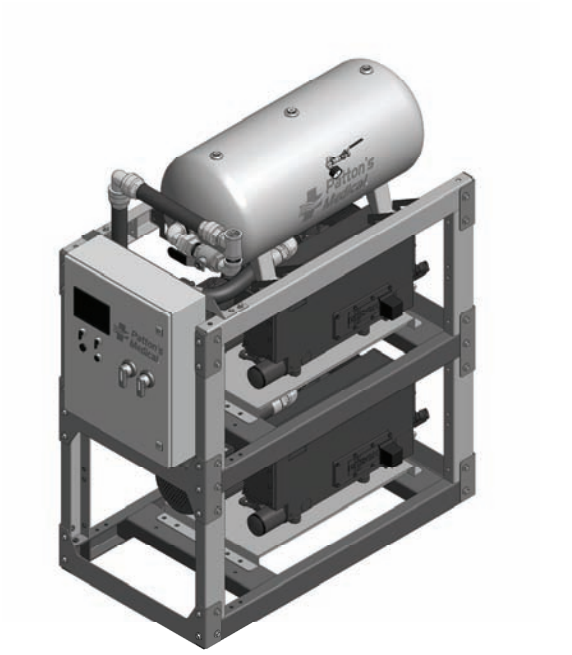
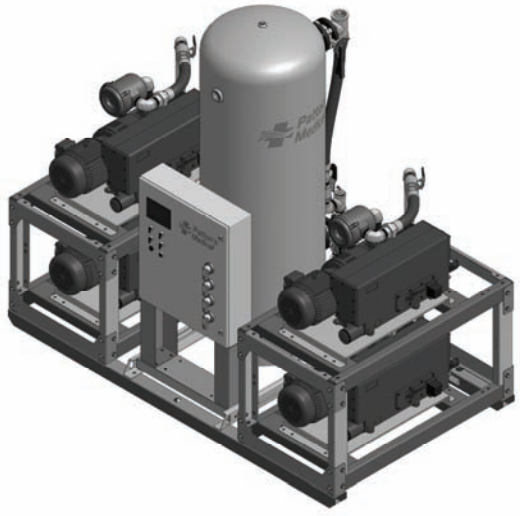
Patton's Medical

Lube Rotary Vane Medical Vacuum System





SIGNAL 1™

Installation Operation and Maintenance Manual 1.5 - 25 Hp

Model Number:	
Serial Number:	
Date Purchased:	
Purchased from:	

For further technical assistance, service or replacement parts, please contact:

Patton's Medical
3201 South Boulevard
Charlotte, NC 28209

Customer Service: 1-866-960-0087
Phone: 704-529-5442
FAX: 704-525-5148

www.pattonsmedical.com

Please include the unit serial number located on the control panel with all inquiries.

Patton's Medical reserves the right to make changes and improvements to update products sold previously without notice or obligation.

Issue Date: September 25, 2012

Table of Contents

(Continued on next page)

Table of Contents

Safety Precautions

The operator should have carefully read and become familiar with the contents of this manual before installing, wiring, starting, operating, adjusting and maintaining the system. The operator is expected to use common sense safety precautions, good workmanship practices and follow any related local safety precautions.

In addition:

- **Before starting any installation or maintenance procedures, disconnect all power to the package.**
- All electrical procedures must be in compliance with all national, state and local codes and requirements.
- A certified electrician should connect all wiring.
- Refer to the electrical wiring diagram provided with the unit before starting any installation or maintenance work.
- Release all vacuum from the package before removing, loosening, or servicing any covers, guards, fittings, connections, or other devices.
- Notify appropriate hospital personnel if repairs or maintenance will affect available vacuum levels.
- Prior to using the Medical Vacuum system, the medical facility must have a certifier perform all installation tests as specified in the latest edition of NFPA 99 and is responsible for ensuring that the Medical Vacuum system meets the minimum requirements as specified in the latest edition of NFPA 99.
- This is a high speed, rotating piece of machinery. Do not attempt to service any part while machine is in operation.
- To prevent automatic starting, disconnect all electrical power before performing any maintenance functions.
- Do not operate unit without guards, shields or screens in place.
- Make sure that all loose articles, packing material, and tools are clear of the package.
- Check all safety devices periodically for proper operation.
- The "Hand" mode of operation should only be used for emergencies such as a PLC malfunction and should not be used for normal operation.
- Electrical service must be the same as specified on the control panel nameplate or damage to the equipment may occur.
- Vibration during shipment can loosen electrical terminals, fuse inserts, and mechanical connections. Tighten all electrical connections prior to energizing the control panel.

1.0 General Information

System Configurations
The lubricated, rotary vane Medical Vacuum systems are either base mounted or tank mounted units in configurations of duplex, triplex, quadruplex or other multiplexed configurations. All are compliant to the latest edition of the NFPA 99 code and consist of at least two vacuum pumps, two motors, an inlet filter and isolation valve for each pump, an integral pre-wired control panel and air receiver. The systems are constructed as either single point connection (SPC) or modular packages. The complete package is pre-wired, pre-piped, and assembled either on one common base with single point connections for electrical, intake air, discharge air, and condensation drain or as a modular system with connection points for the above.

Vacuum Module
The vacuum pump is a lubricated rotary vane type direct-driven through a shaft coupling. Lubrication is provided by an integral, fully recirculating oil supply that is filtered by an automotive-type, spin-on oil filter. The vacuum pump is equipped with a high discharge temperature switch and oil drain valve assembly with temperature gauge. The oil separation system is integral and consists of no less than three stages of internally installed oil and smoke eliminators through which the exhaust gas stream must pass. This system consists of bulk separation, oil mist elimination, and smoke elimination, and is capable of removing 99.9+ percent of all oil and smoke particles from the exhaust gas stream.
The pump design is air-cooled, consisting of three non-metallic, non-asbestos vanes with a minimum life of 30,000 hrs. A built-in check valve to prevent backflow through off-cycle units is mounted at the pump inlet along with a 10 micron inlet filter for removal of particulates. The pump is equipped with vibration isolation.

Vacuum Drive and Motor
The pump is direct driven through a shaft coupling. The 1.5-10 hp motors are NEMA rated, C-faced TEFC, 1750 RPM, with 1.15 service factor suitable for 208 or 230/460V electrical service. The 15-25 hp motors are NEMA rated, C-faced TEFC, 1150 RPM, with 1.15 service factor suitable for 208 or 230/460V electrical service.

Intake Piping
Each vacuum pump has a piped intake with one "hospital type" inlet air filter and threaded opening for remote intake piping. An inlet check valve and isolation valve is piped on each pump. The vacuum pumps are connected to a common manifold and piped to a receiver. A flexible connector is located between each pump and the manifold.

1.0 General Information

Vacuum Receiver
The vacuum system includes a vacuum receiver vertically or horizontally oriented in the package. The receiver is ASME Code stamped and National Board Certified. The receiver is rated for a minimum 200 psig design pressure and includes an integrally mounted tank bypass, manual drain, and vacuum gauge.

Control System
The mounted and wired control system is NEMA 12 and U.L. labeled. The control system provides automatic lead/lag sequencing with circuit breaker disconnects for each motor with external operators. The control panel also includes full voltage motor starters with overload protection, redundant 120V control circuit transformers, visual and audible reserve unit alarm with isolated contacts for remote alarm, and hand-off-auto selector switches. Automatic alternation of vacuum pumps is based on a first-on/first-off principle with provisions for simultaneous operation if required, automatic activation of the reserve unit if required. Visual and audible alarms indicators for high discharge temperature shutdown, with isolated contacts for remote alarm, are included.

An HMI (Human Machine Interface) touch screen display is mounted in the control panel door. It includes:

- a vacuum display
- a runtime display
- an alarm history display
- a maintenance schedule and history display
- a service indicator
- a replacement parts display
- a battery backup for history display

2.0 Installation

2.1 Receiving Inspection

The Medical Vacuum system should be carefully inspected upon delivery. Any damage by the carrier should be noted on the delivery receipt, especially if the system will not be immediately uncrated and installed. The system may remain in its shipping container(s) until ready for installation. If the system is to be stored prior to installation, it must be protected from the elements to prevent rust and deterioration.

DO NOT REMOVE the protective covers from the inlet and discharge connection ports of the unit until they are ready for connecting to the hospital's pipeline distribution system.

2.2 Handling

!!WARNING!!
USE APPROPRIATE LOAD RATED LIFTING EQUIPMENT AND OBSERVE SAFE LIFTING PROCEDURES DURING ALL MOVES.

The vacuum package can be moved with either a forklift or dollies. Keep all packing in place during installation to minimize damage. If disassembly of the unit is necessary to access doorways or low ceiling clearances, carefully label all electrical connections that are removed for easier re-assembling at the final destination. Units should be placed to ensure easy access to perform maintenance and high visibility of indicators and gauges.

2.3 Location

The Medical Vacuum system should be installed indoors in a clean, well-ventilated environment. Areas of excessive dust, dirt or other air-borne particulate should be avoided.

Secure the package to a flat, level surface capable of supporting the weight and forces of the unit. Make sure that the main base is not bowed, twisted, or uneven. Because of the internal flexible hose connections and vibration isolators, **no special foundation is required**. However, the unit base must be securely bolted using all mounting holes provided in the base. If a raised concrete pad is used, the base must not overhang the concrete pad. A method to drain away moisture is necessary. If a gravity drain is not available, a connection to a drain is necessary. After securing the unit to the floor, remove all packing material.

The area should have an ambient temperature of between 40^{o}F and 105^{o}F. (If the maximum ambient exceeds 105°F, contact the factory for special instructions). The system should be located as close as possible to the point of usage to prevent excessive loss of operating vacuum due to pressure drop.

2.0 Installation

2.4 Space Requirements

The Medical Vacuum system should be placed to ensure easy access to perform maintenance and high visibility of indicators and gauges. It is recommended that a minimum space of 24” be allowed on all sides of the vacuum system for ventilation and maintenance. A minimum space of 36" in front of the control panel is required by NEC code. A vertical distance of 36” is required above the unit for ventilation and maintenance.

2.5 Locations Above Sea Level

All vacuum pumps above sea level have reduced flow and should be de-rated. After determining the correct flow needed for the medical vacuum system, multiple this number by the adjustment factor in the following chart. After determining the new flow required, use this number to size the medical vacuum system.

Altitude Adjustment Factor

Altitude (ft)	Normal Barometric Pressure (inches HG)	Multiplier Used for Required SCFM
0	29.92	1.00
500	29.39	1.02
1000	28.86	1.04
1500	28.33	1.06
2000	27.82	1.08
2500	27.32	1.10
3000	26.82	1.12
3500	26.33	1.14
4000	25.84	1.16
5000	24.90	1.20
6000	23.98	1.25
7000	23.09	1.30
8000	22.23	1.35
9000	21.39	1.40
10000	20.58	1.45

2.0 Installation

2.6 Component Assembly

Modular systems are shipped as separate units to facilitate a variety of installations. All modular and tank mount units are designed to fit through a standard 36" doorway, though some receiver modules may need to be tipped slightly.

Some interconnecting piping and wiring between modules may be necessary on modular systems only.

2.7 Wiring

WARNING!
BE SURE TO DISCONNECT ALL ELECTRICAL POWER TO THE VACUUM SYSTEM BEFORE PERFORMING ANY ELECTRICAL PROCEDURES.

Refer to the electrical diagram provided with the unit before starting any installation or maintenance work.

Do not operate the vacuum system on a voltage other than the voltage specified on the system's nameplate.

All customer wiring should be in compliance with the National Electrical Code and any other applicable state or local codes.

CAUTION: In the Duplex configuration, all voltages will be disconnected from the vacuum modules using the circuit breaker. Opening the appropriate fused knife-switch disconnect will disconnect the control power. Turning off the appropriate motor circuit breaker disconnects motor power as well as the control voltage for that motor circuit only.

Electrical power for the Medical Vacuum system must be supplied from the emergency life support circuit.

Check the control voltage, phase and amp ratings before starting the electrical installation, and make sure the voltage supplied by the hospital is the same.

The wire size should be able to handle peak motor amp load of all operating units, refer to the full load amperes on the wiring diagram.

Check all electrical connections within the vacuum system that may have loosened during shipment.

Only qualified electricians should make power connections to the control panel and any interconnecting wiring.

2.0 Installation

2.7 Wiring (continued)
Ensure that the emergency generator system's electrical supply is consistent with the vacuum system's requirements.

Three-phase power supplied from the emergency generator(s) must match that of the normal supply to allow for correct direction of the motor rotation at all times.

