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 NC 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.

Manual Index

List of Sections

Section 1 Description

Section 2 Operation

Section 3 Troubleshooting

Section 4 Preventive Maintenance

Section 5 Disassembly, Inspection and Reassembly

Section 1 Description

1.1 About This Manual

This operational manual provides essential details for individuals in charge of NES Vacuum Pumps and Compressors, specifically models NC-2, NC-3, NC-4, NC-5, NC-6 and NC-7. The content encompasses operational guidelines and maintenance procedures for these units.

It's important to note that throughout this manual, the term "pump" refers to both vacuum pumps and compressors, unless specified otherwise.

1.2 Working Principle

Figure 1.1 depicts the primary functional components of the NES NC pumps. An external motor drives a rotor and shaft assembly within the pump. The rotor is situated in a chamber formed by the body casing. A liquid compressant, typically water and referred to as seal liquid, is introduced into the chamber through an inlet in the head and cone. The resulting mixture of compressed gas and seal liquid is expelled through the pump discharge. Figure 1.2 illustrates the sequential operations within the pump, facilitated by the offset axis of the body casing from the rotor axis.

The rotation of the liquid in the pump serves as a compressant for the gas, and the liquid compressant functions as a seal, preventing gas leakage into the atmosphere.

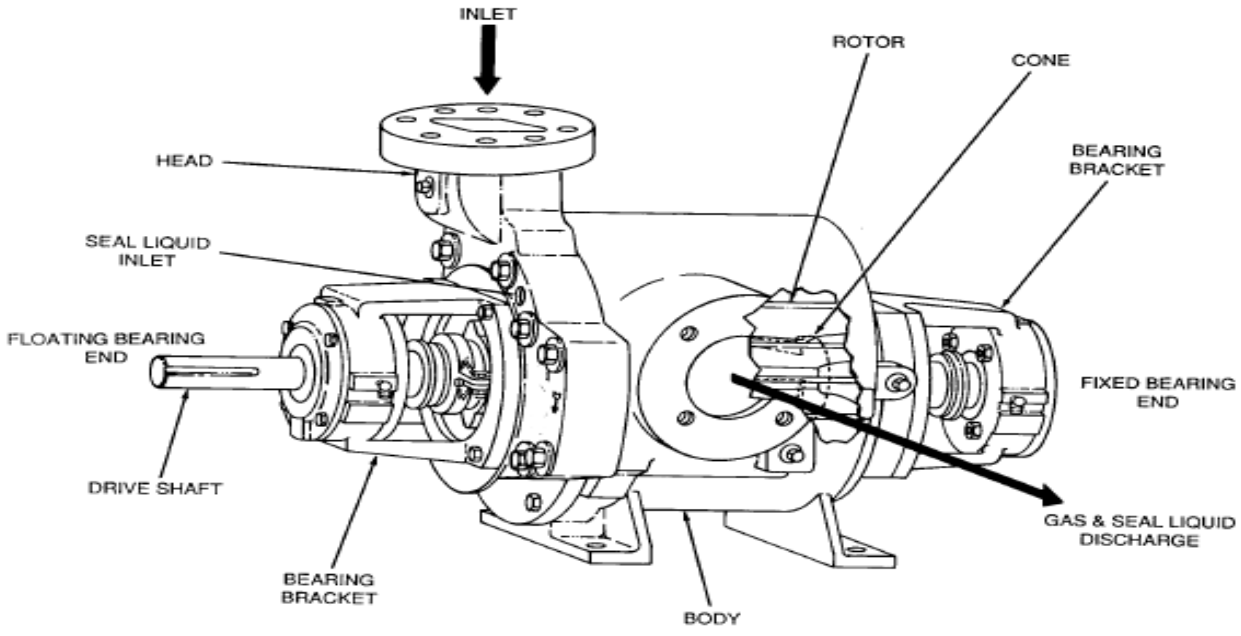


Fig. 1.1 Functional Elements of Pump

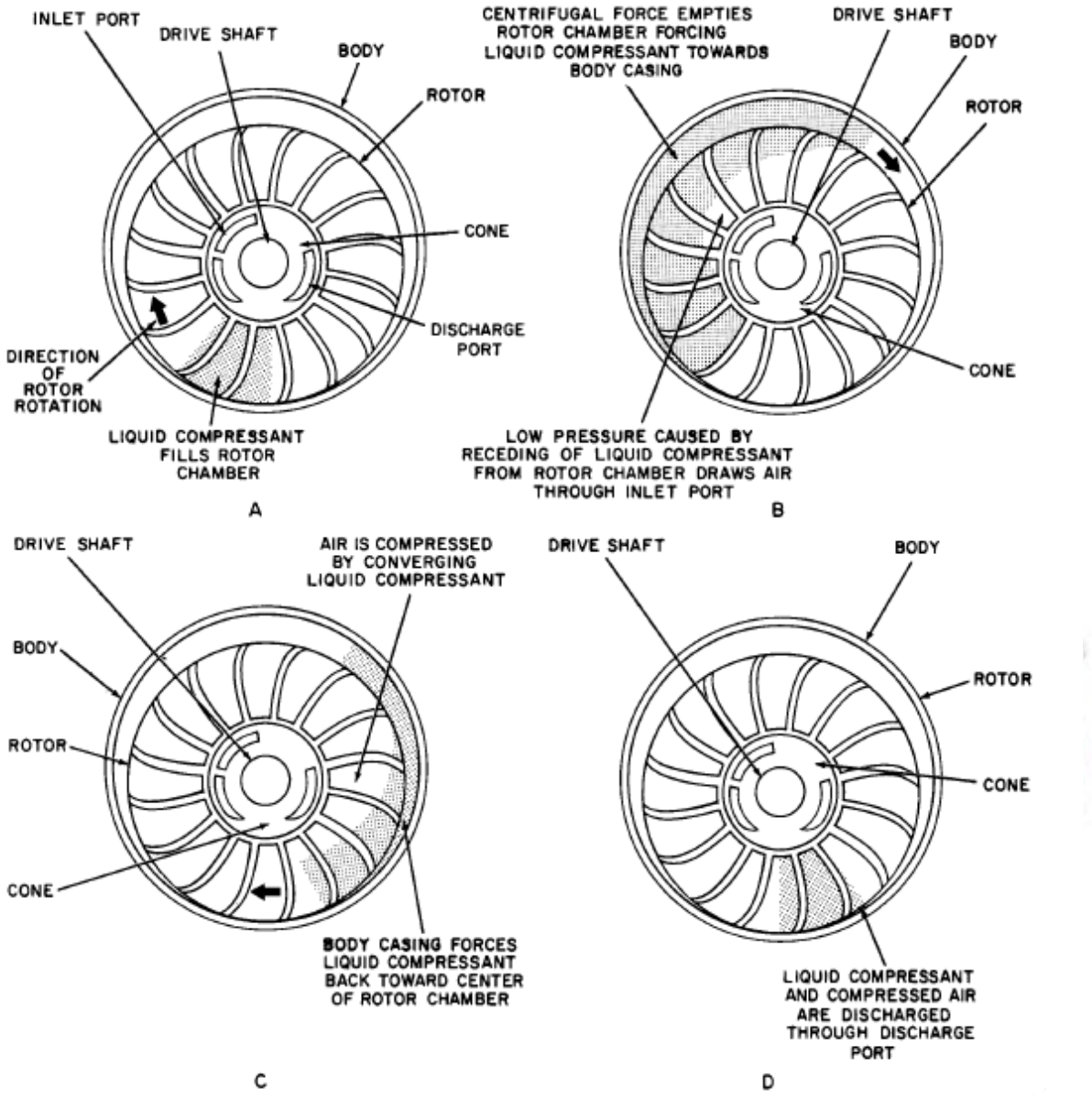


Fig. 1.2 Liquid Compressant and Air Flow

Section 2 Operation

2.1 Preparation for Initial Start-Up

NOTE
CONTACT YOUR NES REPRESENTATIVE FOR START-UP ASSISTANCE.

2.2 Liquid Compressant (Seal Water)

All connections for liquid compressant supply must be established according to the diagrams in Figures 2.1a, 2.1b and 2.2a, 2.2b. The typical liquid compressant is fresh water at a temperature of 60°F (15°C). The specified flow rate to the pump should be adhered to, with a permissible variance of ±20%, as exceeding this range might impact the pump's capacity.

For compressors, the recommended seal liquid flow rate is approximately 1/4 gallon per minute (GPM) per horsepower (HP). When employing the orifice, cock, and gauge configuration, adjust the cock until the pressure gauge registers 10 pounds per square inch gauge (psig) to achieve the required flow rate.

DIMENSION / SIZE	DIMENSIONS IN INCHES			
	NC-2	NC-3, NC-4, NC-5	NC-6	NC-7
A	2	3	6	6
B	3 x 7 1/2	4 x 9	6	6
C	1/2	3/4	1	1
D	2 x 6	3 x 7 1/2	4	6
E	1/2	3/4	1	1

