Installation, Operation and Maintenance Manual

1.5-7.5 Hp Medical "Oil-Less" Rotary Vane Vertical Vacuum System

This unit 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
13325-A Carowinds Blvd.
Charlotte, NC 28273

Telephone: (704) 588-0854
Fax: (704) 588-4949

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MAN 01-011

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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 package before removing, loosening, or servicing any covers, guards, fittings, connections, or other devices.
- Notify appropriate hospital personnel if repairs or maintenance will affect available vacuum levels.
- Prior to using the **LifeLine** 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 system 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 the 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.
- **Do not add lubricating oil** of any kind to the vacuum pump. Absolutely no oil is required 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 as necessary.

1.0 Installation

1.1 Uncrating

Upon delivery, the condition of the **LifeLine** Medical Vacuum System should be carefully inspected. 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. The vacuum system may remain in its shipping container until ready to be installed. If the system is to be stored prior to installation, it must be protected from the elements to prevent rust and deterioration.

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

1.2 Location

The **LifeLine** 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 any 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 unit for ventilation and maintenance.

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

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 general maintenance.

1.0 Installation

1.3 Locations Above Sea Level

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

Altitude Adjustment Factor		
Altitude (ft)	**Normal Barometric Pressure (inches HG)**	**Multiplier used for Required SCFM**
0	29.92	1.00
500	29.39	1.02
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
5,000	24.90	1.20
6,000	23.98	1.25
7,000	23.09	1.30
8,000	22.23	1.35
9,000	21.39	1.40
10,000	20.58	1.45

1.4 System Configuration

All vertical vacuum systems are designed to fit through a standard 36" doorway. Refer to general assembly drawing located in control panel during shipment for dimensional information.

1.0 Installation

1.5 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 full load amperes on the wiring diagram.

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

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

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 leads when performing start-up, if the pump rotation is in the wrong direction.

1.6 Intake Piping

Before connecting any piping, the plastic thread protector installed in the connection port must be removed. 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.

To ensure that no restriction of airflow will occur, all intake vacuum lines must be sized and piped in accordance with NFPA 99. All pipe must be either seamless copper tubing or other corrosion-resistant metallic tubing, such as galvanized steel or stainless steel, as detailed in NFPA 99.

1.0 Installation

1.7 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 the following chart. A flexible connector (shipped loose) must be installed on each exhaust port of the vacuum pump before connecting to the main exhaust line leading outdoors. Additionally, a drip leg must be installed at each exhaust port connection to allow for the draining of any accumulated moisture. (Refer to the installation schematics located in the control panel during shipment.) The outside pipe must be turned down and screened to prevent contamination.

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

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
Simplex 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
Simplex 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
Simplex 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
Simplex 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
Duplex 1.5 Hp	1.00	1.00	1.00	1.00	1.25	1.25	1.25	1.25	1.25	1.50	1.50	1.50
Duplex 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
Duplex 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
Duplex 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
Duplex 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

Notes:
1. All pipe sizes are based on the following: copper pipe (Type L), 14.7 psia, 70° F.
2. The minimum pipe size must be maintained for the total length of the exhaust pipe. Use next larger size pipe in the event the minimum size is not available.
3. When determining the total pipe length, add all the straight lengths of pipe together in addition to the number of elbows times the effective pipe length for that pipe size. (See the table and example below.)

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

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 x7.9) = 137.4 ft. This is in the allowable range.

2.0 Start-up

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 5 for the required grease type, maintenance and time intervals for the various models.)

2.2 Pump Rotation

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

Using the Hand-Off-Auto switch on the door of the control panel, jog the motor of the specific pump that is to be checked by momentarily turning the switch to "Hand" and back to "Off". By observing the cooling fan on the side of the pump, you can determine the rotation of the pump. 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 at the bottom of the starter in the main control panel. Correct rotation should be confirmed in the previous manner.

CAUTION!
VANES WILL BREAK IF PUMP ROTATES IN THE WRONG DIRECTION. CHECK THE DIRECTION OF ROTATION BEFORE THE INSTALLATION OF PIPEWORK. TO TEST, SUCTION AND DISCHARGE PORTS MUST BE COMPLETELY OPEN. IF UNCERTAIN, UNSCREW UNIONS AT SUCTION AND EXHAUST COMPLETELY.