2.8 Intake Piping
Before connecting any piping, the plastic thread protector installed in the connection port must be removed. The main vacuum line to the receiver should not be reduced below that provided on the receiver. Long piping runs may need to be increased in size to minimize pressure drop. Improper line sizing may result in a loss of capacity. Ideally, piping should be constructed using long radius elbows and a minimum number of turns. All secondary lines should be taken from the top or side of the main line to prevent any accumulated moisture from draining towards the pumps. All lines should slope away from the pumps. Any low points in the piping should be equipped with pipe drains to remove accumulated moisture. All intake vacuum lines must be piped to in accordance with NFPA 99. All pipe must be either seamless copper tubing or other corrosion-resistant metallic tubing, such as galvanized steel or stainless steel, as detailed in NFPA 99.

2.9 Exhaust Piping
The exhaust line must be piped outside of the building in accordance with NFPA 99. To ensure that no restriction of airflow will occur, size the piping according to the chart on next page. All pipe must be either seamless copper tubing or other corrosion-resistant metallic tubing, such as galvanized steel or stainless steel, as detailed in NFPA 99. A flexible connector (shipped loose) must be installed on each exhaust port of the vacuum pump before connecting to the main exhaust line leading outdoors. Additionally, a drip leg must be installed at each exhaust port connection to allow for the draining of any accumulated moisture (Refer to the installation schematics for more details). The outside pipe must be turned down and screened to prevent contamination.

WARNING:
The vacuum exhaust vent must be located away from medical air intakes, doors and openings in the buildings to minimize possible contamination to the facility, in accordance with NFPA 99.

(Pipe Sizing chart on next page)

2.0 Installation

2.9 Exhaust Piping (continued)

Vacuum System	System Pipe Length (ft) - See Notes											
	25	**50**	**75**	**100**	**150**	**200**	**250**	**300**	**350**	**400**	**450**	**500**
Duplex 1.5 HP	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Duplex 2 HP	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Duplex 3 HP	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Duplex 5 HP	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Duplex 7.5 HP	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Duplex 10 HP	3.00	3.00	3.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00
Duplex 15 HP	4.00	4.00	4.00	5.00	5.00	5.00	5.00	6.00	6.00	6.00	6.00	6.00
Duplex 20 HP	4.00	4.00	4.00	5.00	5.00	5.00	5.00	6.00	6.00	6.00	6.00	6.00
Duplex 25 HP	5.00	5.00	5.00	6.00	6.00	6.00	6.00	6.00	6.00	8.00	8.00	8.00
Triplex 5.4 HP	3.00	3.00	3.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00
Triplex 7.5 HP	3.00	3.00	3.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00
Triplex 10 HP	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Triplex 15 HP	5.00	5.00	5.00	6.00	6.00	6.00	6.00	6.00	6.00	8.00	8.00	8.00
Triplex 20 HP	5.00	5.00	5.00	6.00	6.00	6.00	6.00	6.00	6.00	8.00	8.00	8.00
Triplex 25 HP	5.00	5.00	6.00	6.00	6.00	6.00	8.00	8.00	8.00	8.00	8.00	8.00
Quad 7.5 HP	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Quad 10 HP	4.00	4.00	4.00	5.00	5.00	5.00	5.00	6.00	6.00	6.00	6.00	6.00
Quad 15 HP	5.00	5.00	6.00	6.00	6.00	6.00	8.00	8.00	8.00	8.00	8.00	8.00
Quad 20 HP	5.00	5.00	6.00	6.00	6.00	6.00	8.00	8.00	8.00	8.00	8.00	8.00
Quad 25 HP	5.00	5.00	6.00	6.00	6.00	6.00	8.00	8.00	8.00	8.00	8.00	8.00

Minimum Pipe Sizes

Notes: 1. All pipe sizes are based on the following: copper pipe (Type L), 14.7 psia.

2. The minimum pipe size must be maintained for the total length of the exhaust pipe. Use next larger size pipe in the event the minimum size is not available.
3. When determining the total pipe length, add all the straight lengths of pipe together in addition to the number of elbows times the effective pipe length for that pipe size. (See the table and example below.)

Example:

Select the pipe size for a Duplex 7.5 HP with 100 feet of straight pipe and four elbows:

A) Select the pipe size of 3" diameter for 100 feet of straight pipe.

B) Determine the eff. pipe length for an elbow of 3" diameter (EPL = 10.0 ft / elbow).

C) Calculate the SYSTEM PIPE LENGTH {SPL (3.0" D) = 100 + (3 x 10.0) = 130 ft

D) Check this SYSTEM PIPE LENGTH to see if it exceeds the minimum pipe size.

Effective Pipe Length Equivalent of a 90 Degree Elbow									
Pipe Size (in.)	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00
Eff. Pipe Length (ft)	3.6	4.9	6.4	7.9	9.4	10.0	11.9	13.2	14.5

2.0 Installation

2.10 Oil Filling

WARNING: Keep the oil fill plug tight as pressure in the exhaust box could cause bodily injury if the plug is blown out. Do not fill/add the pump with oil through the exhaust/inlet ports as there is danger of breaking the vanes!

The 7.5 hp and smaller pumps are shipped without oil. After level installation, and after correct rotation has been established and with the pump switched "off" and secured against accidental start-up, fill the pump with the recommended vacuum oil through the oil filling port, observing the "MAX" and "MIN" position at the oil sight glass. Use only the sight glass reading for proper level. Never overfill!

Non-detergent oil should be used. Do not use detergent motor oil as additives in detergent oil will plug exhaust filter elements and shorten their life. The correct oil can be obtained directly from Patton's Medical. Contact Patton's Medical for details or when using other oils. Approximate quantities of oil are shown on the "Parts" screen of the HMI display on the control panel.

Replace the oil fill plug, making sure that the gasket is in place and properly seated and secured. Some pumps are equipped with an exhaust pressure gauge as an integral part of the oil fill plug. Switch the power back into the "Auto" position.

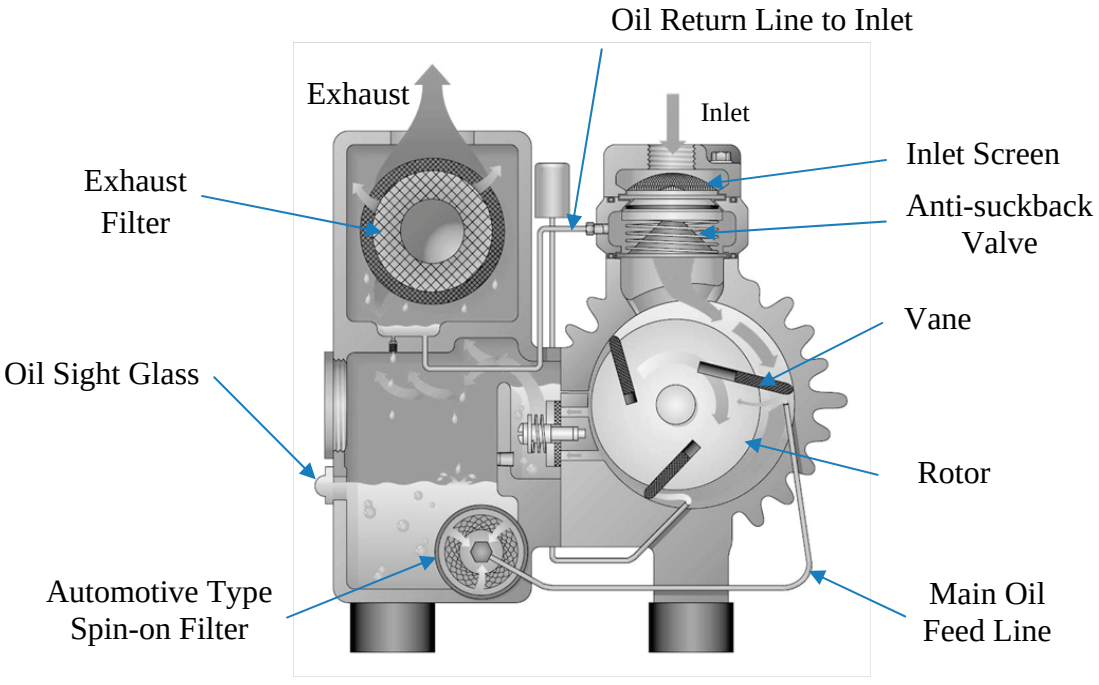
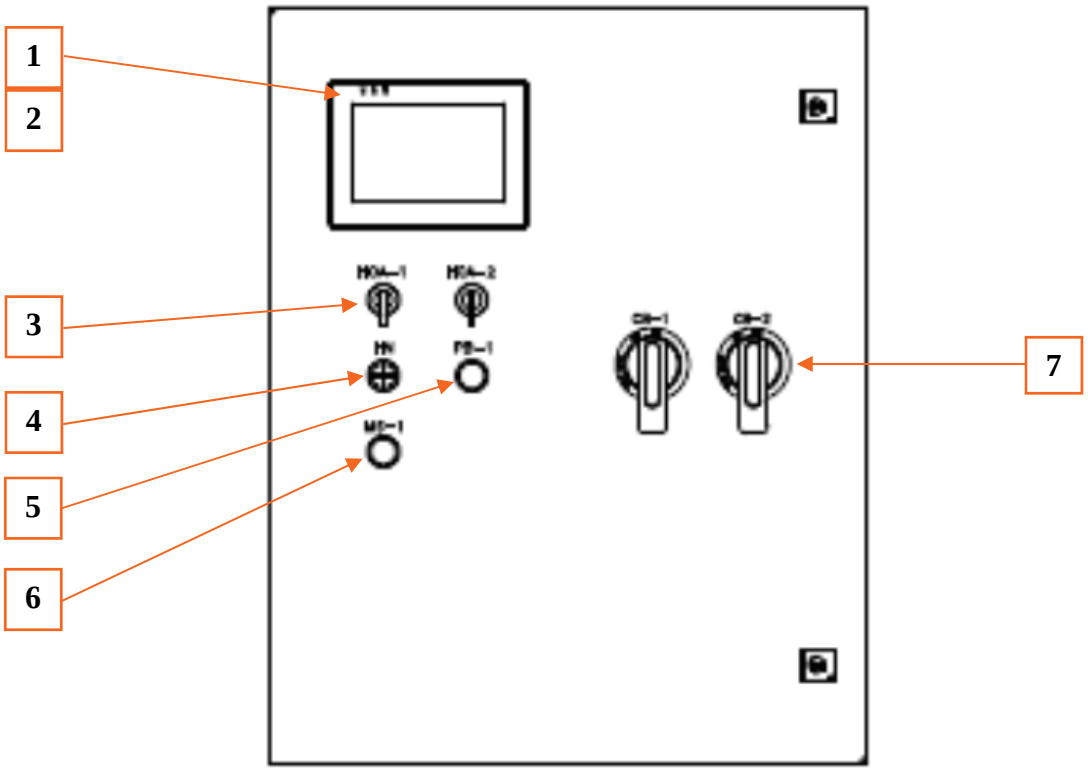


Fig. 1 – Basic Lubricated Vacuum Pump

3.0 Control Panel



1. Display Screen – Displays the systems operating screens.
2. LED's –Yellow PWR: Power is correctly supplied
Green CPU: Indicates the Signal 1 is operating correctly
Red COM: Indicates communication with PLC
Not lighted: Power is not supplied
3. HOA selector switch – Compressor control switch, Hand – Off – Auto.
4. Alarm horn – Sounds when an alarm condition occurs.
5. Alarm Reset/Horn Silence – Pushbutton to silence alarm and reset visual alarm on *Signal 1* screen after alarm condition is corrected.
6. Motion sensor – Turns Signal 1 back light on if movement is present
7. External Operators– Turns Circuit Breakers On - Off

3.0 Control Panel (Continued)

3.1 Signal 1 System touch screen gateway

The Lubricated Vane Medical Vacuum system has a touch screen gateway to control and monitor the complete system operation as well as record service and alarm history of the unit and change pressure setting levels.

3.2 *Signal 1* Main Display Screen The main screen for systems will monitor and display the air receiver vacuum level, run sequence, individual unit total run hours and run status (HOA switch position). Included on this screen is a service due alarm, transducer fault alarms and lag alarm for the system as well as individual alarms for each compressor unit (motor overload, and high discharge air temperature) . The “MENU” button in the upper right corner will allow the operator to navigate through the screens to view the system alarm history, service schedule and records, and vacuum trends, basic troubleshooting, vacuum settings, and system general information. When the ***Signal 1*** is powered up the main control window will appear on the display screen. This screen displays the systems current vacuum level, total hours run for each module, run sequence, HOA switch setting and status of service schedule and alarm conditions.

