bar)
1:1	222012	222012	None	34:1*	0.046 (0.17)	2500 (17, 170) 74 (0.5, 5.2)
1-1/4:1	222019	222015	222019	38:1*	0.034 (0.13)	2500 (17, 170) 66 (0.4, 4.5)
1-1/2:1	222019	222017	222019	41:1*	0.038 (0.14)	2500 (17, 170) 61 (0.4, 4.2)
2:1	222012	222012	222012	23:1	0.068 (0.26)	2300 (16, 161) 100 (0.7, 7)
2-1/2:1	222012	222015	222012	24:1	0.064 (0.24)	2400 (16.8, 168) 100 (0.7, 7)
3:1	222012	222017	222012	25:1	0.061 (0.23)	2500 (17, 170) 100 (0.7, 7)
4:1	222012	222019	222012	27:1	0.057 (0.22)	2500 (17, 170) 93 (0.6, 6.4)

\* Exceeds the pressure rating of the pumps.

## Relief Valve Selection Table

To select the appropriate relief valve:

1. Determine the Maximum Pump Fluid Pressure of your system.
2. Verify that all system components meet or exceed the pressure ratings of the pressure relief valve that you have selected.
3. Select the lowest pressure relief valve with a maximum working pressure that exceeds the Maximum Pump Fluid Pressure.

Part Number	Working Pressure Range psi (MPa, bar)		Cracking Pressure Range psi (MPa, bar)	
	Minimum	Maximum	Minimum	Maximum
237060	475 (3.3, 33)	575 (4, 40)	710 (4.9, 49)	860 (5.9, 59)
237061	950 (6.6, 66)	1150 (7.9, 79)	1425 (9.8, 98)	1725 (11.9, 119)
237112	1400 (9.7, 97)	1800 (12.4, 124)	2140 (14.8, 148)	2590 (17.9, 179)
237062	1800 (12.4, 124)	2300 (15.9, 159)	2850 (19.7, 197)	3450 (23.8, 238)



[illegible]

# Troubleshooting Chart

## WARNING



To reduce the risk of serious injury, always follow the **Pressure Relief Procedure** on page 10 whenever you shut off, check or service any part of the system, install or change spray tips, or stop spraying/dispersing.

## WARNING



Never operate the pump with the air motor shield removed, to reduce the risk of serious injury, including amputation, from moving parts inside the air motor housing.

**NOTE:** Check everything in the troubleshooting chart before disassembling the pump.

PROBLEM	CAUSE	SOLUTION
System won't run or stops	Air pressure or volume too low.	Increase, check air compressor.
	Closed or restricted air line or air valve.	Open or clean as required.
	Fluid valves closed.	Open fluid valves.
	Clogged fluid hose.	Replace fluid hose.
	Air motor worn or damaged.	Service air motor – see instruction manual 307049.
	Displacement pump seized.	Service lower pump – see instruction manual 307944.
System speeds up or runs erratically	Fluid containers are empty.**	Check often – keep filled.
	Air in fluid lines.**	Purge, check connections.
	Displacement pump parts worn or damaged.	Service air motor – see instruction manual 307944.
Pump operates but part A output pressure drops during upstroke.*	Dirty, worn or damaged part A pump piston valve.	Clean, service – see instruction manual 307944.
	Worn or damaged part A pump piston packings.	Replace.
Pump operates but part A output pressure drops during downstroke.*	Dirty, worn or damaged part A pump intake valve.	Clean, service – see instruction manual 307944.
	Fluid not filling cylinder on upstroke, “diving” on top of change-over.	Increase pressure on feed pump. Check inlet filter screen. Check foot valve.
Pump operates but part A output pressure drops during both strokes.*	Dirty, worn or damaged part A pump piston valve.	Clean, service – see instruction manual 307944.
	Fluid supply low.**	Refill or change container.

# Troubleshooting Chart

Pump operates but Part B output pressure drops during upstroke.*	Dirty, worn or damaged part B pump piston valve.	Clean, service – see instruction manual 307944.
	Worn or damaged part B pump piston packings.	Replace.
Pump operates but part B output pressure drops during downstroke.*	Dirty, worn or damaged part B pump intake valve.	Clean, service – see instruction manual 307944.
	Fluid not filling cylinder on upstroke, “diving” on top of change-over.	Increase pressure on feed pump. Check inlet filter screen. Check foot valve.
Pump operates but part B output pressure drops during both strokes.*	Dirty, worn or damaged part B pump intake valve.	Clean, service – see instruction manual 307944.
	Fluid supply low.**	Refill or change container.
Fluid leaks around fluid pump packing nut.	Loose packing nut or worn throat packings.	Tighten, replace.
Relief valve opens too soon or won't close.	Relief valve is damaged.	Service – see instruction manual 308547.

