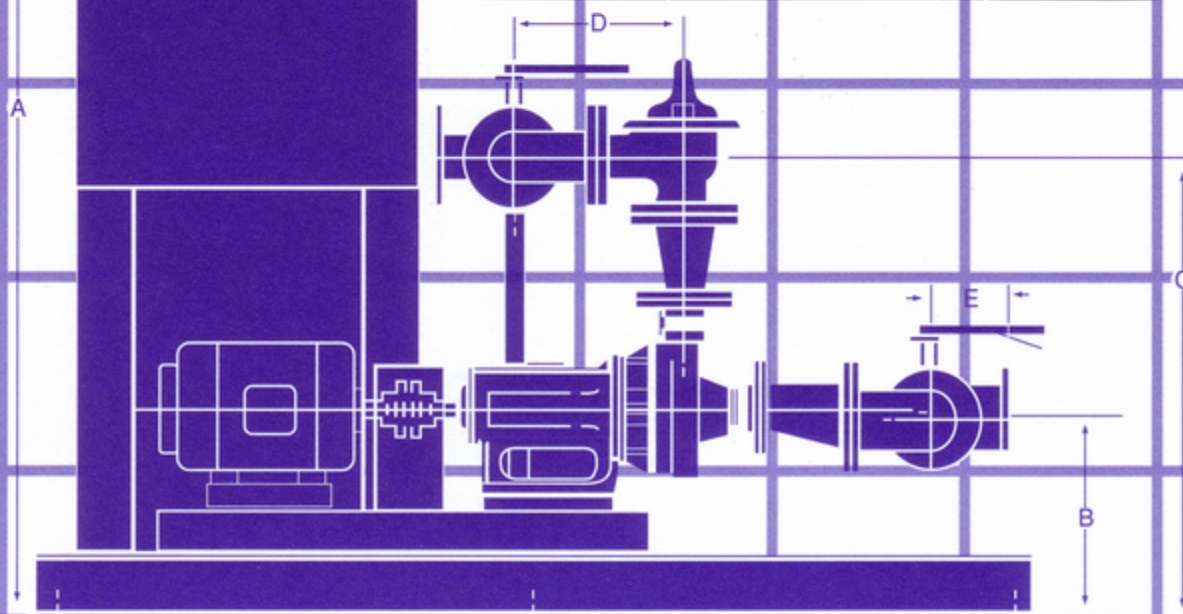


AQUA-PAK
**INSTALLATION, OPERATION &
MAINTENANCE FOR
DUPLEX VARIABLE SPEED SYSTEMS**



**Ultimate
Adaptability...**

FLO-PAK®
A business unit of Patterson Pump Company

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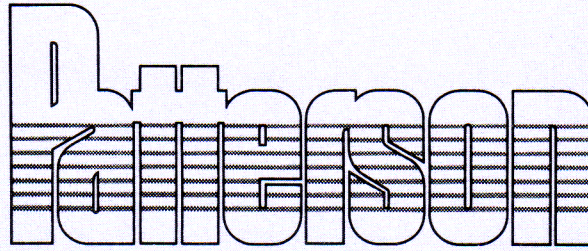
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Warranty

Patterson Pump Company and Divisions of Patterson Pump Company ("Patterson") warrants, to the extent hereinafter set forth, each new piece of Patterson equipment to be free from defects in material and workmanship under the normal use and service for which it was intended if, and only if, it has been properly installed and operated.

Patterson's obligation under the warranty is limited to replacing or repairing, free of charge, F.O.B. point of manufacture, any defective part or parts of the equipment that were manufactured by Patterson and which are returned to Patterson at Toccoa, Georgia, provided that such part or parts are received at the Patterson factory not later than twelve (12) months after installation or eighteen (18) months after shipment whichever occurs first.

As to a part or parts such as engines, motors and accessories which are furnished by Patterson, but not manufactured by it, same will carry only the warranty of the manufacturer of such part or parts, and this shall be the limit of Patterson's liability with respect to such part or parts. Mechanical seals provided on commercial products (HVAC & Plumbing) are not covered by this warranty.

Purchaser must notify Patterson by registered or certified mail, return receipt requested, of a claimed breach of warranty within thirty (30) days after discovery thereof, but not later than the termination of the guarantee period hereinabove provided; otherwise, such claim shall be deemed waived.

Purchaser assumes all risk and liability whatsoever resulting from the use thereof, whether used singly or in combination with other equipment or machinery.

This warranty shall not apply to any Patterson Equipment, or parts thereof, which have been repaired or altered without Patterson's written consent, outside Patterson's factory, or which have been altered in any way so as in the judgement of Patterson, to affect adversely the performance or reliability of the Patterson equipment, or which have been subject to misuse, negligence or accident, or which have been operated under conditions more severe than, or otherwise exceeding, those set forth in the specifications for such equipment.

THIS WARRANTY IS FURNISHED EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE NOT OTHERWISE SET FORTH IN A WRITING SIGNED BY AN AUTHORIZED REPRESENTATIVE OF PATTERSON.

Patterson shall not be liable for any loss or damage resulting, directly or indirectly, from the use or loss of use of the equipment. Without limiting the generality of the foregoing, this exclusion from liability embraces the Purchaser's expenses for downtime or for making up downtime, and/or damage for which the purchaser may be liable to other persons, and/or damages to property, and/or injury to or death of any persons. Patterson neither assumes nor authorizes any person to assume for it any other liability in connection with the sale or use of the Patterson Equipment.

PATTERSON PUMP COMPANY / A Subsidiary of Gorman-Rupp
2129 Ayersville Road
Box 790 / Toccoa, Georgia 30577 (706) 886-2101 / FAX (706) 886-0023
www.pattersonpumps.com

INSTALLATION AND STORAGE REQUIREMENTS FOR PUMP SKID UNIT

INSTALLATION:

1. The skid mounting surface can be a pad, but preferably a footing to support the entire perimeter of each of the skid unit(s). This footing should be designed in accordance with local building codes for the support of similar steel structures.
2. Typically the skid will be fabricated **WITHOUT** anchor bolt holes. Anchoring of the skid is done by placing anchor bolt plates over the bottom of the skid framing member and securing to the footing with expansion or epoxy anchor bolts. The skid is leveled, piping and electrical installation are complete before anchoring. For most installations, a total of eight (8) such anchors are recommended (local authorities may dictate otherwise) for each unit. This would include two (2) anchors down each long side (evenly spaced), with one (2) at each end (evenly spaced). For suggested anchor detail, see sketch attached.
3. After the skid is installed and leveled, but before anchoring, check the doors for fit and ease of movement. The entire package is assembled on a level surface at the factory and checked for proper operation before shipment. Occasionally, when the building is set, the doors do not line- up as they should. This can usually be corrected by shimming to level the skid on the foundation. Some experimenting may be required as each footing will vary slightly and the shim may need to be shifted until satisfactory door alignment is achieved. Once proper alignment is achieved the skid should be anchored down and the interior of the skid filled with concrete over a packed granular fill (gravel). The concrete should be 4"-6" thick and finished with some surface texture. For deckplated skids, the perimeter members of the skid should be grouted.
4. For skids with poured concrete floors, once the floor has cured the baseplate is to be grouted with a non-shrink grout.
5. The field electrician will need to connect the building heater. The field electrician is responsible for grounding the building per local codes.
6. All bolts need to be tightened after shipment. Bolts can become loose due to vibration from traveling and loading and unloading.
7. All valves are to be in the closed position prior to filling the system.
8. All drains in system that are to be field connected need to be routed appropriately by the installing contractor.
9. It is the installing contractor's responsibility to inspect the entire package before receiving the unit. Any damage must be noted in writing on the bill of lading. Pictures should be taken when possible. Failure to do so could result in a denial of a warranty claim.
10. All flexible coupled pumps shall be field aligned once the building has been anchored. Pumps are factory aligned, but vibrations in shipping and flexing of the station during loading and unloading may change the alignment. This shall be done by the installing contractor.

STORAGE:

1. Place on a dry, hard, level surface.
2. Protect from weather and airborne contamination (if not enclosed).
3. Protect from effects of temperature extremes and humidity, to prevent condensation.
4. Protect from physical damage.
5. Maintain corrosion protection on exposed bare metal surfaces.
6. Rotate pump shaft by hand at least once per week. Rotate two revolutions stopping at a point 90 degrees from the initial shaft position.

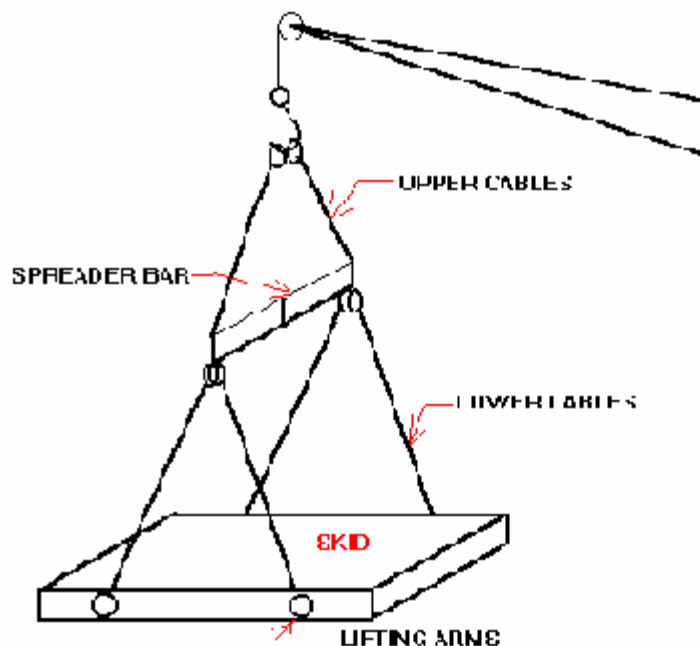
SKID UNLOADING GUIDE

LIFT ARM POSITIONING:

- The skid lifting arms consist of two pipes inserted through two larger Sch 40 pipes that are an integral part of the skid structure. The smaller pipes are approximately 4 FT longer than the skid width and when properly positioned will expand beyond the skid on each side. It is recommended that the lifter cables not be located farther than 6" from the skid structure.
- On larger units, the lifting arms are welded in place and are approximately 8 inches wider than the skid width, 4 inches on each side.
- On small units, four 5/8" eyebolts are used instead of lifting arms.

RIGGING:

- The lower cables attach between the four lift points on the skid and the spreader bar (see sketch). The cables (supplied by the crane operator) should be long enough so that the angle between the cables does not exceed the recommendation of the cable supplier. We have found that an included angle of 40-45 degrees between cables allows for good stability. The longer the cables, the more stable the load.
- The spreader bar (supplied by the crane operator), should be about two feet wider than the skid base. The upper cables should be somewhat longer than the lower cables (approximately 20%). Again, the cable manufacturer's recommendation should be followed.
- Proper rigging of the skid for lifting is the responsibility of the customer. The above rigging suggestions are meant only as a guide and are not to be construed as complete instructions, consequently Patterson Pump Company shall not be responsible for the use or misuse of these suggestions. The customer is encouraged to retain the services of a qualified contractor experienced in the rigging of similar structures.



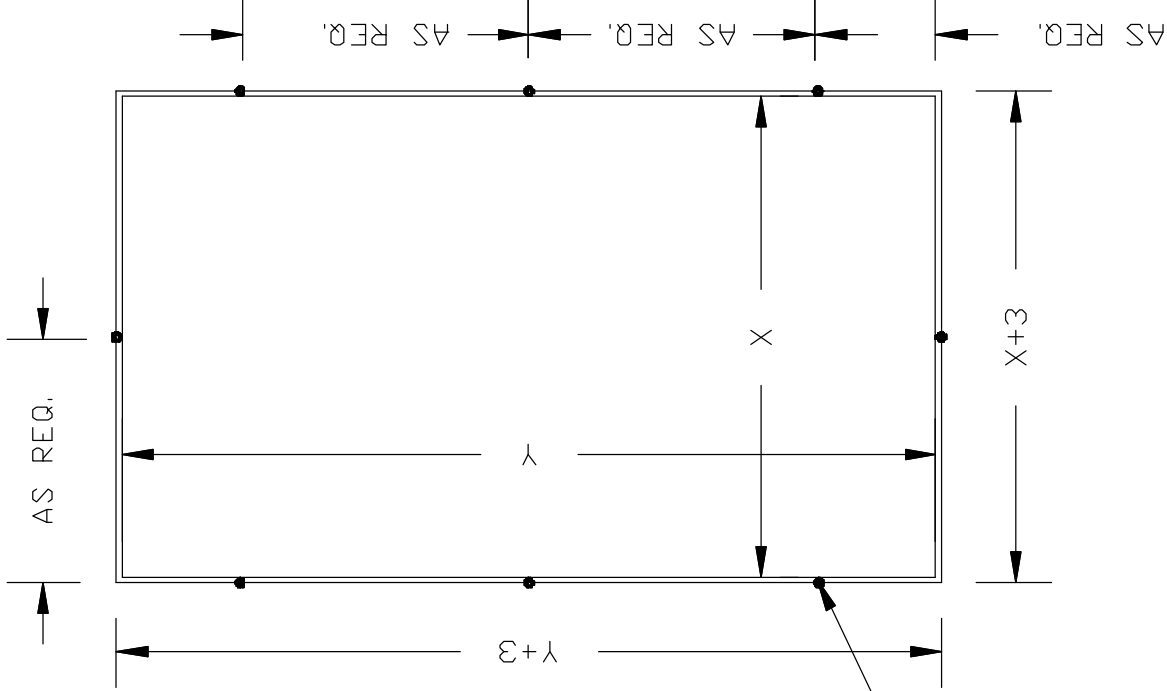
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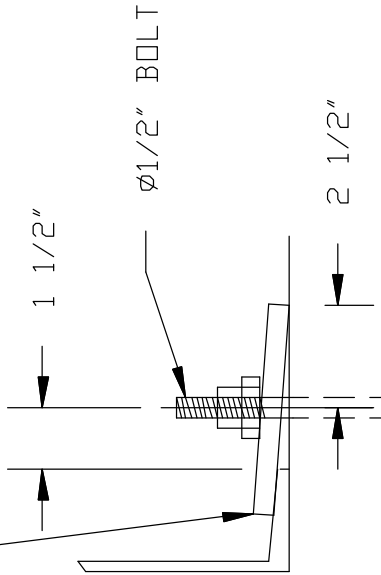
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DATE:	00/00/00
SCALE:	NONE
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DWG. NO.	---
REV. DATE	DESCRIPTION

CERTIFIED FOR APPROVAL ONLY X
CERTIFIED FOR CONSTRUCTION



1/2 x 3 x 6" PLATE



ANCHOR BOLTS
SPACED AS REQUIRED



INSTALLATION, OPERATION & MAINTENANCE MANUAL

Read this entire manual before proceeding.

