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333 Rt 46 W

Building A,

Fairfield, NJ 07004

1-800-297-3550

www.nescompany.com

Operation & Maintenance Manual for NP Series Vacuum Pumps & Compressors

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 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 has become crumbly 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.

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Section 1 - INTRODUCTION

1.1 HOW THE UNIT WORKS

The pump consists of essential components like a rotor and shaft assembly driven by an external motor. Within the pump's casing, a chamber is formed where the rotor operates. Figure 1.1 depicts the primary functional components of the NES NP Series vacuum pump. Liquid compressant, usually water, enters this chamber through an inlet at the head and cone of the pump. As the rotor turns, it causes the liquid compressant to rotate as well. This rotational motion of the liquid serves two main purposes: compressing the gas inside the pump and acting as a seal to prevent gas leakage. The mixture of compressed gas and liquid compressant is then discharged through the pump's outlet. Additionally, the liquid compressant plays a crucial role in dissipating heat generated during the compression process. The pump's design, with an offset axis for the body casing compared to the rotor, enables these operations to occur in sequence as illustrated in Figure 1.2 of the manual.

The NES NP Series Vacuum Pumps and Compressors utilize a rotating liquid compressant (typically water) to compress gas, seal against leakage, and remove heat, facilitated by a carefully engineered offset design for efficient performance.

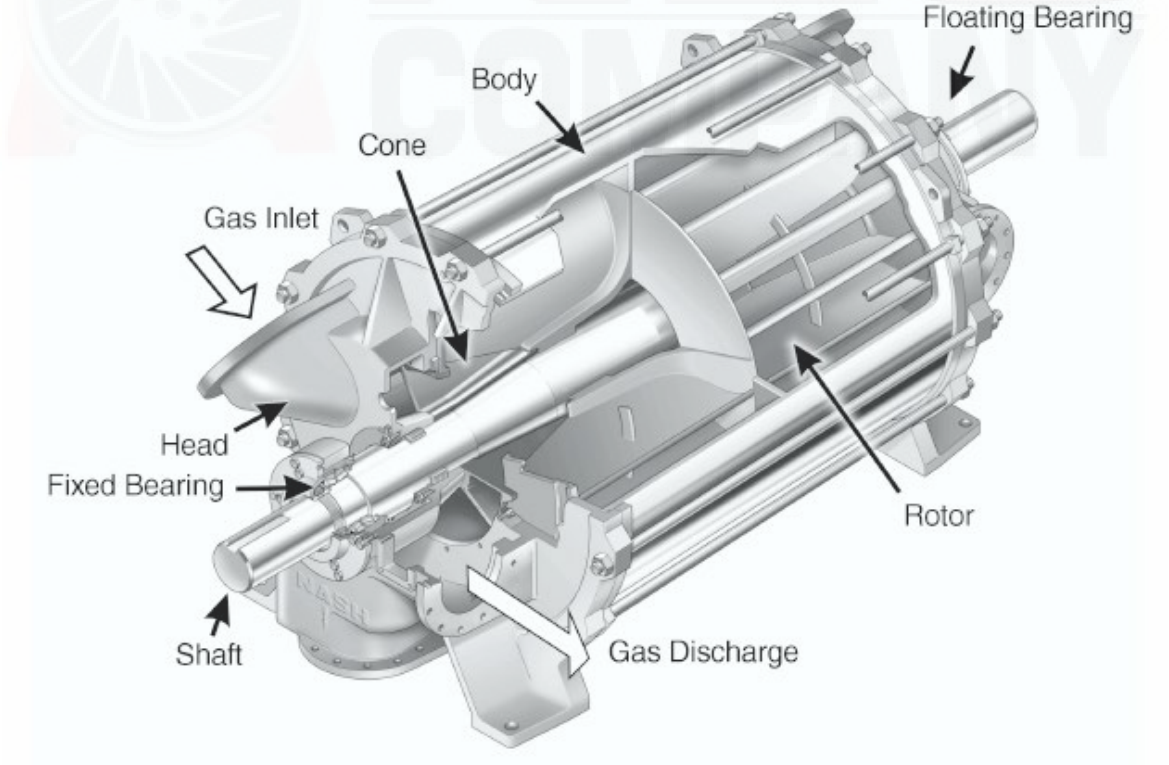


Fig. 1.1 Functional Elements of NES NP Vacuum Pump

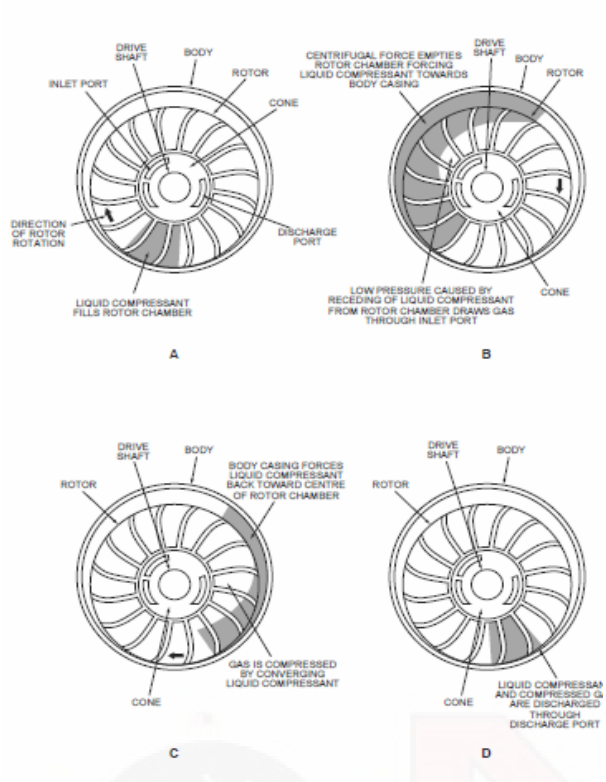


Fig. 1.2 Liquid Compressant and Air Flow

Section 2. Installation

2.1 UNCRATING

a. Verify all components against the provided shipping list for the pump. Conduct a thorough inspection of the pump to detect any potential shipping-related damage. Promptly report any shortages or damages to the local carrier's representative.

b. Pumps and their drive motors are typically shipped from the factory mounted on a base. Coupling halves are separated or V-belts are removed to prevent damage during transit. Parts of the coupling assembly are usually packaged in a bag attached to the shaft under the coupling guard or in a separate container, depending on the coupling size and type. V-belts and other accessories are generally packed in a separate container attached to the pump shipping crate. Ensure that coupling assembly parts, V-belts, and other accessories are properly identified and stored securely until they are ready to be installed on the pump. This precaution helps to prevent loss or damage.

c. When handling the pump, lift it evenly using the four lifting lugs provided on the pump body, as indicated in Figure 2-1. Carefully select chains and hooks of appropriate size to ensure that the pump weight does not exceed the lifting apparatus's load rating.

NOTE

ENSURE THAT ALL COUPLING ASSEMBLY PARTS, V-BELTS, AND ADDITIONAL ACCESSORIES ARE PROPERLY IDENTIFIED AND SAFELY STORED UNTIL THEY ARE READY TO BE INSTALLED ON THE PUMP. THIS PRECAUTION AIMS TO AVOID ANY POTENTIAL LOSS OR DAMAGE.

d. Upon receipt, the shaft of the driver (motor, gear reducer, turbine, etc.) will not be aligned with the pump shaft. Properly align the pump when the base is leveled and securely mounted to its permanent foundation, and all pipe connections to the pump have been completed. NES Engineering Company does not provide this alignment service unless specifically requested for a NES Field Service Technician.

e. If the pump and driver are not going to be installed and operated promptly after receipt, store them in a clean, dry location. Rotate the pump shaft every two weeks to ensure the bearings are coated with lubricant, which helps to prevent oxidation and corrosion. Although the pump is flushed with preservative oil before shipment, refer to Section 6.6 of the manual for specific storage procedures.

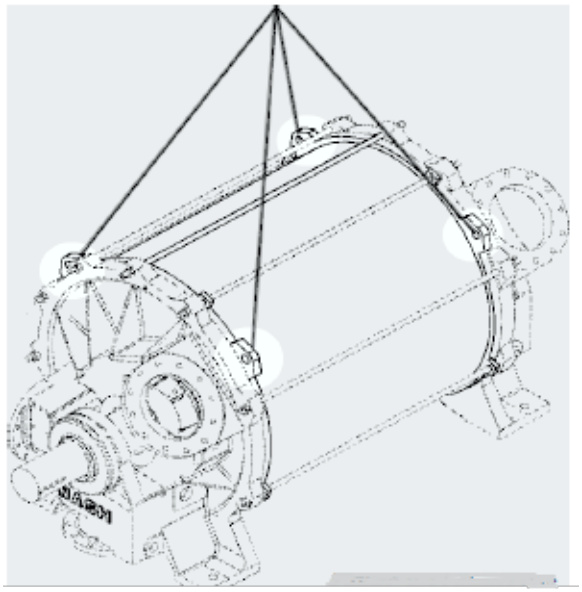


Fig 2.1- Lifting Lugs

Section 3 - SERVICES REQUIRED

NOTE

THE PUMP IS SHIPPED WITH THREAD OR FLANGE PROTECTORS INSTALLED ON ALL OPEN CONNECTION POINTS TO SAFEGUARD AGAINST DAMAGE. BEFORE MAKING ANY PIPING CONNECTIONS, ENSURE THESE PROTECTORS ARE REMOVED. FOR SPECIFIC PIPING REQUIREMENTS, REFER TO THE NES INSTALLATION DRAWING(S) PROVIDED WITH YOUR UNIT.

3.1 PIPING

Piping should be connected to the pump without exerting any strain. Pipe strain on pump castings can lead to difficult-to-diagnose issues once the pump is in operation. These issues can include coupling misalignment, internal part friction, and reduced mechanical seal or bearing life. Therefore, piping should be installed so that it connects to the pump without any need for springing or pulling. No strain from the piping should be transmitted to the pump. The suction and discharge piping should be supported near the pump, with allowances for expansion, to prevent strain from pipe expansion, bending, or twisting forces.

3.1.1 INLET PIPING

3.1.1.1 Connections

Please refer to Fig. 3.2 for vacuum pumps and Fig. 3.3 for compressors. Connect the vacuum pump inlets directly to the process at full size. Similarly, connect the compressor inlets either directly to the process at full size or to the atmosphere if the compressor is being utilized as an air compressor. bypass line and valve sizes.

When connecting two inlets together, use a manifold to increase to a larger pipe size. If the piping run exceeds 30 feet (9 meters), upgrade to the next larger pipe size for the entire length.

NOTE

A flexible connection for the inlet piping is recommended to eliminate piping strain and facilitate removal and testing. Refer to Figure 3.1

3.1.1.2 Inlet Screen & Dirt Pockets

Temporary inlet screens are provided with all pumps. Figures 3-2 and 3-3 illustrate piping installation examples that allow for the cleaning of these temporary inlet screens before their removal. Additionally, these configurations utilize dirt pockets to ensure continuous protection during operation.

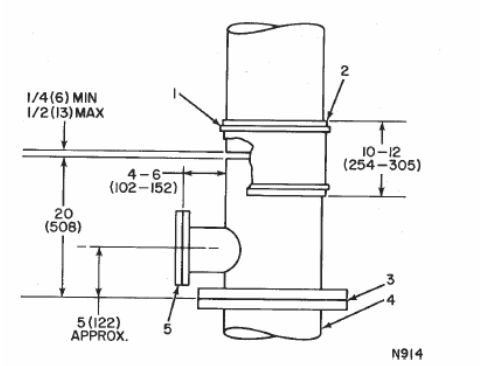
3.1.1.3 Check valves

Check valves should be installed exclusively in horizontal piping, ensuring they are positioned for the correct flow direction and in the specified mounting position. For vacuum systems where the inlet is open and vented at or before pump shutdown, inlet check valves are not necessary.

3.1.2 Discharge Piping

a. For vacuum pump discharge piping, it should be full size from the pump to a suitable

separating system, as shown in Figure 3.2. The discharge line before this separator should not be routed above the pump centerline unless specifically indicated on the installation drawing. The seal liquid discharge line should flow by gravity to a suitable drain, and the air line should be piped full size to a venting location.



1. Hose Clamp (2 Required)
2. Neoprene Composition Hose (½-Inch Thick)
3. Inlet Screen
4. Pump Inlet (2 per Pump)
5. Clean-out (6-Inch NPS Min)

Note - Dimensions are in inches

Figure 3.1. Recommended Flexible Connections for Inlet header Piping, NP Series Vacuum pump.

b. The compressor discharge should be piped to a separator located as close to the compressor as possible, as shown in Figure 3.3. The discharge line from the compressor separator should be full size and lead to the system receiver.

NOTE

WHEN USING BOTTOM DISCHARGE PORTS ON VACUUM PUMPS, IT IS RECOMMENDED TO USE FLEXIBLE CONNECTIONS, AS ILLUSTRATED IN FIGURE 3.5.

3.2 LIQUID COMPRESSANT (SEAL WATER)

Proper pump operation necessitates the provision of liquid compressant (seal water) at the appropriate pressure and flow rate. Recommended flow rates for vacuum pumps are detailed in Tables 8-B, with the standard flow rate for compressors being ¼ GPM per horsepower. Altering the flow rate can impact pump performance, so it should be adjusted to achieve optimal results for specific operating conditions. This regulation can be managed using an orifice union, an adjusting valve, and a pressure gauge, as recommended in Figures 3-2 and 3-3 for seal line controls. Additionally, a strainer should be installed in the upstream piping.

