



**VARIOSPEED® CONSTANT PRESSURE  
BOOSTER SYSTEMS – SIMPLEX**  

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**INSTALLATION - OPERATION - MAINTENANCE  
MANUAL**



Simplex Booster System featuring VARIOspeed® N1



Simplex Booster System featuring VARIOspeed® 3R

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# INTRODUCTION

The Lancaster Simplex Booster System will provide constant water pressure by using the VARIOspeed® variable frequency drive to automatically control the pump speed as flow and head conditions change in the plumbing system. The desired Set Pressure is the target pressure to be maintained at the pump discharge and is limited by the performance of the pump installed. Parameters are pre-programmed at the factory, but Set Pressure may be field adjusted. Sleep Frequency MUST be field adjusted. The VARIOspeed® controller's 4-line LCD display and keypad of the interface provide easy set up and operation, allowing non-VFD experts a greater comfort level with the drive.

The VARIOspeed® controller also provides:

- Motor protection
- Drive protection
- High pressure protection
- Low pressure protection (from pipe burst or run dry)
- Automatic system restart (after power loss, power spikes, brown outs, run dry)
- System fault log
- Energy savings which will result in a reduction of the pump system life cycle cost

**Inspect your system.** Occasionally, products are damaged during shipment. The Lancaster Simplex Booster Systems are shipped in a wooden crate on a wooden pallet and are designed to be lifted from the bottom by fork truck only. Care should be taken when uncrating the system to prevent damage. Any shipping damage should be reported to the shipping carrier/transportation company or your product dealer. Claims for shipping damage must be made through the shipping carrier. Save the system packaging material until the claim is settled.

**Carefully read all the instructions provided with the system.** In addition to this manual, the instruction packet shall include:

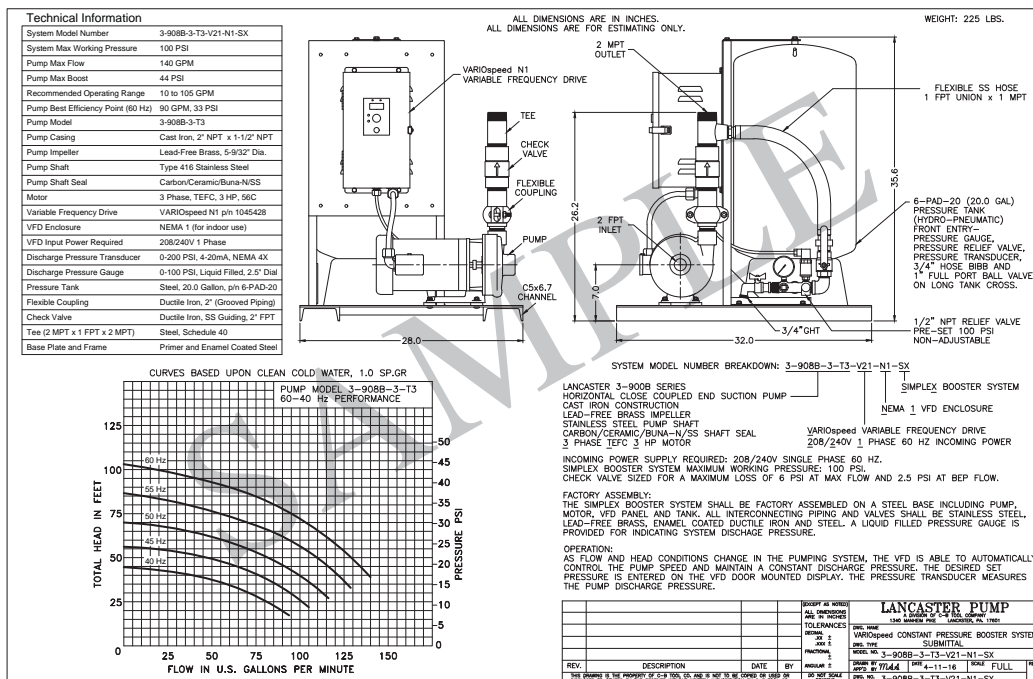
- LANCASTER PUMP VARIOspeed® User Manual with Factory Settings Supplement
- LANCASTER PUMP M900B Pump Manual including pump parts lists and assembly drawings
- LANCASTER PUMP Submittal Drawing for your specific model booster system