3.0 General Operation

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

3.1 Electrical Control Panel

The **LifeLine simplex** control system provides a circuit breaker disconnect for the vacuum pump with an external operator, full voltage motor starter with overload protection, a 120V control circuit transformer with fuses, vacuum control switch, hand-off-auto lighted selector switch and a runtime hourmeter. The control system includes a manually adjustable minimum run timer and a 0-30"Hg vacuum gauge in the control panel. All components are enclosed in a NEMA 12 enclosure.

The **LifeLine Duplex** control panel includes dual 120V control transformers with fuses, visual and audible lag pump alarm, 0-30"Hg vacuum gauge, and the following for each pump: hourmeter, vacuum control switch, illuminated Hand-Off-Auto switch, and motor starter with circuit breaker disconnect. Duplex systems have two disconnects with external operators. 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. The PLC also alternates the lead position between units each time the lead pressure switch (VS-1) closes or when lead pump running time has been exceeded.

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 falling vacuum level. If the one pump can carry the load, then the vacuum level will rise and VS-1 will open. 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 pumps are minimized.

On the **initial** system start-up, when the system vacuum level is below the setpoints of the vacuum control switches, all pumps will operate. 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.

Vacuum Switch Settings for 1.5-7.5 hp Oil-Less Vacuum Systems Except for Model LVV-3D-MN30			
Altitude	VS-1	VS-2	Relief Valve Setting
0'-2000'	16-22" hg	15-21" hg	23
2001'-3000'	15-21" hg	14-20" hg	22
3001'-4000'	15-20" hg	14-19" hg	21
>4000'	Consult Factory		

Vacuum Switch Settings for 3 hp Oil-Less Vacuum Systems (Model LVV-3D-MN30)			
Altitude	VS-1	VS-2	Relief Valve Setting
0'-2000'	16-19" hg	15-18" hg	20
2001'-3000'	15-18" hg	14-17" hg	19
3001'-4000'	15-17" hg	14-16" hg	18
>4000'	Consult Factory		

3.0 General Operation

3.1.1 Minimum Run Timer(s) (Electronic)

All **LifeLine** vacuum systems incorporate minimum run timers to minimize the starts and stops on the vacuum pumps.

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

3.1.2 Minimum Run Timer(s) (Adaptive Control)

For **duplex** systems with adaptive control, there is a minimum run timer built into the PLC for each pump, but they all have the same time value. Once a pump is turned on by the PLC it will not turn it off until its minimum run timer has expired. The PLC automatically adjusts the minimum run time value depending on "current demand".

If the pump is off for a brief period of time, the next pump that starts will run the maximum runtime. As the pump "off-time" increases, the run time will decrease. If the pump is off for a long period of time, the next pump that starts will run for the minimum run time. See the wiring diagram that was shipped with the unit for specific details on runtime.

3.2 Relief Valve

Every **LifeLine** 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 3.0).

The function of the relief 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.

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

3.3 Tank Drain

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

3.0 General Operation

3.4 Emergency Shutdown / Alarms

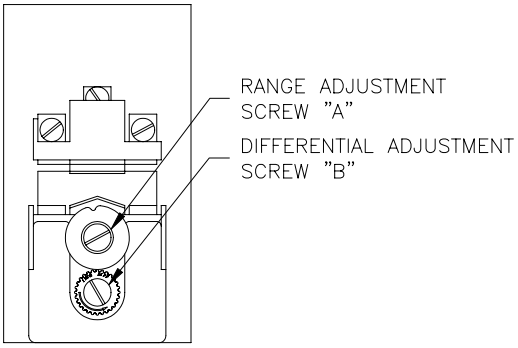
The following conditions may arise during operation.

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

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.

3.5 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 the illustration below for location of adjustment.



