



VACUUM TECHNOLOGIES, INC.

Installation
Operation
and
Maintenance
Manual

AquaSeal

**Water-sealed
liquidring vacuum pump systems**

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WATER-SEALED LIQUID RING VACUUM PUMP SYSTEMS

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INTRODUCTION

The **AquaSeal** water-sealed liquid ring vacuum pump system guarantees you improved reliability and reduced maintenance costs. Compared with other vacuum pump systems the **AquaSeal** water-sealed liquid ring vacuum pump system offers the advantages of no metal-to-metal contact between the impeller and casing. Grease lubricated bearings are mounted external to the pumping chamber, isolated by mechanical shaft seals. This means that the pump requires no internal lubrication.

DEKKER systems have been designed to provide safe and reliable service with low maintenance. Because a vacuum pump is a rotating piece of equipment, the operator must exercise good judgment and follow proper safety procedures to avoid damage to the equipment or personal injury. Please review and follow all instructions in this manual before attempting to install, start or operate equipment.

Safety

All products offered by DEKKER have been designed and manufactured for safe operation. However, the responsibility for safe operation rests with those who use and maintain these products. Your safety department should establish a safety program based on OSHA, federal, state and local codes. It is important that due consideration be given to hazards which arise from the presence of electrical power, hot liquids, toxic gases and rotating equipment. Proper installation and care of protective devices is essential to safe system operation. These safety procedures are to be used in conjunction with the instructions contained in this manual.

STORAGE

Keep the system in a cool dry environment and close the seal fluid isolation valve. Plug all open ports to keep out dirt and foreign objects. Every 2 - 3 months add a small amount of rust inhibitor into the inlet of the liquidring pump and rotate the impeller by rotating the shaft by hand.

After a long idle period, empty the pump completely and remove any scale deposit by using the specially formulated DEKKER descaling compound **Scale-Ex**. When the descaling process is complete, add a small amount of rust inhibitor and rotate the impeller by rotating the shaft by hand. If you cannot rotate the shaft because the impeller is locked up, contact the factory.

INSTALLATION

The design of the piping system, foundation layout and plant location are the responsibility of the purchaser. DEKKER Vacuum Technologies, Inc. and its representatives may offer advice but cannot assume responsibility for operation and installation design.

Please consult an authorized dealer or a specialist skilled in the design of plant layout, system piping design and foundation design. The installer should carefully read this manual before installing the equipment. DEKKER or your local dealer can provide start up assistance in most instances at reasonable cost.

Unpacking

Upon receipt of pump or system, immediately inspect for signs of damage. Carefully remove the packing or crating from around the pump or system. Be sure to keep equipment in the upright position. DEKKER products are shipped F.O.B. factory, which means that any damage is the responsibility of the carrier and should be reported to them.

Lifting

Lift the equipment carefully and with weight evenly distributed. DEKKER is not responsible for equipment that has been damaged through mishandling or dropping.

Location

Install the unit in a well ventilated and dust free area. The pump or system should be a minimum distance of 3 feet from surrounding walls to allow for checking fluid level, temperatures, pressures and general servicing.

Mounting

The pump or system must be installed on a level surface in a horizontal position. The foundation must be designed to support the total unit weight, without any settlement or crushing, be rigid and substantial enough to absorb any equipment vibration, maintain true alignment with any drive mechanism, and must permanently support the system baseplate at all points.

The vacuum system must be leveled and secured with foundation bolts. Foundation bolts must be of adequate size to withstand the mechanical stresses exerted on it.

Systems larger than 40 HP should also be grouted into position. The foundation should be constructed to allow for ¾ to 1-½ inch of grout. The baseplate is set on shims and the grout is poured between the foundation and the baseplate. To have the required body to support the baseplate, grout should be at least ¾ inch thick.

The number and location of shims will be determined by the design of the baseplate. Firm support should be provided at points where weight will be concentrated at the anchor bolt locations. Use enough, and large enough shims to provide rigid support. Baseplates are usually designed with openings to allow pouring grout. When the baseplate has been shimmed and leveled and the anchor bolts have been snugly tightened, a dam is constructed around the foundation to contain the grout. The dam level should be at least ½ inch above the top surface of the shims. Grout should be poured inside and around the outside of the baseplate and leveled. Allow the grout to dry for a minimum of 48 hours before tightening the anchor bolts.

Please note that the pump/motor coupling and V-belt units will need to be realigned prior to start-up, except with monoblock units.

Ventilation

Locate the vacuum system in an area with sufficient airflow and accessibility. To prevent excessive ambient temperature rise it is imperative to provide adequate ventilation. Cooling is an important aspect of reliable equipment operation and it is therefore important to install the unit in a reasonably cool area where the temperature does not exceed 100°F (38°C). For higher ambient temperatures contact the factory.

For water-cooled vacuum systems it is necessary to check cooling water supply. A proper, consistent water flow must be maintained for adequate cooling.

Electrical Preparation

If the system is supplied with a control panel all system wiring is performed at the factory. Check area classification to ensure all electrical enclosures comply to code. Required customer wiring is minimal, but should be done by a qualified electrician in compliance with OSHA, National Electric Code and any other applicable local electrical code concerning switches, fused disconnects, etc. DEKKER includes a wiring diagram for use by the installer. It is recommended by DEKKER that a main disconnect switch be fitted between the vacuum system and the incoming power.

After the electrical wiring connections are completed, check the incoming voltage to make sure that the incoming voltage is the same as the vacuum system voltage. Check the system for proper motor rotation. The direction of rotation is always clockwise when looking at the shaft of the pump and is marked by an arrow on the motor or pump housing. Jog the motor by pressing the START button, and then the STOP button. If the rotation is incorrect switch any two of the three main power leads on the contactor inside the control panel. Failure to do so could result in serious equipment damage.

WARNING: Install, ground, and maintain equipment in accordance with the National Electrical Code and all applicable federal, state and local codes.

WARNING: For NFPA 99 hospital and generator applications, please shut down the vacuum pumps prior to generator testing. The rapid stop and restart may cause damage to the pump and/or motor.

Pipe Connections and Sizing

Before installation, remove all protective inserts on the pump suction and discharge. All piping connected to the system must be installed without imposing any strain on the system components. Improperly installed piping can result in misalignment, pump failure, and general operating problems. Use flexible connectors where necessary. Piping should be cleaned properly before installation.

Inlet Piping

Note: Install a temporary screen at the pump inlet flange at first start-up to protect the unit against carry over of pipe debris and welding slag. The screen must be removed after the initial run-in period.

Inlet and discharge piping should be at least the size of the pump inlet and separator discharge. Install the system as close as possible to the process to minimize losses due to the length of the suction line. If the system has to be installed further away from the process, be sure that the inlet piping is oversized accordingly to minimize the overall line pressure drop. For more information consult your dealer or call the

factory. Pump systems operating in parallel on a common manifold must each have a manual or automatic shut-off valve or a suitable check valve installed in the suction line close to the pump suction flange. This allows each individual system to be isolated when it is not in operation. The line size of the manifold should be a minimum equal to the sum of the individual pipe system area.