**Please read all instructions in their entirety before attempting to install, operate or maintain the system. Failure to follow all safety instructions could result in personal injury and/or property damage! Retain all instructions for future reference.**

Refer to the submittal drawing included in the instructions packet for your booster **system specifications**, including:

- Model number nomenclature description
- Dimensions and weight
- Component descriptions and materials of construction
- Electrical supply requirement (also see chart on page 5)
- Pump performance curves

**Maximum working pressure for the booster system is 100 psi.**



**SUBMITTAL DRAWING EXAMPLE**

# INSTALLATION

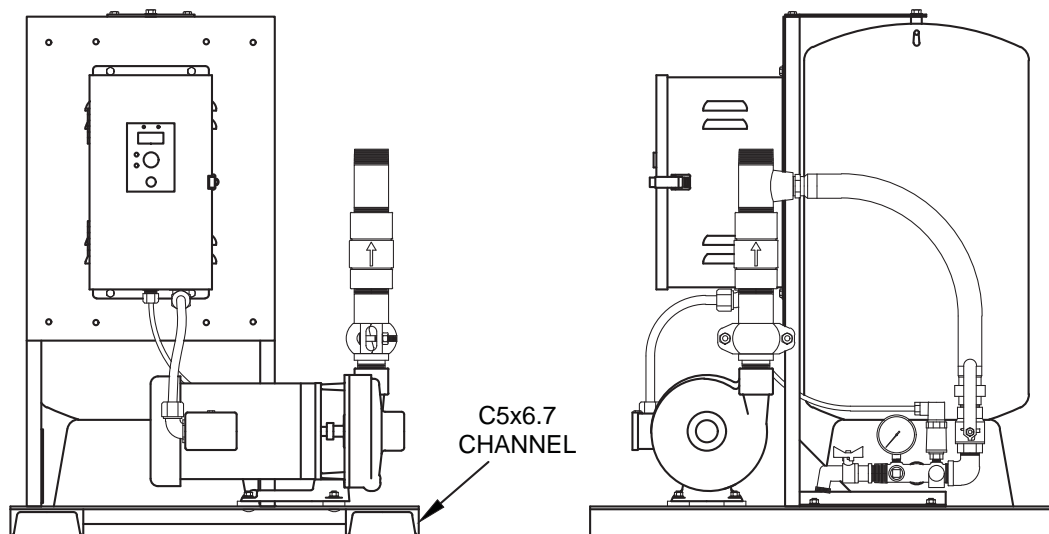
Installation should be performed by licensed or qualified personnel.

## LOCATION SELECTION

The booster system must be located where **ambient temperatures** do not exceed 104°F (40°C). The location should provide protection from the weather and the extremes of heat, humidity and below freezing temperatures. A dry location with ample clearance around the system for free air circulation and accessibility for inspection and maintenance is recommended. The booster system pump is equipped with a totally enclosed fan cooled, or **TEFC motor**. This means that the motor is protected from airborne contaminants, dust and wind-driven rain. The **TEFC motor** has a moderate water seal which allows for an outdoor location but is **not suitable** against high pressure water “wash down”. The booster system model number identifies the VARIOspeed® VFD enclosure as either **N1** or **N3R**. The **N1 (NEMA 1)** rated enclosure is intended for **indoor use only** and protects against dust, light, and indirect splashing but is **not dust-tight**. The **N3R (NEMA 3R)** rated enclosure is for **indoor or outdoor use** and is weather-resistant, protecting against falling dirt and rain, but is **not suitable** against high pressure water “wash down”.

## PLACEMENT

The booster system shall be lifted with the proper lifting equipment (fork lift). The C5x6.7 steel channel supports under the booster system base plate can accommodate fork lift forks. **DO NOT USE THE UPRIGHT FRAME ASSEMBLY TO LIFT THE SYSTEM.** The upright frame used to mount the VARIOspeed® controller is not designed to support the weight of the entire booster system. Install the booster system on a flat surface rated for the weight of the booster system. A properly sized concrete pad is recommended. Attach to pad as necessary.