\* Fluid ratio will be wrong.

\*\* Purge all air out of the system before proportioning the fluids.

# Service

## Displacement Pump Service

### WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 10.

Thoroughly flush the pump with a solvent which is compatible to the fluid being pumped, then relieve the pressure.

### Disassembly (See Fig. 6)

1. Disconnect the fluid riser hoses from the fluid pump's outlets.
2. Unscrew the unions (9) (three displacement pump models) from the intakes of the displacement pumps and remove the manifold (20).
3. Remove the two locknuts (6) from the two outer pumps' displacement rods (E). Screw the fluid pump retaining rings (15) off the fluid pumps (use a screwdriver and hammer to loosen).
4. Pull the two outer pumps (25) down out of the retaining plate (12). Remove the washers (14) from the displacement rods (E).
5. *Three Displacement Pump Models Only*  
Using a wrench on the flats of the center pump's displacement rod (E), screw the rod out of the yoke (13). See Fig. 5. Then remove the center pump (24) and remove the washer (44) from its displacement rod.
6. See instruction manual 307944 for servicing the displacement pump.

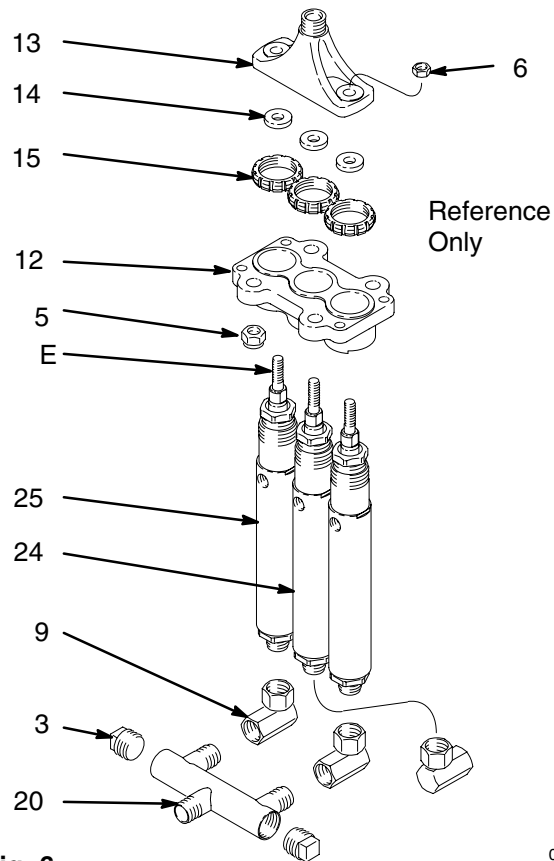


Fig. 6

05231

# Service

## Reassembly (See Fig. 6)

### 1. *Three Displacement Pump Models Only*

Slide the center pump's displacement rod (E) through the retaining plate (12), retaining ring (15), and washer (14). Thread the displacement rod (E) into the yoke (13) by turning the complete cylinder. Use the wrench on the flats of the displacement rod for final tightening. Push the cylinder up into place in the retaining and install the retaining ring.

2. Insert the two outer displacement rods (E) through the retaining plate (12), retaining rings (15), and washers (14). Thread the displacement rods into the yoke (13) by turning the complete cylinder. Install the locknuts (6) loosely on the displacement rods. Push the cylinders up into place in the retaining rings.

3. Move the air motor to the bottom of its stroke. Check the play of the air motor yoke at each displacement rod. With the displacement rods centered, tighten the locknuts (6) securely.
4. After mounting the displacement pumps to the air motor yoke, use a 3/8 in. hex key wrench to tighten the piston studs securely. Tighten the throat packing nut just enough to prevent leakage, no tighter.
5. Install the intake valve housing in the cylinder and torque it to 30–35 ft-lb (41–46 N·m).

# Accessories

## Wall Mounting Bracket 206221

For wall mounting the Bulldog® pump

## Universal Frame 207872

For stationary mounting the Bulldog® pump

## Wheel Kit 208362

For converting universal frame 207872 to portable pump cart

## Grounding Wire and Clamp 237569

25 ft (7.6m) long, 12 ga.



