

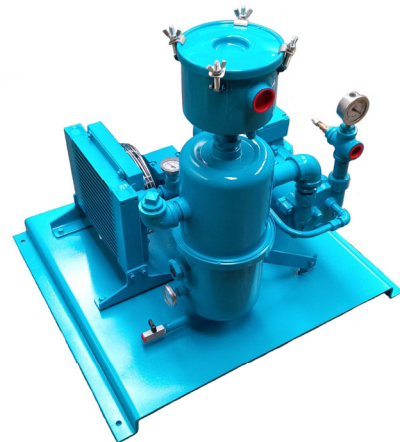
# LRV SERIES

## CLOSE COUPLED LIQUID RING VACUUM PUMPS

**Models** LRV 20NC, 35NC, 55C, 100NC, 150NC, 200NC, 350NC

INSTALLATION  
OPERATION  
MAINTENANCE

# MANUAL



### ***WARNING***

**DO NOT OPERATE BEFORE  
READING MANUAL**



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# SAFETY INSTRUCTIONS FOR LIQUID RING VACUUM PUMPS

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Please read the following safety information on this page before operating your vacuum pump

- Do not operate the pump without the belt guard or coupling guard properly attached. Disconnect the pump from the electrical supply at the main before removing the guard. Replace the guard before reconnecting the power supply. Operating the pump without the guard secured in place exposes people in the vicinity of the pump to risk from rotating drive parts. Make sure the pump is completely reassembled, the belt guard is replaced, and all drain and fill valve and plugs are closed before reconnecting the power supply.
- Do not operate the pump with oxygen enriched gas in the suction line, where the proportion of oxygen exceeds 20%, unless the pump is using water as a sealant or an inert fluid suitable for the application. Pumping oxygen enriched gases with mineral oil or other non-inert fluids can cause an explosion in the pump, resulting in damage or injury.
- Take precaution to avoid prolonged or excessive exposure to oil mist or process materials from the discharge of the pump, or, prolonged or excessive exposure to oil mist from oil sealed pumps. Do not allow the pump to discharge into closed room, or a room without adequate ventilation. Always use a discharge oil mist eliminator for oil sealed systems. Venting the outlet of the pump or oil mist eliminator to the open air is highly recommended.
- Do not restrict the pump discharge line in any way, or place any valves in the discharge line. The vacuum pump is a compressor and will generate high pressures without the motor stalling when at low suction pressures. Excessive pressure build-up could cause damage or injury.
- Accidental starting or operation of the pump while maintenance is in progress may cause injury or damage

# INTRODUCTION

## Models covered by this manual

This manual contains installation and maintenance procedures for the LRV 20 to LRV 350 Close Coupled pumps. The nameplate on the pump provides a letter coding for pump material of construction. All pumps come provided with a 3-ph, 60hz, 230-460v electric motor.

## Nameplate Data

Example: LRV 35NC/FS

The first letters LRV designate **L**iquid **R**ing **V**alve vacuum pump.

The number designation represents nominal pumping capacity in CFM at 60Hz operation (example 35 cfm).

**C** represents that the pump is a Close Coupled unit.

The letters after the pumping capacity represents the pump material of construction. The first letter represents the casing & endplate construction with the second letter representing the impeller construction.

F = Cast Iron

B = Bronze

S = Stainless steel (316)

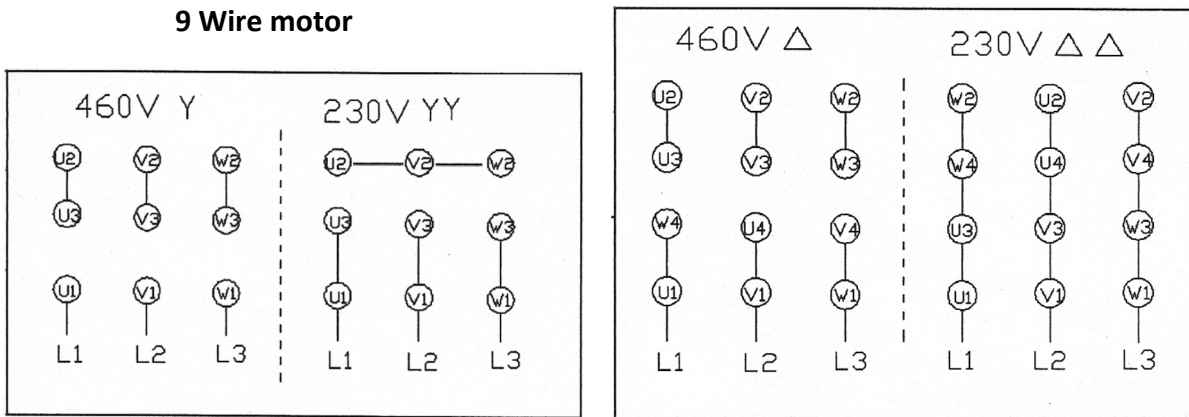
Example: LRV 35NC/FS = Liquid Ring Valve Pump; 35 cfm, Closed-Coupled Design with Cast Iron casing and stainless steel Impeller

## Suitable Applications

U.S. Vacuum Liquid Ring Vacuum Pumps Models LRV are reliable non-pulsating pumps. LRV are Single -stage Configuration, suitable for operation down to 30 Torr absolute (approx. 29 inches Hg vacuum reference 30 inch barometer), when sealed with 60 Deg F. water.

## Motor wiring Diagram

### 12 Wire motor



## WARNING

- THE BELTGUARD OR COUPLING GUARD MUST BE PROPERLY SECURED IN PLACE AT ALL TIMES WHILE THE PUMP IS RUNNING

## CAUTION

- DO NOT OPERATE THE PUMP DRY
- MAKE SURE COOLING LIQUID IS AVAILABLE TO THE PUMP & SEALS
- DO NOT ALLOW SEALANT LIQUID TO FREEZE IN THE PUMP
- DISCHARGE PIPING SHOULD NOT EXCEED 24 INCHES ABOVE THE DISCHARGE FLANGE
- SUCTION MANIFOLD MUST BE FREE OF WELDING SLAG
- DO NOT START THE PUMP WITH SEALANT LEVEL ABOVE SHAFT CENTERLINE

# US Vacuum Pumps LLC

CONGRATULATIONS on your purchase of a new Liquid ring Vacuum Pump from US VACUUM. Please examine the pump for shipping damage, and if any damage is found, report it immediately to the carrier. If the pump is to be installed at a later date make sure it is stored in a Clean, dry location and rotated regularly. Make sure covers are kept on all openings. If pump is stored outdoors be sure to protect it from weather and corrosion.

