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 NHF Series Vacuum Pumps

NES COMPANY

WARNING

Do not operate PUMP before it is 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 or using corrosive liquid compressant nor will clause (4) apply to goods that 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, THAT EXTEND 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 the 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.

6. Please make sure that you have identified the correct port for the INLET of the pump as well as that of the OUTLET of the pump.

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Section 1 - INTRODUCTION

1.1 HOW THE UNIT WORKS

Figures 1.1 illustrate the primary functional components of the NES NHF pumps. In NHF models, an external motor drives the assembly through a pedestal. The rotor is situated within a chamber formed by the casing of a lobe. Seal liquid, typically water enters the lobe's chamber through an inlet in the head or cone.

The pump's sequence of actions is depicted in Figure 1.2, facilitated by the offset alignment of the body casing axis with the rotor axis. The rotational motion of the liquid within the pump serves as a compressant for the gas in the pump. Furthermore, the liquid compressant functions as a seal, effectively preventing gas leakage into the atmosphere.

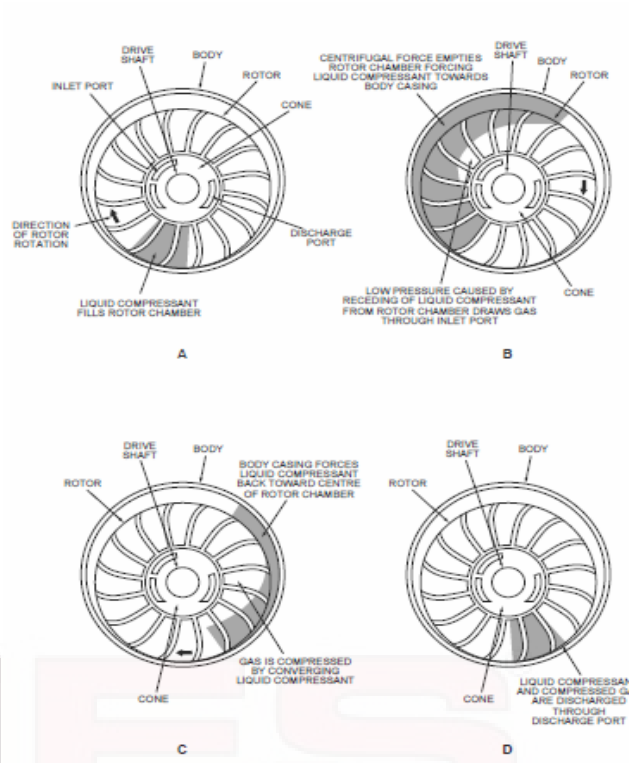


Fig. 1.2 Liquid Compressant and Air Flow

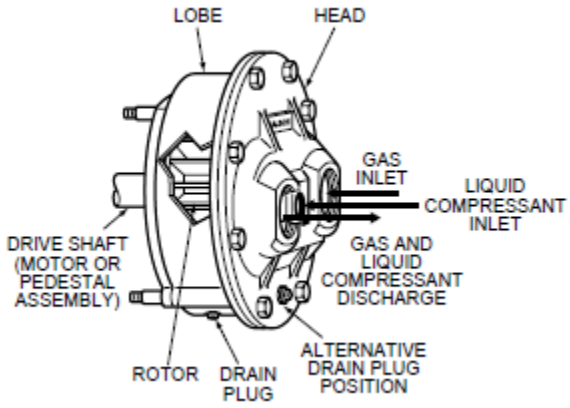


Fig. 1.1 Functional Elements of NES NHF Two-Stage Vacuum Pump

1.2 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. Typically, pumps and their drive motors are shipped from the factory pre-mounted on a base, with the coupling halves separated or v-belts removed. This precaution is taken to prevent damage caused by the movement of the base during transportation. Parts of the coupling assembly are packaged in a bag securely attached to the shaft beneath the coupling guard or placed in a separate container affixed to the pump's shipping crate.

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.

c. When handling the pump, lift it at four or more points on the base. If the pump is supplied with a soleplate or supplied without a base or soleplate then utilize flat belt slings around the lobe close to the pedestal or motor flange. Raise the pump slightly to assess its balance point. If the pump does not lift evenly and horizontally, adjust and reposition the sling until balance is achieved.

WARNING!

ENSURE THAT THE LIFTING SLINGS USED ARE IN A SERVICEABLE CONDITION AND SUITABLE FOR THE MASS OF THE UNIT BEING LIFTED.

Refer to Table 5.1 or the Installation/General Arrangement drawing for the mass of the pump and accessories supplied with your order.

d. The shaft of the drive (motor, gear reducer, turbine, etc.) is not aligned with the pump shaft upon receipt. Correct alignment can only be achieved after leveling the base and securing it to its permanent foundation, along with making all necessary pipe connections to the pump. NES Engineering Company does not provide this service unless an NES Field Service Technician is specifically requested.

e. If the pump and driver are not intended for immediate installation and operation upon receipt, it is advisable to store them in a clean, dry environment. Periodically rotate the pump shaft every two weeks to ensure the bearings are adequately coated with lubricant, thereby preventing oxidation and corrosion. Although the pump is flushed with a water-soluble preservative oil before shipment, detailed storage procedures can be found in Section 8 for reference.

Section 2 - SERVICES REQUIRED

2.1 PIPING (GENERAL REQUIREMENTS)

NOTE

CONSULT THE NES INSTALLATION OR ARRANGEMENT DRAWING(S) PROVIDED WITH THE PUMP FOR PRECISE PIPING REQUIREMENTS.

a. INLET PIPING (refer to Figure 2.1):

Connect the vacuum pump inlet to the process using a full-size connection. Connect the compressor inlet to the process or the atmosphere if it's utilized as an air compressor, ensuring a full-size connection. In cases where atmospheric inlets are used, it's advisable to employ an inlet silencer, which can be provided upon request. To prevent any reduction in volume flow due to lengthy inlet piping runs, adhere to the following guidelines.

Pump Inlet Size (Inches)	Piping Run (Feet)	Use next largest std. pipe size for whole piping run.
1.96	>75.45	
>1.96	>150.91	

WARNING!

ACCESSIBLE OPEN INLET PIPING MUST BE GUARDED TO PREVENT ACCIDENTAL INJURY RESULTING FROM BODILY CONTACT WITH THE PUMP SUCTION.

CAUTION!

OPEN INLET PIPING CREATES AN ADDITIONAL NOISE HAZARD AT THE POINT OF AIR ENTRY. FOR PERMANENT INSTALLATIONS, AN INLET SILENCER SHOULD BE FITTED. DURING COMMISSIONING WITH OPEN INLETS, EAR PROTECTION SHOULD BE WORN.

b. STRAINER (refer to Figures 2.1 and 2.2):

Install a strainer in all liquid seal lines upstream of the pump to prevent dirt and other foreign matter from entering the pump during operation. In cases where a significant amount of foreign matter may be entrained in the seal liquid, it may be necessary to incorporate a cleanout or dirt pocket to facilitate the rapid filling of the strainer element. For systems with recirculated seal liquid, ensure that a strainer is positioned in the return line from the air/water separator.

CAUTION!

FAILURE TO PREVENT FOREIGN MATTER FROM ENTERING THE PUMP VIA THE SEAL LIQUID INLET CAN LEAD TO RAPID WEAR, REDUCING THE PUMP'S LIFESPAN. THE ENTRY OF LARGE PARTICLES INTO THE PUMP MAY RESULT IN THE SUDDEN STOPPAGE OF THE PUMP AND DRIVER.

c. Check Valves (refer to Figure 2.1 & 2.2):

Install check valves exclusively in horizontal piping.

Ensure that check valves are installed with the correct flow direction as indicated in the specified mounting position. Check valves should be of the low-pressure drop/light or balanced flap type to minimize performance loss.

