WARRANTY

SERIAL NUMBER :

Subject to the terms and conditions hereof, POM-VAK warrants that the products and parts of its manufacture specified below, when shipped, and its services when performed, will be free from defects in material and workmanship for 1 (one) year.

This warranty shall apply to liquid ring vacuum product only if they are operated with POM-VAK approved seal fluids, oil, mechanical seal faces and elastomers.

This warranty does not extend to equipment such as electric motors, starters, heat exchangers and other accessories furnished to POM-VAK by third party manufacturers and/or suppliers. These accessories are warranted only by such third parties. Replacement of maintenance items, including, in particular, seals, bearings, filters, etc. supplied in connection with standard maintenance service provided by POM-VAK are not covered by this warranty. POM-VAK disclaims any liability in connection with the malfunctioning of any system or component of system which conforms to designs, specifications and/or instructions mandated by purchasers.

This warranty is limited exclusively to products and/or parts properly installed, serviced and maintained in full compliance with the operating and maintenance chapters of the manual. This warranty shall not extend to products and/or parts which have been misused or neglected or not used for the purpose for which they were intended, including, in particular, products operated at/in excessive temperature or dirty environments, products used in conjunction with corrosive, erosive or explosive liquids or gasses and/or products malfunctioning as a result of build-up of material in the internal parts thereof.

THIS WARRANTY AND POM-VAK'S OBLIGATIONS HEREUNDER ARE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. ALL WARRANTIES WHICH EXCEED THE FOREMENTIONED OBLIGATIONS ARE HEREBY DISCLAIMED BY POM-VAK AND EXCLUDED FROM THIS WARRANTY, WHETHER BASED ON CONTRACT, WARRANTY, NEGLIENCE, INDEMNITY, STRICT LIABILITY OR OTHERWISE. NO EMPLOYEE OF POM-VAK OR OTHER PERSON IS AUTHORIZED TO GIVE ANY OTHER WARRANTY OR TO ASSUME ANY OTHER LIABILITY ON POM-VAK'S BEHALF.

 (\mathbf{R})

OPERATING MANUAL

This manual includes,

Operational Instructions Safety Instructions Disassembly & Assembly Instructions

for liquid ring vacuum pumps and syster



LIQUID RING VACUUM PUMPS Types: PVM - PVN - PVK - PVT LIQUID RING VACUUM SYSTEMS



INDEX				INDEX	
Η	leadline	Page	Н	eadline	Р٤
1	- General instructions	4	5	- Pumps	
2	- Basic instructions	4		5.1 - Working system	
3	- Safety instructions	6		5.2 - Code system	
	3.1 - EMERGENCY	7		5.3 - Pump types	
	3.2 - Moving instructions	7		5.3.1 - PVM series pumps	
	3.3 - Storage instructions	8		5.3.2 - PVN series pumps	
	3.4 - Mechanical safety instructions	10		5.3.3 - PVK series pumps	
	3.5 - Electrical safety instructions	10		5.3.4 - PVT series pumps	
	3.6 - Safety instructions for heat	12		5.3.5 - PVL series systems	
	3.7 - Safety instructions for noise	12		5.3.6 - PVY series systems	
	3.8 - Safety instructions for radiation	12		5.4 - Pump characteristics	
	3.9 - Safety instructions for waste	12		5.5 - Marking-Marks on the pumps	
	3.10- Ergonomic instructions	14		5.6 - Cross-sections and parts	
	3.11- Safety instructions at malfunction	14		5.6.1 - Monoblock type pumps	
4	- Operation	14		5.6.2 - Stage pumps	
	4.1 - Mounting instructions	14	6	- Maintenance	
	4.1.1 - Baseplate mounting	15		6.1 - Periodic maintenance	
	4.1.2 - Mounting motor	15		6.2 - Repair kit	
	4.1.2.1 - Monoblock coupling (Closed-couple)	16		6.3 - Disassembly to replace bearings	
	4.1.2.2 - Alignment of coupling	16		6.4 - Disassembly to replace mechanical seals	
	4.1.3 - Pipeline	18		6.5 - Disassembly	
	4.1.4 - Accessories	19		6.6 - Repairing	
	4.1.4.1 - Open system	20		6.7 - Assembly	
	4.1.4.2 - Semi-open system	21	W	ARRANTY CONDITIONS	
	4.1.4.3 - Closed system	21			
	4.1.4.4 - Equipments of working systems	22	Tl	his manual applies to POM-VAK liquid ring vacuum pumps series PVM, PVI	N, PV
	4.2 - Electrical connection	22	P	VT and systems series PVL and PVY. (Please see chapters 5 for details perta	aining
	4.3 - Check list for start-up	23	sy	/stems.)	
	4.4 - Starting	24	A	11 products manufactured by POM-VAK are guaranteed to meet the conditions ?	listed
	4.4.1- Start-up	25	th	e general terms & conditions of sales and/or conditions listed on the order confir	matio
	4.4.2- Operation	26	Fε	ailure to strictly adhere to the instructions and recommendations listed in this	mant
	4.4.3- Shut down	26	W	ill void the manufacturer's warranty. (The details of warranty can be seen in t	the pa
	4.5 - Energy saving	27	78	<u>3.)</u>	
	4.6 - I rouble shooting	27	In op an at	preparing this manual, every possible effort has been made to help the custo perator with the proper installation and operation of the pump and/or system. If it errors, misunderstandings or discrepancies please do not hesitate to bring the itention.	you fi you fi

GENERAL INSTRUCTIONS

This manual is intended to provide reference to:

- Application and operation safety.
- Installation and maintenance for pump or system.
- Starting, operating and stopping procedures for pump or system. -

This manual should be read CAREFULLY and kept in safe for future reference. It should always be available to the qualified operating and maintenance personnel responsible for the safe operation of the pump or system. The qualified personnel should be experienced and knowledgeable of safety 11. MAKE SURE the direction of rotation is at the same direction as the arrow on the pump. standards, knowledge of first aid, should be recognised by the safety department.



The pump is to be used only for the applications specified on the confirming order for which POM-VAK has selected the design, materials of construction and tested the pump to meet the order specifications.

In the event the pump is to be used for different applications, please consult POM-VAK or 13. MAKE SURE the service liquid enters the pump continuously. NEVER supply pressured liq representative of the manufacturer. POM-VAK declines to assume any responsibility if the pump is used for different applications without prior written consent.

The user is responsible for the verification of the ambient conditions where the pump will be stored 14. Where possible, SUPPLY cool liquid, around 4°C if possible, to the pump. If the temperature or installed. Extreme high or low temperatures may severely damage the pump of system unless proper precautions are taken.

POM-VAK does not guarantee repairs or alterations done by user or other unauthorised Special designs and constructions may vary from the information given in this manual. Please contact POM-VAK should you have any difficulty or doubt.

Note: Drawings appearing in this manual are only schematics. These drawings are not for construction. For construction drawings please contact POM-VAK or any authorized local Liquid ring vacuum systems : representative.

2 - BASIC INSTRUCTIONS

- 1. Mount the baseplate on the ground properly.
- 2. Use proper electric wiring and boxes in accordance with the motor.
- 3. Totally clean the suction line, service liquid line and accessories on them before installing the Oil ring vacuum systems: vacuum pump or system. MAKE SURE NOT any solid or dirt particles like welded parts, nuts, 20. Follow the items of 1, 2, 3, 5, 10 and 11. above for the pump. bolts, etc. comes from the lines, vacuum tanks, or any accessories.
- 4. **NEVER** use smaller diameter pipes than pump's ports of diascharge and service liquid.
- 5. If the pump stands at storage or transports more than 1 (one) month, rotate the shaft by hand 23. Check the oil level on the oil reservoir. If the oil level is lower than the minimum level, add oi after disassembling the shaft guard to avoid possible rust built-up or seizing. If it cannot rotate, 24. Make sure the oil adding port is open to atmosphere. use proper tool such as pipe wrench to rotate from shaft until it can be rotated by hand.
- 6. If the pump suddenly stops, the liquid inside the pump tries going through the vacuum line. Use proper non-return (check) valve on suction line to prevent this.
- 7. When the pump stops, entering the service liquid to the pump should be stopped. It is recommended using a selenoid valve for service liquid enter. If the pump is filled up by water, there will be extremely high force on the blades of impellers at each start. Blades or shaft can be 27. If too much water comes from suction line through the reservoir, the drainage port might not damaged in time.
- 8. NEVER connect more than 80cm height pipeline at discharge port of the pump and NEVER sunk the discharge line into water. The discharge has to be open to the atmosphere.

- 9. Open the syphere valve on the liquid ring vacuum pump and fill water from one of upside po of the pump until it comes from this valve for the first start-up, then stop adding water and cl the valve. NEVER OPERATE THE PUMP DRY !
- 10. Do not make any connection to the syphere valve on the pump. If the pump operates cavitation area, this pump can be opened and sucked air from the atmosphere in order to prev noise and vibration. If cavitation cannot be prevented when doing this, check the temperature the liquid.
- 12. Where possible, do not use hard water. When the service water is hard, lime accumulates ins parts of the pump and causes corrosion, erosion and damages, decreases the pump suct capacity in time and absorbed more power than usual. It needs regularly cleaning with a pro chemical.
- to the pump. The pump can suck the liquid itself from a tank, which is open to the atmosph beside it.
- service water exceeds 15°C, this causes decreasing pump capacity, unefficient vacuum press and cavitation.
- 15. If the pump has packing seal, 15-20 drops water should come our from sealing area in a minu If it comes more, tighten the gland by fastening the nuts and if less, loosen the nuts.
- 16. If the pump will be stored more than 1 (one) month, add anti-freeze to the water inside the pu or drain it and fill the pump with a proper oil or preserved liquid.

- 17. Follow the items of 1,2,3,5,6,9,10,11,12 and 16. above for the pump.
- 18. Fill water to the defined level of the separator water tank. Check the level while operating an water level is under the minimum level, add water. (See chapter 4.1.4')
- 19. Do not make any connection to discharge ports of the tank.

- 21. Do not make any connection to discharge ports of the tank.
- 22. Make sure running the circulating pump just 2-5 seconds before the vacuum pump.

- 25. NEVER connect any pipe to the water drainage port of the oil reservior. If any pipe connected, this causes a syphonic effect and draines the oil from reservoir.
- 26. There is water under the oil at the bottom of the oil reservoir. This water prevents the drained.. Do not drain this water. If drains accidentally, add water to the reservoir from discharge port of the seperator.
- sufficient enough. When this situation occurs, open the drain valve onto the cleaning door reservoir and drain water until oil comes from valve. Close the valve, add water to the reserv from the discharge port of the separator.

3 - SAFETY INSTRUCTIONS



CAREFULLY READ AND STRICTLY ADHERE TO THE INSTRUCTIONS LISTED BELOW TO PREVENT PERSONAL INJURIES AND/OR EQUIPMENT DAMAGE

- 1. ALWAYS apply the pump for the conditions outlined on the confirming order.
- 2. Electrical connections on the motor or accessories must **ALWAYS** be carried out by authorised personnel and in accordance to the local codes.
- 3. Any work on the pump should be carried out by at least 2 (two) people.
- 4. When approaching and working on the pump, **ALWAYS** wear proper cloth, avoid use of clothes with wide sleeves, necklaces, etc and/or wear safety equipments like hard hat, safety glasses, safety shoes, etc. adequate for the work to be done.
- 5. For whatever the reason, ALWAYS stop the pump prior to touching it.
- 6. ALWAYS disconnect the power to the motor prior to working or removing the pump from the installation.
- 7. NEVER work on the pump when it is hot.
- 8. After completion of the work ALWAYS re-install the safety guards previously removed.
- 9. ALWAYS be careful when handling pumps that convey acids or hazardous fluids, use proper gloves.
- 10. ALWAYS have a fire extinguisher in the vicinity of the pump installation.
- 11. **DO NOT** operate the pump in the wrong direction of rotation. BE SURE the direction of rotation is right according to arrow label on it.
- 12. NEVER put hands or fingers in the pump or system openings or cavities.
- 13. NEVER step on pump and/or piping connected to the pump.
- 14. When maintenance or repair is carried out, pump or piping must NEVER be under pressure or vacuum.
- 15. There are materials in the pump that might be hazardous to people suffering from allergies. Maintenance and operating personnel should consult the table-1 for such materials.

Material	Usage	Possible danger
Oil & grease	General lubrication, ball or roller bearings	Skin and eye irritation
Plastic & elastomer components	O-ring, V-ring, splash ring, oil seals, mechanical seal parts	Release of fumes and vapours when overheated.
Teflon & kevlar fibres	Packing seals, rings	Release of dangerous powders, release of fumes when overheated.
Paint or varnishes	Exterior pump surface	Release of powder and fumes in case of rework, flammable
Liquid compounds	Gasket between flat surfaces	Skin, eye and breathing organs irritation
Protective liquids	Pump inside surface	Skin and eye rash
	Table-1	

3.1. EMERGENCY

In the case of dangerous events by controlling the power by hand, use emergency stop according to EN 418 ve EN 61310-1. If the normal stopping system is suitable for emergency stop, mark it as it is.