LRV vacuum pumps are built to exacting standards and if properly installed and maintained will provide many years of reliable service. We urge you to take time to read and follow every step of these instructions when installing & maintaining your pump.

**WARNING: Serious injury can result from operating or repairing this machine without first reading the service manual and taking adequate safety precautions.**

**IMPORTANT: Record the pump model and serial number in the OPERATING DATA form below. You will save time and expense by including this reference information on any replacement parts orders.**

## OPERATING DATA

It is to the user's advantage to have the requested data filled in below and available in the event a problem should develop in the vacuum pump. This information is also helpful when ordering spare parts.

Model No \_\_\_\_\_ Sealing Fluid \_\_\_\_\_  
Serial No. \_\_\_\_\_ Operating Vacuum \_\_\_\_\_  
Startup Date \_\_\_\_\_ Inlet Gas Composition \_\_\_\_\_  
Motor Hp \_\_\_\_\_ RPM \_\_\_\_\_ Accessories supplied \_\_\_\_\_

NOTES: \_\_\_\_\_  
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# GENERAL

## UNPACKING

Inspect the box and pump carefully for any signs of damage incurred in transit and report with-in 7 days of receipt. Since all our pumps are shipped F.O.B. our factory, such damage is the responsibility of the carrier and reported to them. The inlet & exhaust of the pumps are covered with plastic caps to prevent dirt and other foreign substances from entering the pump. Leave the caps in place until you are ready to pipe the pump to your equipment.

The pumps are tested and preserved with a water soluble preservative prior to shipment. As the pump cannot be completely drained, some of the preservative remains in the pump when shipped. This solution should be flushed from the pump if it is to be used on a closed system where other than water is used.

## LOCATION

Install the pump in a horizontal position on a level surface so that the pump is evenly supported on it's steel baseplate. Leave 12-18" of access around the pump to allow proper access for maintenance. If the unit is provided as an AIR-COOLED system, allow for proper air circulation around the radiator.

When selecting a location for the pump one consideration should be that the pump liquid must not be allowed to freeze.

## POWER REQUIREMENTS

A schematic diagram for the electric motor terminal box is located inside the junction box cover . The motor must be connected according to applicable electrical codes through a fused switch in order to protect the motor against electrical or mechanical overload conditions. The overload of the motor starter must be set at a level equal to the full load motor current listed on the nameplate.

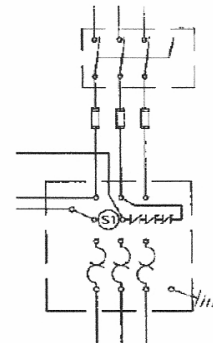
After the motor starter and disconnect switch have been installed, turn the pump by hand and determine that the impeller is free to turn and then momentarily start the motor to check direction of rotation. The direction of the pump must rotate as indicated by the arrows on the drive and casing. If the pump rotates in the wrong direction, have an electrician reverse any two of the motor leads.

**WARNING:** DISCONNECT PUMP FROM SOURCE OF ELECTRICAL POWER PRIOR TO MAKING REPAIRS OR ADJUSTMENTS TO ANY COMPONENT OF THE UNIT. ALL ELECTRICAL CONNECTIONS ARE TO BE MADE A QUALIFIED ELECTRICIAN IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE (NEC) OR CANADIAN ELECTRICAL CODE.

## SHORT CIRCUIT PROTECTION

According to the National Electrical Code, branch circuit over-current protection must be provided for each contactor or starter. The following table is provided as a guide. DO NOT EXCEED MAXIMUM PROTECTIVE DEVICE RATINGS.

Maximum HP Maximum Volts					NEMA Size	Maximum Voltage	Class K5 or R Fuse (Ampere)	Class K1 or J Fuse (Ampere)	Inverse-Time Circuit Breaker (Ampere)
Single Phase 115v	230v	Three Phase 208v 250v 600v							
1/2	1	1 1/2	1 1/2	2	00	600	10	15	15
						250	12	15	15
1	2	3	3	5	0	600	20	30	20
						250	25	30	35
2	3	7 1/2	7 1/2	10	1	600	30	60	40
						250	40	60	60
-	-	10	15	25	2	600	60	100	80
						250	60	100	90
-	-	25	30	50	3	600	100	200	125
						250	125	200	150



# **GENERAL (cont.)**

## **VACUUM CONNECTION**

Use a pipe size that is at least the size of the pump inlet connections. Smaller lines result in reduced pump capacity.

Pumps operating in parallel on a common main line should have a manual or automatic shut-off valve or positive acting check valve installed in the suction line of the pump.

Should the process gas contain dust or other foreign material, a suitable inline particulate filter should be connected to the inlet port.....contact U.S. Vacuum for recommendations.

The vacuum piping should be designed to insure that no liquids such as condensate or liquid carryover from the process can reach the pump. If this possibility exists, a knock-out liquid separator should be installed.....contact U.S. Vacuum for recommendations.

If an exhaust manifold is used, install a drip leg near the pump exhaust port and drain to prevent exhaust condensate from entering the pump exhaust box.

### **WARNING:**

When running the pump with no cavitation protection, the suction pressure should not be lower than 2.36"Hg absolute when the water temperature is 60F and dry gas temperature is 70F. The higher temperatures, the pump will have difficulty obtaining maximum allowable suction pressure. Cavitation will cause excessive damage to the pump...install a vacuum relief valve on the suction inlet of the pump to prevent cavitation.

## **VAPOR/FLUID INGESTION**

The LRV-NC series of pumps are designed for applications where they may be required to ingest saturated vapors and/or liquid slugs. Excessive liquid carryover can result in the pump impeller and electric motor becoming overloaded. Monitor motor current draw to determine excessive loading. A liquid separator may be required to be installed in front of the vacuum pump to capture and reduce the amount of liquid carryover entering the pump.

When pumping hot gas or steam over 175F, it is suggested the seal water flow rate be doubled to keep the pump cool and prevent cavitation.

### **Maximum discharge pressure**

Maximum discharge pressure is 19 PSIA.. Check operating backpressure while the pump is running to verify maximum back pressure is not being exceeded.

