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INSTRUCTIONS

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

Rev. B
Supersedes Rev. A
and PCN B

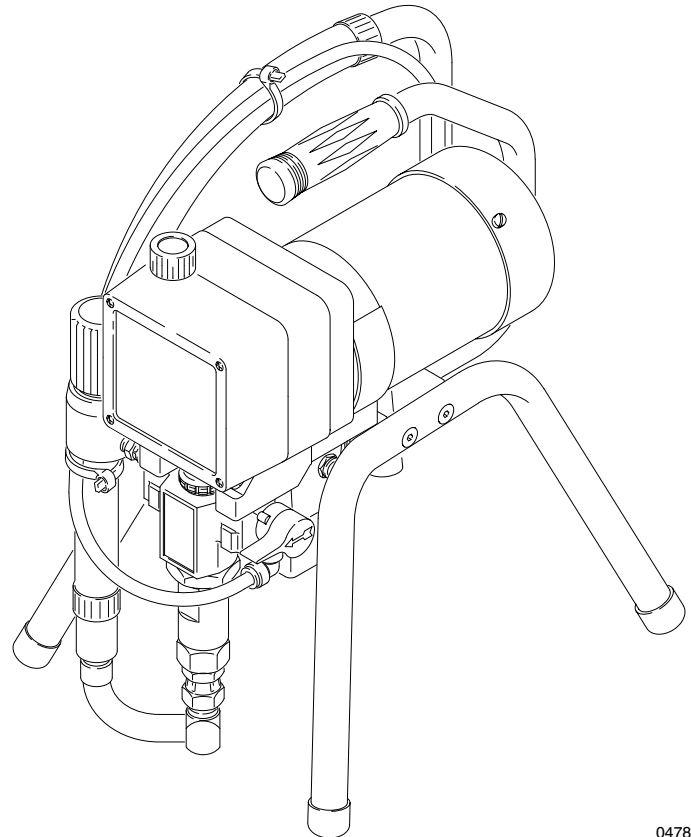
ELECTRIC, 100 VAC/50 or 60 HZ

490st Airless Paint Sprayer

19.5 MPa, 195 bar (2750 psi) Maximum Working Pressure

Model 231-311, Series C

Basic sprayer



04784

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

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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 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. Use only genuine Graco parts.
- 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 38 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).
- Do not lift pressurized equipment.
- Comply with all applicable local, state, and national fire, electrical, and safety regulations.
- Wear hearing protection when operating this equipment.
- Do not use 1,1,1-trichloroethane, methylene chloride, other halogenated hydrocarbon solvents or fluids containing such solvents in pressurized aluminum equipment. Such use could result in a chemical reaction, with the possibility of explosion.

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 may 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 6 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.
- Fluid hoses must have spring guards on both ends, to help protect them from rupture caused by kinks or bends near the couplings.



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.

⚠ 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.

- 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.
- Disconnect all electrical 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.
- Ground the sprayer to a true earth ground with the ground wire and clamp (supplied).
- Use only electrically conductive hoses.



MOVING PARTS HAZARD

Moving parts can pinch or amputate your fingers.

- Keep clear of all moving parts when starting or operating the sprayer.
- Before servicing the equipment, follow the **Pressure Relief Procedure** on page 6 to prevent the equipment from starting unexpectedly.

NOTE: This is an example of the English language DANGER label on your sprayer. This label is supplied with the sprayer in other languages. Before operating the sprayer, apply a DANGER label in the appropriate language for your operators, according to the separate instructions supplied with it.

⚠ DANGER ⚠			
	FIRE AND EXPLOSION HAZARD		SKIN INJECTION HAZARD
Spray painting, flushing or cleaning equipment with flammable liquids in confined areas can result in fire or explosion. Use outdoors or in extremely well ventilated areas. Ground equipment, hoses, containers and objects being sprayed. Avoid all ignition sources such as static electricity from plastic drop cloths, open flames such as pilot lights, hot objects such as cigarettes, arcs from connecting or disconnecting power cords or turning light switches on and off. Failure to follow this warning can result in death or serious injury.		Liquids can be injected into the body by high pressure airless spray or leaks – especially hose leaks. Keep body clear of the nozzle. Never stop leaks with any part of the body. Drain all pressure before removing parts. Avoid accidental triggering of gun by always setting safety latch when not spraying. Never spray without a tip guard. In case of accidental skin injection, seek immediate “Surgical Treatment”. Failure to follow this warning can result in amputation or serious injury.	
READ AND UNDERSTAND ALL LABELS AND INSTRUCTION MANUALS BEFORE USE			

Setup

General Information

NOTE: Reference numbers and letters in parentheses in the text refer to the callouts in the figures and the parts drawing.

**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.



Grounding

1. *Sprayer:* plug the power supply cord, or extension cord into a properly grounded outlet. Do not use an adapter. All extension cords must have three wires and be rated for 15 amps.
2. *Fluid hoses:* use only grounded hoses with a maximum of 150 m combined hose length to ensure grounding continuity.
3. *Spray gun:* obtain grounding through connection to a properly grounded fluid hose and sprayer.
4. *Object being sprayed:* according to local code.
5. *Fluid supply container:* according to local code.
6. *All solvent pails used when flushing,* according to local code. Use only metal pails, which are conductive. Do not place the pail on a non-conductive surface, such as paper or cardboard, which interrupts the grounding continuity.
7. *To maintain grounding continuity when flushing or relieving pressure,* always hold a metal part of the gun firmly to the side of a grounded metal pail, then trigger the gun.

Pressure Relief Procedure

**WARNING**

**INJECTION HAZARD**
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. Engage the gun safety latch.
2. Turn the ON/OFF switch to OFF.
3. Unplug the power supply cord.
4. Disengage the gun safety latch. Hold a metal part of the gun firmly to the side of a grounded metal pail, and trigger the gun to relieve pressure.
5. Engage the gun safety latch.
6. Open the pressure drain valve, having a container ready to catch the drainage. Leave the 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, wrap a rag around the tip guard retaining nut or hose end coupling and very slowly loosen the part to relieve pressure gradually. Now clear the tip or hose.

Setup

IMPORTANT: The model 231–311 sprayer is shipped without a spray gun or hose. When a spray gun and hose are referred to throughout this manual, the instructions and figures depict a Graco® product. Your gun and hose may be different.

⚠ WARNING

If you supply your own hoses and spray gun, be sure the hoses are electrically conductive, that the gun has a tip guard, and that each part is rated for at least 19.5 MPa, 195 bar (2750 psi) Maximum Working Pressure. This is to reduce the risk of serious injury caused by static sparking, fluid injection, or over-pressurization and rupture of the hose or gun.

⚠ CAUTION

To avoid damaging the pressure control, which may result in poor equipment performance and component damage, follow these precautions.

1. Always use nylon spray hose at least 6 m long.
 2. Never use a wire braid hose as it is too rigid to act as a pulsation dampener.
 3. Never install any shutoff device between the pump and the hose. See Fig. 2.
1. Plug the power cord (57) into the inlet receptacle located below the motor. Tighten the screw (A) of the cord clamp (65) securely. See Fig. 1.

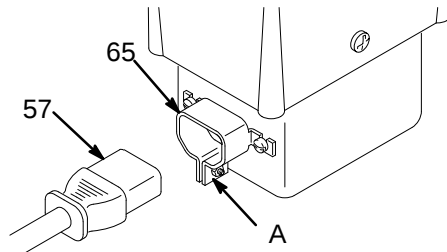


Fig. 1

03174

2. Attach the fluid filter (85) to the sprayer.
3. Connect the hose and gun and screw it onto the outlet nipple (28). Don't use thread sealant, and don't install the spray tip yet!
4. Fill the wet-cup (102). Pry off the wet-cup seal. Fill the cup 1/3 full with Graco Throat Seal Liquid (TSL), supplied. Install the seal.
5. Check the electrical service. It must be 100 VAC, 50/60 Hz, 10 Amp (minimum) and must be protected by a fuse or circuit breaker with a rating of not more than 16 amps.
6. You may use a 3-wire, 2.0 mm² (14 AWG) (minimum) extension cord up to 45 m long. Longer lengths affect sprayer performance.
7. Plug in the sprayer. Be sure the ON/OFF switch (52) is OFF. Plug the cord into a grounded outlet at least 6 m away from the spray area.

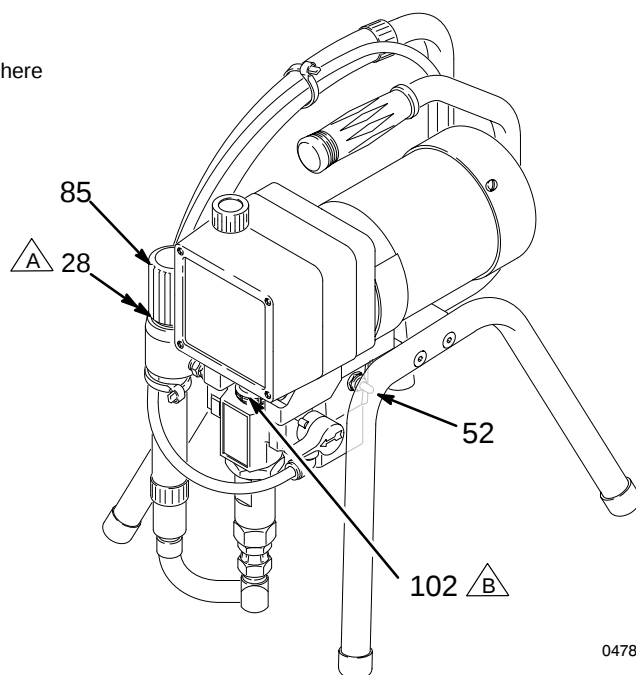
⚠ WARNING

Proper electrical grounding is essential to reduce the risk of fire or explosion which can result in serious injury and property damage. Also read the **FIRE AND EXPLOSION HAZARD** on page 3.

8. Flush the pump to remove the oil which was left in to protect pump parts after factory testing. See page 14.
9. Prepare the paint according to the manufacturer's recommendations. Remove any paint skin. Stir the paint to mix pigments. Strain the paint through a fine nylon mesh bag to remove particles that could clog the gun filter or spray tip. This is an important step toward trouble-free paint spraying.

Setup

- A** 1/4 npsm(m):
Do not install any shutoff device here
- B** Fill 1/3 full with TSL



04785

Fig. 2

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Operation

Refer to the **IMPORTANT** note on page 7.

How to use the gun safety latch

When engaged, the gun safety latch (A) prevents the gun from accidental triggering. See Fig. 3.

! WARNING

If the gun still sprays when the safety latch is engaged, adjust the gun. See your gun manual.

- A** Safety latch shown in "ON SAFE" position
- B** Safety latch shown in "OFF SAFE" position

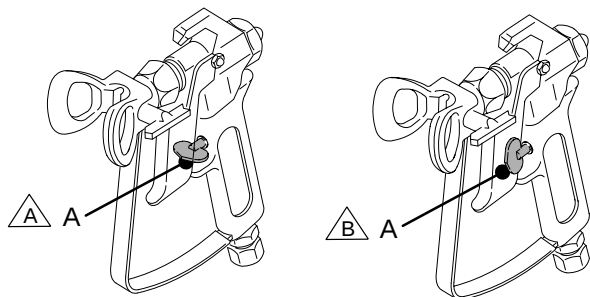


Fig. 3

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How to use the pressure drain valve

Use the pressure drain valve (45) to relieve fluid pressure from the pump and to help prime the pump. If the valve senses an overpressure condition, it opens automatically to relieve fluid pressure. If this happens, stop spraying immediately, shut off and unplug the sprayer. Correct the problem before using the sprayer again. Refer to Troubleshooting, page 15. See Fig. 4.

- A** Closed (spray) position
- B** Open (drain) position

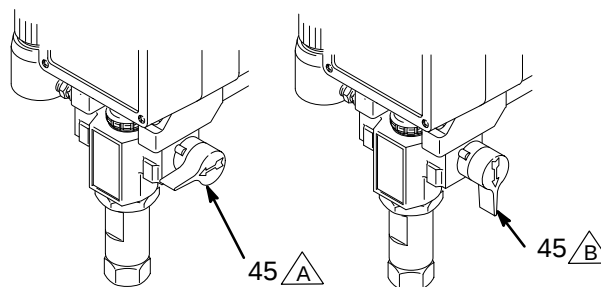


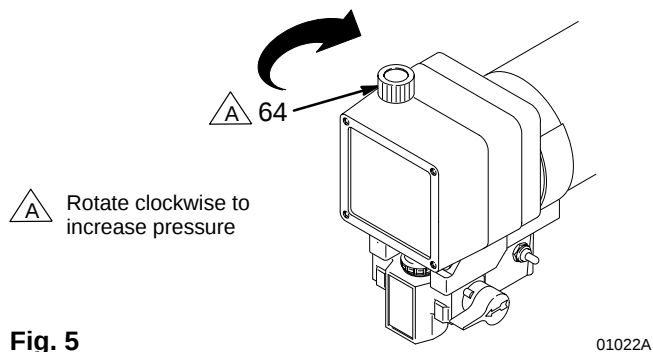
Fig. 4

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Operation

How to use the pressure control

The pressure control controls the motor operation so the sprayer maintains constant fluid pressure at the pump outlet. Turn the pressure control knob (64) fully counterclockwise to obtain the minimum setting. Turn the knob clockwise to increase pressure. See Fig. 5.



