INSTRUCTIONS-PARTS LIST 6000205E

Rev. B
Supersedes A

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

INSTRUCTIONS

AIR-POWERED BULLDOG□

Variable Ratio Hydra-Cat□ Proportioning Pump

5 bar (72 psi) Maximum Working Air Pressure
200 bar (2800 psi) Maximum Working Pressure

Model 098–229, Series A
1:1 to 4.5:1 Variable Ratio Range

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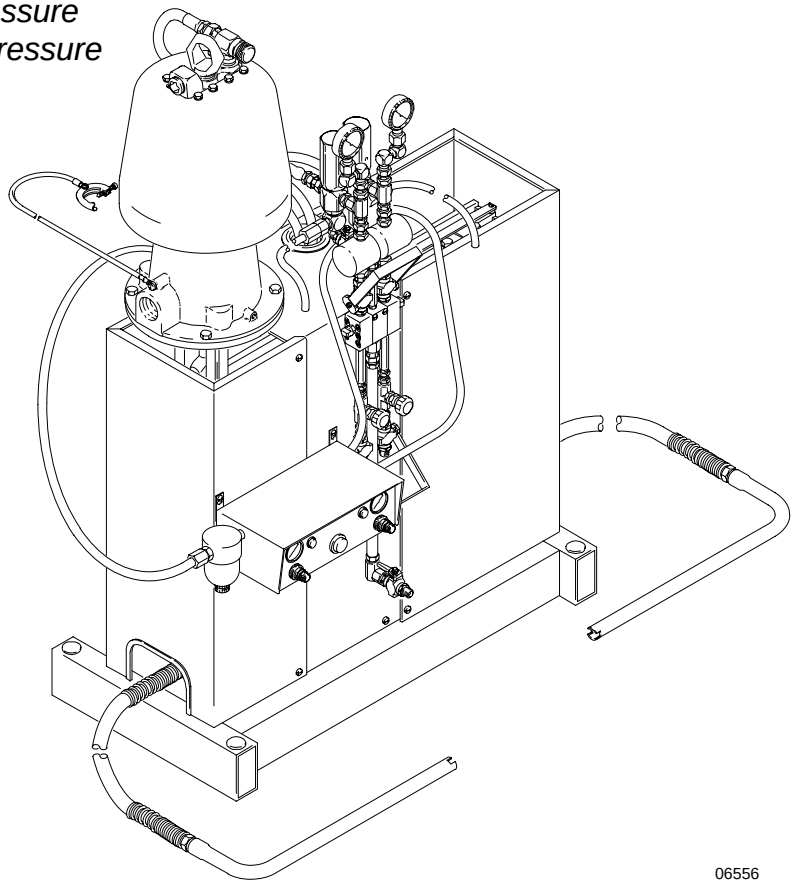

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⚠ WARNING

Graco Inc. does not manufacture or supply any of the reactive chemical components that are used in this equipment and is not responsible for their effects. Because of the vast number of chemicals that could be used and their varying chemical reactions, the buyer and user of this equipment should determine all factors relating to the fluids used, including any of the potential hazards involved. Particular inquiry and investigation should be made into potential dangers relating to toxic fumes, fires, explosions, reaction times, and exposure of human beings to the individual components or their resultant mixtures. Graco assumes no responsibility for loss, damage, expense or claims for bodily injury or property damage, direct or consequential, arising from the use of such chemical components.

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Table of Contents

Definition of Terms

VRHC: An abbreviation for Variable Ratio Hydra-Cat Pump. This system automatically proportions and mixes two or three fluids in a prescribed ratio, which is variable within the ranges listed on the cover of this manual.

BASE: Also called polyol or resin, is one of two reactive chemicals used in a plural component system.

REDUCER: Also called true solvent or diluent, is used to thin the base.

CATALYST: Also called hardner or activator, is the fluid which reacts with the base fluid.

PART: An undefined unit of measurement. When you determine the size of the unit (ounce, pint, gallon), use that measurement consistently in setting up your system.

Symbols

Warning Symbol

⚠ WARNING

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

Caution Symbol

⚠ CAUTION

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

⚠ WARNING

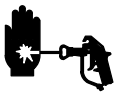
INSTRUCTIONS

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 not sure, call your Graco distributor.
- Do not alter or modify this equipment.
- Check equipment daily. Repair or replace worn or damaged parts immediately.
- Do not exceed the maximum working pressure of the lowest rated system component. Refer to the **Technical Data** on page 35 for the maximum working pressure of this 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.
- Do not use hoses to pull 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).
- Wear hearing protection when operating this equipment.
- Do not lift pressurized equipment.
- Comply with all applicable local, state, and national fire, electrical, and safety regulations.

⚠ WARNING



INJECTION HAZARD

Spray from the gun, 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 gun when spraying.
- Check the 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 14 if the spray tip clogs and before cleaning, checking or servicing the equipment.
- Tighten all fluid connections before operating the equipment.
- Check the hoses, tubes, and couplings daily. Replace worn or damaged parts immediately. Do not repair high pressure couplings; you must replace the entire hose.
- Use only Graco approved hoses. Do not remove the spring guard that is used to help protect the hose from rupture caused by kinks or bends near the couplings.

MOVING PARTS HAZARD

Moving parts, such as the air motor piston, 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 14 to prevent the equipment from starting unexpectedly.

⚠ 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 8.
- 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.

TOXIC FLUID HAZARD

Hazardous fluid or toxic fumes can cause serious injury or death if splashed in the eyes or on the skin, inhaled, or swallowed.

- 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.

Specifications

The following chart gives specifications for the Bulldog Hydra-Cat Pumps using No. 10 weight oil. The volumetric ratio is expressed as the proportion of the volume of fluid of the primary pump compared to the volume of fluid of the secondary pump.

Model* Number	Pump		Volumetric Ratio Adjustment		Volume Output liter/min (gpm) at 40 cpm		Stall Pressure with 5.2 bar (76 psi) Inbound bar (psi)	
	Primary	Secondary	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
098–229	222–012	222–012	1:1	4.5:1	6.8 (1.8)	4.2 (1.1)	172 (2528)	296 (4351)

*The Model number is given on a plate attached to the safety panels.

Installation

The Typical Installations in Fig. 1 and 2 are only guidelines to setting up the complete VRHC system. Two types of applications are shown: an airless spray dispensing system for spraying light viscosity fluids, and a dispensing system for medium viscosity fluids.For assistance in designing a system to suit your particular needs, contact your Graco distributor.

KEY

E	Air Supply
F	Base Supply
G	Catalyst Supply
H	Base Supply Pump
J	Air Shutoff Valve
K	Catalyst Supply Pump
L	Air Line Filter
M	Air Line Lubricator
N	Mixer Manifold Reducer Inlet
P	Static Mixer
R	Primary Pump Inlet
T	Secondary Pump Inlet
U	Reducer Pump
V	Airless Spray Gun
W	Dispensing Valve
X	Grounded Fluid Hose
8	Air Pressure Gauge
13	Air Regulator
45	Bleed–type Master Air Valve
46	Pressure Relief Valve
104	Pressure Gauge
119	Sampling Valves
120	Mixer Manifold
123	Primary Proportioning Pump
124	Secondary Proportioning Pump

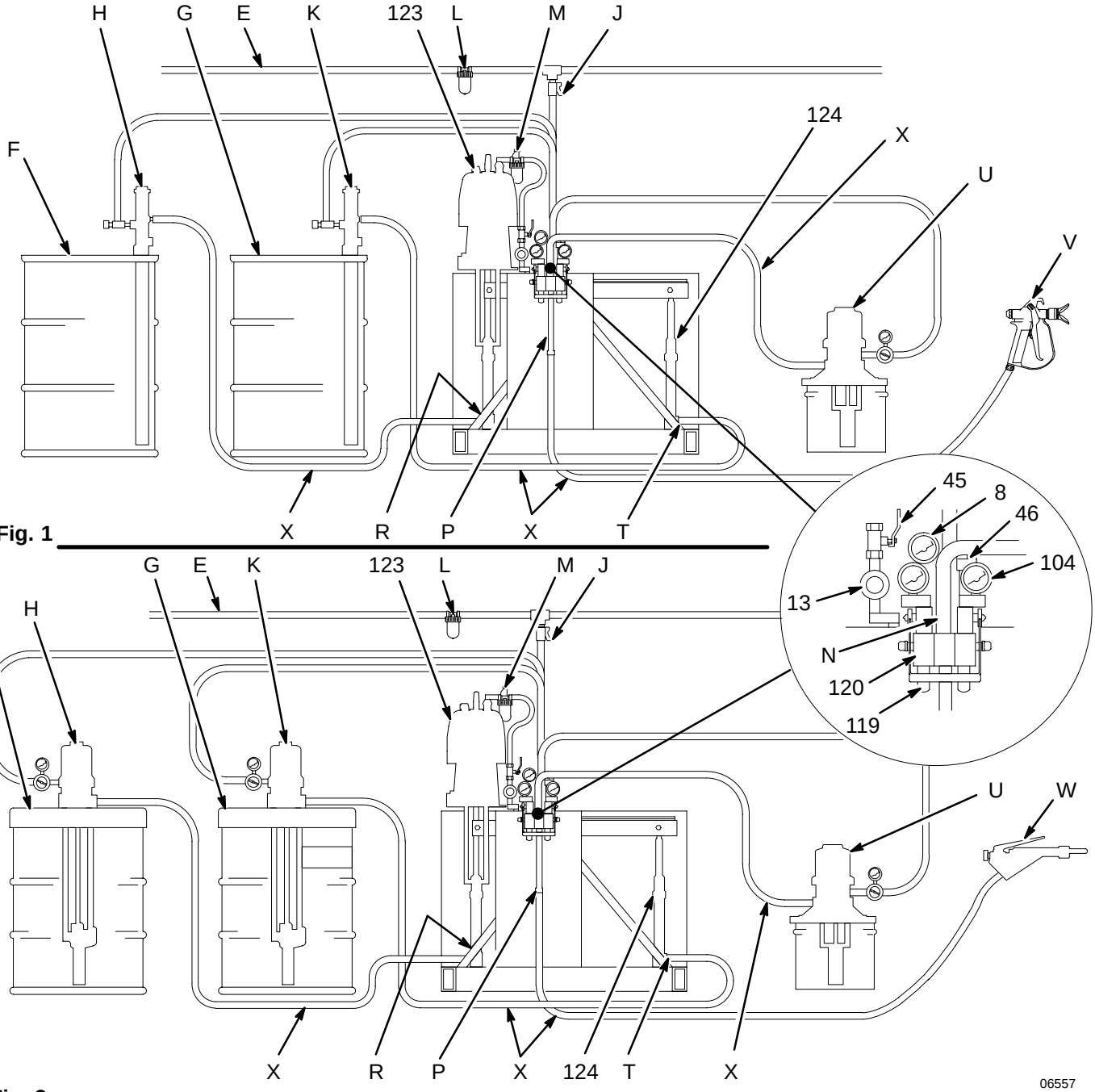


Fig. 1

Fig. 2

Installation

NOTE: Reference numbers and letters in the text refer to Figures 1 to 18 and the Parts drawings.

Location

Sit the proportioner on a flat floor positioner.

Connect the Solvent Flush Supply Line

Remove the safety panels (38,39,40). See Fig. 4 on page 9. Connect a grounded fluid hose (X) from the solvent flush pump to the 3/8 npt solvent flush inlet (N) of the mixer manifold.

Connect the Fluid Supply Lines

Connect grounded fluid hoses to the 3/4 npt(f) pump inlet fittings (R,T). If the unit will be pressure fed from separate supply pumps, install a fluid pressure gauge at each inlet.

NOTE: Pressurized fluid supplies must not exceed 1/4 the operating fluid pressure of the President pump. Pressure above that level will feed through the pump and improper proportioning will result.

Connect the Static Mixer to the Manifold

Connect a static mixer (P) to the 1/2 npt(m) manifold outlet. Connect a grounded fluid hose and spray gun or dispensing valve to the end of the static mixer.

Tighten all fittings. Replace the safety panels (38,39,40).

System Accessories

Refer to Figures 1 and 2 and the ACCESSORIES on page 34.

NOTE: To ensure maximum pump performance, be sure all accessories are properly sized to meet your system requirements.

In the air line, install an air filter (L) to remove harmful dirt and moisture from the compressed air supply. Downstream from the air filter, the air regulator (13) and the bleed-type master air valve (45), install an air line lubricator (M) to provide automatic lubrication to the motor.

⚠ WARNING

The bleed-type master air valve (45) is required in your system to relieve air trapped between this valve and the pump after the pump is shut off. Trapped air can cause the pump to cycle unexpectedly, resulting in serious injury, including amputation.

Connect the Air Supply Line

Connect a grounded air supply hose to the 1/2 npt(f) port of the air manifold (37). Open the bleed-type master air valve (45), and using the pressure gauge (8), set the air regulator (13) to the desired pressure. See Figures 1 and 2 and the parts drawing on page 30.

Pressure Relief Valve

Before operating the VRHC, make sure all components have rated working pressures of 200 bar (2900 psi) or greater. For more information about the pressure relief valve, see Instruction Manual 308–547.

Installation

Grounding

⚠ WARNING

FIRE AND EXPLOSION HAZARD
Before operating the pump, ground the system as explained below. Also read the section **FIRE OR EXPLOSION HAZARD** on page 5.

1. *Pump:* use the ground wire and clamp (supplied). See Fig. 3. Loosen the grounding lug locknut (W) and washer (X). Insert one end of the ground wire (Y) into the slot in lug (Z) and tighten the locknut securely. Connect the other end of the wire to a true earth ground.