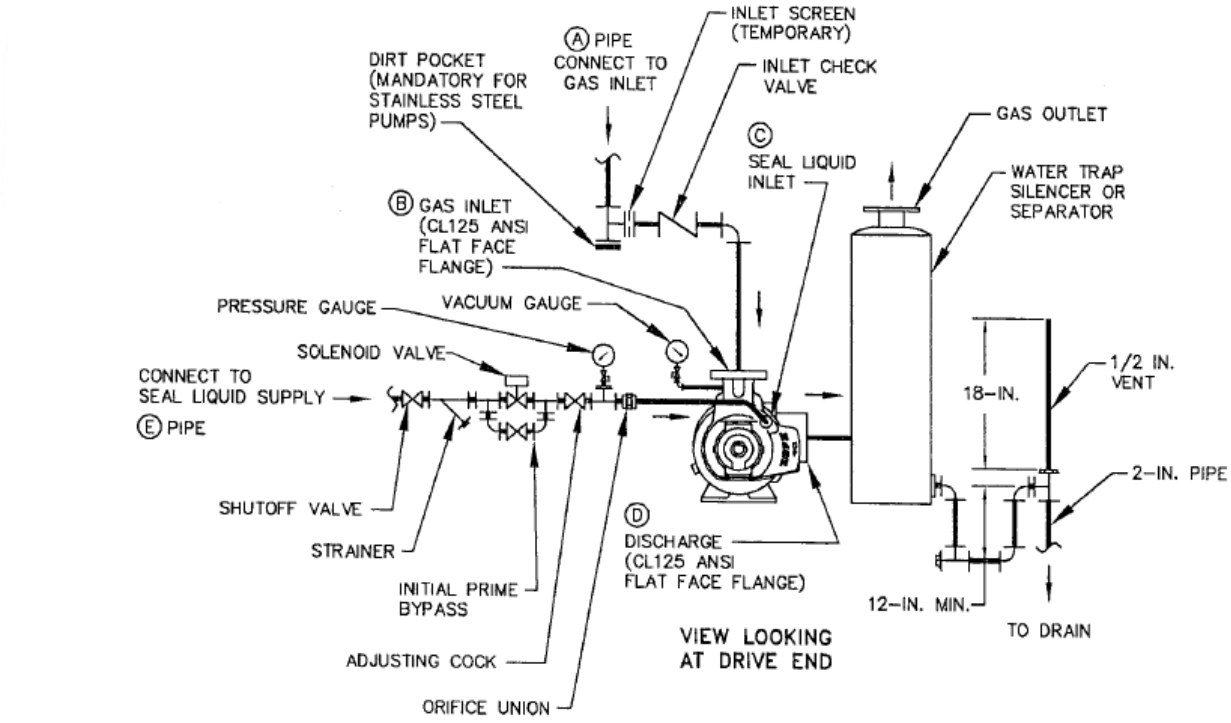


Fig. 2.1a Typical Vacuum pump piping connections for NC2 to NC-5

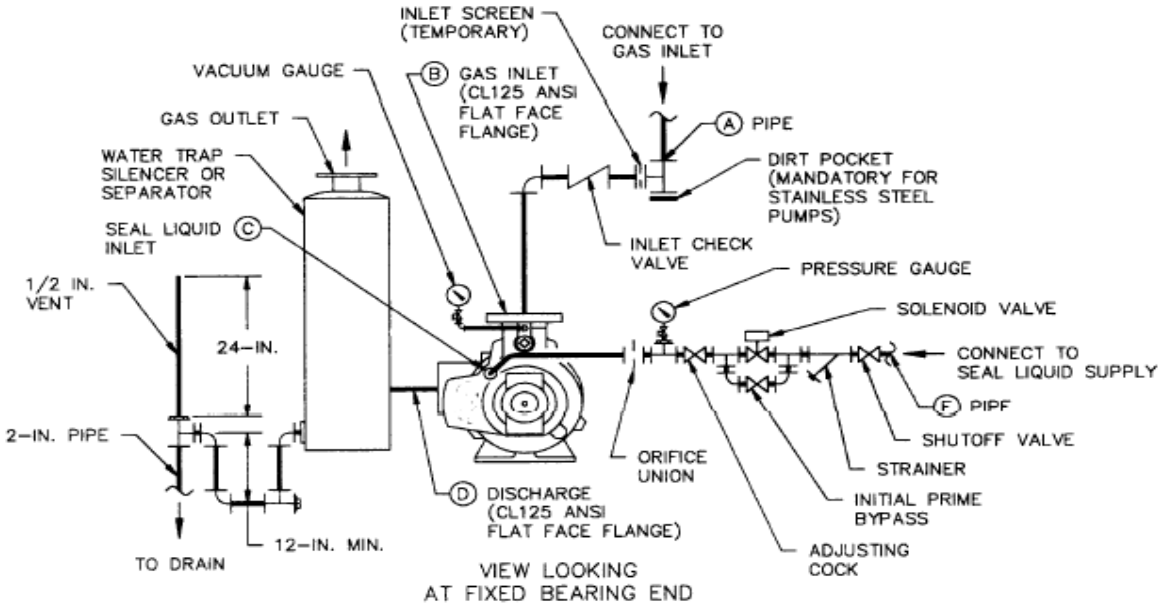


Fig. 2.1b Typical Vacuum pump piping connections for NC-6 & NC-7

For Iron Vacuum Pump

Pump Size	Pump Speed-RPM	Flow Rate 0 to 25 in. Hg Vac.	U.S.GPM 25 to 28 in. Hg Vac
NC-2	1450	1	3
	1750	1/2	
NC-3	980	4	8
	1170		
	1450		
	1600	8	8
	2100	3	3
NC-4	1170	5	10
	1320		
	1450		
NC-5	1170	5	10
	1280		
	1450		
NC-6	820	7	14
	980		
	1170		
NC-7	705	12	18
	795		
	880		
	930		

For Stainless Steel and stainless Steel Fitted Vacuum Pumps.

Pump Size	Pump Speed-RPM	Flow Rate 0 to 25 in. Hg Vacuum	U.S.GPM 25 to 28 in. Hg Vacuum
NC-2	1450	3	6
	1750		
	2100		
NC-3	980	4	8
	1170		
	1450		
	1600	8	8
NC-4	1170	5	10
	1320		
	1450		
NC-5	1170	5	10
	1280		
	1450		
NC-6	820	7	14
	980		
	1170		
NC-7	705	12	18
	795		
	880		
	930		

It's important to note that the same seal liquid flow rate applies to both stainless steel and iron pumps. When using the orifice cock and gauge setup, adjust the cock until the pressure gauge upstream from the orifice reads 10 psig greater than the gauge downstream of the orifice.

CAUTION!

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

2.3 Draining and Flushing

Before initiating the pump after completing the alignment process outlined NES installation guide, Installation Instructions for NES Vacuum Pumps and Compressors, take the following steps:

Remove the seal water drain plugs (22-1, Figure 5.12 and 5.13) from the head and body of the vacuum pump. Open the shut-off valve for the seal water supply. The pump is shipped with a water-soluble preservative oil, visible as a cream-colored liquid. Allow the seal water to drain from all plugs, then close the shut-off valve. Replace the drain plugs using a pipe thread compound.

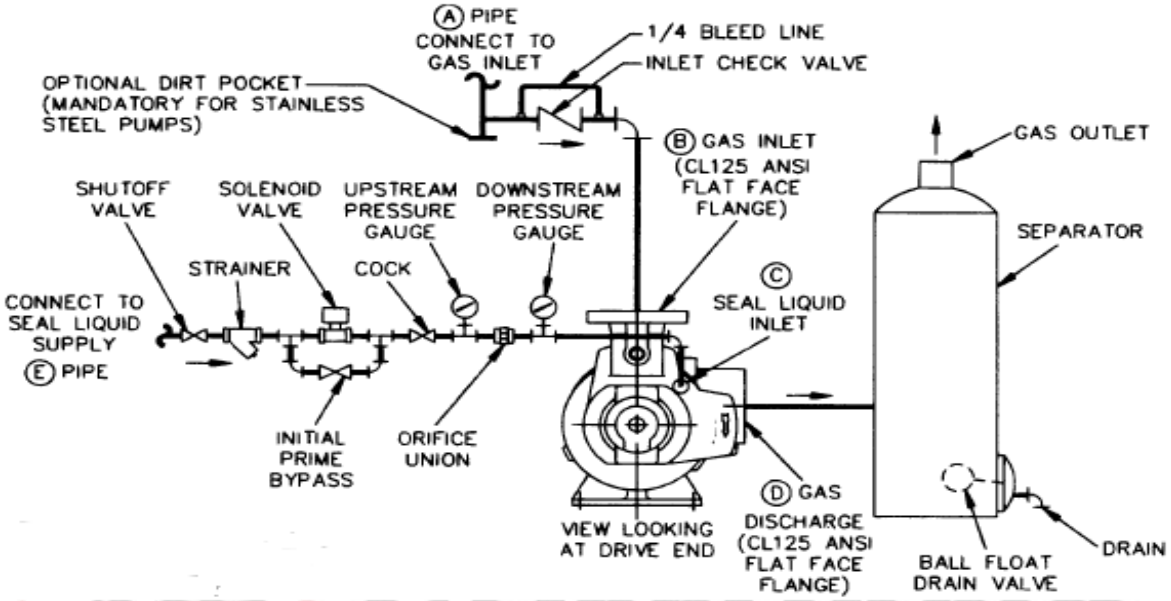


Fig. 2.2a Typical Compressor Piping Connections for NC-2 to NC-5

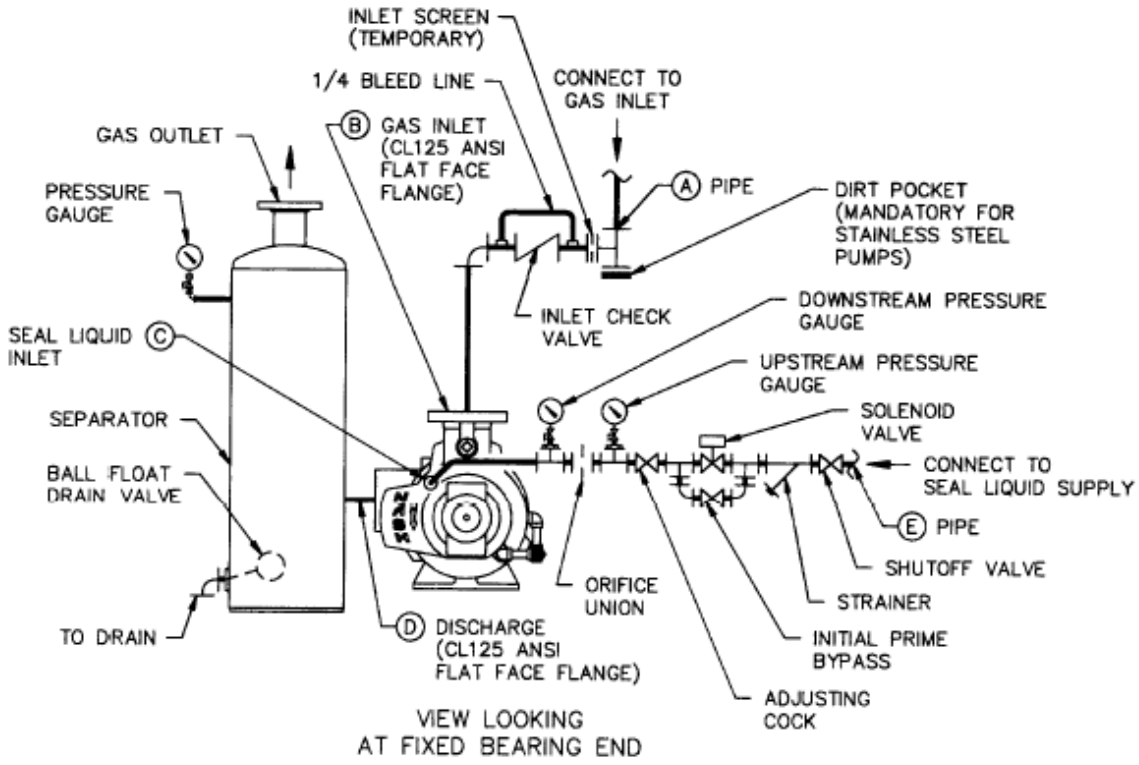


Fig. 2.2b Typical Compressor Piping Connections for NC-6 & NC-7

DIMENSION / SIZE	DIMENSIONS IN INCHES			
	NC-2	NC-3, NC-4, NC-5	NC-6	NC-7
A	2	3	6	6
B	3 x 7 1/2	4 x 9	6	6
C	1/2	3/4	1	1
D	2 x 6	3 x 7 1/2	4	6
E	1/2	3/4	1	1

2.4 Preliminary Inspection:

WARNING!
PERFORM ALL OF THE FOLLOWING STEPS IN ORDER TO ENSURE PERSONNEL SAFETY AND EQUIPMENT PROTECTION.

a. Isolate all power sources to the driver unit to prevent accidental starting.

b. Ensure all drain plugs are properly installed.

c. Manually prime the pump with liquid compressant until there is a flow from the overflow drain.

d. Inspect the separator, receiver, and heat exchanger (if used) for removed shipping plug protectors and properly connected open connections.

e. Inspect piping to ensure correct size, secure connections, and proper support according to supplied NES installation drawings.

f. Check pump and drive hold-down bolts, as well as base or soleplate foundation bolts for tightness.

g. Inspect all major operational component connections associated with the pump, ensuring compliance with respective equipment manufacturers' recommendations.

h. Inspect pump control components (valves, gauges, etc.) for proper positioning according to NES installation drawings, ensuring correct orientation for flow and functionality.

i. Inspect the pump inlet, ensuring proper connection and absence of tools, equipment, and debris.

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

k. Remove the coupling or V-belt guard and manually rotate the pump shaft in the specified direction indicated by an arrow on the pump body and installation drawing. The pump shaft must rotate freely; if bound, seek assistance from an NES Representative.

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

l. Check coupling or V-belt alignment per NES Installation guide.

CAUTION!
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).

m. Do not operate the pump without adequate prime and liquid seal flow. Verify proper flow from the vacuum pump discharge or water trap silencer.

n. With main supply valves open and the pump primed (as in step c), gently bump the drive motor to check for the correct direction of shaft rotation.

WARNING!
ENSURE THE COUPLING OR V-BELT DRIVE IS ENCLOSED WITH A GUARD BEFORE STARTING THE DRIVE MOTOR. EXERCISE CAUTION TO AVOID ATTEMPTING TO FREE A PUMP SHAFT FROM A BINDING CONDITION USING POWER, AS SEVERE DAMAGE MAY RESULT.

2.5 Start-Up and Operating Checks

Upon completion of the preliminary inspection and preoperational checks, initiate the pump and perform the following checks:

WARNING!
IF CHECKING THE PUMP IN A SYSTEM, NOTIFY APPROPRIATE PLANT PERSONNEL BEFORE PLACING THE PUMP ONLINE, ESPECIALLY DURING THE INITIAL STARTUP. UNEXPECTED SYSTEM STARTUPS MAY LEAD TO PERSONNEL INJURY.

NOTE
REFER TO SECTION 3, TROUBLESHOOTING, IF ANY OPERATIONAL DIFFICULTIES ARISE DURING THE FOLLOWING STEPS.

a. Check the pump and the system for adequate priming, then turn on all main water supply sources to the pump or heat exchanger.

