EXPERT IN ENGINEERED

VACUUM SYSTEMS SINCE 1993

Performance. Reliability. Efficiency.

333 Rt 46 W

Building A,

Fairfield, NJ 07004

1-800-297-3550

www.nescompany.com

Operation & Maintenance Manual

for NTS Series Vacuum Pumps

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 LISTED ON THE BACK COVER OF THIS MANUAL. 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 Head Quarters: 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 gases of using corrosive liquid compress ant 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 the 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

Manual Index

List of Sections

1. General

1.1 Safety-related terms

The signal terms **DANGER**, **WARNING**, **CAUTION** and **NOTE** are used in these instructions to point out particular dangers or unusual information which must be particularly noted.

DANGER indicates that death and or substantial property damage will result if proper precautions are not taken.

WARNING indicates that severe personal injury and or substantial property damage will result if proper precautions are not taken.

CAUTION indicates that personal injury or property damage will result if proper precautions are not taken.

NOTE indicate special technical product information which may not be particularly obvious to qualified personnel and therefore needs to be highlighted.

It is equally imperative, however, to comply with other notes on transport, assembly, operation and maintenance not particularly emphasized, and with technical date (in the operating instruction, product documentation and on the machine itself) to avoid faults which, in turn, might directly or indirectly result in severe personal injury or property damage.

Qualified personnel are persons who, on account of their training, experience and instruction and their knowledge of relevant standards, specification, accident prevention regulations and operating conditions, have been authorized by those responsible for the safety of the plant to carry out the necessary work and who are able to recognize and avoid possible dangers.

Among other things, knowledge of first aid is also required, as is information about local rescue facilities.

WARNING!

The machines with the relevant drive motors consist of equipment for use in industrial systems including heavy current installation, depending on the operating condition, particularly where dangerous media may be used, improper handing could lead to severe personal injury or property damage.

Those responsible for safety of the installation must therefore ensure that

- Only qualified personnel are entrusted with work on the machines,
- These persons always have at their disposal the supplied operating instructions and other products documentation when doing such work, and they undertake to follow any such instructions constantly.
- Nonqualified personnel are not permitted to work on or near the machines.

1.2 General safety information

The machines described here are parts of installations for industrial applications and are designed in accordance with generally accepted engineering practice.

DANGER!

Owing to their functional characteristics, such equipment may cause serious personal injury or material damage when improperly used, wrongly operated, insufficiently serviced, or in the event of unauthorized interventions by unqualified personnel. This is particularly true of machines which involve the use or transport of high temperatures or pressure difference or of hazardous media.

WARNING!

It is presumed that basic planning work concerning the installation and all work regarding transport, assembly, commissioning, maintenance, and repair will be done by qualified personnel or checked by responsible skilled personnel. In doing so, noted must be taken of the following:

- The technical date and information concerning permissible use (assembling, connection, ambient and operating condition) contained, among other things, in the catalog, order document, operating instructions, data plate and other product documents,
- The general erection and safety regulations
- The Local, plant-specific specifications and requirements,
- The proper use of tools, hoisting gear and transport devices,
- The use of personal protective gear.

Operating instructions can't claim to cover all details of possible equipment variations, nor can they provide every possible example of installation, operation or maintenance. Accordingly, the instructions relating to machines for industrial applications normally only include the directions that need to be mentioned for qualified personnel (See above) where the equipment is used for its defined purpose.

If, in special cases, it is intended to use machines in nonindustrial areas, where requirements may be more stringent, compliance with such requirements must be assured during installation by providing additional protective measures on site.

If there are any uncertainties in this respect, particularly in the event of a lack of product-related information, clarification must be obtained visa our sales department. Please always indicate the machine type and serial number.

1.3 Transport

1.3.1 Unpacking and inspection on delivery

Unpack the pump/aggregate on delivery and inspect it for transport damage.

Report any transport damage to the NES Company immediately.

Dispose of packaging material according to local regulations.

1.3.2 Manual transport

CAUTION!

Risk of injuries caused by lifting heavy loads.

Observe the permissible weights for lifting and carrying machine components.

1.3.3 Transport with lifting gear

DANGER!

Risk of death or contusions from falling goods to be transported.

- Select lifting gear in accordance with the total weight to be transported.
- Transport the pump/aggregate in horizontal position only.
- Never suspend the pump/aggregate to the free shaft end or the ring lug of the motor.
- Attach the lifting gear in accordance with the following figures.
- Do not stand under suspended loads.

Please refer to Figures 1 and 2.

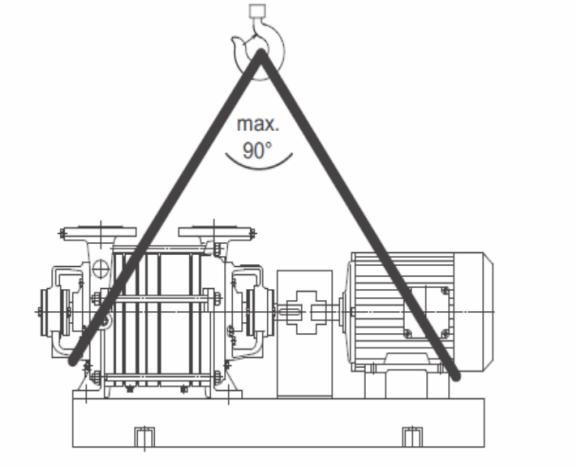

Fig. 1 Attaching lifting gear to the aggregate

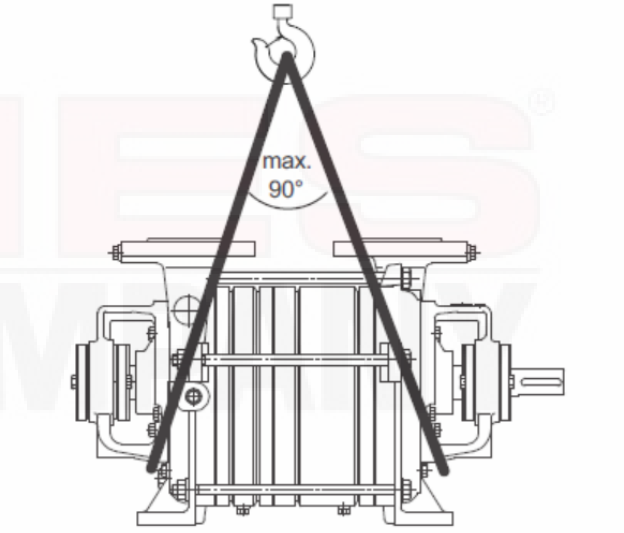

Fig. 2 Attaching lifting gear to the pump

1.4 Storage

If a machine is not put in operation immediately after arrival, store it in a dry, vibration-free room.

NOTE: If required by the material involved, the machines are protected with an anti-corrosion agent which permits them to be stored for approx. 3 months. If longer storage is envisaged, special anti-corrosion measures are generally necessary, e.g., drying the machine and sealing it in foil in which bags of silica gel have been inserted.

2. Description

2.1. Design and functional principle

The vacuum pump is operated in accordance with the liquid ring principle. The impeller is positioned eccentrically in the cylindrical pump casing and transfers centrifugal force to the seal liquid, which forms a ring that is concentric to the casing when the vacuum pump is started.

The gaseous medium remaining in the casing distributes around the impeller due to the lower density in the hub area. The available space for the gas between the surface of the liquid and the hub becomes crescent-shaped due to the aforementioned eccentricity.

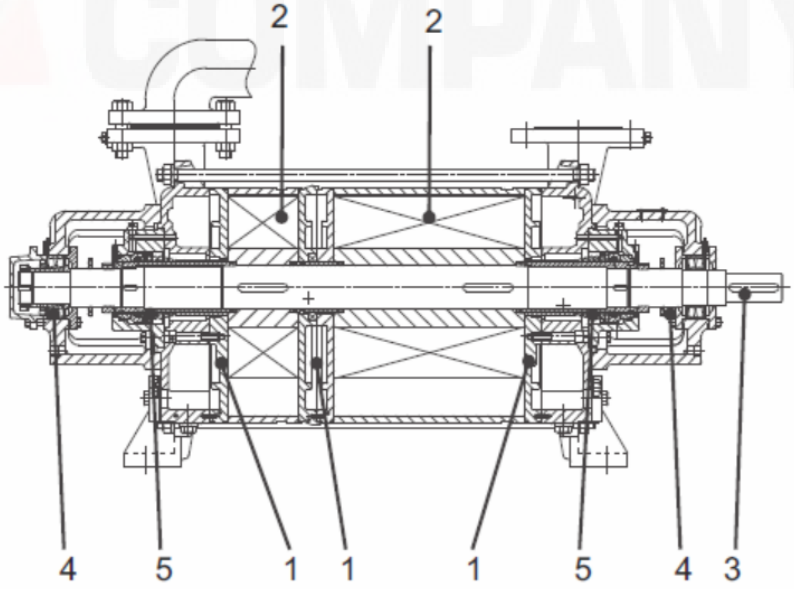

Fig. 3 A typical NTS series vacuum pump

1. Inter casings 2. Impeller 3. Motor/pump shaft 4. Rolling bearing 5. Mechanical seal

This way, the remaining space for the gas between the blade expands and shrinks during each rotation.

1. Suction opening
2. Pressure opening
3. Liquid ring

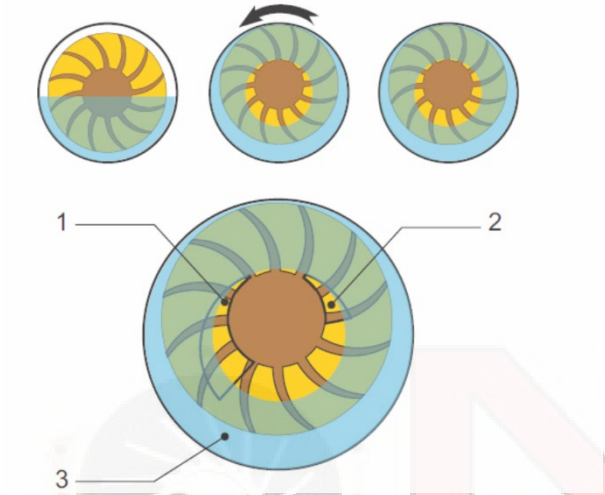

Fig. 4 Functional principle of liquid ring vacuum pumps

The arrangement of suction and pressure openings in the inter casing allows for the suction, compression and discharge of gas. The liquid both serves the sealing between the individual impeller chambers and the absorption of heat produced during compression. The vacuum pump must be permanently supplied with operating liquid during operation as a portion of the liquid continuously escapes from the pump together with the gas. The discharged operating liquid can be separated from the gas by means of a downstream separator and re-used.

