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Building A,

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1-800-297-3550

www.nescompany.com

Operation & Maintenance Manual

NTC Series Two-Stage Liquid RingVacuum Pumps

N E S C O M P A N Y

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 pump the 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 be 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 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 N.E.S. 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 N.E.S. 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 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 New Jersey Head Quarters: 333 RT 46 W, BLDG: A, FAIRFIELD NJ 07004. Telephone number is 800-297-3550, Fax No. 973-933-6322.

WARRANTY

N.E.S. 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. N.E.S. 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.

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Section 1. Safety Precautions

Safety first.

Wear safety glasses, lab coats, long pants, close-toed shoes, and gloves when performing all vacuum operations. Vacuum pumps must be stored on spill trays to prevent oil spills. The running area of the Vacuum Pump may be insulated for noise, if necessary. All used vacuum pump oils must be disposed of through prevailing EH & S procedures.

Safety During Operation

While the pump is under Continuous Operation, following safety precautions to be taken care as described below.

- Ensure that electrical cables/cords and power switches are free from defects or loose connections.
- Ensure that pumps have belt guards in place during Operation to prevent hands or do not wear loose clothing from getting caught in the belt pulley.
- Do not operate pumps near containers of flammable chemicals, flammable chemical wastes, or combustible materials such as paper or cardboard.
- Use correct vacuum tubing (thick walls), not thin Tygon-type hoses.
- Do not place pumps in an enclosed, unventilated cabinet allowing heat and exhaust to build up.
- Replace old tubing; crumbly tubing can degrade performance.
- Use the shortest length of tubing that reaches where needed.
- Do not use solvents that might damage the pump.
- Always close the valve between the vacuum vessel and the pump before shutting off the pump to avoid sucking vacuum oil into the system.
- Place a pan under pumps to catch/collect oil drips.
- Check oil levels and change the oil when necessary. Replace and adequately dispose of vacuum pump oil that is contaminated with condensate. Used pump oil must be disposed of as hazardous waste as per EH&S Procedures.
- With oil filed total recirculation service pumps, many vapors condense in the pump oil. Solvents in the oil degrade its performance (and eventually ruin the pump), create a chemical hazard when the oil is changed, and are emitted in an oil mist vented from the system. Other vapors pass directly into the exhaust stream. To avoid these problems:
- Trap evaporated materials with a cold trap before they reach the pump. Depending on the material that is to be trapped, this can be a filtration flask either at room temperature or placed in an ice bath. For more volatile solvents, more sophisticated options exist (e.g., dry ice trap).
- Ensure vent the pump exhaust properly.

Safety During Service

Before engaging in the Operation or maintenance of a vacuum pump or compressor, the following precautions should be taken care of as described below -.

- First, stop the pump.
- Make sure current/power switches, circuit breakers are shut off and identify with proper tagging for "Do Not Switch On."
- Pass air into/out of the piping so that the pump pressure equal to atmospheric pressure
- Empty/clear the service liquid before opening the pump.
- If the pump operated in harmful liquid/media, make sure to wash with an appropriate liquid.
- Keep a record for each pump to record oil change dates, bearing greasing date and shaft rotation and keep track of the maintenance schedule.

Section 2 About this manual

This manual contains information for owners and operators of the N.E.S. Two-Stage Vacuum Pump, NTC. Series. This information includes a description of how to operate and maintain these vacuum pumps.

Note

For installation information refers to manual No. XXX, Installation Instructions, N.E.S. Vacuum Pumps and Compressors.

Section 3 How the N.E.S. Vacuum Pump works

The main functional assemblies of the N.E.S. NTC two-stage vacuum pump are shown in Figure-1.1. A external motor turns a two-stage rotor in the vacuum pump. Both rotor's portions lies within a first-stage chamber and second stage chamber formed by the is formed by the casing of body; the other portion of the rotor lies within a second stage chamber that is also formed by the body's casing. Liquid compressant (usually water), also known as the seal liquid, is applied to the body's first stage chamber, from a cone's liquid passage. The mixture of liquid compressant and compressed gas is discharged through the first stage discharge passage and an internal manifold to the second stage. All of the liquid compressant and gas from the first stage discharge passes through the second stage to the pump discharge. Both pump stages function identically. Figure 1-2 shows the sequence of actions through the first stage. The steps illustrated are made possible by the cause the body casing axis is offset from the rotor's axis. The offset of the body is designed so that the forces on the rotor balance out, resulting in a smooth, quiet operation. The offset in the second stage is diametrically opposite the offset in the first stage, resulting in force vectors' neutrality.

Section 4 Operation

4.1 Preparation for Preliminary Start-up

Note: Contact your N.E.S. Representative for start-up assistance

4.2 Liquid Compressant (Seal Water)

Piping connections must be made to a liquid compressant supply. (See Figure 2-1.) The usual liquid compressant is fresh water at 60°F (15°C). Variations in the flow rate of ± 50 percent will not damage the pump but alter pump capacity.

Caution – The compressant liquid flow must be started before energizing the pump drive motor, even when the pump is only being operated just to check the direction of rotation.

4.3 Draining and Flushing

Before starting the vacuum pump upon completion of alignment (as specified in manual No. XXX, Installation Instructions, N.E.S. Vacuum Pumps and Compressors), remove the seal water drain plugs (22-1 and 22-2, Figure 5-12) from the heads and body of the vacuum pump. Turn on the shut-off valve for the seal water supply. Allow the seal water to flow until there is clear flow from all drains. Although the vacuum pump is flushed with inhibiting before prior to shipment, a light film of rust may form before installation is complete. This film will disappear after the vacuum pump shaft has been manually rotated a few times. Close the shut-off valve for the seal water supply. Replace the seal water drain plugs using a pipe thread compound.

