

OPERATION AND MAINTENANCE MANUAL

ELECTRIC SOAP SKID KDS-ESS 100 SERIES



This manual contains important safety information. Do not destroy this manual.

This manual must be available to the personnel who operate and maintain this compressor.

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FOREWORD

INFORMATION

The contents of this manual are considered to be proprietary and confidential to Keystone Drill Services, Inc. (herein referred to as "Keystone Drill" or "KDS") and should not be reproduced without the prior written permission of Keystone Drill.

Nothing contained in this document is intended to extend any promise, warranty, or representation, expressed or implied, regarding the Keystone Drill products described herein. Any such warranties or other terms and conditions of sale of products shall be in accordance with the standard terms and conditions of sale for such products, which are available upon request.

This manual contains instructions and technical data to cover all routine operation and scheduled maintenance tasks by operation and maintenance staff. Major overhauls are outside the scope of this manual and should be referred to an authorized Keystone Drill Service department.

All components, accessories, pipes, and connectors added to any of the three systems present on the Soap Skid (pumped water, injected media, and compressed air) should be:

- of good quality, procured from a reputable manufacturer and, wherever possible, be of a type approved by Keystone Drill.
- clearly rated for a pressure at least equal to the pump discharge safety valve setting.
- compatible with the injected media.
- accompanied with instructions for safe installation, operation, and maintenance.

Details of approved equipment are available from the Keystone Drill Service department. The use of repair parts other than those included within the approved parts list may create hazardous conditions over which Keystone Drill has no control. Therefore, Keystone Drill cannot be held responsible for equipment in which non-approved repair parts are installed.

Keystone Drill reserves the right to make changes and improvements to products without notice and without incurring any obligation to make such changes or add such improvements to products sold previously.

The intended uses of this Soap Skid are outlined below, and examples of unapproved usage are also given. However, Keystone Drill cannot anticipate every application or work situation that may arise. If in doubt, consult supervision.

This Soap Skid has been designed and supplied for above ground operation to be used for the pumping of freshwater (combined with an injected media) containing no additional liquids or particles within the ambient temperature range specified in the General Data section of this manual.

This Soap Skid should NOT be used:

- for direct or indirect human consumption of the pumped water (regardless of injected media).
- outside the ambient temperature range specified in the General Data section of this manual.
- when an actual or foreseeable risk of hazardous levels of flammable gases or vapors exists.
- with other than Keystone Drill approved components.
- with guards, controls, or switches missing or disabled.
- for storage or transportation of materials inside or on the enclosure.

Keystone Drill accepts no responsibility for errors in translation of this manual from the original English version.

You, as the customer, are expected to provide certain service and maintenance items. Your Keystone Drill dealer will provide all other more detailed service and maintenance items on a special preventive maintenance schedule for each Soap Skid. It is very important that the minimum service and maintenance requirements explained in this manual be performed at the required intervals. Exceeding these intervals may reduce the reliability of the Soap Skid.

The purpose of this manual is to train the operator with functions, operation, and basic service and maintenance requirements of the Soap Skid. During the preparation of this manual, every effort was made to ensure the adequacy and accuracy of the contents.

Your Keystone Drill dealer will assist with setup and initial startup of the Soap Skid. He will also provide brief operating and service instructions. Before starting the Soap Skid, this manual and instructions should be carefully read to obtain a thorough knowledge of the duties to be performed. Please take pride in the Soap Skid, keep it clean, and in good mechanical condition.

SAFETY

SAFETY PRECAUTIONS

Never operate the Soap Skid without first observing all safety warnings and carefully reading the Operation and Maintenance Manual shipped from the factory with this Soap Skid.

Ensure the operator reads and understands the decals and consults the manuals before operation or maintenance.

Ensure maintenance personnel are adequately trained, competent, and have read the manuals.

Ensure all protective covers are in place and panel doors are closed during operation.

A weekly visual check must be made of all fasteners/fixing screws securing mechanical parts. In particular, safety-related parts.

All components which are loose, damaged, or unserviceable must be rectified without delay.

Water pumped from this Soap Skid may contain contaminants which will cause serious injury or death. Do not drink discharged water.

Never inspect or service the Soap Skid without first disconnecting the electric supply cables, however, ensure there is no power to the cables prior to disconnecting. The 600 volt supply must be de-energized (with Approved Lock Out/Tag Out Protection) until the service and/or maintenance procedure is completed.

Do not use petroleum products (solvents or fuels) under high pressure as this can penetrate the skin and result in serious illness. Wear eye protection while cleaning the Soap Skid with compressed air to prevent debris from injuring eye(s).

Rotating belts and pullies can cause serious injury. Do not operate pumps without belt guards in place.

Never operate the Soap Skid with guards, covers, or screens removed. Keep hands, hair, clothing, tools, blow gun tips, etc. away from moving parts.

COMPRESSED AIR

Compressed air is needed for operation of the two chemical injector pumps installed on this Soap Skid. Each injector is supplied compressed air by a small (size -4 hose) regulated air supply.

Compressed air can be dangerous if incorrectly handled. Prior to performing any maintenance or service on the injectors, ensure all pressure is vented from the air supply and the injectors cannot be started accidentally.

Ensure the injectors are operating at the rated pressure and the rated pressure is known to all relevant personnel.

All air pressure equipment installed on, or connected to, the injectors must have safe working pressure ratings of at least the injector safety valve setting (after regulator) or the air supply regulator (before regulator).

Compressed air must NOT be used for a direct feed to any form of breathing apparatus or mask.

Compressed air can cause serious injury or death. Relieve pressure before removing filler plugs/caps, fittings, valves, hoses, or covers.

Air pressure can remain trapped in air supply line which can result in serious injury or death. Always carefully vent air supply line at injector or regulator before performing any service or maintenance.

Compressed air contains a very small percentage of lubricating oil and care should be taken to ensure that downstream equipment is compatible.

When using compressed air, always use appropriate personal protective equipment.

All pressure containing parts, especially flexible hoses and their couplings, must be regularly inspected, be free from defects, and be replaced according to the manual instructions.

Avoid bodily contact with compressed air.

The safety valve located at the injectors must be checked periodically for correct operation.

Disconnected air hoses whip and can cause serious injury or death. Always attach a safety flow restrictor to each hose at a source of supply or branch line in accordance with OSHA Regulation 29CFR Section 1926.302(b).

Never allow the injectors to sit shutdown with pressure in the injectors or supply lines.

HIGH PRESSURE WATER/INJECTED CHEMICALS

High pressure water can be dangerous if incorrectly handled. Prior to performing any maintenance or service on the Soap Skid, ensure all pressure is vented from the system and the Soap Skid cannot be started accidentally.

Ensure the Soap Skid pumps are operating at the rated pressure and the rated pressure is known to all relevant personnel.

All pressurized equipment installed in, or connected to, the Soap Skid must have safe working pressure ratings of at least the Soap Skid safety valve setting.

ANY water pumped from the Soap Skid must NOT be used for human consumption.

High pressure water can cause serious injury or death. Relieve pressure before removing filler plugs/caps, fittings, valves, hoses, or covers.

Water pressure can remain trapped in pump discharge line which can result in serious injury or death. Always carefully vent pump discharge line downstream or at tank recirculation valves before performing any service or maintenance.

Discharged water may contain chemicals from injected waters and care should be taken to ensure that downstream equipment is compatible.

When using high pressure water, always use appropriate personal protective equipment.

All pressure containing parts, especially flexible hoses and their couplings, must be regularly inspected, be free from defects, and be replaced according to the manual instructions.

Avoid bodily contact with high pressure water.

The safety valve located in the discharge piping near the storage tank must be checked periodically for correct operation.

Disconnected high pressure water hoses whip and can cause serious injury or death. Always attach a hose restraint (whipsock or whipchecks) at each hose connection prior to operation.

Never allow the Soap Skid to sit shutdown with water pressure in the discharge piping.

When refilling the water tank, fill equipment must be rated at or lower than the pressure rating of the fill piping. Personnel refilling the tank must always remain observant to the water level of tank while filling.

Review safety data sheets of chemicals being injected in high pressure water. The proper PPE listed in the safety data sheet of chemicals must be worn.

Adjust speed and flow rate of injector pumps per the injector manufacturer's specifications for safe chemical transfer to high pressure water discharge piping.

ELECTRICAL

Be sure the machine is properly grounded/earthed in accordance with site and National Code requirements.

The main circuit breaker on this machine has a 400A rating. Connect to appropriate power source.

The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. All current-carrying parts and other components protected by this device should be examined and replaced if damaged.



The Soap Skid contains three Variable Frequency Drives for each pump motor. When they are switched off and the motor is stopped, the capacitors store a potentially lethal voltage. DO NOT REMOVE COVERS FROM DRIVES and attempt any service work unless properly trained. There are no user serviceable components under the individual drive covers. Wait at least 10 minutes after disconnecting power before servicing or troubleshooting Variable Frequency Drive component fuses or connections within the control panel.

MATERIALS

Ensure that adequate ventilation of the control panel and input panel is maintained at all times.

The following substances are used in the manufacture of this Soap Skid and may be hazardous to health if used incorrectly:

- pump crankcase oil
- preservative grease, lubricating grease
- rust preventative
- thread sealant
- thread locking compound



Avoid ingestion, skin contact, and inhalation of fumes.

Safety data sheets for injected chemicals should be obtained from the chemical supplier.

Should the injected chemical(s) come into contact with the eyes and/or skin, refer to the first aid procedures listed in the chemical safety data sheet. Consult a physician if large amounts of injected chemical(s) are ingested or if chemical(s) are inhaled. Never give waters or induce vomiting if the patient is unconscious or having convulsions.

Do NOT start or operate this Soap Skid in a confined area.

This Soap Skid includes such materials as motor oil which may require proper disposal when performing maintenance or service tasks. Contact local authorities for proper disposal of these materials.

TRANSPORT

When loading or transporting the Soap Skid, ensure that the specified lifting and tie down points are used, and that the Soap Skid is loaded or transported by the end designated on the Soap Skid.

When loading or transporting the Soap Skid, ensure that the towing vehicle, its size, weight, towing hitch, winch, and electrical supply are all suitable to provide safe and stable towing. Do not exceed gross vehicle weight rating. Do not exceed the capabilities of the towing vehicle for loading, unloading, or towing.