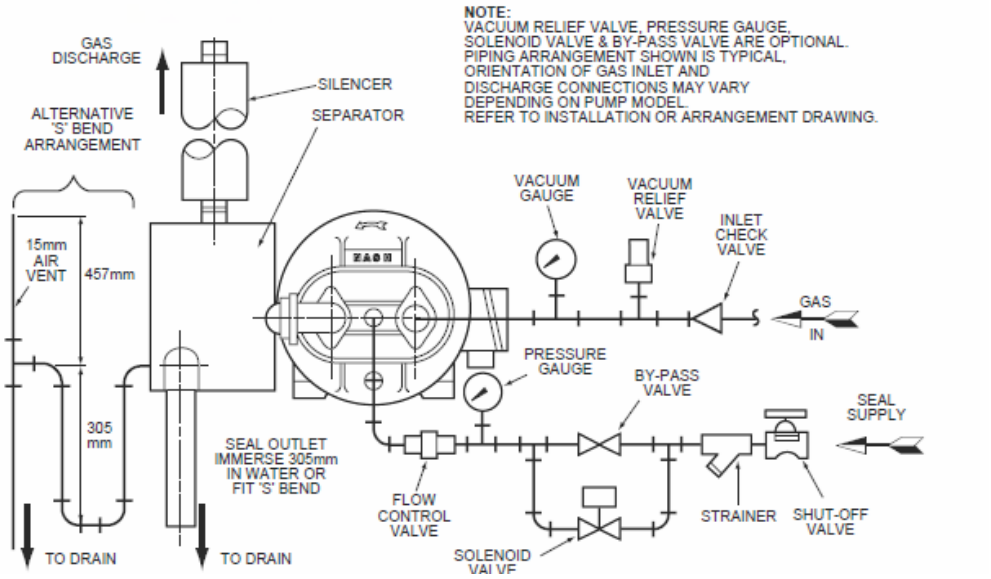


Figure 2.1. Typical Vacuum Pump Piping Connections

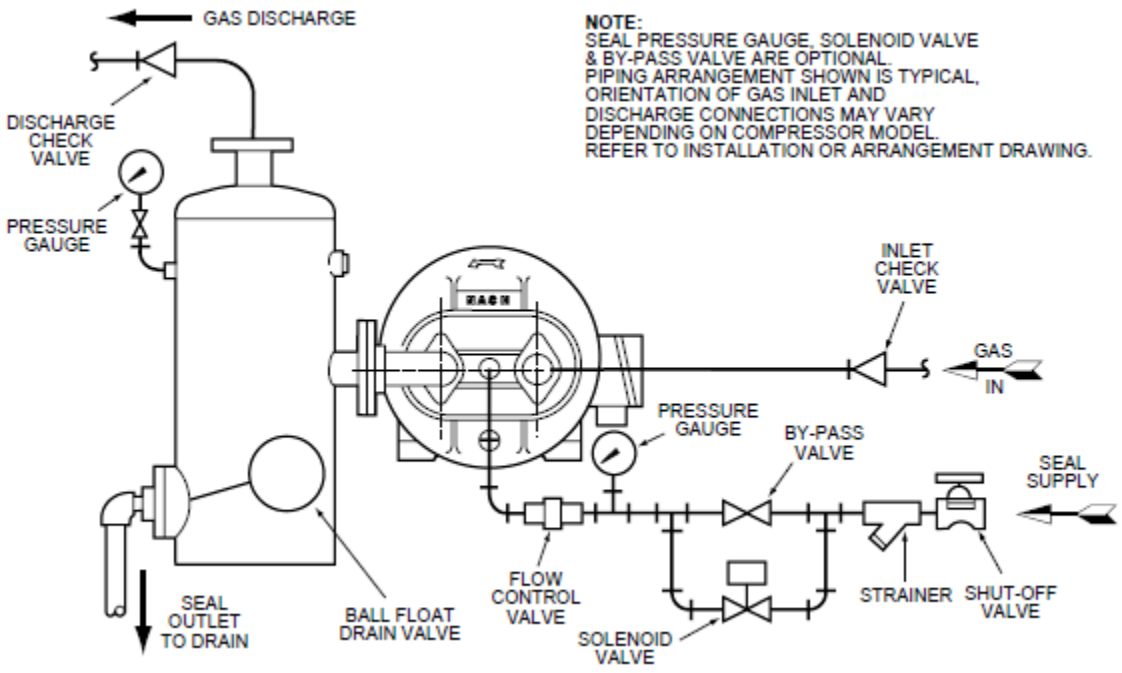


Figure 2.2. Typical Compressor Piping Connections

NOTE

WHEN AN INLET MANIFOLD IS SUPPLIED, A SINGLE SCREEN WILL BE FITTED ON THE MANIFOLD INLET FLANGE.

CAUTION!

FAILURE TO PREVENT FOREIGN MATTER FROM ENTERING THE PUMP VIA THE PUMP SUCTION CAN CAUSE RAPID WEAR OR SERIOUS DAMAGE. THE ENTRY OF LARGE PARTICLES INTO THE PUMP MAY RESULT IN THE SUDDEN STOPPAGE OF THE PUMP AND DRIVER.

CAUTION!

THE USE OF AN UNSUITABLE INLET CHECK VALVE MAY LEAD TO THE VACUUM PUMP OPERATING AT SUCTION PRESSURES OUTSIDE THE RECOMMENDED RANGE. THIS CAN RESULT IN ABNORMAL WEAR AND INCREASED OPERATING NOISE.

d. CHECK VALVES (refer to Figure 2.1):

Install check valves exclusively in horizontal piping. Ensure proper installation with the correct direction of flow in the specified mounting position. Opt for low-pressure drop, light, or balanced flap check valves to minimize performance loss. If necessary, NES can provide suitable valves upon request; please contact your NES Engineer.

2.1.1 VACUUM PUMP DISCHARGE PIPING

a. Vacuum pump discharge piping should be full size from the pump to a suitable separating system (see Figure 2.1). The discharge piping between the pump and the separating system should not rise above the centerline of the pump discharge connection unless specifically indicated on the Installation or Arrangement drawing. It is recommended to fit an elbow between the separating system and the pump discharge for inspection purposes. The discharge of seal liquid from the vacuum pump separator should flow by gravity to a suitable drain. Pipe sizes must be sufficient to prevent water buildup in the separator, which may reduce gas/water separation efficiency. The air discharge from the top of the vacuum pump separator should be piped full size to a venting location or equipped with a discharge silencer.

CAUTION!

SLIGHT CARRY-OVER OF WATER DROPLETS INTO THE AIR DISCHARGE FROM THE TOP OF THE SEPARATOR MAY OCCUR WHEN THE VACUUM PUMP OPERATES AT HIGH SUCTION PRESSURES OR WITH LARGE AMOUNTS OF WATER ENTERING THE PUMP SUCTION. THIS MAY CAUSE SLIGHT WETTING OF FLOOR SURFACES, WHICH CAN BE AVOIDED BY PIPING TO A SUITABLE VENTING LOCATION.

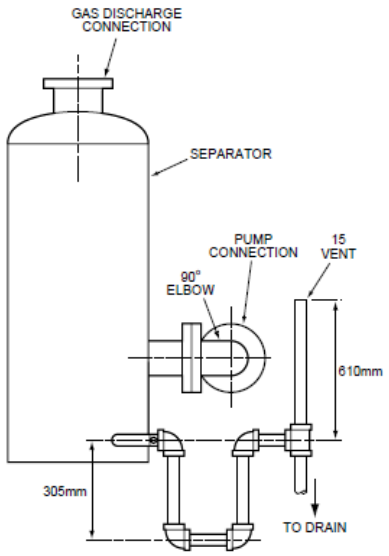


Fig. 2.2. Water Drain 'S' Bend Connected to Vacuum Pump Separator

2.1.2 COMPRESSOR DISCHARGE PIPING

Pipe the compressor discharge fully to a separator positioned as close to the compressor as feasible (refer to Figure 2.2). The discharge line leading to the compressor separator should not ascend above the center line of the compressor discharge unless explicitly indicated on the installation or arrangement drawing.

2.2 LIQUID COMPRESSANT (SEAL WATER)

a. Liquid Compressant (usually water):

A sufficient quantity of liquid compressant, typically water, is essential for proper pump operation. It should be maintained at a minimum pressure as specified in Table 2-1. Optimal pump performance is usually achieved when the coolest available water is used.

b. Refer to Section 6.2:

For comprehensive details on seal liquid requirements and recommended control methods, please refer to Section 6.2.

Type of Service	*Minimum Pressure in bar g at Pump Connections
Vacuum Pump Recirculated Pump (NES Supplied Heat Exchanger)	0.7 0.35 pressure drop across the heat exchanger
*Indicated pressure is that required at pump connections. Normally, certain controls will be required ahead of this connection to start and stop the flow of water and to assist in the adjustment of water quantities. When these additional controls are used, the pressure drop through these controls must be added to the pressure required at the vacuum pump. Add the following to pressures at the vacuum pump in order to determine the necessary minimum supply pressure.	
Orifice Control:	0.7
Flow Control Valve:	1.0
Solenoid Control Valve:	0.7
Example: A vacuum pump with a seal water flow control and a solenoid control valve:	
Pressure at Vacuum Pump:	0.7
Flow Control Valve:	1.0
Solenoid Valve:	0.7
Total:	**2.4**
Thus, the minimum supply pressure required for this vacuum pump is 2.4 bar g.	

Table 2-1. Seal Water Minimum Pressure

2.3 DRAINS

Drains must be sized to allow gravity flow from separators at a rate equivalent to that supplied to the pump. If the anticipation of liquid carry-over from the system to the pump exists, this quantity must also be considered in sizing the drains.

CAUTION!

IF THERE IS ANY RISK THAT THE DISCHARGED SEAL LIQUID MIGHT BE CONTAMINATED BY THE PROCESS OR MAY BE UNACCEPTABLE FOR DISCHARGE INTO DRAINS ACCORDING TO NATIONAL AND LOCAL REGULATIONS, TESTS SHOULD BE CONDUCTED BY AN AUTHORIZED, COMPETENT BODY PRIOR TO COMMISSIONING. NO LIQUIDS SHOULD BE ALLOWED TO PASS INTO DRAINS THAT MAY VIOLATE REGULATIONS IN FORCE.

2.4 POWER SUPPLY

a. Voltage Matching:

The available voltage must match the motor nameplate data and that indicated for solenoid valves, if supplied or required.

b. Solenoid Valve Voltage:

Note that solenoid valve voltage requirements may differ from the motor voltage.

c. Starter and Supply Lines:

Starter and supply lines must be appropriately sized to match power requirements.

WARNING!