# SPECIFICATIONS

PUMP TYPE		LRV20NC	LRV 35NC	LRV 55NC	LRV 100NC	LRV 150NC	LRV 200NC	LRV 350NC
Nominal Capacity	CFM	18	34	56	113	157	192	342
Speed	RPM	3500	3500	3500	1750	1750	1750	1150
Motor-Installed power	HP	2	3	5	7.5	10	15	25
Noise level at 60 Torr	db(A)	69	69	75	74	74	77	78
Average service liquid flow	GPM	1.5	1.5	1.5	4	4	5	11
Inlet/Outlet connection	Inches	1"	1"	1.5"	2" Flg	2" Flg	2.5" Flg	3" Flg
Maximum Vacuum	Torr	25 TORR (29" Hg)						
Weight	Lbs	75	79	150	231	269	721	721



# System Components

The following are some of the components available for installation either when the pump is ordered, or later to be installed in the field.

**Inlet elbow:** Used to adapt vertical pump inlet to horizontal for mounting inlet check valve, etc. A similar elbow may be used to connect the discharge separator tank.

**Inlet vacuum gauge:** Used to measure pump inlet vacuum. Standard 2-1/2" and optional 4" dial gauge has brass bourdon tube and reads 0-30" Hg. The gauge is mounted on the pump suction. Stainless steel vacuum gauges are available at additional cost.

**Inlet check valve:** Used to automatically isolate the pump from the process chamber when the vacuum pump is shut down, by blocking the backflow of air and sealant. Valve must be mounted in a horizontal position.

**Inlet vacuum relief valve:** Used to control pump inlet vacuum. If pump capacity exceeds the system requirements at present vacuum, then the valve open and admit ambient air. Valve selection is dependant upon desired vacuum setting and pump size.

**Flexible connector:** Used to accommodate some motion and misalignment between pump and system.

**Inlet shut off valve:** Used to positively isolate pump from process chamber. Ball valves are supplies up to 2" NPT. Butterfly valves are supplied for connections larger than 3"

**Sealant solenoid valve:** Used to establish sealant flow when motor is energized and return to closed position when motor is de-energized. Also prevents flooding the pump with sealant when pump is off.

**Flow controller:** Used to establish sealant flow rates to the vacuum pump.

**Sealant circulation pump:** Used to circulate recovered sealant. Required for use when operation at high pressure such as frequent cycling or when operating for prolonged periods above 400 Torr.

**Strainer:** Used to filter solid particles from the sealant

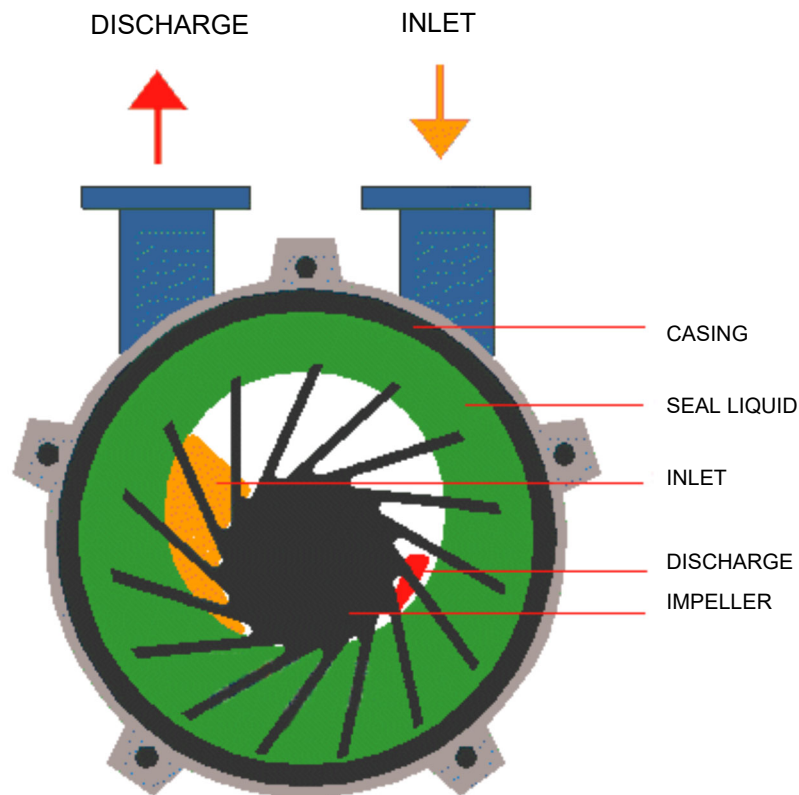
**Heat exchanger:** Used to cool circulated sealant.

# PRINCIPLE OF OPERATION

U.S. Vacuum Pumps LRV series Liquid ring Vacuum Pumps are durable Single Stage pumps having vacuum capabilities to approximately 29" Hg.

When the pump is operating, a continuous flow of seal liquid is entering the pump and forms a seal between the impeller and casing. The impeller is offset above center of the pump casing and as the impeller rotates, pumping action begins in the space between the impeller & pump casing by filling and emptying similar to a reciprocating compressor. Gas inlet and discharge ports are positioned so as to draw gas into the cavity inside the liquid sealed ring during the expansion segment and discharges gas along with some liquid during the compression segment. The discharged liquid can be recovered and re-circulated through the use of a gas/liquid separator.

Water is normally used as the liquid seal but may be unsuitable for some pump applications. Other commonly used fluids are oil, glycol and solvents.



## TYPE OF SEALANT SYSTEMS

### NO SEALANT RECOVERY (Figure 2, page 12)

This arrangement takes water directly from the water main, circulates the water and discharges it through a separator tank to drain without re-circulation. This arrangement is most common on small pumps, in installations where water conservation is not a factor, or where contamination of sealant may be a problem

### PARTIAL SEALANT RECOVERY (Figure 3, page 13)

This arrangement has the pump discharging water and gas into a gas/liquid separator tank where the gas-water mixture is separated, releasing the gas to atmosphere and retaining the water. Some water is disposed of through an overflow and the remainder is retained in the separator tank for re-circulation. A small continuous amount of sealant is added in quantity necessary to maintain the operating pressure.

This is the most commonly used arrangement where sealing liquid conservation is required.

### FULL SEALANT RECOVERY (Figure 4, page 14)

This arrangement is similar to Partial Recovery, the difference being that incoming make-up sealant is controlled by a level switch on the recovery tank and a heat exchanger is added. The heat exchanger may be refrigerated water (shell & tube) or cooled air (Radiator). At pressures above 100 mm Hg, a circulation pump is installed to insure the proper amount of sealant is re-circulated.

Full recovery systems often operate under conditions where condensation will cause the liquid level to rise. The opposite condition can exist whereby liquid evaporation will make it necessary to add make-up liquid.