AquaSeal systems are supplied with an inlet check valve as standard. This valve provides a minimum of resistance close to the pump suction flange to prevent back flow of process gas and seal fluid when the pump is stopped.

If the possibility exists that the pump inlet can become closed during operation it will be essential to install some type of vacuum relief valve (anti-cavitation valve) so that air can enter the pump inlet.

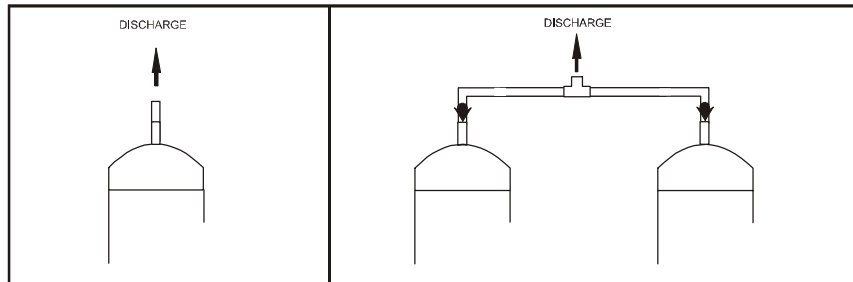
Never run a pump with a closed suction, which causes cavitation and will damage the pump.

Discharge Piping

Do not discharge the exhaust gases from the pump system into the room where the system is installed. Install an exhaust line of at least the same diameter as the discharge connection on top of the separator reservoir leading outside. See the illustration on page 5.

For pump systems operating in parallel on a common discharge, we recommend the installation of a suitable check valve close to the separator discharge flange of each unit. When discharging more than one pump in a common discharge line and/or over a long distance, oversize pipe accordingly.

Discharge piping diagrams



Cooling water piping (Full recovery systems only)

Full recovery **AquaSeal** systems require an adequate supply of cooling water at a maximum of 65° F and a minimum supply pressure of 20 psig. If the cooling water temperature is higher or available pressure lower, consult your dealer or call the factory.

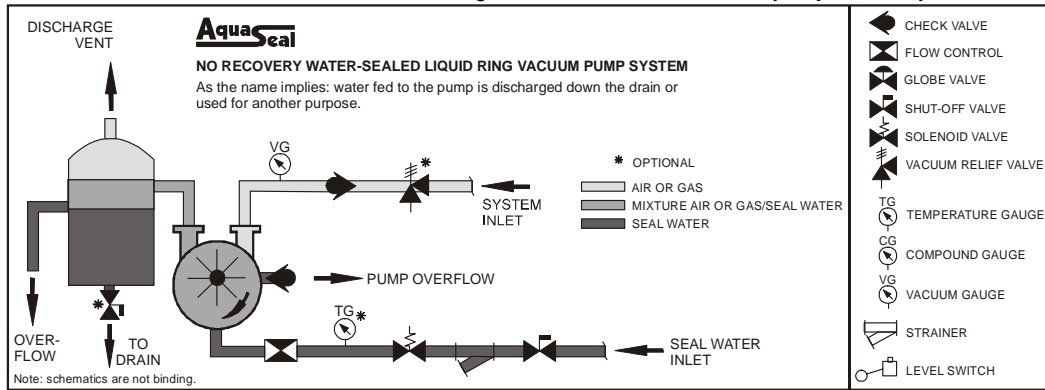
Normal pump discharge operating temperature is between 45-100°F. This is only an average value and may need to be readjusted based on particular application processes.

THEORY OF OPERATION

The DEKKER **AquaSeal** water-sealed liquid ring vacuum pump system includes our high efficiency liquid ring vacuum pump. The liquid ring vacuum pump is known for its simplicity in design and low maintenance requirements, due to the absence of wearing parts such as pistons, sliding vanes and internal bearings. The impeller assembly is the only moving part, which rotates freely in the casing without metal-to-metal contact. This means that no internal lubrication is required. The function of the sealing liquid is to create a liquid piston action and to remove the heat of compression. The seal fluid in the system circulates in a once-through (no recovery) configuration, a partial re-circulation (partial recovery) configuration, or a closed loop (full recovery) configuration, which includes an air- or water-cooled heat exchanger that removes the heat of compression. The discharge separator/reservoir holds the seal fluid and incorporates a separator arrangement to separate the seal fluid from the air or gases discharged by the pump. See Piping and Instrument Diagrams of the **AquaSeal** water-sealed liquid ring vacuum pump systems on the next page.

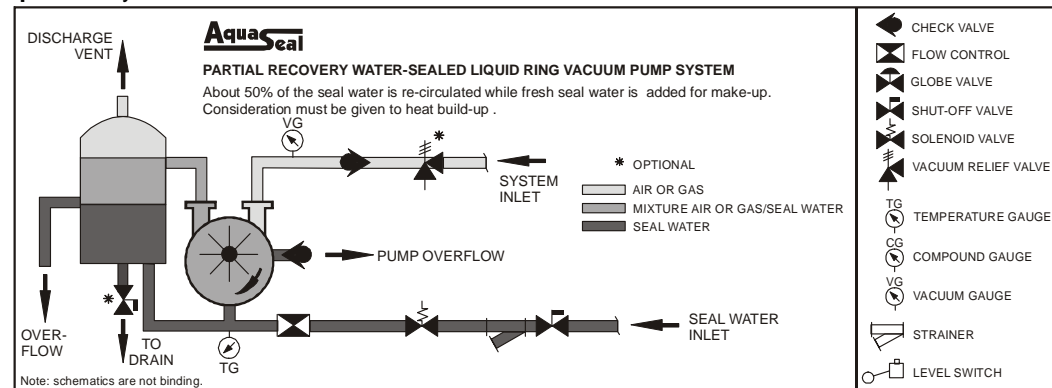
No recovery system

The DEKKER **AquaSeal** liquid ring vacuum pump systems include a no recovery, or once-through service liquid system. This arrangement is preferred when large quantities of service liquid are available and no financial advantages are foreseen for re-utilization of the same. See the diagram below for a no recovery **AquaSeal** system.