How to use the RAC IV tip guard

WARNING

To reduce the risk of serious injury from fluid injection:

Never operate the spray gun with the tip guard removed.

Do not hold your hand, body, or a rag in front of the spray tip when cleaning or checking a clogged tip. Always point the gun toward the ground or into a pail when checking to see if the tip is clear.

Do not try to “blow back” paint; this is not an air spray sprayer.

The tip guard alerts you to the risk and helps prevent placing any part of the body close to the spray tip. The tip guard also adjusts the vertical or horizontal spray pattern. See page 11. The tip guard holds a reversing spray tip. The tip is in the spraying position when the tip handle (B) points forward. See Fig. 6.

Clean the front of the tip frequently during the day's operation. First, follow the **Pressure Relief Procedure Warning** on page 6.

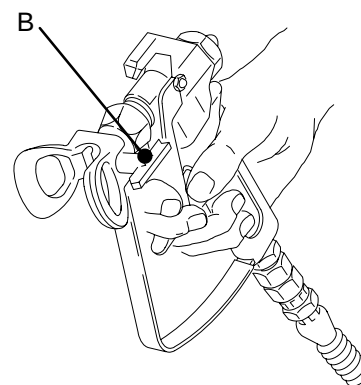


Fig. 6

How to remove a tip clog

1. Release the gun trigger. Engage the gun safety latch. Rotate the RAC IV tip handle 180°. See Fig. 6.
2. Disengage the gun safety latch. Trigger the gun into a pail or onto the ground to remove the clog.
3. Engage the gun safety latch. Rotate the tip handle (B) to the spraying position.
4. If the tip is still clogged, engage the gun safety latch, shut off and unplug the sprayer, and open the pressure drain valve to relieve pressure. Clean the spray tip as shown in your gun manual.

Startup

Refer to the **IMPORTANT** note on page 7.

Use this procedure each time you start the sprayer to help ensure the sprayer is ready to operate and that you start it safely.

WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

CAUTION

To reduce the risk of damage to the displacement pump packings, never run the pump without fluid in it for more than 30 seconds.

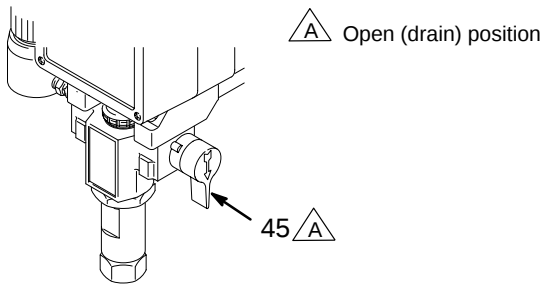


Fig. 7 03034

NOTE: If this is a first-time startup, flush the sprayer. See page 14.

NOTE: Refer to Fig. 9 and the other figures referenced in the text as you start the sprayer.

1. Open the pressure drain valve (45). See Fig. 7.
2. Don't install the spray tip until the pump is primed!
3. Put the suction hose (32) into the paint.
4. Turn the pressure control (64) to minimum.
5. Disengage the gun safety latch. See Fig. 3, page 8.
6. To prime the pump, turn the sprayer switch (52) on. Slowly increase the pressure until the sprayer starts. When fluid comes from the pressure drain valve, close the valve.

WARNING

To reduce static sparking and splashing, always remove the spray tip from the gun, and hold a metal part of the gun firmly to the side of a grounded metal pail when priming or flushing.

7. To prime the hose, lower the pressure to reduce splashing. Hold a metal part of the gun firmly against and aimed into the side of a grounded metal pail. See the **WARNING**, above. Hold the trigger open and slowly increase the pressure until the pump starts. Keep the gun triggered until all air is forced out of the system and the fluid flows freely from the gun. Release the trigger and engage the gun safety latch.
8. Check all fluid connections for leaks. **Relieve the pressure** before tightening any connections.
9. Install the spray tip. Engage the gun safety latch first! Refer to your gun manual on how to install the tip.

Startup

10. Adjust the spray pattern.

- a. Increase the pressure just until spray from the gun is completely atomized. To avoid excessive overspray and fogging, and to extend tip and sprayer life, always use the lowest pressure needed to get the desired results.
- b. If more coverage is needed, use a larger tip rather than increasing the pressure.
- c. Test the spray pattern. To adjust the direction of the spray pattern, engage the gun safety latch and loosen the retaining nut. Position the tip guard horizontally for a horizontal pattern or vertically for a vertical pattern. Hold the tip guard in place while tightening the retaining nut. See Fig. 8.

NOTE: Spray patterns will change as tips wear. Change the spray tip if adjusting the pressure will not improve the spray pattern.

-  Tip guard; shown in vertical position
-  Tip guard; shown in horizontal position

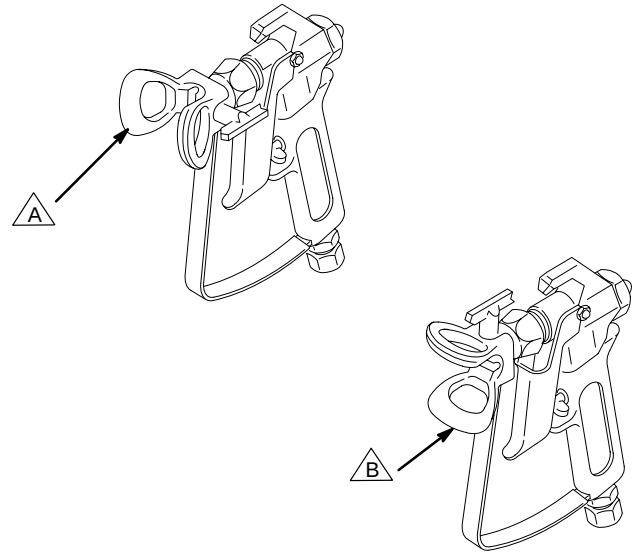


Fig. 8

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-  Rotate clockwise to increase pressure

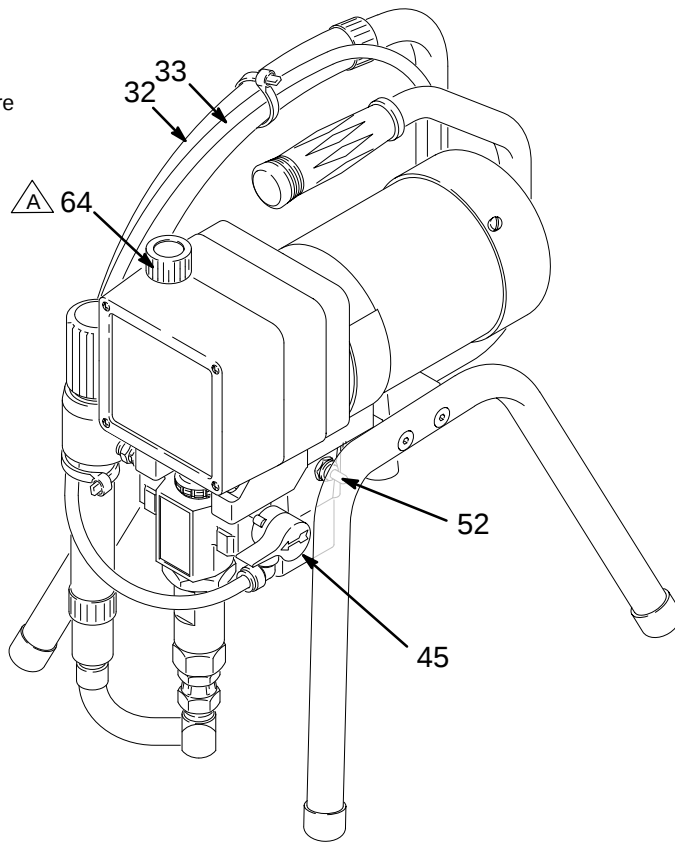


Fig. 9

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Shutdown and Care

Refer to the **IMPORTANT** note on page 7.

WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

1. Check the packing nut/wet-cup (102) daily. Relieve pressure first. Keep the wet-cup 1/3 full of TSL at all times to help prevent fluid buildup on the piston rod and premature wear of packings.
2. Tighten the packing nut/wet-cup (102) just enough to stop leakage. Over-tightening causes binding and excessive packing wear. Use a round punch or brass rod and a light hammer to adjust the nut. See Fig. 10.
3. Clean the gun's fluid filter (if present) often and whenever the gun is stored. Relieve pressure first.
4. Periodically clean paint residue from the pressure transducer vent hole (A) area. See Fig. 11. Replace the transducer when leakage is excessive. See page 33.
5. Lubricate the bearing housing after every 100 hours of operation. Remove the front cover. Fill the bearing housing cavity (B) with several drops of SAE 10 non-detergent oil. See Fig. 11.
6. Flush the sprayer at the end of each work day and fill it with mineral spirits to help prevent pump corrosion and freezing. See page 14.

CAUTION

To prevent pump corrosion, and to reduce the chance of fluid freezing in the pump in cold weather, never leave water or any type of paint in the sprayer when it is not in use. Freezing can seriously damage the sprayer or result in loss of pressure or stalling.

7. For very short shutoff periods, leave the suction hose in the paint, **relieve the pressure**, and clean the spray tip.

8. Coil the hose when storing it, even for overnight, to help protect the hose from kinking, abrasion, coupling damage, etc.

WARNING

See the **WARNINGS** on page 3 for information on the hazard of using damaged hoses.

-  With pressure relieved, turn packing nut clockwise to tighten

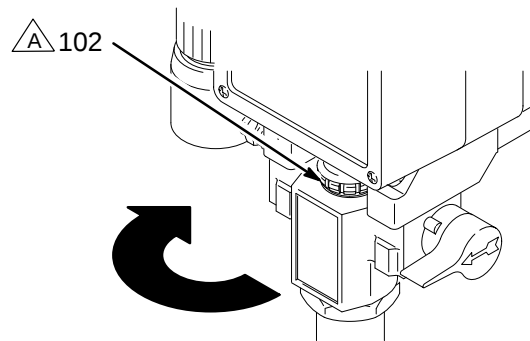


Fig. 10

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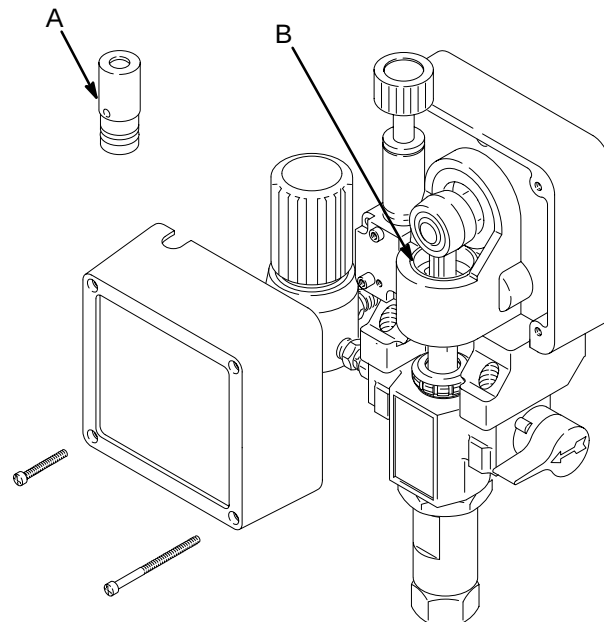


Fig. 11

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[illegible]

Flushing

Refer to the **IMPORTANT** note on page 7.

When to flush

1. Before using a new sprayer, flush out the oil which was left in to protect pump parts.

Before using water-base paint, flush with mineral spirits followed by soapy water, and then a clean water flush.

Before using oil-base paint, flush with mineral spirits only.