Orifice Unions: These provide a flow rate dependent on the pressure differential at 10 psig, regardless of whether one or two orifices are used.

Water Meter: Installing a water meter (or flow indicator) allows for monitoring the actual seal water flow rate to the unit.

In certain conditions, pump performance can be enhanced by condensing water vapor from the process. This can be achieved by directing a portion of the seal water to inlet spray nozzles, as shown in the recommended piping arrangement in Figure 3.4.

3.3 LANTERN GLAND

Lantern glands are optional components installed in a pump. These lantern gland tappings should be connected to a clean liquid source, typically water. When connecting the liquid source to the lantern gland, it is essential to include a strainer, an adjusting valve, and a pressure gauge calibrated from 0 to 15 psig for precise pressure control. With the pump in operation, adjust the pressure to the lantern gland to a value between 2.5 and 3.5 psig.

NOTE

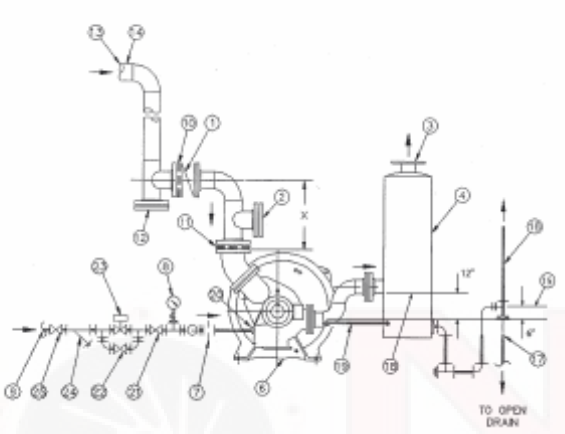
EXCESSIVE PRESSURE ON LANTERN GLANDS WILL LEAD TO EXCESS PACKING WEAR AND EXTERNAL LEAKAGE

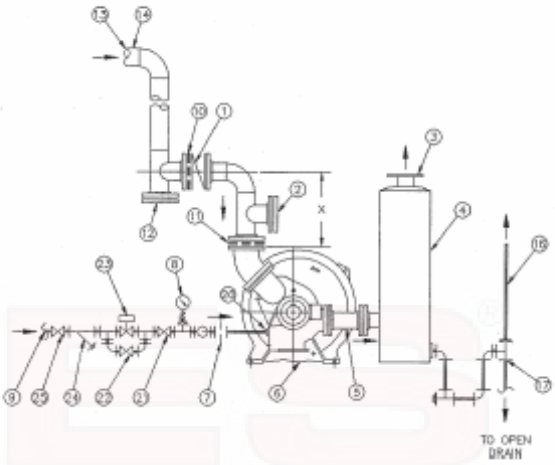
3.4 DRAINS

Drains should be sized to allow gravity flow from the separators at a rate equal to the liquid supplied to the pump. If liquid carryover from the system to the pump is expected, this amount must also be considered when sizing the drains.

3.5 POWER SUPPLY

Ensure that the available voltage matches the motor nameplate data and the voltage requirements for any solenoid valves provided or required. Note that solenoid voltage may differ from motor voltage. Starters and supply lines must be appropriately sized to meet the power requirements.





1) *Inlet Check Valve (See note 2)*
2) Clean-out (See note 7)
3) Vapor Discharge
4) Separator
5) Reducer (if necessary, see note 3)
6) Vacuum Pump
7) Orifice Union
8) Pressure Gauge (See note 1)
9) Seal Supply
10) Temporary Screens, Preferred Location (See note 4)
11) Temporary Screens, Alternate Location (See note 4)
12) Dirt Pocket (See note 6)
13) Inlet
14) From System
15) Maximum Height of Drain Loop from Centerline of Pump Discharge Flange
16) Vent
17) Drain
18) Maximum Discharge Level from Centerline of Pump Discharge Flange
19) Equalizer Line (1 inch minimum, see note 5)
20) Seal Liquid Inlet
21) Adjusting Cock
22) Initial Prime Bypass
23) Solenoid Valve
24) Strainer
25) Seal-line Isolation Valve
26) Vacuum Gauge

NOTES:

1) Typical piping arrangements shown; make certain to refer to the NES installation drawing(s) supplied with your unit for specific piping requirements and seal supply pressure.
2) The inlet check valve must be installed in the horizontal line for proper operation. An inlet check valve is not required for filter applications or where vacuum will not be maintained on pump shutdown.
3) The distance between the pump and the separator should be kept to a minimum. The liquid level in the separator should never be allowed to be higher than the pump shaft centerline. The pump discharge and separator inlet connections are not always the same size. Refer to the NES installation drawing(s) supplied with your unit for connection sizes.

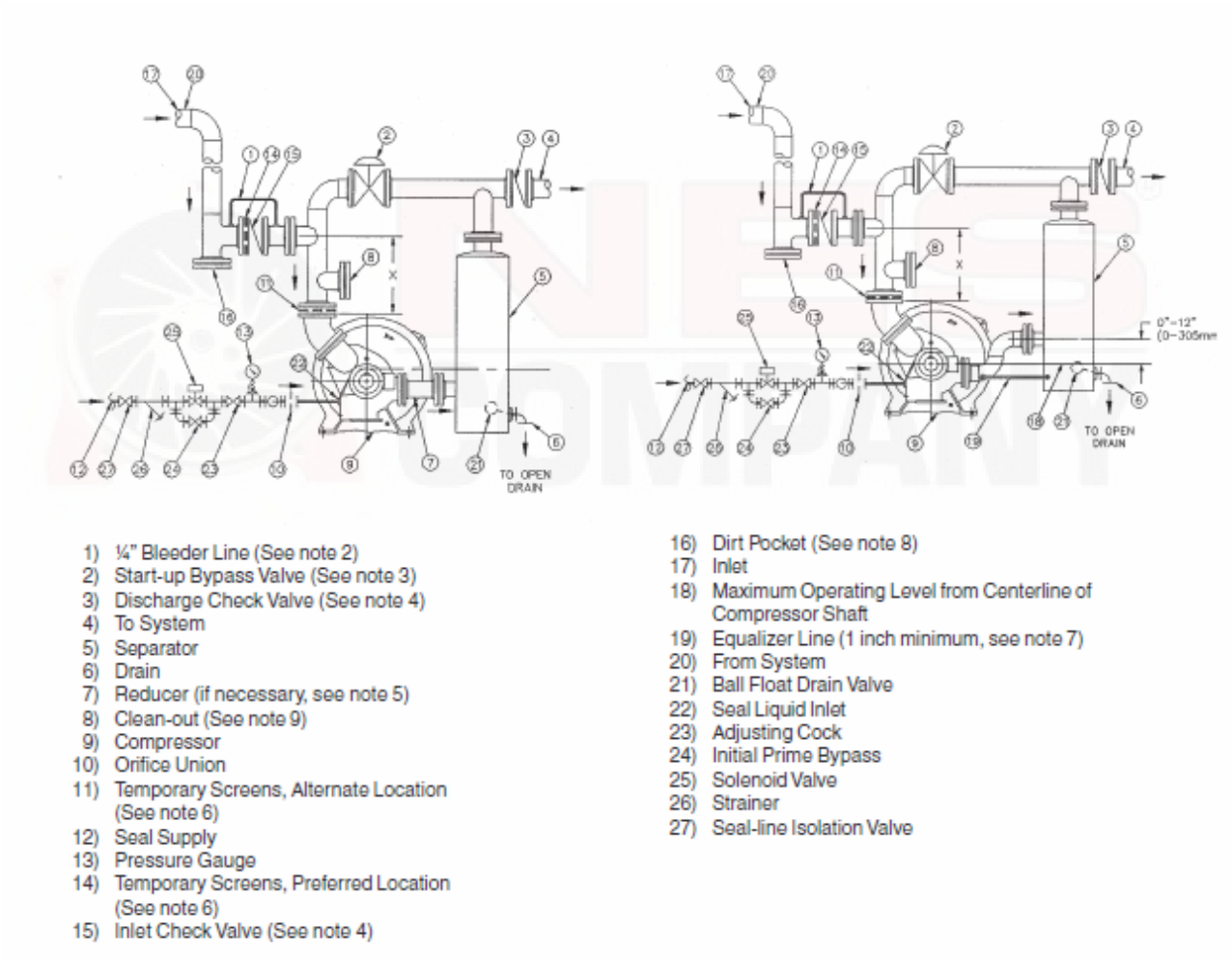
4) Stainless steel temporary screens are supplied by the NES Engineering Co. for protection from foreign material during the start-up period. One screen (coarse mesh) will be supplied with iron pumps. Two screens (fine and coarse mesh) will be supplied with stainless steel pumps. The fine mesh screen should be installed on the upstream side of the coarse mesh screen. All temporary screens should be cleaned after initial start-up. When all debris has been cleared, the screens should be removed.

5) With a slightly elevated pump discharge, an equalizer line is used to balance the liquid level between the pump and the separator.

6) Avoid long vertical drops (refer to dimension X) of 10 feet (3 meters) or more directly into the pump by diverting the stream as shown. If the gas stream has a possibility of dirt carry-over, install a dirt pocket. A dirt pocket is mandatory for stainless steel pump installations.

7) Install clean out in this location when temporary screen is used in alternate location (item 11). If temporary screen is installed in preferred location (item 10), use dirt pocket (item 12) for clean-out.

Fig. 3.2 Typical piping Arrangements for NP Series vacuum Pumps



1) ¼" Bleeder Line (See note 2)
2) Start-up Bypass Valve (See note 3)
3) Discharge Check Valve (See note 4)
4) To System
5) Separator
6) Drain
7) Reducer (if necessary, see note 5)
8) Clean-out (See note 9)
9) Compressor
10) Orifice Union
11) Temporary Screens, Alternate Location (See note 6)
12) Seal Supply
13) Pressure Gauge
14) Temporary Screens, Preferred Location (See note 6)
15) Inlet Check Valve (See note 4)
16) Dirt Pocket (See note 8)
17) Inlet
18) Maximum Operating Level from Centerline of Compressor Shaft
19) Equalizer Line (1 inch minimum, see note 7)
20) From System
21) Ball Float Drain Valve
22) Seal Liquid Inlet
23) Adjusting Cock
24) Initial Prime Bypass
25) Solenoid Valve
26) Strainer
27) Seal-line Isolation Valve

NOTES:

1) Typical piping arrangements shown; make certain to refer to the NES installation drawing(s) supplied with your unit for specific piping requirements and seal supply pressure.

2) A bleeder line located around the inlet check valve allows venting of the compressor on shutdown.

3) A start-up bypass valve is required for start-up and
should be capable of passing the full rated flow from the compressor. Please note: A bypass line is not required for the SC product line.
4) The inlet check valve presents a slug of water from
rushing into the inlet piping when the compressor stops. The discharge check valve maintains system pressure when the compressor stops. Check valves must be
installed in horizontal lines for proper operation.
5) The distance between the compressor and the separator should be kept to a minimum. The liquid level in the separator should never be allowed to be higher than the compressor shaft centerline. The compressor discharge and separator inlet connections are not always the same size. Refer to the NES installation drawing(s) supplied
with your unit for connection sizes.
6) Stainless steel temporary screens are supplied by the NES Engineering Co. for protection from foreign material during the start-up period. One screen (coarse mesh) will be supplied with iron compressors. Two screens (fine and coarse mesh) will be supplied with stainless steel
compressors. The fine mesh screen should be installed on the upstream side of the coarse mesh screen. All temporary screens should be cleaned after initial start-up. When all debris has been cleared, the screens should be removed.
7) With a slightly elevated compressor discharge, an
equalizer line is used to balance the liquid level between the compressor and the separator.
8) Avoid long vertical drops (refer to dimension X) of 10 feet (3 meters) or more directly into the compressor by diverting the stream as shown. If the gas has a possibility of dirt carry-over, install a dirt pocket. A dirt pocket is mandatory for stainless steel compressor installations.
9) Install a clean out in this location when temporary screen is used in alternate location (item 11). If temporary screen is installed in preferred location (item 14), use dirt pocket (item 16) for clean out.