Main Screen (Duplex System shown)

3.0 Control Panel (Continued)

3.2 HMI Main Display Screen (Continued)

1. MENU: Displays menu screen which allows the operator to access the systems operating history, service requirements, and vacuum trends, troubleshooting info and main system info.
2. VACUUM (inches Hg): Display's the current vacuum level inside the air receiver.
3. SERVICE DUE: Service intervals and types of service are preprogrammed into the HMI. The button will flash yellow when service is due. Pressing the "service due" button when flashing will display the service schedule screen.
4. TDC FAULT: Indicator will flash red and horn will sound if the transducer fails. Vacuum reading on the display screen will default to "30" hg. Selecting the indicator when flashing red will open a trouble shooting window.
5. LAG ALARM: Indicator will flash red and horn will sound when last available vacuum unit comes on. Press the reset button to silence the alarm. If the condition is corrected both the alarm and indicator will turn off. If a lag condition remains the indicating light on the HMI will remain on. Selecting the indicator when flashing red will open a trouble shooting window. Once the lag condition is corrected, press the reset button again to turn off alarm light.
6. UNIT RUN HOURS: Displays total run hours for each vacuum module.
7. HAND-OFF-AUTO: Displays status of each vacuum module. The green "HAND" displays when the vacuum is running and the HOA selector switch is in the HAND setting. The green "AUTO" displays when the vacuum is running in the normal sequencing mode. The "OFF" indicator is displayed when the HOA selector switch is in the "OFF" position for the pump that is not running.
8. MOTOR OVLD: Display will flash red and sound an alarm when overload switch is tripped in the control panel. The vacuum in question will not re-start until the reset button on the starter inside the main control cabinet is reset. Press the reset button on front panel to silence the alarm. Selecting the indicator when flashing red will open a trouble shooting window. The indicator on the HMI will remain on until motor starter is reset.
9. FAILED START: Display will flash red if the vacuum module failed to start/run when signaled to start. This alarm will also activate when a Motor Overload Shutdown occurs. Press the reset button on the front panel to silence the alarm. Selecting the indicator when flashing red will open a trouble shooting window. The indicator light on the HMI will remain on until the problem has been resolved and the reset button pushed again.

3.0 Control Panel (Continued)

3.3 Control Buttons

3.3.1 MENU

The MENU button in the upper right corner on the main screen when selected will display the "MENU" window that will allow the operator to access information shown on screen below. Each button will be explained in detail in this section.

3.3.2 – "MAIN" Button

The main button can be found on many of the screens within the *Signal 1* Controller. At any time when the "MAIN" button is selected, the *Signal 1* display will return to the Main Display Screen.

3.0 Control Panel (Continued)

3.3 Control Buttons (Continued)

3.3.3 – "ALARM HISTORY" Button

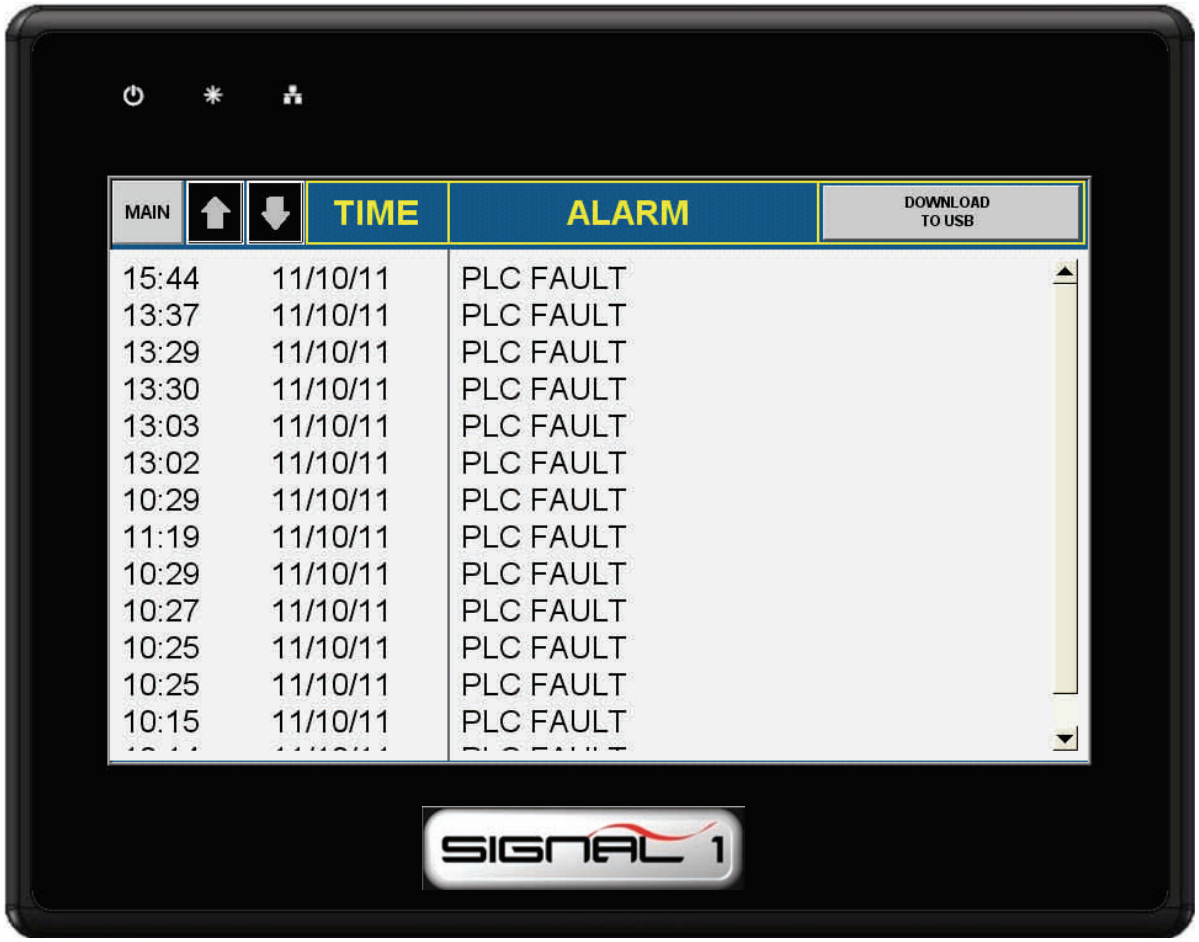
The "ALARM HISTORY" button on the "Menu" screen will open a new window listing all the alarm conditions that have occurred as well as routine maintenance alerts. The list will show the date and time of the incident, type of incident and when the condition was cleared/corrected. This creates a permanent record of the history of the unit and cannot be reset.

1. "MAIN" button will return you to the main screen.
2. "HISTORY" button will open a new History screen shown on the next page

3.0 Control Panel (Continued)

3.3 Control Buttons (Continued)

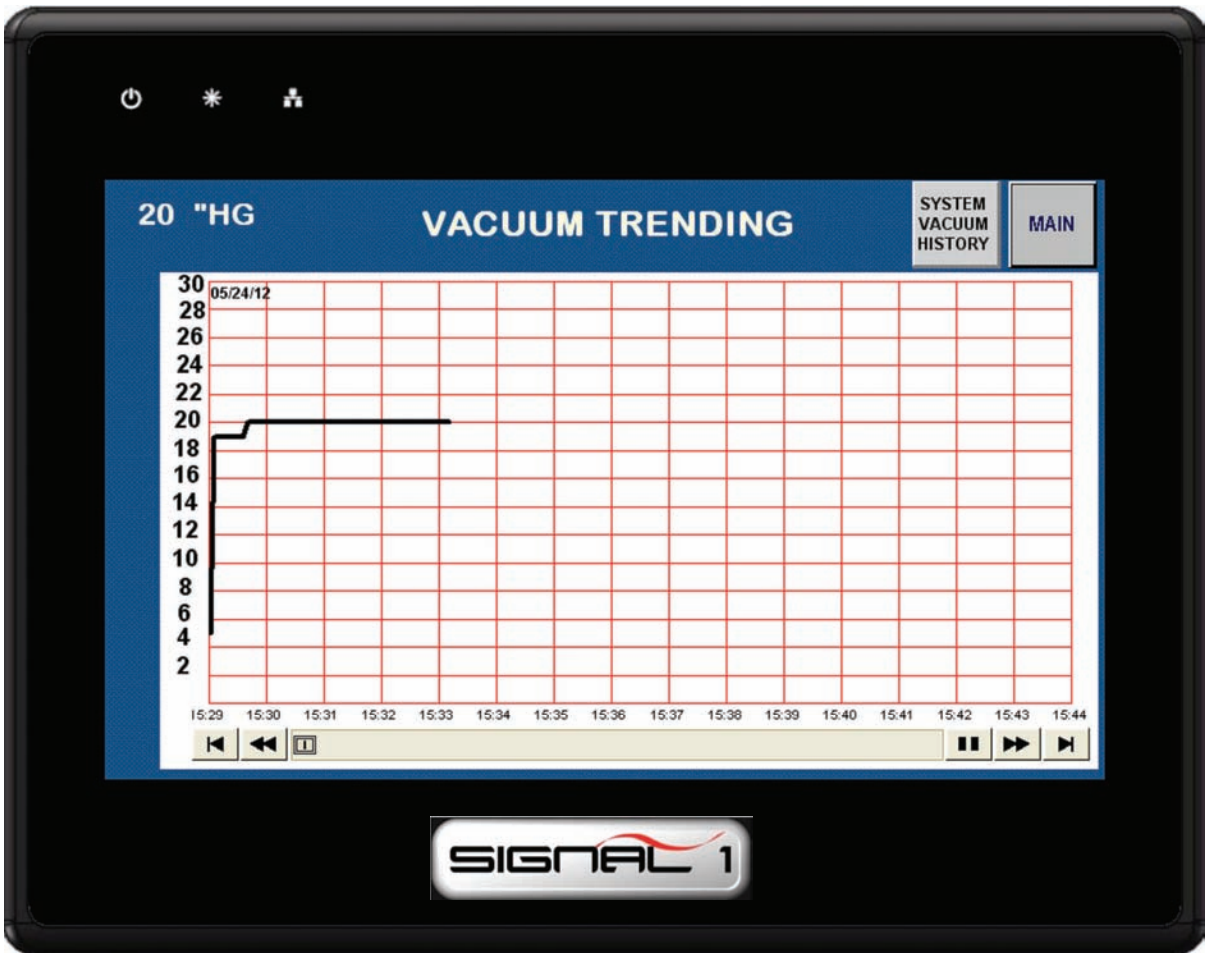
3.3.4 – "HISTORY" screen displayed from pressing "History" button on "Alarm History" screen shown below. Pressing the up and down arrows will display alarm/maintenance history one day at a time. History can be down loaded to a USB memory stick by inserting the memory stick into the USB slot on the back of the *Signal 1* and pressing the "Download To USB" button on the screen. Files can be saved to PC and viewed in an excel format.



