

Operation

E-Flo[®] 4-Ball Pumps



with Sealed or Open Wet Cup Lowers

3A3385B

EN

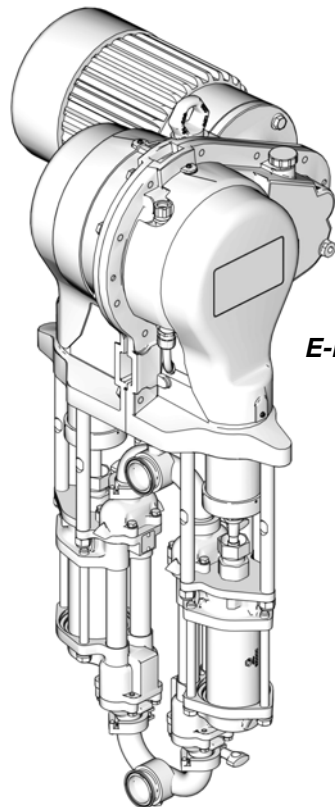
**Piston pumps for high-volume paint circulation applications.
For professional use only.**



Important Safety Instructions

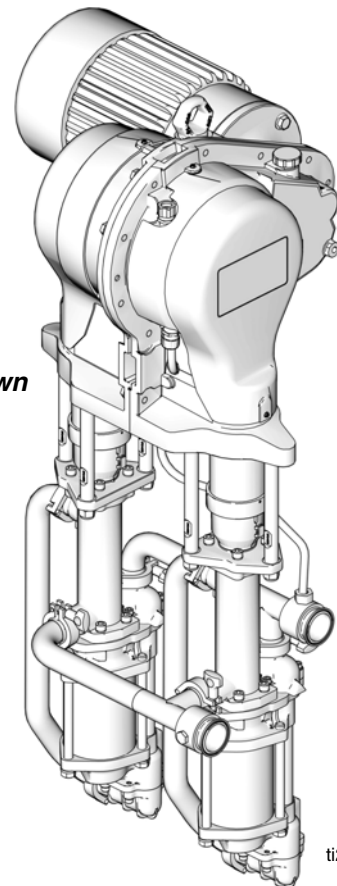
Read all warnings and instructions in this manual.
Save these instructions.

See page 3 for model information, including maximum working pressure. See page 4 for approvals.



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E-Flo 4000 Pump Shown



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Related Manuals

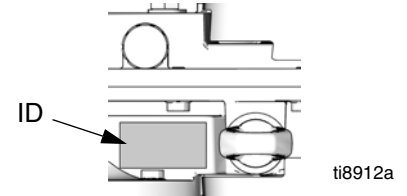
Manual Description

- 311592 E-Flo Installation Manual
- 3A3386 E-Flo Repair Manual
- 311595 Pneumatic Back Pressure Regulator
- 311596 Variable Frequency Drive Instructions
- 311603 Sensor Circuit Option
- 333022 Sealed 4-Ball Lowers
- 3A3452 4-Ball Lowers with Open Wet Cup

Models

E-Flo 4-Ball Piston Pumps

Check your pump's identification plate (ID) for the 6-digit part number of your pump. Use the following matrix to define the construction of your pump, based on the six digits. For example, Pump Part No. **E P 2 1 D 0** represents electric power (**E**), pump (**P**), 230/460V motor (**2**), sensor circuit installed (**1**), 1000 cc lower with an open wet cup (**D**), and no stand installed (**0**). To order replacement parts, see Manual 3A3386.



E	P	2	1	D	0
First Digit	Second Digit	Third Digit	Fourth Digit	Fifth Digit	Sixth Digit
Power Source	Equipment Style	Motor	Sensor Circuit	Lower Size	Stand Option
E (electric)	P (pump)	0 No motor	0 No circuit installed	A 1000cc Sealed	0 No stand installed 1 Stand installed
		1 230/400V, 5 HP, ATEX	1 Circuit installed	B 1500cc Sealed	
		2 230/460V, 5 HP, UL/CSA		C 2000cc Sealed	
		3 230/400V, 3 HP, ATEX		D 1000cc Open Wet Cup	
		4 230/460V, 3 HP, UL/CSA		E 1500cc Open Wet Cup	
				F 2000cc Open Wet Cup	
				G 750cc Sealed	
				H 750cc Open Wet Cup	

Maximum Working Pressure and Pump Operational Limits

EPxxGx and EPxxHx: 425 psi (2.93 MPa, 29.3 bar) Maximum Working Pressure

EPxxAx and EPxxDx: 460 psi (3.22 MPa, 32.2 bar) Maximum Working Pressure


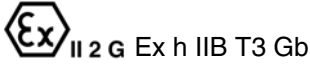






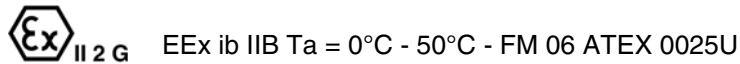
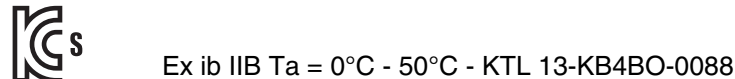
EPxxBx and EPxxEx: 330 psi (2.31 MPa, 23.1 bar) Maximum Working Pressure

EPxxCx and EPxxFx: 250 psi (1.75 MPa, 17.5 bar) Maximum Working Pressure

See **Performance Charts**, page 16, for pressure and flow limits.





Approvals

The E-Flo Pump meets requirements of the following approval agencies.
 Refer to the individual components for other specific hazardous location listings.






Component	Description	Approvals
Mechanical Pump		 
Motor	ATEX (for pump Models EP1XXX and EP3XXX)	 
	UL/CSA (for pump Models EP2XXX and EP4XXX)	 Class I, Div. 1, Group D, Class II, Div. 1, Group F and G, T3B Hazardous Locations 
IS Sensor Circuit	(for pump Models EPX1XX)	   

Warnings

The following warnings are for the setup, use, grounding, maintenance, and repair of this equipment. The exclamation point symbol alerts you to a general warning and the hazard symbols refer to procedure-specific risks. When these symbols appear in the body of this manual or on warning labels, refer back to these Warnings. Product-specific hazard symbols and warnings not covered in this section may appear throughout the body of this manual where applicable.