ALL ELECTRICAL INSTALLATION WORK SHOULD BE CARRIED OUT BY A QUALIFIED ELECTRICIAN.

Section 3 – INSTALLATION

3.1 LOCATION

a. The pump should be situated in a location that is easily and entirely accessible, shielded against flooding, freezing, excessive moisture, and overhead dripping. Adequate provisions should be made to facilitate proper piping arrangement and dismantling. The chosen location should allow sufficient clearance as specified on the NES Installation or Arrangement drawing(s) provided with your unit. Alternatively, overhead lifting equipment can be utilized to transfer the pump to a workshop.

3.2 FOUNDATION

a. The foundation must provide a rigid support for the pump to maintain proper alignment. It should be placed on hard, compacted soil or on piles driven to a depth ensuring they rest on solid, compacted soil.

b. Create pockets at each foundation bolt position to accommodate the foundation bolts or as specified on the supplied Installation or Arrangement drawing. This can be achieved using styrofoam or equivalent materials or by constructing removable wooden boxes.

c. Pour concrete to a height within 13 to 38mm of the finished foundation level (refer to Figure 3.1).

d. Allow the concrete to set. Position the foundation bolts in the base or pump soleplates, ensuring they hang freely when lifted. Align the base or pump so that the bolts enter the foundation pockets and lower onto packing plates or shims set at the finished foundation height. Fill the pockets with concrete to secure the foundation bolts in the correct positions. Allow the concrete to set before removing the base for final leveling and installation.

3.3 SETTING BASE, SOLEPLATES OR PUMP

a. Ensure that bases are specifically designed to provide robust support for both the pump and drives, offering rigid support at all foundation bolt locations.

b. Soleplates are intended to elevate motor-mounted pumps above the foundation level. In cases where a soleplate is not provided, it might be required to raise the foundation beneath the motor feet. Please consult the installation or arrangement drawing(s) provided with your unit by NES for guidance.

c. When pumps are installed without a base or soleplate, ensure they are rigidly supported on a smooth surface, with each foot leveled appropriately.

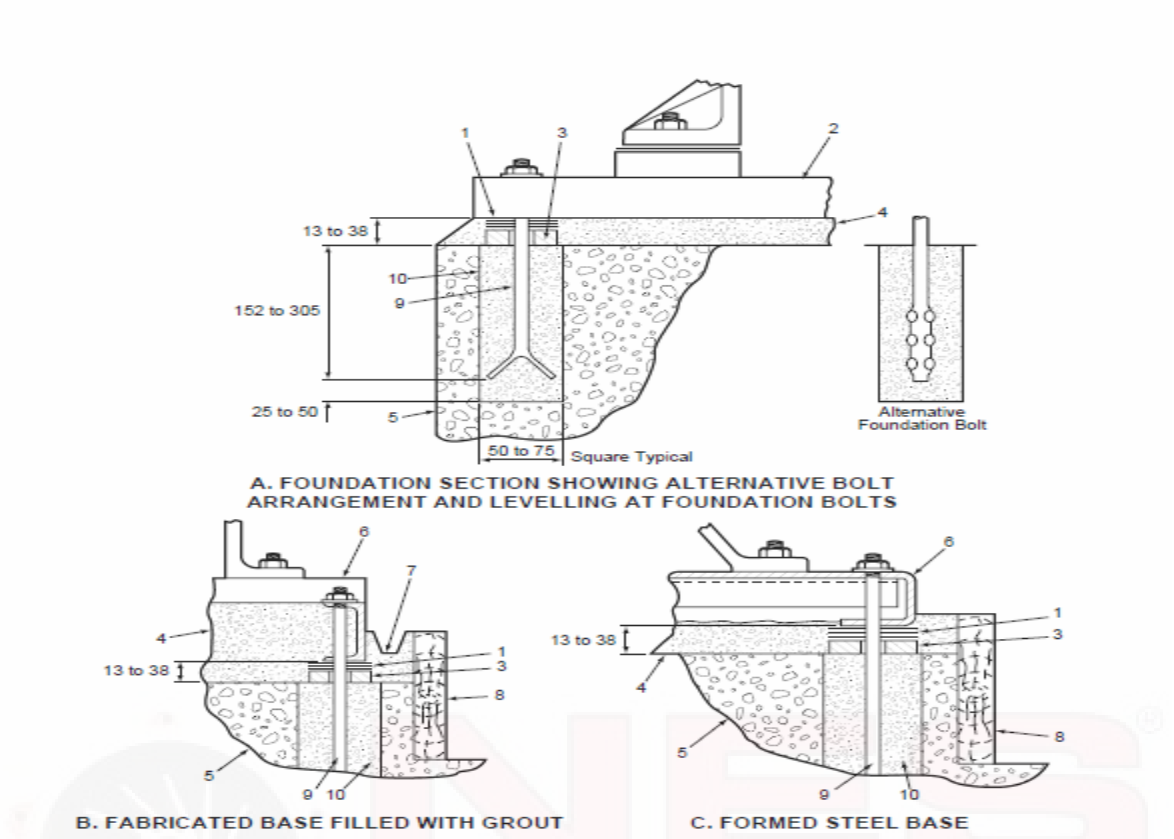
d. After verifying and leveling the foundation bolt locations, proceed to install the base or pump carefully.

In cases where soleplates are used, position the pump and soleplate on the foundation, making necessary shims under the foundation bolts. For final leveling and shimming, remove the pump from the soleplates (refer to Figure 3.2).

e. Before tightening the foundation bolts, place shims under each bolt as illustrated in Figure 3.1.

f. Ensure that the foundation bolt nuts are tightened evenly.

g. With soleplates and bases in place, confirm that the final coupling or v-belt drive alignment can be successfully established. For guidance, refer to Section 3.7 or 3.8 as applicable.



Note: Dimensions are in mm

Figure 3.1 Foundation Bolt Installation and Grouting

WARNING!

ALL LIFTING OPERATIONS SHOULD BE CARRIED OUT EXCLUSIVELY BY COMPETENT PERSONNEL WHO ARE TRAINED IN THE PROPER USE OF LIFTING EQUIPMENT. IT IS CRUCIAL TO ENSURE THAT ALL LIFTING EQUIPMENT IS IN A SERVICEABLE CONDITION AND DEEMED SUITABLE FOR THE MASS INTENDED TO BE LIFTED. FAILURE TO ADHERE TO THESE PRECAUTIONS MAY RESULT IN SERIOUS INJURY OR EQUIPMENT DAMAGE.

NOTE

REFER TO TABLE 5.1 FOR THE MASS OF THE PUMP. ADDITIONALLY, FOR THE MASS OF ACCESSORIES, CONSULT THE INSTALLATION OR ARRANGEMENT DRAWING(S) PROVIDED WITH YOUR ORDER.

3.4 GROUTING

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

3.5 PIPE INSTALLATION

NOTE

THE PUMP IS DISPATCHED WITH THREAD AND FLANGE PROTECTORS PRE-INSTALLED IN ALL OPEN CONNECTION POINTS TO SAFEGUARD THE PUMP FROM DAMAGE. TO ENSURE A CLEAN INSTALLATION AND PREVENT THE ENTRY OF CEMENT DUST AND OTHER DEBRIS, IT IS ESSENTIAL TO REMOVE THESE PROTECTORS. THIS REMOVAL SHOULD BE PERFORMED AFTER COMPLETING ALL FOUNDATION WORK BUT BEFORE MAKING ANY PIPING CONNECTIONS.

a. Refer to the NES Installation or Arrangement drawing(s) supplied with the pump for specific piping requirements.

b. Consult Section 2.1 for general piping requirements.

c. When connecting piping to the pump, ensure it is done without strain, as pipe strain on pump castings may lead to challenging-to-trace problems once the pump is in operation. Obtain permissible flange loadings from your NES Engineer.

CAUTION!

PIPING MUST BE INSTALLED IN A MANNER THAT ALLOWS CONNECTION TO THE PUMP WITHOUT CAUSING SPRINGING OR PULLING ON THE PIPING AND WITHOUT TRANSMITTING EXCESSIVE STRAIN TO THE PUMP. CONSIDERATION MUST BE GIVEN TO THERMAL EXPANSION, BENDING, AND TORSIONAL MOMENTS IN THE DESIGN OF PIPING CONNECTIONS AND SUPPORTS.

d. Use dirt pockets as an inexpensive form of insurance to protect the pump from the entry of pipe scale, welding shot, and foreign material present in the inlet piping.

CAUTION!

Failure to prevent foreign matter from entering the pump via the pump suction can lead to rapid wear or severe damage. Additionally, the ingress of large particles into the pump may cause an abrupt stoppage of both the pump and the driver.

e. Flexible piping connections are necessary for installations where the pump is mounted on a vibration isolation base.

h. If the separator water discharge is not via a sealed pipe system or immersed in a water tank or sump, it should be fitted with an 'S' bend configuration as shown in Figure 2.1.

i. 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.

3.6 PUMP DRIVES (GENERAL)

a. Typically, NES pumps are powered by electric motors, predominantly of the induction type.

b. The drive is conveyed either directly through a flexible coupling or via a V-belt drive.

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.

3.7 COUPLING ALIGNMENT

a. Couplings may be provided separately and need to be fitted after the installation of the pump and driver. When a pump and driver are supplied mounted on a base, the couplings are typically pre-fitted on the shafts, but the drive pins or driving elements are removed for shipment.

