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Building A,

Fairfield, NJ 07004

1-800-297-3550

www.nescompany.com

Operation & Maintenance Manual for NPV Series Vacuum Pumps Models: 62240, 72200, 72300, 72400

NES COMPANY

WARNING

Do not operate PUMP before primed and connected to the constant supply of clean compressant liquid. **IF RUN DRY, PUMP WILL BE DAMAGED**; always use a strainer to prevent sand and scale from entering the pump with liquid sealant.

Specific operating conditions combined with water hardness may result in excessive lime deposits inside the pump, causing it to bind. Should this condition be evident, flush the pump with a solvent at regular intervals.

This pump has been drained and flushed with water-soluble preservative oil before shipment. After the pump has been in service, do not store without draining as specified in this manual. The freezing of the preservative oil can damage the pump.

USE CAUTION when removing inlet screens. Any foreign material on the screen may fall into the pump and cause extensive damage at start-up.

The base must be mounted to a leveled foundation, and final coupling alignment is done during installation. (Refer to manual No.XXX, Installation Instructions, N.E.S. Company Vacuum Pumps and Compressors.)

NOTICE

SERVICE AND PARTS

SERVICE AND PARTS FOR NES VACUUM PUMPS ARE ASSURED THROUGH A WORLDWIDE NETWORK OF SALES AND SERVICE OFFICES. ANY REQUEST FOR INFORMATION, SERVICE, AND PARTS SHOULD BE DIRECTED TO THE NEAREST NES SITE / FIELD OFFICE.

WHEN ORDERING REPLACEMENT AND SPARE PARTS, SERIAL NUMBERS AND PUMP SIZES MUST BE PROVIDED.

Serial number and pump size are located on nameplates riveted/fastened to the pump's casing/body. Parts must be identified by index number and name. Refer to pump exploded view and legend found in this manual.

If the location of the nearest office is unknown, information may be secured directly from N.E.S. Company Inc. New Jersey Headquarters: 333 RT 46 W, BLDG: A, FAIRFIELD NJ 07004. Telephone number is 1-800-297-3550, Fax No. 973-933-6322

WARRANTY

NES Company warrants that (1) the goods will be of the kind described on its acceptance of Buyer's order as modified by any subsequent mutual agreement of the parties, (2) it will convey to Buyer good title to such goods, (3) such goods will be delivered free of any lawful security interest or lien or encumbrances unknown to Buyer, and (4) such goods will be of merchantable quality and free from defects in material or workmanship defects under normal use and prescribed maintenance for a period of two (2) years from the date of shipment. The warranties specified shall also extend to goods manufactured by others and supplied by N.E.S., unless such goods have been separately stated and quoted by N.E.S., in which case only the warranties in clauses (1), (2) and (3) shall apply. NES MAKES NO WARRANTY, EXPRESS OR IMPLIED, AS TO THE MERCHANTABILITY OF GOODS MANUFACTURED BY ITS SUPPLIERS AND SEPARATELY STATED AND QUOTED HEREIN. N.E.S. 's warranty in clause (4) above shall not apply to goods of standard construction when handling corrosive gasses of using corrosive liquid compressant nor will clause (4) apply to goods which have been damaged, altered, or negligently maintained after delivery. Buyer's exclusive remedy for N.E.S.'s breach of the warranties outlined in clauses (1), (2) and (3) above shall be the replacement by N.E.S. of non-conforming goods with conforming goods, without extra cost to Buyer, F.O.B. point of manufacture, with transportation prepaid to U.S. destination or domestic port, and Buyer's exclusive remedy for N.E.S. 's breach of the

warranty contained in clause (4) above shall be the repair by N.E.S. without charge, or the furnishing by N.E.S. F.O.B. point of manufacture, with transportation prepaid to U.S. destination or domestic port of a part or item of equipment to replace any part or item of equipment which is proved to have been defective; provided that (1) Buyer shall have notified N.E.S. of any such breach not later than ten days after the expiration of two (2) years from the date of shipment of the goods, and that (2) N.E.S. shall have the option of requiring the return of any defective material transportation prepaid to establish a claim. N.E.S. shall in no event be liable for Buyer's manufacturing costs, lost profits, goodwill, expenses, or any other consequential or incidental damages resulting from a breach by N.E.S. of any warranty. THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, WHICH EXTENDED BEYOND THE WARRANTIES SET FORTH HEREIN.

SAFETY PRECAUTIONS

1. Wear appropriate personal protective equipment, including safety glasses, lab coats, long pants, closed-toe shoes, and gloves, when working with vacuum pumps.
2. Store vacuum pumps on spill trays to prevent oil spills and ensure proper containment.
3. Insulate running areas of the vacuum pump for noise reduction, if necessary.
4. Dispose of used vacuum pump oils according to prevailing EH&S (Environmental Health and Safety) procedures.

Safety During Operation:

During continuous operation of the pump, observe the following safety precautions:

1. Ensure electrical cables/cords and power switches are in good condition and free from defects or loose connections.
2. Keep belt guards in place to prevent hands or loose clothing from getting caught in the belt pulley.
3. Avoid operating pumps near containers of flammable chemicals, flammable chemical wastes, or combustible materials such as paper or cardboard.
4. Use appropriate vacuum tubing with thick walls, avoiding thin Tygon-type hoses.
5. Avoid placing pumps in enclosed, unventilated cabinets to prevent heat buildup and exhaust accumulation.
6. Replace old tubing that is crumbling to maintain optimal performance.
7. Use the shortest length of tubing necessary to reach the desired location.
8. Avoid using solvents that may damage the pump.
9. Always close the valve between the vacuum vessel and the pump before shutting off the pump to prevent vacuum oil from being drawn into the system.
10. Place a pan under pumps to catch and collect oil drips.
11. Regularly check oil levels and change the oil as needed. Properly dispose of vacuum pump oil contaminated with condensate following EH&S procedures.
12. For oil-filled pumps with total recirculation service, be aware that many vapors can condense in the pump oil. Use cold traps or other appropriate methods to trap evaporated materials and ensure proper venting of the pump exhaust.

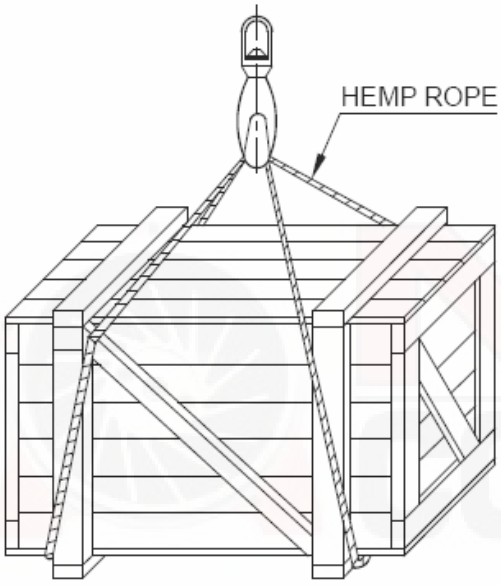
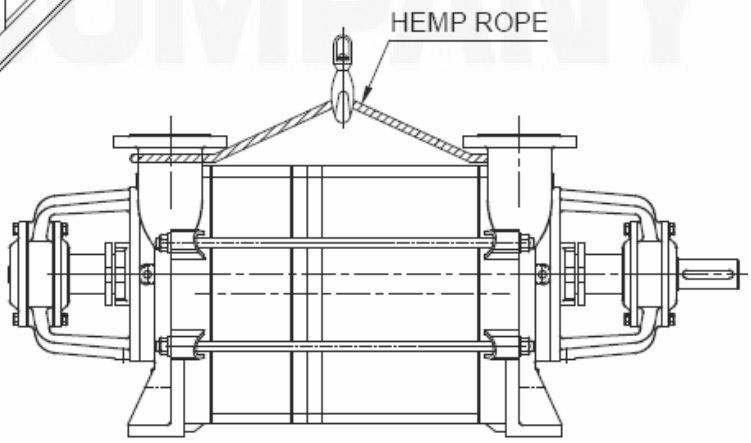
Safety During Service:

Before performing maintenance or service on a vacuum pump or compressor, adhere to the following safety precautions:

1. Stop the pump and ensure all power switches and circuit breakers are turned off. Use proper tagging to indicate "Do Not Switch On."