SECTION I – INTRODUCTION

- 1-1** This manual provides general instructions for the installation and maintenance of the package pumping unit manufactured by Flo-Pak, Inc. / A Business Unit of Patterson Pump Company, Toccoa, Georgia.
- 1-2** After carefully uncrating or unpacking, check the equipment against the shipping papers, and inspect for any damage incurred during shipment. Immediately notify the carrier of any damage or shortage found.
- 1-3** The type and sizing of the unit was built to meet requirements provided by the purchaser. Among the more important requirements are the following:
- Liquid pumped
 - Flow in gallons-per-minute
 - Temperature of liquid pumped degree Fahrenheit
 - Suction condition, pressure or lift
 - Discharge pressure
 - Power supply characteristics
 - Location
- 1-4** If any of the requirements change after the order was placed, we suggest that each change be reviewed with the factory.

CAUTION: Operation of the package under conditions different from the design requirements may void the warranty!

SECTION II – INSTALLATION

2-1 Location

Select a location for the package which will be clean, well ventilated, properly drained, and provide accessibility for inspection and maintenance. Outdoor installation may require protection from the elements, particularly freezing.

PACKAGE PUMPING SYSTEMS

*** Installation
*** Operation
*** Maintenance

Read the entire manual before attempting to install, operate or repair this equipment.

Properly installed your Flo-Pak package will give you satisfactory and dependable service. We urge that you carefully read these step-by-step instructions to simplify any problems of installation, operation or repair.

Failure to read and comply with installation and operation instruction will void the responsibility of the manufacturer and may also result in bodily injury, as well as property damage.

This manual is intended to be a permanent part of your package installation and should be preserved in a convenient location for ready reference. If these instructions should become soiled, obtain a new copy from Flo-Pak. Be sure to include the package serial number you request.

2-2 Foundation

Concrete (reinforcement as necessary or required) is most widely used for the foundation. In sufficient mass it provides rigid support which minimizes deflection and vibration. It may be located on soil, structural steel or building floors, provided the combined weight of the package, grout and foundation does not exceed the allowable bearing load of the support. Allowable bearing loads of structural steel and floors can be obtained from engineering handbooks, building codes or local communities which give the recommended allowable bearing loads for different types of soil.

- 2-3** Before pouring, roughen the top surface to provide a good bond. Ordinarily the proportions used are 1 part cement to 3 parts sand and 4 parts medium aggregate.

- 2-4** If vibration or noise will be objectionable, as in office building, it may be advisable to use vibration dampeners between the package unit and foundation in conjunction with suction and discharge piping vibration suppressor.

2-5 Mounting

Set the package unit on the foundation base. Level the unit and check the alignment on the bearing frame units; tighten the foundation bolts.

2-6 Alignment Bearing Frame Units Only

Reliable, trouble-free and efficient operation of the unit depends on the correct alignment of the pumps and driver shafts. Misalignment may be the cause of:

- a. Noisy pump operation
- b. Vibration
- c. Premature bearing failure
- d. Excessive coupling wear

Note: Complete units are aligned at the factory. Experience has shown that all bases, no matter how rugged or deep in section, will twist during shipment. At the very least, the alignment must be checked after mounting.

Factors which may change the alignment of the unit after the initial installation:

- a. Settling of the foundation
- b. Springing of the base
- c. Piping strain
- d. Settling of the building
- e. Shift of pump driver on the foundation

2-7 Grouting

Grouting compensates for unevenness in the foundation and the base, as well as distributes the weight of the unit uniformly over the foundation. It also helps to prevent the unit from shifting after mounting. It is essential that the unit be expertly grouted by use of non-shrinking grout. Grout the unit as follows:

- a. Build a form of plywood or thin planking around the foundation to contain the grout. Support adequately to prevent deformation.

- b. Soak the top of the concrete pad thoroughly with water before grouting. Remove all surface water before pouring.
- c. A recommended mix of grout satisfactory for most applications is as follows:
 - 1. One part of normal Portland Cement – 94#
 - 2. One part of Embeco Cement – 100#
 - 3. One part of coarse clean sand – 100#
 - 4. One and one-half parts of ¼" pea gravel (1½ cu. Ft.)
 - 5. approximately 5 ½ gallons water
- d. Pour the grout into the base and, while pouring, tamp liberally in order to fill cavities and prevent air pockets. In order to prevent the base from shifting, grout 4" out from all sides of the base. Slant outside edges of the grout to prevent chipping.
- e. Approximately fourteen days after the grout has been poured or when the grout is thoroughly dried, apply an oil base paint to all exposed surfaces of the grout to prevent air and moisture from coming in contact with the grout.

2-8 Piping

The suction and discharge piping should be arranged for the most simple, direct layout and be of sufficient size and internally free of foreign material. The piping must never be pulled into position by the flange bolts. It must be independently supported and arranged in order to not induce any strain on the package.

Note: Piping should be cleaned and flushed prior to installing the package. A large number of packing, mechanical seals and seizure troubles of the pumps are due to improperly cleaned system.

2-9 Electricity

Connect the power supply to the package conforming to the National Electrical and local codes. Line voltage and wire capacity must match the rating stamped on the control panel nameplate.

- a. Only when the coupling halves are disconnected (frame mounted pumps) and the water supply is to the suction of the pumps, momentarily energize the panel and check that rotation of the pumps is correct by setting the hand-off-auto switch into the hand position.

- b. If the rotation is inaccurate, correct by changing any two of the three power leads.

SECTION III – LUBRICATION

3-1 Couplings

Couplings with rubber drive parts do not require lubrication; however, most couplings do require some form of lubrication. After completion of installation and alignment, and before operating the unit, lubricate couplings in accordance with the manufacturer's specific instruction contained in the package installation manual.

3-2 Ball Bearings

Reasonable care and proper lubrication of bearings will result in many years of service. The lubricant provides a film between the balls, separator and races, giving low friction and preventing excessive temperature rise and corrosion.

3-3 The normal life of ball bearings is terminated only by fatigue. Improper lubrication practices are the primary cause of failure. Good practice includes the following:

- a. Keep lubricant clean; provide and use a dust-tight cover on the storage container.
- b. Use the oldest lubricant first.
- c. Clean lubrication fittings before re-lubrication.
- d. Use clean dispensing equipment.
- e. Use the proper amount of lubricant. Too much grease results in churning and unnecessary power consumption, rapid heating to high temperatures which break down the grease.
- f. Use the correct lubricant. Grease Lithium Soap Base, meeting National Lubricating Grease Institute Grade 2 specifications. This has a safe operating temperature higher than 300 degrees Fahrenheit.

3-4 Operating Temperature

Use of the lubricants and procedures given in this manual will allow safe operation at bearing temperatures to 250 degrees Fahrenheit. Past experience, however, indicates the normal temperature will not exceed 250 degrees if the pumped fluid is well below that temperature.

- 3-5** A high normal operating temperature is not a sign of bearing failure. Normal temperatures vary with the seasons and the environment and may range from 0 to approximately 200 degrees Fahrenheit. A continuous rise from established normal operating temperature indicates trouble and probable failure of the bearings. Shut down the unit immediately. Disassemble, clean and inspect the bearings. Replace if required.

3-6 Re-Lubrication

Grease that has been in service does not “wear away.” It needs replacing only because of contamination by dust, metal particles, moisture or high temperature breakdown.

- a. Thoroughly clean greased fitting.
- b. Remove grease drain plug on equipment so equipped.
- c. Inject clean new grease.

SECTION IV – OPERATION

- 4-1** When making an initial start, after installation or major maintenance, check the following:

- a. Coupling alignment (if frame mounted).
- b. Bearing lubricant on pumps and drives.

- 4-2** Start the package as follows:

1. When possible, turn the pump shaft by hand to make sure parts do not bind.
2. Open suction valves.
3. Start drive in “hand” and check rotation. (Correct as necessary.)
4. With pump running in “hand” regulate system pressure by adjusting the pressure regulating valve. (See data sheet in manual.) Repeat this for all pumps on package.

SECTION V – MAINTENANCE

WARNING – DISCONNECT THE POWER TO ANY ROTATING OR ELECTRICAL COMPONENTS BEFORE STARTING ANY REPAIRS!

5-1 Regular consistent maintenance is the best way to avoid serious trouble which may require taking the unit out of service for extensive repair.

5-2 Bearings

It is essential to provide proper lubrication and keep bearings clean. Frequency of lubrication must be determined by experience as it depends upon bearing size, speed, operating conditions and location (environment). Table 1 should be used as a guide for grease re-lubrication.

TABLE 1	
<u>Operating Conditions</u>	<u>Lubricate</u>
Normal, 8-hour day operation. Area free of dust and damaging atmosphere.	Every six (6) months.
Severe, 24-hour day operation. Area with moderate dust and/or damaging atmosphere or outdoor service.	Every month.
Light, approximately 10-hour week. Area relatively free of dust and damaging atmosphere.	Every year.

5-3 Alignment – (Bearing frame unit only) – Check alignment yearly.

TABLE 2

<u>Problems</u>	<u>Probable Cause</u>	<u>Remedy</u>
Failure to deliver liquid or sufficient pressure.	Control valve not adjusted correctly.	Adjust control valve. (See valve manual.)
	Incorrect pump rotation.	Change rotation.
	Discharge head too high.	Check that all discharge valves are open and discharge line is free from obstructions. In some cases the installation needs to be altered or pump of suitable rating supplied.
	Impeller passages restricted.	Disassemble the pump and clean the impeller.
	Pump not up to speed.	Check for low motor voltage or motor overload.
	Worn wearing rings.	Replace worn parts.
Overload of driver.	Damaged impeller.	Replace or repair impeller.
	Total head lower than rating	Check suction and discharge pressure and determine the total dynamic head. If TDH is lower than rated, throttle discharge valve to rated TDH.
	Mechanical problem in pump or driver.	See if unit turns freely.
Vibration or noise.	Misalignment bearing (frame units only).	Realign unit.
	Worn ball bearing.	Replace bearings.
	Cracked foundation.	Replace foundation.
All pumps running lag units cycle off and back on again.	Control valve setting and start pressure switch not adjusted correctly in relation to one another.	Readjust.
	Too low setting on start delay timer.	Readjust.

TABLE 2
(Continued)

All pumps running lag units cycle off and back on again.	Package undersized for load.	Verify operating flow and head.
Low suction alarm tripping.	Low suction switch adjusted incorrectly or poorly.	Check adjustment.
	Actual low suction condition.	Check suction pressure with test gauge.
All other alarms.	Switches adjusted incorrectly.	Readjust.
	Actual alarm condition.	Verify and correct.
	Delay timer set too low.	Increase time delay.

5-4 Spare Parts

To keep delay to a minimum when package repairs are required, we suggest that the following spare parts be stocked:

Panel

- a. Spare set of fuses.
- b. Spare timer.
- c. Spare relay.
- d. Spare system pressure switch and suction pressure switch.

Pumps

- a. Spare mechanical seal for each size pump.
- b. Spare casing gasket for each size pump.
- c. Spare shaft sleeve for each size pump.
- d. Spare impeller for each size pump.

5-5 To obtain quick and accurate service when ordering spare parts, provide the following information:

1. Package serial number.
2. The name and number of parts shown on the data provided for the individual component.
3. Quantity required on each item.

Aid may be obtained from the Flo-Pak representative in your area or from the factory.

Flo-Pak, Inc.
P.O. Box 790
Toccoa, Georgia 30577
Telephone: 706-886-2101
Fax: 706-886-0023
www.flo-pak.com

A Business Unit of Patterson Pump Company

5/28/04



PUMP COMPANY / A Subsidiary of The Gorman –Rupp Co.
P.O. Box 790 / Toccoa, Georgia 30577 / (706) 886-2101 / FAX (706) 886-0023
www.pattersonpumps.com

General Pump Inspection and Maintenance Schedule
Packaged Pump Systems

Any additional inspections, maintenance, or tests required by NFPA- Standards for fire pumps are excluded.
Refer to NFPA Standards for additional requirements for fire pumps.

Actions required only for specific pump types are so noted.
The symbol (■) used in the table below indicates that the action indicated may not be applicable to a specific pump of a particular type.
For more information regarding inspection and maintenance requirements refer to the Patterson O & M manual supplied with the pump.
Contact Patterson Pump Company if assistance is needed to determine the inspection and service requirements for a specific pump.