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

NOTE

IF PUMP OPERATION BECOMES UNSTABLE, WITH INCREASED VIBRATION LEVELS AND DECREASED PUMPING VOLUME, AND IF STABILIZATION IS NOT ACHIEVED, SHUT DOWN THE SYSTEM IMMEDIATELY TO DETERMINE THE CAUSE.

c. While stabilizing the pump at the required inlet vacuum, check the flow of liquid seal (water) to the pump, ensuring it flows out of the water trap silencer or separator drain.

d. Monitor the temperature of the pump casing during startup. If the temperature rises rapidly or exceeds 40°F above the liquid supply temperature, shut down the unit immediately and determine the cause.

e. After starting the pump, monitor the temperature of the bearing housing until it stabilizes or starts to drop. This may take several hours and should level out at approximately 30°F (17°C) greater than the casing or ambient temperature.

CAUTION!

IF THE BEARING HOUSING TEMPERATURE EXCEEDS 180°F (82°C) OR 50°F FOR NC-6&7 DURING STARTUP OR IF ABNORMAL BEARING NOISE, VIBRATION, ODOR, OR SMOKING OCCURS, SHUT DOWN THE PUMP IMMEDIATELY AND INVESTIGATE THE CAUSE.

f. Excessive bearing temperatures may result from factors like excessive v-belt drive pull, coupling misalignment, excessive piping loads, or improper greasing of bearings. The primary cause is often over-greasing. Check the grease quantity in the outer bearing housing cap; if more than 1/3 full, remove excess grease. If minimal or no grease is present, add grease through the fitting until it extrudes from the bearing face.

g. Inspect the pump for vibration and noise. Excessive vibration and noise are abnormal conditions for a NES pump. Shut down the pump immediately to identify the cause.

h. Check the speed (RPM) of the pump shaft rotation using a tachometer inserted into the fixed bearing outer cap. Compare the measured speed with the rated speed for the pump, which can be determined from purchase specifications or by consulting your NES Representative.

i. After the pump has run for ten minutes, tighten the gland nuts evenly by one-quarter turn. Repeat at ten-minute intervals until there is a leakage of approximately 45 to 60 drops per minute from the gland with no overheating. Subsequent tightening of the gland nuts by one-quarter turn should be done with the pump operating at normal working temperature and pressure.

Section 3 Troubleshooting

3.1 Locating Troubles

NES vacuum pumps and compressors typically demand minimal attention, with focus primarily on assessing the unit's ability to achieve full volume or maintain a consistent vacuum. When utilizing a V-belt drive, it's advisable to periodically check V-belt tension and inspect for excessive wear. V-belts generally have a service life of 24,000 hours.

In the event of operational challenges, conduct the following checks:

a. Verify the proper seal water flow rate as outlined in Section 2.2.

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

c. Ensure that the unit operates at the correct RPM, not necessarily the test RPM stamped on the pump nameplates (refer to Section 2.5, step g).

d. Investigate any restrictions in the gas inlet line.

e. If the pump is shut down due to temperature changes, abnormal noise, or vibration, inspect bearing lubrication, bearing condition, and coupling or V-belt drive alignment. Consult, Installation Instructions for NES Vacuum Pumps and Compressors, for alignment procedures and V-belt tensioning.

NOTE

IF THE ISSUE PERSISTS DESPITE THESE CHECKS, CONTACT YOUR NES REPRESENTATIVE BEFORE ATTEMPTING TO DISMANTLE OR DISASSEMBLE THE PUMP. THEY WILL PROVIDE ASSISTANCE IN IDENTIFYING AND ADDRESSING THE PROBLEM.

Section 4 Preventive Maintenance

4.1 Periodic Maintenance

NOTE

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

4.2 Six-Month Intervals

a. For lubricated drive couplings, ensure they are filled with oil or grease following the guidelines provided by the coupling manufacturer.

b. Examine the pump bearings and apply lubrication as detailed in Section 4.4.

c. Reapply lubrication to the drive motor bearings based on the instructions provided by the motor manufacturer.

4.3 Twelve-Month Intervals

a. Examine the pump bearings and apply lubrication according to the instructions outlined in Section 4.4.

b. Substitute the stuffing box packing in adherence to the guidelines provided in Section 4.5.

4.4 Bearing Lubrication

The pump in this series have grease-lubricated bearings that are pre-lubricated before shipment and are designed to operate without additional lubrication for approximately six months. In such cases, it's crucial to follow the manufacturer's recommendations and guidelines for maintaining the bearings.

a. Pull back or remove the inner and outer bearing caps.

b. Examine the condition of the grease in the bearing cap for contamination or the presence of water.

c. If the grease is contaminated, follow Section 5.2, steps a through h for the fixed bearing (120), or Section 5.3, steps a through g for the floating bearing (119). Remove the fixed or floating bearing bracket (109 or 108), fixed or floating bearing (120 or 119), and associated parts. Discard the bearing.

d. Clean the bearing bracket and bearing cap thoroughly to remove all grease.

e. For Sizes NC-2, NC-3, and fixed bearing only for Sizes NC-4-7, manually pack both sides of the new bearing, as specified in Table 5.1, with grease as outlined in Table 4.1.

f. Install the bearing bracket, bearing, and associated parts as specified in Section 5.17 and as follows:

For the floating bearing (119), perform steps a, c, d, and e in Section 5.17; and steps b and c in Section 5.19 (Sizes NC-2, NC-3) or Section 5.19A (Sizes NC-4, NC-5).

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 4.1 General Grease Specifications

NOTE

LUBRICATE THE BEARINGS ANNUALLY UNLESS THE PUMP OPERATES IN A CORROSIVE ATMOSPHERE OR WITH A LIQUID COMPRESSANT OTHER THAN WATER, IN WHICH CASE, THE INTERVAL SHOULD BE SHORTENED.
ENSURE THE NEW LIP SEAL (5-1) IS SEATED IN THE FLOATING BEARING OUTER CAP (115) WITH THE SEALING LIP AWAY FROM THE BEARING.

Install the new lip seal (5-1) and secure the floating bearing outer cap (115) and new gasket (115-3) to the floating bearing bracket (108) as specified in Section 5.20, steps m through p.

Rotate the shaft (111) by hand and confirm there is no rubbing or metal-to-metal contact.

For the fixed bearing (120), perform steps a, c, d, and e in Section 5.17; and steps b through g in Section 5.18.

CAUTION!

ENSURE THE THICKNESS OF SHIMS (4) EQUAL TO THE THICKNESS OF SHIMS REMOVED FROM THE PUMP IS REINSTALLED TO MAINTAIN THE REQUIRED END TRAVEL.

Install shims (4) and the fixed bearing outer cap (117) on the fixed bearing bracket (109) as specified in Section 5.20, steps j and k.

Rotate the shaft by hand and ensure there is no rubbing or metal-to-metal contact.

4.5 Stuffing Box Packing

Establish a preventive maintenance schedule for the regular tightening and replacement of packing in the stuffing boxes of the pump. For pumps used in continuous process systems, it is recommended to replace the packing during the annual shutdown. More frequent replacement may be necessary for severe process applications where the liquid compressant in the pump is contaminated by foreign material. The packing material consists of five rings with dimensions listed in Table 5.1.

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

a. If lantern glands (10, Figure 5.12 and 5.13) are used, record the position and number of packing rings on each side of the lantern gland to ensure correct alignment.

b. Slide the slinger (3) against the bearing inner cap (116 or 118).

c. Loosen and remove gland nuts (101-1 or 102-1, Figure 4.3) from studs.

d. Slide the packing gland assembly (112) as far from the stuffing box as possible. Remove two nuts, lockwashers, and screws holding halves of the packing gland assembly together and remove the two halves.

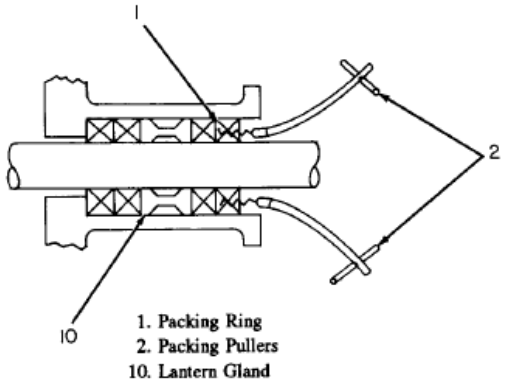


Fig. 4.1 Removing Stiffing Box Packing

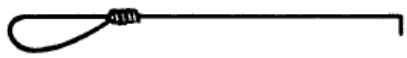
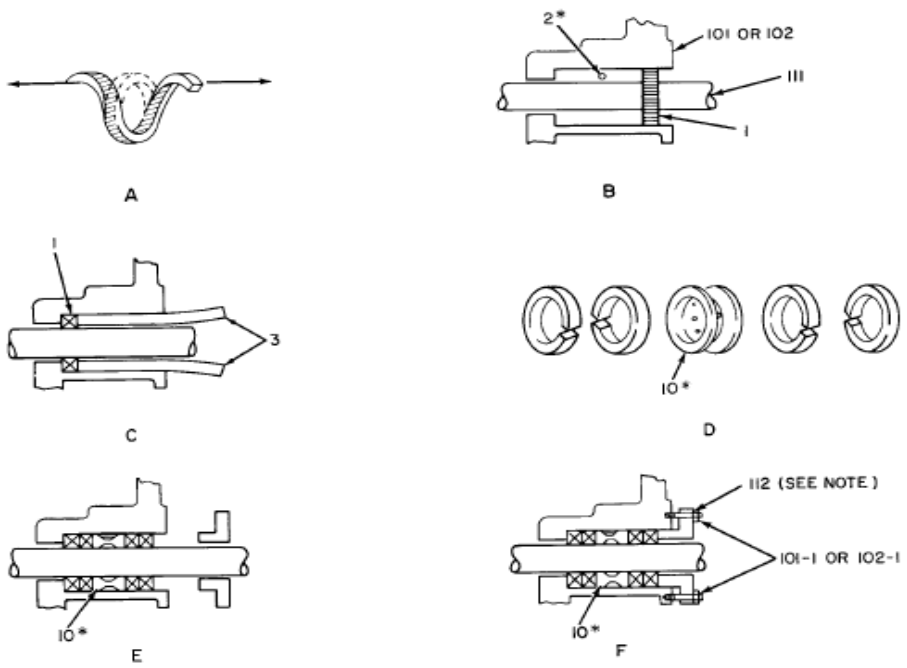


Fig. 4.2 Stuffing Box Lantern Gland Puller



NOTE: View F rotated 90° to show gland studs and nuts.

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

Fig. 4.3 Packing Stuffing Boxes

e. Screw tips of packing pullers (2, Figure 4.1) into the packing (1).

f. Pull the packing out of the stuffing box.

g. If a lantern gland (10, Figure 4.3) is supplied, form two lantern gland pullers from 1/8" diameter steel wire as shown in Figure 4.2.

h. Work the bent tip of each lantern gland puller around the outer diameter of the lantern gland in the stuffing box until pullers are felt catching in slots in the lantern gland on opposite sides.

i. Pull the lantern gland out of the stuffing box.

j. Screw tips of packing pullers (2, Figure 4.1) into the remaining packing in the stuffing box and pull the packing out.

k. Thoroughly clean the stuffing box and check the shaft for severe scoring and wear as specified in Section 5.11 before installing new packing.