4.4 Preliminary Inspection

Perform the following preliminary Inspections before starting the pump:

WARNING PERFORM ALL OF THE FOLLOWING STEPS IN THE SAME ORDER DESCRIBED TO ENSURE PERSONAL SAFETY AND EQUIPMENT PROTECTION.

a. Isolate all power sources to the driver unit to make sure that no accidental starting occurs.
b. Inspect the pump to make sure that all drain plugs have been properly installed.
c. Manually prime the pump with liquid compressant until there is a flow from the overflow.
d. Inspect the separator, the receiver, and the heat exchanger (if used) to make sure that all shipping plug protectors have been removed and that all open connections have been plugged or piped.

e. Inspect all piping to make sure that proper connections have been made to the pump and its basic system in accordance following the N.E.S. installation drawings that have been supplied with the pump. Make sure that all piping is the correct size, securely connected, and adequately supported.

f. Check vacuum pump and drive hold-down bolts and base or soleplate foundation bolts for tightness. Shim the base if necessary.

g. Inspect all other significant operational component connections, associated with the pump, to make sure that they are following the respective equipment manufacturer's recommendations.

h. Inspect all pump control components (control valves, gauges, etc.) to make sure that they have been located according to N.E.S. installation drawings. Ensure that these components are correctly oriented in the piping scheme to achieve the proper flow and functional operation.

i. Inspect the pump inlet to make sure that the inlet screen and clean –out connections have been properly made and free of tools, pieces of equipment and debris.

j. Make sure that the liquid discharge connection is free of obstructions.

k. Remove the coupling or V-belt guard and rotate the pump shaft by hand in the operation's specified direction as inscribed in the drive end casing of the pump. The specified direction of rotation is indicated by an arrow cast on the pump body and is illustrated on the installation drawing.

THE PUMP SHAFT MUST ROTATE FREELY. If the pump shaft is bound and cannot be freed by rotating it manually, contact your N.E.S. Representative for assistance.

CAUTION
DO NOT ATTEMPT TO FREE PUMP SHAFT FROM A BINDING OR BOUND CONDITION BY APPYING POWER TO THE DRIVE MOTOR.SEVERE DAMAGE MAY RESULT DUE TO SUCH ACTION

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. PLEASE CHECK RESPECTIVE FLOW RATES BY CONTACTING N.E.S. REPRESENTIVE CHECK FOR FLOW FROM VACUUM PUMP DISCHARGE (OR WATER TRAP SILENCER).

1. With main supply valves open and the pump primed, as in step c , bump the drive motor for the pump to check for the proper direction of shaft rotation.

WARNING MAKE SURE THAT THE COUPLING OR V-BELT DRIVE IS ENCLOSED WITH A GUARD BEFORE STARTING THE DRIVE MOTOR.

2-5 STARTUP AND OPERATING CHECKS

When the preliminary inspection and preoperational check procedures have been completed, start the pump and check pump operation as follows:

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

Note Refer to Troubleshooting, Section 3-, if any operational difficulties arise when performing the following steps.

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

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

Note
If pump operation becomes unstable, pump vibration levels will increase and the pumping volume will decrease. IF THE PUMP DOES NOT STABILIZE, SHUT DOWN THE SYSTEM IMMEDIATELY, AND DETERMINE THE CAUSE.

c. While the pump is being stabilized at the required inlet vacuum, check the pump's liquid seal flow (water). Make sure that the fluid seal is flowing out of the water trap silencer drain.

d. Maintain a constant check on the temperature of the pump casing during the start-up procedure. If the temperature rises rapidly or is 25˚F (14˚C) or more above the liquid compressant temperature, shut down the unit immediately and determine the cause.

e. After starting the pump, monitor the bearing bracket's temperatures stabilize for a minimum of 30 minutes.

CAUTION

IF A BEARING BRACKET TEMPERATURE IS MORE THAN 30˚ F(17˚C) ABOVE THE PUMP CASING TEMPERATURE, SHUT DOWN THE PUMP IMMEDIATELY AND DETERMINE THE CAUSE.

CAUTION

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

f. Check the pump for vibration and noise. Excessive vibration and noise are an abnormal condition on a N.E.S. pump. Shut down the pump immediately to prevent further damage determine the cause.

g. Check the speed (R.P.M.) of pump shaft rotation by prying the nameplate cap from the fixed bearing outer cap and inserting a tachometer with a shaft extension, if necessary. 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 N.E.S. Representative.

Section 5 Troubleshooting

5.1 LOCATING TROUBLES

N.E.S. NTC two-stage vacuum pumps require little attention other than checking the vacuum pump's ability to obtain the full capacity of maintaining a constant vacuum. If a V-belt drive is used, V-belt tension should be checked periodically, and the V-belt should be inspected for excessive wear. V-belts are generally rated for service lives of 24,000 hours. If operating difficulties arise, make the following checks:

h. After the pump has been running for ten minutes with steady leakage from the stuffing box, tighten the gland nuts evenly 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. This dripping is necessary to provide lubrication for the packing and prevent it from scoring and burning the shaft. Subsequent tightening of the gland nuts one-quarter turn should be done with the pump operating at average working temperature and vacuum.

a. Check proper seal water flow rate as specified in Paragraph 2-2.

b. Check for the correct direction of vacuum pump shaft rotation as cast on the drive end's vacuum pump head.

c. Check for a restriction in the gas inlet line.

d. If the pump is shut down because of a change in temperature, noise and vibration from normal operating conditions, check bearing lubrication, bearings condition, coupling or V-belt drive alignment. Refer to Bulletin No.XXX, Installation Instructions, N.E.S. Vacuum Pumps, and Compressors, for alignment procedures and V-belt tensioning.

Note

If the trouble is not located through these checks, call your N.E.S. Representative before dismantling or disassembling the vacuum pump.

Section 6 Preventive maintenance

6.1 Periodic maintenance

Note

The following schedules should be modified as necessary for your specific operating conditions.

