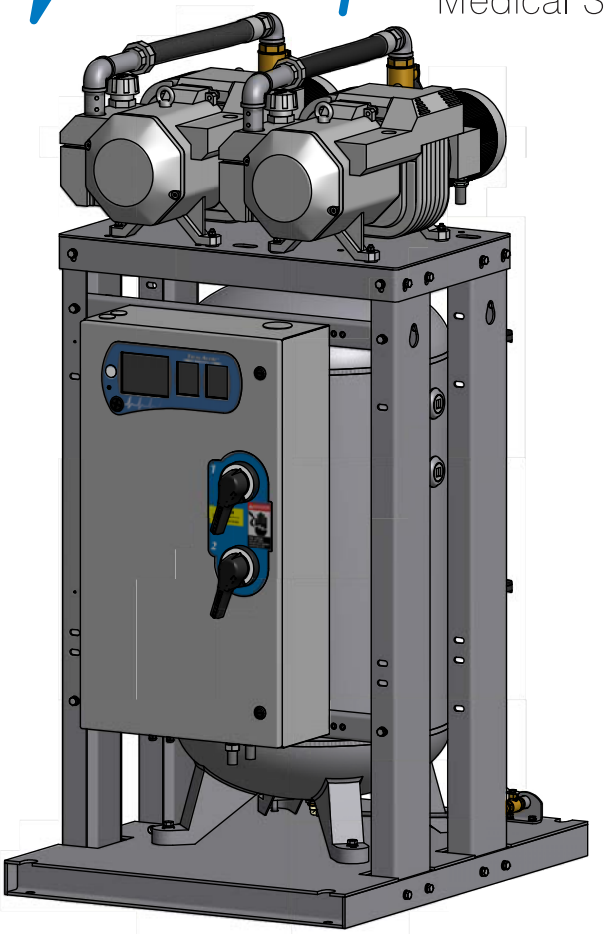
Installation, Operation and Maintenance Instructions

Lifeline
Medical Systems



“Oil-Less” Rotary Vane Medical Vacuum System

Part number 4107 9017 01
Revision 01
11 April 2018

BeaconMedæs®

Lifeline
Medical Systems

Installation, Operation and Maintenance Manual

1.5 - 10 Hp “Oil-Less” Rotary Vane Medical Vacuum System

This unit is purchased from: _____

Date purchased: _____

Model number: _____

Serial number: _____

Option(s) included: _____

Any information, service or spare parts requests should include the machine serial number and be directed to:

BeaconMedæs
1059 Paragon Way
Rock Hill, SC 29730

Telephone: (888) 463-3427
Fax: (803) 817-5750

BeaconMedæs reserves the right to make changes and improvements to update products sold previously without notice or obligation.

Part number 4107 9017 01
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11 April 2018

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Safety Precautions

The operator should carefully read the entire 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 affected components 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 LifeLine® "Oil-Less" Rotary Vane Medical Vacuum System, 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.
- 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.
- 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 Electromagnetic Immunity

Note: This section applicable to "Oil-Less" Rotary Vane Medical Vacuum Systems with the TotalAlert Embedded electronic control system.

EN 61000-6-2

Medical Electrical Equipment needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in this manual.

Portable and mobile RF communications equipment can affect Medical Electrical Equipment.

The use of accessories, transducers, and cables other than those specified by the manufacturer, may result in decreased immunity of the TotalAlert Embedded control system.

The TotalAlert Embedded control system should not be used adjacent to other equipment. If adjacent use is necessary, the TotalAlert Embedded control system should be observed to verify normal operation in the configuration in which it will be used.

1.0 Electromagnetic Immunity

EN 61000-6-2 (Cont.)

Guidance and manufacturer's declaration - electromagnetic immunity			
The TotalAlert Embedded control system is intended for use in the electromagnetic environment specified below. The customer or the user of the TotalAlert Embedded control system should assure that it is used in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Electrostatic Discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete, metal or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/ output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment
Voltage dips, short Interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5 % U_T (>95 % dip in U_T) for 0,5 cycle <40 % U_T (>60 % dip in U_T) for 5 cycles <70 % U_T (>30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 sec	<5 % U_T (>95 % dip in U_T) for 0,5 cycle <40 % U_T (>60 % dip in U_T) for 5 cycles <70 % U_T (>30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of the TotalAlert Embedded control system requires continued operation during power mains interruptions, it is recommended that the system be installed on an emergency power service.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE: U_T is the a.c. mains voltage prior to application of the test level.			

1.0 Electromagnetic Immunity

EN 61000-6-2 (Cont.)

Guidance and manufacturer's declaration - electromagnetic immunity			
The TotalAlert Embedded control system is intended for use in the electromagnetic environment specified below. The customer or the user of the TotalAlert Embedded control system should assure that it is used in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the TotalAlert Embedded control system, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance $d = 1,2\sqrt{P}$ $d = 1,2\sqrt{P}$ 80 MHz to 800 MHz $d = 2,3\sqrt{P}$ 800 MHz to 2,5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m).
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2,5 GHz	3 V/m	Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 
NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies. NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicticted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the TotalAlert Embedded control system is used exceeds the applicable RF compliance level above, the TotalAlert Embedded control system should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the TotalAlert Embedded control system. [b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.			

2.0 Installation

2.1 Inspection Upon Receiving

The condition of the **LifeLine®** "Oil-Less" Rotary Vane Medical Vacuum System should be carefully inspected upon delivery. Any indication of damage by the carrier should be noted on the delivery receipt, especially if the system will not be immediately uncrated and installed. **BeaconMedæs** ships all systems F.O.B. factory; therefore, damage is the responsibility of the carrier, and all claims must be made with them. "Oil-Less" Vane systems may remain in their shipping containers until ready for installation. If **LifeLine®** "Oil-Less" Vane systems are to be stored prior to installation, they 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. Walk along the route the unit must travel and note dimensions of doorways and low ceilings. Most **LifeLine®** "Oil-Less" Vane systems are designed to go through 36" doorways.

Most Single Point Connection systems can be separated to fit through 36" doorways. If separating bases, carefully label all removed electrical connections for easier re-assembly at the final destination.

Modular systems are shipped as separate units to facilitate a variety of installations. Most 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.

Refer to the diagrams supplied with your system for dimensional, wiring and installation information.

Place units to ensure high visibility of indicators and gauges and for performing maintenance on the system. Refer to your installation diagram. If you do not have one, please contact **BeaconMedæs Technical Support** at 888-4-MEDGAS.

2.3 Location

The **LifeLine®** "Oil-Less" Rotary Vane 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.

Certain considerations should be given to the placement of the system. The package may be installed in a location that is flat, level, and will support its weight. Clearance between the unit and adjacent walls should be no less than 24" to ensure sufficient airflow for cooling. There should be a minimum of three feet of clearance in front of the control panel for safe operation and maintenance. A vertical distance of 24" is required above the modules for ventilation and maintenance.

No special foundation is required. However, all units must be securely bolted using all mounting holes provided. If a raised concrete pad is used, the module bases must not overhang the concrete base. A method to drain away moisture is necessary.

2.0 Installation

Adequate ventilation is required. The pumps are air-cooled. Therefore, it is very important that the ambient temperature should be between 40˚F and 105˚F (if the maximum ambient exceeds 105˚F, contact 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.

When selecting the location for the system, remember to keep in mind the requirements for service, such as cleaning, changing filters, and changing vanes.

2.4 Locations Above Sea Level

The safety relief valves and vacuum control switches on the **Lifeline** "Oil-Less" Vacuum systems are factory set for an altitude less than or equal to 2000 ft. However, if the altitude is greater than 2000 ft, certain adjustments may be necessary to compensate for a lower barometric pressure.

Note: Lifeline "Oil-Less" Vacuum Systems should never be used above an elevation of 4000 ft.

Table 2.1 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
1,000	28.86	1.04
1,500	28.33	1.06
2,000	27.82	1.08
2,500	27.32	1.10
3,000	26.82	1.12
3,500	26.33	1.14
4,000	25.84	1.16
>4,000	Contact factory. Do NOT use Oil-Less Vacuum Pumps.	

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, multiply this number by the adjustment factor located in Table 2.1. After determining the new flow required, use this number to size the medical vacuum system.

2.5 Electrical Requirements

WARNING:

BE SURE THAT ALL POWER IS TURNED OFF PRIOR TO PERFORMING ANY WORK ON THE ELECTRICAL PANEL!

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

Do not operate vacuum pump on a voltage other than the voltage specified on the control panel nameplate.

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

Refer to the wiring diagram(s) that came with the vacuum pump system for pertinent wiring connections.

Electrical power for the medical 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 vacuum pump system minimum circuit ampacity on the wiring diagram.

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

2.0 Installation

Qualified electricians only should make power connections to the control panel and any interconnecting wiring. The control panel has openings for electrical and alarm/data connections. **Do not drill additional holes in the control panel as this may void the system warranty.** See Figure 2.1 for opening locations.

Figure 2.1 Electrical/Alarm/Data Openings

Ensure that the emergency generation system electrical supply is consistent with the vacuum system's requirements.

The electrical controls for the system were wired at the factory and were fully tested.

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

NOTE: It may be necessary to switch two of the incoming power leads when performing start-up, if the pump rotation is in the wrong direction.

2.6 Intake Piping

Before connecting any piping, the plastic thread protector installed in the connection port must be removed. We recommend that 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 in accordance with NFPA 99. All pipe must be either seamless copper tubing or other corrosion-resistant metallic tubing, as detailed in NFPA 99.

2.7 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 Table 2.2. All pipe must be either seamless copper tubing or other corrosion-resistant metallic tubing as detailed in NFPA 99. A flexible connector 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, as flex connectors and drip legs are factory installed on base mount systems). The outside pipe must be turned down and screened to prevent contamination.

2.0 Installation

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.

Table 2.2 Exhaust Pipe Length

LifeLine Units		System Exhaust Pipe Length (ft) - See Notes											
		25	50	75	100	150	200	250	300	350	400	450	500
SIMPLEX	1.5 Hp	0.75	0.75	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	2 Hp	1.00	1.00	1.00	1.00	1.00	1.00	1.25	1.25	1.25	1.25	1.25	1.25
	3 Hp	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.50	1.50	1.50	1.50	1.50
	5 Hp	1.50	1.50	1.50	1.50	1.50	1.50	2.00	2.00	2.00	2.00	2.00	2.00
	7.5 Hp	1.50	1.50	1.50	1.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	10 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	1.5 Hp	1.00	1.00	1.00	1.00	1.00	1.25	1.25	1.25	1.25	1.50	1.50	1.50
	2 Hp	1.25	1.25	1.25	1.25	1.25	1.50	1.50	1.50	1.50	2.00	2.00	2.00
	3 Hp	1.50	1.50	1.50	1.50	1.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	5 Hp	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00
	7.5 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
	10 Hp	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	4.00
TRIPLEX	7.5 Hp	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00
	10 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
QUAD	7.5 Hp	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	4.00
	10 Hp	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00

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 following table and example.)

2.0 Installation

Table 2.3 Pipe Length for 90˚ Elbow

Effective Pipe Length Equivalent to each 90 degree Elbow										
Pipe Size (in.)	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00
Eff. Pipe Length (ft)	3.4	4.0	4.9	6.4	7.9	9.4	10.0	11.9	13.2	14.5

Example:

Select the pipe size for a Duplex 7.5 HP with 90 feet of straight pipe and six elbows:

A) Select the pipe size of 2" diameter for 90 feet of straight pipe.

B) Determine the eff. pipe length for an elbow of 2" dia. (EPL= 4.9 ft / elbow).

C) Calculate the SYSTEM PIPE LENGTH {SPL (2.0" D) = 90 + (6 x 4.9) = 119.4 ft}

D) Check this SYSTEM PIPE LENGTH to see if it exceeds the minimum pipe size. In this case it does, select the next larger pipe size from the table (D = 3").

E) To double-check the pipe size, recalculate the SPL with the new diameter. SPL (D = 3") = 90 + (6 x 7.9) = 137.4 ft. This is in the allowable range.

3A.0 Start Up - TotalAlert Embedded Controls

Note: This section applicable to "Oil-Less" Rotary Vane Medical Vacuum Systems with the TotalAlert Embedded electronic control system.

3A.1 Prestart-up

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

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

WARNING:

Prior to putting the LifeLine® "Oil-Less" Rotary Vane 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.

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

WARNING:

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

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°C).

- Check the intake piping for proper size and connection to the vacuum modules.
- Check all piping system joints that might have come loose during shipment and installation to ensure they are tight.
- Check the air receiver, controls, and pumps for damage.
- Check the drain valve on the air receiver.
- Check all valves for full open and full close travel. Ensure that the system's valves are positioned for proper operation. (Refer to labeling on valve handles)
- **Remove all packing material from the unit.**
- Check the electrical connections to the control cabinet.
- Verify electrical service. Before starting the 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 Automatic-Off-Manual touch screens 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.

3A.0 Start Up - TotalAlert Embedded Controls

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 components.
- 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.

3A.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. The facility's supply circuit breaker should also be locked out.

3A.2.1 Lubrication

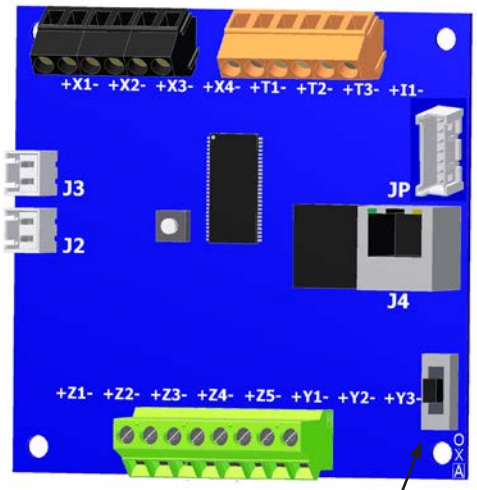
The pumps are 100% Oil-Less. On some models, the only lubrication that is necessary is to grease the bearings. (See Section 6 for the required maintenance and time intervals for the various models.)

3A.2.2 Pump Rotation

Inside the control panel, make sure that all unit printed circuit boards are set to the manual override "Off" position. This is indicated by the middle position "X" on the three-position sliding switch as shown in Figure 3.1.

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

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



Manual Override Switch

O - On Manual
X - Off
A - Automatic

Figure 3A.1 Unit PCB Override Switch

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

Inside the control cabinet, switch one of the unit printed circuit boards from the manual override "Off" position to the bottom position, the default "Automatic" mode. Make sure the Pump Mode on the Unit touchscreens are in the Off position, see Figures 3A.2 and 3A.3. (See Figure A.15 for complete list of Screen Toolbar Descriptions).

Check for correct direction of rotation of each pump by pressing the "Rotation" button on touchscreen display (found in the Service section of the Unit touchscreens) and observing rotation. See Figure 3A.4. The Pump Mode for each compressor must be in the Off Position for the Rotation to function.

3A.0 Start Up - TotalAlert Embedded Controls

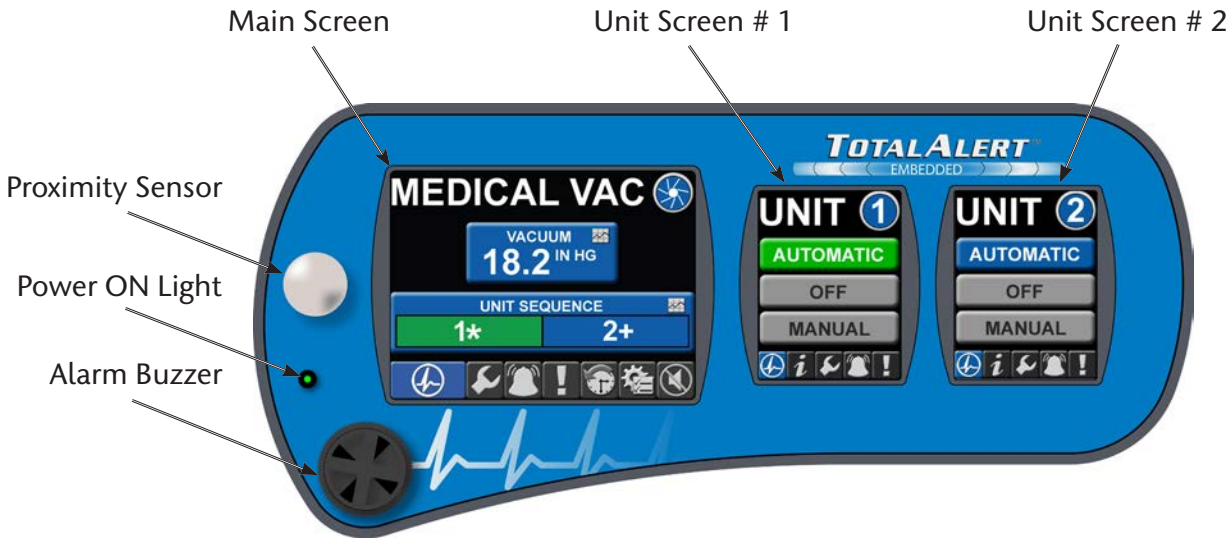


Figure 3A.2 Touchscreen Controls

Figure 3A.3 Unit Screen - Off Position

Figure 3A.4 Unit Screen - Service: Rotation

By observing the cooling fan of the motor, you can determine the rotation of the pump. After pressing the "Rotation" button on the touchscreen, there is a 5 second delay before the pump will start for a brief amount of time. Pump rotation should be clockwise 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:

Do not allow the vacuum pump to run backwards.

Repeat the process of switching the Unit printed circuit boards from the manual override "Off" position to the default "Automatic" position and testing rotation.

3A.0 Start Up - TotalAlert Embedded Controls

3A.3 Initial Operation

Start each pump by pressing "Automatic" on the touchscreen. See Figure 3.5.

Figure 3A.5 Unit Screen - Automatic Mode

WARNING:

Pumps that have reached operating temperature may have a high surface temperature on the top of the exhaust muffler.

DO NOT TOUCH!

WARNING:

Never add oil to the inlet of Oil-Less pumps.

Run the pump for two minutes in the correct rotation. After testing each pump, if everything appears normal, put each pump into the "Automatic" mode and allow each pump to run until vacuum builds. Check for any leaks in the piping. Repair leaks, if needed.

3B.0 Start Up - Basic Controls

Note: This section applicable to "Oil-Less" Rotary Vane Medical Vacuum Systems with the Basic control system.

3B.1 Prestart-up

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

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

WARNING:

Prior to putting the LifeLine® "Oil-Less" Rotary Vane 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.