CAUTION!

WHEN COUPLING HALVES ARE FITTED TO THE PUMP AND DRIVER SHAFTS, AS SUPPLIED, IT IS CRUCIAL TO CONDUCT THE COUPLING ALIGNMENT CHECKS BELOW BEFORE FITTING THE DRIVING PINS OR DRIVING ELEMENT AND OPERATING THE MOTOR.

b. Standard NES-supplied couplings typically include taper-locking type bushes fitted in each coupling half, facilitating easy installation and removal.

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!

COUPLINGS SHOULD NEVER BE FORCED ONTO THE PUMP OR DRIVER SHAFTS. IF A SLIP FIT IS NOT ACHIEVED, EXPAND THE COUPLING HALF BY HEATING IT TO A MAXIMUM TEMPERATURE OF 302°F. DO NOT FORCE THE COUPLING HALF, AS DOING SO MAY CAUSE DAMAGE TO THE PUMP OR DRIVER BEARINGS, OR THE PUMP'S INTERNAL SURFACES OR PARTS.

NOTE

A FLEXIBLE COUPLING ALLOWS FOR SOME DEGREE OF MISALIGNMENT, SUCH AS THAT CAUSED BY TEMPERATURE CHANGES OR OTHER VARIATIONS FOR A SHORT PERIOD. HOWEVER, CONTINUOUS OPERATION REQUIRES THE COUPLING TO BE IN ALIGNMENT UNDER ALL CIRCUMSTANCES.

CAUTION!

EXCESSIVE MISALIGNMENT LEADS TO WEAR, VIBRATION, AND LOADS THAT RESULT IN PREMATURE BEARING FAILURE, MECHANICAL SEAL WEAR, OR THE EVENTUAL SEIZING OF THE PUMP.

d. APPROXIMATE ALIGNMENT

Conduct an approximate alignment before attempting the final alignment, as follows:

d-1. Level the base (using shims) and securely fasten it to its permanent foundation at all foundation locations. Refer to Section 3.3.

d-2. Roughly align the pump and driver shaft centerlines in the horizontal plane (make them straight enough) so that final alignment adjustments can be made at the driver only.

d-3. Roughly align the pump and driver shaft centerlines in the vertical plane (make them level enough) so that final alignment adjustments can be made at the driver only. It may be necessary or desirable to shim the feet of the pump to achieve adequate elevation.

NOTE

PUMPS DRIVEN BY GEAR REDUCERS AND/OR MOTORS NOT SUPPLIED BY NES SHOULD BE INSTALLED SO THAT THE CENTERLINE OF THE DRIVEN SHAFT IS APPROXIMATELY 0.8 TO 1.6MM HIGHER THAN THE CENTERLINE OF THE DRIVER SHAFT. THIS ALLOWS FINAL ALIGNMENT AS DETAILED IN SECTION 3.7E.

d-4. On couplings with taper-locking bushes secured by set screws, adjust the coupling gap to that specified on the Installation or Arrangement drawing supplied with your order.

CAUTION!

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

d-5. Check coupling halves to ensure that the coupling fit to the shaft is not too loose. A loose fit (when used) should not have a diametral clearance greater than 0.10mm, or excessive stresses may cause premature key and keyway failures.

NOTE

THE GAP BETWEEN THE SHAFTS SHOULD BE NO LESS THAN THE COUPLING GAP. IF COUPLING HALVES MUST BE OVERHUNG, IT IS GOOD PRACTICE TO OVERHANG BOTH HALVES BY AN EQUAL AMOUNT (REFER TO THE INSTALLATION OR GENERAL ARRANGEMENT DRAWING).

d-6. When inserting shims under the motor's feet, sandwich the thinner shim layers between thicker layers to prevent bending and create even footings.

WARNING!

THE SHIMS MAY BE EXTREMELY SHARP. WEAR GLOVES WHEN CUTTING AND FITTING SHIMS IN PLACE.

d-7. Securely fasten the pump to the base after accomplishing rough alignment in both the vertical and horizontal planes and achieving the proper coupling gap.

d-8. Make all final piping connections to the pump after accomplishing rough alignment and before performing the final alignment.

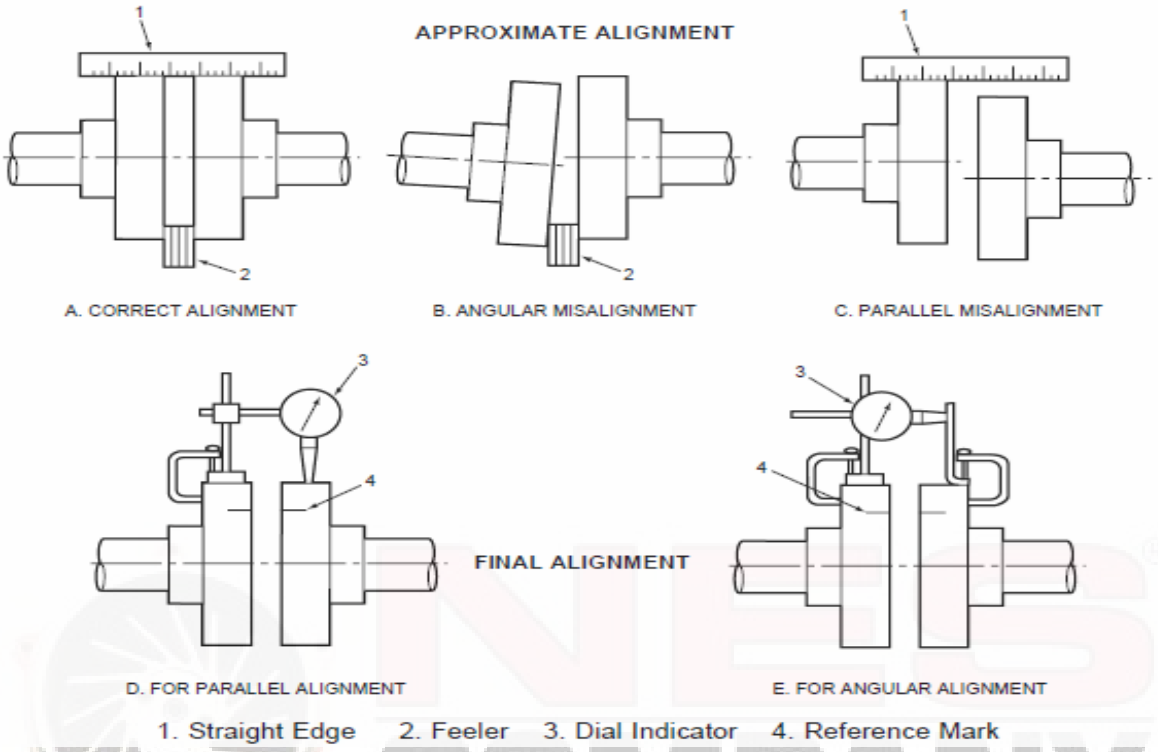


Figure 3.2 Approximate and Final Coupling Alignment Methods

e. FINAL ALIGNMENT

After completing the approximate alignment, proceed with the final alignment using a dial indicator (refer to Figure 3.3). It is crucial to shim the driving unit for final alignment.

e-1. Mark a reference or benchmark on the outside diameter of both coupling halves.

e-2. If necessary, separate the coupling halves and install a dial indicator as illustrated in Figure 3.2 for angular alignment. Use a small V-block magnetic mount or a strap-type dial indicator mount for the best attachment method.

e-3. Rotate both shafts simultaneously and note the highest and lowest dial indicator readings. Ensure that the reference marks on both coupling halves remain in alignment during the dial indicator readings.

NOTE

ALWAYS MAINTAIN ALIGNMENT OF THE REFERENCE MARKS ON BOTH COUPLING HALVES WHEN RECORDING DIAL INDICATOR READINGS.

e-4. Shim and position the driver unit, repeating the third step until the readings are within (less than) 0.10mm of the total dial indicator reading for a complete revolution of the shafts. Ensure that the dial indicator reading is a maximum of 0.05mm on each side.

e-5. After completing the angular alignment in steps e-2 through e-4, reattach the dial indicator for parallel alignment, following the procedure in Figure 3.2. Repeat steps 3 and 4.

e-6. Once steps 1 through 5 are finished, securely tighten the unit to the base and recheck both angular and parallel alignments until the

requirements of step 4 are met for both angular and parallel alignment.

e-7. Verify the coupling gap for the coupling halves to ensure it is within the recommended value.

e-8. Reset the coupling gap if necessary and fully tighten all set screws.

Post Alignment

Upon completing the final alignment procedure, follow these steps:

f-1. Install coupling pins or other applicable driving elements specific to the coupling type.

f-2. Fully tighten nuts and set screws uniformly.

Important: Special couplings tailored to customer specifications include manufacturer's instructions. Always consult these instructions during installation, adjustment, and maintenance.

f-3. Install and securely fasten the coupling guard.

WARNING!

DO NOT ATTEMPT TO START THE EQUIPMENT WITHOUT THE PROPERLY INSTALLED AND SECURED COUPLING GUARD. NES ENGINEERING COUPLING GUARDS, WHEN PROVIDED, MEET CURRENT SAFETY STANDARDS. DO NOT MODIFY ANY GUARDS WITHOUT CONSULTING YOUR NES ENGINEER BEFOREHAND.

f-4. During pump operation, monitor for excessive noise and vibration. Improper alignment may cause one or both of these issues.

