

TECHNICAL SERVICE MANUAL: INSTALLATION, OPERATION & MAINTENANCE



LIQUID-SPECIFIC PRODUCT LINE:
REFRIGERATION AMMONIA
4924A SERIES™
SIZES: HL, K, KK, LQ, LL

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MODEL NUMBER CHART

MECHANICAL SEAL
HL4924A
K4924A
KK4924A
LQ4924A
LL4924A

INTRODUCTION

The illustrations used in this manual are for identification purposes only and cannot be used for ordering parts. Obtain a parts list from your Viking Pump® representative. Always give a complete name of part, part number and material with the model number and serial number of pump when ordering repair parts. The unmounted pump or pump unit model number and serial number are on the nameplate. This manual only applies to the pump models specified in the "Model Number Chart" on page 1. Pump specifications and recommendations are listed in the Catalog Sections, which are available at vikingpump.com.

FIGURE 1: HL SIZE



SAFETY INFORMATION & INSTRUCTIONS

IMPROPER INSTALLATION, OPERATION OR MAINTENANCE OF PUMP MAY CAUSE SERIOUS INJURY OR DEATH, AND/OR RESULT IN DAMAGE TO PUMP AND/OR OTHER EQUIPMENT. VIKING'S WARRANTY DOES NOT COVER FAILURE DUE TO IMPROPER INSTALLATION, OPERATION OR MAINTENANCE.

THIS INFORMATION MUST BE FULLY READ BEFORE BEGINNING INSTALLATION, OPERATION OR MAINTENANCE OF PUMP, AND MUST BE KEPT WITH PUMP. PUMP MUST BE INSTALLED, OPERATED AND MAINTAINED ONLY BY SUITABLY TRAINED AND QUALIFIED PERSONS.

THE FOLLOWING SAFETY INSTRUCTIONS MUST BE FOLLOWED AND ADHERED TO AT ALL TIMES.

 **DANGER** = FAILURE TO FOLLOW THE INDICATED INSTRUCTION MAY RESULT IN SERIOUS INJURY OR DEATH.

 **WARNING** = IN ADDITION TO SERIOUS INJURY OR DEATH, FAILURE TO FOLLOW THE INDICATED INSTRUCTION MAY CAUSE DAMAGE TO PUMP AND/OR OTHER EQUIPMENT

DANGER

BEFORE opening any liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc.) be sure that:

- Any pressure in the chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.
- The pump drive system (motor, turbine, engine, etc.) has been "locked out" or otherwise been made non-operational, so that it cannot be started while work is being done on the pump.
- You know what material the pump has been handling, have obtained a material safety data sheet (MSDS) for the material, and understand and follow all precautions appropriate for the safe handling of the material.

DANGER

BEFORE operating the pump, be sure all drive guards are in place.

DANGER

DO NOT operate pump if the suction or discharge piping is not connected.

DANGER

DO NOT place fingers into the pumping chamber, or its connection ports, or into any part of the drive train if there is any possibility of the pump shaft being rotated.

WARNING

DO NOT exceed the pumps rated pressure, speed, and temperature, or change the system/duty parameters from those the pump was originally supplied, without confirming its suitability for the new service.

WARNING

BEFORE operating the pump, be sure that:

- It is clean and free from debris.
- All valves in the suction and discharge pipelines are fully opened.
- All piping connected to the pump is fully supported and correctly aligned with the pump.
- Pump rotation is correct for the desired direction of flow.

WARNING

INSTALL pressure gauges/sensors next to the pump suction and discharge connections to monitor pressures.

WARNING

USE extreme caution when lifting the pump. Suitable lifting devices should be used when appropriate. Lifting eyes installed on the pump must be used only to lift the pump, not the pump with drive and/or base plate. If the pump is mounted on a base plate, the base plate must be used for all lifting purposes. If slings are used for lifting, they must be safely and securely attached. For weight of the pump alone (which does not include the drive and/or base plate) refer to the Viking Pump® product catalog.

DANGER

DO NOT attempt to dismantle a pressure relief valve that has not had the spring pressure relieved or is mounted on a pump that is operating.

DANGER

AVOID contact with hot areas of the pump and/or drive. Certain operating conditions, temperature control devices (jackets, heat-tracing, etc.), improper installation, improper operation, and improper maintenance can all cause high temperatures on the pump and/or drive.

WARNING

THE PUMP must be provided with pressure protection. This may be provided through a relief valve mounted directly on the pump, an in-line pressure relief valve, a torque limiting device, or a rupture disk. If pump rotation may be reversed during operation, pressure protection must be provided on both sides of pump. Relief valve adjusting screw caps must always point towards suction side of the pump. If pump rotation is reversed, position of the relief valve must be changed. Pressure relief valves cannot be used to control pump flow or regulate discharge pressure. For additional information, refer to **Appendix, General Installation Notes**, item 5 on Pressure Protection or contact your Viking Pump® representative for Engineering Service Bulletin ESB-31.

WARNING

THE PUMP must be installed in a manner that allows safe access for routine maintenance and for inspection during operation to check for leakage and monitor pump operation.

GENERAL INSTALLATION NOTES

Consideration of the following points during design and installation of the system will help ensure successful operation of the Viking Refrigeration Ammonia Pump.

- 1. SUBMERGENCE** - Submergence is the head of liquid ammonia above the centerline of the pump suction port. A liquid head is necessary to keep the ammonia from flashing as it goes into the pump. The minimum liquid head or submergence for good pump operation is 4 feet; this is assuming a large, short suction line.
- 2. SUCTION LINE** - A large, short suction line is necessary for good operation.
A good suction line:
 - a. is a suction line that is at least one size larger than the pump suction port connection
 - b. is connected to the pump by an eccentric reducer (with the offset or eccentric portion down) when suction to the pump is horizontal
 - c. is as short as practical for the installation
 - d. has no strainer (sometimes a temporary strainer is used during start up to keep weld beads, etc., from going through the pump)
 - e. uses a long sweep elbow if any elbow is unnecessary
 - f. has a full flow shut off valve
 - g. is fully insulated to prevent heat pickup
- 3. INSULATION** - Insulation on the suction line and on the pump helps reduce the amount of heat pickup by the liquid ammonia.
- 4. PUMP SPEED** - The slower the operating speed, the longer the service life. This is particularly true on refrigeration ammonia pumps where:
 - a. the liquid has virtually no lubrication value or film strength to prevent surface to surface contact
 - b. the heat generated by friction can cause the ammonia to vaporize, which in turn causes cavitation
- 5. TESTING** - All Viking Ammonia pumps are tested prior to shipment, but it is good practice to pressure test the pump along with the rest of the system before adding the ammonia. Shipping, storage, and installation all have strange ways of producing detrimental effects on sound equipment.

- 6. SYSTEM CLEANLINESS** - Ammonia is a good detergent, as such it has a tendency to remove all the dirt, pipe scale, weld beads, and loose or foreign material in the system. Unfortunately, not all of this material settles out in traps or can be caught in strainers; and as a result, a considerable amount goes through the pump. The abrasive solids going through the pump will cause excessive wear during the start up of a new system. Thus the cleaner a new system is before start up, the less wear and trouble with the pump.
- 7. STAND BY EQUIPMENT** - Stand by equipment is always good insurance when possible breakdown of any single piece of equipment could jeopardize the operation of the entire system. Often on circulating systems, two pumps are used with operation of the pumps alternated by day or week. Alternating operation of the pumps is not always considered the best practice since both pumps may both wear out at the same time. If operation of the pumps is not alternated, the stand by pump should be run for several hours at least once a month to make sure it is in good operating condition. Sometimes on large systems three pumps are used; two running continuously with the third for use as a standby and for peak loads.

PUMP INSTALLATION

One of the most important considerations on any circulation Refrigeration Ammonia pump installation is proper design of the pump inlet line. Refrigeration Ammonia, when stored in a closed container, will exert a pressure within the container equal to its saturated vapor pressure. The saturated vapor pressure of a liquid may be defined as the pressure at which both liquid and vapor exist in equilibrium in the same container. The vapor pressure has a different value for each temperature. The saturated vapor pressure of water at 212°F (water's boiling point) is 14.7 PSIA. In other words, when handling Refrigeration Ammonia, we are handling a liquid, which is at its boiling point. A slight reduction in the pressure being exerted on the liquid will cause boiling and thus vapor formation.

With this information in mind let us examine "**Figure 2**" on page 3, which illustrates one of the most important considerations when installing a pump to handle Refrigeration Ammonia.

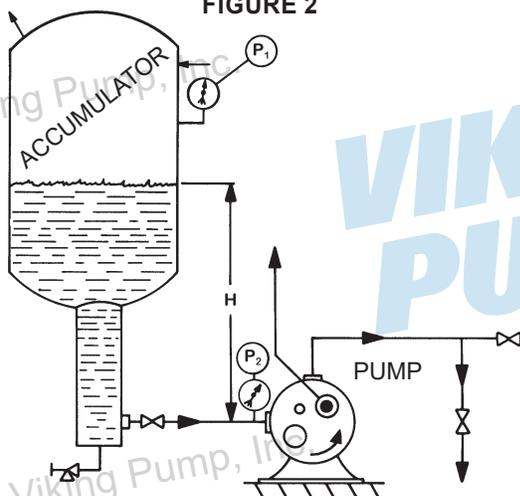
The pressure (P1) in the accumulator is equal to the saturated vapor pressure of the ammonia. When the pump is not running, the pressure (P2) at the pump inlet is equal to the tank pressure (P1) plus the static head (H). $P_2 = P_1 + H$

As soon as the pump is started and the liquid begins to flow, the pressure at the pump (P2) will drop by an amount equal to the pressure loss in the piping between the accumulator and the pump. When liquid is flowing: $P_2 = P_1 + H - (\text{pressure loss in the piping})$.

In order to have an installation in which the pump handles all liquid and no vapor, the pressure drop in the piping must be equal to or less than the static head (H) on the pump inlet. If the piping loss is greater than the static head, the liquid ammonia will start to boil or vaporize, and the pump will be required to take in a mixture of liquid and vapor. Since a given weight of vapor takes up a much greater volume than the same weight of liquid, handling both liquid and vapor will reduce the liquid output from the pump. The vapor is compressed back to a liquid on the discharge side of the pump causing it to be noisy and to wear rapidly.

Values for pipe friction losses for calculating suction line pressure drop can be found in refrigeration hand books.

FIGURE 2



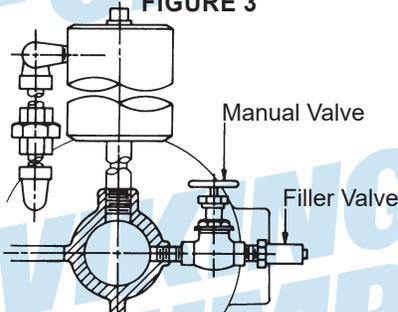
Since Viking pumps are of the positive displacement type, be sure that there is no obstruction in the discharge line and that all valves are in operating position before starting the pump. Factory assembled port orientation will have right hand port suction and top port discharge unless otherwise specified. Port location is determined by looking at shaft end of pump. The pressure relief valve on the pump provides over pressure protection. Return-to-Tank pressure relief valves should be mounted on the discharge side of the pump. Internal type pressure relief valves should be mounted with the cap pointing towards the suction side of pump. Also refer to information under **"Pressure Relief Valve Instructions"** on page 11. The Viking pump mounted return-to-tank pressure relief valve (see **"Figure 15"** on page 11, **"Figure 16"** on page 12, **"Figure 17"** on page 12, and **"Figure 18"** on page 12) is fitted with a pressure relief plug to keep a valved off return line from building up excessive pressures.

⚠ DANGER !

Include provision for a pressure relief device in any part of a pump and piping system that can be valved off and, thus, completely isolated. Cold liquid ammonia when isolated will, as it warms up to room temperature, expand and exert tremendous pressures which may rupture the pump or piping unless relieved.

Refer to **Appendix, General Installation Notes** for additional general installation information.

FIGURE 3



PREVENTATIVE MAINTENANCE

Series 4924A pumps are designed for long, trouble free life under a wide variety of application conditions with minimum maintenance. However, the following should be considered:

LUBRICATION

Periodic external lubrication should be applied slowly with a hand gun at all lubrication fittings.

A good quality multi-purpose, polyurea, NLGI #2 grease is satisfactory in the majority of cases, however, applications involving very low temperatures may require other types of lubricants. Suggested frequency of lubrication is once every 500 hours of operation. Refer to Engineering Service Bulletin ESB-515. Consult your Viking Pump® representative if you have specific lubrication questions.