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

WARNING:

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

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°C).

- Check the intake piping for proper size and connection to the vacuum modules.
- Check all piping system joints that might have come loose during shipment and installation to ensure they are tight.
- Check the air receiver, controls, and pumps for damage.
- Check the drain valve on the air receiver.
- Check all valves for full open and full close travel. Ensure that the system's valves are positioned for proper operation. (Refer to labeling on valve handles)
- **Remove all packing material from the unit.**
- Check the electrical connections to the control cabinet.
- Verify electrical service. Before starting the 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 Automatic-Off-Manual 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.

3B.0 Start Up - Basic Controls

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 components.
- 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.

3B.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. The facility's supply circuit breaker should also be locked out.

3B.2.1 Lubrication

The pumps are 100% Oil-Less. On some models, the only lubrication that is necessary is to grease the bearings. (See Section 6 for the required maintenance and time intervals for the various models.)

3B.2.2 Pump Rotation

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

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

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

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:

Do not allow vacuum pump to run backwards.

Repeat the process of testing rotation for each vacuum pump.

3B.3 Initial Operation

Using the "Hand-Off-Auto" switch, start pump by switching to "Auto".

Run the pump for two minutes in the correct rotation.

WARNING:

Pumps that have reached operating temperature may have a high surface temperature on the top of the exhaust muffler.

DO NOT TOUCH!

3B.0 Start Up - Basic Controls

WARNING:

Never add oil to the inlet of Oil-Less pumps.

After testing each pump, if everything appears normal, put each pump into the "Auto" mode and allow each pump to run until vacuum builds. Check for any leaks in the piping. Repair leaks, if needed.

4A.0 General Operation - TotalAlert Embedded Controls

Note: This section applicable to "Oil-Less" Rotary Vane Medical Vacuum Systems with the TotalAlert Embedded electronic control system.

WARNING:

NEVER ADD OIL TO THE INLET OF OIL-LESS PUMPS!

4A.1 Electrical Control Panel

The LifeLine multiplex control system is U.L. labeled. The control system has a touch screen control, automatic lead/lag sequencing, external operators with circuit breaker disconnects, full voltage motor starters, overload protection, 24V control circuit, and automatic-off-manual selector for each vacuum pump. Automatic alternation of all vacuum pumps is based on first-on/first-off principle with provisions for simultaneous operation if required. Automatic activation of reserve unit, if required, will activate an audible alarm as well as a visual alarm on the control panel. The control panel displays service alert, run hours for each vacuum pump, system status, and system vacuum level. A complete alarm and service history is available on the control panel. (see Appendix A for more details)

During normal operation, all pumps should be in the "Automatic" position so that the control system can effectively run the system. The control system monitors the system vacuum level, starts and stops the pumps depending on changing vacuum level conditions and minimum run time values, and automatically alternates the lead position between units.

On the **initial** system start-up, when the system vacuum level is below the set point of the vacuum transducer, pump 1 will start immediately. Another pump starts after a programmed time delay. The time delay prevents high inrush current after a power failure or emergency power switch over. During this initial system start-up, the lag alarm may come on at this point and is normal. It can be reset once the system reaches its normal operating vacuum and the lag pump times out and stops. See Figure 4A.1.

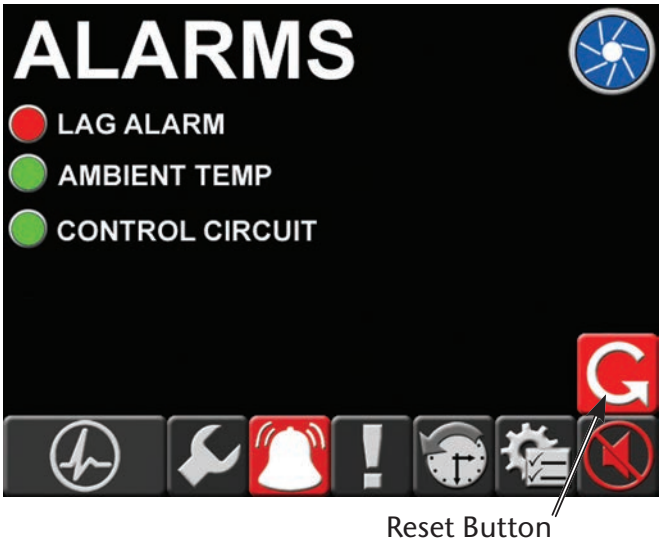


Figure 4A.1 Main Screen - Reset Button

In a typical **duplex** system, one pump will be able to handle the system load. The control system will signal the lead pump to start when the vacuum transducer senses the vacuum level below its set point. If one pump can carry the load, then the vacuum level will rise and maintain the vacuum level setting. At this point, if the minimum run timer for that pump has been satisfied, the control system 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 below the vacuum level setting, the control system will automatically sequence the lead role to the other pump and will start it. This is also known as "first on/first off" instead of the more traditional "last on/first off".

4A.0 General Operation - TotalAlert Embedded Controls

With the "first on/first off" sequencing technique, starts and stops on the pump are minimized. If the lead pump runs continuously in lead for more than the minimum run time, the control system will automatically sequence the pump attempting to evenly distribute the run time among all available pumps. If during operation, the second pump is required to come on in addition to the lead pump, the control system will turn on the "Lag Alarm" (see section 4A.3).

In a **triplex** or **quadruplex** system, the operation is very similar to the duplex operation described above with the following differences. 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 control system turns on the lag alarm, it counts the number of units in the "Automatic" position and makes a decision based on the vacuum transducer signal. A lag alarm occurs when the last available pump (in automatic) starts.

4A.1.1 Run Timer

All LifeLine Oil-Less vacuum systems incorporate run timers to minimize the starts and stops on the vacuum pumps. After the pump has stopped, its runtime will be adjusted based on how long the lead pump is off.

- 1.5 Hp through 5 Hp pumps runtime range is 2.5 - 10 minutes
- 7.5 Hp through 10 Hp pumps runtime range is 5 - 15 minutes

4A.2 Tank Drains

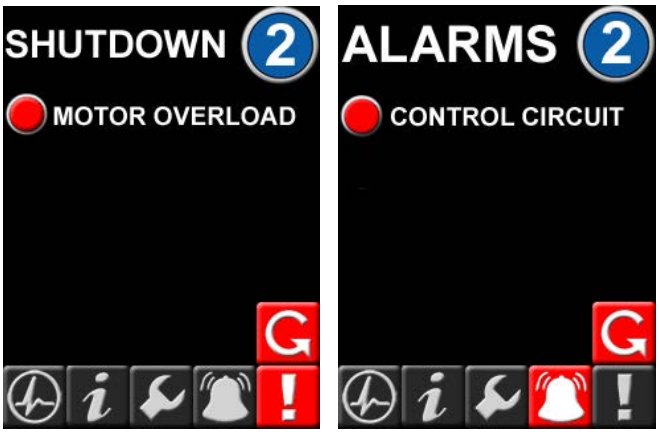
The standard tank drain consists of a manually operated ball valve.

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.

4A.3 Emergency Shutdown / Alarms

The following conditions may arise during operation.

4A.3.1 Unit Shutdown / Alarms



Unit Screens

Figure 4A.2 Unit Screens - Shutdown and Alarms

Motor Overload Shutdown - This will shut down the pump in question and will not re-start the pump until the reset button on the starter is reset (See "Motor breakers trip" in the Trouble Shooting Section 5). Press the alarm silence button on the main display screen to silence the alarm. After the starter is reset, push the "Reset" button on the Unit Shutdown screen. On the Unit screen, put the pump into "Automatic" mode to make the pump available for operation.

Control Circuit Alarm - This will not shut down the pump in question but instead is a notification that there is a loss of communication between printed circuit boards within the control panel. See Appendix A on Control System for trouble shooting.

4A.0 General Operation - TotalAlert Embedded Controls

4A.3.2 System Alarms

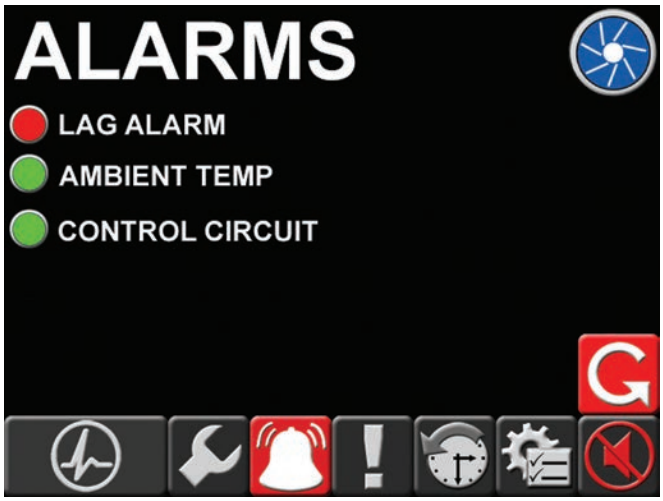


Figure 4A.3 Main Screen

Lag Unit Running Alarm - This alarm will activate if the last available vacuum pump comes on. Press the alarm silence button on the main display screen to silence the alarm. If a lag condition remains, the "Red" indicating light on the Main screen will remain on. Once the lag condition is corrected, press the reset button to turn off alarm light on display screen.

In the case of a duplex system, it will activate when the second vacuum pump turns on based on the signal from the vacuum transducer. 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 pumps are set to "Automatic", then the lag alarm will trigger when the fourth unit comes on. If on the same system, three (3) of the four pumps are set to "Automatic" and the other to "Off" or "Manual", then the lag alarm will activate when the third unit comes on. 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 not be reset if the lag pump is still running. This can happen due to the run timer not having expired, but the lag vacuum level itself may be above the alarm setting.

The Lag Alarm will activate if the vacuum transducer signal circuit is lost or the transducer malfunctions. Press the alarm silence button on the main display screen to silence the alarm (see Troubleshooting Section 5). The vacuum level reading on the main display will read "ERR" when this alarm occurs. The vacuum system will continue to run off the backup vacuum switch.

Ambient Temperature Alarm - This alarm will activate when the temperature in the room exceeds the set point. The audible alarm will not sound but the touchscreen will show an active alarm and record it in the event log. The alarm remains latched until the alarm condition is reset by the operator.

Control Circuit Alarm - This alarm will activate when there is a loss of communication between printed circuit boards within the control panel. See Appendix A on Control System for trouble shooting.

4A.3.3 Service Warnings

Service Due Alarm - Service intervals and type of service are preprogrammed into the control system. The background of the wrench icon on the main display screen toolbar will turn red when one of these services are required. See Table 6.1 Maintenance Schedules.

4A.0 General Operation - TotalAlert Embedded Controls

4A.4 Backup Vacuum Switch Set Point Adjustments

The backup switch is set at the factory to the operating point(s) as stated on the wiring diagram supplied with the unit. It is good practice to cycle the switch to determine actual operating points before proceeding with readjustment. Refer to Figure 4A.4 for location of adjustment.

CAUTION:

- ALWAYS change vacuum setting gradually.
- ALWAYS check switch setting before making any adjustments.
- DO NOT force adjustment sleeve when it becomes difficult to turn.
- ALWAYS isolate the vacuum transducer before adjusting the backup vacuum switch.

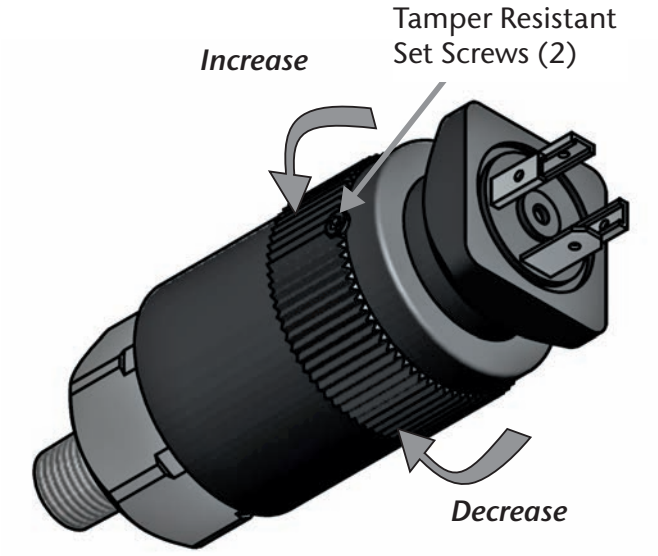


Figure 4A.4 Backup Vacuum Switch

Adjusting Instructions

1. To adjust, loosen the tamper resistant set screws (2) on the adjustment sleeve.
2. Secure the hex body with an open-end wrench. Hand turn the adjustment sleeve: counter-clockwise to increase and clockwise to decrease the set point. The backup vacuum switch should always be set with falling vacuum level starting at a vacuum level higher than the setpoint.
3. Using the vacuum gauge determine the actuation point of the switch.
4. If the actuation point is above the desired value, turn the adjustment sleeve clockwise to decrease the actuation point, and if it is below, turn the adjustment sleeve counter-clockwise to increase it.
5. For exact vacuum setting, cycle vacuum switch and make fine adjustments by repeating steps 2 through 4 (trial and error process) until the desired setting is obtained.
6. Secure the tamper resistant set screws (2) on the adjustment sleeve.

CAUTION: Do not overtighten set screws.

4A.5 Relief Valve

Every **LifeLine** "Oil-Less" vacuum pump is built with an integral vacuum relief valve. The purpose of this relief valve is to prevent the pump from operating at a vacuum level that is too high. The maximum operating point varies by model and is factory set before shipping. Relief valve settings may be different for higher altitudes (see Section 2.4 and/or "Wiring Control Drawing" for the system).

The function of the relief valve is very important to the successful long-term operation of the vacuum system. Since these pumps have no oil or water to carry away the heat of compression, an adequate flow of air *through* the pump, as well as air circulation *around* the pump, is vital.

WARNING:

NEVER SET THE VACUUM RELIEF VALVE AT A POINT THAT EXCEEDS THE FACTORY RECOMMENDED LEVELS!

4B.0 General Operation - Basic Controls

Note: This section applicable to "Oil-Less" Rotary Vane Medical Vacuum Systems with the Basic control system.

WARNING:

NEVER ADD OIL TO THE INLET OF OIL-LESS PUMPS!

4B.1 Electrical Control Panel

The LifeLine simplex control panel includes a 0-30"Hg vacuum gauge. It also has the following: 24V power supply with fuses, hourmeter, vacuum control switch, illuminated Hand-Off-Auto switch, motor starter and circuit breaker with external disconnect. All components are enclosed in a NEMA 12 enclosure.

The LifeLine multiplex control panel includes a visual and audible lag pump alarm and a 0-30"Hg vacuum gauge. It also has the following for **each pump**: 24V power supply with fuses, hourmeter, vacuum control switch, illuminated 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 switch condition, starts and stops the pumps depending on changing vacuum switch conditions 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 the lead vacuum switch (VS-1) closes with decreasing vacuum level. If the one pump can carry the load, then the vacuum level will rise and VS-1 will open.

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 and VS-1 closes, the PLC will automatically sequence the lead role to the other pump and will start it. This is also known as "first on/first off" instead of the more traditional "last on/first off". With the "first on/first off" sequencing technique, starts and stops on the pump are minimized. If the lead pump runs continuously in lead for more than 15 minutes, 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.) 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".

On the **initial** system start-up, when the system vacuum level is below the setpoints of the vacuum control switches, pump 1 will start. After a 7 second delay, pump 2 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 wiring diagram supplied with the system for the correct vacuum switch settings.

4B.2 Tank Drains

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.

4B.0 General Operation - Basic Controls

4B.3 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 the pump until the reset button on the starter inside the main control cabinet is reset. See Section 5 for troubleshooting information.

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 or the lag vacuum switch (VS-2) closes. To silence the alarm, press the amber push 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.

4B.4 Vacuum Switch Set Point Adjustments

The vacuum switch is set at the factory to the operating point(s) as stated on the wiring diagram supplied with the unit. It is good practice to cycle the switch to determine actual operating points before proceeding with readjustment. Refer to Figure 4B.1 for location of adjustment.

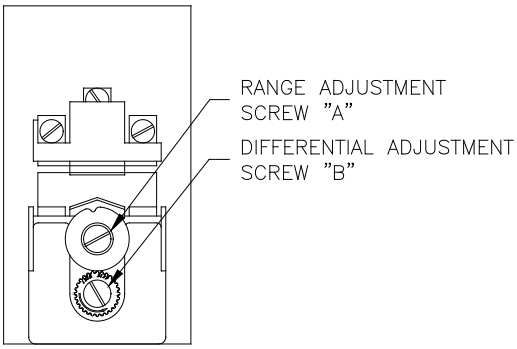


Figure 4B.1 Vacuum Switch

Adjusting Instructions

1. First - Adjust the range (screw "A") to the required cut-in vacuum setting. Turning the screw clockwise lowers the cut-in and cut-out vacuum settings equally.

2. Second - Adjust the differential (screw "B") to the required cut-out vacuum setting. Turning the screw counter-clockwise will increase the cut-out vacuum setting. Turning the screw counter-clockwise will increase the cut-out vacuum setting only. Differential is the difference between cut-in and cut-out settings.

4B.5 Relief Valve

Every **LifeLine** "Oil-Less" vacuum pump is built with an integral vacuum relief valve. The purpose of this relief valve is to prevent the pump from operating at a vacuum level that is too high. The maximum operating point varies by model and is factory set before shipping. Relief valve settings may be different for higher altitudes (see Section 2.4 and/or "Wiring Control Drawing" for the system).

The function of the relief valve is very important to the successful long-term operation of the vacuum system. Since these pumps have no oil or water to carry away the heat of compression, an adequate flow of air *through* the pump, as well as air circulation *around* the pump, is vital.

WARNING:

NEVER SET THE VACUUM RELIEF VALVE AT A POINT THAT EXCEEDS THE FACTORY RECOMMENDED LEVELS!

5.0 Trouble Shooting

Problem	Possible Causes	Solution
Power failure	Main fuse blown	Replace fuse
	Fuse blown in control circuit	Replace fuse
Unit lacks sufficient vacuum or lag alarm has occurred	System may not be vacuum tight.	Check hose/pipe and connections for possible leaks.
	Clogged inlet filter	Clean filter or change filter.
	Stuck rotor vanes	Disassemble unit and clean all oil traces from internal parts. Replace carbon vanes, since they become hygroscopic when exposed to oil. Check for oil contamination in the suction line.
	Vacuum relief valves need adjusting	Re-calibrate valves
	Leaks or restictions in piping	Open pipe connections and examine for internal contamination or buildup Tighten all piping connections Replace rubber hoses
	Insufficient pump speed (RPM)	Check voltage and amperage to motor. Inspect motor and coupling halves. Check that the pump shaft turns freely.
	Clogged ports	Clean and open all ports
	Defective gaskets	Inspect gaskets for breakage or disintegration. Replace if necessary.
	Line losses too high	Piping diameter too small- replace with larger diameter. Check for clogged filter elements - replace if necessary.