If the pump breaks down and leaks gas and/or service liquid, **IMMEDIATELY DISCONNECT** electric power. In the event dangerous substances have been inhaled and/or have come in contact wit human body, **IMMEDIATELY CONTACT** the medical staff and follow the instructions given by company's internal medical safety procedures. If possible, disassemble the pump from the motor an the sucking media is dangerous, flammable or toxic, **IMMEDIATELY** quarantine the area. Alert related personnel, at least two people should intervene using precautions as it is required for the spec installation. After correction of all the problems that created emergency situation, it is necessary to ci out all the recommended starting procedures seen at the section 4.4.1.

3.2. Moving Instructions

When a POM-VAK product arrives, please check the receipt and verify that the material received the exact compliance with the items listed on the packing slip and invoice and follow instructions listed below:

- 1. Check for visible damages on the crate that could have occurred during transport.
- 2. Carefully remove the packaging material.
- 3. If there is a damage during transportation, IMMEDIATELY inform the transport company a to POM-VAK's customer service department.
- 4. If there is a damage during transportation, IMMEDIATELY prepare a report to the transp company and to POM-VAK's customer service department.
- 5. Carefully remove the packaging materials from the working are in order to avoid personal inju
- 6. Check the receipt and verify that the materials received matches the items listed on packing s and invoice. Verify that the product aligns with ordered specifications. If you believe rhere is error or you have received the wrong product, please inform us IMMEDIATELY.

While removing the POM-VAK products, check the following instructions.

- 1. The pump or assembly must ALWAYS be moved and transported in the horizontal position.
- 2. Find total weight.
- 3. Find center of gravity.
- 4. Find maximum outside dimensions.
- 5. Find proper lifting points location.



It is recommended to use ropes or belts properly positioned on the pump, lift eyebolts and make correct movement for safe lifting to prevent damages and personal injuries.

- 7. There might be lifting eyebolts on electric motor or similar equipments. These might be themselves only. Do not use them for lifting the assembled unit.
- 8. Avoid lifts whereby the ropes or straps, form a triangle with the top angle over 90° as seen at figure-1.
- 9. ALWAYS drain any pumped fluid from the pump, piping and accessories, rinse and plug all openings to prevent spillage prior to moving the unit from an installation.

Check proper and non-proper lifting positions at Figure-2 on page 9.

3.3. Storage Instructions

1. Store the pump in a location that is closed, clean, dry and free of vibrations.





Where the ambient temperature is less than 5°C it is recommended to drain the pump, piping, separator, heat exchanger, etc. or add an anti-freeze solution to prevent damage to the equipment.

- 3. After the test, the internal parts of the pumps have been treated at the factory with a rustpreventative liquid. This liquid is capable of protecting the pump against rust for a period of 3 to 6 months. For a long term storage, fill the pump with similar liquid. This liquid must be suitable with gasket, elastomers, o-rings inside the pump and pump materials.
- 4. After disassembling th shaft, manually rotate the shaft to prevent any rust build up or sizing. If the shaft does not rotate by hand. Use an appropriate tool to carefully rotate the shaft until it moves freely by hand.
- 5. Plug all openings that connect the pump internals to the atmosphere.
- 6. Cover the unit with plastic sheet or similar protective material.
- 7. Pump accessories should be subjected to similar procedure.

3.4. Mechanical Safety Instructions

- Touching to the moving parts is prevented by using guards designed according to EN 953. A guard is accepted a proper one if it prevents "testing finger", which defined in EN 60529, to touch to moving parts. The guards on POM-VAK products are settled considering these
- All sharp corners and parts on the pump is to be bevelled in order to prevent personal injuries.
- All openings, which might be reached into the pump mechanism, are plugged by covers or labels. Do not remove these until the installation.
- Body of the pump and its parts are strong enough not breaking down because of vacuum pressure during the working life. There is not need any protection box or guard aorund the pump. It is verified in product test for each product at the factory.
- The design of our products are made considering not create a danger because of accumulation the waste of sucked media inside the pump.

The pump can be stuck and stopped because of accumulation or any narrowing discharge port but these cannot create a danger like cracking, breaking out, plunging, etc. User has to supply precautions not entering the dirt and solid parts through the pump. If dirt or solid parts reaches the impeller inside the pump it can break the wings and might create cracks on the body but the pump still stands, is stuck and stopped but not hurt anybody.

- Our pumps and systems are designed to be stable. If they can be moved 10 $^{\circ}$ angle from horizontal position, they never fall down. This is verifed by testing in the factory for all newly designed pumps.
- There is not any oily liquid in our liquid ring vacuum pumps therefore there is not any oil leakage from the pumps. There are mechanical seals inside the pumps to prevent leakage of service liquid.
- The pump itself has mechanical seals and preventions against oil leakage are supplied at our oil ring vacuum systems.
- Liquid ring vacuum pumps are in the range of centrifugal type pumps and there is no need to obey any other safety instructions like steam jets, kryojenic pumps, Getter pumps, molecular pumps apart from this manual.



Figure-2

3.5. Electrical Safety Instructions

Our liquid ring vacuum pumps are delivered to customers with standard electric motors if the or includes a motor.

If an order does not include special electric connection, liquid ring vacuum pumps are delive without electric connection schemes.

If an order does not include a special electric box, liquid ring vacuum systems and oil ring vacuum systems are generally delivered with an electric box which consist of the connection of circulating pump and cooling fan not main liquid ring vacuum pump's motor. POM-VAK does not provide service for electric connection for liquid ring vacuum pumps an systems. For electric:

- 1. Supply the electric connections according to IEC 61010-1 or EN 60204-1 standards.
- 2. Apply the electric power and equipments according to the safety objectives of (2006/95/AT).
- 3. Connect the protection equipments and keys to the electric connection by obeying the "bug safety" rules in your local area or country.
- 4. Electric motors must be protected against overloading by means of circuit breakers and/or fuses. Check all needed safety rules if the systemis in open area.
- 5. If an order does not include an electric box, our pumps and systems does not include an electrical accessories. Therefore, There is not any swich of keys on pumps and systems to cut the power supply. Be sure to supply a key near the pump or your electric box to cut power instantly for an emergency.
- 6. Circuit breakers and fuses must be sized in accordance with the full load amperage appearing on the motor nameplate.
- 7. Be sure that any mistake at your software or logic systems on your command system does not occur any dangerous situation.
- 8. Supply prevention of unexpected start of the pump or system itself.
- command in your software or logic systems.
- 10. If there is a wireless command system, supply an automatic stop system when the connection Liquid ring vacuum pumps are in the range of centrifugal type pumps and there is no need to of signal is lost or commands are confused.
- 11. Use pictures or sketches on electric box, command panel or near them for safely used.
- 12. If necessary, put the emergancy stop outside of the danger area.
- on pumps or systems to disassemly and assembly situations.
- 14. When the power off then on again, be sure the systems never work itself. If system works by itself, supply any needed electrical equipments to prevent from dangerous situation not occur because of frequency oscillation.
- 15. If power supply differs a from standard electrical source, please ensure that all necessary precautions are in place to prevent all potential risks.

If an order includes electric panel, there are needed equipments to cut power on panel. Cables, which are used on our liquid ring and oil ring vacuum systems, are safe and inside elastic pipes. Cables do not touch to the hot surfaces directly and has proper isolation.

POM-VAK produces the products with proper materials in order to use them in probable explosion and fire risks environment, and can use ex-proof type electric motors. It is necessary to get details before order. Our company has not any responsibility for electric connection at usage area.

- 1. Use electric accessories and equipments according to EN 50014 standard for such these environments.
- 2. There is not any parts which can produce electrostatic charge. Conversely, If there is a chance to occur any danger or any source of ignition, prevent to occur any electrostatic charges by grounding all stable conductive elements.

3. Choose and use the all needed safety accessories and equipments properly by considering harm effects like short-cut, outer impacts, irragulation of frequency, electromagnetic areas, ground faults, etc.

Liquid ring vacuum pumps are in the range of centrifugal type pumps and there is no need to ol any other safety instructions like steam jets, kryojenic pumps, etc. apart from this manual.

3.6. Safety Instructions for Heat

The temperature of outside surface of a liquid ring vacuum pump is not less than -10°C and more than 70°C.

The temperature of oil in oil ring vacuum systems is limited by a cooler fan on the systems. T cooler fan never let the oil temperature exceed this 70°C at outside of the radiator.

- 1. If the temperature can exceed this temperature because of heat working envirenment, watch oil temperature and when it exceeds, stop or secure the system by isolating.
- 2. The service liquid of a liquid ring vacuum pump can be heater than the limit because of suck hot steam or gas or working closed system with a small seperator. The temperature of the pu body and/or connection parts can be exceed the limit. In this situation, isolate the parts a connections or entire system to avoid touching them by accidentally and mark them by pro and easily seen warning signs.
- 3. If there are moving or free connection parts, prevent them to touch any wooden parts flammable materials.
- 9. When a stop command is given to the system, be sure there won't be any error to prevent this 4. Supply limitation of heat at surface of the pump and sattle the pump far from any flamma sources if the environment has flammable gas or particles.

any other safety instructions like steam jets, kryojenic pumps, Getter pumps, molecular pumps ar from this manual.

3.7. Safety Instruction for Noise

13. Supply a key which cuts of the power entirely and not start itself again during technicians work The noise level at liquid ring vacuum pumps and systems is under 80 db at 50 mbar absol pressure, 20°C suction gas temperature and 15°C service liquid temperature. This level is measu 1 meter far from the pump's surface and 1.6 meters high from the basement.

> Under 50 mbar absolute pressure, the noise level can be exceed 80 db. When the pump or syst should work under this pressure, use earplugs.

3.8. Safety Instruction for Radiation

Liquid ring vacuum pumps are in the range of centrifugal type pumps and there is no need to ol ionised vacuum pumps apart from this manual.

3.9. Safety Instruction for Waste

- 1. Use proper filters or equipments in order to eliminate the harmful effects of hazardous was which probably comes from sucking gas or service liquid. Some gasses go through the pump a can be discharged to the atmosphere or compounds with service liquid.
- 2. Use smoke hole and a proper filter for harmful smokes comes from sucking gas.
- 3. Prevent the dirt liquid or solid particles comes to the pump or system from suction line by us proper seperators or traps before the pumps.
- 4. If there are lots of solid dirt particles like ashes or trims which accumulate inlet and outlet pe of the pumps or systems, use proper seperators, traps or vacuum vessel before the suction por order to supply the pumps or systems work at its biggest capacity safely.

- 5. Even if filters or suction ports blocked by lime or any other dirts, a liquid ring vacuum pump can 1. Use a proper protection when the power supply cuts off. shorter. Besides, it works noiser. That's why, clean the lines, filters, any equipments and pump regularly.
- 6. POM-VAK produces the products with proper materials in order to use them in probable flammable, explosion and fire risks environment. It is necessary to get environment details before order. Unless our company is informed about environment before order, POM-VAK does not take any responsibility. If the pump or system works different from ordered application, seek advise from POM-VAK representative.
- 7. There is not any parts which can produce electrostatic charge. Conversely, If there is a chance to occur any danger or any source of ignition, prevent to occur any electrostatic charges by grounding all stable conductive elements.
- 8. If there are flammable parts which can be flamed by touching the rotating shaft comes from Grease oil, oil and service liquid used in our products can resist faced overpressure and overheatin incoming gas, prevent them to enter the pump or system.
- 9. If incoming gas consists of flammable or explosive parts at the result of any oxidizing materials, the trace of any organic dirts must be cleaned by a proper chamical before assembly. For such this application, POM-VAK has to be informed before order. Otherwise, POM-VAK does not have any responsibility. If the application is like that, consult authorized POM-VAK personnel or representative.
- 10. If incoming gas consists of flammable or explosive parts at the result of any oxidizing or parraferic materials, the pump materials must be chosen carefully. For such this application, POM-VAK has to be informed before order. Otherwise, POM-VAK does not have any responsibility. If the application is like that, consult authorized POM-VAK personnel or Before operation, be sure that the mounting and alignment are proper. Follow the instruction in t
- 11. When incoming gas consists of flammable or explosive parts at the result of any oxidizing or paraferic materials, if possible, an inert gas which is suitable for mentioned gasses can be used as diluent.

If the system must be used for flammable, explosive or hazardous gasses or steams. supply all safety setups and obey the gas supplier's safety rules.

If there is an explosion risk, the pumps are designed against the blasting pressure and tested for each types.

Liquid ring vacuum pumps are in the range of centrifugal type pumps and there is no need to obey any other safety instructions like steam jets, kryojenic pumps, Getter pumps, molecular pumps apart from this manual.

3.10. Ergonomic Instructions

- 1. Mark start and stop devices easily understandable and seen. POM-VAK marks start and stop devices in the electric panel which controls circualting pump and cooler fan on oil ring vacuum systems according to obeying EN 418 or IEC 60417 standard.
- 2. Settle manually control devices or buttons easily reachable and usable with minimum efforts.
- 3. Settle these devices easily seen from the operator room or cabin.
- 4. Settle the control devices easily understandable and not making mistakes.

Our pumps and systems are designed to let any liquid goes through the pumps and systems during 5. Be careful that the ground must be strong enough against the weight of the pump or system a filling, cleaning, aeration and evacuation.

3.11. Safety Instructions at Malfunction

- work and this does not occur any danger. The pump works at cavitation area and life will be 2. Supply proper guard devices or tools during malfunction or the power supply comes again prevent danger.
 - 3. Apply this precaution for all equipments on the pump or system like service liquid feed system, valves positions, control devices, etc.