Install the new packing in the stuffing boxes as follows:

a. Fabricate two hard rubber strips to fit between the outer diameter of the shaft (111) and the inner diameter of the stuffing box, as shown in Figure 4.3, Part C, to use as packing ring pushers.

b. Lubricate the inside diameter of the packing rings with Molykote G-n paste or equivalent.

c. Open the packing ring into a spiral by pulling the ends axially apart as shown in Figure 4.3, Part A.

d. Work each packing ring onto the shaft and into the stuffing box area as shown in Figure 4.3, Part B.

e. Using pushers fabricated in step a, push the first packing ring into the stuffing box as firmly as possible. Ensure that the packing ring is seated against the end of the stuffing box as shown in Figure 4.3, Part C. As each additional packing ring is installed, stagger the location of the butted ends of the ring so that successive rings are offset by 180 degrees (see Figure 4.3, Part D). Ensure that each packing ring is firmly seated.

f. Install the lantern gland (10) if supplied (see Figure 4.3, Part E).

g. Install the remaining packing rings as specified in step e.

h. Install the two halves of the packing gland assembly on the shaft and assemble with two screws, lockwashers, and nuts. Slide the packing gland assembly on the gland studs so that it is flush against the last packing ring installed. Install and tighten the gland nuts 101-1 or 102-1(for NC-2,3,4,5) and 101-1 or 103-1(for NC-6&7) evenly, finger-tight (see Figure 4.3, Part F).

i. Start the pump as specified in Section 2.6. Check the temperature of the pump stuffing box area as the pump operates. Ensure there is leakage from the stuffing box. If there is no leakage or if the stuffing box overheats, shut down the pump and determine the cause. Replace the packing if necessary.

j. After the pump has been running for ten minutes, tighten the gland nuts evenly one flat at a time. Repeat at ten-minute intervals until there is a leakage of approximately 45 to 60 drops per minute from the gland with no overheating. Subsequent tightening of gland nuts should be done with the pump operating at normal working temperatures and vacuum.

4.6 Shutdown Periods (Cast Iron pumps only)

If the pump is scheduled to be inactive for a period of 2 to 3 weeks, manually rotate both the vacuum pump and recirculating pump (if applicable) at least once a week. This practice helps prevent the accumulation of rust between cast iron parts, mitigating the risk of seizing. In case 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 due to rust formation:

NOTE

THESE PRESERVATION PROCEDURES ARE APPLICABLE EXCLUSIVELY TO IRON AND NODULAR IRON PUMPS AND SHOULD BE CARRIED OUT IN COVERED STORAGE.

a. Remove pipe plugs (22-1, Figure 5.12 and 5.13) from the pump body (101) and head (102), draining all liquid from the pump. Replace pipe plugs.

b. Disconnect the discharge piping and seal off the pump discharge flange.

c. Fill the pump one-quarter full of water-soluble preserving oil, such as J.L. Quimby NRP1OO or an equivalent, through the inlet flange.

d. Start the pump and rotate it for 5 to 15 seconds, then shut it down.

e. Drain all preserving oil from the pump for reuse by removing pipe plugs as specified in step a. Replace pipe plugs using pipe thread compound.

f. Remove all packing as specified in Section 4.5 and flush the stuffing boxes with a rust inhibitor.

g. Touch up any areas where paint has chipped and apply Houghton's Rust Veto #344 coating compound or an equivalent to external surfaces as needed.

h. Seal off the pump inlet:

NOTE

FOR LONG-TERM PRESERVATION PROCEDURES FOR STORAGE PERIODS EXCEEDING ONE YEAR, CONSULT YOUR NES REPRESENTATIVE.

i. When the pump is ready to be put back in service, follow these steps:

Remove blanks from the pump inlet and discharge flanges. Reconnect piping.

Repack stuffing boxes with new packing as specified in Section 4.5.

Flush the pump as specified in Section 2.4.

Start the pump as specified in Sections 2.5 & 2.6.

j. After flushing the preserving oil from the pump, rotate the vacuum and recirculating pumps at weekly intervals until the pump resumes continuous service.

Section 5 Disassembly, Inspection and Reassembly

5.1 Dismantling Pump

Prior to dismantling the pump, ensure the electrical input is isolated, and disconnect the seal liquid connections, coupling to the drive motor or V-belt drive, and inlet and outlet connections. Perform the disassembly and reassembly on a level surface, marking all parts as they become accessible during the process to ensure correct positioning for reassembly. Collect the necessary parts, materials, and standard tools before starting disassembly, and fabricate any special tools listed in the following sections, which are essential for the disassembly and reassembly of the pump.

Parts and Materials:

a. Minimum recommended spares as specified in the Legend for Figure 5.12 and 5.13 (to be kept on hand at all times).

NOTE

IT IS NOT ADVISABLE TO DISASSEMBLE A PUMP UNLESS THE FOLLOWING REPLACEMENT ITEMS ARE AVAILABLE FOR REASSEMBLY: TWO SETS OF STUFFING BOX PACKING (1); ONE SET OF ADJUSTING SHIMS (4); ONE SET OF GASKETS; AND FLOATING AND FIXED BEARINGS (119 AND 120). REFER TO TABLE 5.1.

b. Molykote G-n Paste or equivalent.

c. Locquic Primer T and Loctite 242 (required only if gland studs (101-2 or 102-2) require replacement).

d. Any standard grease.

e. Grease as specified in Table 4.1.

f. Solvent such as kerosene.

g. Two 5/8-11 eyebolts with nuts to remove and install the head (102).

h. Two 5/16-18 (Size NC-2) or 3/8-16 (Sizes NC-3, NC-4, NC-5, NC-6) OR 7/16 (Size NC-7) jackscrews as shown in Figure 5.10a and 5.10b to set end travel.

Standard Tools:

a. Socket wrench set with shaft extension. In most cases, open-end or box wrenches can be substituted for socket wrenches.

b. Hexagonal (Allen) wrenches.

c. Spanner wrench (for fixed bearing locknut).

d. Bearing puller.

e. Press: approximately 40-ton capacity. Press must indicate the amount of force applied and is only required if the rotor or shaft requires replacement.

f. Spirit level.

g. Leaf (feeler) gauge.

h. Metal straightedge.

i. Rawhide mallet.

j. Machinist's dial indicator with suitable clamps and mounts.

k. Needle-nosed pliers.

l. Propane torch and 250°F (121°C) temp stick (required only if gland studs require replacement.)

m. Asbestos gloves.

n. Hoist and slings.

WARNING!

MAKE PROVISIONS FOR HANDLING HEAVY PARTS DURING DISASSEMBLY TO AVOID INJURY TO PERSONNEL OR DAMAGE TO PARTS. REFER TO TABLE 5.2 FOR APPROXIMATE WEIGHTS OF PARTS.

Part Name (See Fig. 5.12 and 5.13	Pump Size				
	NC-2	NC-3	NC-4, NC-5	NC-6	NC-7
Packing (1)* Dimensions	3/8 sq x 1 3/4 ID x 2 1/2 OD	3/8 sq x 2 1/8 ID x 2 7/8 OD	3/8 sq x 2 ¼ ID x 3 OD	1/2 sq x 3 ID x 4 OD	5/8 sq x 4 ID x 5 1/4 OD
No. of Rings per Stuffing Box**	5	5	5	5	5
Lip Seal (5), Floating and Fixed Bearing Inner Caps	(2 req.) 1.750 Shaft Dia. 2.375 Bore Dia. 0.312 Wide	(2 req.) 2.125 Shaft Dia. 2.500 Bore Dia. 0.312 Wide	(2 req.) 2.250 Shaft Dia. 3.125 Bore Dia. 0.500 Wide	(2 req.) 3.000 Shaft Dia. 4.000 Bore Dia. 0.500 Wide	(2 req.) 4.000 Shaft Dia. 5.000 Bore Dia. 0.500 Wide
Body Gasket (101 – 3), 0.010 Thick Qty.	1	1	1	1	1
Cone Gasket (104 – 3), 0.010 Thick Qty.	1	1	1	1	1
Floating Bearing (119) Drive-End	Single Row Ball Bearing (Non-filling slot)	Spherical Roller Bearing	Cylindrical Roller Bearing	Spherical Roller Double Row Bearing	Spherical Roller Bearing
Fixed Bearing (120) Idle-End	Single Row Ball Bearing (Non-filling slot)	Double Row Ball Bearing	Single Row Ball Bearing (Non-filling slot)	Spherical Roller Double Row Bearing	Spherical Roller Bearing
*Contact your NES Representative for required packing material specification.					
**If lantern glands (10, Fig. 5.12 and 5.13) are used, one less packing ring is required.					

Fabricated Tools:

a. Bushing or pipe section as specified in Section 5.6, step c (required only if the rotor or shaft requires replacement).

b. 1 1/2 inch (Size NC-2) or 2 inches (Sizes NC-3, NC-4, NC-5) steel pipe machined as specified in Section 5.15, step d. 2-1/2 inch (size NC-6) or 3-1/2 inch (size NC-7) Schedule 40 steel pipe machined as specified in section 5.15 step.

NOTE

DO NOT DISASSEMBLE THE PUMP BEYOND THE POINT REQUIRED TO REMEDY THE OBSERVED ISSUE. BEFORE DISASSEMBLING THE PUMP, REMOVE THE DRAIN PLUGS (22-1, FIGURE 5.12 AND 5.13) FROM THE HEAD (102/103) AND THE BODY (101) TO DRAIN ALL LIQUID FROM THE PUMP.

5.2 Disassembling Fixed Bearing End

For NC-2 to NC-5

a. Remove three screws (117-4), four nuts (117-2), four screws (117-1), and fixed bearing outer cap (117) from fixed bearing bracket (109).

b. Discard damaged metal shims and all paper shims; remove shims (4).

c. For NC-2, NC-3, NC-4, NC-5, remove four screws (109-1) and fixed bearing bracket from body (101).

d. Discard two fixed bearing ring gaskets (120-3).

e. Using a spanner wrench or brass drift and hammer, loosen and remove fixed bearing locknut (120-1) from shaft (111).

f. Use a bearing puller as shown in Figure 5.1a to remove fixed bearing (120) from the shaft; discard the bearing. Remove fixed bearing inner cap (118) from the shaft.

g. Remove lip seal (5) from fixed bearing inner cap; discard the lip seal.

h. Remove tension spring (3-1) (Sizes NC-2, NC-3 only) and slinger (3) from the shaft.

i. Remove two gland nuts (101-1) from studs (101-2) and remove gland assembly (112) from body (101).

j. Remove packing (1) and lantern gland (10), if present, from the body; discard the packing.

k. If gland studs (101-2) require replacement, heat the stud base to 250°F (121°C) maximum using a propane torch and 250°F temp stick to free Loctite 242 and remove the stud.

Fig. 5.22 Index No.	Part Name	Weight in Pounds					
		NC-2	NC-3	NC-4	NC-5	NC-6	NC-7
101	Body	99	172	189	200	330	545
102	Head	49	81	86	86	150	230
104	Cone	3 1/2	14	16	16	24	52
108 109	Bearing Brackets	15 each	22 each	25 each	25 each	35 each	58 each
110	Rotor	27	61	88	103	277	290
111	Shaft	18	35	41	43	89	168
119 120	Floating and Fixed Bearing	2 each	2 1/2 each	3 1/2 each	3 1/2 each	6 1/2 each	10 each
-	Pump (Dry)	243	451	469	535	915	1450

For NC-6 and NC-7

a. Remove three screws (117-4), four nuts (117-2), four screws (117-1), and fixed bearing outer cap (117) from fixed bearing bracket (109).

b. Discard damaged metal shims and all paper shims; remove shims (4).

c. Discard two fixed bearing ring gaskets (120-3).

d. Using a spanner wrench or brass drift and hammer, loosen and remove fixed bearing locknut (120-1) from shaft (111).

e. Remove and discard bracket screws (109-1).

f. Use a 17-1/2 ton bearing puller and impact wrench as shown in Fig. 5.1b, engage puller jaws on back face of fixed inner cap (118). Apply air pressure to impact wrench until fixed bearing (120) is free of bearing journal on shaft (111).

g Remove lip seal (5) from fixed bearing inner cap; discard the lip seal.

h. Remove tension spring (3-1) and slinger (3) from the shaft.

5.3 Disassembling Floating Bearing End

a. Remove shaft key (111-1, Fig. 5.12 and 5.13) from shaft (111).

b. Remove four outer cap nuts (115-2), screws (115-1), outer cap (115), and gasket (115-3) from bearing bracket (108); discard the gasket.

c. Remove lip seal (5-1) from bearing outer cap; discard the lip seal.

d. Remove four bracket screws (108-1) and the bearing bracket from the bearing end head (102 or 101 for NC-6&7).

For NC-2 to NC-5

e. On sizes NC-4, NC-5: if bearing (119) is a ball bearing, use a bearing puller as shown in Figure 5.2 to remove the bearing from the shaft; discard the bearing.