## Wrench 176881

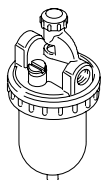
For tightening throat packing nut

## Air Line Lubricator 214849

250 psi (1.7 MPa, 17.5 bar)

Maximum Working Pressure

3/4 npt inlet and outlet



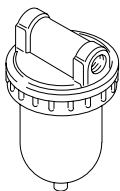
## Air Line Filter

250 psi (1.7 MPa, 17.5 bar)

Maximum Working Pressure

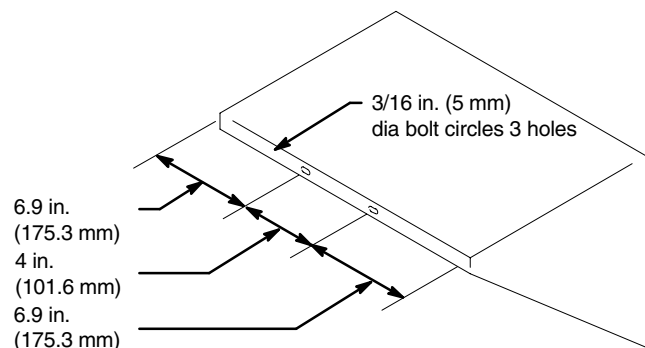
106149 1/2 npt(f) inlet and outlet.

106150 3/4 npt(f) inlet and outlet



## Mounting Bracket 178470

Has two mounting holes for Relief Valve Installation Kits 209005 and 209006



## Throat Seal Liquid

Non-evaporating solvent for wet-cup

206994 8 oz (0.2 liter)

206995 1 qt (0.9 liter)

206996 1 gal (3.8 liter)

## Air Regulator 205712

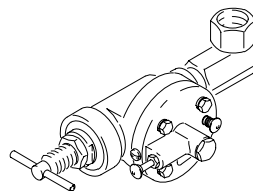
400 psi (2.8 MPa, 28 bar)

Maximum Working Pressure

1/2 in. size

## Pump Runaway Valve 224040

Shuts off air to pump automatically if it senses that the pump is running too fast, a condition caused by a depleted fluid supply. 3/4 npt(f) inlet and outlet.

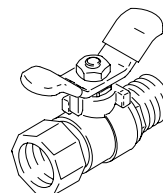


## Bleed-type Master Air Valve 107142

300 psi (2.1 MPa, 21 bar)

Maximum Working Pressure

Relieves air trapped in the air line between the pump air inlet and the valve when closed. 1/2 npt(f x m).

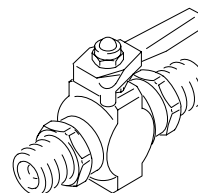


## Fluid Drain Valve 210658

5000 psi (35 MPa, 350 bar)