Fig 4 shows the functional principle of liquid ring vacuum pump.

2.2 Shaft sealing

Mechanical seal

Mechanical seals play a critical role in preventing fluid leakage and ensuring the efficient operation of pumps, compressors, and other rotating equipment.

• Single-acting mechanical seal

In a single-acting mechanical seal, the primary sealing faces are pressed together by a spring or other means to create a seal. The seal is oriented to work efficiently in one direction of rotation.

• Double-acting mechanical seal

A double-acting mechanical seal is designed to provide sealing in both

directions of rotation. It offers effective sealing regardless of whether the equipment rotates clockwise or counterclockwise.

• Special seals

Special seals are designed to address specific operational challenges or unique requirements that may not be adequately handled by standard single-acting or double-acting seals. hey can include advanced features such as tandem seals, pressure-relief mechanisms, barrier fluids, and specific material combinations to handle extreme conditions like high temperatures, high pressures, aggressive chemicals, or abrasive fluids.

3. Set-up and connection

3.1.1 Checking Ambient Conditions

- Ensure that the necessary ambient conditions are being maintained for the installation.
- If the pump/aggregate is to be set up at an altitude exceeding 1000 m above sea level, it's advisable to consult the NES Company for guidance specific to this situation.

3.1.2 Preparing the Installation Site

- Confirm that the installation site fulfills the following criteria:
- The pump/aggregate can be accessed from all sides without obstruction.
- Adequate space is available to install and remove pipes, and for maintenance and repairs. This is especially important for tasks involving the pump/aggregate and motor installation or disassembly.
- Prevent the pump/aggregate from exposure to external vibrations to avoid potential bearing damage.
- Implement measures for frost protection, safeguarding the pump/aggregate from cold temperatures.

3.1.3 Preparing Foundation and Surface

Choose from the setup options available:

- With concrete foundation
- With steel foundation frame
- Without foundation

Ensure that the foundation and surface adhere to the following conditions:

- The foundation and surface are level.
- The area is free from contaminants such as oil or dust.
- The foundation's load carrying capacity accommodates both the aggregate's weight and operational forces.
- The foundation provides sufficient stability for the aggregate's setup.
- If using a concrete foundation, opt for standard concrete of strength class B 25.

3.2 Set-up with Foundation

Note that this setup option is only possible when using a base plate.

CAUTION!

Risk of material damage caused by distortion of the base plate.

Position and fix the base plate on the foundation as follows.

3.2.1 Positioning Aggregate on Foundation

Please ensure you have the necessary auxiliary tools, materials, and equipment:

- Foundation bolts
- Steel washers
- Non-shrinking mortar grout
- Spirit level

Use these items for placing the aggregate onto the foundation securely. Also, refer to Fig. 5 & 6 for setup drawing for with or without foundation.

1. Lift the aggregate

2. Hook the foundation bolts from below into the base plate fixing holes.

Observe the NES Company's specifications when using adhesive anchors.

3. Place the aggregate on the foundation.

Insert the foundation bolts into the provided anchoring holes.

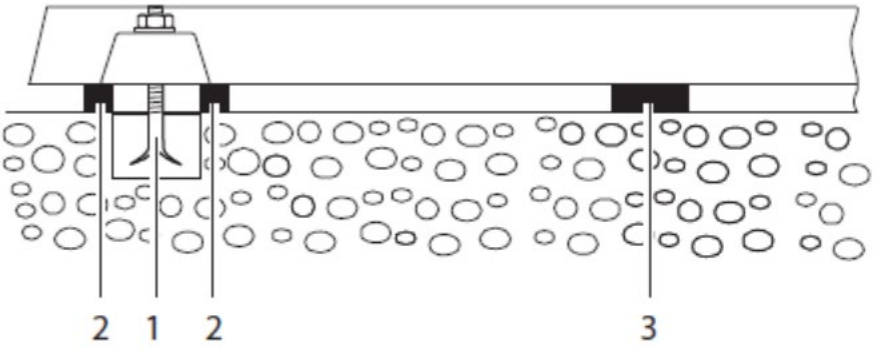

Fig. 5 Set-up with foundation

4. Use steel washers to align the aggregate to height and system dimensions as follows:

Place 1 steel washer (2) at the left- and right-hand side of each foundation bolt (1).

With >750 mm clearances between the anchoring holes, an additional steel washer (3) must be positioned in the middle of each side of the base plate.

5. Make sure the steel washers are in surface contact with the base plate.

6. Use the integrated spirit level to check whether the pump/aggregate is level end to end and side to side with a maximum allowable tilt of 1 mm/m.

7. Repeat this process until the base plate has been correctly aligned.

3.2.2 Fixing aggregate

Filling the base plate with mortar grout improves the dampening behavior.

1. Fill the anchoring holes with mortar grout.

2. When the mortar grout has set, bolt down the base plate with the specified torque at three points

3. Before tightening the remaining bolts, compensate for any unevenness in the surface using metal spacing shims next to each bolt.

4. Make sure the base plate is not distorted.

3.3 Set-up without foundation

With base plate

Please ensure you have the necessary auxiliary tools, materials, and equipment:

- wrench
- spirit level

Fig. 6 Set-up without foundation

1. Hexagon nut

2. Hexagon nut

3. Levelling foot

1. Lift the base plate with the aggregate

2. Mount the four levelling feet as illustrated.

3. Position the aggregate on the surface.

4. Adjust the base plate height by means of the levelling feet as illustrated above:

Use the wrench to hold the hexagon nut at the levelling foot (3).

Loosen the hexagon nut (1).

The height can be adjusted by turning the hexagon nut (2).

Tighten the hexagon nut (1)

Use the integrated spirit level to check whether the pump/aggregate is level end to end and side to side with a maximum allowable tilt of 1 mm/m.

Repeat this process until the base plate has been correctly aligned.

3.4 Set-up on torsion-resistant level surface/frame

This setup is possible with motor feet only.

Please ensure you have the necessary auxiliary tools, materials, and equipment:

- wrench
- Surface/frame

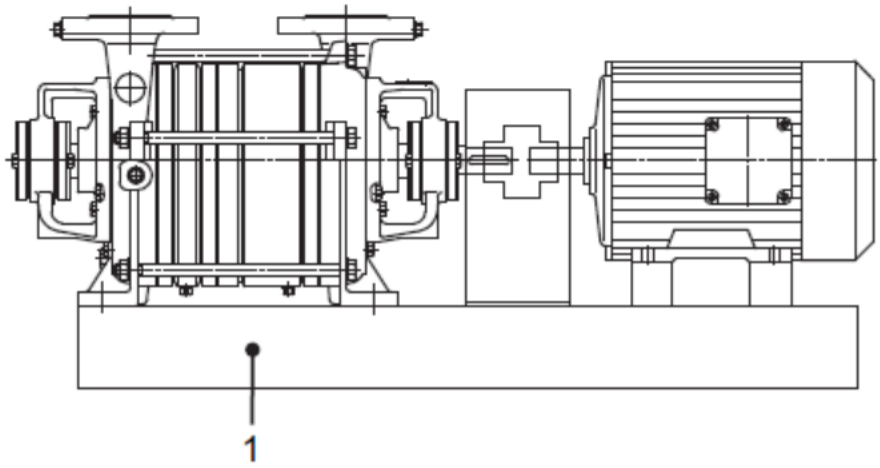

Fig. 7 Set-up on level surface/frame

1. Mount the motor feet as illustrated. Please see Fig. 7 for setup on level surface.

2. Position the aggregate on a torsion-resistant level surface/frame

3. Screw the aggregate to the surface/frame.

3.5 Motor installation

Only necessary if aggregate set-up is completed at the installation site.

CAUTION!

Risk of material damage caused by knocks and bumps.

►Do not tilt the coupling halves when slipping them on.

► Do not knock on or hit any pump components.

1. Apply a razor-thin layer of molybdenum disulfide (e.g. Molykote®) on the pump and motor shaft.

2. Insert fitting keys (if required).

3. Without mounting rig:

Remove the rubber buffers.

Heat the coupling halves to approx. 100 °C.

4. Slip on the pump and motor-side coupling halves until the shaft end is flush with the coupling hub.

Make sure to keep the required clearance between the coupling halves.

5. Tighten the grub screws on both coupling halves.

6. Lift the motor and put it down on the base plate.

7. Adjust the motor shaft to the height of the pump shaft using suitable shims for the motor.

8. Screw in and slightly tighten the motor screws

3.6 Planning pipe system

3.6.1 Dimensioning supports and connections.

CAUTION!

Risk of material damage if the pipes apply excessive forces and torques to the pump/aggregate!

1. Evaluate the piping forces and carefully consider various operating conditions, including:
   - Cold and warm conditions
   - Empty and filled states.
   - Depressurized and pressurized situations
   - Potential changes in position
2. Ensure that the pipe supports possess enduring low-friction characteristics and are resistant to corrosion-induced seizing.
3. If necessary, incorporate pipe compensators as needed.

3.6.3 Determining Pipe Lengths

1. When dimensioning the suction and pressure operating liquid pipes, aim for minimal lengths.
2. If employing extended suction, pressure, and operating liquid pipes, consider increasing their cross-sectional areas. *Note: The vertical or diagonal rise of the pressure pipe should not exceed 1 meter.*

3.6.4 Modifications in Cross-Section and Direction

1. Prevent radii of curvature less than 1.5 times the nominal pipe diameter.
2. Avert abrupt alterations in both cross-section and direction within the piping system.