Inspect (✓) or service (●) at the indicated calendar time or run time interval – whichever comes first	4 hours	Routinely	Monthly	2000 hours or 3 months	4000 hours or 6 months	8000 hours or 12 months
Replenish grease lubricated sleeve bearing grease per the O & M manual using the manual grease lubricator. Perform every 3 months while idle. (vertical wet pit pumps so equipped) ■	●					
Unusual noise		✓				
Unusual vibration		✓				
Unusual temperature		✓				
Leaks in pump or piping		✓				
Pressure gauge readings		✓				
Visual inspection of equipment general condition		✓				
Anytime a pump is opened, inspect the running clearances and restore them to original specifications if the running clearances have doubled (adjust ring clearances if so supplied or install new wear rings)		✓ ●				
Anytime a pump is opened, inspect the impeller for corrosion or excessive wear.		✓ ●				
Packing box – verify slight leakage (if excessive, adjust gland or seal water valve; replace packing if required) ■		✓ ●				
Mechanical seal (should be no leakage) ■		✓				
Drain lines are working properly ■		✓				
Coupling integrity ■		✓				
Drive shaft integrity ■		✓				
Verify proper operation of oil drip lubricator (vertical wet pit pumps so equipped) ■			✓			
Verify proper operation of automatic grease lubricator (vertical wet pit pumps so equipped) ■			✓			
Operate the pump (note – for vertical wet pit pumps first verify proper lubrication)			✓			
Tightness of foundation and hold-down bolts				✓		
Check coupling alignment and integrity (maintain records) ■				✓		
Add grease to pump anti-friction bearings (maintain records) ■				●		
Add grease to universal joint shafting u-joint bearings, anti-friction steady bearings (maintain records) ■				●		
Add grease to coupling (maintain records) ■				●		
Change anti-friction bearing oil (maintain records) ■				●		
Replace packing (all packing; not just the outermost ring) ■					●	
Clean and oil gland bolts (packed pumps) ■					●	
Verify free movement of packing glands (packed pumps) ■					✓	
Universal joint shafting and steady bearings wear check (replace bearings if required) ■					✓ ●	
Clean packing box						●
Check and flush seal water and drain piping						●
Perform a comparative field test (flow, pressures, and power) with calibrated instruments. Restore internal running clearances if results are unsatisfactory (install new wear rings).						✓ ●
Perform a comparative vibration test						✓
Remove packing and inspect sleeve(s). Replace if worn. (packed pumps) ■						✓ ●
Realign coupled pumps (maintain records) ■						●
Remove pump handhole covers and inspect impeller for corrosion and excessive wear (sewage pumps) ■						✓
Remove handhole covers to inspect the wear ring clearances. When the wear ring clearances have doubled, adjust the ring clearances to original specifications if so supplied or install new wear rings (sewage pumps). ■						✓ ●
Examine running clearance between propeller and propeller housing. When the running clearance has doubled, repair or replace the housing, housing liner, or propeller as appropriate. (model AFV axial flow pumps) ■						✓ ●
Inspect the impeller running clearance. Inspect the impeller housing for excessive wear. If the wear is not excessive, perform impeller adjustment. If the wear is excessive, repair or replace the impeller housing. (open impeller mixed flow pumps, such as models SAF, SAFV, SAFH, or TMF) ■						✓ ●
Inspect batteries & battery charger for proper charge.			✓			
Observe operation of fans & dampers such that the fans & dampers operate at set temperature, and damper opens upon operation of the diesel engine.			✓			
Jockey Pump – See manual for specific jockey maintenance requirements.			✓			
Engine Maintenance (Belts / Filters / Oil / Fuel Strainer) [See O&M manual for Engine]			✓ ●			
Replace any worn caulk around pipe exits on buildings.					✓	
Building Heater - Inspect for proper operation.					✓	
Inspect operation of all valves in system.					✓	
Lights (Outside, Inside, Emergency) – Inspect for proper operation.					✓	



Sequence of Operation

Duplex Variable Speed Booster

Rev. 2 07/19/10
(For PLC program Rev 8 and later)

Basic Operation

The pumps are started and stopped according to discharge pressure.

The “PID Set-point” is the set-point pressure desired to be maintained at the discharge header.

The start and stop set-points for the lead and lag pumps are “deviations” below the “PID Set-point”.

The operator can adjust the speed of the VFDs manually by placing the speed command to manual in the operator interface and altering the pump(s) speed by using the increase and decrease (up and down arrow) buttons.

The lead pump will start after an adjustable time delay when the discharge pressure drops to the start lead pressure set-point.

The lag pump will start after an adjustable time delay when the discharge pressure drops to the start lag pump pressure set-point or if the optional flow sensor is supplied, when the flow rate meets or exceeds the start lag pump set-point.

Once a pump has started, it will run for an adjustable minimum run time. The factory default minimum run time is set to 10 minutes.

Shutdown will occur in reverse order according to the starting sequence.

The lag pump will stop when the discharge pressure has risen to the stop lag pump set-point, its minimum run timer has expired and if the optional flow sensor is supplied, when the flow rate drops to or below the stop lag pump set-point.

The lead pump will stop when the discharge pressure has risen to the stop lead pump set-point, its minimum run timer has expired, the lag pump has stopped, the speed (PID Output) has dropped below an adjustable set-point and there is no flow as sensed by the optional no flow switch.

An optional no-flow switch can be provided to hold the lead pump on as long as there is 5 or more GPM still flowing through the system. This prevents unnecessary “cycling” of the lead pump.

Equal sized pumps are alternated every time all equal pumps have stopped (duty cycle alternation) or every 24 hours, whichever occurs first. The operator can select the hour for the 24 hour alternation.

Once the system piping has been filled and pressurized, the operator simply performs the following:

Set the HOA switches in the automatic position.

Set the desired PID pressure setpoint.

Set the starting and stopping set-point pressure deviations of the lead and lag pumps.

Set the starting and stopping flow rate set-points of the lag pumps if optional flow sensing is provided.

Set the speed control mode to “Auto”

System Safety Startup Mode

In the automatic mode of operation, if the pumps are stopped for certain conditions such as a shutdown alarm or if the system is disabled, the controller contains a routine which will take the system into a safety startup mode once the shutdown alarm condition has been reset or the system has been re-enabled.

Once a shutdown condition has been reset or the system has been re-enabled, the controller compares the current discharge pressure to the goal (final) PID set-point pressure. If the current discharge pressure is not more than 5 PSI below the goal PID

set-point, then the goal set-point is moved into the set-point register and normal operation is resumed. If the current discharge pressure is more than 5 PSI below the goal PID set-point, then the current discharge pressure plus the lead start deviation (typically set at 1 psi) is used as the initial startup set-point.

When the discharge pressure reaches the initial set-point, then 5 psi is added to the set-point after a 10 second time delay. This routine continues until the discharge pressure is within 5 psi of the goal set-point.

Once the discharge pressure is within 5 psi of the goal set-point, the goal set-point is moved into the set-point register and normal operation is resumed.

During the startup mode, the lag pumps are locked out from starting (in the automatic mode of operation).

During the startup mode, if the system fails to maintain any set-point pressure for an adjustable time (default of 5 minutes), the pump is stopped and the system is locked out, requiring a manual reset.

The conditions are as follows:

- Power loss
- Low suction shutdown
- High suction shutdown (if option provided)
- High discharge shutdown
- Irregular power (if option provided)
- Discharge pressure transducer failure
- All pumps have failed
- All pump HOA switches are turned off
- System has been disabled (via timeclock enable/disable)
- Goal set-point has been set to "0"

Low Suction Shutdown

In the event of low suction (supply) pressure, the pumps will be stopped and the Low Suction Pressure alarm will be initiated after an adjustable time delay. The alarm will automatically reset after 10 seconds if configured for auto reset or will require a manual reset if the alarm is configured for manual reset when the pressure rises above the alarm set-point. Once reset, the pumps will be re-enabled.

High Suction Shutdown

In the event of the optional high suction (supply) pressure, the pumps will be stopped and the High Suction Pressure alarm will be initiated after an adjustable time delay. The alarm will automatically reset after 10 seconds if configured for auto reset or will require a manual reset if the alarm is configured for manual reset when the pressure drops below the alarm set-point. Once reset, the pumps will be re-enabled.

Low Discharge Alarm

In the event of a low discharge pressure condition, the Low Discharge Pressure alarm will be initiated after an adjustable time delay. The alarm will automatically reset after 10 seconds if configured for auto reset or will require a manual reset if the alarm is configured for manual reset when the discharge pressure rises above the alarm set-point.

High Discharge Shutdown

In the event of a high discharge pressure condition, the pumps will be stopped and the High Discharge Pressure alarm will be initiated after an adjustable time delay. The alarm will automatically reset after 10 seconds if configured for auto reset or will require a manual reset if the alarm is configured for manual reset when the discharge pressure drops below the alarm set-point. Once the alarm is reset, the pumps will be re-enabled.

Discharge Pressure Transducer Failure

In the event of discharge pressure transducer failure, the pumps will be stopped and the PLC will remove this failed sensor from operation. The operator will be required to start the pumps manually (Hand) and use the manual speed mode for speed adjustment.

PLC Failure

In the event of programmable logic controller (PLC) failure, the pumps will stop. The operator will be able to start the pumps manually in an emergency only using the Remote/Local key on each VFD. When the pumps are started in this manner, there

are no pump or system shutdown safeties. The operator must monitor the system continuously when operating pumps in the backup start mode to prevent damage to the system, the pumps or other devices connected to the system.

HMI (Operator Interface) Failure

In the event that the HMI should fail, the PLC will continue to operate the system based on the last states for which the PLC was adjusted via the HMI. For example, if the HOA switches and speed control mode were left in the “auto” position, the PLC will continue to start, stop and regulate the pumps speed as if the HMI had never failed. Should the operator be required to stop the pumps, each VFD can be stopped at the VFD keypad by pressing the “Stop” key, the individual pump branch breakers can be opened or the main power disconnect can be opened to de-energize the system. Once power is restored, the system will return to the operating state before power was removed (will operate pumps automatically).

Pump/VFD Failure

In the event of a VFD fault or if the pump(s) HOA switch is placed in the off position, the PLC will ignore the failed pump in the starting/running sequence and will start the remaining pump in its place. The PLC will put the failed pump back into the starting/running sequence once the VFD fault has been cleared or when the HOA switch is put into the Auto position.

Operator Interface

All start/stop set-points and timers are adjustable via the operator interface. The touchscreen is menu driven for ease of navigation.

“System Setup” requires a level 1 password. These are the set-point screens for items such as PID set-point pressure, pumps start/stop, low suction or low discharge alarms, pump(s) minimum run timers, etc. To change data, the operator touches the data to be changed and a keypad will pop up. The operator inputs the new data and presses the enter (ENT) key. Note that if the “defaults loaded” alarm condition exists, the operator will not be able to change any set-points. The “defaults loaded” alarm must first be cleared in order to be able to change set-points.

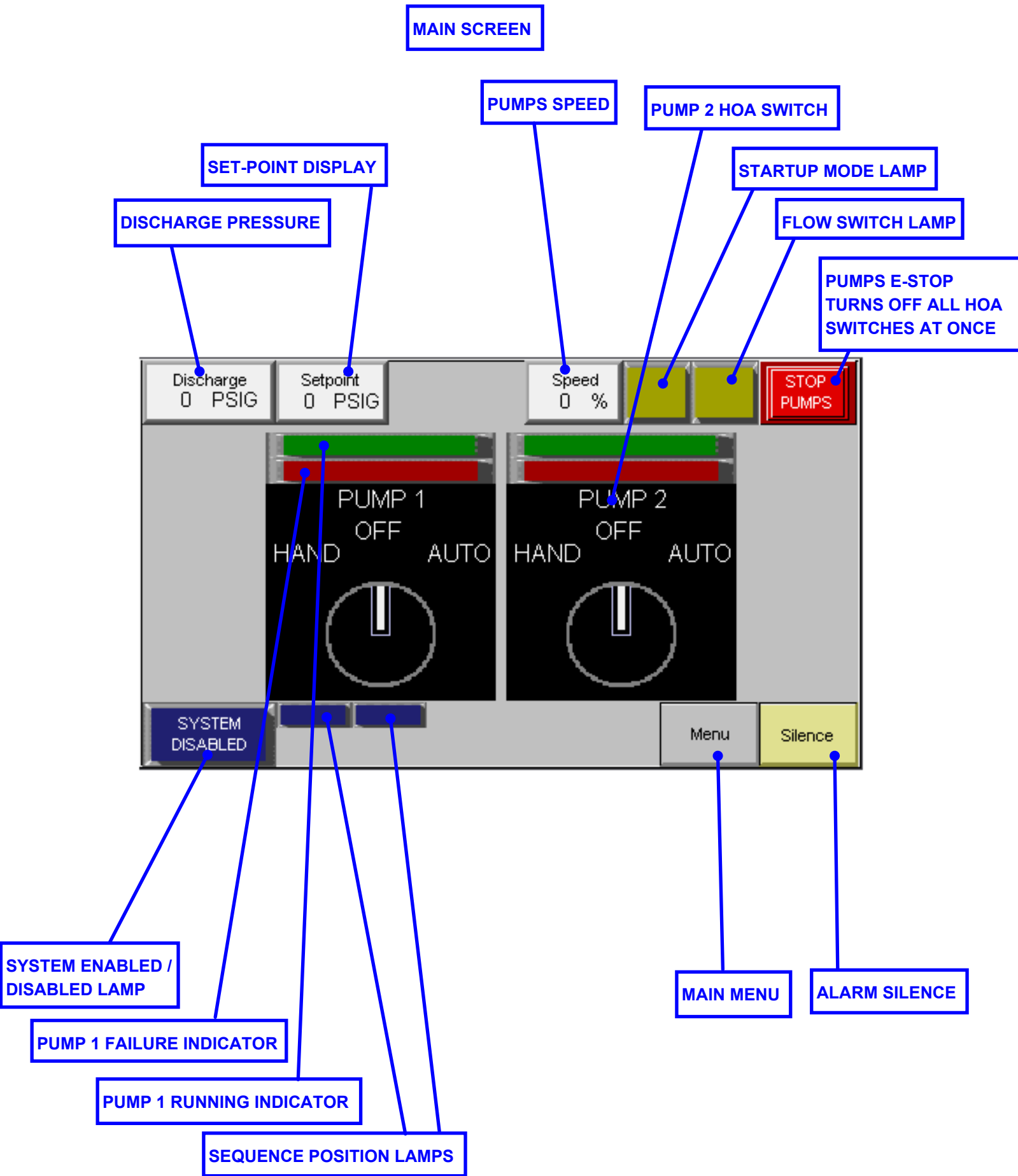
“Alarms” displays the alarm screen. The operator can touch an alarm lamp to bring up the reset type screen. If the operator desires a particular alarm to be of the manual reset type, the “Configuration” button is pressed to enter the reset type configuration screen. Not all alarm resets are configurable.

Alarms that require a manual reset are reset via the “Manual Alarms Reset” button located on the alarms screen.