1. Double Mechanical Seal Reservoir: The Series 4924A ammonia pumps are shipped without oil in the reservoir. Before letting ammonia into a new or rebuilt pump, fill the reservoir with one pint of light Refrigeration Oil that is compatible with the Neoprene seal and has a maximum viscosity of 15,000 SSU at operating temperature.

Before opening valves and allowing ammonia to fill the pump, be sure the hand valve on the reservoir (⊙ in **"Figure 6"** on page 6) is open.

Change the oil in your double seal pump reservoir after the first 200 hours of operation and then every 1000 hours of operation by the method mentioned below:

- a. Stop pump and close hand valve (⊙ in **"Figure 6"** on page 6) on oil reservoir.

⚠ DANGER !

Be sure ammonia pressure in pump is not above 5 PSIG when filling reservoir. If pressure is higher, pumping chamber should be bled down to reduce pressure to 5 PSIG or below. (Before bleeding pump, read **"Safe Practices"** on page 5 and **"Venting the Pump"** on page 5). Pressure above 5 PSIG in the pump may cause inner seal seat to be unseated or may force the faces of the inner seal apart allowing any dirt accumulated around the inner seal to be forced between the faces, which may cause the seal to leak when the pump is started.

- b. Remove ½ inch NPT oil filler plug in top of reservoir carefully and allow the small amount of ammonia trapped in the reservoir to vent.
- c. Open oil drain plug and allow old oil to drain.
- d. Replace oil drain plug and fill reservoir with light Refrigeration Oil to within 1½ inch of the top (approximately 1 pint).
- e. Replace ½ inch NPT oil filler plug in top of reservoir.
- f. Open hand valve.
- g. Wait one minute then start the pump and allow it to run from two to three minutes before the liquid is introduced into the pump. This will allow the seat to seal itself properly before the pressure is applied.

NOTE: If your pump has an automatic snap on filler valve arranged similar to that shown in **"Figure 3"** on page 4, it is not necessary to stop the pump to add oil to the reservoir. Merely connect lubrication pump to automatic filler valve. Open manual valve and fill reservoir with light Refrigeration Oil to approximately 1½ inch from the top. Close manual valve and remove lubrication pump from filler valve. To change oil: proceed as indicated in steps a through g except vent pumping chamber to atmosphere before changing oil.

END CLEARANCE ADJUSTMENT

After long term operation, it is sometimes possible to improve the performance of a pump, without major repair, through adjustment of the end clearance of the pump. Refer to instruction under **"Thrust Bearing Adjustment"** on page 10, for information regarding this procedure.

CLEANING THE PUMP

It is good practice to keep the pump as clean as possible. This will facilitate inspection, adjustment, and repair work and help prevent overlooking a dirt covered grease fitting.

STORAGE

If pump is to be stored or not used for six months or more, pump must be drained and a light coat of non-detergent SAE 30 weight oil must be applied to all internal pump parts.

Lubricate fittings and apply grease to pump shaft extension. Viking suggests rotating pump shaft by hand one complete revolution every 30 days to circulate the oil. Tighten all pump assembly bolts before putting pump in service after being stored.

SUGGESTED REPAIR TOOLS

The following tools must be available to properly repair these pumps. These tools are in addition to standard mechanics' tools such as open-end wrenches, pliers, screwdrivers, etc. Most of the items can be obtained from an industrial supply house.

1. Soft Headed Hammer
2. Allen wrenches (some mechanical seals and set collars)
3. Mechanical Seal Installation Sleeve
2-751-002-730-00 for 1.125" Seal; HL4924A
2-751-003-730-00 for 1.4375" Seal, K-LL4924A
4. Bearing Locknut Spanner Wrench
5. Spanner Wrench, adjustable pin type for use on bearing housing (Source: #482 J.H. Williams & Co. or equal)
6. Brass or plastic bar
7. Arbor press

MAINTENANCE

IMPORTANT: READ THE FOLLOWING BEFORE REMOVING A PUMP FROM AN AMMONIA SYSTEM OR BEFORE STARTING REPAIR WORK ON A PUMP.

⚠ DANGER !

Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc.) Be sure:

1. That any pressure in the chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.
2. That the driving means (motor, turbine, engine, etc.) has been "locked out" or made non-operational so that it cannot be started while work is being done on pump.
3. That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a material safety data sheet (MSDS) for the liquid to be sure these precautions are understood.

Failure to follow above listed precautionary measures may result in serious injury or death.

AMMONIA (Anhydrous Ammonia, NH₃)

Ammonia is a colorless gas or liquid, has a pungent odor, as a gas is lighter than air, is easily liquefied by pressure alone, and is very soluble in water. It boils at -28°F; vapor pressure is 16 PSIG at 0°F, 45 PSIG at 30°F, 93 PSIG at 60°F, and 138 PSIG at 80°F.

⚠ DANGER !

Exposure to ammonia causes intense irritation to the surface tissue of the eyes, nose, throat, and lungs. Exposure to high concentrations of ammonia may blind, burn, strangle, or kill.

SAFE PRACTICES

Basic safety practices and equipment should always be used when working with ammonia. Only personnel familiar with ammonia systems should work on these pumps.

A listing of safe practices and equipment are available from many sources, including those listed below. A copy of such a listing and safe practices and equipment should be made available to everyone working where ammonia is used.

The Safety Department of any company using ammonia should have information about the basic safety practices and equipment to use when working with ammonia. The supplier of the ammonia should always have the same information.

ANSI - American National Standards Institute, Inc.:
www.ansi.org (Bulletin ANSI-K61.1)

CGA - The Compressed Gas Association, Inc.:
www.cganet.com (Pamphlet G-2 on Anhydrous Ammonia)

IIAR - International Institute of Ammonia Refrigeration:
www.iiar.org

OSHA - Occupational Safety and Health Administration, U.S. Department of Labor: www.osha.gov

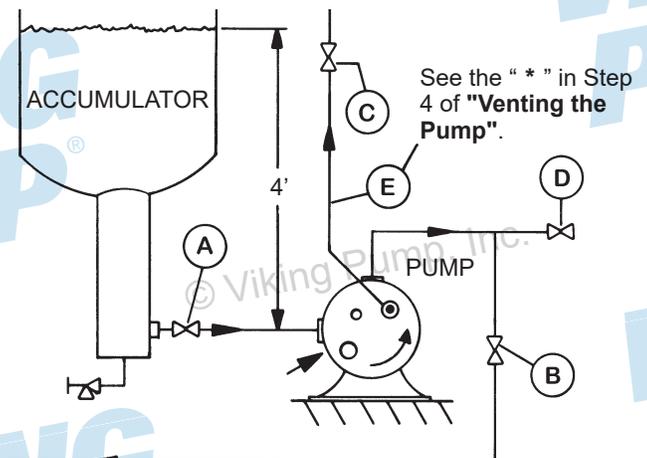
The above references give specifics on safety practices and equipment. In addition to those, some general precautions include:

- **WORK CAREFULLY.**
- **DO NOT HURRY.**
- **LOOK AT ANY PRESSURE GAUGES TO DETERMINE CONDITIONS IN THE SYSTEM.**
- **HAVE PLENTY OF WATER AVAILABLE.**

VENTING THE PUMP

1. Stop the pump (some maintenance people close the inlet shutoff valve before stopping the pump; but, this is not recommended practice).
2. Close the inlet (suction) side shutoff valve. Ⓐ in "Figure 4" on page 5.
3. Close the discharge side shutoff valve. Ⓑ in "Figure 4" on page 5.

FIGURE 4:
SCHEMATIC OF PIPING AND VALVES FOR A LIQUID AMMONIA RECIRCULATING PUMP IN A REFRIGERATION SYSTEM



- Close all other shut off valves in lines connected to the pump. Typical shut off valves include valve ③ in line ⑥* in "Figure 4" on page 5 from the pump mounted return-to-tank type relief valve to the accumulator or the valve from an in line mounted safety relief valve to the accumulator or the valve in a pressurizing line from the high pressure side of the system to the pump double seal oil reservoir, line ② in "Figure 5" on page 6.

* The segment of line (⑥ in "Figure 4" on page 5) between the return to tank pressure relief valve and the shutoff valve, ③, should include a pressure relief valve vented to a safe area.

- Allow ice on pump to melt. This process can be sped up by running cold water over the pump.

Start the venting process as soon as convenient after the ice has been removed from the pump. This will allow venting the ammonia at the lower pressures of a cold pump rather than at the high vapor pressures in a room temperature pump.

For systems with vent (purge or bleed) valves (e.g. ④ "Figure 4" on page 5) go to step 6; for systems without a vent valve, go to step 7.

- A hose should be connected to any vent valve (e.g. ④ in "Figure 4" on page 5) in the blocked off portion of the system. The open end of the hose should be placed under water in a tank containing at least 10 times as much water as there is ammonia in the blocked off portion of the system or the end of the hose should be lead to a safe, well ventilated area. After the hose has been attached and the open end properly located under water, then open the vent valve. Check the open end of the hose to make sure the ammonia is venting. After ammonia has stopped venting, continue with step 8.
- If there are no vent valves in the blocked off piping, the Viking 4924A Series™ ammonia pump should be vented by carefully loosening the fitting (① in "Figure 5" on page 6) on the lower end of the tubing that runs from the pump bracket to the double seal oil reservoir.

THERE SHOULD BE A DISTINCT "PSST" SOUND WHEN THE AMMONIA VAPOR LIQUID STARTS TO VENT. LEAVE THE AREA UNTIL THE VENTING IS COMPLETE.

If there is rigid pipe instead of tubing running from the pump bracket to the double seal oil reservoir, the pipe union should be loosened carefully until the "psst" is heard.

If there is no line from the bracket to the reservoir, carefully loosen the pipe plug (drain), ③ in "Figure 6" on page 6 towards the bottom of the bracket. This pipe plug is found only on the K, KK, LQ and LL size 4924A Series™ pumps. The small HL4924A does not have a pipe plug. When working on an HL4924A pump that has no line between the bracket and double seal oil reservoir, carefully loosen the pipe plug, ④ in "Figure 6" on page 6, in the suction port of the pump.

- Carefully loosen any unions or tubing fittings in any other lines to the pump that have been blocked off by closing the shutoff valves so that venting from these segments of the system can be accomplished. Typical of such lines would be that from the pump mounted return-to-tank relief valve to the accumulator, ⑥* in "Figure 4" on page 5, or a line from the high pressure side of the system to the double seal oil reservoir, line ② in "Figure 5" on page 6.

ALWAYS LISTEN FOR THE "PSST" AT ANY POINT LOOSENED TO PROVIDE VENTING.

- Carefully loosen the fill plug, ⑤ in "Figure 5" on page 6, in the top of the double seal oil reservoir.
- After the ammonia has stopped venting, turn the pump shaft, ⑦ in "Figure 5" on page 6, over for at least ⑧ 10 complete revolutions. This will make sure that there is no pocket of accumulated ammonia that has not been exposed to a venting point.
- Carefully loosen the plugs, ④ in "Figure 6" on page 6 and ⑦ in "Figure 5" on page 6, in the suction and discharge ports of the pump. If ammonia continues to vent, wait until the venting stops. When venting from all the loosened connections stops, then complete the loosening of the fittings and complete the removal of the plugs.
- When all venting has stopped, continue with removing the pump from the system or disassembly of the pump in place.