Our vacuum pumps are produced with proper materials and shape against fatigue, aging, fragil corrosion, degradation, chemical reactions, heat and electroststic effects. POM-VAK must informed about application before order to choose proper materials of the pump or system.

The materials used in our pumps are not dangerous for the health and safety of personnels. Chi the table-1 in page-11 for possible dangers.

Our pumps and systems are produced with suitable materials for the applications. Using pro materials is depend on the information about application before the order.

Gaskets and seals used in our products resist faced overpressure and overheating.

- If pump or system stopped automatic or manually using by safety devices, make the res system to work only manually.
- If using a keyboard between the controls and operator, be sure that any dangerous command entered by accidentally.
- Make the system to run safely if any malfunctional software or computer hardware sends a dangerous command to the controls. The hardware must run if any dangerous command cor from malfunctional working software or computer's hadrware.

4 - OPERATION

manual.

4.1. Mounting Instructions

Check the following size of the pump or system from our catalogue or section 5.3 in this manual settle the area, base, suction and discharge pipelines.

- 1. Positions and dimensions of the inlet and outlet ports.
- 2. Position and dimention of the entering port of service liquid.
- 3. Positions and dimention of the baseplate connection to the ground.
- 4. General dimensions of the pump or system.

Consider the followings before settling the pump or system.

- 1. Supply enough space considering maintenance there or moving from there for any reason will easy in the future.
- 2. Supply a lift system or enough space to bring and use a mobile lift easily near the pump system for any reason in the future.
- 3. Supply enough and clean space around the pump or system what if any on-site maintena: work will be necessary in the future.
- 4. Supply enough, clean, dustless and good air conditioning space in order to work the fan of electric motors and/or cooling fans properly.
- vibrations when running. Generally prefer concrete or steel grounds.
- 6. If the ground is concrete, be sure it is rested for enough time, clean and dry.

7. Be careful to mount the electric motor and/or electric control panels not affected from dust and not overheated because of the environment. Prefer good air conditioned area.

4.1.1. Baseplate Monting

Mount the baseplates of the pumps or systems to the ground as seen in figure-4. It is seen a baseplate for stage pumps at figure-3. Mount the same holes from the monoblock (closed-coupled) pumps and systems' baseplates.



4.1.2. Motor Mounting

If the pump has been purchased with free shaft end, a proper baseplate is required to mount the pump and motor assembly.

The baseplate must be properly designed for maximum rigidity to prevent vibrations and distortions. It is recommended the use of a fabricated baseplate manufactured with rigid NPU shaped steel profiles as seen in figure-3.

When the pump has been purchased without the electric motor, it is then required to select the proper motor before preceeding the installation of the unit's equipments like coupling, baseplate, etc. Selection of motor must consider the followings:

- 1. Maximum power absorbed by the pump over the total operating range (kW)
- 2. Pump operating speed (rpm)
- 3. Available power (Frequency-Hertz, Voltage, etc.)
- 4. Motor enclosure type (IP, TEFC, EX, vb.)
- 5. Motor body size (AGM, GM, GMM)
- 6. Motor mount (B3, B5, B14, horizontal, vertical, etc.)

Flexible couplings are selected for stage pumps to couple the pump to the motor on baseplate 5. The use of rubber hammers and even pre-heating of the metal half couplings may be required considering the followings:

- 1. Nominal motor power.
- 2. Motor operating speed.
- 3. Coupling guards dictated by EN 12100-1 and 2 directives.
- 4. Size of the motor's shaft and key.
- 5. Size of the pump's shaft and key.

4.1.2.1. Monoblock Coupling (Closed-couple)

POM-VAK does not accept any order without motor for only PVM 150 series pumps. For other PVM types and all PVN types, consider the followings:

- 1. Use B35 mounted electric motor.
- 2. Mount the pump to the B5 motor flange with suitable size bolts and nuts. Prefer 8.8 quality bolts. 6. If there is still a little gap between shaft and the coupling, lightly tighten the set screws seen
- 3. Disassembly the 5 bolts or nuts from the front cover connected to the pump.
- 4. During splitting up the front cover, be careful not to do any harm pressed-paper gasket between the cover and the body.
- 5. Split up the front cover. At PVN series pumps, the plate comes from the body with front cover, tied each other.

- 6. Put the pressed-paper gasket on a clean and dry surface without any harm.
- 7. Screw the bolt which is located inside the center of impeller to motor's shaft.
- 8. Be sure if the impeller rotates easily with hand.
- 9. Put the pressed-paper gasket on the body and front cover. If the gasket slips away dur assembly, use a little bit grease oil on the gasket in order not to slip.
- 10. Screw the bolts or nuts of front cover back.
- 11. Disassebly the guard of electric motor's cooler fan back from the motor. Check if the motor shaft rotates easily with hand. If not, do the same things and screw the impeller's bolt again.
- 12. Assembly the guard of electric motor's cooler fan.
- 13. Assembly the pump and/or motor on the baseplate and finish the coupling.

4.1.2.2. Alignment of Coupling

- 1. Use proper elastic coupling. POM-VAK defines and highly recomends the size of els coupling as seen at the table-2.
- 2. Even if the pump has been ordered with motor on baseplate, alignment can be affected ba because of bad transport, lifting or moving. If there is any suspect about that, check the coupl alignment considering this chapter. If there is wrong, do the alignment by following instructions mentined in this chapter. Bad alignments will result in coupling failures and dama to pump and both pump and motor's bearings.
- 3. Use a proper hand protections such as gloves when carrying out the operations listed below.
- 4. Throughly clean pump and motor shaft ends and keys. Place the shaft keys in the proper key v slots and fit the coupling halves in line with the shaft ends.

	1 0									
Pump series	Coupling diameter [Ømm]		Pompa series	Coupling diameter [Ør						
PVK/T 230 Series	125		PVK/T 380 Series	180 - 200						
PVK/T 250 Series	140		PVK/T 520 Series	180 - 200						
PVK/T 275 Series	160		PVK/T 520 Series	250						
T 11 A										

Table-2

seen at figure-6.



- figure-6 and figure-7.
- 7. Couple the electric motor to the pump lantern engaging the two coupling halves.
- 8. Place the electric motor on the baseplate and bring the two coupling halves together with " seen at figure-7 and chosen from table-3 between them keeping the motor axially aligned w the pump shaft.

9. Make the alignment considering the "B", "C1" and "C2" values seen at figure-8 come from table-3. Measure the "B" value from at least 3 positions around the coupling. (C=C1-C2)



10. Use chims under the pump or motor feet to correct the alignment. B

11. Measure C1 and C	C2 as seen at figure-8. I	Find C=C1-C2 value.	Compare thi	is value with table-3.

Coupling	Gap	Parallel	Angular							
D [mm]	A [mm]	B [mm]	C [mm]							
125	$2 \sim 2.50$	0.15	0.25							
140	$2 \sim 2.50$	0.15	0.25							
160	3~3.75	0.15	0.30							
200	3 ~ 3.75	0.15	0.30							
250	3~3.75	0.20	0.30							
300	$4 \sim 4.75$	0.20	0.35							

Table-3

12. When the measured values fall within the tolerances, the pump and the motor mounting bolts can be tighten on baseplate as seen at figure-9.



- 13. After tighten the bolts, check the values again.
- 14. Install the coupling guard on the pump. The gap between motor frame and the guard should not be greater than 2 to 3 mm as seen at figure-10.



- 4.1.3. Pipeline
- 1. Size the pipeline considering inlet and outlet ports of the pump or system.
- 2. Use proper filter or garbler at suction line to prevent any solid particles through the pump or system.

- 3. Before mounting the pump to the pipeline, clean the suction line and be sure there is not a solid particles like welded burr, nut, bolt, etc.
- 4. Use proper size of flanges to the pump ports.
- 5. Be sure that the hole of gaskets between the flange and the pump's port is not smaller than port's hole.
- 6. Tie and secure the pipeline not to load its weight on the pump.
- 7. Be sure the suction line is mounted on the suction port of the pump.
- 8. Check if there is any leakage from your suction line.
- 9. NEVER use smaller diameter of pipe than outlet port's hole diameter for discharge pipeline possible, use bigger.
- 10. Do discharge pipeline open to the atmosphere.
- 11. NEVER mount discharge pipeline to a vessel which is not open to the atmosphere.
- 12. NEVER sink discharge pipeline into water or any liquid.
- 13. NEVER do discharge pipeline more than 80cm height from the pump port.
- 14. NEVER do discharge pipeline more than 1 meter horizontally from the pump.
- 15. NEVER mount pressured service liquid from any pressure tank or any pump. A liquid r vacuum pump can suck the needed water from a tank beside.
- 16. If service liquid have to come from a pressured tank, use a proper valve which can decrease pressure under 3 bars on the pipeline.
- 17. Never mount any line to the syphere valve on the pump. This valve supplies air from atmosph by opening a little bit if the pump works in cavitation area.
- 18. For liquid ring vacuum systems, follow the instruction 1 8., then from 19. The discharge l designs and prepared for these systems.
- 19. Do not close the discharge port of the liquid seperator on liquid ring vacuum system; or mount a pipe which is sunk into water from that.
- 20. A tunnel or a pit can be mounted to the seperator's top hole but never close that.
- 21. NEVER mount anything to water discharge port on oil ring vacuum systems. Any connectior this port behaves like a siphonic system therefore the oil in the reservoir can go through 1 connection.

4.1.4. Accessories

- 1. Use a non-return valve on the suction line because when the pump stops, the liquid in the pu tries to go suction line.
- 2. If the pump always works in cavitation area, the pump life will be shorter and noise will greater. To prevent that, use a pressure control valve on vacuum vessel, suction line or necessary onto the syphere valve on the pump and arrange it the needed pressure.
- 3. When the pump starts to work, service liquid should go through the pump and when it sto flow of the service liquid is cut off. Use a selenoide valve onto the service liquid line. If there not such valve on that, the pump fully filled with liquid when it stops. Then when the pu starts to work, this fully filled liquid creates fatigue on shaft and impeller's blades and they be broken.
- 4. If the pump can get service liquid from a tank beside it and if there is a discharge port which the same level of pump's shaft on the tank, there is not need using a selenoide valve.

- 5. Use a vacuum gauge onto the suction line that can easily be seen from the pump nearby.
- 6. Use a proper filter onto the service liquid line to prevent dirt particles entering to the pump.
- 7. If necessary, use a heat exchanger to supply cold water to the pump. Water is commonly used as service liquid for liquid ring vacuum pumps. The heat of service liquid affects the vacuum pressure in a liquid ring vacuum pump. (See diagrams, tables and samples in chapter 5)
- 8. If a vacuum vessel is used into the system, choose it as big as it can fit the area because of preventing the pump often start and stop.
- 9. Prefer a water seperator instead of direct pipeline for service liquid.
- 10. A liquid ring vacuum system contains liquid ring vacuum pump, water seperator and its connections. They are delivered with the accessories defined by order. Use these accessories by checking the ordered information.
- 11. An oil ring vacuum system is a whole system which contains liquid ring vacuum pump, seperator tank, cooler fan or heat exchanger, circulating pump, oil reservoir and connections. For more info please check chapter 5.

A liquid ring vacuum pump continuously needs service liquid because of working principle. This liquid is discharged from outlet port of the pump with sucked media. The needed service liquid amounts can be seen in table at chapter 5.

When the pump pressurizes the media through the discharge section, there will be an increase heat. This heat is captured by service liquid. The temperature of service liquid increases around $3 - 4^{\circ}C$ each cycle. If the temperature exceeds $15^{\circ}C$ for water, the pump capacity and the vacuum pressure will be affected negatively. The colder service liquid is the greater suction capacity and vacuum pressure. (For more info, please check chapter 5.

Temperature of surfaces on the pump or system might exceed 60°C while working. Do not touch pump or accessories with bear hand to avoid bursts.

Seperators for liquid ring vacuum pumps can be many different designs. Generally three types are commonly used. They are:

4.1.4.1. Open System

- The system is seen at figure-11.
- In this system, service liquid is supplied from a main water network directly.
- Sucked media and water go through a water seperator.
- Water is drained from this seperator.
- Pressure of service liquid should not be more than 0.4 bar. Otherwise, water fills the pump.

- Ensure that the drainage hole should be aligned at the same level as the pump shaft to allow for proper drainag This system is used more common. It continuously needs fresh liquid. If there are hazardous chemicals in sucked media and they are combined with the service water then the discharge goes for water treatment, this system is recommended. Otherwise, working with this system is expensive and consumes water.

4.1.4.2. Semi-open System

- The system is seen at figure-12
- In this system, part of the liquid in seperator returns to the pump as a part of service liquid.
- Sucked media and water go through a water seperator.
- Water is drained from this seperator.
- Pump itself can suck the water aligned to.



The hole of drainage should be the same level as the pump shaft.

This system gains most amount of discharged water from the seperator. Some of the service wa may vaporizes due to the heat generated in the discharge section of the pump. Therefore, fresh wa should be supplied from main water network. The discharged water and fresh water mixed into seperator and goes through the pump.



4.1.4.3. Closed System

- The system is seen at figure-13
- In this system, part of the liquid in seperator is cooled by a cooler and returns to the pump service liquid.
- Sucked media and water go through a water seperator.



- Water is drained from this seperator.
- Pump itself can suck the water from seperator.
- The hole of drainage should be aligned to the pump shaft.