 <h1 style="margin: 0;">WARNING</h1>	
	<p>FIRE AND EXPLOSION HAZARD</p> <p>Flammable fumes, such as solvent and paint fumes, in work area can ignite or explode. Paint or solvent flowing through the equipment can cause static sparking. To help prevent fire and explosion:</p> <ul style="list-style-type: none"> • Use equipment only in well ventilated area. • Eliminate all ignition sources; such as pilot lights, cigarettes, portable electric lamps, and plastic drop cloths (potential static sparking). • Ground all equipment in the work area. See Grounding instructions. • Never spray or flush solvent at high pressure. • Keep work area free of debris, including solvent, rags and gasoline. • Do not plug or unplug power cords, or turn power or light switches on or off when flammable fumes are present. • Use only grounded hoses. • Hold gun firmly to side of grounded pail when triggering into pail. Do not use pail liners unless they are anti-static or conductive. • Stop operation immediately if static sparking occurs or you feel a shock. Do not use equipment until you identify and correct the problem. • Keep a working fire extinguisher in the work area.
	<p>ELECTRIC SHOCK HAZARD</p> <p>This equipment must be grounded. Improper grounding, setup, or usage of the system can cause electric shock.</p> <ul style="list-style-type: none"> • Turn off and disconnect power at main switch before disconnecting any cables and before servicing or installing equipment. • Connect only to grounded power source. • All electrical wiring must be done by a qualified electrician and comply with all local codes and regulations.
	<p>PRESSURIZED EQUIPMENT HAZARD</p> <p>Fluid from the equipment, leaks, or ruptured components can splash in the eyes or on skin and cause serious injury.</p> <ul style="list-style-type: none"> • Follow the Pressure Relief Procedure when you stop spraying/dispensing and before cleaning, checking, or servicing equipment. • Tighten all fluid connections before operating the equipment. • Check hoses, tubes, and couplings daily. Replace worn or damaged parts immediately.

! WARNING

	<p>EQUIPMENT MISUSE HAZARD</p> <p>Misuse can cause death or serious injury.</p> <ul style="list-style-type: none"> • Do not operate the unit when fatigued or under the influence of drugs or alcohol. • Do not exceed the maximum working pressure or temperature rating of the lowest rated system component. See Technical Data in all equipment manuals. • Use fluids and solvents that are compatible with equipment wetted parts. See Technical Data in all equipment manuals. Read fluid and solvent manufacturer's warnings. For complete information about your material, request Safety Data Sheet (SDS) from distributor or retailer. • Check equipment daily. Repair or replace worn or damaged parts immediately with genuine manufacturer's replacement parts only. • Do not alter or modify equipment. Alterations or modifications may void agency approvals and create safety hazards. • Make sure all equipment is rated and approved for the environment in which you are using it. • Use equipment only for its intended purpose. Call your distributor for information. • Route hoses and cables away from traffic areas, sharp edges, moving parts, and hot surfaces. • Do not kink or over bend hoses or use hoses to pull equipment. • Keep children and animals away from work area. • Comply with all applicable safety regulations.
	<p>MOVING PARTS HAZARD</p> <p>Moving parts can pinch, cut or amputate fingers and other body parts.</p> <ul style="list-style-type: none"> • Keep clear of moving parts. • Do not operate equipment with protective guards or covers removed. • Pressurized equipment can start without warning. Before checking, moving, or servicing equipment, follow the Pressure Relief Procedure and disconnect all power sources.
	<p>TOXIC FLUID OR FUMES HAZARD</p> <p>Toxic fluids or fumes can cause serious injury or death if splashed in the eyes or on skin, inhaled, or swallowed.</p> <ul style="list-style-type: none"> • Read Safety Data Sheet (SDS) to know the specific hazards of the fluids you are using. • Store hazardous fluid in approved containers, and dispose of it according to applicable guidelines.
	<p>BURN HAZARD</p> <p>Equipment surfaces and fluid that is heated can become very hot during operation. To avoid severe burns:</p> <ul style="list-style-type: none"> • Do not touch hot fluid or equipment.
	<p>PERSONAL PROTECTIVE EQUIPMENT</p> <p>Wear appropriate protective equipment when in the work area to help prevent serious injury, including eye injury, hearing loss, inhalation of toxic fumes, and burns. Protective equipment includes but is not limited to:</p> <ul style="list-style-type: none"> • Protective eyewear, and hearing protection. • Respirators, protective clothing, and gloves as recommended by the fluid and solvent manufacturer.

Overview

An electric motor (B) provides input to a 75:1 gear reducer (GR), which drives two fluid pumps (FP). See FIG. 1. The stroke positions of the two pumps are offset to achieve consistent flow from the pump assembly. See FIG. 2.

