A Medical Systems

Installation, Operation and Maintenance Manual LVS "Camel" Liquid Ring Medical Vacuum System

NASH Pump - Type 2 Configuration Sizes: 10, 15, 20, and 30 HP - Vectra Series

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

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

Issue Date: November 1, 2006 MAN 01-019

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Table of Contents

Safety Precautions

1. Installation

- 1.1 Uncrating
- 1.2 Location
- 1.3 Locations Above Sea Level
- 1.4 Vibration Control
- 1.5 Coupling Alignment
- 1.6 Piping
- 1.7 Electrical requirements

2. Preparation for Initial Start-up

- 2.1 Draining and Flushing
- 2.2 Preliminary Inspection

3. General Operation

- 3.1 How the Vacuum Pump Works
- 3.2 How the Vacuum System Works
- 3.3 Electrical Control Panel
- 3.4 Relief Valve
- 3.5 Anti-Siphon Valve
- 3.6 Tank Drain
- 3.7 Vacuum Check Valve
- 3.8 Emergency Shutdown / Alarms

4. Start-up and Operating Checks

- 4.1 Manual Operation
- 4.2 Automatic Operation
- 4.3 Vacuum Switch Set Point Adjustments

5. Trouble Shooting

6. Maintenance

- 6.1 Routine Checks
- 6.2 Bearing Lubrication
- 6.3 Coupling Installation

7. Replacement Parts

- 7.1 Replacement parts for Vectra System
- 7.2 Replacement Parts for Vacuum Pump

8. Warranty

9. Maintenance Record

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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.
- All wiring should be connected by a certified electrician.
- Refer to the electrical wiring diagram provided with the unit before starting any installation or maintenance work.
- Do not operate until pump is initially primed and connected to a constant supply of clean compressant liquid. THE PUMP WILL BE DAMAGED IF RUN DRY. Always use a strainer to prevent sand and scale from entering the pump with liquid. Certain operating conditions in combination with water hardness may result in excessive lime deposits within the pump, which can cause it to bind. Should this condition be evident, flush the pump with a solvent at regular intervals. Contact your local **BeaconMedæs** representative for more information. Each pump has been drained and flushed with a water-soluble rust inhibitor prior to shipment. After the pump has been in service, do not store without draining as specified within this manual, since freezing can damage the pump.
- 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.

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1. Installation

1.1 Uncrating

Upon delivery, the condition of the **LifeLine** "Camel" 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. **LifeLine** systems may remain in their shipping containers until ready to be installed. If the unit is to be stored prior to installation, it must be protected from the elements to prevent rust and deterioration. Rotate the vacuum pump motor shafts every two weeks. Although the vacuum pumps are flushed with a water-soluble preservative prior to shipment, refer to your **BeaconMedæs** representative for storage instructions.

Accessories are shipped in a separate container that is attached to the system shipping crate. TO AVOID LOSS OR DAMAGE, MAKE CERTAIN THAT ACCESSORIES ARE IDENTIFIED AND KEPT IN A SAFE PLACE UNTIL THEY ARE INSTALLED ON THE SYSTEM. These include a receiver, vacuum relief valve, stand-alone gauge glass, receiver vacuum gauge, intake flex hose, discharge flex hose, and seal water flex hose. Where applicable a flex hose for the cooling water will be included.

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

1.2 Location

The **LifeLine** "Camel" Medical Vacuum System should be installed indoors in a clean, well-ventilated environment. This location should be protected against flooding, freezing, excessive moisture and overhead dripping. 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. When selecting the location for the system, provisions should be made to permit proper piping arrangement and dismantling. Allow space for service, such as cleaning, changing filters, and component replacement. 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 units must be securely bolted using all mounting holes provided. If a raised concrete pad is used, it must form a rigid support for the system. Pour a 4" to 6" concrete "housekeeping" pad large enough for the system plus approximately 6" per side. The unit's base must not overhang the concrete base. A method to drain away moisture is also necessary.

Adequate ventilation is recommended. Although the pumps are water-cooled, 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.

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1.3 Locations Above Sea Level

The safety relief valves and vacuum control switches on the **Lifeline** "Camel" 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.

1.3.1 Compensation for Altitude

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 in the following chart. After determining the new flow required, use this number to size the medical vacuum system.

Altitude Adjustment Factor							
Altitude	Normal Barometric Pressure	Multiplier used					
(ft)	(inches HG)	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					
>6,000	Contact BeaconMedæs	Contact BeaconMedæs					

1.4 Vibration Control

Each system is supplied with vibration isolators and flexible connections to isolate the surrounding area and piping from undue vibration. These accessories are shipped in a separate container that is attached to the system shipping crate. The flexible connections are for straight-line connection only, and are provided for the vacuum inlet, seal water connections, as well as the discharge. Flex hoses for chilled water connections (20 & 30 HP only) are also shipped separately. It is essential to each installation that flex connections and vibration isolators are used in conjunction with one another. Failure to do so could result in the warranty being voided.

1.5 Coupling Alignment

The vacuum systems are shipped with the vacuum pump and drive motor mounted on a base with the couplings assembled. The shafts of the motors are in alignment with the shafts of the vacuum pumps from the factory. A flexible coupling will accept some degree of misalignment such as that caused by temperature change or other variations for a short period of time. However, a coupling must be in alignment for continuous operation in all cases. Excessive misalignment causes wear, vibration and bearing loads that may result in premature bearing failure or ultimately seizing of the vacuum pump. Misalignment can be angular, parallel or a combination of these; in

addition, misalignment can be in the horizontal plane, vertical plane or both. Check that the pumps and motors are in alignment after receiving. If proper alignment cannot be achieved, re-check the tightness of the foundation bolts and the leveling provided by the shimming of the base. Proper alignment can be established correctly only after the base is leveled and secured to its permanent foundation and all pipe connections have been made to the system.



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1.5.1 Coupling Alignment Procedure

THE MOTOR MUST BE ALIGNED TO THE VACUUM PUMP IN ACCORDANCE WITH FOLLOWING INSTRUCTIONS. A dial indicator is required to perform the following procedures.