Before transporting the Soap Skid, ensure:

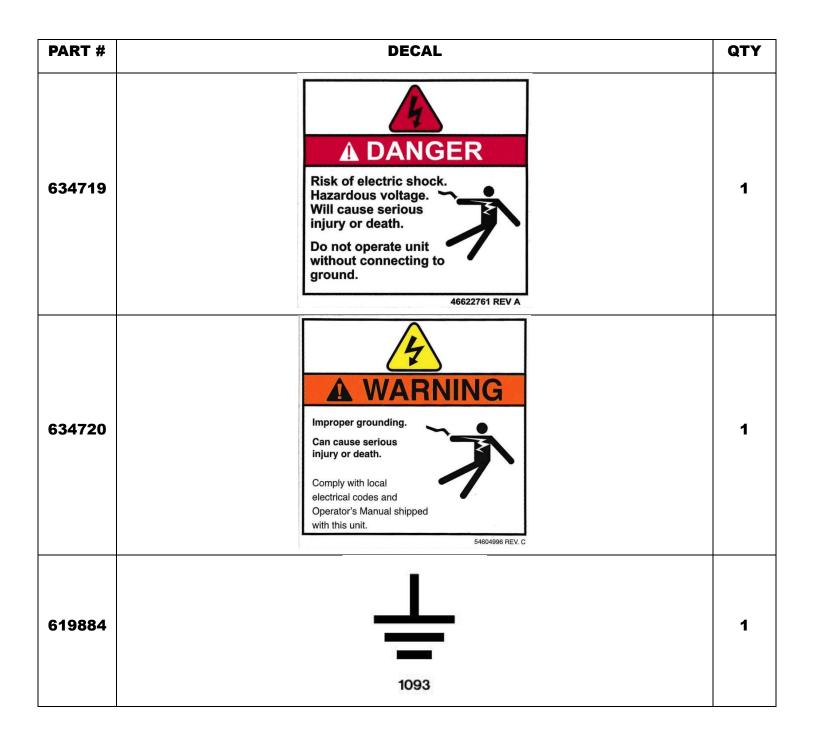
- the panel doors are closed and secure
- all ancillary equipment is stored and in a safe and secure manner
- all electrical connections, air hoses, and water discharge hoses are properly disconnected
- all water is drained from piping and holding tanks

DECALS

Decals are located on the Soap Skid to point out potential safety hazards. Read and follow these instructions. If you do not understand these instructions, inform your supervisor.

If decals are illegible or missing, please contact Keystone Drill for a replacement. Ensure that all of the following decals are present on the Soap Skid.

PART #	DECAL		
604841	Dropping this unit may cause damage to heavy components, their mounting brackets, etc. Do Not drop unit when unloading or moving.	4	
604844	A WARNING Falling off machine. Can cause serious injury or death. Access lifting bail from inside machine.	4	
604843	WARNING High pressure air. Can cause serious injury or death. Relieve pressure before removing filler plugs/caps, fittings or covers.	1	



PART #	DECAL	
635148	DO NOT POWER WASH THIS UNIT. (high pressure spray) ELECTRONIC EQUIPMENT WILL BE DAMAGED. 4006	
635149	Risk of Electric Shock could result in serious injury or death. Only qualified personnel should service this panel. Remove all power and lockout system before plugging and unplugging.	
635150	Electrical Shock Hazard. Do Not Touch.	2
635151	Arc flash and shock hazard. Appropriate PPE required.	2

PART #	DECAL	QTY
635152	DANGER 480 VOLTS 4010	
635154	Electrical shock hazard. Do not open. No user serviceable parts inside. Refer servicing to qualified service personnel.	3
635155	TOWER LIGHT: RED: • A LOW OR HIGH LEVEL PARAMETER HAS BEEN REACHED • FAULT CODE PRESENT (MAIN DISPLAY) AMBER: • MACHINE OPERATION IS APPROACHING A HIGH OR LOW LIMIT PARAMETER GREEN (STEADY): • MACHINE RUNNING • ALL PARAMETERS ARE WITHIN SAFE OPERATING LIMITS GREEN (FLASHING): • MACHINE IS IN STARTUP OR SHUTDOWN SEQUENCE	1
	WARNING WARNING	
635156	EMERGENCY STOP NOT TO BE USED	2
	DOES NOT FOR NORMAL	
	KILL INPUT POWER SHUTDOWN 4002	

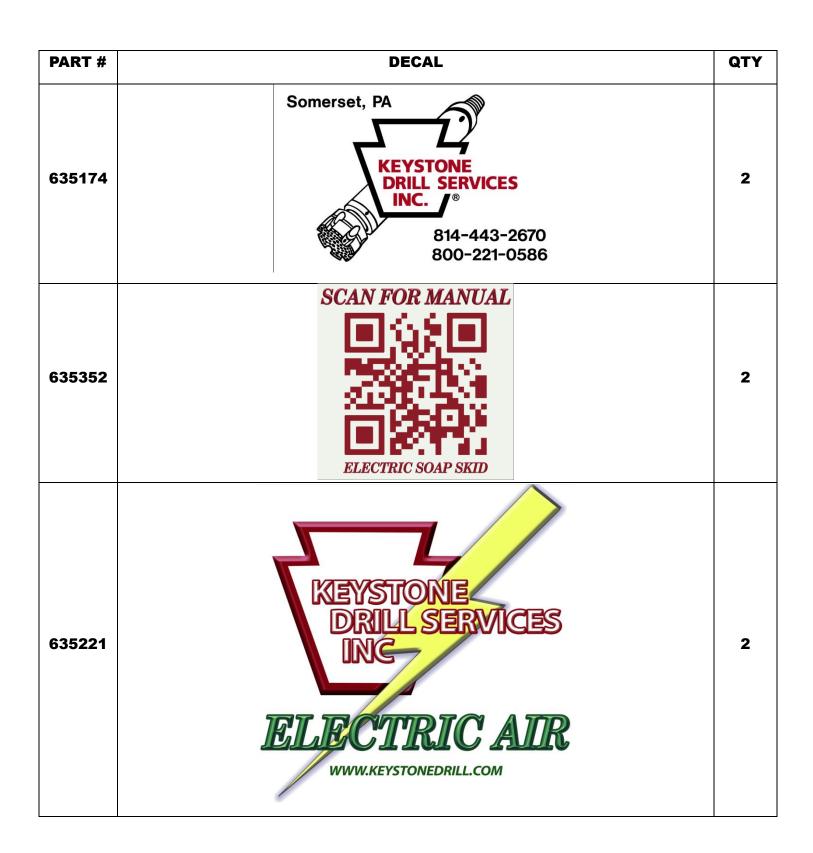
PART #	DECAL	
635157	ELECTRIC PANEL CONTAINS EXPOSED CONNECTIONS	2
635158	ASSUME ALL CONNECTIONS ARE ENERGIZED	2
635159	! WARNING DO NOT DISCONNECT WHILE ENERGIZED	
635164	CAUTION DO NOT WELD ELECTRONIC DAMAGE WILL OCCUR Machine is equipped with sensitive electronic components 1259	

PART #	DECAL	
606791	AIR INLET	
606807	CAUTION ROTATING PARTS	
606831	DO NOT EXCEED RATED DISCHARGE PRESSURE (R.D.P.) 1500 PSI MAX. OPERATING PRESSURE	
606846	EYE PROTECTION REQUIRED	2
606858	GUARD MUST BE IN PLACE WHEN OPERATING	6

PART #	DECAL	QTY
	SOAP PUMP PERFORMANCE (GPM = TOTAL OF 2 PUMPS RUNNING)	
635173	HERTZ Pump Speed GPM 32.8 32.8 23 478 37.8 27 562 44.4 30 625 49.3 33 687 54.2 36 750 59.1 40 833 65.7 43 895 70.6 47 979 77.2 50 1041 82.1 53 1103 87.1 57 1187 93.7 60 1250 98.6 Warning: 1) DAMAGE TO PUMPS WILL OCCUR F PUMPS ARE OPERATED AT SPEEDS LESS THAN 400 RPM 2) Maximum Discharge Pressure - 1,500 PSI 1265	1
609548	READ INSTRUCTION/PARTS MANUAL BEFORE OPERATING	1
619180	HOSE WHIP RESTRAINTS MUST BE IN PLACE WHEN OPERATING SEE SAFETY & OPERATION MANUAL 1225	1

PART #	DECAL	QTY
606788	1235	1
606796	1236	1
606802	1237	1
606817	1238	1
606836	1239	3

PART #	DECAL	QTY
606847	1240	1
606853	C	1
606859	1242	1
606860	1243	1
635165	LIFT FROM TRANSFORMER END ONLY	2



GENERAL DATA

GENERAL DATA INFORMATION

SPECIFICATIONS LISTED BELOW ARE FOR TWO OF THREE PUMPS OPERATING SIMULTANEOUSLY

MODEL	KDS-ESS100		
TRIPLEX PUMPS			
Water Delivery – gpm (liters/min)	32.8 - 98.6 (124.2 – 373.2)		
Rated Operating Pressure – psi (bar)	1500 (103.4) MAX		
Safety Valve Setting – psi (bar)	1500 (103.4)		
PUMP N	IOTOR(S)		
Operating Speed (rpm)	1775		
Nominal Horsepower of package, HP (kW)	100 (74)		
Full Load Amps at 480Vac (A)	118.4		
AMBIENT TEMPERATURE RANGE			
With Standard Features, °F (°C)	-4 to 104 (-20 to 40)		
MAIN POWER SERV	ICE REQUIREMENTS		
Nominal Supply Voltage (Vac)	600		
Operating Frequency (Hz)	60		
Operating Voltage (Vac)	480		
Input Panel Circuit Breaker Rating (A)	400		
VFD Protection Fuse Rating (A)	(3X) 80		
Three Phase with Ground	L1-White/Black, L2-Red, L3-Blue, GND-Green		

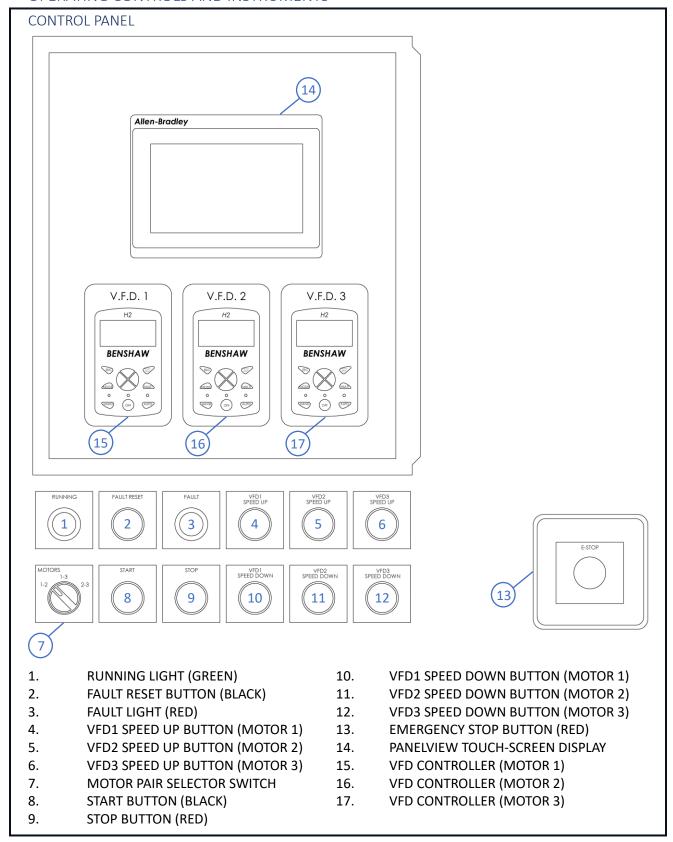
TRANSFORMER		
Primary Voltage (Vac)	600 Delta	
Secondary Voltage (Vac)	480 Wye	
KVA	300	
Туре	Isolated, Dry-type	
Conductor	Copper	
MEASUREMENTS/WEIGHTS		
Overall Length – feet (meters)	35'-4" (10.8)	
Overall Width – feet (meters)	8′ (2.4)	
Overall Height – feet (meters)	8'-6" (2.6)	
Gross Weight (empty tanks), lb (kg)	31,000 (14,062)	
Holding Tank Capacity (total), gal (liters)	5,100 (19,306)	



Any departure from the specifications may make this equipment unsafe.