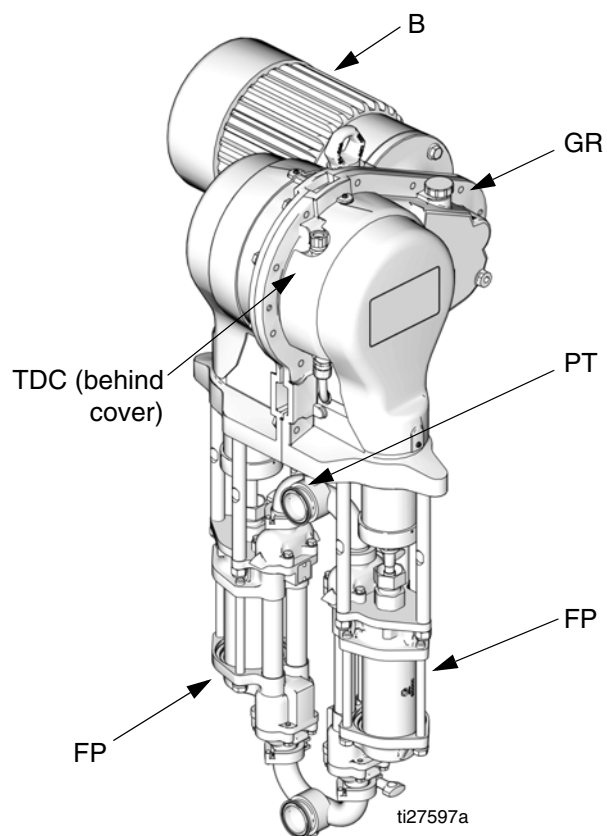


FIG. 1. E-Flo Electric Circulation Pump

The optional sensor circuit includes a top dead center (TDC) sensor which assists software in measuring motor speed, and a pressure transducer (PT) with circuit board, which measures fluid pressure at the pump outlet. The Graco VFD software mimics the effect of a camshaft, constantly adjusting motor speed to keep steady fluid flow and achieve minimal pressure variation. The output shaft of the gearbox and the connecting rods experience the effect of the imaginary camshaft by speeding up when the pressure drops (pump lower is at a changeover) and slowing down when pressure increases (both lowers are pumping).

The VFD can be controlled by a local control box mounted in the hazardous area, via communication protocol (such as modbus), or directly from the keypad.

FIG. 3 shows a layout of a typical North American system. The pump (A) may be controlled by a local control box (C) mounted in the hazardous area, a variable frequency drive (D) mounted in the non-hazardous area, or remotely from a computer (Y). See manual 311592 for pump and accessory installation information.

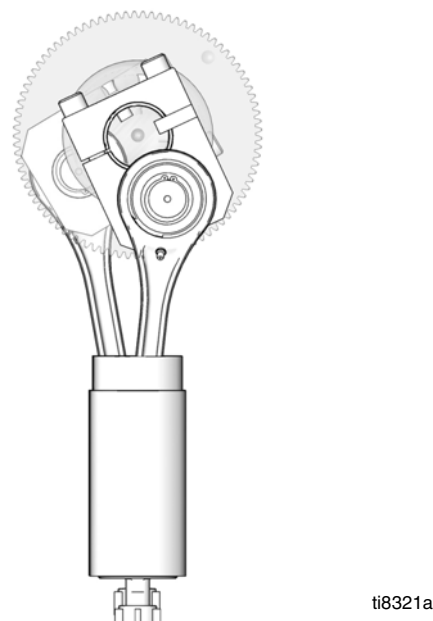
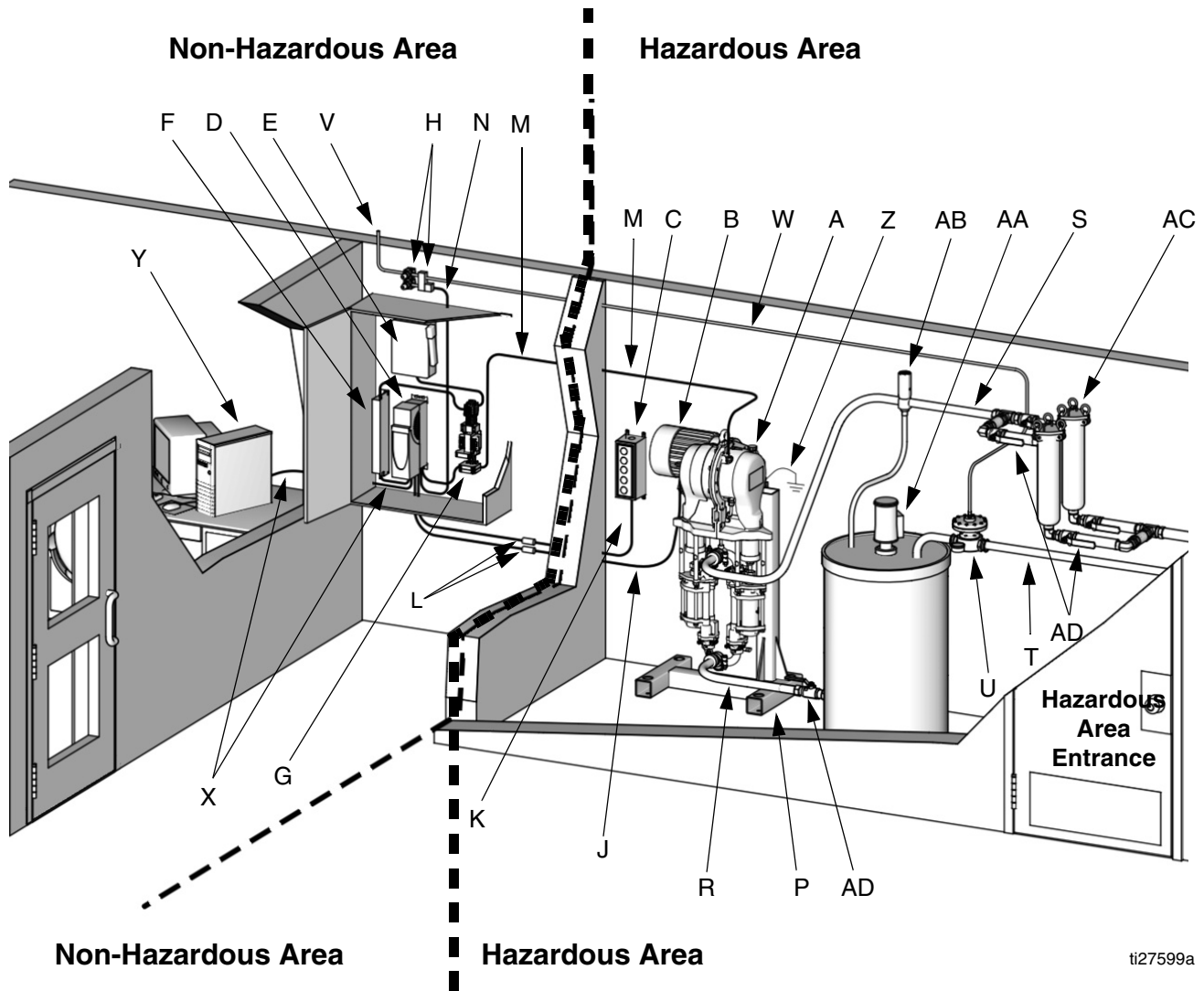