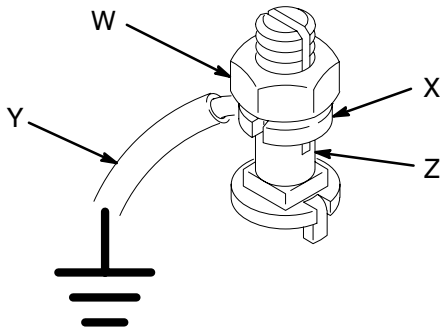


Fig. 3

2. *Air and fluid hoses:* use only electrically conductive hoses.

3. *Air compressor:* follow manufacturer's recommendations.

4. *Spray gun:* ground through connection to a properly grounded fluid hose and pump.

5. *Fluid supply container:* follow your local code.

6. *Object being sprayed:* follow your local code.

7. *Solvent pails used when flushing:* follow your local code. Use only metal pails, which are conductive, placed on a grounded surface. Do not place the pail on a nonconductive surface, such as paper or cardboard, which interrupts the grounding continuity.

8. *To maintain grounding continuity when flushing or relieving pressure*, hold a metal part of the spray gun firmly to the side of a grounded *metal* pail, then trigger the gun.

Ratio Adjustment

Understanding the terms used with the **Variable Ratio Hydra–Cat (VRHC) System,** how it functions, and how to find and set the correct ratio(s) for your application, is the key to easier, more versatile operation of your proportional system.

Be sure to read and understand the following information before operating the equipment.

Terms

The **ratio** refers to the simultaneous output of a certain volume of fluid by the primary and secondary pumps.

The **primary pump** (123) is directly under the air motor; it usually pumps the base fluid.

The **secondary pump** (124) is on the opposite end of the lever arm (49). It usually pumps the catalyst. One or two secondary pumps may be used: one for pumping catalyst and the other for reducer injection. If two secondary pumps are used, then two ratios exist.

The **ratio index clamp** (30) is used to adjust the ratio of the secondary pump(s).

There are three main points to remember when applying the use of ratios:

1. Determine the ratio required.
2. Calculate the ratio setting.
3. Set the ratio on the VRHC System.

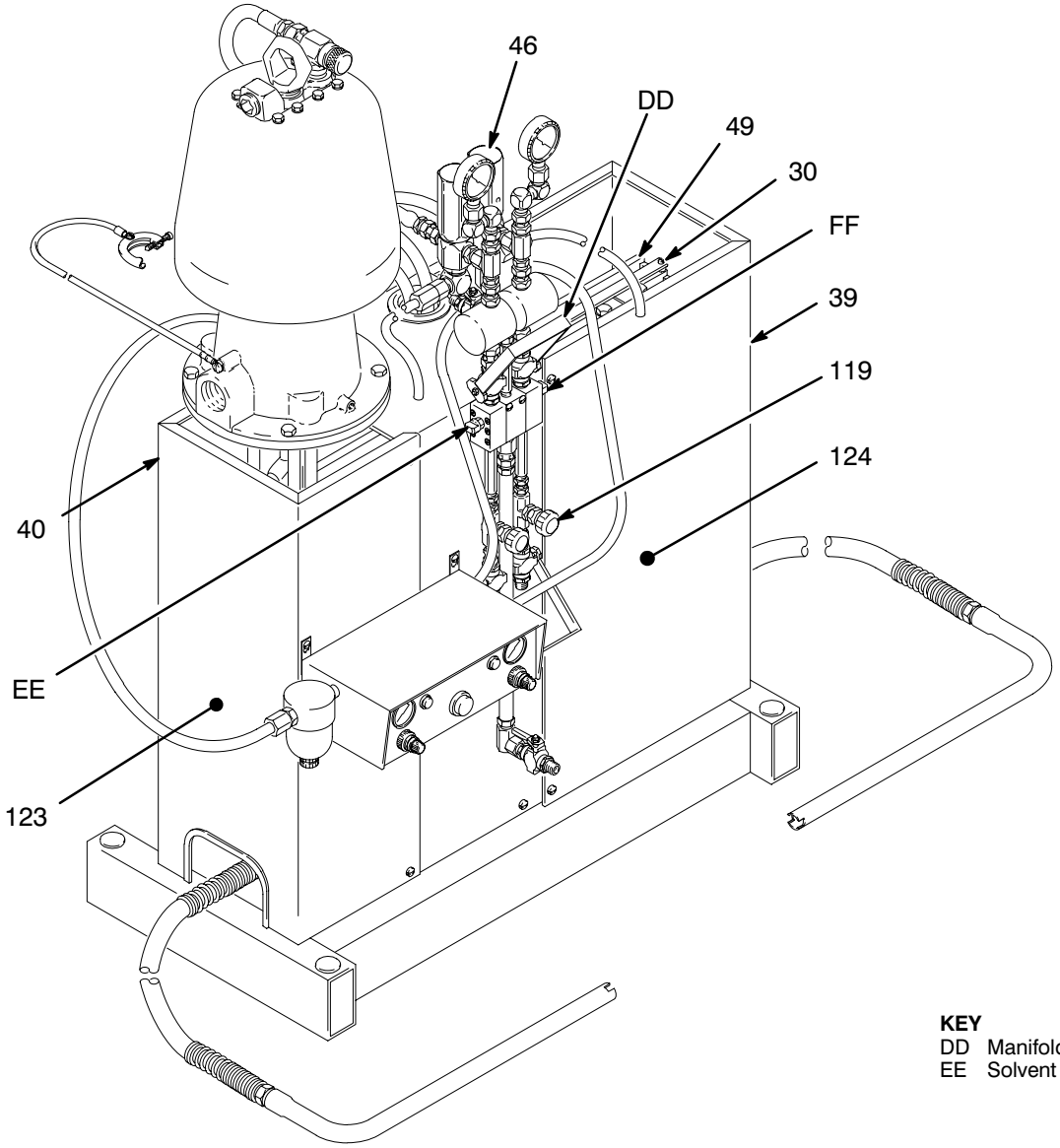


Fig. 4

Determining the Ratio

Determine your system conditions

If these are your conditions – one primary pump, one secondary pump, fluids are ready-to-spray viscosity – set the ratio as explained under **Setting the Secondary Pump(s)** on page 13.

If these are your conditions – one primary pump and one secondary pump, fluids are NOT ready-to-spray viscosity – the ratio must be determined after the reducer is added to the base, as instructed in **Procedure 1**.

If these are your conditions – two secondary pumps, one for pumping the catalyst and one for reducer injection – determine the ratio as instructed in **Procedure 2** if the mixing instructions say to reduce the base by a certain number of parts reducer, or as in **Procedure 3** if the instructions say to reduce the base by a percentage.

NOTE: Evaporation of the reducer in the base causes changes to the ratio. To prevent evaporation, store the base in closed containers.

NOTE: Some reducers have very little ability to lubricate and may cause seals to dry out. To prolong seal life, be sure your pump seals are compatible with the base's reducer. Contact your Graco representative for the correct seals to use.

Procedure 1: Base Is Pre-reduced

When adding reducer to the base before proportioning with the VRHC System, determine the ratio of the base/reducer mixture to the catalyst in order to set the secondary pump at the correct position.

In this example, the instructions on the can say, "Mix 5 parts base to 1 part catalyst. Then reduce 3 parts of this mixture to 1 part reducer.

1. Add the parts of the base and catalyst to find the parts mixture.

    5 parts base
    + **1** parts catalyst
    6 parts mixture

2. The next statement on the can says, "Reduce 3 parts of the mixture." So divide the parts of the mixture by 3 parts to reduce to find the parts reducer.

    6 parts mixture
    ÷ **3** part catalyst
    2 parts reducer

3. To determine the ratio of the secondary pump, add the appropriate parts of base and reducer to find the parts combined base/reducer.

    5 parts base
    + **2** parts reducer
    7 parts combined base/reducer to 1 part catalyst:

    Result: The ratio of the secondary pump is 7:1.

Procedure 2: Reducer Injection by a Third Displacement Pump

Using the same can instructions as in Procedure 1, you know you need:

5 parts base
2 parts reducer (see Procedure 1, Step 2)
1 part catalyst

1. Treat each secondary pump as a separate assembly. The ratio of base to catalyst is 5:1, so set the catalyst pump for a 5:1 ratio.

2. The ratio of base to reducer is 5:2. But since the number on the right side of the ratio must always be one, divide the base proportion by the reducer portion.

    5 parts base
    + **2** part catalyst
    2.5 parts base

Procedure 3: Reducer Injection by a Third Displacement Pump

Use this procedure if the mixing instructions say to reduce the base by a percentage.

In this example, the instructions on the can say, "Mix 6 parts base to 1 part catalyst; reduce the base 20%."

1. Treat each secondary pump as a separate assembly. The ratio of base to catalyst is 6:1, so set the catalyst pump for a 6:1 ratio.

2. Convert the percentage to a fraction. 20% equals 1/5 or a ratio of 5:1. The ratio of base to reducer is 5:1, so set the reducer pump for a 5:1 ratio.

Set the Ratio

Fig. 5 shows the relationship between the primary pump and the secondary pump.

To set the secondary pump on a standard VRHC System with only two pumps, refer to **Setting the Secondary Pump(s)** on page 13.

To set the secondary pump on a non-standard VRHC System or for an additional secondary pump, refer to **Calculate the Ratio Setting**, following.

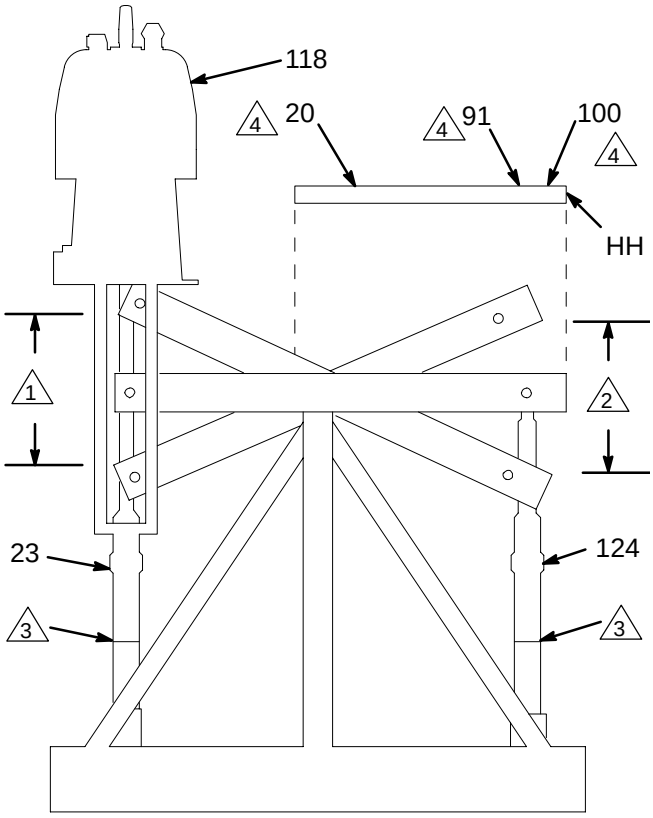
NOTE: The **91 index setting** provides equal primary and secondary pump stroke lengths. 100 is 1.1 times the primary pump stroke, allowing adjustability on both sides of the nominal ratio setting of 91. If the same primary and secondary pump models are used, a 91 setting will give a 1:1 ratio. If different pump models are used, you must know the pump's effective area to determine the setting. The displacement pumps effective areas are listed in the **Pump Specifications Chart**, following.

Pump Specifications Chart

Pump	Effective Area	Max. Stroke	Secondary Conn. Rod
222–019	0.277 in.□	4.75”	177–113
222–017	0.370 in.□	4.75”	177–113
222–015	0.443 in.□	4.75”	177–113
222–012	0.554 in.□	4.75”	177–113

Relationship Between Primary and Secondary Pump

Moving the secondary pump closer to the primary pump (to a lower index setting) reduces the secondary stroke length, reducing its fluid output. Moving the secondary pump further from the priming pump (to a higher index setting) increases the secondary stroke length, which increases its fluid output.



KEY
HH Lever Arm Index

1 Primary Stroke – 120.6 mm (4.75”)
2 Secondary Stroke
3 Effective Area
4 Index Setting

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Fig. 5

Calculate the Ratio Setting

In this example,

- A 3:1 ratio of base to catalyst is required.
- A 2:1 ratio of base to reducer is required.
- The base/primary pump Model is 222–012; its effective area is 0.554 in.²
- The catalyst/secondary pump Model is 222–012; its effective area is 0.554 in.²
- The solvent/secondary pump Model is 222–012; its effective area is 0.554 in.²

1. To determine the base to catalyst setting.

   a. Multiply the primary pump's effective area by 91 (nominal ratio setting).

   0.554 primary pump's effective area
   × **91** nominal ratio setting
   50.41 answer a

   b. Multiply the catalyst pump's effective area by the ratio required.

   0.554 catalyst pump's effective area
   × **3** ratio required
   1.662 answer b

   c. Divide answer a by answer b to determine the index setting.

   50.41 answer a
   ÷ **1.662** answer b
   30.33 catalyst pump index setting

2. To determine the base to reducer setting:

   a. Multiply the primary pump's effective area by 91 (nominal ratio setting).

   0.554 primary pump's effective area
   × **91** nominal ratio setting
   50.41 answer a

   b. Multiply the reducer pump's effective area by the ratio required.

   0.554 reducer pump's effective area
   × **2** ratio required
   1.108 answer c

   c. Divide answer a by answer c to determine the index setting.