### GENERAL

When installing a "No Sealant Recovery System", a drain connection may be installed as shown in figure 4, page 6 to drain liquid down to shaft level prior to starting the pump. Draining to shaft level may be necessary to avoid overloading the pump and motor when starting. Normally it is not necessary to drain to pump level prior to starting if during the prior pump shutdown the incoming sealant flow is stopped simultaneously while stopping the pump. An automatic solenoid valve (normally closed) is convenient for this use.

As the pump creates it's own vacuum it will draw in the required amount of seal water so that the seal water need will not be under pressure when pumping below 150 mm Hg.

If there is extensive piping fittings, valves and other restrictive devices in the seal line, the water would need to be adequately pressurized in order to overcome the pressure drop due to these fittings.

When operating, a fixed amount of seal water is being drawn into the pump. The pressure on the seal line will vary, depending upon the inlet pressure.

On a Full Recovery System which does not use a circulation pump, the seal water is drawn into the pump under pump suction entirely. For sustained operation above 150 mm Hg (abs), a circulation pump may be required.

## SEALING WATER ARRANGEMENTS

There are three (3) sealing liquid arrangements as shown in figure 2,3,4 based upon the amount of sealing water recovered and recirculated. The water available at the pump site may contain minerals which when used as a seal water will cause an undesirable scale to form inside the pump. This should be a consideration in selecting the most satisfactory arrangement, as any pump size and model can have any one of the three arrangements (Figures 2,3,4).

**CAUTION:**

- The pump must not run dry.
- Never start the pump with liquid level above the shaft line

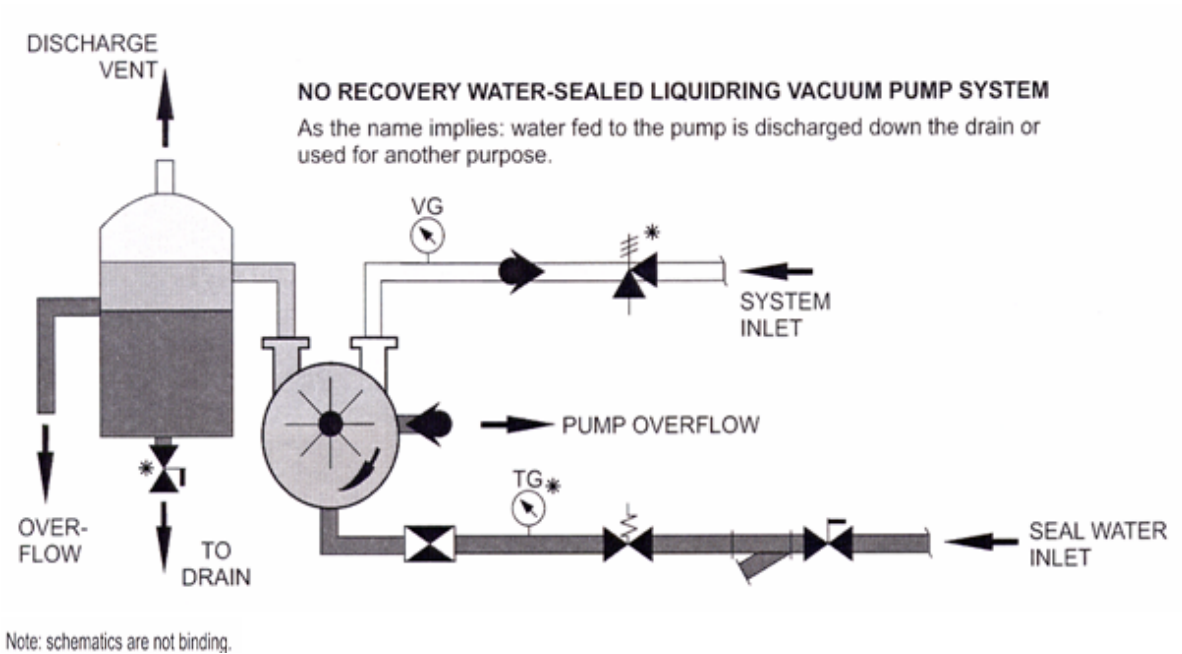
















FIGURE 2

	CHECK VALVE	TG	TEMPERATURE GAUGE	*	OPTIONAL
	FLOW CONTROL	CG	COMPOUND GAUGE		COOLING WATER
	GLOBE VALVE	VG	VACUUM GAUGE		AIR OR GAS
	SHUT-OFF VALVE				MIXTURE GAS/SEAL FLUID
	SOLENOID VALVE		STRAINER		SEAL FLUID
	VACUUM RELIEF VALVE		LEVEL SWITCH		RECIRCULATING PUMP
					HEAT EXCHANGER