Fig. 3.3 Typical piping Arrangements for NP Series vacuum Pumps

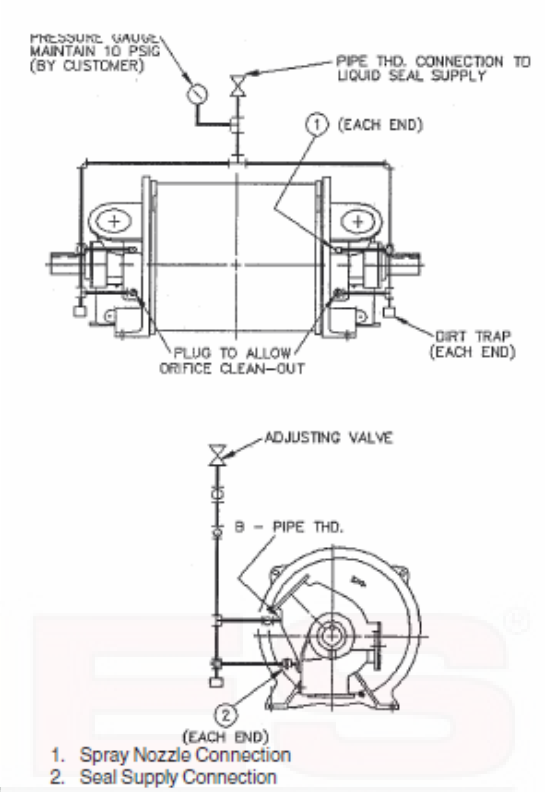
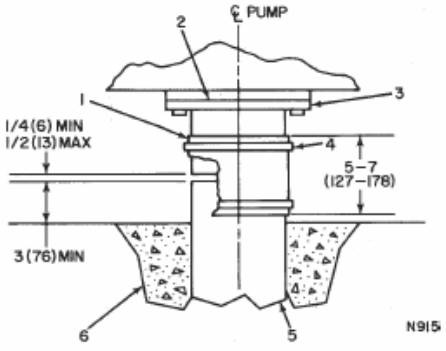


Fig. 3.4 Seal Liquid Piping with Spray Nozzles



NOTES:
1. Items 1 and 4 can be furnished by The NES Engineering Company, as optional equipment.
2. Dimensions are in inches
Figure 3.5 Recommend Flexible Connections from Bottom Discharge Port to Trench, NP Series Pumps

Section 4 – INSTALLATION

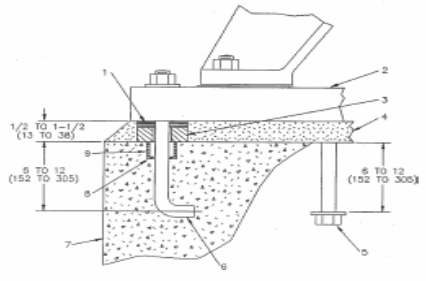
4.1 LOCATION

The pump should be placed in a fully accessible location that is protected from flooding, freezing, and excessive moisture. Ensure that the site allows for proper piping arrangements and easy dismantling. Adequate clearance must be provided for servicing the pump, as specified in the NES installation drawings supplied with your unit.

4.2 FOUNDATION

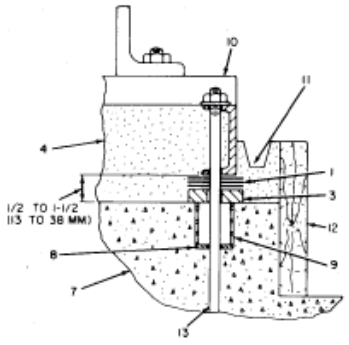
The foundation must provide a rigid support to maintain proper alignment. It should be constructed on hard, compacted soil or piles driven to a depth sufficient to rest on hard, compacted soil. Pour concrete to within ½ to 1-1/2 inches of the finished foundation height. Install foundation bolts as specified in Figure 4.1, ensuring they are located according to the prints supplied with your pump. Set the bolts as shown in Part A of Figure 4.1, using pipe sleeves that are two or three times the diameter of the bolts, allowing for adjustment to conform to the soleplate slot locations after the concrete is poured.

The foundation at each bolt location must be smooth and level. A metal plate leveled in mortar or grout is an effective way to achieve this smooth, level surface (see Figure 4-2). Shims can be used for final adjustments. The plate or shim area should support a load not exceeding 300 pounds per square inch (4267 kilograms per square centimeter). Allow the foundation to cure for several days before mounting and aligning the equipment.



1. Shims
2. Soleplate
3. Plate
4. Grout
5. Alternate Bolt and Washer
6. Foundation Bolt Bend
7. Concrete Foundation
8. Washer
9. Bolt Sleeve [3 in. (76 mm) long]

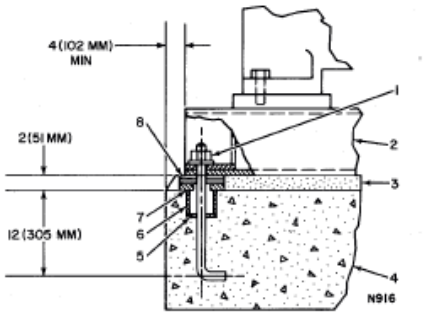
Figure 4-1a *Foundation Section Showing Alternate Foundation Bolt Arrangement and Leveling at Foundation Bolts.*



1. Shims
2. Soleplate
3. Plate
4. Grout
5. Alternate Bolt and Washer
6. Foundation Bolt Bend
7. Concrete Foundation
8. Washer
9. Bolt Sleeve [3 in. (76 mm) long]
10. Base
11. Drip Lip Formed in Grout
12. Form
13. Anchor Bolt

NOTE - Dimensions are inches with dimensions in millimeters shown in parentheses.

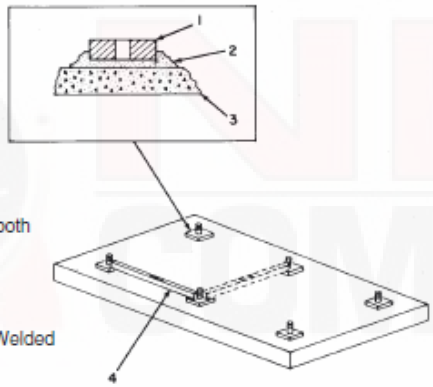
Figure 4-1b *Fabricated Base Filled with Grout*



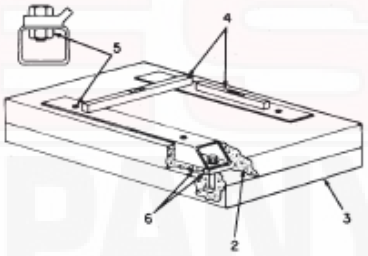
1. Foundation Bolt
2. Base
3. Grout
4. Concrete Foundation
5. Washer
6. Bolt Sleeve [3 in. (76 mm) long]
7. Plate
8. Shims

NOTE - Dimensions are inches with dimensions in millimeters shown in parentheses.

Figure 4-1c *Fabricated Skid*



1. Pad (Level carefully in both directions.)
2. Grout
3. Concrete Foundation
4. Level
5. Pump Mounting Nuts (Welded to Skid)
6. Steel Shim Blocks



NOTE: Level pads with each other; use shims if necessary. Level accurately between skids before grouting; shims with steel blocks each side of all four foundation bolts.

Figure 4-2 *Preparing Foundation Bolt Pads and Installing and Grouting Skids*

4.3 SETTING BASE, SOLEPLATE OR PUMP

Bases are designed to support the pump and driver when they are securely anchored at all foundation bolt locations. Soleplates must be carefully grouted to provide a rigid support over the entire area of the soleplate. Pumps mounted without soleplates must be firmly supported on a smooth, level surface at each foot.

After verifying and leveling the foundation bolt locations, carefully install the base, soleplate, or pump. If using skids, place the pump and skid on the foundation, shimming as needed under the foundation bolts. Remove the pump for final leveling and shimming. Before tightening the foundation bolts, shim underneath each bolt as shown in Figure 4.2.

Securely tighten the foundation bolts. For soleplates, ensure that the top is level. For skids and bases, check to ensure that final coupling or V-belt drive alignment can be achieved. If alignment within the specified tolerances in Paragraph 4.6 or 4.7 cannot be attained, recheck the tightness of the foundation bolts and the levelness of the foundation under the bolts.

4.4 Grouting

When using a soleplate in the pump installation, grout between the soleplate and foundation to fill irregularities and ensure uniform load distribution. Use a high-strength, non-shrinking, non-expanding grout mixture. Prepare the concrete foundation surface for better adhesion by acid etching or chipping the surface.

If the base is fabricated from structural shapes, fill it with grout, packing or rodding to completely fill the space between the base and the foundation. If using skids, refer to Figure 4.1c for grouting. Allow the grout to set completely before attempting any alignment.

NOTE

FOR PUMPS DRIVEN BY GEAR REDUCERS AND MOTORS NOT SUPPLIED BY NES ENGINEERING COMPANY, INSTALL THEM SO THAT THE CENTERLINE OF THE DRIVEN SHAFT IS APPROXIMATELY 1/32 TO 1/16 INCH (0.8 TO 1.6 MM) HIGHER THAN THE CENTERLINE OF THE DRIVER SHAFT TO ALLOW FOR FINAL ALIGNMENT AS SPECIFIED IN PARAGRAPH 4.6.

a. In cases where an accessible space is formed between a fabricated base and the foundation, it is recommended to fill it with grout to ensure uniform load distribution. Use a high-strength, non-shrinking, non-expanding grout mixture.

b. For grouting when skids are used, refer to Figure 3.2.

c. Allow the grout to set completely before attempting any alignment.

4.5 LOCATING COUPLINGS AND MOUNTING THE PUMP ON THE BASE

4.5.1 For loose-fit couplings with set screws, adjust the coupling halves to the recommended gap for your specific type of coupling while the coupling halves are installed. If the couplings are supplied by NES Engineering, refer to the Engineering Data Sheet for your order to determine the manufacturer's recommended gap.

CAUTION!

TOO MUCH VARIATION IN THE COUPLING GAP MAY CAUSE PREMATURE COUPLING AND/OR BEARING FAILURE.

4.5.2 Ensure that the coupling halves are properly fitted to the shaft, avoiding excessive looseness. If there is a loose fit, ensure the diametral clearance does not exceed 0.004 inch (0.10 mm), as this could lead to excessive stresses that may result in premature key and keyway failures.

CAUTION!

COUPLINGS SHOULD NOT BE FORCED ON THE PUMP SHAFT. IF THERE IS NOT A SLIP FIT, EXPAND THE COUPLING HALF BY HEATING IT TO A MAXIMUM TEMPERATURE OF 300°F (149°C). DO NOT FORCE THE COUPLING HALF! FORCING MAY DAMAGE THE BEARINGS OR THE PUMP INTERNAL SURFACES. MAKE CERTAIN THAT PUMP TO COUPLING HUB FACE DIMENSIONS IS AS SPECIFIED IN FIGURE 4.3.

NOTE

AS A RULE OF THUMB, THE GAP BETWEEN THE SHAFTS SHOULD BE NO LESS THAN THE COUPLING GAP. WHEN COUPLING HALVES MUST BE OVERHUNG IN ORDER TO ACHIEVE THE CORRECT COUPLING GAP, IT IS A GOOD PRACTICE TO OVERHANG BOTH COUPLING HALVES BY AN EQUAL AMOUNT. FOR NP PUMPS, MAKE CERTAIN THE PUMP TO COUPLING HUB DIMENSION SPECIFIED IN FIGURE 4.3 IS MAINTAINED.

4.5.3 Soft Foot Inspection

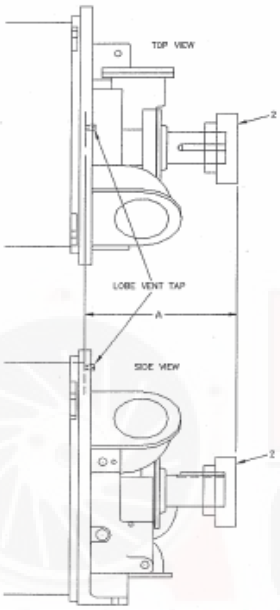
CAUTION!

FAILURE TO PERFORM THIS PROCEDURE MAY RESULT IN A BEARING FAILURE OR PUMP SEIZURE.

Purpose: Inspect the pump mounting to ensure it is uniformly supported. This inspection should be conducted with all piping and drive components disconnected.

4.5.3.1 Verify that the base structure is adequately supported and securely fastened as specified in paragraphs 4.1 through 4.4.

4.5.3.2 Position the pump as close as possible to its intended final location.



NP SERIES PUMP MODEL	DIMENSION	
	INCHES	MM
2160 & 2200	33.88	861
2280	35.94	913
2370 & 2480	39.56	005
2620	41.63	1057

SINGLE AND DOUBLE EXTENDED SHAFTS

REMOVE THE ½ NPT LOBE VENT PLUG – EACH END. MEASURE DISTANCE "A" FROM MACHINED SURFACE OF LOBE THROUGH VENT HOLE IN HEAD FLANGE

REPLACE PLUG

Fig. 4.3 Coupling Assembly Dimensions, NP Series

4.5.3.3 Install all four pump mounting bolts and securely tighten three of them.

4.5.3.4 Use a feeler gauge to measure any gap under the loose foot. Record measurements for each side of the foot.

4.5.3.4.1 Adjust shims to reduce any gap to less than 0.005 inches.

4.5.3.4.2 Adjust shims to ensure any misalignment is less than 0.010 inches.

4.5.3.5 Firmly tighten the loose bolt and loosen one of the other bolts.

4.5.3.6 Repeat step 4.5.3.4.

4.5.3.7 Repeat steps 4.5.3.4, 4.5.3.4.1, 4.5.3.4.2, and 4.5.3.5 for the remaining two bolts.

CAUTION!
ENSURE THE INTEGRITY OF THESE SHIMS DURING THE FINAL ALIGNMENT OF THE DRIVE

4.5.4.1 Securely attach the pump to the base after rough alignment in both the vertical and horizontal planes, and after achieving the correct coupling gap.