FIGURE 5: VIKING REFRIGERATION AMMONIA PUMP WITH RETURN-TO-TANK PRESSURE RELIEF VALVE

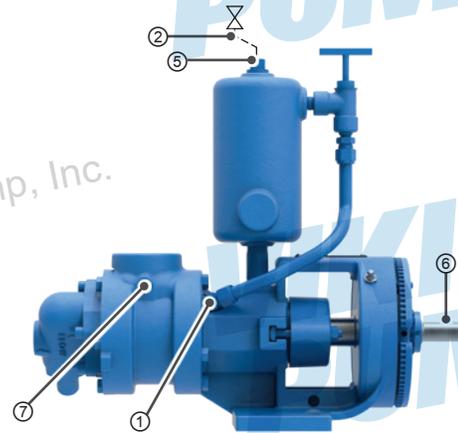


FIGURE 6: VIKING REFRIGERATION AMMONIA PUMP WITH INTERNAL PRESSURE RELIEF VALVE

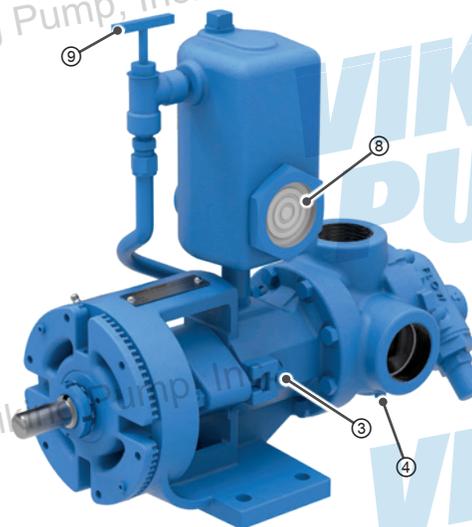
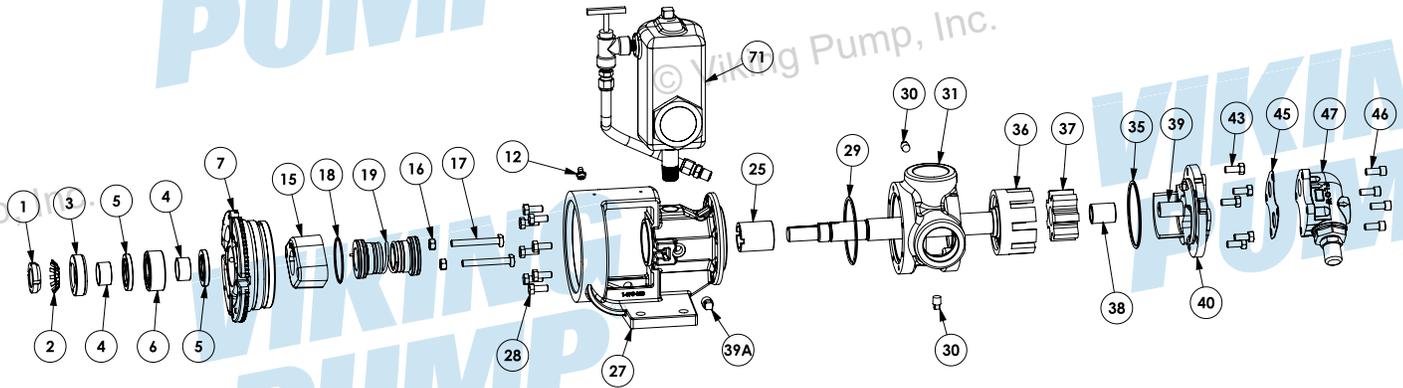


FIGURE 7: EXPLODED VIEW (LQ SIZE)



Item	Name Of Part	Item	Name Of Part	Item	Name Of Part
1	Locknut	18	Seal Gland O-Ring	38	Idler Bushing
2	Lockwasher	19	Seal, Double Mechanical	39	Idler Pin, Lube
3	End Cap for Bearing Housing	25	Bracket Bushing	39A	Pipe Plug
4	Bearing Spacer Collar	27	Bracket & Bushing	40	Head & Idler Pin
5	Lip Seal for Bearing Housing (2 Req'd)	28	Capscrews for Bracket (8 Req'd)	43	Capscrews for Head
6	Ball Bearing	29	O-Ring Gasket for Bracket	45	Relief Valve Gasket or O-Ring (2 Req'd)
7	Bearing Housing	30	Pipe Plug (2 Req'd)	46	Capscrews for Valve
12	Grease Fitting	31	Casing	47	Return-To-Tank Relief Valve
15	Seal Gland	35	O-Ring Gasket for Head	71	Reservoir with Sight Glass & Plug
16	Locknuts for Seal Gland (2 Req'd)	36	Rotor & Shaft		
17	Bolts for Seal Gland (2 Req'd)	37	Idler & Bushing		

⚠ DANGER !

Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc.) be sure:

1. That any pressure in the chamber has been completely vented through the suction or discharge lines, or other appropriate openings or connections.
2. That the driving means (motor, turbine, engine, etc.) has been "locked out" or made non-operational, so that it cannot be started while work is being done on pump.
3. That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a material safety data sheet (MSDS) for the liquid to be sure these precautions are understood.

Failure to follow above listed precautionary measures may result in serious injury or death.

PUMP DISASSEMBLY

NOTE: BE SURE TO READ ALL PREVIOUS PAGES PRIOR TO PUMP DISASSEMBLY.

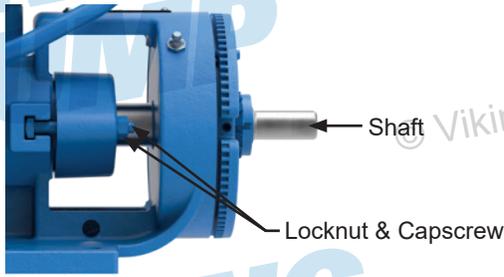
1. Mark head and casing before disassembly to ensure proper reassembly. The idler pin, which is offset in pump head, must be positioned toward and equal distance between port connections to allow for proper flow of liquid through the pump.

Remove head from pump.

Do not allow idler to fall from idler pin. Tilt top of head back when removing to prevent this. Avoid damaging head O-Ring. If pump is furnished with pressure relief valve, it need not be removed from head or disassembled at this point. Refer to "Pressure Relief Valve Instructions" on page 11.

2. Remove idler and bushing assembly from the idler pin.
3. Bend up the tang on the lockwasher and use a spanner wrench to remove the lockwasher and locknut, see "Figure 7" on page 7. **NOTE:** A piece of brass or wood inserted through the port opening and between the rotor teeth will keep the shaft from turning.
4. Loosen the two seal gland locknuts and remove the seal holder plate. For parts identification, see "Figure 7" on page 7.
5. Loosen two setscrews in the face of the bearing housing and remove the bearing housing assembly from the Bracket. See "Figure 9" on page 8.

FIGURE 8



6. Drive the shaft forward approximately $\frac{1}{2}$ " and remove the pair of half round rings (K - LL size) under the inner bearing spacer collar or the shaft shoulder (HL size) at the end of the inner bearing spacer collar, see "Figure 9" on page 8.

NOTE: The half round rings (K - LL size) must be removed before the rotor and shaft can be removed from the pump. These rings will not pass through the mechanical seal and bracket bushing.

7. Carefully remove the rotor and shaft. As the shaft is being removed decreasing shaft diameters tend to allow the shaft to drop onto the bracket bushing. To avoid damaging the bracket bushing, support the rotor and do not allow either end of the shaft to tilt downward.

NOTE: Considerable force may be required to remove the rotor and shaft from the pump. Be careful as not to damage seal parts as the rotor and shaft is removed. Some of the seal parts may fall off when the rotor and shaft are removed. Place them to the side to be put with other mechanical seal parts when they are removed.

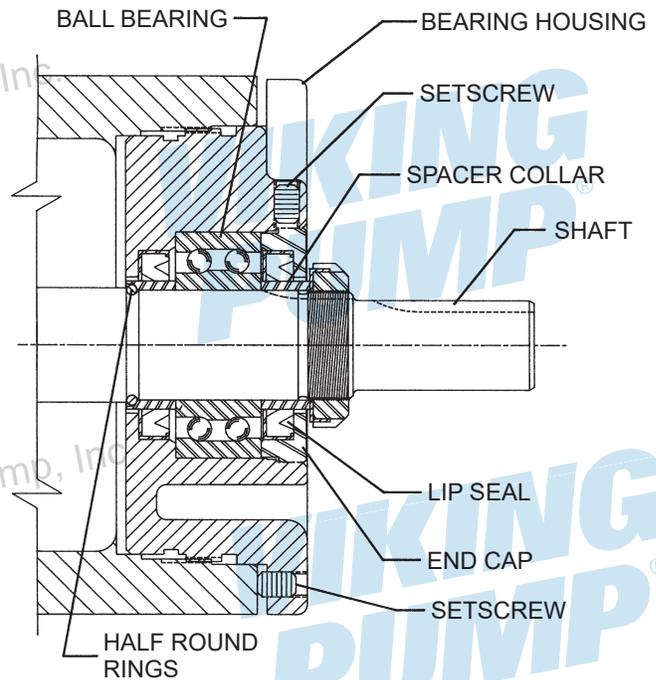
8. Loosen two radial setscrews in flange of bearing housing and with a spanner wrench remove the outer end cap with closure and outer bearing spacer collar.

9. Remove the double row ball bearing, lip seal, and inner bearing spacer collar from the bearing housing.

NOTE: The inner end cap can be removed through the side opening in the bracket.

10. The seal seats and rotary members of the seal may be removed from the side opening of the bracket; see step 14 for removal of the double mechanical seal.

FIGURE 9



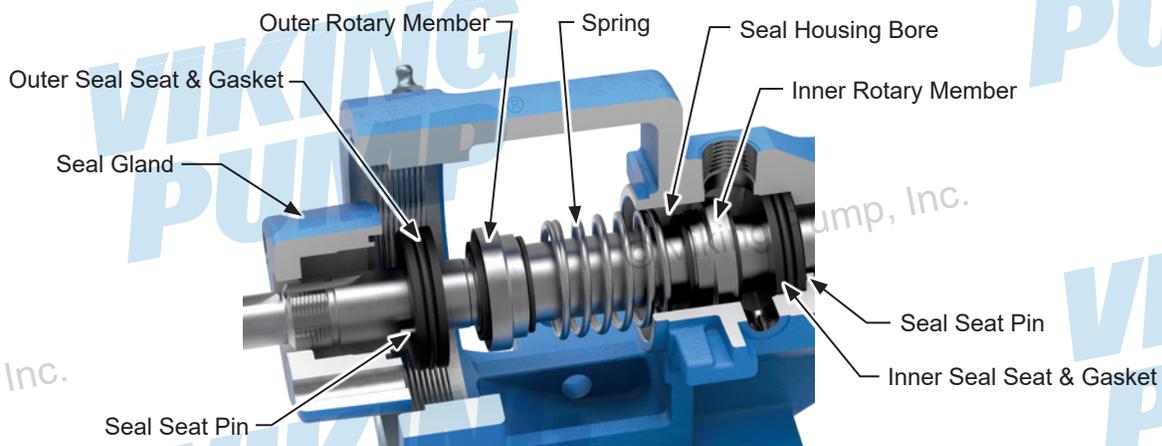
11. Clean all parts thoroughly and examine for wear or damage. Check lip seals, ball bearing, bushings, and mechanical seal and replace as necessary. Check all other parts for nicks, burrs, excessive wear, and replace if necessary.

NOTE: Be sure that the shaft is free from burrs and foreign particles that might damage the bracket bushing. Scratches on the shaft in the seal area will provide leakage paths under the mechanical seal.

12. Check casing for wear or damage while mounted to the bracket.

13. See "Figure 10" on page 8. The mechanical seal consists of five basic parts. They are: inner and outer seal seats with O-ring gaskets; inner and outer rotary members; and spring. When pump is running, the seal cap and inner and outer seal seats with O-ring gaskets remain stationary in the bracket seal housing bore; the inner and outer rotary members turn with the shaft.

FIGURE 10: DOUBLE MECHANICAL SEAL



14. The pump has now been disabled to the point where the double mechanical seal may be removed from the seal housing bore of the bracket.

NOTE: Pay particular attention to the location, arrangement and construction of the seal parts as it will help considerably when the pump is reassembled.

15. The O-ring gaskets of the seal seats may have become slightly sealed against the side of the housing and require extra effort. If this happens, apply light oil in the seal housing bore in front of the seats so they will slide freely.
16. After removing the outer seal seat, the outer rotary member, the spring, and the inner rotary member can be removed.
17. Remove the inner seal seat and gasket by bending the ends of two lengths of wire and then by inserting the bent end in the slots in the bushing and pulling the seal seat through the housing from the shaft end. If removal is difficult, an arbor press may be used to push the bracket bushing, seal seat, and gasket out of the bore from the rotor end. Another coating of light oil may be helpful to ease the seal seat out of the housing.

Another way of removing the inner seal seat is to drive it out while inserting a screwdriver through the bracket bushing from the casing end so it hits the seal seat at the notches in the bracket bushing. Be careful and do not damage the bracket bushing when removing the inner seal seat in this manner.