3.6.5 Safety and control devices

3.6.5.1 Avoid contamination

1. Integrate low-resistance filters in the suction pipe.

2. Install a differential pressure gauge with contact manometer to monitor the contamination process.

3.6.5.2 Avoiding backflow

- Install a ball check valve between the suction pipe and the suction connection of the aggregate to prevent operating liquid from flowing back into the suction pipe after aggregate shutdown.

3.6.5.3 Provisions for isolating and shutting off pipes

For maintenance and repair works always provide for shut-off devices in the suction, pressure, and process water pipes.

3.6.5.4 Provisions for measuring operating conditions.

1. For pressure measuring: provide manometers in the suction and pressure pipe.

2. Provide for a power sensor at the motor side.

3.7 Connecting pipes

3.7.1 Providing clean piping.

CAUTION!

Risk of material damage caused by pump/aggregate contamination!

Make sure contamination does not enter the pump/aggregate.

1. Clean all piping parts and fittings prior to assembly.

2. Make sure no flange seals project inwards.

3. Make sure no sealing material (sealing tape, adhesive) project inwards.

4. Remove any blank flanges, plugs, protective foils and/or protective paint from the flanges.

3.7.2 Installing suction pipe.

1. Remove the transport and sealing covers from the pump/aggregate.

2. Avoid air pockets: lay out the pipes with a continuous slope down to the aggregate.

3. Make sure no seals project inwards.

4. Make sure no sealing material (sealing tape, adhesive) projects inwards.

5. Install a ball check valve in the suction pipe to prevent Operating liquid from flowing into the suction pipe at standstill.

3.7.3 Installing pressure pipe

1. Remove the transport and sealing covers from the pump/aggregate.

2. Install the pressure pipe

3. The pressure pipe must not rise more than 1 m vertically or diagonally upwards.

4. Avoid air pockets: lay out the pipes with a continuous slope from the aggregate.

5. Make sure no seals project inwards.

6. Make sure no sealing material (sealing tape, adhesive) project inwards.

3.8 Fine adjustment of coupling

CAUTION!

Risk of material damage caused by improper coupling adjustment!

► Accurately adjust the motor to the pump in case of height, lateral or angular offset.

► Accurately adjust the motor to the pump in case of height, lateral or angular offset.

3.8.1 Checking coupling adjustment

Please ensure you have the necessary auxiliary tools, materials, and equipment:

- Feeler gauge
- Straightedge
- Dial gauge (possible with couplings with spacer)

Other suitable tools, e.g. laser adjustment tool

1.Gauge

2. Straightedge

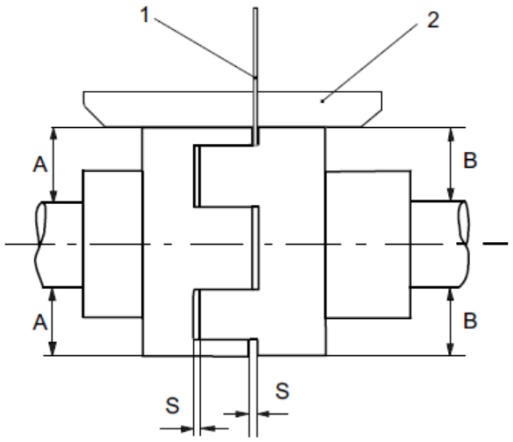

Fig. 8 Checking coupling adjustment.

Coupling protection has been disassembled.

1. Take the measurements at the circumference of the coupling in two planes with a 90° offset. Refer to Fig. 8 for checking coupling adjustment.

2. Check the light gap towards the outer diameter using a straightedge (1):

Position the straightedge over both coupling halves.

Adjust the motor if you detect a light gap at the outer diameter.

3. Check the gap size using a feeler gauge (2):

Permissible gap size

Use a feeler gauge to measure the gap (A) between the coupling halves.

If the measured gap size is impermissible, adjust the motor.

4. Install coupling protection.

3.9 Motor adjustment

1. Adjust the motor in a way which ensures that the coupling halves are accurately aligned and use adjustment shims if required.

2. Check the motor adjustment.

3. Repeat the adjustment process if height or angular offset have not yet been fully compensated.

4. Then, tighten the motor screws.

3.9.1 Motor connection

Observe the NES specifications for the motor.

1. Connect the motor in accordance with the circuit diagram.

2. Exclude any risk associated with electric power.

3. Install an Emergency-Stop button.

3.9.2 Checking direction of rotation

DANGER!

Risk of death from rotating parts

► Use protective equipment when carrying out any works on the aggregate.

► Keep an adequate distance to rotating parts.

CAUTION!

Risk of material damage caused by dry running or incorrect direction of rotation!

► Pump filled with operating liquid up to the middle of the shaft

1. Switch the aggregate on and immediately off again.

2. Check whether the direction of rotation of the motor is in accordance with the arrow indicating the direction of rotation on the aggregate.

Wrong direction of rotation may result in damage and escape of operating liquid at the mechanical seal.

RISK OF ELECTRIC SHOCK!

Risk of death from electric shock

► Any electrical works must be carried out by qualified electricians only.

► Observe the IEC 30364 (DIN VDE 0100) and for potentially explosive areas the IEC 60079 (DIN VDE 0165) standard

3. In case of deviating direction of rotation: Swap the two phases.

4. Operation:

4.1 Preparations for commissioning

4.1.1 Identifying pump type:

To identify the specific pump/aggregate type, consider various factors such as the materials used in construction, suction capacity, type of shaft sealing, and any auxiliary operating systems in place. Different pump types include centrifugal pumps, positive displacement pumps, vacuum pumps, and more, each with distinct characteristics for various applications.

4.1.2 Removing Preserving Agent:

The step of removing the preserving agent is only necessary for treated pumps, where the NES Company applies a protective agent to prevent corrosion during storage and transportation.

4.1.3 Checking Shut-down Period:

For shut-down periods longer than one year, it is advised to contact the NES company to inquire about the necessary measures to ensure the pump's proper functioning after such extended inactivity.

For shut-down periods shorter than one year, follow all steps required for commissioning the pump.

4.1.4 Filling:

To fill the pump with operating liquid, follow these steps:

1. Remove the screw plug from port UV.
2. Fill the pump with operating liquid, ensuring it reaches a level up to the middle of the shaft.
3. Stop the filling process when the operating liquid starts to escape from port UV.
4. Screw the screw plug back into port UV to secure it.
5. Open the fitting at the suction side.
6. Open the fitting at the pressure side.
7. Verify that all ports and connections are tight and secure.

4.2 Commissioning

4.2.1 Switch-on:

The aggregate has been set up and connected correctly. The motor is properly connected, and the coupling adjustment has been checked. All connections are stress-free and effectively sealed. If available, auxiliary operating systems are ready for operation. All safety devices have been installed and checked for proper functioning. The pump/aggregate has been appropriately prepared, filled, and is ready for use.

1. Open the fitting on the pressure side.
2. If a ventilation port is available, open the fitting.
3. Turn on the motor.
4. Open the fitting for the operating liquid.
5. Open the fitting on the suction side.
6. If a ventilation port is available, close the fitting once the motor reaches its nominal speed.
7. Ensure the aggregate exhibits smooth running behavior.
8. Check the aggregate and connections for tightness.

DANGER!

Risk of injuries caused by running aggregate!

► Do not touch the running aggregate.

► Do not carry out any works on the running aggregate

RISK OF ELECTRIC SHOCK

Risk of death from electric shock!

► Any electrical works must be carried out by qualified electricians only.

CAUTION!

Risk of cavitation when throttling down the suction flow!

Risk of cavitation when the fitting in the suction pipe is closed!

► Completely open the fitting at the suction side and do not use it for controlling the flow rate.

► Open the fitting at the pressure side.

WARNING!

Risk of injuries caused by vacuum or harmful media to be pumped and operating liquid!

Use protective equipment when carrying out any works on the pump/aggregate.

CAUTION!

Risk of material damage caused by dry running!

► Make sure the pump has been properly filled.

CAUTION!

Risk of material damage caused by a closed pressure pipe!

► Do not operate the aggregate when the fitting at the pressure side is closed.

► Observe the

max. permissible operating limits

max. permissible pressure difference

max. permissible compression pressure

max. permissible operating liquid temperature

max. permissible operating liquid viscosity

max. permissible operating liquid density

max. permissible temperature of the medium to be pumped

4.2.2 Switch-off

1. Close the fitting for the operating liquid.
2. Turn off the motor.
3. If a ventilation port is available, open the fitting.
4. Check all connecting screws and tighten if necessary (only after the initial commissioning).

4.3 Setting the operating liquid flow rate

4.3.1 Continuous-flow cooling

- Switch on the aggregate.
- Set the pressure in the operating liquid pipe to max. 0.2 bar overpressure. Please see Fig. 9 for continuous-flow cooling.

WARNING!

Risk of injuries caused by vacuum or harmful media to be pumped and operating liquid!

Use protective equipment when carrying out any works on the aggregate.