6.2 Six- month intervals

a. If the drive coupling is lubricated, it should be filled with oil or grease following the coupling manufacturer's instructions.
b. Check the pump bearings and lubricate, if necessary, specified in paragraph 4-4.
c. Relubricate the drive motor bearings according to the motor manufacturer's instructions.
d. Check to ensure that the lobe unloader 3/8-inch orifice in the orifice plug in the body is not plugged as follows:

1. Remove pipe pug (22-2, Figure 5-12) from fixed bearing en head (103) and inspect orifice plug (21).
2. If the orifice is plugged, use a rod to clean out any obstructions.
3. If the orifice plug cannot be cleaned with a rod, use wrench and remove the orifice plug. Remove obstruction if possible and reinstall or replace the plug.
4. Reinstall pipe plug in fixed bearing end head.

6.3 Twelve- Month Intervals

a. Inspect the pump bearings and lubricate, if necessary, as specified in Paragraph 4-4.
b. Replace the stuffing box packing as specified in Paragraph 4-5.

6.4 BEARING LUBRICATION

The pumps, covered in this Bulletin have grease-lubricated bearings installed in bearing brackets with grease fittings. Bearings are lubricated before shipment and require no lubrication for approximately six months.

To add grease and check the condition of grease in the bearing bracket proceed as follows:

a. While the pump is running, add grease according to specifications in Table 4-1 to grease fitting (23, Figure 5-12).
b. Check the condition of grease after initial flow from bearing cap for contamination or presence of water.

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c. If grease is contaminated, remove fixed or floating bearing bracket (109 or 108), fixed or floating bearing (120 or 119) and associated parts as specified in Paragraph 5-2, steps a through g for fixed bearing (120), or Paragraph 5-3, steps a through f for floating bearing (119). Discard bearing.
d. Flush bearing bracket and bearing cap to remove all grease.
e. Hand pack both sides of new bearings as specified in Table 5-1 with grease as specified in Table 4-1.
f. Install bearing bracket, bearing and associated parts as specified in Paragraph 5-18 and as follows:

1. For floating bearing (119), perform steps a through c, Paragraph 5-20.

Note

Ensure that lip seal (5-1) is seated in floating bearing outer cap (115) with sealing lip first, away from bearing.

2. Secure floating bearing outer cap (115) and new gasket (115-3) to floating bearing bracket (108) as specified in Paragraph 5-21, steps u, v and w.
3. Rotate shaft (111) by hand and make sure there is no rubbing or metal –to –metal contact.
4. For fixed bearing (120), proceed as specified in Paragraph 5-19, steps a through h.

CAUTION

THICKNESS OF SHIMS (4) EQUAL TO THICKNESS OF SHIMS REMOVED FROM PUMP MUST BE REINSTALLED TO MAINTAIN REQUIRED END TRAVEL.

5. Install shims (4) and fixed bearing outer cap (117) on fixed bearing bracket (109) as specified in Paragraph 5-21, steps p and q.

6. Rotate the shaft by hand and make sure there is no rubbing or metal –to-metal contact.

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

N.E.S. STANDARD GREASE RECOMMENDATIONS:

The following is a list, by manufacturer, of some grease that exhibit 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

6.5 STUFFING BOX PACKING

A preventive maintenance schedule should be established to tighten and replace the packing in the pump's stuffing boxes. The packing in the stuffing boxes in pumps used in continuous process systems should be replaced at the annual shutdown. A more frequent replacement may be required on several process applications in which liquid compressant in the pump is contaminated by foreign material or is incompatible with the existing packing material . (The packing material consists of four rings with the dimensions listed in Table 5-1.) In some cases, a different packing materials may be required because of the liquid compressant used.

When replacing the packing in a stuffing box, remove the old packing as follows:

a. Slide slinger (3, Figure 5-12) against bearing inner cap (116 or 118)
b. Loosen and remove gland nuts (102-1 or 103-1, Figure 4-3) from studs.

c. Slide packing gland assembly (112) as far from the stuffing box as it will go, remove two nuts, lock washers and screws holding halves of packing gland assembly together and remove two halves.
d. Screw tips of packing pullers (2, Figure 4-1) into packing (1).
e. Pull packing out of the stuffing box.
f. Form two lantern gland pullers from 1/8 inch diameter steel wire as shown in Figure 4-2.
g. Work bent tip of each lantern gland puller around the outer diameter of lantern gland (10 Figure 4-3) in stuffing box until pullers are felt catching in slots in lantern gland on opposite sides.
h. Pull lantern gland out of stuffing box.
i. Screw tips of packing pullers (2, Figure 4-1) into remaining packing in the stuffing box and pulling out.
j. Thoroughly clean stuffing box and check shaft for severe scoring and wear as specified in Paragraph 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 O.D. of shaft the (111) and I.D. of the stuffing box, as shown in Figure 4-3, Part C, to use as packing ring pushers.
b. Lubricate inside diameter of packing rings with Molykote G-n paste or equivalent.
c. Open packing ring into a spiral by pulling 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 packing ring is installed, the stagger location of butted ends of the ring so that successive ring is offset by 90 degrees. (See Figure 4-3, Part D). Make sure certain that each packing ring is firmly seated.
f. Install lantern gland (10). (See Figure 4-3, PART E).
g. Install remaining two packing rings as specified in step e.
h. Install two halves of packing gland assembly on the shaft and assemble with two screws, lock washers and nuts. Slide packing gland assembly on gland studs so that it is flush against the last packing ring installed. Install and tighten gland nuts (102-1 or 103-1), evenly, finger tight. (See Figure 4-3, Part F.)
i. Turn on the pump (Paragraph2-5). Check the temperature of the pump stuffing box area as the pump operates. Ensure there is no leakage or if the stuffing box overheats, shut down the pump and determine the cause.
j. After the pump has been running for ten minutes with steady leakage from the stuffing box, tighten gland nuts evenly one –quarter turn. Repeat at ten-minute intervals until there is leakage of approximately 45 to 60 drops per minute from the gland with no overheating. This dripping is necessary to provide added lubrication for packing and prevent it from scoring and burning the shaft. Subsequent tightening of gland nuts one-quarter turn should be done with pimp operating at average working temperature and vacuum.