3.0 Control Panel (Continued)

3.3 Control Buttons (Continued)

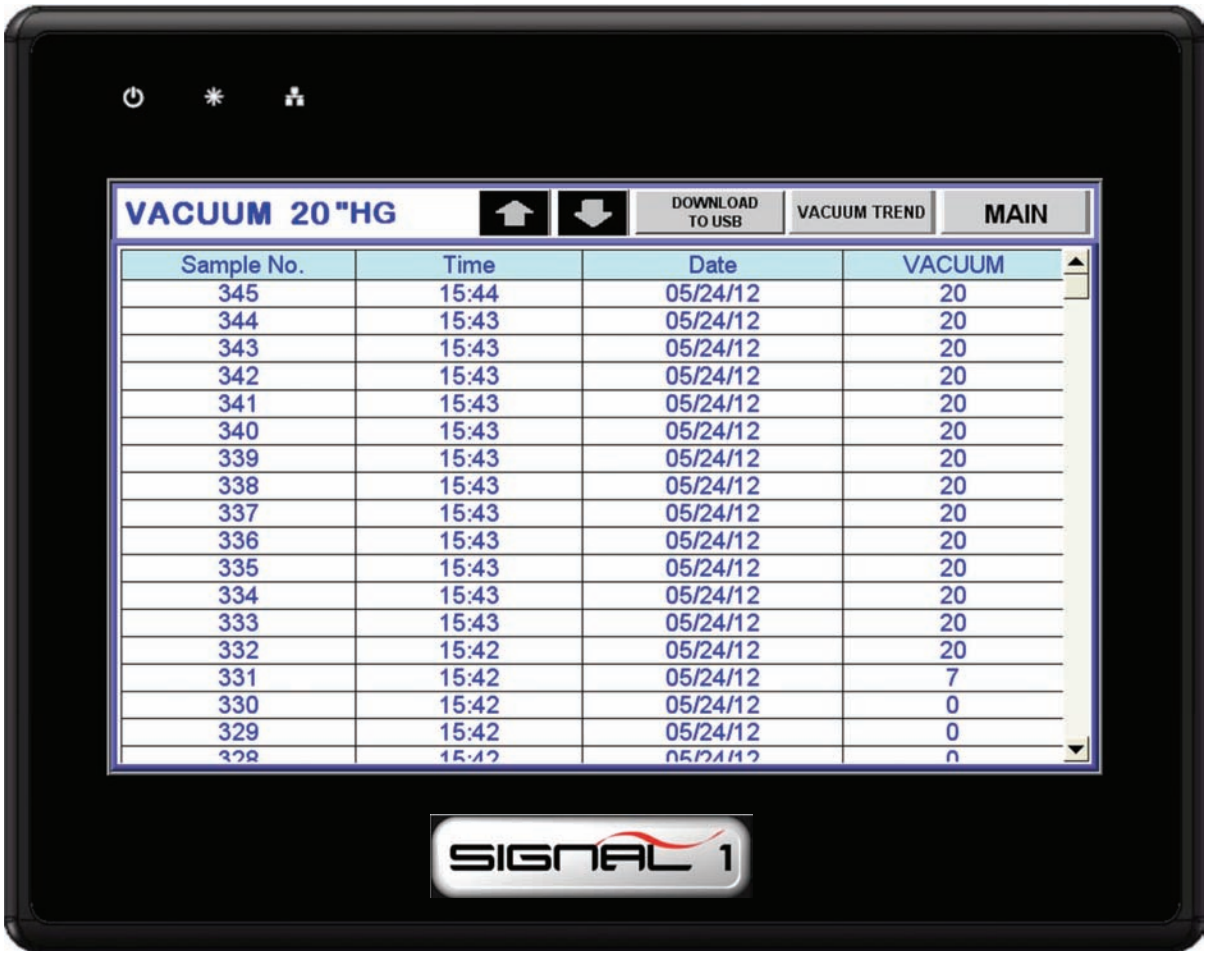
3.3.5 – "VACUUM TREND" Pressing the "Vacuum Trend" button on the "Menu" screen will display the screen below. Screen displays 15 minutes of trending and has a scroll bar on the bottom of screen to scroll to different time frame.
1. "MAIN" button will return you to the main screen.
2. "SYSTEM PRESSURE HISTORY" button will open a new screen shown on the next page



3.0 Control Panel (Continued)

3.3 Control Buttons (Continued)

3.3.6 – "VACUUM TREND HISTORY" screen shown below. Pressing the up and down arrows will display pressure trending history one day at a time. History can be down loaded to a USB memory stick by inserting the memory stick into the USB slot on the back of the *Signal 1* and pressing the "Download To USB" button on the screen. Files can be saved to PC and viewed in an excel format.

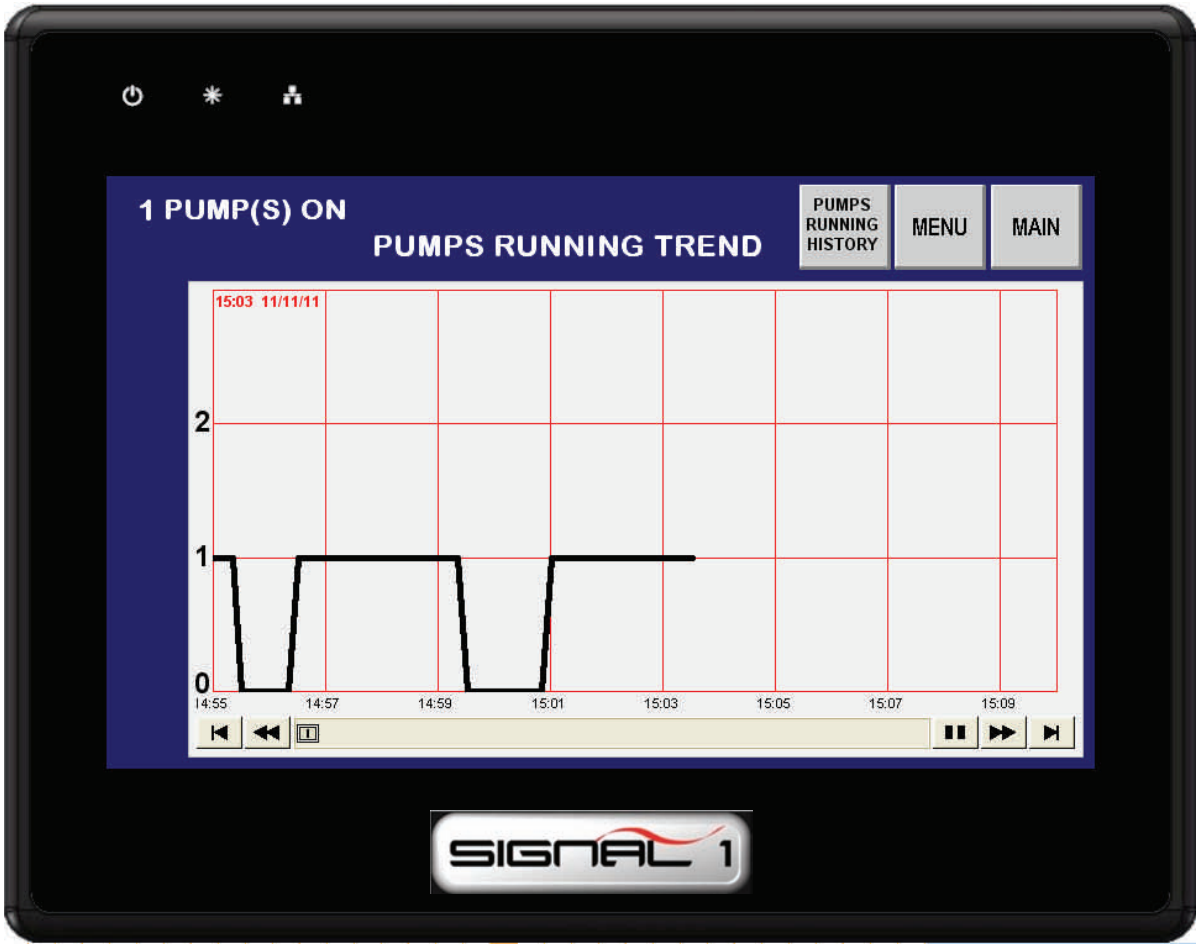


3.0 Control Panel (Continued)

3.3 Control Buttons (Continued)

3.3.7 – "NUMBER PUMPS RUNNING TREND" Pressing the **"**NUMBER PUMPS RUNNING TREND" button on the "Menu" screen will display the screen below. Screen displays 15 minutes of trending and has a scroll bar on the bottom of screen to scroll to different time frames.

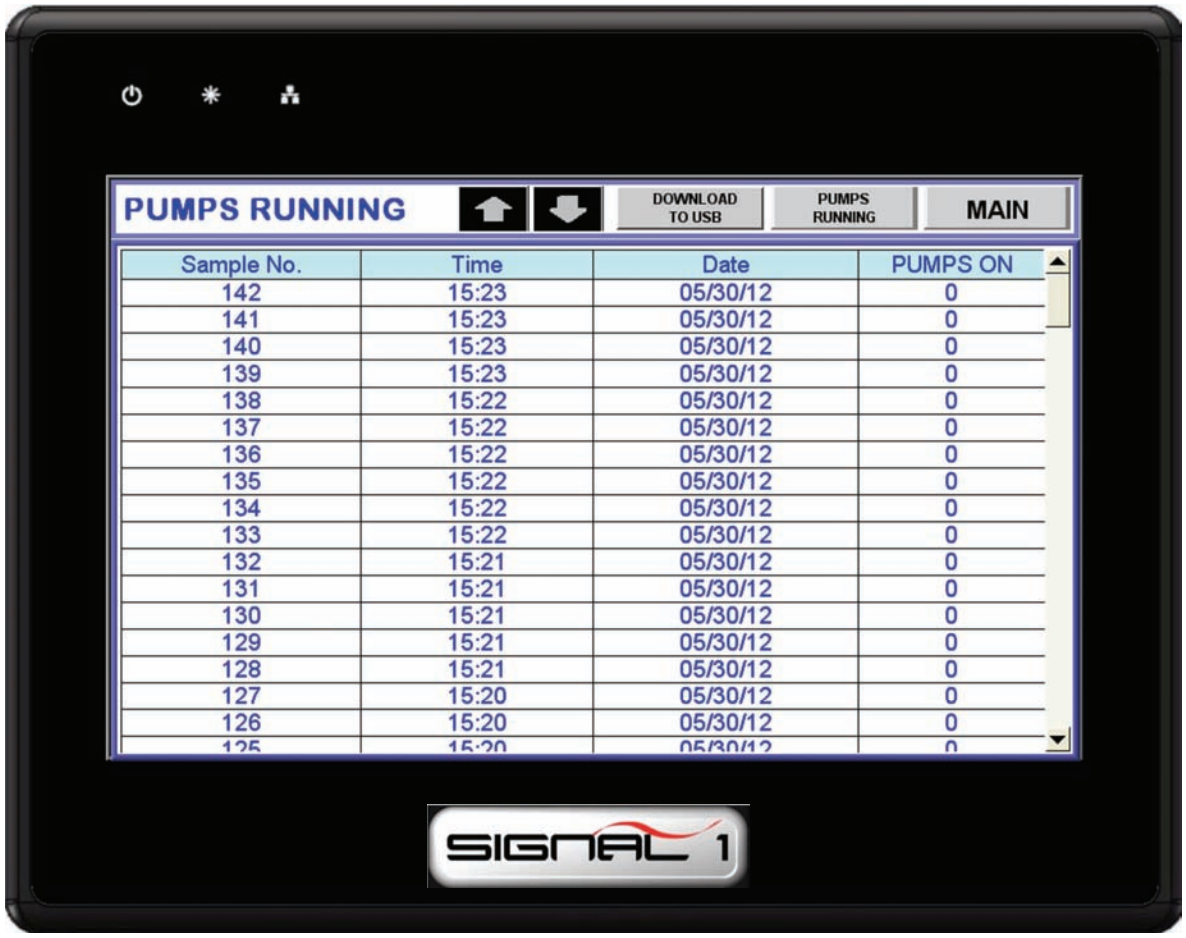
1. "MAIN" button will return you to the main screen.
2. "PUMPS RUNNING HISTORY" button will open a new screen shown on the next page



3.0 Control Panel (Continued)

3.3 Control Buttons (Continued)

3.3.8 – "PUMPS RUNNING HISTORY" screen shown below. Pressing the up and down arrows will display number of pumps running trending history one day at a time. History can be down loaded to a USB memory stick by inserting the memory stick into the USB slot on the back of the *Signal 1* and pressing the "Download To USB" button on the screen. Files can be saved to PC and viewed in an excel format.