4.5.4.2 Complete all final piping connections to the pump after rough alignment and before performing final alignment.

4.5.4.3 Coupling Alignment Shim Kit: NES Engineering provides a shim kit for all pumps mounted on a common pump/motor base. The shims, approximately 1/16 inch (1.6 mm) thick in total, are laminated with each layer being 0.003 inch (0.076 mm). Use a knife to lift and separate the laminations to achieve the desired thickness. Exercise caution as the laminations can be sharp. Gloves should be worn to avoid minor cuts. Note: Final alignment is typically achieved by shimming the driving unit (gear reducer, motor, turbine, etc.), although in certain cases, aligning the driven unit to the driver, such as with turbine drives, may be preferable.

WARNING!

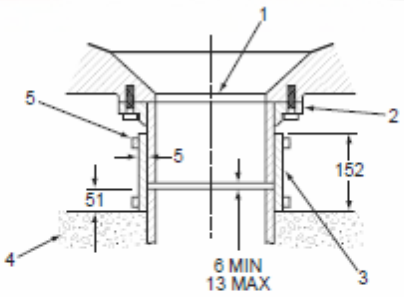
THE LAMINATIONS CAN BE EXTREMELY SHARP. WEAR GLOVES WHILE PEELING SHIMS TO AVOID MINOR CUTS.

NOTE

FINAL ALIGNMENT SHOULD (IN MOST CASES) BE ACCOMPLISHED BY SHIMMING THE DRIVING UNIT (GEAR REDUCER, MOTOR, TURBINE, ETC.). IN SOME CASES, SUCH AS TURBINE DRIVES, IT MAY BE EASIER TO ALIGN THE DRIVEN UNIT TO THE DRIVER.

h. Flush seal liquid piping to remove any foreign matter before connecting it to the pump. The piping should be full size to the pump connection and properly supported to avoid strain in the piping and pump connection. Install a strainer in the seal liquid piping to prevent rust and scale from entering the pump, refer to Section 2-1b and Figure 2-1. By incorporating an isolating valve, a strainer, and an adjusting valve or cock in that order, the strainer may be isolated to enable cleaning out when the pump is not operating.

j. When spray nozzles are required, piping should be as detailed in Figure 3.5 or as shown on the Installation or Arrangement drawing.



1. Pump Bottom Discharge
2. Pipe Flange
3. Neoprene Composition Hose
4. Concrete Foundation
5. Hose Clamp (2 required)

Fig. 3.4 Recommended Flexible Connections from Bottom

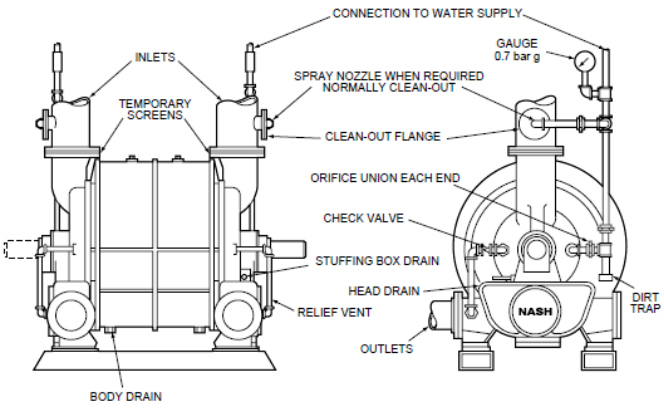


Fig. 3.5 Typical Seal Water piping with Spray Nozzles

NOTE

NES PUMPS DO NOT POSE ANY UNCOMMON CHALLENGES WITH DIRECT ON-LINE (D.O.L.) STARTING OR SYNCHRONOUS MOTOR PULL-IN. THERE IS NO NECESSITY FOR SPECIAL HIGH STARTING TORQUE MOTORS.

4.6 COUPLING ALIGNMENT

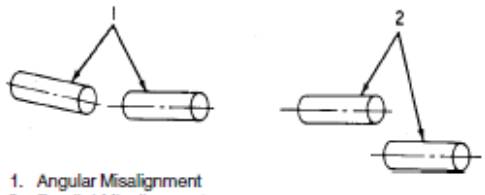
In some cases, pumps and their drivers are shipped with the pump and driver mounted on the base, while coupling assembly parts are shipped separately. At the factory, these units are checked on level pads or the customer's base to ensure that field alignment can be achieved when the base is mounted on a level foundation. However, as noted in Paragraph 2.4, they are not initially aligned.

Motor shims are packed separately and shipped with base-mounted pumps to accommodate the drive motor. Flexible couplings can tolerate some degree of misalignment due to factors like temperature changes, but precise alignment is essential for continuous operation. Excessive misalignment can lead to wear, vibration, and increased loads, which may cause premature failure of bearings, seal wear, or even pump seizure.

Misalignment can occur angularly, in parallel, or a combination of both, and can also manifest in horizontal and vertical planes (refer to Figure 4.4). If

achieving proper alignment proves difficult, verify the tightness of foundation bolts and reevaluate the leveling provided by shim adjustments to the foundation bolts.

Drivers (such as motors, gear reducers, turbines, etc.) must be aligned to the pump in the field before operation, following the instructions below:



1. Angular Misalignment
2. Parallel Misalignment

Figure 4-4 *Types of Misalignment*

CAUTION!

TO AVOID BUILD-UP OF TOLERANCES ON MULTIPLE PUMP INSTALLATIONS, ALIGN ALL PUMP AND DRIVER SHAFTS OPTICALLY.

4.6.2 Rough Alignment:

- Level the base by shimming and securely fasten it to the permanent foundation at all designated locations.
- Roughly align the pump and driver shaft centerlines horizontally to facilitate final adjustments at the driver unit.
- Similarly, align the pump and driver shaft centerlines vertically to allow for final adjustments at the driver unit.

Adjustments may include shimming the pump feet for proper elevation. Peel individual shim layers to make precise adjustments to the total shim thickness. When inserting thin shim layers under the motor feet, place them between thicker layers to maintain even footing and prevent bending.

4.6.3 Final Alignment (Preferred Method): After completing rough alignment and initial shimming:

Use a dial indicator to align the units precisely:

If necessary, separate the coupling halves and mount a dial indicator for angular alignment.

Rotate both shafts simultaneously to determine the highest and lowest dial indicator readings.

Shim and position the driver unit until the readings align within specifications.

These steps ensure the final alignment is accurate, optimizing performance and minimizing wear on components.

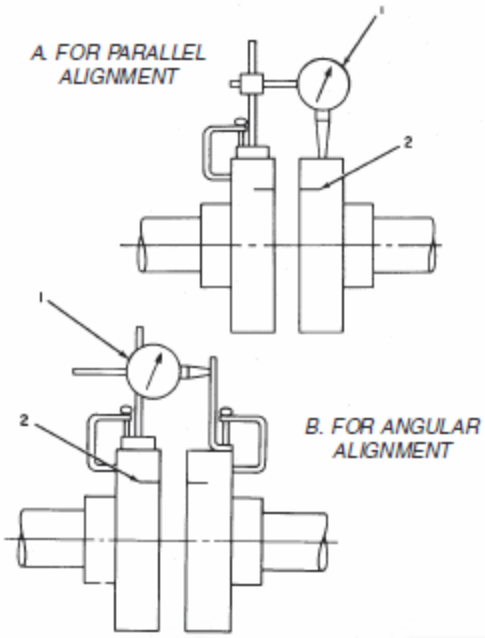
c. Upon customer order, alternative coupling types with a plain shaft bore may be provided. In such instances, it might be necessary to heat the coupling halves to facilitate easy installation onto the shafts.

CAUTION!

NEVER PRY UP OR LIFT A UNIT THAT IS RESTRAINED BY SOLID PIPE CONNECTIONS OR BY FOUNDATION BOLTS WHEN SHIMS ARE TO BE PLACED UNDER THAT UNIT'S MOUNTING FEET.

TURBINE ALIGNMENT MUST BE PERFORMED AT OPERATING TEMPERATURE. CONSULT THE TURBINE MANUFACTURER'S INSTALLATION AND OPERATION MANUAL OR HIS REPRESENTATIVE FOR RECOMMENDATIONS ON ALIGNMENT PROCEDURES AND FOR THERMAL GROWTH ALLOWANCES THAT SHOULD BE MADE BETWEEN SHAFT CENTERLINES FOR YOUR TURBINE AND DRIVEN EQUIPMENT.

4.6.3.1 Place a reference or benchmark on the outside diameter of both coupling halves.



1. Dial Indicator
2. Reference Mark

***Figure 4-5** Checking Alignment with Dial Indicator*

4.6.3.2 If necessary, separate the coupling halves and mount a dial indicator as illustrated in Figure 4-5b for angular alignment. Use a small V-block magnet mount or a strap-type dial indicator mount for optimal attachment.

4.6.3.3 Rotate both shafts simultaneously and observe the highest and lowest dial indicator readings, ensuring that the reference marks on both coupling halves remain aligned.

NOTE

WHEN MAKING DIAL INDICATOR READINGS, MAKE CERTAIN THAT THE REFERENCE MARKS ON BOTH COUPLING HALVES ARE ALWAYS IN ALIGNMENT.

4.6.3.4 Shim and adjust the position of the driver unit, repeating the previous step until the dial indicator readings are within 0.004 inches (0.10 mm) of the total reading for a complete revolution of the shafts.

4.6.3.5 After achieving angular alignment in steps 2 through 4, reposition the dial indicator for parallel alignment as shown in Figure 4-5a. Repeat steps 3 and 4 for parallel alignment.

4.6.3.6 Once steps 1 through 5 are completed, securely fasten the unit to the base and verify both angular and parallel alignments until they meet the specifications outlined in step 4.

4.6.3.7 Verify the coupling gaps between the coupling halves to ensure they fall within recommended values. For loose-fit couplings with setscrews, adjust the position of the coupling halves if necessary to bring them within limits.

4.6.3.8 Securely tighten the setscrews for the coupling halves where applicable. Note that loose-fit couplings must have setscrews, while interference-fit couplings may or may not require them.

NOTE

NOTE - LOOSE-FIT COUPLINGS MUST HAVE SETSCREWS; INTERFERENCE-FIT COUPLINGS MAY OR MAY NOT HAVE SETSCREWS.

4.6.4 Post-Alignment: Upon completing the final alignment procedure, follow these steps:

- 4.6.4.1 Assemble the coupling according to the manufacturer's instructions.
- 4.6.4.2 Install and securely fasten the coupling guard. It is crucial not to start the equipment without ensuring the coupling guard is properly installed and secured.
- 4.6.4.3 During pump operation, monitor for excessive noise and vibration, as these can indicate improper alignment and potentially lead to operational issues.

4.7 V-BELT DRIVE ALIGNMENT

CAUTION!

DO NOT ATTEMPT TO FORCEFULLY INSTALL V-BELT SHEAVES ONTO THE PUMP SHAFT. IF THE BUSHING IS DIFFICULT TO SLIDE ONTO THE SHAFT, USE A SCREWDRIVER WEDGED INTO THE SAW CUT TO GENTLY OVERCOME THE TIGHT FIT. IT'S CRUCIAL NOT TO FORCE THE SHEAVE, AS DOING SO CAN POTENTIALLY CAUSE DAMAGE TO THE BEARINGS, INTERNAL PARTS, OR SURFACES OF THE PUMP.

WARNING!

INSTALLING AND REMOVING BELTS CAN POSE HAZARDS. TO MINIMIZE RISKS, REDUCE THE CENTER DISTANCE AS MUCH AS POSSIBLE AND USE A FLAT BAR TO ACCURATELY POSITION THE BELTS IN THEIR DESIGNATED GROOVES.

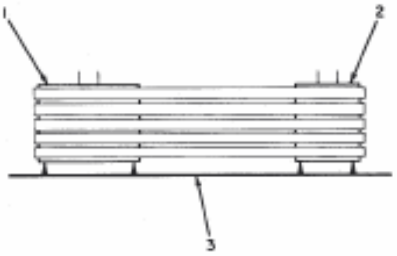
PUMPS MOUNTED ON BASES WITH MOTOR AND SLIDING ADJUSTMENTS PROVIDE SUFFICIENT FLEXIBILITY FOR INSTALLING AND ADJUSTING V-BELT DRIVES ACCORDING TO THE PROCEDURES OUTLINED BELOW:

FOR V-BELT INSTALLATION, WHEN POSITIONING THE MOTOR RELATIVE TO THE PUMP SHAFT, ENSURE THAT BELT TIGHTENING IS DONE IN ACCORDANCE WITH TABLE 4-A (ULTRA V DRIVE). THE DIMENSIONS SPECIFIED UNDER 3V, 5V, AND 8V HEADINGS INDICATE THE MINIMUM DISTANCES BELOW THE STANDARD CENTER DISTANCE WHERE BELTS SHOULD BE INSTALLED. THE MINIMUM TAKE-UP ALLOWANCE SPECIFIES THE MINIMUM DISTANCES REQUIRED TO TIGHTEN THE BELTS.