6.6 SHUTDOWN PERIODS

If the pump is shut down for 2 to 3 weeks, rotate the vacuum pump and recirculating pump (if used) by hand at least once every week to prevent rust build-up between cast iron parts which may result in seizing. If the pump must be taken out of service for more than three weeks up to one year, proceed as follows to prevent seizing during the storage due to rust information:

Note:

These preservation procedures apply to all-cast iron pumps only, maintained in covered storage.

a. Remove pipe plugs (22-1 and 22-2, Figure 5-12) from pump body (101), and heads (102 and 103) and drain all liquid from the pump.
b. Remove all packing as specified in Paragraph 4-5 and flush out stuffing boxes with a rust inhibitor. Reinstall packing.
c. Touch up any areas where paint has chipped and apply Houghton's Rust veto #344 coating compound equivalent, to external surfaces, as necessary.
d. Disconnect discharge piping and blank-off pump discharge flange.
e. Fill the pump with water-soluble preserving oil, J.L.Quimby NRP100 or equivalent, through an inlet flange.
f. Rotate pump shaft by hand 10 to 15 revolutions.

Note

For long term preservation procedures for storage periods of more than one year, **contact your N.E.S. Representative.**

g. When pump is to be put back in service, proceed as follows:

1. Remove pipe plugs (22-1 and 22-2) from pump body and heads and drain all preserving oil.
2. Remove blanks from pump discharge flanges and reconnect discharge piping.
3. Repack stuffing boxes with new packing as specified in Paragraph 4-5.
4. Flush pump as specified in Paragraph 2-3.
5. Replace drain and vent pipe plugs in the body using Key-Tite pipe compound. Start pump as specified in Paragraphs 2-4 and 2-5.

Section 7 Disassembly, Inspection and Reassembly

7.1 DISMANTLING PUMP

Before disassembling the pump, isolate the electrical input and disconnect the seal liquid connections, coupling to drive motor or V-belt drive, and inlet and outlet connections. Disassemble and reassemble the pump on a level surface. Mark all parts as they become accessible during disassembly to ensure correct positioning for reassembly. Before starting disassembly, collect the parts, materials and standard tools, and fabricate the special tools listed in the following paragraphs, required for assembly and reassembly of the pump.

Parts and Materials

a. Minimum recommended spares specified in Legend for Figure 5-12 (which should 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 : one set of stuffing box packing

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(1) one set of adjusting shims (4) one set of gaskets; and floating and fixed bearings(119 & 120). (Refer to table 5-1.)

b. Molykote G-n Paste or equivalent.
c. Lacquer Primer T and Loctite 242(required only if gland studs(102-2 or 103-2) require replacement).
d. Yellow grease.
e. Grease as specified in Table 4-1.
f. A solvent such as kerosene.
g. Two 5/8-11 eyebolts with nuts to remove and install heads (102 and 103).
h. Two 3/8-16 jackscrews as shown in Figure 5-10 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).

Note

Machinist's hammer and brass drift can be substituted if the spanner wrench is not available.

d. Bearing puller.
e. Press: approximately 40 ton capacity. Press must indicate the amount of force applied and is only required if 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.

Table 7-1. Pump Data

NOTE: Al dimensions are in inches

Part Name (See Figure X).	NTC-2&3 Iron	NTC-2&3 Stainless	NTC-5 Iron	NTC-5 Stainless
Packing (1) * Dimensions	3/8 square x 2 1/8 ID x 2 7/8 OD	2 1/8 dia. mechanical seal (2 req.)	3/8 square x 1.75 I.D. x 2.50 O.D.	2 ¼ dia. mechanical seals (2 req.)
No. Of Rings per Stuffing box	4		4	
Lip seal (5) Floating and Fixed Bearing Inner Caps	2 req. 55 mm shaft dia. 70 mm bore dia. 8 mm wide		2 req. 1.75 in shaft dia. 2.375 in O.D. X.312 I.D.	
Lip Seal (5-1), Floating Bearing outer Cap	1 req. 40 mm shaft dia. 60.33 mm OD 11.1 mm wide		1 req. 1.375 in shaft dia. 2.000 in O.D. x .312 I.D.	
Body Gasket (101-3) Qty. Floating Bearing End	5 (0.010 in) thick	4 (0.010 in) thick 2 (0.030 in) thick	1 (.030 in) thick 3 (.010 in) thick	2 (.030 in) thick 3 (.010 in) thick
Body Gasket (101-4) Qty. Fixed Bearing End	5 (0.010 in) thick	4 (0.010 in) thick 2 (0.030 in) thick	1 (.030 in) thick 3 (.010 in) thick	2 (.030 in) thick 3 (.010 in) thick
Cone Gaskets Qty (104-2 and 105-3)	1 (0.010 in) thick		1 (.010 in) thick	
Floating Bearing (119)1	Single row ball bearing (non-filling slot)		Single row ball (non-filling slot)	
Fixed Bearing (120)	Double row ball bearing (filling slot)		Single row ball (non-filling slot)	

NTC-7 Iron	NTC- 7 Stainless	NTC-11 Iron	NTC-11 Stainless
3/8 square x 2 1/8 ID x2 7/8 OD	2 1/8 dia. mechanical seals (2 req.)	3/8 square x 2 ¼ ID x 3 OD	2 ¼ dia. mechanical seals (2 req.)
4		4	
2 req. 55 mm shaft dia. 70 mm bore dia. 8 mm wide	1 req. 2.250 shaft dia. 3.125 bore dia. 0.500 wide		
1 req. 40 mm shaft dia. 60.33 mm O.D. x 11.1 mm wide	1 req. 1.625 shaft dia. 2.500 in. O.D. x 0.438 in. wide		
5 (.010 in) thick	4 (.010 in) thick 2 (.030 in) thick	4 (.010 in) thick	8 (.010 in) thick
5 (.010 in) thick	4 (.010 in) thick 2 (.030 in) thick	4 (.010 in) thick	8 (.010 in) thick
1 (.010 in) thick	1 (.010 in) thick		
Single row ball (non-filling slot)	Single row ball bearing (non-filling slot) (2 req.)		
Single row ball (non-filling slot)			

*Contact your N.E.S. Representative for required packing material specification.