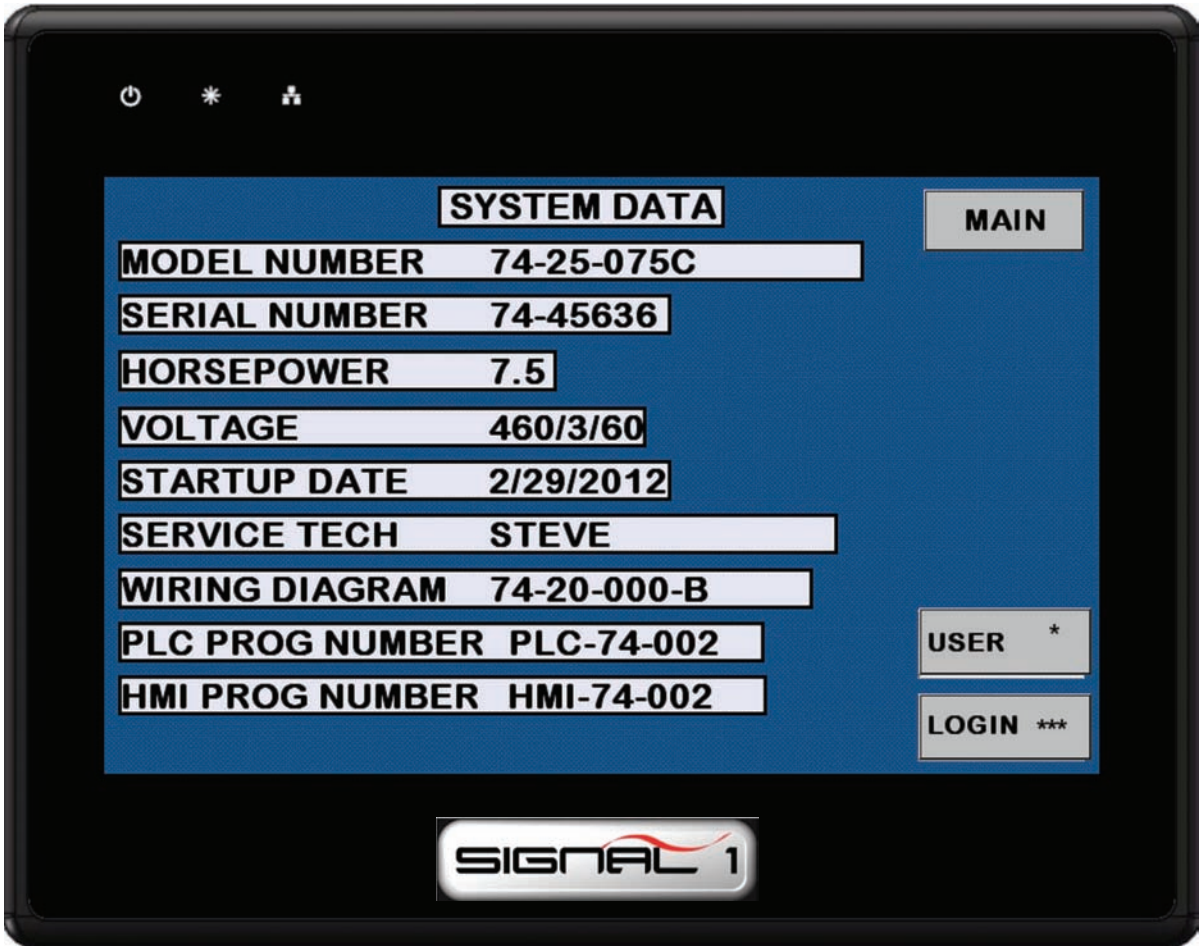


3.0 Control Panel (Continued)

3.3 Control Buttons (Continued)

3.3.9 "SYSTEM DATA" Button

The "System Data" button displays all the system information required when scheduling maintenance or purchasing spare parts from Patton's Medical. The information includes model number, serial number, horsepower, system voltage, and unit start up date. This information will be programmed into the *Signal 1* at startup by a Patton's Medical authorized technician.



3.0 Control Panel (Continued)

3.3 Control Buttons (Continued)

3.3.10 "PARTS MENU" Button

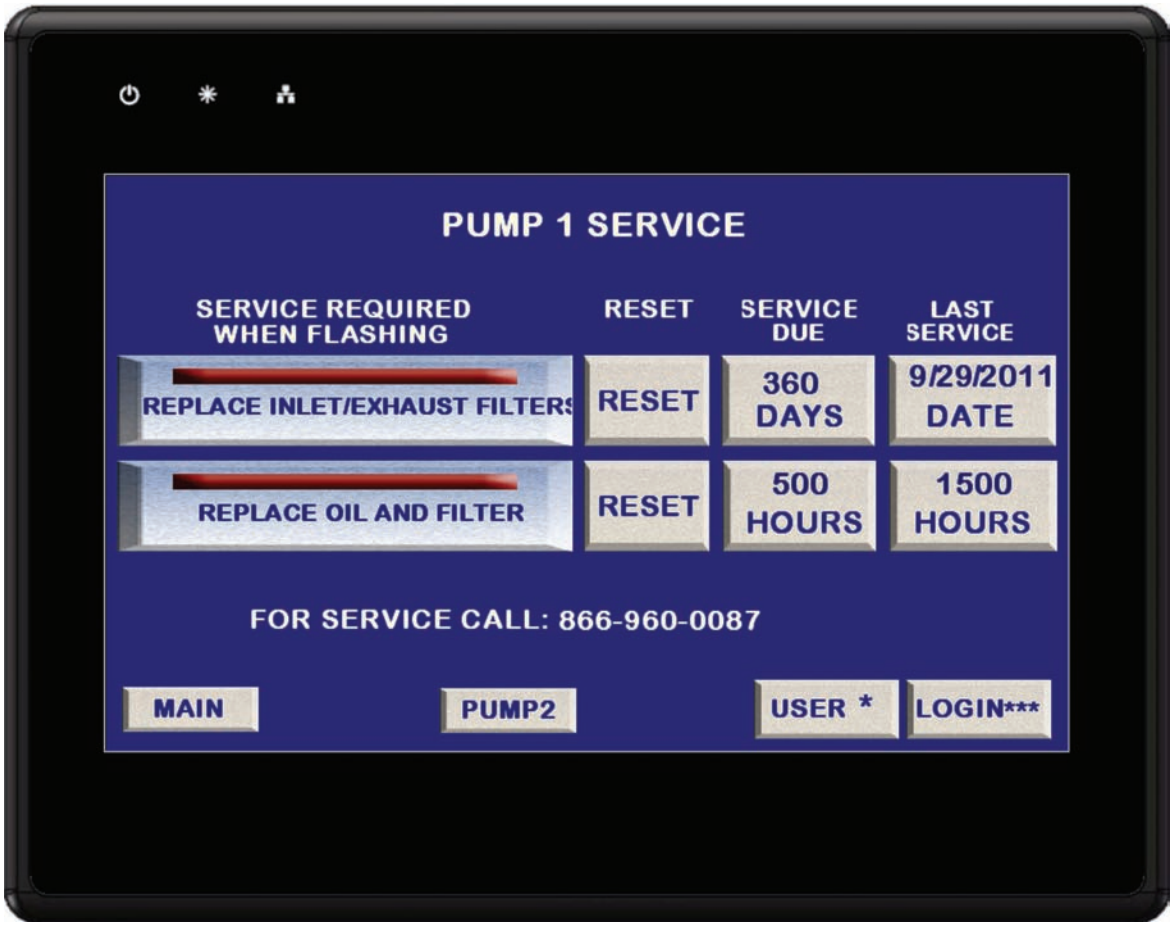
The "Parts Menu" button displays routine maintenance parts required when performing scheduled maintenance.

3.0 Control Panel (Continued)

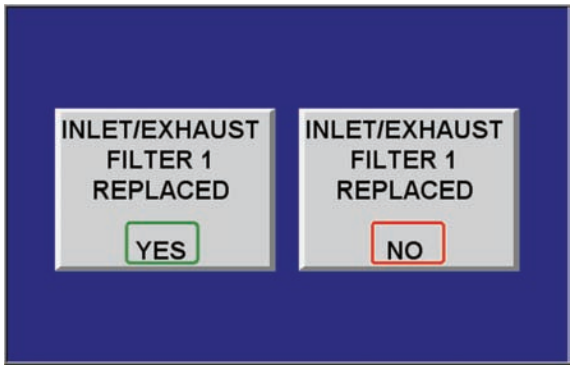
3.3 Control Buttons (Continued)

3.3.11 – "PUMP SERVICE" Buttons

1. Select "**USER #**" button and enter "3" and press "enter".
2. Select "**LOGIN**" button and enter "350" and press "enter".
3. Press "**RESET**" button next to item requiring maintenance red light will be flashing.



4. Screen to right will display press "YES" to reset maintenance performed. Service due date and Last Service date will reset.

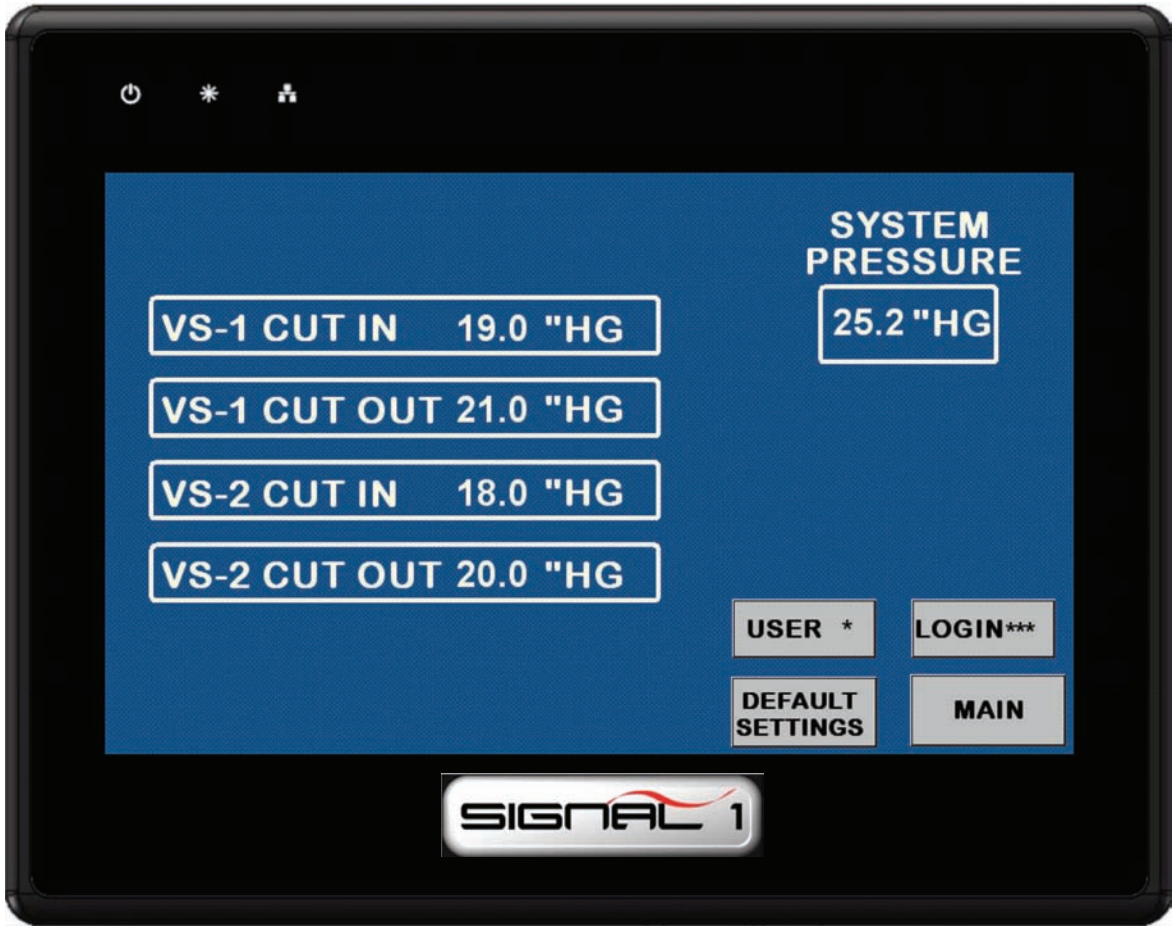


3.0 Control Panel (Continued)

3.3 Control Buttons (Continued)

3.3.12 – "VACUUM SETTING" Button

1. Select "**USER #**" button. Enter "2" and select "enter".
2. Select "**LOGIN**" button. Enter "327" and select "enter".
3. Press setting to be changed and screen to right will display. Enter pressure setting desired then "ENT".
4. Pressing "RESTORE DEFAULTS" at anytime will change all settings to original factory settings.



4.0 System Operation

4.1 Pre-start-up

The contractor should notify **Patton's Medical** two weeks prior to start-up date to schedule an appointment for an authorized technician to review the installation prior to start-up.

WARNING:

Prior to putting the Medical Vacuum system into use, the medical facility must have a Certifier perform all installation tests as specified in NFPA 99. The medical facility is also responsible for ensuring that the Medical Vacuum meets the minimum requirements for Medical Vacuum as specified in NFPA 99.

CAUTION: Failure to install the unit properly and have an authorized technician from **Patton's Medical** start-up the system can void the manufacturer's warranties.

WARNING:

Have more than one person on hand during prestart-up and start-up procedures to ensure safety and to facilitate certain checks.

Prestart-up and start-up procedures should be performed for a new installation or when major maintenance has been performed.

The main power source to the control panel should be OFF for the duration of the visual inspection.