NOTE

IF THE BEARING IS A CYLINDRICAL ROLLER BEARING, PROCEED TO STEP F.

f. For sizes NC-2, NC-3: use a bearing puller as shown in Figure 5.2a to remove the bearing from the shaft; discard the bearing.

CAUTION!

WHEN HEATING THE INNER RING, ENSURE NOT TO HEAT THE SHAFT (111).

g. For sizes NC-4 and NC-5, remove and discard the outer ring of bearing (119). Install a bearing puller with jaws engaging the inner ring and threaded post against the end of the shaft. Using a propane torch, heat the inner ring until tightening the bearing puller can remove the inner ring from the shaft shoulder; discard the inner ring.

h. Remove inner cap gasket (116-3) and inner cap (116) from the shaft; discard the gasket.

i. Remove lip seal (5) from the inner cap; discard the lip seal.

j. Remove tension spring (3-1, sizes NC-2 and NC-3 only) and slinger (3) from the shaft.

For NC-6 and NC-7

NOTE

USE OF THREE JAW BEARING PULLER INSTEAD OF ILLUSTRATED TWO-JAW PULLER IS ADVISED WHEN PERFORMING STEP E.

e. Apply same process as done in section 5.2 step f, engaging puller jaws on back of floating bearing inner cap (116) as shown in Fig. 5.2b to free floating bearing (119) from bearing journal on shaft (111).

f. Floating bearing cap is to be removed, bearing bracket and floating bearing from shaft should also be taken off. Remove floating bearing from floating bearing bracket and discard bearing.

g. Remove floating bearing inner cap gasket (116-3) and discard gasket.

h. Remove lip seal (5) from the inner cap; discard the lip seal.

i. Remove tension spring (3-1) and slinger (3) from the shaft.

j. Remove two gland nuts (101-1) from studs (101-2) and remove gland assembly (112) from body (101).

k. Remove packing (1) and lantern gland (10), if present, from the body; discard the packing.

l. If gland studs (101-2) require replacement, heat the stud base to 250°F (121°C) maximum using a propane torch and 250°F temp stick to free Loctite 242 and remove the stud.

5.4 Disassembling Head and Cone Assembly

a. Install two 5/8-11 (NC-2 to NC-5) or 3/4-11 (NC-6&7) eyebolts in holes 180° apart in the inlet flange of the head (102 for NC-2 to NC-5 or 103 for NC-6&7, Figure 5.12 and 5.13) and secure them with nuts Fig. 5.2c. Connect a chain hoist to the eyebolts and support the head without lifting.

b. Remove six floating bearing end head screws (102-4) and two (Size NC-2) or four (Sizes NC-3, NC-4, NC-5) head screws (102-5) or six fixed bearing end screws for NC-6&7.

c. Remove the head and cone assembly from the body (101).

NOTE

IF THE HEAD AND CONE ASSEMBLY DOES NOT SEPARATE FROM THE BODY, REINSTALL THE FLOATING BRACKET (108) AND SECURE IT WITH FOUR SCREWS (108-1). USING A BEARING PULLER, REMOVE THE FLOATING BEARING BRACKET, HEAD, AND CONE AS ASSEMBLY. REMOVE THE FLOATING BEARING BRACKET FROM THE HEAD.

d. Remove the body gasket (101-3) and discard it.

e. Remove two gland nuts (102-1) from studs (102-2) and remove the gland assembly (112) from the head.

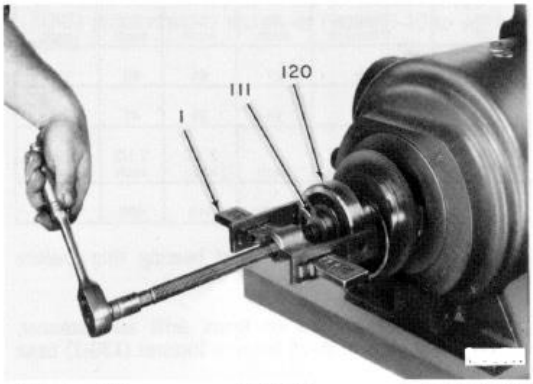


Fig. 5.1a Pulling Fixed Bearing for NC-2 to NC-5

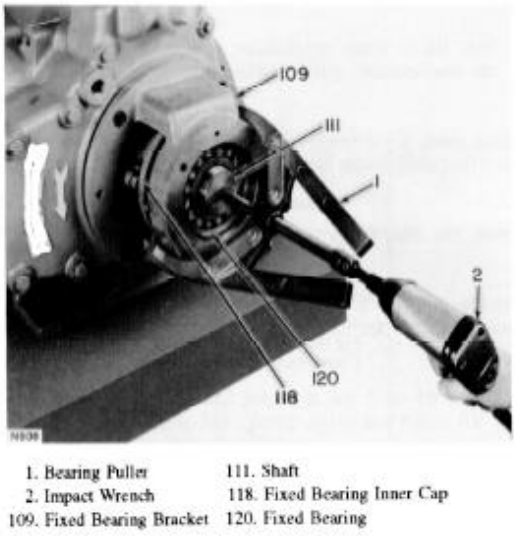


Fig. 5.1b Pulling Fixed Bearing for NC-6 & NC-7

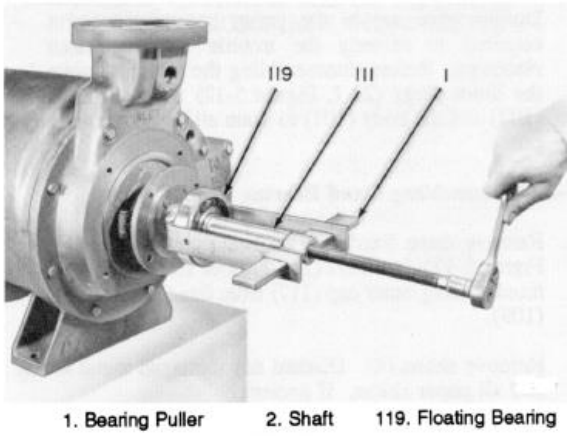


Fig. 5.2a Pulling Floating Bearing for NC-2 to NC-5

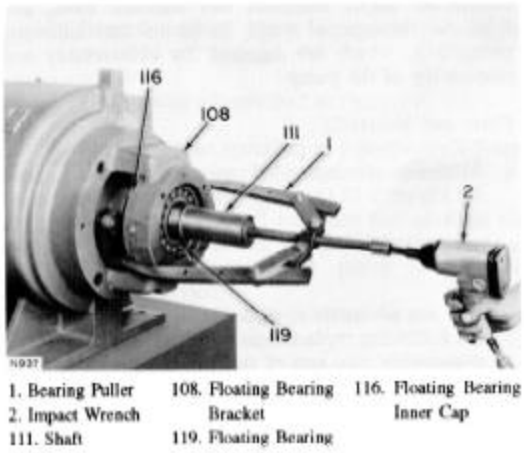


Fig. 5.2b Pulling Floating Bearing for NC-6 & 7

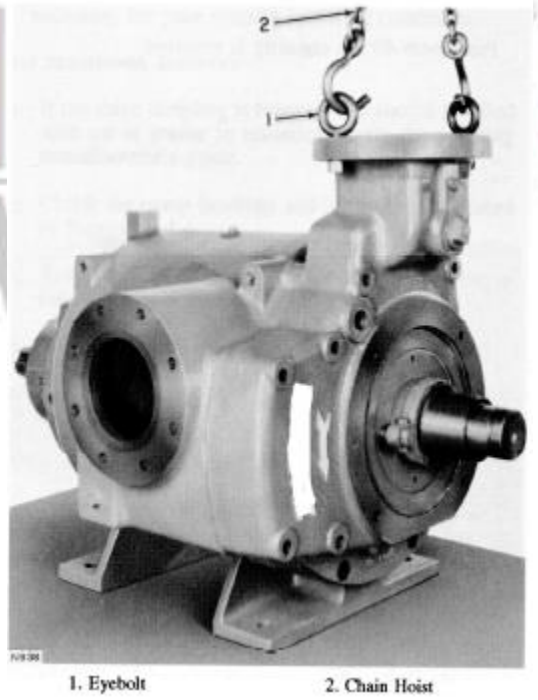


Fig. 5.2c Supporting fixed bearing end head for NC-6 & NC- 7

f. Remove packing (1) and lantern gland (10), if present, from the head. Discard the packing.

g. If gland studs (102-2) require replacement, heat the base of the stud to a maximum of 250°F (121°C) using a propane torch and a 250°F (121°C) temp stick to free Loctite 242, then remove the stud.

h. Inspect the cone (104) as specified in Section 5.9.

5.5 Removing Rotor and Shaft Assembly

a. Grasp the floating bearing end of the shaft (111, Figure 5.12 and 5.13) and slide the shaft and rotor (110) assembly out of the body (101).

b. As soon as the rotor extends beyond the body, support the rotor with a sling and a chain hoist as shown in Fig. 5.6a and 5.6b, repositioning the sling to the point of balance as the rotor and shaft assembly is removed.

c. Inspect the rotor tapered bores and shaft as specified in Sections 5.10 and 5.11.

5.6 Removing Rotor From Shaft

If inspection of the rotor (Section 5.10) or the shaft (Section 5.11) indicates that either part requires replacement or repair which requires disassembly, proceed as follows:

a. Measure and record dimension A, Figure 5.5a and 5.5b, from the flat face of the rotor to the fixed bearing journal shoulder.

For NC-6 & NC-7 only, thread fixed bearing locknut (120-1, Fig. 5.13) on shaft to protect threads.

b. Lift the rotor and shaft assembly with a chain hoist and sling.

c. Slide a bushing or pipe section sized to fit over the fixed bearing end of the shaft with the face of the bushing contacting the rotor hub face only.

Fig. 5.3 Loosening Cone Screws

Fig. 5.4 Checking cone for Wear

NOTE

A PRESS WITH A 40-TON CAPACITY IS REQUIRED.

d. Position the rotor and shaft assembly in the press with the floating bearing end of the shaft against the press ram and the bushing (installed in step c) against the press backup plate.

e. Provide support for the fixed bearing end of the shaft as it is pushed from the rotor. Support the rotor with blocks or a sling passed through the rotor blades and around each shroud.

f. Ensure that the shaft is level and apply ram force to remove the shaft from the rotor.

5.7 Removing Cone From Head

If inspection of the cone (Section 5.9) indicates that the cone must be replaced or reworked, proceed as follows:

a. Insert an Allen wrench into the socket of each cone screw (104-1 or 105-1(for NC-6& 7), Figure 5.12 and 5.13). Tap the Allen wrench with a mallet as shown in Figure 5.3 to loosen and remove six cone screws (Size NC-2) or eight cone screws (Sizes NC-3, NC-4, NC-5).

b. Tap the side of the cone (104 or 105 for NC-6& 7) with a soft-headed mallet to free the cone from the head (102 or 103 for NC-6& 7).

c. Pull the cone from the head.

d. Remove the gasket (104-3 or 105-3 for NC-6& 7) and discard it.

5.8 Inspection of Disassembled Parts:

With the pump disassembled, inspect the parts for wear as described in the following sections.

NOTE

IF THERE IS ANY QUESTION ABOUT THE REUSABILITY OR REPAIR OF WORN MAJOR PUMP PARTS, CONTACT YOUR LOCAL NES REPRESENTATIVE.

5.8-A Cone

Normally worn tapered surfaces of the cone will be smooth, requiring only cleaning and light filing around the ports and tips. If foreign material has entered the pump suction inlet during operation, circular score marks may be noticed around the outside of the cone tapers. Inspect the cone for damage and wear as follows:

Check for uneven wear and scoring between the ports and at the edges of the ports with a straightedge and feeler gauge as shown in Figure 5.4.

Localized wear or scoring not more than 0.030 inch deep is acceptable unless the pump is required to operate at or near maximum capacity. If score marks are not too deep, high spots can be removed by light filing. If localized wear or scoring exceeds 0.030 inch in depth, contact your NES Representative for assistance in determining the reusability.