FIG. 2. Cutaway Showing Offset Stroke Positions



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Fig. 3: Typical Installation

Key:

- A E-Flo Electric Circulation Pump
- B* Explosion-Proof Electric Motor
- C* Local Control Box
- D* Variable Frequency Drive (VFD)
- E** System Power Disconnect Switch
- F* Electrical Noise Filter
- G* Power Module
- H* VFD/BPR Pneumatic Control Kit
- J** Electric Power Cable, VFD to Electric Motor
- K** Electric Control Cable, Local Control Box to VFD
- L** Explosion-Proof Seal Fittings
- M** Electric IS Control Cable, Power Module to Pump Sensor Circuit
- N** Electric Cable, VFD to 3-Way Solenoid Valve (2 meters provided by Graco)
- P* Pump Stand
- R** Fluid Inlet Line
- S** Fluid Outlet Line

- T** Fluid Return Line
- U* Pneumatic Back Pressure Regulator
- V** Air Supply Lines to 3-Way Solenoid Valve
- W** Air Line, Solenoid Valve to Back Pressure Regulator
- X** Ethernet Cable, VFD to Computer
- Y** Personal Computer
- Z** Pump Ground Wire
- AA* Explosion-Proof Electric Agitator
- AB** Pressure Relief
- AC* Fluid Filters
- AD* Fluid Line Isolation Valves

* Option available from Graco.
 ** Supplied by integrator.

Ground the System

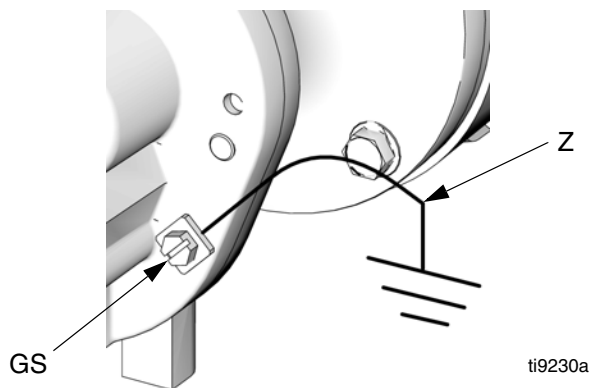
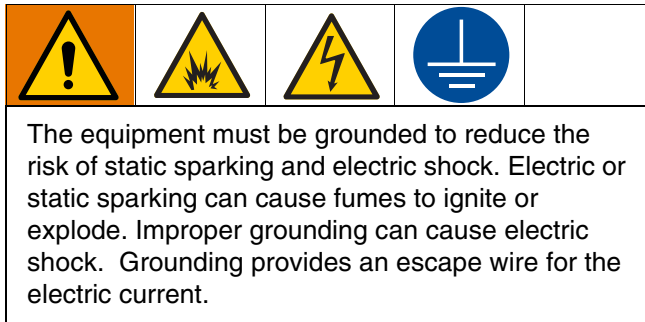


FIG. 4. Oil Fill

Ground the following equipment:

- *Pump:* use ground screw (GS) to attach a ground wire (Z) to the pump. Tighten the screw securely. Connect the other end of the ground wire to a true earth ground.
- *Variable frequency drive:* grounded through proper connection to power source.
- *Local control box:* follow your local code.
- *Fluid supply container:* follow your local code.
- *Solvent pails used when flushing:* follow your local code. Use only metal pails, which are conductive, placed on a grounded surface. Do not place pail on a non-conductive surface, such as paper, plastic, or cardboard, which interrupts grounding continuity.
- *To maintain grounding continuity when flushing or relieving pressure:* Hold metal part of the spray gun or valve firmly to the side of a grounded metal pail, then trigger the gun or open the valve.

Controls and Indicators

Variable Frequency Drive (VFD)

Use a variable frequency drive (VFD) accessory to provide motor drive control to the pump. Graco supplies accessory 240V and 480V VFDs that optimize pump performance. See manual 311596.

Local Control Box

The local control box contains five controls. See FIG. 5.

Secure/Disable Switch

- Push in to secure.
- Pull out to disable.

Start/Stop Switch

- Set to START to start pump.
- Set to STOP to stop pump.

Alarm Reset Button

Press to clear an alarm.

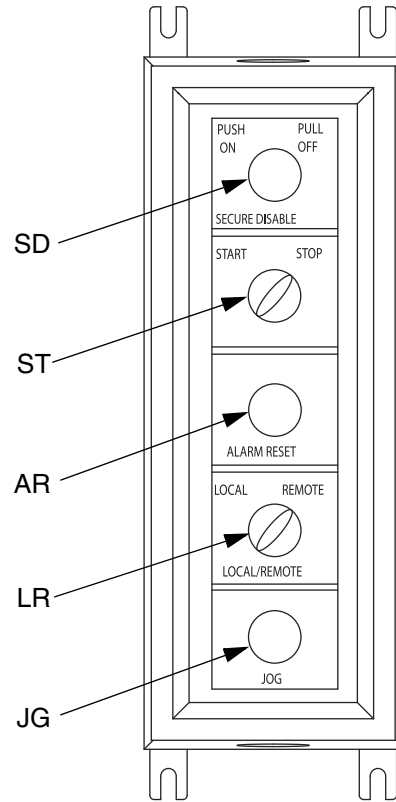
Local/Remote Switch

- Set to LOCAL to control pump using local control box.
- Set to REMOTE to control pump from a PC in a remote location.

Jog Button

Press to enter jog mode.