CAUTION

NEVER PRY UP OR LIFT A UNIT THAT IS RESTRAINED BY SOLID PIPE CONNECTIONS OR BY FOUNDATION BOLTS WHEN SHIMS ARE TO BE PLACED UNDER THAT UNIT'S MOUNTING FEET. REGARDLESS OF THE ELEVATION THAT IS REQUIRED, PRYING UP OR LIFTING MIGHT DAMAGE THE UNIT.

- a. Remove the coupling guard.
- b. Adjust the coupling halves to the dimension shown in Section 6.3.
- c. Mark both halves of the coupling with a reference or benchmark.
- d. Mount a dial indicator as shown for angular alignment in the diagram below. A small V-block magnetic mount or a strap-type dial indicator mount will provide the best method for attaching the dial indicator.
- e. Slowly rotate *both* shafts together and make all measurements between the reference marks. Make certain that the foundation bolts are securely tightened when taking these readings. Determine the value and location of the highest and lowest dial indicator readings.
- f. Adjust the position of the drive motor until the coupling hubs are aligned within a total dial indicator reading of less than 0.005 inch angular and .010 inch parallel.
- g. With the angular alignment of steps d through f complete, remount the dial indicator as shown for parallel alignment in the diagram below and repeat steps e and f. If coupling alignment cannot be made within limits specified, check to ensure that base mounting bolts are tight and foundation is level.



A. FOR PARALLEL ALIGNMENT

B. FOR ANGULAR ALIGNMENT

- h. With steps d through g complete, securely tighten the unit to the base and recheck that angular and parallel alignment is in accordance with steps d through g. If necessary, readjust the alignment until the requirements of step f are satisfied for both angular and parallel alignment.
- i. Recheck the coupling gap between the coupling halves as specified in step a and reposition the coupling halves, if necessary, to bring the gap within limits.
- j. Securely tighten and torque the setscrews in the coupling halves.
- k. Complete the assembly of the coupling as specified in the manufacturer's instructions in Section 6.2. Install and securely fasten the coupling guard.

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1.6 Piping

Connect piping to the system so that no strain is applied at the point of connection. Pipe strain on vacuum pump castings may cause hard-to-trace troubles after the system is in operation. Support inlet and discharge piping near the system. Allow for expansion and flexibility in those cases in which rigid piping is used in order to prevent strain from pipe expansion, bending and twisting forces. Use the provided flexible piping connections at the inlet, discharge, chilled water (if applicable) and seal water lines as well as the resilient mounts when installing the system. Remove any foreign matter from piping by flushing the piping before connecting it to the system. After piping connections are made, check to make certain that the vacuum pump can be turned over freely by hand.

1.6.1 Intake Piping

Before connecting any piping, the plastic thread protector installed in the connection port must be removed. Connect the vacuum system piping to the inlet connection. Each vacuum module must be connected to the receiver. Refer to the drawing(s) supplied with your system and NFPA 99 for specific piping requirements. The main vacuum line to the receiver must never 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 intake vacuum lines must be piped to in accordance with NFPA 99. Ensure that no restriction of airflow will occur. Use care to avoid long horizontal pipe runs and/or dips in piping that could accumulate condensate causing high inlet back pressure. All piping must be either seamless copper tubing or other corrosion-resistant metallic tubing, such as galvanized steel or stainless steel, as detailed in NFPA 99.

1.6.2 Seal Water Piping

Connect the seal water supply to the seal water line dielectric union. Refer to the drawing(s) supplied with your system and NFPA 99 for specific piping requirements. Seal water piping connections must satisfy the following requirements:

- a. Flow rate per vacuum pump shall be as specified in the table below
- b. Minimum seal water supply pressure shall be 25-psig. If a 25-psig supply is not available, contact your **BeaconMedæs** Representative.
- c. The seal water shall be non-corrosive to system materials. Make certain that the seal water meets the following requirements:

Maximum ph - 6-1/2 to 8-1/2 Maximum chlorides - 100 ppm Maximum total dissolved solids - 200 ppm Total hardness - 200 ppm max calcium carbonate

Seal Water Flow Rates – GPM*							
System Size - HP	Fresh Water	Recirculation Water					
10	1	1/2					
15	1	3					
20	1	4					
30	1	4					

*Per vacuum pump

WARNING

The seal water flow must be started before energizing the pump drive motor, even if the pump is only being operated to check the direction of rotation.

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1.6.3 Drain Piping

Connect pipe to the seal water drain connection. Refer to the drawing(s) supplied with your system. The seal water drain line should flow by gravity to a suitable drain with an air break at the drain point. The drain loop is vented.

1.6.4 Exhaust Piping

Connect flex hose and pipe to the air discharge connection on the Camel reservoir. This 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. All piping must be either seamless copper tubing or other corrosion-resistant metallic tubing, such as galvanized steel or stainless steel, as detailed in NFPA 99. A flexible connector (shipped loose) must be installed on the exhaust port of each Camel reservoir before connecting to the main exhaust line leading outdoors. 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		System Exhaust Pipe Length (ft) - See Notes										
Systems	25	50	75	100	150	200	250	300	350	400	450	500
Simplex 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
Simplex 15 HP	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00
Simplex 20 HP	3.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00
Simplex 30 HP	3.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Duplex 10 Hp	3.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00
Duplex 15 Hp	3.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00
Duplex 20 Hp	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00
Duplex 30 Hp	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	6.00	6.00	6.00
Triplex 10 Hp	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00
Triplex 15 Hp	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Triplex 20 Hp	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	6.00	6.00	6.00	6.00
Triplex 30 Hp	5.00	5.00	5.00	5.00	5.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Quad 10 Hp	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00
Quad 15 Hp	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	6.00	6.00	6.00	6.00
Quad 20 Hp	5.00	5.00	5.00	5.00	5.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Quad 30 Hp	5.00	5.00	5.00	5.00	6.00	6.00	6.00	8.00	8.00	8.00	8.00	8.00

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)	4	5	7	8	10	12	13	15	17

Example:

Select the pipe size for a Duplex 10 HP with 190 feet of straight pipe and six elbows:

- A) Select the pipe size of 3" diameter for 190 feet of straight pipe.
- B) Determine the Effective Pipe Length for an elbow of 3" dia. (EPL= 8 ft / elbow).
- C) Calculate the SYSTEM PIPE LENGTH {SPL (3.0" D) = 190 + (6 x 8) = 238 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 = 4").
- E) To double-check the pipe size, recalculate the SPL with the new diameter. SPL $(D = 4") = 190 + (6 \times 12.0) = 262$ ft. This is in the allowable range.