5.0 Trouble Shooting

Problem	Possible Causes	Solution
Unit lacks sufficient vacuum	Unit is operating at an elevated altitude	Contact the factory for assistance. Performance may be reduced when operating above sea level (see Section 2.4).
	Carbon dust separator clogged	Inspect, clean, or replace
	Transducer fault with lag alarm.	Replace Transducer (TAE controls only).
Motor breakers trip	Defective motor	Test motor and replace if necessary.
	Heaters too small	Replace with correctly sized heaters
	Low motor voltage	Check at motor terminals. Contact electric service provider.
	Ambient temperature too high	Reduce ambient temperature.
	Stuck rotor	Disassemble pump to determine reason. Replace all necessary parts.
	Clogged carbon dust separator - back pressure too high	Clean or replace dust separator
Unit runs rough and cannot be rotated manually	Broken rotor vane	Disassemble unit and replace vanes. Check cylinder for wear.
	Worn coupling disc	Remove motor and inspect rubber coupling disc and pins. Replace, if necessary, and realign.
	Seized bearings	Remove end shields and inspect cylinder. Replace if necessary. Re-shim bearings to maintain proper clearance.
	Grease in the cylinder	Remove end shields and inspect cylinder. Clean grease and replace vanes. Clean unit thoroughly. DO NOT OVER GREASE THE BEARINGS
	Locked rotor	Remove end shields and inspect cylinder. Remove contamination.
Pump overheats	Cooling ducts blocked	Clean cooling ducts.
	Cooling fan broken	Replace fan.
	Inadequate clearance or ventilation	Move unit and/or provide ventilation

6.0 Maintenance

6.1 General Maintenance

WARNING:

ISOLATE POWER BEFORE STARTING ANY MAINTENANCE PROCEDURES, TO PREVENT ELECTRICAL SHOCK OR ACCIDENTAL STARTING OF EQUIPMENT.

WARNING:

Pumps that have reached normal operating temperature may have a high surface temperature.

Do not perform any maintenance until after a sufficient cool down period.

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

Table 6.1 Maintenance Schedule

Item	Frequency	Action
Exhaust drip leg	Daily/Adjust as needed	Check for accumulated moisture
Inlet filters	4,000 hours or annually	Replace the inlet filter elements
Bearings*		
1.5 - 5 Hp	Not required	
7.5 Hp	2,000 hours or annnually	7 grams of grease per fitting
10 Hp	3,000 hours or annually	10 grams of grease per fitting
Vanes	3,000 hours or annually	Inspect for wear and replace if at or below minimum recommended width. Refer to service manual for procedures.
1.5 - 2 Hp Pump	33 mm minimum width	
3 Hp Pump	44 mm minimum width	
5 Hp Pump	26 mm minimum width	
7.5 Hp Pump	32 mm minimum width	
10 Hp Pump	41 mm minimum width	
Coupling		Inspect coupling rubbers for wear. Replace as needed.
1.5 - 2 Hp motors	Not required	
3 - 10 Hp motors	Annually	

* Pump bearings have been lubricated at the factory. Pumps that do not have the re-grease capability (no grease fittings) are factory lubricated for the normal life of the bearings.

6.0 Maintenance

Maintain the pump regularly to achieve the best operating results. Maintenance intervals will depend on the pump's use and ambient conditions. Each pump in the LifeLine system is an oil-less rotary vane vacuum pump.

Do not add oil at any time to the intake of the pump.

6.1.1 Greasing the Motor Bearings (5 - 10 Hp)

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. If this occurs, the excess grease will spill out of the motor and drip onto the vacuum pump. While the pump is running, grease motor bearings with specified quantity of grease per fitting every 12 months or as specified in Table 6.1. Use good quality rust inhibited polyurea-based grease, such as Chevron SRI. Motors that do not have re-greasing capabilities (no grease fittings) are factory lubricated for normal bearing life.

6.2 1.5 Hp and 2 Hp Maintenance

Refer to Figure 6.1 for exploded view of components.

6.2.1 Inlet Filter

Each pump is equipped with an inlet filter. The filter cartridge should be checked on a monthly basis and cleaned as required. The filter cartridge should be changed annually.

To service the inlet filter:

1. Close the pump isolation valve.

2. Remove the front cover (70) of the pump by releasing the plastic tabs (78) on the side. Remove the three bolts (28) attached to the filter cover (24). The air filter (27) is located behind this filter cover. Pull the filter out and clean or replace.

3. The filter cartridge may be cleaned by blowing with compressed air from the inside. Care must be taken not to use too much pressure, which could damage the element.

4. Re-assemble in reverse order.

6.2.2 Vanes

The vanes are subject to wear due to abrasion from the walls of the enclosure. Check vane width every 3,000 operating hours or annually. Replace the vanes if their widths are 33mm or less.

To inspect or replace vanes:

1. Remove front cover (70), remove the filter cover (24), and remove the inlet filter (27).

2. Remove the four bolts (19) attached to the housing cover (18). Remove the gasket (22) and the housing cover.

3. Carefully pull the vanes (6) out of the rotor (5). Vanes must be changed as a complete set.

4. On replacement, carefully blow out the enclosure with dry compressed air.

5. Carefully slide the new vanes into the rotor. Place the vanes with the radius outwards such that the bevel is in the direction of rotation and corresponds with the radius of the housing.

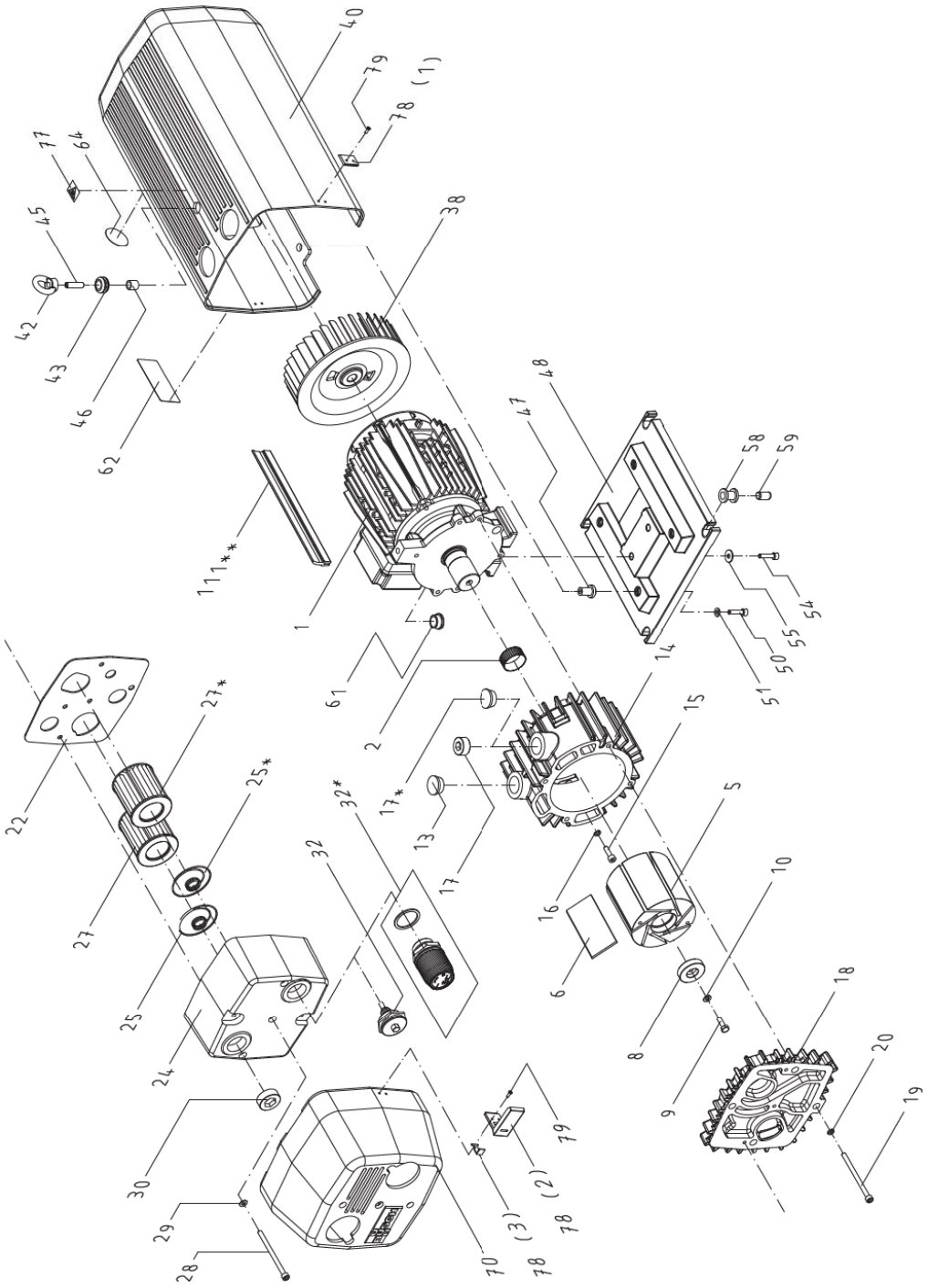
6. Replace the gasket and re-fit with cover and four bolts. Re-fit the inlet filter, filter cover, and three bolts. Re-fit the cover.

6.2.3 Pump Bearings

The roller bearings in the vacuum pump are pre-lubricated for life and will not require maintenance. Replace with original roller bearings only.

6.0 Maintenance

Figure 6.1: 1.5 HP and 2 HP Exploded View



6.0 Maintenance

6.3 3 HP Maintenance

Refer to Figure 6.2 for exploded view of components.

6.3.1 Inlet Filter

Each pump is equipped with an inlet filter. The filter cartridge should be checked on a monthly basis and cleaned as required. The filter cartridge should be changed annually.

To service the inlet filter:

1. Close the pump isolation valve.

2. Remove the side cover (55) of the pump by removing the four bolts (50) attached to the main housing (1). The air filter (53) is located behind this side plate. Pull the filter out and clean or replace.

3. The filter cartridge may be cleaned by blowing with compressed air from the inside. Care must be taken not to use too much pressure, which could damage the element.

4. Re-assemble in reverse order.

6.3.2 Vanes

The vanes are subject to wear due to abrasion from the walls of the enclosure. Check vane width every 3,000 operating hours or annually. Replace the vanes if their widths are 44mm or less.

To inspect or replace vanes:

1. Remove front cover (44) by removing the two bolts (46).

2. Remove the four bolts (36) attached to the housing cover (28). Remove the housing cover.

3. Carefully pull the vanes (8) out of the rotor (5). Vanes must be changed as a complete set.

4. On replacement, carefully blow out the enclosure with dry compressed air.

5. Carefully slide the new vanes into the rotor. Place the vanes with the radius outwards such that the bevel is in the direction of rotation and corresponds with the radius of the housing.

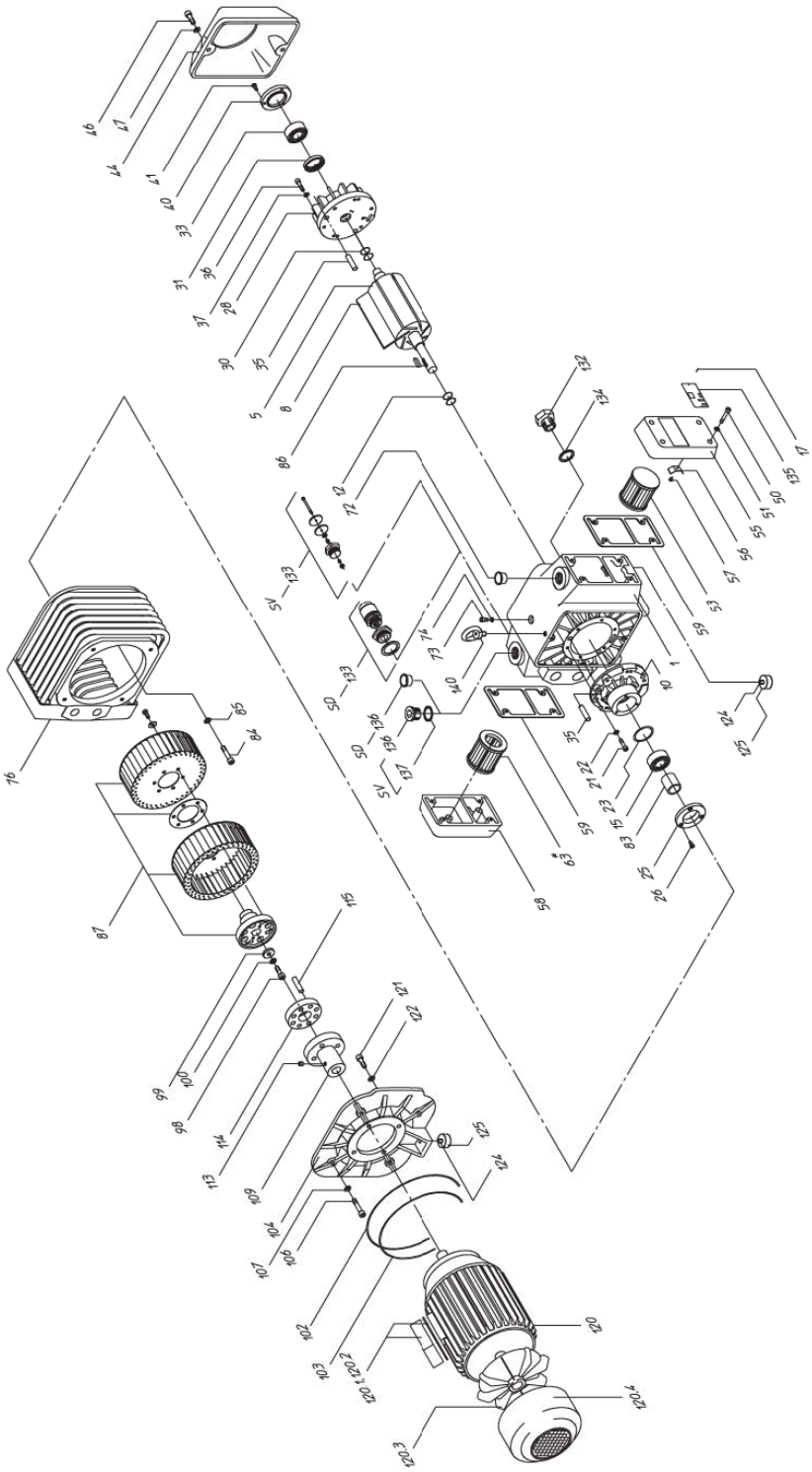
6. Install the gasket and re-fit with cover and four bolts. Re-fit the inlet filter, face plate, and three bolts. Re-fit the cover.

6.3.3 Pump Bearings

The roller bearings in the vacuum pump are pre-lubricated for life and will not require maintenance. Replace with original roller bearings only.

6.0 Maintenance

Figure 6.2: 3 HP Exploded View



6.0 Maintenance

6.4 5 HP Maintenance

Refer to Figure 6.3 for exploded view of components.

6.4.1 Inlet Filter

Each pump is equipped with an inlet filter and a pressure side filter. The filter cartridges should be checked on a monthly basis and cleaned as required. The filter cartridges should be changed annually.

To service the filters:

1. Close the pump isolation valve.

2. Remove the side covers (58 and 92) of the pump by removing the bolts (59 and 93) attached to the housings (30 and 80). The air filters (55 and 90) is located behind these side plates. Pull the filters out and clean or replace.

3. The filter cartridges may be cleaned by blowing with compressed air from the inside. Care must be taken not to use too much pressure, which could damage the element.

4. Re-assemble in reverse order.

6.4.2 Vanes

The vanes are subject to wear due to abrasion from the walls of the enclosure. Check vane width every 3,000 operating hours or annually. Replace the vanes if their widths are 26mm or less.

To inspect or replace vanes:

1. Remove front cover (50) by removing the two bolts (51).

2. Remove the four bolts (9) attached to the housing cover (40). Remove the gasket (41) and the housing cover.

3. Carefully pull the vanes (35) out of the rotor (20). Vanes must be changed as a complete set.

4. On replacement, carefully blow out the enclosure with dry compressed air.

5. Carefully slide the new vanes into the rotor. Place the vanes with the radius outwards such that the bevel is in the direction of rotation and corresponds with the radius of the housing.