120373 UL/CSA Control Box



120991 ATEX Control Box

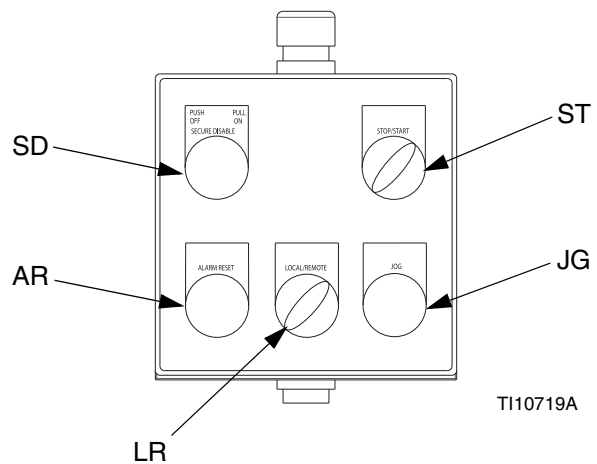


FIG. 5: Local Control Box

Setup

Fill Gear Reducer Reservoir with Oil

Open the fill cap (FC) and fill the gear reducer oil reservoir with 2 quarts (1.9 liters) of Graco 288414 Oil (twelve 1 quart bottles). Check the oil level in the sight glass (SG) on the gear reducer housing. Do not overfill. See FIG. 6.

NOTE: 2 quarts brings oil level above sight glass (SG) when off, but level drops when operating.

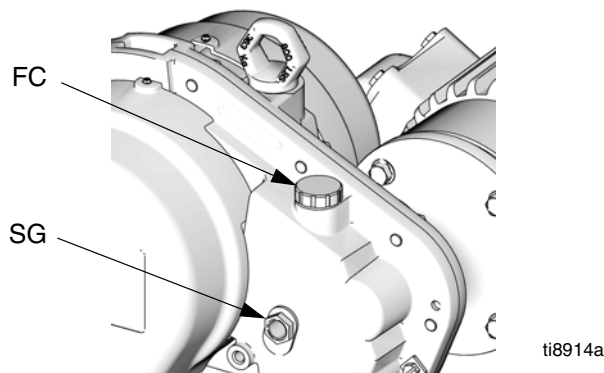


FIG. 6. Oil Fill

Flush Before Using Equipment

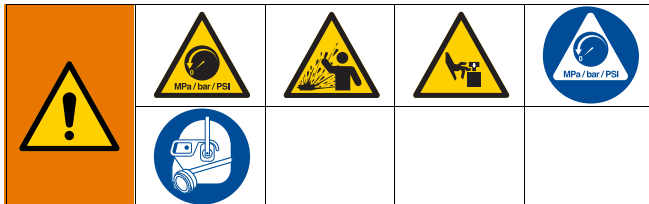
The equipment was tested with Stoddard Solvent, which is left in the fluid passages to protect parts. To avoid contaminating your fluid with solvent, flush the equipment with a compatible solvent or water before using the equipment. See **Flushing**, page 15.

Operation



Follow the Pressure Relief Procedure whenever you see this symbol.

Pressure Relief Procedure



This equipment stays pressurized until pressure is manually relieved. To help prevent serious injury from pressurized fluid, such as splashing fluid and moving parts, follow the Pressure Relief Procedure when you stop spraying and before cleaning, checking, or servicing the equipment.

1. Set START/STOP switch (ST) to STOP. See FIG. 5.
2. Push in SECURE DISABLE (SD) switch.
3. Open the back pressure regulator (U) and all fluid drain valves in the system, having a waste container ready to catch drainage. Leave open until you are ready to pressurize system again.
4. Check that the pressure gauges on fluid supply and return lines read zero. If the gauges do not read zero, determine cause and carefully relieve pressure by VERY SLOWLY loosening a fitting. Clear obstruction before pressurizing system again.

Priming

1. Open the back pressure regulator and any other accumulators in the system.
2. Start the pump, see **Startup**.
3. Set START/STOP switch (ST) to STOP. See FIG. 5.
4. Set the back pressure regulator as desired. The system is ready to run.

Startup

1. Close the main power disconnect.
2. Use the VFD to set motor to a low flow (approximately 15 Hz). Adjust as needed. See VFD manual 311596 for specific flow set procedure. See FIG. 5.
3. Push in SECURE DISABLE (SD) switch. See FIG. 5.
4. Set START/STOP switch (ST) to STOP. See FIG. 5.
5. Pull the SECURE DISABLE switch (SD) out to disengage it. See FIG. 5.
6. Set the motor speed on the VFD to achieve the desired flow rate See FIG. 7.

NOTICE
To avoid overheating the motor, do not exceed a motor speed of 60 Hz for more than 3 minutes.

7. Set START/STOP switch (ST) to START. The speed will ramp up; it is not an immediate change. See FIG. 5.
8. Set BPR to obtain desired line pressure.

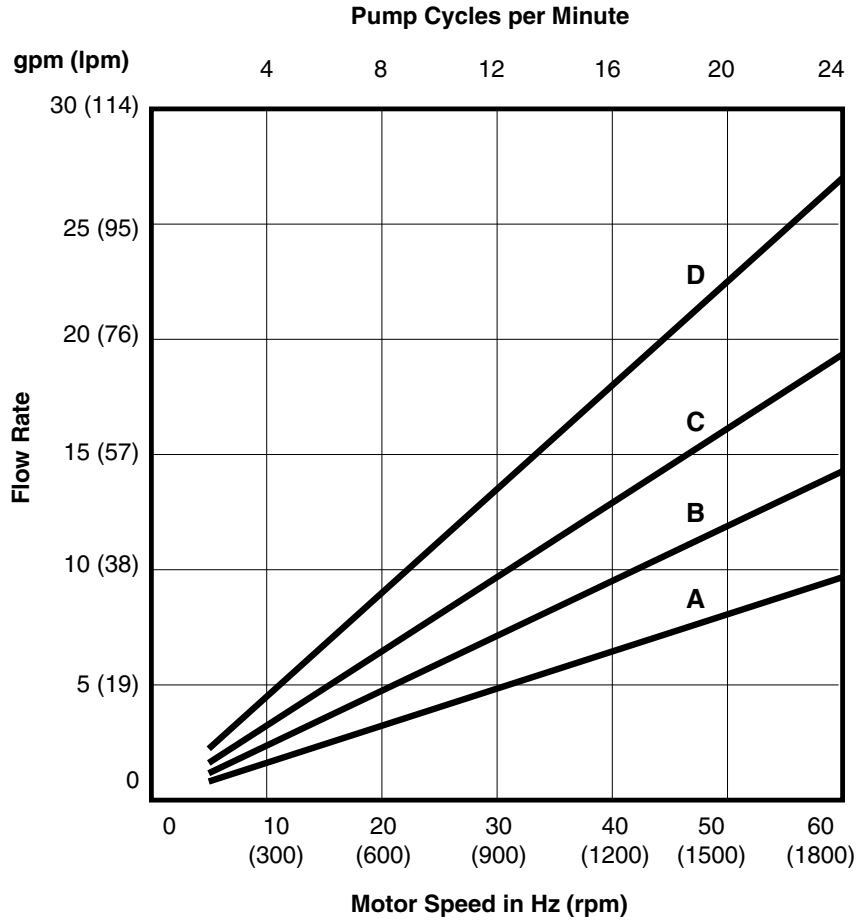
Shutdown



Follow the **Pressure Relief Procedure**.