2. When changing colors, flush with a compatible solvent such as mineral spirits or water.
3. When changing from water-base to oil-base paint, flush with warm, soapy water, and then mineral spirits.
4. When changing from oil-base to water-base paint, flush with mineral spirits, then warm, soapy water, and then a clean water flush.
5. Storage after using water-base paint: flush with water and then mineral spirits. Leave the system filled with mineral spirits. Relieve pressure. Leave the drain valve open.

Storage after using oil-base paint: flush with mineral spirits. Relieve pressure. Leave the drain valve open.

CAUTION

Never leave water or water-based fluids in the sprayer if there is a chance it could freeze. Push the water out with mineral spirits. Frozen fluid in the sprayer prevents it from being started and may cause serious damage.

6. Startup after storage. Before using water-base paint, flush out the mineral spirits with soapy water and then a clean water flush. When using oil-base paint, flush out the mineral spirits with the paint to be sprayed.

How to flush

WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

1. Relieve the pressure.
2. Remove the spray tip and clean it separately. Unscrew the bowl (A) and remove the filter screen. Then reinstall the bowl, hand tight, without the screen. Clean the screen.

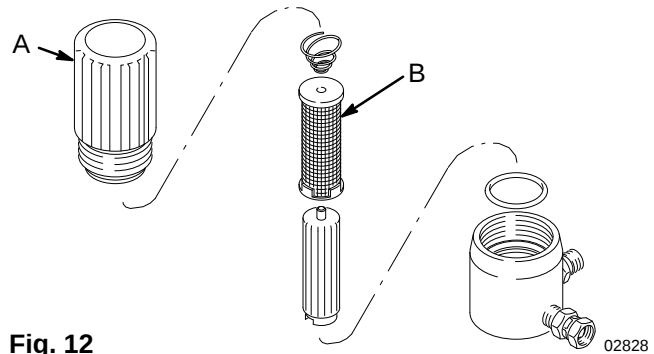


Fig. 12

3. Pour 2 liters of compatible solvent into a grounded metal flushing pail. Put the pump in the pail.
4. Open the pressure drain valve.

WARNING

To reduce static sparking and splashing, always remove the spray tip from the gun, and hold a metal part of the gun firmly to the side of a grounded metal pail when priming or flushing.

5. If you have been spraying and want to save the paint still in the pump and hose, follow Step 5, except put the drain hose in the paint container. As soon as solvent appears, close the drain valve. Move the drain hose to the flushing pail. Trigger the gun into the paint pail. As soon as solvent appears, release the trigger. Continue with Step 6.

Flushing

7. Lower the pressure setting. Turn on the sprayer. Maintaining metal-to-metal contact, trigger the gun into the flushing pail. Slowly increase the pressure just until the pump operates. Keep the gun triggered until the solvent flows freely from the gun. Circulate the solvent to thoroughly clean the sprayer. Release the gun trigger. Engage the gun safety latch.
8. Open the drain valve and circulate the solvent through the drain hose to thoroughly clean it. Close the drain valve.
9. Remove the pump from the pail. Disengage the gun safety latch. Trigger the gun to force solvent from the hose and run the sprayer a few seconds more to push air into the hose. Relieve pressure.
10. Remove the filter bowl and reinstall the clean filter screen. Hand tighten the bowl.
11. Remove the inlet strainer and clean it thoroughly. Wipe paint off the suction hose and drain hose.
12. If you flushed with mineral spirits and are going to use a water-base paint, flush with soapy water followed by a clean water flush. Relieve pressure.
13. Leave the drain valve open.



CAUTION

To reduce the risk of damage to the displacement pump packings, never run the pump without fluid in it for more than 30 seconds.

Troubleshooting

Refer to the **IMPORTANT** note on page 7.

Check everything in the guide before disassembling the sprayer.



WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

Basic Problem Solving

TYPE OF PROBLEM	WHAT TO CHECK <i>If check is OK, go to next check</i>	WHAT TO DO <i>When check is not OK, refer to this column</i>
Fluid Pressure	1. Check pressure control knob setting. The pump won't develop much pressure if it is at minimum setting (fully counterclockwise).	1. Slowly increase pressure setting to see if motor starts.
	2. Check for a clogged spray tip (see page 9) or a clogged fluid filter (see page 14).	2. If tip is still clogged, relieve pressure; refer to separate gun or tip instruction manual for tip cleaning. Clean or replace the filter element.
Mechanical	1. Check for frozen or hardened paint in pump (20). Using a screwdriver, carefully try to rotate fan at back of motor by hand. See page 21.	1. Thaw. Plug in sprayer and turn on. Slowly increase pressure setting to see if motor starts. If it doesn't, see NOTE 1, below.

NOTE 1: Thaw sprayer if water or water-based paint has frozen in it, due to exposure to low temperatures, by placing it in a warm area. Do not try to start sprayer until it has thawed completely or damage to motor and/or start board may occur. If paint hardened (dried) in sprayer, the pump packings and/or pressure transducer must be replaced. See page 25 (pump) or 33 (pressure transducer).

Troubleshooting

Basic Problem Solving (continued)

TYPE OF PROBLEM	WHAT TO CHECK <i>If check is OK, go to next check</i>	WHAT TO DO <i>When check is not OK, refer to this column</i>
Mechanical (continued)	2. Check pump connecting rod pin (17). It must be completely pushed into connecting rod (15), and retaining spring (18) must be firmly in connecting rod groove. See page 25.	2. Push pin into place and secure with spring retainer.
	3. Check for motor damage. Remove drive housing assembly (11). See page 30. Try to rotate motor fan by hand.	3. Replace motor (4) if fan won't turn. See page 28.
Electrical	1. Check electrical supply with volt meter. Meter should read 90–110 VAC.	1. Reset building circuit breaker; replace building fuse. Try another outlet.
	2. Check extension cord for visible damage. Use a volt meter or test lamp at extension cord outlet to check.	2. Replace extension cord.
	3. Check sprayer power supply cord (57) for visible damage such as broken insulation or wires.	3. Replace power supply cord.
	4. Check motor brushes for the following: a. Loose terminal screws. b. Broken or misaligned brush springs. c. Brushes binding in holders. d. Broken leads. e. Worn brushes. NOTE: The brushes do not wear at same rate on both sides of motor. Check both brushes.	4. Refer to page 22. a. Tighten. b. Replace broken spring and/or align spring with brush c. Clean brush holders. Remove carbon with small cleaning brush. d. Replace brushes e. Replace brushes if less than 10 mm long.
	5. Check motor armature commutator for burn spots, gouges and extreme roughness. Remove motor cover and brush inspection plates to check. See page 22.	5. Remove motor and have motor shop resurface commutator if possible. See page 28.
	6. Check motor armature for shorts using armature tester (growler) or perform motor test. See page 21.	6. Replace motor. See page 28.
	7. Check leads from pressure control and motor to motor start board (47) to be sure they are securely fastened and properly mated.	7. Replace loose terminals; crimp to leads. Be sure male terminal blades are straight and firmly connected to mating part.
	8. Check motor start board (47) by substituting with a good board. See page 29. CAUTION: Do not perform this check until motor armature is determined to be good. A bad motor armature can burn out a good board.	8. Replace board. See page 29.
	9. Check power supply cord (57). Disconnect cord from inlet filter (51). Connect voltmeter to cord's receptacle and plug into wall outlet. Meter should read 90–110 VAC. Unplug sprayer.	9. Replace power supply cord.
	10. Check inlet filter (51). Disconnect black and white power inlet filter terminals; connect volt meter to these leads. Plug in sprayer. Meter should read 90–110 VAC. Unplug sprayer.	10. Replace inlet filter.

Troubleshooting

Basic Problem Solving (continued)

TYPE OF PROBLEM	WHAT TO CHECK <i>If check is OK, go to next check</i>	WHAT TO DO <i>When check is not OK, refer to this column</i>
<i>Electrical, continued</i>	11. Check ON/OFF switch (52). Disconnect the wire labeled "L", between motor start board (47) and switch. Connect volt meter between exposed terminal on switch and white wire on inlet filter (51). Plug in sprayer and turn ON . Meter should read 90–110 VAC. Turn off and unplug sprayer.	11. Replace ON/OFF switch. See page 25.
	12. Check motor thermal cutout switch. Connect ohmmeter between motor's red leads. Meter should read 1 ohm maximum.	12. Allow motor to cool. Correct cause of overheating. If switch remains open after motor cools, replace motor.
	13. Remove pressure control (64) and check microswitch operation with ohmmeter: a. With pressure knob at lowest setting and stem pushed into control, readings should be: white & black = 1 ohm max. white & red = open. b. With pressure knob at highest setting, readings should be: white & black = open; white & red = 1 ohm max.	13. Replace pressure control. See page 32.
	14. Check pressure transducer (29) for hardened paint or damaged or worn components. See page 33.	14. Replace transducer. See page 33. Thorough system flushing will help extend life of transducer.

Intermediate Problem Solving

TYPE OF PROBLEM	WHAT TO CHECK <i>If check is OK, go to next check</i>	WHAT TO DO <i>When check is not OK refer to this column</i>
Low Output	1. Check for worn spray tip.	1. Relieve the pressure , then replace tip. See your separate gun or tip manual.
	2. Be sure pump does not continue to stroke when gun trigger is released. Plug in and turn on sprayer. Prime with paint. Trigger gun momentarily, then release and engage safety latch. Relieve pressure, turn off and unplug sprayer.	2. Service pump. See page 24.
	3. Release gun trigger. Observe resting position of pump rod (107).	3. If pump consistently comes to rest with rod (107) fully extended, the piston packings and/or piston valve may be worn. Service the pump. See page 25.
	4. Check electrical supply with volt meter. Meter should read 90–110 VAC.	4. Reset building circuit breaker; replace building fuse. Repair electrical outlet or try another outlet.
	5. Check extension cord size and length; must be at least 2.0 mm ² gauge wire and less than 45 m.	5. Replace with a correct, grounded extension cord.

Troubleshooting

Intermediate Problem Solving

TYPE OF PROBLEM	WHAT TO CHECK <i>If check is OK, go to next check</i>	WHAT TO DO <i>When check is not OK, refer to this column</i>
	6. Check motor brushes. See What To Check, item 4, on page 16.	6. See page 22.
	7. Check motor start board (47) by substituting with a good board. CAUTION: Do not perform this check until motor armature is determined to be good. A bad motor armature can burn out a good board.	7. Replace board. See page 29.
	8. Check motor armature for shorts by using an armature tester (growler) or perform motor test. See page 21.	8. Replace motor. See page 28.
Drain Valve Leaks	1. Check for correct torque and/or worn parts. Check for debris trapped on seat.	1. Tighten to 21 N.m. Clean valve and replace with new gasket (42a) and sealant (42e). See page 34.
Transducer Leaks	1. Slight leakage is normal.	1. Periodically remove residue from its cylinder port. See page 33.
No Output: Motor Runs And Pump Strokes	1. Check paint supply.	1. Refill and reprime pump.
	2. Check for clogged intake strainer.	2. Remove and clean, then reinstall.
	3. Check for loose siphon tube or fittings. See page 24.	3. Tighten; use thread sealant on npt threads of inlet tube (38). Check for damaged o-ring (27).
	4. Check to see if intake valve ball and piston ball are seating properly. See page 24.	4. Remove intake valve and clean. Check ball and seat for nicks; replace as needed. See page 24. Strain paint before using to remove particles that could clog pump.
	5. Check for leaking around throat packing nut which may indicate worn or damaged packings. See page 24.	5. Replace packings. See page 25. Also check piston valve seat for hardened paint or nicks and replace if necessary. Tighten packing nut/wet-cup.
	6. Release gun trigger. Observe resting position of pump rod (107).	6. If pump consistently comes to rest with rod (107) fully extended, the piston packings and/or piston valve may be worn. Service the pump. See page 25.
No Output: Motor Runs But Pump Does Not Stroke	1. Check displacement pump connecting rod pin (17). See page 24.	1. Replace pin if missing. Be sure retainer spring (18) is fully in groove all around connecting rod.
	2. Check connecting rod assembly (15) for damage. See page 30.	2. Replace connecting rod assembly. See page 30.
	3. Be sure crank in drive housing rotates; plug in sprayer and turn on briefly to check. Turn off and unplug sprayer. See page 30.	3. Check drive housing assembly for damage and replace if necessary. See page 30.