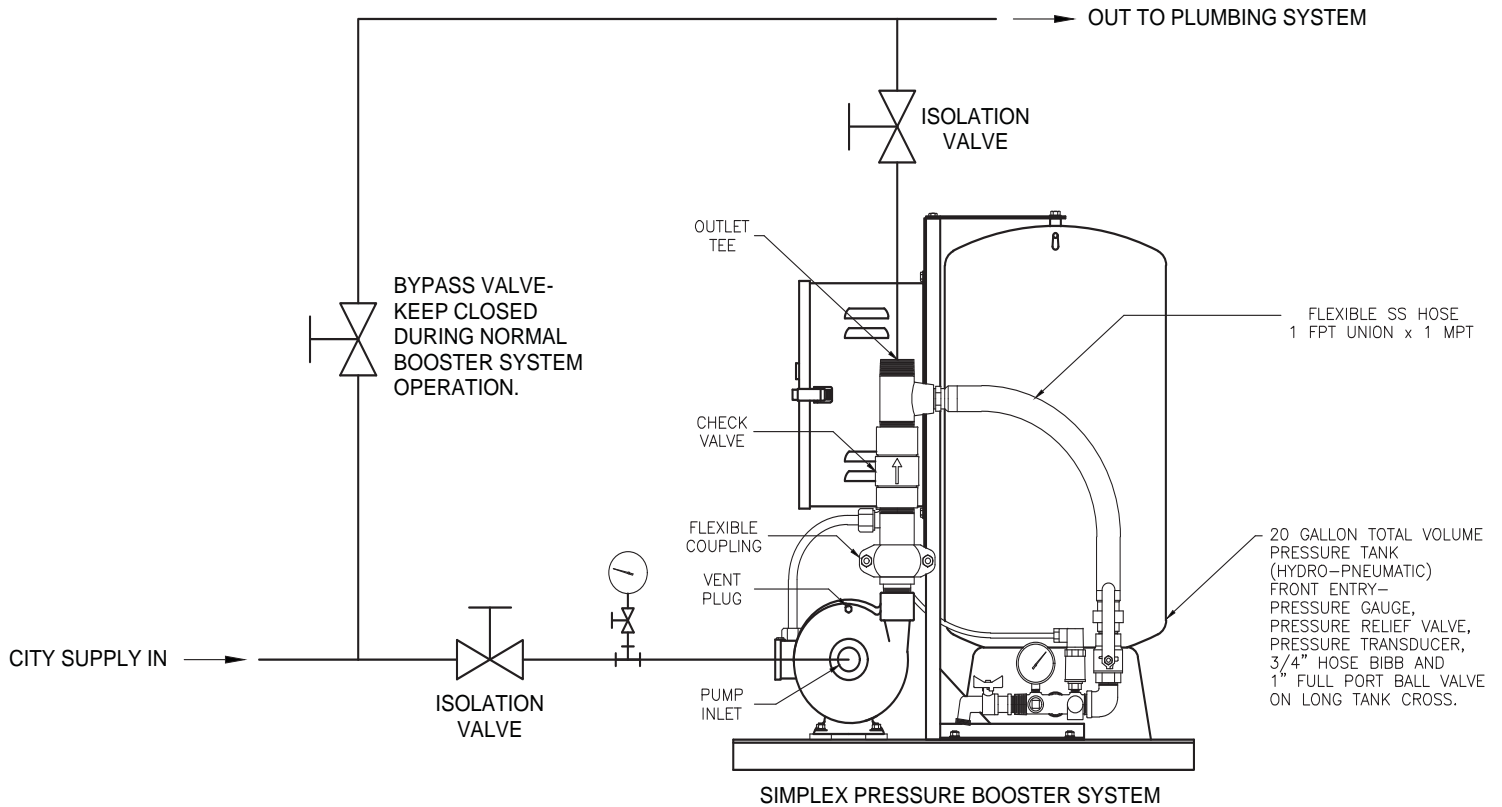
## PIPING

Use pipe compound or Teflon® tape on all male threads. To avoid strain on the booster system, all pipes should be aligned and supported independently before making any connections. When installing extra-long pipe, provide a means to take care of expansion in the pipes. Expansion joints can reduce the strain on the suction and discharge piping associated with system misalignment during installation. Expansion joints can also help reduce noise and vibration transmitted through the discharge piping to the downstream user.

The **suction pipe** should be at least the same size as the inlet tapping of the pump, and should be larger if the suction piping is long. The booster system **discharge pipe** fittings are sized to minimize pressure losses between the pump discharge tapping and outlet tee. To avoid causing damage to the booster system fittings, when tightening on the threads of the outlet tee, a pipe wrench should be used on the booster system fittings to keep them from turning. The discharge pipe should be at least the same size as the discharge tapping of the pump, and should be larger if the discharge piping is long.