FIGURE 11

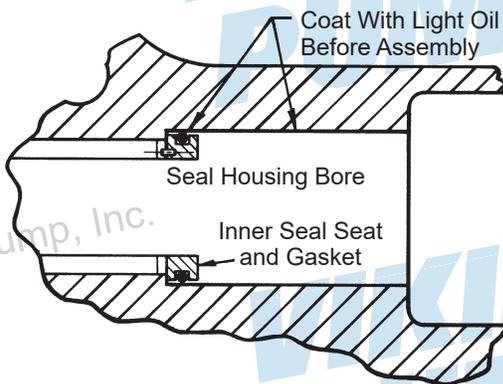


FIGURE 12



FIGURE 13



NOTE: Coat rotor shaft, tapered installation sleeve and inner diameter of mechanical seal with P-80® or equivalent before assembly.

PUMP ASSEMBLY

1. Installing a new seal: The seal is simple to install and good performance will result if care is taken in installation, see "Figure 10" on page 8 for parts identification.

Seals made by different manufacturers are used in these pumps and are used interchangeably though they may look different and have a different spring.

After all parts have been examined and cleaned or replaced as necessary, the first step in reassembling the pump is installation of the inner seal seat.

Good performance will result if care is taken during installation.

NOTE: Never touch mechanical seal faces with anything except clean hands, cardboard, or clean cloth. Minute particles can scratch the seal faces and cause leakage.

2. Clean the bracket seal housing bore, making sure it is free of dirt and grit.
3. Coat the outside of the inner seal seat and O-ring gasket and also the inside diameter of the seal housing bore with light Refrigeration Oil (not grease), see "Figure 11" on page 9. Press the inner seal seat with O-ring gasket into place in the seal housing bore with your fingers or by putting a piece of cardboard over the face of the seal seat and pressing with a block of wood or squared off piece of pipe. Remove the cardboard. "Figure 12" on page 9 shows how the inner seal seat pin fits into either of the slots in the end of the bracket bushing. Be sure the pin engages one of these slots in the bushing when you have finished pushing the seal seat into the seal housing bore. Check by looking through the bracket bushing from the casing end.
4. Clean and coat the pump shaft with light Refrigeration Oil. Check to be sure no scratches have been cut into the shaft in the seal area.
5. After replacing the casing on the bracket, place the rotor and shaft into the casing.

NOTE: If the casing is removed from the bracket, be sure the bracket O-ring is in place before placing casing on bracket.

6. Place the O-ring or head gasket on the head.
7. Coat idler pin with light Refrigeration Oil and place idler and bushing on idler pin in head. If replacing carbon graphite bushing, refer to "Installation: Carbon Graphite Bushings" on page 10. Install head and idler assembly onto the pump. Make sure the idler pin, which is offset in the pump head, is positioned toward and equal distance between port connections to allow for proper flow of liquid through the pump. Tighten the head capscrews evenly.
8. Place the tapered installation sleeve (furnished with replacement seals - all sizes) on the shaft as shown in "Figure 13" on page 9.
9. Clean and oil the I.D. of the inner rotary member, place on shaft and slide over the tapered installation sleeve into position against the inner seal seat. Push against the rubber tail section of the bellows with a sleeve or smooth piece of pipe having an inside diameter no more than $\frac{1}{32}$ inch larger than the shaft diameter and a wall thickness of at least $\frac{1}{8}$ inch. Be sure to install correct end against seal seat, see "Figure 10" on page 8. Be sure carbon face does not fall out of the rotary member.

10. Slide the spring along the shaft and make sure it seats properly over the inner rotary member. It may be helpful to stand pump on end to facilitate centering the spring.

11. Coat the outer seal seat and O-ring gasket with light Refrigeration Oil. Spread a thin film of grease on the seal cap. Place the outer seal seat in position on the seal cap. Make sure the pin in the seal seat engages the hole in the seal cap. The film of grease will hold these two parts together; set them aside temporarily.

12. Coat the inside diameter of the outer rotary member with light Refrigeration Oil. Place it on the shaft and slide over the tapered installation sleeve until it engages the spring. Be sure to install the correct end towards the spring, see "Figure 10" on page 8.

13. Install the seal gland O-ring in the seal gland groove and install the seal gland bolts in the T-slots. Quickly install the outer seal seat prepared in step 11 over the shaft. Fit the seal gland with the O-ring onto the seal gland bolts and press down against the outer rotary member until the seal gland hits the end of the bracket. This compresses the spring and positions the outer rotary member. Do not release the seal gland.

14. Still holding the seal gland against the end of the bracket, tighten the two locknuts uniformly. This holds the seal gland in position and ensures proper positioning of seal.

NOTE: Do not permit either the inner or outer rotary member to remain on the shaft in any position other than their final position for more than 30 seconds since the rubber bellows of the rotary members have a tendency to stick to the shaft. If the bellows are not in correct position, the rotary member will be improperly seated.

15. Remove tapered sleeve.

16. Install the lip seal (lip toward end of shaft) in the bearing housing and turn the bearing housing into the bracket.

17. Pack the ball bearing with grease, place on the shaft and push or drive into place in housing.

18. Install the lipseal (with lip toward end of shaft) and bearing spacer collar in the outer end cap and turn the end cap into the bearing housing until tight against the bearing. Lock in place with two set screws in the flange of the bearing housing.

19. Put lockwasher and locknut on shaft. Insert brass or plastic bar through port opening between rotor teeth to keep shaft from turning. Tighten locknut to 50-70 ft.-lbs. torque (H, HL) or 100-130 ft.-lbs. torque (K, KK, LQ, LL). Bend one tang of lockwasher into slot of locknut. If tang does not line up with slot, tighten locknut until it does. Failure to tighten locknut or engage lockwasher tang could result in early bearing failure and cause damage to pump. Remove brass or plastic bar from port opening.

20. Adjust pump end clearance as indicated in "Thrust Bearing Adjustment" on page 10.

21. Lubricate all grease fittings with multi-purpose grease, NLGI #2.

22. Insert the pipe plug (drain) into the bracket. Close the hand valve and fill the reservoir to within 1½ inches of the top with light Refrigeration Oil. It is recommended that the oil be drained and the reservoir be refilled after the first 200 hours of operation and then after every 1000 hours.

NOTE: Re-open the hand valve before the pump is put into operation. The double mechanical seal will not function properly if it is exposed to ammonia pressure with this valve closed.

THRUST BEARING ADJUSTMENT

1. Loosen the two set screws in the outer face of the bearing housing and turn this thrust bearing assembly clockwise until it can no longer be turned by hand. Back off counter-clockwise until the rotor shaft can be turned by hand with a slight noticeable drag.
2. For standard end clearance, back off the thrust bearing assembly the required length measured on the outside diameter of the bearing housing. See "Table 1" on page 10.
3. Tighten the two self-locking type "Allen" set screws, in the outboard face of the bearing housing, with equal force against the bracket. Your pump is now set with standard end clearances and locked.

NOTE: Be sure the shaft can rotate freely. If not, back off.

TABLE 1: END CLEARANCE

Pump Size	Standard End Clearance (Inch)	Turn Bearing Housing CCW Length on O.D. (Inch)
HL	120-150	1 - .015", 2 - .006"
K, KK, LQ, LL	170-190	2 - .015", 1 - .006"

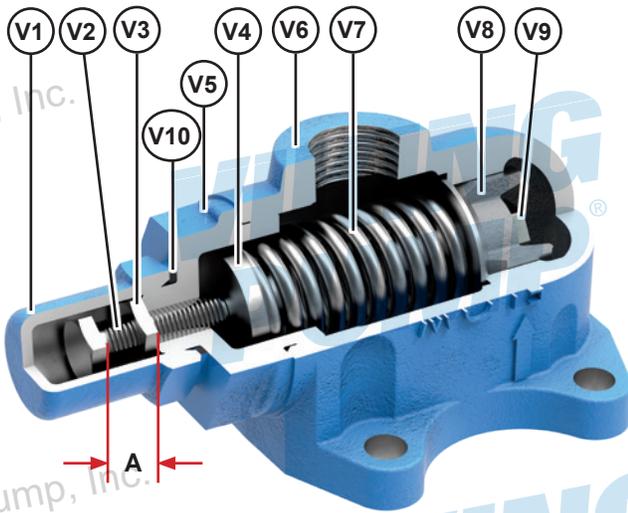
INSTALLATION: CARBON GRAPHITE BUSHINGS

When installing carbon graphite bushings, extreme care must be taken to prevent breaking. Carbon graphite is a brittle material and easily cracked. If cracked, the bushing will quickly disintegrate. Using a lubricant and adding a chamfer on the bushing and the mating part will help in installation. The additional precautions listed below must be followed for proper installation.

1. A press must be used for installation.
2. Be certain bushing is started straight.
3. Do not stop pressing operation until bushing is in proper position. Starting and stopping will result in a cracked bushing.
4. Check bushing for cracks after installation.

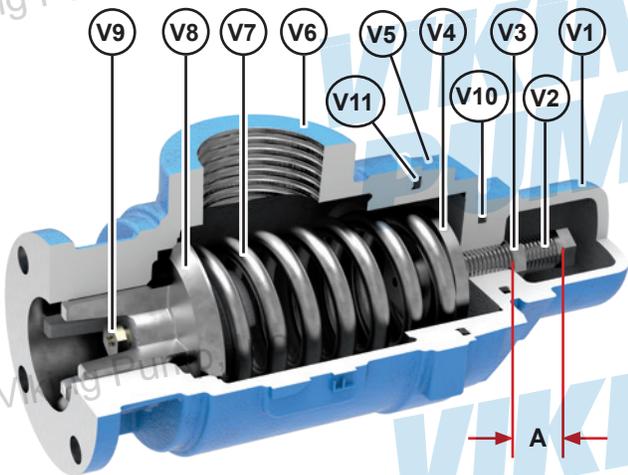
PRESSURE RELIEF VALVE INSTRUCTIONS

FIGURE 14: RELIEF VALVE - HL SIZE
NOTE: Image is representative only.



Valve - List Of Parts			
V1.	Valve Cap	V6.	Valve Body
V2.	Adjusting Screw	V7.	Valve Spring
V3.	Lock Nut	V8.	Poppet
V4.	Spring Guide	V9.	Pressure Relief Plug
V5.	Bonnet	V10.	Cap Gasket

FIGURE 15: RELIEF VALVE - K, KK, LQ, LL SIZES
NOTE: Image is representative only.



Valve - List Of Parts			
V1.	Valve Cap	V7.	Valve Spring
V2.	Adjusting Screw	V8.	Poppet
V3.	Lock Nut	V9.	Pressure Relief Plug
V4.	Spring Guide	V10.	Cap Gasket
V5.	Bonnet	V11.	Bonnet Gasket
V6.	Valve Body		

⚠ DANGER !

Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc.) be sure:

1. That any pressure in the chamber has been completely vented through the suction or discharge lines, or other appropriate openings or connections.
2. That the driving means (motor, turbine, engine, etc.) has been "locked out" or made non-operational, so that it cannot be started while work is being done on pump.
3. That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a material safety data sheet (MSDS) for the liquid to be sure these precautions are understood.

Failure to follow above listed precautionary measures may result in serious injury or death.

DISASSEMBLY

Mark valve and head before disassembly to ensure proper reassembly.

1. Remove valve cap.
2. Measure and record length of extension of adjusting screw. Refer to "A" on "Figure 14" on page 11 and "Figure 15" on page 11.
3. Loosen locknut and back out adjusting screw until spring pressure is released.

Remove bonnet, spring guide, spring and poppet from valve body. Clean and inspect all parts for wear or damage and replace if necessary.

ASSEMBLY

Reverse procedures outlined under Disassembly. If valve is removed for repairs be sure to replace in same position.

"Figure 16" on page 12 shows the standard pump rotation (clockwise). When viewing the shaft end, the inlet port is on the right and the outlet on the top.

If the pump rotation is reversed as shown on "Figure 17" on page 12 to give counterclockwise rotation when viewing the shaft end, the inlet port is on the top and the outlet port on the right.

On "HL" size pumps equipped with Return-To-Tank pressure valves, (see "Figure 14" on page 11) the cap should point towards the suction side of pump.

On "K" - "LL" size pumps equipped with return-to-tank pressure relief valves, (see "Figure 15" on page 11) the valve must always be mounted on the valve port nearest the pump discharge port, see "Figure 18" on page 12. Valve port nearest the pump inlet port must be covered with the valve cover plate.

⚠ DANGER !

Before starting pump, be sure all drive equipment guards are in place.

Failure to properly mount guards may result in serious injury or death.