2. Equalize the pump pressure with atmospheric pressure by passing air into or out of the piping.
3. Empty or clear the service liquid from the pump before opening it.
4. If the pump has operated with harmful liquids or media, wash it thoroughly with an appropriate liquid as specified in the Material Safety Data Sheet (MSDS) of the operating fluid.
5. Maintain a record for each pump, documenting oil change dates, bearing greasing dates, shaft rotation dates, and maintenance schedule.
Please NOTE that these rephrased instructions are provided for clarity and understanding. It is important to follow the specific safety guidelines and procedures recommended by your organization and the equipment manufacturer.

Lifting Arrangement

CAUTION
Take following precaution for lifting the pump either in packed / unpacked condition. 1. Do not use chains or straps around the body to lift the pump. Lifting in this manner will cause damage to the axial assembly rods and will **void warranty** of the pump. Do not use jacks on the body to lift the pump as it may distort the body and **void warranty**. See Figure – A, B for acceptable lifting methods. 2. It is preferred to use Hemp rope only as a chain or wire rope tends to slip 3. Protect paint coating by providing felt padding under the rope at the contact points. 4. The pump should hang upright with its weight distributed evenly. Avoid shock at all events. 5. Handle the pump by lifting it evenly as shown in Figure – B. take proper care in sizing the hemp ropes and hooks used to lift the pump to ensure that the pump weight does not exceed the load rating of the lifting apparatus. 6. The approximate weights of the pump and heavy parts are given in Table-1; this will be helpful in the selection of suitable lifting tackles.    Fig-A    Flg-B

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1. IMPORTANT

Please read the instructions carefully and follow them before any attempt is made to install, operate and/or repair the pump. If difficulty is experienced, please contact NES immediately for assistance.

2. WARNING

2.1 Unless the pump is first connected to a continuous supply of clean seal liquid/water, do not run the pump. Dry running will over heat the gland and shaft, and may damage the pump.

2.2 Use a strainer in seal liquid/water line to prevent solids and pipe scale from entering the pump.

2.3 While connecting the pump to a new system use a perforated sheet or a wire mesh as a strainer in the suction line flange joint as near the pump as possible to prevent pipe scale, welding shots, metal chips and other foreign material that may be lying in the piping from entering the pump. This strainer should be removed from the piping after 24-48 hours of pump operation.

2.4 When the seal liquid is hard water, excessive scaling may form on the surface of the parts and the rotor may bind to the cones. Regularly clean the internal surfaces free of scale by flushing the pump with scale removing agents.

2.5 Operation of pump at high vacuum / low absolute pressure on the suction side may result in noisy operation due to cavitation of seal liquid. Pump should not be operated at such high vacuum.

3. RECEIVING AND STORING

On receiving, check the contents of the package with the packing slip attached to the pump. Any loss or damage should be brought to the notice of the Transporter and ensure with a copy to NES.

Store the pump and its accessories at a safe place where there is no danger of foreign materials entering the interior of the pump and other parts. Protective covering on the inlet flange, outlet flange and seal liquid inlet, which are affixed at our factory, should NOT be removed until the pump is installed and is ready for connection to process piping. If solids enter the pump and are not removed, the pump will be damaged upon start-up and operation.

4. WEIGHTS OF PARTS

The weight of the pump and heavy parts are given below. The weights are approximate and will be helpful in the selection of suitable lifting tackles. Ref. Table No. – 1.

Description	QTY.	Weight of each part (in lbs. approx.)			
		NPV-62240	NPV-72200	NPV-72300	NPV-72400
Bare pump	1	805	1246	1433	1654
Rotor Shaft Assembly	1	183	247	325	391

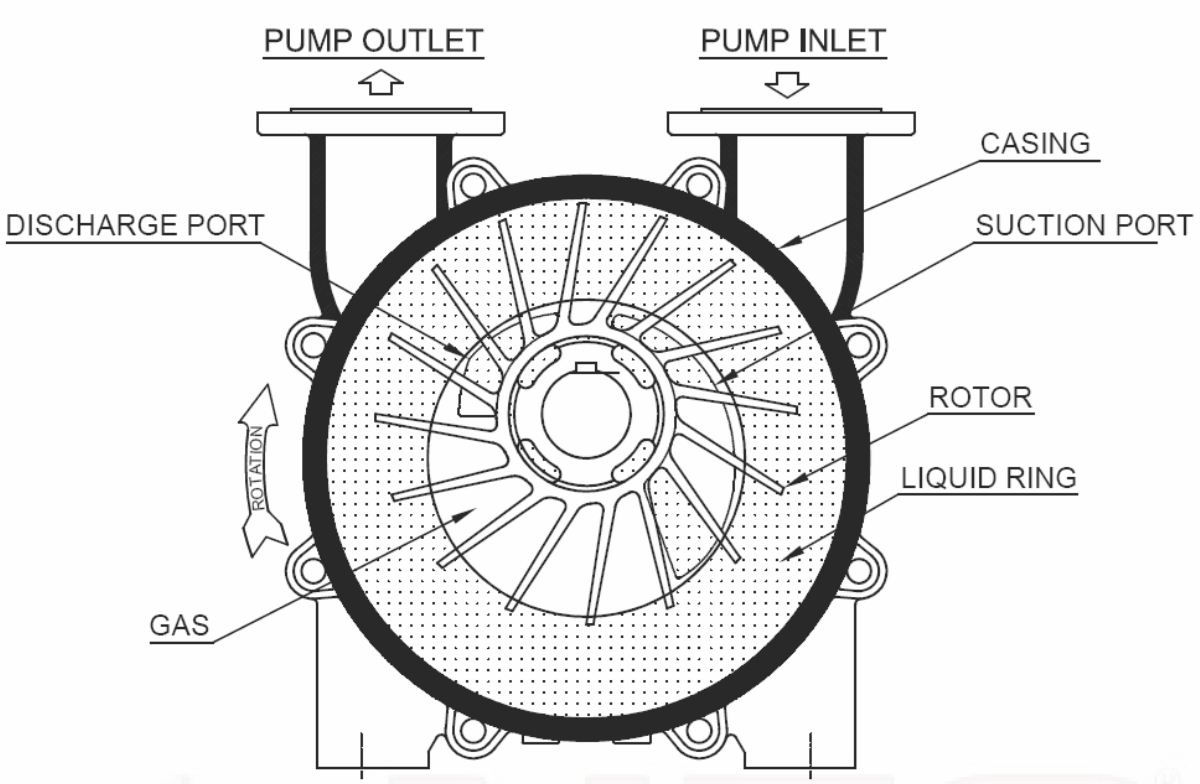


Fig - 1

5. PRINCIPLE OF OPERATION

NES Company Inc. NPV Series Vacuum Pumps are of the liquid ring type. Single and two stage pumps are available in a wide range of sizes and materials. A major component of the NES pump is the multi-bladed rotating assembly (impeller) positioned eccentrically in a cylindrical casing (See Figure 1). This impeller is driven by an external power source, typically an electric motor. Service liquid (usually water) is introduced into the pump. As the impeller rotates, centrifugal force is imparted on the service liquid, causing it to create a liquid ring along the walls of the casing that is concentric to the casing.

At the inlet, the area between the impeller blades (buckets) increases in size, drawing gas in. As the impeller continues to rotate towards the discharge, the impeller bucket area decreases in size, compressing the gas. This gas, along with the service liquid from the pump, is discharged through the outlet nozzle. The service liquid is separated from the gas and cooled for reuse as the pump's service liquid or sent to drain. In addition to being the compressing medium, the liquid ring performs two other important functions:

1. It absorbs the heat generated by compression, friction, and condensation of the incoming vapor.
2. It absorbs and washes out any process contaminants entrained in the gas.

A continuous supply of service liquid is necessary to limit the temperature rise in the pump caused by the heat of compression friction, and condensation. Any excessive rise in temperature will have a detrimental effect on performance, reducing the capacity and degree of vacuum attainable.