   50.41 answer a
   ÷ **1.108** answer c
   45.5 reducer pump index setting

3. To make sure the index setting does not exceed the secondary pump's maximum stroke length:

   a. Multiply the index setting by 0.052 (a constant number).

   30.3 catalyst pump setting
   × **0.052** constant
   1.58 catalyst pump stroke length

   45.5 reducer pump setting
   × **0.052** constant
   2.366 reducer pump stroke length

   b. See the Pump Specifications Chart on page 11 for the pumps' maximum stroke length. Do not use an index setting which will exceed the maximum stroke length for your pump model.

4. To make sure the index setting does not go below the secondary pump minimum ratio setting, see the **Ratio Setting Charts**, below.

5. These numbers (**1.58** and **2.366** from step 3.a.) do not exceed the pump maximum stroke nor do they go below the minimum ratio setting, so set the catalyst pump at the 30.3 index setting and the reducer pump at the 45.5 index setting.

Ratio Setting Chart

Volumetric Ratio	Ratio Setting
1.00 : 1.0	91
1.25 : 1.0	73
1.50 : 1.0	61
1.75 : 1.0	52
2.00 : 1.0	46
2.25 : 1.0	40
2.50 : 1.0	36
2.75 : 1.0	33
3.00 : 1.0	30
3.25 : 1.0	28
3.50 : 1.0	26
3.75 : 1.0	24
4.00 : 1.0	23
4.25 : 1.0	21
4.50 : 1.0	20

NOTE: Ratio setting 100 cannot be used with secondary lower pumps 222–012, 222–015, 222–017, or 222–019.

Setting the Secondary Pump(s)

The numbers in the Ratio Setting columns of Charts 1, 2 and 3, or the pump settings calculated from the procedures in the section, **Calculate the Ratio Setting**, correspond to the scale numbers on the lever arm (49) of the VRHC. See Fig. 6.

⚠ WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 14.

1. **Relieve the pressure.**
2. Flush the unit as instructed on page 15 before setting the pump.
3. Remove the safety panel (39). See Fig. 8 on page 16.
4. Loosen the four capscrews (16) holding the secondary pump(s) in place.
5. Open the fluid outlet and lift or push the lever arm (49) to the horizontal position.
6. Move the secondary pump so that the line on the index clamp (30) is at the desired setting on the scale (26).
7. With the secondary pump as vertical as possible, tighten the four screws (16) to 50 ft-lb (78 N.m).
8. Replace the safety panel (39).

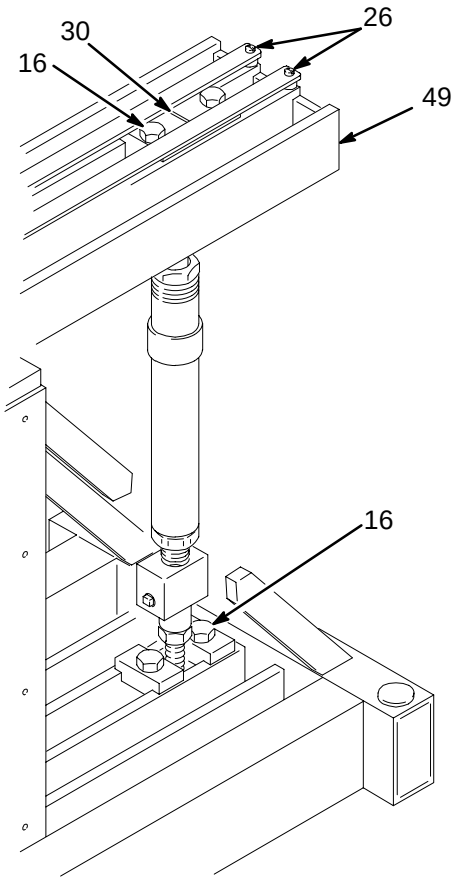


Fig. 6

Operation

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,
- stop spraying,
- check or service any of the system equipment,
- or install or clean the spray tips.

1. Lock the gun trigger safety.
2. Close the red-handled bleed-type master air valve (F, required in your system).
3. Unlock the gun trigger safety.
4. Hold a metal part of the gun firmly to the side of a grounded metal pail, and trigger the gun to relieve pressure.
5. Lock the gun trigger safety.
6. Open the drain valve (D, required in your system), having a container ready to catch the drainage.
7. Leave the drain valve open until you are ready to spray again.

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

Operation

The pumps, mixer manifold and other components were tested with lightweight oil at the factory. Before operating the pump, thoroughly flush the VRHC to prevent contamination of the fluids.

System Flushing

NOTE: Flush the mixer, hose and gun often enough to prevent fluid from reacting or curing in them. Contact your fluid manufacturer for the effective pot life of the fluid you are using.

1. Put the pump intake hoses into a 5 gallon (20 liter) container of compatible solvent. Refer to the fluid manufacturer's recommendations.

2. Start the pump as explained below.

3. Do not install the spray tip yet. Hold a metal part of the gun firmly to the side of a grounded metal pail. Using the lowest possible fluid pressure, trigger the gun into the pail.

4. When clean solvent comes from the gun, release the trigger and carefully check all connections in the system for leaks.

5. Take the hoses out of the solvent and trigger the gun until all solvent has been pumped out of the hoses.

Starting the Pump

NOTE: To open the mixer manifold (120), put in the handle in the down position. To close the mixer manifold, put in the handle in the up position. See Fig. 7.

1. Close the bleed-type master air valve. Turn the air regulator knob all the way out (counterclockwise).

2. Turn on the main air supply.

3. Open the mixer manifold handle, trigger the gun, slowly open the bleed-type master air valve, and turn the air regulator knob clockwise until the pump starts.

4. Allow the pump to cycle slowly until all the air is pushed out of the lines. Release the trigger – the pump will stall against the pressure.

5. The manifold handle controls fluid flow. When the manifold is open, base and catalyst are supplied to the gun. To stop the flow, close the handle.

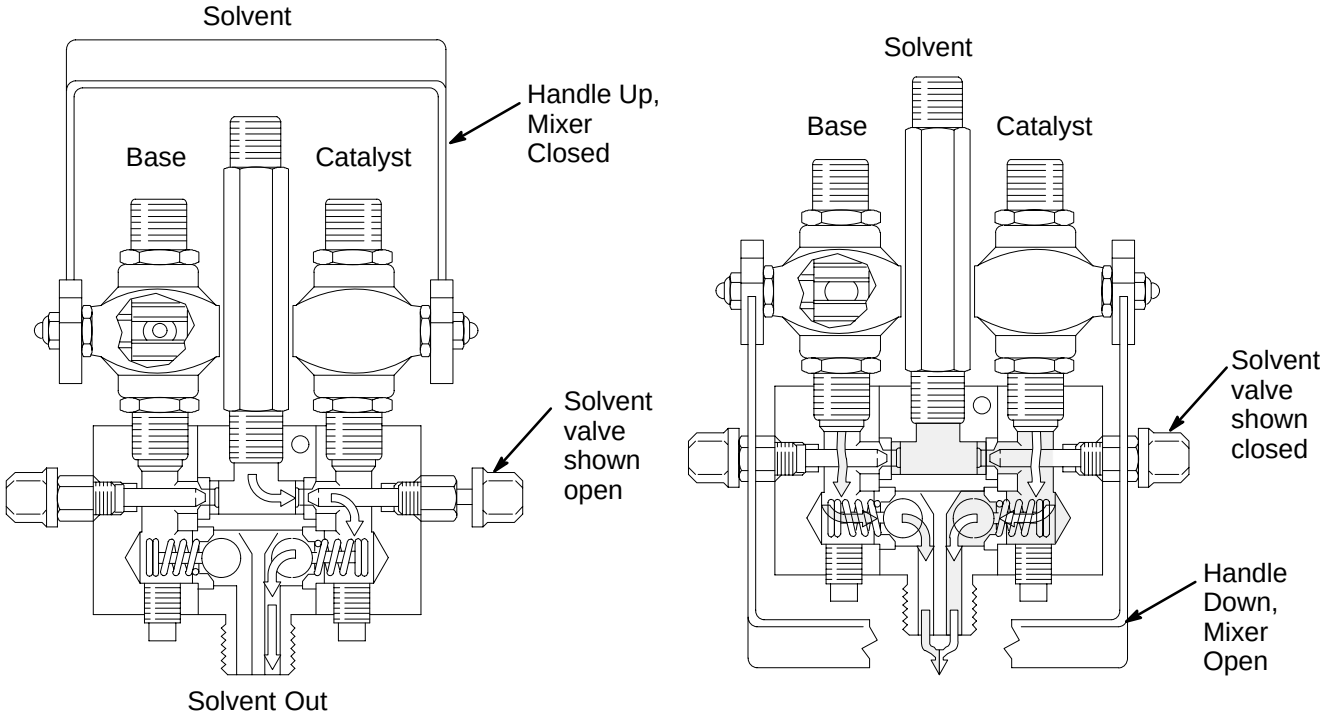


Fig. 7

Operation

NOTE: To open the mixer manifold (120), put in the handle in the down position. To close the mixer manifold, put in the handle in the up position. See Fig. 7 on page 15.

Standard Operating Flushing

1. Use the solvent valves to flush contaminants and mixed fluids from the mixer manifold, hose and gun. Follow the procedure below.

   a. Start the solvent pump. Close the mixer manifold.

   b. Open one of the solvent valves (EE).

   c. Trigger the gun into the metal pail until the valve is thoroughly flushed. Release the trigger.

   d. Close the open solvent valve. Open the other solvent valve. Repeat step c.

   e. With both solvent valves open, flush until all contaminants and fluids are removed. Release the trigger.

2. To flush the sampling valves (119), place a grounded metal pail under them. Turn the valve handle to the open position. Flush until all contaminants and fluids are removed. Close the sampling valves and solvent valves. The solvent valves should be finger tight only, but must be tight enough to prevent solvent from mixing with the fluid during operation.

3. Trigger the gun to relieve pressure.

Checking the Ratio

1. Open the mixer manifold (120).

2. Set the operating pressure. After determining the operating pressure, release the gun trigger and engage the safety latch.

3. Close the mixer manifold.

4. Open the sample valve (119) on the secondary pump side approximately three turns. Open the sampling valve on the primary pump side just one turn. This prevents the pressure from building up on the secondary pump, which would cause the relief valve (46) to open.

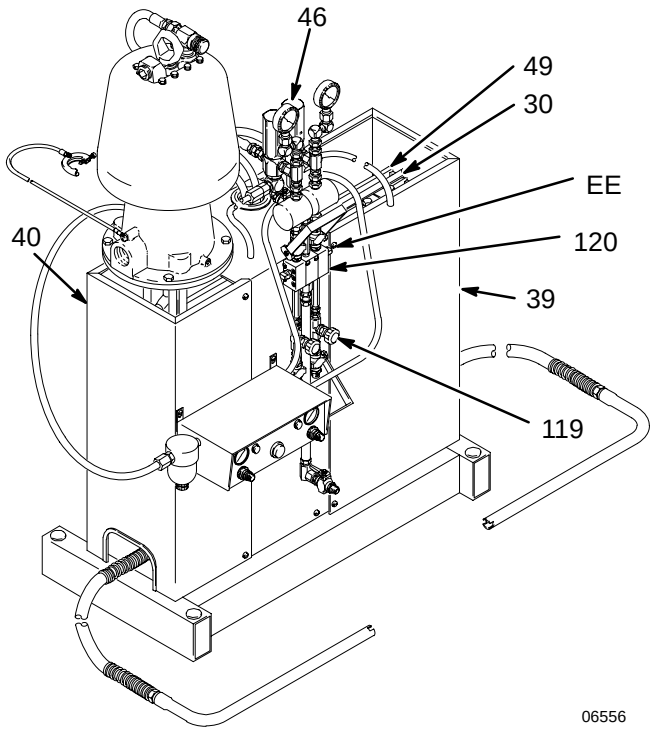


Fig. 8

5. Place a grounded metal pail under the sampling valves.

6. Open the mixer manifold. Use the sampling valves to adjust the pressures to your normal operating pressure.

NOTE: The pressure must be within 20% of your normal operating pressure to get a useable sample.

7. Close the mixer manifold. Put the sampling containers under the sampling valves.

8. Open the mixer manifold. Check the ratio. Make sure the pressure is within 20% of the normal operating pressure. Close the mixer manifold when enough fluid has been dispensed into the sampling containers.

NOTE: If the pressure is not within 20% of the normal operating pressure, follow the flushing procedure on page 15, and then take another sample. If the sample ratio is incorrect, there is a problem with the sample valves, secondary pump setting or the pump operation. Check the pump setting or service the sampling valves or pump.

Operation of the Ratio Monitor

Refer to instruction manual 6 000 198 for ratio monitor operating instructions.

Troubleshooting

Troubleshooting Techniques

Because the pumps are mechanically linked, the action of one pump can affect the readings of the second pump. Therefore, the key to successful troubleshooting is to be sure to isolate the problem.

For example, the secondary pump pressure, as read on the gauge, is low and sluggish during pump changeover. The most likely problem is a binding primary pump.

⚠ WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 14.

To isolate the pump:

1. **Relieve the pressure.**

2. Disconnect the index clamp (30) from the secondary pump and lean the pump out of the way of the lever arm (49). Now you can verify the operation of the primary pump alone.

3. Use the sampling valves (119) at the mixer manifold (120).

   a. Check the outlet ratio for the primary side.

   b. With the sampling valves closed, check for pump stalling on both the up and down strokes.

   c. Check for rapid gauge response during pump changeover.