Always flush the pump before the fluid dries on the displacement rod. See **Flushing** on page 15.

Motor Speed and Flow Chart



Key:

- A** 750 cc Pumps
- B** 1000 cc Pumps
- C** 1500 cc Pumps
- D** 2000 cc Pumps

Equations for each line:

$$\text{Flow (gpm)} = 1.13 \times \frac{30 \times \text{VFD (Hz)}}{75.16}$$

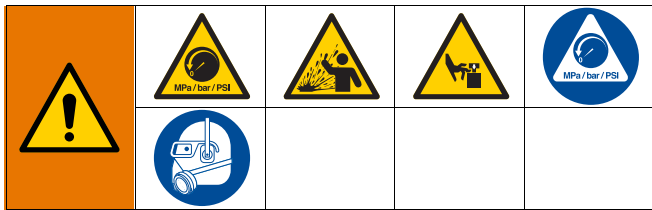
$$\text{Flow (gpm)} = 0.811 \times \frac{30 \times \text{VFD (Hz)}}{75.16}$$

$$\text{Flow (gpm)} = 0.598 \times \frac{30 \times \text{VFD (Hz)}}{75.16}$$

$$\text{Flow (gpm)} = 0.406 \times \frac{30 \times \text{VFD (Hz)}}{75.16}$$

FIG. 7: Motor Speed and Flow Chart

Maintenance



Preventive Maintenance Schedule

The operating conditions of your particular system determine how often maintenance is required. Establish a preventive maintenance schedule by recording when and what kind of maintenance is needed, and then determine a regular schedule for checking your system. Your maintenance schedule should include the items on the following pages.

Check Gear Reducer Oil Level

Every day, check the oil level in the sight glass (SG) on the gear reducer, with the motor running. Oil level (with motor running) should fall between top and bottom of the sight glass (SG). Open the fill cap (FC) and fill the gear reducer oil reservoir as required with Graco 288414 Oil (package includes twelve 1 quart bottles). Do not overfill. See FIG. 8.

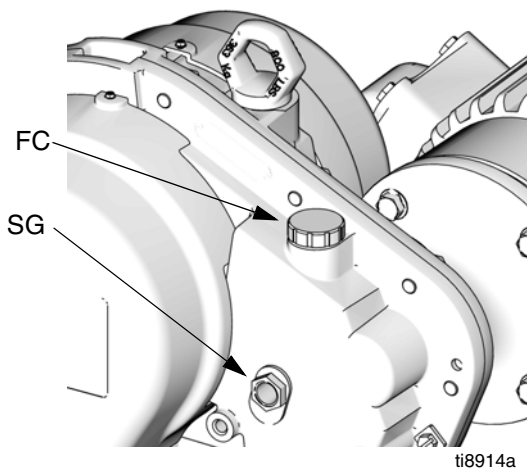


FIG. 8. Oil Fill

Gear Box and Drive Lubrication

Replace the gear box lubricant after a break-in period of 200,000-300,000 cycles. Order 288414 Replacement Oil.

Following the break-in period, replace the gear box lubricant once a year.

See FIG. 9. Every 6 months, lubricate the wrist pin bearing (7a) on the connecting rod with 1 shot (1 cc) of 107411 Grease or equivalent, using grease zerk (GZ). Replace both wrist pin bearings annually. Order Wrist Pin Replacement Kit 255216. Lubricate the crank pin bearing (X) annually, using grease zerk (GZ).

NOTE: A faint clicking may be heard while the motor is running. This is normal and is due to necessary clearances between the coupler (28), motor shaft, and motor key. If the intensity increases significantly over time, it could indicate the coupler is wearing and should be replaced. Do not open the gear reducer. The gear reducer is not field serviceable beyond the maintenance recommended in this manual

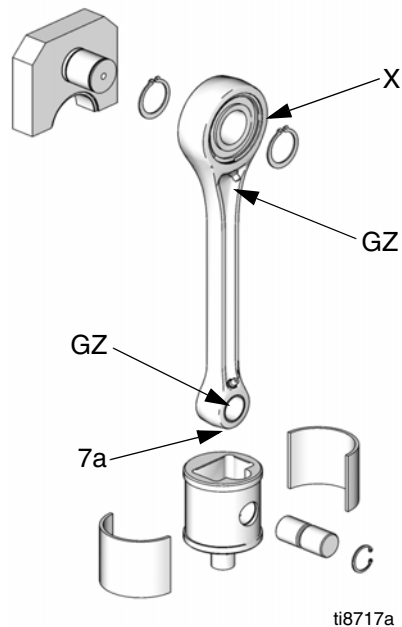


FIG. 9. Lubricate Wrist Pin Bearing Every 6 Months

Clean the Slider Cylinder Collectors

Every month, check the slider cylinder collectors for dirt or debris. Remove the shield covering the coupling assembly. Loosen the three set screws (SS) on the collector (CL). Lower the collector and wipe the inside with a clean, damp cloth. Return the collector to its operating position. Tighten the screws finger tight. Reinstall the shields.