6. INSTALLATION

Prepare reinforced cement concrete foundation for the pump and the driving motor at least two weeks before the erection of the pump. The depth and strength of the foundation should be such that it withstands the load imposed by the pump and motor and the belt tension if necessary, and maintains the alignment between pump and motor. Leave pockets for the foundation bolts and an allowance of about 2" in the height of foundation for filling it with cement grout at the time of erecting the pump.

The pump is supplied along with a Mild Steel Base fitted to its feet by four Bolts. Generous allowance is provided on the diameter of holes drilled in the pump feet for the bolts to pass. After the pump and base is grouted on the concrete foundation and the base is permanently set in concrete, place the pump and base with foundation bolts on the foundation and level the pump by placing steel shims under the base as near to the foundation bolts as possible.

In case of a V-belt driven pump, grout the foundation bolts and base. After 3-4 days mount the V / Flat Belt pulley on the pump. Fix the slide rails along with foundation bolts to the feet of the motor and the V / Flat Belt pulley on the motor shaft. Ensure that the slide rails and the face of the motor V / Flat Belt pulley are parallel to one another. Grout the motor slide rails along with their foundation bolts after the motor and pump pulleys are brought into alignment and their center distance is as indicated.

The V / Flat pulley will have light interference fit on the shaft. Do not drive the pulley on the shaft by hammering it, as this will transmit the hammer's force to the idle end bearing and may damage it. Fix the mounting stud on the end of the pump shaft as shown in the Fig. No – 2; by tightening the nut uniformly mount the pulley along with the cap. After removing the stud, fix the cap to the pulley by tightening two socket head cap screws.

Mount the V / Flat Belts and follow the instructions published by any reputed V / Flat Belt manufacturer.

In case of a direct coupling, Pumps supplied from the factory packaged with a motor on a base plate have had their shafts aligned prior to shipment. This ensures that alignment can be done in the field. It is required that the shaft alignment be rechecked after mounting on a level foundation and prior to start-up.

For smoother operation and longer life of the coupled equipment, the following maximum misalignment tolerances are recommended:

The maximum allowable parallel shaft misalignment for standard couplings is ±0.05mm and for spacer couplings is ±0.025mm per 1mm of space length.

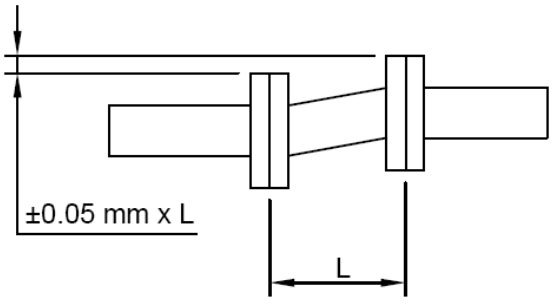


Fig - 2

The maximum allowable angular shaft misalignment is ±0.013 per mm of coupling diameter.

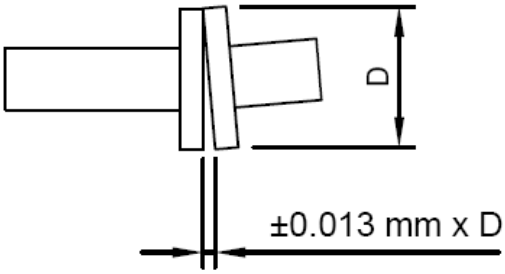


Fig - 3

Pumps provided with a C-face mounted motor do not require alignment; however, the coupling should be inspected prior to start-up.

7. PIPING

The weight of the piping connected to the inlet / suction and outlet / discharge flanges should not be allowed to come on the pump. The piping should be supported such that, in the absence of tightening bolts on the manifold flanges, the pipeline stays in line with the manifold flanges. Once this is ensured, tightening the flange bolts will not distort the pump, as the pipeline load will not be transferred to the pump.

The pump handles a considerable quantity of liquid along with air / gasses, hence gradual slopes should be provided in the piping for the smooth flow by gravity of any liquids entering the piping. For this reason, suction / inlet side piping should slope down towards the pump. When the liquid entering the pump is more than the gas entering, a separator should be provided to remove the liquid from the system before it enters the pump. More details can be given by your NES representative.

Pipeline interior should be free from rust, scale deposits, weld-shots, weld-slag, cut pieces of metal and other solids like bolts, nuts, and washers when they are installed. The perforated sheet or wire-mesh supplied with the pump must be left for at least 24 hours after the initial pump start-up. When the mesh is removed, see to it that the accumulated solids do not enter the pump.

The pump has one inlet flange and one outlet flange. The pipeline size should be the same as the size of the inlet and outlet nozzles on the manifolds or larger.

8. SEAL LIQUID / WATER SUPPLY

Connect the screwed end “Seal Water Inlet” (shown on the layout drawing) to constant source of cool, clean, soft water. One strainer, two valves and a water pressure gauge should be arranged in the water supply line. The strainer will prevent solids from entering the pump via the water supply line. It should be inspected and cleaned at regular intervals.

Out of the two valves, one is a shut-off valve and is used for fully opening/closing the water supply to the pump before starting/after stopping pump operation respectively. The other regulates the water entering the pump for optimal performance. Once this valve is adjusted for the optimal performance of the pump, its setting is not to be disturbed.

Refer to Table – 2 for sealing requirements.

Table – 2

Pump Model	Normal Seal Water (±10%)	
	LPM	USGPM
NPV-62240	65	18
NPV-72200	75	20
NPV-72300	84	23
NPV-72400	90	24
NPV-82350	97	26

The pressure gauge will indicate the pressure of water entering the pump at the seal water inlet connection of the pump. This is typically around 7.1 to 11.4 psig $\left[0.5\ to\ 0.8\ \frac{kg}{cm^2}\right]$. The seal water should be supplied at a higher pressure than this to compensate the pressure drop int eh strainer, valve and supply line. A rotameter / flow indicator of a suitable flow range may be installed in the water line to indicate the actual flow rate of water.

9. DRAINS

At the bottom of the pump body, two plugs are fitted. The seal liquid can be completely drained from the body through these holes when the pump is shut-off. By fixing a length of pipe with a valve in these tappings, part of the seal liquid can be continuously drained from the body during operation. This is helpful in draining larger quantities of water entering the pump at the suction and flushing the interior of the pump free of foreign material entering the pump during operation.

10. STUFFING BOX PACKING

On both ends, stuffing boxes are packed with rings of impregnated packing rope While repacking, see that the joints of all the rings are not aligned. The gland nuts should be tightened slowly and uniformly when the pump is running. Allow constant dripping from the gland, as this will ensure gland cooling, prevent packing burn, and prevent shaft scoring.

Refer to Table No. – 3 for packing rope details. For optimal performance in high vacuum, a separate shaft seal cooling arrangement to the pump connected to the lantern ring of the pump is available. A separate passage is provided in the head to achieve the same results.

11. BEARINGS – LUBRICATION

The pump has two identical spherical roller bearings, one on each end. The bearings are lubricated by CASTROL LM all-purpose grease before the pump is tested and shipped from factory. Re-lubricate after every three months of operation. After a year of operation, remove the bearing caps and inspect the condition of the bearings and grease. If the grease appears contaminated, clean the bearing with solvent and light lubricating oil. Repack the interior of the bearing full and the bearing covers half-full with grease and reassemble the covers. Follow the instructions issued by reputed bearing manufacturers on bearing maintenance and replacement.

11.1 GREASE SPECIFICATIONS

A) Premium quality industrial bearing grease
B) Consistency grade: NLGI #2
C) Oil viscosity (minimum)
   @ 101°F – 108 St
   @ 210°F – 10 cSt
D) Thickener (Base) : Lithium or Lithium Complex for optimal water resistance.
E) Performance Characteristics at operating temperature:
   i. Operating temperature range: at least 65°F to 250°F
   ii. “Long life” performance
   iii. Good mechanical and chemical stability
F) Additives – Mandatory:
   i. Oxidation inhibitors
   ii. Rust inhibitors
G) Additives – Optional:
   i. Anti-water agents
   ii. Corrosion inhibitors
   iii. Metal deactivators
   iv. Extreme Pressure agents
H) Additives – Objectionable:
   i. Molybdenum disulfide
   ii. Tackiness agents

The following is a list by manufacturer, of some grease that exhibits the desired characteristics.