FOLLOW THESE INSTRUCTIONS FOR V-BELT INSTALLATION:

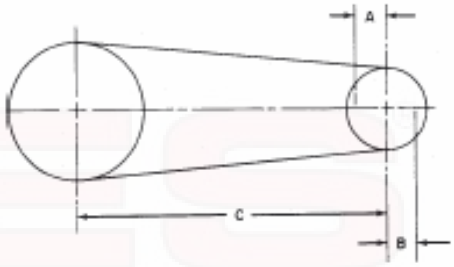
4.7.1 PLACE THE BELT(S) INTO THE GROOVES WITHOUT USING EXCESSIVE FORCE.

4.7.2 ALIGN THE BELT DRIVE USING THE FOUR-POINT METHOD WITH A STRAIGHTEDGE. ALIGNMENT IS ACHIEVED WHEN THE NEAR AND FAR POINTS ON EACH SHEAVE'S FACE TOUCH THE STRAIGHTEDGE, AS SHOWN IN FIGURE 4.6.



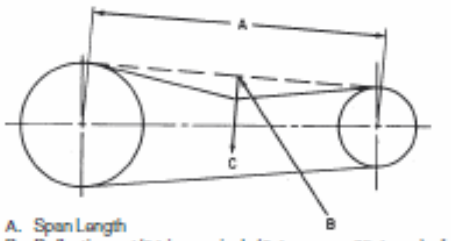
1. Driven Sheave
2. Driver Sheave
3. Straightedge

Figure 4-6 Four-Point V-Belt Alignment Method



A. Allowance for V-Belt Installation
B. Allowance for V-Belt Take-Up
C. Center Distance

Figure 4-7 V-Belt Center Distance Determination



A. Span Length
B. Deflection – 1/64 in. per inch (0.4 mm per 25.4 mm) of Span
C. Force

Figure 4-8 Checking V-Belt Tension

4.7.3 REFER TO TABLE 4-A TO DETERMINE INSTALLATION AND TAKE-UP DIMENSIONS, ESTABLISHING THE CENTER DISTANCE AND STANDARD BELT LENGTH DIMENSIONS (REFER TO FIGURE 4-7). ALLOW FOR ADJUSTMENTS TO BRING THE CENTERS CLOSER TOGETHER AS SPECIFIED IN

TABLE 4-A, WHICH PREVENTS BELT DAMAGE. ADJUSTMENTS SHOULD ALSO CONSIDER THE MINIMUM TAKE-UP ALLOWANCE TO ACCOUNT FOR MANUFACTURING TOLERANCES, BELT STRETCH, AND WEAR DURING OPERATION.

4.7.4 MEASURE THE SPAN LENGTH OF THE INSTALLED BELT (DIMENSION A IN FIGURE 4-8).

4.7.5 USE A SPRING SCALE TO APPLY A PERPENDICULAR FORCE TO ANY ONE BELT AT THE CENTER OF SPAN A. ENSURE THE FORCE IS SUFFICIENT TO DEFLECT THE BELT BY 1/64 INCH (0.4 MM) PER INCH (25.4 MM) OF SPAN LENGTH. FOR INSTANCE, A 30-INCH (762-MM) SPAN WOULD DEFLECT BY 0.469 INCH (11.9 MM).

CAUTION!

THE SHEAVES MUST BE TURNED BY HAND THROUGH SEVERAL REVOLUTIONS AFTER EACH TENSION ADJUSTMENT TO OBTAIN ACCURATE FORCE MEASUREMENTS.

4.7.6 COMPARE THE DEFLECTION FORCE APPLIED IN STEP 4.7.5 WITH VALUES IN TABLE 4-B. INITIALLY TIGHTEN THE BELT TO THE SPECIFIED VALUE FOR THE RUN-IN PERIOD. IDEALLY, TENSION SHOULD BE SUFFICIENT TO PREVENT SLIPPING UNDER PEAK LOADS.

4.7.7 ONCE PIPING CONNECTIONS (SECTION 3.1) ARE COMPLETED, ENSURE THE PUMP ROTATES FREELY.

CAUTION!

ALWAYS ENCLOSE V-BELT DRIVES WITH A GUARD BEFORE STARTING THE DRIVER. REFER TO SECTION 5 FOR PROPER START-UP PROCEDURES.

4.7.8 MONITOR BELT TENSION REGULARLY DURING THE INITIAL 24 TO 48 HOURS, ENSURING IT ALIGNS WITH VALUES ESTABLISHED IN STEPS 4.7.5 AND 4.7.6. ADJUST BELT TENSION IF NECESSARY AFTER 48 HOURS, COMPARING IT WITH VALUES IN TABLE 4-B FOR NORMAL OPERATION.

4.7.9 REGULARLY INSPECT THE V-BELTS TO KEEP THEM FREE FROM DEBRIS AND MAINTAIN THE V-BELT DRIVE SYSTEM.

Standard Belt Length Inches (mm)	Minimum Installation Allowances -Inches (mm)			Minimum Take-Up Allowance -Inches (mm)
	Belt Sections			
	3V	5V	8V	
25 to 50+ (635 to 1270)+	½ (13)	-	-	1 (25)
50 to 80 (1270 to 2032)	¾ (19)	1 (25)	-	1-¼ (32)
80 to 112 (2032 to 2845)	¾ (19)	1 (25)	1- ½ (38)	1-½ (28)
112 to 140 (2845 to 3556)	¾ (19)	1 (25)	1- ½ (38)	1-¾ (44)
140 to 180 (3556 to 4572)	-	1 (25)	1- ½ (38)	2-¼ (57)
180 to 224 (4572 to 5690)	-	1 (25)	1-¾ (44)	2-½ (64)
224 to 250 (5690 to 6350)	-	1-¼ (32)	1-¾ (44)	2-¾ (70)
250 to 280 (6350 to 7112)	-	1-¼ (32)	1-¾ (44)	3-¼ (83)
280 to 315 (7112 to 8001)	-	1-¼ (32)	1-¾ (44)	4 (102)
315 to 400 (8001 to 10160)	-	1-¼ (32)	2 (51)	4-½ (114)
400 to 500 (10160 to 12700)	-	-	2 (51)	5-½ (140)

***Table 4-A** Ultra V-Belt Drive Installation Dimensions*

+In each group the range is to, but not including the second length.

Dimensions in millimeters shown in parentheses.

Belt Section	*Small Diameter Range	+Deflection Force for Run-In Period (Startup)	+Deflection Force for Normal Running Tension
3V	2.65 to 3.65 (67.31 to 92.71)	6 (2.7)	3 to 4½ (1.4 to 2.0)
3V	4.12 to 6.00 (104.6 to 152.4)	8 (3.6)	4 to 6 (1.8 to 2.7)
5V	7.10 to 10.90 (180.3 to 276.9)	16 (7.3)	8 to 12 (3.6 to 5.4)
5V	11.80 to 16.00 (299.7 to 406.4)	20 (9.1)	10 to 15 (4.5 to 6.8)
8V	12.50 to 17.00 (317.5 to 431.8)	36 (16.3)	18 to 27 (8.2 to 12.2)
8V	18.00 to 22.40 (457.2 to 569.0)	40 (18.1)	20 to 30 (9.1 to 13.6)

***Table 4-B** V-Belt Tension*

**Dimensions are in inches with millimeters in parentheses.*

+Dimension forces are shown in pounds with kilograms in parentheses.

Section 5 – OPERATION

5.1 PREPARATION FOR INITIAL START-UP

Seek assistance from a NES Engineer for startup, if needed.

5.2 DRAINING AND FLUSHING

Before starting the pump after completing alignment, follow these steps:

- Remove the drain plugs as depicted in Figure 5-1 from both the floating and fixed bearing end heads.
- Open the shut-off valve for the seal liquid supply. Although the pump is initially flushed with an inhibiting oil before shipment, a light rust film may develop until installation is finished. This film will disappear shortly after the pump begins operating.
- Close the shut-off valve for the seal liquid supply.
- Reinstall the drain plugs using pipe thread compound. If the pump will not be in continuous service for more than three weeks after draining and flushing, refer to Section 6-6 for preservation procedures.

WARNING!

COMPLETE ALL STEPS METICULOUSLY TO ENSURE PERSONNEL SAFETY AND PROTECT EQUIPMENT.

CAUTION!

DO NOT START THE PUMP'S DRIVER UNTIL THEN SEAL LIQUID SUPPLY IS TURNED ON. THE UNIT MUST RECEIVE SEAL LIQUID BEFORE STARTING, EVEN FOR TESTING PURPOSES SUCH AS CHECKING THE DRIVER SHAFT ROTATION DIRECTION

5.3 PRELIMINARY INSPECTION

Before starting the pump, conduct the following inspections:

5.3.1 Ensure all power sources to the driver unit are isolated to prevent accidental starting.

5.3.2 Verify that all drain plugs on the pump and any recirculation pump (if used) are correctly installed.
5.3.3 Inspect the separator, receiver, and heat exchanger (if applicable) to ensure all shipping plug protectors are removed and all open connections are properly plugged or piped.

5.3.4 Check all piping against the NES installation drawings supplied with the pump. Ensure all connections are correct in size, securely fastened, and adequately supported.

5.3.5 Inspect connections of other major operational components (recirculation pump, dryer, turbine, etc.) associated with the pump, following the recommendations of their respective manufacturers.

5.3.6 Review all pump control components (valves, flow meters, check valves, strainers, gauges, etc.) to confirm they are installed as per the NES installation drawings. Ensure correct orientation in the piping scheme for proper flow direction and functional operation.

5.3.7 Inspect the pump inlet to verify proper connection of the inlet screen and clean-out connections, ensuring they are free of tools, equipment, and debris.

5.3.8 Remove the coupling or V-belt guards and manually rotate the pump shaft in the designated direction of rotation. The correct rotation direction is indicated by an arrow cast on the pump and shown in the installation drawing. The pump shaft must rotate freely. If the shaft is stuck and cannot be rotated manually, contact your NES Representative for assistance.

5.3.9 Prime the pump with a seal liquid.

CAUTION!

DO NOT ATTEMPT TO FREE A PUMP SHAFT FROM A BINDING OR BOUND CONDITION BY APPLYING POWER TO THE DRIVER. SEVERE DAMAGE MAY RESULT.

NEVER OPERATE THE PUMP WITHOUT ADEQUATE PRIME AND LIQUID SEAL FLOW. HIGH LIQUID SEAL SUPPLY PRESSURES DO NOT NECESSARILY INDICATE THAT THE FLOW IS ADEQUATE CHECK FOR FLOW FROM VACUUM PUMP DISCHARGE (OR WATER TRAP SILENCER).

5.3.10 OPEN INLET AND DISCHARGE ISOLATION/CONTROL VALVES

5.3.11 After opening the main supply valves and priming the pump, briefly activate the pump motor to verify correct shaft rotation and ensure the recirculating pump (if applicable) operates correctly.

5.4 START-UP AND OPERATING CHECKS, VACUUM PUMP ONLY

Upon completion of the preliminary inspection and preoperational check procedures, initiate the pump and assess its operation using the following steps:

WARNING!

IF THE PUMP IS TO BE CHECKED IN A SYSTEM, NOTIFY THE APPROPRIATE PLANT PERSONNEL BEFORE PLACING A PUMP ONLINE, ESPECIALLY WHEN PLACING THE PUMP ONLINE FOR THE FIRST TIME. STARTING UP A SYSTEM UNEXPECTEDLY MAY CAUSE PERSONNEL INJURY.

NOTE

REFER TO LOCATING TROUBLES, SECTION 7, IF ANY OPERATING DIFFICULTIES ARISE DURING THE SUBSEQUENT STEPS:

5.4.1 Inspect the pump and the system to ensure adequate priming, then activate all main water supply sources to the pump or heat exchanger.

5.4.2 With the water supply sources activated and all personnel and equipment clear of the pump system, apply power to the drive motor.

NOTE

IF PUMP OPERATION BECOMES UNSTABLE, LEADING TO INCREASED VIBRATION LEVELS AND A DECREASE IN PUMPING VOLUME, IMMEDIATELY SHUT DOWN THE SYSTEM AND IDENTIFY THE CAUSE.

5.4.3 While the pump is stabilizing at the required inlet vacuum, verify the flow of liquid seal (water) to the pump. Confirm that the liquid seal is flowing out of the separator drain.

5.4.4 Continuously monitor the temperature of the pump casing during the start-up procedure. If the temperature rises rapidly or exceeds 25°F above the liquid compressant temperature, promptly shut down the unit and investigate the cause.

5.4.5 After starting the pump, monitor the temperature of the bearing housings until the temperatures stabilize and begins to drop. During startup, monitor the bearing housing temperature closely as it should stabilize approximately 30°F (17°C) higher than the casing or ambient temperature.

CAUTION!

DURING STARTUP, MONITOR THE BEARING HOUSING TEMPERATURE CLOSELY AS IT SHOULD STABILIZE APPROXIMATELY 30°F (17°C) HIGHER THAN THE CASING OR AMBIENT TEMPERATURE. IF THE BEARING HOUSING TEMPERATURE EXCEEDS 180°F (82°C) OR IF UNUSUAL BEARING NOISE, VIBRATION, ODOR, OR SMOKING OCCURS, IMMEDIATELY SHUT DOWN THE PUMP TO INVESTIGATE THE ISSUE.

5.4.6 Excessive bearing temperatures can result from various factors such as excessive V-belt drive tension, coupling misalignment, excessive piping loads, or improper greasing of bearings. If over greasing is suspected as the main cause, retract the outer bearing housing cap and assess the grease level inside. If it's more than one-third full, remove

the excess grease and reassemble the cap. If there's minimal or no grease, apply grease through the fitting until it extrudes from the bearing face. Fill the cap to one-third capacity and reassemble.