Adjusting Instructions

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

4.0 Troubleshooting

Problem	Possible Cause	Solution
Unit lacks sufficient vacuum	Clogged Filters	Clean or change filters
	Stuck rotor vanes	Disassemble unit and clean all grease traces from internal parts. Replace carbon vanes, since they become hygroscopic when exposed to grease.
	Vacuum relief valves need adjusting	Re-calibrate valves
	Leaks or restrictions 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.
	Unit is operating at an elevated altitude	Contact the factory for assistance. Performance may be reduced when operating above sea level
Motor breakers trip constantly	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.

4.0 Troubleshooting

Problem	Possible Cause	Solution
Unit runs rough and cannot be rotated manually	Broken rotor vane	Disassemble unit and replace vane. 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 bearings. 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

5.0 Maintenance

5.1 General Maintenance for all Sizes

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

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

Item	Frequency	Action
Exhaust drip leg	Daily/Adjust as needed	Check for accumulated moisture
Inlet filters	4000 hours or annually	Replace the inlet filter elements
Motor bearings 1.5 – 3 HP Pumps (VLT25-60) 3 – 7.5 HP Pumps (VTA60-140)	 Not Required Annually	Grease the motor bearings with 8 grams of grease per fitting. See the service manual for grease specifications.
Pump bearings 1.5 – 3 HP Pumps (VLT25-60) 3 HP Pumps (VTA60) 5 HP Pumps (VTA-100) 7.5 HP Pumps (VTA140)	 Not required 5,000 hours or annually 4,000 hours or annually 2,000 hours or annually	Grease the pump bearings with 6 grams of grease per fitting while the pump is running. See service manual for grease specifications.
Vanes 1.5 HP Pump (VLT25) 2 - 3 HP Pumps (VLT40-60) 3 – 7.5 HP Pumps (VTA60-140)	3000 hours or annually 24 MM minimum width 35 MM minimum width 38 MM minimum width	Inspect for wear and replace if at or below minimum recommended width. See service manual for procedures
Coupling 1.5 – 3 HP Pumps (VLT25-60) 3 – 7.5 HP Pumps (VTA60-140)	 Not Required Annually	Inspect coupling rubbers for wear. Replace as needed

5.1.1 Pumps

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 vacuum pumps.

5.1.2 Exhaust Drip Leg Valve

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

5.1.3 Greasing the Motor Bearings (3-7.5 Hp Only)

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.

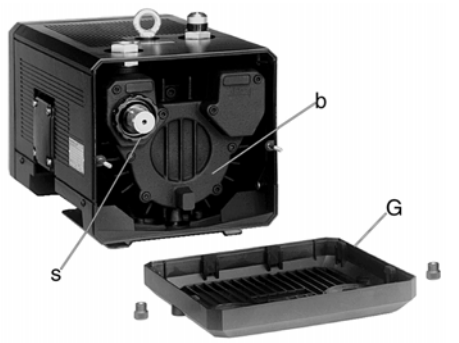
Grease motor bearings with 8 grams of grease per fitting every 12 months. Use good quality rust inhibited polyurea-based grease, such as Chevron SRI. Motors that do not have re-greasing capabilities (no grease fittings) are factory lubricated for normal bearing life.

5.0 Maintenance

WARNING!
BE SURE THAT ALL POWER IS TURNED OFF PRIOR TO PERFORMING ANY MAINTENANCE.

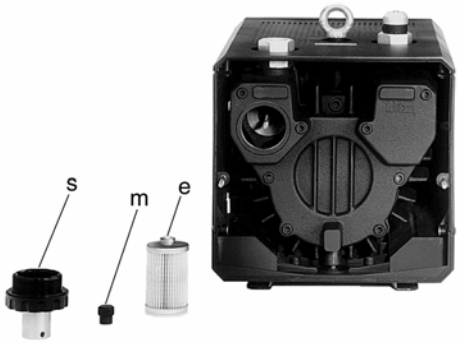
5.2 Maintenance - 1.5, 2 & Small 3 Hp

5.2.1 Inlet Filters



Each pump is equipped with a 5-micron inlet filter. It is located behind exhaust grid (G) and can be serviced as follows:

1. Close the pump isolation valve.
2. Remove the exhaust grid (G). Take off the screw cap (s) and the milled knob (m). Pull the filter cartridge (e) off and clean or replace. It is recommended that the filter be checked every week, initially. The filter should be replaced every 4000 hours of operation.
3. The filter cartridge (e) 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 element.
4. Re-assemble in reverse order.