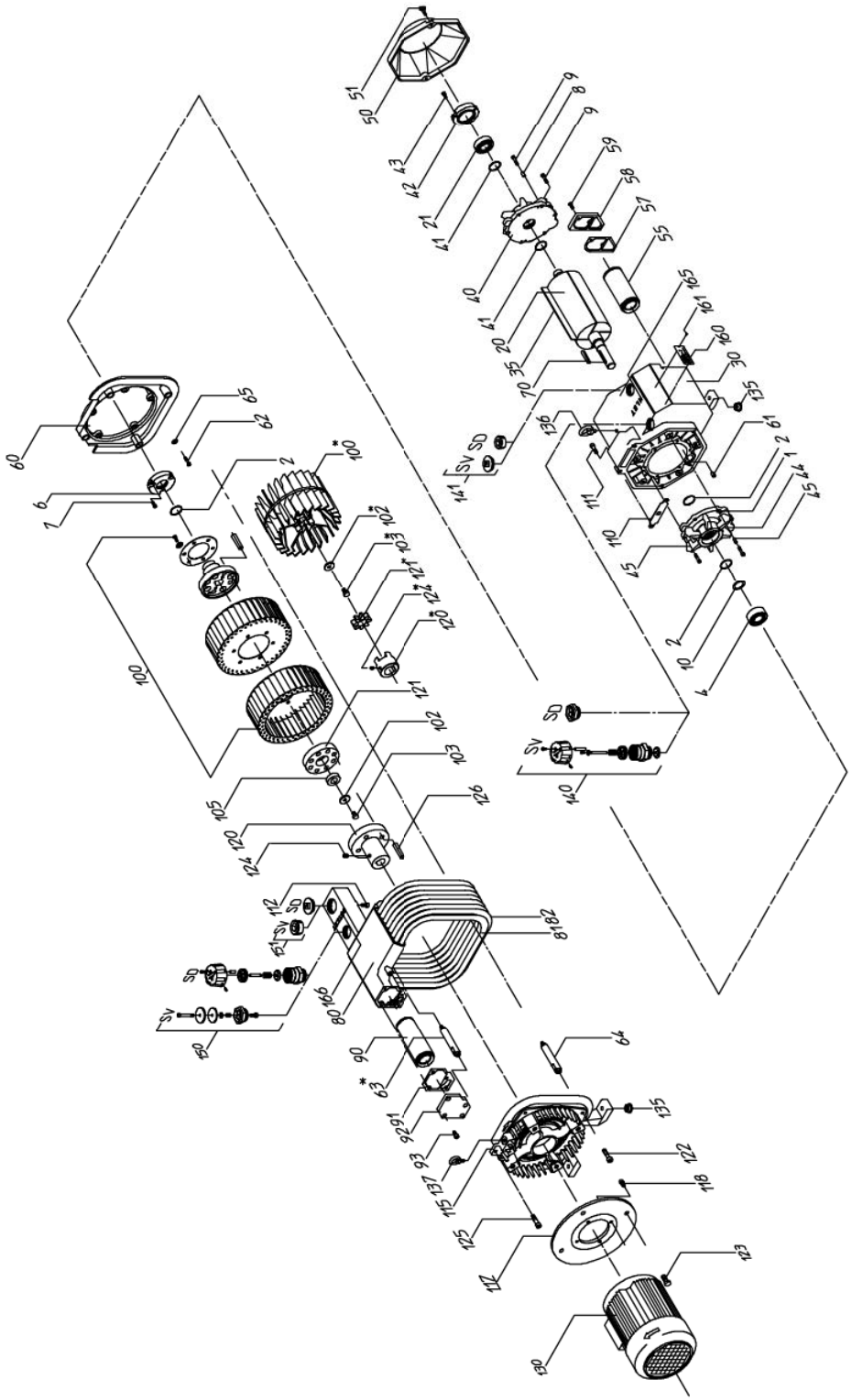
6. Replace the gasket and re-fit with cover and four bolts. Re-fit the inlet filter, face plate, and three bolts. Re-fit the cover.

6.4.3 Pump Bearings

The roller bearings in the vacuum pump are pre-lubricated for life and will not require maintenance. Replace with original roller bearings only.

6.0 Maintenance

Figure 6.3: 5 HP Exploded View



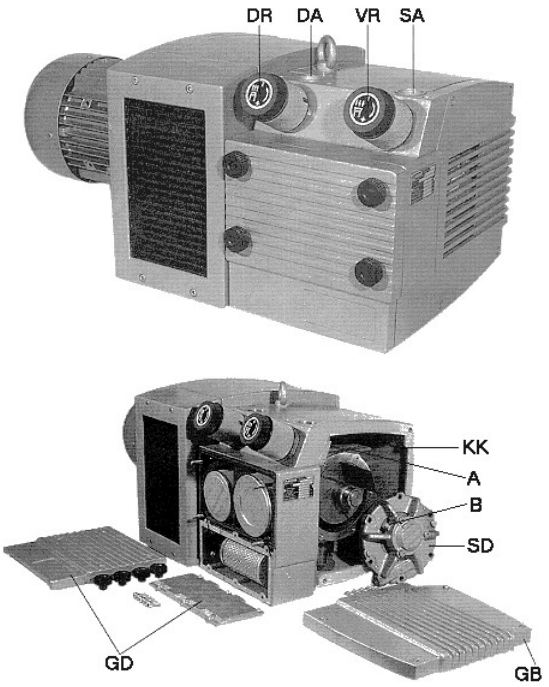
6.0 Maintenance

6.5 7.5 HP Maintenance

Refer to Figure 6.4 for exploded view of components.

6.5.1 Inlet Filter

Each pump is equipped with two 5-micron inlet filters. They are located behind cover GD and can be serviced as follows:



1. Close the pump isolation valve.

2. Remove the bolts on the filter housing and remove the filter elements. It is recommended that the filter be checked every week, initially. The filter should be replaced annually or every 4000 hours of operation.

3. The filter element may be cleaned by blowing with compressed air from the inside. Care must be taken not to use too much pressure, which could damage the element. Replace blocked, oily or greasy elements.

4. Blow out any dirt in cooling channels KK with compressed air before replacing housing cover.

6.5.2 Vanes

The vanes are subject to wear due to abrasion from the walls of the enclosure. Check vane width every 3000 operating hours or annually. Replace the vanes if their widths are less than 32 mm.

To inspect or replace vanes:

1. Remove housing cover GB.

2. Remove vane cover plate SD by inserting two screws into holes G and force off evenly from rotor. **Do not impose a radial load on the rotor**.

3. Carefully pull vanes out of rotor.

4. On replacement, blow out enclosure with dry compressed air.

5. Carefully slide new vanes into rotor.

6. Clean grease off of rotor shaft and inside of the cover plate SD.

7. Re-apply grease to B-side rotor bearings inside cover SD.

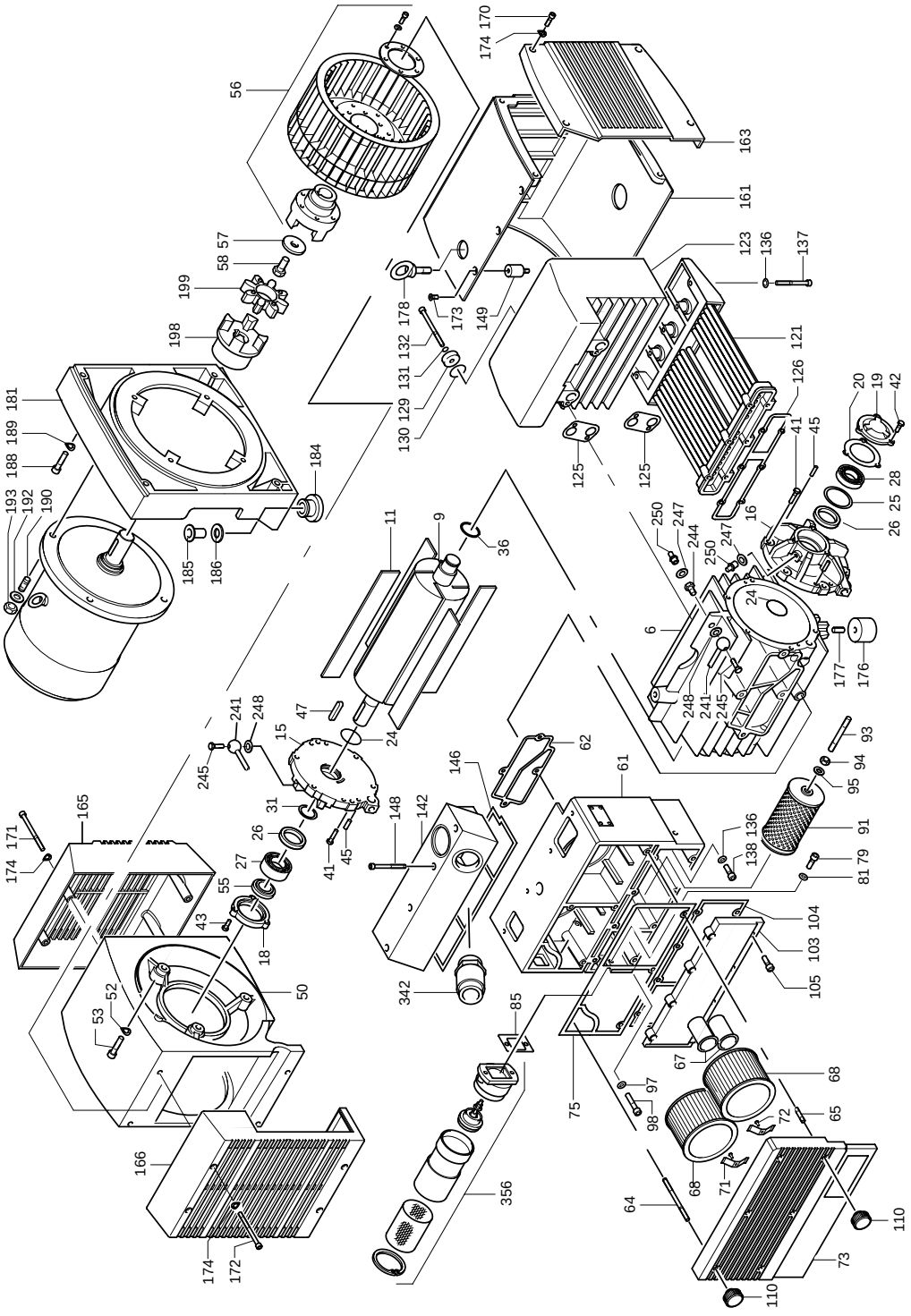
8. Replace vane cover plate and housing cover.

6.5.3 Pump Bearings

Grease vacuum pump roller bearings after 2,000 hours of operation. Using a grease gun, apply 7g of Amblygon TA 15/2 at both of the grease nipples A & B while the vacuum pump is running. Use only Amblygon TA 15/2 grease. Replace with original roller bearings only.

6.0 Maintenance

Figure 6.4: 7.5 HP Exploded View



6.0 Maintenance

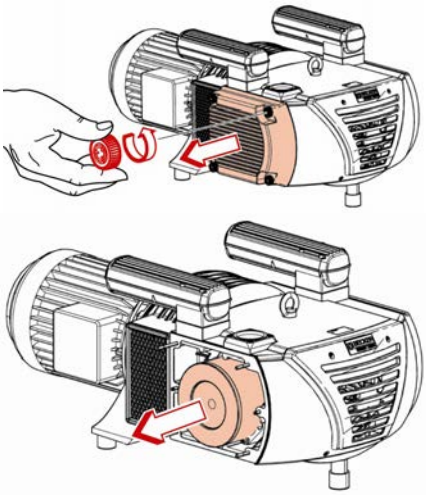
6.6 10 HP Maintenance

Refer to Figure 6.5 for exploded view of components.

6.6.1 Inlet Filter

Each pump is equipped with a 5-micron inlet filter. It can be serviced as follows:

1. Close the pump isolation valve.
2. Remove the bolts on the filter housing and remove the filter elements. It is recommended that the filter be checked every week, initially. The filter should be replaced annually or every 4000 hours of operation.
3. The filter element may be cleaned by blowing with compressed air from the inside. Care must be taken not to use too much pressure, which could damage the element. Replace blocked, oily or greasy elements.
4. Blow out any dirt in cooling channels with compressed air before replacing housing cover.

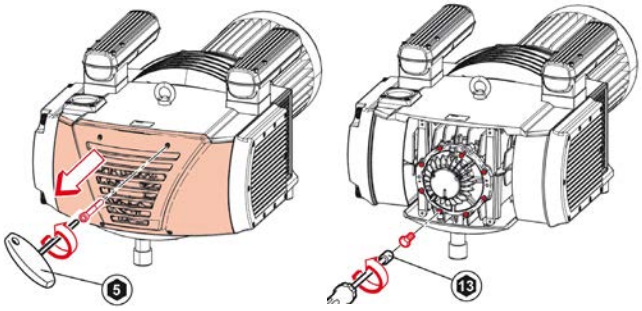


6.6.2 Vanes

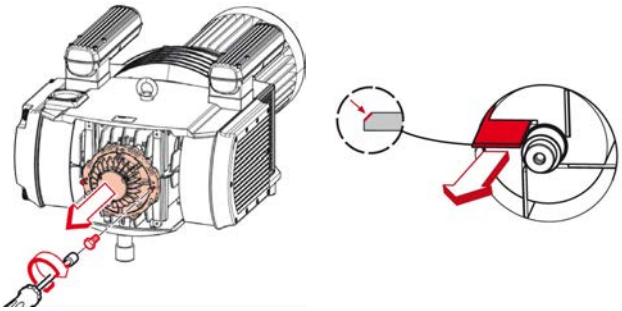
The vanes are subject to wear due to abrasion from the walls of the enclosure. Check vane width every 3,000 operating hours or annually. Replace the vanes if their widths are 41 mm or less.

To inspect or replace vanes:

1. Remove housing cover.
2. Remove vane cover plate by inserting two screws into holes as pictured, and force off evenly from rotor. **Do not impose a radial load on the rotor**.



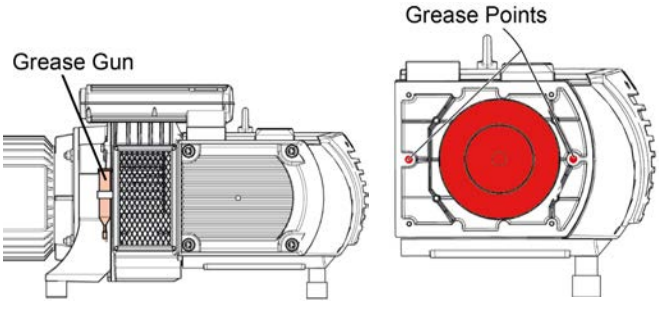
3. Carefully pull vanes out of rotor.



4. On replacement, blow out enclosure with dry compressed air.
5. Carefully slide new vanes into rotor.
6. Replace vane cover plate and housing cover.

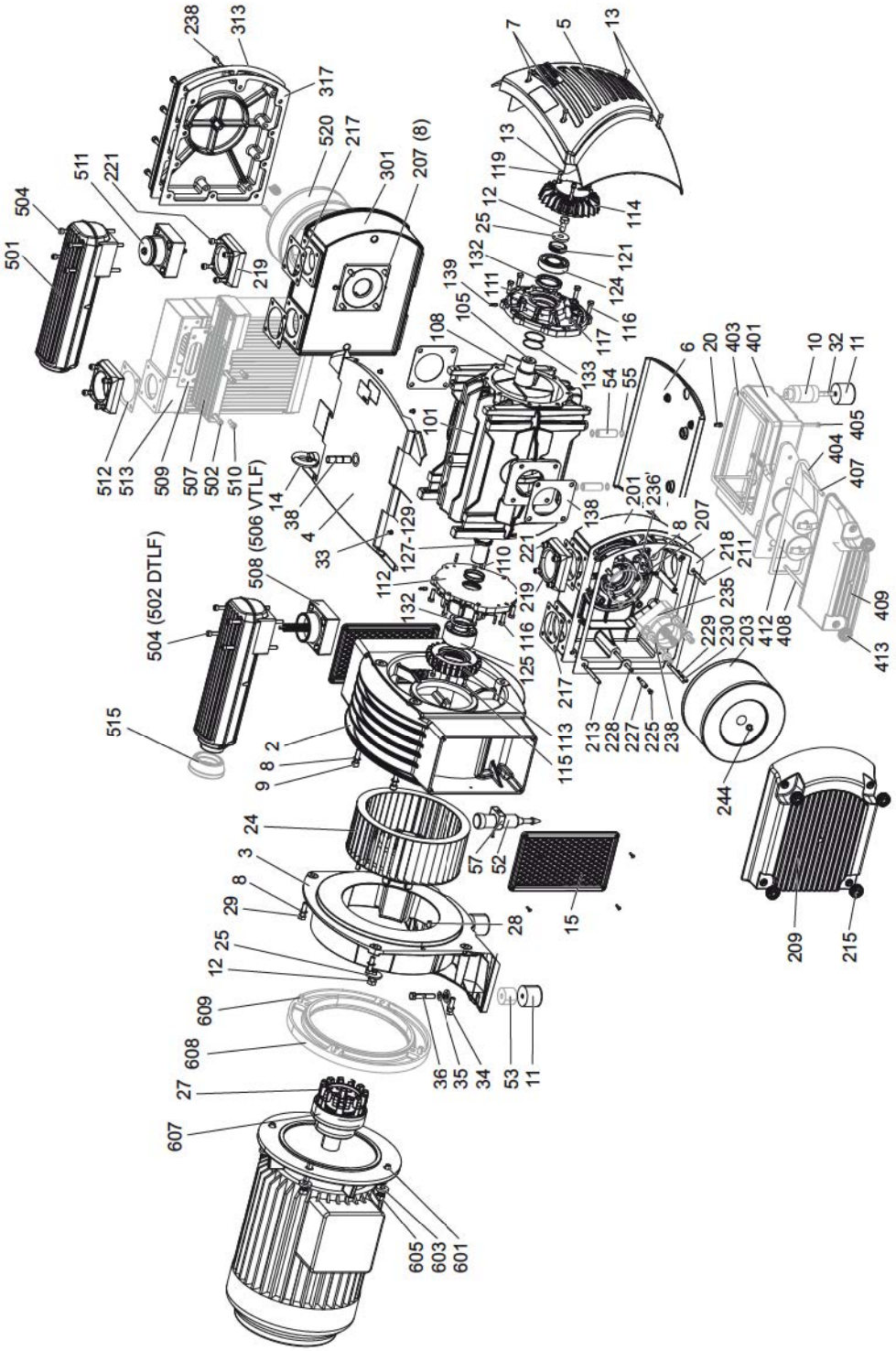
6.6.3 Pump Bearings

Grease vacuum pump roller bearings after 3,000 hours of operation. Using the grease gun located on the pump, apply 10g of Amblygon TA 15/2 at both of the grease nipples while the vacuum pump is running. Use only Amblygon TA 15/2 grease. Replace with original roller bearings only.



6.0 Maintenance

Figure 6.5: 10 HP Exploded View



6.0 Maintenance

6.7 General Inspections

6.7.1 Exhaust Drip Leg Valve

Each pump should have a drip leg installed by the factory or 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.

6.7.2 Monthly Inspections

A general inspection should be performed on a regular basis (monthly) for safety items. Items to inspect include all wiring, flex hoses, and other items. If a damaged item is viewed, call your local **BeaconMedæs** service technician for a thorough inspection and report of findings.

6.7.3 Every Six Months

A thorough inspection of the vacuum pump cooling air intake and discharge grating should be performed at least every six months or more frequently if conditions require. If a dust/dirt buildup is visible, clean the grating to remove the buildup. Excess dust/dirt buildup in these areas will prevent air from cooling the vacuum pump, affecting peformance of the vacuum system.