FIGURE 16

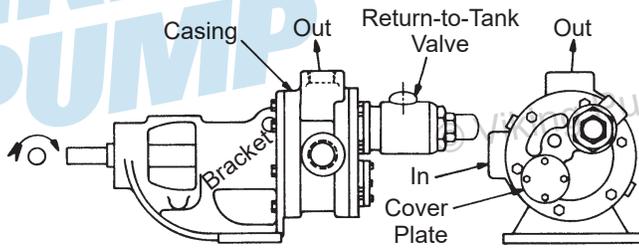


FIGURE 17

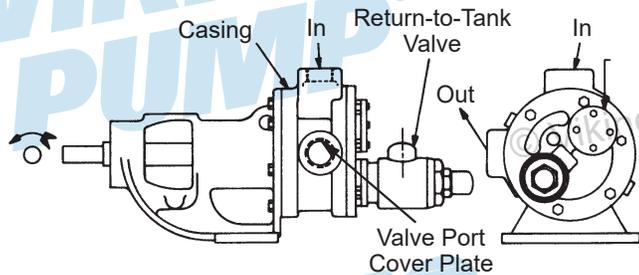
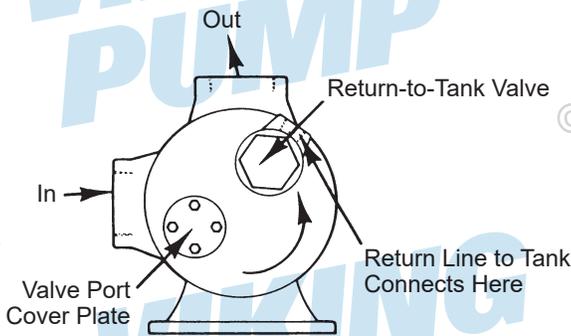


FIGURE 18



! DANGER !

Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc.) be sure:

1. That any pressure in the chamber has been completely vented through the suction or discharge lines, or other appropriate openings or connections.
2. That the driving means (motor, turbine, engine, etc.) has been “locked out” or made non-operational, so that it cannot be started while work is being done on pump.
3. That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a material safety data sheet (MSDS) for the liquid to be sure these precautions are understood.

Failure to follow above listed precautionary measures may result in serious injury or death.

PRESSURE ADJUSTMENT

If a new spring is installed or if pressure setting of pressure relief valve is to be changed from that which the factory has set, the following instructions must be carefully followed.

1. Carefully remove valve cap which covers adjusting screw. Loosen locknut which locks adjusting screw so pressure setting will not change during operation of pump.
2. Install a pressure gauge in discharge line for actual adjusting operation.
3. Turn adjusting screw CW (in) to increase pressure and CCW (out) to decrease pressure. For guidance dimensions, contact your Viking Pump® representative for Engineering Standard ES-37.
4. Close the discharge line at a point beyond the pressure gauge. Limit the amount of time the pump is being operated at this condition. The temperature inside the pump will rise rapidly. Gauge will show maximum pressure that valve will allow while pump is in operation.
5. Once pressure is set, tighten locknut and replace cap gasket and valve cap.

IMPORTANT ORDERING INFORMATION

In ordering parts for pressure relief valve, always give model number and serial number of pump as it appears on nameplate and name of part wanted. When ordering springs, be sure to give pressure setting desired.

TROUBLESHOOTING

A Viking pump that is properly installed and maintained will give long satisfactory performance.

If trouble does develop, one of the first steps toward finding the difficulty is to install a vacuum gauge in the suction line and a pressure gauge in the discharge line. Readings on these gauges often give a clue on where to start looking for trouble.

1. Pump will not start to rotate

- a. Motor not hooked up or hooked up correctly - check wiring.
- b. Something has gotten into pump and has jammed rotating parts - remove head and take out obstruction.
- c. End clearance has been set too close - adjust end clearance.
- d. Drive equipment jammed - remove obstruction.

2. Pump fails to pump

- a. Suction line valve not open - open valve.
- b. Suction strainer is plugged - clean strainer.
- c. Pump vapor bound - vent discharge lines.
- d. Relief valve bypassing - remove obstruction or open valve. Weld bead or other foreign material under poppet - disassemble valve and remove foreign material. Valve setting too low for differential pressure required - increase setting or get heavier spring.
- e. Pump rotating wrong way - change direction of motor rotation or change piping.
- f. No liquid in accumulator - check controls.
- g. Drive equipment broken - repair or replace.

3. Pump is noisy

- a. Cavitation (liquid vaporizing on suction side of pump) - increase head of liquid on pump; reduce line loss in suction piping; insulate suction line; reduce pump speed.
- b. Pump is starved due to no liquid in the accumulator - adjust floats or time cycle.
- c. Relief valve chattering - increase pressure setting of relief valve.
- d. Binding - check alignment of unit; check for pipe strain.
- e. Drive equipment worn or damaged - repair or replace.

4. Low capacity

- a. Motor running at wrong speed - check wiring.
- b. Speed too slow - change drive or get motor with faster rated speed.
- c. Too much end clearance - adjust end clearance.
- d. Internal wear - replace worn parts.
- e. Pump too small - use a larger pump or two small ones.
- f. Suction line too small - reduce length or increase size.
- g. Relief valve opening - increase pressure setting.
- h. Bypass line valve open - adjust valve.

5. Rapid wear

- a. Dirt in the system - install suction line strainer temporarily until system is clean.
- b. Cavitation (liquid vaporizing on suction side of pump) - increase head of liquid on pump; reduce line loss in suction piping; insulate suction line; reduce pump speed.
- c. Pump misaligned or distorted - check alignment of unit; check for pipe strain.
- d. Running too fast - change drive or use larger pump that could run slower.
- e. Pump runs dry part of time - check level controls to be sure there is always liquid in the pump.

6. Relief valve does not function

- a. Installed incorrectly - return-to-tank type relief valve should be mounted on the head opening toward the discharge side of pump. Internal type relief valve should be mounted so the cap points toward suction port of pump.
- b. Setting too high - reduce setting or get lighter spring.
- c. Valve poppet binding - remove poppet, check for burrs or foreign material.
- d. Shut-off valve in relief valve return line closed - open valve (would apply only to pumps with return-to-tank type relief valves).

7. Mechanical seal leak

- a. Normal wear - replace seal.
- b. Improper installation - refer to seal installation steps in **Pump Assembly**.
- c. Abrasive material in liquid - if abrasive material on ammonia side, use traps or strainer to clean system; if on oil side, change oil more frequently and use clean oil.
- d. Pump operating at very low temperature causing oil to become heavy - use lighter oil or use immersion heater to heat oil.

AMMONIA

Ammonia (Anhydrous Ammonia, NH₃)

Ammonia is a colorless gas or liquid, has a pungent odor, as a gas is lighter than air, is easily liquefied by pressure alone, and is very soluble in water or alcohol.

Ammonia is one of the best known and widely used refrigerants in use today in ice plants, food lockers, cold storage warehouses, and other industrial cooling processes. Ammonia has a higher refrigeration effect, per unit of liquid volume, than any other type of commonly used refrigerant; other advantages are low initial cost and low pipe friction losses.

TABLE 2: PHYSICAL PROPERTIES

Boiling point (atmospheric pressure)	-28°F.
Freezing point (atmospheric pressure)	-107.9°F.
Viscosity at -28°F.	0.27 cP
Specific Gravity at -28°F.	0.68
Liquid Density at -28°F.	42.6 lbs./ft ³
Liquid Density at -28°F.	5.7 lbs./gal.
* Latent heat of vaporization at -28°F.	589 BTU/lb.

* (Number of BTU's to change one pound liquid ammonia from liquid to gas)

Ammonia, like LP-Gas and other high vapor pressure liquids, has to be kept in a closed container to keep it from boiling away. For a given temperature, the pressure built up within the container is equal to the vapor pressure or saturation pressure. Conversely for any given pressure, there is a temperature at which the liquid and vapor are in equilibrium (saturation temperature); see "Table 3" on page 14. If the pressure in the container is held constant and the vapor is withdrawn, the ammonia will vaporize (boil). As it boils, it picks up heat from the area around the container since over 500 Btu's are necessary to change one pound of ammonia from liquid to vapor. If the pressure over the ammonia is reduced, the boiling temperature will be reduced and the boiling temperature will be lowered.

Thus the temperature around the container can be controlled by the pressure maintained in the container. "Table 3" on page 14 shows the ammonia vapor pressure for various temperatures.

The saturation properties of ammonia make it desirable for use as a refrigerant. The temperatures necessary for freezing and keeping food products can be quite easily achieved with pressures or vacuums readily developed by available equipment.

Grades of Ammonia Available - commercial grade 99.5%, refrigeration grade 99.95%.

Explosive Limit in Air, by Volume - 15 to 28%.

Corrosion - Ammonia will not attack iron or steel even in the presence of moisture; it will attack copper, brass, bronze, and zinc in the presence of moisture.

Toxicity - Concentrations of ammonia in air as low as 53 parts per million can be detected by the sharp penetrating odor.

Exposure to ammonia causes intense irritation to the surface tissues of the eyes, nose, throat, and lungs. Exposure to high concentration of ammonia may blind, burn, strangle, or kill.

The effect of ammonia on the skin is that of a caustic burn, varying in severity with the concentration of ammonia and the length of time exposed. Changes in respiratory and heart action produced are reflex actions resulting from the irritation of the respiratory tract.

For information on the safe handling of ammonia, refer to "Safe Practices" on page 5.

TABLE 3: AMMONIA VAPOR PRESSURE

Saturated Vapor Pressure			
Temp. °F.	"Hg. Vacuum	PSI Gage	PSI Absolute
-100	27.4		1.24
-80	24.3		2.74
-60	18.6		5.55
-50	14.3		7.67
-40	8.7		10.4
-30	1.6		13.9
-28	0	0	14.7
-20		3.6	18.3
-10		9	23.7
0		15.7	30.4
10		23.8	38.5
20		33.5	48.2
30		45	59.7
40		58.6	73.3
50		74.5	89.2
60		92.9	108
80		138	153
100		197	212

"Figure 19" on page 15 is a schematic of a simple Vapor Ammonia Refrigeration System with the major pieces of equipment named and numbered. Each piece of equipment is described briefly and its function in the system discussed in the following paragraphs. To illustrate temperatures and pressures that would exist in an actual installation, there is given with the discussion of each piece of equipment the actual temperature and pressure for a system operating with a condenser temperature of 86°F and an evaporator temperature of 5°F.

RECEIVER - A storage tank for ammonia at ambient temperatures. The receiver "receives" the liquid ammonia as it comes from the condenser. The pressure in the receiver will correspond to the vapor pressure of the ammonia at the temperature of the cooling medium used in the condenser. In this case with an 86°F condenser temperature, the ammonia pressure would be 154 PSI (the saturation pressure corresponding to a temperature of 86°F).

EXPANSION VALVE - A throttling valve that controls the amount of liquid that flows into the evaporator. It can be controlled manually or by thermostats located in the evaporator. The temperature and pressure of the liquid on the inlet side of the expansion valve is the same as that in the receiver (86°F and 154 PSIG); the pressure on the outlet side of the expansion valve is that maintained in the evaporator by the compressor; (the compressor would have to pull down and hold the pressure in the evaporator at 19 PSIG to maintain the evaporator temperature at 5°F; this is the saturation temperature corresponding to 19 PSIG).

EVAPORATOR - The evaporator is the main purpose for the existence of the refrigeration system. It is through the evaporator that heat is picked up by the ammonia. The temperature in the evaporator area will be "pulled down"

APPENDIX (FORMERLY TSM 000)

NOTE: This Appendix section is for reference only. Not all pump construction features apply to pumps within this Technical Service Manual.

GENERAL INSTALLATION NOTES

Before installation is started, a few items of a general nature should be considered.

- 1. Location** - always locate the pump as close as possible to the supply of liquid to be pumped. Locate it below the liquid supply if at all practical. Viking pumps are self priming but the better the suction conditions the better the performance.
- 2. Accessibility** - the pump should be located where it is accessible for inspection, maintenance, and repair. For large pumps, allow room to remove the rotor and shaft without removing the pump from the base.
- 3. Port Arrangement** - since the pumps have different port arrangements depending on the model, port location should be checked before starting the installation. The ports may be upright, opposite or at right angles to each other, see **Figure A1**. The right angle ports are normally right-hand, see **Figure A2**; some models are available with left-hand arrangements; still other models are available with the right angle ports located in any one of eight positions including right-hand and left-hand.
- 4. Suction/Discharge** - shaft rotation will determine which port is suction and which is discharge. A look at **Figure A3** will show how rotation determines which port is which. As the pumping elements (gears) come out of mesh, point "A" on **Figure A3**, liquid is drawn into the suction port. Then at point "B" the gears come into mesh, and the liquid is forced out the discharge port. Reversing the rotation reverses the flow through the pump. When determining shaft rotation, always look from the shaft end of the pump. Unless otherwise specified, rotation is assumed to be clockwise (CW), which makes the suction port on the right side of the pump. The idler pin, which is offset in the pump head, should be properly positioned toward and an equal distance between the port connections. See **Figure A3** for correct idler pin location in relation to pump ports.