PUMP SIZE	DIMENSION A - INCHES
NC-2	5 43/64 to 5 45/64
NC-3	6 43/64 to 6 45/64
NC-4	7 3/64 to 7 5/64
NC-5	6 39/64 to 6 41/64
NC-6	6 63/64 to 7 1/64
NC-7	7 55/64 to 7 57/64

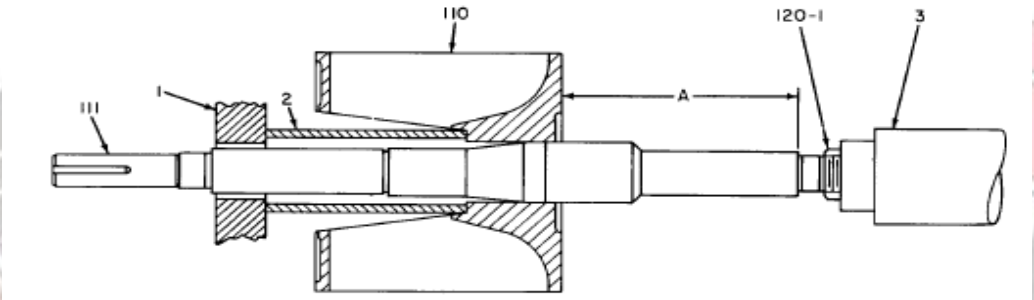


Fig. 5.5a Pressing Rotor Onto Shaft for NC-2 to NC-5

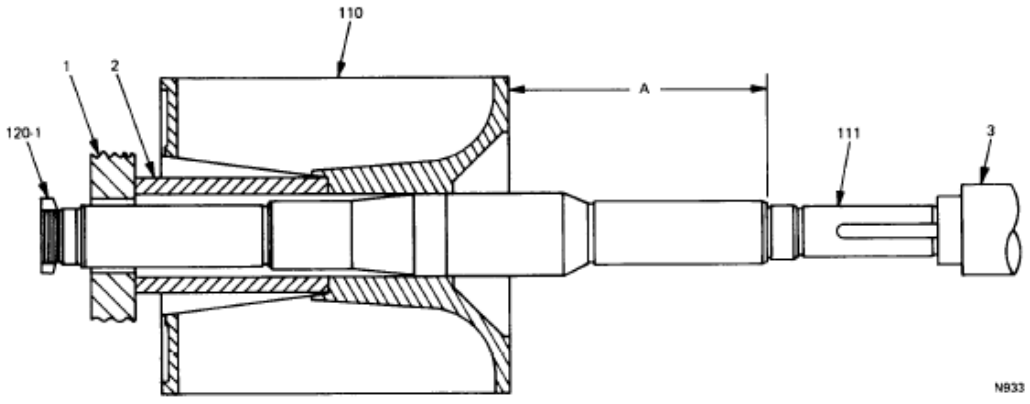


Fig. 5.5b Pressing Rotor Onto Shaft for NC-6 & NC-7

5.8B Rotor

Inspect the taper cone bores of the rotor using the same criteria as the tapered surface of the cones. Follow these steps:

Check for uneven wear, undercutting, or scalloping on the cone bore tapered surface with a straightedge and feeler gauge, similar to the procedure shown in Figure 5.4a and 5.4b.

If localized wear, undercutting, or scalloping exceeds 0.030 inches in depth, contact your NES Representative for guidance on determining the reusability of the rotor. Minor pitting is acceptable.

5.8C Shaft

Check the shaft diameters where the packing sits for excessive wear. If the shaft exhibits scoring or has worn through the metal surface, consult your NES Representative to assess the reusability of the shaft.

Inspect shaft journals for signs of pick-up and thoroughly examine all surfaces for wear or damage.

5.9 Reassembling the Pump

CAUTION!

BEFORE REASSEMBLY, ENSURE ALL PARTS ARE THOROUGHLY CLEANED. REMOVE ANY OLD GASKET MATERIAL FROM MOUNTING FLANGES, ELIMINATE BURRS FROM MATING SURFACES, AND CLEAN MOUNTING FACES.

5.10 Reassembling Rotor and Shaft:

To reassemble the rotor on the shaft, follow these steps:

CAUTION!

THIS PROCEDURE APPLIES SPECIFICALLY TO THE ASSEMBLY OF AN IRON ROTOR ON A SIBEL SHAFT. THE ROTOR AND SHAFT MUST BE AT THE SAME TEMPERATURE DURING ASSEMBLY.

a. File taper bores of rotor (110, Figure 5.12 and 5.13, 5.13) to eliminate burrs and high spots.

b. Inspect the shaft for dents or rough spots on the rotor seat and bearing journals.

c. Stone or polish the shaft smooth.

d. Coat the rotor hub bore and rotor seat of the shaft with Molykote G-n paste or an equivalent lubricant to prevent damage from friction or pick-up when the shaft is pressed into the rotor.

e. Thread the fixed bearing locknut (120-1) onto the shaft to protect the threads.

f. Slide the drive end of the shaft (111) into the flat end of the rotor. Gently tap the threaded end of the shaft with a soft-headed mallet.

g. Slide the same bushing or pipe section used in disassembly onto the floating bearing end of the shaft (See Figure 5.5a and 5.5b).

h. Sling the rotor and shaft with a sling placed around the outside diameter at the point of balance. Place the rotor and shaft in a press with the fixed bearing end of the shaft in line with the ram end of the press. Ensure the face of the bushing or pipe section contacts the rotor hub face only, with the bushing or pipe section supported by the press backup plate. Level the rotor shaft assembly.

i. Press the shaft into the rotor until dimension A, Figure 5.5 a and 5.5b, from the flat face of the rotor to the fixed bearing journal shoulder is within the specified limits. Record the force

applied. The maximum allowable force is as specified:

Pump Size	Allowable Force-Tons	
	Maximum	Minimum
NC-2	11	3 1/2
NC-3	14	4 1/2
NC-4	16	5
NC-5	22	7
NC-6	24	8
NC-7	34	17

CAUTION!

IF THE RECORDED ASSEMBLY FORCE EXCEEDS THE SPECIFIED LIMITS, DO NOT INSTALL THE ASSEMBLED ROTOR AND SHAFT IN THE PUMP. CONTACT YOUR LOCAL NES REPRESENTATIVE TO DETERMINE WHETHER THE ROTOR/SHAFT MUST BE REPLACED.

WARNING!

BEFORE REMOVING THE ROTOR AND SHAFT ASSEMBLY FROM THE PRESS, MOVE THE SLING TO A NEW POINT OF BALANCE TO AVOID INJURY OR DAMAGE.

j. Remove the fixed bearing locknut from the shaft.

5.11 Installing Cone in Head

If the head and cone assembly has been disassembled, follow these steps for reassembly:

a. If installing a new cone, carefully check it against the old cone for the correct part number. Remove any rust preventative from surfaces using a solvent such as kerosene.

b. File the taper surfaces on the cone smooth, paying special attention to the edges of cone ports.

c. Apply a light coat of grease to the replacement cone gasket (104-3 or 105-3 for NC-6 & NC-7), Figure 5.12 and 5.13) and position the gasket on the head (102 or 103 for NC-6 & NC-7).

d. Lower the cone into place on the head, ensuring that the eight holes in the cone flange align with the tapped holes in the head. Thread in the appropriate socket head cone screws (104-1) and tighten them.

e. After tightening the screws, tap the Allen wrench with a mallet to finish tightening each screw.

5.12 Installing Rotor and Shaft Assembly into Body

Follow these steps to install the rotor and shaft assembly into the body:

a. If gland studs (101-2, Figure 5.12 and 5.13) were removed from the body (101), install new studs by applying Locquic Primer T to tapped holes in the body and stud threads. Allow the primer to dry. Apply Loctite 242 to stud threads and install studs in the body.

b. Fasten the mounting feet of the body to a level surface.

c. Lift the rotor and shaft assembly with a sling and chain hoist, as shown in Figure 5.6a and 5.6b, and install the fixed bearing end of the shaft into the body (101).

d. Keep moving the rotor and shaft assembly, adjusting the position of the sling as necessary, until the shaft passes through the stuffing box in the body (101), and the rotor shroud seats against the body.

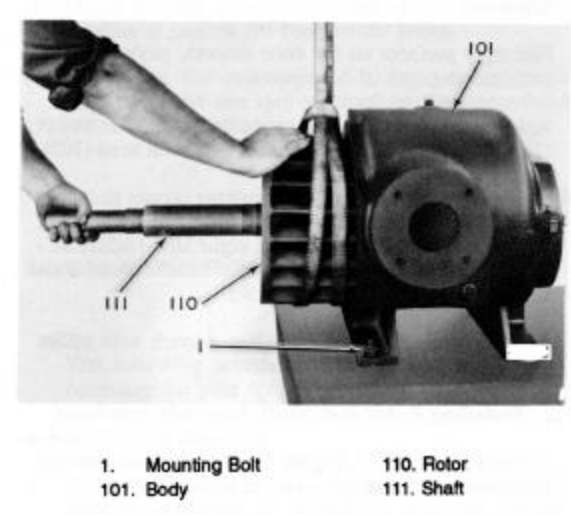


Fig. 5.6a Installing Rotor and Shaft Assembly for NC-2 to NC-5

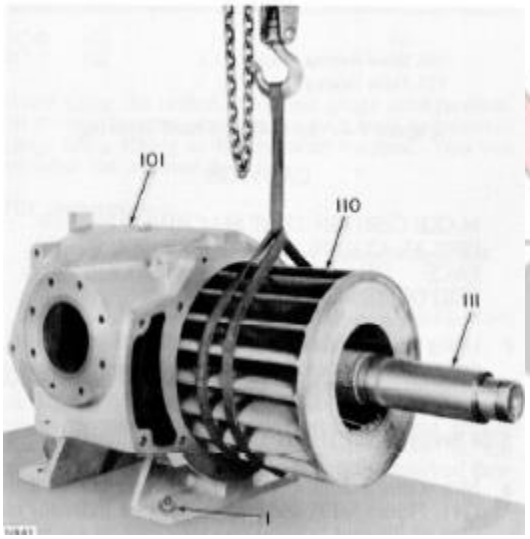


Fig. 5.6b Installing Rotor and Shaft Assembly for NC-6 & NC-7

5.13 Installing Head and Cone Assembly on Body

Follow these steps to install the head and cone assembly on the body:

a. If gland studs (102-2 or 103-2 for NC-6 & NC-7, Figure 5.12 and 5.13) were removed from the head (102 or 103 for NC-6 & NC-7), install new studs by applying Locquic Primer T to tapped holes in the head and stud threads. Allow the primer to dry. Apply Loctite 242 to stud threads and install studs in the head.

b. Apply a light coat of grease to the new body gasket (101-3) and position the gasket on the head.

c. Using eyebolts and a chain hoist as specified in Section 5.4, step a, position the head and cone assembly on the body. Ensure that the head rabbet seats in the body bore and that the mounting holes in the head align with the tapped holes in the body.

d. For NC-2 to NC-5 secure the head to the body with screws (102-4) and screws (102-5) and for NC-6 & NC-7 secure head to body with six screws (103-4) and four screws (103-5).

5.14 Assembling Bearing Ends

Follow these steps to assemble the bearing ends:

a. Install new lip seals (5, Figure 5.12 and 5.13) in bearing inner caps (116 and 118). Apply a light coat of grease to the outer diameter and sealing lips of the lip seals. Install the lip seals in the caps with the sealing lips facing away from the bearing housing. Ensure that the lip seals are properly seated.

b. Install slingers (3) and tension springs (3-1) on the floating and fixed bearing ends of the shaft (111).

c. Install floating and fixed bearing inner caps and the floating bearing inner cap gasket (116-3) on the shaft.

d. Slide the slingers and inner caps beyond the bearing journal shoulder toward the head (102) and body (101).

e. Install bearing brackets (108 and 110) on the head and body, securing each with screws (108-1 and 110-1). Ensure that pipe plugs (22) and grease fittings (23) are installed in the brackets.

5.15 Installing Fixed Bearing

Follow these steps to install the fixed bearing:

a. Pack the new fixed bearing (120) with grease as specified in Table 4.1.