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1.6.5 Cooling Water Piping (20 & 30 HP ONLY)

Connect flex hose and pipe to chilled water inlets/outlets.

1.6.6 Flex Hoses



Sim	Simplex OV with Vectra Pump								
HP	Seal Water	NPT	L	Inlet	NPT	L	Discharge	NPT	L
10			107	CPL 09 008	3"	22" (559mm)	CPL 09 007	2"	18" (457mm)
15 20 30	CPL 09 002	1/2"	(254mm)	CPL 09 009	4"	27" (686mm)	CPL 09 008	3"	22" 559mm

Dup	Duplex OV with Vectra Pump								
HP	Seal Water	NPT	L	Inlet	NPT	L	Discharge	NPT	L
10			107	CPL 09 008	3"	22" (559mm)	CPL 09 007	2"	18" (457mm)
15 20 30	CPL 09 002	1/2"	10 (254mm)	CPL 09 009	4"	27" (686mm)	CPL 09 008	3"	22" (559mm)

Trip	Triplex OV with Vectra Pump								
HP	Seal Water	NPT	L	Inlet	NPT	L	Discharge	NPT	L
10			100	CPL 09 008	3"	22" (559mm)	CPL 09 007	2"	18" (457mm)
15 20 30	CPL 09 002	1/2"	(254mm)	CPL 09 009	4"	27" (686mm)	CPL 09 009	4"	27" (686mm)

Qua	Quad OV with Vectra Pump								
HP	Seal Water	NPT	L	Inlet	NPT	L	Discharge	NPT	L
10			102	CPL 09 008	3"	22" (559mm)	CPL 09 007	2"	18" (457mm)
15 20	CPL 09 002	1/2"	(254mm)	CPL 09 009	4"	27"	CPL 09 009	4"	27"
30						(686mm)			(686mm)

Ref. DIA 14 505

1.7 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.

Ground the control panel and the motor frame solidly. Do not use the system piping for the ground.

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.

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2. Preparation for Initial Start-up

2.1 Draining and Flushing

<u>WARNING!</u> ISOLATE POWER SOURCE TO THE MOTOR OF EACH VACUUM PUMP TO ENSURE THAT ACCIDENTAL STARTING CANNOT OCCUR.

Contact your BeaconMedæs representative for start-up assistance.

Before starting the system, coupling alignment must be checked. The following procedures must be performed on all vacuum pumps in a multiplex system:

- a. Remove the drain plugs from head and body of vacuum pump, vent/receiver line of the reservoir and the re-circulation line.
- b. On the seal water solenoid valve, turn the manual operator (small standard screw on side of valve) to open valve. A flat head screwdriver may be required.
- c. Open the inlet valve and close the discharge valve on the anti-siphon valve.
- d. Open shut-off valve for the seal water supply as rapidly as possible. Some water may spray from antisiphon valve but it will stop quickly.
- e. Open the discharge valve on the anti-siphon valve.
- f. Open the shut-off valve in the seal water inlet line to the vacuum pump.
- g. Allow the seal water to flow until there is clear flow from all drains including the reservoir. As soon as the flow from the vacuum pump is clear, replace the drain plugs using teflon tape or suitable pipe thread compound. Allow seal water to flow until the Camel reservoir is full. Drain and refill until water is flowing from the drain loop. Then close the shut-off valve in the seal water inlet line. Although the vacuum pump is flushed with water-soluble preservative prior to shipping, a light film of rust may form before installation. This film will disappear after vacuum pump shaft is rotated several times.
- h. Turn the manual operator on the seal water solenoid valve to close the solenoid valve.
- i. Remove and clean the screen of seal line strainer. Replace the screen. If the system, after draining and flushing, will not be in continuous operation for two weeks or longer, contact your **BeaconMedæs** representative for preservation procedures.

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2.2 Preliminary Inspection

Perform the following preliminary inspections on each of the vacuum pumps separately before starting the system:

- a. Inspect all piping to make certain that the proper connections have been made in accordance with the installation drawing(s) supplied with your system. Make certain that the piping is the correct size, at proper elevation, securely connected and properly supported so that no stress is applied to system components.
- b. Check the vacuum control tank to make certain that all shipping plugs and protectors have been removed and all open connections have been plugged or piped.
- c. Inspect each drain loop to ensure that they are properly installed and vented.
- d. Check that the power supply to the motor has the correct voltage and amperage as specified on the control panel nameplate supplied with your system.
- e. Isolate the power source from the motor in order to make certain that accidental starting cannot occur.
- f. Remove coupling guard and rotate vacuum pump shaft in direction of rotation indicated by arrow on head of vacuum pump. THE VACUUM PUMP SHAFT MUST TURN FREELY. If the vacuum pump shaft is bound and cannot be moved by turning it manually, contact your BeaconMedæs representative for assistance.

WARNING

Do not attempt to free a pump shaft from a binding or bound condition by applying power to the drive motor. Severe damage may result.

- g. With main seal water supply valve open, open the shut-off valve in the seal water inlet line to the vacuum pump. Check that the reservoir is full and that the water flows from drain loop to drain. h. Check that the seal water supply pressure is 25 psig minimum.

WARNING

Never operate the pump without adequate prime and service liquid flow. High service liquid supply pressures do not necessarily indicate that the flow is adequate. Check for flow from vacuum pump discharge or water trap silencer.

WARNING

Make certain that the coupling is enclosed with a guard before starting the drive motor.

i. Turn the power on to the system. Momentarily set the HAND-OFF-AUTO selector switch on the control panel for each vacuum pump to the HAND position. Then set the switch back to the OFF position, and check that direction of rotation of each vacuum pump is as indicated by the arrow on the head of the vacuum pump. Turn the power off.