7.0 Replacement / Maintenance Parts

Service Kits for "Oil-Less" Rotary Vane Medical Systems

KIT NUMBER	DESCRIPTION	QTY	WHERE USED	CONTENTS
1-Year Basic Service Kit				
4107 4017 37	Inlet Filter Kit Size A & B	1 per pump	1.5 - 2 Hp	(1) Inlet Filter Element
4107 4017 38	Inlet Filter Kit Size C	1 per pump	3 Hp	(1) Inlet Filter Element
4107 4017 39	Inlet Filter Kit Size D	1 per pump	5 Hp	(2) Inlet Filter Elements
4107 4017 40	Inlet Filter Kit Size E	1 per pump	7.5 Hp	(3) Inlet Filter Elements
4107 4017 41	Inlet Filter Kit Size F	1 per pump	10 Hp	(1) Inlet Filter Element
1-Year Vane Replacement Kit				
4107 4017 42	Vane Replacement Kit - Size A	1 per pump	1.5 Hp	(1) Set of Carbon Vanes (1) Gasket
4107 4017 43	Vane Replacement Kit - Size B	1 per pump	2 Hp	(1) Set of Carbon Vanes (1) Gasket
4107 4017 44	Vane Replacement Kit - Size C	1 per pump	3 Hp	(1) Set of Carbon Vanes (1) Gasket
4107 4017 45	Vane Replacement Kit - Size D	1 per pump	5 Hp	(1) Set of Carbon Vanes (1) Gasket
4107 4017 46	Vane Replacement Kit - Size E	1 per pump	7.5 Hp	(1) Set of Carbon Vanes (1) Gasket (1) Roller Bearing Grease
4107 4017 47	Vane Replacement Kit - Size F	1 per pump	10 Hp	(1) Set of Carbon Vanes (1) Gasket (1) Roller Bearing Grease

8.0 Maintenance Record

Model Number _____

Serial Number _____

Installation Date _____

Date of Service								
Hours								
Load								
Ambient Temp.								
Vacuum Level								
Inlet Filters								
Vanes								
Pump Bearings								
Motor Bearings								
Coupling Inserts								
Relief Valves								
Misc.								
Serviced By								

Appendix A: TotalAlert Embedded Control System

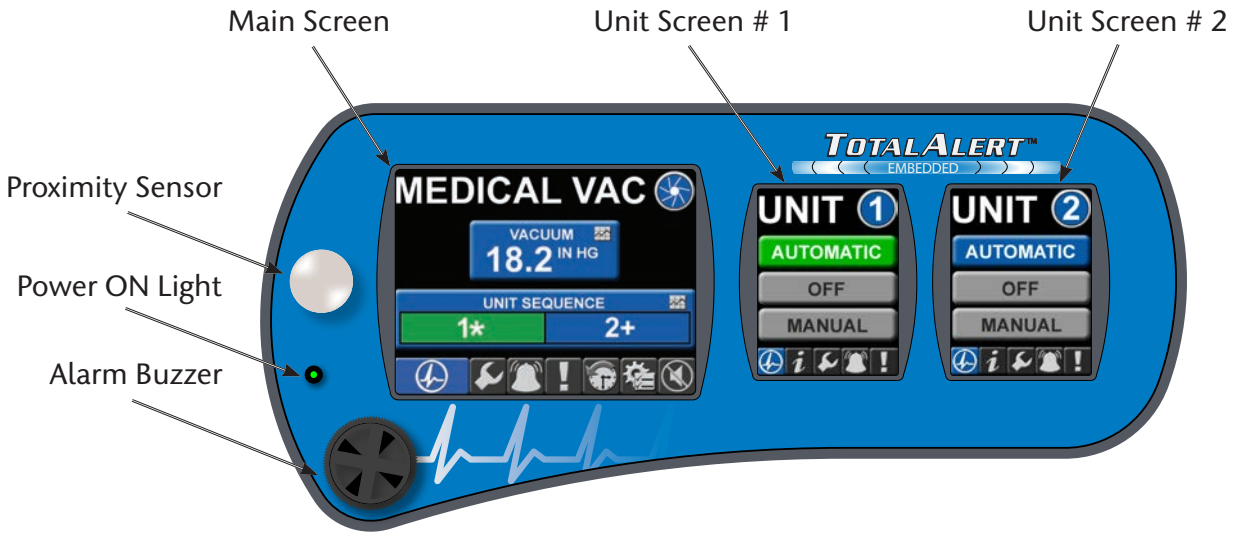
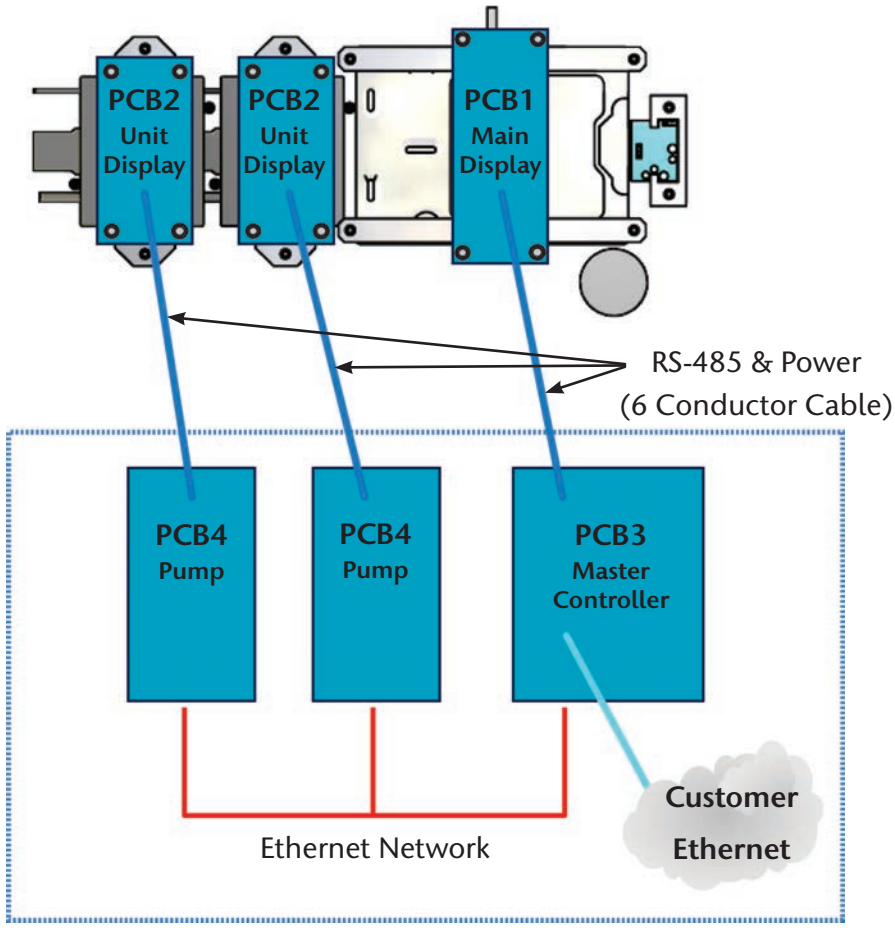


Figure A.1 Touchscreen Controls



PCB3 & PCB4 Mounted on Back Panel

Figure A.2 Duplex Medical Vacuum Configuration - Printed Circuit Boards

Appendix A: TotalAlert Embedded Control System

A.1 Board Configurations

The source control system is comprised of four (4) different printed circuit boards (PCBs) with interconnecting wiring (RS-485 or Ethernet) for internal communications between the boards. See Figure A.2.

1. PCB1: Display Board for 5.7" Touch Screen Display
2. PCB2: Display Board for 3.5" Touch Screen Display
3. PCB3: Master Source Controller Board
4. PCB4: Pump Controller Board

In a standard medical vacuum duplex system, the PCB configuration consists of the following quantities and types of boards:

- PCB1 – (1) One for the Main 5.7" display
- PCB2 – (2) One for each of the Unit 3.5" displays
- PCB3 – (1) Master Controller
- PCB4 – (2) One for each pump

In a standard medical vacuum quadruplex system, the PCB configuration consists of the following quantities and types of boards:

- PCB1 – (1) One for the Main 5.7" display
- PCB2 – (4) One for each of the Unit 3.5" displays
- PCB3 – (1) Master Controller
- PCB4 – (4) One for each pump

A.2 PCB1 (5.7" Display Controller)

A.2.1 Basic Software Architecture

The primary purpose of PCB1 is to drive the LCD display for the 5.7" Master screen. Its other functions include the following:

1. Communicate to the Master Controller Board (PCB3) via a RS-485 bus to relay commands from the touch screen interface and display messages from the master controller.
2. Interface to the 5.7" Display touch screen to interpret the user interaction.
3. Drive the 24VDC local alarm horn when signaled by the master controller via the RS-485 bus.
4. Read the input from the motion detector at the front panel and relay the status to the master controller so it can distribute the information to the other pump controllers and then to their corresponding 3.5" display boards (PCB2).
5. Accept new firmware via the Ethernet jack when connected to a PC configured with genuine **BeaconMedæs** software for reprogramming.

Appendix A: TotalAlert Embedded Control System

A.2.2 5.7" User Interface for Source Systems

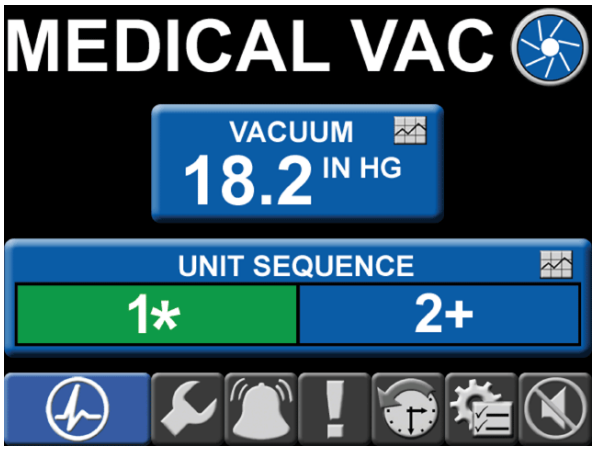


Figure A.3 Main Screen

The primary master screen user interface is displayed on a 5.7" 640 x 480 pixel display as shown in Figure A.3. The interface is designed such that any information can be accessed with a minimal amount of touches by the user.

The 5.7" screen is divided into two main areas – the top portion above the toolbar which changes depending on the icon selected on the toolbar and bottom portion which contains the toolbar (Figure A.4) and is available on most screens.

Figure A.4 5.7" Screen Toolbar

From left to right, the toolbar icons represent the following:

Main Screen (default)

Service

Alarms (no Shutdown)

Shutdown

Event History Log

System Configuration Settings

Horn Silence

A.2.3 5.7" Boot/Communication Screen

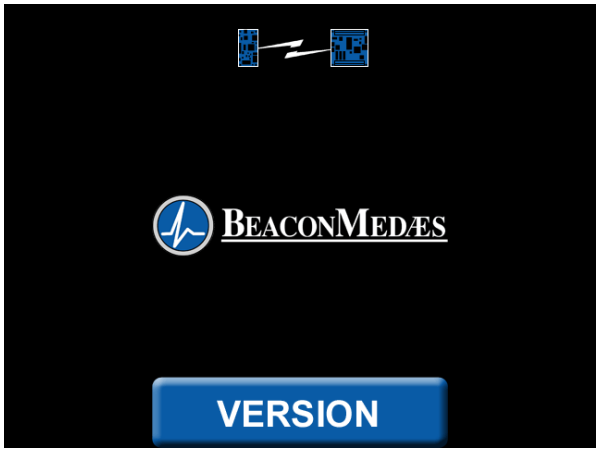


Figure A.5 Boot/Communication Screen

The boot/communication screen (Figure A.5) shows at boot time and will change to the default main screen once communication and compatibility are confirmed:

- If a RS-485 link failure is detected the link icon at the top of the screen will appear and the bottom version button will appear to allow the user to check display board (PCB1) version information.
- If the connecting board is incompatible with the display board (for example, board not properly connected), only the bottom version button will appear with a red button background.

Appendix A: TotalAlert Embedded Control System

A.2.4 5.7" Main Screen

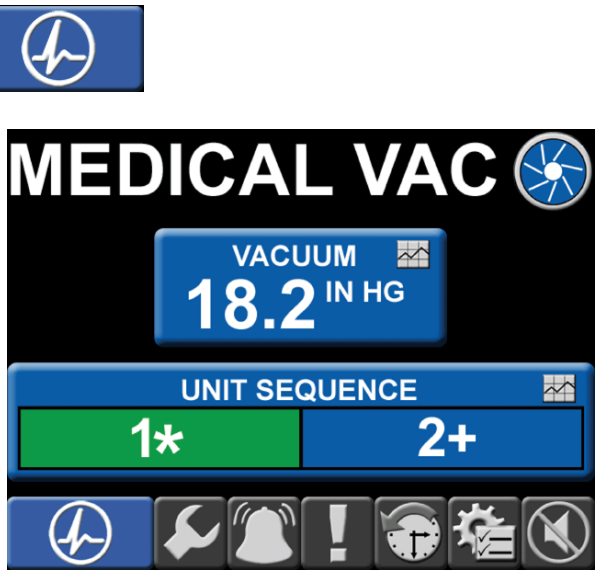


Figure A.6 Main Screen

The main (default) screen (Figure A.6) shows the pertinent system measurements as well as unit sequence information.

The pertinent system measurements include Vacuum Level. Pressing pertinent system data buttons shows Trend information for that value.

Unit Sequence information shows all system units.

- If the unit is running, that color bar shows green and the adjoining symbol shows "*" for across the line (full speed).
- If a unit is available and not running, that color bar shows blue and the adjoining symbol shows "+" if that unit is next to start.
- If a unit is stopped, that color bar shows red and the adjoining symbol shows "!" if stopped for a shutdown.
- If the unit is unavailable and not running, that color bar shows dark grey and the adjoining symbol shows "X".
- If a unit is unavailable because it is in Manual mode and it is running, that color bar shows green and the adjoining symbol shows "X".
- If the unit is unavailable because the unit is an expandable unit, that color bar shows dark grey and the adjoining symbol shows "E".
- If the unit is unavailable because the unit cannot be reached via ethernet, that color bar shows dark grey and the adjoining symbol shows "?".

A.2.5 5.7" Trend Screen

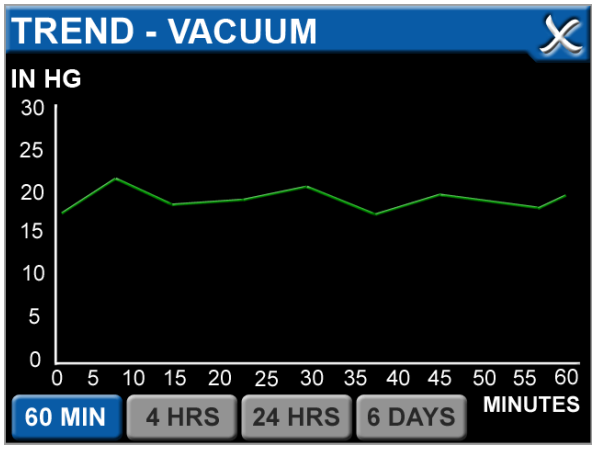


Figure A.7 Trend Screen

The trend screen (Figure A.7) shows the measured value over a specific time period:

- The default time period when opening the window is the last 60 minutes. For a given period, the maximum amount of data stored will only be for the most recent time period and the older data will be removed from view and memory.
- Another time period is selected by pressing the buttons at the bottom of the window. These periods are 60 minutes (240 data points – 0.25 min resolution), 4 hours (240 data points – 1 min resolution), 24 hours (240 data points – 6 min resolution) and 6 days (240 data points – 0.6 hour resolution).

Appendix A: TotalAlert Embedded Control System

A.2.6 5.7" Service Screen

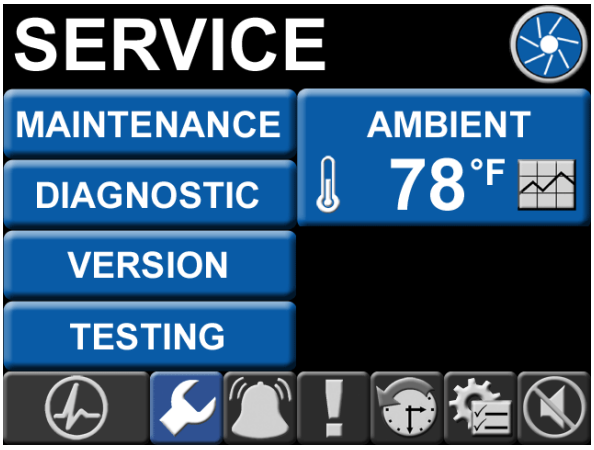
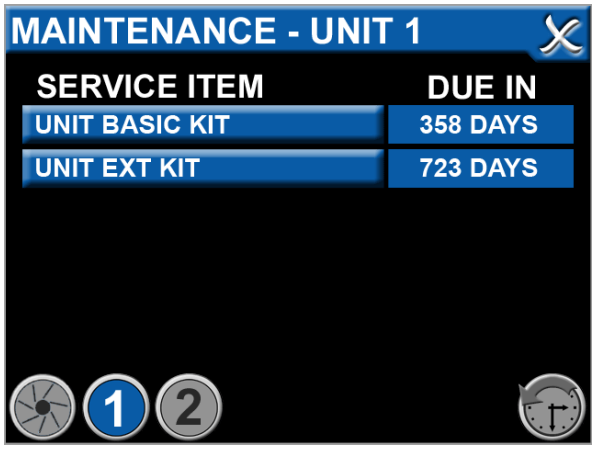


Figure A.8 Service Screen

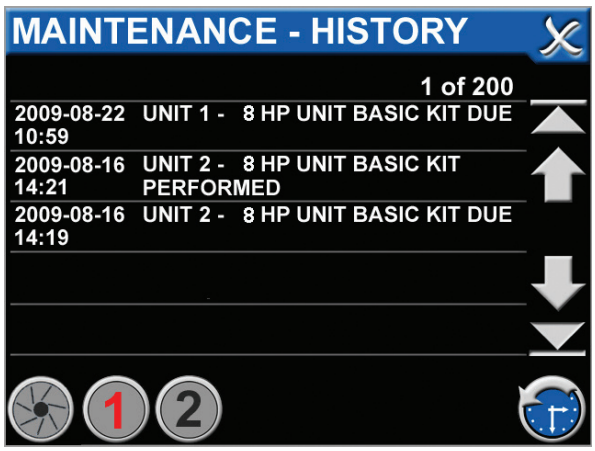
The service screen (Figure A.8) allows the selection of various sub screens along with the current ambient temperature at the system:

- Maintenance – Additional multiple screens depicting suggested and required maintenance items with resettable timers. When maintenance is due, both the maintenance button and the service icon on the tool bar turn red instead of blue.
- Diagnostic - Depicts the I/O status of the connecting unit controller board. For example, the digital inputs (X1-X7 as 0 or 1), the analog readings (T1-T2, I1-I4, P1-P2 and V1-V2 with A/D values), the 24VDC powered digital outputs (Z1-Z2 as 0 or 1) and the dry contacts (Y1-Y12 as 0 or 1).
- Version – Displays the RS-485 communication version, firmware versions for the 5.7 display board and the connecting controller board.
- Testing – Allows for test mode of all alarm events. See Section A.5 for more information.
- Ambient – Current ambient temperature. When the button is pressed, the trend information is available for this temperature.