Ensure that the equipment is installed on a solid level surface. Walk around the system to ensure that there is enough clearance on all sides to perform operational checks/actions and maintenance. The temperature of the area containing the modules should be approximately 70°F (21.1°C) with a minimum ambient temperature of 40°F (4.4°C) and a maximum ambient temperature of 105°F (40.5°C).

Check the inlet piping for proper size and connection to the vacuum system.

Check all piping system joints that might have come loose during shipment and installation to ensure they are tight.

Check the vacuum receiver, controls, and vacuum pumps for damage.

Check the drain valves on the receiver.

4.0 System Operation

4.1 Prestart-up (continued)
Check all valves for full open and full close travel. Ensure that the system's valves are positioned for proper operation. (Refer to indicators on the valve handles.)

Remove all packing material from the unit.

Check the electrical connections to the control cabinet.

Verify electrical service. Before starting the Medical Vacuum system, check to see that voltage, amperage, and wire size are appropriate.

CAUTION: Electrical service must be as specified or damage to equipment may occur.

WARNING:
To prevent electrical shock, ensure that ALL electrical power to the system is OFF, including the disconnect switches and H-O-A switches on the control panel. The facility's supply circuit breaker should also be locked out.

Open the electrical cabinet by loosening the fasteners on the front.

CAUTION: Vibration during shipment and installation can loosen electrical terminals, fuse inserts, and mechanical connections. Tighten as necessary.

Check the electrical cabinet for any broken switches, lights, etc.

Check that all motor starter connections are tight and that there are no loose objects such as terminal lugs, screws, nuts, etc., in the cabinet.

4.0 System Operation

4.2 Initial Start-up

CAUTION: Complete the prestart-up procedure before continuing with the initial start-up procedure

WARNING:
To prevent electrical shock, ensure that ALL electrical power to the system is OFF, including the disconnect switches and H-O-A switches on the control panel. The facility's supply circuit breaker should also be locked out.

WARNING:
Ensure that all loose articles, packing material, and tools are clear of the system.

Set the H-O-A switches are to "O" (OFF).

Check all voltages supplied to the system to ensure they are the required value and phases needed by the control panel.

Open the inlet isolation valve on each vacuum pump.

Open the outlet isolation valve on each vacuum pump.

Open the receiver isolation valves.

Close the receiver bypass valve.

Apply power to the system and turn the disconnect switches to "On

4.0 System Operation

4.2 Initial Start-up (continued)

4.2.1 Pump Rotation
Prior to actual operation, the pumps must be checked for correct rotation.

Using the Hand-Off-Auto switch on the door of the control panel, jog the motor of the specific pump that is to be checked by momentarily turning the switch to "Hand" and back to "Off". By observing the cooling fan of the motor, you can determine the rotation of the pump. Pump rotation should be counterclockwise when looking at the rear of the motor. Directional arrows are located on each pump.

If the pumps are rotating in the wrong direction, rotation can be reversed by switching any two main power leads to the panel. Correct rotation should be confirmed in the previous manner.

WARNING:
REMOVE POWER BEFORE WORKING ON ANY ELECTRICAL CONNECTIONS.

4.3 Start-up
Fill the pump with oil as described in Section 2.10 – Oil Filling.

Start the unit and immediately close the inlet. Run the pump for a few minutes before checking the oil level again. With the pump shut off, the oil level should be visible in the oil sight glass, between the "MIN" and "MAX" mark.

Add oil, if necessary, but only add it when the pump has been shut off and the circulating oil has had sufficient time to return to the oil sump.

The collected oil is drawn continuously during operation of the vacuum pump to the inlet flange via the oil return line. The oil return line is connected directly to the area of the exhaust box, downstream of the exhaust filter, which is at atmospheric pressure. Therefore, a constant amount of air is sucked into the pump. These pumps can run continuously without having to shut them off for the oil to drain back.

WARNING!
PUMPS THAT HAVE REACHED OPERATING TEMPERATURE MAY HAVE A HIGH SURFACE TEMPERATURE.
DO NOT TOUCH!

4.0 System Operation

4.4 General Operation

4.4.1 Electrical Control Panel

The Medical Vacuum's **multiplex** control panel includes a visual and audible lag pump alarm and a 0-30"Hg vacuum indication. It also has the following for **each pump**: 120V control transformer with fuses, hour meter, vacuum transducer, Hand-Off-Auto switch, motor starter and circuit breaker with external disconnect. All components are enclosed in a NEMA 12 enclosure.

During normal operation, all H-O-A switches should be turned to the "Auto" position so that the PLC can effectively control the system. The PLC monitors the system vacuum level, starts and stops the pumps depending on changing vacuum levels and minimum run time values, and automatically alternates the lead position between units.

In a typical **duplex** system, one pump will be able to handle the system load. The PLC will signal the lead pump to start when pump's vacuum level reaches the cut-in set point. If the one pump can carry the load, then the vacuum level will rise to the cut-out set point. At this point, if the minimum run timer for that pump has been satisfied, the PLC will turn off the lead pump. If the minimum run timer for that pump has not been satisfied, the lead pump will continue to run until the timer expires. When the system vacuum drops again, the PLC will automatically sequence the lead role to the other pump and will start it. If the lead pump runs continuously in lead for more than the minimum run time, the PLC will automatically sequence the pump attempting to evenly distribute the run time among all available pumps. (This value is variable and is equal to the current minimum run time value, see wiring schematic for more details.) If during operation, the second pump is required to come on in addition to the lead pump, the PLC will turn on the "Lag Alarm" (see section 4.6).

In a **triplex** or **quadruplex** system, the operation is very similar to the duplex operation described above with the following differences. For each additional pump, there is an additional vacuum switch. With a triplex or a quadruplex system, the lag unit running alarm may not necessarily correspond to the third or fourth pump coming on. To determine when the PLC turns on the lag alarm, it counts the number of units in the "Auto" position and makes a decision based on the vacuum switch conditions. For instance, in a quadruplex system with only 2 H-O-A switches in the "Auto" position, the lag alarm will turn on when the second unit is started.

4.0 System Operation

4.4 General Operation (continued)

4.4.1 Electrical Control Panel (continued)
On the **initial** system start-up, when the system vacuum level is below the set points of the vacuum transducer, pumps 1 start. After a 10 second delay, pump 2 will start. After another 10 second delay, pump 3 will start.
The time delay is to prevent high inrush current after a power failure or emergency power switch over. During this initial system start-up, the lag alarm will come on at this point and is normal. It can be reset once the vacuum level is high enough to open the lag vacuum switch. Refer to the table on page 35 for the correct cut-in and cut-out settings.

Note: For a pump to be recognized by the PLC, its H-O-A switch must be in the "Auto" position. If a Pump is in the "Hand" position it will start and run continuously. This should only be used for maintenance situations.

4.4.2 Minimum Run Timer(s)
The Medical Vacuum systems incorporate minimum run timers to minimize the starts and stops on the vacuum pumps.

For **simplex systems**, there is a minimum run timer that is factory set at 10 minutes. During operation, the minimum run timer starts when the vacuum switch opens. If the vacuum switch stays open long enough for the timer to expire, the pump will turn off. If the vacuum switch closes before the minimum run time expires, then the minimum run timer will reset.

For **multiplex systems**, there is a minimum run timer built into the PLC for each pump and all have the same time value. Once a pump is turned on by the PLC, it will not turn it off until its minimum run timer has expired. The PLC automatically adjusts the minimum run time value depending on current demand. It starts a timer when all pumps are off and VS-1 is open. It takes that time value an subtracts it from 15 minutes and derives the minimum run time value.

During operation, if the vacuum switch is still closed but the minimum run timer has expired, the PLC will rotate to the next available pump.

4.4.3 Stopping the Pump
To stop the pump, turn the HOA switch to "OFF". The pump has a built-in, anti-suck-back valve to prevent the pump from rotating backwards when it is shut off.

4.0 System Operation (Continued)

4.5 Tank Drain

The standard tank drain consists of a manually operated ball valve. To drain the liquid from the tank, open the tank bypass valve and close the tank isolation valves. Then open the vent and drain valves. When draining is complete, close the vent and drain valves first, then open the tank isolation valves and close the tank bypass valve.

4.6 Emergency Shutdown / Alarms

The following conditions may arise during operation.

Motor Overload Shutdown - This will shut down the pump in question and will not re-start until the reset button on the starter inside the main control cabinet is reset. See Section 4 for troubleshooting information.

High Discharge Air Temperature Shutdown – This will shutdown the vacuum pump and will not re-start until the alarm reset button is pressed on the main control panel. Before allowing the unit to re-start, the cause should be checked. After pushing the button, the unit may not re-start depending on the system sequencing and system vacuum. A high air temperature light will display on the HMI and an audible alarm will sound.

Lag Unit Running Alarm - This alarm will activate if the last available vacuum pump comes on. In the case of a duplex system, it will activate when the second pump turns on. In the case of a multiplex system, the lag alarm will activate when the last available unit is required to come on. For example, in a quadruplex system, if all four (4) H-O-A switches are set to “Auto”, then the lag alarm will trigger when the fourth unit comes on. If on the same system, three (3) of the four (4) H-O-A switches are set to “Auto” and the other to “Off” or “Hand”, then the lag alarm will activate when the third unit comes on. To silence the alarm, press the alarm reset button. In the event the lag alarm is persistent, check to see if any leaks or valves are open downstream or reduce the system load.

Please note that the lag alarm may be reset even if the lag pump is still running. This can happen due to the minimum run timer not having expired, but the lag vacuum switch itself may be open.

4.7 Vacuum Settings Adjustments

The cut-out vacuum setting refers to the vacuum level at which the unit will stop and is indicated by the vacuum readout on the HMI display.

5.0 Troubleshooting

Problem	Possible Causes	Solution
Failure to start	Main power disconnected	Turn on main power
	Power failure	Restore power
	Main fuse blown	Replace fuse
	Fuse blown in control circuit	Replace fuse
	Overload tripped on starter	Reset & check for system overload
Power failure	Main fuse blown	Replace fuse
	Fuse blown in control circuit	Replace fuse
Unit lacks sufficient vacuum or lag alarm has occurred	Clogged Filters	Clean filters
	Restrictions in piping	Open pipe connections and examine for internal contamination or buildup
	Leaks in piping	Tighten all piping connections
	Insufficient pump speed (RPM)	Check voltage and amperage to motor
		Inspect motor and coupling halves
		Check that the pump shaft turns freely
	Line losses too high	Piping diameter too small—replace with larger diameter pipe

5.0 Troubleshooting

Problem	Possible Causes	Solution
Unit lacks sufficient vacuum or lag alarm has occurred	Line losses too high	Check for clogged filter elements—replace if necessary
	Unit is operating at an elevated altitude	Contact the factory for assistance. Performance may be reduced when operating well above sea level.
	The oil tank may be low/empty of oil.	Immediately shut off the pump, drain the remaining oil from the tank and replenish with new fresh oil.
	The oil tank has contaminated oil or was filled with the incorrect type of oil.	Make sure pump has reached its operating temperature before shutting down and replace with fresh new oil.
	Fine wire mesh screen may be clogged.	Clean wire mesh inlet screen. If problem repeats frequently, consult factory for filtration advice.
	Inlet check valve plate assembly may be worn or damaged due to process contamination.	Disassemble valve plate assembly, clean, replace worn or damaged parts and reassemble.
	Leaking oil lines on the pump could introduce an atmospheric pressure bleed spoiling the vacuum.	Check all oil lines for leakage. Replace or tighten as required. Make sure to use the same size and type of line when replacing.

5.0 Troubleshooting

Problem	Possible Causes	Solution
Unit lacks sufficient vacuum or lag alarm has occurred	Defective gaskets	Contact factory for assistance
	Exhaust valve may not be properly seated or stuck open.	Contact the factory for assistance. Have pump model and serial number available.
	Shaft seal may be leaking.	
	Radial clearance between rotor and cylinder may need adjustment.	
	Internal parts may be damaged or worn.	
Motor breakers trip constantly	Defective motor	Test motor and replace if necessary
	Heaters incorrectly adjusted too small, or defective	Adjust or replace with correctly sized heaters
	Low motor voltage	Check at motor terminals. Contact electric service provider.
	Ambient temperature too high	Reduce ambient temperature
Unit runs rough and cannot be rotated manually	Broken rotor vane	.Contact factory for assistance
	Worn Coupling	Remove motor and inspect coupling element. Replace if necessary.
	Worn bearings	Contact factory for assistance

5.0 Troubleshooting

Problem	Possible Causes	Solution
Pump does not reach "blank-off" pressure, which is the lowest absolute pressure (best vacuum) when running with the inlet closed.	Contaminated oil is the most common cause of not reaching the ultimate pressure.	Shut off pump, after operating temperature has been reached, drain the warm oil from pump and exchange automotive-type oil filter (where applicable), if necessary. Flush and fill pump with new oil and take new blank-off measurement after operating temperature is reached (at least 20-30 minutes).
	Vacuum system or vacuum piping not leak-tight	Check hose and pipe connections for possible leak.
	Wire mesh inlet screen plugged.	Clean wire mesh inlet screen. Install inlet filter if problem repeats frequently.
	No oil or not enough oil in oil reservoir.	Shut off the pump, add the necessary oil, or if oil seems contaminated, drain balance of oil from pump, exchange automotive oil filter, and refill with fresh oil. Flush if necessary.
	Automotive-type oil filter is dirty or clogged (where applicable).	Replace automotive-type oil filter, exchange oil, if necessary, and refill with fresh oil.
	Inlet valve plate stuck in closed or partially open position due to contamination.	Disassemble inlet valve and screen. Clean as required.