*Quantities listed are for trial assembly with extra gaskets at the fixed bearing end to remove gaskets to obtain the final correct Rotor. (End) travel.

Needle-nosed pliers.

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

l. Asbestos gloves.

m. Hoist and slings.

WARNING

MAKE PROVISIONS FOR HANDLING HEAVY PARTS DURING DISASSEMBLY TO AVOID NJURY TO PERSONNEL OR DAMAGE TO PARTS.REFER TO TABLE 5-2 FOR APPROXIMATE WEIGHTS OF PARTS.

Fabricated Tools

a. Bushing or pipe section as specified in Paragraph 5-6, step c (required only if Rotor or shaft requires replacement).

b. Two-inch steel pipe machined as defined in Paragraph 5-19, step 3.

Note

Do not disassemble the pump beyond the point needed to remedy the trouble that has been observed. Before disassembling the pump, remove the drain plugs (22-1 and 22-2, Figure 5-12) from the floating and fixed bearing end heads (102 and 103) and the body (101) to drain all liquid from the pump.

7.2 Disassembling Fixed Bearing End

a. Remove three fixed bearing outer cap screws (117-1, Figure 5-12), four nuts (117-4), four screws (117-2) and fixed bearing outer cap (117) from the fixed bearing bracket (109)

b. Remove and discard shims (4).

c. Remove four fixed bearing bracket screws (109-1) and fixed bearing bracket from fixed bearing end head (103).

d. Remove and discard two fixed bearing ring gaskets (120-3).

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

f. As shown in Figure 5-1, using a bearing puller remove fixed bearing (120) from the shaft. Discard bearing.

g. Remove fixed bearing inner cap(118) from the shaft.

h. Remove lip seal (5) from the fixed bearing inner cap. Discard lip seal.

i. Remove slinger (3) from the shaft.

j. Remove four fixed bearing end head screws (103-4) and six head screws (103-5)

k. Rotate discharge flange of fixed bearing end head (103) 90 degrees to the vertical position and install two 5/8-11 eyebolts in tapped holes 180 degrees apart in discharge flange. Connect chain hoist to eyebolts.

l. Slide fixed bearing end head and cone assembly off the shaft, taking up on chain hoist to support the head.

m. Remove body gaskets (101-4). Record the number of gaskets removed and discards baskets.
n. Remove two gland nuts (103-1) from studs (103-2) and remove gland assembly (112) from the head.
o. Remove packing (1) and lantern gland (10) from head. Discard packing
p. If gland studs (103-2) require replacement, heat base of the stud to 250˚F (121˚C) maximum, using propane torch and 250˚F(121˚C) temp stick, to free Loctite 242 and remove the stud.
q. Inspect fixed bearing end cone (105) as specified in Paragraph 5-9.

Table 5-2. Approximate Weights of Parts

Figure Index No.	Part Name	NTC-2 Iron	NTC-2 Stainless	NTC-3 Iron	NTC-3 Stainless	NTC-5 Iron	NTC-5 Stainless	NTC-7 Iron	NTC-7 Stainless	NTC-11 Iron
101	Body	134	150	144	161	216	242	*	*	1320
102	Floating Bearing End Head	56	63	56	63	86	96	*	*	528
103	Fixed Bearing End Head	54	60.5	54	60.5	84	84	*	*	532
104	Floating Bearing End Cone	11.5	13	11.5	13	16	18	*	*	121
105	Fixed Bearing End Cone	7.5	8.5	7.5	8.5	12 1/2	14	*	*	95
108	Floating End Bearing Bracket	22	22	22	22	25	25	*	*	138
109	Fixed End Bearing Bracket	22	22	22	22	25	25	*	*	138
110	Rotor	59	66	64	72	96	108	*	*	1166
111	Shaft	37	37	41	41	50	56	*	*	520
119	Floating Bearing	2	2	2	2	3.5	3.5	*	*	35
120	Fixed Bearing	3.3	3.3	3.3	3.3	3.5	3.5	*	*	35
*For more information, please contact your NES representative.										

7.3 Disassembling Floating Bearing End

a. Remove shaft key (111-1, Figure 5-12) from shaft (111).
b. Remove four floating bearing outer cap nuts (115-2), screws (115-1) floating outer cap (115) and gasket (115-3) from the floating bearing bracket (108). Discard gasket.
c. Remove lip seal (5-1) from floating outer bearing cap. Discard lip seal.
d. Remove four floating bearing bracket screws (108-1) and floating bearing bracket from floating bearing end head (102).
e. As shown in Figure 5-2, using a bearing puller removes floating bearing (119) from the shaft. Discard bearing.
f. Remove floating bearing inner cap gasket (116-3) and inner cap (116) from the shaft. Discard gasket.
g. Remove lip seal (5) from floating inner bearing cap. Discard lip seal.
h. Remove slinger (3) from the shaft.

7.4 Removing Rotor and Shaft Assembly

a. Grasp fixed bearing end of the shaft (111, Figure 5-12) and slide shaft and rotor (110) assembly out of the body (101).
b. As soon as Rotor extends beyond the body, support the rotor with sling and chain hoist as shown in Figure 5-6. Reposition sling to the point of balance as Rotor and shaft assembly is removed.
c. Inspect rotor tapered bores and shaft as specified in Paragraph 5-10 and 5-11.