OPERATING INSTRUCTIONS

OPERATING CONTROLS AND INSTRUMENTS



PANELVIEW

The PanelView 800 Display is a touch-screen device that is used for displaying Soap Skid data, warnings, and to control different features. The display defaults to the automatic screen on start-up and does not require interaction for running the equipment. If necessary, the machine can be started or stopped in automatic mode from the screen shown in Figure 1 by pressing the corresponding buttons on the display. The following information is to familiarize the operator with the PanelView and its different features. Understanding how to operate will be explained later in the Chapter.

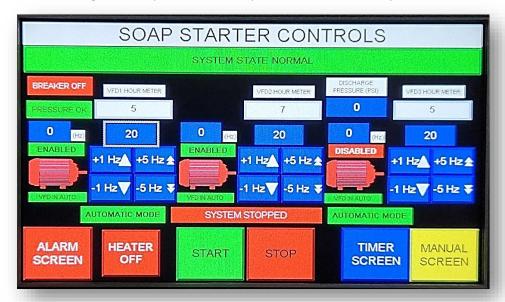


Figure 1- Display in AUTOMATIC MODE, no warnings, control panel breaker open

AUTOMATIC MODE (DEFAULT) SCREEN

SYSTEM STATUS

The top of the display indicates the system status by text and color. A normal status is shown in Figure 1 with a green ribbon across the top of the screen. Below are the different status designations:

Color	Status	Meaning
Green	Normal	All readings are within normal parameters
Yellow	Warning	Data is approaching the limits of set parameters
Orange	Pre-start Warning	Current parameters are outside of automatic mode starting parameters
Red	Alarm	A reading is outside of set parameters. System shuts down

BREAKER + PRESSURE STATUS

The top left of the PanelView display indicates whether the breaker on the control panel is open (tripped) or closed (on). This breaker supplies power to each VFD drive for the pump motors. Also, below the breaker indicator is a pressure indicator to monitor water pressure in the discharge line.

Text (Color)	Status
BREAKER ON (green)	VFD circuit is closed, energized
PRESSURE OK (green)	Pressure in discharge line ok for start-up



Text (Color)	Status
BREAKER OFF (red)	VFD circuit is open, de-energized
HIGH PRESSURE (red)	Pressure in discharge line high for start-up





Although the breaker indicator may show that the breaker is tripped (open), there is still power being supplied to the Control Panel.

DISCHARGE PRESSURE

The Discharge Pressure is displayed at the top right of the screen inside a blue square. The value shown in the image below is ideal for machine start-up.



Discharge Pressure may also be viewed at the analog gauge on the discharge line located to the lower right of the control panel. Also note the pressure transducer identified in green used for discharge pressure readout on PanelView display.



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OPERATING INDICATORS

The various blocks and images across the center of the screen show the operating status via their symbol color. A red icon/symbol indicates that the operation is off or stopped. A green icon/symbol indicates that the operation is on or running. These icons/symbols are not interactive (in AUTOMATIC MODE) and are only displaying feedback from the automated process.

Text/Symbol	Description	Color	Meaning
DISABLED	Motor not selected for operation	Red / Green	Off / On
ENABLED	Motor selected for operation	Red / Green	Off / On
MOTOR	Motor for each pump	Red / Green	Off / On
VFD IN AUTO	VFD operations are process controlled	Green	Automatic
VFD IN MANUAL	VFD is manually controlled	Amber	Manual
AUTOMATIC MODE	Automatic mode controls	Green	Automatic
MANUAL MODE	Manual mode controls	Amber	Manual
SYSTEM STOPPED	System is not running, status	Red	Off
SYSTEM RUNNING	System is running (or in process), status	Green	On

INTERACTIVE CONTROLS

Some of the buttons in AUTOMATIC MODE are interactive to allow the operator to control the unit from the screen and monitor different aspects of the process. Below are the buttons that are interactive on the AUTOMATIC MODE screen.

NOTE: Some of these controls navigate you to different screens within the program. Review the full Operations section of this manual to understand how to properly navigate the program prior to pressing any interactive buttons.

Text	Description
+1/-1 Hz	Adjust motor speed by 1 Hz increments from PanelView
+5/-5 Hz	Adjust motor speed by 5 Hz increments from PanelView
ALARM SCREEN	Navigates to the Alarm Screen to review a log of Alarms and ability to reset
HEATER ON	Closes contact to energize heater
HEATER OFF	Opens contact to deenergize heater
START	Starts the automatic process for running the Soap Skid
STOP	Stops the process for running the Soap Skid and enters shut-down process
TIMER SCREEN	Navigates to Timer Screen to adjust parameters for operations *see below*
MANUAL SCREEN	Navigates to Manual Screen for controlling the unit manually

^{*}Timer Screen is password protected to limit access to parameter controls.

MANUAL MODE SCREEN

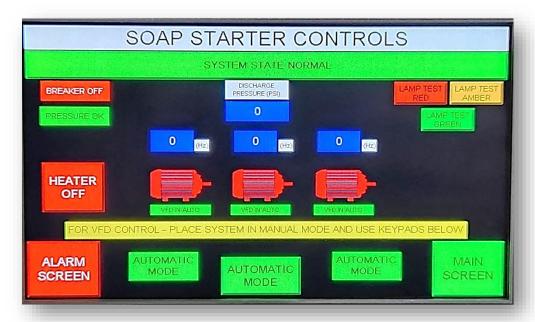


Figure 2 – Display on MANUAL SCREEN, no warnings, system stopped

The MANUAL SCREEN shows similar data compared to the AUTOMATIC SCREEN but adds the ability to manually control different parts of the machine independently.

OPERATING INDICATORS

Various blocks and images across the screen show the operating status via their symbol color. A red icon/symbol indicates that the operation is off or stopped. A green icon/symbol indicates that the operation is on or running. These specific icons/symbols are not interactive and are only displaying feedback from the manual controls.

NOTE: The Motor icons are feedback from the VFD controllers external to the PanelView display.

Text/Symbol	Text/Symbol Description		Meaning
MOTOR	Motor for each pump	Red / Green	Off / On
VFD IN AUTO VFD operations are process controlled		Green	Automatic
VFD IN MANUAL	VFD IN MANUAL VFD is manually controlled		Manual
AUTOMATIC MODE Automatic mode controls are active		Green	Automatic
MANUAL MODE Manual mode controls are active		Amber	Manual

MANUAL CONTROLS

The purpose of the MANUAL SCREEN is to operate different features independently from the automated process. Below are the buttons that are interactive on the MANUAL SCREEN.

Text	Description	Color
LAMP TEST RED	Operates the red tower light	Red
LAMP TEST AMBER	Operates the amber tower light	
LAMP TEST GREEN	Operates the green tower light	Green
HEATER OFF	Opens contact to deenergize heater F	
HEATER ON	Closes contact to energize heater	
AUTOMATIC MODE	Indicates unit is in Automatic Mode. Press to switch to Manual Mode	Green
MANUAL MODE Enables manual controls and disables automated processes		Amber
ALARM SCREEN Navigates to the Alarm Screen to review a log of Alarms and ability to reset F		Red
MAIN SCREEN	Navigates to Main Screen for controlling the unit automatically	Green

ALARM SCREEN

If there is a machine fault or the Emergency Stop switch was pressed, the screen will display a System Status message notifying the operator that an alarm is present.

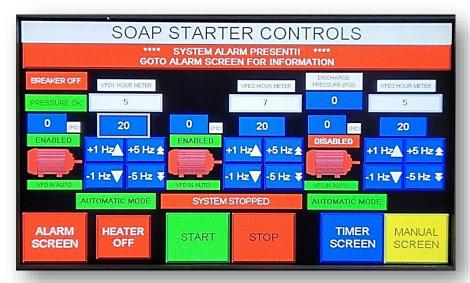


Figure 3 - Main display showing Alarm Status

The Alarm Screen shows the operator what caused the machine to fault and logs the information with a timestamp. The Alarm Screen is accessible from both the Automatic and the Manual Screen by pressing the Alarm Screen button in the lower left portion of the screen.



Figure 4 - Alarm Screen showing faults

All of the buttons across the bottom of the screen are interactive. To return to the Main Screen, press the green button in the lower right corner of the screen.

VFD CONTROLLER

The three VFDs (Variable Frequency Drive) for the Soap Skid operate each pump motor. The VFDs are used to adjust the speed of each pump to achieve desired flow and pressure. When the PanelView is in AUTOMATIC MODE with the VFD controllers set to AUTO (default setting upon startup), the controllers do not need to be monitored or adjusted.

Text	Description
ESC	Escape
PROG/ENT	Selection button for different operations
MODE	Navigate through different modes
MULTI	Refer to VFD manual
HAND	Operates the VFD manually
OFF	Stops the VFD when running
AUTO	Allows the program to run automatically
ARROWS	Navigate the curser within the display



A CAUTION

When controlling the pump motors manually, the motor pair selector switch is no longer active. The user can operate each pump individually with the VFD controllers when in manual mode. Amperage draw and pressure shutdowns will remain active regardless of control method.

BREAKERS

The Soap Skid is equipped with two breakers: 400A/600V input breaker, and 400A/480V breaker for all three VFDs. The input breaker is located on the input panel (upper images), while the VFD breaker is located on the control panel (lower images). When the breakers are down, with black handle exposed, they are open (off). When the breakers are up, with red handle exposed, they are closed (on).





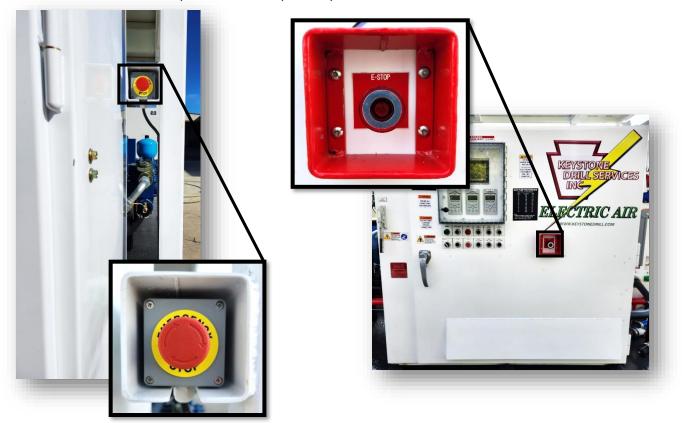




EMERGENCY STOP

There are two E-STOP switches on each compressor, and on opposite sides of the unit. One switch is located on the front of the control panel (lower right image) and the other switch is located on the top of the input panel (lower left image).

Each E-STOP switch is clearly marked to easily identify the location.