5.2.2 Pump Bearings

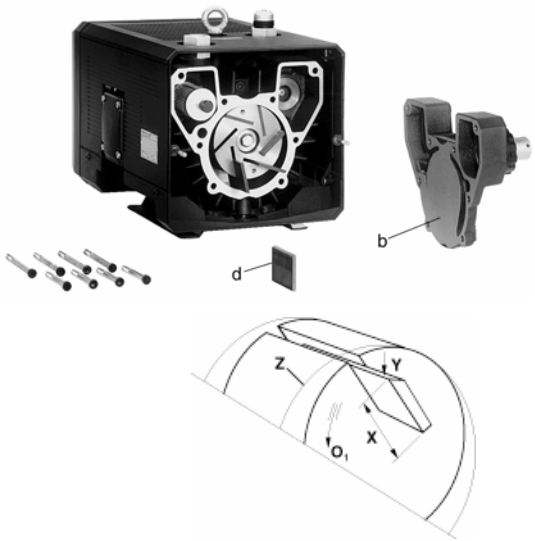
The roller bearings in the vacuum pump are pre-lubricated for life and will not require maintenance. Replace with original roller bearings only.

5.2.3 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: 1.5 hp 24 mm or less, 2 & 3 hp 35 mm or less.

To inspect or replace vanes:

1. Remove exhaust grid (G) and remove housing cover (b).
2. Carefully pull vanes (d) out of rotor.
   Vanes must be changed as a complete set.
3. On replacement, blow out enclosure with dry compressed air.
4. Carefully slide new vanes into rotor. Place the vanes with the radius outwards such that the bevel (Y) is in the direction of rotation (O_1) and corresponds with the radius of the housing (Z).
5. Re-fit the housing cover and exhaust grid.

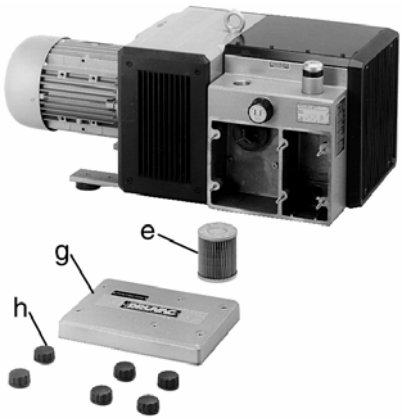


5.0 Maintenance

WARNING!
BE SURE THAT ALL POWER IS TURNED OFF PRIOR TO PERFORMING ANY MAINTENANCE.

5.3 Maintenance - Large 3 Hp, 5 & 7.5 Hp

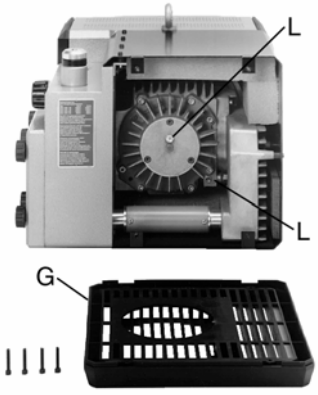
5.3.1 Inlet Filters



Each pump is equipped with a 5-micron inlet filter (e). It is located behind the filter housing cover (g) and can be serviced as follows:

1. Close the pump isolation valve.
2. Remove the thumbscrews (h) on the filter housing cover (g) and remove the filter elements. It is recommended that the filter be checked every week, initially. The filter should be replaced 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. Re-assemble in reverse order.

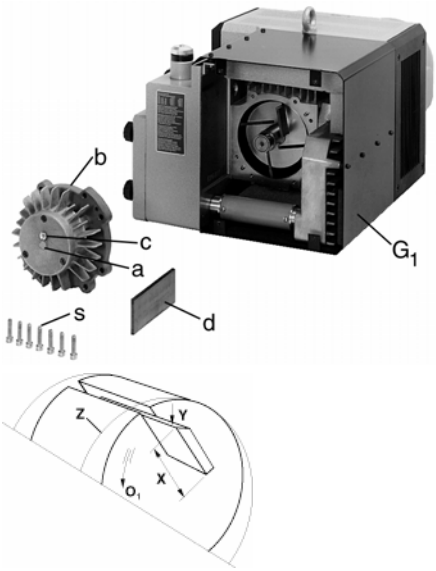
5.3.2 Pump Bearings



Remove intake grid (G) before greasing bearings. Grease vacuum pump roller bearings annually or after 5,000 hours of operation for the 3 hp, 4,000 hours for the 5 hp, and 2,000 hours for the 7.5 hp system. Using a grease gun, apply 6 g of Kluber Petamo GY 193 at both of the grease points (L). When necessary, replace with original roller bearings only.