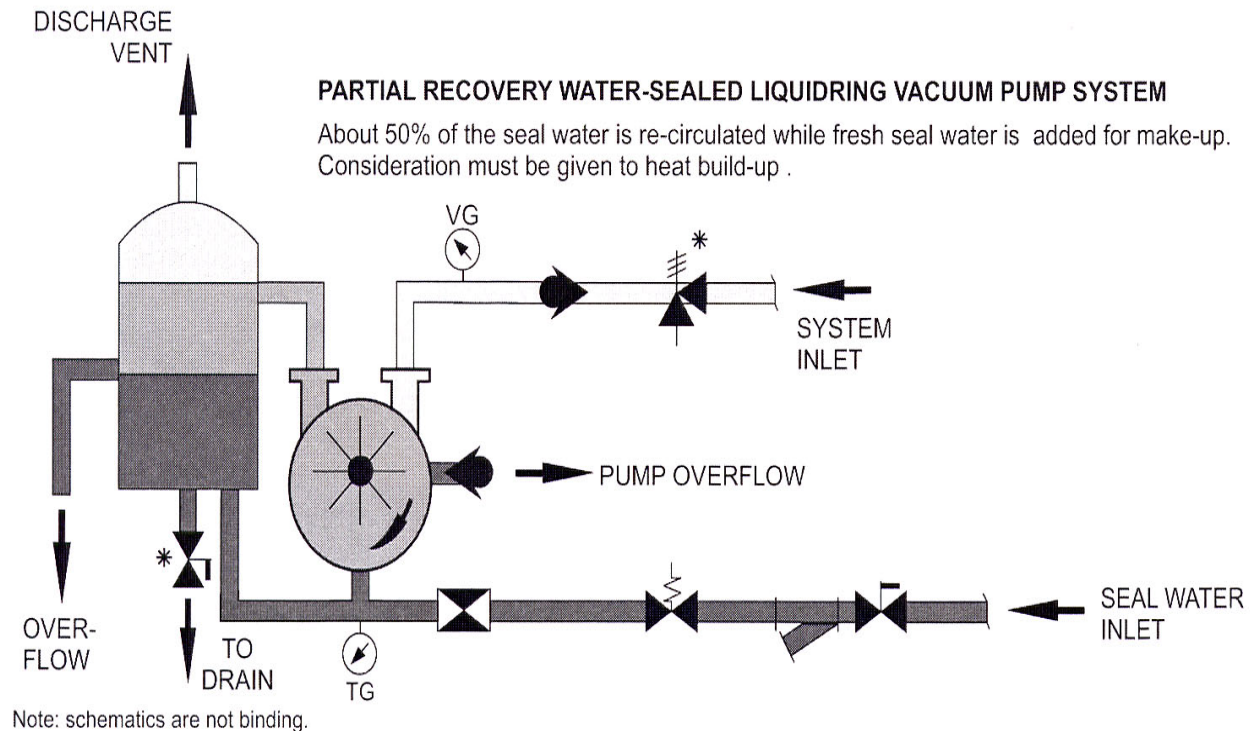
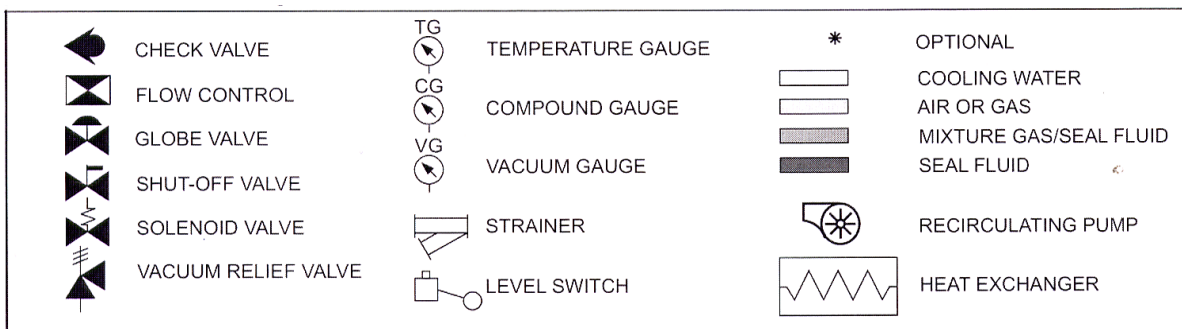


FIGURE 3



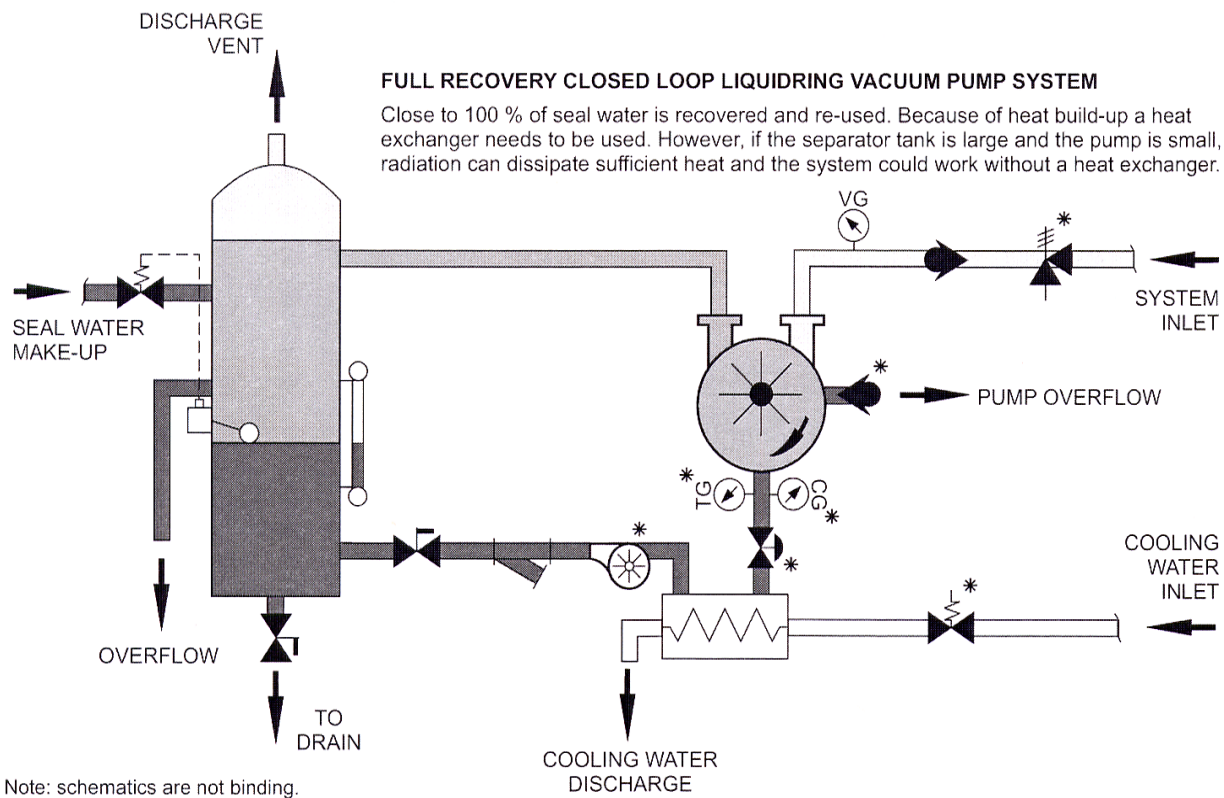
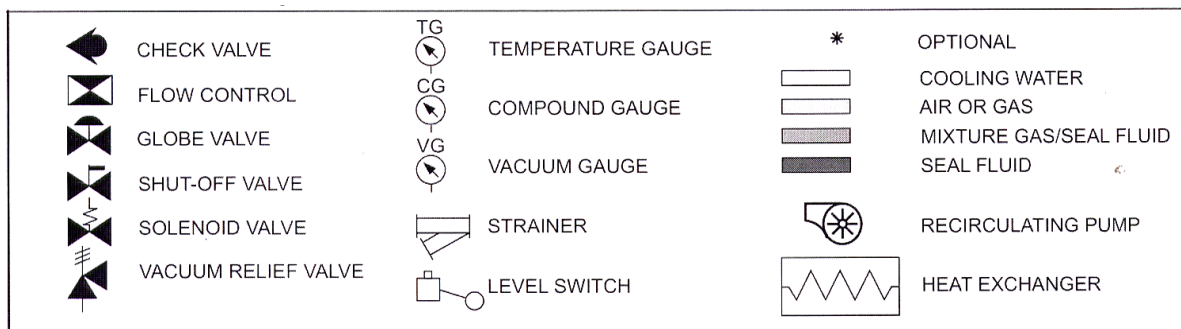