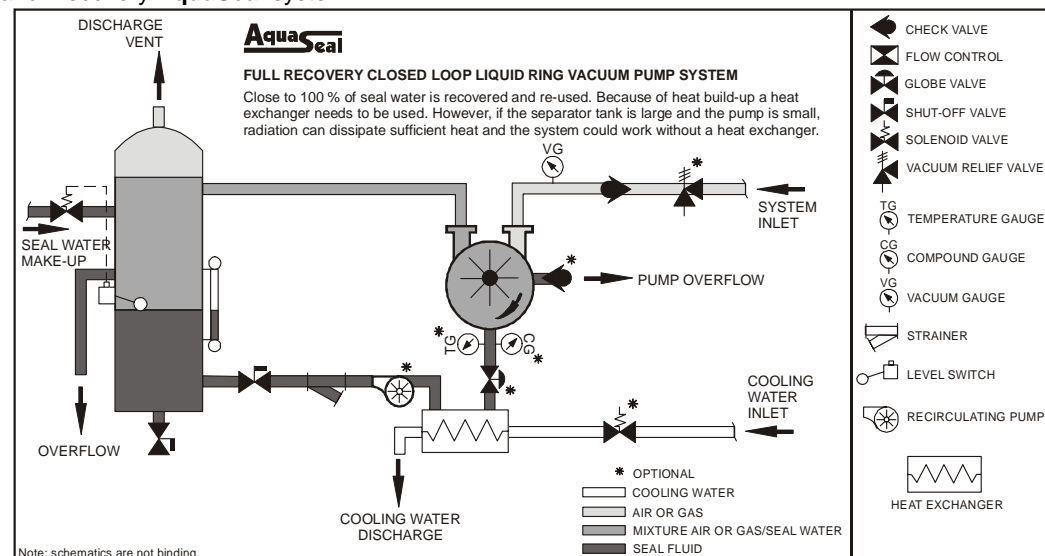
Partial recovery system

The DEKKER **AquaSeal** liquid ring vacuum pump systems include a configuration with partial recovery or partial re-circulation of the service liquid. This arrangement allows for up to 50% savings of service liquid. Variations in application and pump models will affect the amount of service liquid savings. See the diagram below for a partial recovery **AquaSeal** system.

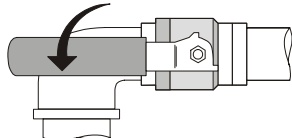
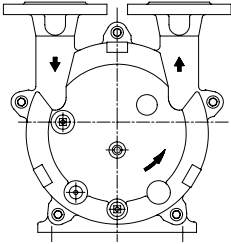
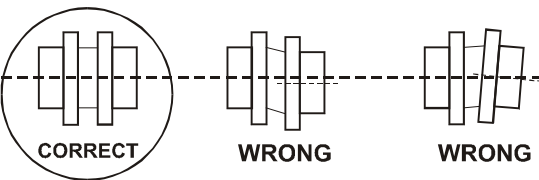
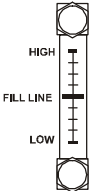
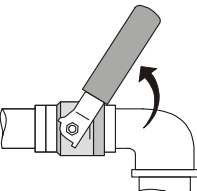



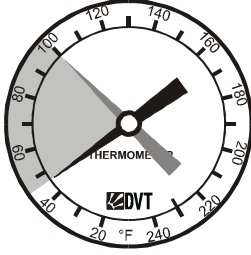
Full recovery system

The DEKKER **AquaSeal** full-recovery liquid ring vacuum pump systems offer total re-circulation of the service liquid. In this arrangement the service liquid is re-circulated in a closed loop system through a heat exchanger, which removes the heat of compression. This arrangement is used when corrosive or toxic gases are conveyed. See the diagram below for a full-recovery **AquaSeal** system.



START-UP PROCEDURES

<p>1</p>	<p>Connect the service liquid supply to the seal fluid connection. Ensure seal fluid isolation valve is open. Add a small amount of seal fluid into the pump inlet. Do not overfill the pump past the shaft centerline.</p>	
<p>2</p>	<p>Jog the motor briefly and check direction of rotation. The correct direction of rotation is marked by an arrow on the motor or pump housing. If direction is incorrect, switch any two of the three leads at the power connection. The correct direction of rotation is clockwise facing the pump from the drive end and counter-clockwise if viewed from the non-drive end.</p>	
<p>3A</p>	<p>Check drive coupling alignment. Angular alignment should be within .035"-.175". Parallel alignment should be within .010"-.025". Consult the factory for specific system size alignment. Mono-block units do not require any field adjustment (motors are C-face mounted).</p>	
<p>3B</p>	<p>For units utilizing V-belt drives, make sure the sheaves are properly installed and aligned before attempting to tension the drive. The V-belts should be placed over the sheaves and in the grooves without forcing them over the sides of the grooves. The tensioning steps 1, 2, 3 and 4 can be used for all types of V-belts, all cross sections and number of belts and all types of construction.</p> <p>Avoid excessive heat (140°F and higher); belt life will be shortened. Never switch or mix belts from one groove to another on the sheaves. Do not use belt dressing. Sheaves should remain free of oil and grease. When replacing belts install an identical set.</p> <p>For more specific V-belt tensioning guidelines consult factory.</p>	<ol style="list-style-type: none"> 1. With all belts in their grooves, adjust centers to take up the slack until they are fairly taut. Use standard V-belt tensioning guidelines. 2. Start the drive and continue to adjust until the belts have only a slight bow on the slack side while operating with load conditions. 3. After several days of operation, the belts will seat themselves in the sheave grooves. Further tensioning may be necessary to the point that the drive shows a slight bow in the slack side. Insufficient tension is often evidenced by slipping (squealing) at start-up. 4. If the unit is idle for an extended period of time, the tension on the belts should be removed.
<p>4</p>	<p>For full recovery systems check fluid level in separator reservoir. The fluid level should be at the FILL LINE on the sight gauge. Add fluid if necessary.</p>	
<p>5</p>	<p>If your system contains an inlet valve, set it to approximately 3/4 closed, and start pump. After 3 minutes running time, slowly open valve completely.</p>	

6	<p>Check the voltage and motor current, they should be within the specifications for the motor. Standard motors have a 1.15 S.F. (Service Factor).</p> <p>Note: This test should also be performed under normal system operating vacuum levels.</p>	 <p>DANGER: HIGH VOLTAGE! Lethal shock hazard present. USE EXTREME CAUTION!</p>
7	<p>After 15-30 minutes of operation check pump discharge temperature, which should be in the 45-100°F range. Please note specific applications can cause large variances in discharge temperature. Consult your dealer or the factory for assistance.</p> <p>(Optional accessory)</p>	

SHUT-DOWN PROCEDURE

To stop the pump system follow the procedure as lined out below.

Push the STOP button, or turn switch to the OFF position. The inlet check valve will prevent fluid from the system being sucked back into the inlet manifold. In addition, in no recovery and partial recovery systems the solenoid valve will stop the flow of seal fluid back into the pump.

Note: If inlet piping could be under vacuum for an extended period of time without the pump running, inlet piping should be vented to atmosphere.

Note: Close the seal fluid isolation valve and the pump inlet isolation valve during extended periods of storage or when transporting. Open valves before starting system.

SEQUENCE OF OPERATION

The following sequence of operation is a description of how DEKKER AquaSeal liquid ring vacuum pump systems should operate. The description is general to cover simplex to multiplex (more than one pump) systems. It is assumed that all start-up procedures have been followed. When applicable, ensure that pump reservoir(s) are filled with seal fluid (See "Start-up Procedures", page 7). Make sure that the seal-fluid isolation valve is in the open position. If any of the below do not occur, see the "Trouble-shooting" section (page 17). Once the power connection to the system has been made, the following should occur:

- ◆ If disconnects or circuit breakers are installed on the control panel, and are turned to the ON position, the system will be energized. If POWER ON indicating lights are installed on the panel, the lights will be illuminated.
- ◆ If any other lights are illuminated, see the "Trouble-shooting" section (page 17).
- ◆ If HAND-OFF-AUTO selector switches are installed and are turned to the HAND mode, the pump(s) will immediately start. If PUMP ON light(s) are installed on the panel, they should light up to indicate pump operation. We suggest that each pump be tested ("bump started") in the HAND mode initially to check rotation of the pump. When facing the drive end of the pump, the correct rotation is clockwise. When in HAND mode, the pumps will run continuously unless an alarm condition is triggered. If such a condition occurs, see the "Trouble-shooting" section.
- ◆ When the HAND-OFF-AUTO selector switch is placed in the AUTO mode, the pumps will operate from vacuum switches (if installed). In multiplex pump systems, each vacuum switch is set with a differential as well as an offset relative to the next switch. The switches should not be set identically. The differential is usually between 3 to 6" Hg. For details on setting the vacuum switches, see the "Accessories and Protective Devices" section on page 13. Below is an example for a duplex system. The differential for each switch is 4"Hg, offset between the two switches is 2"Hg.