5.3.3 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 38 mm or less.



To inspect or replace vanes:

1. Remove intake grid (G).
2. To remove the end cover (b) from the housing, remove bolt (a) from the center of the bearing cover (c). To do this, one of the fixing bolts (s) from the housing cover should be screwed into the center of the bearing cover (c).
3. Carefully pull vanes out of rotor.
   Vanes must be changed as a complete set.
4. On replacement, blow out housing, rotor slots, and enclosure (remove G_1) with dry compressed air.
6. Carefully slide new vanes into rotor. Place the vanes with the radius outwards such that the bevel (Y) is in the direction of rotation (O_1) and corresponds with the radius of the housing (Z).

5.0 Maintenance

5.3 Maintenance - Large 3 Hp, 5 & 7.5 Hp (continued)

5.3.3 Vanes (continued)

7. Before refitting the end cover (b) redistribute the grease from the bearing cover (c) onto the appropriate bearing. It is important that the shaft end is completely clean so that no grease can enter the housing. This could mix together with carbon dust and give a viscous paste that could result in the vanes becoming stuck in the rotor slots.
8. When re-fitting the end cover (b) tighten the bolts evenly so that the end cover fits correctly onto the fixing pins.
9. Re-fit the intake grid (G).

5.3.4 Coupling

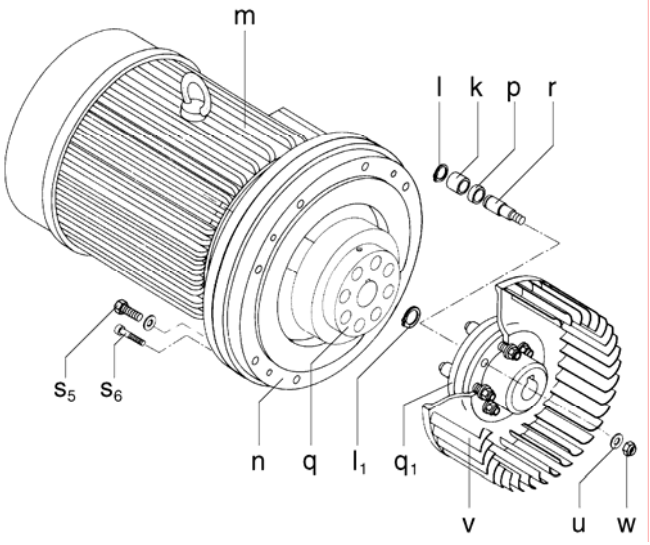
The coupling isolators (k) should be checked annually. Worn coupling isolators can be detected by a knocking sound when the pump is started.

WARNING!

Defected coupling isolators can cause extensive damage and in some extreme cases break the rotor shaft.