11.2 GREASE MANUFACTURER PRODUCT

BP OIL: ENERGREASE LS-EP2

CASTROL OIL: AP2/SPHEEROL SW 2 EP

MOBIL OIL: MOBILITH SHC100 OR

MOBILITH AW 2

SHELL OIL: ALVANIA 2 OR ALVANIA EP 2

GULF OIL: GULF CROWN No. 2

To maximize grease performance, it is recommended that inter mixing of different grease be kept to an absolute minimum.

PERIODICAL LUBRICATION OF BEARINGS IS AS FOLLOWS:

Table 3

PUMP MODEL	GREASE QTY. FOR THE LUBRICATION IN LBS.			
	Refilling every three months (lbs.)		Complete refilling annually (lbs.)	
	Drive End	Idle End	Drive End	Idle End
NPV-62240	0.33	0.44	1.32	1.76
NPV-72200	0.33	0.44	1.32	1.76
NPV-72300	0.33	0.44	1.32	1.76
NPV-72400	0.33	0.44	1.32	1.76

12. STARTING

Before the pump is run on motor power, ensure:

1. Pump pulley and motor pulley are in proper alignment.
2. Belt tension is properly adjusted.
3. Belt guard is in place.
4. Seal water is available at the required pressure.
5. Perforated sheet/wire mesh supplied with the pump is properly fitted in the suction manifold
6. Motor is connected to supply for **proper direction of rotation** marked on the pump body.

Open both the valves in the seal water line and allow the water to flow into the pump. Open the drain plugs at the bottom of the body and see that the seal water flows freely out of the pump, then close the drain plugs. Rotate the pump pulley by hand at least two turns to check for free movement of the rotor-shaft assembly. (If any metallic sound is heard from the inside of the pump, do NOT run the pump. The sound could be due to the presence of some solids that may have entered the pump; the pump may need to be dismantled for cleaning.) Start the driving motor. Check the speed of the pump and the motor current, and compare with the specified values. Check the temperature rise of the bearing housing at 15-minute intervals for the first two hours of operation. If the temperature does not stabilize below 158°F, stop the pump and investigate.

13. ADJUSTING SEAL LIQUID / WATER FLOW

For every operating condition, the optimal quantity of seal water can be adjusted as described below. Fully open both valves in the water line. While watching the vacuum gauge, gradually close the adjusting valve until the vacuum starts to fall. Slightly open the valve to maintain the maximum vacuum and no more.

Excessive seal water, though not harmful to the pump, will reduce the pump's capacity to handle air and increase the power input to the pump. The adjusting valve setting should be left without disruption and the shut-off valve should be used for fully opening/closing the water supply to the pump before starting/after stopping the pump.

14. DISMANTLING INSPECTION AND REPAIRS

Complete disassembly of the pump is seldom necessary and may only be required for repair or service. Before any servicing takes place, it is recommended that you obtain the necessary factory parts. To make the selection process complete, NES offers a Pump Rebuild Kit for most pump models.

The items in this kit enable you to replace the *normal wear items* in the pump. This includes the mechanical seals, lip seals, bearings, and gaskets. The kit also includes the necessary bearing and impeller locknuts, as well as an impeller spacer. Refer to the cross-sectional drawings for complete spare parts present in the pump.

For complete disassembly and assembly, the presence and guidance of an NES technician is strongly recommended.

15.TROUBLESHOOTING

The pump is simple in construction, with only one moving part (rotor-shaft assembly). Besides bearing lubrication, there is scarcely much maintenance. If at any time, trouble is experienced in obtaining the specific discharge and vacuum, the following points should be checked before deciding to dismantle the pump.

PROBLEM	CAUSE	CORRECTIVE ACTION
Hot Bearing	Contaminated lubricant	Clean thoroughly and relubricate
	Lack of lubricant	Lubricate
	Excess lubricant	Clean out bearing caps / remove excess grease
	Coupling misalignment	Check alignment and coupling gap, rectify
	Belt drive too tight	Adjust belt tension
	Pipe stress	Adjust piping
	Soft foot	Shim pump feet
	Gland packing too tight	Loosen gland slightly
	High pump operating temperature	Check operating temperature vs. design conditions
	High seal water flow	Check water supply pressure
		Check orifice size (if provided)
	Flooded operation	Check water drain system
	Damaged bearing	Contact NES Repair Center for assistance
	Hot fixed bearing due to axial load	Check for excess vacuum differential on inlets
		Check for plugged inlet, discharge, or seal water piping on one end of pump
		Check for improper coupling gap
Insufficient vacuum pressure or capacity	Air leaks	Tighten pipe joints
		Repair control or isolation valves
		Replace leaky pipe
	Low pump speed	Adjust drive belts & Check power supply
	Low seal water flow	Check water pressure
		Check orifice size (if provided)
		Check for plugged orifices, piping, strainers
	High seal water flow	Check water pressure
		Check orifice size (if provided)
		Check for excess carryover from the process
	Internal wear	Increase seal water flow
		Check the seal water pH (Inlet and Outlet)
		Contact NES for assistance with internal inspections
	Restricted inlet and discharge piping	Clean inlet screens / remove if not required
		Check for product buildup
		Contact NES for assistance with internal inspections
	Pump rotation incorrect	Check rotation vs. cast arrows on pump heads
	Hot sealing water	Check the coolant flow and heat exchanger. The cooler the sealing water is, the higher the maximum vacuum capability is.
	Excessive backpressure	Eliminate the cause of the back pressure.

PROBLEM	CAUSE	CORRECTIVE ACTION
Abnormal noise	High Vacuum	Restricted inlet piping
		Plugged inlet screen
		Inoperative relief valve
		Inlet passages plugged by solids; contact NES for inspection assistance
	Excess discharge pressure	Discharge air / water passaged plugged by solids; contact NES for inspection assistance
		Small discharge line
	Loose drive belts	Adjust belt tension
	Excess internal clearances	Increase water flow
		Contact NES for inspection assistance
	Unstable operation	Vent the inlet and discharge to atmospheric pressure, wait 5 minutes, and resume normal operation while remaining attentive to abnormal conditions.
	Separator configuration	Check separator mounting
		Check for correct water level
	Defective bearing	Replace bearing
	Cavitation	Open attenuation valve or adjust vacuum relief valve
		Check cause of backpressure
	Excessive / insufficient service liquid	Adjust flow rate
High Horsepower	High pump speed	Check speed vs. curve
	Excess backpressure	Check for restricted discharge piping
	High seal water flow	Check water pressure
		Check seal orifice size
		Check for excess carryover from process
	Restricted discharge passages	Clean passages
		Contact NES for inspection assistance
	Poor electrical power quality	Measure power consumption with a watt meter
		Check motor efficiency rating
	Shaft packing too tight	Repack the pump / check for internal metallic sound, if any
	Restricted water drain	Inspection and cleaning of drain lines
	Defective bearing	Replace bearing
	Gland follower too tight	Loosen gland follower
High operating temperature on body	Low seal water flow	Check seal water supply pressure
		Check orifice size (if provided)
		Check for plugged water supply components
	Hot process conditions	Check for carryover from the process
		Check for inoperative inlet separators
	High seal liquid supply temperature	Check cooling system for plugging/fouling/heat exchanger