PUMP	PUMP ON	PUMP OFF
Pump 1 (lead pump)	@ 21"Hg	@ 25"Hg
Pump 2 (lag pump)	@ 19"Hg	@ 23"Hg

- ◆ The switches are set in this manner so that if pump 1 (lead pump) cannot satisfy demand and the vacuum level drops below 21"Hg, the lag pump (2) will start-up when the vacuum level reaches 19"Hg and stops at 23" Hg.
- ◆ All multiplex systems are supplied with "Automatic alternation" and "Frequent stop/start protection" unless otherwise specified.
- ◆ "**Automatic alternation**" allows the pumps to operate equally (even run time) by alternating each pump whenever the pump(s) shut down. When alternation occurs, the "lead" pump becomes the "lag" pump and the "lag" pump becomes the "lead" pump.
- ◆ "**Frequent stop/start protection**" is used to allow the pump(s) to operate a minimum amount of time. The time period is factory-set at 10 minutes. This allows the pump(s) to warm up and eliminate frequent starting of the pump(s) which can cause premature coupling failure and breakdown of electrical components. The pump(s) will continue to operate after the vacuum level has been satisfied. If the possibility exists that the pump could work with a closed suction, a relief valve must be installed to prevent cavitation.
- ◆ If the pump(s) are not alternating and/or are frequent starting, one of the electrical components may be defective. Contact the factory for more information.

SYSTEM ALARM CONDITIONS

The following is a description of how alarm conditions will affect the operation of the system.

- ◆ If a "**Lag pump in operation**" alarm is installed in the panel, observe the following. Such an alarm is usually only supplied with medical packages. The alarm consists of a warning light and an audible alarm. The alarm will trigger when the "lag" pump starts up. The alarm will not affect the operation of the system. The light will illuminate and the alarm will sound. The audible alarm can only be silenced by physically (or remotely) pushing the ALARM SILENCE button. This will not stop the LAG PUMP ON light from illuminating. The light can be reset by physically (or remotely) pressing the ALARM RESET button.
 Note: If the lag pump is still operating when the ALARM SILENCE or ALARM RESET" buttons are pressed, the alarm will continue to sound. The alarm will only reset if the lag pump is not running.
- ◆ "**Transformer failure**" light (optional). Only installed if more than one control voltage transformer is supplied. If the TRANSFORMER FAILURE light is illuminated, one of the transformers has malfunctioned and the second one has picked up. As long as a back-up transformer is available, the above alarm will not affect the operation of the system. If both transformers fail, the system will shut down.

MAINTENANCE

As you proceed in reading this section, it will become clear that the "Maintenance Schedule" for DEKKER AquaSeal liquid ring vacuum pump systems is quite minimal. The use of the service gauges will alert you when service is required.

WARNING: Before attempting any maintenance, disconnect all power from the system by switching off the main breaker or disconnect switch. This will prevent the system from automatically starting from a vacuum switch.

Bearing Lubrication Pump

The .25 – 20 HP Titan-series single-stage liquid ring vacuum pumps are installed with sealed bearings that require no field lubrication.

The 25 – 40 HP Titan-series single-stage liquid ring vacuum pumps which are belt-driven, the 50 – 100 HP Titan-series single-stage pumps and the 2 – 60 HP two-stage Titan-series pumps require lubricating every 3000 hours. Extreme operating conditions may require more frequent lubricating. Grease fittings are located on the top of each bearing housing.

For Titan-series two-stage pumps 100 HP and up, please consult Factory.

The Maxima-K series of large capacity single-stage liquid ring vacuum pumps require lubricating every 1500 hours of operation. Grease fittings are located on the top of each bearing housing.

Use a good quality high temperature lithium based grease of #2 consistency. Typical products are Texaco Premium RB and Chevron SR1 #2.

See lubricating schedule chart on the next page.

Pump bearing lubricating schedule

Pump type	Pump HP	Greasing schedule
Titan-series single-stage	.25 - 20	none required
Titan-series single-stage	25 – 100	every 3000 hours
Titan-series two-stage	2 – 60	every 3000 hours
Titan-series two-stage	100 - up	consult factory
Maxima-K-series large capacity	50 - up	every 1500 hours

Bearing Lubrication – Motor (where required)

The motors are shipped from the factory with the bearings properly packed with grease. During extended storage of 6 months or greater, the ball-bearings should be re-lubricated prior to starting with a good quality high temperature lithium based grease of #2 consistency. Typical products are Texaco Premium RB and Chevron SR1 #2. Roller-bearings (V-belt drive systems) use Texaco Premium RB or Chevron Black Pearl EP #2.

The bearings may be lubricated with the motor running or stationary. Stationary with the motor warm is preferred. Locate the grease inlets – there is one on each end of the motor.

Note: This is generally the case with domestic motors. European motors use sealed bearings and do not require lubrication. Consult Factory with any questions.

Clean the area and replace the pipe plug with a grease fitting as generally they are not equipped with a grease fitting. Remove the grease drain plug, located at the lower portion of each motor face (typically a plastic plug), and loosen any hardened grease that may block the drain. Add the recommended volume of the previously described grease using a hand operated grease gun. Run the motor for two hours. Replace the pipe plug in grease drain.

Mixing of lubricants is not recommended due to possible incompatibility. Signs of incompatibility are extreme souppiness from the grease relief drain or from the shaft opening. If changing a lubricant, grease and then re-grease after 100 hours of service.

Frequency/volume of greasing is based on service conditions, speed and frame size. See tables below.

Standard conditions: 8 hour day operation, normal or light loading, clean environment at a 100 °F maximum ambient temperature.

Severe conditions: 24 hour operation or shock loading, vibration, dirty or dusty environment, running at a 100 °F to 120 °F ambient temperature.

Extreme conditions: heavy shock, vibration, or dust.

Motor bearing lubricating schedule

Lubrication Frequency – Ball Bearings				
Roller bearings – divide time by 2				
Speed (RPM)	NEMA Frame	Standard Conditions	Severe Conditions	Extreme Conditions
1800	182-215	3 years	1 year	6 months
1800	254-365	2 years	6-12 months	3 months
1800	404-449	1 year	6 months	1-3 months
3600	ALL	6 months	3 months	1 month

Lubrication Volume	
NEMA Frame	Volume (Cubic inches)
182-215	0.5
254-286	1.0
324-365	1.5
404-449	2.5

Inlet Filter (if installed)

Check after first 8 hours of operation. Clean or replace inlet filter element every 1000 to 3000 hours depending on application or if excessive pressure drop is noticed. In some applications it may be necessary to clean filter more often.