7.5 Removing Floating Bearing End Head and Cone Assembly

a. Install two 5/8-inch eyebolts in holes 180 degrees apart in inlet flange of floating bearing end head (102 Figure 5-12) and secure with nuts. Connect chain hoist to eyebolts and support but do not lift head.
b. Remove four floating bearing end head screws (102-4) and six head screws (102-5).
c. Remove floating bearing end head and cone assembly from the body (101).
d. Remove body gaskets (101-3). A record number of gaskets removed and discards gaskets.
e. Remove two gland nuts (102-1) from studs (102-2) and remove gland assembly (112) from the head.
f. Remove packing (1) and lantern gland (10) from the head. Discard packing.
g. If gland studs (102-2) require replacement, heat base stud to 250˚F (121˚C) maximum, using propane torch and 250˚F (121˚C) temp stick, to free Loctite 242 and remove the stud.
h. Inspect floating bearing end cone (104) as specified in Paragraph 5-9.

7.6 Removing Rotor from Shaft

If inspection of the Rotor (Paragraph 5-10) or the shaft (Paragraph 5-11) indicates that either part requires replacement or repair which requires disassembly, proceed as follows:

a. Measure and record dimension A, Figure 5-5, from the rotor taper's outer face to floating bearing journal shoulder.
b. Lift rotor and shaft assembly with chain hoist and sling.
c. Slide bushing or pipe section sized to over fixed bearing end of the shaft with the face of bushing contacting rotor hub face only.

Note
Press with 40- ton capacity is required.

d. Position rotor and shaft assembly in press large enough to handle rotor diameter with floating bearing end of shaft against press ram and bushing, installed in step c, against press back up plate.
e. Make provision to support the fixed bearing end of the shaft as it is pushed from Rotor. Support rotor with blocks or sling passed through rotor blades and around each shroud.
f. Ensure that shaft is level and apply ram force to remove the shaft from Rotor.
g. If the rotor taper bore is to be machined oversize, contact our local N.E.S. representative for guidance on dimensions to be used.

7.7 Removing Cone from Head

If inspection of the cone (Paragraph 5-9) indicates that the cone must be replaced or reworked, proceed as follows:

a. Insert Allen wrench in the socket of each cone screw (104-1 or 105-1 , Figure 5-12) in turn; tap Allen wrench with a mallet as shown in Figure 5-3 to loosen and remove eight cone screws.
b. Tap side of floating or fixed bearing end cone (104 or 105) with the soft-headed mallet to free cone from head (102 or 103).
c. Pull cone from the head.
d. Remove gaskets (104-3 or 105-3). Record the number of gaskets removed and discard gaskets.

7.8 INSPECTION OF DISASSEMBLED PARTS

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

Note

If there is any question about the reusability or repair of worn major pump parts, **contact your local N.E.S. representative.**

7.9 Cones

Usually, cone's worn tapered surfaces 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 cones 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. Replace the cone if the localized wear or scoring exceeds 0.030 inches in depth. Minor pitting is acceptable.

Note

A cone with uneven wear or scoring may be repaired by building up the surfaces by flame spraying and re-machining. **Contact your N.E.S. representative for** specific requirements and dimensions before attempting any repairs.

The cones have an 8-degree taper. If the tapered cone surface is worn or requires light machining, additional gaskets (104-3 or 105-3, Figure 5-12) must be added between the cone (104 or 105) and the head (102 or 103) during assembly to compensate for the total amount of material removed on a 7 to 1 ratio. For example, if 0.003 inches is removed from the cone tapered surface, 0.021 –inch additional thickness of gasket is required. Gaskets supplied are 0.010- in thick each; therefore, two to three gaskets per cone must be added. The maximum total thickness of gaskets that can be placed under each cone is 0.050 inches.

7. 10 Rotor

Inspect the taper cone bores of the Rotor on the same basis as the tapered surface of the cones as follows:

Check for uneven wear, undercutting or scalloping on the cone bore tapered surface with a straightedge and feeler gauge that shown in Figure 5-4. Localized wear, undercutting or scalloping not more than 0.030-inch deep is acceptable. Replace the Rotor if localized wear, undercutting, or scalloping exceeds 0.030 inches in depth. Minor pitting is acceptable.

Suppose the Rotor tapered bore is won or requires light machining. In that case, the total amount of material that is removed must be compensated for on a 7 to 1 ratio by placing gaskets (104-3 and 105-3, Figure 5-12) under the cones in the same manner as specified in Paragraph 5-9. The maximum total thickness of gaskets placed under each cone is specified in Paragraph 5-9.

7.11 Shaft

Check the shaft diameters on which the packing seats for excessive wear. If the shaft is scored or worn through the metalized surface, remove the metalizing, clean the shaft thoroughly and re-metalize, **contact your N.E.S. representative** for procedures and dimensions required.

7.12 REASSEMBLING PUMP

CAUTION

THOROUGHLY CLEAN ALL PARTS BEFORE REASSEMBLY. BE SURE TO REMOVE ALL OLD GASKET MATERIAL FROM MOUNTING FLANGES. REMOVE BURRS FROM MATING SURFACES AND MOUNTING FACES.

7.13 Reassembling Rotor and Shaft

To reassemble the Rotor on the shaft, proceed as follows:

CAUTION

THIS PROCEDURE APPLIES TO ASSEMBLY OF IRON ROTOR ON STEEL SHAFT ONLY. ROTOR AND SHAFT MUST BE AT SAME TEMPERATURE DURING ASSEMBLY.

a. File taper bores of Rotor (110, Figure 5-12) to remove burrs and high spots.
b. Check shaft for dents or rough spots on rotor seat and bearing journals.
c. Stone or polish shaft smooth.
d. Coat rotor hub bore and rotor seat of the shaft with Molykote G-n paste, or equivalent to prevent damage from friction or pick –up when the shaft is pressed into Rotor.
e. Thread fixed bearing locknut (120-1) on the shaft to protect threads.
f. Slide floating bearing end of the shaft (111) into Rotor ensure that rotor blades curve in the clockwise direction viewed from floating bearing

end. Gently the tap fixed end of the shaft with the soft-headed mallet.

g. Slide same bushing or pipe section used in disassembly, on floating bearing end of the shaft. (See Figure 5-5.)