FIGURE A1



FIGURE A2



FIGURE A3

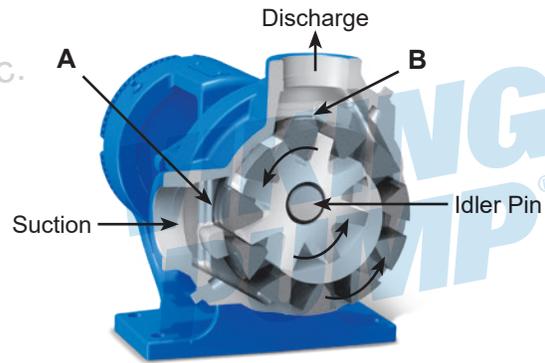


FIGURE A4: CUTAWAY OF VIKING INTERNAL PRESSURE RELIEF VALVE

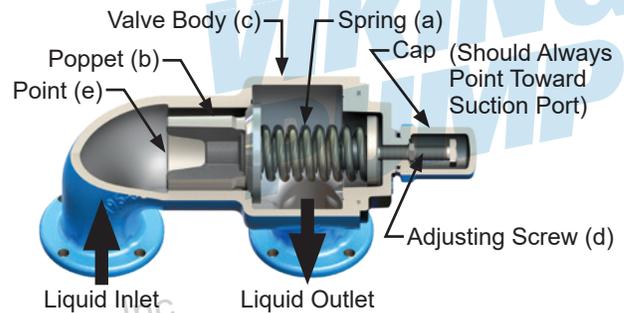
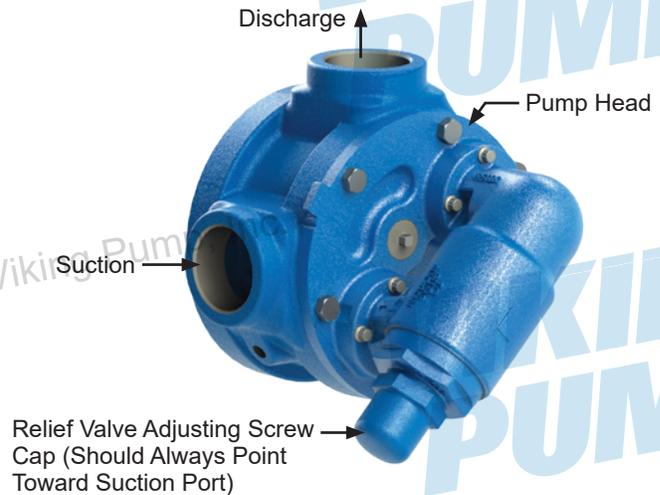
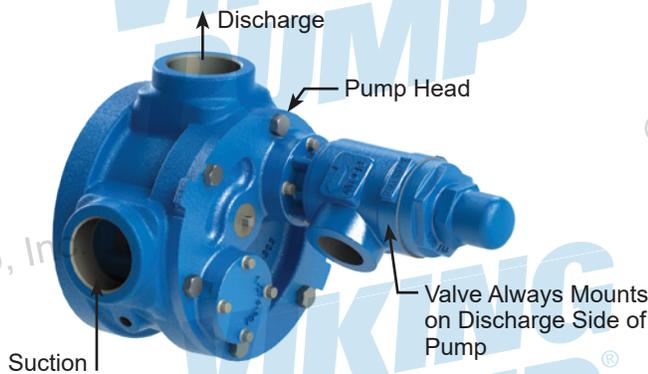


FIGURE A5-A: INTERNAL PRESSURE RELIEF VALVE



**FIGURE A5-B:
RETURN-TO-TANK PRESSURE RELIEF VALVE**



⚠ CAUTION !

Internal type relief valves mounted on Viking pumps should always have the cap or bonnet pointed toward the suction side of the pump. Return-to-tank type relief valves should always be mounted on the discharge side of the pump. If pump rotation is reversed, change the relief valve. Turn the internal type end for end; move the return-to-tank type to the other port. If on a particular installation rotation is reversed, e.g., using one pump to fill a tank, and then by use of a reversing switch or other means of changing the rotation to permit the same pump to circulate the liquid through a heater or to load out, then pressure protection must be provided on both sides of the pump for both rotations. This may be a combination of relief valves, torque limiting devices or rupture disks.

⚠ CAUTION !

Pumps or systems without relief valves should have some form of pressure protection, e.g. torque limiting devices or rupture disks.

5. Pressure Protection - Viking pumps are positive displacement pumps. This means that when the pump is rotated, liquid will be delivered to the discharge side of the pump. If there is no place for this liquid to go, i.e. the discharge line is blocked or closed, pressure can build up until the motor stalls, the drive equipment fails, a pump part breaks or ruptures, or the piping bursts. Because of this, some form of pressure protection must be used with a positive displacement pump. This may be a relief valve mounted directly on the pump, an inline relief valve, a torque limiting device or a rupture disk.

The pressure relief valve mounted on most Viking pumps and most in-line valves are of the spring-loaded poppet design. See **Figure A4**. The spring (a) holds poppet (b) against the seat in the valve body (c) with a given force determined by the spring size and by how tightly it is compressed by the adjusting screw (d). The pump discharge pressure pushes against the underside of the poppet at point (e). When the force exerted by the liquid under the poppet exceeds that exerted by the spring, the poppet lifts and liquid starts to flow through the valve.

As the discharge pressure builds up, more and more of the liquid flows through until a pressure is reached at which all of the liquid being pumped is going through the valve. This pressure is the relief valve setting.

Viking pumps can be furnished with either an internal pressure relief valve - one which directs the flow from the valve back to the suction side of the pump - or a return-to-tank valve - which directs the flow through piping back to the supply tank. See **Figure A5-A** and **Figure A5-B**. An inline relief valve mounted in the discharge piping also directs the flow back to the supply tank. This type of valve should be mounted close to the pump so that the pressure drop through the piping between the pump and the valve is at a minimum. Be sure there are no shutoff valves between the pump and relief valve. Piping from a return-to-tank or an in-line valve to the supply tank should also be as short and as large as possible.

NOTE: On some models, the relief valve is mounted on the pump casing instead of the pump head.

The spring-loaded poppet-type valve is strictly a differential valve, sensing only those pressures on each side of the poppet. It should not be used as a pressure or flow control device. It is intended strictly as a relief valve.

The pressure at which either the return-to-tank or internal relief valve bypasses can be changed by turning the adjusting screw. Do not back the adjusting screw all the way out. Stop when spring tension is off the screw (the screw starts to turn easily). For details on maintenance of the relief valve, refer to the Technical Service Manual covering your model series.

6. Motor - follow local electrical codes when hooking up motors.

FOUNDATION

Every pump should have a solid foundation. It may be any structure sufficiently strong to hold the pump rigid and to absorb any strain or shock that may be encountered.

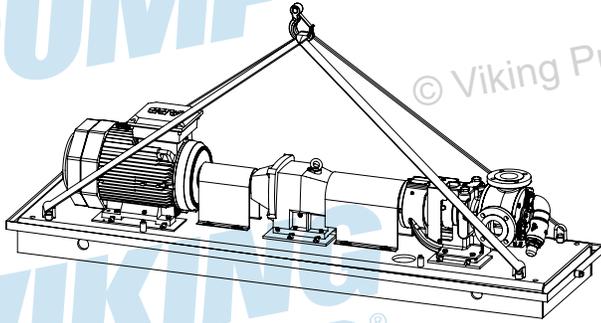
A certified print of the pumping unit should be used in preparing the foundation. If a separate foundation is provided, make it at least four inches wider and longer than the base of the unit.

When the unit is placed on the foundation, it should be leveled and checked for position against the piping layout and then fastened down.

COMPONENT & UNIT LIFTING FEATURES

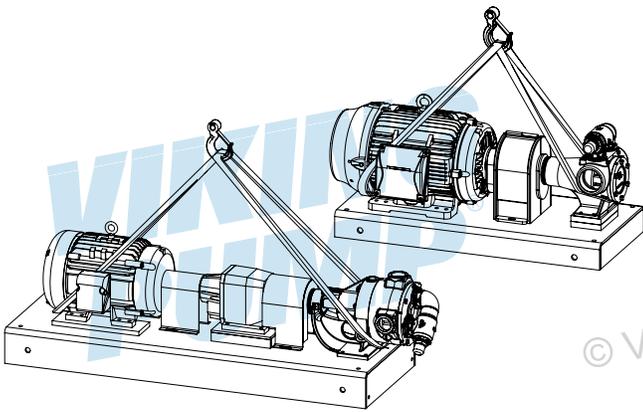
Removable lifting features, such as threaded eye bolts and hoist rings, installed in components (pumps, reducers, motors, etc.) and baseplates should be left on the components. These features are used to safely lift and move the individual components. Following are general guidelines for lifting Viking Pump® units.

**FIGURE A6:
EXAMPLE OF PROPER LIFTING METHOD**



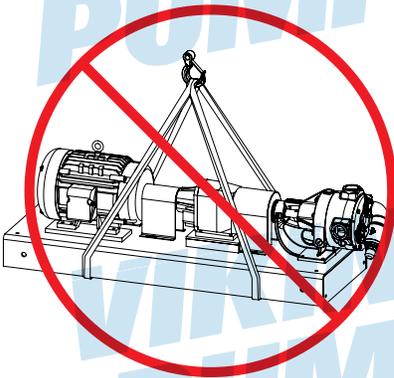
NOTE: Units should be lifted by the base lifting features using two or more lifting slings.

**FIGURE A7:
EXAMPLES OF PROPER LIFTING METHOD**



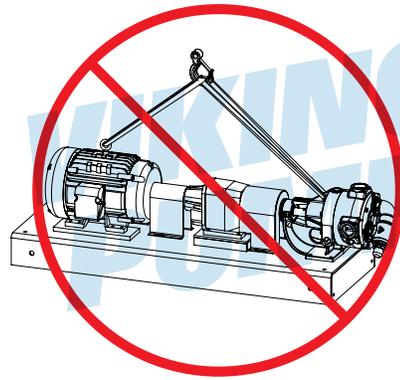
NOTE: Use two or more lifting slings around the pump and the motor when the base does not have lifting features. Make sure the slings are secure and the load is balanced before attempting to lift.

**FIGURE A8:
EXAMPLE OF IMPROPER LIFTING METHOD**



NOTE: NEVER lift the unit with slings unsecured under the base. The slings can slide, allowing the unit to tip and/or fall. Improper lifts can result in personal injury and/or damage to the unit.

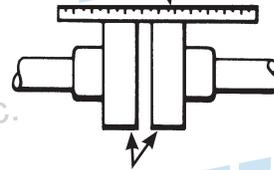
**FIGURE A9
EXAMPLE OF IMPROPER LIFTING METHOD**



NOTE: NEVER lift the unit with slings connected to the component lifting features. The lifting features are designed for the individual component and are not rated to lift the entire unit. Improper lifts can result in personal injury and/or damage to the unit.

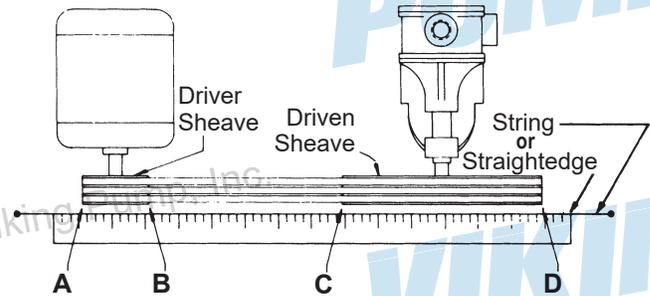
FIGURE A10-A

Use a straightedge. These surfaces must be parallel.



Check width between these surfaces with inside calipers to be certain the faces are equal distance apart and parallel.

FIGURE A10-B



When sheaves are properly aligned, all points A, B, C, D will touch string or straightedge.

ALIGNMENT

CHECK ALIGNMENT AFTER MOUNTING

For detailed coupling alignment procedures see coupling manufacturers' recommendations.