This system gains most of the used liquid as service liquid. Heated liquid is cooled with a cooler fan or any heat exchanger, then returns to the pump as service water.

While sucked gas is being pressured in discharge chamber of the pump, this process creates heat. Most of this heat is absorbed by service liquid and some of them is vaporized. When it is cooled, most of the liquid is gained back. Little part of vapour goes to the atmosphere. That's why, fresh liquid should be added to the seperator tank time to time.

4.1.4.4. Equipments of Working Systems

The equipments seen at figure-11, figure-12 and figure-13 are like that :

- 1. Liquid seperator
- 2. Non return valve
- 3. Shut off valve
- 4. Liquid ring vacuum pump
- 5. Selenoid valve
- 6. Electric motor
- 7. Level gauge glass
- 8. Float valve
- 9. Heat exchanger
- 10. Make-up selenoid valve
- 11. Drain valve
- 12. Flow control valve
- 13. By-pass valve
- 14. Compound gauge
- 15. Level switch

- 16. Filter (y-strainer)
- 17. Automatic drain valve (check valve)
- 18. Valve for spare vacuum connection
- 19. Vacuum gauge
- 20. Anti-cavitation valve
- 21. Circulating pump
- 22. Pressure relief valve
- 23. Overflow valve
- 24. Draining selenoid valve
- 25. Selenoid valve for heat exchanger
- 26. Temperature gauge
- 27. Fill-up connection
- 28. By-pass piping
- 29. Orifice flow
- 30. Automatic drain valve or water trap

4.2. Electrical Connection



Electrical connections must be made exclusively by qualified personnel accordance with the instructions from the manufacturer of the motor or ot electrical components and must adhere to the local National Electrical Code.



FOLLOW ALL SAFETY PRECAUTIONS AS LISTED IN CHAPTER BEFORE DURING ANY WORK TO THE INSTALLATION DISCONNE ALL POWER SUPPLIES.

- Electric motors must be protected against overloading by means of circuit breakers and/or fus Circuit breakers and fuses must be sized in accordance with the full load amperage appearing the motor nameplate.
- It is advisable to have an electrical switch near the pump for emergency situations.
- Prior to connecting the electrical wiring, rotate the pump shaft by hand to make sure tha rotates freely.
- Connect the electrical wiring in accordance with local electric codes.
- Ensure that the motor is grounded properly
- Motor connection should be as indicated on the motor tag (frequency and voltage) and discussed in the motor instruction manual.
- It is recommended that motors over 5.5 kW be wired for Star-Delta start-up, to avoid electri overloads to the motor and mechanical overloads to the pump.
- Be sure to replace all safety guards before switching on the electrical power.
- Make sure the pump cannot start-up dry. Add water into the pump before first run.
- Check the direction of rotation before the motor is coupled to the pump but protect the mc shaft to prevent any accidents; or see arrow on the pump for correct rotation.
- If turning direction of the motor is wrong, cut whole electric power, supply all sat precautions, then arrange the connection cables in proper design.
- Please be aware operating the pump in the wrong direction and/or running it dry can ca severe pump damage.
- Electrical instruments such as selenoid valves, level swithes, temperature switches, etc. if wh are supplied with the pump or system must be connected and handled in accordance with instructions supplied by their respective manufacturers.
- Oil ring vacuum systems have an electric panel for only cooler fan and circulating pump or all including vacuum pump's motor. Wire them with proper eqipment.
- If a liquid ring vacuum system or oil ring vacuum system has been ordered with compl electric control panel, supply proper wiring and power to this panle and do not always check the direction of rotation mentioned in this chapter.
- It is recommended for systems that prepare the control panel by start-up the circulating pu just before (2-5 seconds) the main vacuum pump.
- According to the order, if you don't have manufacturer's manual of electrical equipments w the system, ask POM-VAK representative.

4.3. Check List for Start-up



All questions listed below must have POSITIVE answer prior to proceeding to pump start-up. Please note that the following is a partial list.

1. Has this manual been completely read and understood entirely?

- 2. Has the piping system been flushed of any foreign particles like welding, impurities, bolts, nuts, etc.?
- 3. Have all piping and pump obstruction been removed?
- 4. Are all connections and piping leak proof?
- 5. Are there no external forces or moments applied to the piping or pump flanges?
- 6. Are pump and motor properly lubricated if necessary?
- 7. Has pump-motor alignment been checked if it is correct?
- 8. Has mechanical seal flushing line been connected, where required?
- 9. Are all valves in the installation in the correct position?
- 10. Is there enough service liquid in the pump for first start-up?
- 11. Are all safety guards in place?
- 12. Have all direction of rotation been checked by jogging the motors.
- 13. Is the pump Stop switch clear and visible?
- 14. Are pump as well as installation ready for start-up?

Special design pumps may need additional safety and/or operation instructions. If the pump which Follow the instructions to start-up oil ring vacuum systems. has been purchased as special design, please ask POM-VAK representative for additional and/or changed instructions, where required.

4.4. Starting

- 1. Make sure the direction of rotations for all motors correct.
- 2. Rotate the pump shaft manually to make sure that the pump rotor is free. In the event the shaft does not turn, try to free it up by applying a torque to the pump coupling with a pipe wrench. Do that until it turns by hand freely. Do the same onto the motor shaft after disassembly the back cover and cooler fan of the motor for monoblock type pumps.
- 3. In the event the pump does not become free with the above procedures, fill up the pump with a suitable solvent or lubricating liquid; let it rest for several hours to allow softening of the rust build-up inside the pump. Then drain the pump and apply torque to the pump shaft as described above to finally free the rotor. The selected solvent or lubricating fluid must be compatible with the pump, seals and gasketing materials.



first start-up. If pump or motor has been removed from the installation for maintenance or other reasons, check alignment every start-up.

- 5. Prior to starting the pump, verify that all auxiliary components are available, ready for use and 10. Gradually open the valve at gas suction side till the required vacuum level is reached. where required, they are in open position.
- 6. If the gas and/or service liquid temperatures are in dangerous levels, it is recommended to 12. Check the system for abnormal conditions. or thermal shock.
- 7. Make sure that the oil filling port of oil ring vacuum system's reservoir is open to the 14. If you observe any abnormal working or think anything wrong, shut off the system and do the
- 8. NEVER mount anything to water discharge port on oil ring vacuum systems. Any connection to this port behaves like a siphonic system therefore the oil in the reservoir can go through this connection.

4.4.1. Start-up

Follow the instructions to start-up liquid ring vacuum pumps which uses water as service liquid.

- 1. Fill the pump to the shaft centerline, seperator and piping of system with service liquid throu pump inlet flange or fill a connection. You can open the sphere valve on the pump during fill until drain liquid from this valve.
- 2. Open valve at pump and gas discharge of seperator tank if installed. Never close discharge po
- 3. Partially open the valve at suction line. Stay open the spyphere valve on the pump.
- 4. START-UP THE PUMP.
- 5. Open the service liquid valve, soon after start the circulating pump if applicable by hand.
- 6. Close the syphere valve on the pump.
- 7. Gradually open the valve at gas suction side till the required vacuum level is reached.
- 8. Check the system for liquid leakage.
- 9. Check the system for abnormal conditions.
- 10. If you observe any abnormal working or think anything wrong, shut off the system and do the controls again.

- 1. If the system has been purchased without oil, first add around 20 liter water then add oil wh recommended by POM-VAK until water comes from drain of the oil reservoir. If with oil, ch the oil level from gauge onto the oil reservoir and add oil if necessary.
- 2. Fill the liquid ring vacuum pump in the system by oil to the shaft centerline. You can open sphere valve on the pump during filling until drain liquid from this valve. If the system has be purchased with oil, filling the liquid ring vacuum pump is not necessary.
- 3. Make sure the gas discharge of the seperator open to the atmosphere.
- 4. Open the syphere valves on the pump and on the front vacuum tank onto the pump, connected to the observing glass.
- 5. Fill water in the room next to observing plexiglass of the front vacuum tank up to the upper le of the sphere valve which is connected to this room.
- 6. START-UP THE SYSTEM.
- 7. Check if the circulating pump works just 2-3 seconds before the liquid rng vacuum pump not, arrange it like that.
- Checking pump-motor coupling alignment for stage pumps must be done prior to the 8. Make visual control from the transparent pipe connected to service liquid inlet if the liq enters the liquid ring vacuum pump. Or not, check the circulating pump, and radiator.
 - 9. Close the syphere valve on the pump.

 - 11. Wait the system comes to the full working regime.
- insulate the pump, piping and separator to avoid direct contact with their surface, avoid freezing 13. Check if the cooler fan starts when the heat up. If not, check the connections of cooler fa motor.
 - controls again.

4.4.2. Operation

After starting the pump check the following:

1. The vacuum level is as desired or adjust the flow regulating valve on the pump, system, suction line to the required vacuum.

 Motor does not draw more amperage than shown on its nameplate. You can control that by adjusting the valve onto the service liquid pipeline. Fix this adjustment for service liquid. If the motor draws more amperage than shown on its nameplate even the controlling the service liquid amount, check the wiring connections and control panel and supplied power to the motor. The operating temperature at full load, does not exceed approximately 85°C. Pompa vakum basıncıçok yüksek değerlere ulaşıp kavitasyon nedeniyle çok yüksek ses çıkartıyorsa, pompa üzerindeki küresel vanayı minimal düzeyde açarak bu sesi kesiniz. The pump-motor assembly does not have abnormal vibrations and noises such as cavitation. If there is, check the alignment or open a vacuum breaker valve on suction line or syphere valve onto the pump to the atmosphere. If the operating temperature at full load exceeds 85°C, stop the pump or system, check the instructions again and isolate the heated parts of the pump or system in order to prevent any harm. Check the liquid level in seperator is between the minimum and the maximum. If necessary, add liquid. Check the oil level in reservoir at oil ring vacuum systems is between the minimum and the maximum. If necessary, add oil. Check the dirt in the water in the room beside the observing glass on front vacuum tank at oil 	 <u>9</u> 1. Use suitable wiring to the electric motor and its electric box, panels. <u>2. Never decrease the diameters of pump discharge and service liquid pipeline.</u> <u>3. Never prepare discharge pipeline more than 80cm height and 2m length.</u> 4. If the gas discharge is not open to the immediate atmosphere but it is piped to other locat the pump discharge should be checked for back-pressures that could causes higher p consumption and loss of pump capacity. 5. Make sure the direction of rotation is the same as the arrow on the pump. 6. If possible, use soft water for service liquid. Lime can accumulate on the pumps parts inside causes erosion, corrosion, breaking wing of impeller, loss of pump capacity, more p e consumption, needs of cleaning often. 7. Supply service liquid continuously. This service liquid is never from pressured line. The p can suck the service liquid from any tank beside it. 8. If the pump has packing seals, there must be 15-20 water drops in a minute. If there is 1 tighten the gland and If there is less, loosen the gland. 9. Never put the discharge line into the water. 10. Do not full open the valve onto the service liquid from the suction line. When the pump gets liquid than need, it needs more power to discharge that. 12. Make sure that the outlet port of the pump is not closed and if it connected to a seperator, 				
ring vacuum systems. If the water has more dirt, drain it time to time. NEVER OPERATE THE PUMP DRY !	 Adjust the valve adjusting this valve 4.6. Trouble Shooting 	at service liquid line that the pur- re and find the lowest amperage ar	mp works efficient. Check the amperage ad stays the valve at that position.		
	HOU II OUDIC SHOOTH	<u>6</u>			
14.3 Shut Down	Consult the following	g table when problems are experi	ienced, if solutions are not found in this		
Anticipation Never ALLOW THE PUMP TO OPERATE IN THE CAVITATION AREA ! 4.4.3. Shut Down 1 1 Never stop the pump suddenly except in the case of an emergency.	Consult the following chart or should ther	g table when problems are experience e be any doubts, do not hesitat	ienced, if solutions are not found in this te to contact POM-VAK or your local SOLUTION		
NEVER ALLOW THE PUMP TO OPERATE IN THE CAVITATION AREA ! 4.4.3. Shut Down 1. Never stop the pump suddenly except in the case of an emergency. 2. Where possible, gradually decrease the vacuum level by opening suction line to the atmosphere.	Consult the following chart or should ther TROUBLE	g table when problems are experi e be any doubts, do not hesitat CAUSE	ienced, if solutions are not found in this te to contact POM-VAK or your local SOLUTION		
 NEVER ALLOW THE PUMP TO OPERATE IN THE CAVITATION AREA ! 4.4.3. Shut Down 1. Never stop the pump suddenly except in the case of an emergency. 2. Where possible, gradually decrease the vacuum level by opening suction line to the atmosphere. If the system stays in vacuum, close the value at suction line. 	Consult the following chart or should ther TROUBLE Motor does not work	g table when problems are experi e be any doubts, do not hesitat CAUSE No power in control panel Cables not connected	ienced, if solutions are not found in this te to contact POM-VAK or your local SOLUTION Check the power supply. Check the wiring		
 NEVER ALLOW THE PUMP TO OPERATE IN THE CAVITATION AREA ! 4.4.3. Shut Down 1. Never stop the pump suddenly except in the case of an emergency. 2. Where possible, gradually decrease the vacuum level by opening suction line to the atmosphere. If the system stays in vacuum, close the valve at suction line. 3. Then open the syphere valve on the liquid ring vacuum pump. 	Consult the following chart or should ther TROUBLE Motor does not work when start-up.	g table when problems are experi e be any doubts, do not hesitat CAUSE No power in control panel Cables not connected Broken start button	ienced, if solutions are not found in this te to contact POM-VAK or your local SOLUTION Check the power supply. Check the wiring. Change the button.		
 NEVER ALLOW THE PUMP TO OPERATE IN THE CAVITATION AREA ! 4.4.3. Shut Down 1. Never stop the pump suddenly except in the case of an emergency. 2. Where possible, gradually decrease the vacuum level by opening suction line to the atmosphere. If the system stays in vacuum, close the valve at suction line. 3. Then open the syphere valve on the liquid ring vacuum pump. 4. Turn off the power to motor and close any accessories and flushing lines. 5. Close the syphere valve on the liquid ring vacuum pump. 6. Close the service liquid flow if there is not any selenoid valve on the system. 7. Make sure the non-return valve (check valve) is working properly and leak tight. 8. Check if there is a leakage around the mechanical seal areas. 9. if the pump will remain idle for an extended period, cut the power to the motor and its electric panels and add anti-freeze to the water in the liquid ring vacuum pump. 	Consult the following chart or should ther TROUBLE Motor does not work when start-up. Pump shaft is stuck time to time, there is a noise in the pump and sometimes the pump is stuck and not turn while working.	g table when problems are experi e be any doubts, do not hesitat CAUSE No power in control panel Cables not connected Broken start button Solid particles like welded parts, nuts, etc. have been reached to the pump and couldn't come out.	ienced, if solutions are not found in this te to contact POM-VAK or your local SOLUTION Check the power supply. Check the wiring. Change the button. Disassemble the pump, clean from particles, repair any defaction occured and assemble.		
 A Shut Down 1. Never stop the pump suddenly except in the case of an emergency. 2. Where possible, gradually decrease the vacuum level by opening suction line to the atmosphere. If the system stays in vacuum, close the valve at suction line. 3. Then open the syphere valve on the liquid ring vacuum pump. 4. Turn off the power to motor and close any accessories and flushing lines. 5. Close the syphere valve on the liquid ring vacuum pump. 6. Close the service liquid flow if there is not any selenoid valve on the system. 7. Make sure the non-return valve (check valve) is working properly and leak tight. 8. Check if there is a leakage around the mechanical seal areas. 9. if the pump will remain idle for an extended period, cut the power to the motor and electric panels and add anti-freeze to the water in the liquid ring vacuum pump. 10. If the oil ring vacuum system won't work for a while, cut the power to the motor and electric panels and close all ports open to atmosphere. 11. Drain the water in the room beside observing glass on the front vacuum tank. 12. Where available, close the liquid circulating system to the mechanical seals. 	Consult the following chart or should ther TROUBLE Motor does not work when start-up. Pump shaft is stuck time to time, there is a noise in the pump and sometimes the pump is stuck and not turn while working. The pump body cracked	g table when problems are experie e be any doubts, do not hesitat CAUSE No power in control panel Cables not connected Broken start button Solid particles like welded parts, nuts, etc. have been reached to the pump and couldn't come out. Solid particles have been reached inside the pump and stuck between the impeller and the body. This can be cracked body chamber with impeller's wing.	ienced, if solutions are not found in this ie to contact POM-VAK or your local SOLUTION Check the power supply. Check the wiring. Change the button. Disassemble the pump, clean from particles, repair any defaction occured and assemble. Disassemble the pump, clean from particles, repair changed defacted parts then assemble.		