A **bypass line** with properly placed valves is recommended. Unions and isolation valves on the inlet and discharge plumbing will provide serviceability of the booster system and protection of discharge plumbing fixtures down line of the booster system.

# TYPICAL FIELD PIPING



## WIRING

**WARNING:** Electrical installations shall be in accordance with the National Electric Code (NEC) and all applicable local codes and regulations. A licensed electrician should perform installation.

**DANGER:** Always disconnect the power source before performing any work on or near the booster system. If the power disconnect point is out-of-sight, lock it in the open position and tag it to prevent unexpected application of power. Refer to the VARIOspeed® User Manual; read and understand all of its warnings and precautions before attempting to wire the system!

With the electrical power supply OFF, wire the input power per the terminal connection diagrams available inside the VARIOspeed® enclosure and VARIOspeed® User Manual. The electrical power supply **must match** that as stated inside the VARIOspeed® enclosure and the following chart. Wire sizing between the electrical service entrance and the VARIOspeed® controller must be sufficient to provide the required **max input amps** to the controller while conforming to the latest edition of the NEC and local codes and regulations. Branch circuit protection via circuit breaker or fused disconnect switch must be provided and comply with the NEC and local codes and regulations.

Booster System Model	Power Supply Input to VFD	Max Input Amps	Booster Pump 3-phase Motor HP	* VFD Output to Motor	Max Output Amps	VFD Enclosure	VFD Enclosure Includes Circuit Breaker Disconnect
3-906B-3-T2-V21-N1-SX	208/240 VAC Single Phase	17.4	2	Three Phase	7.0	NEMA 1	NO
3-906B-3-T2-V21-N3R-SX	208/240 VAC Single Phase	17.4	2	Three Phase	7.0	NEMA 3R	YES: 2-pole 20A
3-908B-3-T3-V21-N1-SX	208/240 VAC Single Phase	24.2	3	Three Phase	10.0	NEMA 1	NO
3-908B-3-T3-V21-N3R-SX	208/240 VAC Single Phase	24.2	3	Three Phase	10.0	NEMA 3R	YES: 2-pole 30A
3-909B-3-T5-V23-N1-SX	208/240 VAC Three Phase	22.2	5	Three Phase	16.5	NEMA 1	NO
3-909B-3-T5-V23-N3R-SX	208/240 VAC Three Phase	22.2	5	Three Phase	16.5	NEMA 3R	YES: 3-pole 25A
3-910B-3-T7-V23-N1-SX	208/240 VAC Three Phase	37.5	7.5	Three Phase	31.8	NEMA 1	NO
3-910B-3-T7-V23-N3R-SX	208/240 VAC Three Phase	37.5	7.5	Three Phase	31.8	NEMA 3R	YES: 3-pole 50A
3-910B-3-T7-V43-N1-SX	480 VAC Three Phase	23.8	7.5	Three Phase	16.0	NEMA 1	NO
3-910B-3-T7-V43-N3R-SX	480 VAC Three Phase	23.8	7.5	Three Phase	16.0	NEMA 3R	NO: non-fused disconnect

\* The output voltage of the VFD cannot exceed the incoming voltage. Example: 208V in, 208V out (max).

## OPERATION

After the installation is completed, the following procedures **MUST** be completed **BEFORE** starting the system.

**Make sure the VARIOspeed® controller's OFF/AUTO switch is in the OFF position. Power may be applied to the booster system in order to display the VARIOspeed® controller features. Refer to the VARIOspeed® User Manual for display descriptions and programming examples. Lancaster Pump has pre-programmed the VARIOspeed® controller for your booster system. Refer to the Supplement sheet initialed and dated by the Lancaster Pump Technician. DO NOT start the pump yet. Keep the OFF/AUTO switch in the OFF position.**

### PRESSURE TANK AIR PRE-CHARGE

A pressure tank is required to maintain constant pressure and prevent frequent start up. A properly sized pressure tank is included on the booster system and has been air pre-charged to 42 psi at the factory in order to correlate with the VARIOspeed® controller 60 psi Set Pressure default value. Set Pressure is the target pressure to be maintained at the pump discharge. If the Set Pressure value is edited by the installer, the pressure tank air pre-charge should be adjusted to 70% of the edited Set Pressure value.