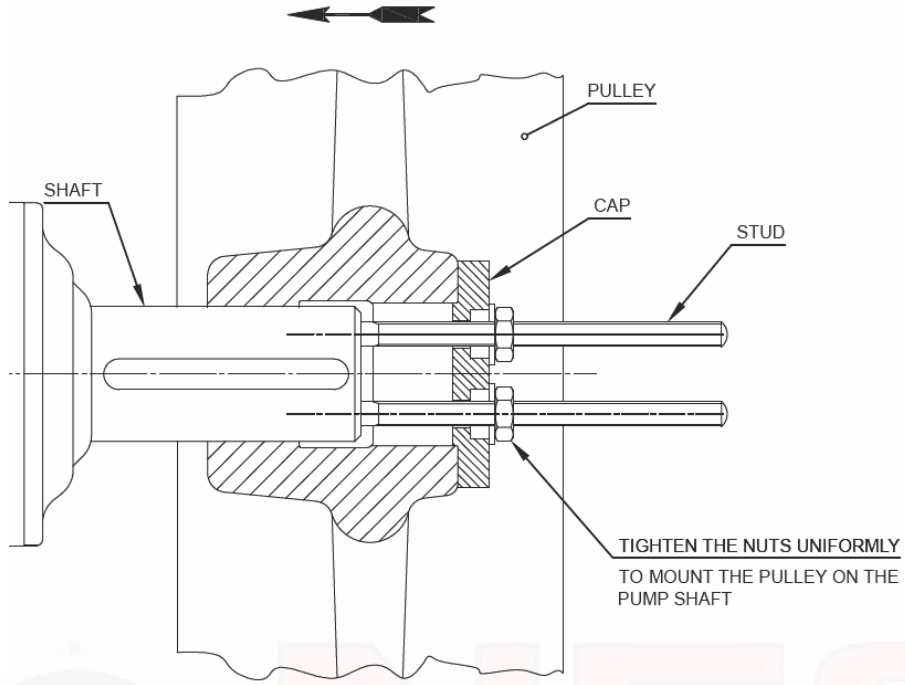
PROBLEM	CAUSE	CORRECTIVE ACTION
Abnormal vibration	Excess service liquid	Check seal water pressure and orifice
		Excess carryover from process
	Loose mounting	Check that mounting bolts are tight and grouting is intact
	Unstable operation	Vacuum / pressure level beyond operating point
	Out-of-balance drive components	Balance sheave or coupling
	Product buildup on rotor	Contact NES for inspection assistance and descaling procedures
	Flooded start/operation	Check for proper discharge drain system
	Misaligned drive	Realign
	Loose belts	Adjust belt tension
	Defective bearing	Replace bearing
	Cavitation	Open attenuation valve or adjust vacuum relief valve
	Backpressure	Eliminate cause of backpressure
Shaft will not turn / partially seizes	Scale build-up	Descale pump
	Foreign object in pump	Remove foreign object
	Piping load on pump flange	Support connecting pipework
	Improperly mounted pump	Make sure surface is level and all feet touch the surface; shim if necessary.
		Correct pump/motor mounting.
Excessive gland leakage	Worn packing loose gland	Replace packing
	Gland coolant pressure too high	Tighten gland follower
		Reduce pressure
Overheating; Abnormal Bearing Wear / Failure	Shaft misalignment	Realign shafts
	Piping load on pump flange	Support connecting pipework
	Mechanical seal leakage	Replace seals
	Shaft slinger missing	Replace slinger

16. STANDARD PARTS

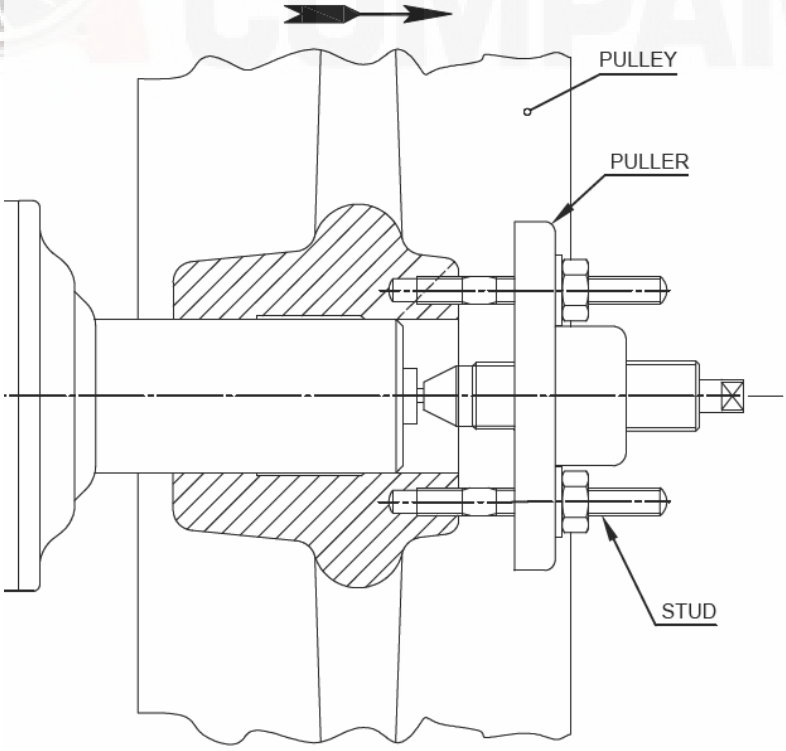
S.NO.	PARTS NAME & LOCATION	QTY.	Ref. STD. / MAKE	SPECIFICATIONS			
				NPV-62240	NPV-72200	NPV-72300	NPV-72400
1	Bearing – DE & IE	2	SKF/TIMKEN	Type: Radial Ball Bearing Brg No.: 6310 Size: Ø50xØ110xØ27	Type: Spherical Roller Bearing Brg No.: 21314 Size: Ø70xØ150xØ35	Type: Spherical Roller Bearing Brg No.: 21314 Size: Ø70xØ150xØ35	Type: Spherical Roller Bearing Brg No.: 21314 Size: Ø70xØ150xØ35
2	Locknut – DE & IE	2	*	KM10-M50 x 1.5	KM14-M70 x 2	KM14-M70 x 2	KM14-M70 x 2
3	Lockwasher – DE & IE	2	*	MB10-Ø50	MB14-Ø70	MB14-Ø70	MB14-Ø70
4	Oil seal – DE Outer Brg. Covers	1	*	B-Ø48 x Ø62 x 8	B-Ø65 x Ø85 x 10	B-Ø65 x Ø85 x 10	B-Ø65 x Ø85 x 10
5	Oil seal – DE & IE Inner Brg. Covers	2	*	B-Ø58 x Ø72 x 8	B-Ø75 x Ø95 x 10	B-Ø75 x Ø95 x 10	B-Ø75 x Ø95 x 10
6	Key parallel – shaft-coupling	1	IS:2048	A14 x 9 x 60	A16 x 10 x 100	A16 x 10 x 100	A16 x 10 x 100
7	Key parallel – Rotor 1st stage	1	IS:2048	A18 x 11 x 100	A18 x 11 x 150	A18 x 11 x 250	A18 x 11 x 250
8	Key parallel – Rotor 2nd stage	1	IS:2048	A18 x 11 x 75	A18 x 11 x 80	A18 x 11 x 130	A18 x 11 x 130
9	Gland packing rope stuffing box DE & IE	12 Ring	*	10sq. x 214 long	12sq. x 276 long	12sq. x 276 long	12sq. x 276 long
10	Stud – head – gland	4	IS:1862	B M10 x 70 B 8.8	B M10 x 70 B 8.8	B M10 x 70 B 8.8	B M10 x 70 B 8.8
11	Gland Two Halves	4	IS:1862	B M8 x 65 B 8.8	-	-	-
12	Hex. bolt – top inlet flange (mf)	8 / 10	IS:1363	B M16 x 60	B M20 x 60	B M20 x 60	B M20 x 60
13	Socket – head cap bolt head and port plate	4	IS:1363	B M10 x 115	B M12 x 110	B M12 x 110	B M12 x 110
14	Tie rod – head and body	8	EN – 8/24	B M16 x 610	B M20 x 600	B M20 x 750	B M20 x 850
15	Stud IE Bearing Covers	3	IS:1363	B M10 x 80	B M10 x 80	B M10 x 80	B M10 x 80
16	Stud DE Bearing Covers	3	IS:1363	B M10 x 80	B M10 x 80	B M10 x 80	B M10 x 80
17	Hex. Screw DE & IE Outer Cover	6	IS:1363	B M10 x 35	B M10 x 35	B M10 x 35	B M10 x 35
18	Hex. Bolt Head – Bracket	8	IS:1363	B M12 x 45	B M16 x 45	B M16 x 45	B M16 x 45