Pressing the E-STOP switch does not kill incoming power.



Do not press the E-STOP switch to shut down the machine under normal conditions.

RECEPTACLES, POWER SUPPLY

The supply power will be connected to the unit at the input panel using the Eaton Roughneck connections located on the left side of the panel (image below). This configuration is designed to accept three single-feeders of 600VAC supply power, and a single equipment ground.

Cable receptacles will be male and the Panel receptacles will be female.

Color	Phase/Line
White/Black	L1
Red	L2
Blue	L3
Green	Ground



Be sure that supply lines are de-energized before connecting or disconnecting cables.



When the cables are installed into the receptacles, be sure to utilize the locking device that retains the cable within the receptacle. Between use, install the weather caps into the receptacles to protect the connections from wear.

RUNNING THE SOAP SKID

The following section will inform the operator on the proper procedures for unit preparation and starting the Soap Skid. The steps are intended to be followed in order.

UNIT PREPARATION

Prior to connecting the supply power or starting the unit, the operator must inspect the electrical and mechanical components to ensure safe operation.

Open the Input Panel Breaker and Control Panel Breaker prior to inspecting the unit.



All steps within this section must be done prior to connecting supply power. Failure to comply may result in serious injury or death. If any discrepancies are identified, lock out/tag out the unit per site SOP until the issue is corrected.

ELECTRICAL

- Check the grounding straps from the transformer, motors, and panels to the skid to ensure connections are tight and that the straps are intact.
- Ensure the receptacle locking devices are operating and that the locking pins are present.
- If the unit was stored outdoors, check inside the panels for any standing water that may need to be evacuated.
- Check any exposed cables for worn or damaged insulation.
- Ensure all guards, clamps, and supports are in place for cables.
- Check panels and enclosures for any exterior damage.

MECHANICAL

- Check the belts on the pump motors for any damage and proper tension.
- Check the pump belt guards for missing hardware or damage.
- Check the discharge piping and hoses for any loose connections or damage.
- Check the suction piping and hoses for any loose connections or damage.
- Check the chemical injection lines for cracks, breaks, or loose connections.
- Check for water leaks and ensure pump oil level is within operating limits.

OPERATING INSTRUCTIONS

SUPPLY CABLES

Connect the power supply electric cables to the Input Panel receptacles. Once the cables are installed into the receptacles, be sure to utilize the locking device and pin to retain the cables. Cable color and receptacle color should match the proper phase.

Connect the supply ground to the equipment ground receptacle on the Input Panel.

When routing the cables, be sure to reduce the amount of strain on the cables and Soap Skid equipment.



Be sure that supply lines are de-energized before connecting or disconnecting cables.

DISCHARGE HOSE CONNECTION



Discharged water from this Soap Skid is pumped at high pressure and can be dangerous if incorrectly handled. Prior to performing any maintenance or service on the discharge piping, ensure all pressure is vented from the discharge piping and pumps cannot be started accidentally.

All pressure equipment installed on, or connected to the discharge piping must have safe working pressure ratings of at least the discharge safety relief valve setting.

Relieve all pressure before removing filler plugs/caps, fittings, valves, hoses, or covers.

Disconnected high pressure hoses whip and can cause serious injury or death. Always attach a safety hose restraint to each hose at a source of supply or branch line.

Do not connect the discharge hose from this Soap Skid onto a common header with any other unit of any description, or any other source of compressed air or water, without first making sure a check-valve is used between the header and the Soap Skid. If this Soap Skid is connected in parallel with another piece of pressure producing equipment with higher discharge pressure and capacity, a safety hazard could occur in a back-flow condition.

DISCHARGE HOSE RESTRAINT

Safety devices such as hose restraints (whipchecks or whipsocks) must be used to prevent hose whipping if a connection fails.

The mounts and/or shackles are to be of the same or greater strength as the restraint. An engineer should be consulted about suitability of whipchecks, whipsocks, mounts, mounting points, shackles, and fittings as well as strength rating of materials. Restraints must be used at the hose origination, termination, and each hose-to-hose connection.

Hoses can fail in areas other than at connecting points and require daily inspection of hoses for:

- Cuts, cracks or kinks
- Weakened clamps due to rust and corrosion
- Damaged connections
- Deformity
- Incorrect or incompatible components or fittings
- Any visible damage

Hoses must be selected that are rated for the application as to the maximum pressure and temperature to be encountered as well as compatible with the materials being conveyed inside the hose. Hoses must be compatible with any chemical that may be injected during Soap Skid operation.

The Soap Skid is equipped with tie-down lugs at the discharge piping that are designed to accept shackles for restraining the hose.



COMPRESSED AIR CONNECTION

Compressed air is needed for operation of the two chemical injection pumps installed on this Soap Skid. Each injector is supplied compressed air by a small (size -4 hose) regulated air supply.



Compressed air can be dangerous if incorrectly handled. Prior to performing any maintenance or service on the injectors, ensure all pressure is vented from the air supply and the injectors cannot be started accidentally.

All air pressure equipment installed on, or connected to the chemical injectors must have safe working pressure ratings of at least the injector safety relief valve setting (after regulator) or the air supply regulator (before regulator).

Relieve all pressure before removing filler plugs/caps, fittings, valves, hoses, or covers.

Disconnected air hoses whip and can cause serious injury or death. Always attach a safety flow restrictor to each hose at a source of supply or branch line in accordance with OSHA regulation 29 CFR Section 1926.302 (b).

FILLING HOLDING TANKS

The Soap Skid is equipped with two holding tanks for the water that is to be pumped to drilling equipment. The two tanks are referenced as "left" and "right" in this manual as viewed from the discharge hose connection end of the Soap Skid.



Care must be taken to ensure that the equipment connected to the fill piping on the rear of the Soap Skid does not exceed the pressure rating of the fill piping (150 psi).

The operator tasked with filling the Soap Skid holding tanks must remain alert to water level while filling tanks. An unsafe condition may occur if excess water is allowed to spill over the top of holding tanks and onto sensitive electrified equipment.

BREAKERS

Prior to closing the breakers, the supply electric cables may be energized.



Follow site PPE guidelines and SOP for energizing/de-energizing systems. Do not open or close a breaker while the unit is under load.

Close the Input Panel Breaker. Next, close the Control Panel Breaker.



With the Breakers closed (ON), the system is considered energized.

WATER OUTLET

With the panel prepared to run, the Soap Skid valves will need to be configured to minimize the initial load on the pump electric motors. Refer to sequence charts on the next page for valve configurations.

Valve configuration diagrams are also located at the end of this manual.

After valves are configured for startup, the ball valves located at the water end of each pump may also be opened at this time. It is important that the ball valves are held open long enough to purge any trapped air between the tank suction valve and pump inlets.



^{*}Damage to pumps will occur if started without sufficient water flow to pump inlet*

OPERATING INSTRUCTIONS

VALVE SEQUENCE CHARTS

START-UP / SHUT-DOWN / RECIRCULATION LEFT TANK:

VALVE I.D.	VALVE NAME	POSITION
А	SUCTION VALVE – LEFT TANK	OPEN
В	SUCTION VALVE – RIGHT TANK	CLOSED
С	RECIRCULATION VALVE – LEFT TANK	OPEN
D	RECIRCULATION VALVE – RIGHT TANK	CLOSED
E, F	DRAIN VALVES	CLOSED
G	DISCHARGE VALVE	CLOSED

START-UP / SHUT-DOWN / RECIRCULATION RIGHT TANK:

VALVE I.D.	VALVE NAME	POSITION
Α	SUCTION VALVE – LEFT TANK	CLOSED
В	SUCTION VALVE – RIGHT TANK	OPEN
С	RECIRCULATION VALVE – LEFT TANK	CLOSED
D	RECIRCULATION VALVE – RIGHT TANK	OPEN
E, F	DRAIN VALVES	CLOSED
G	DISCHARGE VALVE	CLOSED

OPERATION LEFT TANK:

VALVE I.D.	VALVE NAME	POSITION
Α	SUCTION VALVE – LEFT TANK	OPEN
В	SUCTION VALVE – RIGHT TANK	CLOSED
С	RECIRCULATION VALVE – LEFT TANK	CLOSED
D	RECIRCULATION VALVE – RIGHT TANK	CLOSED
E, F	DRAIN VALVES	CLOSED
G	DISCHARGE VALVE	OPEN

OPERATION RIGHT TANK:

VALVE I.D.	VALVE NAME	POSITION
Α	SUCTION VALVE – LEFT TANK	CLOSED
В	SUCTION VALVE – RIGHT TANK	OPEN
С	RECIRCULATION VALVE – LEFT TANK	CLOSED
D	RECIRCULATION VALVE – RIGHT TANK	CLOSED
E, F	DRAIN VALVES	CLOSED
G	DISCHARGE VALVE	OPEN

STARTING THE SOAP SKID

If this is the first time running the Soap Skid with this configuration, i.e., new site, different generator, different distribution panel, etc., the pump rotation will need to be confirmed prior to running. There is a potential for the phases to be misconfigured between the power source and the Soap Skid. Once correct rotation is confirmed, start-up may proceed. If incorrect rotation was discovered, notify site management.

The Operator may observe and monitor parameters displayed on the PanelView. If feedback is within start-up parameters, the unit is ready to run in AUTOMATIC MODE.

AUTOMATIC MODE

Select the pair of motors to be operated followed by pressing the START button on the Control Panel





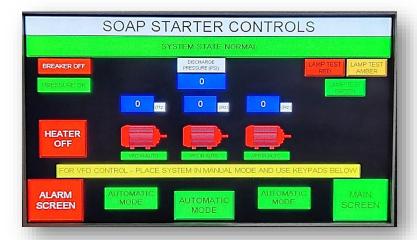
The water pressure in the discharge line must be below 10psi in order for the control panel to allow the pump motors to start.

When the motors selected enter the running process, the green indicator will illuminate (RUNNING)

In the event the controller detects a parameter outside of normal starting limits, the PanelView will display the cause. Depending on the cause, the starting process may enter a time-delayed process or may be unable to be run in AUTOMATIC MODE. If the unit fails to run in AUTOMATIC MODE, and the cause for being outside starting parameters is deemed safe for equipment and personnel to be run manually, proceed to starting the Soap Skid in MANUAL MODE.

MANUAL MODE

Starting the Soap Skid manually eliminates the automated process involved with different functions of the starting procedure. In order to properly start the Soap Skid, this procedure needs to be conducted manually per the following:



- 1. Navigate to the MANUAL SCREEN on the PanelView controller.
- 2. Enter MANUAL MODE
- 3. Using the VFD Controllers, press the HAND button to enter MANUAL MODE. The motor corresponding to the VFD Controller selected will start as soon as HAND button is pressed.
- 4. Using the arrows on the VFD Controller, navigate the curser on the VFD Controller screen to adjust the speed of the desired motor.



Soap Skid is to be operated in manual mode when only <u>one</u> pump needs to be used. If more than two pumps are in operation simultaneously, they will exceed the Soap Skid design limitations. Exceeding the design limitations will cause damage to pumps, motors, and personnel.