FIGURE 4



## Properties of sealants

Water is the most commonly used sealant in liquid ring vacuum pumps. Other fluids may be used to obtain process compatibility. In these applications special consideration should be given to the properties of the sealant, which may affect pump performance. Some of the properties of sealant, which should be considered are:

- Specific gravity
- Specific heat
- Viscosity
- Vapor Pressure

Additionally, the solubility of process gas in the sealant can be of significance and should be evaluated especially if the partial or full recovery system is used. When water is the sealant its chemical content should be evaluated since certain conditions will affect the service life of the pump. Generally if water is suitable to drink it is suitable for pump use. Hardness greater than 500 PPM will result in internal plating and fouling of pump parts. Service with hardness of less than 500 PPM depends on operating temperature and the nature of the salt deposit. Naturally occurring well water with organic acid of pH-5 or higher is generally suitable, however pH of 7 or higher is preferred. Chemically treated water with sulfur content requires pH-7 or more. Water, which has a pH less than 5 should be treated, or the pump should have special materials of construction.

## Sealant temperature

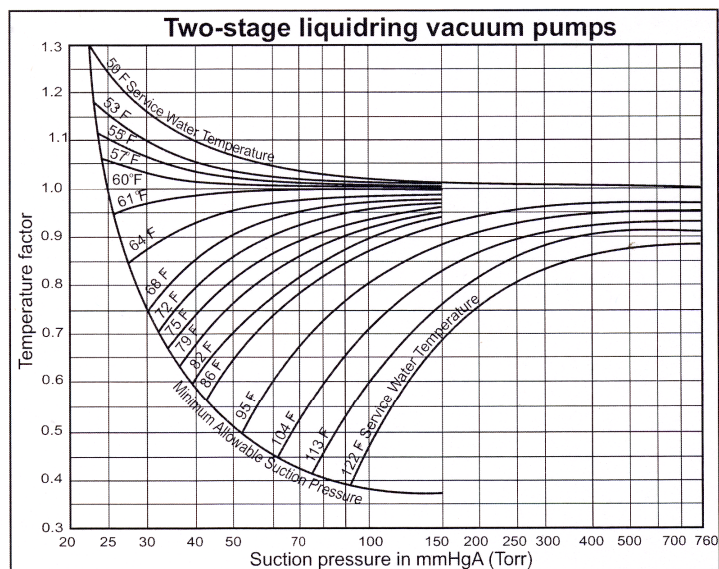
The rated capacity (ACFM) of LRH Liquid Ring vacuum pumps are based upon the use of incoming seal water of 60 Deg F. Seal water temperature affects the pump capacity. To calculate pumping capacity (ACFM) when using water at other than 60 Deg F the following formulas apply.

$$S_a = S_{60} \times \frac{(P_1 - P_c)}{(P_1 - 13.3)}$$

Where:  $S_a$  = Actual capacity in ACFM at  $P_1$   
 $S_{60}$  = Pump capacity with 60 Deg sealant at  $P_1$ .  
 $P_1$  = Inlet pressure in Torr  
 $P_c$  = Vapor pressure of sealant at actual sealant temperature

### REFERENCE CHART

For calculating pumping Capacity of two-stage Liquid ring vacuum Pumps using various Seal water temperatures



## **OPERATION**

### **SEALING LIQUID**

The pump performance curves are determined by the temperature of the sealing liquid and influences the base pressure and pumping speed (capacity-cfm). At lower sealing liquid temperatures, the pump capacity increases and at higher temperatures the pump capacity decreases. The temperature/efficiency ratio is not linear and the most profound effect, in terms of percentage-of-change, is at low pump pressures.

Most pumps are recommended to utilize a water flow orifice which regulates the amount of water flow, if at least 15 PSI water pressure is supplied.

### **PROCEDURE FOR MINIMUM SEAL WATER REQUIREMENTS**

The requirements for seal water as shown in our specifications are the maximum GPM for any application. To determine the minimum quantity of seal water required for a specific application proceed as follows:

Lower the pump suction pressure to between 50-150 mm Hg (abs). To steady the pressure with-in this range, bleed air into the suction of the pump and adjust this air until the pressure level remains constant within the range of 50-150 mm Hg. With the pressure level steady, slowly decrease the flow of seal water into the pump until the pressure begins to fluctuate and then gradually increase the flow until the pressure again becomes steady and this is the setting to allow the minimum seal water flow.

### **CAVITATION**

Cavitation is recognized as a metallic noise in the pump when the pressure is low and the air flow is slight. When this occurs, slowly bleed air into the pump through the cavitation valve until the noise disappears. Bleeding air into the pump suction will also eliminate this noise, but a rise in pressure will occur.

### **STARTING THE PUMP**

If the pump has been idle for an extended period of time, it is advisable to turn the pump over by hand prior to energizing the motor to determine that the impeller is free to turn. Some conditions to consider are (1) has the pump been idle for an extended period of time and not properly preserved, or (2) have repairs or alterations caused the piping to be disconnected thus the possibility of harmful objects entering the pump. If the shaft cannot be turned loosening the tie rods may free the impeller. Tighten the tie rods when impeller is free. Lightly tap the pump body with a soft faced hammer if scale build-up is obstructing the impeller.

The water level must be no higher than the pump shaft when starting the pump in order to prevent overloading the pump and motor. The cavitation valve is convenient for lowering the pump liquid to shaft level, however, this method may be too time consuming and if so, a drain cock should be provided on the seal water piping.

### **CAUTION**

THE PUMP MUST NOT START OR RUN DRY

### **STOPPING THE PUMP**

- Isolate the pump from the system
- Shut off the seal water supply
- Stop the pump & bleed off excess water



# MAINTENANCE

## GENERAL

Elementary rules of cleanliness, periodic inspections, and a preventative maintenance policy of the pump will produce optimum performance and prolong the life of the pump.

## STORAGE

If the pump is to be idle for an extended period of time, the interior must be preserved by circulating a water-soluble rust inhibitor through the pump with ports sealed. Rotate the pump by hand periodically.