**For more information, please contact your NES representative.*

17.V/FLAT PULLEY MOUNTING AND DISMANTLING

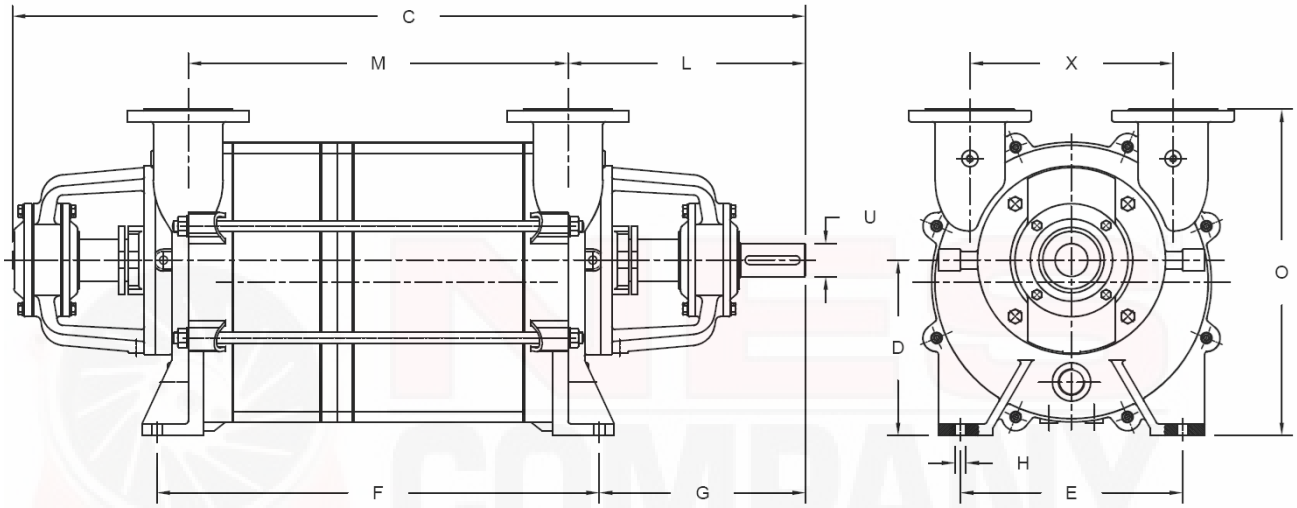


PULLEY MOUNTING FIG - 7



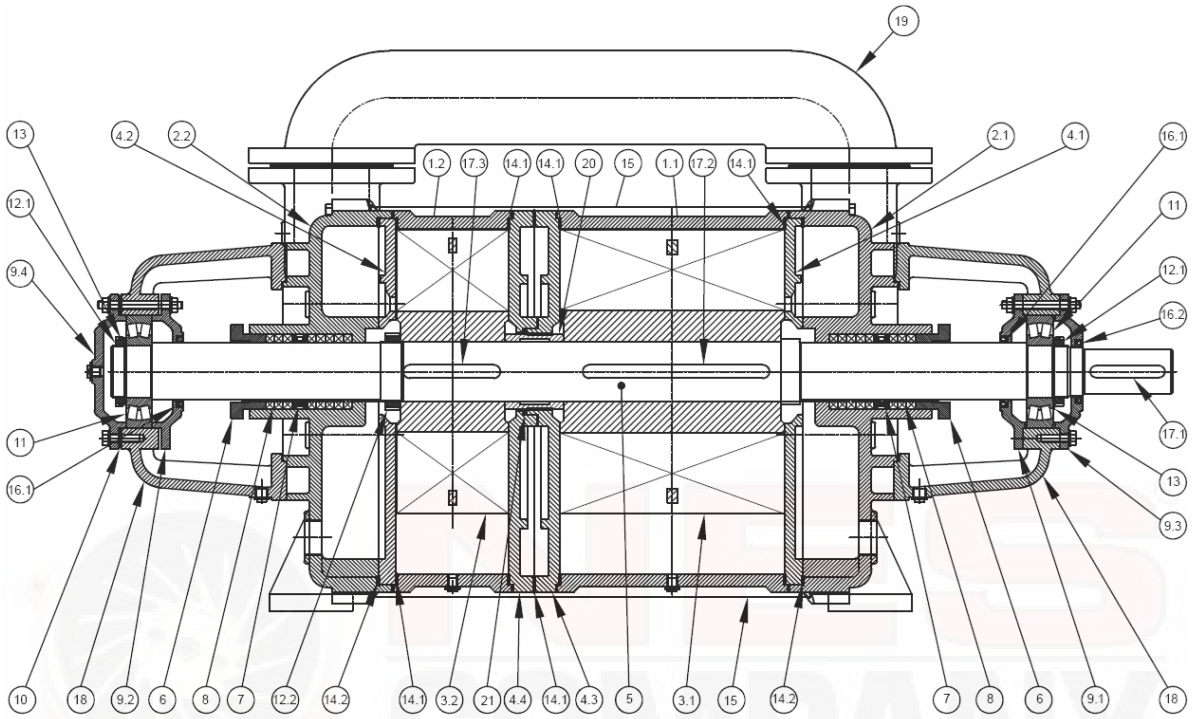
PULLEY DISMANTLING FIG - 8

Dimension Sheet: NPV Series Liquid Ring Vacuum Pump



PUMP SIZE	FLANGE NB	E	H	D	O	X	F	M	L	C	G	N	U
NPV-62160	3”	12½”	⅞”	10”	2½”	11½”	16½”	17⅜”	13⅞”	41⅛”	12¼”	3⅜”	1¾”
NPV-62240	3”	12½”	⅞”	10”	18¼”	11½”	25⅜”	22”	13⅞”	46”	12¼”	3⅜”	1¾”
NPV-72200	4”	15¾”	⅞”	12½”	23½”	14½”	25⅞”	21½”	17”	56⅞”	15”	4¾”	2⅜”
NPV-72300	4”	15¾”	⅞”	12½”	23½”	14½”	31¾”	27⅜”	17”	56⅞”	14¾”	4¾”	2⅜”
NPV-72400	4”	15¾”	⅞”	12½”	23½”	14½”	35⅝”	31¼”	17”	60⅜”	15”	4¾”	2⅜”
NPV-82350	4”	15¾”	⅞”	12½”	23½”	14½”	41½”	37½”	17”	76½”	15”	4¾”	2⅜”

The figures provided are to the nearest eighth-inch.



P.No.	PART NAME	QTY.
1.1	BODY 1st STAGE	1
1.1	BODY 2nd STAGE	1
2.1	HEAD D.E	1
2.2	HEAD I.E	1
3.1	ROTOR 1st STAGE	1
3.2	ROTOR 2nd STAGE	1
4.1	SUCTION PORT PLATE	1
4.2	DISCHARGE PORT PLATE	1
4.3	INTERMEDIATE PLATE 1st STAGE	1
4.4	INTERMEDIATE PLATE 2st STAGE	1
5	SHAFT	1
6	GLAND	2
7	LANTREN RING	2
8	PACKING ROPE – GLAND	2 SETS. 16 Nos.
9.1	BEARING COVER D.E.INNER	1
9.2	BEARING COVER I.E.INNER	1
9.3	BEARING COVER D.E.OUTER	1
9.4	BEARING COVER I.E.OUTER	1
10	SET OF SHIMS or SPACER	1 SET
11	BEARING (Brg No.: 21314)	2
12.1	LOCK NUT – BEARING (KM14)	2
12.2	LOCK NUT – ROTOR	1
13	LOCK WASHER – BEARING(MB14)	2
14.1	PACKING (BODY)	1 SET
14.2	PACKING (HEAD)	1 SET
15	TIE ROD	8
16.1	OIL SEAL (INNER COVERS)	2
16.2	OIL SEAL (D.E OUTER COVER)	1
17.1	KEY – SHAFT(Pulley / Coupling)	1
17.2	KEY – SHAFT(ROTOR 1st STAGE)	1
17.3	KEY – SHAFT(ROTOR 2nd STAGE)	1
18	BEARING BRACKET	2
19	MANIFOLD	1
20	ROTOR SPACER	1
21	INTERMEDIATE PLATES SEAL RING	1

GENERAL WARNINGS

WARNINGS
The machines and their corresponding drive motors are equipment for use in industrial systems and voltage systems. Depending on operating conditions (especially for possible use with hazardous fluids) improper use can cause serious bodily injury or physical damage. The persons responsible for system safety MUST ensure that: • Only persons qualified to work on the machines are authorized. • These persons will always possess the operating manual supplied and other documents from the product documentation during all work AND are required to follow these documents strictly. • Work on the machines or in their vicinity is prohibited for all unqualified persons.