When the preliminary inspection and pre-operational check procedures have been completed, and you understand the general operations of the system as described in Section 3, General Operation, start the system and check system operation as specified in Section 4, Start-Up and Operating Checks.

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3. General Operation

3.1 How the Vacuum Pump Works

The main functional assemblies of the Nash Vectra pump are shown in Figure 3-1. A rotor and shaft assembly in the pump is turned by an external motor. The rotor lies within a chamber that is formed by the lobe and heads.

Liquid compressant (usually water), referred to as seal liquid, is applied to the chamber in the body from an inlet through the head and cone. The mixture of liquid compressant and compressed gas is discharged through the pump discharge. Figure 3-1-2 shows the sequence of actions through the pump. The actions illustrated are made possible by the fact that the axis of the body casing is offset from the axis of the rotor.

The motion of the liquid being rotated in the pump operates as a compressant for the gas in the pump. In addition, the liquid compressant acts as a seal, preventing gas leakage to the atmosphere.



Fig. 3-1-1 Functional Elements of Pump



Fig. 3-1-2 Liquid Compressant and Air Flow

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3.2 How the Vacuum System Works (See Figures 3-2-1 & 3-2-2)

The **BeaconMedæs** "Camel" Liquid Ring Medical Vacuum System works basically like other vacuum systems with the air from the system piping (vacuum system inlet) being drawn through the vacuum control tank, then through the inlet check valve, and finally into the inlet of the vacuum pump. The air is then discharged into the "Camel" reservoir tank, which is vented to the atmosphere (air discharge).

The **BeaconMedæs** "Camel" vacuum system is unique because it uses water instead of pistons, screws, etc., to compress the air in the vacuum pump and to produce a vacuum in the inlet lines. The water is also used to seal the internal clearances, absorb the heat of compression as well as scrub the air of impurities.

The path of the water goes through a dielectric union, anti-siphon valve, strainer, solenoid valve, and flow control valve, before it enters the vacuum pump. The water then enters the pump and combines with a spinning rotor to compress the air creating a vacuum. The vacuum pump discharges both the air and the water into a specially designed muffler/baffle system located inside the Camel water reservoir. The water is then reclaimed by the reservoir while the air is discharged to the atmosphere via the vent line.

The **BeaconMedæs** system is a package consisting of a direct driven pump and motor combination supported by a series of components which enable the system to run automatically without operator attention.

The 10 and 15 hp systems include five functional groups of components:

- a. Vacuum Inlet Line
- b. Water Supply Line
- c. Air Discharge Line
- d. Camel Reservoir Tank
- e. Water Re-circulation Line

The 20 and 30 hp systems have a heat exchanger in addition to the groups listed above.

3.2.1 Vacuum Inlet Line

The vacuum inlet line is connected to the receiver. (A 3-valve bypass should be provided on the receiver to allow for isolation and service without shutting down the vacuum system.) The vacuum inlet line continues to the vacuum pump(s) through an isolation valve and check valve. The check valve is used to isolate the vacuum pump from the system when the vacuum pump is stopped.

3.2.2 Water Supply Line

The water supply line includes an anti-siphon valve, strainer, solenoid valve, flow control valve and dielectric fitting. The anti-siphon valve is used to prevent back-siphoning of the seal water from the vacuum pump into the water supply. The strainer is used to catch any pipe scale or foreign matter in the water line that might harm the vacuum pump. The solenoid valve turns on the water supply when the vacuum pump runs. The flow control valve regulates the flow to a specific gpm rate as required by the vacuum pump (See Section 1.6.2). The dielectric fitting helps to isolate the vacuum system electrically from the water supply to prevent galvanic corrosion in the vacuum pump.

3.2.3 Air Discharge Line

The air and water is discharged into the Camel reservoir through a specially designed muffler/baffle system. The water is retained in the Camel reservoir and the air is discharged to atmosphere via the vent line. (See Section 1.6.4 for correct exhaust piping sizes)

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.

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3.2.4 Camel Reservoir Tank

The Camel reservoir has three specific functions. It separates the air and water discharge from the vacuum pumps by means of a specially designed muffler/baffle system. It reclaims discharge water and holds it for use as recirculated seal water. Finally, it is used to dissipate heat generated by the vacuum pumps. Under normal operation, the water in the camel reservoir is replaced or turned over up to 6 times per day. The water in the reservoir is turned over by means of a fresh water purge while the system is operating.

In the unlikely event that fresh water service is lost, the camel tank acts as a water reservoir. The reservoir allows the vacuum pumps to continue to operate normally for up to 48 hours without requiring any additional water.

3.2.5 Water Re-circulation Line

All systems have a water re-circulation line. Included in this line are a strainer, check valve and flow control orifice.

3.2.6 Water Re-circulation Line (For 20 & 30 hp systems only)

Because the heat of compression is greater for 20 & 30 hp models, a shell and tube heat exchanger is installed to reduce the temperature of the re-circulation water.

Chilled water (at 50°F) should be piped in the opposite flow direction of the hot seal water. This "counter-flow" provides heat transfer between two fluids.

Cooling water requirements:

20 hp - 12 gpm chilled water to the heat exchanger 30 hp - 15 gpm chilled water to the heat exchanger

"Camel" Liquid Ring Medical Vacuum

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Camel System 20-30 hp with Vectra Pump & Heat Exchanger Fig. 3-2-2

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3.3 Control Panel Description and Operation

Each control panel contains the following components mounted in a NEMA 12 enclosure:

- a. Across-the-line magnetic starter with thermal overload protection for each pump
- b. 115-volt secondary control transformer.
- c. A circuit breaker with through the door disconnect
- d. If multiplexed, control panels contain a PLC for automatic alternation.
- e. A HAND-OFF-AUTOMATIC selector switch mounted on the door of enclosure
- f. One SILENCE ALARM push button mounted on the door of enclosure
- g. Indicator Lights
 - 1. One green Illuminated "Hand-Off-Auto" selector switch for each motor
 - 2. One amber LAG PUMP RUN per vacuum system
- h. One RUN TIME METER for each pump

NOTE:

FOR MORE INFORMATION, REFER TO THE WIRING DIAGRAM SUPPLIED WITH YOUR UNIT.