Troubleshooting

Intermediate Problem Solving

TYPE OF PROBLEM	WHAT TO CHECK <i>If check is OK, go to next check</i>	WHAT TO DO <i>When check is not OK, refer to this column</i>
Spray Pattern Variations	1. Spray tip worn beyond sprayer pressure capability.	1. Replace spray tip. NOTE: A smaller size tip will provide longer life.
	2. Check transducer (29) for wear or damage.	2. Replace transducer. See page 33.
	3. Check pressure control (64) for smooth operation.	3. Replace pressure control. See page 32.
	4. Check LOW OUTPUT section, page 17.	
Motor Is Hot and Runs Intermittently	1. Determine if sprayer was operated at high pressure with small tips, which causes excessive heat build up.	1. Decrease pressure setting or increase tip size.
	2. Be sure ambient temperature where sprayer is located is no more than 32°C and sprayer is not located in direct sun.	2. Move sprayer to shaded, cooler area if possible.
	3. Check motor. (See NOTE 1, page 15.)	3. Replace motor. See page 28.
Building Circuit Breaker Opens As Soon As Sprayer Switch Is Turned On.	1. Check all electrical wiring for damaged insulation, and all terminals for loose fit or damage. Also check wires between pressure control and motor. See page 37.	1. Repair or replace any damaged wiring or terminals. Securely reconnect all wires.
	2. Check for missing motor brush inspection plate gasket (see page 23), bent terminal forks or other metal to metal contact points which could cause a short.	2. Correct faulty conditions.
	3. Check motor armature for shorts. Use an armature tester (growler) or perform motor test. See page 21. Inspect windings for burns.	3. Replace motor. See page 28.
	4. Check motor start board (47) by substituting with a good board. CAUTION: Do not perform this check until motor armature is determined to be good. A bad motor armature can burn out a good board.	4. Replace board. See page 29.
Circuit breaker opens after sprayer operates for 5 to 10 minutes.	1. Check 'Basic Problems – Electrical' on page 15.	
Building circuit breaker opens as soon as sprayer is plugged into outlet and sprayer is NOT turned on.	1. Check wiring for correct connections.	1. Correct improper connections.
	2. Check ON/OFF switch (52). <i>Be sure sprayer is unplugged!</i> Disconnect wires from switch. Check switch with ohmmeter. The reading should be infinity with ON/OFF switch OFF, and zero with switch ON. CAUTION: A short in motor circuit can damage switch and/or motor start board (47).	2. Replace ON/OFF switch. See page 25.
	3. Check power supply cord (57). Disconnect black and white power inlet filter terminals; connect volt meter to these leads. Plug in sprayer. Meter should read 90–110 VAC. Unplug sprayer.	3. Replace power supply cord.

General Repair Information

Refer to the **IMPORTANT** note on page 7.

WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

Required Tool List

Tool	Used for:
3/8" Allen® wrench	pump manifold
3/16" Allen® wrench	gear housing, legs, handle
#1 Phillips® screwdriver	junction box, pressure control, front cover
3/8" socket wrench	motor mount
5/8" socket wrench	drain valve, outlet fittings, on/off switch, boot, piston
13/16" socket wrench	drain valve
1-1/4" socket wrench	pump inlet valve
1/2" open end wrench	pump rod
11/16" open end wrench	piston jam nut
15/16" open end wrench	flats of inlet tube
1-3/4" open end wrench	pump jam nut
5/64" drive pin	drain valve pin
3" needle nose pliers	wiring, on/off switch
Hammer & punch	packing nut
Torque wrenches	various fasteners

1. When disconnecting wires in the junction box assembly, use needle nose pliers to separate mating connectors.
2. When reconnecting the wires, be sure the flat blade of the insulated male connector is centered in the wrap-around blade of the female connector.

CAUTION

To reduce the risk of a pressure control malfunction, be sure to properly mate connectors, and never pull on a wire to disconnect it. Pulling on a wire could loosen a the connector from the wire.

3. Route wires carefully through the drive housing and motor. Avoid pinching the wires between the junction box and the motor.

CAUTION

Improper wire routing can result in poor sprayer performance or damage to the pressure control.

4. Keep all screws, nuts, washers, gaskets, and electrical fittings removed during repair procedures. These parts are not normally provided with replacement assemblies.
5. Test your repair before regular operation to be sure the problem is corrected.
6. If the sprayer does not operate properly, verify that everything was done correctly. Also refer to the Troubleshooting Guide, starting on page 15, to help identify other possible problems and solutions.

WARNING

To reduce the risk of serious injury including electric shock, do not touch any moving parts or electrical parts with your fingers or a tool while inspecting the repair.

Shut off the sprayer and unplug it as soon as you complete the inspection.

Reinstall all covers, gaskets, screws, and washers before operating the sprayer.

WARNING

During operation, the motor and drive housing become very hot and could burn your skin if touched. Flammable materials spilled on the hot, bare motor could cause a fire or explosion.

Motor Test



WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

For checking armature, motor winding and brush electrical continuity.

Setup

1. Remove the drive housing. See page 30. This is to ensure that any resistance you notice in the armature test is due to the motor and not to worn gears in the drive housing.
2. Remove the motor brush inspection covers (A). See Fig. 13.
3. Remove the junction box screws (56). Lower the junction box. Disconnect the two leads (C) from the motor to the board (47). See Fig. 14.

Armature Short Circuit Test

1. Remove the fan cover (B). See Fig. 13.
2. Spin the motor fan by hand. If there are no shorts, the motor will coast two or three revolutions before coming to a complete stop. If the motor does not spin freely, the armature is shorted and the motor must be replaced. See page 28.

Armature, Brushes, and Motor Wiring Open Circuit Test (Continuity)

1. Connect the two black motor leads together with a test lead. Turn the motor fan by hand at about two revolutions per second.
2. When turning the fan on a DC motor, normally you sense an even, pulsing resistance. If there is irregular turning resistance, or no turning resistance, check and repair the following as needed: broken brush springs, brush leads, motor leads; loose brush terminal screws, motor lead terminals; worn brushes. See page 22.
3. If there is still uneven or no turning resistance, replace the motor. See page 28.

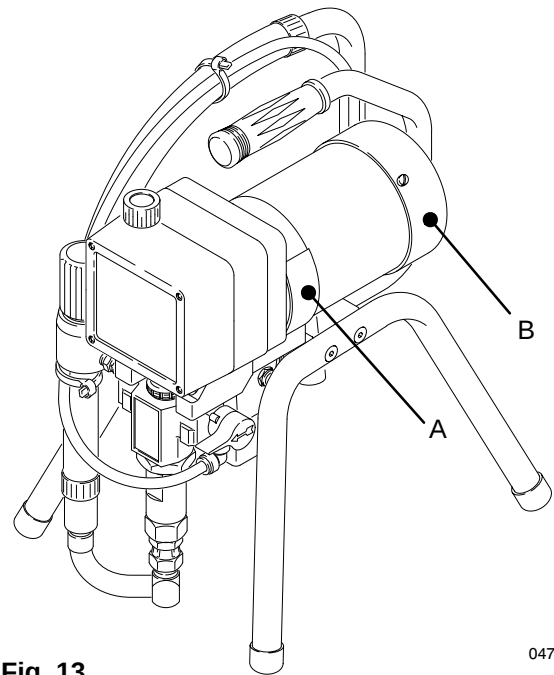


Fig. 13

04784

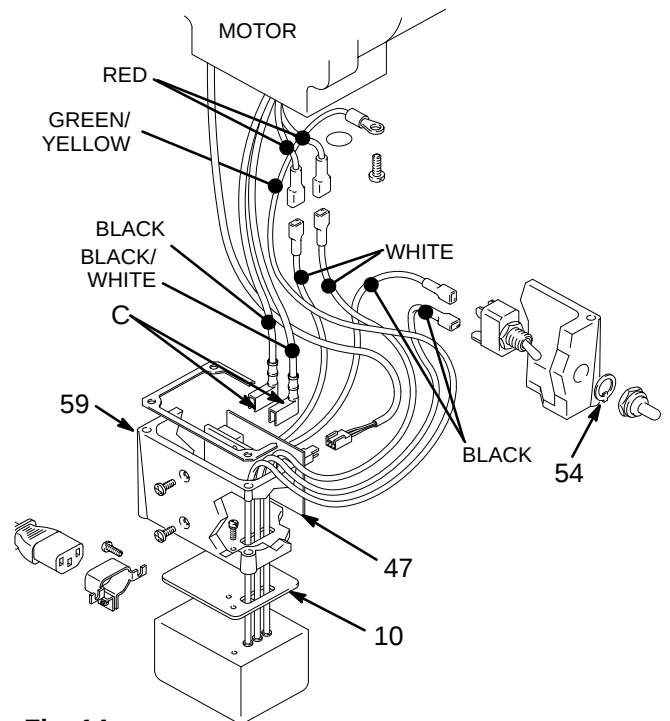


Fig. 14

03177

Motor Brush Replacement

NOTE: Replace the brushes when they have worn to less than 10 mm. Refer to Fig. 16. Note that the brushes wear differently on each side of the motor, so check them both. Brush Repair Kit 235–727 is available.

NOTE: Replacement brushes may last only half as long as the original ones. To maximize brush life, break in the new brushes by operating the sprayer with no load (remove the pump connecting rod pin) for at least 1 hour.

⚠ WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

1. Remove both inspection covers (A) and their gaskets. See Fig. 15.

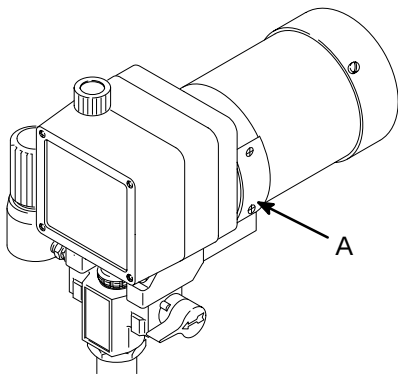


Fig. 15 02831A

2. Push in the spring clip (G) and release its hooks from the brush holder (B). Pull out the spring clip. See Fig. 16.
3. Loosen the brush lead terminal screw (E). Pull the brush lead away, but leave the motor lead terminal (C) in place. Remove and discard the brush (F). See Fig. 16.
4. Inspect the commutator for excessive pitting, burning or gouging. A black color on the commutator is normal. Have the commutator resurfaced by a qualified motor repair shop if the brushes seem to wear too fast or arc excessively. See Step 10.d. also.
5. Repeat for the other side.
6. Place a new brush (F) in the holder (B) so the lead is closer to the fan-end of the motor. Slide the terminal under the terminal screw (E) washer. Be sure the motor lead is still connected at the screw. Tighten the screw (E). See Fig. 16.
7. Holding the spring/clip (G) at a slight angle, slide the spring/clip into the brush holder (B) and hook it over the end of the brush holder. See Fig. 17. Pull on the spring/clip to be sure it stays in place. Be sure the brush lead (D) is tucked under the spring/clip tab.
8. Repeat for the other side.
9. Continue on the next page.

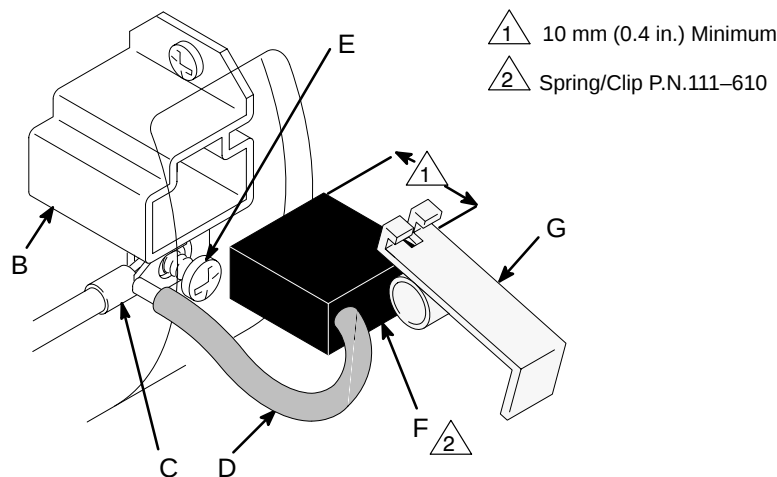


Fig. 16 01065

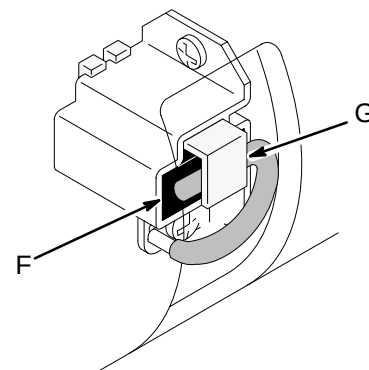


Fig. 17 01066

Motor Brush Replacement

10. Test the brushes.

- a. Remove the pump connecting rod pin.
- b. With the sprayer OFF, turn the pressure control knob fully counterclockwise to minimum pressure. Plug in the sprayer.
- c. Turn the sprayer ON. Slowly increase the pressure until the motor is at full speed.
- d. Inspect the brush and commutator contact area for excessive arcing. Arcs should not “trail” or circle around the commutator surface.