Safety-related terms.

The **safety alert symbol** is located in the safety precautions in the highlighted heading field on the left next to the signal words Danger, Warning, and Caution.

Safety precautions with a safety alert symbol indicate danger of injury.

Be sure to follow these safety precautions to prevent injury or death.

Safety precautions without a safety alert symbol indicate danger of damage.

Signal words

DANGER
WARNING
CAUTION
NOTICE
NOTE

The **signal words** are located in the safety precautions in the highlighted heading field.

These words follow a certain hierarchy and, in conjunction with the safety alert symbol, indicate the **severity of danger** and the **warning type**.

DANGER

Danger of injury.

Indicates an imminent hazard that will result in death or serious injury if the corresponding measures are not taken.

WARNING

Danger of injury.

Indicates a potentially hazardous situation that may result in death or serious injury if the corresponding measures are not taken.

CAUTION

Danger of injury.

Indicates a potentially hazardous situation that may result in minor or moderate injury if the corresponding measures are not taken.

CAUTION

Danger of damage.

Indicates a potentially hazardous situation that may result in property damage if the corresponding measures are not taken.

NOTICE

Indicates a possible disadvantage.

i.e. undesirable conditions or consequences can occur if the corresponding measures are not taken.

NOTE

Indicates a possible disadvantage if the corresponding measures are not taken.

General safety information.

The machines involved are parts of systems for industrial use. They are implemented in accordance with approved technological regulations, local, regional, and global.

DANGER

Because of the features that are contingent upon operation, this equipment can cause very serious injury or damage, e.g. from improper use or handling, insufficient maintenance, or inappropriate intervention by unqualified personnel. This especially applies to machines that are used in such a way that high temperatures or pressure differences can occur during operation, or hazardous fluids are used or discharged.

WARNING

Improper use of the machine can cause serious injury or death.

These operating instructions:

- Must have been read and understood completely before beginning any work with or at the machines.
- Must be strictly and continuously observed.
- Must be available at the operating location of the machine.

WARNING

Improper use of the machine can cause serious injury or death.

These machines may only be operated:

- For the purpose indicated under intended use
- With the fluids indicated under intended use
- With the valves indicated under the description.

WARNING

Improper use of the machina can cause serious injury or death.

All work on and with the machine (transport, installation, commissioning, shut-down, maintenance, disposal) may only be carried out by trained, reliable, and qualified personnel.

WARNING

When working on the machine, there is danger of injury in the form of shearing, cutting, tearing, crushing, and burning.

During all work on an with the machine (transport, installation, commissioning, shut-down, maintenance, disposal) the equipping of personal safety equipment is **required** (safety helmet, protective gloves, safety boots)

WARNING

Hair and clothing can be pulled into the machine or caught and wound by moving parts.

Do NOT wear long, loose hair or loose-fitting clothing or accessories. Use a hair net if necessary.

WARNING

Danger from rotating parts (impeller, shaft):

- **Shearing/cutting/cutting of extremities**
- **Grasping/winding of hair and clothing**

Danger due to gauge pressure and vacuum:

- **Sudden removal of fluid from skin and eyes**
- **Sudden pull of hair and clothing**

Danger due to escaping fluid:

- **Burns/scalding**
- **Slipping/falling**

Commissioning and operation should only be carried out under the following conditions:

- In the completely mounted state.

In particular:

- With connected lines on inlet and discharge connections. Keep unused connections closed with blind flanges.
- With closed inspection covers on the end shields.
- With mounted lines and fittings on the connections in the end shield. Keep unused connections closed with the sealing devices provided (plugs, covers).

WARNING

Danger from rotating parts (impeller, shaft):

- **Shearing/cutting/cutting of extremities**
- **Grasping/winding of hair and clothing**

Danger due to gauge pressure and vacuum:

- **Sudden removal of fluid from skin and eyes**
- **Sudden pull of hair and clothing**

Danger due to escaping fluid:

- **Burns/scalding, slipping/falling**

Before beginning any work on the machine or dismantling, take the following measures:

- Shut down machine and secure against being switched on again.
- Hang a warning sign on the system controller and on the control element for the machine:
  "Danger. Maintenance work on vacuum pump/compressor."
  "Do not switch on."
- Wait for the machine to come to a complete stop.
  Watch run-on time.
- Shut off lines.
  Carry out pressure relief.
  Drain off excess liquid.
- Make sure that no gauge pressure or vacuum is present in the lines, tanks, etc. to be opened.
  In particular, do not remove the following components until after the machine has come to a complete stop, the lines have been shut-off and the pressure has been released:
  The lines and blind flanges on the inlet and discharge connections.
  The inspection covers on the end shields.
  The lines, fittings and closures (plugs, covers) on the connections in the end shield.

WARNING

Danger from rotating parts (impeller, shaft):

- **Shearing/cutting/cutting of extremities**
- **Grasping/winding of hair and clothing**

Danger due to gauge pressure and vacuum:

- **Sudden removal of fluid from skin and eyes**
- **Sudden pull of hair and clothing**

Danger due to escaping fluid:

- **Burns/scalding, slipping/falling**

Restarting only under the following conditions:

- After completing all work on the machine.
- After complete reassembly.

In particular:

- With connected lines on inlet and discharge connections.
  Keep unused connections closed with blind flanges.
- With closed inspection covers on the end shields.
- With mounted lines and fittings on the connections in the end shield.
  Keep unused connections closed with the sealing devices provided (plugs, covers).

WARNING

Danger due to gauge pressure and vacuum:

- **Sudden escape of fluid (skin and eye injury)**
- **Sudden pull of hair and clothing**

Danger due to escaping fluid:

- **Burns/scalding**
- **Slipping/falling**

For inlet and discharge side, as well as for the feed and discharge of operating liquid and sealing liquid the following applies:

- Use connections, lines, fittings, and containers with sufficient freedom from leaks and strength for the resulting pressures.
- Before commissioning, following dismantling and reassembly, as well as at regular intervals, check the connections of the pipe/hose connections, lines, and containers for strength, leaks, and firm seating.
  Check connection elements and tighten if necessary.

WARNING

Danger due to gauge pressure and vacuum:

- **Impermissibly high pressure leading to bursting of parts, abrupt escape of fluid (skin and eye injury).**
- **Sudden pull of hair or clothing.**

Extreme Danger.

The machine must not be operated with a blocked inlet or discharge. Before operating, ensure the following:

- The closures of the inlet and discharge connections used must be removed.
- All pipes must be connected.
- The shut-off device (e.g. valves, gate valves, etc.) in the lines must be open
- The connection and lines may not be /become clogged with deposits or solid materials.
- When feeding fluids containing materials, suitable screens or filters must be connected upstream of the machine.

WARNING

Danger of burns/scalding by hot fluids and machine surfaces (shaft bearings).

Do not touch during operation.
Allow to cool after shut-down.
This especially applies to inlet and pressure lines and the surface of the shaft bearings.

WARNING

Danger from rotating parts (exposed shaft ends, drive [drive motor, gear unit, coupling]):

- **Injury from rubbing (scrapes, burns)**
- **Crushing of extremities**
- **Grasping/winding of hair and clothing**

For the attachment of the drive (drive motor, gear unit, coupling) and the exposed shaft end, the following applies:

- Rotating parts must be protected against touching.
  Provide safety device (e.g. cover).
- For the machine design with a second shaft end:
  Mount provide protective hood for the second shaft end.
- Only start up and operate with safety device mounted.
- Before removing the safety device, wait for the rotating parts to come to a complete stop.
  Watch run-on time.

WARNING

Openings in bearing bracket/shaft mounting of end shields:

- **Danger from rotating parts (shaft):**
  - **Injury from rubbing (scrapes, burns)**
  - **Shearing, cutting on shaft shoulders**
  - **Grasping/winding of hair or clothing**
- **Danger from fluids spraying out**
  - **Skin and eye injuries.**

For the openings in the bearing bracket/shaft mounting of the end shields, the following applies:

- Do not look or reach into the openings in the bearing bracket/shaft mounting of the shield while the machine is running.
- Always conduct work in this area ONLY AFTER the shaft has come to a complete stop.
  Watch run-on time.
- When conducting work in this area that must be carried out with the machine running, wear personnel safety equipment (protective gloves, hair net, protective goggles).