## MAINTENANCE General:

To prolong pump life and reduce impeller and body wear and blockage dust and debris from normal operations should be regularly flushed out through the flushing mouth on pump cover base. If the liquid seal fluid is hard water, it should be softened or flushed regularly with solvent. If the impeller, air inlet port, or air vent are blocked by scale from hard water, fill the pump with a 10% oxalic acid solution for 30 minutes and flush.

## Lubrication:

After normal pump operation for 20,000 hours or not more than 3 years every pump should be lubricated by cleaning the old bearing grease and supply new grease. The new grease will should occupy 50% space of bearing, and 65% space of bearing cover. If the pump application is severe, the lubrication replacement schedule should be shortened.

## Disassembly & Mechanical Seal Replacement:

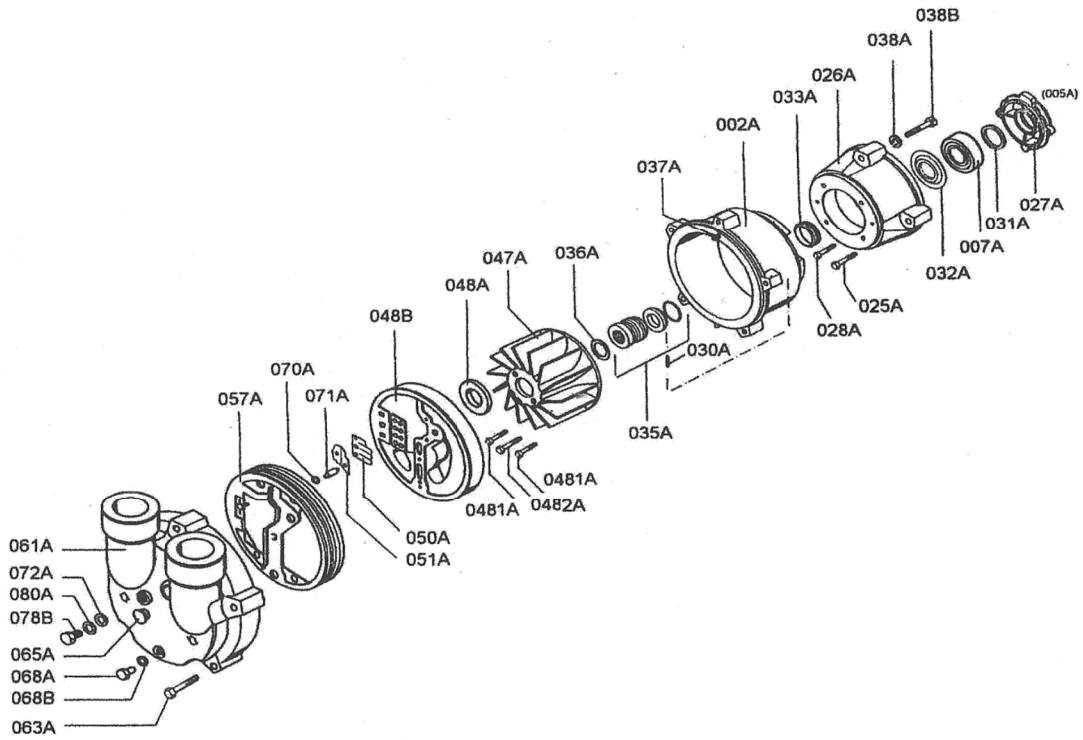
When disassembling first remove the cover and carefully inspect and inventory each component as you remove it. As you disassemble the pump look for excessive signs of wear and/or scale build-up. Clean the pump thoroughly and replace all worn components as necessary (reference appendix A for part numbers and description). After disassembling the pump you should replace the mechanical seal and gaskets provided with the standard repair kit.

**Assembly & Clearance Settings:** After the mechanical seal has been replaced, place the impeller on the pump shaft and tighten the impeller shaft screw all the way to ensure that the impeller is fully seated. After the impeller is seated, measure the clearance between the impeller and port plate. The minimum clearance should comply with the following chart. Make sure you place the appropriate number of ship gaskets under the impeller bolt in order to maintain the appropriate clearance. After the clearance has been set complete the assembly of the pump and rotate it by hand to ensure it turns freely.

PN	Minimum Clearance (b/w)
	Port Plate & Impeller (in)
LRV20NC	.003-.004"
LRV35NC	.003-.004"
LRV55NC	.003-.004"
LRV100NC	.006-.008"
LRV150NC	.006-.008"
LRV200NC	.008-.010"
LRV350NC	.010-.012"