TROUBLE	CAUSE	SOLUTION	TROUBLE	CAUSE	SOLUTION	
	Wiring and/or control panel are not prepared with suitable equipments.	Check the voltage, frequency, motor type, power consumption, rotation, wiring connections, phase consistency then change the equipments.		Service liquid is pressured.	Supply the service liquid pressure to enter to the puunder 1 bar.	
	CAUSE SOLUTIC Wiring and/or control panel are not prepared with suitable equipments. Check the voltage, frequency, motor rotation, wiring connections, phase or equimments. Motor is not rotated. Disassembly the motor from the p maintenance personnel. There might wires, etc. There is corrosion between the impeller and the plates. This cannot let the pump rotate. Cut the power. Rotate the pump sh turns, try to free it up by applying at to solvent or lubricating oil. Let it rest softening of the rust build-up inside and applied torque to the pump shaft it is not allowed to run the pump. Fill up the pump with a suitable che lime but not harm pump parts. Let allow clean the lime. Drain the pump there is still lime inside the pump, dis and applied torque to the pump dis solvent or lubricating of the rust build-up inside and applied torque to the service. Service liquid is not enough. Open the valve onto the service Baseplate is not properly settled. Disassembly the pump by following Change bearings. Alignemnet is defacted. Renew the bearings. Pump has been worked in cavitation area. Deer the syphere valve on the cavitation. Pump has been worked in cavitation area because of the heat of service liquid. Service liquid flow througi installing a cyclon or any equip priping weight resting on the pump Disassemble and repair the pum for stable. The frequency or voltage of the power is not stable. Check the wiring again and aga There has been a short-cut inside the motor or its connector. Change the electric motor.	Disassembly the motor from the pump and ask for qualified maintenance personnel. There might be broken bearings, burned wires, etc.		The amount of service liquid is too much.	Decrease the amount of service liquid by adjusting valve on its pipeline.	
	There is corrosion between the impeller	Cut the power. Rotate the pump shaft by hand. If it does not turn, try to free it up by applying a torque to the pump coupling with a pine wranch. If the same fill up the pump with a suitable	The fuse of the motor	Pump outlet port or the seperator port is closed or drained into water.	Open the discharge ports to the atmosphere.	
Motor has power but pump don't run when	and the plates. This cannot let the pump rotate.	solvent or lubricating oil. Let it rest for several hours to allow softening of the rust build-up inside the pump. Drain the pump and applied torque to the pump shaft to finally free the rotor	turns off time to time while working. The	The discharge pipe's diameter is smaller than the pump's outlet port's.	Change the discharge pipe and make it bigger than pump's.	
start-up.		Fill up the pump with a suitable chemical which can solve the	motor exceeds its	The discharge pipe is higher and/or longer than limits.	Never make the discharge pipe higher than 8 th and/or longer than 2m.	
	I here is much lime inside the pump and it is not allowed to run the pump.	lime but not harm pump parts. Let it rest for several hours to allow clean the lime. Drain the pump and clean it with water. If there is still lime inside the pump, disassembly and clean it.	limit sometimes.	There is much lime in a short time.	Use limeless water. Fill up the pump with suit chemical and rest several hours. Then drain chemical and clean the inside of the pump. If prob	
	If the fuse in control panel turns off, the pump is stuck.	ntrol panel turns off, the Disassembly the pump by following instructions in this manual. Change bearings and interfere the surfaces by qualified			is not solved, disassembly the pump by quali personnel and claen the surfaces entirely,	
	Service liquid is not enough.	Open the valve onto the service liquid line.		Pump is sucking too much water from suction line.	Do not allow water entering the pump by usir cyclon, condensation tank or any equipment before	
	Baseplate is not properly settled.	Disassembly the baseplate and resettle it properly. If necessary, use vibration chumps		Blind the suction port of the pump and add a gauge to the syphere valve on the	d e t Disassemble and repair the pump or send a qual	
	Alignemnet is defacted.	Check the alignment and arrange it again.		pump. Check the vacuum pressure that		
	Bearings are defacted.	Renew the bearings.		not supply necessary pressure, there	service point of FOM-VAK.	
There is too much	Pump has been worked in cavitation area.	Open the syphere valve on the pump a little to cut the cavitation.		might be a wrong in it.	Arrange the electric connecton for right direction	
noise or vibration.	Pump has been worked in cavitation	Decrease the temperature of the service water below	Pump does not	Dirction of rotation is wrong.	rotation.	
	area because of the heat of service liquid.	15 ° C by using equipments like cooler fan, heat exchanger, cooling tower, etc.	pressure	Service liquid is not enough.	Open the valve on service liquid line to right among of water.	
	Too much water enters through the	Reduce the liquid flow through the pump suction by		Syphere valve on pump is open.	Close this valve.	
	pump from suction line.	installing a cyclon or any equipment before the pump.		There is air leakage at suction line.	Find the leakage points and isolate them.	
	Piping weight resting on the pump	Support the piping with hangers or other means.		There is air leakage from mechanical	1	
	Foreign particles in the pump	Disassemble and repair the pump.		seals. (It is seen liquid leakage when the	Change the mechanical seals.	
	The frequency or voltage of the power is not stable.	Check the power supply.		pump stops.) Service liquid is pressured	Supply the service liquid pressure to enter to the p	
	The wiring is wrong.	Check the wiring again and again.		Service inquia is pressured.	under 1bar.	
	There has been a short-cut inside the motor or its connector.	Change the electric motor.		The amount of service liquid is too much.	Decrease the amount of service liquid by adjusting valve on its pipeline.	
Bobbins of electric	Water enters through motor.	Change or isolate the area of the motor not affected from rain, snow, brook, etc.	Pump shaft is not	Pump outlet port or the seperator port is closed or drained into water.	Open the discharge ports to the atmosphere.	
motor are burned.	Electric motor is overheated.	Check the temperature of the environment. Supply air conditioning to the area if necessary.	shaft is cut off.	The discharge pipe's diameter is smaller than the pump's outlet port's.	Change the discharge pipe and make it bigger than pump's.	
	The fuse of the motor is smaller than the proper one or adjust wrongly.	Check the fuse, adjust or change it if necessary according to motor's nameplate.		The discharge pipe is higher and/or longer than limits.	Never make the discharge pipe higher than 8 and/or longer than 2m.	
	Do not forget the guar not any fuse or not ad	rantee doen not contain the motor if there is just properly into the system.		Pump has full of water before each start- up.	Use selenoid valve on service liquid line. If then check if it is broken. If broken, change it.	

TROUBLE	CAUSE	SOLUTION	TROUBLE	CAUSE	SOLUTION	
The fuse of motor in				Oil is not enough.	Check the oil level, if necessary, add oil.	
electric control panel turns off immediately when start-up.	The fuse is not suitable for the motor's amperage and its nameplate, or broken.	Check the fuse and use proper one.			Check the cooler fan if runs or not. If not, check electrical connections of fan's motor and heat gaug they are out of order, change them.	
Pump cannot reach					If the cooler fan runs, check the thermostat and ac it 35-40°C. If it is out of order, change it.	
needed vacuum pressure	the suction line does not open properly so the air flow is not good enough.	Make sure the valve is proper one for vertical or horizontal usage at the suction line and make sure it can be fully opened.	or c it of Pump cannot reach needed vacuum pressure	Oil is overheated.	Check the surface of the radiator. If air transpas tunnels are stuffed with dirt, disassemble the radi	
	The rotation speed of the pump is lower	Use suitable electric motor.			and clean it.	
	than motor's speed which seen at catalogues.	Check the electric box, its electrical equipments and wiring and make sure they are correct.	Pump cannot reach		If the sucked media has too much temperature, additional equipments to cool the media before the	
	Dirction of rotation is wrong.	Arrange the electric connecton for right direction of rotation.	needed vacuum	The non-return valve before the pump is	Change the value	
	There is air leakage at suction line.	Find the leakage points and isolate them.	pressure	our of order or broken.	Change the valve.	
	There is not any leakage seen when the suction line and the vacuum system	Check the one way valves where available if they are		The room beside the observing glass in the front vacuum tank is fully fitted by	Open the valve on it and drain the water. Open observing glass and clean the room.	
	stays in a pressure, the gauge is no changed.	reverse way when stopped.		Oiil adding port is closed.	Open this port to the atmosphere.	
				Discharge port of the seperator is closed.	Open this port to the atmosphere.	
Pump cannot reach	The service liquid is overheated.	Decrease the temperature of the service water below 15 ° C by using equipments like cooler fan, heat exchanger, cooling tower, etc.		If there is an oil filter connected to outlet port of the seperator, this might be chooked up.	Clean this filter or change it if necessary.	
needed vacuum pressure	Service liquid is not enough.	Open the valve on service liquid line to right amount of water.		The radiator is choked up and oil connot	Disassemble the radiator and clean. Change i necessary. Prevent the dirt particles comes through	
	The discharge pipe is higher and/or longer than limits.	Never make the discharge pipe higher than 80cm and/or longer than 2m.		r	system with proper equipments before the system.	
	There is leakage from sealing area.	Change the seals. Change the shaft if necessary.			electrical connections of fan's motor and heat gaug	
	Gaskets on the body and/or between flanges and valves are defacted and there	Renew the gaskets where necessary.			they are out of order, change them.	
	is leakage from there.	y.			it 35-40°C. If it is out of order, change it.	
	The capacity of the pump is	Choose bigger pump for your application.		The oil is overheated and vanorized	Check the radiator if choked up and oil connot	
	Too much water enters through the pump from suction line.	Reduce the liquid flow through the pump suction by installing a cyclon or any equipment before the pump.		The off is overheated and vaporized.	through easily. Disassemble the radiator and cl Change it if necessary. Prevent the dirt particles co through the system with proper equipments before	
	There are defactions inside the pump.	Disassemble and repari the pump or send to POM- VAK for repairing.	The oil level is decreasing sharply		system.	
	Gauges shows wrong value.	Calibrate the gauges or renew them.			additional equipments to cool the media before the	
There is water	Mechanical seals are defacted	Change the seals.			ring vacuum system.	
leakage from the	Gaskets are defacted	Change the gaskets		If there is an oil filter connected to outlet		
pump.	Some parts inside the pump are defacted	Change the defacted parts.		port of the seperator, this might be	Clean this filter or change it if necessary.	
-				Oil is easily vaporized.	Use recommended oil by POM-VAK.	
Oil ring vacuum syste valid for the pump. T	ms have liquid ring vacuum pump he service liquid is oil in these sys	o on it. The trouble shooting charts above are stems and check following additional trouble		A hose or pipe is connected to the drainage port.	Never connect any hose or pipe to this port.	
shootings.	-	-		Oil adding port is closed.	Open this port to the atmosphere.	