3.3.1 Operation (Multiplex System)

Selector Switch Positions

a. HAND

The vacuum pump operates continuously. The vacuum relief valve may open.

b. AUTO

Each vacuum pump starts and stops in response to vacuum switches that monitor the vacuum level in the control tank. When the vacuum level drops to the low setting of the lead vacuum switch (VS-1), the vacuum switch sends a signal to the control panel to turn on the lead vacuum pump. If the vacuum level continues to fall after the lead pump starts, the lower setting of the lag vacuum switch (VS-2) will turn on the lag vacuum pump to compensate the demand. When the second vacuum pump turns on, however, a signal is sent to the control panel that illuminates the lag pump run light and activates the alarm. The alarm and lag run light must be reset manually when the vacuum level in the control tank reaches the high setting of the lag vacuum switch (VS-2). Pressing the "Horn Silence" push button can silence the alarm. Each time the vacuum system reaches the high setting of the lead vacuum switch (VS-1) the pumps will automatically alternate, meaning the previous lead vacuum pump will now become the lag vacuum pump and vice versa

c. OFF

The vacuum pump will shut down.

Motor Overload Reset

- a. Depressing the RESET button on the starter manually resets the motor thermal overload and the relay overload.
- b. The associated overload contact closes to restore power to the control circuit.

Minimum Run Timer(s)

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

For **multiplex** systems, there is a minimum run timer built into the PLC for each pump, but they all have the same time value. The timer is adjustable from 0 to 10 minutes. Once a pump is turned on by the PLC it will not turn it off until its minimum run timer has expired. During operation, if VS-1 is still closed but the minimum run timer has expired, the PLC will rotate to the next available unit after a 17-minute maximum run time. (See wiring schematic for recommended timer settings.)

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3.4 Relief Valve

One relief valve is supplied with each vacuum pump. The purpose of this relief valve is to prevent the pump from operating at a vacuum level that is too high. All relief valves on units are factory set. Relief valve settings may be different for higher altitudes. Refer to the wiring diagram supplied with the system for the correct settings.

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

3.5 Anti-Siphon Valve

This valve is designed to prevent back siphoning of polluted water into a potable water supply. When the line pressure drops to 1 psi or below, the spring-loaded disc float opens the atmospheric vent and the spring loaded check valve closes the inlet. This prevents the creation of a vacuum in the discharge line and prevents back siphoning. As water flows through the valve, it pushes the check valve open and lifts the disc float that closes the atmospheric vent, thus preventing leakage. The disc float is free floating without close fitting guides, which assures freedom from sticking. The durable silicone disc on the disc float and the check valve permits use on hot and cold water lines



Pressure - Temperature

Working temperature: 33° F - 210° FMaximum pressure:150 PSIMinimum pressure:15 PSI

15 PSI

Note: This valve is not designed, tested, or approved to protect against backpressure backflow.

3.6 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.

3.7 Inlet Check Wafer Valve

Wafer style body valves are designed with flangeless bodies with relatively short face-to-face dimensions. They are clamped between mating flanges that are connected by studs and nuts. The long-leg spring action allows plates to open and close without seat scrubbing. A hinge support sleeve reduces friction and minimizes water hammer through independent plate suspension.

3.8 Emergency Shutdown / Alarms

The following conditions may arise during operation.

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3.8.1 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 5 for troubleshooting information.

3.8.2 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. In the case of a multiplex system, the lag alarm will activate when the last available unit is required to come on. For example, in a quadruplex system, if all four (4) H-O-A switches are set to "Auto", then the lag alarm will trigger when the fourth unit comes on. If on the same system, three (3) of the four (4) H-O-A switches are set to "Auto" and the other to "Off" or "Hand", then the lag alarm will activate when the third unit comes on. To silence the alarm, press the 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.

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4. Start-up and Operating Checks

4.1 Manual Operation

WARNING

Notify the appropriate hospital personnel before placing a pump on line, particularly when placing the pump online for the first time. Starting up a system unexpectedly may cause personnel injury.

Check manual operation as follows:

- a. Close the source isolation valve to isolate the system. Air will enter through relief valve.
- b. Make certain that the seal water shut-off valve is open.
- c. Apply power to system. Set the HAND-OFF-AUTO selector switch for vacuum pump No. 1 to the HAND position. Observe the vacuum gauge. The vacuum gauge should start indicating within 15 seconds. IF NO VACUUM IS INDICATED, TURN THE HAND-OFF-AUTO SELECTOR SWITCH TO THE OFF POSITION IMMEDIATELY and repeat steps a-f in Section 2.1 and steps a-I in Section 2.2
- d. As the vacuum pump continues to run, monitor the vacuum gauge. Check that the vacuum increases until it reaches the setting of the relief valve such that the relief valve opens.
- e. Check that there is a flow of seal water from the drain loop.

Note

No water should be discharged from the anti-siphon valve during operation. If seal water supply is shut off for any reason, perform steps c, d and e, in Section 2.1 before restarting unit.

- f. Continue to operate the vacuum pump for 1/2 hour and check for the following:
 - 1. Stable vacuum.
 - 2. Check the temperature of the Vacuum pump body. If the temperature rises rapidly, SHUT DOWN VACUUM PUMP IMMEDIATELY AND DETERMINE THE CAUSE.
 - 3. Check the temperature at bearing housing area of bearing brackets on the vacuum pump. If the temperature exceeds 140°F (60°C) SHUT DOWN THE VACUUM PUMP IMMEDIATELY AND DETERMINE THE CAUSE. See Section 5 Troubleshooting
 - 4. Check for unusual noise or vibration.

CAUTION

IF THE BEARING HOUSING TEMPERATURE EXCEEDS 50°F (28°C), OR MORE ABOVE THE PUMP CASING TEMPERATURE, OR IF ABNORMAL BEARING NOISE, VIBRATION, ODOR OR SMOKING OCCURS, SHUT DOWN THE PUMP IMMEDIATELY AND DETERMINE THE CAUSE.

Refer to the Troubleshooting, Section 5 in this manual for possible causes.