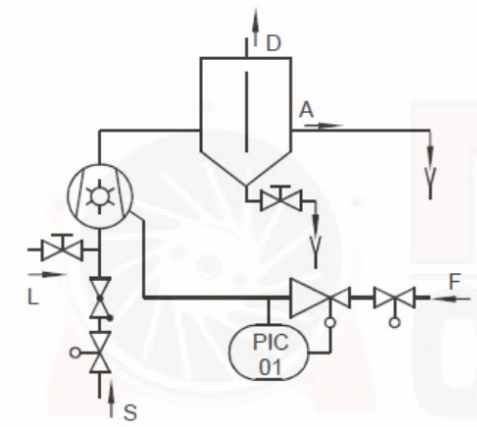

Fig. 9 Continuous-flow cooling

4.3.2 Open circulation cooling

- Switch on the aggregate.
- Set the pressure in the operating liquid pipe to max. 0.2 bar overpressure (Please see diagram Fig. 10, 11, 12)
- Observe the permissible operating liquid temperature

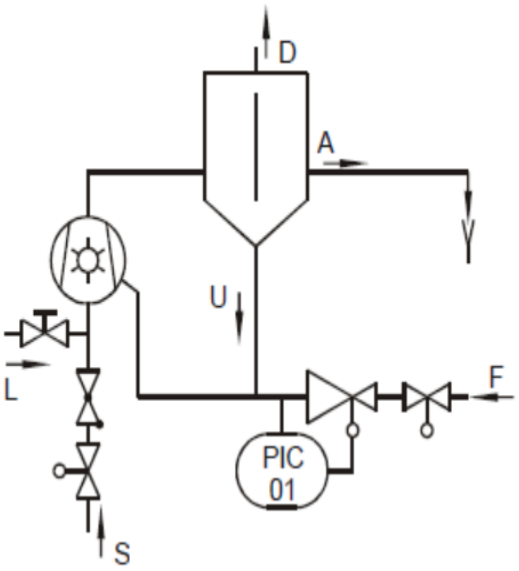

Fig. 10 Open circulation cooling

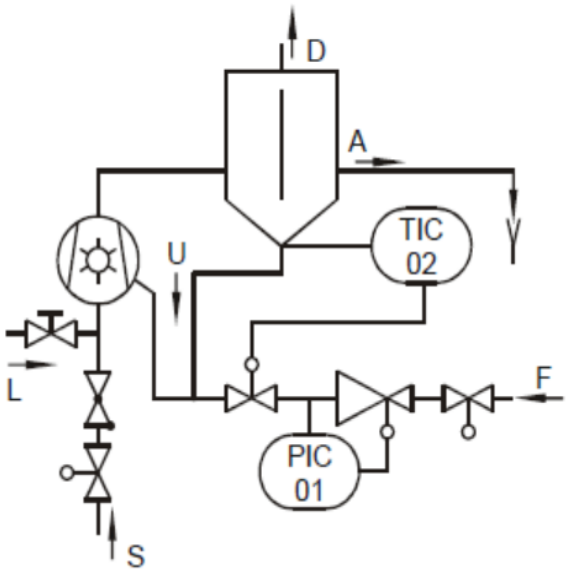

Fig. 11 Open circulation cooling with temperature control

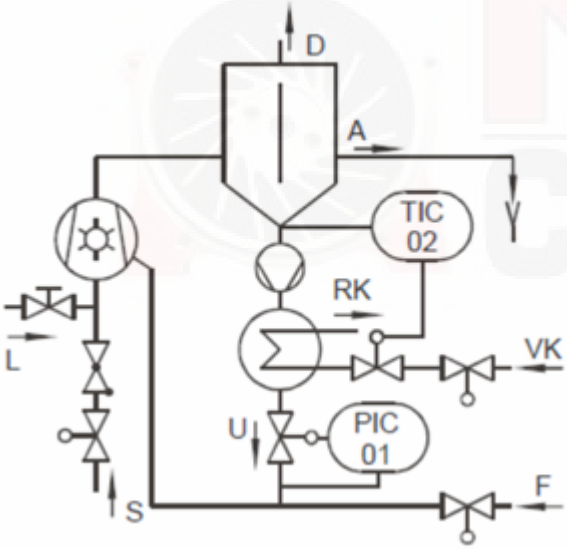

Fig. 12 Closed circulation cooling

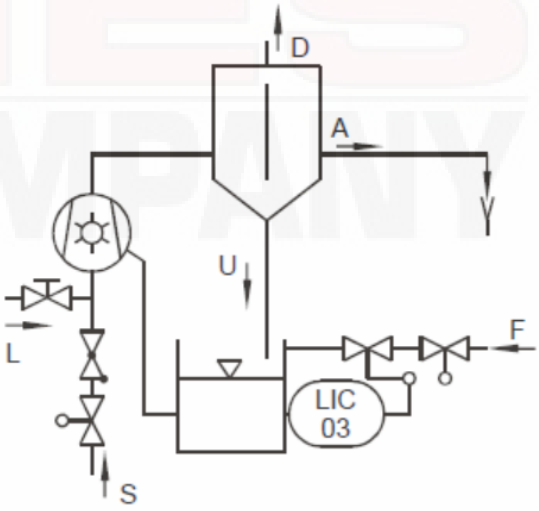

Fig. 13 Open circulation cooling with controlled liquid feed

4.3.3 Closed circulation cooling

- Switch on the aggregate.
- Set the pressure in the operating liquid pipe to a value which is 0.1 bar smaller than the compression pressure (Diagram Fig. 13)
- Observe the permissible operating liquid temperature.

Table 1 is the legend for the symbols.

Pos.	Meaning	Pos.	Meaning
S	Suction connection	VK	Feed-in cooling agent
L	Ventilation port	RK	Return cooling agent
D	Pressure connection	TIC	Temperature
A	Overflow	PIC	Pressure
U	Circulation liquid	LIC	Filling level
F	Fresh liquid		

Table. 1 Legend of symbol

4.4 Decommissioning

Implement the following measures when taking the pump/aggregate out of operation:

Implement the following measures when taking the pump/aggregate out of operation. Please see the Tab. 2 & 3 below.

WARNING!

Risk of injuries caused by vacuum or harmful media to be pumped and operating liquid!

Use protective equipment when carrying out any works on the pump/aggregate.

Reliably collect escaping media to be pumped and dispose of in an environmentally friendly way.

Pump/ aggregate is	Measure
shut down while remaining ready for operation	►Shortly operate (approx. 5 minutes) the aggregate at intervals of at least one month but not exceeding 3 months
shut down for a longer period of time	► Implement measures in accordance with the condition of the operating liquid
drained	►Close all fittings.
disassembled	►Disconnect the motor from the power supply and secure it against unauthorized switch-on.
stored	►Observe the measures to be implemented for storage

Tab. 2 Measures to be taken when putting the pump out of service.

Operating liquid	Duration of shut-down (process-dependent)	
	Short	Long
Water	► Drain pump/aggregate and separator	► Drain pump/aggregate and separator. ► Treat pump/ aggregate with a reserving agent
Other media		► Drain pump/aggregate and separator. ► Treat pump/aggregate with a reserving agent

Tab. 3 Measures depending on the behavior of the operating liquid.

4.5 Re-commissioning

Shut-down periods > 1 year:

1. Prepare commissioning.
2. Perform commissioning procedures.
3. Monitor the aggregate following commissioning.

4.6 Operating stand-by aggregate

Stand-by aggregate filled.

Operate the stand-by aggregate at least once per week.

5.Maintenance and servicing

A qualified service team provides support for assembly and repair works. Provide a certificate documenting the safety of the media to be pumped.

5.1 Monitoring

Risk of Electric Shock!

Death from electric shock

- Any electrical works must be carried out by qualified electricians only.
- Observe the IEC 30364 (DIN VDE 0100) and for potentially explosive areas the IEC 60079 (DIN VDE 0165) standard

DANGER!

Risk of injuries caused by running aggregate!

Do not touch the running aggregate.

Do not carry out any works on the running aggregate

WARNING!

Risk of injuries caused by vacuum and harmful media to be pumped and operating liquid.

Use protective equipment when carrying out any works on the aggregate.

1. Check at appropriate intervals:

- deposits on aggregate and separator (if available)
- compliance with the operating liquid flow rate
- compliance with the operating liquid temperature
- compliance with the max. permissible compression pressure
- compliance with the limit values applicable to the delivery of liquids
- power consumption of the drive
- contamination of the drive
- contamination of filters (if available)
- running noise of the rolling bearings (motors)
- normal operating conditions unchanged

2. For trouble-free operation, ensure the following:

- no dry running
- tightness
- no cavitation
- open gate valves at the suction side
- free and clean filters
- no unusual running noise or vibrations
- no impermissible leaks at the shaft sealing
- proper functioning of the auxiliary operating systems (if available)

3. Check shaft sealing:
Mechanical seals are maintenance-free sealing systems.
In case of leaks: Have the mechanical seal with auxiliary seals replaced by service staff or the NES Company. Check auxiliary operating systems (if available) for proper functioning.

The lubrication intervals apply to bearing temperatures of up to 158°F. Temperature rises of 59°F require lubrication at half intervals.

Type	Interval [hrs]	Amount of lubricant per bearing [Oz]
NTS500/600	2000	0.282

Tab. 4: Lubrication intervals for rolling bearings.

5.2 Lubrication intervals for rolling bearings

Pump types NTS 110–400 are equipped with maintenance-free rolling bearings (sealed deep groove ball bearings).
Pump types NTS 500– 600 are equipped with rolling bearings which should be maintained in regular intervals. Refer to Tab. 4 for lubrication intervals.

5.3 Disassembly

5.3.1 Disassembly of NTS 140/180

Cross-sectional drawing NTS 140–180
The pump has been removed from the system and is positioned in a clean and level assembly area.
1. Disassembly of pipes
Loosen the hexagon nuts (920/920.1), remove the pipes (700/700.1) and seals (400).
2. Disassembly of bearing housing on the suction casing (drive side)
Remove the fitting key (940) from the pump shaft (211).
Loosen the hexagon head screws (901.1) on the bearing housing (330), pull the bearing housing with the
ball bearing (320) off the pump shaft (211).
3. Disassembly of mechanical seal (RU 1)
Loosen the hexagon head screws (901.1) on the shaft sealing casing (441).

Pull the shaft sealing casing (441) and the rotating unit of the mechanical seal (047) off the pump shaft (211).

4. Disassembly of bearing housing on the discharge casing (non-drive side)

Loosen the hexagon head screws (901.1) and take off the bearing cover (360.1).

Loosen the lock washer (931.1) and the shaft nut (921) and pull them off.

Loosen the hexagon head screws (901.1) and pull the bearing housing (330) with the rolling bearing (320) off the pump shaft (211).

5. Disassembly of mechanical seal (RU 2)

Loosen the hexagon head screws (901.1) and pull the casing for the shaft sealing (441) off the pump shaft (211).

Pull the rotating unit of the mechanical seal (047.1) off the pump shaft (211).

6. Disassembly of suction casing

Rotate the pump 90° (drive side pointing up).

Loosen the hexagon nuts (920.1), remove the nuts and casing bolts (563).

Remove the suction casing (106).

7. Disassembly of stage casing and pump shaft

Remove the stage casing (110).

Remove the pump shaft (211) with the impeller (230).

Remove the pump shaft (211) with the inter casings (137.1/137.2) and impellers (230/230.1).

Remove the stage casing (110.1).