Set Pressure (psi)	Pressure Tank Air Pre-Charge (+/-2 psi)
30	21
35	25
40	28
45	32
50	35
55	39
60	42
65	46
70	49
75	53
80	56

The desired Set Pressure is limited by the performance of the pump installed on the booster system. Adjust the tank air pre-charge when the tank is empty, i.e. no water pressure. To maintain optimum pressure control, air pressure should be checked periodically. Water must be drained from the tank in order to accurately measure and adjust the air pressure using the air charge stem valve on the top of the tank and a tire gauge.

### PRIMING

**Flooded Suction Systems:** Flooded suction systems will have an incoming positive pressure from either a city main or elevated holding tank. Ensure that the user installed discharge isolation valve is closed. The 1" ball valve located on the booster system tank tee should be open. Remove the top most hex head plug from the front of the pump body to provide a vent for air trapped within the casting. Open the user installed suction isolation valve to allow water pressure to fill the booster system. Replace the pump vent plug when a steady stream of airless water runs out the hole. The 3/4" hose bib located on the booster system tank tee can be used to push out air from the system. Close the hose bib.

**Suction Lift Systems:** Although the booster system is primarily used for flooded suction applications as described in the previous paragraph, it can be used for suction lift applications. The LANCASTER PUMP M900B Pump Manual provides detailed instruction and a diagram regarding suction piping for suction lift systems. Suction lift systems require a foot valve installed at the opening of the suction pipe. The booster system discharge piping can be removed at the flex coupling to provide an opening above the pump body to be used as a fill port. Remove the top most hex head plug from the front of the pump body to provide a vent for trapped air to escape the pump casing. Fill the pump and suction piping with an external water source. Replace the pump vent plug when a steady stream of airless water runs out the hole. Ensure entire suction piping is pressure tight. Re-connect/seal the discharge piping.

### CHECK MOTOR ROTATION

After the booster pump system is filled and vented by following the priming instructions, the motor rotation can be checked. **Remember never operate the pump dry.** Rotate the pump shaft by hand to be certain it turns freely. Direction of rotation should be checked by observation of the pump shaft through the openings in the motor support casting. Briefly apply power to the pump motor by turning the VARIOspeed® controller OFF/AUTO switch to the AUTO position. Quickly switch back to the OFF position and observe the pump shaft direction of rotation as it slows down to a stop. Direction of rotation should be as shown by the cast arrow on the pump body. Viewing the front of the pump body, rotation should be CCW. In the event that the rotation is incorrect, **disconnect power to the VARIOspeed® VFD and WAIT 10 MINUTES before removing the VFD cover. Internal capacitors contain lethal voltage and need this time to fully discharge.** After 10 minutes, interchange any two of the three pump motor leads on the VARIOspeed® VFD terminal block (U, V, W). **It is ultimately the installers responsibility to ensure correct rotation.**

## STARTING THE SYSTEM

Now that the **pump is primed** and the motor **rotation is correct** the system is almost ready to be started. **Before starting**, make sure the user installed suction isolation valve (if installed) is completely open. When starting the system for the first time, and when there is no pressure in the discharge line, leave the user installed discharge isolation valve closed or partially open. **Start the system** by turning the VARIOspeed® controller OFF/AUTO switch to the AUTO position. Gradually open the discharge isolation valve and open valves farthest away from the system to bleed air out of the system and piping. Do not fully open the discharge isolation valve until all the air has been purged from the lines. Opening this valve too fast may cause water hammer in the discharge line. After all systems lines have been filled with water, the discharge isolation valve may be fully open.

## OFF/AUTO

**OFF:** when the VARIOspeed® controllers OFF/AUTO switch is in the **OFF** position, **the pump will not run. Programming adjustments** should be made with the switch in the **OFF** position.

**AUTO:** when the VARIOspeed® controllers OFF/AUTO switch is in the **AUTO** position, the pump will not run if the pressure is above the **Set Pressure**. The pump will start automatically if the pressure drops below the **Set Pressure** less the **Start Diff. Pressure**. The pump will stop running and the VARIOspeed® controller will enter the “sleep” mode when the output frequency of the VFD drops below the **Sleep Frequency** for a period of time (**Sleep Time**).