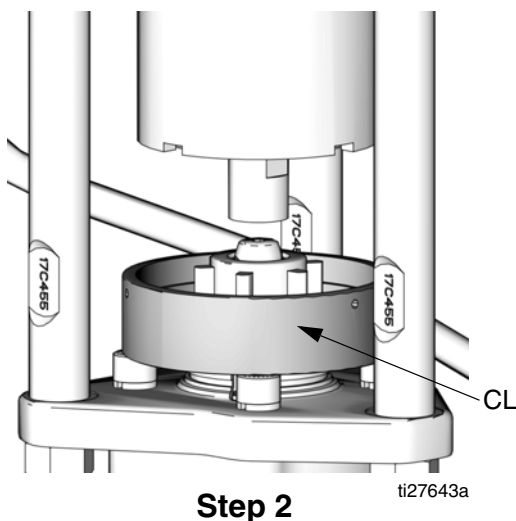
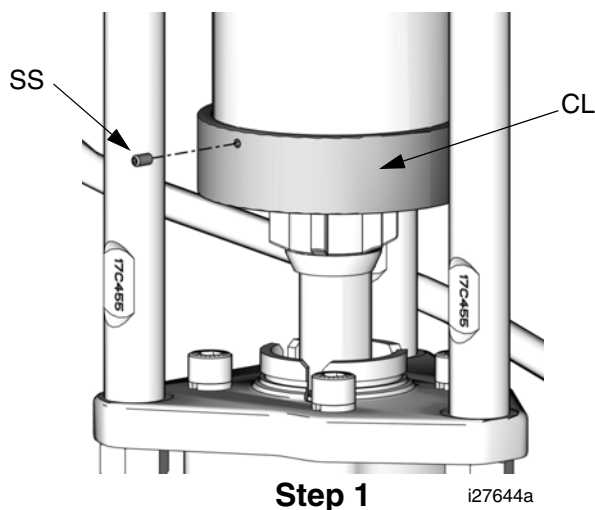


FIG. 10. Slider Cylinder Collector

Flushing



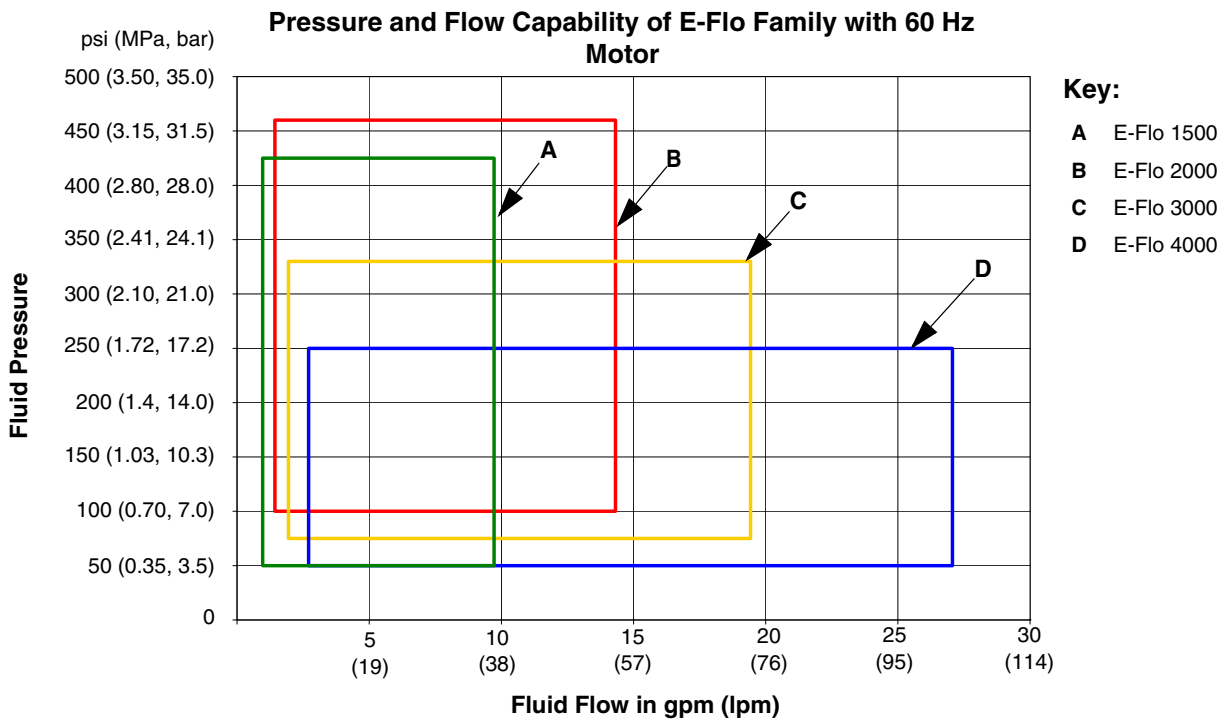
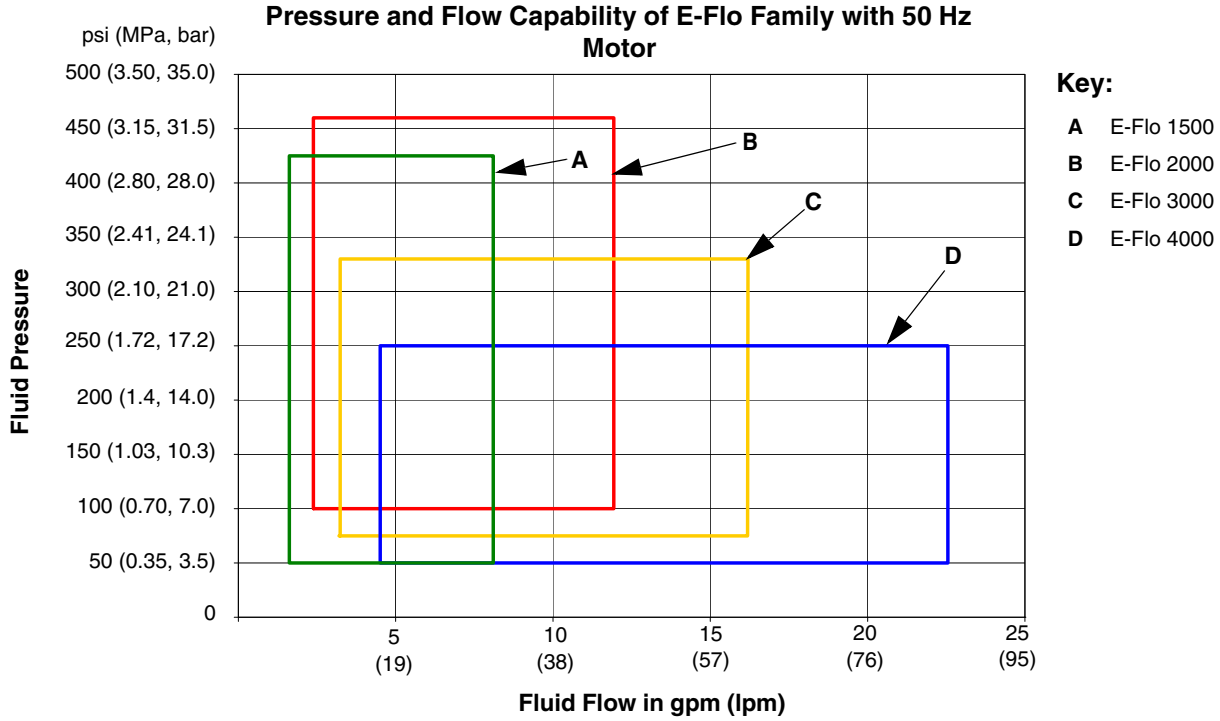
To avoid fire and explosion, always ground equipment and waste container. To avoid static sparking and injury from splashing, always flush at the lowest possible pressure.