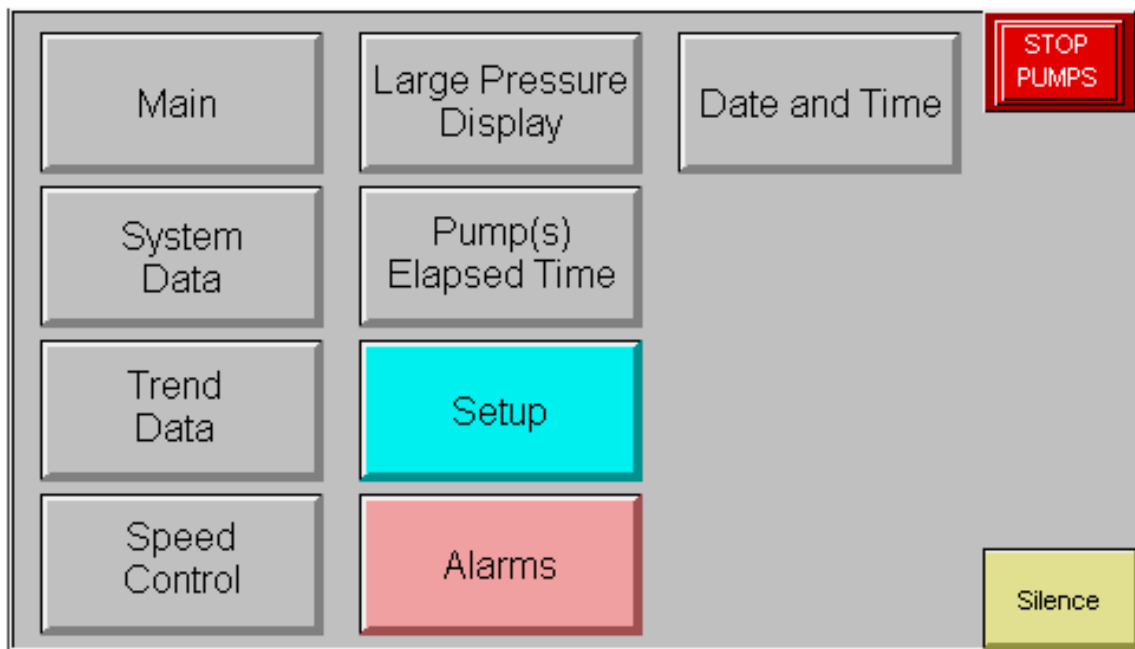
While in the “Alarms” screens, pressing the “Last 20 Alarms” button displays the last 20 alarms in order of occurrence. The operator uses the scroll up and scroll down arrows to scroll the list. The alarm status is such that if the alarm is red in color, it still exists or if white in color has been reset.

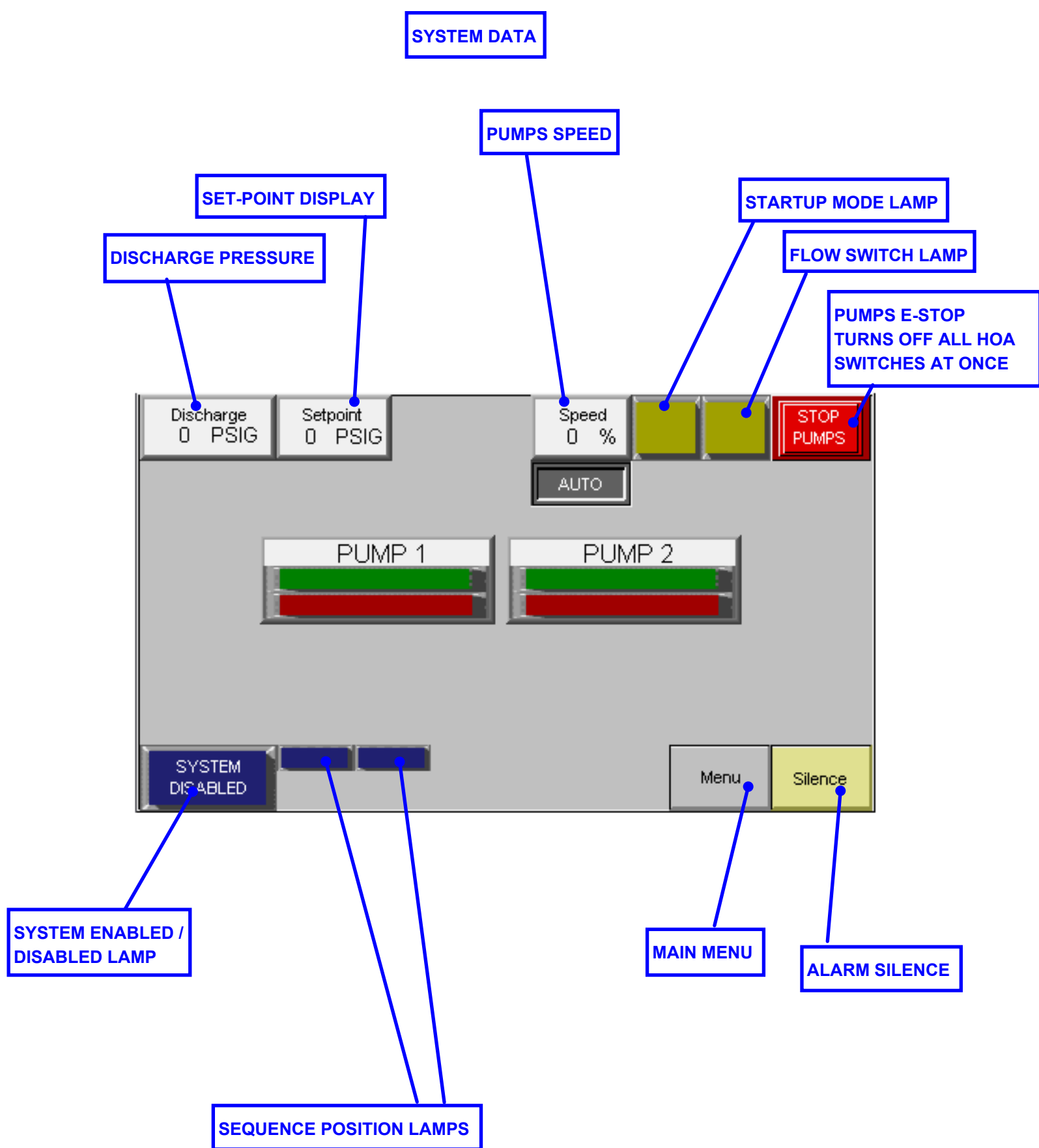
Communication

The control panel provides one dry normally open contact for system common alarm.