A.2.7 5.7" Maintenance Screen



Unit Maintenance Screen



Maintenance History Screen

Figure A.9 Maintenance Screens

The maintenance screens (Figure A.9) are accessed via the service screen:

- Additional multiple screens depicting suggested and required maintenance items with resettable timers. If an item is past due the button color changes from blue to red if the item is a required maintenance versus a suggested maintenance.

Appendix A: TotalAlert Embedded Control System

- The first (default) screen shows as the System maintenance. Items that are suggested are shown as a grey button and indicators are not visible or flagged for these items. When the user resets the timer, the action is logged in the service history.

- Other screens (Unit and History) are accessed by pressing the bottom round icons. Note that only unit icons are shown if the unit is physically installed and not an expansion unit.

A.2.8 5.7" Alarms Screen

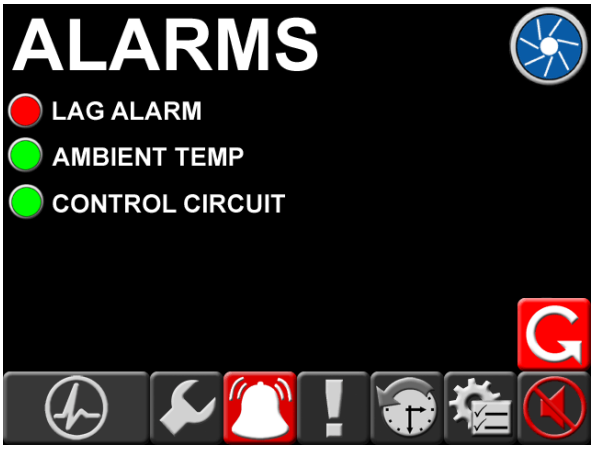


Figure A.10 Alarms Screen

The alarms screen (Figure A.10) shows all of the system alarm information. An alarm is classified as an event of significance that does not shut the system down. These alarms are latched and are not cleared until a user presses the reset button on the alarms screen. This reset button will reset all alarms for that given system.

- Green alarm condition indicates a normal status for that condition.

- Red alarm condition indicates an abnormal status for that condition.

- The horn silence button at the bottom right will show Red if the horn is on and not reset yet. Once the horn is silenced, the button will return back to the gray condition.

A.2.9 5.7" Shutdown Screen

Figure A.11 Shutdown Screen

The shutdown screen (Figure A.11) shows the unit shutdown event information. A shutdown is classified as an event of significance that shuts the unit down. Shutdown events are latched and are not cleared until the condition is corrected and a user presses the reset button on the unit shutdown screen. See Section A.3.9 for details. Unit "X" shutdown events are latched at the individual unit screen and reset at that screen.

- Green shutdown condition indicates a normal status for that condition.

- Red alarm shutdown indicates an abnormal status for that condition.

CAUTION: After a Shutdown condition is corrected and reset, the unit needs to be placed back in Automatic on the Unit main screen for the pump to resume normal operation.

Appendix A: TotalAlert Embedded Control System

A.2.10 5.7" History Screen

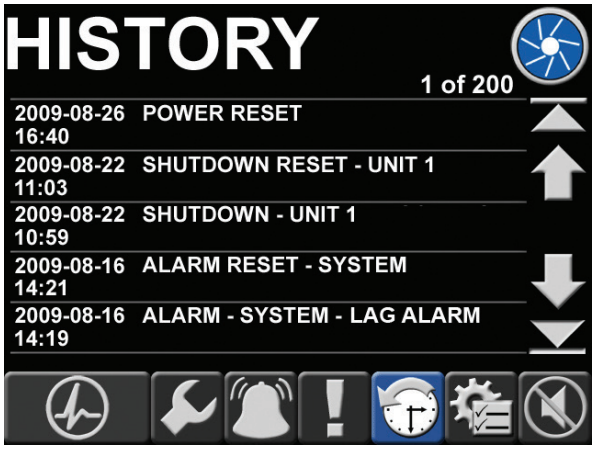


Figure A.12 History Screen

The history screen (Figure A.12) shows all of the system event history excluding service maintenance history.

- Most recent events are shown on the first (default) page and are shown in descending date/time order. Located at the top right are the page number and the total number of pages . The maximum number of pages is 200 (1000 events divided by 5 events per page).
- Page up and Page down arrows change the view 5 events up or down at a time and are only visible if subsequent event information is available. The Home button changes the view to the top or most recent events and the End button changes to the bottom or the oldest events.
- A maximum of 1000 most recent events are stored for the system.

A.2.11 5.7" Settings Screen

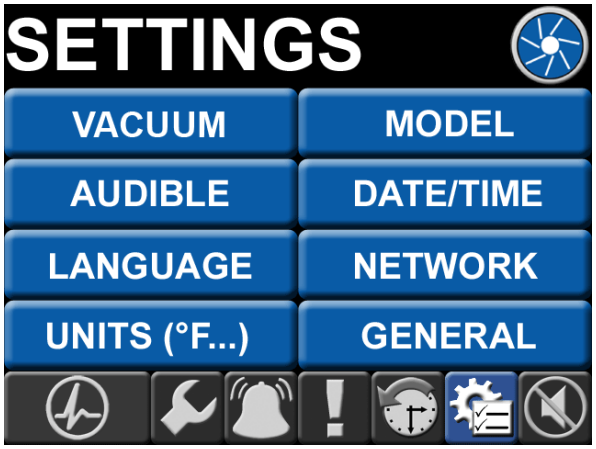


Figure A.13 Settings Screen

The settings screen (Figure A.13) allows the selection of various sub screens that pertain to system configuration data. All value/adjustment changes are password protected.

- Vacuum – Allows the adjustment of system vacuum operating range.
- Audible – Allows the horn to re-initiate if an alarm or shutdown event has not cleared, but the horn was silenced. The allowable values for re-initiate time are never, 15 min, 30 min, 1 hour, 8 hours, and 24 hours.
- Language – Allows the choice of pre-defined display language.
- Units – Allows the display units to be displayed and changed.
- Model – Displays the pertinent system model information.
- Date/Time – Allows the date/time to be displayed and changed.
- Network – Allows the network (IP address, etc) to be displayed and changed.
- General – Allows the miscellaneous general information to be displayed and changed.

Appendix A: TotalAlert Embedded Control System

A.3 PCB2 (3.5" Display Controller)

A.3.1 Basic Software Architecture

The primary purpose of PCB2 is to drive the LCD display for the 3.5" Unit screen. Its other functions include the following.

1. Communicate to the Pump Controller Board (PCB4) via a RS-485 bus to relay commands from the touch screen interface and display messages from the pump controller.

2. Interface to the 3.5" Display touch screen to interpret the user interaction.

3. Accept new firmware via the Ethernet jack when connected to a PC configured with genuine BeaconMedaes software for reprogramming.

A.3.2 3.5" User Interface for Source Systems

Figure A.14 Unit Screen

The primary unit screen user interface (Figure A.14) is displayed on a 3.5" 240 x 320 pixel display. The interface is designed such that any information can be accessed with a minimal amount of touches by the user.

The 3.5" screen is divided into two main areas – the top portion above the toolbar which changes depending on the icon selected on the toolbar and bottom portion which contains the toolbar (Figure A.15) and is visible on most screens.

Figure A.15 3.5" Screen Toolbar

From left to right, the toolbar icons represent the following:


Main Screen (default)


Status/Information (Hourmeter)


Service


Alarms (no Shutdown)


Shutdown

A.3.3 3.5" Boot/Communication Screen

Figure A.16 Boot/Communication Screen

The boot/communication screen (Figure A.16) shows at boot time and changes to the default main screen once communication and compatibility are confirmed:

- If a RS-485 link failure is detected the link icon at the top of the screen appears and the version button appears to allow the user to check display board (PCB2) version information.

Appendix A: TotalAlert Embedded Control System

- If the connecting board is incompatible with the display board (for example, the boards are not properly connected), only the bottom version button appears with a red button background.

A.3.4 3.5" Main Screen

Figure A.17 3.5" Main Screen

The main (default) screen (Figure A.17) shows the operation mode of the unit along with its automatic versus manual mode setting:

- Automatic (Blue = Standby, Grey = Unselected, Green = Unit Running)
- Off (Red = Selected, Grey = Unselected)
- Manual (Blue = Standby – Backup Vacuum Switch is not closed, Grey = Unselected, Green = Unit Running)

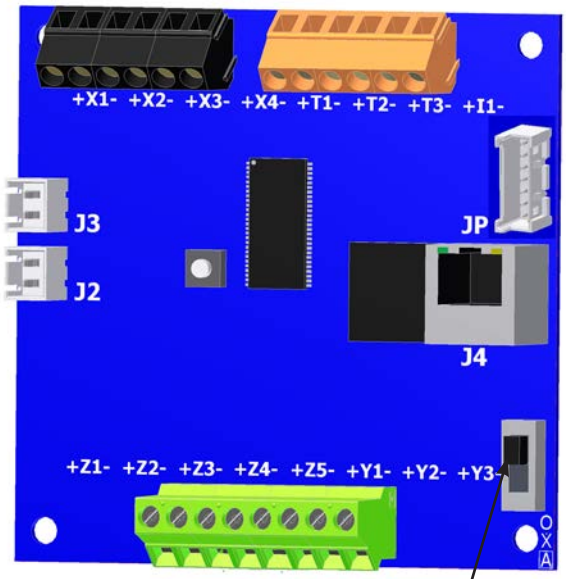
A.3.5 3.5" Main Screen: Manual Override

During the system startup, the manual override, located on the printed circuit board (PCB4), switch is utilized to ensure the pump is in the Off position. The manual override switch on PCB4 is a safety measure as well, for emergency situations to ensure the pump unit produces medical vacuum.

In the event of an emergency and the control system is not operating effectively, the manual override switch can be moved from the Automatic position to the Manual position. See Figure A.18. Moving to this position forces the pump to operate against the backup vacuum switch, starting and stopping according to the switch settings.

Appendix A: TotalAlert Embedded Control System

3.5" Unit screen with Manual Override selected



Manual Override Switch

O - On Manual

X - Off

A - Automatic

PCB4 with Manual Override switch On

Figure A.18 Manual Override

If the switch is in Manual or Off postion on PCB4, the touchscreen controls no longer control the vacuum pump. Moving the switch back to the Automatic position puts the unit under the control of the TotalAlert Embedded control system.

CAUTION: The "Manual Override" mode of operation should only be used for emergencies such as a loss of unit display board or loss of display touchscreen and should not be used for normal operation.

A.3.6 3.5" Status Screen

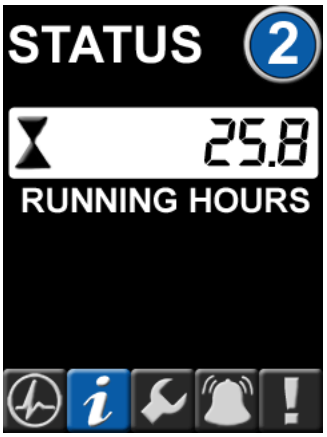


Figure A.19 3.5" Status Screen

The status screen (Figure A.19) shows the running hour meter values.

Appendix A: TotalAlert Embedded Control System

A.3.7 3.5" Service Screen

Figure A.20 3.5" Service Screen

The service screen (Figure A.20) allows access to the unit "jog" feature, diagnostic screen and version screen:

- Rotation – Allows the unit to run for a short period to check rotation. When pressed, the unit will either begin the "jog" sequence or show a screen instructing you to place the unit in "OFF" mode first (the unit must be in "OFF" mode before it can check rotation). When "jog" mode is started, the unit will first delay for 5 seconds to allow the user to get in position to check the rotation, then run the unit for a brief period.
- Diagnostic – Depicts the I/O status of the connecting unit controller board. For example, the digital inputs (X1-X4 as 0 or 1), the analog readings (T1-T3 and I1 with A/D values), the 24VDC powered digital outputs (Z1-Z5 as 0 or 1) and the dry contacts (Y1-Y3 as 0 or 1).
- Version – Displays the RS485 communication version, the firmware versions for the 3.5 display board and the connecting controller board.
- Testing – Allows for test mode of all shutdown events. See Section A.5 for more information.

A.3.8 3.5" Alarms Screen

Figure A.21 3.5" Alarms Screen

The alarms screen (Figure A.21) shows all of the unit alarm information. An alarm is classified as an event of significance that does not shut the unit down. These alarms are latched and are not cleared until a user presses the reset button on the alarms screen. This reset button will reset all alarms for that given unit.

- Green alarm condition indicates a normal status for that condition.
- Red alarm condition indicates an abnormal status for that condition.

Appendix A: TotalAlert Embedded Control System

A.3.9 3.5" Shutdown Screen

Figure A.22 3.5" Shutdown Screen

The shutdown screen (Figure A.22) shows all of the unit shutdown event information. A shutdown is classified as an event of significance that shuts the unit down. These shutdown events are latched and are not cleared until a user presses the reset button on the shutdown screen. This reset button will reset all shutdown events for that given unit.

CAUTION: The unit will need to be placed back in Automatic for the pump to resume normal operation.

- Green shutdown condition indicates a normal status for that condition.
- Red alarm shutdown indicates an abnormal status for that condition.

A.4 Password Access

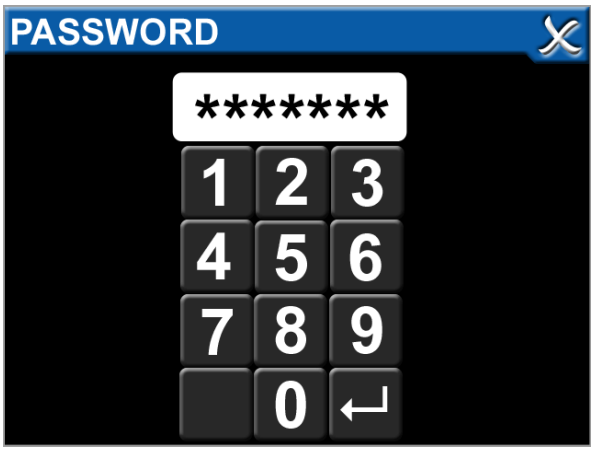


Figure A.23 Password Screen

The TotalAlert Embedded control system contains items that can be changed or adjusted. Before making any changes on the system or unit screens, a password prompt appears. A proper password must be entered before adjusting the control system. See Figure A.23.

The password for the Oil-less Rotary Vane Medical Vacuum System is "121212". After entering the password, the password remains valid for approximately ten minutes or until the unit resets itself to the default display screens. Reentering the password after "timing out" allows the user to continue making system adjustments.

A.4.1 Main Screen Password Items

On the 5.7" main screen, several screens allow adjustments with the proper password.

- Maintenance - Resetting a Service Activity: A service notification activates when a service item is past due. Upon completion of the past due service activity, reset the service due counter by pressing the item on the service screen, selecting reset, and entering the password when prompted.

Appendix A: TotalAlert Embedded Control System

- Maintenance - Testing the System Alarms: The Testing button allows the operator to create an Alarm or Shutdown condition to test the complete alarm network. See section A.5 for additional information.

- Settings - Pressure: Adjust system "Max" and "Min" operating pressure settings within a factory-set range of pressures.

- Settings - Horn: An option is available to reinitiate the horn during an alarm/shutdown event. The operator can elect to have the horn reinitiate after a set period of time after the silencing of the horn.

- Settings - Language: The operator can select from the language options available on the system.

- Settings - Display Units: The operator can select preferences for the display of pressure, dew point, and other temperatures.

- Settings - Date and Time: Ensure the correct date and time for the system, as this impacts history log reporting.

- Settings - Network Configuration: Configure how the system operates remotely within the existing facility network.

- Settings - General Options: Select method for displaying alarms/shutdowns. Operator can change the timer setting for sleep mode on the screens.

A.4.2 Unit Screen Password Items

In the Service section of the Unit screens, the operator can create alarm or shutdown conditions to test the complete alarm network. See section A.5 for additional information.

A.5 Testing Alarms

In the Service section of the Main screen and Unit screens, the operator is able to test each alarm and shutdown event. When an alarm/shutdown event is selected to test, the actual alarm/shutdown is latched. At this point, the system responds as if an actual alarm/shutdown has occured.

CAUTION: If testing a shutdown event, the pump being tested will shut down. Notify the appropriate hospital personnel **BEFORE** testing any alarms.

For an alarm/shutdown event, the following will occur (in addition to the pump shutting down for a shutdown event):

- The horn will initiate.

- All appropriate control screens will show the alarm/shutdown condition.

- An alarm/shutdown signal will be sent to the Master alarms.

- The operator must respond and reset the alarm/shutdown signal by pressing the "reset" button on the appropriate main screen or unit screen.

- A History item will be created that shows the "Test" alarm/shutdown event and a subsequent event for the correction of the "Test" item.

- If testing a Shutdown condition, the operator must restart the pump by pressing Automatic on the Unit screen.

CAUTION: When testing a Shutdown condition, the pump shuts down and must be restarted after the test. Press Automatic on the Unit main screen.

Appendix A: TotalAlert Embedded Control System

A.6 Maintenance

A.6.1 Maintenance Screens

The TotalAlert Embedded touchscreen displays all of the necessary information to plan service activities and order the correct service kits to perform the maintenance.

To view the service schedule, press the Service icon on the 5.7" main screen (Figure A.8), then select Maintenance from the list of headings.

When the Lube Vane icon located in the bottom left is blue or red, this indicates that the service items and service due times pertain to the general medical vacuum system (Figure A.9). By selecting the numbers next to the Lube Vane icon in the bottom left, the service activities for the individual units (pumps) are displayed.

To see details on an individual service activity, press that service on the touchscreen and details of the activity appear, with a description of the service kit required to perform the service.