8. Disassembly of impeller and pump shaft

Loosen the shaft nut (922) and the lock washer (931) at the drive side and, together with the impeller (230), pull them off the pump shaft (211).

Remove the fitting key (940.1) from the pump shaft (211).

Pull the inter casings (137.1/137.2) jointly off the shaft sleeve (523).

Pull the impeller (230.1) and the shaft sealing (523) off the pump shaft.

Pull the fitting key (940.1), the shaft nut (922) and the lock washer (931) off the pump shaft (211).

9. Disassembly of mechanical seal (SU 1/2)

Push stationary units of the mechanical seals (047/047.1) out of the shaft sealing casings (441).

10. Disassembly of inter casing of the suction/discharge casing

Loosen the hexagon socket head screw (914) in the suction/discharge casing (106/107).

Remove the inter casing (137/137.3) from the suction/ discharge casing (106/107).

Separate the inter casings (137.1/137.2) in the center.

Remove the packing gland (461) from the inter casing (137.1).

5.3.2 Disassembly of NTS 300/350/400

Cross-sectional drawing NTS 300/350/400

The pump has been removed from the system and is positioned in a clean and level assembly area.

1. Disassembly of pipes

Loosen the hexagon nuts (920), remove the pipes (700) with hexagon head screws (901) and seals (400.1).

2. Disassembly of bearing housing on suction casing (drive side)

Remove the fitting key (940.1) from the pump shaft (211).

Loosen the hexagon head screws (901.3), pull the bearing housing (330) with the rolling bearing (320) off the pump shaft (211).

Pull off the splash ring (507).

3. Disassembly of mechanical seal (RU 1)

Loosen the hexagon head screws (901.2). Pull the shaft sealing casing (441) and the rotating unit of the mechanical seal (047) off the pump shaft (211).

Pull off the spacer sleeve (525).

4. Disassembly of bearing housing on discharge casing (non-drive side)

Loosen the hexagon head screws (901.1). Pull the bearing cover (360.1) off the pump shaft (211).

Loosen the lock washer (931.1) and the shaft nut (921) and pull them off.

5. Disassembly of mechanical seal (RU 1)

Loosen the hexagon head screws (901.2), pull the shaft sealing casing (441) and the rotating unit of the mechanical seal (047.1) off the pump shaft (211).

Pull off the spacer sleeve (525).

6. Disassembly of suction casing

Rotate the pump 90° (drive side pointing up).

Loosen the nuts (920/920.1), remove the nuts and the casing bolts (563).

Remove the suction casing (106).

7. Disassembly of stage casing and pump shaft

Remove the stage casing (110).

Remove the pump shaft (211) with the impeller (230).

Remove the pump shaft (211) with the inter casings (137.1/137.2) and impellers (230/230.1).

Remove the stage casing (110.1).

8. Disassembly of impeller and pump shaft

Loosen and remove the shaft nut (922) and the lock washer (931) at the drive side.

Pull the impeller (230) off the shaft.

Remove the fitting key (940) from the pump shaft (211).

Pull the inter casings (137.1/137.2) jointly off the shaft protection sleeve (523).

Pull the impeller (230.1) and the shaft protection seal (5 23) off the pump shaft (211).

Pull the fitting key (940.1), the lock washer (931) and the impeller nut (922) off the pump shaft (211).

9. Disassembly of mechanical seal (SU 1/2)

Push the stationary units of the mechanical seal (047/047.1) out of the shaft sealing casings (441).

10. Disassembly of inter casing of suction/discharge casing

Loosen the hexagon socket head screw (900/900.1) on the suction/discharge casing (106/107).

Remove the inter casing (137/137.3) from the suction/discharge casing (106/107).

Separate the central inter casings (137.2/137.1).

5.3.3 Disassembly of NTS500/600

Cross-sectional drawing NTS 500 - 600

The pump has been removed from the system and is positioned in a clean and level assembly area.

1. Disassembly of pipes

Loosen the hexagon nuts (920), remove the pipes (700/700.1), the hexagon head screws (901) and the seals (400.1).

2. Disassembly of bearing housing on suction casing (drive side)

Remove the fitting key (940) from the pump shaft (211).

Loosen the hexagon head screws (901.2/901.4), pull the bearing housing (330) with the rolling bearing (320) off the pump shaft.

Pull off the splash ring.

3. Disassembly of mechanical seal (RU1)

Loosen the hexagon head screws (901.1/901.2). Pull the shaft sealing casing (441) and the rotating unit of the mechanical seal (047) off the pump shaft.

Pull off the spacer sleeve (525).

4. Disassembly of bearing housing on discharge casing (non-drive side)

Loosen the hexagon head screws (901.1).

Remove the bearing cover (360.2).

Loosen the lock washer (931.1) and the shaft nut (921.1) on the pump shaft (211) and pull them off.

Pull off the ring (500.1).

Loosen and pull the withdrawal sleeve (531) off the pump shaft by tightening the supplied shaft nut (921).

Loosen the screws (901.2/901.4), pull off the bearing housing (330) with the rolling bearing (320.1) and the ring (500).

Pull off the splash ring (507).

5. Disassembly of mechanical seal (RU2)

Loosen the hexagon head screws (901.1/901.2), pull the shaft sealing casing (441) and the rotating unit of the mechanical seal (047.1) off the pump shaft (211).

Pull off the spacer sleeve (525).

6. Disassembly of suction casing

Rotate the pump 90° (drive side pointing up).

Loosen the nuts (920/920.1), remove the nuts and the casing bolts (563).

Remove the suction casing (106).

7. Disassembly of stage casing and pump shaft

Remove the stage casing (110)

Remove the pump shaft (211) with the impeller (230)

Remove the pump shaft (211) with the inter casings (137.1/137.2) and impellers (230/230.1).

Remove the stage casing (110.1).

8. Disassembly of impeller and pump shaft

Loosen and remove the impeller nut (922) and the lock washer (931) at the drive side.

Pull the shaft protection sleeve (524) and the impeller (230) off the pump shaft (211).

Remove the fitting key (940) from the pump shaft.

Pull the inter casings (137.1/137.2) jointly off the shaft protection sleeve (524.1).

Pull the impeller (230.1) and the shaft protection seal (524.1) off the pump shaft.

Pull the fitting key (940), the lock washer (931) and the impeller nut (922) off the pump shaft (211).

9. Disassembly of mechanical seal (SU 1/2)

Push stationary units of the mechanical seals (047/047.1) out of the shaft sealing casings (441).

10. Disassembly of inter casing of the suction/discharge casing

Loosen the hexagon socket head screw (914) in the suction/discharge casing (106/107).

Remove the inter casing (137/137.1) from the suction/ discharge casing (106/107).

Separate the central inter casings (137.1/137.2)

Remove the packing gland (461) from the inter casing (137.2).

5.4 Assembly

5.4.1 Assembly of NTS140/180

Cross-sectional drawing NTS 140 – 180

1. Assembly of inter casings on suction/discharge casing

Adjust the inter casing (137) (marks) and force it into the suction casing (106).

Adjust the inter casing (137.3) (marks) and force it into the discharge casing (107).

Screw hexagon socket head screws (914) through the suction/discharge casing into the inter casings (137/137.3) and fasten them.

Insert the packing gland (461) into the inter casing (137.1)

Adjust the inter casings (137.1/137.2) (mark), deflect and compress them.

2. Assembly of impeller and pump shaft

Push the lock washer (931) onto the non-drive side of the pump shaft.

Screw the impeller nut (922) onto the pump shaft (211).

Insert the fitting key (940.1) into the pump shaft.

Vertically clamp the pump shaft (211) with the drive side pointing up.

Push the impeller (230.1) onto the pump shaft (211).

The impeller blades must be tilted in the direction of rotation.

Push the shaft sleeve (523) onto the pump shaft (211).

Push the inter casings (137.1/137.2) jointly over the shaft sleeve (523).

Insert the fitting key (940.1) into the pump shaft.

Push the impeller (230) onto the pump shaft.

The impeller blades must be tilted in the direction of rotation.

Push the lock washer (931) onto the pump shaft.

Screw the impeller nut (922) onto the pump shaft (211).

Set the impellers in accordance with adjustment dimension L by turning the impeller nuts.

Following the setting procedure, secure the impeller nuts (922) using lock washers (931).

3. Assembly of stage casing and pump shaft

Horizontally clamp the discharge casing (107) (inter casing on top).

Adjust the inter casing (110.1) (marks) and compress it into the suction casing (137.3).

Insert the complete pump shaft (211, drive side pointing up) into the discharge casing (107).

Adjust the inter casings (marks), put them down on the stage casing (110.1).

Force the stage casing (110) into the inter casing (137.1).

4. Assembly of suction casing

Adjust the suction casing (106) (marks) and force it onto the stage casing (110).

Secure the casing bolts (563). Slightly fasten them with hexagon nuts (920.1).

5. Assembly of mechanical seal (drive side)

Moisten the auxiliary seal of the rotating unit (047) with lubricant (grease containing PTFE).
Push the rotating unit (047) onto the pump shaft (211) by a screwing movement in the sense of winding of the spring.
Moisten the auxiliary seal of the stationary unit with lubricant (alcohol, water).
Manually press the stationary unit (047) into the shaft sealing casing (411).
Adjust the shaft sealing casing (441) (observe the flushing channel), force it into the suction casing (106) and fasten it to the suction casing (106) by means of hexagon head screws (901.1).
6. Assembly of bearing housing on the suction casing (drive side)
Force the bearing cover (360.2) into the bearing housing (330) and adjust it, fasten with hexagon head screws (901.1).
Push the bearing housing (330) over the pump shaft (211), force it into the suction casing (106) and fasten with hexagon head screws (901.1).
Press the rolling bearing (320) onto the pump shaft (211).
Force the bearing cover (360) into the bearing housing (330), adjust it and fasten with hexagon head screws (901.2).
Insert the fitting key (940) into the pump shaft.
7. Assembly of mechanical seal (non-drive side)
Rotate the pump 180° (drive side pointing down).
Moisten the auxiliary seal of the rotating unit (047.1) with lubricant (grease containing PTFE).
Push the rotating unit (047.1) onto the pump shaft (211) by a screwing movement in the sense of winding of the spring.
Moisten the auxiliary seal of the stationary unit with lubricant (alcohol, water).
Manually press the stationary unit (047.1) into the shaft sealing casing (411).
Adjust the shaft sealing casing (441) (observe the flushing channel), force it into the discharge casing (107) and fasten it to the discharge casing (106) with hexagon head screws (901.1).
8. Assembly of bearing housing on the discharge casing (non-drive side)
Force the bearing cover (360.2) into the bearing housing (330) and adjust it, fasten with hexagon head screws (901.1).
Force the bearing housing (330) into the discharge casing (107) and fasten with hexagon head screws (901.1).
Press the rolling bearing (320) onto the pump shaft (211).
Push the lock washer (931.1) onto the pump shaft.
Screw the shaft nut (921) onto the pump shaft, fasten and secure with lock washer (931.1).