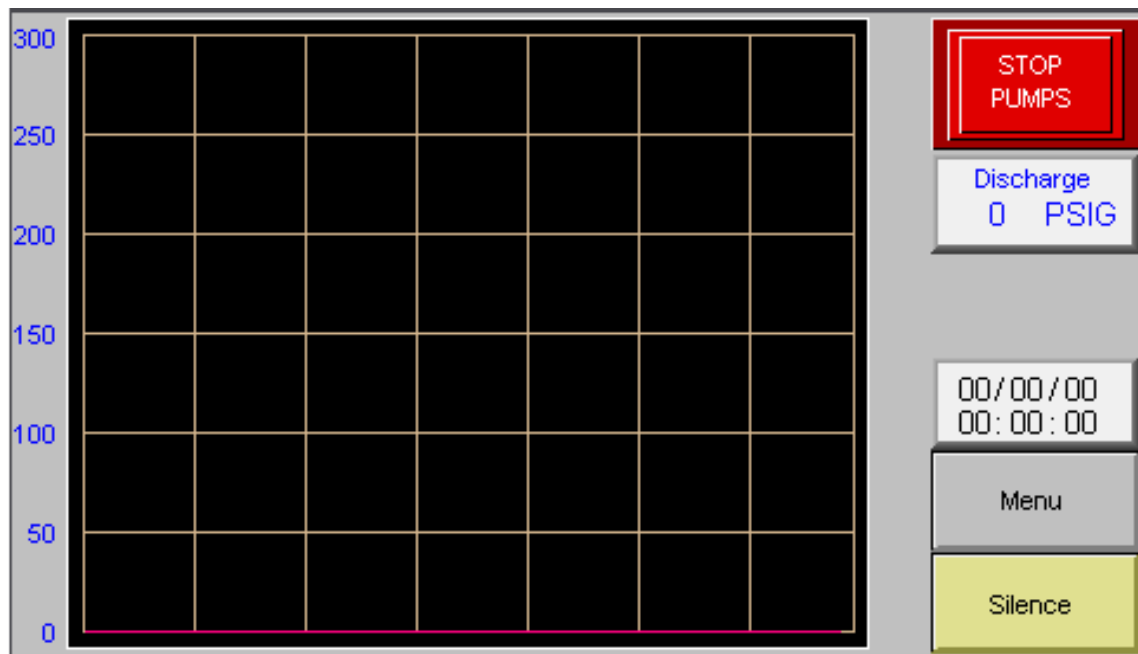


MAIN MENU





TREND DATA



SPEED CONTROL SCREEN

Discharge
0 PSIG

Setpoint
0 PSIG

STOP
PUMPS

Speed Control

Auto

Manual

Increase

Decrease

AUTO

Speed
0 %

SYSTEM
DISABLED

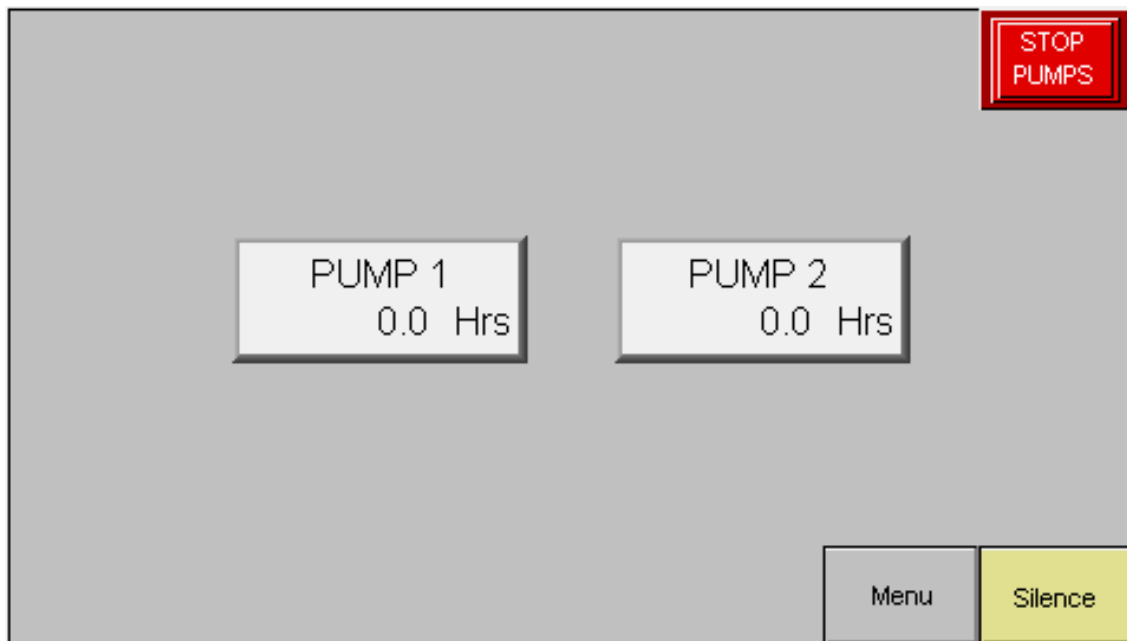
Menu

Silence

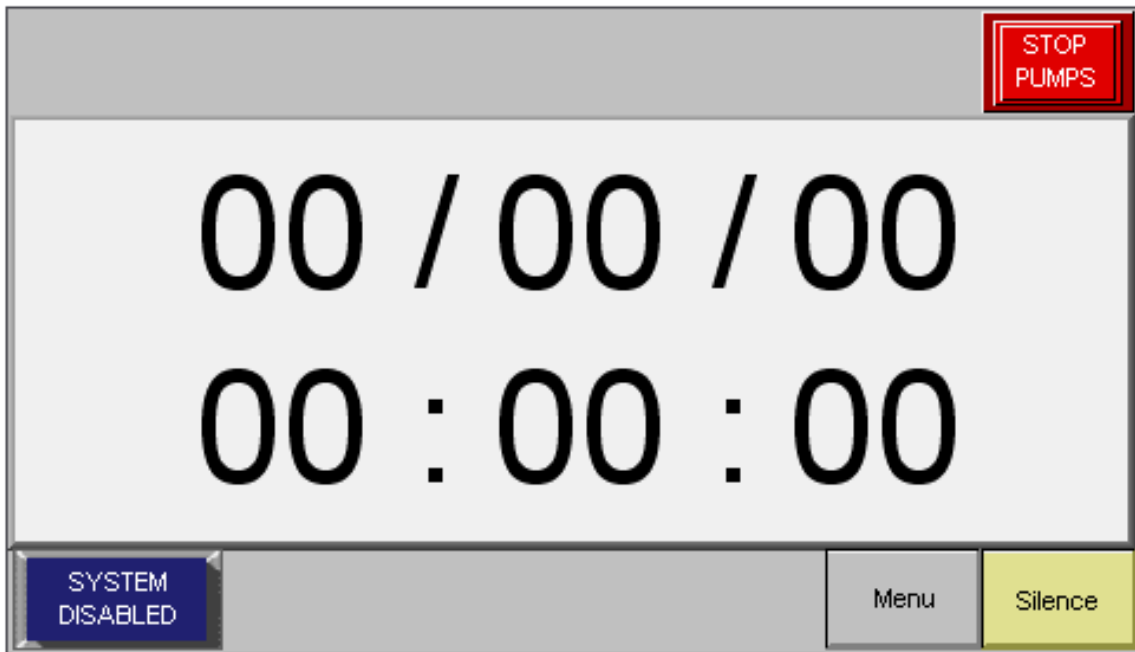
LARGE PRESSURE DISPLAY



ELAPSED TIMERS



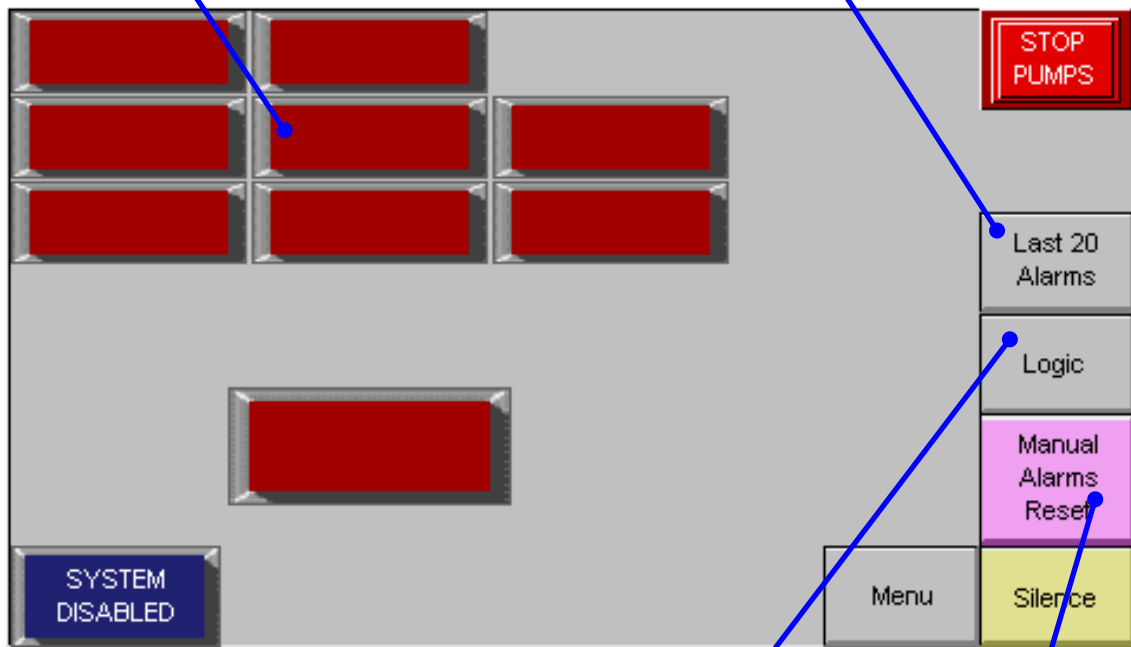
DATE / TIME



ALARM SCREENS

TOUCH ALARM TO VIEW RESET TYPE

TOUCH FOR LAST 20 ALARMS SCREEN



PUMPS START LOGIC SCREENS

RESET FOR MANUAL RESET TYPE ALARMS

ALARM RESET TYPE SCREEN

LOW DISCHARGE RESET METHOD	AUTO	DISCHARGE XDUCER RESET METHOD	AUTO
HIGH DISCHARGE RESET METHOD	AUTO	DEFAULTS ALARM RESET METHOD	MANUAL
LOW SUCTION RESET METHOD	AUTO	MEMORY BATTERY RESET METHOD	AUTO
		PUMP(s) FAILURE RESET METHOD	AUTO

NOTE:
RESET METHOD IS THE METHOD REQUIRED AFTER
THE ALARM CONDITION HAS BEEN CORRECTED.
(NOT ALL ARE CONFIGURABLE)

Back Configure

TOUCH FOR ALARM RESET TYPE
CONFIGURATION SCREEN

ALARM RESET TYPE CONFIGURATION SCREEN

The diagram illustrates the 'ALARM RESET TYPE CONFIGURATION SCREEN'. It features a table with three rows for different alarm types: 'SELECT LOW DISCHARGE RESET METHOD', 'SELECT HIGH DISCHARGE RESET METHOD', and 'SELECT LOW SUCTION RESET METHOD'. Each row has three columns: 'MANUAL' (cyan), 'AUTO' (cyan), and 'AUTO' (gray). Callouts point to the 'MANUAL' button in the first row, the 'AUTO' button in the first row, and the 'AUTO' button in the third row. A 'Back' button is located at the bottom right. A note at the bottom left explains the reset method.

SELECT LOW DISCHARGE RESET METHOD	MANUAL	AUTO	AUTO
SELECT HIGH DISCHARGE RESET METHOD	MANUAL	AUTO	AUTO
SELECT LOW SUCTION RESET METHOD	MANUAL	AUTO	AUTO

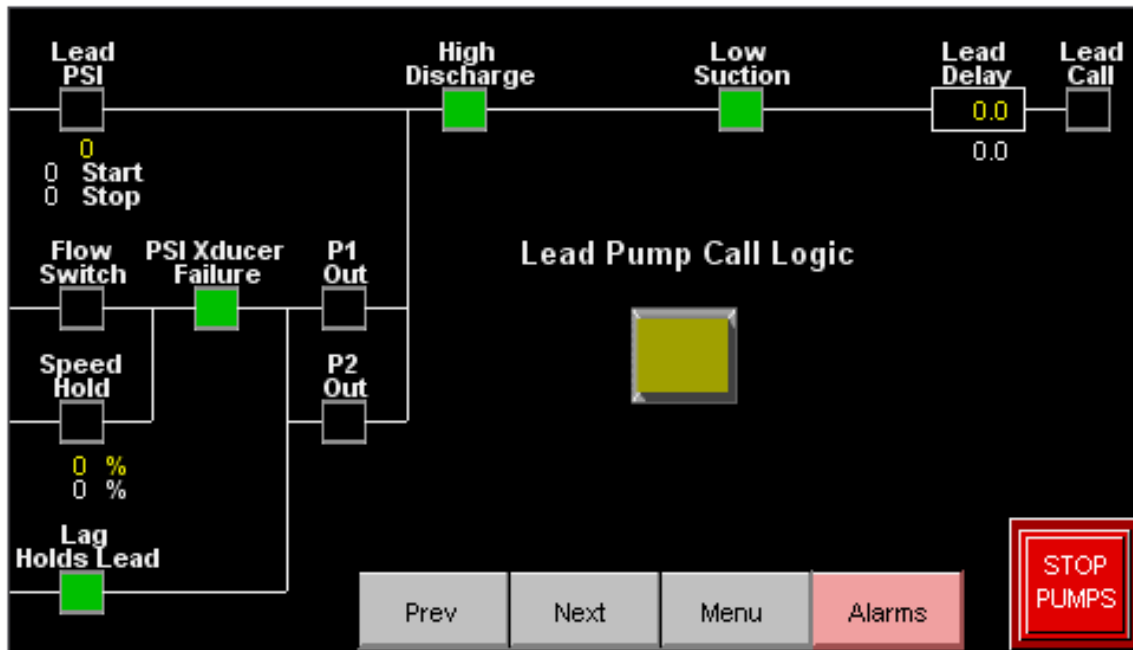
NOTE:
RESET METHOD IS THE METHOD
REQUIRED AFTER THE ALARM
CONDITION HAS BEEN CORRECTED

Back

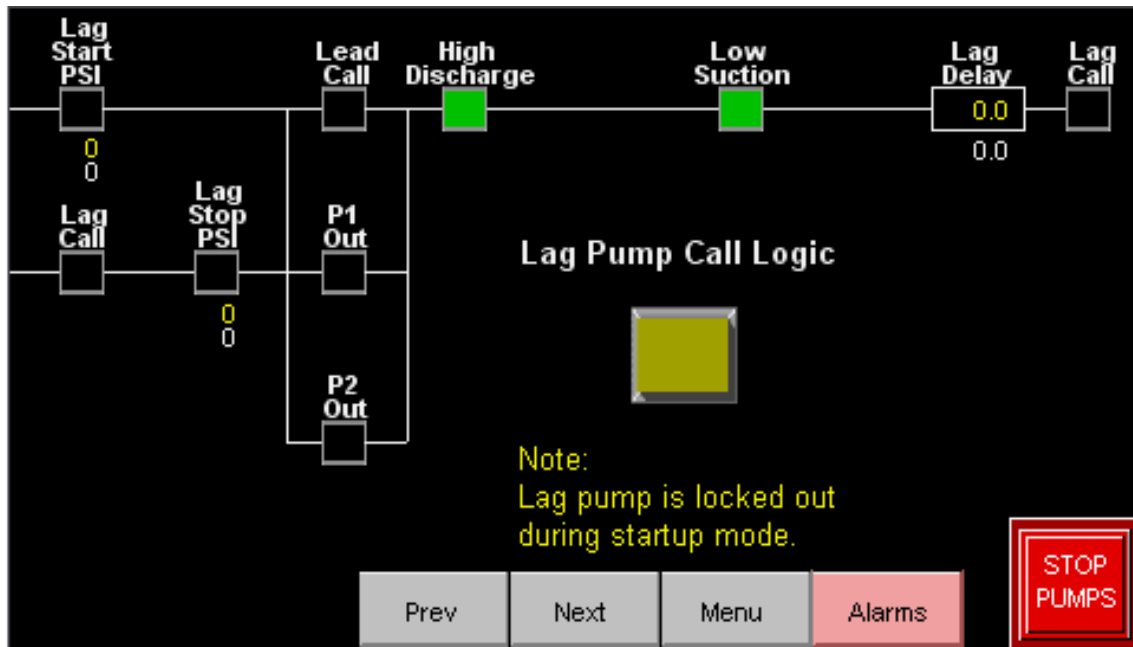
LAST 20 ALARMS SCREEN

System Events	00/00/00 00:00:00	STOP PUMPS
<div></div>		
ALARM STATUS WHITE = RESET RED = ACTIVE	Alarms	Menu Silence

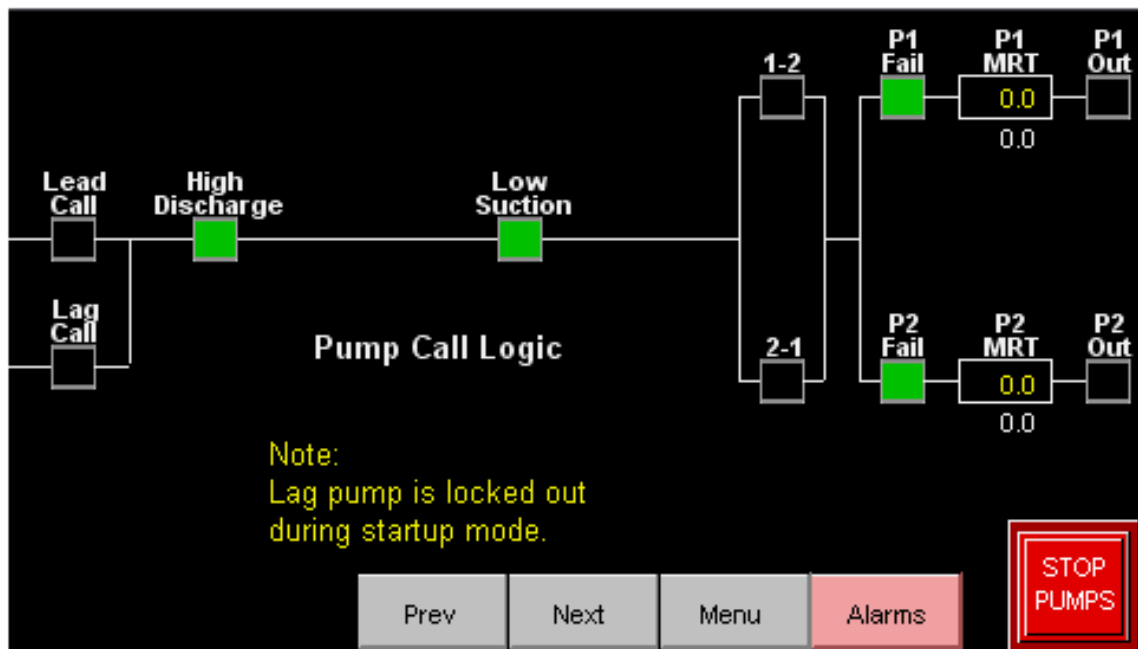
PUMPS START LOGIC SCREENS



PUMPS START LOGIC SCREENS



PUMPS START LOGIC SCREENS



SETUP SCREEN

To Enter Setup:

1. Note User # On Desired Setup Button
2. Press "User #" Button
3. Enter User #
4. Press "Password" Button
5. Enter Password
6. Press Desired Setup Button


STOP
PUMPS

User #
1

Password
*

System
Setup
(User 1)

PPTech
(User 2)

 Password Error

Menu

Silence

SETUP SCREEN

TOUCH DATA TO CHANGE VALUE

The screenshot shows a control interface with a black background and white text. A blue callout box with the text "TOUCH DATA TO CHANGE VALUE" has an arrow pointing to the yellow "0" value in the "PID Discharge Pressure Set-Point" line. The interface includes a red "STOP PUMPS" button in the top right, a "Speed 0 %" display, a "Discharge 0 PSIG" display, and a bottom navigation bar with "Menu", "Prev", and "Next" buttons. A small "1" is visible in the bottom left corner.