WARNING

Do not touch the brushes, leads, springs, or brush holders while the sprayer is plugged in to reduce the risk of electric shock and serious injury.

11. Install the brush inspection covers and gaskets.

12. Break in the brushes. Operate the sprayer for at least one hour with no load. Then install the pump connecting rod pin.

Displacement Pump

⚠ WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

NOTE: Packing Repair Kit 235–703 is available. Reference numbers of parts included in the kit are marked with an asterisk, i.e., (121*). Use all the new parts in the kit.

NOTE: Check the motor brushes (see page 22) and clean the transducer (see page 33) whenever you re-pack the pump. Replace these parts as needed.

Removing the Pump (See Fig. 18)

1. Flush the pump, if possible. **Relieve the pressure.** Stop the pump with the piston rod (107) in its lowest position, if possible. To lower the piston rod manually, rotate the motor fan blades.
2. Remove the filter (85). While pulling upward on the suction hose (32), unscrew the hose from the inlet tube (38).
3. Unscrew the drain hose (33) from adapter (36).

NOTE: If repairing only the intake valve assembly, go to **Intake valve repair**, below.

4. Use a screwdriver to push the retaining spring (18) up and push out the pin (17).
5. Loosen the screws (21) and remove the pump (20).

Intake Valve Repair (See Fig. 18)

1. Unscrew the intake valve (118) with swivel (82) attached. Remove the o-ring (119*), ball guide (120), stop pin (122*) and ball (121*) from the valve.

2. Clean and inspect the parts for wear or damage. Replace parts as needed. Use a new o-ring (119*). Reassemble the pump, or for additional pump repair, go to page 25.

Installing the Pump (See Fig. 18 and 19)

1. Mount the pump on the drive housing. Tap it into the alignment pins with a soft hammer. Tighten the screws (21) to 68 N.m.



Torque to 68 N.m



Apply sealant (42e)

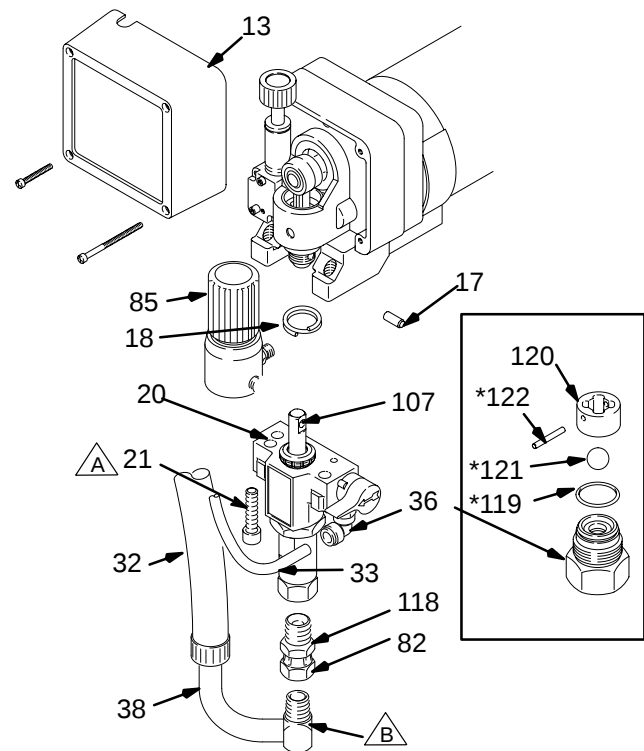


Fig. 18

02832A

Displacement Pump

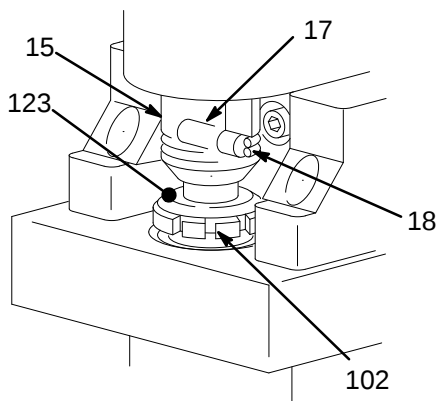


Fig. 19

01068

- Align the hole in the rod (107) with the connecting rod assembly (15). Use a screwdriver to push the retaining spring up and push in the pin (17). Push the retaining spring (18) into place around the connecting rod.

! WARNING

Be sure the retaining spring (18) is firmly in the groove all the way around, to prevent the pin (17) from working loose due to vibration. See Fig. 19.

If the pin works loose, it or other parts could break off due to the force of the pump action. These parts could be projected into the air and result in serious injury or property damage, including the pump connecting rod or bearing housing.

- Reconnect the drain hose (33).
- Tighten the packing nut (102) enough to stop leakage, but no tighter. Fill the wet-cup 1/3 full with TSL. Push the plug (123) into the wet-cup.

Disassembling the pump

(See Fig. 20 except where noted)

- Remove the intake valve (118). See page 24.
- Unscrew the packing nut (102) and plug (123).

- Use a plastic mallet to tap the piston rod (107) down, and then pull the rod out through the bottom of the cylinder.
- Remove the throat packings (104*,105*) and glands (103*,106*).
- Loosen the jam nut (117). Remove the cylinder (115) and the o-ring (116*).
- Clamp the flats of the piston rod in a smooth jaw vise. Use an open-end wrench to loosen the retaining nut (110) and then unscrew the piston valve (108) from the rod (107).
- Remove all parts from the piston valve (108).

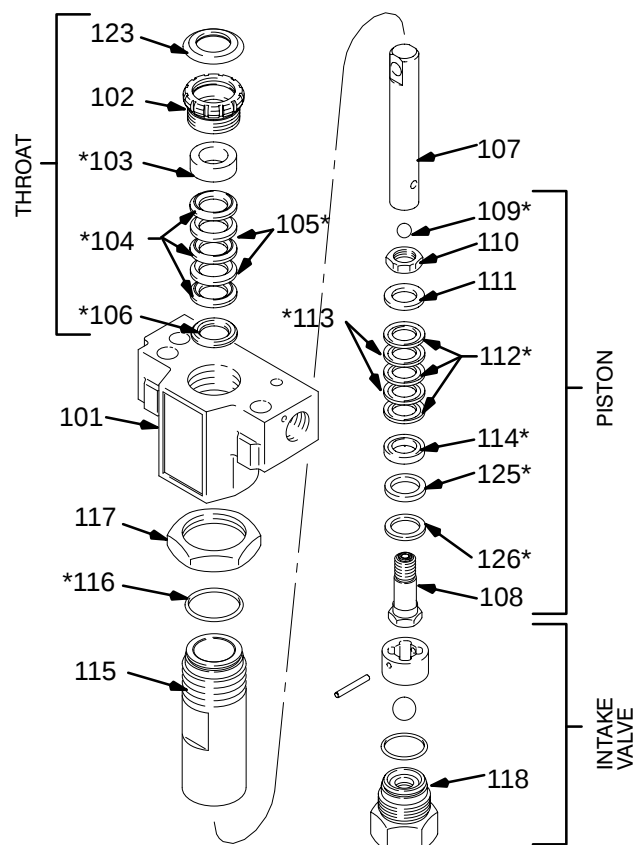


Fig. 20

03148A

Displacement Pump

Reassembling the pump

NOTE: Alternate plastic and leather packings. See Fig. 20. The lips of the throat V-packings face down, against pressure. The lips of the piston V-packings face up, against pressure. The lips of the u-cup face down. Incorrect installation damages the packings and causes pump leaking.

NOTE: Soak the leather packings in oil before reassembling the pump.

1. Check the outside of the piston rod (107) and the inside of the cylinder (115) for wear. Replace worn parts to ensure a good seal with the new packings.
2. Stack these parts onto the piston valve (108) one at a time: the backup washer (126*) and u-cup (125*), female gland (114*), alternately three plastic (112*) with two leather packings (113*), and the male gland (111*). See Fig. 21.
3. Tighten the nut (110) onto the piston valve (108) to 0.23 N.m. See Fig. 21.

NOTE: Note the alignment of the piston (108) to the nut (110). Maintain this alignment through Step 8.

4. Clean all residue from the piston valve threads. Apply one drop of adhesive, supplied, to the threads.
5. Place the ball (109*) on the piston valve (108). See Fig. 21.

CAUTION

Step 6, tightening the piston valve into the rod, is critical. Follow the procedure carefully to avoid damaging the packings by overtightening.

6. Hand tighten the valve into the piston rod just until the nut (110) contacts the rod. See Fig. 22.
7. Place the flats at the top of the rod in a vise.

8. **CAREFULLY** tighten the nut (110) against the piston rod to 25 N.m. See Fig. 22.

Use two wrenches to maintain the alignment mentioned in the NOTE, above.

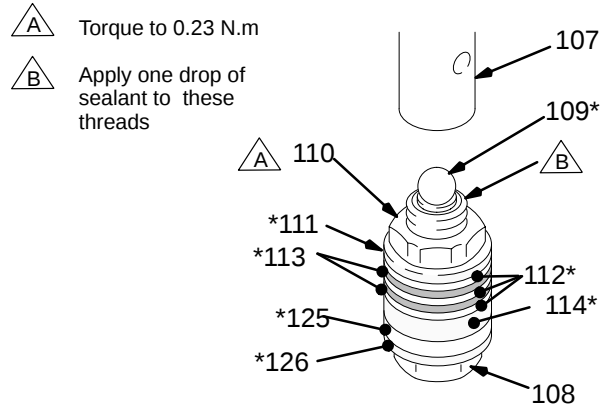


Fig. 21 03178

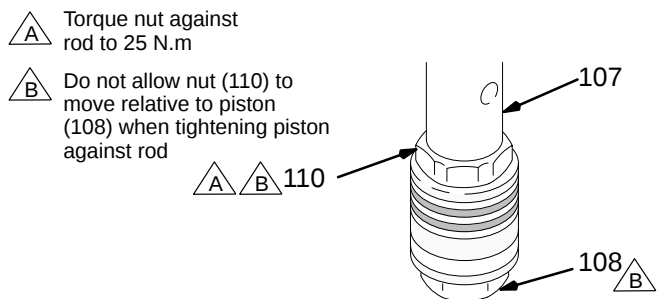


Fig. 22 03179

9. Stack these parts one at a time into the top of the manifold (101): the male gland (106*), alternately three plastic packings (104*) with two leather packings (105*), and then the female gland (103*). See Fig. 23.
10. Install the packing nut (102) and plug (124), but leave loose for now. See Fig. 23.
11. Place a new o-ring (116*) firmly in the cylinder groove. See Fig. 24.

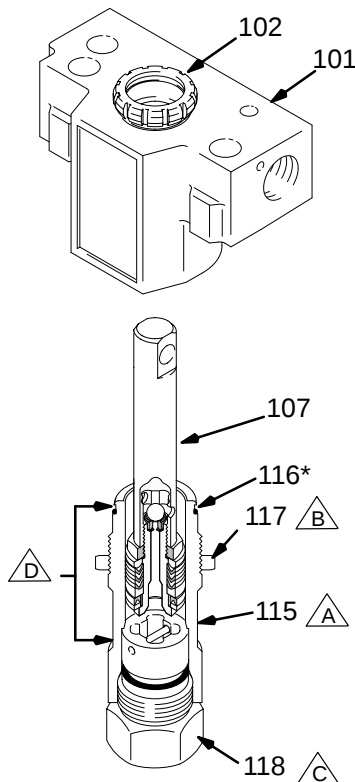
Displacement Pump

12. Coat the piston rod and packings with oil. Carefully slide the assembly **INTO THE TOP OF THE CYLINDER (115)**. See Fig. 23.
13. Put the manifold in a vise. Fully thread the jam nut (117) onto the cylinder (115). Guide the rod/cylinder assembly down through the manifold (101). Screw the cylinder (115) into the manifold.
14. Place the ball guide (120), stop pin (122) and ball (121*) in the cylinder (115). Screw the intake valve into the cylinder and torque to 71 N.m. This will also properly torque the cylinder into the manifold. See Fig. 24.