Force the bearing cover (360.1) into the bearing housing (330), adjust it and slightly fasten with hexagon head screws (901.1).

9. Pump adjustment

Rotate the pump 90° (horizontal position).

Adjust the pump on level ground.

Tighten the casing bolts (563) and hexagon nuts (920.1) crosswise.

10. Set the impeller position (non-drive side)

Loosen the hexagon head screws (901.1) on the bearing cover (360.2).

Fasten the hexagon head screws (901.1) on the bearing cover (360.1) until the impeller is in contact with the inter casing (suction casing).

Start the gauge at the front (drive side) of the pump shaft.

Loosen the hexagon head screws (901.1) on the bearing cover (360.1).

Fasten the hexagon head screws (901.1) on the bearing cover (360.2) until the impeller is in contact with the inter casing (discharge casing).

Halve the determined measure X and adjust the pump shaft/impeller by half the measure X (towards drive side).

Fasten the pump shaft/impeller in this position by evenly tightening the hexagon head screws (901.1) on the bearing covers (360.1/360.2).

Verify unobstructed movement of the pump. Manually rotate the pump shaft.

11. Pipe assembly

Put the seals (400) and pipes (700) onto the suction/ discharge flanges, fasten them with hexagon head screws (901) and hexagon nuts (920).

5.4.2 Assembly of NTS 300/350/400

Cross-sectional drawing NTS 300/350/400

Assembly of inter casings on suction/discharge casing.

Adjust the inter casing (137) (marks) and compress it into the suction casing (106).

Adjust the inter casing (137.3) (marks) and compress it into the discharge casing (107).

Screw hexagon socket head screws (914) through the suction/discharge casing into the inter casings (137/137.3) and fasten them.

Adjust the inter casings (137.1/137.2) (mark), deflect and compress them.

3. Assembly of impeller and pump shaft

Push the lock washer (931) onto the non-drive side of the pump shaft.

Screw the impeller nut (922) onto the pump shaft (211).

Insert the fitting key (940.1) into the pump shaft.

Vertically clamp the pump shaft with the drive side pointing up.

Push the impeller (230.1) onto the pump shaft.

The impeller blades must be tilted in the direction of rotation.

Push the shaft sleeve (523) onto the pump shaft.

Push the inter casings (137.1/137.2) jointly over the shaft sleeve (523).

Insert the fitting key (940.1) into the pump shaft.

Push the impeller (230) onto the pump shaft.

The impeller blades must be tilted in the direction of rotation.

Push the lock washer (931) onto the pump shaft.

Screw the impeller nut (922) onto the pump shaft.

Set the impellers in accordance with adjustment dimension L by turning the impeller nuts.

Following the setting process, secure the impeller nuts (922) using lock washers (931).

4. Assembly of stage casing and pump shaft

Horizontally clamp the discharge casing (107) (inter casing on top).

Force the stage casing (110.1) into the inter casing (137.3).

Insert the complete pump shaft (drive side pointing up) into the discharge casing (107).

Adjust the inter casings (marks), force them onto the stage casing (110.1) and put them down.

Force the stage casing (110) into the inter casing (137.1).

5. Assembly of suction casing

Adjust the suction casing (106) (marks) and force it onto the stage casing (110).

Secure the casing bolts (563). Slightly fasten them with hexagon nuts (920.1

6. Assembly of mechanical seal (drive side)

Moisten the auxiliary seal of the rotating unit (047) with lubricant (grease containing PTFE).
Push the rotating unit (047) onto the pump shaft (211) by a screwing movement in the sense of winding of the spring.
Moisten the auxiliary seal of the stationary unit with lubricant (alcohol, water).
Manually press the stationary unit (047) into the shaft sealing casing (411).
Adjust the shaft sealing casing (441) (observe the flushing channel), force it into the suction casing (106) and fasten it with hexagon head screws (901.1).
Push the splash ring (507) onto the pump shaft.
7. Assembly of bearing housing on suction casing (drive side)
Force the bearing cover (360.2) into the bearing housing (330) and adjust it, fasten with hexagon head screws (901.1).
Push the bearing housing (330) over the pump shaft (211), force it into the suction casing (106) and fasten with hexagon head screws (901.1).
Press the ball bearing (320) onto the pump shaft.
Force the bearing cover (360) into the bearing housing (330), adjust it and fasten with hexagon head screws (901.2).
Insert the fitting key (940) into the pump shaft.
8. Assembly of mechanical seal (non-drive side)
Rotate the pump 180° (drive side pointing down).
Moisten the auxiliary seal of the rotating unit (047.1) with lubricant (grease containing PTFE).
Push the rotating unit (047.1) onto the pump shaft (211) by a screwing movement in the sense of winding of the spring.
Moisten the auxiliary seal of the stationary unit with lubricant (alcohol, water).
Manually press the stationary unit (047.1) into the shaft sealing casing (411).
Adjust the shaft sealing casing (441) (observe the flushing channel), force it into the discharge casing (107) and fasten it with hexagon head screws (901.1).
9. Assembly of bearing housing on the discharge casing (non-drive side)
Force the bearing cover (360.2) into the bearing housing (330) and adjust it, fasten with hexagon head screws (901.1).
Force the bearing housing (330) into the discharge casing (107) and fasten with hexagon head screws (901.1).
Push the ring (500.1) onto the pump shaft (211).
Press the rolling bearing (320) onto the pump shaft (211).
Push the lock washer (931.1) onto the pump shaft (211).
Screw the shaft nut (921) onto the pump shaft (211), fasten and secure with lock washer (931.1).
10. Pump adjustment

Position the pump horizontally and adjust it on level ground.

Tighten the casing bolts (563) and hexagon nuts (920.1) crosswise.

11. Set the impeller position (non-drive side)

Loosen the hexagon head screws (901.1) on the bearing cover (360.2).

Fasten the hexagon head screws (901.1) on the bearing cover (360.1) until the impeller is in contact with the inter casing (suction casing).

Start the gauge at the front (drive side) of the pump shaft.

Loosen the hexagon head screws (901.1) on the bearing cover (360.1).

Fasten the hexagon head screws (901.1) on the bearing cover (360.2) until the impeller is in contact with the inter casing (discharge casing).

Halve the determined measure X and adjust the pump shaft/impeller by half the measure X (towards drive side).

Fasten the pump shaft/impeller in this position by evenly tightening the hexagon head screws (901.1) on the bearing covers (360.1/360.2).

Verify unobstructed movement of the pump. Manually rotate the pump shaft.

12. Pipe assembly

Put the seals (400) and pipes (700) onto the suction/ discharge flange. Fasten them with hexagon head.

5.4.3 Assembly of NTS 500/600

Cross-sectional drawing NTS 500/600

1. Assembly of inter casings to suction/discharge casing

Adjust the inter casing (137) (marks) and force it into the suction casing (106).

Adjust the inter casing (137.3) (marks) and force it into the discharge casing (107).

Screw hexagon socket head screws (914) through the suction/discharge casing into the inter casings and fasten them.

Insert the packing gland (461) into the inter casing (137.2).

Adjust the inter casings (137.1/137.2) (mark), deflect and compress them.

2.Assembly of impeller and pump shaft

Insert fitting keys (940/940.1) into the pump shaft (211) (non-drive side).

Insert an O-ring (412) into the groove of the shaft protection sleeve (524).

Push the shaft protection sleeve (524) and the lock washer (931) onto the pump shaft.

Screw the impeller nut (922) onto the pump shaft.

Vertically clamp the pump shaft with the drive side pointing up.

Push the impeller (230.1) onto the pump shaft.

The impeller blades must be tilted in the direction of rotation.

Insert O-rings (412) into the grooves of the shaft protection sleeve (524.1).

Push the shaft protection sleeve (524.1) onto the pump shaft.

Push the inter casings (137.1/137.2) jointly over the shaft protection sleeve (523) .
Insert the fitting key (940) into the pump shaft.
Push the impeller (230) onto the pump shaft.
The impeller blades must be tilted in the direction of rotation.
Insert the fitting key (940.1) into the pump shaft.
Insert an O-ring (412) into the groove of the shaft protection sleeve (524).
Push the shaft protection sleeve and the lock washer (93 1) onto the pump shaft.
Screw the impeller nut (922) onto the pump shaft.
Set the impellers in accordance with adjustment dimension L by turning the impeller nuts.
Following the setting process, fasten the impeller nuts and secure them with the lock washers.
3. Assembly of stage casing and pump shaft
Horizontally clamp the discharge casing (107) (inter casing on top).
Force the stage casing (110.1) into the inter casing (137.3).
Insert the complete pump shaft (drive side pointing up) into the discharge casing (107).
Adjust the inter casings (137.2/137.1) (marks), force them onto the stage casing (110.1) and put them down.
Force the stage casing (110) into the inter casing (137.1).
4. Assembly of suction casing
Adjust the suction casing (106) (marks) and force it onto the stage casing (110).
Secure the casing bolts (563). Fasten them with hexagon nuts slightly (920.1)
5. Assembly of mechanical seal (drive side)
Push the spacer sleeve (525) onto the shaft protection sleeve (524).
Moisten the auxiliary seal of the rotating unit (047) with lubricant (grease containing PTFE).
Push the rotating unit (047) onto the shaft protection sleeve (524) by a screwing movement in the sense of winding of the spring.
Moisten the auxiliary seal of the stationary unit with lubricant (alcohol, water).
Push the stationary unit (047) into the shaft sealing casing (411).
Adjust the shaft sealing casing (441) (observe the flushing channel), force it into the suction casing (106)an d fasten it with hexagon head screws (901.1).
Push the splash ring (507) onto the pump shaft.
6. Assembly of bearing housing on suction casing (drive side)
Force the bearing cover (360.2) into the bearing housing (330), adjust and fasten it to the bearing housing by means of hexagon head screws (901.1).