The pump, drive, and motor were properly aligned at the time they were assembled. During shipping and mounting the alignment is often disturbed. **BE SURE TO RECHECK ALIGNMENT AFTER THE PUMP UNIT IS INSTALLED!**

1. Check pump ports to be sure they are square and in the proper position; shim or move the pump as required. Do not force piping to line up with the ports.
2. If the pump is driven by a flexible coupling(s) either directly connected to the motor or through a reducer, remove any coupling guards or covers and check alignment of the coupling halves. At a minimum, a straightedge (such as a piece of key stock) across the coupling must rest evenly on both rims at the top, bottom, and sides. See **Figure A10-A**.
3. If the pump is driven by V-belts, check the alignment by using a long straightedge or tightly drawn string across the face of the sheaves. See **Figure A10-B**.
4. Make a final check on alignment after piping is hooked up. Refer to item 13 in **Piping** section.

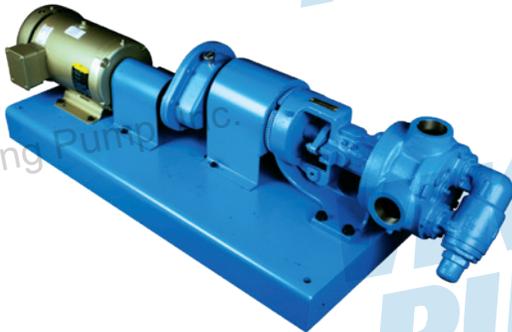
Figure A11 and **Figure A12** show typical direct drive and gear reducer drive units.

5. For high temperature applications (those above 300°F) allow the pump to reach operating temperature, then recheck alignment.

FIGURE A11: DIRECT DRIVE



FIGURE A12: REDUCER DRIVE



PIPING

The cause of many pumping problems can be traced to suction piping. It should always be as large and short as practical. For help in selecting the proper size suction and discharge piping, refer to **Viking General Catalog Section 510**.

Before starting the layout and installation of your piping system, consider the following points:

1. Never use piping smaller than the pump port connections.
2. Be sure the inside of the pipe is clean before hooking it to the pump.
3. **FOOT VALVE** - When pumping a light liquid with a suction lift, a foot valve at the end of the suction piping or a check valve in the first horizontal run will hold the liquid in the line and make it easier for the pump to prime. Be sure the foot or check valve is big enough so that it doesn't cause excessive line loss.
4. When approaching an obstacle in the suction or discharge line, go around the obstacle instead of over it. Going over it creates an air pocket. See **Figure A13**.
5. Where practical, slope the piping so no air or liquid pockets will be formed. Air pockets in the suction line make it hard for the pump to prime.
6. For a suction line with a long horizontal run, keep the horizontal portion below the liquid level if possible. This keeps the pipe full of liquid and reduces the amount of air the pump must evacuate at startup. This is most helpful when there is no foot valve. See **Figure A14**.
7. When piping a hot or cold system (liquid being handled is at a temperature different from the air surrounding the pump), be sure allowance is made for expansion and contraction of the piping. Loops, expansion joints, or unsecured (this does not mean unsupported) runs should be used so the pump casing is not distorted.
8. **STRAINER** - It is always good practice to consider a strainer on the suction side of a positive displacement pump. The strainer will keep foreign objects from going into the pump. Without a strainer objects can lock the pump, and damage the internals and drive. The strainer basket mesh or perforation size should be big enough so that it does not cause excessive pressure drop, but it should be fine enough to protect the pump. When in doubt as to the proper size, check with the manufacturer, giving pipe size, flow rate, and viscosity involved. Provision should be made for cleaning the strainer. If the pump operates continuously, a bypass should be built around the strainer, or two strainers should be put in parallel with proper valving so they can be isolated for cleaning. Use of a strainer is particularly important at start up to help clean the system of weld beads, pipe scale, and other foreign objects. For additional information, refer to **TSM 640**.
9. If the pump is not equipped with a relief valve, consideration should be given to mounting one in the discharge line. Refer to discussion on pressure protection under item 5 in **General Installation Notes** section.
10. The pump should not be used to support the piping. The weight of the piping should be carried by hangers, supports, stands, etc.
11. When fastening the piping to the pump it should not be necessary to impose any strain on the pump casing. "Springing" or "drawing" the piping up to the pump will

cause distortion, possible misalignment, and probable rapid wear of the pump. Do not use the pump to correct errors in piping layout or assembly.

12. All joints of the piping system should be tight; pipe sealer will help assure leak-free threaded joints. Leaks in the suction line permitting air to be drawn in may cause a noisy pump or a reduction in capacity. It is not recommended to use PTFE tape on NPT ports as a pipe sealer. This action can result in cracks in the pump.
13. **ALIGNMENT** - Check the alignment of the drive after the piping is hooked up. As a final check on pump alignment, remove the head of the pump and with a feeler gauge determine if there is clearance all the way around between the rotor and casing. Because of manufacturing tolerances, bushing clearances, etc., the rotor may not be centered in the casing, but it should not drag; dragging would indicate unit misalignment or casing distortion from piping strain. Making this check is most desirable on installations involving Q, M and N size general purpose pumps.
14. The auxiliary piping hooked to jackets, glands, etc. for heating, cooling, quenching, or for other purposes should receive the same attention as the piping handling the pumped liquid.
15. Provide a pressure relief device in any part of a pump and piping system that can be valved off and, thus, completely isolated. This is particularly important:
 - a. When handling a cold liquid such as refrigeration ammonia that can warm up to ambient temperatures when the pump is shut off.
 - b. When handling a liquid such as asphalt or molasses that has to be heated before it can be pumped.

The rise in temperature causes the liquid to expand; if there is no provision for pressure relief in the closed off section, there is a chance that the pump or piping will rupture.

FIGURE A13

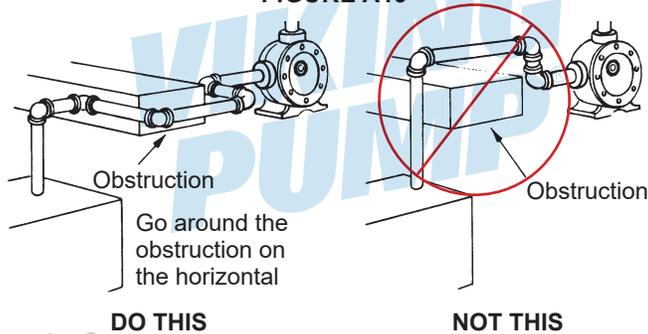
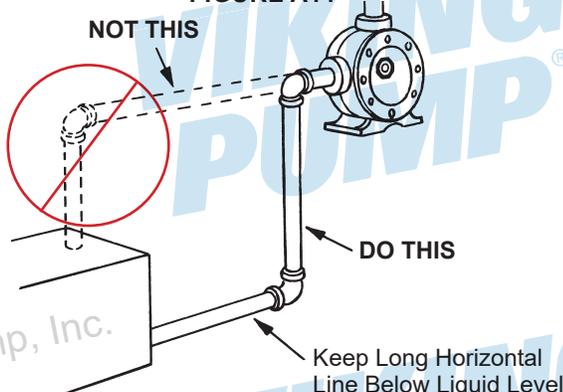


FIGURE A14



START UP

Before starting the pump, check the following:

1. Are there vacuum and pressure gauges on or near the pump? These gauges are the quickest and most accurate way of finding out what is happening in the pump.
2. Check alignment - See suggestions in the Alignment section of this manual.
3. Check piping to be sure there is no strain on the pump casing.
4. Rotate the pump shaft by hand to be sure it turns freely. **MAKE SURE THE PUMP DRIVER IS LOCKED OUT OR CANNOT BE ENERGIZED BEFORE DOING THIS.**
5. Jog motor to be sure it is turning in the right direction; refer to discussion on pump rotation under item 4 in **General Installation Notes** section.
6. Check any relief valves to be sure they are installed correctly. Refer to discussion on relief valves in **General Installation Notes** section.
7. Check suction piping to be sure:
 - a. It is all connected and tight
 - b. Valves are open
 - c. End of pipe is below liquid level
8. Check discharge piping to be sure:
 - a. It is all connected and tight
 - b. Valves are open
 - c. There is a place for the liquid to go
9. Lubricate any grease fitting on the pump using a #2 NLGI polyurea grease. Check any gear reducer, motor, coupling, etc. for instructions and lubricate as recommended. Contact your Viking Pump® representative for **Engineering Service Bulletin ESB-515**.
10. For packed pumps, loosen packing gland nuts so gland can be moved slightly by hand. Adjust gland to reduce leakage only after pump has run long enough to reach constant temperature. Packing should weep a little to keep it cool and lubricated.
11. Do not use the Viking pump to flush, pressure test or prove the system with water. Either remove the pump or run piping around it while flushing or testing. Pumping water, dirty or otherwise, can do more damage in a few minutes than months of normal service.
12. Check to be sure all guards are in place.
13. Check the pump to be sure it is heated to operating temperature (if jacketed or heat traced).

If the pump begins to deliver liquid within 60 seconds, it can continue to be operated. If liquid is not leaving the discharge port, stop the pump. Running the pump longer than one minute without liquid inside it can damage the pump. Review the steps just outlined, consider what the suction and discharge gauges indicate, and see **Troubleshooting** section. If everything appears to be in order, put some liquid in the pump. This will help it prime.

The pump can be restarted. If nothing is flowing within two minutes, stop the pump. The pump is not a compressor; it will not build up much air pressure. It may be necessary to vent the discharge line until liquid begins to flow.

If the pump still does not deliver flow, the cause may be one or more of the following:

1. Suction line air leaks. Vacuum gauge reading should help determine if this is the problem.
2. End of suction pipe not submerged deep enough in liquid.
3. Suction lift is too great or the suction piping is too small.
4. Liquid is vaporizing in the suction line before it gets to the pump.

If after consideration of these points it still does not pump, review again all points under **START UP**. Read through **Troubleshooting** in this manual and try again. If it still does not pump, contact your Viking Pump® representative.

TROUBLESHOOTING

A Viking pump that is properly installed and maintained will give long and satisfactory performance.

NOTE: Before making any pump adjustment or opening the pump liquid chamber in any manner, make sure that:

1. Any pressure in the pumping chamber has been vented through the suction or discharge lines or other openings provided for this purpose.
2. The driver has been “locked out” so that it cannot inadvertently be started while work is being done on the pump.
3. The pump has been allowed to cool down to the point where there is no chance of anyone being burned.

If trouble does develop, one of the first steps toward finding the difficulty is to *install a vacuum gauge in the suction port and a pressure gauge in the discharge port*. Readings on these gauges often will give a clue as to where to start looking for the trouble.

VACUUM GAUGE - SUCTION PORT

1. High reading would indicate:

- a. Suction line is blocked by a stuck foot valve, stuck gate valve, or plugged strainer.
- b. Liquid is too viscous to flow through the piping.
- c. Lift is too high.
- d. Line is too small.

2. Low reading would indicate:

- a. Air leak in suction line.
- b. End of pipe is not in liquid.
- c. Pump is worn.
- d. Pump is dry - should be primed.

3. Fluttering, jumping, or erratic reading:

- a. Liquid is vaporizing.
- b. Liquid is coming to pump in slugs, possibly an air leak, insufficient liquid above the end of the suction pipe.
- c. Vibrating from cavitation, misalignment, or damaged parts.

PRESSURE GAUGE - DISCHARGE PORT

1. High reading would indicate:

- a. High viscosity, small diameter discharge line or long discharge line.
- b. Gate valve is partially closed.
- c. Filter is plugged.
- d. Vertical head did not consider a high specific gravity liquid.
- e. Line is partially plugged from build up on inside of pipe.
- f. Liquid in the pipe is not up to temperature.
- g. Liquid in the pipe has undergone a chemical reaction and has solidified.
- h. Relief valve is set too high.

2. Low reading would indicate:

- a. Relief valve is set too low.
- b. Relief valve poppet is not seating properly.
- c. Bypass around the pump is partially open.
- d. Too much extra clearance.
- e. Pump is worn.

3. Fluttering, jumping, or erratic reading:

- a. Cavitation.
- b. Liquid is coming to the pump in slugs.
- c. Air leak is in the suction line.
- d. Vibrating from misalignment or mechanical problems.