5.4.7 After the pump has operated for ten minutes with consistent leakage from the stuffing box, gradually tighten the gland nuts evenly in increments of 30 degrees. Repeat this process at ten-minute intervals until there is a controlled drip from the gland without overheating. Further adjustments to the gland nuts should be made when the pump is running at normal operating temperature and vacuum conditions.

5.5 START-UP AND OPERATING CHECKS, COMPRESSOR ONLY

Upon completion of the preliminary inspection and pre-operational check procedures, initiate the compressor and assess its operation using the following steps:

WARNING!

IF THE COMPRESSOR IS TO BE CHECKED WITHIN A SYSTEM, INFORM THE RELEVANT PLANT PERSONNEL BEFORE PUTTING THE COMPRESSOR ONLINE, ESPECIALLY WHEN DOING SO FOR THE FIRST TIME. STARTING A SYSTEM UNEXPECTEDLY MAY RESULT IN PERSONNEL INJURY.

NOTE

REFER TO LOCATING TROUBLES, SECTION 7, IF ANY OPERATING DIFFICULTIES ARISE WHEN PERFORMING THE FOLLOWING STEPS.

5.5.1 Ensure that the compressor and the system have sufficient priming before activating all primary water supply outlets to the compressor and the heat exchanger.

5.5.2 Fully open the separator bypass valve.

5.5.3 With the water supply outlets activated and all personnel and equipment kept clear of the compressor system, energize the driver. Gradually close the separator bypass valve until the separator pressure gauge reads a maximum of 3 PSI gauge pressure.

CAUTION!

IN ONCE-THROUGH SYSTEMS, IF THE WATER LEVEL IN THE SEPARATOR RISES ABOVE THE GAUGE GLASS, IMMEDIATELY SHUT DOWN THE COMPRESSOR AND INSPECT FOR ANY OBSTRUCTIONS IN THE WATER DISCHARGE PATH FROM THE SEPARATOR. IF THE SEPARATOR PRESSURE FALLS BELOW 3 PSIG, ADJUST A DISCHARGE VALVE AND RE-EVALUATE. DURING NORMAL OPERATION, THE SYSTEM'S BACK PRESSURE SHOULD ADEQUATELY PRESSURIZE THE SEPARATOR. CONSULT YOUR NES REPRESENTATIVE FOR RECOMMENDATIONS ON POTENTIALLY NEEDING A DISCHARGE ORIFICE.

NOTE

IF THE COMPRESSOR EXPERIENCES INSTABILITY—EVIDENCED BY INCREASED VIBRATION LEVELS AND REDUCED PUMPING CAPACITY—FULLY OPEN THE SEPARATOR BYPASS VALVE. IF STABILITY RETURNS, GRADUALLY ADJUST (THROTTLE) THE SEPARATOR BYPASS VALVE. IF STABILITY IS NOT REGAINED, SHUT DOWN THE SYSTEM IMMEDIATELY AND INVESTIGATE THE ROOT CAUSE.

5.5.4 While stabilizing the compressor at the set discharge pressure, verify the flow of seal liquid to the compressor. In once-through systems, ensure the seal liquid exits the ball float correctly. For recirculated systems, confirm the operation of the recirculation pump (if applicable).

5.5.5 Continuously monitor the temperature of the pump casing during startup. If the temperature rises rapidly or exceeds 25°F (14°C) above the seal liquid temperature, check for any flow restrictions. If the temperature difference reaches 35°F (19°C), shut down the unit immediately and determine the cause.

5.5.6 After starting the compressor, monitor the temperature of the bearing housing until it stabilizes and begins to decrease. This stabilization process may take several hours and should result in a

temperature approximately 30°F (17°C) higher than the casing or ambient temperature.

5.5.7 Once the compressor has stabilized for operation at 3 psig, gradually close the separator bypass valve until reaching the normal discharge operating pressure. Monitor for any abnormal noise or vibration during this adjustment. If observed, open the separator bypass valve until the abnormality disappears. Then, throttle the separator bypass valve again to achieve the desired discharge pressure. If noise or vibration persists, shut down the compressor and investigate the cause.

5.5.8 After the compressor has operated for ten minutes with consistent leakage from the stuffing box, tighten the gland nuts evenly one flat at a time. Repeat this process at ten-minute intervals until achieving a leakage rate of approximately 45 to 60 drops per minute from the gland, without overheating. Subsequent adjustments to the gland nuts should be made in increments of 30°, with the compressor operating at normal temperature and pressure.

Checking and adjusting these clearances necessitate dismantling the pump. Contact your NES Engineer before proceeding with pump dismantling. They will

Section 6 – PREVENTATIVE MAINTENANCE

6.1 ROUTINE MAINTENANCE

PERIODIC INTERVALS	Check oil level in gear reducer	See gear reducer manufacturer's recommendation
	Check lobe purge for plugging	See Paragraph 6.5.
	Check stuffing box drain	See Paragraph 6.4.
6 MONTH INTERVALS	Lubricate coupling	See coupling manufacturer's recommendation.
	Lubricate motor bearings	See motor manufacturer's recommendation.
	Gear reducer oil change	See gear reducer manufacturer's recommendation.
	Lubricate pump bearings	See Paragraph 6.2.
12 MONTH INTERVALS	Replace stuffing box packing	See Paragraph 6.3.

Table 6A Preventive Maintenance Intervals

NOTE

MORE FREQUENT CLEANING MAY BE NECESSARY DEPENDING ON OPERATING CONDITIONS.

6.2 BEARING LUBRICATION

Bearings in the pumps described in this bulletin are initially lubricated with grease before shipment and typically do not require further lubrication for approximately six months.

NOTE

LUBRICATE THE BEARINGS EVERY SIX MONTHS UNLESS THE PUMP OPERATES IN A CORROSIVE ENVIRONMENT OR WITH A NON-WATER SEAL LIQUID, IN WHICH CASE LUBRICATION INTERVALS SHOULD BE MORE FREQUENT. LUBRICATION SHOULD BE PERFORMED WHILE THE PUMP IS RUNNING.

FOLLOW THESE STEPS FOR LUBRICATING THE BEARINGS.

NOTE

DURING LUBRICATION, THE BEARING TEMPERATURE MAY RISE BY 40°F (22°C) OR MORE. THIS INCREASE IS NORMAL AND THE BEARING TEMPERATURE WILL GRADUALLY RETURN TO ITS ORIGINAL LEVEL.

6.2.1 Ensure that the slots at the bottom of the floating and fixed bearing cartridge and outer caps are clear of old, dried-out grease.

6.2.2 Apply grease as specified in Table 6-B to the grease fittings (23) in the floating and fixed bearing cartridge until grease flows from both inner and outer slots.

6.2.3 After initial grease flow from the slots, inspect the grease for contamination or presence of water.

6.2.4 If the grease is contaminated, shut down the pump, remove the cap, thoroughly clean the cap, bearing cartridge, and bearing of contaminated grease. Inspect the bearing; if undamaged, reinstall the cap and add fresh grease as specified below. If damaged, replace with a new bearing and consult your NES Representative.

6.2.5 Use fresh grease as specified in Table 6B. Pump grease into the grease fittings at both ends of the pump until grease extrudes from the end of the rollers. While slowly rotating the shaft 360°,

continue pumping grease into the outer bearing cap until it is approximately one-third full. Reassemble with caution: Ensure that the total thickness of shims (4) and shim gaskets (4-1) matches the thickness removed from the fixed bearing end to maintain the required end travel.

6.2.6 Regularly monitor the operation and temperature of the bearings during normal pump operation.

This maintenance procedure ensures optimal bearing performance and longevity in the specified pump systems.

GENERAL REQUIREMENTS:

A. Premium quality industrial bearing grease.
B. Consistency grade: NLGI #2
C. Oil viscosity (minimum):
   @100° (38° C)- 500 SSU (108 cSt)
   @ 210° (99° C)- 58 SSU(10c St)
D. Thickener (Base): Lithium or Lithium Complex for optimum WATER RESISTANCE.
E. Performance characteristics at operating temperature:
   1. Operating temperature range; at least 0° to 250° (18° to 121° C)
   2. "Long-Life" performance
   3. Good mechanical and chemical stability.
F. Additives – Mandatory:
   1. Oxidation inhibitors
   2. Rust inhibitors
G. Additives – Optional:
   1. Anti-wear agents
   2. Corrosion Inhibitors
   3. Metal deactivators
   4. Extreme Pressure (E.P.) agents
H. Additives – Objectionable:
   1. Molybdenum disulfide
   2. Tackiness agents

NES STANDARD GREASE RECOMMENDATIONS:
The following is a list, by manufacturer, of some grease that exhibits the desired characteristics required by N.E.S.

Grease Manufacturer	Product
AMOCO	Super Permalube or Amolith 2EP
B.P. Oil	Energrease LS-EP2
Castrol Oil	Spheerol SW 2 E.P.
Chevron Oil	Ulti-Plex Synthetic EP2
Exxon	Unirex N2 or Unirex EP2
Mobil Oil	Mobilith SHC 100 or Mobilith AW2
Shell Oil	Alvania 2 or Alvania EP2
Texaco Oil	Starplex 2 or Marfak MP2
Thames	Lithium EP2

Table 6B General Grease Specifications

6.3 STUFFING BOX PACKING

To maintain the performance of pump stuffing boxes, it is essential to establish a preventive maintenance schedule for tightening and replacing packing. For pumps in continuous process systems, it is recommended to replace packing annually during shutdowns. However, more frequent replacements may be necessary for severe process applications where seal liquid is contaminated or incompatible with existing packing materials. In such cases, different packing materials may be required.

NOTE

WHEN USING LANTERN GLANDS, IT'S CRUCIAL TO RECORD THE POSITION AND NUMBER OF PACKING RINGS ON EACH SIDE OF THE LANTERN GLAND. THIS RECORDED INFORMATION WILL BE ESSENTIAL DURING REASSEMBLY TO ENSURE PROPER ALIGNMENT OF THE LANTERN GLAND. THIS STEP HELPS MAINTAIN EFFECTIVE SEALING AND PREVENTS LEAKS IN THE PUMP SYSTEM.

When replacing the packing in a stuffing box, follow these steps:

6.3.1.1 Move the slinger and slinger spring (3-1 or 3-4) away from the stuffing box on the shaft.

6.3.1.2 Loosen and remove the gland nuts (102-1, 103-1) from the studs (Figure 6.1).

6.3.1.3 Move the packing gland assembly (112) as far away from the stuffing box as possible. Remove the two nuts, lockwashers, and screws holding the halves of the packing gland assembly together, then take out the two halves.

6.3.1.4. Insert the tips of packing pullers (2, Figure 6.2) into the packing (1).

6.3.1.5. Pull the packing out of the stuffing box.

6.3.1.6. When lantern rings are fitted, form two lantern gland pullers from 1/8 inch diameter steel wire as shown in Figure 6.3.

6.3.1.7. Maneuver the bent tip of each lantern gland puller around the outer diameter of the lantern gland in the stuffing box until the pullers catch in the slots in the lantern gland on opposite sides.

6.3.1.8. Extract the lantern gland from the stuffing box.

6.3.1.9. Screw the tips of packing pullers (Figure 6.2) into the remaining packing in the stuffing box and pull the packing out.

6.3.1.10. Thoroughly clean stuffing box and check shaft for severe scoring and wear. Severe scoring will rapidly wear the packing and should be rectified by metal spraying or replacement of the shaft. Contact your NES Representative for assistance in determining the re-usability of the shaft.

6.3.2 Follow this procedure to install the new packing in the stuffing boxes:

6.3.2.1 Create two hard rubber strips to fit between the outer diameter of the shaft (111) and the inner diameter of the stuffing box, as depicted in Figure 6.1 Part C. These strips will serve as packing ring pushers.

6.3.2.2 Apply lubrication to the inside diameter of the packing rings, using Molykote G-n paste or an equivalent.

6.3.2.3 Open the packing ring into a spiral by pulling the ends axially apart, as illustrated in Figure 6.1 Part A.

6.3.2.4 Guide each packing ring onto the shaft and into the stuffing box area, following the steps outlined in Figure 6.1 Part B.

6.3.2.5 Using the pushers created in step a-12, firmly insert the initial packing ring into the stuffing box, ensuring it is properly seated against the end of the stuffing box, as depicted in Figure 6.1 Part C. Arrange the butted ends of each succeeding ring so that they are staggered by 180 degrees (refer to Figure 6.1 Part D). Verify that each packing ring is securely seated.

NOTE

WHEN LANTERN GLAND (10) IS USED, INSTALL CORRECT NUMBER OF PACKING RINGS AS RECORDED AT DISASSEMBLY TO ENSURE THAT LANTERN GLAND WILL BE CORRECTLY POSITIONED AXIALLY BELOW SUPPLY CONNECTION FOR STUFFING BOX.