4. When the operation of the primary side has been verified, reconnect the lever arm (49) to the secondary pump. Let the primary pump run freely in a pail of fluid and repeat the checks in Step 3 on the secondary side.

⚠ WARNING

Use very low air pressure to the air motor when making these checks. This system can produce very high fluid pressure, which can cause serious injury, including injection, splashing in the eyes or on the skin, and injury from moving parts. Follow the **Pressure Relief Procedure** on page 14.

⚠ WARNING

To reduce the risk of injuring or amputating a hand, fingers or other body parts, never place your hands or any part of your body or any tools inside the safety panel at any time, for any reason, while the unit is operating.

Troubleshooting

Problem	Cause	Solution
System won't run or stops while running	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 manual 307–304.
	Displacement pump stuck	Service displacement pump. See manuals listed in the chart on the next page.
Reducer not being delivered to system	Air pressure or volume is too low	Increase; check air compressor.
	Closed or restricted air line or valve	Open or clean as required.
	Manifold clogged	Clean and service as required. See manual 307–400.
	No reducer in reservoir	Refill reducer reservoir.
	Air motor worn or damaged	Service air motor; see manual 307–304.
Fluids not mixing properly	Clogged filter in fluid line	Clean; replace element if necessary
	Manifold problems	Refer to manual 307–400.
	Check ratio	Check; replace pump.
	Clogged fluid hose	Replace fluid hose.
System speeds up or runs erratically	Fluid containers are empty	Check often – keep filled.
	Displacement pump parts worn or damaged	Service displacement pump. See manuals listed in the chart below.
Squeaking or knocking noise is heard	Bearing(s) dry or worn	Lubricate; replace bearing(s) if necessary.
	Pump bottoming out	See below.
System stops running on the end of a stroke	Secondary displacement pump bottomed out because ratio index clamp was set too far out	Adjust ratio index clamp.
	Secondary displacement pump bottomed out because top pivot bearings are set too high	Adjust bearings. See **Removing the Lever Arm from the VRHC Frame** on page 20.

Service

Bearing and Pump Lubrication

⚠ WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 14.

1. **Relieve the pressure.**

2. Insert one end of the nylon hose (52) into the wet-cup.

3. Pour Throat Seal Liquid (44) into the hose until the wet-cup is full.

4. Lubricate the VRHC periodically with Graco Gear Reducer Oil (43). If the pump is operating continuously at 60 cycles/min, lubricate at the points shown in Fig. 9 once every five days.

Service instructions are in the manuals for the separate components. See the chart below.

Refer to the manuals listed below to repair the VRHC components.

Component	Description	Manual No.
215–255	Air Motor	307–304
215–626	Manifold Valve	307–400
223–160	Fluid Filter	307–273
222–012, 222–015, 222–017, 222–019	Displacement Pump	307–944

Air Lubrication

If your air supply is very dry, install air line lubricators between the air regulators and pumps for automatic air motor lubrication. See page 34, ACCESSORIES, for a lubricator.

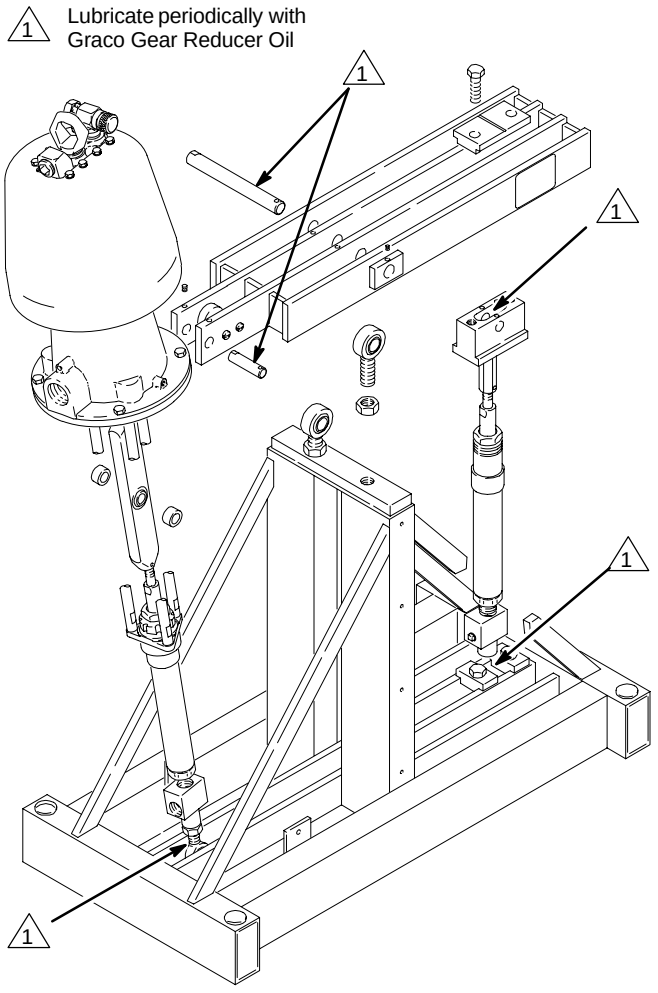


Fig. 9

Required Service Tools

Tool	Use for
3/32”–90□ or T-handle hex key	All setscrews
3/4” open end wrench	Clamp bolts and fluid hose on pump outlet
1” open end wrench	Locknuts on capscrews
9/16” open end wrench	Tie rod nuts
1/2” open end wrench	Loosening tie rods from motor base
1–1/8” open end wrench	Pivot bearing locknuts
Adjustable open end wrench	Tightening connecting rod to pumps
Needle nose pliers	Bending and pulling cotter pins
Medium slotted screwdriver	Removing shields
Small hammer and 6” punch	Tapping out pins

Service

Detecting Bearing and Pin Wear

Audio Detection
When a bearing fails, it makes a knocking noise each time the pump changes stroke. Shut off the system immediately to avoid serious damage. Replace the bearing(s).

Visual Detection
Check the movement of the lever arm (49) by watching it through the opening in the safety panel (39). If it bounces, shut off the system immediately to avoid serious damage. Replace the bearing pin.

Removing the Lever Arm from the VRHC Frame

⚠ WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 14.

1. Flush the entire system with a solvent which is compatible with the fluid being pumped. Disconnect the air line and **relieve the pressure.**

2. Remove the safety panels (38,39,40). See Fig. 10.

3. Loosen the two setscrews (59) holding the primary displacement pump pin (35c) in the lever arm (49). See Fig. 11. The setscrews must be backed out far enough to clear the countersinks of the pin. Tap the pump pin out of the lever arm and bearing.

4. Slide the primary pump out of the lever arm (49) slot and save the two nylon spacers (27c).

5. Slowly lower the pump to the floor until it supports itself with the lower bearing (14d). See Fig. 17 on page 27.

6. Push down on the secondary displacement pump end of the lever arm (49) at point (JJ) until it is at the bottom of the stroke. See Fig. 11 on page 21.

7. Remove the two top capscrews (16a) from the index clamp (30).

8. Raise the lever arm (49) slowly. Lower the secondary pump to the floor until it supports itself with the lower bearing.

9. Loosen the two setscrews (17) located above the ends of the frame pin 33). The setscrews must be turned out far enough to clear the countersinks of the pin.

10. Using a long punch and hammer, gently drive the frame pin (33) out from one end until it can be pulled out.

⚠ CAUTION

Do not drop the pin; dents will make reassembly difficult.

11. Remove the punch and lift the lever arm (49) off the VRHC frame.

12. Loosen the two pivot bearing locknuts (2) and turn the bearings (15) out of the housing (122). The bearings should be only hand tight. If they are tighter, use a wrench on the flats of the bearing (15) to unscrew the bearing from the frame.

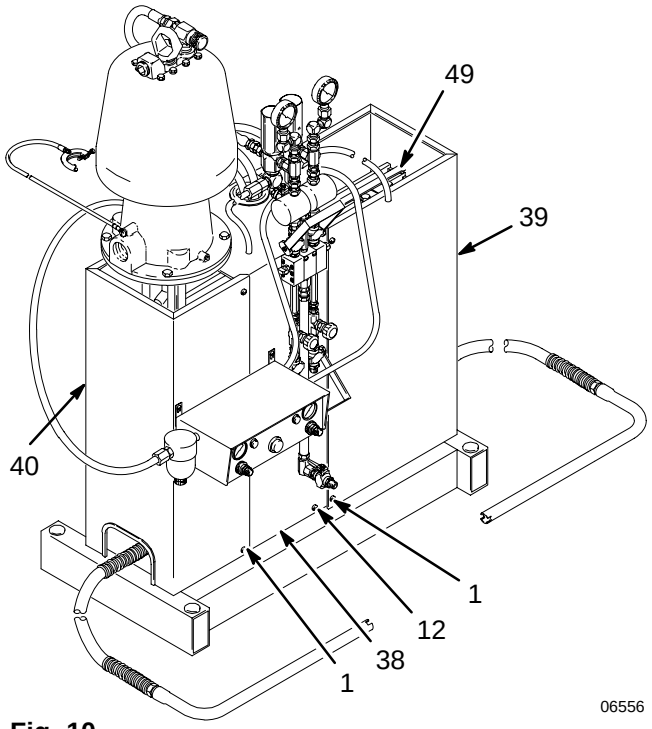

49
39
40
1
12
38
1
06556

Fig. 10

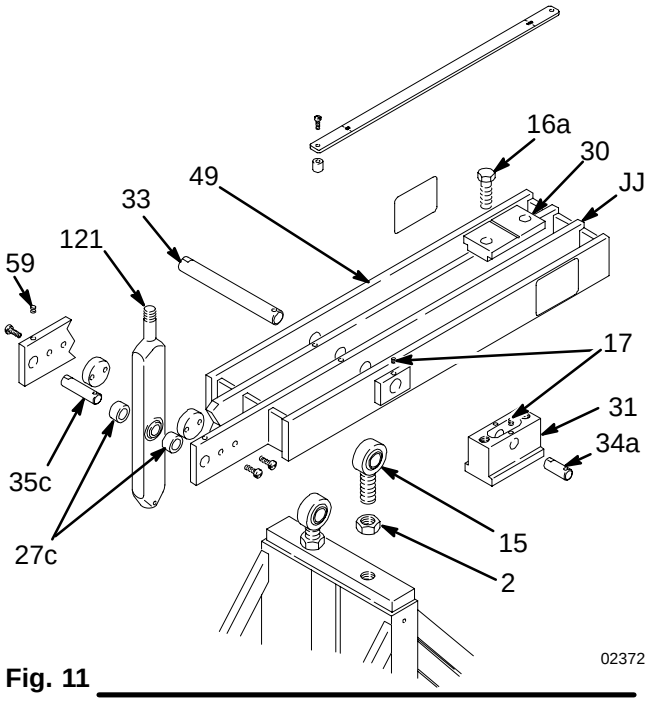

16a
30
JJ
49
33
121
59
17
31
34a
35c
27c
15
2
02372

Fig. 11

Service

Determining Which Pin and/or Bearing is Worn

1. Disassemble the VRHC. After the pins and bearings are removed, wipe them off with a clean rag.

2. Visually inspect the pins for scoring, lines, grooves and scratches on the area in contact with the bearing. Then feel the surface of the pin for rough areas or a difference in size. If these signs of wear are detected, replace both the pin and bearing.

3. To check the bearings, hold the threaded part of the bearing in one hand and use the other hand to move the balls inside the bearing up and down. If there is any noticeable movement, replace the bearings. Also check the bearings for roundness. If a bearing appears to be out of round (egg-shaped), replace it.

Fitting the Pins into the Bearings

Tolerances between the surface of the pin and the bearings are very close. Never force the pin into the bearing. If the pin does not fit, sand it from the end to just past the countersinks with 500 grit sandpaper. See Fig. 12. If the pin still does not fit, return it to the factory for replacement. If the pin needs replacement, replace the bearing also.

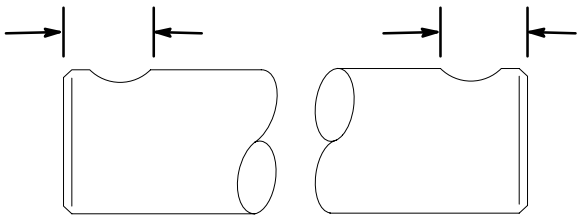


Fig. 12 02373

Storage of Spare Pins and Bearings

Completely coat spare pins and bearings with Graco Gear Reducer Oil (43) or the equivalent when storing these parts. Never use grease.

Removing the Secondary Pump and/or the Bearings and Pins

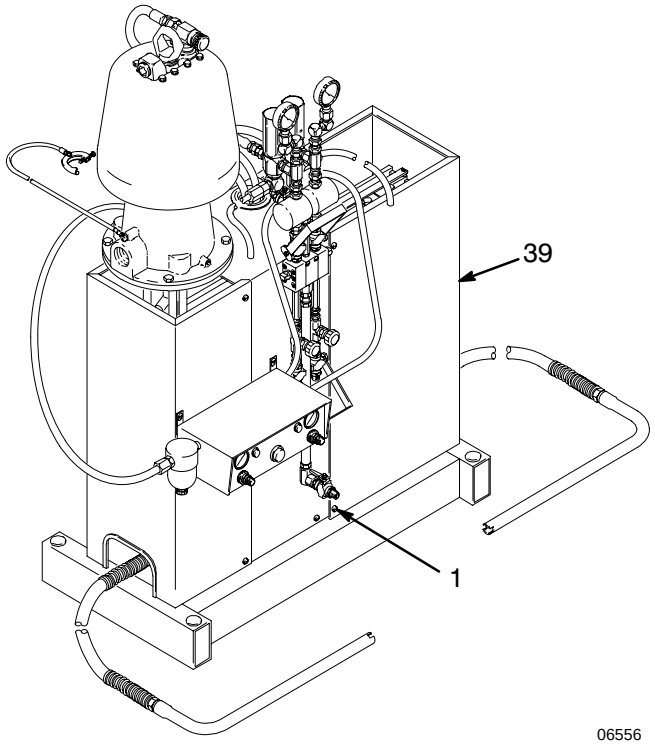
1. Flush the entire system with a compatible solvent.