15. Tighten the cylinder jam nut (117) to 98 N.m. See Fig. 23.

16. Install the pump. See page 24.

-  A Torque cylinder (115) into manifold (101) to 71 N.m
-  B Torque jam nut (117) 98 N.m
-  C Torque intake valve (118) into cylinder (115) to 71 N.m
-  D Piston assembly



-  E Leather throat packings: lips must face down
-  F Leather piston packings: lips must face up
-  G Torque to 71 N.m
-  H Plastic throat packings: lips must face down
-  J Plastic piston packings: lips must face up

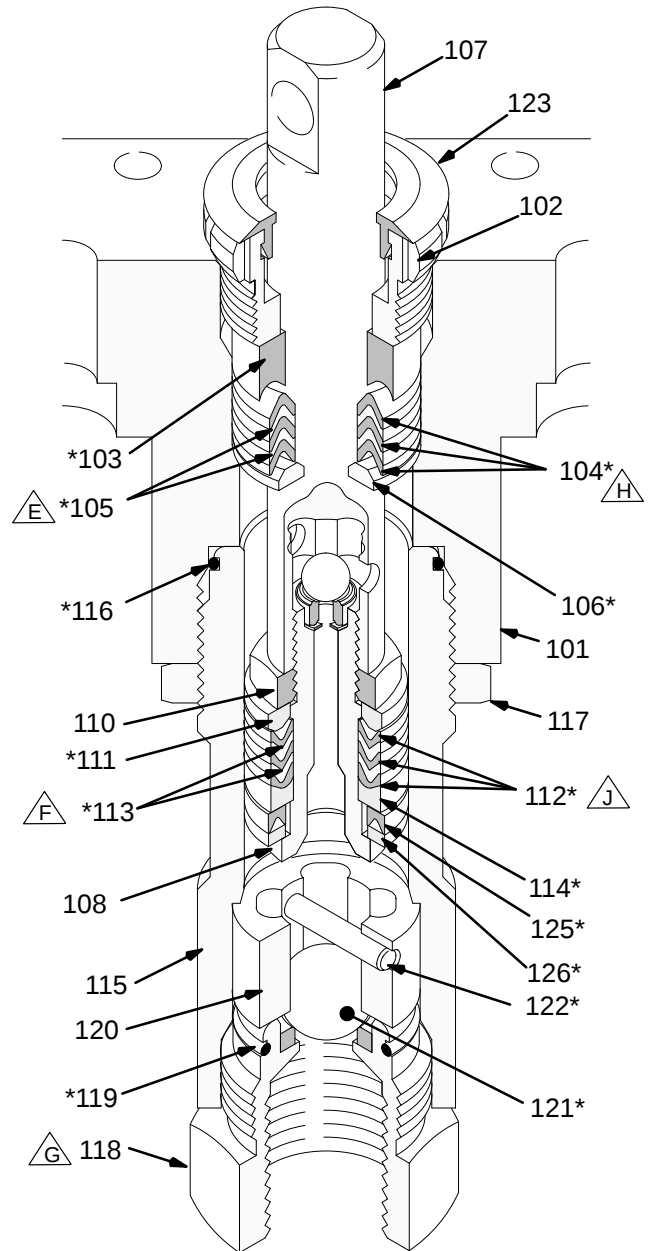


Fig. 23 01072A

Fig. 24 03147

Motor

WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

1. **Relieve the pressure.**
2. Try to stop the pump with the piston rod (107) in its lowest position. To lower the piston rod manually, rotate the motor fan blades. Use a screwdriver to push the retaining spring (18) up and push out the pin (17). See Fig. 25.
3. Remove the screws (56) and lower the junction box (59). Disconnect the motor wires and the pressure control wire (A) from the motor start board. Refer to Fig. 26 on page 29.
4. Remove the drive housing cover (13).
5. Remove the pressure control (69) while guiding the harness (A) through the motor.
6. Remove the motor fan blades (10) and the motor fan (11) from the drive housing (13). See Fig. 27.
7. Remove the motor fan blades (10) and the motor fan (11) from the drive housing (13). See Fig. 28.
8. Tap the lower rear of the drive housing (11) with a plastic mallet to loosen the motor. Pull the drive housing straight off the motor. Do not allow the gear (16) to fall. Read the CAUTION on page 30.
9. Remove the two screws (46) and lift the motor off the base (66).
10. Align the new motor with the base and reinstall the screws.
11. Assemble the drive housing to the motor. Follow Steps 8 to 10 on page 30.
12. Connect the wires in the junction box. Refer to Fig. 26 on page 29. Install the junction box.
13. Reconnect the piston rod (107) to the drive housing; see page 25, Installing the Pump, Step 2 and the Warning that follows the step.

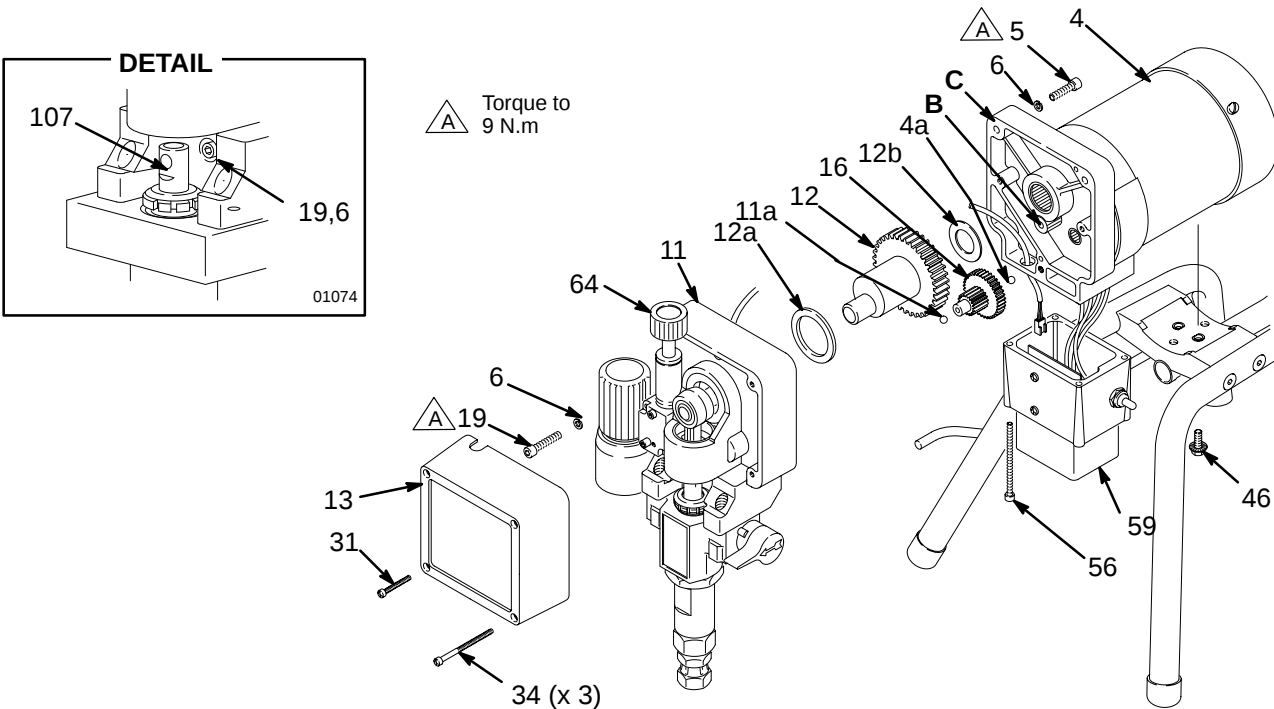


Fig. 25

Motor Start Board

⚠ WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

1. Remove the junction box screws (56) and lower the junction box (59). See Fig. 25.
2. Disconnect the motor wires (B) and the 3-wire connector (A) from the motor start board (47). Disconnect the wire from the ON/OFF switch. Observe where connections are made. See Fig. 26.
3. Remove the screws (58) and motor start board (47). Transfer the white thermal paste from the old board to the new board. See Fig. 26.

4. Install the new motor start board. Reconnect all wires. Mount the junction box. See Fig. 26.

NOTE: Route wires through the gasket (50) before making connections.

⚠ CAUTION

Be sure the flat blade of the insulated male connector is centered in the wrap-around blade of the female connector when the connections are made.

Route all wires carefully to avoid interference with the motor start board or junction box.

These precautions are essential to avoid interference with the motor start board or junction box.

On/Off Switch

⚠ WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

1. Remove the junction box screws (56) and lower the junction box (59). See Fig. 25.
2. Remove the nut and rubber boot (55).
3. Disconnect the wires from the ON/OFF switch (52) and replace the switch. See Fig. 26.
4. Powder the inside of the rubber boot (55) with talcum, then shake the excess out of the boot. Install the nut and rubber boot and tighten.

NOTE: Route wires through any gaskets before making connections.

5. Reconnect the ON/OFF switch wires.

6. Install the junction box. Be sure no leads are pinched against the motor or by the motor start board.

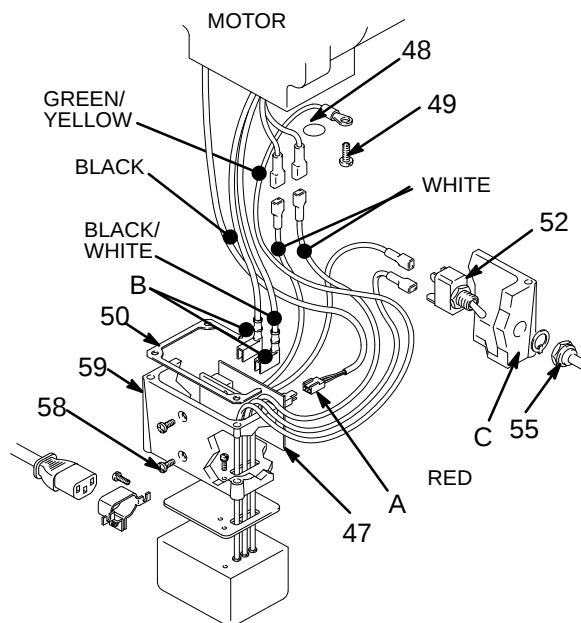


Fig. 26

03177

Drive Housing, Connecting Rod, Crankshaft

WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

NOTE: Inspect parts as they are removed. Replace parts that are worn or damaged.

1. Remove the displacement pump. See page 24.
2. Remove the pressure control (64). See page 32.
3. Turn the displacement pump rod (107) so the pin hole aligns with the bottom drive housing screw (19). See the DETAIL in Fig 27. Remove the three drive housing screws and lockwashers (19,6).
4. Remove the two motor screws and lockwashers (5,6).

CAUTION

Do not allow the gear (16) to fall; it may stay attached to the drive housing or to the motor.

Do not lose the thrust balls (11a or 4a) or allow them to fall between the gears, which will seriously damage the drive housing if not removed. The balls, which are heavily covered with grease, usually stay in the gear recesses, but could be dislodged. If the balls are not in place, the bearings will wear prematurely.

5. Tap the lower rear of the drive housing (11) with a plastic mallet to loosen the motor. Pull the drive housing straight off the motor.
6. Remove and inspect the crankshaft (12) and the connecting rod (15).
7. Install the connecting rod.

NOTE: The gears and bearings between the drive housing (11) and motor front end bell (C) should contain a total of 90 ml of grease.

8. Lubricate the inside of the drive housing bearing with SAE non-detergent oil. Pack the roller bearing and gears with the grease supplied.
9. Place the large washer (12a) and then the small washer (12b) on the crankshaft (12).
10. Lift the crank to the top of the stroke and insert the crankshaft (12). Align the drive housing and motor with the locating pins. Push the drive housing onto the motor. Install the screws (5,19) and lockwashers (6) and tighten evenly to 9 N.m.
11. Install the pressure control (64). See page 32.
12. Install the displacement pump. See page 24.
13. Install the front cover (13).