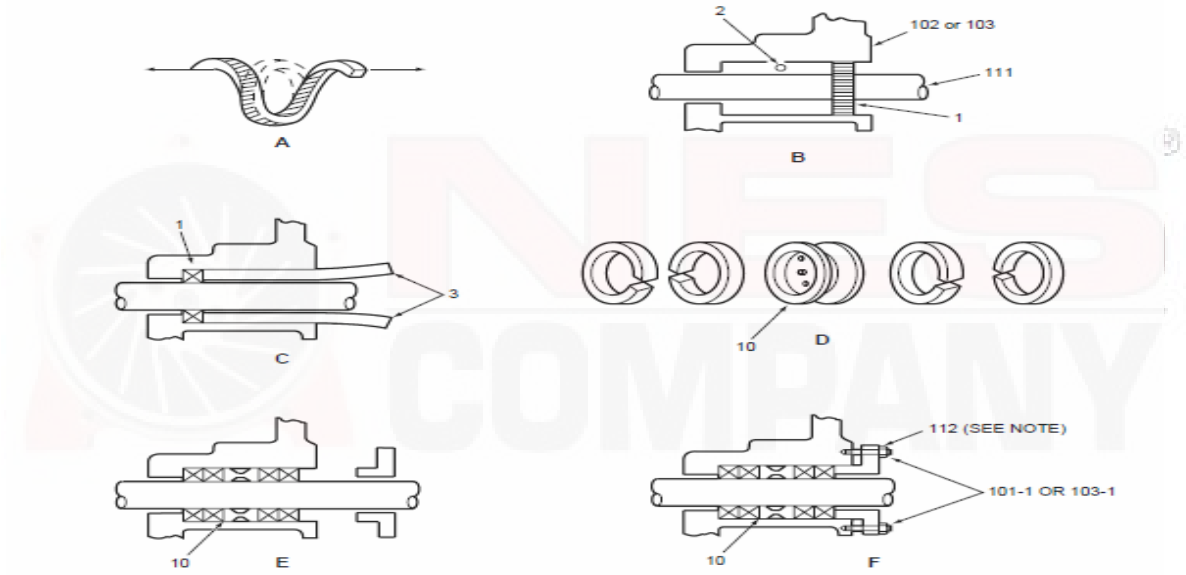
6.3.2.6 Place the lantern gland (10) back into its original position, as marked during removal (refer to Figure 6.1 Part E).

6.3.2.7 Install the remaining packing rings according to the instructions in step 6.3.2.5.

6.3.2.8 Slide packing gland (112) on shaft so that it is flush against last packing ring installed. Install and tighten the gland nuts (102-1 or 103-1) evenly, finger tight (See Figure 6-. Part F).

6.3.2.9 Turn shaft (111) to make certain that shaft turns freely.

6.3.2.10 Start up pump and adjust stuffing box leakage as specified in Paragraph 5.4.7. or 5.5.8.



Note: Rotated 90 degrees to show gland studs and nuts

1. Packing Ring	102 Floating Bearing End Head
2. Lantern Gland Supply Connection	103. Fixed Bearing End Head
3. Packing Ring Pusher	103-1. Gland Nut
10. Lantern Gland	111. Shaft
101-1. Gland Nut	112. Packing Gland Assembly

Figure 6.1 Packing Stuffing Boxes

Figure 6.2 Removing Stuffing Box Packing

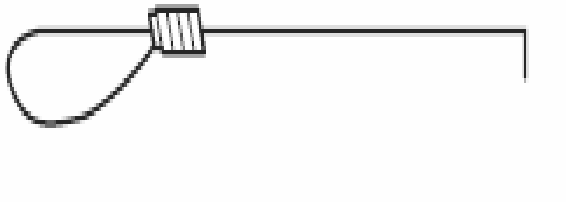


Figure 6.3 Stuffing Box Lantern Gland Puller

6.4 STUFFING BOX DRAIN

Regularly inspect the area around the stuffing box and remove any accumulated debris. If the stuffing box drain is connected to a pipe, ensure the entrance is clear to allow proper drippage flow.

6.5 LOBE PURGE

If the pump is equipped with lobe purges, periodically disconnect the lobe purge tubing from the fitting near the side discharge flange. Check for unrestricted flow of liquid from the pump body as depicted in Figure 5.1.

If there is no flow, clear both ends of the tubing using a rod or wire. If flow is still obstructed, remove the fittings and carefully clear the connections with a wire before reassembling.

6.6 SHUTDOWN PERIODS

If the pump will be idle for 2 to 3 weeks, drain it and manually rotate both the pump and any recirculating pump weekly. This prevents rust buildup between cast iron parts that could lead to seizing.

For longer shutdowns, follow these steps to prevent rust formation and ensure preservation:

6.6.1 Remove drain plugs from the pump as described in Paragraph 5.2 and drain all seal liquid. Replace the drain plugs securely.

6.6.2 Close off the pump discharge flanges.

6.6.3 Fill the pump to one-quarter capacity with a preservation fluid such as E. H. Kellogg Co., Inc. NRP100 or equivalent through the inlet flanges.

6.6.4 Start the pump and run it for 5 to 15 seconds, then shut it down. Repeat this process.

6.6.5 Drain and recover all preservation oil from the pump by removing the drain plugs specified in Paragraph 5.2. Use pipe compound when replacing the drain plugs.

6.6.6 Remove all packing from the stuffing boxes as detailed in Paragraph 6.3.1 and flush the boxes with a rust inhibitor.

6.6.7 Roughen any areas where paint has chipped, and apply Houghton's Rust Veto #344 coating compound or an equivalent on external surfaces as needed.

6.6.8 Close off the pump inlets.

Note: For preservation procedures exceeding one year of storage, consult your NES representative for specialized guidance.

6.6.9 After flushing the preservation fluid from the pump, rotate the vacuum pump and recirculating pump (if used) weekly until the pump is ready for continuous operation.

6.6.10 Before putting the pump back into service, install new packing in the stuffing boxes according to Paragraph 6.3.2, drain and flush as specified in Paragraph 5.2, inspect the condition of bearing grease as outlined in Paragraph 6.2, and start the pump according to the procedures in Paragraphs 5.4 and 5.5.

These steps ensure the pump remains in optimal condition during shutdown periods and is ready for reliable operation when needed.

Section 7 – TROUBLESHOOTING

PROBLEM	REASON	SOLUTIONS
Hot Bearing	Contaminated lubricant	Clean thoroughly and relubricate per paragraph 6.2
	Lack of lubricant	Lubricate per paragraph 6.2
	Excess lubricant	Clean out bearing caps and relubricate per paragraph 6.2
	Coupling misalignment	Check alignment and coupling gap per paragraph 4.6
	Belt drive too tight	Adjust belt tension per paragraph 4.7
	Pipe Stress	Adjust piping per paragraph 3.1
	Soft foot	Shim pump feet per paragraph 4.5.3
	Packing too tight	Repack per paragraph 6.3
	High pump operating temperature	Check operating temperature vs. design conditions
	High seal water flow	Check water supply pressure Check orifice size
	Flooded operation	Check water drain system
	Damaged bearing	Contact the local 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 the pump Check for improper coupling gap

PROBLEM	REASON	SOLUTIONS
High operating temperature on body	Low seal water flow	Check seal water supply pressure Check orifice size 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 or fouling

PROBLEM	REASON	SOLUTIONS
Insufficient vacuum pressure or capacity incorrect	Air leaks	Tighten pipe joints Repair control or isolation valves Replace leaky pipe
	Low pump speed	Adjust drive belts
	Low seal water flow	Check water pressure Check orifice size Check for plugged orifices, piping, strainers
	High seal water flow	Check water pressure Check orifice size Check for excess carryover from the process
	Internal wear	Increase seal water flow Contact the local NES Repair Center for assistance with internal inspections
	Restricted inlet and discharge piping	Clean inlet screens Check for product build up Contact the local NES Repair Center for assistance with internal inspections
	Pump rotation	Check rotation vs. cast arrows on pump heads

PROBLEM	REASON	SOLUTIONS
High horsepower	High pump speed	Check speed vs curve
	Excess back pressure	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 Repair Center 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 per paragraph 6.3
	Restricted water drain	Inspect and clean drain lines

PROBLEM	REASON	SOLUTIONS
Abnormal noise	High vacuum	Restricted inlet piping Plugged inlet screen Inoperative relief valve Inlet passages plugged with solids, contact the NES Repair Center for inspection assistance.
	Excess discharge pressure	Discharge air or water passages plugged with solids, contact the NES Repair Center for inspection assistance Small discharge line
	Loose drive belts	Adjust belt tension per paragraph 4.7
	Excess internal clearances	Increase seal water flow Contact the NES Repair Center for inspection assistance.
	Separator configuration	Check separator mounting Check for correct water level

PROBLEM	REASON	SOLUTIONS
Abnormal vibration	Excess water	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 design point Incorrect seal water flow Worn pump internals
	Out of balance drive components	Balance sheave or coupling
	Product buildup on rotor	Contact NES Repair Center for inspection assistance and descaling procedures
	Flooded start or operation	Check for proper discharge drain system
	Misaligned drive	Realign per paragraph 4.6
	Loose belts	Adjust belt tension per paragraph 4.7

Section 8 – DIMENSIONS, PARTS, TECHNICAL DATA

Table 8A	**Pump Maintenance Parts Data**				
Part Name	Index No.	NP Pump Model			
		2620	2480 & 2370	2280	2200 & 2160
Packing Dimensions	1	.75” Square x 11.25” ID x 12.75” OD	.75” Square x 9.75” ID x 11.25” OD	.75” Square x 8.75” ID x 10.25” OD	.75” Square x 7.375” ID x 8.875” OD
No. of Rings per Stuffing Box*		6	6	6	6
Lip Seal Floating and Fixed Bearings Inner Caps	5	11.25” ID x 12.75” OD x 0.63” Wide	7.50” ID x 8.50” OD x 0.5” Wide	7.25” ID x 8.5” OD x 0.63” Wide	5.88” ID x 7.0” OD x 0.63” Wide
Lip Seal Floating and Fixed Bearing Outer Caps	5-1	9.8” ID x 11.4” OD x 0.63” Wide	7.50” ID x 8.50” OD x 0.5” Wide	7.25” ID x 8.5” OD x 0.63” Wide	5.88” ID x 7.0” OD x 0.63” Wide
Body Gasket+ 0.010” Thick, Qty. Floating Bearing End	101-3	6	6	6	6
Qty. Fixed Bearing End	101-3	6	6	6	6
Cone Gaskets 0.010” Thick, Qty.	104-3 105-3	1 Each End	1 Each End	1 Each End	1 Each End
Floating Bearing and Fixed Bearing	119 120	2 cones 1 cup 1 spacer Bench Play – 0.016”	2 cones 1 cup 1 spacer Bench Play – 0.012”	2 cones 1 cup 1 spacer Bench Play – 0.012”	2 cones 1 cup 1 spacer Bench Play – 0.012”
If Lantern Glands (10) are used, one less Packing Ring is required. +Quantities listed are for trial assembly with extra Gaskets at the non-drive end to allow removal of Gaskets to obtain the final (end) travel. *For more information, please contact your NES representative.*					

Table 8-B	Seal Flow Rates (GPM)	
NP Model	Vacuum Level	
	0-15” HgVac	Above 15” HgVac
2620	100	190
2480	84	160
2370	66	126
2280	62	120
2200	60	114
2160	56	106

Table 8-C	Noise Data – NP Series Vacuum Pumps				
Pump Model	2620	2480	2370	2200	2160
Speed Range (RPM)	180 - 277	200 - 327	200 - 327	200 - 327	200 - 327
Overall Sound Pressure Level dBA	82 – 97*	80 – 96*	79 – 93*	76 – 90*	76-89*
Overall Sound Power Level dBA	84 – 105*	82.5 – 104*	82 – 100*	N/A	N/A