TROUBLE	CAUSE	SOLUTION		
	Oil adding port is closed.	Open this port to the atmosphere.		
Overflow the oil	Drainage port is choked up	Drain the oil, open the door of reservoir and clean it.		
from reservoir tank.	Oil level is up from maximum level.	Open the valve onto the door of oil reservoir and drain water from that until the oil level comes under the maximum level.		
Water and oil	Water and oil are mixed each other.	Use oil which is recommended by POM-VAK.		
the drainage port.	Water and oil becomes and emulsion with bonding a foreign material.	Prevent dirt like dust, sand, soil, etc. not entering through the system by using proper equipments.		

- PUMPS

POM-VAK water ring vacuum pumps are suction pumps. They are particularly used for clear vacuum assure. They can be added to increase suction capacity on available vacuum systems.

POM-VAK water ring vacuum pumps are manufactured the effective place with various materials. Single and two stage pumps are fixed on an NPU steel profile base and connected to electrical motor with elastic coupling. Monoblock pumps are directly connected to the motor with flanges.

Water is generally used as fluid in POM-VAK liquid ring vacuum pumps. That's why, we call our pumps as water ring vacuum pumps. This water can be reinforced during operation. It is avoided from using hard water for longer life work. If necessarry, any other liquids close to the water can be used in our liquid ring vacuum pumps. Dirt and strict particles are sometimes absorbed from suction port with gasses or vapour. These particles do not emanete from pump because of the centrifugal force. Particularly, they cause some wears at the continuoal pumps. On account of this, a filter should be put before the pump's admission part.

Every pump is tested and passed through quality control before delivery. Material choice can be seen at table-4.

Body	Body Impeller		Seaing			
Cast iron GG25	Bronze	Steel	Mechanical seal			
Cast iron GGG40 Cast iron GGG40		Stainless steel	Packing seal			
Steel	Plastic reinforced glass fiber					
Stainless steel	Stainless steel					
Table - 4						

Stainless steel materials can be AISI 420, 304, 316, 316Ti.

Plastic material is an engineering plastic reinforced with glass fiber.

5.1. Working System

While the only moving part, the shaft and the impellers, which are mounted offset from the center axis of the cylinder jackets with partly full of working liquid, are rotating, a dense liquid ring is formed because of centrifugal force. As the rotor, the shaft and the impellers, turns, the liquid in the cylinder jacket is thrown against the outside wall by centrifugal force. A ring of liquid forms along the body wall. Because of the offsetting rotor, each revolution, the liquid ring firstly fills each chamber between the rotor blades and then recedes.

Gas or steam which vacuum is applicated pump's auxilary suction connection with split suction comes to the expension cell as seen at figure-14. Rotation of impellers pushes gas and vapour forward of the direction of smaller blade cells. Pumping gas and vapour isolated to its area. With the part of the service liquid discharge from the insided the pump's pressure hole and the pressure fastener port. In tight impellers at two stage pumps, suction and pressure hole regulate unidirectionally to fill and discharge the impeller's cell. In large impellers, giving and taking the gas is done with two sides and regulation way.



Figure-14

These are not contact pieces without the shaft and the impeller in water ring vacuum pumps. Th are not connected with the simple pieces of the pump body, so mechanical erosion while working. Vacuum pressure is related to the altitude because the higher from sea level, the lower atmosphe pressure. It is seen at figure-15. Vacuum pumps work against atmospheric pressure and, vacu pressure, which is produced, is calculated from the environment atmospheric pressure with m commen vacuum gauges.

Sometimes solid particles may enter through the liquid ring vacuum pumps. These particles can be discharged easily and cause wearness inside the pumps in a short time. If they are big and rou enough, they can break the impellers' wings. It is important that they are not allowed entering to pump through suction line and liquid enter.

Water is used as liquid in vacuum pumps. Necessary energy for rotation of the impellers and frict losses in the pumps is transducered from the condensation gas by water.



Changing Pressure with Altitude

While this operation is being performed, the service liquid warms by virtue of the pressure and friction one part of the service liquid discharge with the condensation gas from the part of the c along pumping, one part, heat of the great which recovered when the condensation pend discharge with the service liquid.

Taking this opportunity for keeping fixed the service liquid's heat and quantity, fresh service liq is given to the pump. In the gas discriminator, gas and service liquid's heat discharged with the exhaust pipe to the discriminator or atmosphere.

The constant effect of temperature of service water is seen at figure-17 for monoblock types a figure-18 for double stage liquid ring vacuum pumps.



For example, when 22 °C water is used as service liquid for a double stage liquid ring vacuum pump which has 100 m³/h capacity at 60mbar absolute pressure, the constant of capacity comes from figure-18 as 0.85. When this value multiplies by the capacity we find 0.85x100=85 m³/h and reachable pressure is 43mbar.

The water flow which should be added to a semi-open system (see chapter 4.1.4.2) will be like that:



When these are combined, the needed additional water flow which means vaporized water from system is found like that:

$$Qt = \frac{Qs x \left(\frac{Qc + Qk + Qf}{Qs x \rho x cp}\right)}{T2 - T1 - \left(\frac{Qc + Qk + Qf}{Qs x \rho x cp}\right)} = \frac{Qs x (Qc + Qk + Qf)}{(Qs x \rho x cp) x (T2 - T1) - (Qc + Qk + Qf)}$$

Where the index and its units are:

Qt	[m ³ /h]	:	Additional water flow
Qs	[m³/h]	:	Service water flow
ΔT	[K]	:	Changing the service water temperature within a cycle
Qh	[kj/h]	:	Heat energy absorbed by the water
Qc	[kj/]	:	Isothermal compression heat
			Qc = 0.90 x P x 3600
Р	[kW]	:	Absorbed power at working point
Qk	[kj/h]	:	Condensated heat
			Qk = mv x r
mv	[kg/h]		: Mass flow which comes from condensated water
r	[kj/kg]		: Vaporized heat
Qf	[kj/h]		: Cooling heat (generally ignored)
			$Qf = mg x cph x \Delta Ta$
mg	[kg/h]	:	Mass flow of sucked gas
cph	[kj/kg.K]	:	Internal heat of sucked gas
∆Ta	[K]	:	Temperature difference between sucked gas and discharged water (T
			ΔΤ)

ρ	[kg / m	1 ³]	: Density of service l	iquid.	uid. (1000 for water)							
cp	[kj/kg.	K]	: Internal heat of serv	vice li	ce liquid (It can be accepted 4.2 for water, 1 for air,							
			1.84 for water vapour.)								K	
T2	[K]		: Temperature of serv	vice li	ce liquid entering to the pump							
T1	[K]		: Temperature of add	litiona	l service	e liq	luid					
5.2. C	ode Syst	em										
<u>P</u>	V	<u>N</u>	<u>210/080</u>		A	-	<u>D</u>	<u>K</u>	<u>P</u>	<u>K</u>	<u>0</u>	
Pı	ump Ser	ies	Pump type		D.type			Ν	Aateria	ls		1
POM-VAK	Liquid ring vacuum pump	Pump series	ump series type		Design type of ports		Impeller	Body	Leg plate	Cover, legs and carriers	Shaft	
		Pun	p Series	Т	Port design type							- HTX-
M :	Monob	lock ty	pe, threaded ports	А	A : Threaded							F
N :	Monob	lock ty	pe, flanged ports	В	B : Compact							Ĩ.
К:	Double	stage		С	C : Mini							N/
Т:	Single s	stage		D	D : Flanged							
				Mater	ials							
A :	Alumin	ium			R	:	AISI 3	16 grad	e stainl	ess steel	l	(A)
В:	Bronze				S : Cast iron GGG-40							Ĩ
C :	Steel				Z : Special material							L.
D :	AISI 42	20 grad	e stainless steel		0	:	Non-de	efined				
Ι:	Steel			Th	e impell	ler i	s moun	ted on 1	notor's	shaft an	d there	
К:	Cast irc	on GG-	25	is	not pur	np's	s own	shaft ir	n mono	block (closed-	I
L :	Engineering plastics			co	upled) t	ype	s excep	t PVM	150 ty	pes. Th	e shaft	
P :	AISI 30	ma	terial is	sho	wn as z	ero.						
5.3. P	ump Typ	oes										
Our li	quid ring	g vacui	im pumps are three seri	ies of	monobl	lock	, doubl	e stage	and sir	ngle stag	ge. Our	
system	ns are two	o series	s of Water ring vacuum	syster	ns and o	oil ri	ing vacu	uum sys	stems. T	These se	ries are	
seen a	t figure-l	9,20,2	1,22,23,24,25,26 and 27	' with	connect	ion	ports an	nd direc	tion of	rotation	s.	

- 1. Suction port
- 2. Discharge port
- 3. Service liquid port
- Direction of rotation Arrow:

5.3.1. PVM Series Pumps

PVM series pumps connected to the motors which rotates 3000 rpm at 50Hz. They have threaded inlet and outlet ports. They are seen at figure-19 as design type Afor PVM 115 series and PVM 130/065, figure-20 as A for PVM 150 Series pumps.

5.3.2. PVN Series Pumps

PVN series pumps connected to the motors which rotates 1500 rpm at 50Hz. They have threaded inlet and outlet ports. They are seen at figure-22 as design type A, figure-23 as B and figure-24 as D.



2

5.3.3. PVK Series Pumps

PVK series pumps are double stage pumps. There are two impellers inside the pump, at each stage. It is seen at figure-25.

5.3.4. PVT Series Pumps

PVT series pumps are single stage pumps. There is one or two impellers inside pump at one stage. It is seen at figure-26.





All these four series of PVM, PVN, PVK and PVT pumps are also used in water ring vacuum systems and oil ring vacuum systems. Consult for your special solutions to POM-VAK.

5.3.5. PVL Series Systems

PVL series systems are water ring vacuum systems. The system has liquid ring vacuum pump, water seperator tank and connected accessories. One or two pumps can be used at applications. A one pump system with a monoblock pump is seen at figure-27 and two pumps system at figure-28. Where :

- 1. Suction port
- 2. Discharge port
- 3. Service water
- 4. Seperator tank





6.

5. Non-return (check) valves

Water drain

5.3.6. PVY Series Systems

4. Radiator

5. Circulating pump

6. Water drain port

7. Oil reservoir

8. Cleaning door

9. Oil level gauge

PVY series systems are working with oil as service fluid and named as oil ring vacuum systems. oil ring vacuum system is a complete system with oil reservoir, seperator tank, oil radiator w cooler fan or heat exchanger, circulating pump, electric panel, front vacuum tank and all accessor needed connections. Optional accessories can be added according to application. General equipments are seen at figure-28.



- 12. Discharge port
 - 12. Discharge port
 - 13. Liquid ring vacuum pump
 - 14. Electric motor of the vacuum pump
 - 15. Observing glass
 - 16. Electric panel
 - 17. Non-return (check) valve

An oil ring vacuum system is seen with a monoblock type vacuum pump at figure-30 and v double stage pump at figure-31. The same way, an oil ring vacuum pump can be with single st liquid ring vacuum pumps.