NOTE

DURING ROUTINE MAINTENANCE AND ANY REPAIR WORK, THOROUGHLY INSPECT FLANGE ALIGNMENT AND RESILIENT ELEMENTS FOR SIGNS OF WEAR.

3.8 V-BELT DRIVE ALIGNMENT

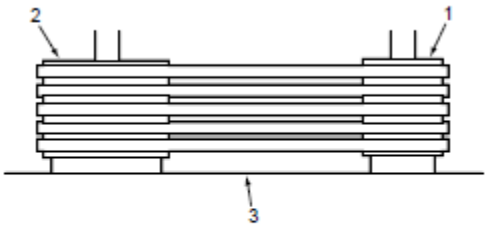
CAUTION!

AVOID FORCING V-BELT SHEAVES ONTO THE PUMP SHAFT. IF THE BUSHING RESISTS SLIDING ONTO THE SHAFT, USE A SCREWDRIVER IN THE SAW CUT TO ALLEVIATE TIGHTNESS. DO NOT EXERT FORCE ON THE SHEAVE, AS IT MAY CAUSE DAMAGE TO BEARINGS OR INTERNAL PARTS OF THE PUMP.

a. Pumps mounted on bases with motor and slide rails provide ample adjustment range for v-belt drive installation and take-up, following specified procedures.

b. When positioning the motor relative to the pump shaft for a v-belt drive, consider belt tightening according to Table 3.1. Check your General Arrangement drawing for any special requirements. The dimensions in this table under SPA, SPB, and SPC represent the minimum distances below the standard center distance for belt installation (refer to Figure 3.4). The dimensions under "minimum take-up allowance" indicate the minimum distances to allow for belt-tightening.

c. V-belts should be factory or field-matched in required sets for optimal performance.



1. Driver Sheave
2. Driven Sheave
3. Straightedge

Figure 3.3 Four-Point V-Belt Alignment

d. Install the V-belts following these instructions:

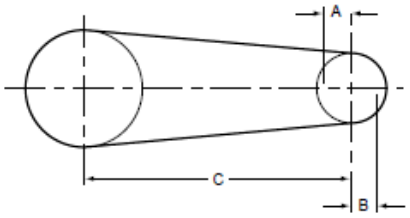
d-1. Place the belt(s) in the grooves without exerting force.

d-2. Align the belt drive using the four-point method with a straightedge. Alignment is achieved when two points (near and far) on the face of each sheave touch the straightedge (see Figure 3.3).

d-3. Determine installation and take-up allowance dimensions by referring to Table 3-1 for the appropriate belt pitch length. Allow for moving the centers closer together by the amount specified in Table 3.1 to facilitate belt installation without damage (refer to Figure 3.4). Account for center adjustment based on the Minimum Take-Up Allowance in Table 3.1 to compensate for manufacturing tolerance, possible stretch, and wear of belts during initial run-in and operation.

INSTALLATION AND TAKE-UP ALLOWANCE TABLE				
Belt Pitch Length (In)	Installation Allowance (In)			Minimum take-up allowance (In)
	SPZ Z	SPA A	SPB B	
16.14 to 20.86				
20.86 to 33.07				0.98
33.46 to 45.66				
46.06 to 59.05	0.78	0.98	1.18	
59.44 to 72.04				1.96
72.44 to 85.43				
85.82 to 111.41				
111.81 to 137.79				

Table 3.1 V-Belt Installation Dimensions



A. Allowance for V-Belt Installation
B. Allowance for V-Belt Take-up
C. Centre Distance

Figure 3.4 V-Belt Centre-Distance Determination

Belt Section	Force Required to Deflect Belt 0.62 inches/Feet of Span		
	Small Pulley Diameter (In)	Newton	Pound force
SPZ	2.20 to 3.74	13 to 20	2.86 to 4.40
	3.93 to 5.51	20 to 25	4.40 to 5.51
SPA	3.14 to 5.19	25 to 35	5.51 to 7.93
	5.51 to 7.87	35 to 45	7.93 to 10.14
SPB	4.40 to 8.81	45 to 65	10.14 to 14.55
	9.29 to 12.40	65 to 85	14.55 to 19.18

Table 3.2 V-Belt Tension

d-4. Measure the span length of the installed belt (dimension D in Figure 3.5).

d-5. Apply a perpendicular force to any ONE of the belts at the center of span D using a spring scale. The force should be sufficient to deflect the belt by 16mm per meter of span length.

d-6. Compare the deflection force from step d-5 with the values in Table 3.2. Initially tighten the belt to the specified value for the run-in period. The ideal tension is the least tension that prevents belt slipping under peak load conditions.

d-7. Reinstall the V-belt drive guard and secure all fasteners.

WARNING!

ALWAYS ENCLOSE V-BELT DRIVES WITH A GUARD BEFORE STARTING THE DRIVER. NES V-BELT GUARDS, WHEN SUPPLIED, ADHERE TO CURRENT SAFETY STANDARDS. DO NOT ATTEMPT TO MODIFY ANY GUARDS WITHOUT CONSULTING YOUR NES ENGINEER.

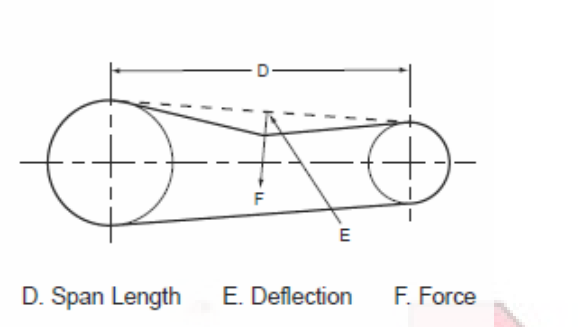


Figure 3.5 Checking V-Belt Tension

d-8. Monitor the tension regularly during the initial 24 to 48 hours, verifying it against the value determined in steps d-5 and d-6. If any changes occur, readjust the belt tension. After 48 hours, stop the driver and recheck the tension. Compare this tension with the value in Table 3-2 and adjust it if necessary.

CAUTION!

EXCESSIVE TENSIONING SHORTENS BELT AND BEARING LIFE.

PRIME THE PUMP AND TURN ON THE SEAL WATER SUPPLY BEFORE STARTING THE PUMP, EVEN TO CHECK THE DIRECTION OF ROTATION.

e. After completing piping connections (Section 3.5), ensure that the pump rotates freely and the v-belt drive turns the pump in the correct direction of rotation. Refer to Section 6 for pump operation.

f. Keep the V-belts free of foreign material at all times and regularly inspect the V-belt drive. Look for:

Small cracks on the V-belt side and base - Generally caused by insufficient belt tension, but excessive heat and/or chemical fumes can also lead to the same failure.

V-belt swelling or softening - Caused by excessive contamination by oil, certain cutting fluids, or rubber solvent.

Whipping during running - Usually caused by incorrect tensioning, primarily on long center drives.

NOTE

STORE V-BELTS IN A DRY STOCKROOM AND CAREFULLY AVOID CONTACT WITH HOT PIPES AND DIRECT SUNLIGHT. WHEN HANDLING, IF POSSIBLE, KEEP THE BELTS LOOSELY IN SINGLE COILS AND REFRAIN FROM TYING THEM WITH THIN STRING.

FOR A DRIVE THAT WILL STAND UNUSED FOR AN EXTENDED PERIOD, IT IS ADVISABLE TO RELAX THE BELT TENSION TO PREVENT BELT DAMAGE. IN SUCH CASES, RE-TENSION THE BELTS BEFORE START-UP.

Section 4 - EXPLOSIVE / HAZARDOUS ENVIRONMENTS

4.1 GENERAL INSTALLATION CONSIDERATIONS

a. Packaged units provided by NES will be equipped with the necessary components to meet safety standards for the relevant process environment, including the pump materials of construction.

WARNING: Before relocating any existing pumps in such environments, discuss the safety aspects of pump construction with your NES Engineer.

b. Bare shaft pumps supplied will necessitate special additional equipment, such as motors, valves, electrical monitoring equipment, etc., designed and certified for such use.

c. Guards for couplings and v-belts should be constructed of non-sparking materials. This can be achieved through either a fully manufactured guard in a suitable material or a specially manufactured guard with additional clearances and non-sparking rubbing strips fitted in selected areas.

d. For v-belt drive installations, it may also be necessary to consider fitting F.R.A.S. belts (Fire-Resistant Anti-Static). These belts are designed to comply with the "fire-resistant anti-static" requirements of B.S.3790 and the National Coal Board Specification Number 244.

If in doubt, seek expert advice from your NES Engineer.

Section 5 - TECHNICAL DATA

5.1 INTRODUCTION

The data given in this section shows the standard for the pump series.