Drive Housing, Connecting Rod, Crankshaft

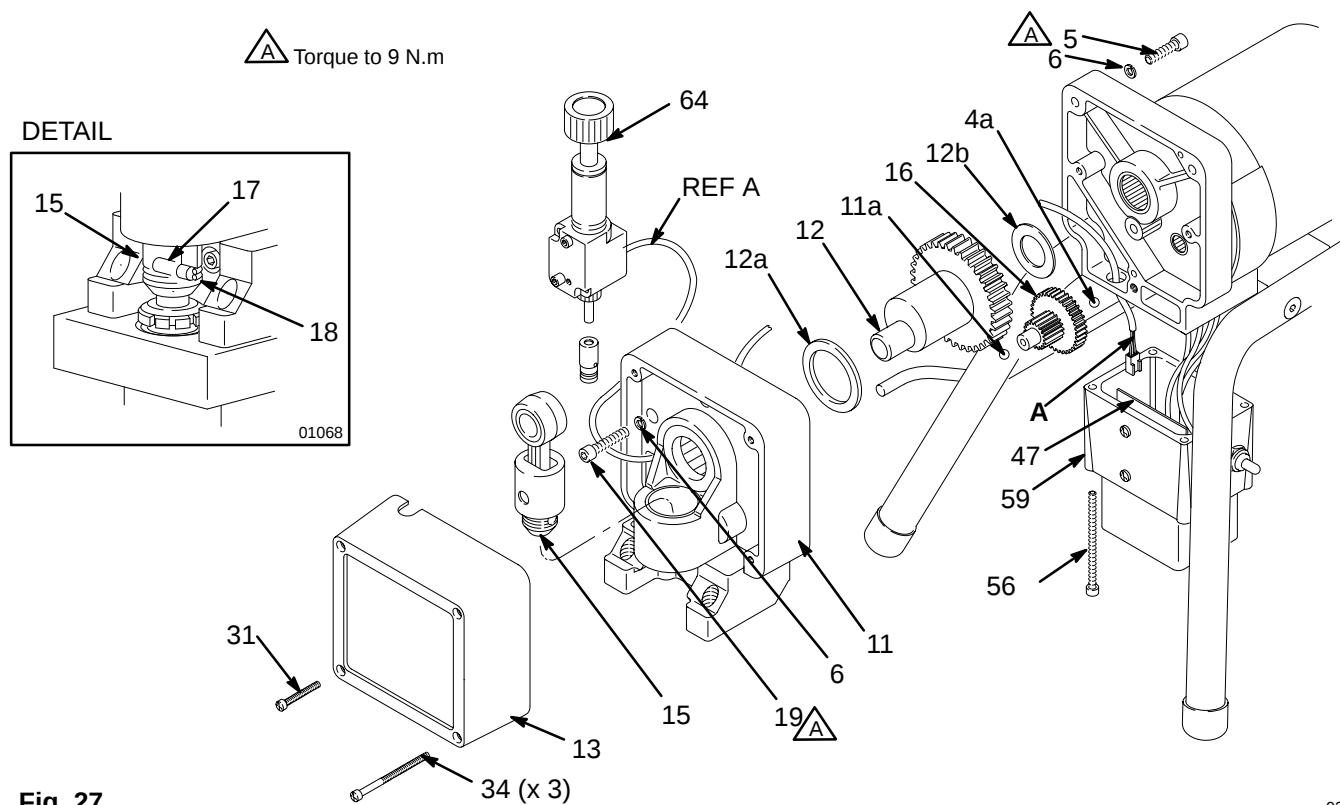


Fig. 27

03181

Pressure Control

WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

NOTE: The pressure control (64) cannot be repaired or adjusted. If it has malfunctioned, replace it.

1. Remove the front cover (13). Remove the screws (56). Lower the junction box (59).
2. Disconnect the harness connector (A) from the motor start board (47). Turn the pressure adjustment knob (B) fully counterclockwise.
3. Remove the screws (63). Pull forward on the pressure adjusting knob and tip the pressure control (64) forward and up to detach it from the drive housing (11).
4. Guide the harness (A) through the motor and drive housing and remove the pressure control.
5. Guide the harness of the new pressure control through the drive housing and motor passages.
6. Install the new pressure control. Tip the pressure control down and back into the drive housing (11). Do not pinch or damage the harness (A).
7. Loosely install the screws (63) and then torque them to 2.4 N.m.
8. Install the front cover (13). Connect the harness (A) to the motor start board (47).
9. Install the junction box. Be sure no leads are pinched against the motor or by the motor start board.

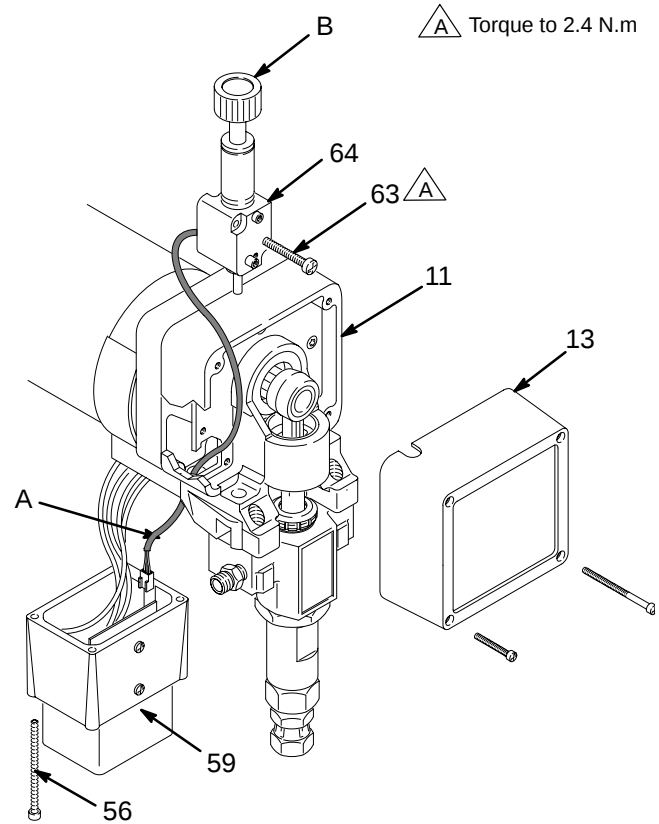


Fig. 28

03182

Pressure Transducer



WARNING

To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

1. Remove the displacement pump. See page 24.
2. Use a pull–twist motion to remove the transducer (29) from the pump manifold (101).
3. Clean paint residue from the hole in the manifold; do not scratch the surface of the hole.
4. Lightly apply oil to the o–ring of the new transducer.
5. Install the transducer in the pump manifold, while guiding the o–ring and backup ring into place.
6. Align the holes in the transducer as shown by the arrows in Fig. 29.

7. Install the displacement pump. See page 24.

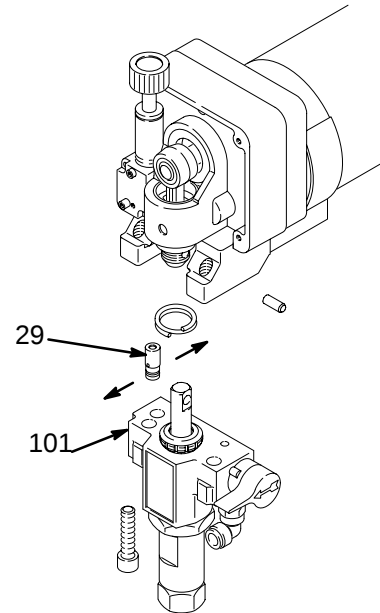


Fig. 29

02817B

Drain Valve

⚠ WARNING

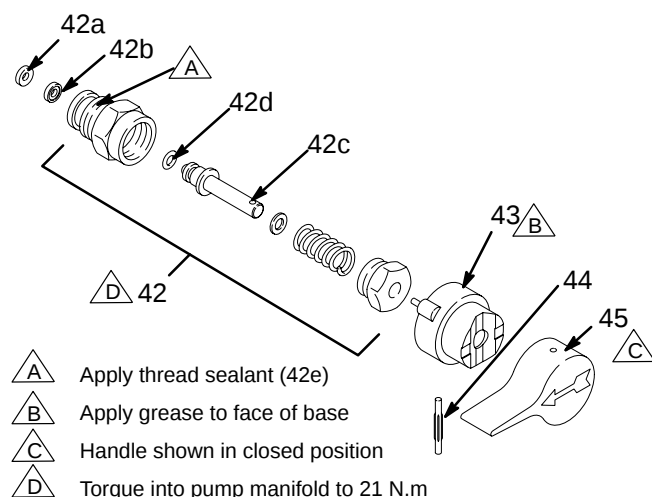
To reduce the risk of serious injury whenever you are instructed to relieve pressure, always follow the **Pressure Relief Procedure** on page 6.

1. Turn the handle (45) to the closed position. Drive out the pin (44). Remove the handle.
2. Remove the base (43).
3. Unscrew the drain valve (42). The gasket (42a) and seat (42b) will stay in the valve.

Repair

1. Unscrew the spring retainer from the valve body. Remove the spring, washers and stem/ball. Clean any debris from the ball or seat area.
2. If replacing the gasket (42a) or seat (42b), pry out the gasket.

NOTE: Whenever the gasket (42a) is removed, replace it with a new one.



3. Coat the o-ring (42d) with grease. Press the stem into the valve body. Install the spring, washers and spring retainer into the valve body.
4. Place the seat (42b) in the valve body so the lapped side is toward the ball. Apply a small amount of grease to the new gasket (42a) and install it in the valve body.

NOTE: The gasket will protrude from the end of the valve until the valve is tightened into pump, which correctly seats the gasket.

Replacement

1. Apply a small amount of thread sealant (42e) onto the valve (42) threads. Tighten the valve into the pump manifold to 21 N.m.
2. Lightly grease the face of the base (43) and install the base. Turn the stem so the pin hole is vertical.
3. Securely install the handle (45) and drive the pin (44).

Fig. 30 02819

Displacement Pump Parts

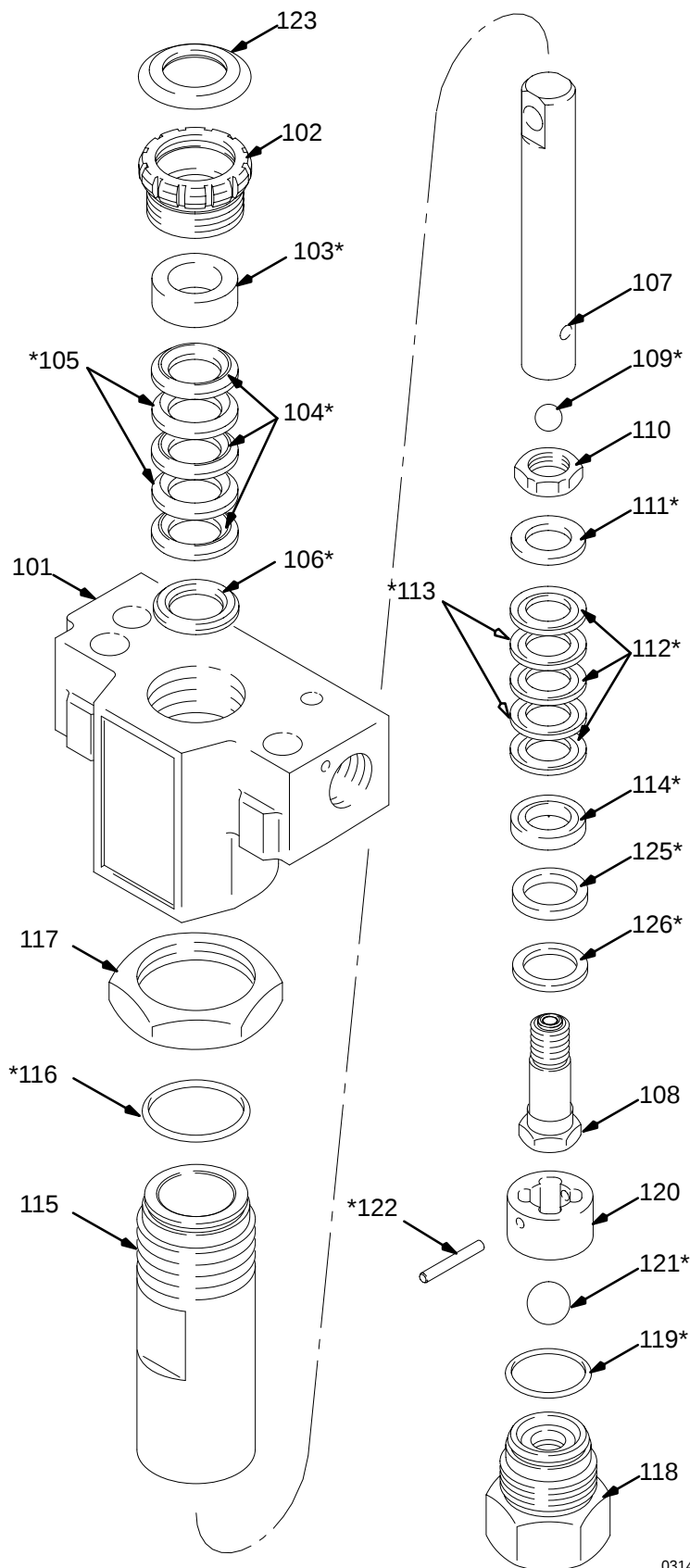
Model 235–699, Series A

Includes items 101 to 126

Ref No.	Part No.	Description	Qty.
101	187–611	MANIFOLD, pump	1
102	176–758	NUT, packing	1
103	176–757*	GLAND, female. throat	1
104	176–997*	V–PACKING, plastic, throat	3
105	176–755*	V–PACKING, leather, throat	2
106	176–754*	GLAND, male. throat	1
107	235–709	ROD, displacement	1
108	218–197	PISTON, valve	1
109	105–444*	BALL, 5/16", piston	1
110	176–751	NUT, hex, 1/2–20 unf–2b	1
111	176–750*	GLAND, male, piston	1
112	176–882*	V–PACKING, plastic, piston	3
113	176–749*	V–PACKING, leather, piston	2
114	180–073*	GLAND, female, piston	1
115	235–708	CYLINDER, pump	1
116	108–526*	PACKING, o-ring, Teflon®	1
117	187–614	NUT, jam, 1–3/8–18 unef–2b	1
118	224–966	VALVE, inlet	1
119	111–603*	PACKING, o-ring, Teflon®	1
120	176–760	GUIDE, ball	1
121	105–445*	BALL, 1/2", inlet	1
122	176–759*	PIN, ball stop	1
123	180–656	PLUG	1
124	102–969*	SEALANT (not shown)	1
125	105–522*	PACKING, u-cup polyurethane	1
126	186–652*	WASHER, backup, steel	1