PID Discharge Pressure Set-Point	0	PSIG
Lead Pump Will Start	0	PSIG Below PID Setpoint
Lead Pump Will Stop	0	PSIG Below PID Setpoint
Hold Lead Pump On Until Speed Below	0	%
Lead Pump Start Delay	0.0	Seconds

1

Menu Prev Next

Speed
0 %

Discharge
0 PSIG

STOP PUMPS

SETUP SCREEN

Lag Pump Will Start0PSIG Below PID Setpoint

Lag Pump Will Stop0PSIG Below PID Setpoint

Lag Pump Start Delay0.0Seconds

STOP
PUMPS

Speed
0%

Discharge
0 PSIG

2

Menu

Prev

Next

SETUP SCREEN

Suction Pressure Setpoints

Low Suction Shutdown Delay 0.0 Seconds (0-99.9)

Low Suction Shutdown Auto Reset Delay 0.0 Seconds (0-99.9)

STOP PUMPS

3

MenuPrevNext

SETUP SCREEN

Discharge Pressure Setpoints		STOP PUMPS
Low Discharge Setpoint Is	0 PSIG Below PID Setpoint (0-300)	
Low Discharge Alarm Delay	0.0 Seconds (0-99.9)	
Low Discharge Alarm Auto Reset Delay	0.0 Seconds (0-99.9)	
High Discharge Setpoint Is	0 PSIG Above PID Setpoint (0-300)	
High Discharge Shutdown Delay	0.0 Seconds (0-99.9)	
High Discharge Shutdown Auto Reset Delay	0.0 Seconds (0-99.9)	

4

MenuPrevNext

Discharge
0 PSIG

SETUP SCREEN

Pump Minimum Run Timers

Pump 1 Minimum Run Time 0.0 Seconds (0-999.9)

Pump 2 Minimum Run Time 0.0 Seconds (0-999.9)

System Startup Mode Lockout Delay Time 0.0 Seconds (0-600.0)

Enter Any Number Below 9999 To Restore Default Parameters 0

5

MenuPrevNext

STOP PUMPS

SETUP SCREEN

STOP
PUMPS

PID Gain "P" 0.00 0.01 CV%/PV%

PID Integral "I" 0.000 Repeat/.001 secs

PID Derivative "D" 0.00 0.01 secs

PID OFF
ERROR

Speed
0 %

Discharge
0 PSIG

6

Menu

Prev

Next

SETUP SCREEN

Analog Input 1 Scaling (Discharge Pressure)

Analog Input 1 Scale Output High Value 0 PSIG (0-999)

Analog Input 1 Scale Output Low Value 0 PSIG (0-999)

Discharge
0 PSIG

7 Menu Prev Next

SETUP SCREEN

Time Clock Adjustment (24 Hour)			2010	STOP PUMPS
To Set Timeclock: - Stop The Clock - Enter New Values - Start The Clock		Month/Year 0000	Hours/Date 0000	Seconds/Minutes 0000
Stop Clock	Start Clock			
		SYSTEM DISABLED		
8	Menu	Prev	Next	00/00/00 00:00:00

Elapsed Timer Reset

STOP
PUMPS

Press To Reset
Pump 1
Elapsed Timer

Press To Reset
Pump 2
Elapsed Timer

0.0 Hrs

0.0 Hrs

9

Menu

Prev

Next

SETUP SCREEN

System Enable / Disable Time (Hour 0-23)

Sunday

Enable

00

Disable

00

Monday

Enable

00

Disable

00

Tuesday

Enable

00

Disable

00

Wednesday

Enable

00

Disable

00

Thursday

Enable

00

Disable

00

Friday

Enable

00

Disable

00

Saturday

Enable

00

Disable

00

STOP
PUMPS

Equal Times
For Full Time
Enable

SYSTEM
DISABLED

00/00/00
00:00:00

10

Menu

Prev

Next

24 Hour Alternation Override Time (Hour 0-23)

00

Device	Program	Revision
HMI	VS2EQ	8
PLC		0

STOP
PUMPS

SYSTEM
DISABLED

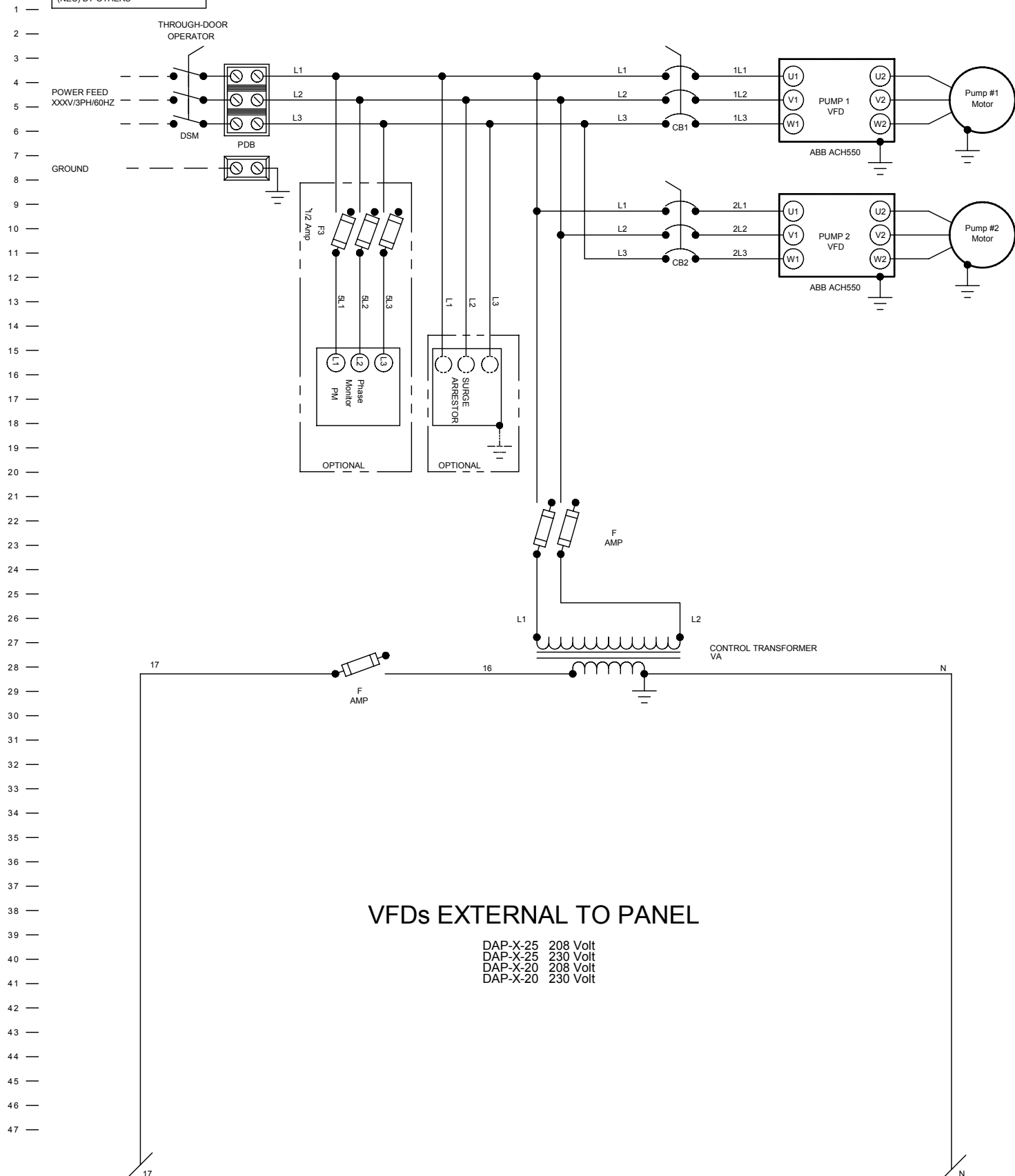
00/00/00
00:00:00

11

MenuPrevNext

OVERCURRENT PROTECTION
PROVIDED AND INSTALLED
IN ACCORDANCE WITH NFPA70
(NEC) BY OTHERS

VFDs EXTERNAL TO PANEL



DUPLEX VARIABLE SPEED AQUA-FLOPAC

Page 1A

FLO-PAK I NC.
A business unit of Patterson Pump Company

PUMP #1

PUMP #2

Power Feed

HP
FLA
BRKR

HP.
FLA
BRKR

XXXV/3PH/60Hz

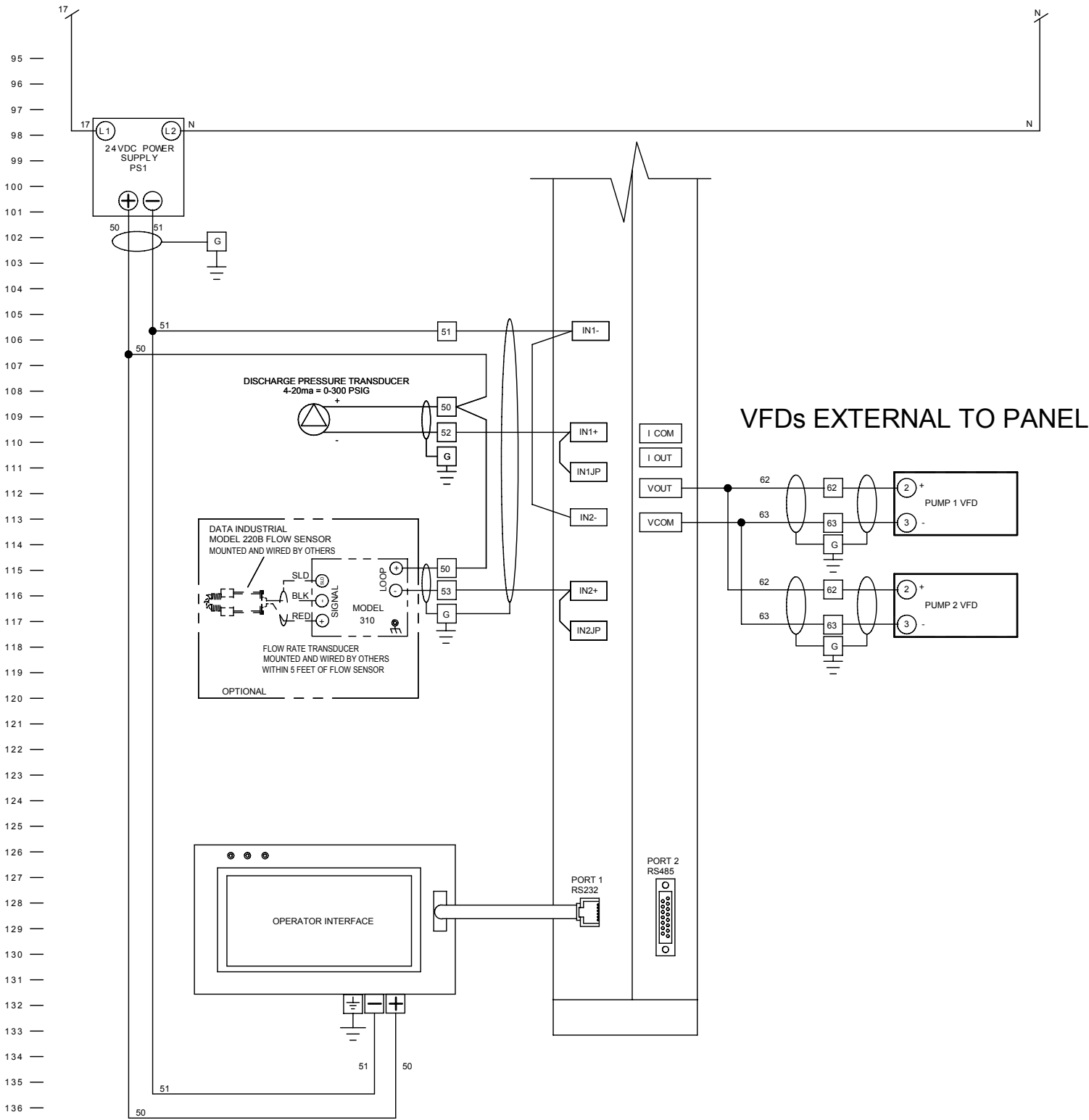
MCA - XX

Drawn By: WRW

Date 07/19/2010

Dwg Number: A85-109239-1

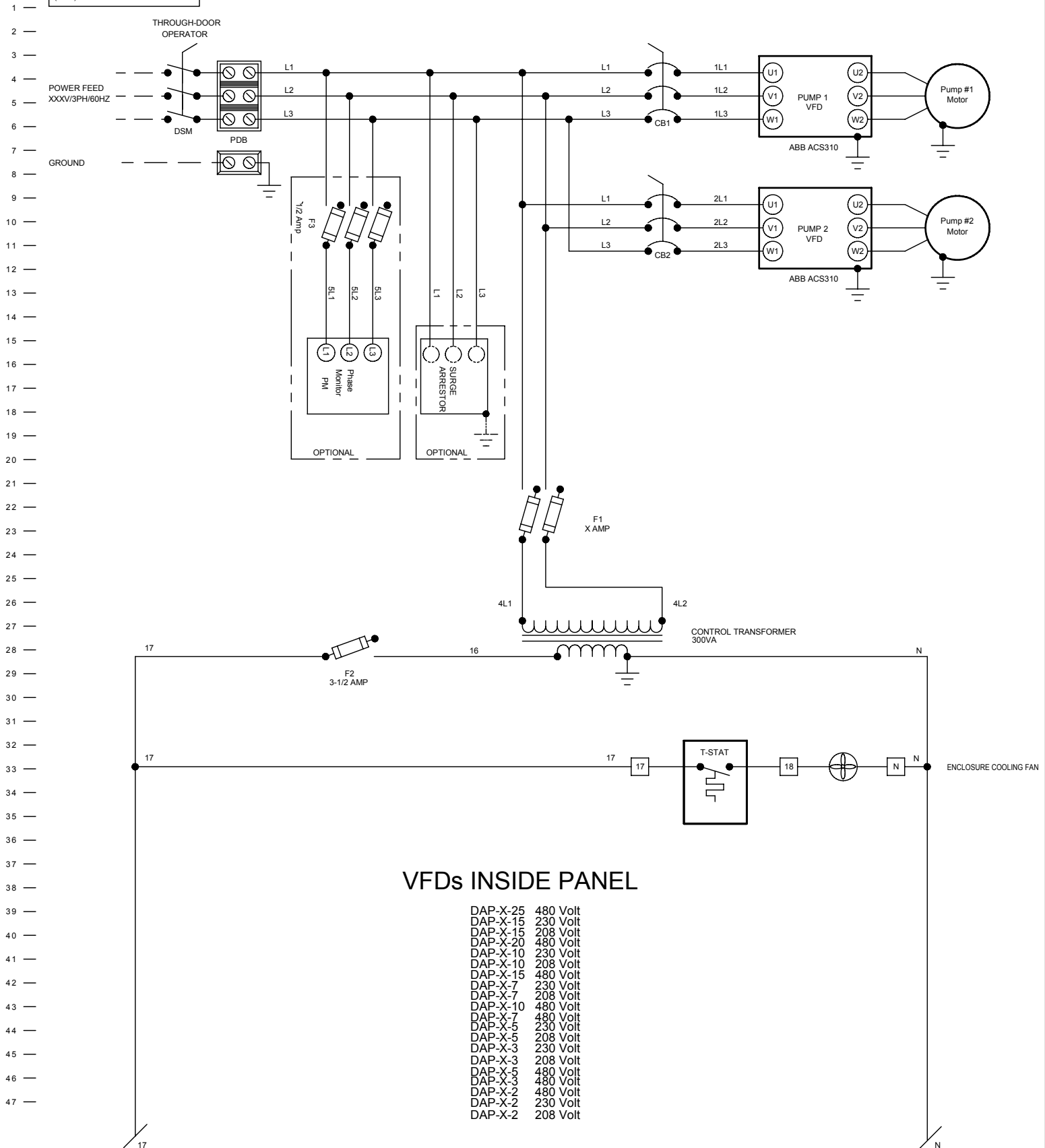
Rev: 1



INSTALLED OPTIONS	
<input type="checkbox"/>	PHASE MONITOR
<input type="checkbox"/>	SURGE ARRESTOR
<input type="checkbox"/>	FLOW SENSOR/TRANSMITTER
<input type="checkbox"/>	NO FLOW SWITCH
<input type="checkbox"/>	HIGH SUCTION PRESSURE SWITCH
<input type="checkbox"/>	LARGE OPERATOR INTERFACE