⚠ WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 14.

2. **Relieve the pressure.**

3. Remove the safety panel (39). See Fig. 13. Disconnect the inlet and outlet fluid hoses of the secondary displacement pump (124).



06556

Fig. 13

Service

NOTE: Refer to Fig. 14 for steps 4 to 10.

4. Push down on the lever arm (49) until the wrench flats (KK) on the secondary pump (124) are just above the wet-cup (LL). Remove the ratio index clamp capscrews (16a) and the index clamp (30).

NOTE: Some fluid will drip from the pump when you are removing the ratio index clamp.

5. Raise the lever arm (49) off the pivot pin support (31a).

6. Remove the connecting rod cotter pin (102), if the pump has one. Unscrew the connecting rod assembly (117, 14a, 34a, 31a) in one piece from the pump.

7. If you are removing only the pump, remove it from the inlet manifold (32). If the secondary pump(s) need repair, follow the instructions in its manual.

8. If you are removing the bearings and pins, tilt the secondary pump (124) forward until it rests on the floor. Then follow Steps 9 and/or 10.

9. If you are removing the upper bearing (14a) and support pin:

   a. Loosen the two setscrews (17a). Back out the setscrews far enough to clear the countersinks of the support pin (34a).

   b. Place the support (31a) in a vise. Unscrew the connecting rod (117) from the bearing (14a). The connecting rod and bearing are sealed with thread sealant and may be difficult to unscrew.

   c. Remove the support (31a) from the vise. Gently tap the support pin (34a) out with a hammer and punch.

   d. Replace the support pin and bearing.

10. If removing the lower bearing (14b) and support pin (34b):

   a. Remove one of the lower clamps (28) and capscrews (16b).

   b. Loosen the locknut (3) and screw the pump manifold (32) off the bearing (14b) to remove the secondary displacement pump (124).

   c. Remove the remaining clamp (28) and capscrew (16b) from the lower support (31b).

   d. Raise the VRHC lower frame (50) and remove the support (31b).

   e. Gently tap the support pin (34b) out with a hammer and punch.

   f. Replace the pin and bearing.

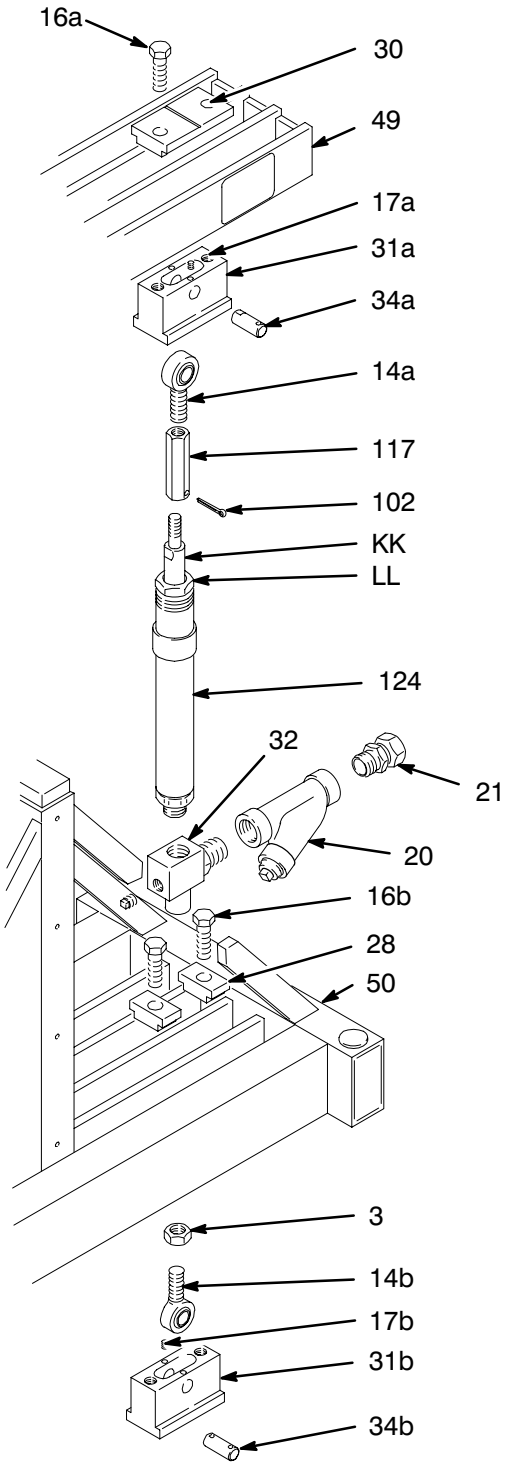


Fig. 14

Service

Replacing the Secondary Pump and/or the Bearings and Pins

NOTE: Refer to Fig. 14 for Steps 1 to 3.

1. If only the secondary pump is being replaced:

    a. Screw the secondary pump (124) into the inlet manifold (32). The manifold must face the end of the VRHC as shown in Fig. 14. If it does not, rotate the secondary displacement pump until it does, and tighten the locknut (3) against the inlet manifold. Torque the locknut to 60 ft-lb (81 N.m).

    b. Replace the connecting rod assembly (117, 14a, 34a, 31a) onto the displacement rod, and line up the cotter pin holes. Insert the cotter pin (102).

    c. Raise the lever arm (49) and place the support (31a) under the proper slot.

    d. Push down the lever arm until the support fits into the slot. If the support does not line up with the slot, rotate it clockwise until it does.

    e. Place the ratio index clamp (30) over the top of the support (31a). Insert the capscrews (16a).

    f. Set the index clamp (30) for the proper ratio and tighten the capscrews (16a).

2. If replacing the lower bearing (14b) and support pin (34b):

    a. Place a generous amount of Graco Gear Reducer Oil (43) on the inside of the lower bearing (14b) and the surface of the support pin (34b).

    b. Screw the locknut (3) onto the bearing (14b) threads until the locknut bottoms out.

    c. Slide the bearing into the slot in the support (31b). Insert the pin (34b) into place with the countersinks under the setscrew (17) holes. Tighten the setscrews to 35 in-lb (4 N.m). These are 10–32 self-locking setscrews. If no drag is felt while turning, replace the setscrew.

    d. Screw the secondary displacement pump (124) and manifold (32) onto the bearing (14b) until it bottoms out. Be sure it is not resting against the locknut (3).

    e. Align and loosely install the two clamps (28) and capscrews (16b).

3. If replacing the upper bearing (14a) and support pin (34a):

    a. Place a generous amount of Graco Gear Reducer Oil (43) on the inside of the upper bearing (14a) and the surface of the support pin (34a).

    b. Slide the support (31a) onto the bearing (14a). Insert the support pin (34a) with the countersinks in place under the setscrew (17a) holes.

> **⚠ CAUTION**
>
> Do not force the pin into place. Check for burrs on the pin or in the VRHC frame if the pin does not slide into place.

    c. Tighten the setscrews (17a) to 35 in-lb (4 N.m). These are 10–32 self-locking screws. If no drag is felt while turning, replace the setscrews.

    d. Place the support (31a) in a vise and screw the connecting rod (117) onto the bearing (14a). The connecting rod and the bearing can be disassembled and then reused one time before needing replacement. Be sure seal the connecting rod and the bearing with thread sealant such as Loctite® No. 271–05 or the equivalent. Apply 3 drops of the sealant to the threads of the bearing.

    e. Screw the connecting rod (117) onto the pump (124) until the cotter pin holes line up (if the displacement pump has them). Install the cotter pin (102) and tighten the connecting rod against the piston shoulder of the displacement rod.

    f. Follow steps 1.c. to 1.f. at left.

    g. Tighten the capscrews (16b) at the bottom of the secondary displacement pump (124).

Service

Removing the Primary Pump and/or the Lower Bearing and Pin

1. Flush the entire system with a compatible solvent.

⚠ WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 14.

2. **Relieve the pressure.**

3. Remove the safety panels (39,40). Disconnect the inlet and outlet hoses on the primary displacement pump (123).

NOTE: Refer to Fig. 15 for Steps 4 to 6.

4. Remove the three tie rod locknuts (103) and push up on the air motor (118) until the tie rods (116) clear the mounting holes of the displacement pump. See Fig. 15.

5. Using a wrench on the flats of the tie rods, unscrew them from the air motor base.

6. Remove the upper cotter pin (102c) and unscrew the air motor from the connecting rod (121).

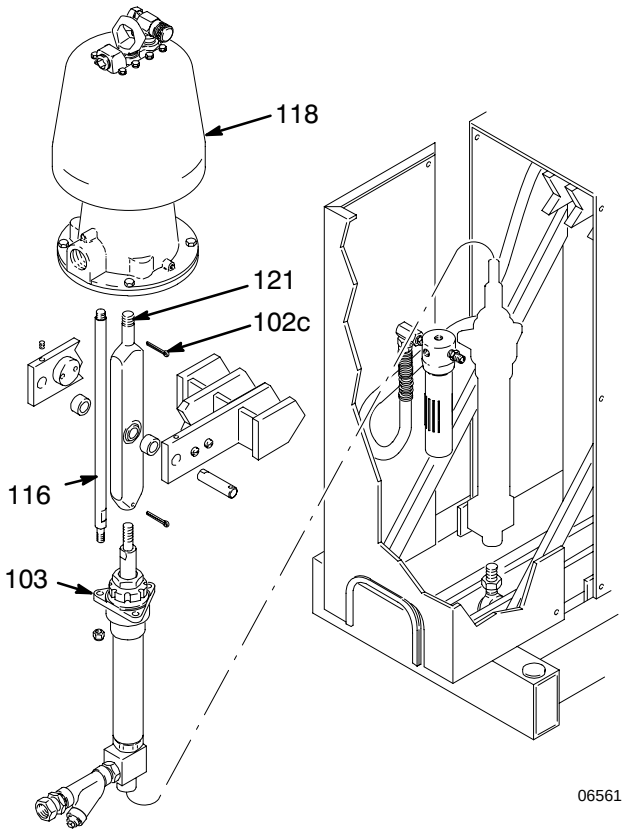


Fig. 15

Service

NOTE: If only the air motor needs repair, follow the instructions in manual 307–304, supplied.

NOTE: Refer to Fig. 16 for Steps 7 to 15.

7. Remove the lower cotter pin (102d) from the connecting rod (121) (if the pump has one) and loosen the two setscrews (59). The setscrews must be backed out far enough to clear the countersink of the bearing support pin (35c).

8. Hold the connecting rod (121) and gently tap out the support pin (35c) with a hammer and punch.

9. Slowly pull the connecting rod (121) away from the lever arm (49) and tilt the pump (123) forward until it rests on the frame. Save the two nylon spacers (27c).

10. Unscrew the connecting rod (121) from the displacement pump (123). If necessary, replace the connecting rod.

11. If removing the pump only, remove it from the manifold (32). If the primary pump needs repair, follow the instructions in the separate pump manual.

12. If removing the lower bearing (14d) and pin (35d), tilt the primary pump (123) forward until it rests on the floor. Then follow steps 13 to 15.

13. Loosen the lower rod end locknut (3) and unscrew the pump manifold (32) to remove the primary pump (123).

14. Loosen the two setscrews (17b). The setscrews must be backed out far enough to clear the countersinks of the support pin (35d).