5.2 TECHNICAL DATA CONTENTS

TABLE 5.1 MASS / CONSTRUCTION DATA – NHF VACUUM PUMPS & COMPRESSORS

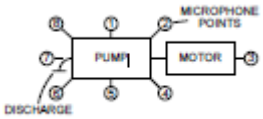
PUMP MODEL	MATERIAL of CONSTRUCTION	TOTAL MASS UNIT DRY (Lb.)	TOTAL MASS UNIT WET (Lb.)	Index No.	MASS of COMPONENT PARTS (Lb.) 103	106	110	301	302
				Part Name	Head	Lobe	Rotor	Pedestal Body	Shaft
NHF 50	CISR	97.44	95.01		18.95	20.06	11.90	27.99	7.93
	St. Steel	100.97	102.95		21.16	22.48	11.90	27.99	8.15
NHF 75	Bronze	94.57	97.88		16.09	18.95	16.97	27.99	7.93
	St. Steel	95.90	99.20		16.53	19.40	17.41	27.99	8.15
NHF 80	CISR	95.01	97.88		18.95	18.95	14.99	27.99	7.93
	Bronze	106.04	108.90		21.16	21.16	14.99	27.99	8.15
NHF 120	CISR	115.08	117.06		24.03	22.04	18.07	31.08	11.90
	St. Steel	126.10	128.08		26.89	24.69	18.07	31.08	12.12

1. CISR = Cast Iron construction with Stainless Steel.
2. St. Steel = stainless Steel construction.

Table 5.2	PUMP MAINTENANCE PARTS DATA			
PUMP MODEL	MECHANICAL SHAFT SEAL		PEDESTAL BEARINGS	
	Non. St. Steel Units	Stainless Steel Units	Drive End	Pump End
NHF 50 & NHF 80	Shaft Dia 1.375	Shaft Dia 1.375	--	--
NHF 75	8”	8”	Lip seal size 1.1x1.9x0.27”	Lip seal size 1.5x2.1x0.27”
NHF 120	Shaft Dia 1.75	Shaft Dia 1.75” Dwg. CF-SP-42110	--	--
For more information, please contact your NES Representative.				

NOISE DATA - AT VACUUM PUMPS				
MAXIMUM READING at PUMP DESIGN SPEED:-				
PUMP MODEL				
	NHF 50	NHF 75	NHF 80	NHF 120
DESIGN SPEED (RPM)	1750	1750	1750	1750
OVERALL SOUND PRESSURE LEVEL “A” Weighted dB(A)	81		75	82
MICROPHONE LOCATION (See diagram below	5		1	5

Note: 1. Sound Pressure Level Ref. 2 x 10-5 N/m2



2. See Diagram for Microphone Location.
3. Microphone Height: 5,25 Ft above floor level.
4. Microphone Points: 3.28 Ft from Unit Envelope
5. ACCESSORIES: Discharge Separator, Silencer

Table 5.3 Noise Data of Vacuum Pump

Table 5.4	**MATERIAL CLASS / STANDARDS - ISO METRIC PRODUCTS**
CATEGORY	INFORMATION
Pump Parts	Relevant British / International Standard for Material(s) of Construction
Gaskets	Non-asbestos
Packing	Non-asbestos
Safety	BS.5304 - British Standard Code of Practice for Safety of Machinery
Pipe Threads	BS.21 - Pipe Threads for Tubes and Fittings where Pressure - Tight Joints are Made on the Threads

SEAL WATER GUIDELINES	
Guidelines for Suitable Water are:-	
Minimum PH	7
Maximum Chlorides	10 ppm
Maximum Total Dissolved Solids	200ppm
Maximum Hardness	200ppm
Note: 1. Water that is not clean or is abrasive should be avoided whenever possible. 2. Extremely hard water may result in the formation of scale deposits within the pump. Such deposits can be removed by periodic treatment or the installation of a water treatment system	

Table 5.5 Seal Water Guidelines

SEAL WATER FLOW RATES		
PUMP MODEL	SPEED (RPM)	FLOWRATE - GPM
NHF 50	ALL	1.5
NHF 75	1450	2
	1750	3
NHF 80	ALL	2
NHF 120	ALL	3

Table 5.6 Seal Water Flowrates

Table 5.7 Lubricating Grease Data

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
BP	Energrease LS2
Shell	Alvania R2
Mobil	Mobilux 2
Esso	Beacon 2
Texaco	Multifak Multipurpose 2
Gulf	Gulfcrown No. 2
Century	Lupus A2
Nynas	Alexol L-42

Section 6 – OPERATION

6.1 PREPARATION FOR INITIAL START-UP

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

6.2 LIQUID COMPRESSANT (SEAL WATER)

a. Normal pump operation requires a supply of clean liquid compressant, typically water, at the correct pressure and flow rate. This water, serving to seal clearances between the rotor and cone(s), is referred to as seal water.

b. If the quality of water intended for use as the liquid compressant (or seal water) is unknown or in doubt, conduct a water analysis, and share the results with an NES Engineer for comments. A general guide to seal water quality requirements is provided in Table 5.5.

Note: Minimum seal water quality depends on operating conditions and pump material of construction. Consult your NES Engineer for assistance.

c. Install a strainer upstream of the pump and any seal water controls to prevent the ingress of solid particles, such as pipe scale (refer to Section 2.1 b).

d. Normal seal water flow rates are outlined in Table 5.6 Variations in flow rate can impact pump performance, and by regulating it, optimal results can be achieved under specific operating conditions. Various methods for correctly regulating seal flow are outlined below:

d-1. Water Meter or Flow Indicator - Install a water meter or flow indicator to show the actual seal water flow rate to the pump. Use a valve or adjusting cock upstream of the meter or flow indicator to regulate the flow as per Table 5.6 requirements.

d-2. Flow Control Valve - A pressure compensating flow control valve (refer to Figures 2.1, 2.2) offers the capability to automatically maintain a consistent seal water flow rate, irrespective of fluctuations in the upstream supply pressure. It's crucial to ensure that the valve operates effectively by maintaining the manufacturer's specified minimum pressure differential across the valve, typically around 14.5 PSIG. A flow control valve is included as part of the standard seal water piping accessory, available for purchase alongside the pump. However, it's important to note that this method of flow control is not suitable for pumps or compressors operating with a recirculated seal water system. In such cases, orifice control, as detailed in Section d-3, is recommended.

d-3. Seal Water Orifice and Pressure Gauge - For controlling seal water flow, a square-edged orifice is a viable option. In once-through seal water systems, it's advisable to install an upstream valve and pressure gauge to facilitate adjustment of the pressure for achieving the desired flow rate. In recirculated seal water systems, an orifice can be positioned in the seal line originating from the separator or reservoir tank to the pump. For guidance in determining the appropriate orifice size, please reach out to your NES Engineer for assistance.

e. For pumps or compressors experiencing high rates of water carry-over (i.e., water entering the pump via the gas inlet), it may be necessary to adjust the seal water flows at the pump seal water connection to levels lower than the standard. Additionally, pumps or compressors operating with seal liquids other than water might require flow rates that deviate from those provided in Table 5.6. In such instances, it is recommended to reach out to your NES Engineer for guidance and assistance.

f. In installations lacking a flow meter, it is advisable to verify the seal water flow rate. This can be accomplished by collecting water

discharged from the separator outlet over a measured period of time and subsequently calculating the flow rate in liters per minute.

CAUTION!

THE FLOW OF THE LIQUID COMPRESSANT MUST BE INITIATED BEFORE STARTING THE PUMP DRIVE MOTOR, EVEN IF THE PUMP IS ONLY BEING OPERATED TO VERIFY THE DIRECTION OF ROTATION.

BOTH STAGES MUST BE PRIMED, AND THE LIQUID COMPRESSANT FLOW MUST BE TURNED ON BEFORE THE PUMP DRIVE MOTOR IS OPERATED, EVEN IF THE PUMP IS ONLY BEING OPERATED TO CHECK THE DIRECTION OF ROTATION.

ENSURE CORRECT REGULATION OF THE LIQUID COMPRESSANT FLOW. EXCESSIVE FLOW MAY INCREASE

POWER ABSORPTION ABOVE DRIVE MOTOR LIMITS AND REDUCE PUMP LIFE THROUGH EROSION.

6.3 DRAINING AND FLUSHING

a. Before shipment, the pump is flushed with specially prepared rust-preventative oil. This oil, forming an emulsion with water, will appear as a milky liquid.

b. Before initiating the pump following the alignment procedure outlined in Section 3, Installation, it's essential to remove the seal water drain plug (Index No. 22, Figures 9-1 to 9-14) from either the head or body of the pump. Next, open the shut-off valve for the seal water supply and allow the seal water to flow until a clear flow is observed from all drains. Despite the pump being flushed with inhibiting oil before shipment, a slight film of rust may develop before installation completion. This film will dissipate after manually rotating the pump shaft a few times. Subsequently, close the shut-off valve for the seal water supply and reinstall the seal water drain plugs using a pipe thread compound.

CAUTION!

IT IS THE RESPONSIBILITY OF THE USER TO DETERMINE IF THIS RUST PREVENTATIVE IS HAZARDOUS WASTE AT THE TIME OF DISPOSAL. PLEASE BE CERTAIN THAT DISPOSAL OF THE MATERIAL IS IN COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. (SEE ALSO SECTION 8, STORAGE AND DISPOSAL.)

6.4 PRELIMINARY INSPECTION

Conduct the following preliminary inspections before starting the pump:-

WARNING!