- g. Turn the HAND-OFF-AUTO selector switch to the OFF position. Bleed the vacuum from vacuum control tank.
- h. Repeat steps a through g for each vacuum pump in the system.

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4.2 Automatic Operation

Check automatic operation as follows:

- a. Set the HAND-OFF-AUTO selector switch to the AUTO position on all the vacuum pumps.
- b. Monitor the vacuum gauge and check that each vacuum pump starts when the vacuum reaches the low vacuum setting of the vacuum switch. Refer to the table below for the correct switch settings. In a new installation a bleed may need to be established on the system to properly cycle the pumps.
- c. Check that each vacuum pump shuts off after satisfying the time setting on the minimum run timer (See Section 3.3.1 Minimum run timers).
- d. For Duplex and Triplex systems, check that the vacuum pumps alternate each time a vacuum pump starts.
- e. Set the HAND-OFF-AUTO selector switch for each vacuum pump to OFF position. Bleed vacuum from vacuum control tank.

Vacuum Switch Settings*											
For Operating		Setting - inches Hg Vacuum									
Vacuum of	Simplex System		Duplex System		Triplex	Triplex System		Quad System			
19 in. Hg	Start	Stop	Start	Stop	Start	Stop	Start	Stop			
Vacuum Pump #1	19	23	19	23	19	23	19	23			
Vacuum Pump #2	-	-	17	21	17	21	17	21			
Vacuum Pump #3	-	-	-	-	15	19	15	19			
Vacuum Pump #4	-	-	-	-	-	-	13	17			

*Settings can be field adjusted

4.3 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 counter-clockwise will increase the cut-out vacuum setting only. Differential is the difference between cut-in and cut-out settings.

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5. Trouble Shooting

General Operation							
Problem	Solution						
No power to the system	 Check main circuit breaker Check system disconnect(s) Check fuses in control panel Check for 115V at output of control transformer(s) 						
Manual Operation - HAND-OF	F-AUTO switch in HAND position						
Vacuum pump will not start. HOA indicator light is not illuminated.	 Check fuse(s) in control panel Check motor starter in control panel Check motor thermal overload and relays in the control panel. Press the RESET pushbutton. Check the setting of the overload relays. 						
Failure to reach required vacuum	 Check the vacuum switch settings and operation of the vacuum switch. Low seal water flow to the vacuum pump. Increase flow. Blocked or restricted inlet or discharge. Clear blockage On duplex or triplex systems, inlet check valve on the other vacuum pump is stuck open or leaking. Replace defective check valve. Check vacuum pump for mechanical damage or excessive wear. 						
Vacuum pump motor stops If you have: a. Normal motor amperage	 Check overload relays for tripping Check for excessive cycling. Check for improperly sized or incorrectly set thermal overload relay. 						
b. Excessive motor amperage	 Vacuum pump horsepower demand excessive, blocked discharge, high backpressure. Clear blockage. Excessive seal water flow to vacuum pump. Check flow control valve for proper operation. Check for low voltage. Check vacuum pump for build-up of scale. De-scale the pump. Motor defective. Replace motor. 						
Vacuum pump stalling (Recognized by high-pitched screeching sound)	 Check for operation beyond maximum design vacuum. Check the setting of the vacuum relief valve. Clean or replace as needed. Check vacuum switch setting and operation of the vacuum switch. Check operation of the inlet check valve, valve may be stuck closed. Excessive seal water flow to the vacuum pump. Check flow control valve for proper operation. Check and adjust clearance in the vacuum pump. 						

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Manual Operation - HAND-OFF-AUTO switch in HAND position							
Problem	Solution						
	CAUTION SHUT DOWN VACUUM PUMP IMMEDIATELY.						
Change in vacuum pump operating temperature, noise or vibration	 If the vacuum pump bearing brackets bearing housing temperature exceeds 140°F (60°C), check for vacuum pump bearing failure or excessive grease in bearings. Refer to Trouble-item 5. (Vacuum pump stalling) If the vacuum pump is running hotter than normal, check for low seal water flow to pump. 						
Automatic Operation - HAND- On duplex and triplex systems:	OFF-AUTO switch in AUTO position						
Vacuum pump will not start	1.) Refer to Trouble-item 2. (Vacuum pump will not start)						
On multiplex systems: vacuum pumps not alternating	1.) Check operation of high vacuum switch (VS-1).						
Vacuum pumps come on at same time	1.) Check to see if the high vacuum switch (VS-1) and the low vacuum switch (VS-2) connections or settings are reversed.						
Lag vacuum pump does not start when vacuum drops to low setting of low vacuum switch (VS-2)	 Refer to Trouble-item 2. (Vacuum pump will not start) Check the vacuum switch settings and operation of the low vacuum switch (VS-2). 						

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6. Maintenance

6.1 Routine Checks

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

6.1.1 Weekly

- a. Check the temperature of the bearing housing area or bearing brackets on the vacuum pump.
- b. Check that the vacuum level is within the vacuum range of the lead vacuum switch.

CAUTION IF BEARING HOUSING TEMPERATURE EXCEEDS 140°F (60°C) SHUT DOWN VACUUM PUMP <u>IMMEDIATELY</u> AND DETERMINE CAUSE.

6.1.2 Six Month Intervals

- a. Lubricate vacuum pump bearings. Refer to Section 6.2.
- b. Check for proper operation of the vacuum switches and readjust as necessary. Refer to vacuum switch instructions located in Section 4-3 of this manual.
- c. On duplex and triplex systems, check for proper alternation of pumps.
- d. Check operation of seal water solenoid valves.
- e. Check the condition of screens in the seal line strainers and clean if necessary.
- f. Check the condition of the vacuum control tank gauge glass and clean if necessary

6.1.3 One Year Intervals

- a. Lubricate vacuum pump bearings. Refer to Section 6.2.
- b. Clean and check for proper operation of the inlet check valves. Inspect the hinge pins, pivots, springs and clapper nut for wear. Repair or replace check valves if contamination, binding or wear is detected.
- c. Check that the vacuum control tank relief valve is free to operate properly.
- d. Remove Camel Reservoir 4" inspection pipe plug and check for any debris or accumulated water deposits inside reservoir. Clean and flush if necessary.