WARNING

Danger of injury from tilting or falling parts.

When the mounting of some parts is released, the parts are only held by their centering devices, seat, or not held at all, allowing for them to tilt or fall.

- Only carry out start-up and operation in the completely assembled state.
- Check mounting elements regularly for secure seating.
- Exercise appropriate caution during removal and mounting.
- Check following each removal and remounting whether all mounting elements have been remounted and tightened.

WARNING

Danger from flammable or explosive substances
Fire, explosion.
Danger from aggressive or toxic substances:
Irritations and caustic burns, poisoning, injury to the eye.

In the case of dangerous fluid (operating liquid, sealing liquid, pumped gasses/vapors), take the following measures.

- Make sure that fluids cannot escape.
- Use suitable shaft seals (e.g. mechanical seals with external sealant supply).
- Provide closed systems for the feed and discharge of the fluids.
- Equip fluid feed pipes and discharge pipes with shut-off fittings.
- Before start-up, flush entire system with inert gas.
- Before working on the machine or system, drain and decontaminate.
- When working on the machine or system, wear personal safety equipment (protective glove, protective goggles, breathing protection)!
- Observe safety data sheets of fluids manufacture!
- Immediately neutralize and dispose of escaped fluids.
- Attach warning sign(s) on the machine if necessary:
  "Warning, flammable substances"
  "Warning, explosive substances"
  "Warning, caustic substances"
  "Warning, hazardous or irritation substances"
  "Warning, toxic substances"

WARNING

Danger of injuries from tilting or falling of the machine!
Take the following measures:

- The machine must be installed on a level surface.
- The machine must be anchored to the installation surface with the fixing lugs in the feet.
- Check mounting elements regularly for secure seating.
- Check following each removal and remounting whether all mounting elements have
- been remounted and tightened.

CAUTION

Danger slipping and falling due to escaping liquid.
Before start-up and operation, following removal and remounting as well as at regular intervals:

- Check shaft seal for leaks. If necessary, readjust or replace.
- Wipe up escaped liquid immediately.

NOTE

More detailed information on general work is contained in our assembly instructions, e.g. inspecting incoming deliveries (damage during transport), long term storage and preservation of the machine, foundation testing, and fitting coupling, preparing and aligning the machines, installation measures, and much more.

WARNING

Basic system design work and all work related to transport, assembly, installation, service start up, maintenance and repair must be carried out by qualified personnel or checked by the appropriate specialists.

In particular, please take into consideration:

- Technical data and specifications for implementation (condition for assemvly, connection, environment and operation) that are contained in the catalog, PO documents, operating manual specification on plates and other manufacturing documentation.
- The general installation and safety regulations.
- The local and plant specifications and requirements.
- The proper use of tools, lifting and transporting equipment.
- The use of personal protection equipment.

The obligation by those responsible to provide safety instruction for the employees involved according to analogous national rules for the safe use of substances for which bodily or environmental injury is possible, e.g. for cleaning or lubricant materials, adhesives, painting etc. detailed information for special products is available in each safety data sheet from the product manufacturer or importer.

Because the operating manual is essential an overview, it does not contain all the detailed information on various design and cannot take into consideration every possible situation related to assembly, operating or maintenance. Accordingly, the only advice contained in the operating manuals is essential what is necessary for qualified personnel (see above) when the machines are implemented for industrial uses in accordance with those specifications.

In the event of a special case of intentional use of the machine in a non-industrial site, additional requirement possibly apply; these conditions must be secured at the system site by means of additional safety measures during assembly.

For unclear issue related to this, especially for product-specific, detailed information that is lacking, the clarifications required must obtained from the competent sales office. For this, please provide information on the type of machine and the manufacturing number.

IT IS RECOMMENDED TO UTILIZE THE SUPPORT AND SERVICE FROM NES PERSONNEL FOR ISSUES RELATED TO DESIGN, ASSEMBLY, START UP, AND SERVICE.

Residual dangers

WARNING

Danger zone:
Opening in bearing brackets/shaft mounting of end shields: rotating shaft, fluids spraying out.
Hazard:

- Injuries from rubbing (scrapes, burns)
- Cutting on shaft shoulders.
- Grasping/winding of hair or clothing
- Skin and eye injuries.

Protective measures

- Do not look or reach into the opening in the bearing bracket/shaft mounting of the end shields while the machine is running.
- Always only conduct work in this area after the shaft has come to a complete stop.
- Watch run-on time.
- When conducting work in this area that must be carried out with the machine running, wear personal safety equipment (protective gloves, hair net, protective goggles)
- Do not wear long, loose hair or accessories, or loose-fitting clothing.
- Use a hair net if necessary.

WARNING

Danger zone:

- Exposed shaft end.
- Drive (drive motor, gear unit, coupling) attachment by operator.

Hazard:

- Injuries from rubbing (scrapes, burns)
- Crushing of extremities
- Grasping/winding of hair and clothing

Protective measures

- It must be ensured that rotating parts with non-uniform, smooth surfaces do not touch each other.
- Provide safety device (e.g. cover).
- Only start up and operate with safety device mounted.
- Before removing the safety device, wait for the rotating parts to come to a complete stop.
- Watch run-on time.
- Do not wear long, loose hair or accessories, or loose-fitting clothes.
- Use a hair net if necessary.

WARNING

Danger zone:

- Discharge connection
- The inspection covers on the end shields

Hazard

In the case of aggressive or toxic fluids (operating liquid, sealing liquid, pump gasses/vapors): Danger of irritation and caustic burns, poisoning, eye injury.

Protective measures:

In the case of aggressive or toxic fluids (operating liquid, sealing liquid, pump gasses/vapors):

- When working on the machine or near the machine, wear personal safety equipment (protective gloves, protective goggles, breathing protection)
- Attach warning sign(s) on the machine if necessary:
  - "Warning, caustic substances"
  - "Warning, hazardous or irritating substances"
  - "Warning, toxic substances"

WARNING

Hazard

Hot fluids (pumped gasses/vapors)

Hazard:

Burns/scalding.

Protective measures:

At fluid temperature (pumped gasses/vapors) from 140°F, attach warning sign to the machine: "Warning, hot liquids and vapors/gasses"

WARNING

Danger zone:

Hot surface of shaft bearing.

Hazard

Burns/scalding.

Protective measures:

- Do not touch during operation.
- Allow to cool after shut-down.
- During mounting and removal, wear personal safety equipment (protective gloves)

Additional instructions

NOTE

Specific instructions are contained in the additional operating manual for special modules and, depending on the delivery scope of the machine (baseplate, mechanical seal, couplings, gear units, etc.) they are to be followed.

Intended Use / Application of the product

The NES Company Inc. liquid ring vacuum pumps are machines for generating a vacuum and gauge pressure.

When operating with NES liquid ring vacuum pumps, the limits listed in these operating instructions and the given specifications must always be complied with and taken into consideration.

Only qualified personnel are allowed to work with, on, or near the pumps.

It is prohibited to extract, deliver and compress explosive flammable, corrosive or toxic fluids unless the vacuum pump delivered is specifically designed for this purpose and/or to be used in rooms in which these conditions can occur.

Heavy duty pumps are able to serve a wide range of applications which can include paper machine de-watering, autoclaves, carburetor testing, chucking, condenser air removal, container filling, cooking, de-aerating, drying, exhausting, extruder venting, fiber setting, filtering, forming, ash handling, molding, pickup and conveying, priming, slot extraction, solvent recovery, etc.

Disposal

The main components of the machine consist of non-alloyed and/or alloyed iron and steel materials.

Some components (such as valve plates, seals, etc.) consists of non-metallic materials.

For exact information on the materials, see the cross-sectional drawing of the pump and the given specifications provided during the order stage.

Use this information to determine the necessary measures for disposal in accordance with the respective applicable local, regional, national, and global regulations.