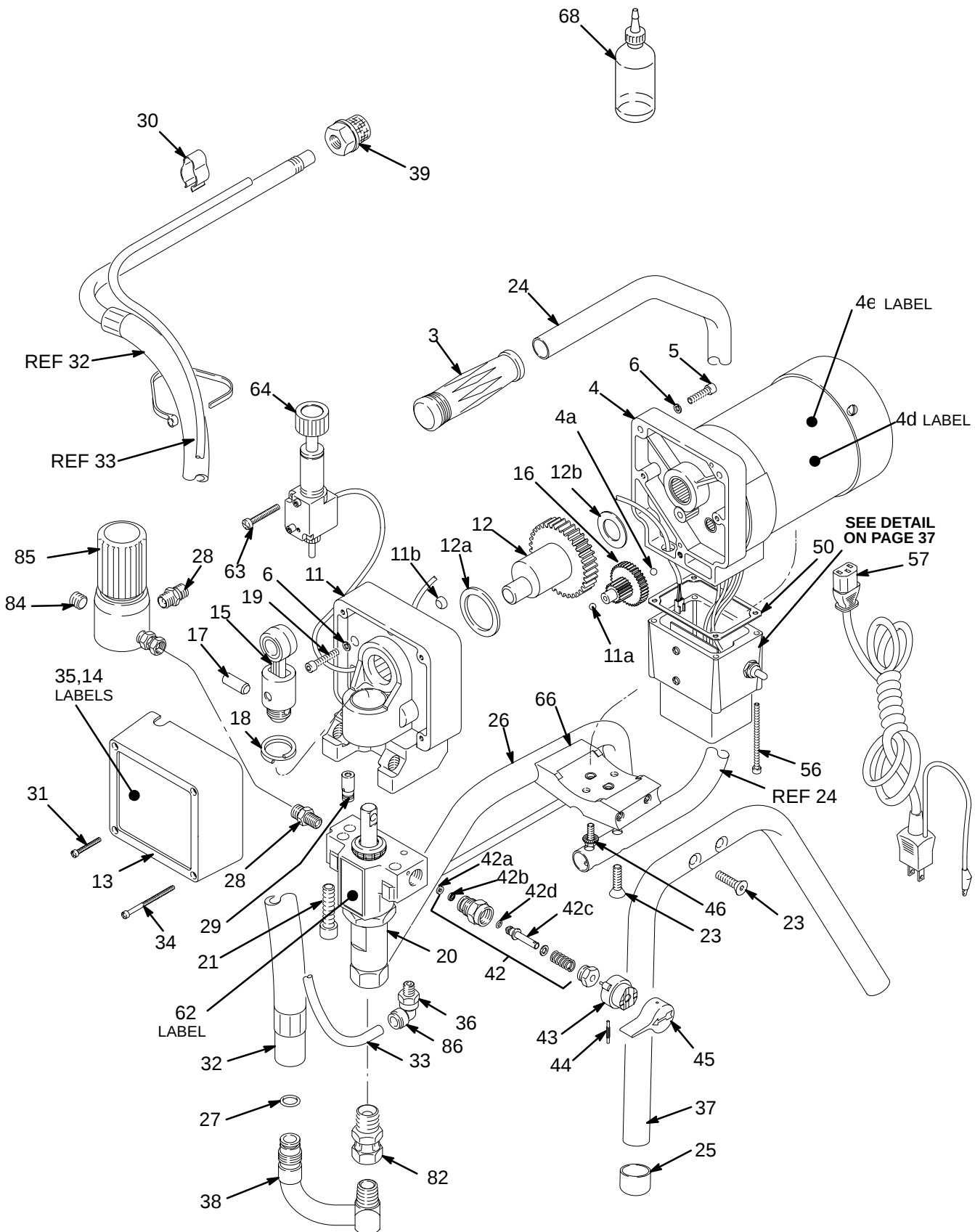
***Supplied in Repair Kit 235–703.**

Keep a repair kit on hand to reduce down time.



03148A

Complete Sprayer Parts



Complete Sprayer Parts

Model 231–311, Series C

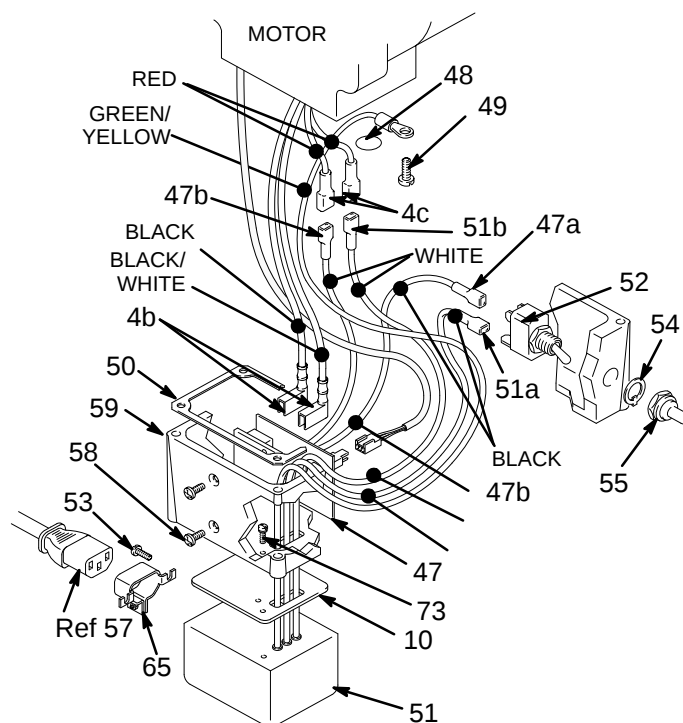
Includes items 3 to 85 as listed below

Ref. No.	Part No.	Description	Qty.
3	111-700	GRIP, handle	1
4	236-812†	MOTOR KIT <i>Includes 4a to 4e</i>	1
4a	100-069	. BALL, SST, 1/4" dia.	1
4b	111-616	. TERMINAL, 1/4" F, 16 AWG	2
4c	107-503	. TERMINAL, 3/16" M, 18 AWG	2
4d	189-699	. LABEL, Warning, Shock	1
4e	189-702*	. LABEL, DANGER, Japanese	1
5	100-643	SCREW, sch, 1/4-20 x 1"	2
6	105-510	LOCKWASHER, spring, 1/4"	5
10	187-962	GASKET, inlet filter	1
11	224-965	DRIVE HOUSING KIT	
		<i>Includes 11a, 11b</i>	1
11a	100-069	. BALL, stainless steel, 1/4" dia.	1
11b	111-726	. PLUG	1
12	224-803	CRANKSHAFT <i>Includes 12a, 12b</i>	1
12a	181-131	. BEARING, thrust	1
12b	107-434	. BEARING	1
13	187-789	COVER, front	1
14	189-700*	LABEL, Warning	1
15	218-359	ROD, CONNECTING	1
16	218-364	GEAR REDUCER	1
17	176-818	PIN, straight, hdls, 3/8" dia. x 1"	1
18	176-817	SPRING, retaining	1
19	103-345	SCREW, sch, 1/4-20 x 1-1/4"	3
20	235-699	PUMP KIT <i>see parts on page 35</i>	1
21	111-706	CAPSCREW, sch, 7/16-14 x 1-3/4"	2
23	111-715	SCREW, special, 5/16-18 x 1-1/4"	6
24	187-631	HANDLE, sprayer	1
25	112-613	CAP, tubing	4
26	235-307	LEG, w/gusset	1
27	104-938	O-RING	1
28	162-453	NIPPLE, 1/4 npsm x 1/4 npt	2
29	235-009	PRESSURE TRANSDUCER	1
30	111-602	CLIP, 3/4"	1
31	108-850	SCREW, filh, 8-32 x 1-1/4"	1
32	187-624	SUCTION HOSE & TUBE	1
33	190-336	DRAIN HOSE	1
34	111-705	SCREW, filh, 8-32 x 2-1/2"	3
35	188-421	LABEL, identification	1
36	190-446	ADAPTER, stem	1
37	187-895	LEG, sprayer	1
38	187-627	TUBE, inlet	1
39	235-004	STRAINER	1
42	235-014	DRAIN VALVE KIT <i>Includes 42a-42e</i>	1
42a	111-699	. GASKET, valve seat	1
42b	187-615	. SEAT, drain valve	1
42c	224-968	. STEM, drain valve	1
42d	168-110	. O-RING, stem	1
42e	110-110	. SEALANT, pipe (not shown)	1
43	224-807	BASE, valve	1
44	111-600	PIN, grooved, 3/32 x 1"	1
45	187-625	HANDLE, drain valve	1
46	110-997	SCREW, washer/hex hd, 5/16"	2
47	235-707	MOTOR START BOARD	
		<i>Includes 47a, 47b</i>	1
47a	107-260	. TERMINAL, 1/4" F, 16 AWG	1
47b	107-267	. TERMINAL, 3/16" F, 16 AWG	1
48	186-620*	LABEL, ground terminal	1

49	110-037	SCREW, mach, pnhd, 10-24 x 5/8"	1
50	187-963	GASKET, junction box	1
51	236-524	FILTER, power inlet	1
51a	107-262	TERMINAL, 1/4" F, 18 AWG	1
51b	107-504	TERMINAL, 3/16" F, 18 AWG	1
52	105-679	SWITCH, ON/OFF	1
53	111-840	SCREW, panhead, M3 x 10 mm	2
54	105-658	RING, locking	1
55	105-659	BOOT, switch	1
56	111-703	SCREW, filh, 10-24 x 3"	4
57	235-981	POWER CORD with IEC-320 Connector	1
58	100-035	SCREW, panhd, 8-32 x 5/16"	2
59	187-958	JUNCTION BOX	1
62	189-698*	LABEL, Warning	1
63	111-704	SCREW, filh, 10-24 x 1-5/8"	2
64	224-828	PRESSURE CONTROL KIT	1
65	112-402	CLAMP, power cord	1
66	187-770	BASE, motor	1
68	206-994	TSL, 8 oz.	1
73	111-839	SCREW, panhead w/lockwasher, 6-32 x .375"	2
82	156-684	FITTING, swivel	1
84	100-721	PLUG, 1/4 npt	1
85	235-677	FLUID FILTER <i>See manual 308-249 for parts</i>	1
86	190-447	ELBOW	1

**Extra warning labels available free of charge.*

† Motor Brush and Spring Replacement Kit, P.N. 235-727 is available. Purchase separately.



03177

Technical Data

Power Requirements 100 VAC, 50/60 Hz,
1 phase, 10 amp minimum
Working Pressure Range 0–19.5 MPa, 0–195 bar
(0–2750 psi)
Cycles/Liter 164
Power Cord 2.0 mm², 3 wire, 2.0 m
Inlet Paint Strainer 1525 micron
Stainless Steel Screen, reusable
Pump Inlet Size 1/2 npt(f)
Fluid Outlet Size 1/4 npsm
Wetted Parts:
 Displacement Pump .. Stainless steel, Carbon steel,
 Aluminum, Polyethylene, Delrin®, Leather
NOTE: Delrin® is a registered trademark of the
DuPont Company.

Dimensions

Weight (dry w/o packaging) 16.6 kg
Height 483 mm
Length 381 mm
Width 356 mm

Accessories

FLUID HOPPER KIT **236–342**
(Includes hopper, lid, screen, and Installation Kit.)
WHEELED LO–CART KIT **235–710**
WHEELED UPRIGHT CART KIT **236–328**

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GRACO INC. P.O. BOX 1441 MINNEAPOLIS, MN 55440-1441
<http://www.graco.com>

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