6.1.4 Four Year Intervals

- a. Replace the seal water flow control valves. Contact your local BeaconMedæs representative.
- b. Replace or rebuild all seal water solenoid valves. Contact your local BeaconMedæs representative.

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6.2 Bearing Lubrication

Bearings are lubricated before shipment and require no lubrication for approximately six months. To check the condition and quantity of grease in the bearing bracket proceed as follows:

NOTE:

Lubricate the bearings every year, unless the pump is being operated in a corrosive atmosphere or with a liquid compressant other than water, in which case, the internal should be shortened.

- a. Pull back or remove outer bearing caps.
- b. Check condition of grease in the bearing caps for contamination or presence of water.
- c. If grease is contaminated, have the bearing removed and discarded. **Contact your BeaconMedaes** Service representative to conduct this procedure.
- d. Flush bearing housing and bearing cap to remove all grease and contaminants.
- e. Install bearing, cap and associated parts.

	Table 6-1 General Grease Specifications							
A	Premium quality industrial bearing grease	E	Performance characteristics at operating temperature: 1.Operating temperature range; at least 0° to 250° F (18° to 121°C) 2."Long-Life" performance 3. Good mechanical and chemical stability.					
В	Consistency grade: NLGI #2	F	Additives - Mandatory: 1. Oxidation inhibitors 2. Rust inhibitors					
С	 C Oil viscosity (minimum): @100° (38°C) - 500 SSU (108cSt) @210° (99°C) - 58 SSU (10 cSt) 		Additives - Optional: 1. Anti-wear agents 2. Corrosion inhibitors 3. Metal de-activators 4. Extreme Pressure (EP) agents					
D	Thickener (Base): Lithium or Lithium Complex or Polyurea for optimum WATER RESISTANCE.	Н	Additives - Objectionable: 1. Molybdenum disulfide (MoS ₂) 2. Tackiness agents					
Nasl The	n standard grease recommendations: following is a list, by manufacturer, of some grease	s tha	t exhibit the desired characteristics required by Nash.					
ManufacturerProductAMOCORykon Premium 2AtlanticArco MultipurposeChevronChevron SRI-2ExxonUnirex N2Gulf OilGulfcrown No. 2MobilMobilux 2		N TI be su as	ote: nis list is not an endorsement of these products and is to e used only for reference. Have your local lubricant upplier cross reference these greases for an equivalent, long as it meets the General Requirements.					
Grea reco	use Compatibility Note: The above greases are the N mmended that intermixing of different greases be k	Jash ept to	Standard Grease. To maximize grease performance, it is o a minimum.					

6.3 Coupling Replacement & Installation

To replace a worn or damaged coupling:

- a. Inspect all coupling components and remove any protective coatings from bores, mating surfaces and fasteners. Remove any existing burrs, etc. from the shafts.
- b. Slide one coupling flange onto each shaft, using snug-fitting keys where required.
- c. Position the flanges on the shafts to approximately achieve the G1 dimension shown in Table 6-3. It is usually best to have an equal length of shaft extending into each flange. Tighten one flange in its final position. Refer to the table below for fastener torque values. Slide the other flange far enough away to install the sleeve. With a two-piece sleeve do not move the wire ring to its final position; allow it to hang loosely in the groove adjacent to the teeth.
- d. Slide the loose flange on the shaft until the sleeve is completely seated in the teeth of each flange, (The G-1 dimension is for reference and not criteria). Secure the flange to the shaft using the torque values from the table below.

Table 6-2 Fastener Torque Values (ftlbs.)*							
HP	Coupling Size	2 Set Screws at 90°					
10	7	13					
15	9	23					
20	9	23					
30	10	23					

*Torque values apply to hub size when different than flange size.

e. Check parallel and angular alignment with a dial indicator (Refer to Section 1.5 for instructions) and adjust as necessary using shims under the motor feet. The maximum parallel and angular run out should not exceed the values shown in Table 6-3.

Table 6-3 Maximum RPM and Allowable Misalignment (in.)								
HP	Sleeve Size	Maximum RPM	Parallel	Angular	G ₁			
10	7	5250			2.563			
15	9	3750	010	005	3.500			
20	9	3750	.010	.005	3.500			
30	10	3600			4.063			



Note: Values shown above apply if the actual torque transmitted is more than 1/4 the coupling rating. For lesser torque, reduce the above values by 1/2.

f. If the coupling has two-piece sleeve with a wire ring, force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screwdriver.

CAUTION

COUPLING SLEEVES MAY BE THROWN FROM THE COUPLING ASSEMBLY WITH SUBSTANTIAL FORCE WHEN THE COUPLING IS SUBJECTED TO A SEVERE SHOCK LOAD OR ABUSE.

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7. Replacement Parts

Service and parts for **BeaconMedæs** systems and NASH pumps are assured through a network of sales and service offices. For information, service or parts contact your nearest **BeaconMedæs** representative.

If the location of the nearest office is unknown, or you are requesting parts and service, contact **BeaconMedæs** Customer Service at **1-888-463-3427**, Fax 704-588-4949.

WHEN ORDERING REPLACEMENT AND SPARE PARTS, TEST NUMBERS, SERIAL NUMBERS AND PUMP SIZES MUST BE PROVIDED. The system serial number plate is located on the side of the control cabinet. The test number and pump sizes for the pump are located on nameplate fastened to the pump body. If nameplate has been destroyed, the test number will be found stamped on the body. Refer to the system diagram (Fig. 7.1) and the pump diagram (Fig. 7-2) along with the parts lists on the following pages. Parts must be identified by reference number and name.