Maximum Working Pressure

3/8 npt(mbe); Vitron® seals



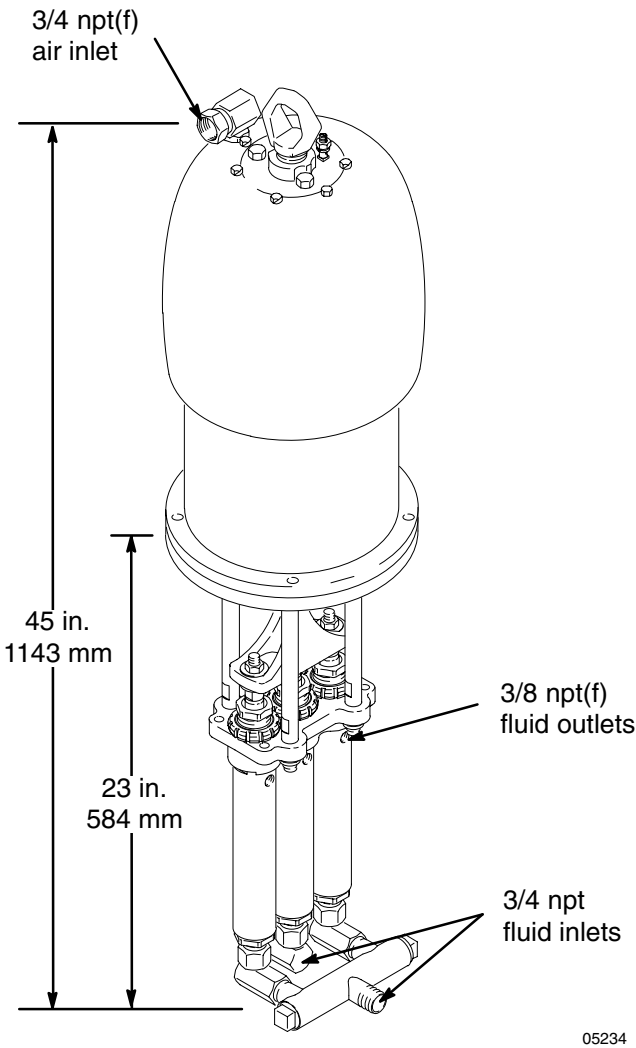
## Nitrogen Regulator Kit 210658

For controlling harmful moisture in plural component fluid supply containers

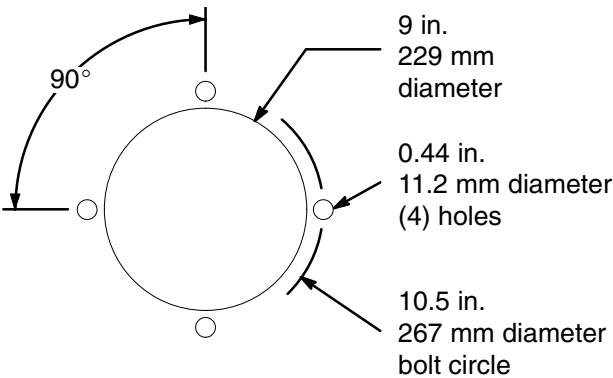
[illegible]

# Dimensions

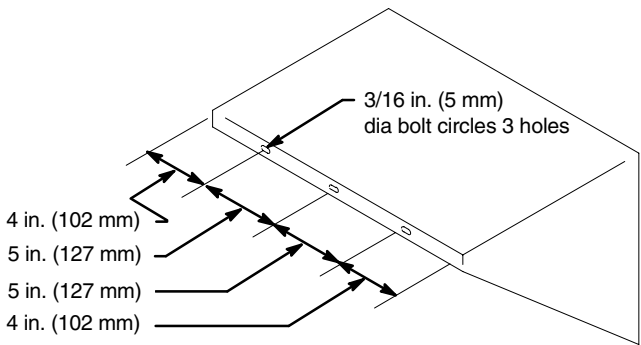
88 lb (40 kg): two displacement pump model  
97 lb (44 kg): three displacement pump model



# Mounting Hole Layout



## Wall Mounting Brackets





# Technical Data

Air Operating Range ..... 40–100 psi  
(0.3–0.7 MPa, 3–7 bar)\*  
Air Consumption ..... See example below  
Fluid Inlet Size ..... 3/4 npt  
Fluid Outlet Size ..... 3/8 npt  
Air Inlet Size ..... 3/4 npt  
Maximum Fluid Outlet Pressure ..... 2500 psi  
(17 MPa, 170 bar)  
Maximum Fluid Inlet Pressure ..... 250 psi  
(1.7 MPa, 17 bar)  
Wetted parts . . . Stainless Steel; Tungsten Carbide;  
Chrome Plating, Carbon Steel,  
Ultra–High Molecular Weight Polyethylene

Relief valves: See instruction manual 308547.

\* *NEVER exceed 2500 psi (17 MPa, 170 bar) fluid pressure.*

## **Air Consumable Example**

When the air pressure to the pump is 60 psi (0.4 MPa, 4 bar) and you are dispensing 1 gal (3.8 liter) of mixed fluid per minute, air volume used, in cfm, will be approximately the same as the larger pressure ratio figure of your pump. See page 16 for pressure ratios of pumps.

# The Graco Warranty and Disclaimers

Graco warrants all equipment listed in this manual which is manufactured by Graco and bearing its name to be free from defects in material and workmanship on the date of sale by an authorized Graco distributor 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.

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, gas engines, switches, hose, etc.), are subject to the warranty, if any, of their manufacturer. Graco will provide purchaser with reasonable assistance in making any claim for breach of these warranties.

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

## **FOR GRACO CANADA CUSTOMERS**

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

## Graco Phone Number

**TO PLACE AN ORDER**, contact your Graco distributor, or call this number to identify the distributor closest to you:  
**1-800-367-4023 Toll Free**

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

**Sales Offices:** Minneapolis, Detroit  
**International Offices:** Belgium, Korea, Hong Kong, Japan

**GRACO INC. P.O. BOX 1441 MINNEAPOLIS, MN 55440-1441**

PRINTED IN U.S.A. 307132 June 1974, Revised August 2000