CAUTION: Be careful not to allow foreign material to fall in the pump suction opening when removing the filter cartridge. Horizontal filter installation is recommended to prevent this. Filters must be disposed of properly as they might contain toxic substances carried over from the process.

Seal Fluid

The system is shipped from the factory without the service fluid. If water is used as the service fluid, cool, clean water should be supplied. Standard performance is based on actual tests at a seal water temperature of 60°F. Temperatures above 60°F result in capacity reduction. Water that is not clean or abrasive should be avoided whenever possible. Extremely hard water may result in the formation of scale deposits within the pump. Such deposits can be removed with periodic circulation of DEKKER's **Scale-eX** descaling fluid or the installation of a water treatment system.

Guidelines for suitable water are:

- Minimum pH: 7
- Maximum Chlorides: 10 ppm
- Maximum total dissolved solids: 200 ppm
- Maximum hardness: 200 ppm

When charging the system with new fluid, make sure that the pump is filled with fluid to the shaft centerline level. **Do not fill the pump above the shaft centerline.** Starting the pump with fluid level above the shaft centerline may result in shaft or impeller damage or failure. You can add fluid by removing the suction or discharge flange and pouring fluid through pump suction or discharge port.

Descaling

In areas with hard water, scale build-up may occur in the pump, which could cause the pump to cease. If this is the case use DEKKER's specially formulated **Scale-eX** descaling fluid according to the instructions supplied.

Scale-eX (part no.: 5235-0010-000) - 1 gallon

Scale-eX (part no.: 5235-0050-000) - 5 gallons

Scale-eX (part no.: 5235-0550-000) - 55 gallons

Seal Fluid Strainer

After the first 50 hours of operation, clean the strainer in the seal fluid line. This is done to remove any debris carried over from the service liquid line. Clean and inspect the strainer every 1000-3000 hours depending on application

Mechanical Shaft Seals

All DEKKER liquid ring vacuum pumps are fitted with mechanical shaft seals. Mechanical seals do not require maintenance unless there is more than a small amount of leakage. To define this we differentiate between the following:

Weepage: Mechanical seals work by having two flat surfaces pushed together by axial force from the closing mechanism and by product pressure in the seal chamber. When the seal is in operation, the seal fluid lubricates the two faces. This thin film of lubrication protects the faces of the seal from heat and excessive wear, but it can also allow for a small amount of leakage across the seal face. This small leakage is called a "weep". While a weep has rather arbitrary limits, it is commonly considered to be a leakage rate of less than one drop of liquid every minute. Seal weeps are not covered under warranty.

Leakage: a leakage rate of more than one drop per minute is considered to be a "leak". Seal leakage is normally a result of a build-up of abrasive particles carried over in the pump suction. These particles cause excessive wear on the seal faces. Leakage caused by wear and tear is not covered under warranty.

Seal replacement is addressed in the assembly and disassembly instruction for the specific pump model used. Consult factory for assistance.

MAINTENANCE SCHEDULE

To help ensure trouble free system operation, a basic maintenance schedule consisting of the following system checks is recommended.

First 8 hours operation

Check inlet filter element, if installed. Clean strainers and remove temporary inlet screen. Check piping for signs of leakage and tighten if necessary.

500 hours operation

Under normal operating conditions repeat 8 hour check procedure as described above.

1000 hours operation

Clean or replace inlet filter element every 1000 to 3000 hours depending on application or if excessive pressure drop is noticed.

Remove debris from pump housing, motor fan guard and heat exchanger.

1000-3000 hours of operation

On pumps equipped with grease fittings located on each bearing housing, grease bearings with a #2 quality lithium grease. Do not over-grease, 3 to 4 pumps with a grease gun is sufficient under normal conditions.

30,000 hours of operation

Or every 5 years, it is recommended that you replace the vacuum pump's mechanical seals and bearings as preventative maintenance. This should be done by a DEKKER authorized distributor or properly trained service technician.

ELECTRICAL CONTROLS (if included)

- ◆ **Disconnect Handles:** must be turned on to energize the system. The handles must be turned off to open control panel.
- ◆ **CAUTION: High voltage, main disconnect must be off when servicing panel.**
- ◆ **HOA (Hand-Off-Auto) Selector Switches:** are supplied only if vacuum switches are supplied. Pump units will start in HAND mode (unless units are in a shutdown alarm condition). The pumps will bypass vacuum switches. AUTO mode, allows units to start upon contact closure of the vacuum switch.
- ◆ **Stop/Start Push Buttons:** are included if HOA selector switch is not installed.
- ◆ **Reset Button:** is used to reset the starter overloads.
- ◆ **Power On Light:** indicates that power is on in panel.
- ◆ **Pump Running Light:** indicates a pump is operating.
- ◆ **High Temperature Overload Light:** indicates a pump has overheated and shuts the pump down. The ALARM RESET button needs to be pressed to reset the alarm condition. If high temperature condition has not been fixed, the alarm will not reset.
- ◆ **High Back-pressure Light:** indicates the exhaust filter element in the vacuum pump needs to be replaced. Alarm does not shut down the pump. Replace element as soon as possible.
- ◆ **Transformer Failure Light:** indicates transformer failure. If alternate transformers are included in the panel, the alternate transformer will pick up. The pump will shut down if only one transformer is present and fails.
- ◆ **Lag Pump In Operation Light:** When the light illuminates, the lag pump is in operation.
- ◆ **Audible Alarm:** signals that the lag pump is in operation. The alarm can be silenced by pressing the ALARM SILENCE button. The audible alarm may also be used to signal other alarm conditions, such as high temperature, low fluid level or high back pressure.
- ◆ **Alarm Silence Button:** is used to silence the audible alarm, but the light will remain on unless alarm condition has been corrected.
- ◆ **Alarm Reset Button:** is used to reset an alarm condition when the condition has been rectified. The ALARM RESET button will stop the light and alarm if alarm condition has been corrected.
- ◆ **Hour Meter:** is a running clock that indicates how many hours each pump has been operating. It should be used to determine scheduled maintenance periods. See Maintenance Schedule.

ACCESSORIES AND PROTECTIVE DEVICES (if included)

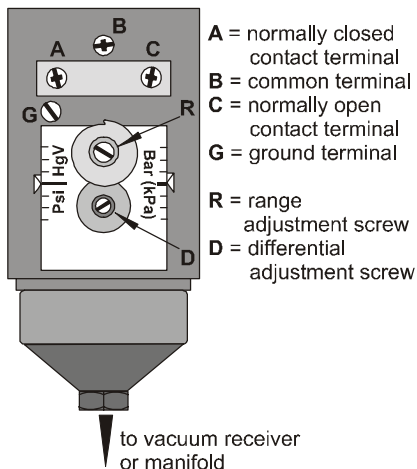
Accessories

The following accessories are available for **AquaSeal** water-sealed liquidring vacuum pump systems.