7.1 Replacement Parts for the Vacuum System (Ref. Fig. 7-1)

Item	Part. No.	Description	10 HP	15HP	20HP	30 HP
1.1	VAL 01-037	Inlet Check Valve	1	-	-	-
	VAL 01-038	Inlet Check Valve	-	1	1	1
1.2	VAL 20-006	Inlet Relief Valve	1	-	-	-
	VAL 20-007	Inlet Relief Valve	-	1	1	1
2.1	VAL 15-002	Seal Water Anti-siphon Valve	1	1	1	1
2.2	STN 01-003	Seal Water Strainer	1	1	1	1
2.3	VAL 04-025	Seal Water Solenoid Valve	1	1	1	1
2.4	VAL 14-050C	Seal Water Flow Control Valve	1	1	1	1
3.1	UNN 10-050-10	Re-circulated SW Orifice Union	1	-	-	-
	UNN 10-050-20	Re-circulated SW Orifice Union	-	1	-	-
	UNN 10-050-24	Re-circulated SW Orifice Union	-	-	1	1
3.2	VAL 01-027	Re-circulated SW Check Valve	1	1	1	1
4	CLR 02-003	Heat Exchanger	-	-	1	1
5	CPL 04-013	Discharge Pipe Coupling	1	-	-	-
	CPL 04-014	Discharge Pipe Coupling	-	1	1	1
6.1	TNK 02-007-ASM	Camel Tank Assembly*	1	1	1	1
6.2	GKT 02-017	Tank Cover Plate Gasket	1	1	1	1
7.1	GAG 07-003	Sight Glass	1	1	1	1
7.2	GAG 07-001	Sight Glass Valves	1	1	1	1
7.3	GAG 07-008	Sight Glass Rods	1	1	1	1
8.1	CPL 11-003	Drive Coupling Insert	1	-	-	-
	CPL 11-005	Drive Coupling Insert	-	1	1	-
	CPL 11-006	Drive Coupling Insert	-	-	-	1
8.2	CPL 10-006	Coupling Hub – Motor Half	1	-	-	-
	CPL 10-012	Coupling Hub – Motor Half	-	1	1	-
	CPL 10-014	Coupling Hub – Motor Half	-	-	-	1
8.3	CPL 10-033	Coupling Hub – Pump Half	1	-	-	-
	CPL 10-032	Coupling Hub – Pump Half	-	1	1	-
	CPL 10-031	Coupling Hub – Pump Half	-	-	-	1
9	MOT 07-018	Motor 10 HP	1	-	-	-
	MOT 08-046	Motor 15 HP	-	1	-	-
	MOT 09-029	Motor 20 HP	-	-	1	-
	MOT 11-003	Motor 30 HP	-	-	-	1
10	VAC 06-051	Pump Model GL 35	1	-	-	-
	VAC 06-053	Pump Model GL 60	-	1	-	-
	VAC 06-054	Pump Model GL 80	-	-	1	-
	VAC 06-055	Pump Model GL 100	-	-	-	1

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Fig. 7.1 Vacuum System Replacement Parts

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Ref. No.	Description	Qty	Ref. No.	Description	Qty
2	*Seal Assembly	2	103	Head	1
4	*Shim	AR	105	Cone, I.E.	1
5	*Lip Seal	2	105-1	Bolt, I.E. Cone	AR
5-1	*Lip Seal, D.E.	1	105-2	Studs	AR
18	Check Valve Ball	2	105-3	*Gasket, I.E. Cone	1
18-1	Check Valve Ball Retainer	1	110	Rotor	1
18-2	Retainer Screw	AR	111	Shaft	1
18-4	Stop Plate	1	111-1	Shaft Key	1
18-5	Stop Plate Screw	2	115	Cap, D.E.	1
22	Pipe Plugs	2	115-1	Bolts, D.E. Bearing Cap	4
22-1	Pipe Plugs	5	115-3	*Gasket, D.E. Bearing Cap	1
22-2	Pipe Plugs	2	117	Cap, I.E.	1
22-4	Pipe Plugs	2	117-1	Bolts, I.E. Bearing Cap	4
101	Body	1	117-2	Nameplate, Cap	1
101-2	Axial Rod	5	119	*Bearing, D.E.	1
101-3	*Gasket	2	120	*Bearing, I.E.	1
101-4	Rod Nuts	10	120-1	*Locknut, I.E. Bearing	1
101-5	Rod Washers	10	120-3	*Gasket, I.E. Bearing	1
			150	End Plate	1

7.2 Replacement Parts for the Vectra Pump (Ref. Fig. 7-2)

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8.0 Warranty

BeaconMedæs warrants all **LifeLine[®]**"Camel" Liquid Ring Medical Vacuum Systems, except bare pumps, to be free of defects in material and workmanship under normal use for a period not to exceed <u>thirty(30)</u> months from date of shipment, or twenty four (24) months from date of start-up.

All Liquid Ring bare pumps incorporated in the **LifeLine®** "Camel" Medical Vacuum System shall be warranted to be free of defects in material and workmanship under normal use for a period not to exceed eighteen (18) months from shipment, or twelve (12) months from date of start-up.

This warranty covers all necessary parts used in repair, as well as all reasonable labor expense.

Normal consumable parts and lubricant required for routine scheduled system maintenance are not covered under this warranty. Further, the following conditions must be adhered to:

- All preventative maintenance must be performed correctly and documented in adherence to the Maintenance Schedule published in the Operation & Maintenance Manual.
- All maintenance work must be performed by Authorized **BeaconMedæs** personnel.

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

- BeaconMedæs is notified promptly within the warranty period above of any warranty claim.
- **BeaconMedæs**' examination of such items shall disclose to its reasonable satisfaction that claimed products defect has not been caused by misuse, neglect, improper handling, installation, repair, alteration, or accidents.
- An authorized **BeaconMedæs** representative performs initial start-up.

Product modification performed by the customer without **BeaconMedæs**' prior written approval shall invalidate the above **BeaconMedæs** warranty.

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

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9.0 Maintenance Record

Model Number _____

Serial Number

Installation Date

Date of Service				
Hours				
Load				
Ambient Temp.				
Inlet Filter				
Vacuum Level				
Flow Control Valves				
Seal Water Solenoid Valves				
Strainer Screens				
Inlet Check Valve				
Relief Valve				
Misc.				
Serviced By				

In hiteline

9.0 Maintenance Record

Model Number

Serial Number

Installation Date

Date of Service				
Hours				
Load				
Ambient Temp.				
Inlet Filter				
Vacuum Level				
Flow Control Valves				
Seal Water Solenoid Valves				
Strainer Screens				
Inlet Check Valve				
Relief Valve				
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