OVERCURRENT PROTECTION
PROVIDED AND INSTALLED
IN ACCORDANCE WITH NFPA70
(NEC) BY OTHERS

VFDs INSIDE PANEL



DUPLIX VARIABLE SPEED AQUA~FLOPAC

Page 2A

FLO-PAK I NC.
A business unit of Patterson Pump Company

PUMP #1

PUMP #2

Power Feed

HP
FLA
BRKR

HP.
FLA
BRKR

XXXV/3PH/60Hz

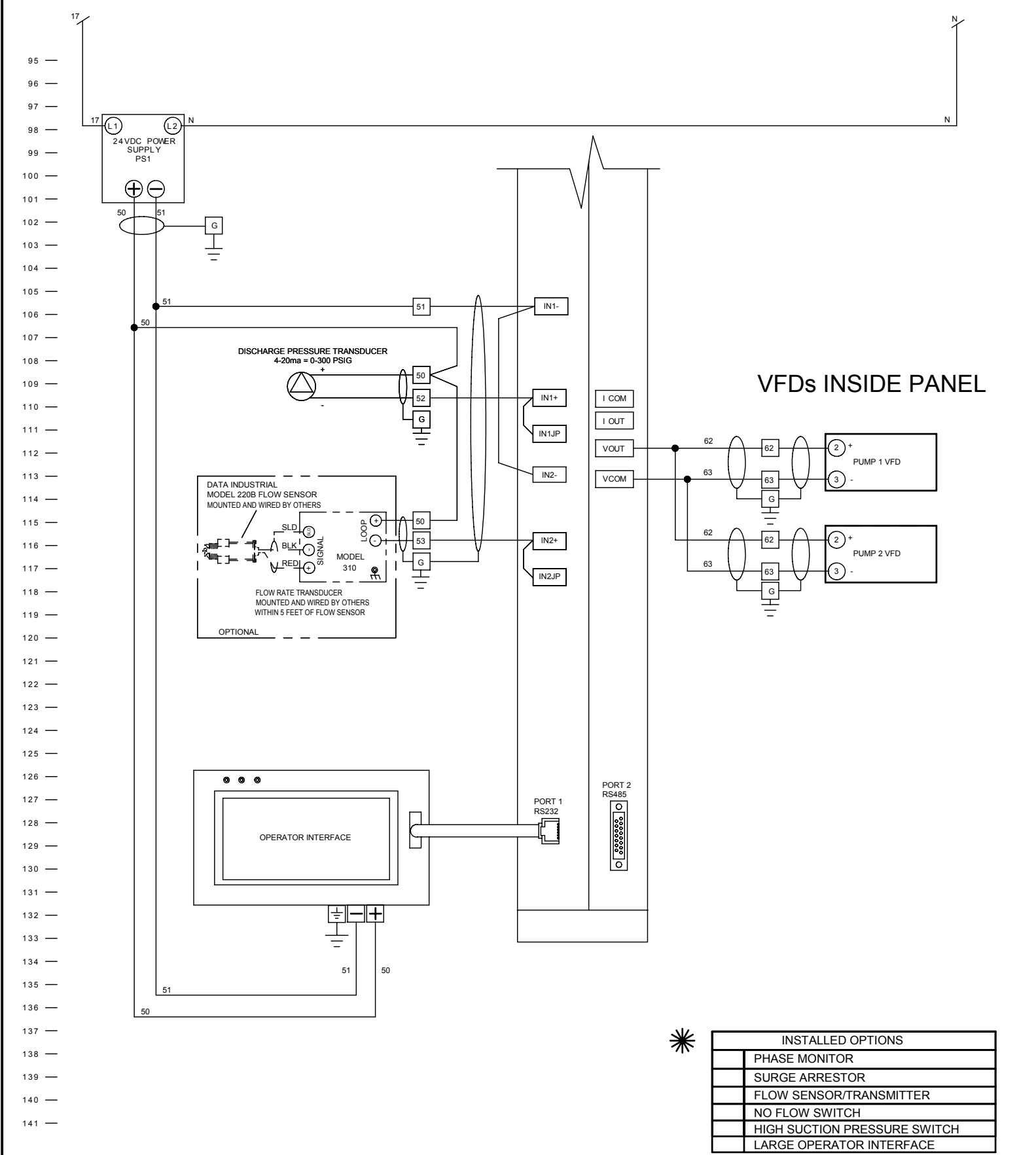
MCA - XX

Drawn By: WRW

Date 07/19/2010

Dwg Number: A85-109239-1

Rev: 1



Duplex Amperage Chart

MODEL	208v-3-60hz			230v-3-60hz			460v-3-60hz			380v-3-50hz		
	Pump(s) FLA		System MCA	Pump(s) FLA		System MCA	Pump(s) FLA		System MCA	Pump(s) FLA		System MCA
	P1	P2		P1	P2		P1	P2		P1	P2	
DAP-1-2	7.5	7.5	19	6.8	6.8	17	3.4	3.4	9	4.3	4.3	11
DAP-1-3	10.6	10.6	26	9.6	9.6	23	4.8	4.8	12	6	6	15
DAP-2-3	10.6	10.6	26	9.6	9.6	23	4.8	4.8	12	6	6	15
DAP-1-5	16.7	16.7	40	15.2	15.2	36	7.6	7.6	18	9.6	9.6	23
DAP-2-5	16.7	16.7	40	15.2	15.2	36	7.6	7.6	18	9.6	9.6	23
DAP-2-7	24.2	24.2	56	22	22	51	11	11	26	13.9	13.9	33
DAP-3-5	16.7	16.7	40	15.2	15.2	36	7.6	7.6	18	9.6	9.6	23
DAP-3-7	24.2	24.2	56	22	22	51	11	11	26	13.9	13.9	33
DAP-3-10	30.8	30.8	71	28	28	65	14	14	33	17.7	17.7	41
DAP-3-15	46.2	46.2	106	42	42	96	21	21	48	26.5	26.5	61
DAP-3-20	59.4	59.4	136	54	54	123	27	27	62	34.1	34.1	78
DAP-4-10	30.8	30.8	71	28	28	65	14	14	33	17.7	17.7	41
DAP-4-15	46.2	46.2	106	42	42	96	21	21	48	26.5	26.5	61
DAP-4-20	59.4	59.4	136	54	54	123	27	27	62	34.1	34.1	78
DAP-4-25	74.8	74.8	170	68	68	155	34	34	78	42.9	42.9	98



Pump Emergency Backup (Local) Operation

Duplex Variable Speed Controller With External VFDs

CAUTION

THE BACKUP (LOCAL) VFD STARTING MODE IS FOR EMERGENCY USE ONLY IN THE EVENT OF PLC FAILURE.

WHILE IN THE BACKUP (LOCAL) VFD STARTING MODE, THERE ARE NO PUMP OR SYSTEM SHUTDOWN SAFETIES.

THE SYSTEM MUST BE MONITORED BY THE OPERATOR AT ALL TIMES WHILE OPERATING IN THE BACKUP (LOCAL) VFD STARTING MODE.

TO CHANGE VFD TO BACKUP (LOCAL) MODE, THE FOLLOWING IS PERFORMED AT THE VFD KEYPAD:

- PRESS THE "OFF" (BOTTOM LEFT) BUTTON
- PRESS THE "MENU" (TOP RIGHT) BUTTON
- PRESS UP OR DOWN ARROW KEY UNTIL "PARAMETERS" IS HIGHLIGHTED
- PRESS THE "ENTER" (TOP RIGHT) BUTTON
- PRESS THE UP OR DOWN ARROW KEY UNTIL "16 SYSTEM CONTROLS" IS HIGHLIGHTED
- PRESS THE "SEL" (TOP RIGHT) BUTTON
- PRESS THE UP OR DOWN ARROW KEY UNTIL "1606 LOCAL LOCK" IS HIGHLIGHTED
- PRESS THE "EDIT" (TOP RIGHT) BUTTON
- PRESS THE UP OR DOWN ARROW KEY UNTIL "NOT SEL" IS DISPLAYED
- PRESS THE "SAVE" (TOP RIGHT) BUTTON
- PRESS THE "EXIT" (TOP LEFT) BUTTON 3 TIMES TO RETURN TO THE NORMAL DISPLAY

TO START/STOP VFD WHILE OPERATING IN BACKUP MODE:

- PRESS THE "HAND" (BOTTOM RIGHT) BUTTON TO START VFD
- PRESS THE "OFF" (BOTTOM LEFT) BUTTON TO STOP VFD

TO CHANGE VFD SPEED WHILE OPERATING IN BACKUP MODE:

- USE UP/DOWN ARROW KEYS TO ADJUST SPEED
- SPEED IS DISPLAYED IN TOP RIGHT OF KEYPAD

TO RETURN PUMP VFD TO AUTO (PLC) CONTROL MODE:

- PRESS THE "OFF" (BOTTOM LEFT) BUTTON TO STOP THE VFD
- PRESS THE "MENU" (TOP RIGHT) BUTTON
- PRESS UP OR DOWN ARROW KEY UNTIL "PARAMETERS" IS HIGHLIGHTED
- PRESS THE "ENTER" (TOP RIGHT) BUTTON
- PRESS THE UP OR DOWN ARROW KEY UNTIL "16 SYSTEM CONTROLS" IS HIGHLIGHTED
- PRESS THE "SEL" (TOP RIGHT) BUTTON
- PRESS THE UP OR DOWN ARROW KEY UNTIL "1606 LOCAL LOCK" IS HIGHLIGHTED
- PRESS THE "EDIT" (TOP RIGHT) BUTTON
- PRESS THE UP OR DOWN ARROW KEY UNTIL "ON" IS DISPLAYED
- PRESS THE "SAVE" (TOP RIGHT) BUTTON
- PRESS THE "EXIT" (TOP LEFT) BUTTON 3 TIMES TO RETURN TO THE NORMAL DISPLAY
- PRESS THE "AUTO" BUTTON
- "AUTO" IS DISPLAYED IN TOP LEFT OF KEYPAD



Pump Emergency Backup (Local) Operation

Duplex Variable Speed Controller With Internal VFDs

CAUTION

THE BACKUP (LOCAL) VFD STARTING MODE IS FOR EMERGENCY USE ONLY IN THE EVENT OF PLC FAILURE.

WHILE IN THE BACKUP (LOCAL) VFD STARTING MODE, THERE ARE NO PUMP OR SYSTEM SHUTDOWN SAFETIES.

THE SYSTEM MUST BE MONITORED BY THE OPERATOR AT ALL TIMES WHILE OPERATING IN THE BACKUP (LOCAL) VFD STARTING MODE.

TO CHANGE VFD TO BACKUP (LOCAL) MODE, THE FOLLOWING IS PERFORMED AT THE VFD KEYPAD:

- PRESS THE "LOC/REM" BUTTON
- "LOC" WILL APPEAR IN THE TOP LEFT OF THE KEYPAD DISPLAY

TO START/STOP VFD WHILE OPERATING IN BACKUP MODE:

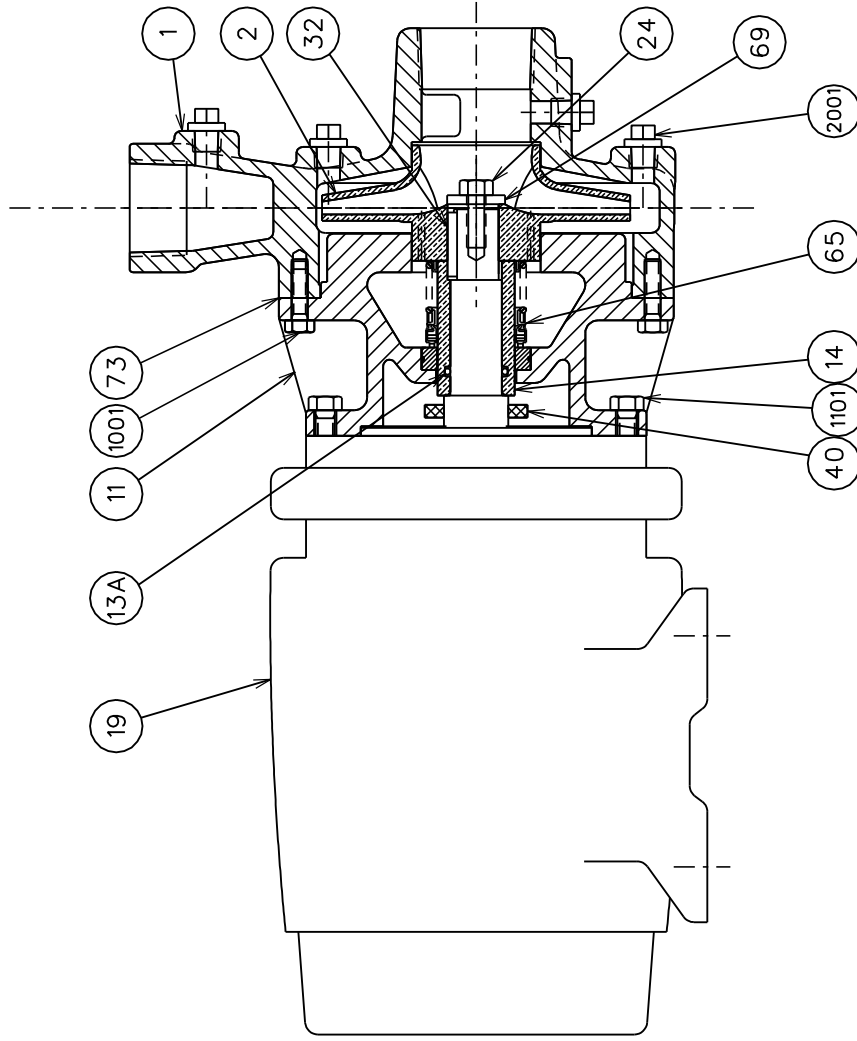
- PRESS THE "START" BUTTON TO START VFD
- PRESS THE "STOP" BUTTON TO STOP VFD

TO CHANGE VFD SPEED WHILE OPERATING IN BACKUP MODE:

- PRESS "ENTER" THEN THE UP OR DOWN ARROW KEY UNTIL "rEF" IS DISPLAYED
- PRESS "ENTER" AGAIN AND THE SPEED REFERENCE WILL APPEAR
- USE UP/DOWN ARROW KEYS TO ADJUST VFD SPEED
- PRESS "EXIT" TWICE TO RETURN TO THE NORMAL DISPLAY

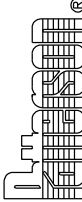
TO RETURN PUMP VFD TO AUTO (PLC) CONTROL MODE THE FOLLOWING IS PERFORMED AT THE VFD KEYPAD:

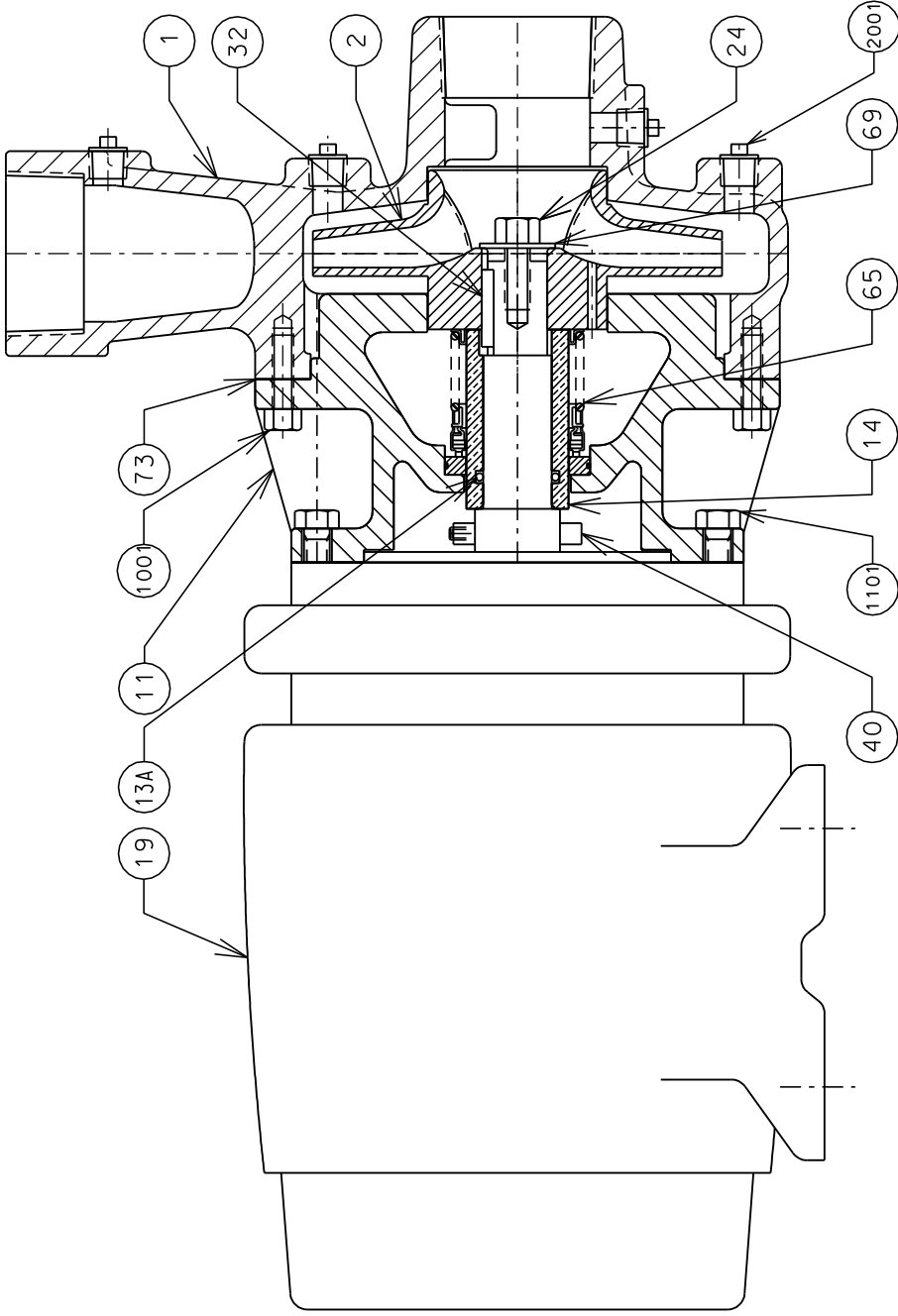
- PRESS THE "LOC/REM" BUTTON
- "REM" WILL APPEAR IN THE TOP LEFT OF THE KEYPAD DISPLAY



NOTE: SOME FEATURES SHOWN ROTATED FOR CLARITY

ITEM	DESCRIPTION
1	CASING
2	IMPELLER
11	VOLUTE COVER
13A	SHAFT SLEEVE O-RING
14	SHAFT SLEEVE
19	MOTOR
24	IMPELLER SCREW
32	IMPELLER KEY
40	DEFLECTOR
65	MECHANICAL SEAL
69	IMPELLER WASHER
73	GASKET
1001	CASING BOLT
1101	VOLUTE COVER BOLT
2001	PIPE PLUG

<div>  <p>PATTERSON PUMP COMPANY A SUBSIDIARY OF THE GORMAN-RUPP COMPANY</p> </div>	<div> <p>ASSEMBLY SECTION FOR 2 X 1 1/2 X 6 HES PUMP</p> </div>		<div> <p>DWG. NO. B05-83429</p> </div>	<div> <p>REV.</p> </div>
			<div> <p>DRAWN</p> </div>	<div> <p>DATE</p> </div>
			<div> <p>SCALE</p> </div>	<div> <p>3-12-02</p> </div>
			<div> <p>NONE</p> </div>	<div> <p>APPRVD. EJC</p> </div>

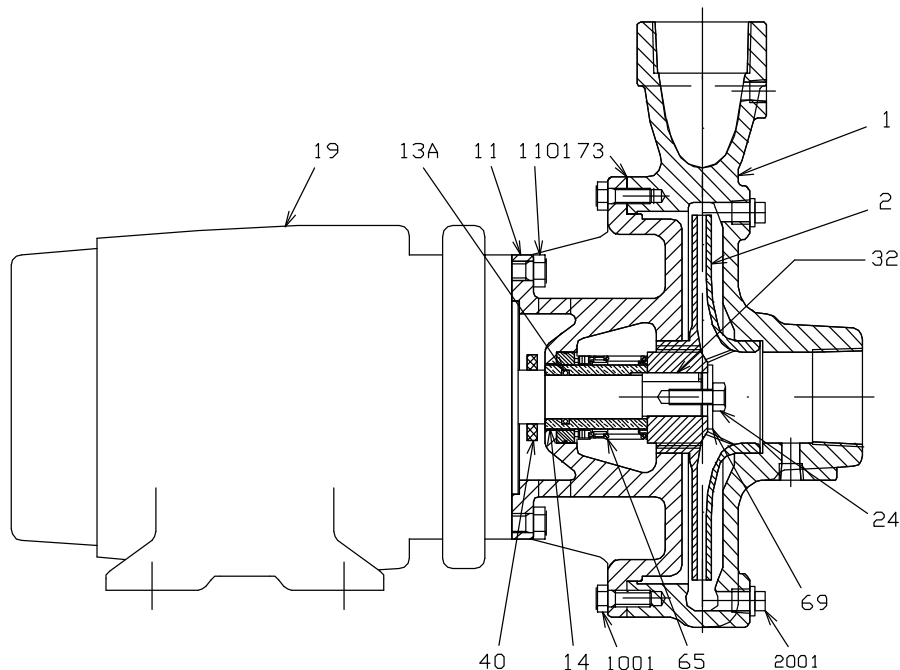


NOTE: SOME FEATURES SHOWN ROTATED FOR CLARITY

ITEM	DESCRIPTION
1	CASING
2	IMPELLER
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<div>  <p>PATTERSON PUMP COMPANY A SUBSIDIARY OF THE GORMAN-RUPP COMPANY</p> </div>		<div> <p>ASSEMBLY SECTION for 2X2X6 HES</p> </div>		DWG. NO.	B05-82811	REV.	
				DRAWN	L HOWARD	DATE	2-8-02
				SCALE	NONE	APPRVD.	EJC

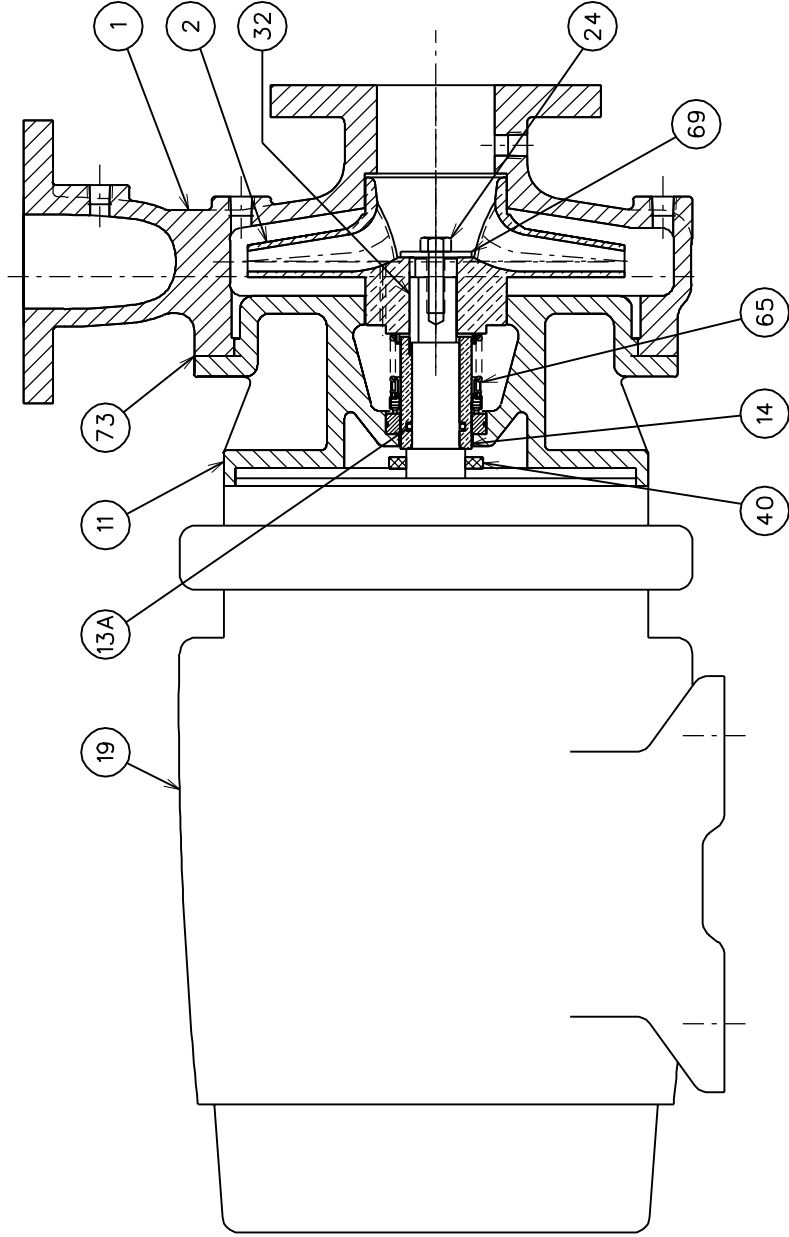
2 x 2 x 8 HES END SUCTION PUMP



FEATURES:

- REGISTERED FITS AT THE VOLUTE COVER AND VOLUTE MAINTAIN PUMP ALIGNMENT
- DYNAMICALLY BALANCED IMPELLER
- HYDROSTATICALLY TESTED TO 1 1/2 TIMES SHUT-OFF
- FITTED WITH SHAFT SLEEVE AND SELF FLUSHING MECHANICAL SEAL
- O-RING SEAL UNDER SHAFT SLEEVE
- BACK PULL-OUT DESIGN ALLOWS REMOVAL OF ROTATING ELEMENT WITHOUT DISTURBING SUCTION AND DISCHARGE CONNECTIONS

ITEM	DESCRIPTION	MATERIAL
1	CASING	Cast Iron - ASTM A48-CL40
2	IMPELLER	Bronze - B584-875
11	VOLUTE COVER	Cast Iron - ASTM A48-CL35
13A	SHAFT SLEEVE O-RING	Nitrile
14	SHAFT SLEEVE	Bronze - B505-954
19	MOTOR	Manufacturers Standard
24	IMPELLER SCREW	Stainless Steel - ASTM F593 GR 1 Type 304
32	IMPELLER KEY	Stainless Steel - ASTM Type 304
40	DEFLECTOR	Neoprene
65	MECHANICAL SEAL	Carbon vs. Silicon Carbide
69	IMPELLER WASHER	Stainless Steel - AISI 416
73	GASKET	Vellumold
1001	CASING BOLT	Steel - SAE J429 GR 2
1101	VOLUTE COVER BOLT	Steel - SAE J429 GR 2
2001	PIPE PLUG	Cast Iron



NOTE: SOME FEATURES SHOWN ROTATED FOR CLARITY

ITEM	DESCRIPTION
1	CASING
2	IMPELLER
11	VOLUTE COVER
13A	SHAFT SLEEVE O-RING
14	SHAFT SLEEVE
19	MOTOR
24	IMPELLER SCREW
32	IMPELLER KEY
40	DEFLECTOR
65	MECHANICAL SEAL
69	IMPELLER WASHER
73	GASKET

DWG. NO. B05-83431		REV.	
DRAWN		DATE	
SPENCER		3-12-02	
SCALE		APPRVD.	
NONE		EJC	

ASSEMBLY SECTION
FOR

2 1/2 X 2 X 8 HES PUMP



PATTERSON PUMP COMPANY
A SUBSIDIARY OF THE GORMAN-RUPP COMPANY