MONITOR AND CONTROL

With the Soap Skid running, review the parameters on the PanelView display. The Operator should conduct a walk-around inspection of the unit to ensure that the Soap Skid is running safely. The visual inspection should include:

- Check for water leaks and bad connections
- Check for excessive vibration
- Check for loosening hardware

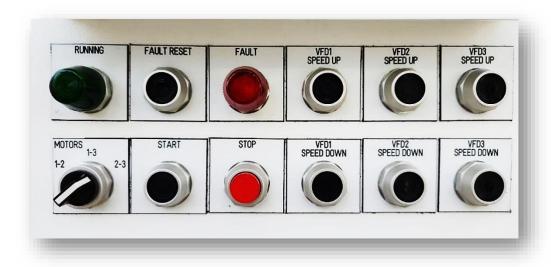
Following the visual inspection and assurance that the Soap Skid is circulating water, Soap Skid valves can be configured for desired operation. Refer to valve sequence charts for operation valve positions.

When there is a demand for high pressure water, the discharge ball valve can be opened to supply water downstream.

ADJUSTING OUTPUT

The volume of water pumped into the discharge piping is directly related to the speed of the two pumps being operated. Refer to the decal located to the right of PanelView display for the volume of water pumped at different pump speeds.

To adjust speed of pumps, use the VFD SPEED UP and VFD SPEED DOWN buttons for selected motors.



PARAMETERS

The equipment's status is indicated by the tower lights on the control panel and provides a general idea on the health of the Soap Skid from a distance. Some of the parameters that are monitored by the control panel are:

Parameter	Warning (Amber)	Upper Limit/Fault (Red)
Discharge Pressure	1500 PSI	1600 PSI
Amperage Draw	N/A	HIGH LIMIT
Circuit Breaker Tripped	N/A	TRIPPED
Supplied Voltage	N/A	OUTSIDE LIMITS

When the green tower light is illuminated, all parameters are within normal operating ranges. If parameters reach the warning limit, the amber tower light will illuminate, but the Soap Skid will continue to run. If the upper limits are reached, the red tower light will illuminate, and the Soap Skid will shut down in a fault status. The alarm will need to be reviewed and cleared prior to restarting the Soap Skid.

SWITCHING PUMPS

The Soap Skid controls are designed to operate any combination of two pumps at one time while keeping a third pump idle. If problems should arise with a running pump, the pump selector switch can be flipped while pumps are operating. However, it is necessary to first open the appropriate recirculation valve to relieve discharge pressure before switching pumps.





Discharge pressure must be relieved by opening a recirculation valve before switching pumps. The pump motors will stall if a starting attempt is made with pressure in the discharge line. Damage to pumps and pump motors may occur if pressure is not relieved before switching pumps.

SHUTTING DOWN

When the demand for high pressure water is complete, the shutdown sequence is to be followed in order to properly shut down the equipment.



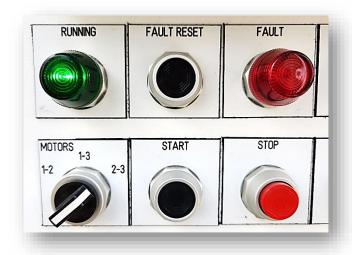
The E-STOP switches located on the Soap Skid are not to be used for normal shut-down procedures. The E-STOP switches are for Emergency shut-down only. Repeated use may cause damage to the equipment.

Open the recirculation valve for the tank of water being injected. Next, close the discharge ball valve to isolate the Soap Skid. The Soap Skid is now prepared for shutdown.



If recirculation valve is not opened before discharge valve is closed, the control panel will shut down machine operation from a high-pressure fault and pump damage may occur.

Press the STOP button on the Control Panel.



The Soap Skid will enter the shutdown process and the green indicator on the Control Panel "RUNNING" along with the green tower light will begin to flash during the process. The shutdown process may take up to 90 seconds and is dependent on feedback within the system.

A WARNING

Even after pressure is relieved from the piping system, any discharge line from the Soap Skid could remain under pressure and cause serious personal injury or death. After the Soap Skid shuts down, carefully open a valve downstream to exhaust any pressure prior to removal or servicing.

A CAUTION

Never allow the Soap Skid to sit stopped with pressure in the discharge piping. As a precaution, open the recirculation valves to vent any pressure back into the tanks.

CHEMICAL INJECTION

The Soap Skid is equipped with two high-pressure injectors that can be used to inject chemicals into the water pumped by the Soap Skid.

Both injectors are to be supplied compressed air for operation at the regulator inlet port shown below.





Per injector manufacturer's recommendation, <u>do not</u> exceed 50 psi of regulated air pressure to injectors. Injector damage and personal injury may occur.

Refer to the installation and operation manual from the injector manufacturer for detailed operation and safety procedures of the high-pressure injectors.

RE-FILLING HOLDING TANKS

The holding tanks may be refilled while Soap Skid is operating. To re-fill, use the fill piping and the appropriate valves located at the rear of the holding tank.



The operator tasked with filling the Soap Skid holding tanks must remain alert to water level while filling tanks. An unsafe condition may occur if excess water is allowed to spill over the top of holding tanks and onto sensitive electrified equipment.

STORAGE

DAILY

Suction and discharge lines must be drained when Soap Skid is shut down if water is being pumped and ambient temperature is below freezing ($32^{\circ}F / 0^{\circ}C$). Winterization of pumps must also be performed, which is described on the following page. First, shut both suction valves ("A" + "B") followed by opening wye strainer drain valves (3x "E"). To drain discharge line, open drain valve "F". The discharge valve "G" may also need to be opened to completely purge water from discharge line.

To completely purge water from fluid end of pumps, the four hex shaped plugs may be removed to drain excess water. The pump may have to be rotated slowly for a few revolutions to completely purge water.



If water being pumped is corrosive or may harden when pumps are left idle, flushing of the suction lines, discharge lines, and pumps is required. Valve positions for flushing of the piping system will be dependent on fluid/media being used to flush and operator preference.

OPERATING INSTRUCTIONS

PUMP WINTERIZATION

Before pumps can be winterized, piping and pumps must be purged of any excess water. To winterize, draw one gallon of RV type antifreeze into each pump. The antifreeze can be drawn into pumps through the 1/2" npt elbow shown while running the pumps at low speed long enough to empty antifreeze container.



EXTENDED STORAGE (1 WEEK OR LONGER)

All water must be drained from piping system and holding tanks for extended storage. A 2" NPT drain plug is provided at the rear of each holding tank for drainage purposes. Piping may also be added at these drain port locations to direct water to an appropriate location. Refer to sequence chart below for extended storage valve configuration.

If water being pumped is corrosive or may harden when pumps are left idle, flushing of the piping system and holding tanks is required for extended storage.

EXTENDED STORAGE:

VALVE I.D.	VALVE NAME	POSITION
Α	SUCTION VALVE – LEFT TANK	OPEN
В	SUCTION VALVE – RIGHT TANK	OPEN
С	RECIRCULATION VALVE – LEFT TANK	OPEN
D	RECIRCULATION VALVE – RIGHT TANK	OPEN
E, F	DRAIN VALVES	OPEN
H1	FILL VALVE – LEFT TANK	OPEN
H2	FILL VALVE – RIGHT TANK	OPEN
G	DISCHARGE VALVE	OPEN

MAINTENANCE

GENERAL INFORMATION

This section refers to the various components which require periodic maintenance and replacement.

The Maintenance Schedule indicates the various components' descriptions and the intervals when maintenance is required. Water capacities can be found in the General Data Section of this manual.

Pressurized waters and compressed air can be dangerous if incorrectly handled. Please review all maintenance precautions listed below before attempting any maintenance work on the Soap Skid.

MAINTENANCE PRECAUTIONS

Prior to attempting any maintenance work, ensure:

- 1. All pressure is vented from the system and the Soap Skid cannot be started accidentally.
- 2. The discharge piping is depressurized by opening a recirculating valve or discharge valve while keeping clear of any pressurized water.
- 3. Maintenance personnel are adequately trained, competent, and have read the Operation and Maintenance Manual.



Risk of electrical shock. Hazardous Voltage. Will cause serious injury or death. Disconnect external power source before servicing. Lockout/Tagout the equipment.

Prior to opening or removing panels or covers inside the Soap Skid, ensure:

- 1. Anyone entering the Soap Skid is aware of the reduced level of protection and the additional hazards, including hot surfaces and intermittently moving parts.
- 2. The Soap Skid cannot be started. Post warning signs and/or fit anti-start devices. Use appropriate Lockout/Tagout procedures.

Prior to attempting any maintenance work while Soap Skid is running, ensure:

- 1. The work carried out is limited to only those tasks which require the Soap Skid to run.
- 2. The work carried out with safety protection devices disabled or removed is limited to only those tasks which require the Soap Skid to be running with safety protection devices disabled or removed.
- 3. All hazards present are known (e.g. pressurized components, electrically live components, removed panels, covers and guards, extreme temperatures, compressed air, intermittently moving parts, safety valve discharge, etc.).
- 4. Appropriate personal protective equipment is worn.
- 5. Loose clothing, jewelry, long hair etc. is made safe.
- 6. Warning signs indicating that Maintenance Work is in Progress are posted in a position that can be clearly seen.

Upon completion of maintenance task and prior to returning the Soap Skid into service, ensure:

- 1. The Soap Skid is suitably tested.
- 2. All guards and safety protection devices are refitted.
- 3. All panels are replaced, canopy and doors closed.
- 4. Hazardous materials are effectively contained and disposed of.

The maintenance schedule in this manual describes the service intervals that should be followed for "normal" applications of this Soap Skid. This page may be reproduced and used as a checklist by service personnel.

In some applications where the water being pumped has a high percentage of suspended solids present, frequent service intervals will be required to ensure long component life.

High percentage of suspended solids (dirty water), high humidity, and high temperatures will affect lubricant life and will also affect service intervals for inlet y-strainers.

SERVICE PARTS

DESCRIPTION

PART#

CONSUMABLES

PREVENTIVE MAINTENANCE SCHEDULE

If operating in extreme conditions (very hot, cold, dusty, or wet), these time periods should be reduced.