A.6.2 Maintenance Alerts

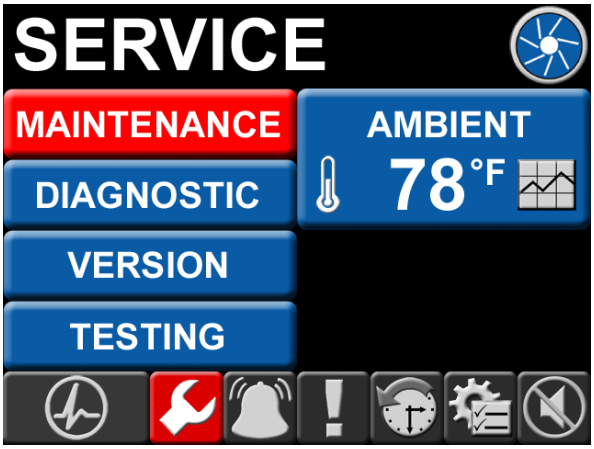


Figure A.24 Maintenance Alert

When a maintenance activity is due, a notification appears on the main 5.7" screen (Figure A.24). The Service icon appears in Red. There is not an audible horn activated to alert to the service activity, just the colored icon.

To view the alert, press the Service icon on the toolbar, then select the Maintenance choice from the menu. This is highlighted in Red.

Within the Maintenance screen, if one of the Service Items on the list appears in red, the overdue Service Activity is a System maintenance item. If one of the Unit numbers in the bottom right corner appears in red, the overdue service activity is related to the particular unit. Press the Unit number to move to the service screen for that unit to find the overdue activity.

By selecting the activity that is overdue (in red), the detail screen appears for that service item and provides the necessary information for the service activity: part number, description.

A history is available for all maintenance due alerts and maintenance performed by pressing the "History" icon (clock) located in the lower right hand corner of the Maintenance screen. See Figure A.9.

A.6.3 Resetting a Service Activity

Figure A.25 Resetting a Service Activity

Appendix A: TotalAlert Embedded Control System

After a service activity is performed, to reset the schedule, do the following:

- Select the service activity on the touchscreen (Figure A.25).
- Press the Reset button.
- Enter the password (as explained in Section A.4).

A.7 Remote Monitoring

CAUTION: The information systems personnel should be notified before changing any of the network settings. Changing the settings could keep the equipment from working properly.

A.7.1 Set Up: Equipment Required

- PC with an Ethernet connection
- PC with a web browser, such as Microsoft Internet Explorer
- Cat5 or better Ethernet cable

A.7.2 Set Up: Physical Connection

WARNING:

ONLY CONNECT THE CUSTOMER NETWORK TO THE CUSTOMER ETHERNET CONNECTION AS SHOWN IN FIGURE A.26.

DO NOT UNPLUG EXISTING ETHERNET CABLES USED FOR THE INTERNAL CONNECTIONS. DO NOT ATTEMPT TO REMOVE ETHERNET SECURITY PROTECTORS TO USE FOR CUSTOMER ETHERNET CONNECTION.

IF THE CUSTOMER ETHERNET IS PLACED IN AN INTERNAL ETHERNET CONNECTION, THE INTERNAL ETHERNET FUNCTIONALITY WILL NOT PERFORM AS DESIGNED.

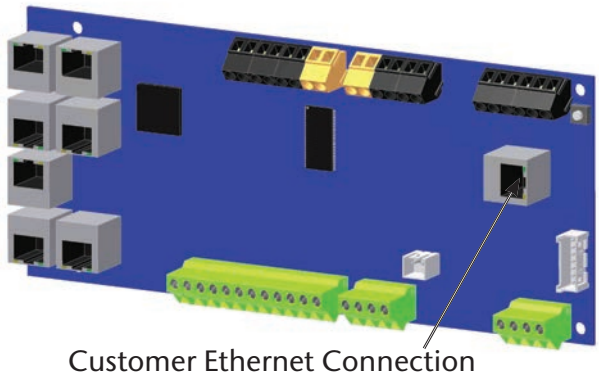
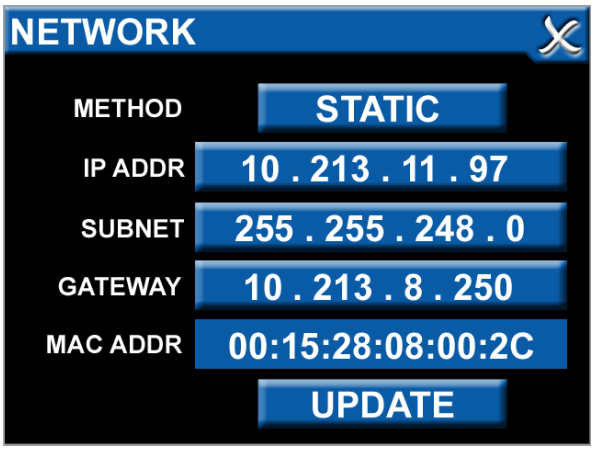


Figure A.26 Connecting the cable

1. Using a Cat5 Ethernet cable, connect the medical vacuum system to an Ethernet switch or hub. Connect the cable to the Customer Ethernet Connection (Figure A.26) on PCB3 Master board.
2. Verify the green LINK LED on the printed circuit board illuminates.

Appendix A: TotalAlert Embedded Control System

A.7.3 Set Up: Network Configuration



(Network screen is found in Settings section from Main toolbar)

Figure A.27 System IP Address

1. **IP Address using DHCP method:** Upon power-up of the system, the device will search for a DHCP server. If a DHCP server is found, IP Address, subnet mask and gateway are automatically obtained. If not found, the device will check for a DHCP server every 30 seconds. When found, the IP Address, subnet mask and gateway are automatically obtained.

2. **IP Address using Static method:** Upon power-up of the system, the device will immediately begin using the fixed IP configuration.

A.7.4 Set Up: Connecting to the Embedded Website of the Vacuum System

1. Start a web browser such as Microsoft Internet Explorer.

2. Enter the system's IP address in the browser's address bar.

Example: http://10.213.11.97

Note: To learn the IP address of the vacuum system, go to the 5.7" main touchscreen, press the Settings icon, press Network from the listing and the IP address will appear in the second line underneath the method. See Figure A.27.

Appendix A: TotalAlert Embedded Control System

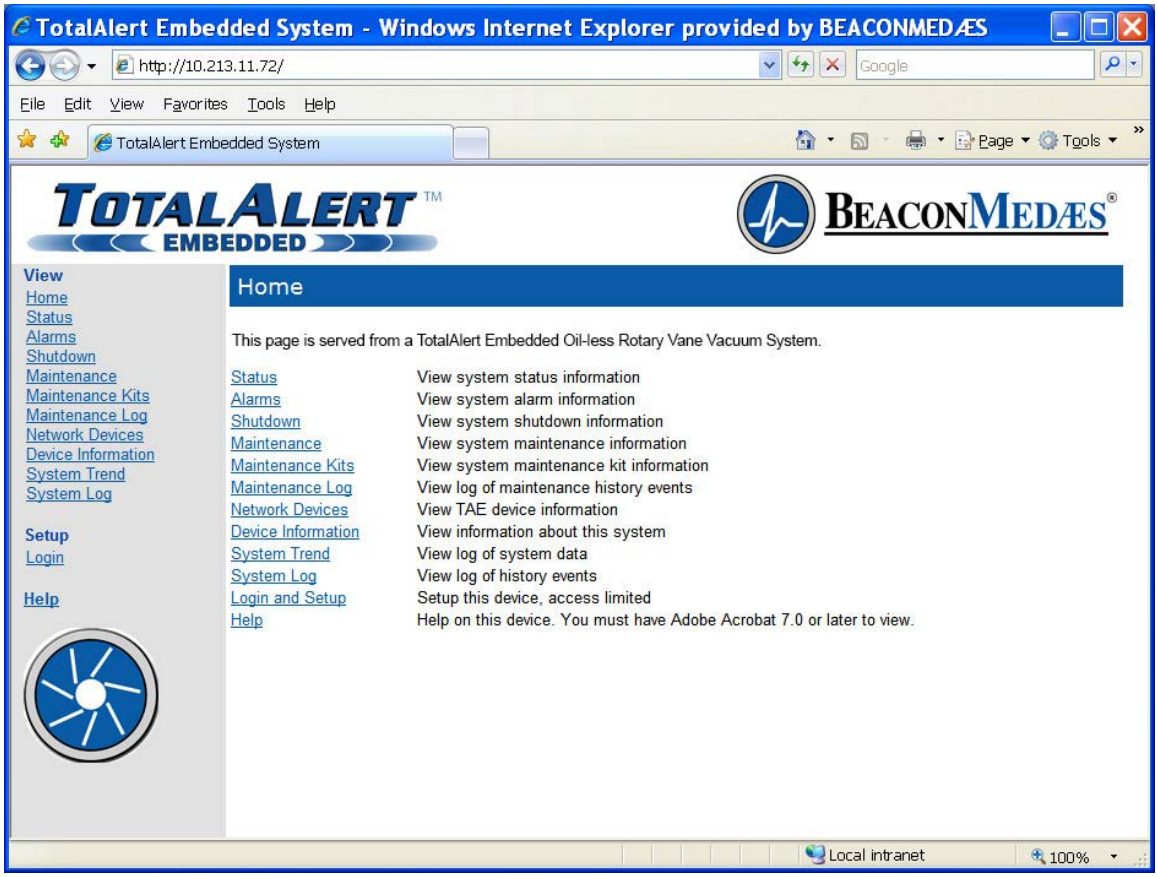


Figure A.28 Typical Medical Vacuum System home page

A.7.5 Login to Setup Pages

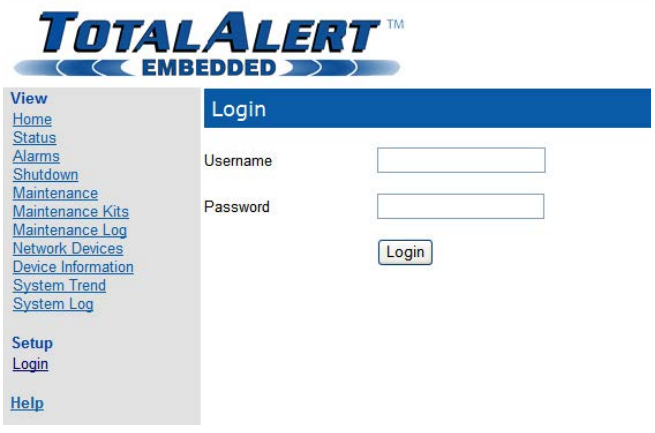


Figure A.29 Login for Setup Pages

1. Once connected to the TotalAlert Embedded control system, your browser will display the typical home page (Figure A.28).

2. Click "Login" on the menu bar in the left pane. The web browser will request a username and password (Figure A.29).

3. The factory defaults are:

   Username: new

   Password: new

4. The left sidebar will now contain the setup links (Figure A.30).

Appendix A: TotalAlert Embedded Control System

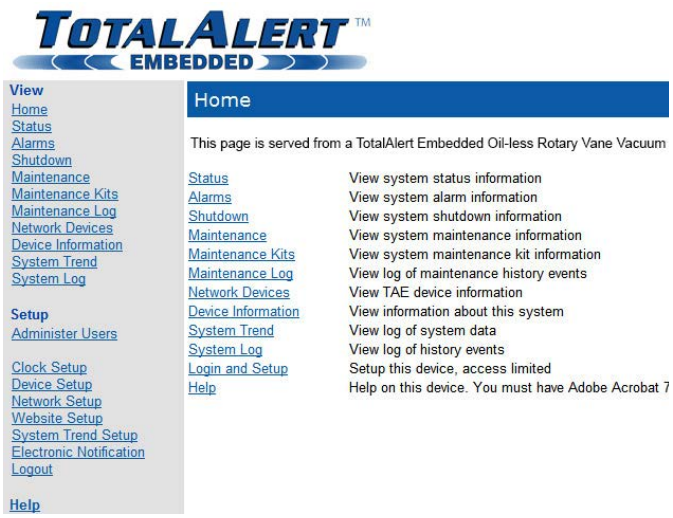


Figure A.30 Setup Menu

A.7.6 Device Setup

This Device Setup page (Figure A.31) is used to configure the medical vacuum system name, location, facility name, and contact information.

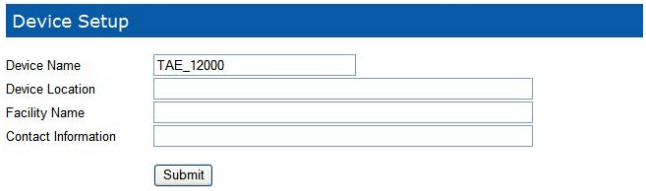


Figure A.31 Device Setup

1. Click Device Setup to access the Device Setup page.
2. Enter the new device name.
3. Enter the location
4. Enter the facility description.
5. Enter the contact information.
6. Click the Submit button.

A.7.7 Network Setup

This Network Setup page (Figure A.32) is used to configure the facility network information and e-mail server configuration.

NOTE: Obtain the IP Address and DNS Name from the facility's Information Systems department.

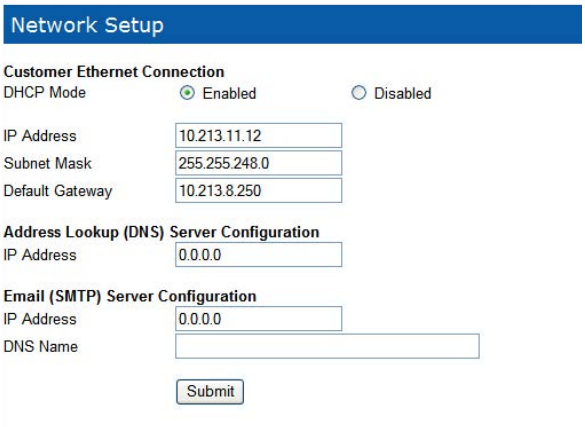


Figure A.32 Network Setup

1. Click Network Setup to access the Network Setup page.
2. Select Enable or Disable for the DHCP Mode.
3. Enter the IP Address for the DNS server configuration.
4. Enter the IP Address and DNS name for the e-mail SMTP server configuration.
5. Click the Submit button.

A.7.8 Website Setup

This Website Setup page (Figure A.33) is used to configure the automatic refresh interval for the website. By selecting an auto-refresh interval, the web page will be refreshed automatically, keeping all information current during a viewing period.

Appendix A: TotalAlert Embedded Control System

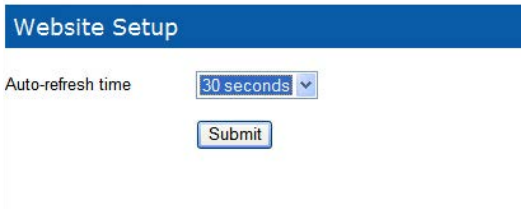


Figure A.33 Website Setup

1. Click Website Setup to access the Website Setup page.

2. Select a time interval from the pull-down list of options.

3. Click the Submit button.

A.7.9 System Trend Setup

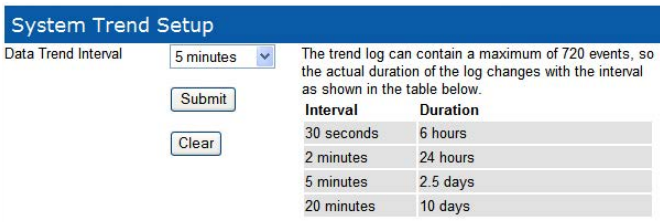


Figure A.34 System Trend Setup

This System Trend Setup page (Figure A.34) is used to configure the trend log for the website and to allow the data to be cleared. The System Trend screen contains a maximum of 720 events for each of the items recorded, so the actual duration of the trend log changes with the time interval selected. The durations available to select are 6 hours, 24 hours, 2.5 days, and 10 days.

1. Click System Trend Setup to access the System Trend Setup page.

2. Select a time interval from the pull-down list of options.

3. Click the Submit button.

A.7.10 Electronic Notification Setup

This Electronic Notification Setup page (Figure A.35) is used to configure the Electronic Notification feature of the TotalAlert Embedded control system. By setting up the Electronic Notification, key personnel can receive notifications of all alarm/shutdown alerts and/or all maintenance alerts (e-mail, pager, phone text message). The device acts as an SMTP client. An SMTP server is required for electronic notification to function.

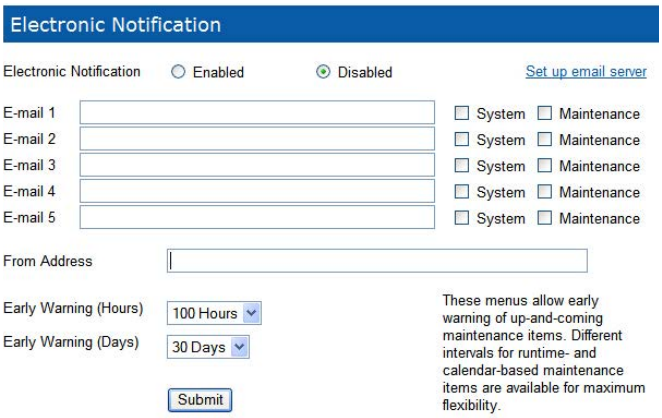


Figure A.35 Electronic Notification Setup

1. Click Electronic Notification Setup to access the Electronic Notification Setup page.

2. Select Enable to enable the e-mail notification tool.

3. Enter up to five email addresses.

4. For each address, select "System" for that person to receive all alarm/shutdown alerts. Select "Maintenance" for that person to receive all maintenance alerts. An individual may receive both types of alerts.

5. Enter an email address in the "From" box as this will be the sender of the notifications.

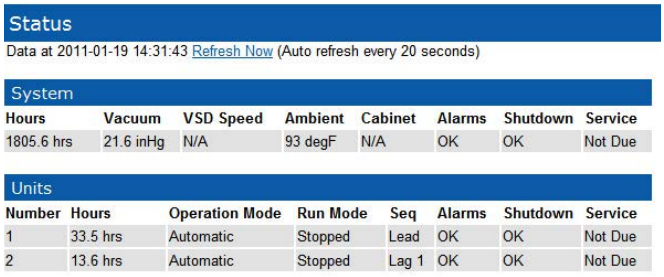
Appendix A: TotalAlert Embedded Control System

6. If desired, early warning notifications can be set up for maintenance items. By selecting these time intervals, a notification will be sent before the maintenance item is due, providing time for planning the service activity.