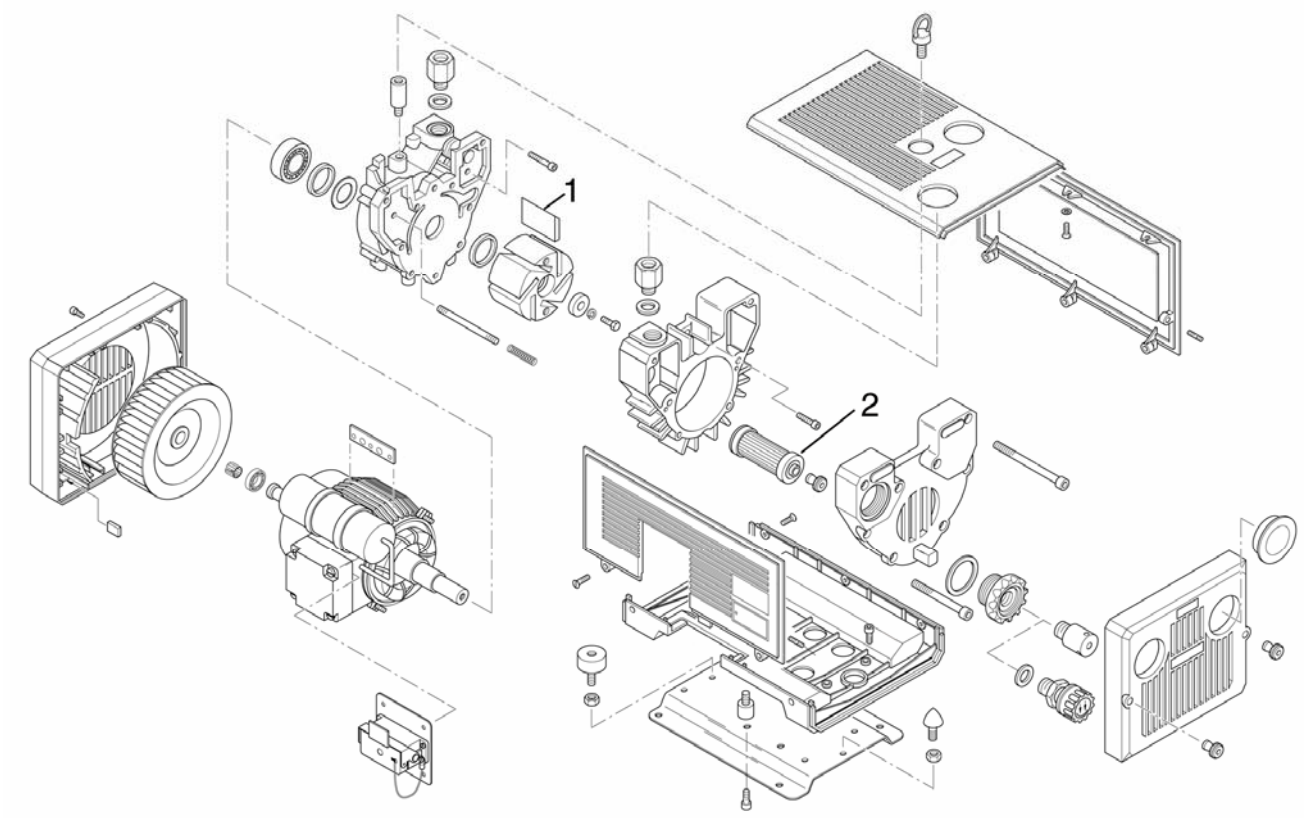
To check the coupling:

1. Close the pump isolation valve.
2. Stop the motor (m) and isolate.
3. Remove the screws (s_5) on the motor flange (n).
4. Pull off the motor together with the motor side coupling half (q).
5. If the coupling isolators (k) are damaged, remove the circlips (l) from the coupling bolt (r) and replace the isolators (k).
6. Leave the spacer (p) in place, check the coupling bolts (r) for any wear and replace if necessary.
7. To replace coupling bolts, remove the circlip (l_1), pull off the coupling and fan (v) complete from the pumpshaft. Remove the nut (w) with washer (u) and replace the coupling bolts.
8. Re-assemble in reverse order.