12M0S 2000 Hrs

000 Hrs MOS

×	Wye Strainer Element	ent						
Belts	lts			DAILY	WKLY	MO.	3 MOS	۷9
M	Motor Sheave			ж:—:У	les sylv	250 Hrs	500 Hrs	100
Ĭ	Motor Sheave Bushing	ning	Pump Crankcase Oil Level	U				
Pui	Pump Sheave)	Pump Piston Cups for Leaks	S			ō.	
Pul	Pump Sheave Bushing	ing	PanelView	C				
Par	Panel – Fuse, 5A, Fast Acting	ast Acting	Emergency Stop	_			9	
Par	Panel – Fuse, 15A, Fast Acting	Fast Acting	Suction Piping	D				
Par	Panel – Fuse, 20A, Time Delay	Time Delay	Discharge Piping	D			ō.	
Par	Panel – Fuse, 80A, High Speed	High Speed	Piping System*	*_				
IDED C	RECOMMENDED CRANKCASE OILS		Inlet Wye Strainers	: : : : : : : : : : : : : : : : : : : :	С			
			Check for Leaks (Oil, Fluid)		C		5.	
ended oi	Using recommended oils will help insure optimal pump	ptimal pump	Fluid Hoses			C		
performance and long life. Oil capacity is 1 gallon per	performance and long life. Oil capacity is 1 gallon per pump.		Belt Drive Tension**	K:	Sec.	2	40	
			Safety Valve				C	
	Motor Oil	Synthetic Oil	Factorore Guarde	ó	S.		J	
General Service	30W	5W-40	l astellers, Odalus		25	C.	ر	
High Ambient Service	50W	5W-40	Pump Crankcase Oil					~
Low Ambient Service	20W	5W-40	Pump Stuffing Box Bolts	(:				C
	2		Pump Connecting Rod Bolts		. 3			O
			Torque Electrical Connections		54	0.0	0.0	
R= Replace D= Drain	ain F= Flush		*FLUSHING ONLY REQUIRED IF FLUID BEING PUMPED MAY HARDEN OR IS COF	UID BEING	PUMPED	MAY HAR	DEN OR IS	9

^{*}FLUSHING ONLY REQUIRED IF FLUID BEING PUMPED MAY HARDEN OR IS CORROSIVE*

G= Grease CR= Check and Report

T= Test

C= Check (and Adjust or Replace if Necessary)

For Parts and Service Call: 1-800-221-0586

^{**}TENSION IS CORRECT IF BELT DEFLECTS 1/2" WHEN APPLYING 12-17 LBS OF FORCE PER ONE BELT**

WYE STRAINER

There are three wye strainers located on the suction piping underneath each pump. The strainers are to prevent debris that may collect in holding tanks from entering the pumps during operation.

Wye strainers much be flushed periodically to keep pumps operating at peak performance. Refer to the Maintenance Schedule for recommended servicing intervals. Flushing of the wye strainers is performed simply by removing the 1-1/2 npt plug and opening the ball valve on each strainer until element is clean.

▲ CAUTION

The mating pump to the wye strainer being flushed must be stopped before opening wye strainer ball valve. If the ball valve is opened while mating pump is in operation, damage to pump may occur.

BELT TENSION

Each pump is equipped with pulleys and 3 v-belts to drive the pump from the electric motors.

Tension on the drive belts must be monitored for the correct operation of pumps and long life of belt drives. Refer to the Maintenance Schedule for recommended servicing intervals and tension specifications. Check belt tension by using a belt tension gauge on <u>one</u> drive belt at a time.



Do not attempt maintenance or service of the belt drive(s) without first making sure the pumps are shut down and the system has been completely relieved of all water pressure. (Refer to SHUTTING DOWN in the OPERATING INSTRUCTIONS section of this manual).

PUMP MAINTENANCE

Per pump manufacturer, each pump(s) Piston Cups, Stuffing Box Bolts, and Connecting Rod Bolts need periodic inspection to determine if maintenance and/or replacement of these components is needed.

The Maintenance Schedule lists recommended inspection intervals. Refer to pump manufacturer's operation and maintenance manual for detailed instructions on inspection and replacement of these pump components.



Do not attempt maintenance or service of the pump(s) without first making sure the pumps are shut down and the system has been completely relieved of all water pressure followed by draining piping system. (Refer to SHUTTING DOWN in the OPERATING INSTRUCTIONS section of this manual).

PRESSURE SYSTEM

Regularly, it is necessary to inspect the external surfaces of the system, from the tank suction valves, recirculation valve, and discharge valve including hoses, tubes, tube fittings and the safety relief valve, for visible signs of impact damage, excessive corrosion, abrasion, tightness, and chafing. Any suspect parts should be replaced before the Soap Skid is put back into service.

ELECTRICAL SYSTEM



Risk of electrical shock. Hazardous Voltage. Will cause serious injury or death. Disconnect external power source before servicing. Lockout/Tagout the equipment. This Soap Skid contains multiple Variable Frequency Drives. When it is switched off and motor is shut down, the capacitors store a potentially lethal high voltage. DO NOT REMOVE COVERS FROM THE DRIVES and attempt any service work unless properly trained. There are no user serviceable components under the individual drive covers. Wait at least 10 minutes after disconnecting power before servicing or troubleshooting Drive component fuses or connections in the Control Panel.

Check the security of electrical devices and sensors to ensure terminals and or connectors are tight. Loose connections may cause local hot spot oxidation.

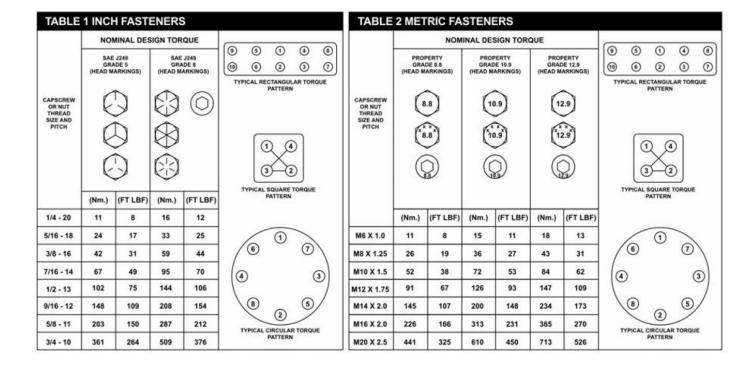
When removing connectors from electrical devices and sensors, inspect the terminals to ensure they have electrical grease on them. If electrical grease is not present or very minimal, then add a small amount of electrical grease to the terminals.

Dirty and/or corroded electrical terminals can be cleaned using electrical contact cleaner.

Inspect the components and wiring for signs of overheating i.e. discoloration, charring of cables, deformation of parts, acrid smells and blistered paint.

Periodically check all electrical connections for tightness and re-torque per Maintenance Chart.

TORQUE VALUES



WELDING

Welding on the electric unit is prohibited, unless the guidelines specified in this section are followed. Damage to the electrical components may occur if the welder does not follow the procedure as outlined.

DO NOT attempt to weld while there is power to the unit or while the compressor is running.

DO NOT weld directly to the control panel or transformer enclosures.

DO WEAR appropriate PPE when welding.

All steps outlined are not required to be followed chronologically but must all be complete prior to welding.

- De-energize and disconnect incoming supply power to the unit. Follow LOTO procedures according to the site.
- Open the main breaker on the input panel, and the two breakers on the control panel.
- Determine the best location for grounding the welder.
 - Ensure that the location is as close as possible to the welding work being performed.
 - o Prepare the surface to provide sufficient contact.
 - Certain equipment on the unit is isolated and utilizes ground straps for continuity between components. Ensure that the grounding location is directly connected to the work being performed.

Following completion of the outlined process, welding may occur. Be aware of welding being conducted and proximity to other components on the unit to prevent unintended damage.

LUBRICATION

GENERAL INFORMATION

Lubrication is an essential part of preventive maintenance, largely affecting the useful life of the Soap Skid. Different lubricants are needed and some components require more frequent lubrication than others. Therefore, it is important that the instructions regarding types of lubricants and the frequency of their application be explicitly followed. Periodic lubrication of the moving parts reduces to a minimum the possibility of mechanical failures.

The Maintenance Schedule shows those items requiring regular service and the interval in which maintenance should be performed. A regular service program should be developed to include all items and waters. These intervals are based on average operating conditions. In the event of extremely severe (hot, cold, dusty or wet) operating conditions, more frequent lubrication than specified may be necessary.

PUMP CRANKCASE OIL



Always check the pump oil levels before the Soap Skid is put into service.

If, for any reason, the Soap Skid pumps have been drained of oil, they must be refilled with new oil before Soap Skid is put into operation.

Refer to the Maintenance Schedule for the recommended servicing intervals. Also note oil type and quantity listed on the Maintenance Schedule.

NOTE: If the Soap Skid has been operating under adverse conditions, or has suffered long shutdown periods, then more frequent service intervals will be required.

CHANGING CRANKCASE OIL



Do not remove the pump crankcase drain plug(s) without first making sure the Soap Skid is shut down. (Refer to SHUTTING DOWN in the OPERATING INSTRUCTIONS section of this manual).

Remove drain plug(s) and drain oil into a suitable container. It is best practice to drain dirty oil from pump crankcase when oil is warm after pumps have been operating.

Replace the drain plug(s) ensuring that each one is secure.

NOTE: If the oil is drained immediately after the pumps have been running, then most of the sediment will be in suspension and will therefore drain more readily. However, the oil will be hot and care must be taken to avoid contact with the skin or eyes.

ELECTRIC MOTOR LUBRICATION CHART

50HP PUMP MOTOR(S)				
DRIVE END NON-DRIVE END				
BEARING TYPE	6312 C3	6212 C3		
SEALING	SEALING V'Ring V'Ring			
LUBRICATION INTERVAL 20000 hours 20000 hours				
LUBRICATION AMOUNT 21g 13g				
LUBRICATION TYPE	Mobil Polyrex EM	Mobil Polyrex EM		

GENERAL LUBRICATION CHART

CABLE SUPPORT BRACKET	GREASE AS NEEDED
ELECTRICAL PANEL DOOR HINGES	GREASE AS NEEDED

TROUBLESHOOTING

INTRODUCTION

Troubleshooting for the Soap Skid is an organized study of a particular problem or series of problems and a planned method of procedure for investigation and correction. The troubleshooting chart that follows includes some of the problems that an operator may encounter during the operation of this Soap Skid.

The chart does not attempt to list all of the troubles that may occur, nor does it attempt to give all of the answers for correction of the problems. The chart does give those problems that are most apt to occur. To use the troubleshooting chart:

- A. Find the "complaint" depicted as a bold heading.
- B. Follow down that column to find the potential cause or causes. The causes are listed in order to suggest an order to follow in troubleshooting.

THINK BEFORE ACTING

Study the problem thoroughly and ask yourself these questions:

- 1. What were the warning signals that preceded the trouble?
- 2. Has a similar trouble occurred before?
- 3. What previous maintenance work has been done?
- 4. If the Soap Skid will still operate, is it safe to continue operating it to make further checks?

DO THE SIMPLEST THINGS FIRST

Most troubles are simple and easily corrected. For example, most complaints are "low capacity" which may be caused by too low a motor speed or "pump squealing noise" which may be caused by belt drives not tight enough.

Always check the easiest and most obvious thing first; following this simple rule will save time and trouble.

DOUBLE CHECK BEFORE DISASSEMBLY

The source of most Soap Skid troubles can be traced not to one component alone, but to the relationship of one component to another. Too often, the Soap Skid can be partially disassembled in search of the cause of a certain trouble and all evidence is destroyed during disassembly. Check again to be sure an easy solution to the problem has not been overlooked.

FIND AND CORRECT BASIC CAUSE

After a mechanical failure has been corrected, be sure to locate and correct the cause of the trouble so the same failure will not be repeated. For example, a complaint of "premature breakdown" may be corrected by repairing any improper wiring connections, but something caused the defective wiring. The cause may be excessive vibration.