	inlet &	Nominal	Moto	r	Liquid amount	Service	Service	N.		inlet &	Nominal	Moto	r	Liquid amount	Service	Service	N
Туре	outlet ports	Capacity	Power	Rotation	level	liquid	liquid inlet port	Noise	Туре	outlet ports	Capacity	Power	Rotation	level	liquid	liquid inlet port	NO
		[m ³ /h]	[kW]	[rpm]	[liter]	[l/min]		[dB]			[m ³ /h]	[kW]	[rpm]	[liter]	[l/min]		[d]
PVM 115/030	R1"	25	0,75	2850	0,3	3	1⁄4"	68	PVT 200/160	DN 50	170	5,5	1450	7,0	30	1/2"	6
PVM 115/050	R1"	50	1,5	2850	0,4	6	1⁄4"	69	PVT 200/200	DN 50	270	7.5	1450	10,0	35	1/2"	6
PVM 130/065	R1"	70	2,2	2850	0,6	9	1⁄4"	68	PVT 230/240	DN 65	430	11	1450	9,0	45	3⁄4"	6
PVM 150/050	R1½"	95	3	2850	0,8	10	1⁄4"	69	PVT 230/300	DN 65	470	15	1450	13,0	50	3⁄4"	6
PVM 150/060	R1½"	115	4	2850	0,9	12	1⁄4"	69	PVT 275/230	DN 80	630	15	1450	14,0	50	1"	6
PVM 150/080	R1½"	160	5,5	2850	1,0	16	1/4"	69	PVT 275/270	DN 80	710	18.5	1450	15,0	55	1"	6
PVN 210/040	DN 40	80	2,2	1450	2,0	12	3⁄8"	65	PVT 275/320	DN 80	800	22	1450	16,0	60	1"	6
PVN 210/065	DN 40	100	3	1450	2,4	14	³ /8"	65	PVT 275/400	DN100	1200	30	1450	18,0	110	1"	6
PVN 210/070	DN 40	120	3	1450	2,8	17	3⁄8"	65	PVT 275/500	DN100	1300	37	1450	20,0	120	1"	6
PVN 210/080	DN 40	120	4	1450	2,8	17	³ /8"	65	PVT 420/350	DN125	1500	37	960	35,0	90	11/2"	6
PVN 220/120	R 2"	190	5,5	1450	3,5	23	1/2"	65	PVT 420/400	DN125	1800	45	960	43,0	100	11/2"	6
PVN 230/120	R 2"	190	5,5	1450	3,5	23	1/2"	65	PVT 420/500	DN125	2300	55	960	55,0	110	11/2"	6
PVN 230/130	R 2"	230	7,5	1450	3,5	24	1/2"	65	PVT 520/450	DN200	2700	75	720	120,0	220	2"	7
PVN 270/120	DN 65	280	7,5	1450	3,5	25	3⁄4"	65	PVT 520/700	DN200	3800	90	720	160,0	250	2"	7
PVN 270/155	DN 65	350	11	1450	4	26	3⁄4"	65	PVT 520/800	DN200	4550	110	880	160,0	280	2"	7
PVK 200/160	DN 40	150	5,5	1450	7	25	1/2"	66	PVT 520/950	DN200	4900	132	950	160,0	290	2"	7
PVK 230/120	DN 50	200	7,5	1450	9	30	3⁄4"	66	PVT 650/500	DN300	5200	132	490	200,0	300	3"	7
PVK 230/160	DN 50	250	11	1450	10	35	3⁄4"	66	PVT 650/600	DN300	6000	160	590	200,0	330	3"	7
PVK 230/220	DN 50	270	15	1450	12	45	³ ⁄4"	66	PVT 650/700	DN300	7000	160	670	200,0	350	3"	7
PVK 250/160	DN 65	300	15	1450	13	40	1"	69	PVT 700/400	DN300	8000	200	390	400,0	400	3"	7
PVK 250/200	DN 65	350	18,5	1450	14	45	1"	69	PVT 700/500	DN300	10000	250	490	400,0	450	3"	7
PVK 250/240	DN 65	400	22	1450	15	50	1"	69	PVT 700/600	DN300	11700	315	590	400,0	500	3"	7
PVK 275/220	DN 80	600	22	1450	17,5	70	1"	69	PVT 700/700	DN300	12500	355	670	400,0	550	3"	7
PVK 275/260	DN 80	700	30	1450	20,5	75	1"	69	PVT 800/400	DN350	13500	315	400	470,0	700	4"	6
PVK 275/280	DN 80	800	37	1450	22	78	1"	69	PVT 800/500	DN350	16500	355	485	470,0	750	4"	6
PVK 380/300	DN100	950	37	960	36	120	11/2"	72	PVT 800/600	DN350	20000	400	590	470,0	900	4"	6
PVK 380/350	DN100	1250	45	960	47	130	11/2"	72									
PVK 380/500	DN100	1500	55	960	52	140	11/2"	72				Tabl	le-5				
PVK 520/400	DN150	1900	75	720	125	200	2"	76									
PVK 520/500	DN150	2300	90	720	130	220	2"	76	Atex certificate c	ontains o	only PVM a	and PVN serie	s monob	lock pumps.			
PVK 520/800	DN150	2600	110	880	130	230	2"	76	See catalogues fo	r the dir	nensions.						







1. Front cover	8. Wide body chamber	15. Mechanical seal	1. Front cover	8.	Impeller	15. Back plate
2. Ball bearing	9. Assembling stud bolts	16. Leg gasket	2. Ball bearing	9.	Shaft	16. Back cover
3. Bearing carrier	10. Middle plate	17. Back cover	3. Bearing carrier	10.	Body chamber	17. Leg gasket
4. Seal cover or gland	11. Impeller fixing nut	18. Stage pipe (manifold)	4. Seal cover or gland	11.	Assembling stud bolts	18. Suction manifold
5. Pump leg	12. Shaft	19. Narrow body chamber	5. Mechanical seal	12.	Service liquid flange	19. Discharge manifold
6. Front plate	13. Body gasket	20. Narrow impeller	6. Pump leg	13.	Service liquid pipeline	20. Impeller keys
7. Wide impeller	14. Bush	21. Keys	7. Front cover	14.	Body gasket	21. Coupling key
Fig	ure-36 : PVK Series double stage v	acuum pumps	F	igure-37 : I	PVT Series single stage vacuur	n pumps



6 - MAINTENANCE

Liquid ring vacuum pumps are nearly maintenance free pumps. The only moving parts are impellers with the shaft. Seals and bearings are needed to change periodically. If used water is limy, cleaning is also required in time.

Periodically maintenance is easy and takes short time. Disassembly and assembly of the pumps are sensitive and takes time therefore it should be planned. Follow the instructions for disassembly and assembly of the pumps.

6.1. Periodical Maintenance

- 1. Ball bearings used on stage pumps have own closed cage and lubrication free bearings. They don't need any outer lubrication. According to application, if necessary, lubricate the bearings everyday from greasors on the pumps.
- 2. Bearings on monoblock pumps are motor's ball bearings. These are also lubrication free type ball bearings. According to application or order, if necessary, lubricate the bearings everyday from greasors on the motors.
- 3. Renew the ball bearings per 6 months if the working hour is 8 hours in a day. Even if working hour cannot reach this total hours, renew the bearings each year.
- 4. If used water is limy, fill up the pump with suitable chemical to solve the lime in the pump within a period which depens on the lime amount. When the pump filled this chemical, rest it several hours, then drain and work again. Otherwise, the performance of the pump decreases.
- 5. If the pump has packing seals, there must be 15-20 water drops in a minute. If there is more, tighten the gland and If there is less, loosen the gland.
- 6. Mechanical seals are consumable parts of the pumps. The manufacturer gives 3 months guarantee if working hours are 8 hours in a day. They can work properly more than 2 years if the environmental conditions are therotically best. POM-VAK recommends to repair the mechanical seals per 6 months and to replace them per 2 years. See chapter 6.4 for disassembly and assembly of the mechanical seals.

Ball bearings used on stage pumps are ZZ type, own closed cage and lubricated free bearings seen at table-6. According to application, different type mechanical seals can be used in the pumps. Bellowed and conical spring mechanical seals are seen at figure-38.

Change the oil in oil ring vacuum systems per 2 years.

6.2. Repair Kit

There are two different type of repair kits for liquid ring vacuum pumps. When the performance of pumps decreases and need repairing, these kits can be replaced. They are :

	Do11		Mee	manical sea	.1		Dealein		
Pump Series	bearing	Type	Size	Rotary	Stationary	Elastomer	seal		
	oouring	Type	[mm]	face	face	Endstonner	5001		
PVM 115-130	or's r		35				-		
PVM 150	mot ture ue.		40				-		
PVN 210	the i ufac alog	Bellowed	43	Carbon					
PVN 210/070	s s s s		45				-		
PVN 220-270			55			y Elastomer Viton spring type Complete			
PVK-PVT 200	6306		45		Silicon		6 x (
PVK-PVT 230	6308	Bellowed or	55	Carlan	carbide		8 x 8		
PVK-PVT 250	6308	Conical spring	60	Carbon			8 x 8		
PVK-PVT 275	6310		60	inted in			8 x 8		
PVK-PVT 380	22211		75	stanness			10 x 1		
PVT 420 front	6310 22211 6314 22314 22213		steel			10 1			
PVT 420 back	22314	Conical spring	80				10 X I		
PVK-PVT 520	22213	Conical spring	110	Stainless			14 x 1		
PVT 650	22221		140		Carbon		14 x 1		
PVT 700	22221	Conical spring	140	steel	Carbon		18 x 1		
PVT 800	22231		180				18 x 1		
В	ellowed typ	be ,	Table -	6	Conical s	pring type			
 Mechanical se Gaskets Plates 	als	}	Gene	eral repair k	it	Complete	repair l		
5 Shaft (for stag	e numne)								
J. Shan (101 stag	e pumps)								

6. Bearings

These whole 6 parts are named as "complete repair kit" and the first 3 parts as "general repair For replacing these parts, follow the instructions of related sections in chapter 6.

The pumps are manufactured in such a manner as to make it possible to replace the mechanical se and the bearings without total disassembly of the pump but only by removing the bearing housi (carriers).

6.3. Disassembly to replace bearings

Monoblock pumps :

- 1. Remove the 5 bolts from front cover.
- 2. Remove the cover with plate.
- 3. Remove the bolt which is in the hole of center of the impeller.
- 4. Remove the impeller with suitable apparatus and by gear puller.

Bearings and mechanical seals used in the pumps are seen at table-6.

- 5. Remove the bolts from motor's connection flange.
- 6. Remove the pump body, the connection flange and back cover of the motor then replace the motor's bearings.
- 7. Check the seal faces when disassmbly.
- 8. If there is a scrach, crack or break on seal faces, also change tham.
- 9. Assemble the back cover, flange and pump body and fasten the bolts.
- 10. Assemble the impeller onto the motor's shaft softly. Be careful there must not be any dirt, oil, grease on the seal faces. Do not hit on the impeller with a hammer or any other equipments. Do 11. Insert the ring on the shaft, slip on the whole rotary part of the mechanical seal. not forget the key on shaft.
- 11. Fasten the impeller's bolt to fix the impeller to the motor's shaft. Do not forget the gasket on it.
- 12. Assemble the gasket on body by greasing a little. If it is defacted, change it.
- 13. Assemble the plate and cover, fasten the bolts.
- 14. Check if the motor's shaft rotates easily by hand moving the shaft from backside cooler fan.
- 15. If shaft cannot be rotate, disassemble the cover and plate and check if the impeller in a proper position. If necessary, more gaskets can be added.

Stage pumps :

- necessary for back bearing.)
- 2. Remove the bolts on the cover and the cover.
- 3. Remove the bolts of bearing housing (carrier)
- 4. Pull the housing for the legs of gear puller by using proper hatchet.
- 5. Remove the housing by using a gear puller.
- 6. Remove the ball bearing.
- 7. Replace new bearing.
- bearing.
- 9. Assemble the cover to the housing and fasten the bolts.
- 10. Assemble the housing to the pump.
- 11. Fasten the bolts of housing.
- 12. Assemble the pump to the motor by checking the alignment.

6.4. Disassembly to replace mechanical seals

Monoblock pumps :

1. Remove the 5 bolts from the front cover.

2. Remove the cover with plate.

- 3. Remove the nut which is in the hole of center of the impeller.
- 4. Remove the impeller with suitable apparatus and by gear puller.
- 5. Remove the stationary part from the pump body and the rotary part from the back of the 10. Insert the ring on the shaft, slip on the whole rotary part of the mechanical seal. impeller.
- 6. Clean the housing of the stationary and impeller's shaft part of the rotary part. Be careful that 12. Assemble the cover of the seal onto the pump's leg softly. Fasten the bolts gently by small step there is not any sharp corner, machining part, etc. around them. If there is, remove or fix them.
- 7. Push the stationary part of the mechanical seal into the housing using a plunger covered with 14. Fasten the bolts of housing. heavy paper board or similar material. The plunger must exert a force perpendicularly to the axis 15. Assemble the pump to the motor by checking the alignment. of the piece.

- 8. The plunger must exert a force perpendicularly to the axis of the piece; for this purpose, either an harbour press or the spindle of a drill.
- 9. Moisten (by using water, liquid soap or similar wetters but avoiding the use of oils and gre oil) the seat in the housing and the o-ring or cap of the stationary part of the mechanical seal.
- 10. The area of the impeller's shaft where the seal fits shall be smooth, clean, without sharp ed and moistened. Even if the shaft has been ground, it shall be polished again with extra fine si paper or emery cloth.
- 12. Gently push the rotary part of the seal with the help of a proper tool not to hurt the seal face.
- 13. Assemble the impeller onto the motor's shaft softly. Be careful there must not be any dirt, grease on the seal faces. Do not hit on the impeller with a hammer or any other equipments. not forget the key on shaft.
- 14. Fasten the impeller's bolt to fix the impeller to the motor's shaft. Do not forget the gasket on it
- 15. Assemble the gasket on body by greasing a little. If it is defacted, change it.
- 16. Assemble the plate and cover, fasten the bolts.
- 17. Check if the motor's shaft rotates easily by hand moving the shaft from backside cooler fan.
- 1. Remove the pump from the motor for the front bearing. (Removing from the motor is not 18. If shaft cannot rotate, disassemble the cover and plate and check if the impeller in a pro position. If necessary, more gaskets can be added.