15. Remove the pin (35d) and save the two nylon spacers (27d) and the bearing (14d).

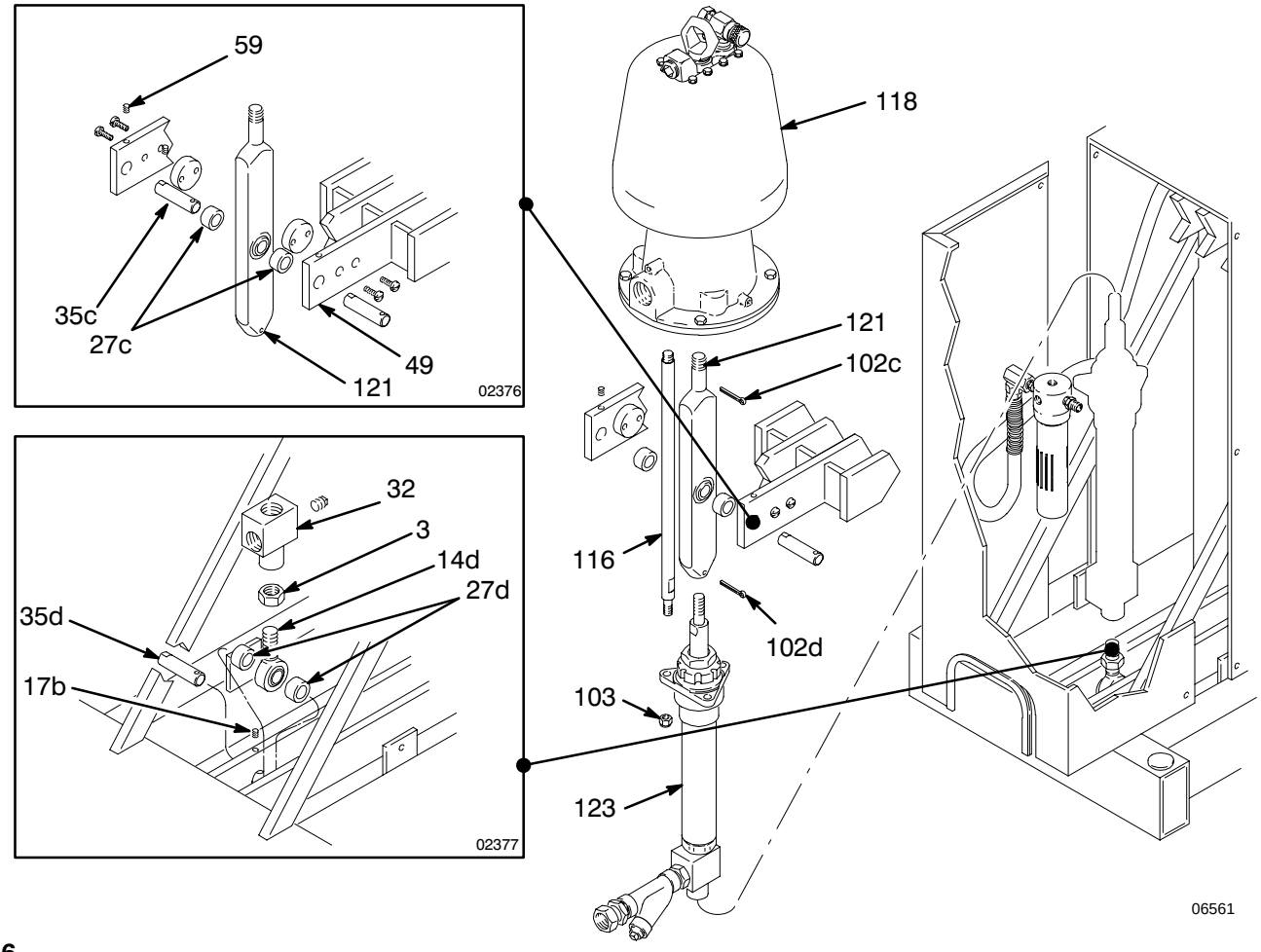


Fig. 16

Replacing the Primary Pump and/or Bearing and Pins

NOTE: Refer to Fig. 17 for Steps 1 to 9 except where noted.

1. Screw the displacement pump (123) into the inlet manifold (32) so the outlet is facing the back, left hand corner.

2. Screw the connecting rod (121) onto the primary displacement pump until the cotter pin holes line up. Install the cotter pin (102d) if the pump has one; if not, bottom out the connecting rod on the displacement pump.

3. Pull the connecting rod upward until the displacement pump stops.

4. Screw the air motor (118) onto the connecting rod until the cotter pin holes line up. Install the cotter pin (102c).

5. Rotate the air motor until the air inlet port is on the same side as the air inlet manifold (37). See the parts drawing on page 30.

6. Screw the three tie rods (116) into the air motor base and torque to 35–50 ft-lb (47–68 N.m).

NOTE: One of the tie rods will run through the lever arm slot.

7. Push down the air motor and place the tie rods into the displacement pump tie plate. Tighten the tie rod locknuts (103).

8. To install the support pin (35c) into the upper bearing:

   a. Remove the two capscrews (16a) from the support (31a) on the secondary pump (124).

   b. Move the lever arm (49) until you can place the nylon spacers (27c) and support pin (35c) in line with the bearing with the connecting rod (121).

   c. Lubricate the support pin with Gear Reducer Oil (43) and tap it into the upper bearing with the countersinks facing up.

> **⚠ CAUTION**
>
> Do not force the pin into place. Check for burrs on the pin or in the VRHC frame if the pin does not slide into place. Sand with 500 grit sandpaper between the countersinks.

   d. Torque the two setscrews (59) to 35 in-lb (4 N.m). See Fig. 18 on page 28.

   e. Move the lever arm (49) back into place and reinstall the two capscrews (16a) onto the support (31a) of the secondary pump.

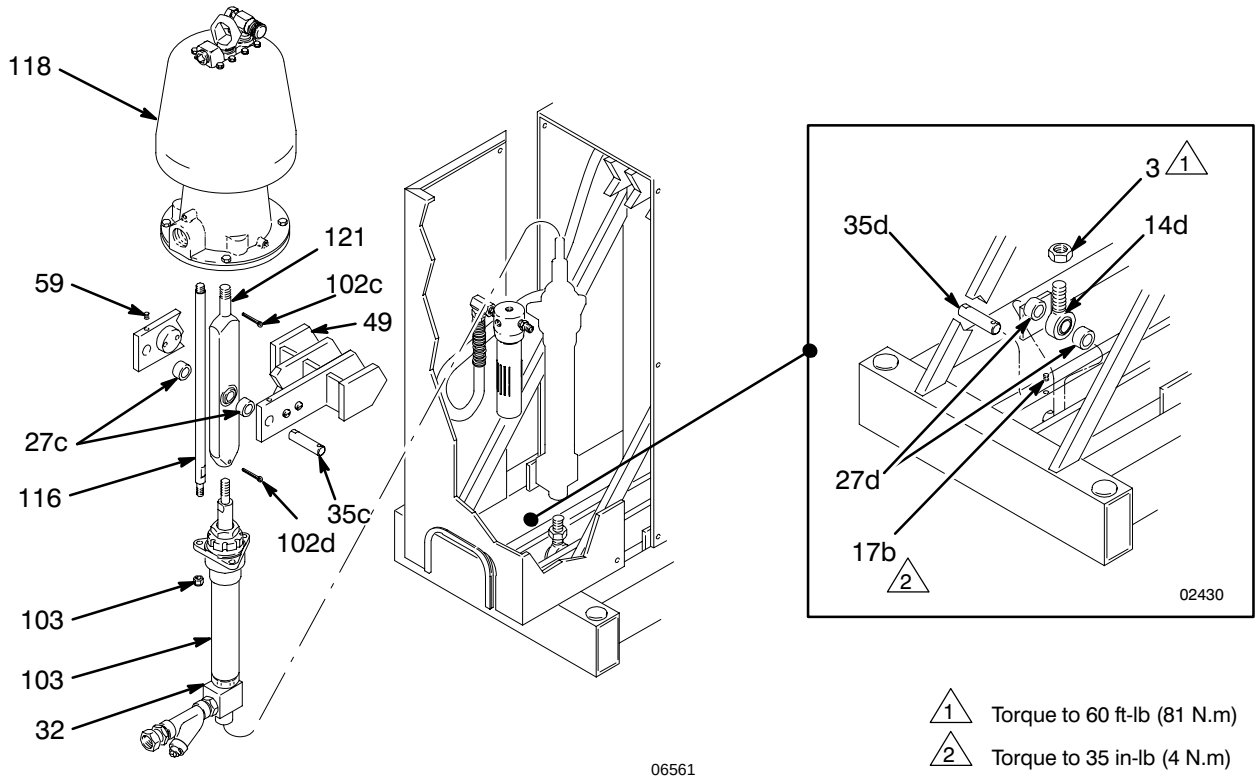


Fig. 17

9. If replacing the lower bearing (14d) and pin (35d):

   a. Thread the locknut (3) all the way onto the bearing.

   b. Screw the inlet manifold (32) onto the bearing twelve turns and tighten the locknut up to the inlet manifold. Torque to 60 ft-lb (81 N.m).

   c. Lubricate the support pin (35d) with Gear Reducer Oil (43). Install the pin with the countersinks facing up, into one side of the frame base (50). Place one nylon spacer (27d) on the end of the support pin.

   d. Install the bearing (14d) and manifold (32) and align them with the support in (35d).

   e. Tap the pin in flush with the opposite side of the frame. Align the second nylon spacer with the support pin, and tap the pin all the way into the side of the frame base (50).

   f. Tighten the two setscrews (17b) onto the support pin (35d). Torque to 35 in-lb (4 N.m).

   g. Follow the procedure for replacing the primary pump on page 27.

Replacing the Lever Arm on the Frame

⚠ CAUTION

Tolerances between the surface of the frame and bearing are very close. Do not force the pin into place. Check for burrs on the pin or in the VRHC frame if the pin does not slide into place. Sand with 500 grit sandpaper between the countersinks.

NOTE: Refer to Fig. 18 for Steps 1 to 5.

1. Screw the locknuts (2) onto the pivot bearing (15).

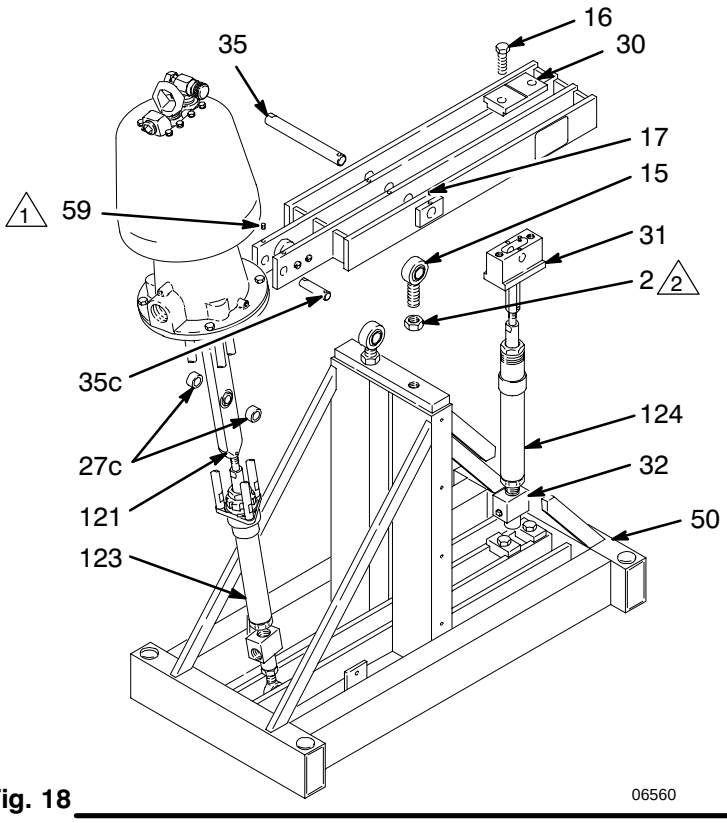
2. Screw the pivot bearing into the frame base (50). Adjust the distance from the top of the support pin (33) to the bottom of the frame (50) to 26.125" (664 mm).

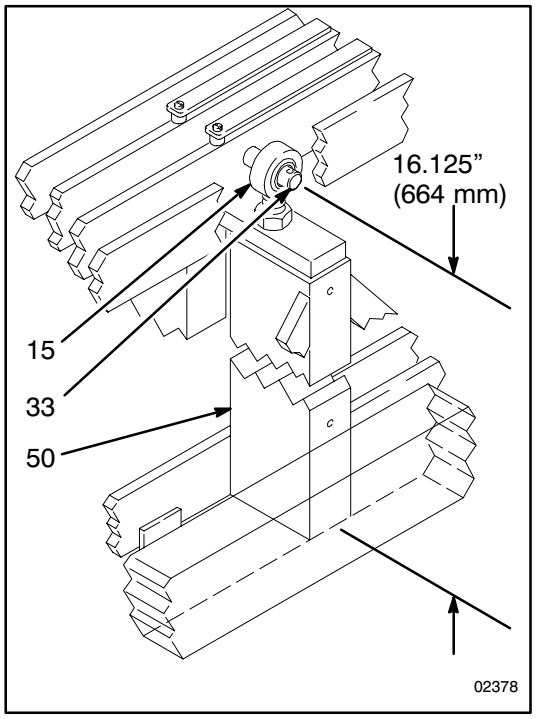
3. With the bearings at the correct height and parallel to each other, torque the locknuts (2) to 60 ft-lb (81 N.m).

4. Place a generous amount of lubricant (43) onto the support pin, and place the lever arm (49) over the bearings (15).

5. Slide the support pin, with the countersinks up, through the lever arm and bearings. Torque the two setscrews (17) to 35 in–lb (4 N.m).

NOTE: If no drag is felt while turning the setscrews, replace them.