- Flush before changing colors, before storing, and before repairing equipment.
 - Flush at the lowest pressure possible. Check connectors for leaks and tighten as necessary.
 - Flush with a fluid that is compatible with the fluid being dispensed and the equipment wetted parts.
1. Follow **Pressure Relief Procedure**, page 12.
 2. Supply the appropriate flushing material to the system.
 3. Set pump to lowest possible fluid pressure, and start the pump.
 4. Flush long enough to thoroughly clean the system.
 5. Follow **Pressure Relief Procedure**, page 12.

Changing the TSL™ On Wet Cup Models

On Wet Cup Models check the condition of the TSL and the level in the wet cup every week, minimum. TSL should be changed at least every month.

Performance Charts



Technical Data

E-Flo 1500, 2000, 3000 and 4000cc Pumps		
	U.S.	Metric
Lower Size		
EPxxGx and EPxxHx	2 @ 750cc each	
EPxxAx and EPxxDx	2 @ 1000cc each	
EPxxBx and EPxxEx	2 @ 1500cc each	
EPxxCx and EPxxFx	2 @ 2000cc each	
Max. Working Pressure		
EPxxGx and EPxxHx	425 psi	2.93 MPa, 29.3 bar
EPxxAx and EPxxDx	460 psi	3.22 MPa, 32.2 bar
EPxxBx and EPxxEx	330 psi	2.31 MPa, 23.1 bar
EPxxCx and EPxxFx	167 psi	1.75 MPa, 17.5 bar
Maximum Fluid Temperature	150°F	66°C
Electrical Requirements		
European Models:	230/400 Vac, 3 phase, 20 A/15 A	230/400 Vac, 3 phase, 20 A/15 A
North American Models:	230/460 Vac, 3 phase, 20 A/15 A	230/460 Vac, 3 phase, 20 A/15 A
Ambient Temperature Range	32-104°F	0-40°C
Maximum Fluid Output	See charts on page 16.	
Fluid Inlet and Outlet Size	2 in. tri-clamp	50.8 mm tri-clamp
Gear Reducer Oil Capacity	2 quarts	1.9 liters
Required Gear Reducer Lubricant	ISO VG220 grade oil (Graco Part No. 288414)	ISO VG220 grade oil (Graco Part No. 288414)
Weight	550 lbs.	249 kg
Electric Motor		
EPxxGx and EPxxHx	3 HP, 1800 rpm (60 Hz) NEMA 182 TC Frame	3 HP, 1500 rpm (50 Hz) NEMA 182 TC Frame
All Others	5 HP, 1800 rpm (60 Hz) NEMA 184 TC Frame	5 HP, 1500 rpm (50 Hz) NEMA 184 TC Frame
Maximum Motor Torque		
EPxxGx and EPxxHx	9.1 ft-lb	(12.3 N•m)
All Others	15 ft-lb	(20.3 N•m)
Gear Reduction Ratio	75.16:1	75.16:1
Wetted Parts	See Lower manual 333022 for Sealed 4-Ball, 3A3452 for Open Wet Cup.	

Graco Standard Warranty

Graco warrants all equipment referenced in this document which is manufactured by Graco and bearing its name to be free from defects in material and workmanship on the date of sale to the original purchaser for use. With the exception of any special, extended, or limited warranty published by Graco, Graco will, for a period of twelve months from the date of sale, repair or replace any part of the equipment determined by Graco to be defective. This warranty applies only when the equipment is installed, operated and maintained in accordance with Graco's written recommendations.

This warranty does not cover, and Graco shall not be liable for general wear and tear, or any malfunction, damage or wear caused by faulty installation, misapplication, abrasion, corrosion, inadequate or improper maintenance, negligence, accident, tampering, or substitution of non-Graco component parts. Nor shall Graco be liable for malfunction, damage or wear caused by the incompatibility of Graco equipment with structures, accessories, equipment or materials not supplied by Graco, or the improper design, manufacture, installation, operation or maintenance of structures, accessories, equipment or materials not supplied by Graco.

This warranty is conditioned upon the prepaid return of the equipment claimed to be defective to an authorized Graco distributor for verification of the claimed defect. If the claimed defect is verified, Graco will repair or replace free of charge any defective parts. The equipment will be returned to the original purchaser transportation prepaid. If inspection of the equipment does not disclose any defect in material or workmanship, repairs will be made at a reasonable charge, which charges may include the costs of parts, labor, and transportation.

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Graco's sole obligation and buyer's sole remedy for any breach of warranty shall be as set forth above. The buyer agrees that no other remedy (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property, or any other incidental or consequential loss) shall be available. Any action for breach of warranty must be brought within two (2) years of the date of sale.

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