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

i. Press shaft into Rotor until dimension A, Figure 5-5, from the outer face of rotor taper bore to floating bearing journal shoulder agrees with the following chart. Record face applied. Maximum allowable force and minimum permissible force are noted on this chart.

Pump	Dim. A	Allowable Press Force	
		Max.	Min.
NTC-2	7 15/32 to 7 1/2	12 tons	3 tons
NTC-3	7 15/32 to 7 1/2	17 tons	3 tons
NTC-5	6 15/32 to 6 31/32	10 tons	3 tons
NTC-7	7 15/32 to 7 ½	12 tons	3 tons
NTC-11	7 15/32 to 7 ½	17 tons	3 tons

CAUTION

IF ASSEMBLY FORCE RECORDED IS NOT WITHIN LIMITS SPECIFIED ABOVE, DO NOT INSTALL ASSEMBLED ROTOR AND SHAFT IN VACUUM PUMP. **CONTACT YOUR LOCAL N.E.S. REPRESENTATIVE** TO DETERMINE WHETRHER ROTOR AND/OR SHAFT MUST BE REPLACED.

WARNING

BEFORE REMOVING ROTOR AND SHAFT ASSMBLY FROM PRESS. MOVE SLING TO NEW POINT OF BALANCE TO AVOID INJURY OR DAMAGE.

7.14 Installing Cone in Head

If one or both the head and cone assemblies have been assembled, reassemble them as follows:

a. If the new cone is being installed, check it carefully against the old cone for the correct part number and remove rust preventive from surfaces with a solvent such as kerosene.

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

c. Apply a light coat of grease to replacement cone gaskets (104-3 or 105-3, Figure 5-12) equal to the number removed at disassembly, and position the gasket on the head (102 or 103). If Rotor or cone has been re-machined as described in Paragraph 5-9 and 5-10, install additional gaskets following requirements specified in Paragraph 5-9 and 5-10.

d. Lower cone into place on the associated head making certain that eight holes in cone flange align with head's tapped holes in head. Thread in eight 3/8-16 UNC3B socket head cone screws (104-1 or 105-1) and tighten screws.

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

7. 15 Installing Floating Bearing End Head and Cone Assembly on Body

a. If gland studs (10202, Figure 5-12) have been removed, install new studs as follows:

1. Apply Lacquer Primer T to tapped holes in head and stud threads. Allow the primer to dry.
2. Apply Loctite 242 to stud threads and install studs in the head.

b. Fasten mounting feet of the body (101) to level surface.

c. Apply a light coat of grease to each new floating bearing end body gaskets (101-3), (see Table 5-1 for qty) and position gaskets on the floating bearing end body head (102).

d. Using eyebolts and chain hoist as specified in Paragraph 5-5, step a, position head and cone assembly on body. Ensure that head rabbet seats in the body bore and that ten mounting holes in head align with tapped holes in ten body.

e. Secure head to the body with four screws (102-4) and six screws (102-5).

7.16 Installing Rotor and Shaft Assembly

a. Lift and shaft assembly with sling and chain hoist shown in Figure 5-6 and install the floating bearing end of the shaft into the body (101).
b. Keep moving Rotor and shaft assembly, adjusting sling position as necessary, until shaft passes through floating bearing end cone (104) and head (102), and rotor taper bore seats on the cone.

7.17 Installing Fixed Bearing End Head and Cone Assembly on Body

a. If gland studs (103-2, Figure 5-12) have been removed, install new studs as follows:
    1. Apply Lacquer Primer T to tapped holes in head and stud threads. Allow the primer to dry.
    2. Apply Loctite 242 to stud threads and install studs in the head.
b. Apply a light coat of grease to each new fixed bearing end body gaskets (101-4), (see Table 5-1 for qty) and position gaskets on the fixed bearing end head (103).
c. Using eyebolts and chain hoist as specified in Paragraph 5-2, step k, slide head and cone assembly over shaft (111) onto the body. Rotate discharge flange 90 degrees to a horizontal position, ensure that head rabbet seats in the body bore and ten mounting holes in head align with tapped holes in the body.
d. Secure head to the body with four screws (103-4).

Note

Do not install six screws (103-5) at this time since it may be necessary to remove the head to remove gaskets (101-4) to obtain proper end travel. (Refer to Paragraph 5-21.)

7. 18 Assembling Floating and Fixed Bearing Ends

a. Install new lip seals (5, Figure 5-12) in floating and fixed bearing inner caps (1116 and 118) as follows:
    1. Apply a light coat of grease to O.D. and sealing lips of lip seals.
    2. Install lip seals in caps with sealing lips facing away from bearing housing. Ensure that lip seals are correctly seated.
b. Install slingers (3) on floating and fixed bearing ends of shaft (111).
c. Install floating and fixed inner bearing caps and floating bearing inner cap gasket (116-3) on the shaft.
d. Slide slingers and inner caps beyond bearing journal shoulder toward heads.
e. Install floating and fixed bearing brackets (108 and 109) on heads (102 and 103) and secure each with four screws (108-1 and 109-1).

Note

Make sure that pipe plugs (22) and grease fittings (23) are installed in brackets.

7. 19 Installing Fixed Bearing

a. Remove fixed bearing locknuts (120-1, Figure 5-12) from shaft (111).
b. Pack new fixed bearing (120) with grease as specified in Table 4-1.
c. Slide new inner bearing ring gasket (120-3) over the shaft's fixed bearing end.
d. Slide bearing onto shaft journal taking care not to damage shaft threads.
e. Machine one end of 2- inch steel pipe, 6-1/2 inches long, square and install pipe cap on the opposite end.