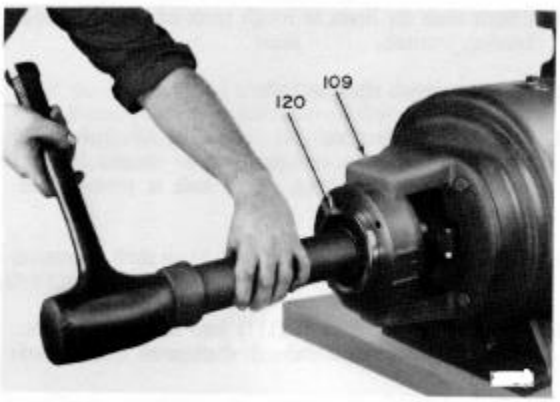
b. Slide the new inner bearing ring gasket (120-3) over the fixed bearing end of the shaft.

c. Slide the bearing onto the shaft journal, taking care not to damage the shaft threads.

d. Machine one end of a 1 1/2-inch (Size NC-2) or 2-inch (Sizes NC-3, NC-4, NC-5) steel pipe, 6 1/2 inches long, square, and thread the opposite end of the pipe. For size NC-6, machine one end of 2-1/2 inch schedule 40 steel pipe, 9 inches long, square. Bore inside diameter of machined end to 2.5625 inches to depth of ½ inch and thread opposite end. For size NC-7, machine one end of 3-1/2 inch schedule 40 steel pipe, 12 inches long, square and thread opposite end. Install a pipe cap.

e. Use the fabricated pipe to drive the fixed bearing onto the shaft until the bearing is seated against the shaft shoulder, ensuring that the machined end of the pipe is clean and contacts the inner race of the bearing only (Fig. 5.7).

f. Thread the fixed bearing locknut (120-1) onto the shaft and tighten it with a spanner wrench or a brass drift and hammer as shown in Fig. 5.8.



109. Fixed Bearing Bracket
120. Fixed Bearing

Fig. 5.7 Installing Fixed Bearing

g. Install the new outer bearing ring gasket (120-3, Figure 5.12 and 5.13) over the shaft and against the bearing.

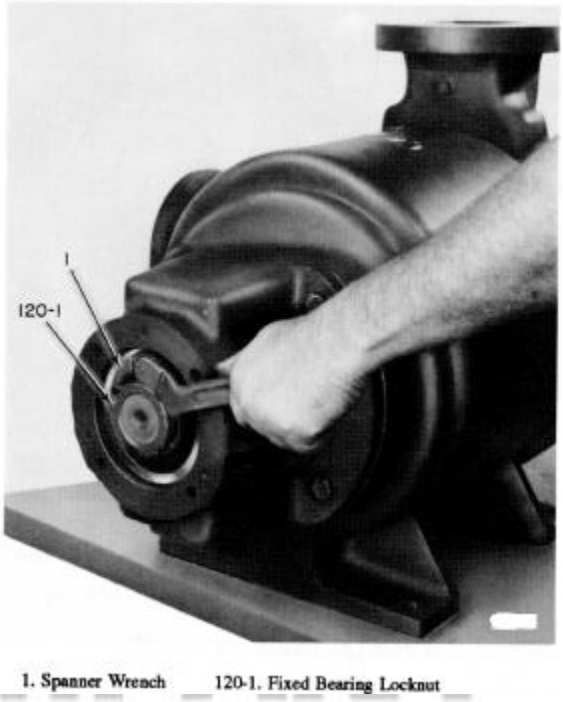
h. Install the fixed bearing outer cap (117) on the bearing bracket (110).

i. Align the holes of the inner and outer caps with the holes in the bearing bracket and secure them with screws (117-1) and nuts (117-2).

5.16A Installing Floating Bearing, Sizes NC-2, NC-3

a. Pack the new floating bearing (119, Figure 5.12 and 5.13) with grease as specified in Table 4.1.

b. Slide the bearing onto the shaft journal.



1. Spanner Wrench 120-1. Fixed Bearing Locknut

Fig. 5.8 Tightening Fixed Bearing Lockout

5.16B Installing Floating Bearing, Sizes NC-4, NC-5

a. Slide the inner ring of the new floating bearing (119, Figure 5.12 and 5.13) onto the shaft journal.

b. Use the fabricated pipe to drive the inner ring onto the shaft until the inner ring is seated against the shaft shoulder.

c. Pack the outer ring and rollers with grease as specified in Table 4.1.

d. Mount the outer ring on the inner ring by slowly rotating and gradually working the outer ring into position on the inner ring.

5.16C Installing Floating Bearing, Sizes NC-6, NC-7

a. Pack the new floating bearing (119, Figure 5.12 and 5.13) with grease as specified in Table 4.1.

b. Slide the bearing onto the shaft journal.

c. Use the fabricated pipe to drive the inner ring onto the shaft until the inner ring is seated against the shaft shoulder.

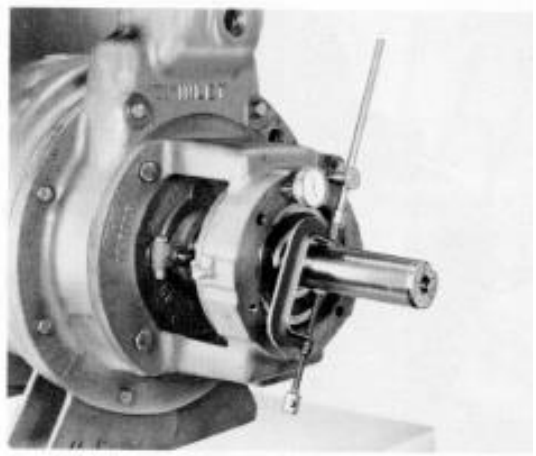


Fig. 5.9 Measuring End Travel at Floating Bearing End

5.17 Setting End Travel and Final Assembly

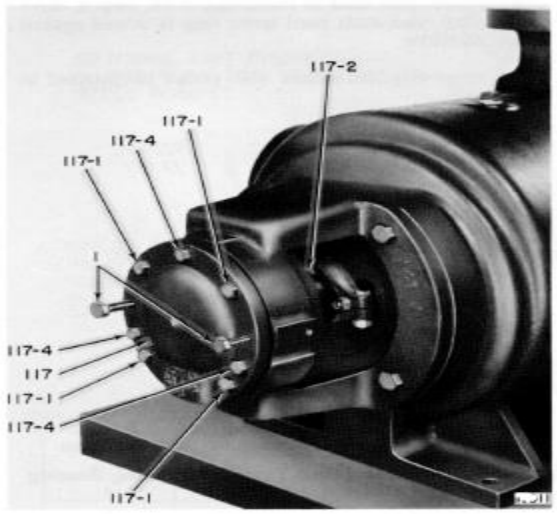
a. Attach a dial indicator to the floating bearing end of the shaft (111, Figure 5.12 and 5.13), positioning the spindle of the dial indicator on the face of the floating bearing bracket (108), as shown in Figure 5.9.

b. Insert three 5/16-18 screws (Size NC-2) or 3/8-16 screws (Sizes NC-3 to NC-7) through the fixed bearing outer cap (117) into the tapped holes in the fixed bearing bracket (109) to serve as takeup screws.

c. Gradually tighten the three takeup screws equally until the shaft cannot be rotated using a spanner wrench engaging the keyway in the drive end of the shaft. Do not tighten the takeup screws beyond this point. The rotor taper bore is now seated on the floating bearing end cone. Zero the dial indicator.

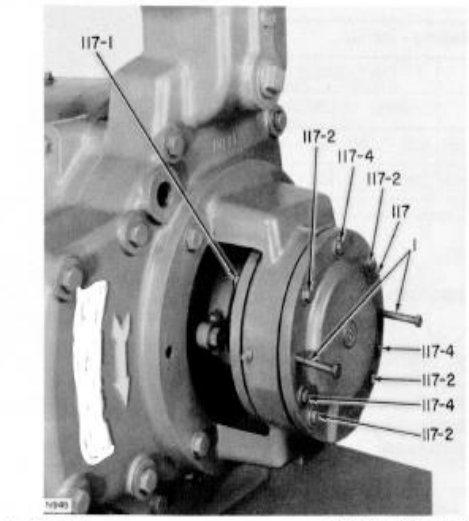
d. Loosen the three takeup screws by at least 1/4 inch.

e. Install two 5/16-18 screws (Size NC-2) or 3/8-16 screws (Sizes NC-3, NC-4, NC-5, NC-6) 0r three 7/16-14 (Size NC-7) in the tapped holes in the fixed bearing outer cap to act as jackscrews.



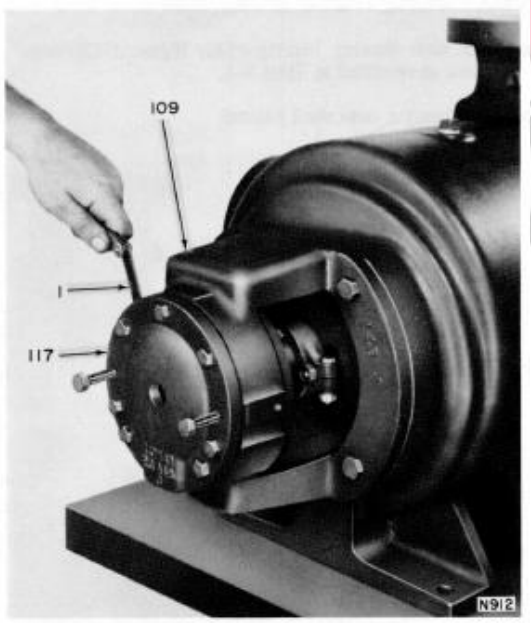
1. Jackscrew 117-2. Fixed Bearing Outer Cap Nut
117. Fixed Bearing Outer Cap 117-4. Takeup Screw
117-1. Fixed Bearing Outer Cap Screw

Fig. 5.10a End Travel check Setup at Fixed Bearing End for NC-2 to NC-5



1. Jackscrew 117-2. Fixed Bearing Outer Cap Screw
117. Fixed Bearing Outer Cap 117-4. Takeup Screw
117-1. Fixed Bearing Outer Cap Nut

Fig. 5.10b End Travel check Setup at Fixed Bearing End for NC-6 & NC-7



1. Leaf (Feeler) Gauge 117. Fixed Bearing Bracket
109. Fixed Bearing Bracket Outer Cap

Fig. 5.11 Measuring Shim Gap

f. Gradually tighten the two jackscrews equally until the dial indicator reading is within the specified limits below:

Dial Indicator Reading - Inches				
Vacuum Pump			Compressor	
Pump	Iron	St. St. *	Iron	St. St. *
NC-2	0.025 – 0.030	0.070 – 0.080	0.050 – 0.060	0.080 – 0.085
NC-3	0.025 – 0.030	0.055 – 0.065	0.050 – 0.060	0.085 – 0.095
NC-4	0.080 – 0.085	0.090 -0.100	0.080 – 0.085	0.090 -0.100
NC-5	0.028 – 0.040	0.070 – 0.080	0.060 – 0.080	0.095 – 0.105
NC-6	0.035 – 0.040	0.070 – 0.080	0.070 – 0.080	0.095 – 0.105
NC-7	0.045 – 0.055	0.090 – 0.100	0.090 - 0.110	0.100 – 0.110
*Stainless steel dial indicator reading s include stainless steel fitted pumps.				

NOTE

ENSURE THAT THE SHAFT ROTATES FREELY WITHOUT ANY RUBBING OR CONTACT.

g. Use a leaf (feeler) gauge to measure the gap between the fixed bearing outer cap (117) and the fixed bearing bracket (109) at four places 90° apart (See Figure 5.11). Add the four measurements and divide the sum by four to compute the average gap.

h. Select a combination of new shims (4, Figure 5.12 and 5.13) equal to the average gap computed in step g.

i. Remove the three screws (117-4), four nuts (117-2), and screws (117-1), and then remove the fixed bearing outer cap.