TROUBLESHOOTING

СО	MPLAINT	CAUSE	CORRECTION
1.	Pump motor(s) will not start	Emergency Stop is pushed	Check Emergency Stop switch
	or run		positions and operation
		Discharge pressure is too high	Open tank bypass valve to purge
			pressure from discharge line
		VFD breaker needs reset	Open and then close VFD
			breaker to reset after a fault
		Loose wire connection	Check wires at switches and
			connectors to find loose
			connection. Make repairs. See
			Electronic Service Manual.
		Defective discharge pressure	Identify and check transducer.
		transducer	Replace if necessary. See
			Electronic Service Manual.
		Improper supply power	Identify cause for overvoltage or
			undervoltage. See Electronic
			Service Manual.
		Pump malfunction	See pump maintenance manual
2.	Excessive pump noise when	Insufficient water flow in	Add water to tank being used or
	in operation	suction lines	switch valves for other tank.
		Plugged wye strainer(s)	Open ball valve at each wye
			strainer to flush out debris.
		Low crankcase oil level	Add crankcase oil until correct
			oil level is reached. Refer to
			maintenance chart.
		Pump malfunction	See pump maintenance manual
3.	Belt drives slipping	Loose belt tension	Tighten belt tension using
			adjusters on pump motor base.
			Refer to maintenance chart.
		Stretched belts	Replace and re-tighten belts.
			Refer to maintenance chart.
4.	Pump motor(s) have	Discharge pressure is too high	Safety Relief Valve has frozen or
	shutdown unexpectedly		is seized. Thaw or replace.
		Defective discharge pressure	Identify and check transducer.
		transducer	Replace if necessary. See
			Electronic Service Manual.
		Blown fuse	Identify and replace fuse. See
			Electronic Service Manual.
		Motor amperage draw too high	Wait for VFD control to reset.
		/ shut down by VFD control.	Reduce output after restarting.
			See Electronic Service Manual.
		Improper supply power	Identify cause for overvoltage or
			undervoltage. See Electronic
		B	Service Manual.
		Pump malfunction	See Pump Maintenance Manual

COMPLAINT	CAUSE	CORRECTION
5. Low electrical system voltage	Loose wire connection	Check wires at switches and connectors to find loose connection. Make repairs. See Electronic Service Manual
	Improper supply power	Identify cause for overvoltage or undervoltage. See Electronic Service Manual.
6. Excessive vibration	Pump malfunction	See Pump Maintenance Manual
7. Low water delivery /	Pump speed too slow	Increase pump speed
Low GPM	Water level of tank being used for suction is low or empty	Add water or switch to other tank
	Suction valve closed or only partially opened	Fully open suction valve
	Discharge valve closed or only partially opened	Fully open discharge valve
	Clogged wye strainer element(s)	Open ball valves at wye strainers to flush debris
	Only one pump running	Use automatic mode to ensure two pumps are running
	Water leaks	Locate and repair leaks
8. High water delivery / High GPM	Pump speed too fast for operating conditions	Decrease pump speed
	Flow of two pumps is too much for operating conditions	Use manual mode to operate one pump only
9. Low pressure	Pump speed too slow	Increase pump speed
	Not enough resistance with drilling equipment	Make adjustments of equipment while drilling to increase water pressure
	Worn check valve	Replace faulty check valve
	Safety relief valve worn	Replace safety relief valve
	Pump malfunction	See pump maintenance manual
10. High pressure	Pump speed too fast	Decrease pump speed
	Discharge valve closed or only partially opened	Fully open discharge valve
	Safety relief valve seized or frozen	Replace safety relief valve
11. Safety valve opens	Operating pressure too high	Reduce pressure to rated operating pressure
	All valves on discharge piping are closed	Open a recirculation valve or the discharge valve
	Safety relief valve worn	Replace safety relief valve



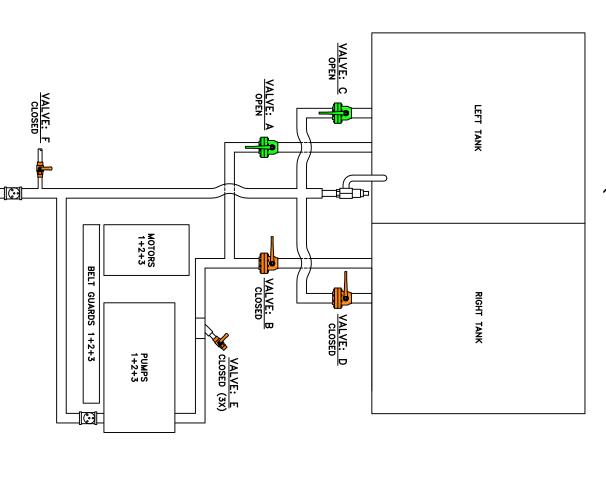


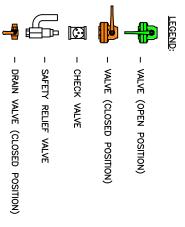
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START-UP & SHUT-DOWN

(LEFT TANK - POSITION OF VALVES)





START-UP & SHUT-DOWN LEFT TANK - POSITION OF VALVES

THE VALVES ARE IN THE FOLLOWING POSITIONS WHEN UNIT IS BEING STARTED OR SHUT-DOWN:

VALVE—B: CLOSED (SUCTION VALVE — RIGHT TANK)

VALVE-B: CLOSED (SUCTION VALVE - RIGHT TANK)
VALVE-C: OPEN (RECIRCULATION VALVE - LEFT TANK)

VALVE-D: CLOSED (RECIRCULATION VALVE - RIGHT TANK)

VALVE-E: CLOSED (DRAIN VALVE 3X)

VALVE-F: CLOSED (DRAIN VALVE)
VALVE-G: CLOSED (DISCHARGE VALVE)

NEVER CLOSE DISCHARGE VALVE WHILE PUMP IS OPERATING WITHOUT FIRST OPENING THE APPROPRIATE RECIRCULATION VALVE

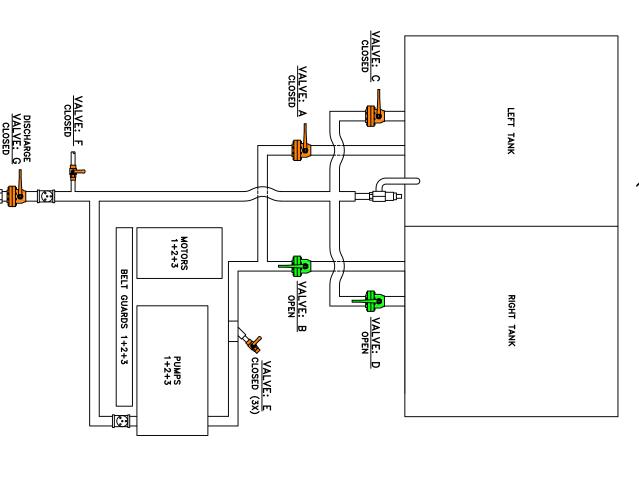
NEVER RUN PUMP WITH SUCTION VALVE(S) CLOSED

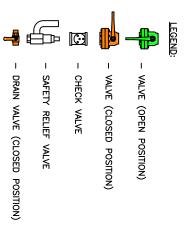
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		VALVES)	유	NOITISO	(LEFT TANK - POSITION OF VALVES)	
		Ž	-DOV	& SHUT	START-UP & SHUT-DOWN	

DISCHARGE
VALVE: G
CLOSED

START-UP & SHUT-DOWN

(RIGHT TANK - POSITION OF VALVES)





RIGHT TANK - POSITION OF VALVES

THE VALVES ARE IN THE FOLLOWING POSITIONS WHEN UNIT IS BEING STARTED OR SHUT-DOWN:

VALVE—A: CLOSED (SUCTION VALVE — LEFT TANK)

VALVE—C: CLOSED (RECIRCULATION VALVE — LEF-VALVE—C: CLOSED (RECIRCULATION VALVE — LEF-

VALVE—C: CLOSED (RECIRCULATION VALVE — LEFT TANK) VALVE—D: OPEN (RECIRCULATION VALVE — RIGHT TANK)

VALVE-E: CLOSED (DRAIN VALVE 3X)

VALVE-F: CLOSED (DRAIN VALVE)

VALVE-G: CLOSED (DISCHARGE VALVE)

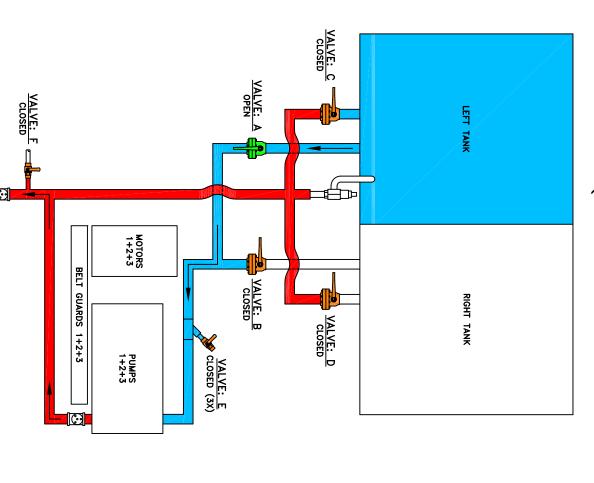
NEVER CLOSE DISCHARGE VALVE WHILE PUMP IS OPERATING WITHOUT FIRST OPENING THE APPROPRIATE RECIRCULATION VALVE

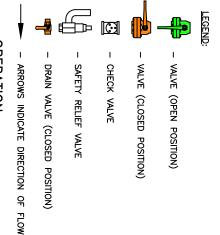
NEVER RUN PUMP WITH SUCTION VALVE(S) CLOSED

	START-UP & SHUT-DOWN (RIGHT TANK - POSITION OF VALVES)	START-UP & SHUT-DOWN T TANK - POSITION OF VI	WN VALVES	;)	
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OPERATION

(LEFT TANK - POSITION OF VALVES)





OPERATION LEFT TANK — POSITION OF VALVES

THE VALVES ARE IN THE FOLLOWING POSITIONS WHEN UNIT IS OPERATING:

VALVE—R: CLOSED (SUCTION VALVE — RIGHT TANK)

VALVE—B: CLOSED (SUCTION VALVE — RIGHT TANK)
VALVE—C: CLOSED (RECIRCULATION VALVE — LEFT 1

VALVE—C: CLOSED (RECIRCULATION VALVE — LEFT TANK)
VALVE—D: CLOSED (RECIRCULATION VALVE — RIGHT TANK)

VALVE E CLOSED (DRAIN VALVE 3X)

VALVE-F: CLOSED (DRAIN VALVE)
VALVE-G: OPEN (DISCHARGE VALVE)