Push the bearing housing over the pump shaft (211), force it into the suction casing (106) and fasten with hexagon head screws (901.4).

Lubricate the rolling bearing (320) and press it onto the pump shaft.

Force the bearing cover (360) into the bearing housing, adjust it and fasten with hexagon head screws (901.1).

Insert the fitting key (940) into the pump shaft.

7. Assembly of mechanical seal (non-drive side)

Rotate the pump 180° (drive side pointing down).

Push the spacer sleeve (525) onto the shaft protection sleeve (524).

Moisten the auxiliary seal of the rotating unit (047.1) with lubricant (grease containing PTFE).

Push the rotating unit (047.1) onto the shaft protection sleeve (524) by a screwing movement in the sense of winding of the spring.

Moisten the auxiliary seal of the stationary unit with lubricant (alcohol, water).

Push the stationary unit (047.1) into the shaft sealing casing (411).

Adjust the shaft sealing casing (observe the flushing channel), force it into the discharge casing (107) and fasten with hexagon head screws (901.1).

Push the splash ring (507) onto the pump shaft.

8. Assembly of bearing housing on discharge casing (non-drive side).

Force the bearing cover (360.2) into the bearing housing (330), adjust it and fasten with hexagon head screws (901.1).

Force the bearing housing into the discharge casing (107) and fasten with hexagon head screws (901.4).

Push the ring (500) onto the pump shaft.

Lubricate the rolling bearing (320.1) and press-fit into the bearing housing.

Push the withdrawal sleeve (531), the ring (500.1) and the lock washer (931.1) onto the pump shaft.

Screw on the shaft nut (921.1), provide for an appropriate bearing clearance and secure the shaft nut with a lock washer (931.1).

Force the bearing cover (360.2) into the bearing housing, adjust it and slightly fasten with hexagon head screws (901.3).

9. Pump adjustment

Position the pump horizontally and adjust it on level ground.

Tighten the casing bolts (563) and hexagon nuts (920.1) crosswise.

10. Set the impeller position (non-drive side)

Loosen the hexagon head screws (901.3) on the bearing cover (360.3).

Fasten the hexagon head screws (901.3) on the bearing cover (360.2) until the impeller is in contact with the inter casing (suction casing).

Start the gauge at the front (drive side) of the pump shaft.
Loosen the hexagon head screws (901.3) on the bearing cover (360.2).
Fasten the hexagon head screws (901.3) on the bearing cover (360.1) until the impeller is in contact with the inter casing (discharge casing).
Halve the determined measure X and adjust the pump shaft/impeller by half the measure X (towards drive side).
Fasten the pump shaft/impeller in this position by evenly tightening the hexagon head screws (901.3) on the bearing covers (360.1/360.2).
Verify unobstructed movement of the pump. Manually rotate the pump shaft.
11. Pipe assembly
Put the seals (400) and pipes (700) onto the suction/discharge flange. Fasten with hexagon head screws (901) and hexagon nuts (920).

5. Troubleshooting:

Defect	Cause	Rectification
Motor does not start	Motor	
	One phase of the power supply is interrupted	► Check the power supply, check the motor
	Two phases of the power supply are interrupted	► Check the power supply
	The motor protection switch has tripped	► Switch on the motor protection switch
	The motor is blocked	► Check the motor
	Pump is blocked	
	Impeller/inter casing is subject to corrosion	► Use rust remover to overcome the blockage of the pump
	Ice inside the pump (solidified operating liquid)	► Carefully heat up and defrost the pump
	Contaminations or foreign bodies inside the pump	► Flush/disassemble the pump, clean it
	Pump calcification	► Descale the pump
	Blocked/defective impeller	► Provide for a correct gap size of the inner casing/impeller or replace
	Defective motor bearing	► Replace the motor bearing
Motor protection triggered	Motor overload	► Check/reduce the operating liquid flow rate
	Excessive backpressure in the outlet nozzle	► Reduce backpressure
	Excessive share of liquid in the suction flow	► Reduce the share of liquid
	Density/viscosity of the operating liquid is too high	► Use an operating liquid complying with the density recommended in the data sheet. Contact NES Company.
	Impeller rubs against the inter casing	► Disassemble the pump, properly set the inner casing/impeller gap size
	Pump contamination/calcification	► Flush/descale/disassemble the pump, clean it
Vacuum pump does not produce vacuum	Lacking operating liquid	► Check the operating liquid supply
	Leak in the suction pipe	► Check/seal the suction pipe and connections
	Wrong direction of rotation of the motor	► Check direction of rotation/swap the 2 phases if need be
Insufficient vacuum	Leak in the system	►Check the system, seal leaking spots
	Excessive operating liquid flow rate	►Reduce operating liquid flow rate
	Insufficient operating liquid flow rate	►Increase operating liquid flow rate
	Operating liquid too hot	►Cool down the operating liquid

	Leak in the suction pipe	►Check/seal the suction pipe and connections
	Wrong direction of rotation of the motor	► Check direction of rotation/swap the 2 phases if need be
	Motor speed is too low	►Increase speed, contact the NES Company
	Gas or liquid channels subject to calcification	►Descale/disassemble the pump, clean
	Internal components are subject to wear	►Replace the affected components
	Worn-out control valve	►Replace the control valve
	Worn-out shaft sealing	►Replace the shaft sealing
	Amount of drained liquid too small	► Provide for free drainage of the liquid and ensure that the connections are not obstructed
	Pump has not been correctly dimensioned	► Replace the pump
Strange noise	Pump cavitation	► Install an anti-cavitation valve or ► Equip the suction pipe with a ventilation valve
	Excessive share of steam in the suction flow	► Reduce the share of steam or provide for condensation upstream the vacuum pump
	Suction-side fitting is closed (excessive inlet pressure)	► Open the suction-side fitting or provide for cavitation protection
	Excessive operating liquid flow rate	►Reduce operating liquid flow rate
	Excessive speed	►Reduce speed, contact the NES Company
Leak in the vacuum pump	Defective shaft sealing	► Replace the shaft sealing
	Defective casing sealing	► Provide the vacuum pump with new sealing
	Worn-out casing components	► Replace the affected components
	Loosened connecting screws/screw plugs	► Tighten the screws, replace the sealing
Vacuum pump does not run smooth	Excessive operating liquid flow rate	►Reduce operating liquid flow rate
	Overload in the pipe system	►Check the pipe connections/pump fixation/bearing clearance of the pipe clamps
	Air pocket in the pipe	► Change the pipe system layout
	Vacuum pump distorted/improperly adjusted	► Check adjustment/re-adjust
	Resonance vibrations in the pipe system	► Check the pipe connections and, if required, use a compensator
	Imbalanced impeller	► Balance/replace impeller
	Deposits on the impeller	► Clean/replace impeller
	Defective vacuum pumps or motor bearing	► Replace vacuum pumps or motor bearing

Tab. 5 Troubleshooting

7. Technical data

7.1 Operating limits

Operating limits encompass the following parameters, setting boundaries for safe and effective pump operation:

1. **Inlet Pressure:** This refers to the maximum pressure at which the pump's inlet can handle the incoming fluid. Exceeding this limit could lead to damage or inefficient operation.
2. **Compression Pressure:** This limit indicates the maximum pressure the pump can generate within its system. Operating beyond this value might strain the pump's components or compromise its performance.
3. **Pressure Difference:** Also known as differential pressure, it signifies the range between the inlet and outlet pressures. Staying within this range ensures proper flow and prevents undue stress on the pump.
4. **Medium to be Pumped:** This pertains to the specific fluid or substance the pump is designed to handle. Deviating from the intended medium could lead to compatibility issues or reduced efficiency.
5. **Operating Liquid:** This involves the fluid used for the pump's operation. Using the correct operating liquid is essential for maintaining lubrication, cooling, and overall performance.
6. **Speed:** The speed indicates how fast the pump's components are moving. Operating at speeds beyond the specified limit might result in wear, inefficiency, or even catastrophic failure.

7. **Switching Frequency:** This parameter defines how often the pump cycles on and off. Operating outside the recommended switching frequency might affect the pump's reliability and longevity.

Adhering to these operating limits is crucial for preventing premature wear, avoiding breakdowns, and ensuring the pump operates within a safe and effective range. Please refer to Tab. 6 & 7 for operating limits range of various NTS pumps.

Pressure	PSIA	Operating liquid		
Min. inlet pressure	0.478625	Temperature	[°F]	
Perm. compression pressure	21.75566		Max.	212
Perm. pressure difference			Min.	14
	Max.	21.75566	Density	[lb/ft3]
	Min.	2.90075475	Max.	74.9135527
Medium to be pumped			Viscosity	[mm2/s]
Temperature	[°C]		Max.	90
	Dry	392	Speed	[min-1]
	Saturated	212	Max.	1750

Tab. 6 Operating limits NTS 110/140/180

Pressure	PSIA	Operating liquid		
Min. inlet pressure	0.478625	Temperature	[°F]	
Perm. compression pressure	21.75566		Max.	176
Perm. pressure difference			Min.	14
	Max.	21.75566	Density	[lb/ft3]
	Min.	2.90075475	Max.	74.9135527
Medium to be pumped			Viscosity	[mm2/s]
Temperature	[°C]		Max.	90
	Dry	392	Speed	[min-1]
	Saturated	212	Max.	1750

Tab. 7 Operating limits NTS 300/350/400/500/600

7.1.1 Media to be pumped

• Dry and wet gases which are not explosive, inflammable, aggressive or toxic.

• Air or air-steam mixtures which are free of solids and contain small amounts of light particulate matter.

7.1.2 Operating liquid

Water having a pH value of 6 to 9, free of solids.