NOTE

IF A 0.010-INCH THICK PAPER SHIM GASKET WAS ONE OF THE SHIMS SELECTED IN STEP H, LIGHTLY GREASE BOTH SIDES OF THE PAPER SHIM GASKET AND INSTALL IT ON THE FACE OF THE FIXED BEARING BRACKET WHEN PERFORMING STEP J.

j. Position the shims selected in step g and the fixed bearing outer cap on the fixed bearing bracket. Align the four holes in the fixed bearing inner cap (118), bearing bracket, and outer cap. Secure the outer and inner caps with four screws (117-1) and nuts (117-2).

k. Secure the outer cap to the bearing bracket with three screws (117-4).

l. Ensure that the dial indicator reading is the same as the value recorded in step f within ±0.005 inches. Then, remove the dial indicator from the shaft.

m. Install a new lip seal (5-1) in the floating bearing outer cap (115) following the procedure specified in Section 5.17, steps a.1 and a.2.

n. Apply a light coat of grease to the new floating bearing outer cap gasket (115-3) and place the gasket on the outer cap.

o. Slide the floating bearing outer cap and gasket over the shaft and position them on the floating bearing bracket (108).

p. Align the four holes in the floating bearing inner cap, bearing bracket, and outer cap, and secure the caps with four screws (115-1) and nuts (115-2).

q. Install a new packing (1), lantern glands (10), if used, and gland assemblies (112) at the floating and fixed bearing ends following the specified procedure in section 4.5.

NOTE

BEFORE PLACING THE PUMP BACK INTO SERVICE, ALIGN THE COUPLING OR V-BELT DRIVE AS SPECIFIED IN INSTALLATION INSTRUCTIONS, NES VACUUM PUMPS AND COMPRESSORS. PRIME THE PUMP AS SPECIFIED IN SECTION 2.4, STEP C, AND START THE PUMP AS SPECIFIED IN SECTION 2.5.

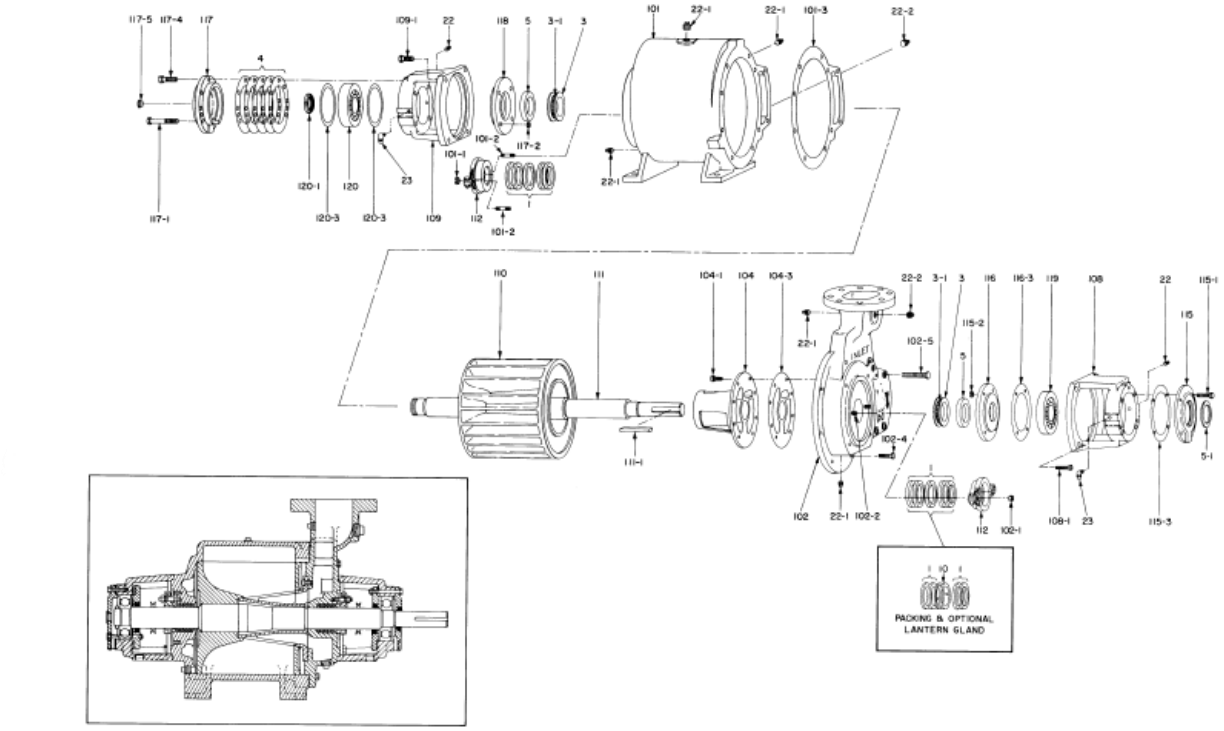


Fig. 5.12 NES exploded view NC-2, NC-3, NC-4, and NC-5 pumps and compressor

Index No	Qty	Part Name	Index No	Qty	Part Name
*1	10 Rings	Packing	108 – 1	4	Floating Bearing Bracket Screw
*3	2	Slinger	109	1	Fixed Bearing Bracket
†*3 – 1	2	Spring, tension	109 – 1	4	Fixed Bearing Bracket Screw
*4	AR	Shim	110	1	Rotor
*5	2	Lip seal	111	1	Shaft
*5 – 1	1	Lip seal	111 – 1	1	Shaft Key
**10	2	Lantern Gland	112	2	Gland Assembly
22	2	Pipe plug	115	1	Floating Bearing Outer Cap
22 – 1	10	Pipe plug	115 – 1	4	Outer Cap Screw
22 – 2	1	Pipe plug	115 – 2	2	Outer Cap Nut
23	2	Grease fitting	*115 -3	1	Outer Cap Gasket
101	1	Body	116	1	Floating Bearing Inner Cap
101 – 1	2	Gland Nut	*116 – 3	1	Inner Cap Gasket
101 – 2	2	Gland Stud	117	1	Fixed Bearing Outer Cap
*101 – 3	1	Body Gasket	117 – 1	4	Outer Cap Screw
102	1	Head	117 – 2	4	Outer Cap Nut
102 – 1	2	Gland Nut	117 – 4	3	Outer Cap Screw
102 – 2	2	Gland Stud	117 – 5	1	Outer Cap Nameplate
102 – 4	6	Head Screw	118	1	Fixed Bearing Inner Cap
102 – 5	4	Head Screw	*119	1	Floating Bearing
104	1	Floating Bearing End Cone	*120	1	Fixed Bearing
104 – 1	8	Cone Screw	*120 – 1	1	Fixed Bearing Locknut
*104 – 3	1	Cone Gasket	*120 - 3	2	Fixed Bearing Gasket
108	1	Floating Bearing Bracket			

Legend for Figure 5.12

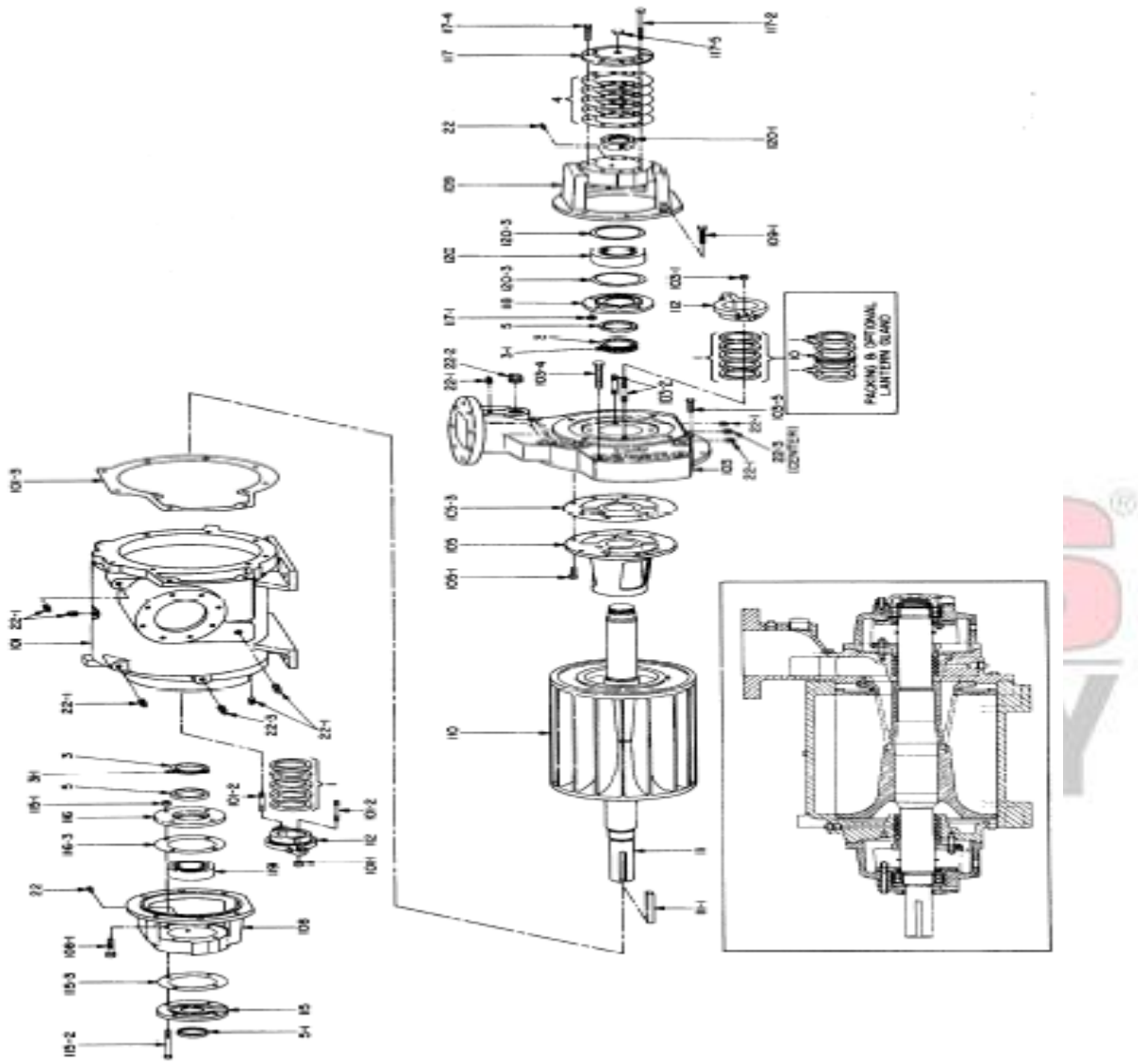


Fig. 5.13 NES exploded view NC-6band NC-7 pumps and compressor

Index No	Qty	Part Name	Index No	Qty	Part Name
*1	10 Rings	Packing	108 – 1	4	Floating Bearing Bracket Screw
*3	2	Slinger	109	1	Fixed Bearing Bracket
†*3 – 1	2	Spring, tension	109 – 1	4	Fixed Bearing Bracket Screw
*4	AR	Shim	110	1	Rotor
*5	2	Lip seal	111	1	Shaft
*5 – 1	1	Lip seal	111 – 1	1	Shaft Key
**10	2	Lantern Gland	112	2	Gland Assembly
22	2	Pipe plug	115	1	Floating Bearing Outer Cap
22 – 1	8	Pipe plug	115 – 1	4	Outer Cap Nut
22 – 2	1	Pipe plug	115 – 2	4	Outer Cap Screw
22-3	2	Pipe plug (Lantern Gland Flush Tapping)	*115 -3	1	Outer Cap Gasket
101	1	Body	116	1	Floating Bearing Inner Cap
101 – 1	2	Gland Nut	*116 – 3	1	Inner Cap Gasket
101 – 2	2	Gland Stud	117	1	Fixed Bearing Outer Cap
*101 – 3	1	Body Gasket	117 – 1	4	Outer Cap Nut
103	1	Head	117 – 2	4	Outer Cap Screw
103 – 1	2	Gland Nut	117 – 4	3	Outer Cap Screw
103 – 2	2	Gland Stud	117 – 5	1	Outer Cap Nameplate
103 – 4	6	Screw	118	1	Fixed Bearing Inner Cap
103 – 5	4	Screw	*119	1	Floating Bearing
103	1	Cone	*120	1	Fixed Bearing
105 – 1	8	Cone Screw	*120 – 1	1	Fixed Bearing Locknut
*105 – 3	1	Cone Gasket	*120 - 3	2	Fixed Bearing Gasket
108	1	Floating Bearing Bracket			

Legend for Figure 5.13