Some of the following may also help pinpoint the problem:

A. Pump does not pump.

1. Pump has lost its prime due to air leak, low level in tank, foot valve stuck.
2. Suction lift is too high.
3. Rotating in wrong direction.
4. Motor does not come up to speed.
5. Suction and discharge valves not open.
6. Strainer is clogged.
7. Bypass valve open, relief valve set too low, relief valve poppet stuck open.
8. Pump is worn out.
9. Any changes in the liquid system or operation that would help explain the trouble, e.g. new source of supply, added more lines, inexperienced operators, etc.
10. Too much end clearance.
11. Head position is incorrect. See **Figure A3**.
12. Temperature changes either in the liquid or environment.
13. **Mag Drive pumps ONLY:** The magnetic coupling is decoupling. Changes in application (temperature, pressure, viscosity, etc.) may require torque beyond coupling capabilities.

B. Pump starts, then loses its prime.

1. Supply tank is empty.
2. Liquid is vaporizing in the suction line.
3. Air leaks or air pockets in the suction line; leaking air through packing or mechanical seal.
4. Pump is worn out.

RAPID WEAR

C. Pump is noisy.

1. Pump is being starved (heavy liquid cannot get to pump fast enough). Increase suction pipe size or reduce length.
2. Pump is cavitating (liquid vaporizing in the suction line). Increase suction pipe size or reduce length. If pump is above the liquid, raise the liquid level closer to the pump. If the liquid is above the pump, increase the head of liquid.
3. Check alignment.
4. May have a bent shaft or rotor tooth. Straighten or replace.
5. Relief valve chatter. Increase pressure setting.
6. May have to anchor base or piping to eliminate or reduce vibration.
7. May be a foreign object trying to get into the pump through the suction port.
8. **Mag Drive pumps ONLY:** The magnetic coupling has decoupled. Shut off and let cool, then restart.

D. Pump not up to capacity.

1. Starving or cavitating. Increase suction pipe size or reduce length.
2. Strainer partially clogged.
3. Air leak in suction piping or along pump shaft.
4. Running too slowly. Check the motor is running at the correct speed and that it is wired correctly.
5. Bypass line around pump partially open.
6. Relief valve set too low or stuck open.
7. Pump is worn out.
8. Too much end clearance.
9. Head position incorrect. See **Figure A3**.

E. Pump takes too much power.

1. Running too fast. Verify the motor speed, reducer ratio, sheave size, and other drive components are correct for the application?
2. The liquid is too viscous for the size of the unit. Heat the liquid to reduce viscosity, increase the pipe size, slow down the pump, or use a larger motor.
3. Discharge pressure higher than calculated. Verify with a pressure gauge. Increase size or reduce length of pipe, reduce speed (capacity), or get bigger motor.
4. Packing gland drawn down too tight.
5. Pump misaligned.
6. Extra clearance on pumping elements may not be sufficient for operating conditions. Check parts for evidence of drag or contact in pump and increase clearance where necessary.
7. System pressure relief valve is set too high.
8. Bushings have locked to shaft or pin, or the liquid has set up in the pump.

F. Rapid Wear.

On most applications the pump will operate for many months or years before it gradually loses its ability to deliver capacity or pressure. Examination of such a pump would show a smooth wear pattern on all parts. Rapid wear, occurring in a few minutes, hours or days, shows up as heavy grooving, galling, twisting, breaking or similar severe signs of trouble. See **Rapid Wear Table**.

RAPID WEAR TABLE

CAUSE		EVIDENCE	POSSIBLE SOLUTION
1	ABRASIVES	Gouges or marks made by large, hard particles; a rapid wearing away of bushings from very small abrasives; or anything in between.	Flush the system with the pump removed. Install strainer in suction line. Most abrasive objects and particulate is removed after a few cycles (or days) of flushing.
2	CORROSION	Rust, pitting or metal appears to be "eaten" away.	Check the Viking General Catalog Liquid List for materials of construction recommendation. Consider whether all of the materials used in pump construction were attacked; consider other materials used in the system to determine how they resisted the liquid. Check to see whether or not the liquid has been contaminated to make it more corrosive than anticipated.
3	EXCEEDING OPERATING LIMITS	Noisy operation, broken bushings, twisted shaft, parts show evidence of high heat (discoloration).	Review General Catalog for operating limits on particular model involved.
4	INSUFFICIENT EXTRA CLEARANCE	Pump may stall. Evidence of heavy contact between end of rotor teeth and head or other parts.	Increase end clearance and/or contact your Viking Pump® representative with details of the application, so that information regarding proper extra clearance may be provided.
5	LACK OF LUBRICATION	Noisy bearings, localized heating at bearings or lip seal, smoke, rapid bushing wear.	Be sure all grease fittings are greased before starting, and instructions for lubrication of drive equipment are followed; consider use of auxiliary lubricating equipment.
6	MISALIGNMENT	Wear on only one part of a surface, e.g., one side of the casing, one side of the packing gland, only a portion of the face of the head.	Double check alignment of drive equipment and piping. Check the alignment under conditions as close to operating conditions as possible.
7	RUN DRY	Pump stalls because parts have uneven expansion caused by frictional heat; galling between surfaces having relative motion; seal seats and idler pins changing color because of high heat.	Be sure there is liquid in the system at the time of start up. Provide some kind of automatic alarm or shut-off if supply tank runs dry.

PREVENTATIVE MAINTENANCE

Performing a few preventative maintenance procedures will extend the life of your pump and reduce the overall cost of ownership.

A. Lubrication - Grease all grease fittings after every 2000 hours of operation. If service is severe, grease more often. Do it gently with a hand gun until the grease exiting the lip seal or relief plug is similar in consistency and color to the new grease.

Use a NLGI #2 polyurea grease for normal applications. For hot or cold applications, use appropriate grease.

B. Packing Adjustment - Occasional packing adjustment may be required to keep leakage to a slight weep. If impossible to reduce leakage by gentle tightening, replace packing or use different type. *Refer to Technical Service Manual on particular model series for details on repacking.*

C. End Clearance Adjustment - After long service, the running clearance between the end of the rotor teeth and the head may have increased through wear. This wear may cause a loss of capacity or pressure. Resetting end clearance will normally improve pump performance. *Refer to TSM on particular model series for procedure on adjusting end clearance for pump involved.*

D. Examine Internal Parts - Periodically remove the head, examine idler and bushing and head and pin for wear. Replacing a relatively inexpensive idler bushing and idler pin after only moderate wear will eliminate the need to replace more expensive parts at a later date. *Refer to TSM on particular model series for procedure in removing head of the pump.* Be sure idler does not slide off the idler pin as the head is removed. If it does slide off the idler can cause personal injury or damage the part.

E. Cleaning the Pump - A clean pump is easier to inspect, lubricate, adjust, and runs cooler.

F. Storage - If pump is to be stored or not used for six months or more, pump must be drained, and a light coat of non-detergent SAE 30 weight oil must be applied to all internal pump parts. Lubricate fittings and apply grease to pump shaft extension. Viking suggests rotating pump shaft by hand one complete revolution every 30 days to circulate the oil. Retighten all gasketed joints before using the pump.

DO'S & DON'TS

Do's and Don'ts for installation, operation, and maintenance of Viking pumps to assure safe, long, trouble-free operation.

INSTALLATION

1. **DO** install pump as close to supply tank as possible.
2. **DO** leave working space around the pumping unit.
3. **DO** use large, short, and straight suction piping.
4. **DO** install a strainer in the suction line.
5. **DO** double check alignment after the unit is mounted and piping is hooked up.
6. **DO** provide a pressure relief valve for the discharge side of the pump.
7. **DO** cut out the center of gaskets used as port covers on flanged port pumps.
8. **DO** record pump model number and serial number and file for future reference.

OPERATION

1. **DON'T** run pump at speeds faster than shown in the catalog for your model.
2. **DON'T** require pump to develop pressures higher than those shown in the catalog for your model.
3. **DON'T** operate pumps at temperatures above or below limits shown in the catalog for your pump.
4. **DON'T** operate pumps without all guards being in place.
5. **DON'T** operate pump without a relief valve on the pump or in the discharge piping. Be sure valve is mounted and set correctly.
6. **DON'T** exceed catalog limits for temperature and pressures of fluids in jacketed areas of pump.
7. **DON'T** use the pump in a system which includes a steam, air, or vapor blow or purge **without** provision for over-speed shutdown, in case the pump starts to act as a turbine and over-speeds the drive.
8. **DON'T** operate the pump with all of the liquid bypassing through a pump mounted internal type relief valve, or without any flow of liquid going through the pump for more than a couple of minutes. Operation under either of these conditions may result in a heat build-up in the pump, which could cause hazardous conditions or happenings.

TECHNICAL SERVICE MANUAL: INSTALLATION, OPERATION & MAINTENANCE**VIKING
PUMP®**LIQUID-SPECIFIC PRODUCT LINE:
REFRIGERATION AMMONIA
4924A SERIES™
SIZES: HL, K, KK, LQ, LL

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MAINTENANCE

- DO** make sure any pump that has residual system pressure in it, or that has handled high vapor pressure liquids, such as LP-gas, ammonia, Freons, etc., has been vented through the suction or discharge lines or other openings provided for this purpose.
- DO** make sure that if the pump is still hooked to the driver while maintenance is being performed that the driver has been "locked out", so that it cannot be inadvertently started while work is being done on the pump.
- DO** make sure any pump that has handled a corrosive, flammable, hot, or toxic liquid has been drained, flushed, vented and/or cooled before it is disassembled.
- DO** remember that a few simple preventative maintenance procedures such as periodic lubrication, adjustment of end clearance, examination of internal parts, etc., will extend the service life of your pump.
- DO** obtain, read and keep maintenance instructions furnished with your pump.
- DO** have spare parts, pumps or standby units available, particularly if the pump is an essential part of a key operation or process.
- DON'T** drop parts during disassembly, e.g., idler can slip from the pin as the head is removed from the pump. It may cause personal injury or damage the part.
- DON'T** stick fingers in the ports of a pump. Serious injury may result.
- DON'T** spin the idler on the idler pin. Fingers may be jammed between teeth and crescent.

VIKING PUMP®**WARRANTY**

Viking pumps, strainers and reducers are warranted to be free of defects in material and workmanship under normal conditions of use and service. The warranty period varies by type of product. A Viking product that fails during its warranty period under normal conditions of use and service due to a defect in material or workmanship will be repaired or replaced by Viking. At Viking's sole option, Viking may refund (in cash or by credit) the purchase price paid to it for a Viking product (less a reasonable allowance for the period of use) in lieu of repair or replacement of such Viking product. Viking's warranty is subject to certain restrictions, limitations, exclusions and exceptions. A complete copy of Viking's warranty, including warranty periods and applicable restrictions, limitations, exclusions and exceptions, is posted on Viking's website (www.vikingpump.com/warranty/warranty-info). A complete copy of the warranty may also be obtained by contacting Viking through regular mail at Viking Pump, Inc., 406 State Street, Cedar Falls, Iowa 50613, USA.

THIS WARRANTY IS AND SHALL BE VIKING'S SOLE AND EXCLUSIVE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ALL WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT, ALL OF WHICH OTHER WARRANTIES ARE EXPRESSLY EXCLUDED.

THE RIGHTS AND REMEDIES UNDER THIS WARRANTY ARE AND SHALL BE THE SOLE AND EXCLUSIVE RIGHTS AND REMEDIES AGAINST VIKING. EXCEPT FOR THE SPECIFIC LIABILITIES AND OBLIGATIONS PROVIDED UNDER THIS WARRANTY, VIKING SHALL HAVE NO LIABILITY OR OBLIGATION WITH RESPECT TO ANY PRODUCT CLAIMED TO BE DEFECTIVE IN ANY MANNER.

UNDER NO CIRCUMSTANCES SHALL VIKING BE LIABLE UNDER THIS WARRANTY OR OTHERWISE FOR SPECIAL, INCIDENTAL, INDIRECT, CONSEQUENTIAL OR PUNITIVE DAMAGES OF ANY KIND, INCLUDING, BUT NOT LIMITED TO, LOST OR UNREALIZED SALES, REVENUES, PROFITS, INCOME, COST SAVINGS OR BUSINESS, LOST OR UNREALIZED CONTRACTS, LOSS OF GOODWILL, DAMAGE TO REPUTATION, LOSS OF PROPERTY, LOSS OF INFORMATION OR DATA, LOSS OF PRODUCTION, DOWNTIME, OR INCREASED COSTS, IN CONNECTION WITH ANY PRODUCT, EVEN IF VIKING HAS BEEN ADVISED OR PLACED ON NOTICE OF THE POSSIBILITY OF SUCH DAMAGES AND NOTWITHSTANDING THE FAILURE OF ANY ESSENTIAL PURPOSE OF ANY PRODUCT.