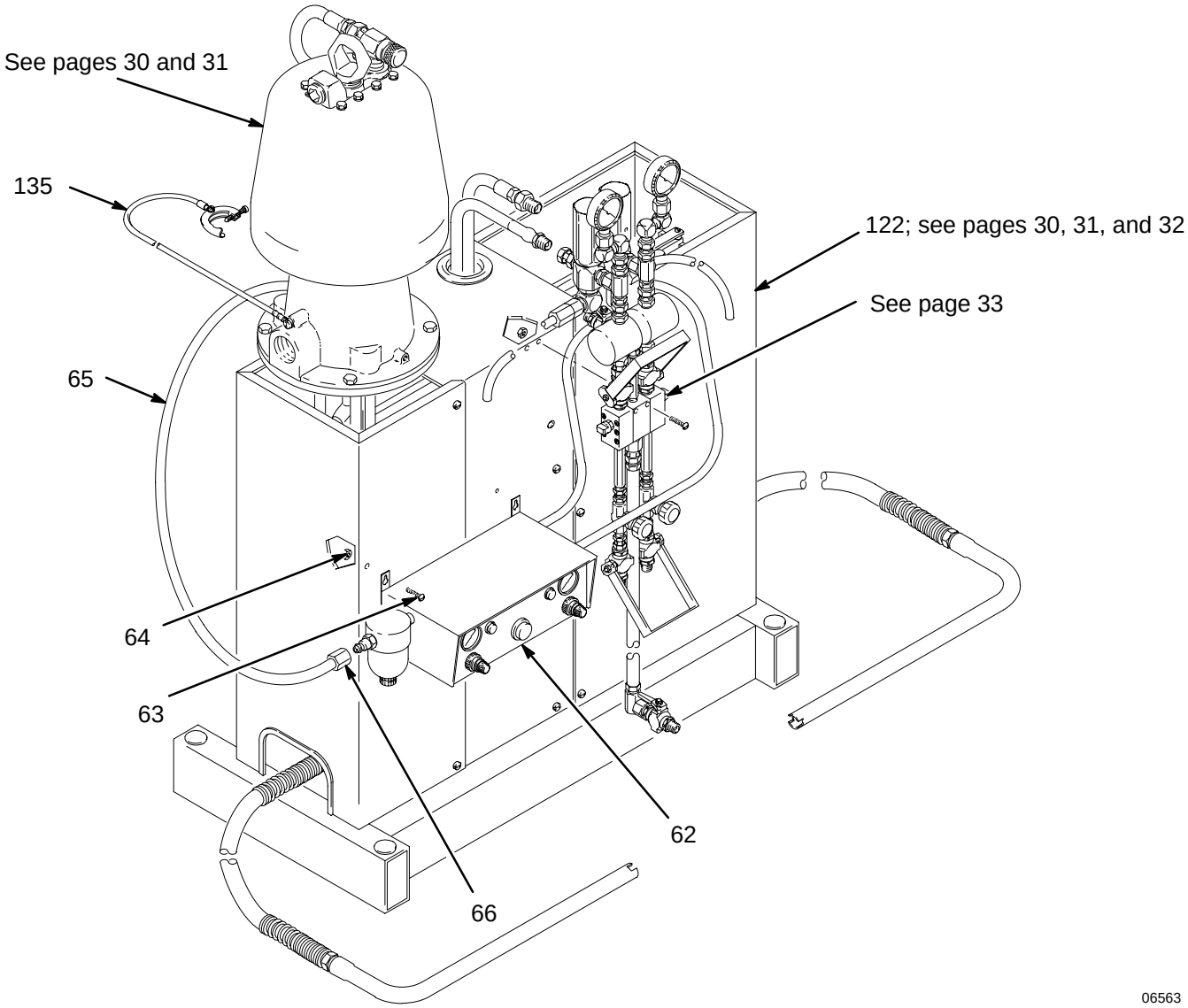


1 Torque to 35 in-lb (4 N.m)

2 Torque to 60 ft-lb (81 N.m)

Fig. 18

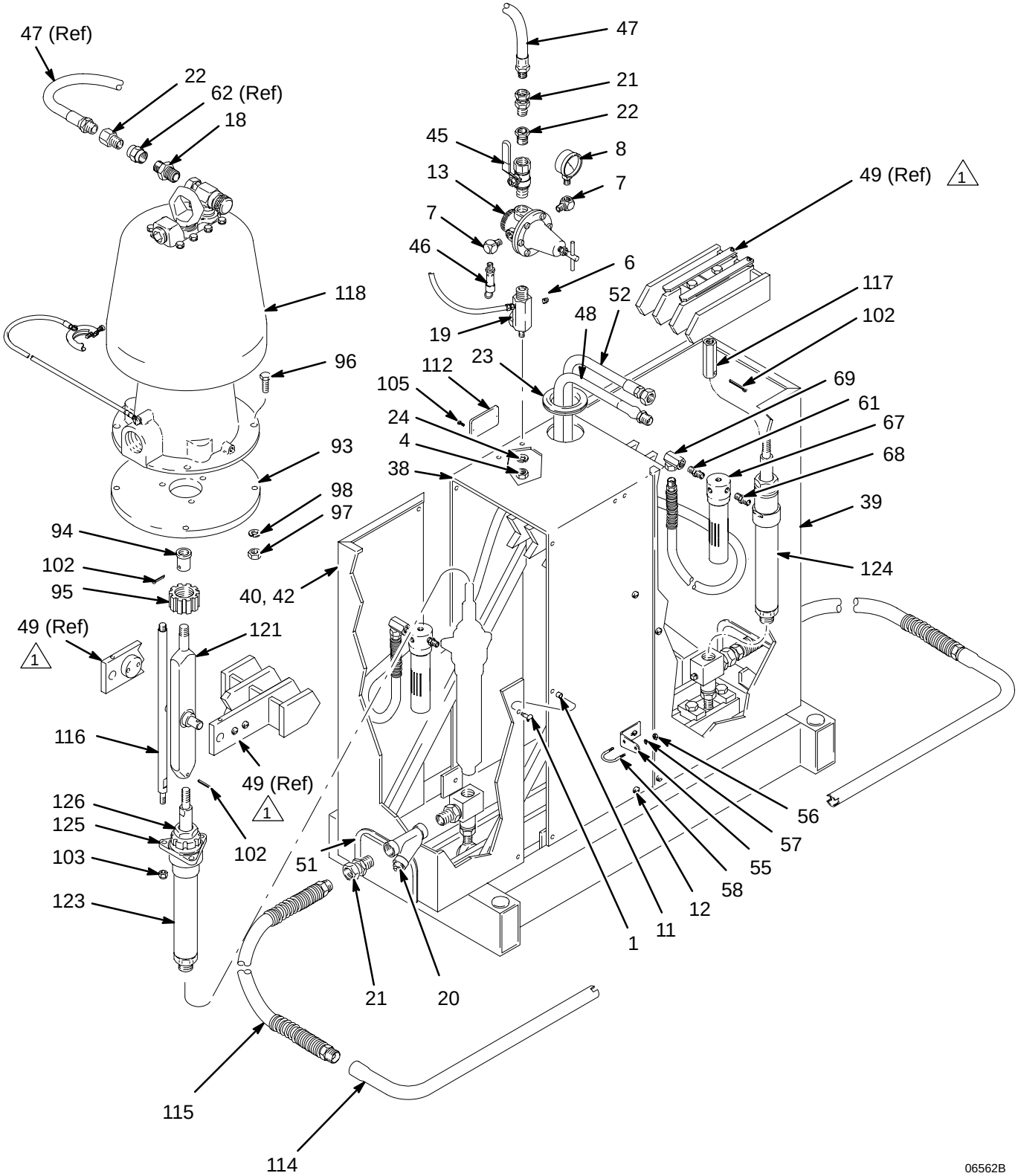
Parts



Ref No.	Part No.	Description	Qty
62	6773317	RATIO MONITOR & SHUT-OFF	1
63	100–220	SCREW	2
64	100–077	NUT	2
65	6773026	HOSE, air	1
66	6773025	COUPLING	2
122	215–925	HOUSING, VRHC; see pages 30, 31, and 32 for parts	1
135	222–011	GROUND WIRE	1

Parts

⚠1 See page 32.



Parts

Ref. No.	Part No.	Description	Qty.
1*	108–036	STUD, fastener	12
4	100–131	NUT	1
6	100–509	PLUG, pipe	4
7*	100–840	ELBOW, street, 1/4 npt (m x f)	2
8*	100–960	GAUGE, air pressure, 0–200 psi (0–14 bar)	1
11*	108–037	NUT, sheet spring, 10–24	12
12*	103–836	SCREW, slotted hd, 10–32 x 3/4” (19 mm) long	12
13	206–197	REGULATOR, air, see 308–168 for parts	1
18	166–443	NIPPLE; 3/4 x 1/2 npt	
19	206–205	MANIFOLD	1
20	101–078	FILTER, inlet	2
21*	157–785	UNION, swivel, straight, 3/4 npt(m) x 3/4 npsm(f) swivel	3
22*	104–969	BUSHING	2
23*	158–244	GROMMET	1
24	100–133	LOCKWASHER	1
29	177–096	LABEL, warning (not shown)	1
38*	177–118	PANEL, safety	1
39*	177–119	PANEL, safety	1
40*	177–120	PANEL, safety	1
41	177–132	LABEL (not shown)	1
42*	177–144	LABEL, warning	4
45*	113–269	VALVE, air, bleed–type	1
46	108–124	SAFETY VALVE	1
47	6773225	HOSE, air	1
48*	215–247	HOSE, nylon, 1/4” (6 mm) ID, coupled 3/8 npt (mbe), 5’ (1.8 m) long	1
51*	062–035	MOLDING, rubber	1.8 ft
52*	223–778	HOSE, Teflon®, 1/4” (6 mm) ID, coupled 1/4 npsm (fbe), 5’ (1.8 m) long	1
55*	180–673	BRACKET	1
56*	100–179	NUT, 10–24	2
57*	100–718	WASHER, no. 10	2
58*	180–674	U–BOLT, 10–24	1
61	156–971	NIPPLE; 1/4 npt	2
67	223–160	FLUID FILTER see 307–273 for parts	2
68	156–849	NIPPLE; 3/8 npt	2
69	162–803	SWIVEL; 1/4 npt x 3/8 npsm (fbe)	2
93	6779009	PLATE, adapter	1
94	6779011	COUPLING	1
95	161–544	NUT, swivel	1
96	112–912	SCREW	4
97	100–131	NUT	4
98	100–133	WASHER	4
102	100–103	PIN, cotter	3
103	101–566	LOCKNUT, sst, 3/6–16	3
105	104–088	RIVET	4
112	290–179	PLATE, designation	1
114	165–767	TUBE, suction	2
115	214–960	HOSE, suction	2
116	6779010	TIE ROD	3
117	177–113	CONNECTING ROD, 66.5 mm (2.62”) long	1
118	215–255	MOTOR, Bulldog; see 307–304 for parts	1
121	215–692	CONNECTING ROD, 300 mm (11.8”)	1
123	222–012	PRIMARY DISPLACEMENT PUMP; see 307–944 for parts	1
124	222–012	SECONDARY DISPLACEMENT PUMP; see 307–944 for parts	1
125	215–690	MOUNTING PLATE	1
126	164–417	LOCKNUT	1

** Included in Unit Frame 215–925. See page 32 for additional frame parts.*

Parts

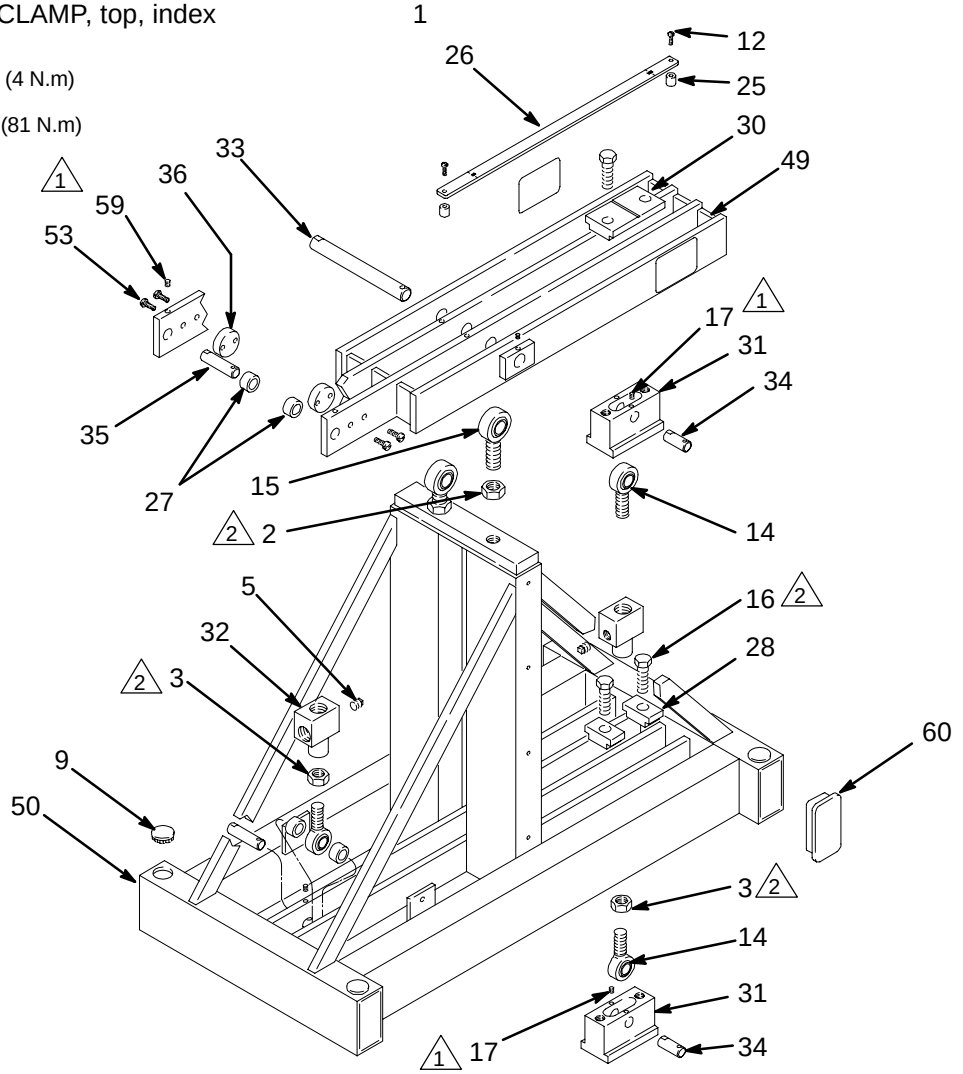
Unit Frame 215–925, Series B

NOTE: See pages 30 and 31 for parts not listed or shown here.