6.0 Replacement Parts

6.1 Replacement Parts - 1.5, 2, & (small) 3 hp

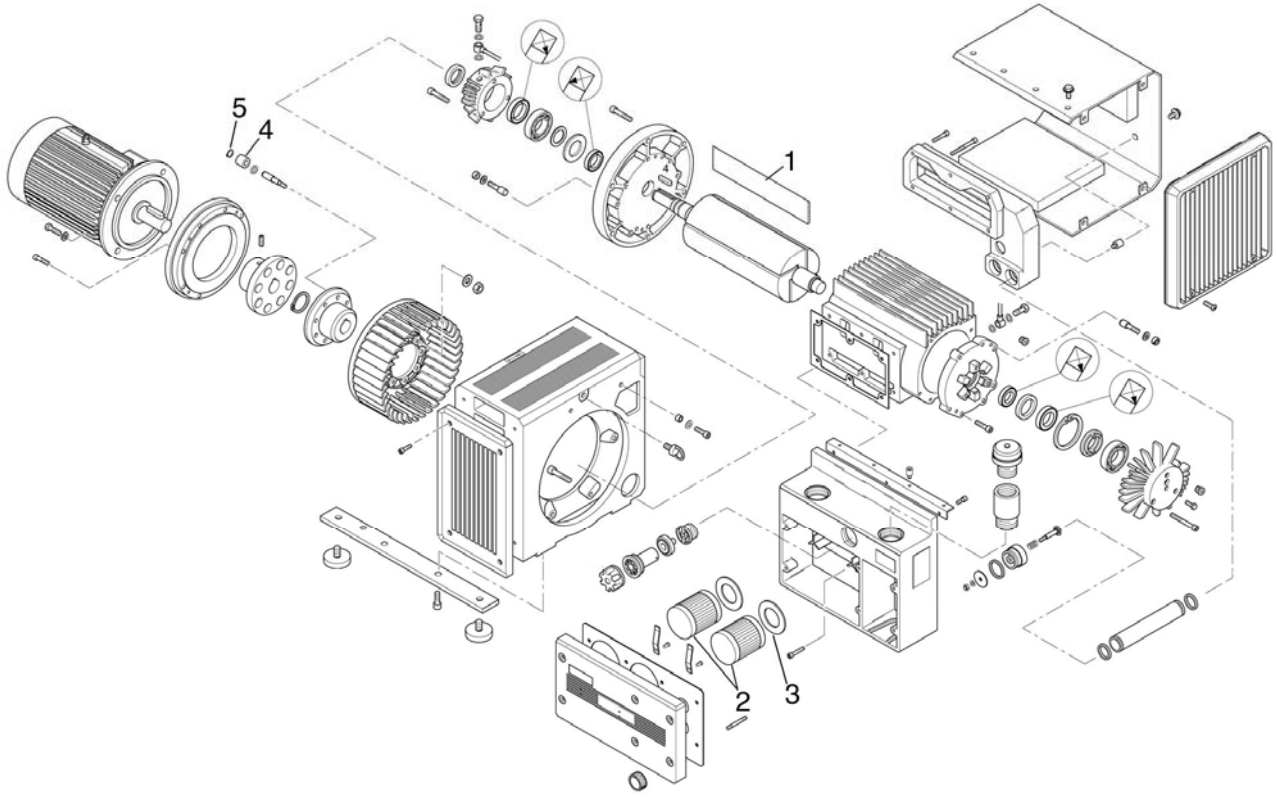


Item	HP	Part Number	Qty.*	Description
1	1.5	VAN 03 001	6	Carbon Vanes
	2	VAN 03 002	7	Carbon Vanes
	3	VAN 03 003	7	Carbon Vanes
2	1.5	ELM 12 013	1	Inlet Filter Element
	2	ELM 12 014	1	Inlet Filter Element
	3	ELM 12 014	1	Inlet Filter Element

*Note: The quantities indicated are for a single vacuum pump.

6.0 Replacement Parts

6.3 Replacement Parts - (large) 3, 5 & 7.5 hp



Item	HP	Part Number	Qty.*	Description
1	3	VAN 03 004	4	Carbon Vanes
	5	VAN 03 005	4	Carbon Vanes
	7.5	VAN 03 006	4	Carbon Vanes
2	3	ELM 12 015	1	Inlet Filter Element
	5	ELM 12 015	2	Inlet Filter Element
	7.5	ELM 12 015	2	Inlet Filter Element
3	3	GKT 13 001	1	Inlet Filter Element Gasket
	5	GKT 13 001	2	Inlet Filter Element Gasket
	7.5	GKT 13 001	2	Inlet Filter Element Gasket
4		CPL 12 001	8	Coupling Isolator
5		RNG 06 001	8	Coupling Locking Ring
6		GRS 01 006	1	Kluber Petamo GY 193 Grease tube (not shown)

*Note: The quantities indicated are for a single vacuum pump.