- ◆ **Flexible Connectors (optional):** are used in piping systems to eliminate vibration transmission from machinery throughout the piping network. If ordered, DEKKER uses braided flexible connectors.
- ◆ **Vibration Isolators (optional):** are used to eliminate vibrations, noise and shock transmission from machinery to the floor. Floor-mount type vibration isolators are used for **AquaSeal** vacuum pump systems. The vibration isolators have a steel top plate, threaded insert and steel base, both totally imbedded in an oil-resistant neoprene. The isolators bolt onto a tank or base-frame with one bolt and have two mounting bolts to mount to the foundation or floor.
- ◆ **System Isolation Valve (optional):** may be installed on the vacuum receiver tank or vacuum pump manifold. Usually the valve is used to isolate the vacuum system from the piping network.
- ◆ **Inlet Filter (optional):** An inlet filter may be installed on the **AquaSeal** water-sealed vacuum pump systems to prevent carry-over of particles into the pump.
- ◆ **Vacuum Relief Valve (optional):** This valve may be installed on the pump suction manifold or on the receiver. The vacuum relief valve is used to protect the vacuum pump from closed suction which can damage the pump.
- ◆ **Vacuum Switch (optional):** is used to automatically switch the vacuum pump ON and OFF, based on demand. This switch is standard on all multiplex systems.

Switches are factory preset for your application and it is NOT RECOMMENDED to adjust the vacuum switch. Each switch is labeled as LEAD or LAG and is marked with the corresponding PUMP ON and PUMP OFF points.

If the vacuum switch must be adjusted, please follow these instructions:



1. To increase the point at which the vacuum pump turns ON, turn the RANGE ADJUSTMENT SCREW (R) counter-clockwise. See the range scale on switch for approximation. Use vacuum gauge to observe actual PUMP ON and PUMP OFF point.
2. To increase the differential, which is the difference between the PUMP ON and PUMP OFF point, turn the DIFFERENTIAL ADJUSTMENT SCREW (D) counter-clockwise. To obtain the correct PUMP OFF point observe the physical opening of the contact switch as compared to the vacuum gauge reading. The vacuum pump will not stop running, because all systems are equipped with "10 minute mimum run" timers.
3. Remember you will need to vary the vacuum level in the receiver or manifold to see a change in the vacuum level, and to adjust the switches.

- ◆ **Microprocessing Controller (optional):** system may be equipped with this very reliable and compact Controller module for controlling and monitoring basic machinery functions. The following instructions should help guide the end user to perform simple changes to the Controllers' pre-programmed settings. The specific preset areas that may be modified are outlined below.

Set the Internal Clock:

Upon powering the system control panel, the installation technician must ensure that the internal clock in the Controller has been set to the current military time setting. The Controller is equipped with an internal capacitor that will hold the time for approximately 80 hrs. If your system has not been installed within the allotted time frame, the alternation of the automatic mode will not occur and only one of the pumps will function until the time parameter has been updated. Refer to the following instructions for access to and changing of the parameters.

Sequence of Operation Automatic Mode:

The switch on the front of the system control panel must be placed in the automatic mode before the Controller program will initiate. Upon starting the system, all pumps should come on line and run for a minimum of 10 minutes each. As the demand for the vacuum pumps change, the individual units will turn off and on as required, each time running for a minimum of 10 minutes after initial start. If all the individual pumps are not placed in automatic mode simultaneously, there may be a pump that does not ramp up to

speed with the lead pump. This does not mean that there is a problem with your vacuum system. The reason for this can be the switch settings for lead and lag pumps. When the system is started and individual units are placed in automatic mode at different times, the demand for lag pump may not be present due to the time lapse between placing the various pumps in automatic mode.

After 24 hours of operation (1 calendar day), the lead pump will become the lag pump and the remaining pumps will shift one spot forward, keeping the same on and off switch settings as before. The alternation of the vacuum pumps will allow equal usage of the equipment and will increase the life expectancy of the system. If the demand for the remaining pumps needs to change, you must enter the necessary value in the Controller for the level of vacuum you wish to maintain as a minimum/maximum for each on/off switch point. If there is not a demand for the lag pump(s) they will never run with the lead pump. Every day the lead pump will change.

When the lead pump cannot handle the demand of the system, the remaining pump(s) will turn on. For medical packages: when the last pump in the system is required to operate, the alarm condition will trigger the audio or visual signal that the lag pump is operating, and the system is near full capacity. The alarm reset button should be pressed and the light or audible sound will stop.

Manual Modes:

Any pump can be independently started manually by placing the system in manual mode. All high temperature and low/high level switches will still be monitoring the equipment, thus ensuring the safe operation of your vacuum system. The Controller program will not initiate and the automatic alternation will not function. The cost of operating the system will be considerably higher than in automatic mode.

Switching to parameterization mode:

In order to change **any** of the preset values in the Controller, the initial procedure is the same:

1. Turn on power to the Controller.
2. Place pump(s) in manual (Hand) mode. This is done so vacuum will be maintained, otherwise when saving changes, the pump(s) will shut down.
3. Press **ESC**, then scroll down to "Set Param", then push **OK**.

The Controller switches to parameterization mode and displays the parameterization menu. The operator can now access the various menus by using the **up** or **down** arrows to toggle to desired menu.

Selecting a parameter:

The following can be parameters:

- The delay times of a time relay.
- The switching times of an alternation time switch.
- The threshold value of a counter.
- The monitoring time of an operating hours counter (internal clock).
- The switching thresholds of a vacuum switch.

To select a parameter, proceed as follows:

1. Select the "Set Param" option from the parameterization menu. (**UP** or **DOWN** arrows)
2. Once you have the cursor (>) on the desired parameter, press **OK**.

The Controller displays the first parameter. If parameters cannot be set or modified, you can use **ESC** to return to the parameterization menu. The **ESC** key can be used at any time to leave the parameterization mode and return to the running mode.

3. Select the desired parameter by using the **UP** or **DOWN** arrows to toggle through until the desired parameter is displayed in the window.
4. To change a parameter, you must select it and press **OK**.

Changing a parameter:

To change a parameter, you first must select it as shown above. Once you have selected the desired parameter, you can change the value by moving the cursor to the desired location with the < or > arrows. The actual value is changed by using the **UP** or **DOWN** arrow. The steps are as follows:

1. Move the cursor to the point at which you want to make the change. (< or > arrows)
2. Change the value. (**UP** or **DOWN** arrows)
3. Accept the value. (**OK**)

Once all parameters are modified, you'll need to exit the "Set Param" mode by following these steps:

1. Press **ESC** until you reach the screen that has **STOP**.
2. Arrow up to **STOP** and press **OK**.
3. When prompted **Stop Prg**, use arrow **UP** or **DOWN** to **Yes** and press **OK**.
4. Arrow down to **Start** and press **OK**. (This will save the changes)
5. Turn pump(s) to Automatic mode.