PERFORM ALL OF THE FOLLOWING STEPS TO ENSURE PERSONNEL SAFETY AND EQUIPMENT PROTECTION.

a. Isolate all power sources to the driver unit to ensure no accidental starting occurs.

b. Inspect the pump to ensure that all drain plugs have been properly installed.

c. Priming the pump manually involves introducing liquid compressant until there is a noticeable flow from the overflow.

d. Inspect the separator, the receiver, and the heat exchanger (if used) to ensure that all shipping plug protectors have been removed and that all open connections have been plugged or piped.

e. Inspect all piping to ensure that proper connections have been made to the pump and its basic system in accordance with the NES Installation or Arrangement drawing(s) that have been supplied with the pump. Ensure that all piping is the correct size, securely connected, and properly supported.

f. Check pump and drive hold-down bolts and base or soleplate foundation bolts for tightness. Where earthing bosses are supplied and indicated on the Installation or Arrangement drawing(s), check that the earthing (or ground) connections have been made.

g. Inspect all other major operational component connections associated with the pump to ensure compliance with the recommendations of their respective equipment manufacturers.

h. Inspect all pump control components (control valves, gauges, etc.) to ensure they have been located in accordance with the NES Installation or Arrangement drawing(s). Confirm that these components are correctly oriented in the piping scheme to achieve the proper direction of flow and functional operation.

i. Inspect the pump inlet to ensure that the inlet screen and cleanout connections have been properly made and are free of tools, equipment, and debris.

j. Ensure that the liquid discharge connection is free of obstructions.

k. With the main supply valves opened and the pump primed, as described in step c, gently engage the drive motor for the pump to verify the correct direction of shaft rotation.

CAUTION!

DO NOT ATTEMPT TO FREE A PUMP SHAFT FROM A BINDING OR BOUND CONDITION BY APPLYING POWER TO THE DRIVE MOTOR. 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 PUMP DISCHARGE (OR SEPARATOR WATER OUTLET).

6.5 START-UP AND OPERATING CHECKS

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, PARAGRAPH 6.6, IF ANY OPERATING DIFFICULTIES ARISE DURING THE SUBSEQUENT STEPS:

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

CAUTION!

WHEN MECHANICAL SEALS ARE FITTED, ENSURE THAT FLUSH SUPPLIES ARE TURNED ON BEFORE OPERATING THE PUMP.

b. 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.

c. 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.

d. Continuously monitor the temperature of the pump casing during the start-up procedure. If the

temperature rises rapidly or exceeds 14oC above the liquid compressant temperature, promptly shut down the unit and investigate the cause.

e. For pedestal-mounted pumps, it's essential to monitor the temperature of the pedestal in the bearing areas until the temperatures stabilize, ensuring a minimum duration of 30 minutes for stabilization.

CAUTION!

IF A BEARING BRACKET TEMPERATURE IS MORE THAN 62.6°F ABOVE THE PUMP CASING TEMPERATURE, SHUT DOWN THE PUMP IMMEDIATELY AND DETERMINE THE CAUSE.

IF ABNORMAL BEARING NOISE, VIBRATION, ODOR, OR SMOKING OCCURS, SHUT DOWN THE PUMP IMMEDIATELY AND DETERMINE THE CAUSE.

f. Inspect the pump for vibration and noise. Abnormal levels of vibration and noise indicate issues with the NES pump. Immediately shut down the pump and investigate the cause.

g. Confirm the speed (RPM) of the pump shaft rotation using a tachometer inserted in the center of the motor shaft. For v-belt driven pumps, compute the pump speed by multiplying it by the drive ratio (Refer to the Installation or Arrangement drawing supplied.) Compare the measured speed with the rated speed for the pump. The rated operating speed and capacity can be determined from the purchase specifications or by consulting with your NES Engineer.

NOTE

THE SPEED INDICATED ON THE PUMP NAMEPLATE (ITEM 1, FIGURE 1.5A) REPRESENTS THE SPEED AT WHICH THE PUMP WAS TESTED DURING MANUFACTURE AND MAY NOT NECESSARILY BE THE SPEED SELECTED FOR ON-SITE OPERATION.

6.6 LOCATING TROUBLES

NES Two-Stage Vacuum Pumps typically require minimal attention, primarily focused on assessing their capacity to achieve full volume or maintain a consistent vacuum or pressure. For systems utilizing a v-belt drive, it is essential to regularly check v-belt tension, following the guidelines outlined in Sections 3-8 d-4 to d-8, and inspect the v-belts for signs of excessive wear. V-belts commonly have a service life of 24,000 hours. In case of operational challenges, perform the following checks:

a. Confirm the appropriate seal water flow rate as outlined in Table 5.6
b. . This involves collecting and measuring the water discharged over a specific duration, followed by calculating the flow in GPM.

b. Verify the correct direction of the pump shaft rotation, as indicated on the pump body.

c. Confirm that the pump operates at the designated rpm, which may differ from the test rpm stamped on the pump nameplates (Refer to Section 1.5).

CAUTION!

PRIOR TO CONDUCTING THE ABOVE CHECK, ENSURE THAT THE VACUUM PUMP IS DEACTIVATED OR THE SOLENOID VALVE IS BYPASSED. AVOID OPERATING THE PUMP WITHOUT SEAL WATER SUPPLY TO PREVENT ANY RISKS.

d. Examine the gas inlet line for any restrictions.

e. Check the mechanical seal for water leakage. This will be apparent by dripping from a slot in the pump body close to the pedestal or motor flange.

f. If the pump is shut down due to changes in temperature, noise, and/or vibration from normal operating conditions, scrutinize bearing lubrication, bearing condition, and the alignment

of the coupling or v-belt drive. Refer to Sections 3.7 and 3.8 for alignment procedures and v-belt tensioning.

NOTE
IF THE ISSUE PERSISTS DESPITE THESE CHECKS, CONTACT THE NES ENGINEER DISMANTLING OR DISASSEMBLING THE PUMP. HE SHALL ASSIST IN LOCATING AND CORRECTING THE TROUBLE.

Section 7 - PREVENTATIVE AND ROUTINE MAINTENANCE

NOTE
FOR SIGNIFICANT OVERHAULS, PLEASE REFER TO THE MAINTENANCE BULLETIN ALSO PROVIDED WITH YOUR PUMP.

7.1 PERIODIC MAINTENANCE

NOTE
THE FOLLOWING SCHEDULES SHOULD BE ADJUSTED AS NECESSARY FOR YOUR SPECIFIC OPERATING CONDITIONS.

a. At each of the intervals mentioned (and during any maintenance/repair work), it is also advisable to inspect the pressure boundary parts (i.e., body, heads, lobe, bracket, manifolds, and manifold cover. Refer to Figures 9.1 to 9.4). If signs indicate, isolate the equipment and water-pressure-test the pump to 1.5 times the working pressure to determine the extent of the damage. Replace faulty components immediately to prevent danger to personnel and plant equipment.

7.2 MONTHLY INTERVALS

a. Ensure to clean the seal liquid line strainer.

b. For v-belt driven pumps, inspect the v-belts for signs of wear and ensure correct tension according to the guidelines provided in Section 3-8.

7.3 SIX-MONTH INTERVALS

a. If the drive coupling requires lubrication, ensure it is filled with oil or grease according to the coupling manufacturer's guidelines.

b. Inspect and lubricate the motor bearings following the instructions provided by the motor manufacturer. Note that many motors used in these pumps come with pre-lubricated bearings that do not need re-lubrication. However, always refer to the motor manufacturer's instructions to verify if re-lubrication is necessary.

c. For NHF-75 Pumps Only: Lubricate the pedestal bearings as outlined in Section 7-5b.

7.4 TWELVE-MONTH INTERVALS

a. For pumps equipped with drive couplings, carefully inspect the resilient drive elements of the coupling for any indications of wear. Replace the drive elements as required.

b. Verify the operation and condition of the inlet check valve (if installed) to ensure proper functionality and assess for any signs of wear.

c. Thoroughly examine the pump for any indications of leakage from the mechanical seal (Index No. 2 Figure 9-1 to 9-14). If there is evidence of seal liquid leakage, replace the mechanical seal following the instructions outlined in the appropriate Maintenance Bulletin (refer to Table 1-1).

7.5 BEARING LUBRICATION

a. All pedestal-mounted pumps, except for the NHF-75, are equipped with double-shielded bearings (Index Nos. 307, 308) that come pre-packed with grease. These bearings do not require additional lubrication.

b. The NHF-75 models feature grease fittings (Index No. 23, Figures 9-6 and 9-14), and re-lubrication every six months should be conducted as follows:

b-1. For NHF-75 Models:

Using a grease gun, inject 5 to 8 grams (1/4 to 1/3 ounce) of grease as specified in Table 5-15 into the drive end and pump end grease fittings (23, Figure 9-6).

b-2. Using a grease gun, inject 57 to 113 grams (2 to 4 ounces) of grease as specified in Table 5-15 into the drive-end grease fitting (23, Figure 9-14).

b-3. Using a grease gun, inject 85 to 170 grams (3 to 6 ounces) of grease as specified in Table 5-15 into the pump end grease fitting (23, Figure 9-14).