7. Click the Submit button.

A.7.11 Navigating the Website

The TotalAlert Embedded website allows the user to easily view the status of all activity pertaining to the medical vacuum system. By clicking the menu items to the left of the screen, a user can view pages displaying accurate and timely information about the system. These pages include:



Status

Data at 2011-01-19 14:31:43 Refresh Now (Auto refresh every 20 seconds)

System

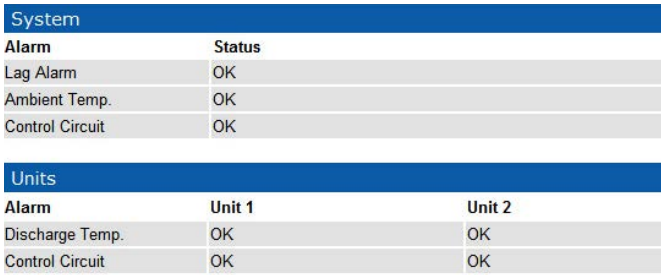
Hours	Vacuum	VSD Speed	Ambient	Cabinet	Alarms	Shutdown	Service
1805.6 hrs	21.6 inHg	N/A	93 degF	N/A	OK	OK	Not Due

Units

Number	Hours	Operation Mode	Run Mode	Seq	Alarms	Shutdown	Service
1	33.5 hrs	Automatic	Stopped	Lead	OK	OK	Not Due
2	13.6 hrs	Automatic	Stopped	Lag 1	OK	OK	Not Due

Figure A.36 Status Page

Status: The Status page (Figure A.36) displays current information for both the overall system (run hours, vacuum level, ambient temperature, alarms, shutdown, and service) and the units (run hours, operation mode, run mode, sequence, alarms, shutdown, and service).



System

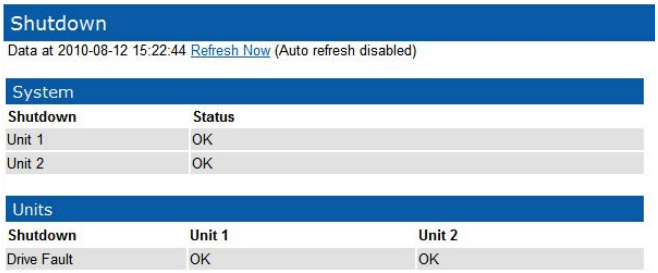
Alarm	Status
Lag Alarm	OK
Ambient Temp.	OK
Control Circuit	OK

Units

Alarm	Unit 1	Unit 2
Discharge Temp.	OK	OK
Control Circuit	OK	OK

Figure A.37 Alarms Page

Alarms: The Alarms page (Figure A.37) displays the current status of all system alarms and alarm status for each unit.



Shutdown

Data at 2010-08-12 15:22:44 Refresh Now (Auto refresh disabled)

System

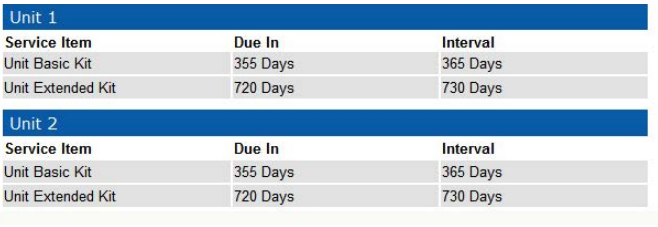
Shutdown	Status
Unit 1	OK
Unit 2	OK

Units

Shutdown	Unit 1	Unit 2
Drive Fault	OK	OK

Figure A.38 Shutdown Page

Shutdown: The Shutdown page (Figure A.38) displays the current status of all system shutdowns and shutdown status for each unit.



Unit 1

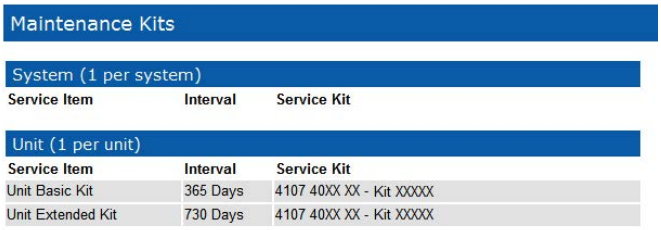
Service Item	Due In	Interval
Unit Basic Kit	355 Days	365 Days
Unit Extended Kit	720 Days	730 Days

Unit 2

Service Item	Due In	Interval
Unit Basic Kit	355 Days	365 Days
Unit Extended Kit	720 Days	730 Days

Figure A.39 Maintenance Page

Maintenance: The Maintenance page (Figure A.39) displays a listing of all service items for both the system and each unit. The display includes the time frame for which the service activity is due and the time interval for each service activity.



Maintenance Kits

System (1 per system)

Service Item	Interval	Service Kit

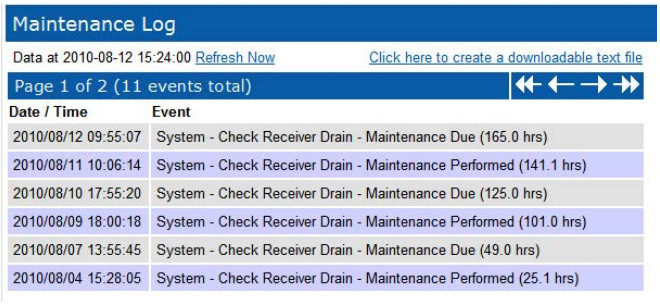
Unit (1 per unit)

Service Item	Interval	Service Kit
Unit Basic Kit	365 Days	4107 40XX XX - Kit XXXXX
Unit Extended Kit	730 Days	4107 40XX XX - Kit XXXXX

Figure A.40 Maintenance Kits Page

Appendix A: TotalAlert Embedded Control System

Maintenance Kits: The Maintenance Kits page (Figure A.40) displays all service kits required to perform the maintenance activities on the Maintenance page. Included on the page are the service item, the time interval for each time, and the part number and description of the service kit required to perform the maintenance function, specific to the medical vacuum system installed.



Maintenance Log

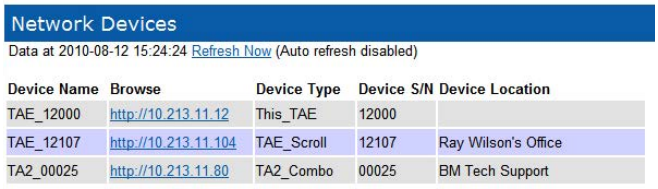
Data at 2010-08-12 15:24:00 Refresh Now Click here to create a downloadable text file

Page 1 of 2 (11 events total)

Date / Time	Event
2010/08/12 09:55:07	System - Check Receiver Drain - Maintenance Due (165.0 hrs)
2010/08/11 10:06:14	System - Check Receiver Drain - Maintenance Performed (141.1 hrs)
2010/08/10 17:55:20	System - Check Receiver Drain - Maintenance Due (125.0 hrs)
2010/08/09 18:00:18	System - Check Receiver Drain - Maintenance Performed (101.0 hrs)
2010/08/07 13:55:45	System - Check Receiver Drain - Maintenance Due (49.0 hrs)
2010/08/04 15:28:05	System - Check Receiver Drain - Maintenance Performed (25.1 hrs)

Figure A.41 Maintenance Log Page

Maintenance Log: The Maintenance Log page (Figure A.41) displays a listing of all maintenance activity for both the system and the units. The log displays the date/time of the event and a description of the event (maintenance due alert, maintenance performed, interval reset). The Maintenance Log page includes the option to create a downloadable text file of the log.



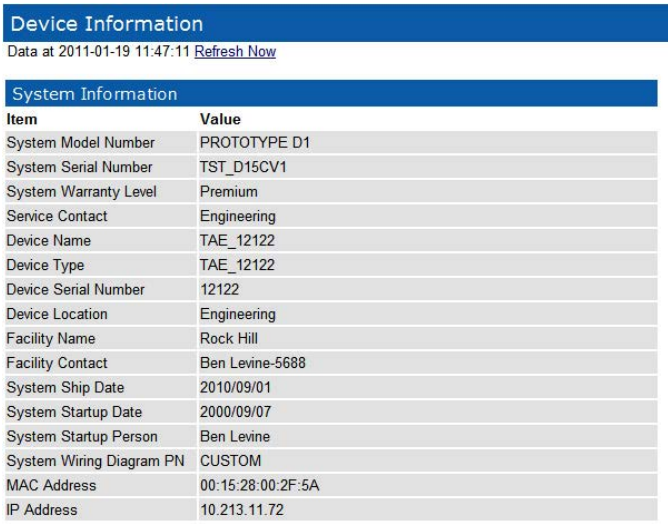
Network Devices

Data at 2010-08-12 15:24:24 Refresh Now (Auto refresh disabled)

Device Name	Browse	Device Type	Device S/N	Device Location
TAE_12000	http://10.213.11.12	This_TAE	12000	
TAE_12107	http://10.213.11.104	TAE_Scroll	12107	Ray Wilson's Office
TA2_00025	http://10.213.11.80	TA2_Combo	00025	BM Tech Support

Figure A.42 Network Devices

Network Devices: The Network Devices page (Figure A.42) displays all TotalAlert and TotalAlert Embedded devices on the facility's network. The page displays the device name, IP address, device type, device serial number, and device location. By clicking the IP address of a device, the user moves to the website of that device.



Device Information

Data at 2011-01-19 11:47:11 Refresh Now

System Information

Item	Value
System Model Number	PROTOTYPE D1
System Serial Number	TST_D15CV1
System Warranty Level	Premium
Service Contact	Engineering
Device Name	TAE_12122
Device Type	TAE_12122
Device Serial Number	12122
Device Location	Engineering
Facility Name	Rock Hill
Facility Contact	Ben Levine-5688
System Ship Date	2010/09/01
System Startup Date	2000/09/07
System Startup Person	Ben Levine
System Wiring Diagram PN	CUSTOM
MAC Address	00:15:28:00:2F:5A
IP Address	10.213.11.72

Figure A.43 Device Information

Device Information: The Device Information page (Figure A.43) displays information specific to the TotalAlert Embedded device. The information displayed includes an array of details pertaining to the system, including model number, serial number, contact information for service, and much more. The Device Information page includes specific information about the printed circuit boards found in the control cabinet (hardware and software descriptions).

Appendix A: TotalAlert Embedded Control System

System Trend

Data at 2011-01-19 11:48:30 Refresh Now | Click here to create a downloadable CSV file

Date / Time	Tank Vacuum (inHg)	Ambient Temp. (Degrees F)
2011/01/19 11:43:58	21.6	98
2011/01/19 11:38:58	21.6	98
2011/01/19 11:33:58	21.6	100
2011/01/19 11:28:58	21.6	104
2011/01/19 11:21:43	21.6	105
2011/01/19 11:14:14	21.6	110
2011/01/19 11:09:09	21.6	115
2011/01/19 10:59:03	21.6	113
2011/01/19 10:54:03	21.6	110
2011/01/19 10:43:36	21.6	107
2011/01/19 10:29:56	21.6	105
2011/01/19 10:24:56	21.6	98
2011/01/19 10:19:56	21.6	97
2011/01/19 10:14:56	21.6	97
2011/01/19 10:09:56	21.6	98
2011/01/19 10:04:56	21.6	97
2011/01/19 09:59:56	21.6	96

Figure A.44 System Trend

System Trend: The System Trend page (Figure A.44) displays multiple items on the system measured at specified time intervals. These items may include vacuum level, pump operation, and ambient temperature. The time intervals may be every 30 seconds, 2 minutes, 5 minutes, or 20 minutes (see section A.7.6 System Trend Setup). The System Trend page includes the option to create a downloadable spreadsheet file of the events. To clear the system trend data, go to the System Trend Setup page on the website (see Section A.7.9).

System Log

Data at 2010-08-12 15:26:45 Refresh Now | Click here to create a downloadable text file

Page 2 of 11 (107 events total)

Date / Time	Event Message
2010/08/11 09:26:12	Alarm - System - Serial Communication Master (18# 76F)
2010/08/11 09:18:33	Alarm - System - Serial Communication Master (18# 76F)
2010/08/09 18:00:09	Alarm Reset - System (18# 76F)
2010/08/09 14:04:40	Network Configuration Successful (18# 76F)
2010/08/09 10:59:58	Alarm - System - Lag Alarm (9# 76F)
2010/08/06 17:25:15	Alarm Reset - Unit 2 (19# 76F)
2010/08/06 17:25:14	Alarm Reset - Unit 1 (19# 76F)
2010/08/06 17:20:01	Power Reset (19# 76F)
2010/08/06 10:05:49	Power Reset (18# 77F)
2010/08/06 10:02:11	Power Reset (19# 77F)

Figure A.45 System Log

System Log: The System Log page (Figure A.45) displays a listing of all alarm and shutdown activity for both the system and the units. The log displays the date/time of the event and a description of the event (alarm/shutdown, reset, test). The System Log page includes the option to create a downloadable text file of the log.

A.7.12 Available for Download

In three of the viewing pages on the website, the user can download information for analysis or record keeping. The Maintenance Log, System Trend, and System Log pages all contain a link for the user to click to create the downloadable file.

1. Click on one of the pages to display the information available for download (Maintenance Log, System Trend, or System Log).

2. Click on the link to create a downloadable file, located in the upper right above the displayed information.

3. Select to view the information on the web page or to save the file to the computer.

The Maintenance Log and the System Log create text files that list all of the events in descending order from most recent to oldest. See Figure A.46.

The System Trend creates a CSV file (spreadsheet) that contains all of the trend information, decsending from most recent to oldest. See Figure A.47.

Appendix A: TotalAlert Embedded Control System

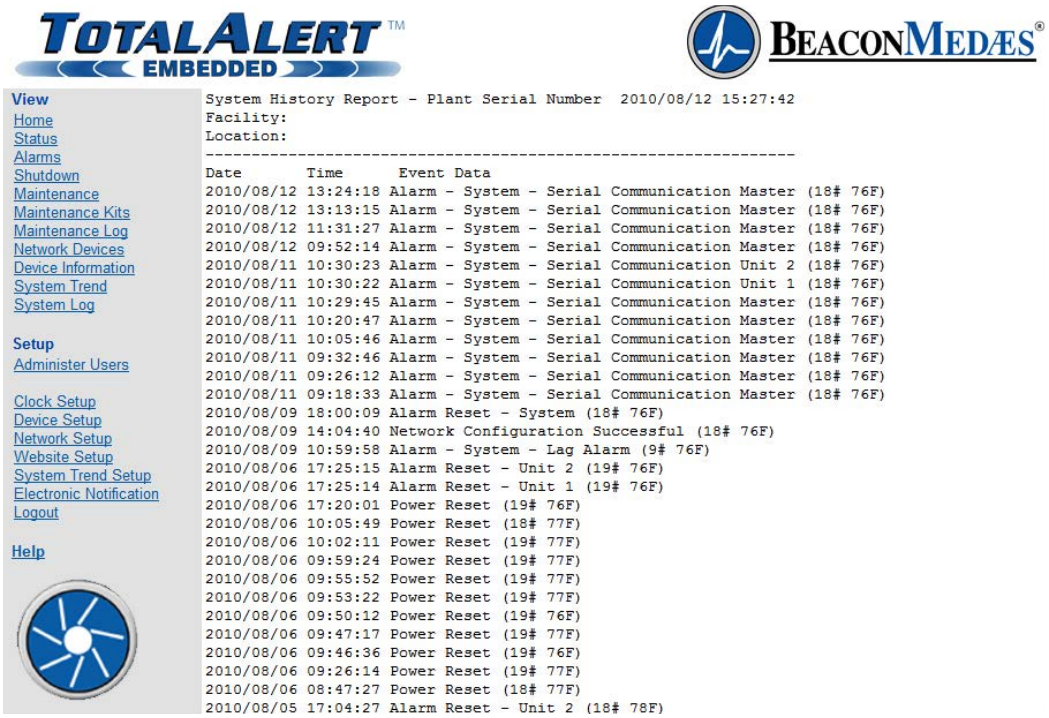


Figure A.46 System Log Download

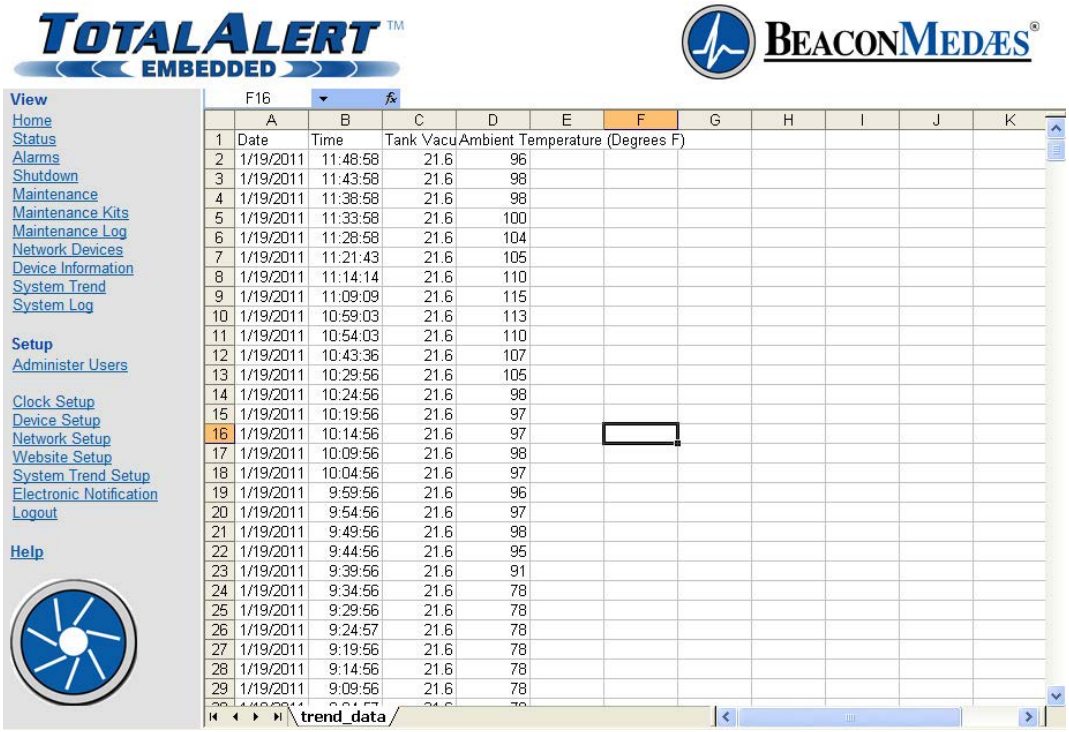


Figure A.47 System Trend Download

1059 Paragon Way Rock Hill, SC 29730
(888) 4-MEDGAS (888) 463-3427
Fax (803) 817-5750
www.beaconmedaes.com