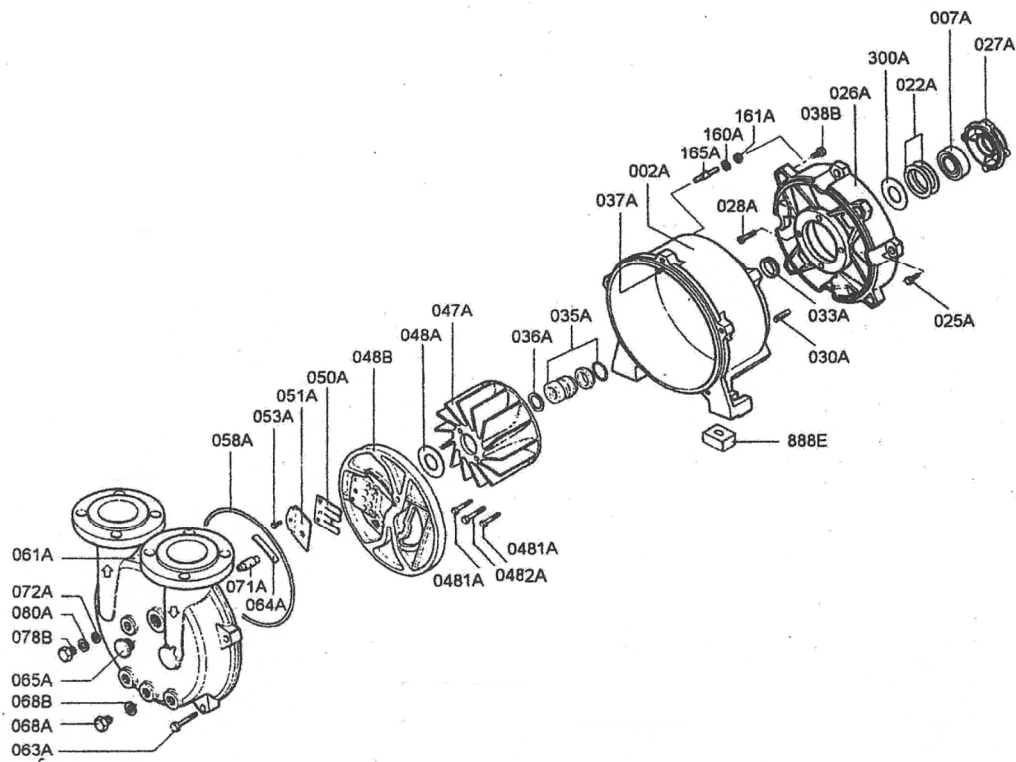
## TROUBLESHOOTING

CONDITION	CAUSE	REMEDY
Seals leaking	Seal incorrectly installed	Re-install seal
	Seal worn or damaged	Replace seal
Reduced capacity	Rotational speed too low	Check supply voltage
	Vacuum leak	Locate and repair
	High sealant temperature	Check coolant flow and temperature Check heat exchanger cleanliness
	Incorrect sealant flow rate	Adjust to correct flow rate
Excessive noise	Defective bearing	Replace
	Too much sealant liquid	Decrease flow rate
	Coupling misaligned	Align
	Cavitation	Open attenuation valve or reset vacuum relief valve to increase flow
Overheating	Defective bearing	Replace
	High sealant temperature	Check coolant flow and temperature
	Suction open to atmosphere	Adjust isolation valve
Excessive Vibration	Coupling misaligned	Align
	Pump not properly anchored	Anchor
	See excessive noise	Check inlet pressure & gas flow
Motor overloaded	Excessive back pressure	Reduce height of pump discharge
	Too much sealant liquid	Decrease flow rate
	Misalignment	Realign motor & pump
	Defective bearing	Replace bearing
Abnormal bearing wear	Misaligned pump assembly	Realign motor & pump
Impeller binding	Accumulation of rust or scale	De-scale or remove rust
	Foreign object in pump	Dismantle pump & remove object
Mechanical seals squeal	Insufficient cooling liquid	Increase coolant flow to seal



LRV20NC Thru LRV55NC

REF#	DESCRIPTION	REF#	DESCRIPTION
002A	PUMP CASING	048A	INTERCEPTING PLATE
007A	BALL BRG	048B	PORT PLATE
025A	BOLT	050A/051A	DISCH. VALVE/ DISC. PLATE
026A	BRG HOUSING	057A	COVER SEAL
027A	BRG CAP	061A	FRONT COVER
028A	BOLT	063A	BOLT
030A	PIN	065A	PLUG
031A	SPACER	068A	BOLT
032A	SEALING RING	068B	SEALING RING
033A	V RING	070A	SEALING RING
035A	SHAFT SEAL	071A	NIPPLE
036A	WASHER	072A	WASHER
037A	PIN	078B	BOLT
038A	WASHER	080A	SEALING RING
038B	BOLT	481A	BOLT
047A	IMPELLER	482A	BOLT



LRV100NC Thru LRV350NC

REF#	DESCRIPTION	REF#	DESCRIPTION
002A	PUMP CASING	051A	INTERCEPTING PLATE
007A	BALL BRG	053A	BOLT
022A	WASHER	058A	SEALING RING
025A	BOLT	061A	FRONT COVER
026A	BRG HOUSING	063A	BOLT
027A	BRG CAP	064A	PLATE
028A	BOLT	065A	PLUG
030A	PIN	068A	BOLT
033A	V RING	068B	SEALING RING
035A	SHAFT SEAL	071A	NIPPLE
036A	WASHER	072A	WASHER
037A	PIN	078B	BOLT
038B	BOLT	080A	SEALING RING
047A	IMPELLER	161A	NUT
048A	INTERCEPTING PLATE	165A	STUD
048B	PORT PLATE	481A	BOLT
050A	DISCHARGE VALVE	481B	BOLT

# **WARRANTY– VACUUM PRODUCTS**

Subject to terms and conditions hereinafter set forth and set forth in General Terms of Sale, US Vacuum Pumps LLC (the seller) warrants products of its manufacturer, when shipped, and its work (including installation & start-up) when performed, will be of good quality and will be free from defects in material and workmanship. This warranty applies only to sellers equipment, under use and service in accordance with seller's written instructions, recommendations and ratings for installation, operating, maintenance and service of products for a period of 12 months. Because of varying conditions of installation and operation, all guarantees of performance are subject to plus or minus 5% variation.

**THIS WARRANTY EXTENDS ONLY TO BUYER AND/OR ORIGINAL END USER, AND IN NO EVENT SHALL THE SELLER BE LIABLE FOR PROPERTY DAMAGE SUSTAINED BY A PERSON DESIGNATED BY THE LAW OF ANY JURISDICTION AS A THIRD PARTY BENEFICIARY OF THIS WARRANTY OR ANY OTHER WARRANTY HELD TO SURVIVE SELLER'S DISCLAIMER.**

All accessories furnished by seller but manufactured by others (motor) will bear only that manufacturer's standard warranty.

All claims for defective products, parts, or work under this warranty must be made in writing immediately upon discovery and, in any event within one (1) year from date of shipment of the applicable item by seller. Unless done with prior written consent of seller, any repairs, alterations or disassembly of sellers equipment shall void warranty. Installation and transportation costs are not included and defective items must be held for seller's inspection and returned to sellers Ex-works point upon request.

**THERE ARE NO WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY WHICH EXTENDS BEYOND THE DESCRIPTION ON THE FACE HEREOF, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS OF PURPOSE.**

After buyers submission of a claim as provided above and its approval, seller shall at its option either repair or replace its product, part, or work at the original Ex-works point of shipment, or refund an equitable portion of the purchase price.

The products and parts sold hereunder are not warranted for operation with erosive or corrosive materials or those which may lead to a build-up of material within the product supplied, nor those which are incompatible with the materials of construction. The buyer shall have no claim whatsoever and no product or part shall be deemed to be defective by reason of failure to resist erosive or corrosive action nor for problems resulting from build-up of material within the unit nor for problems due to incompatibility with the materials of construction.

Any improper use, operation beyond capacity, substitution of parts not approved by seller, or any alteration or repairs by others in such manner as in sellers judgment affects the product materially and adversely shall void this warranty.

No employee or representative of seller other than an officer of US Vacuum Pumps LLC is authorized to change this warranty in any way or grant any other warranty. Any such change by an officer of the company must be in writing.

In no event shall buyer be entitled to incidental or consequential damages. Any action for breach of this agreement must commence within (1) year after the cause of action has occurred.

# NOTES

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