Vacuum pump ON/OFF settings for Microprocessing Controller (Vacuum in "Hg):

When setting the ON and OFF switch points in your Controller, use the following table for reference:

Inches of HgV	PLC Setting
29	234
28	488
27	742
26	996
25	1250
24	1504
23	1758
22	2012
21	2266
20	2520
19	2775
18	3028
17	3282
16	3536
15	3790
14	4044
13	4298
12	4552
11	4806
10	5060

This table will apply to all single and multiplex systems equipped with a Controller after 5/15/02 (all units supplied with a Controller prior to this date must contact the Service or Engineering department with serial number of supplied equipment for assistance). These values are entered directly into the Controller in the appropriate block number for lead and lag pumps. Refer to the specific instruction set provided with the IOM for block number identification.

- The correct value can also be determined by the following formula:

$$7600 - (\text{Inches of HgV} \times 254) = \text{Controller setting}$$

Example: $SW\uparrow = 3282$ – switch pump on at 17”HgV ($7600 - (17 \times 254) = 3282$)

$SW\downarrow = 2520$ – switch pump off at 20”HgV ($7600 - (20 \times 254) = 2520$)

- To determine the vacuum point displayed on the LED of the Controller unit use the following formula: $\text{“HgV} = 29.92 - (\text{Displayed Value}/254)$

Please note that the values you are working with are Torr values multiplied by 10.

A perfect vacuum is approaching a setting of 0 and at atmospheric pressure at sea-level the setting is at 7600 (760 Torr x 10).

Settings for Simplex Systems:

- Unless otherwise noted, the standard switch points for a Simplex System will be set at:

Lead pump ON at 17”HgV – OFF at 20”HgV

- Specific block numbers for Simplex Controller Program:

Lead pump =B15

Setting for Duplex Systems:

- Unless otherwise noted, the standard switch points for a Duplex System will be set at:

Lead pump ON at 17”HgV – OFF at 20”HgV

Lag pump ON at 16”HgV – OFF at 19”HgV

- Specific block numbers for Duplex Controller Program:

Lead pump =B15

Lag pump =B16

Alarm visual/audible =B13 (Typically set to come on and off with lag pump settings)

Setting for Triplex Systems:

- Unless otherwise noted, the standard switch points for a Triplex System will be set at:

Lead pump ON at 17”HgV – OFF at 20”HgV

Mid pump ON at 16”HgV – OFF at 19”HgV

Lag pump ON at 15”HgV – OFF at 18”HgV

- Specific Block number for Triplex Controller Program:

Lead Pump =B15

Mid pump =B16

Lag pump =B23

Alarm visual/audible =B13 (Typically set to come on and off with lag pump settings)

Protective Devices

The following protective devices are available to protect the unit from being damaged and to help with maintenance.

- ◆ **High Temperature Switch (optional):** will signal when the temperature of the seal fluid is exceeding the shut-down level. The switch will shut the unit down. The unit will not restart until the alarm condition is acknowledged and is reset. The switch is a “snap disc” type of switch that is normally closed. When the temperature reaches the maximum setpoint, the switch will open. Once the switch has opened, there is a 10-20°F differential that the temperature will need to drop to, in order for the switch to close.
- ◆ **Lag Pump On Alarm (optional):** An NFPA 99 requirement on medical systems. This is an audio/visual alarm that signals lag pump operation. Once the alarm triggers, the alarm must be acknowledged and reset. The alarm will not reset if the lag pump is still in operation. This alarm indicates vacuum is greater than the supply of the lead pump only.
- ◆ **Transformer Failure Light (optional):** All standard medical NFPA 99 **AquaSeal** water-sealed liquidring vacuum pump systems are supplied with two (2) control voltage transformers (one primary and one for backup). If indication is desired in the event that the primary transformer fails and the backup transformer picks up, a TRANSFORMER FAILURE light will be necessary. The defective transformer should be replaced as soon as possible. When the primary transformer fails, the operation of the system will not be interrupted. If the backup transformer also fails, the system will shut down.
- ◆ **Low Fluid Level Switch (optional):** This switch is installed in the separator of the liquidring vacuum pump. It is a float type of switch. If the level switch is triggered, the affected pump will shut down. The LOW FLUID LEVEL light on the control panel will be illuminated. The low level switch will be wired into the main alarm of the panel. The alarm will have to be reset to restart the pump. **When filling the system with fluid, make sure that the power to the pump is off because if the alarm reset button has been reset and the level switches contacts close while filling the pump, the pump will start-up automatically.**
- ◆ **Frequent Stop/Start Protection (standard on multiplex systems):** Allows each pump to run a minimum amount of time. Frequent stopping/starting can reduce coupling life and is also less efficient from a power consumption standpoint.
- ◆ **Automatic Alternation (standard on multiplex systems unless otherwise specified):** Allows the pumps to alternate. The primary feature of automatic alternation is to equalize the running time on all the pumps.

TROUBLESHOOTING

Following is a basic troubleshooting guide. We recommended that you consult your local dealer for service. Each **AquaSeal** system is tested and checked at the factory. Always indicate system model and serial number when calling.

WARNING: Before attempting any repairs, disconnect all power from the system by switching off the main breaker or disconnect switch. This will prevent the system from automatically starting from a vacuum switch.

TROUBLE SHOOTING FAQs (Frequently Asked Questions)

BARE PUMPS AND AQUASEAL WATER-SEALED LIQUID RING VACUUM PUMP SYSTEMS

START-STOP PROBLEMS:

Pump or system will not start in HAND or AUTO position: (Bare Pumps & AquaSeal)

1. Check if the disconnect or circuit breaker is switched on.
2. Check the overload setting on the starter and fuses.
3. Check alarm reset (light should be off).
4. Ensure that the proper voltage is supplied and that the wire size is correct.
5. Check electrical control panel (if installed). Make sure that all wires are tight. Wires may vibrate loose during shipment or operation.
6. Ensure that the seal-fluid level is correct, that the pump is primed and filled to the shaft centerline only.
7. Check fluid level switch in separator (if installed).
8. Check if the pump has seized by rotating the shaft or coupling by hand (**disconnect power first**), which should rotate freely. If a rubbing noise or binding is observed, contact authorized dealer.
9. Check for scale build-up in pump. If necessary circulate **Scale-eX** descaling fluid.

Pump or system shuts down while running: (Bare Pumps & AquaSeal)

1. Check the overload setting on the starter and fuses.
2. Ensure that the proper voltage is supplied and that the wire size is correct.
3. Check for loose electrical connections.
4. Clean seal-fluid strainer.
5. Check the vacuum switch setting (if installed).
6. Check seal-fluid solenoid valve (if installed)
7. Check if the bearings are greased.
8. Check if the pump has seized by rotating the shaft or coupling by hand (**disconnect power first**), which should rotate freely. If a rubbing noise or binding is observed, contact authorized dealer.
9. Check for scale build-up in pump. If necessary circulate **Scale-eX** descaling fluid.