For other pH values or operating liquids,

please consult the NES company.

7.1.3 Switching frequency.

The max. switching frequency of 20 switching cycles per hour should not be exceeded.

7.2 General technical data

The following data refer to standard values.

For deviating data,

please consult the NES Company.

The weight and drive power of various NTS series pumps are given in Tab. 8 & 9 respectively.

7.2.1 Weight

Type	Weight [lb.]
NTS 140	169.756
NTS 180	189.598
NTS 300	306.443
NTS 350	332.898
NTS 400	359.353
NTS 500	473.994
NTS 600	529.109

Tab. 8 Weight list

7.2.2 Drive power

Type	Rated motor power [HP]		Rated motor speed [min-1]		Direction of rotation as seen from the drive
	50 Hz	60 Hz	50 Hz	60 Hz	
NTS 140	5.36409	7.37562	1450	1750	clockwise
NTS 180	7.37562	10.0577	1450	1750	clockwise
NTS 300	10.0577	14.7512	1450	1750	clockwise
NTS 350	14.7512	20.1153	1450	1750	clockwise
NTS 400	20.1153	29.5025	1450	1750	clockwise
NTS 500	20.1153	29.5025	1450	1750	clockwise
NTS 600	24.80891	40.2307	1450	1750	clockwise

Tab. 9 Drive power

7.2.3.1 Flow rate

7.2.3.2 Delivery of liquids

Maximum permissible delivery of water via the inlet nozzle. Refer to Tab. 10 for filling volume of the operating liquid.

7.2.3.3 Filling volume

Type	Flow rate [GPM] 2.96 inches of HgA/ 60°F	Max. liquid delivery [GPM]	Filling volume up to middle of the shaft [l]
NTS 140	3.963	3.96252	1.45295
NTS 180	4.41214	4.4028	1.8492
NTS 300	12.10036	13.2084	2.37755
NTS 350	13.21	13.2084	2.64172
NTS 400	13.21	13.2084	3.17006
NTS 500	11.889	11.88756	4.22675
NTS 600	11.889	11.88756	5.01927

Tab. 10 Filling volume

7.2.5 Operating connections

Please refer to Tab. 11 for operating connections.

Type	Process water connection		Suction connection		Pressure connection	
	Size	Shape	Size (inches)	Shape	Size (inches)	Shape
NTS 140/180	G ½"	Thread	1 1/2	Flange	1 1/2	Flange
NTS 300/350/400	G 1"	Thread	2	Flange	2	Flange
NTS 500/600	G 1"	Thread	2 1/2	Flange	2 1/2	Flange

Tab. 11 Operating connections

7.2.6 Ambient conditions

Please refer to Tab. 12 for ambient condiyions and any operation under other ambient conditions must be agreed with the NES Company.

Temperature [°F]	Relative humidity [%]		Set up altitude above sea level
	Long-term	Short-term	
+41 to + 104	≤ 85	≤ 100	≤ 1000

Tab. 12 Ambient conditions

7.2.6 Lubricants

Tab. 13 provides the amount of lubricant required.

Pump type	Amount of lubricant per bearing [oz]
NTS 500/600	0.282192

Tab. 13 Lubricants

8. Cross-sectional drawing

8.1 Cross-sectional drawing NTS 140– 400

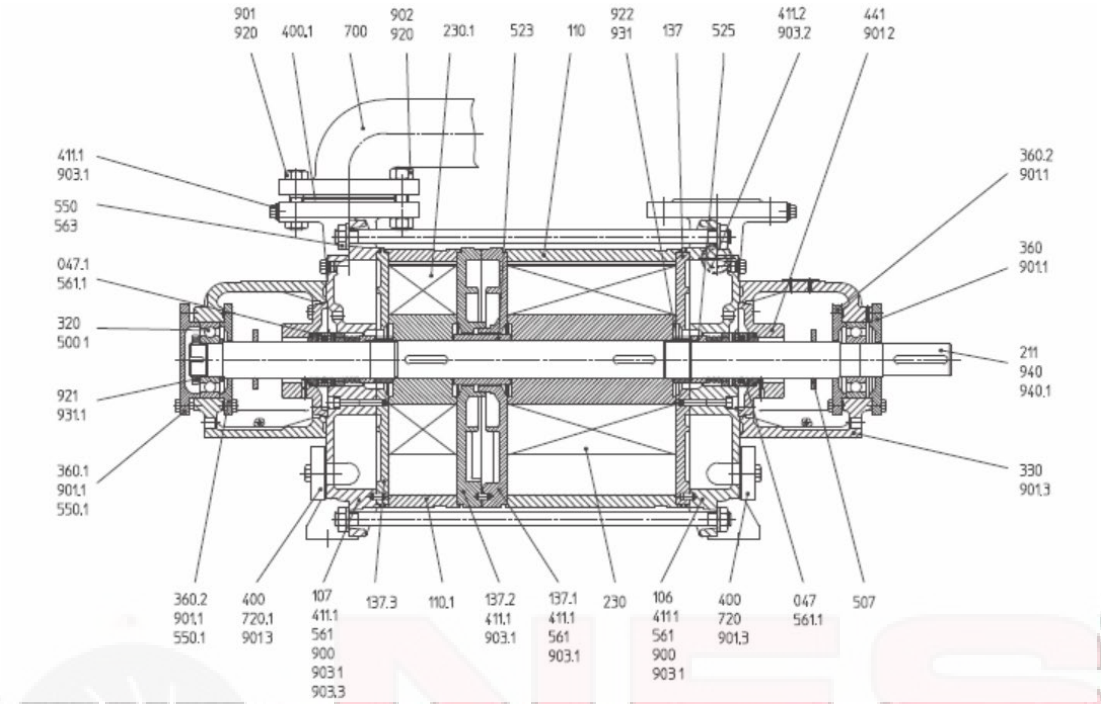

Fig. 14 Cross-sectional drawing NTS 140-400

No.	Designation	No.	Designation	No.	Designation
047/.1	Mechanical seal	400/.1	Sealing	700	Pipe
106	Suction casing	411.1/.2	Sealing ring	720/.1	Counter flange
107	Discharge casing	441	Shaft sealing casing	900	Hexagon socket head screw
110/.1	Stage casing	500/.1	Ring	901-.3	Hexagon head screw
137-.3	Inter casing	507	Splash ring	902	Stud bolt
211	Shaft	523	Spacer sleeve	903.1-.3	Screw plug
230/.1	Impeller	525	Spacer sleeve	920	Hexagon nut
320	Rolling bearing	550/.1	Disc	921	Shaft nut
330	Bearing housing	561/.1	Cylindrical pin	922	Impeller nut
360.-2	Bearing cover	563	Casing bolt	931/.1	Lock washer
				940/.1	Fitting key

Tab. 14 Parts list NTS 140-400

8.2 Cross-sectional drawing NTS 500 –600

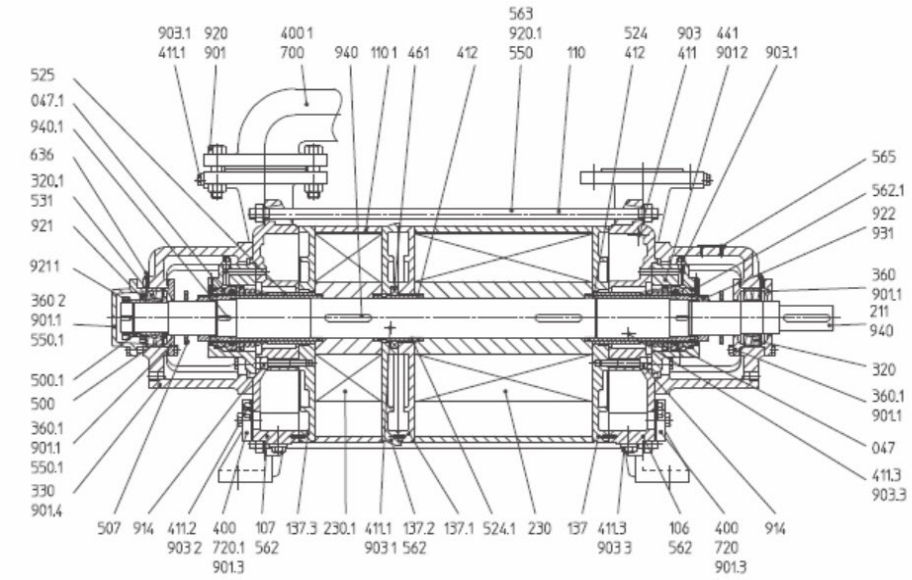

Fig. 15 Cross-sectional drawing NTS 500-600

No.	Designation	No.	Designation	No.	Designation
047/.1	Mechanical seal	411-.3	Sealing ring	565	Riveted bolt
106	Suction casing	412	O-ring	636	Lubrication nipple
107	Discharge casing	441	Shaft sealing casing	700	Pipe
110/.1	Stage casing	461	Packing gland	720/.1	Counter flange
137-.3	Inter casing	500/.1	Ring	901-.4	Hexagon head screw
211	Shaft	507	Splash ring	903-.3	Screw plug
230/.1	Impeller	524/.1	Shaft protection sleeve	914	Hexagon socket head screw
320/.1	Rolling bearing	525	Spacer sleeve	920/.1	Hexagon nut
330	Bearing housing	531	Withdrawal sleeve	921/.1	Shaft nut
360.-2	Bearing cover	550/.1	Disc	922	Impeller nut
400/.1	Sealing	562/.1	Cylindrical pin	931	Lock washer
		563	Casing bolt	940/.1	Fitting key

Tab. 15 Parts list NTS 500-600

Important Notice!

For exported orders, we carry out 100% performance testing for all pumps, then fill anti-corrosive oil to protect the pump. But after transport for extended periods of time, there may still be some corrosion on the pump. Before starting the pump, please turn the pump manually to remove some of the corrosion, and then start the pump.

We fill grease for bearing lubrication in each pump, but after some time in operation, the grease will be due for changing. The grease consumption time may fluctuate according to actual operating environment and conditions; please inspect the grease regularly to avoid damage to the bearings.

We thank you for your cooperation. Please enjoy the ease of use and ease of mind that comes with an NES Company vacuum pump!