5.0 Troubleshooting

Problem	Possible Causes	Solution
Pump does not reach "blank-off" pressure, which is the lowest absolute pressure (best vacuum) when running with the inlet closed.	Radial clearance between the rotor and cylinder is no longer adequate	Contact Patton's Medical assistance
	Internal parts worn or damaged.	Contact Patton's Medical assistance
Pump will not start.	The motor does not have proper supply voltage or is overloaded; motor starter overload settings are too low or wrong setting; fuses are burned; or wire is too small or too long, causing a voltage drop to the motor.	Check correct supply voltage; check overload settings in motor starter for size and setting according to motor nameplate data; check fuses; and install proper size wire.
	Pump or motor is locked.	Contact Patton's Medical assistance

5.0 Troubleshooting

Problem	Possible Causes	Solution
Pump starts, but labors and draws a very high current.	Pump runs in the wrong direction	Check for correct rotation which is counterclockwise when looking at the motor from the motor's fan side. Reverse any two leads on the motor to change the direction of rotation.
	Pump is overfilled with oil or wrong kind of oil is used.	Correct the oil level and quality and use recommended oil.
	Exhaust filters in exhaust chamber are clogged and appear burned black with pump oil.	Replace exhaust filters, maintain proper oil condition, oil level, and use only recommended vacuum oil and filters.
	Loose connection in motor terminal box; not all motor coils are properly connected. Motor operates on two phases only.	Check motor wiring diagram for proper hookup, tighten and/or replace loose connections.
	Foreign particle in pump; the vanes broken; the bearing is seizing	Contact Patton’s Medical assistance

5.0 Troubleshooting

Problem	Possible Causes	Solution
Pump discharges smoke at the exhaust port or expels oil droplets from the exhaust.	Exhaust filter is not properly seated with O-ring in filter base or filter material is cracked.	Check condition and check for proper seating of exhaust filters. Replace if necessary. Also, check filter spring clips for tightness.
	Exhaust filter is clogged with foreign particles.	Replace exhaust filter.
	Oil return line is clogged or broken.	Free clogged line or replace. Check that oil is being drawn out of the exhaust filter area while the vacuum pump is operating. **Note:** An oil filling plug with pressure gauge monitors the pressure in front of the exhaust filters. The green field indicates that the filters are still effective. A continuous reading in the red field requires immediate change of exhaust filters.
Excessive noise level	The coupling may be worn	Replace coupling insert in motor/pump coupling.
	Bearing noise	Contact Patton's Medical assistance
	Internal pump damage	Contact Patton's Medical assistance

5.0 Troubleshooting

Problem	Possible Causes	Solution
The pump runs very hot. **Note:** The oil temperature with a closed inlet should be approximately 185-225°F depending on pump type. At 24 in. Hg, the oil in the pump can go above 225°F. These values are taken at an ambient temperature of 68°F. The maximum recommended ambient operating temperature is 105°F on a continuous basis. When it is necessary to operate a pump in ambient temperatures above this limit, careful oil monitoring is necessary. Contact the factory for details.	Cooling ducts blocked Cooling fan broken High ambient temperature Inlet restricted Exhaust restricted Automotive-type oil filter clogged and pump does not receive enough oil. Not enough oil in oil reservoir, or badly burned oil is used for pump lubrication.	Clean cooling ducts Replace fan Ventilate or cool room Remove restriction Remove restriction Change automotive oil filter. Drain and refill only with Patton's recommended oil. Increase oil change intervals.
Pump is seized.	Pump operated without oil and vanes are broken. Pump was operated for an extended period of time in the wrong rotation. (continued next page)	Contact Patton's Medical assistance Contact Patton's Medical assistance (continued next page)

5.0 Troubleshooting

Problem	Possible Causes	Solution
Pump is seized.	Liquid carryover into the pump cylinder broke vanes while pump was running, or oil broke vanes on start-up.	(a) Pump was overfilled with oil in oil reservoir. Follow oil filling procedure and do not overfill. (b) Built-in, anti-suck-back valve leaking while pump was shut down and vacuum was left in manifold. Clean valve seat and check that anti-suck-back valve holds vacuum on inlet when pump is shut down.
Automotive-type oil filter does not get warm within two to five minutes when cold pump is started.	Automotive-type oil filter is clogged. Wrong automotive-type filter is used and/or oil lines and oil coolers leading to pump are clogged.	Replace automotive-type filter Use only automotive filter and blow lines free. Flush oil cooler.

6.0 Maintenance

WARNING:
BEFORE STARTING ANY MAINTENANCE PROCEDURES, DISCONNECT ALL POWER TO THE PACKAGE.

WARNING:
PUMPS THAT HAVE REACHED NORMAL OPERATING TEMPERATURE MAY HAVE A HIGH SURFACE TEMPERATURE OF MORE THAN 100°C (212°F).
DO NOT PERFORM ANY MAINTENANCE UNTIL AFTER A SUFFICIENT COOL DOWN PERIOD.

Never perform any maintenance functions while the unit is in operation.

The Medical Vacuum unit requires very little maintenance; however, to insure optimum pump performance, the following steps are recommended.

6.1 Pump Oil

6.1.1 Oil Level

CAUTION: Do not add oil while the pump is running since hot oil vapor may escape through the oil fill port.

CAUTION: Insufficient oil quantity in the pump has the potential, under certain conditions, to lead to self-ignition of the remaining oil in the pump.

With the pump installed relatively level, make sure that there is sufficient clean oil in the pump. The oil level should be observed on a daily basis and/or after 8 hours of operation and should be replenished if it drops below the 1/4 mark on the oil sight glass on pumps with one sight glass.

Oil level readings should be done only when the pump is turned off. Oil can be added to the oil fill port if the pump is shut off and the circulating oil has sufficient time to return to the oil sump. The oil might appear to be foamy, which is a normal phenomenon with aerated oil.

Under normal circumstances, it should not be necessary to add or drain oil from the pump between recommended oil changes.

A significant drop in oil level means there is an oil leak or that an exhaust filter is broken, and the pump should be smoking excessively. It is normal for the oil to be foamy and light in color in an operating pump. However, if the oil is

6.0 Maintenance

6.1 Pump Oil (continued)

6.1.1 Oil Level (continued)

milky colored, it is an indication that water is present in the oil. Normally, by operating the pump for an extended period, with the inlet suction blanked off, the water will be purged from the oil. If the oil is dark colored, it is contaminated or carbonized and must be changed. Depending on the severity of the contamination, a thorough flushing may be needed. Contact the factory for flushing oil and flushing procedure.

6.1.2 Oil Type and Quantity
See “Replacement Parts” for details on oil type and quantity (Section 8).

6.1.3 Oil and Filter Change

CAUTION: When changing the oil and filters, it may be necessary to flush the pump to remove any build-up of degraded oil from the sumps, oil lines, radiators, etc., to ensure proper oil flow through the pump. Reduced oil flow, especially through radiators and cooling coils, can cause mechanical damage or extreme overheating, which could cause the oil vapors to ignite.

WARNING:
Always take the necessary precautions concerning personal protective equipment when changing oil and make sure the pump is switched to "off" so that accidental starting will not occur. Oil temperature can reach 212°F and may pose a danger of scalding.

Check the oil for contamination on a weekly basis by shutting the pump off and draining some of the oil into a small glass or a similar transparent container through the oil drain port.

Oil life is dependent upon the conditions to which it is exposed. A clean, dry air stream and an oil operating temperature under 210°F are ideal conditions.

Excessive Heat
When the pump is subjected to operating conditions that will cause the oil to be heated above 210°F, the oil will carbonize and become contaminated after a relatively low number of operating hours. The higher the temperature, the quicker the oil becomes contaminated.

6.0 Maintenance

6.1 Pump Oil (continued)

6.1.3 Oil and Filter Change (continued)
Contaminated Air Stream
Oil change intervals can only be established by experience with the pump operating in the actual conditions (see previous paragraph for some of the conditions). Develop the oil change interval by periodically checking an oil sample removed from the pump. When the oil sample has become dark in color (from solids and carbonized particles) or is milky looking (from water), it is time to discard it. As mentioned before, a thorough flushing may be required.

6.1.4 Oil Flushing Procedure
Flushing is needed under certain conditions. Some pumps will be beyond flushing and will need to be overhauled.

To help determine if flushing is needed, observe the condition of the oil as it is drained from the pump. Is it black and tar like or contaminated in any way? Was the pump noisy, overheating, or was the motor overload shutting the pump off? How old is the pump and when was the last time the oil was changed?

If the above conditions exist or you don't know when the last oil change was performed further investigation is needed.

All of the oil will be removed and replaced with flushing oil, and eventually that will be replaced by whatever Patton’s oil is needed for your particular application. Have enough oil and oil filters on hand for a couple of flushes. The following describes the steps in the flushing procedure:

Shut the pump off and drain all the oil from the pump and remove the access plates from the exhaust box. Remove the metal baffle and take a good look at the internal walls of the oil sump. If the walls are discolored but have no build up of any kind, one can proceed with the flushing. If gelled or burnt oil is clinging to the walls this material must be scraped and removed prior to flushing. Proceed by scraping and cleaning as much of the exhaust box as possible. The more debris that is removed now the more effective the flushing will be later. Re-install the metal baffle, cover and proceed with the flushing. At this point one must remember that the oil lines and oil cooler might also be plugged to a point where no amount of flushing will make a difference and a complete overhaul will be the only option. Depending on the severity of the oil contamination flushing may be a last ditch effort.

6.0 Maintenance

6.1 Pump Oil (continued)

6.1.4 Oil Flushing Procedure (continued)
Drain all of the oil from the pump. The more contaminated oil you remove now the more effective the oil flushing will be.

Remove the oil filter and install a new one. It is recommended that you do not change the exhaust filter or filters until after the flushing to prevent contamination of any new filters.

Fill the exhaust box with the proper amount of flushing oil.

If possible run the pump with the inlet closed and off of the process. Run the pump for approximately six hours, shut the pump off and drain a small sample of oil into a clear container.

Examine it. If it is clear to amber run the pump for another six hours and examine it again. If after the first six hours it is black drain it and fill again using another new oil filter.

If after the second flushing the oil still remains black the pump may have too much contaminated oil in it to flush out properly. There may be residue remaining in the lines and cooler that will not flush out. An overhaul will be necessary.

If after the second six hour period the oil still remains clear to amber in color drain it, change the oil filter and fill with the regular oil. At this point also change the exhaust filters.

Run the pump with a fresh charge of the oil to be used in your application (not R-568), and monitor the operating conditions closely. Check for noise, overheating and oil condition until a regular oil change schedule can be established.

Do not let the oil turn black. Change it before it fails. If the oil is kept in good condition the pump will last for years. If the oil starts to turn black do not hesitate to flush again. Keeping on top of the oil changes will prevent costly overhauls.

6.2 Automotive-Type Oil Filter
The pump is equipped with an automotive-type oil filter. When replacing the automotive-type oil filter, use only a Patton’s genuine filter.

6.0 Maintenance

6.2 Automotive-Type Oil Filter (continued)

Note: Make sure to tighten the oil filter securely against the aluminum sealing surface so that leaks will not occur.

6.3 Exhaust Filter

WARNING:
If the gas entering this pump is a health hazard, use rubber gloves and all necessary personal protection equipment when performing the exhaust filter replacement operation.

Every twelve (12) months, replace the exhaust filter elements. The service life of the exhaust filters varies widely with pump application. It is only necessary to change the filters when the elements become clogged with foreign material or burned oil. Indications of clogged filters are smoke and oil mist coming from the pump exhaust, higher than normal motor current.