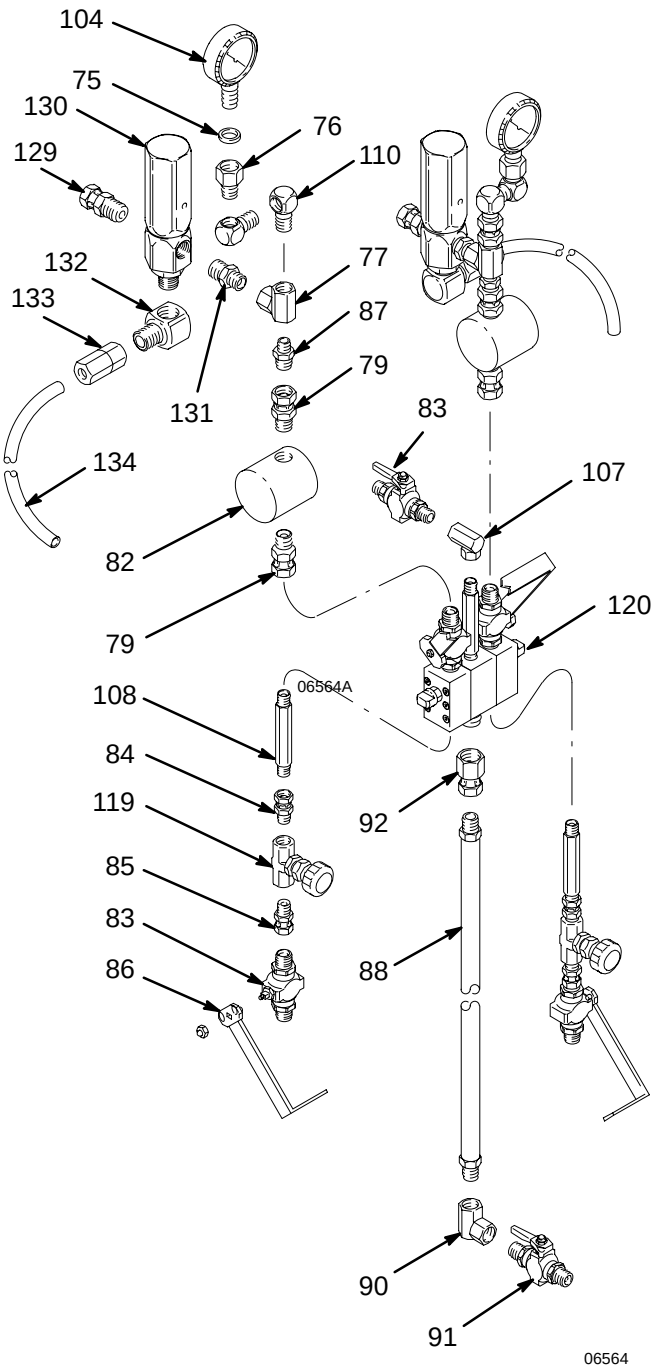
Ref No.	Part No.	Description	Qty
2	100–071	LOCKNUT, hex, 3/4–16	2
3	100–155	NUT, 5/8–18	2
5	100–509	PLUG, pipe, 1/4 npt	3
9	101–747	PLUG, bottom, 1/4 npt(m0	4
12	103–836	SCREW, slotted hd, 10–32 x 3/4” (19 mm) long	12
14	105–751	BEARING, rod end	3
15	105–752	BEARING, rod end	2
16	100–060	CAPSCREW, hex hd, 1/2–13 x 1–3/4” (44 mm) long	4
17	105–762	SETSCREW, hex, 10–32	8
25	159–463	SPACER	4
26	177–042	GAUGE, designation	2
27	177–086	SPACER, 1/4, nylon	4
28	177–089	CLAMP, lower	2
30	177–099	CLAMP, top, index	1
31	177–100	SUPPORT, pivot pin	2
32	177–101	MANIFOLD, inlet	2
33	177–105	PIN, pivot, frame	1
34	177–106	PIN, pivot, housing	2
35	177–107	PIN, pivot, pump	2
36	177–108	PLATE, wear	2
43	217–374	LUBRICANT, gear reducer (not shown)	16 oz
44	206–994	THROAT SEAL LIQUID (not shown)	8 oz
49	215–664	ARM, lever	1
50	215–665	FRAME BASE, VRHC	1
53	102–790	SCREW, 10–24	4
59	108–038	SETSCREW, 10–32	2
60	189–559	CAP, end	4

1 Torque to 35 in-lb (4 N.m)

2 Torque to 60 ft-lb (81 N.m)



Parts



Ref. No.	Part No.	Description	Qty.
75	98255	SEAL	2
76	6779026	ADAPTER	2
77	6773301	SWIVEL	2
79	155–665	UNION	4
82	6773518	SENSOR	2
83	214–037	BALL VALVE	3
84	156–823	SWIVEL	2
85	156–823	SWIVEL	2
86	217–562	HANDLE	1
87	164–672	NIPPLE	2
88	512–506	MIXER (with elements)	1
90	155–677	SWIVEL, 90°	1
91	210–659	BALL VALVE	1
92	161–077	SWIVEL UNION	1
104	6773222	GAUGE, pressure, 400 bar (5900 psi)	2
107	157–676	ELBOW	1
108	177–021	NIPPLE	2
110	155–699	ELBOW	4
119	098260	SAMPLING VALVE, needle	2
120	215–626	MANIFOLD; see 307–400 for parts	1
129	158–256	ADAPTER UNION	2
130	237–063	VALVE, relief; 200–248 bar (2900–3600 psi)	2
131	159–239	NIPPLE; 1/2 x 3/8 npt	2
132	158–683	ELBOW	2
133	113–187	CONNECTOR, tube, female	2
134	190–738	TUBE, nylon	2

Accessories

Additional Pump Installation Kit 215–934

Kit designed for the addition of another displacement pump to the Hydra-Cat. See manual 307–432.

Swivel Caster 102–399

Four required to make VRHC portable. Mount in sockets provided in the frame.

Airless Spray Gun 235–460

5000 psi (350 bar) MAXIMUM WORKING PRESSURE

1/4 npsm(m) fluid inlet. See manual 308–236.

Extrusion Flo Valve 204–355

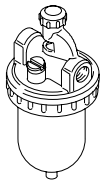
3000 psi (210 bar) MAXIMUM WORKING PRESSURE

3/8 npt(f) fluid inlet. See manual 306–586.

Air Line Lubricator 214–848

250 psi (17.5 bar) MAXIMUM WORKING PRESSURE

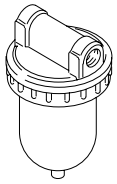
1/2 npt inlet and outlet with metal bowl.



Air Line Filter 106–149

250 psi (17.5 bar) MAXIMUM WORKING PRESSURE

1/2 npt(f) inlet and outlet.



Y–Line Strainer 101–078

500 psi (34 bar) MAXIMUM WORKING PRESSURE

3/4 npt(f) inlet and outlet. 20 mesh screen included.

Heater

Used to control paint viscosity in a heated spray system.

220–522 120 V, 60 Hz, 1/2 npt inlet, 3/8 npt outlet
237–947 240 V, 60 Hz, 1/2 npt inlet, 3/8 npt outlet

Static Mixers

3000 psi (210 bar) MAXIMUM WORKING PRESSURE

A static mixer consists of a tube with helical interior elements which thoroughly blend base and catalyst into the proper mix. Wetted parts are Stainless Steel.

500–639 14” (356 mm) long, 3/8” (9 mm) OD, 0.32” (8.1 mm) ID, 27 elements

500–586 25” (635 mm) long, 1/2” (12 mm) OD, 0.44” (11.2 mm) ID, 32 elements

Tube Fittings

502–170 For 3/8” (9 mm) OD tube x 3/8 npt(m)

502–172 For 1/2” (12 mm) OD tube x 1/2 npt(m)

Supply Pumps

953–179 5:1 Monark, 55 gallon, drum bung, 1.4 gpm (5 l/min), 3/4 npt(f) outlet

953–350 5:1 Monark, 5 gallon, single post ram 1.4 gpm (5 l/min), 3/4 npt(f) outlet

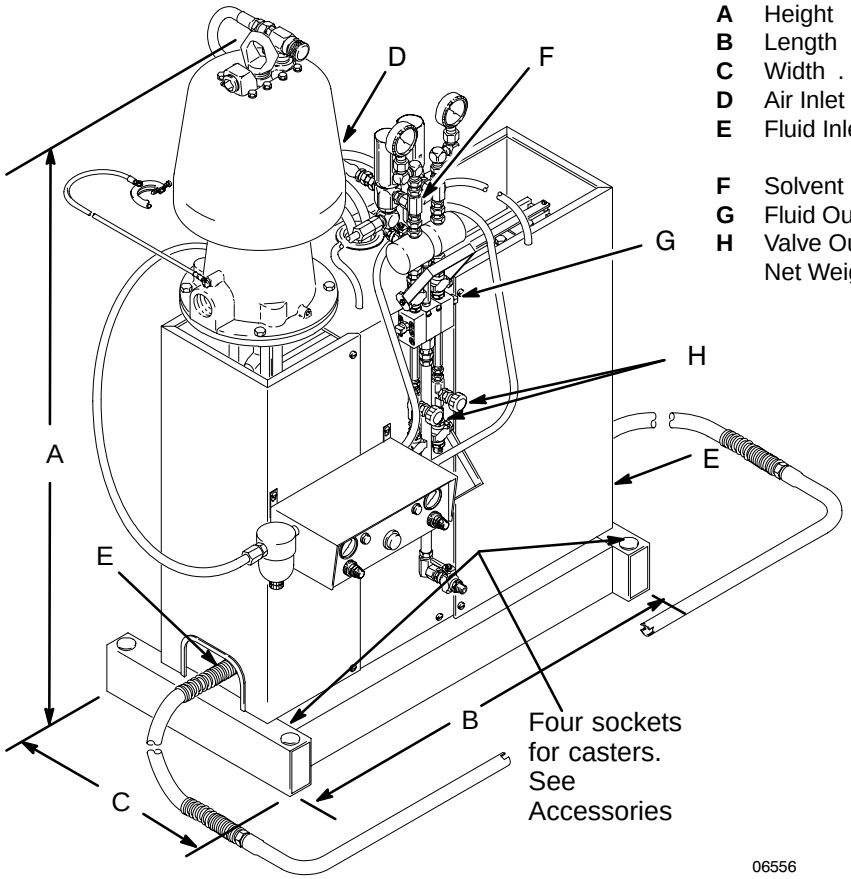
902–278 5:1 Monark, 5 gallon, pail cover 1.4 gpm (5 l/min), 1/4 npt(f) outlet

226–040 2:1 Standard, 55 gallon, drum bung, 1 gpm (4 l/min), 1/2 npt(f) outlet

902–823 5:1 Monark, 55 gallon, drum bung, 1.4 gpm (5 l/min), 3/4 npt(f) outlet

208–177 2:1 Standard, 55 gallon, drum bung, 2 gpm (8 l/min), 1/2 npt(f) outlet

Dimensions



A	Height	1450 mm
B	Length	889 mm
C	Width	457 mm
D	Air Inlet	1/2 npt(f); has four 1/4 npt(f) plugged outlets
E	Fluid Inlets	Two 3/4 npsm(f) swivel, has 1/4 npt(f) plugged cleanout port
F	Solvent Inlets	1/2 npt(m)
G	Fluid Outlet	1/2 npt(m)
H	Valve Outlets	Two 1/4 npt(m)
	Net Weight	192 kg

Technical Data

Air motor effective diameter . . . . . 7 in. (178 mm)
Air motor stroke . . . . . 4.75 in. (120.6 mm)
Operating air pressure range . . . . . 5 bar (72 psi)
Max. working pressure . . . . . 200 bar (2800 psi)
Recommended pump speed . . . . . 40 cycles per minute
Max. fluid inlet pressure* . . . . . 200 psi (14 bar)
Max. pump operating temperature . . . . . 180°F (82°C)
Sound pressure level at 7 bar (100 psi) inlet air at 40 cpm normal load ▯ . . . . . 79.9 dB(A)
Sound power level at 7 bar (100 psi) inlet air at 40 cpm normal load ▯ . . . . . 95.5 dB(A)
Sound pressure level at 8.2 bar (120 psi) inlet air at 60 cpm normal load ▯ . . . . . 82.4 dB(A)
Sound power level at 8.2 bar (120 psi) inlet air at 60 cpm normal load ▯ . . . . . 97.9 dB(A)

* 25% pump outlet pressure maximum.
▯ Tested in accordance with ISO 3744.

Air Consumption

At 40 psi (2.8 bar) cfm (m^3/min)	At 70 psi (4.8 bar) cfm (m^3/min)	At Cycles per Minute
5 (0.14)	10 (0.28)	10
10 (0.28)	20 (0.56)	20
20 (0.56)	40 (1.12)	30
25 (0.70)	50 (1.40)	40
30 (0.84)	60 (1.68)	50
40 (1.12)	70 (1.96)	60

Wetted Parts

Fluid Manifolds	Zinc-Plated Steel
Fluid Hoses	Nylon, Zinc-Plated Steel Couplings
Pressure Relief Valve	304 Stainless Steel, Graphite-Filled Teflon▯, Tungsten Carbide (Nickel Binder)
Mixer Manifold	Chrome Alloy, Nickel Chrome Plated and Zinc Plated Steels, Stainless Steel, Delrin▯, Nylon and Teflon▯ Plastics
Primary and Secondary Displacement Pumps	Stainless Steel, Tungsten Carbide, Chrome Plating, Carbon Steel, Teflon▯

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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 or 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.

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