NEVER CLOSE DISCHARGE VALVE WHILE PUMP IS OPERATING WITHOUT FIRST OPENING THE APPROPRIATE RECIRCULATION VALVE

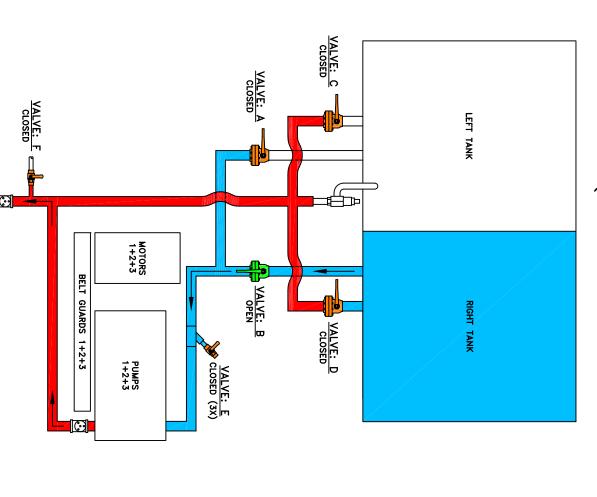
NEVER RUN PUMP WITH SUCTION VALVE(S) CLOSED

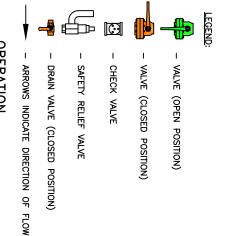
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027	255		

DISCHARGE
VALVE: G
OPEN

OPERATION

(RIGHT TANK -POSITION OF VALVES)





RIGHT TANK — POSITION OF VALVES

THE VALVES ARE IN THE FOLLOWING POSITIONS WHEN UNIT IS OPERATING:

VALVE—A: CLOSED (SUCTION VALVE — LEFT TANK)

VALVE—B: OPEN (SUCTION VALVE — RIGHT TANK) VALVE—C: CLOSED (RECIRCULATION VALVE — LEF

VALVE—C: CLOSED (RECIRCULATION VALVE — LEFT TANK)
VALVE—D: CLOSED (RECIRCULATION VALVE — RIGHT TANK)

VALVE-E: CLOSED (DRAIN VALVE 3X)

VALVE-F: CLOSED (DRAIN VALVE)

VALVE-G: OPEN (DISCHARGE VALVE)

NEVER CLOSE DISCHARGE VALVE WHILE PUMP IS OPERATING WITHOUT FIRST OPENING THE APPROPRIATE RECIRCULATION VALVE

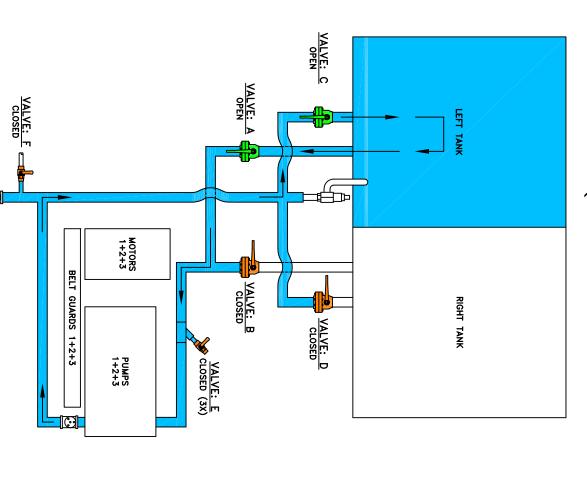
NEVER RUN PUMP WITH SUCTION VALVE(S) CLOSED

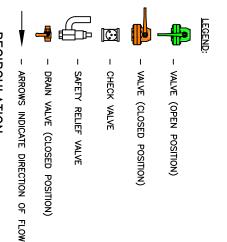
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	(RIGHT TANK - POSITION OF VALVES)	POSITION OF	VALVES)	
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DISCHARGE
VALVE: G
OPEN

RECIRCULATION

(LEFT TANK - POSITION OF VALVES)





RECIRCULATION LEFT TANK — POSITION OF VALVES

THE VALVES ARE IN THE FOLLOWING POSITIONS WHEN UNIT IS BEING RECIRCULATED:

VALVE—A: CLOSED (SUCTION VALVE — RIGHT TANK)

VALVE—B: CLOSED (SUCTION VALVE — RIGHT TANK)
VALVE—C: OPEN (RECIRCULATION VALVE — LEFT TANK)

VALVE-D: CLOSED (RECIRCULATION VALVE - RIGHT TANK)

VALVE-E: CLOSED (DRAIN VALVE 3X)

VALVE-F: CLOSED (DRAIN VALVE)
VALVE-G: CLOSED (DISCHARGE VALVE)

NEVER CLOSE DISCHARGE VALVE WHILE PUMP IS OPERATING WITHOUT FIRST OPENING THE APPROPRIATE RECIRCULATION VALVE

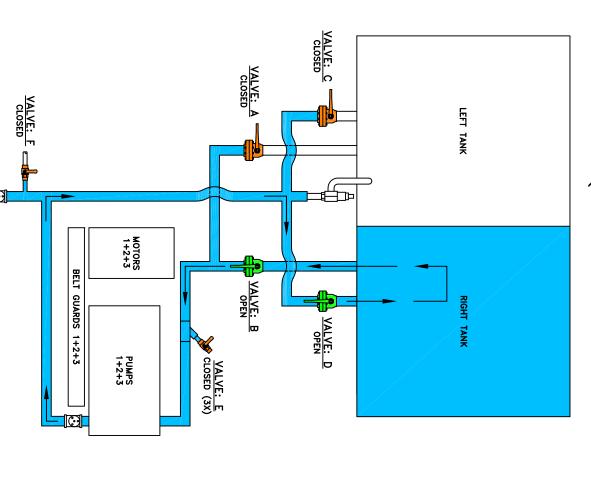
NEVER RUN PUMP WITH SUCTION VALVE(S) CLOSED

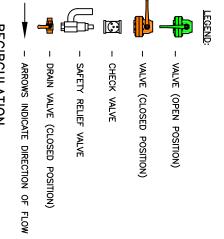
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DISCHARGE
VALVE: G
CLOSED

RECIRCULATION

(RIGHT TANK - POSITION OF VALVES)





RECIRCULATION RIGHT TANK - POSITION OF VALVES

THE VALVES ARE IN THE FOLLOWING POSITIONS WHEN UNIT IS BEING RECIRCULATED:

VALVE-A: CLOSED (SUCTION VALVE - LEFT TANK)

VALVE-B: OPEN (SUCTION VALVE - RIGHT TANK) VALVE-C: CLOSED (RECIRCULATION VALVE - LEF

VALVE—C: CLOSED (RECIRCULATION VALVE — LEFT TANK) VALVE—D: OPEN (RECIRCULATION VALVE — RIGHT TANK)

VALVE-E: CLOSED (DRAIN VALVE 3X)

VALVE-F: CLOSED (DRAIN VALVE)

VALVE-G: CLOSED (DISCHARGE VALVE)

NEVER CLOSE DISCHARGE VALVE WHILE PUMP IS OPERATING WITHOUT FIRST OPENING THE APPROPRIATE RECIRCULATION VALVE

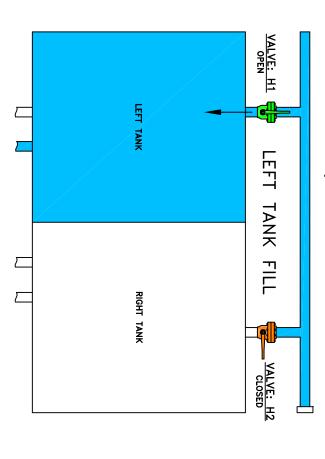
NEVER RUN PUMP WITH SUCTION VALVE(S) CLOSED

	RECIR	RECIRCULATION			
	(RIGHT TANK - POSITION OF VALVES)	OSITION OF	VALVES)	
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DISCHARGE
VALVE: G
CLOSED

TANK FILL

BOTH TANKS | POSITION OF VALVES)



THE VALVES ARE IN THE FOLLOWING POSITIONS WHEN LEFT TANK IS BEING FILLED:

VALVE—A: CLOSED (SUCTION VALVE — LEFT TANK)
VALVE—B: CLOSED (SUCTION VALVE — RIGHT TANK)
VALVE—H1: OPEN (FILL VALVE — LEFT TANK)
VALVE—H2: CLOSED (FILL VALVE — RIGHT TANK)



THE VALVES ARE IN THE FOLLOWING POSITIONS WHEN RIGHT TANK IS BEING FILLED:

VALVE: H1 CLOSED

RIGHT TANK FILL

VALVE: H2 OPEN

VALVE—A: CLOSED (SUCTION VALVE — LEFT TANK)
VALVE—B: CLOSED (SUCTION VALVE — RIGHT TANK)
VALVE—H1: CLOSED (FILL VALVE — RIGHT TANK)
VALVE—H2: OPEN (FILL VALVE — RIGHT TANK)

NEVER CLOSE DISCHARGE VALVE WHILE PUMP IS OPERATING WITHOUT FIRST OPENING THE APPROPRIATE RECIRCULATION VALVE

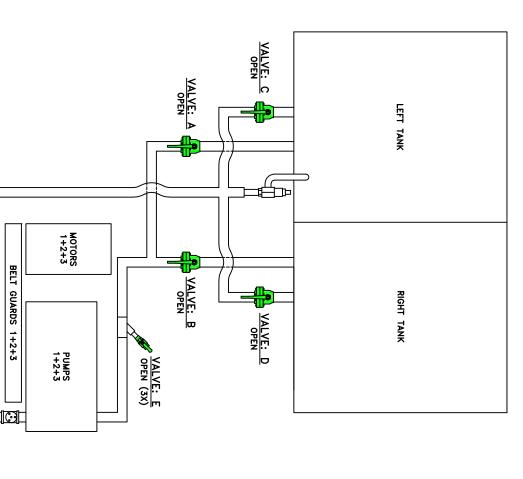
LEFT TANK

RIGHT TANK

NEVER RUN PUMP WITH SUCTION VALVE(S) CLOSED

	TAN (BOTH TANKS –	TANK FILL - POSITION OF VALVES)	VALVE	S)	
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(POSITION OF VALVES) STORAGE





STORAGE POSITION OF VALVES

- DRAIN VALVE (OPEN POSITION)

SAFETY RELIEF VALVE

THE VALVES ARE IN THE FOLLOWING POSITIONS WHEN UNIT IS BEING STORED:

VALVE—A: OPEN (SUCTION VALVE — LEFT TANK)

VALVE-B: OPEN (SUCTION VALVE - RIGHT TANK)

VALVE-C: OPEN VALVE-D: OPEN (RECIRCULATION VALVE - LEFT TANK)

(RECIRCULATION VALVE - RIGHT TANK)

VALVE-F: OPEN (DRAIN VALVE) VALVE-E: OPEN (DRAIN VALVE 3X)

VALVE-H1: OPEN (NOT SHOWN, FILL VALVE - LEFT TANK)
VALVE-H2: OPEN (NOT SHOWN, FILL VALVE - RIGHT TANK)

VALVE-G: OPEN (DISCHARGE VALVE)

NEVER CLOSE DISCHARGE VALVE WHILE PUMP IS OPERATING WITHOUT FIRST OPENING THE APPROPRIATE RECIRCULATION VALVE

NEVER RUN PUMP WITH SUCTION VALVE(S) CLOSED

VALVE: F

DISCHARGE
VALVE: G
OPEN

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				STORAGE	STC	