VACUUM PROBLEMS:

Pump or system operates, but does not achieve desired vacuum level: (Bare Pumps & AquaSeal)

1. Stop pump or system and disconnect power.
2. Check if the inlet valve is open and inlet filter (if installed) is clean.
3. Ensure that no lines are open to the atmosphere, causing loss of vacuum.
4. Check for leaks in piping system using conventional leak detection methods.
5. Ensure that the seal-fluid level is correct and that the pump is primed and filled to the shaft centerline only.
6. Check if the seal-fluid isolation valve is open.
7. Check seal-water temperature, can affect vacuum level and capacity. Consult factory.
8. Check if the solenoid valve (if installed) is working.
9. Check if the motor rotation is correct. Rotation should be clockwise (facing pump from motor side) and is marked by an arrow on the motor or pump housing. If incorrect, switch any two of the three main power leads on the contactor inside the control panel.
10. Check the vacuum switch setting (if installed).

OVERHEATING PROBLEMS:

Pump or system overheats: (Bare Pumps & AquaSeal)

1. Stop pump or system and disconnect power.
2. Check for proper water supply.
3. Check seal-fluid strainer
4. Condensable vapor load entering the pump could be too high. Contact authorized dealer.
5. Check for scale build-up in pump. If necessary circulate **Scale-eX** descaling fluid.
6. On full-recovery systems check for proper cooling water temperature and sufficient cooling water supply to heat-exchanger.

NOISE AND VIBRATION PROBLEMS:

Pump or system is making an abnormal noise or sound: (Bare Pumps & AquaSeal)

1. Stop pump or system and disconnect power.
2. Check the coupling and/or element for proper alignment. If worn or damaged, replace.
3. Check if the bearings are greased. Rotate the shaft or coupling by hand, which should rotate freely. If a rubbing noise or binding is observed, contact authorized dealer.
4. Ensure that the seal-fluid level is correct, that the pump is primed and filled to the shaft centerline only.
5. Check the setting of vacuum relief valve (if installed), adjust as needed.
6. Check if the inlet valve is closed. The pump will cavitate if inlet is closed.
7. Check for scale build-up in pump. If necessary circulate **Scale-eX** descaling fluid.
8. Check the seal-fluid temperature, could be too high.
9. Check the vacuum level, pump could cavitate as a result of a too high vacuum level.

Pump or system is vibrating excessively: (Bare Pumps & AquaSeal)

1. Stop pump or system and disconnect power.
2. Check the coupling and/or element for proper alignment. If worn or damaged, replace.
3. Check if the bearings are greased. Rotate the shaft or coupling by hand, which should rotate freely. If a rubbing noise or binding is observed, contact authorized dealer.
4. Check that the pump and motor mounting bolts are not loose. Tighten as required.
5. Check for scale build-up in pump. If necessary circulate **Scale-eX** descaling fluid.
6. Check if baseplate is properly supported. Uneven floor will distort baseplate, which could cause vibrating problems.

CUSTOMER SERVICE



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E-mail: info@dekkervacuum.com

sales@dekkervacuum.com

aftersales@dekkervacuum.com

techsupport@dekkervacuum.com

Order information

When calling for service, parts or system information always have the pump or system model number and serial number(s) ready. Refer to the bill of lading or the gold-colored system information plate attached to the system.

Parts should be purchased from the nearest authorized DEKKER representative or from the vacuum pump system supplier. If for any reason parts cannot be obtained in this manner, contact the factory directly.

WARRANTY POLICY

Warranty policy for DEKKER vacuum pumps and systems:

April 2006

DEKKER Vacuum Technologies, Inc. (hereafter referred to as the Company) warrants that the products hereunder shall be free of defects in material and workmanship and conform to the specifications given in connection with the sale of the product.

Vmax systems: full **3-year warranty** from date of shipment, provided the system is operated exclusively with DEKKER **Vmaxol** sealing liquid and is operated during the full warranty period as per the instructions given in the Operation and Maintenance Manual. If purchaser elects not to use DEKKER seal-fluids, system warranty shall be 2 years if fluid is approved by DEKKER.

Vmax^{MTH} systems: **1-year warranty** from date of shipment, provided the system is operated exclusively with DEKKER **Vmaxol** sealing liquid and is operated during the full warranty period as per the instructions given in the Operation and Maintenance Manual. If purchaser elects not to use DEKKER seal-fluids, system warranty shall be 1 year if fluid is approved by DEKKER.

DuraVane pumps, systems and compressors: **2-year warranty** from date of shipment, provided the pump(s) are operated during the full warranty period as per the instructions given in the Operation and Maintenance Manual, and where applicable are operated exclusively with DEKKER **Duratex** oil. If purchaser elects not to use DEKKER oil, pump and system warranty shall be 18 months if oil is approved by DEKKER.

TiTan and Maxima-K liquid ring vacuum pumps and compressors and AquaSeal and ChemSeal systems:

2-year warranty from date of shipment, provided the pump or system is operated during the full warranty period as per the instructions given in the Operation and Maintenance Manual.

All other systems not specified above and all custom-engineered systems: **1-year warranty** from date of shipment, provided the pump or system is operated during the full warranty period as per the instructions given in the Operation and Maintenance Manual.

Rebuilt pumps and systems: **6 months warranty** from date of shipment if operated as per the instructions given in the Operation and Maintenance Manual.

All 3rd party components are subject to Manufacturers' warranty.

Mechanical shaft seals are warranted for a period of **ninety (90) days** from date of shipment.

The replacement of **maintenance items** including, but not limited to oil, seals, bearings, filters, vanes in rotary vane pumps, etc., made in connection with normal maintenance service are **not covered** under this warranty.

No warranty shall apply to products that have been misused or neglected, which includes operation in excessive ambient temperatures, dirty environments or the pumping of corrosive, erosive or explosive liquids or gasses or for problems caused by a build-up of material on the internal parts of the product.

Under this warranty the purchaser is entitled to the repair or replacement (whichever DEKKER elects) of any part or parts of the product that do not conform to specifications. This warranty shall be void unless said nonconformance is discovered before the expiration of this warranty. For repairs, the Company has to be notified in writing, a return authorization has to be obtained and the nonconforming part or parts need to be returned to the Company, transport charges prepaid, within thirty (30) days of discovery. Repairs shall be made at the Company's facility without charge, except for return transport charges. Replacement parts provided under the terms of this warranty are warranted for the remainder of the warranty period applicable to the product in which they are installed, as if such parts were original components of that product.

No allowance will be granted for repairs or alterations made by the purchaser without the Company's written consent.

In lieu of the foregoing remedy, the company may (if the Company so elects), redesign and/or replace the product or refund the full purchase price thereof.

If purchaser disassembles the product for any reason without the written consent of the Company, this warranty shall be void.

Limitation of liability for DEKKER vacuum pumps and systems:

The Company's obligations are limited to repair, redesign, replacement or refund of the purchase price, at the Company's option. In no event shall the purchaser be entitled to recover incidental, special or consequential damages arising out of any defect, failure or malfunction of the product.

This warranty and the company's obligation there under is expressly in lieu of all other warranties, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. All warranties, which exceed the aforementioned obligations are hereby disclaimed by the company and excluded from this warranty. No other person is authorized to give any other warranty or to assume any other liability on the company's behalf without written authorization.