Section 8 - STORAGE AND DISPOSAL

8.1 SHUTDOWN PERIODS

a. If the pump is inactive for 2 to 3 weeks, manually rotate the pump and recirculating pump (if applicable) at least once every week to prevent rust accumulation between cast iron parts, which could lead to seizing. If the pump needs to be taken out of service for more than 3 weeks up to one year, follow the steps below to prevent seizing during storage due to rust formation:

NOTE

THE PRESERVATION OIL USED WILL ONLY BE EFFECTIVE IN PREVENTING SEIZING UNDER GOOD STORAGE CONDITIONS. THE ONE-YEAR PERIOD MENTIONED ABOVE IS BASED ON INDOOR, COVERED, AND DRY CONDITIONS. FAILURE TO ADHERE TO THESE CONDITIONS MAY RESULT IN THE PRESERVATION LOSING ITS EFFECTIVENESS IN A FEW MONTHS.

b. The following preservation procedures apply to all pumps with cast iron parts only, maintained as indicated in the note above.

b-1. Unscrew pipe plug (22) from the pump lobe (106) or head (103, 132, or 133) to drain all liquid from the pump. Once drained, reinstall the pipe plug securely.

b-2. Disconnect the discharge piping and seal the discharge port with a threaded plug.

b-3. Fill the pump approximately one-quarter full with water-soluble preserving oil, such as Houghton Rust Veto MP or an equivalent, through the inlet flange.

b-4. Initiate the pump and rotate it for a duration of 5 to 15 seconds, then shut it down. Repeat this process: start the pump, rotate for 5 to 15 seconds, and then shut it down again.

b-5. Drain all preserving oil from the pump by removing the specified pipe plugs. After draining, replace the pipe plugs using pipe thread compound.

b-6. Remove all packing following the instructions in Section 7-6 and flush the stuffing boxes with a rust inhibitor. Do not repack the stuffing boxes; make a note of the lantern rings' positions for future reassembly.

b-7. Touch up any areas where paint has chipped, applying Houghton's Rust Veto #344 coating compound or an equivalent to external surfaces as necessary.

b-8. Seal off the pump inlet.

NOTE
FOR EXTENDED PRESERVATION PROCEDURES DURING STORAGE PERIODS SURPASSING ONE YEAR, SEEK GUIDANCE FROM YOUR NES ENGINEER.

b-9. When preparing to return the pump to service, adhere to the following steps:

a. Remove the seals from the pump inlet and discharge flanges and reconnect the piping.

b. Flush the pump following the specifications in Section 6.3. After the preservation oil has been thoroughly flushed from the pump, rotate the pump and, if applicable, the recirculating pump at weekly intervals until the pump is seamlessly reintegrated into continuous service.

Once the preserving oil has been flushed from the pump, it's important to rotate the pump and the recirculating pump (if applicable) at weekly intervals until the pump is fully operational and back in continuous service. This periodic rotation helps ensure proper lubrication and readiness for regular operation.

8.2 DISPOSAL OF WASTE

a. The diluted preservation oil generated after flushing is not considered a pollutant when effective waste disposal methods are employed. However, it is crucial to keep this material out of sewers and streams.

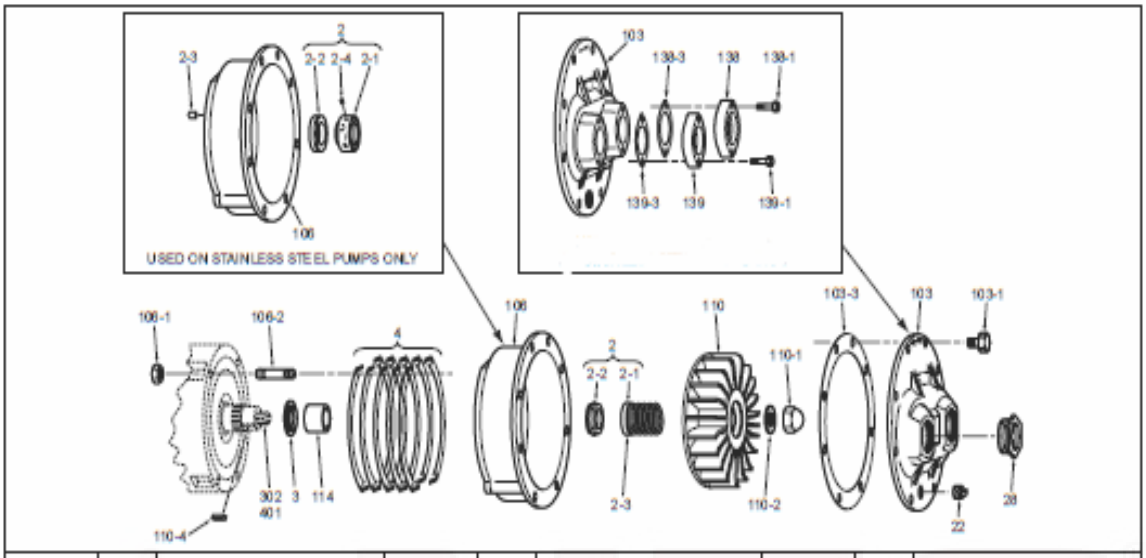
b. Comply with regulations for the disposal of waste petroleum oil. Implement a de-emulsification process to separate the product. Consider the oily layer as waste oil, and neutralize the aqueous layer for release into the treatment plant, following appropriate regulations.

c. Dispose of waste products under regular operating conditions based on the type of compressant used. Always adhere to health and safety requirements.

WARNING
ADHERE TO NATIONAL AND LOCAL REGULATIONS IN EFFECT AT ALL TIMES.

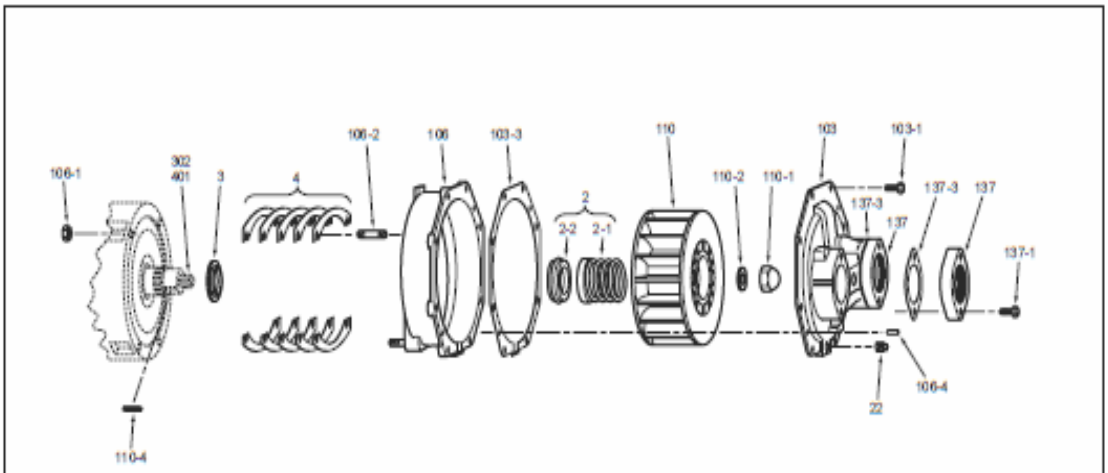
Section 9 - SPARES AND ACCESSORIES

9.1 EXPLODED VIEW



Index No.	Qty	Part Name	Index No.	Qty	Part Name	Index No.	Qty	Part Name
*2	1	Shaft Seal Assembly	103	1	Head	†114	1	Shaft Sleeve
2-1	NP	Rotating Seal	103-1	8	Head Screw	‡138	1	Inlet Flange
2-2	NP	Stationary Seal	*103-3	1	Head Gasket	‡138-1	2	Flange Screw
†2-3	NP	Seal Spring	106	1	Lobe	*‡138-3	1	Flange Gasket
‡2-4	NP	Setscrew	106-1	4	Lobe Nut	‡139	1	Discharge Flange
‡2-5	NP	Holding Pin	106-2	4	Lobe Stud	‡139-1	2	Flange Screw
*3	1	Slinger	110	1	Rotor	*‡139-3	1	Flange Gasket
*4	AR	Shims	*110-1	1	Rotor Nut	302	-	Pedestal Shaft
22	1	Drain Plug	*110-2	1	Rotor Washer	401	-	Motor Shaft
**28	1	Reducing Bushing	*110-4	1	Rotor Key			

Fig. 9.1 Exploded View of NES NHF 50, 80 and 120



Index No.	Qty	Part Name	Index No.	Qty	Part Name	Index No.	Qty	Part Name
*2	1	Shaft Seal Assembly	*103-3	1	Head Gasket	*110-4	1	Rotor Key
2-1	NP	Rotating Seal	106	1	Lobe	137	2	Inlet and Discharge Flange
2-2	NP	Stationary Seal	106-1	4	Lobe Nut	137-1	4	Inlet and Discharge Flange Screw
*3	1	Slinger	106-2	4	Lobe Stud	*137-3	2	Inlet and Discharge Flange Gasket
*4	AR	Shim	106-4	2	Lobe Pin	302	1	Pedestal Assembly Shaft
22	1	Drain Plug	110	1	Rotor	401	1	Motor Shaft
103	1	Head	*110-1	1	Rotor Nut			
103-1	8	Head Screw	*110-2	1	Rotor Washer			

Fig. 9.2 Exploded View of NES NHF 75