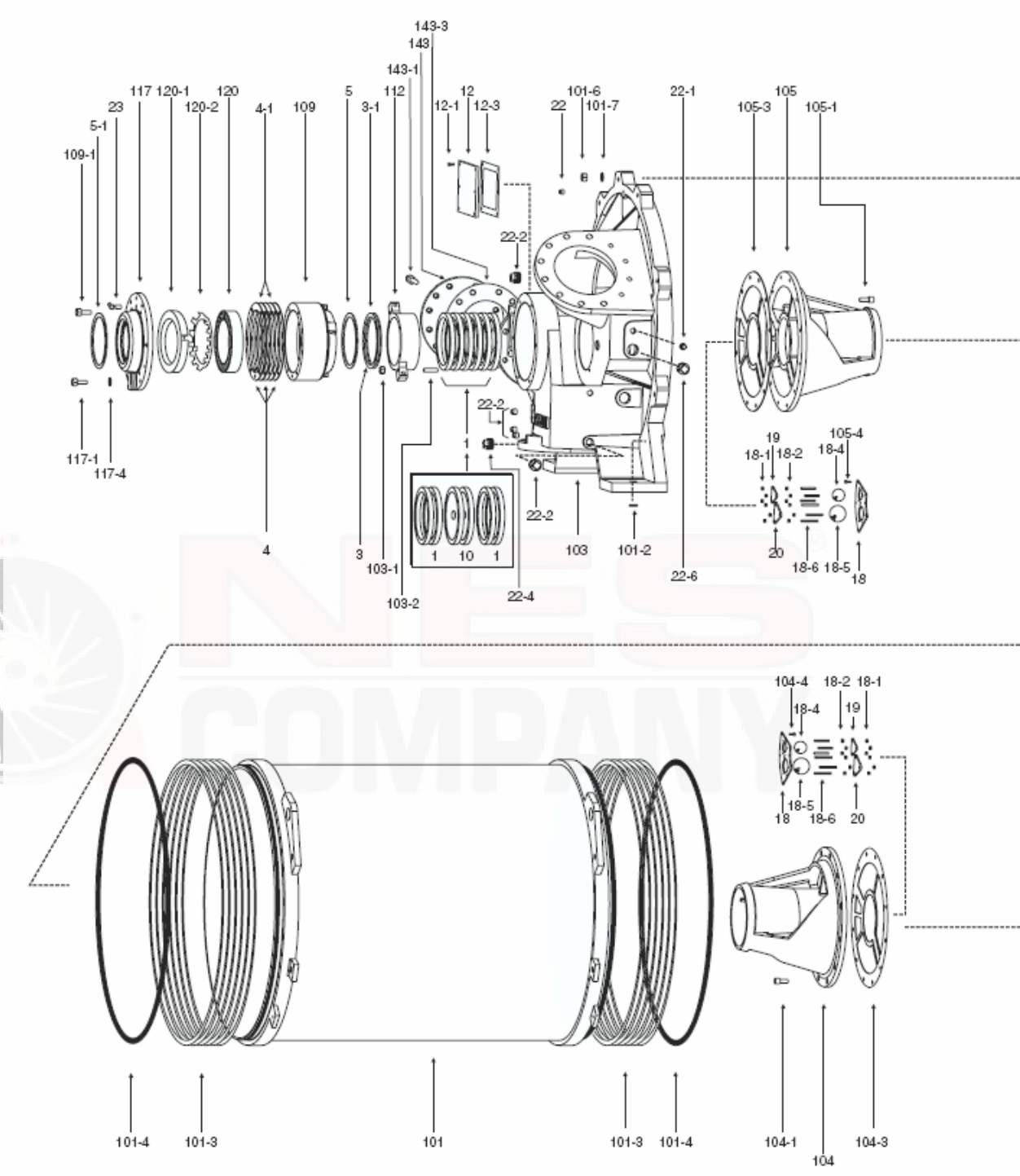
N/A Not Available

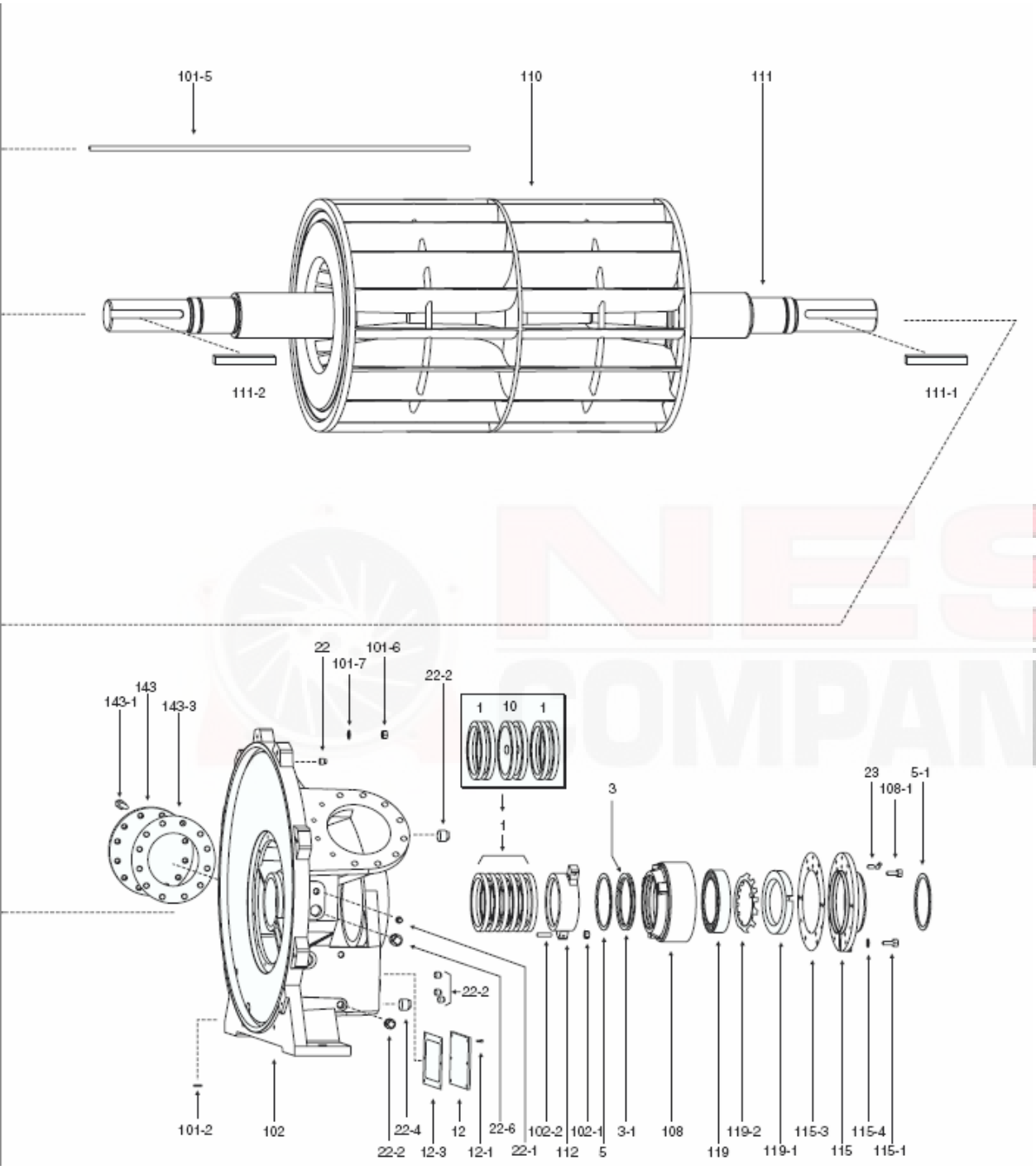
*Anticipated

Table 8D	Parts List – NP Series				
Index No.	Qty.	Part Name	Index No.	Qty.	Part Name
*1	12 Rings	Packing	102	1	Floating End Head
*3	2	Slinger	102-1	2	Gland Nut
3-1	2	Spring	102-2	2	Gland Stud
*4	AR	Shim	103	1	Fixed End Head
*4-1	AR	Shim Gasket	103-1	2	Gland Nut
*5	2	Lip Seal, Inner	103-2	2	Gland Stud
*5-1	2	Lip Seal, Outer	104	1	Floating End Cone
**10	2	Lantern Gland	104-1	12	Cone Screw
12	2	Cover Plate	*104-3	1	Cone Gasket
12-1	12	Cover Plate Screw	105	1	Fixed End Cone
*12-3	2	Cover Plate Gasket	105-1	12	Cone Screw
18	2	Ball Check Plate – Fixed Bearing End / Floating Bearing End	*105-3	1	Cone Gasket
			108	1	Floating Bearing Cartridge
18-1	***24	Stop Plate Nut	108-1	6	Bearing Cartridge Screw
18-2	***12	Stud Nut	109	1	Fixed Bearing Cartridge
18-4	2	Upper Ball – Fixed Bearing End & Floating Bearing End	109-1	6	Fixed Cartridge Screw
			110	1	Rotor
18-5	2	Lower Ball – Fixed Bearing End & Floating Bearing End	111	1	Shaft
			111-1	1	Drive End Shaft Key
18-6	***12	Ball Check Stud	111-2	1	Double Extended Shaft Key
19	***2	Stop Plate, Upper – Floating & Fixed End	112	2	Gland Assembly
			115	1	Floating End Bearing Outer Cap
20	***2	Stop Plate, Lower – Floating & Fixed End	115-1	6	Outer Cap Screw
			*115-3	1	Outer Cap Gasket
104-4	9	Ball Check Plate Screw – Floating End	115-4	3	Outer Cap Lockwasher
105-4	9	Ball Check Plate Screw – Fixed End	117	1	Fixed End Bearing Outer Cap
22	***2	Pipe Plug – Body Vent	117-1	6	Outer Cap Screw
22-1	***8	Pipe Plug – Vacuum Gauge Location	117-4	3	Outer Cap Lockwasher
22-2	***8	Pipe Plug – Head Drains	*119	1	Floating End Bearing
22-4	***2	Pipe Plug – Body Drains	*119-1	1	Floating End Bearing Locknut
22-6	2	Pipe Plug – Spray Nozzle Location	*119-2	1	Floating End Bearing Lockwasher
23	2	Grease Fitting Assembly	*120	1	Fixed End Bearing
101	1	Body	*120-1	1	Fixed End Bearing Locknut
101-2	2	Body / Head Locating Pin	120-2	1	Fixed End Bearing Lockwasher
*101-3	17	Body Gasket	143	2	Blank Flange
*101-4	***2	Body O Ring	143-1	24	Flange Screw
101-5	10	Axial Rod	*143-3	2	Flange Gasket
101-6	20	Rod Nuts			
101-7	20	Rod Washers			

AR – As Required
* Minimum Recommended Spares
** When Used
*** Number may vary with different pump models

Figure 8.1 Exploded View of the NP series




101-5
110
111
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143-3
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3
23
108-1
5-1
22-2
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102
22-4
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12
12-1
22-6
22-1
102-2
112
102-1
5
3-1
108
119
119-2
119-1
115-3
115
115-4
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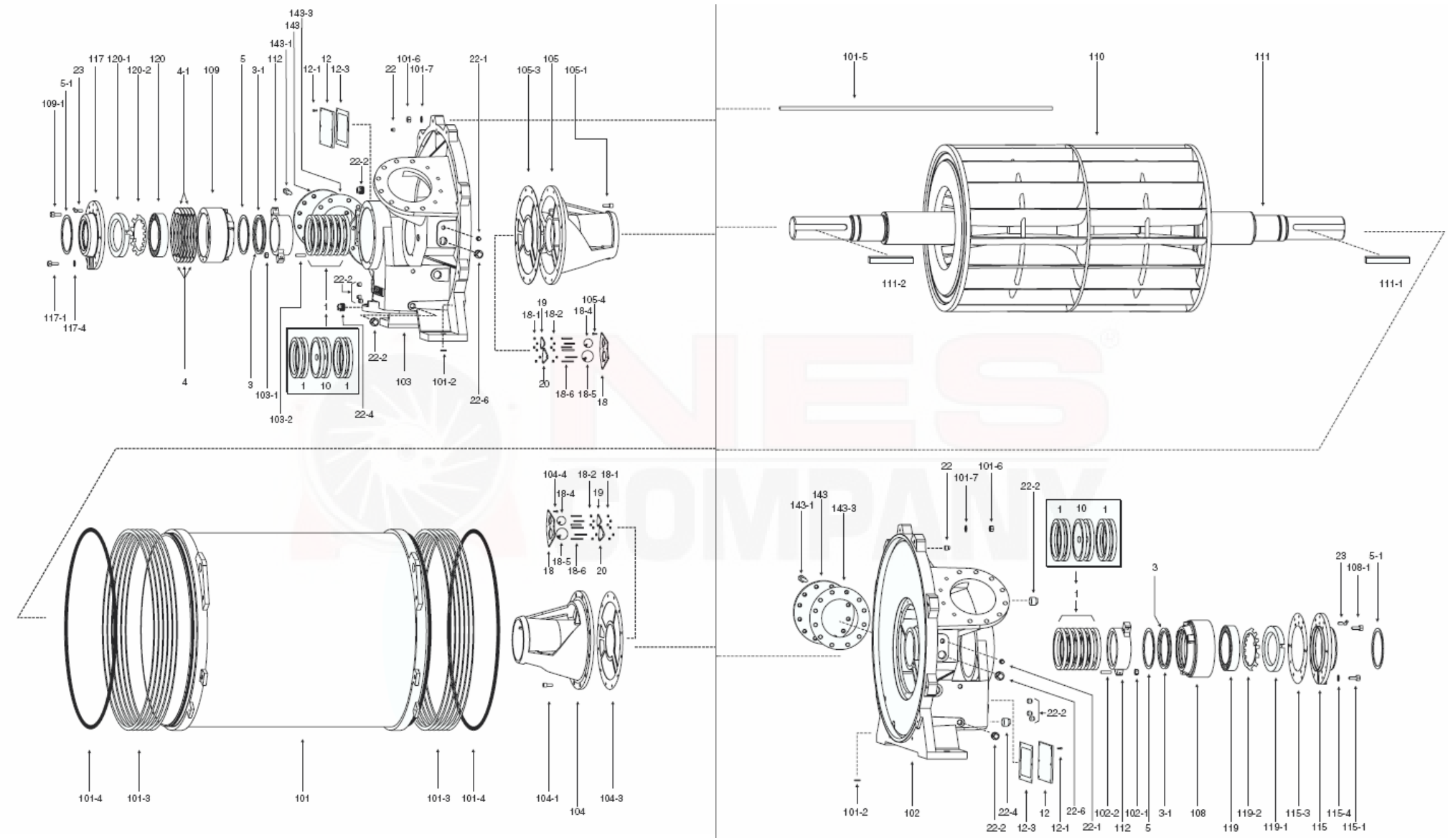
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