Stage pumps :

- 1. Remove the bearing housing as explained the items 1-5 in chapter 6.3.
- 2. Remove the cover of the seal by unfastened its bolts from the pump's leg.
- 3. Remove the stationary part from the cover and the rotary part from the shaft.
- 4. Clean the housing of the stationary and impeller's shaft part of the rotary part. Be careful t there is not any sharp corner, machining part, etc. around them. If there is, remove or fix them
- 8. Use bearing pres to replace bearing. Do not use a hammer or similar equipments which hits 5. Push the stationary part of the mechanical seal into the housing using a plunger covered w heavy paper board or similar material. The plunger must exert a force perpendicularly to the a of the piece.
 - 6. The plunger must exert a force perpendicularly to the axis of the piece; for this purpose, either an harbour press or the spindle of a drill.
 - 7. Moisten (by using water, liquid soap or similar wetters but avoiding the use of oils and gre oil) the seat in the housing and the o-ring or cap of the stationary part of the mechanical seal.
 - 8. The area of the shaft where the seal fits shall be smooth, clean, without sharp edges a moistened. Even if the shaft has been ground, it shall be polished again with extra fine si paper or emery cloth.
 - 9. If there are pit holes on the shaft, disassemble the pump and replace new shaft as explained chapter 6.5.

 - 11. Gently push the rotary part of the seal with the help of a proper tool not to hurt the seal face.

 - 13. Assemble the bearing housing to the pump.

6.5. Disassembly

Monoblock pumps :

- 1. Remove the 5 bolts from front cover.
- 2. Remove the cover with plate.
- 3. Remove the bolt which connects plate and the cover, then remove the plate from the cover.
- 4. Remove the muffer by unfastened its bolts from the plate.
- 5. Remove the bolt which is in the hole of center of the impeller.
- 6. Remove the impeller with suitable apparatus and by gear puller.
- 7. Remove the bolts from motor's connection flange.
- 8. Remove the pump body, the connection flange and back cover of the motor then replace the motor's bearings.
- 9. Remove the stationary part from the pump body and the rotary part from the back of the impeller.

Stage pumps :

- 1. It is suggested to mark the location (rotation and assembly sequence) for the various parts prior to starting to disassembly.
- 2. Drain the pump of any residual liquid, prior to disassembly.
- 3. Remove the pump from the motor, suction and discharge lines.
- 4. Remove the manifolds from the flanges.
- 5. Remove the bearing covers of both front and back side.
- 6. Remove the bolts of bearing housing.
- 7. Pull the housings for the legs of gear puller by using proper hatchet.
- 8. Remove the housings by using a gear puller.
- 9. Remove the ball bearings.
- 10. Remove the covers of the seal by unfastened its bolts from the pump's leg.
- 11. Remove the stationary part from the cover and the rotary part from the shaft.
- 12. Unfasten the stud bolts.
- 13. Remove the pump legs, leg plates and body chambers.
- 14. Remove the fixing nuts of impellers from the shaft.
- 15. Remove the shaft from impellers by using a proper hydraulic press.
- 16. Where there is, remove the middle plate or plates.
- 17. Remove the keys from the shaft.

For liquid ring vacuum system, remove the liquid ring vacuum pump from the system and disassemble it by following the instructions above.

Oil ring vacuum system :

- 1. Unfasten all connections onto the liquid ring vacuum pump.
- 2. Remove the front vacuum tank.
- 3. Remove the non-return (check) valve carefully.
- 4. Remove the liquid ring vacuum pump from the system and disassemble it by following the instructions above.
- 5. Remove the radiator and cooler fan.
- 6. Remove the circulating pump.
- 7. Remove the front suction cover of the circulating pump.
- 8. Remove the impeller from the shaft by unfastened the nut on the impeller.

- 9. Remove the mechanical seal from the shaft.
- 10. Drain the oil reservoir.
- 11. Open the door of reservoir and clean it.

After pump disassembly, inspect all parts for their integrity. If they are in sound condition, clean parts and remove the gasket material from the sealing faces with a nitro-cellulose thinner.

6.6. Repairing

When machining is required to refurbish the faces of the port plates, it is of the utmost importance keep the surfaces parallel, flat and within the permissible dimensions. For the best condition of pump, it is recommended that consulting an authorized service point or directly to POM-VAK. Monoblock pumps :

- 1. Measure the wide of impeller.
- 2. Do machining the face of the impeller not more than 0.5mm.
- 3. Measure the new wide of impeller.
- 4. Do machining the face of the body the same amount as the impeller.
- 3. Do machining the plate face.

Stage pumps :

- 1. Measure the wide of the impellers.
- 2. Do machining the both faces of the impellers.
- 3. Measure the new wide of the impellers.
- 4. Do machining the both sealing faces of the body chambers the same amount as the impellers.
- 5. Measure the wides of the plates.
- 6. Do machining the face of the plates which side works against impellers.
- 7. Measure the new wides of the plates.
- 8. Calculate the accumulation of the difference between the old and new measured wides of parts. Name this amount is X.
- 9. Shorten the shaft the amount of X by machining from A and B area seen at figure-39.
- 10. Make a spacer which diameter is the same as C of the shaft and wide is X.



- 11. Add this spacer to the shaft when assembling.
- 12. Shorten the bush at double stage pumps as the difference of old and new wide of middle plate
- 13. If there is serious defaction inside the body chambers, replace new ones instead of them.
- 14. If the bearing area of shaft diameter is smaller than the tolerances. Change the shaft.
- 15. If the insdie diameter of the impellers are bigger than tolerances, change the shaft or impellers. If the shaft is changed, make new one considering inside diameterss of the impeller
- 16. The area of the impeller's shaft where the seal fits shall be smooth, clean, without sharp ed and moistened. Even if the shaft has been ground, it shall be polished again with extra fine sa paper or emery cloth. If the area damaged more, make coating on the shaft. If not possil change the shaft.
- 17. Shorten the stud bolts as X by machining.

- 18. Shorten the manifolds of single stage pumps as X by cutting a part from them and weld.
- 19. Measure the difference amount of manifold on the pump for stage pumps and cut then weld.
- 20. If the outer diameter of the bearing housing is damaged, change the housing.

6.6. Assembly

- Prior to starting the assembly operations, carefully study these instructions to become familiar with the assembly procedures, the sequence of operations and the procurement of the required tools. Monoblock pumps :
- 1. Use proper motor flange to electric motor.
- 2. Clean the housing of the stationary and impeller's shaft part of the rotary part. Be careful that there is not any sharp corner, machining part, etc. around them. If there is, remove or fix them.
- 3. Push the stationary part of the mechanical seal into the housing using a plunger covered with heavy paper board or similar material. The plunger must exert a force perpendicularly to the axis of the piece.
- 4. The plunger must exert a force perpendicularly to the axis of the piece; for this purpose, use either an harbour press or the spindle of a drill.
- 5. Moisten (by using water, liquid soap or similar wetters but avoiding the use of oils and grease oil) the seat in the housing and the o-ring or cap of the stationary part of the mechanical seal.
- 6. The area of the impeller's shaft where the seal fits shall be smooth, clean, without sharp edges and moistened. Even if the shaft has been ground, it shall be polished again with extra fine sand paper or emery cloth.
- 7. Insert the ring on the shaft, slip on the whole rotary part of the mechanical seal.
- 8. Gently push the rotary part of the seal with the help of a proper tool not to hurt the seal face.
- 9. Assemble the impeller onto the motor's shaft softly. Be careful there must not be any dirt, oil, grease on the seal faces. Do not hit on the impeller with a hammer or any other equipments. Do 14. Make sure inserted the impellers on the shaft, note that the direction of the blades for the pun not forget the key on shaft.
- 10. Fasten the impeller's bolt to fix the impeller to the motor's shaft. Do not forget the gasket on it.
- 11. Assemble the gasket on body by greasing a little. If it is defacted, change it.
- 12. Assemble the plate and the front cover with proper bolt.
- 13. Be careful that the head of the bolt does not higher than plate's face.
- 14. The emptiness between the impeller's face and the plate cannot be more than 0.3mm.
- 15. Assemble the plate and cover to the pump, fasten the bolts.
- 16. Check if the motor's shaft rotates easily by hand moving the shaft from backside cooler fan.
- 17. If shaft cannot rotate, disassemble the cover and plate and check if the impeller in a proper position. If necessary, more gaskets can be added.

Stage pumps :

- 1. Start with front side of the pump.
- 2. Assemble the pump legs with seal covers which the stationary part of the mechanical seal is in it 23. Be careful not rotate the plates while doing leg's alignment. and bearing housings with ball bearings.
- 3. Place the suction casing in horizontal position, resting on a stand similar to that shown on figure-40 on a bearing bell.
- 4. Assemble the impeller for single stage pumps or the wide impeller for double stage pumps first.
- 5. Assemble the impeller casing with the references markings on the casing, in line with the axis of 27. Test the pump to a hydrostatic pressure of 4 bars to verify that there are not any leak. the inlet casing.

- 6. Remove the shaft from vice together with the impellers and middle plates.
- 7. Insert the shaft into the suction casing using a threaded hook screwed on the non-drive end of shaft.
- 8. Assemble the middle plates where available.
- 9. Continue the assembly operations following the instructions given below to help with identification and the location of each component. See also the cross-sectional drawings chapter 5.
- 10. Single stage pumps :
 - Assemble the casing.
 - Double stage pumps :
 - Assemble the wide body chamber.
 - Replace the gasket with a little greasing.
 - Assemble the middle plates.
 - Do not forget adding gasket between each parts with greasing.
 - Assemble bush on the shaft inside the middle plates.
 - Fix between the pump leg and middle plates with a proper tool which stay the parts tight.
 - Check the bush if the face of it is the same level of the plate. If not, do machining on the f of the bush.
 - Assemble the narrow impeller onto the shaft.
 - Assemble the narrow body chamber.
- 11. Fasten the two impeller's fixing nuts on the shaft tight.
- 12. Assemble the plate.
- 13. Assemble the back pump leg without seal, bearing hoursing and ball bearing in it.
- with clockwise rotation should be as per drawings on figure-41.
- 15. Tighten two of the stud bolts with a torque wrench.
- 16. Make sure that the impeller clearances within the housing are correct. Check this by measur the shaft travel when pushed first to one direction and then to the other and dividing this va
- 17. If clearance is not less than 0.15mm each side, disassemble the pump and check all compone until the error is found.
- 18. Assemble the mechanical seal, bearing housing and bearing.
- 19. Tighten the rest stud bolts.



- 20. Place the pump in the horizontal position on a flat table and align the casing.
- 21. Make sure the 4 of pump's legs are on the table.
- 22. If not, loosen the stud bolts and rotate the legs carefully.
- 24. Rotate the shaft by hand making certain that there is not internal metal to metal contact and the rotor rotates freely.
- 25. Assemble the manifolds onto the pump.
- 26. Assemble the pump to the motor on baseplate and make the coupling alignment.
- 28. Test the pump to supply desired vacuum pressure.



Figure-41



•

i

ns.

orts ose

in

rent e of

ide ion

per

uid lere

e of ure

ute.

mp

d if

<u>1.</u>

) is oil

the

of

*v*oir

the			
th a			
the			
d if			
the			
ific			
arry			
5			
1 in			
the			
and			
and			
vort			
Jon			
14777			
шу. 1 [.]			
slip			
an			

ing l/or for

C 1				
ıful				
ino				
ing				
h				
bey				
not				
not				
his				
the				
ino				
ing				
mp				
and				
and				
per				
1				
0"				
01				
ble				
bey				
sort				
Jan				
ute				
uic				
red				
tem				
bey				
5				
stes				
and				
anu				
ina				
mg				
orts				
t in				
~				

ı	to								
i	ing								
i	ity, be								
е	eck								
p	per								
n	ıg.								
ta	art								
n	not								
a: n	ny nes								
tł	his								
1	to								
[]	be								
I	or								
n	nce								
t	the								

and

ing or's

stic dly ing the

age vay nm]

nm]

• ub

1 at

'A"

vith

the

: If

ing

the iere

not

1 to this

mp be

r if

pps, e is mp

can

h is

_	in				
	III				
h	her				
_					
	3				
	5.				
C	CT				
_					
20	200				
50	505.				
: 0	on				
t	t it				
	as				
ic	ical				
	4				
)(otor				
_					
fe	fety				
	•				
119	use				
u	450				
110	licii				
tl	the				
	-				
£	for				
10	101				
le	lete				
	ina				
.11	mg				
n	mp				
vi	vith				
. 1					
-					
tl	the				
	1				

ugh ing

rts.

all

lich eck

the een

not

vel

. If

uid

ın's

all

or

ME			
JIIS,			
wei			
and			
wer			
wei			
mp			
шp			
ore			
,,,,			
ore			
ake			
by			
it if			
ir it,			

cted

ump			
the g			
, i			
1 the			
0cm			
able			
the			
olem			
ified			
then			
ıg a			
: the			
ifier			
mes			
_			
n of			
ount			
ump			
; the			
۱ the			
0cm			
,			
e is,			

the:	ne	
;e. If	If	
ljust	st	
sing	lg	
iator	or	
use	se	
e oil	il	
the		
uie		
it if	if	
ı the		
the		
e If	TA I I I I I I I I I I I I I I I I I I I	
,e. 11		
liust	st	
Just		
pass	ss	
ean.	n.	
mes	es	
: the	ne	
use		
e oil		

. eric um ıost not ugh the ion the exit ing uid gas

and

5

3

ese

Forr

)ar

the

;)

2 +

-



An vith ries

vith age

1 2 3

le



5

s S

5

cit kit. 2018 ngs

ase ges and oil, Do . per :hat . vith ıxis use ase and and

os.

1 in

use

the

e to the

the

s.

s. ges and

the

ble,

the

the in

ace

nps

ing lue ents , J

1

₽

ŧ