## PROGRAMMING

Lancaster Pump has pre-programmed the VARIOspeed® controller for your booster system as indicated on the Parameter Setup List Supplement to the VARIOspeed® User Manual. Refer to the VARIOspeed® User Manual for descriptions of display features, navigation, programming examples and parameters. The following are parameters that the installer must pay particular attention to:

**Set Pressure:** Set Pressure is the target pressure to be maintained at the pump discharge. The desired Set Pressure is limited by the performance of the pump installed on the booster system. If the Set Pressure is edited by the installer, the pressure tank air pre-charge should be adjusted to 70% of the edited Set Pressure value (see PRESSURE TANK AIR PRE-CHARGE section).

**Sleep Frequency:** Sleep Frequency is application specific and **MUST** be adjusted by the installer after determining the “deadhead” Hz when there is no flow of water in the system. When the pump no longer builds pressure while operating at or near the Set Pressure, note the output frequency on the display. Switch the controller OFF/AUTO switch to the OFF position. Enter the settings menu, find and select Set Sleep Frequency. Edit the value to the “deadhead” frequency you noted or to a value just slightly higher. Save to the edited value and exit the editing screen. Return to the main display. Switch the controller OFF/AUTO switch to the AUTO position.

Note – Sleep Frequency is NOT related to the Min Frequency setting.

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## MAINTENANCE

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**WARNING – Lethal voltages are still present inside the VARIOspeed® N1 and 3R VFD after power is disconnected. Wait 10 minutes to allow internal capacitors to fully discharge before attempting to connect or disconnect wire to service this equipment.**

**The VARIOspeed® N1 and 3R VFD contains no serviceable parts; do not attempt to repair this equipment.**

Refer to the VARIOspeed® User Manual for Viewing Log instructions:

- Viewing Pump Motor Run Time
- Viewing VFD Fault History
- Viewing System Fault Log

Refer to the Lancaster Pump M900B Pump Manual for pump maintenance.

To maintain the optimum pressure control, check the air pressure in the tank regularly.

## TROUBLESHOOTING

Refer to the VARIOspeed® User Manual for descriptions of main display messages such as Faults, Alarms and Warning Codes. If a fault is currently active, the fault will flash on the display. After taking appropriate corrective actions to fix the fault, the fault can be reset by pressing the STOP/RESET button on the VFD... the OFF/AUTO switch **MUST** be in the **OFF** position when resetting any fault. An alternative method to reset a fault is to remove power from the VFD and repower after one minute.

Refer to the Lancaster Pump M900B Manual for pump specific troubleshooting.

### SYSTEM TROUBLESHOOTING

Problem	Possible Cause	Corrective Action
Pump is running but does not deliver water.	User installed bypass line/valve open.	Locate bypass valve (if applicable) and close valve entirely.
	User installed inlet and discharge isolation valves closed.	Open isolation valves entirely.
Pump is running but does not deliver enough water flow and/or pressure.	Motor operating in the wrong direction of rotation.	Disconnect power to the VFD. Wait 10 minutes. Interchange any two of the three pump motor leads on the VFD terminal block (U, V, W).
	Booster System too small to meet application demand.	Review system selection performance curves. Consult factory.
Pump cycles on and off too frequently	Incorrect air pressure in tank.	Drain the tank and check the pre-charge air pressure (should be 70% of the system Set Pressure setting).
	Water logged tank	Check tank for bladder damage. Replace tank if necessary.
	<p><b>Sleep Time</b> too low (the amount of time the VFD will wait before entering "sleep" mode after the output frequency drops below the Sleep Frequency).</p> <p><b>Sleep Frequency</b> too high.</p> <p><b>Start Diff. Pressure</b> too low (the amount of pressure drop from the Set Pressure, at which the VFD will wake from sleep and run to maintain the system pressure).</p>	<p>Increase <b>Sleep Time</b>.</p> <p>Lower <b>Sleep Frequency</b>.</p> <p>Increase <b>Start Diff. Pressure</b>.</p> <p>A combination of all three settings may be necessary. Programming adjustments should be made with the OFF/AUTO switch in the OFF position.</p>
Pump continues to run when there is no flow of water in the system.	The VFD does not enter "sleep mode" when there is no flow of water in the system.	<p><b>Sleep Frequency</b> must be increased.</p> <p>Programming adjustments should be made with the OFF/AUTO switch in the OFF position.</p>

# LANCASTER PUMP

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