A pressure gauge is supplied with the vacuum pump as part of the oil fill plug. This gauge has a green field and a red field. A pressure within the green field would indicate normal pressure. Any pressure in the red field (for a continuous period of time) requires an immediate change of the exhaust filter(s).

In order to replace the filter, remove the four socket head cap screws and lock washers retaining the exhaust port housing (see Fig. 2). Pull the housing off the exhaust box and set it aside. Use a slotted head screw driver to loosen the exhaust filter retaining spring, then rotate and remove the spring (see Fig. 3). Pull the filter cartridge out of the exhaust box.

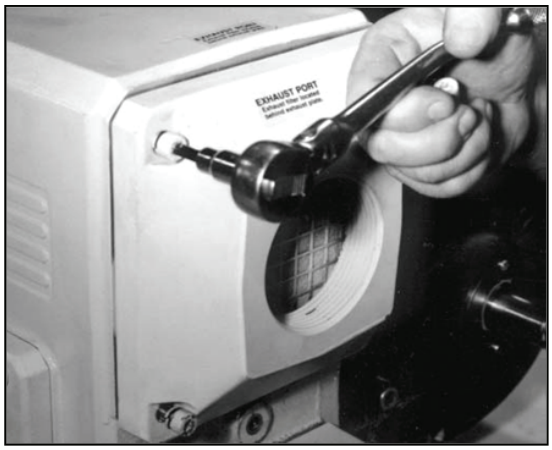


Fig. 2 - Removing the Exhaust

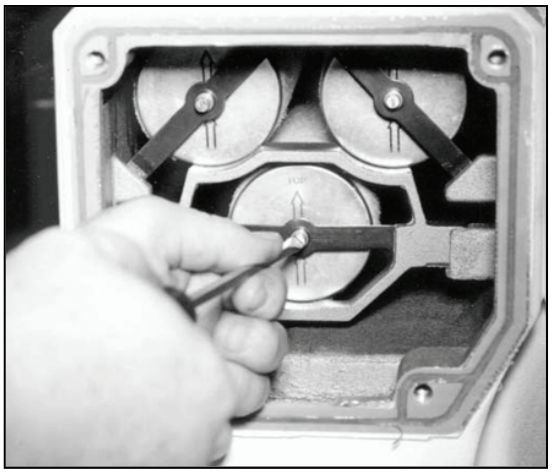


Fig. 3 - Removing the Filter Spring

6.0 Maintenance

6.3 Exhaust Filter (continued)

WARNING:
Wear safety glasses when installing or removing the spring retainers. The retainers can, if not secured correctly, slip off and fly out of the exhaust box.

Reinstall the filter elements. Make sure the open end of the element is properly seated down in its recess in the exhaust box with the O-ring correctly positioned. Retain the filter with the spring clip; tighten the tension screw until the filter is secure. Place the exhaust port gasket and cover in position on the exhaust box and retain with the cap screws.

6.4 Inlet Flange
The standard inlet flange assembly contains an inlet screen which may require occasional cleanly. The frequency of cleaning can only be determined by experience and is affected by hours of operation and particle size being trapped. A vacuum inlet filter is supplied and minimizes the need or frequency of cleaning the inlet screen.

To clean the screen, disconnect the flange from the process piping. Remove the four screws and lock washers. Remove the inlet flange. Remove the screen and clean with compressed air. After cleaning, install the screen and inlet securing them with the screws and lock washers. Make sure the O-ring is in place prior to securing the screws. Reattach the process piping to the inlet.

6.5 Routine Maintenance Schedule
Note: Lack of proper maintenance can result in blocked filters, radiators, oil lines, etc. This condition can lead to excessive heat causing mechanical failure or ignition of the oil vapors.

Daily: Visually check oil level.

Weekly: Check oil for contamination. Inspect inlet filter.

Every twelve (12) months, 1000 hours of operation, or as necessary: Drain and discard oil from the hot pump. Replace the automotive-type oil filter and refill with fresh oil through the fill plug.

Every twelve (12) months: Replace exhaust filter elements.

As necessary: Check and/or clean the standard inlet screen. Replace the inlet filter every twelve (12) months.

6.0 Maintenance

6.5 Routine Maintenance Schedule (continued)
The radiator, fan cover should be inspected regularly for debris. Soiling prevents cool air intake and may lead to overheating of the pump.

Drain drip legs on exhaust piping.

6.6 Overhaul Filter/Oil change
Oil filters, and oil are available from Patton's Medical.

Please specify pump size and model and serial number when ordering replacement parts.

6.7 Motor Lubrication
If greasing the motor becomes necessary, wipe the fittings completely clean and use clean equipment. More bearing failures are caused by dirt introduced by greasing than from insufficient grease. Be careful not to over-grease the motor. Slowly apply the recommended amount of grease, taking 1 minute or so to apply. Motors are pre-greased, normally with Polyrex EM (Exxon Mobil). Mixing dissimilar grease is not recommended.

6.8 Inlet Filters
The capacity of the vacuum pump can be reduced if the air inlet protective mesh is not maintained correctly.
The inlet filter cartridges should initially be cleaned annually or more often depending on the degree of contamination.
Cleaning can be done by blowing with compressed air.

6.9 Exhaust Drip Leg Valve
Each pump should have a drip leg installed by others at the exhaust port on the pump. This valve should be checked daily at first, then depending on the moisture accumulated could be checked less frequently.

7.0 Inspection/Replacement Procedures

7.1 Air Intake Filter

WARNING:
BEFORE STARTING ANY MAINTENANCE PROCEDURES, DISCONNECT ALL POWER TO THE PACKAGE.

Never perform any maintenance functions while the unit is in operation.

The air intake filter element should be changed every 4,000 hours of operation or annually under normal operating conditions. To change the filter:

1. Turn off the vacuum pump being serviced and lock open the appropriate disconnect switches.
2. Close intake isolation valve
3. Remove the protective cover by loosening the wing nut (if applicable) and latches.
4. Remove the element.
5. Clean inside of housing.
6. Insert a new element (note orientation of the element).
7. Replace protective cover and tighten wing nut (if applicable) and latches.
8. Open intake isolation valve
9. Turn on the vacuum pump.

8.0 Replacement Parts

Duplex System

Description	1.5-2 HP	Qty per system
Inlet Filter Element	09-11-011	2
Oil Filter	09-11-150	2
Exhaust Filter Kit	45-02-050	2
Oil (Quart)	43-01-001	3
Description	**3 HP**	**Qty per system**
Inlet Filter Element	09-11-011	2
Oil Filter	09-11-150	2
Exhaust Filter Kit	45-02-046	2
Oil (Quart)	43-01-001	5
Description	**5 HP**	**Qty per system**
Inlet Filter Element	09-11-006	2
Oil Filter	09-11-150	2
Exhaust Filter Kit	45-02-046	2
Oil (Quart)	43-01-001	6
Description	**7.5-10 HP**	**Qty per system**
Inlet Filter Element	09-11-007	2
Oil Filter	09-11-151	2
Exhaust Filter Kit	45-02-051	2
Oil (Quart)	43-01-001	14
Oil (Gallon)	43-01-003	4
Description	**15 HP**	**Qty per system**
Inlet Filter Element	09-11-012	2
Oil Filter	09-11-152	2
Exhaust Filter Kit	45-02-053	2
Oil (Quart)	43-01-001	28
Oil (Gallon)	43-01-003	7
Description	**20-25 HP**	**Qty per system**
Inlet Filter Element	09-11-012	2
Oil Filter	09-11-152	2
Exhaust Filter Kit	45-02-053	2
Oil (Quart)	43-01-001	32
Oil (Gallon)	43-01-003	8

8.0 Replacement Parts

Triplex System

Description	5 HP	Qty per system
Inlet Filter Element	09-11-006	3
Oil Filter	09-11-150	3
Exhaust Filter Kit	45-02-046	3
Oil (Quart)	43-01-001	9
Oil (Gallon)	43-01-003	3

Description	7.5-10 HP	Qty per system
Inlet Filter Element	09-11-007	3
Oil Filter	09-11-151	3
Exhaust Filter Kit	45-02-047	3
Oil (Quart)	43-01-001	21
Oil (Gallon)	43-01-003	6

Description	15 HP	Qty per system
Inlet Filter Element	09-11-012	3
Oil Filter	09-11-152	3
Exhaust Filter Kit	45-02-053	3
Oil (Quart)	43-01-001	42
	43-01-003	11

Description	20-25 HP	Qty per system
Inlet Filter Element	09-11-012	3
Oil Filter	09-11-152	3
Exhaust Filter Kit	45-02-053	3
Oil (Quart)	43-01-001	48
Oil (Gallon)	43-01-003	12

8.0 Replacement Parts

Quadruplex System

Description	5 HP	Qty per system
Inlet Filter Element	09-11-006	4
Oil Filter	09-11-150	4
Exhaust Filter Kit	45-02-046	4
Oil (Quart)	43-01-001	11
Oil (Gallon)	43-01-003	3

Description	7.5-10 HP	Qty per system
Inlet Filter Element	09-11-007	4
Oil Filter	09-11-151	4
Exhaust Filter Kit	45-02-047	4
Oil (Quart)	43-01-001	28
Oil (Gallon)	43-01-003	7

Description	15 HP	Qty per system
Inlet Filter Element	09-11-012	4
Oil Filter	09-11-152	4
Exhaust Filter Kit	45-02-053	4
Oil (Quart)	43-01-001	56
Oil (Gallon)	43-01-003	14

Description	20-25 HP	Qty per system
Inlet Filter Element	09-11-012	4
Oil Filter	09-11-152	4
Exhaust Filter Kit	45-02-053	4
Oil (Quart)	43-01-001	64
Oil (Gallon)	43-01-003	16

9.0 Warranty

Patton's Medical Systems Warranty

Patton's Medical warrants that all systems to be free of defects in material and workmanship under normal use for a period of twenty-four months from start-up, not to exceed thirty months from date of shipment. This warranty covers all necessary parts used in repair as well as all reasonable labor expense. Normal consumable parts required for routine scheduled maintenance (such as filters) are not covered under this warranty.

This warranty does not apply to products that are damaged by external causes, or are improperly warehoused, used, installed, serviced, misapplied or maintained by the customer. The sole liability for **Patton's Medical** under this warranty is limited to repairing, replacing, or crediting, at its election, any such products provided that:

- **Patton's Medical** is notified promptly within the warranty period above of any warranty claim.

- The examination of such items by an authorized representative of **Patton's Medical** will disclose to their reasonable satisfaction that claimed products defect has not been caused by misuse, neglect, improper handling, installation, repair, alteration, or accidents.

- **Patton's Medical** requires that systems above 5 Hp simplex be commissioned by an authorized **Patton's Medical** distributor and requires a start-up report to be filed within 30 days of equipment start-up. Failure to submit a start-up report to **Patton's Medical** will void the warranty.

- Simplex units 5Hp and below as well as retrofit dryer packages do not include factory assisted start-up in their base price unless specifically noted otherwise.

Product modification performed by the customer without prior written approval by **Patton's Medical** will invalidate the above warranty.

This warranty is given in lieu of all other warranties, expressed or implied, including implied warranties of fitness for a particular purpose and merchantability. In no event shall Patton's Medical be liable for damages in excess of the value of the defective product or part, nor shall Patton's Medical be liable for any indirect, special or consequential damages, loss of profits of any kind, or for loss of use of the products.

Patton's Medical shall not be liable to the customer for any claims, loss of damage of any kind whatsoever arising from the nonperformance of **Patton's Medical** of any part of this agreement occasioned by acts of God, fire, war, labor difficulties, governmental regulations, or action of government. **Patton's Medical** shall not be liable to the customer for any other cause, whether of a similar or dissimilar nature beyond its reasonable control.

10.0 Maintenance Record

Model Number _____

Serial Number _____

Installation Date _____

Date of Service					
Hours					
Load					
Ambient Temp.					
Inlet Filter					
Oil/Filter					
Exhaust Filters					
Misc.					
Serviced By:					

Notes:

10.0 Maintenance Record

Model Number _____

Serial Number _____

Installation Date _____

Date of Service					
Hours					
Load					
Ambient Temp.					
Inlet Filter					
Oil/Filter					
Exhaust Filters					
Misc.					
Serviced By:					

Notes:

10.0 Maintenance Record

Model Number _____

Serial Number _____

Installation Date _____

Date of Service					
Hours					
Load					
Ambient Temp.					
Inlet Filter					
Oil/Filter					
Exhaust Filters					
Misc.					
Serviced By:					

Notes:

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