CAUTION: MAKE CERTAIN THAT MACHINED END OF PIPE IS CLEAN AND CONTACTS INNER RACE OF BEARING ONLY WHEN PERFORMING STEP

f. Using pipe fabricated in step e, drive fixed bearing onto shafts as shown in Figure 5-7 until the bearing is seated against the shaft shoulder.
g. Thread fixed bearing locknuts (120-1) onto shaft and tighten with spanner the wrench or brass drift and hammer as shown in Figure 5-8.
h. Install new outer bearing ring gasket (120-3, Figure 5-12) over the shaft and against bearing.

i. Install fixed bearing outer cap (117) on bearing bracket (109).
j. Align holes of inner and outer caps with holes in bearing bracket and secure with four screws (11702) and nuts (117-4).
k.

7.20 Installing Floating Bearing

a. Pack new floating bearing (119, Figure 5-12) with grease as specified in Table 4-1.
b. Slide bearing onto shaft journal.

CAUTION ENSURE THAT MACHINED END OF PIPE IS CLEAN AND TOUCHES INNER RACE OF BEARING ONLY WHEN PERFORMING STEP.

c. Using pipe fabricated in Paragraph 5-19, step e, drive bearing onto the shaft until the bearing is seated against the shaft shoulder.

7.21 Setting End Travel and Final Assembly

a. Mount dial indicator on floating bearing end of shaft (111, Figure 5-12) with the dial indicator's spindle on the face of floating bearing bracket (108), as shown in Figure 5-9
b. Install three 3/8-16 screws (117-1, Figure 5-10) through fixed bearing outer cap into tapped holes in the fixed bearing bracket to act as take-up screws.
c. Gradually tighten three take-up screws equally until the shaft cannot be rotated with a spanner wrench engaging keyway in the drive end of shaft. DO NOT TIGHTEN TAKE-UP SCREWS BEYOND THIS POINT. The rotor taper bore is now seated on a floating bearing end cone. Zero dial indicator.
d. Loosen three take up screws at least ¼ inch.
e. Install two 3/8-16 screws (1, Figure 5-10) in tapped holes in the fixed bearing outer cap to act as jackscrews.
f. Gradually tighten two jackscrews equally until the shaft cannot be rotated as specified in step c. DO NOT TIGHTEN JACKSCREWS BEYOND THIS POINT. Rotor taper bore is not seated on fixed bearing end core. Record dial indicator reading.
g. Compare the End travel from step f with the chart below. If the recorded end travel is greater than the value specified in the chart, proceed to step h; if the value is less than the chart's, value proceed to step j.

Minimum End Travel		
Pump	**Iron**	**Stainless Steel**
NTC-5	.050	.110
NTC-7	.070	.125
NTC-11	.070	.125

h. Subtract 0.080 inches from the value recorded in step f. If the difference is 0.010 inches or more, remove fixed bearing end body gaskets (101-4) as specified in step i; the difference is less than 0.010 inches, end travel is within limits, and proceed to step l.
i. Remove fixed bearing end body gaskets (101-4) as follows:
   1. Remove four screws (103-4).

CAUTION
MAKE CERTAIN THAT COMPLETE GASKET IS REMOVED WHEN PERFORMING STEP i.2.

   2. Move fixed bearing end head (103) back just enough to insert jaws of needle-nosed pliers in space. Tear off the thickness of body gaskets equal to the value calculated in step h. Each gasket is 0.010-inch thick.

Note
Suppose the number of gaskets to be removed is more than quantity installed or will result in only one gasket remaining. In that case, gaskets (104- 3 and 105-3) may have to be added. **Contact your N.E.S. representative** for assistance in establishing acceptable end travel.

   3. Reassemble fixed bearing end head to body in the same manner as specified in Paragraph 5-17, steps c and d.
   4. Remove jackscrews (1, Figure 5-10) and repeat step c through g to ensure that end travel is within limits.
   5. If end travel is acceptable, install six fixed bearing end head screws (103-5).
j. Subtract the End travel from step f from the value specified in the chart. If the difference is

0.010 or more, proceed to step k; if the difference is less than 0.010, proceed to step l.

k. The select thickness of floating bearing end body gaskets (101-3) equal to the difference calculated in step j; disassemble pump and install additional gaskets at floating bearing end as follows:

    1. Remove dial indicator from floating bearing end of shaft (111).
    2. Remove floating bearing bracket (108), floating bearing (119) and associated parts specified in Paragraph 5-3, steps d through h.
    3. Remove floating bearing end head (102) as specified in Paragraph 5-5, steps as, b and c.
    4. Apply a light coat of grease to each additional body gasket and install each separately against body gaskets previously installed.
    5. Reinstall floating bearing end head as specified in Paragraph 5-15, step d and e.
    6. Reinstall floating bearing bracket, floating bearing and associated parts specified in Paragraph 5-18, steps b through e, and Paragraph 5-20.
    7. Repeat steps a through g to ensure that end travel is within limits.

l. To centre, the rotor, remove two jackscrews (1, Figure 5-10) and gradually tighten three take-up screws (117-1) equally until the dial indicator reading is equal to one-half of the final acceptable end travel reading. Ensure that shaft turns freely without any rubbing or contact.

m. Using leaf (feeler) gauge, measure gap between fixed bearing outer cap (117) and fixed bearing bracket (109) at four places 90 degrees apart. (See Figure 5-11.) Add four measurements and divide the sum by four to compute the average gap.

n. Select combination of new shims (4 Figure 5-12) equal to average gap computed in step m.

o. Remove three screws (117-1). Four nuts (117-4) and screws (117-2) and remove fixed bearing outer cap (117).

p. Position shims selected in step m and fixed bearing outer cap on fixed bearing inner cap (118), bearing bracket and outer cap. Secure outer and inner caps with four screws (117-2) and nuts (117-4).

q. Secure outer cap to bearing bracket with three screws (117-1).

r. Ensure that the dial indicator reading is the same as the value recorded in step 1 within +/- 0.010 inches. Then remove the dial indicator from the shaft.

s. Install six fixed bearing end head screws (103-5). Ensure that shaft turns freely without rubbing or contact.

t. Install new lip seal (5-1) in floating bearing outer cap (115) in same the manner as specified in Paragraph 5-18, steps a.1 and a.2.

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

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

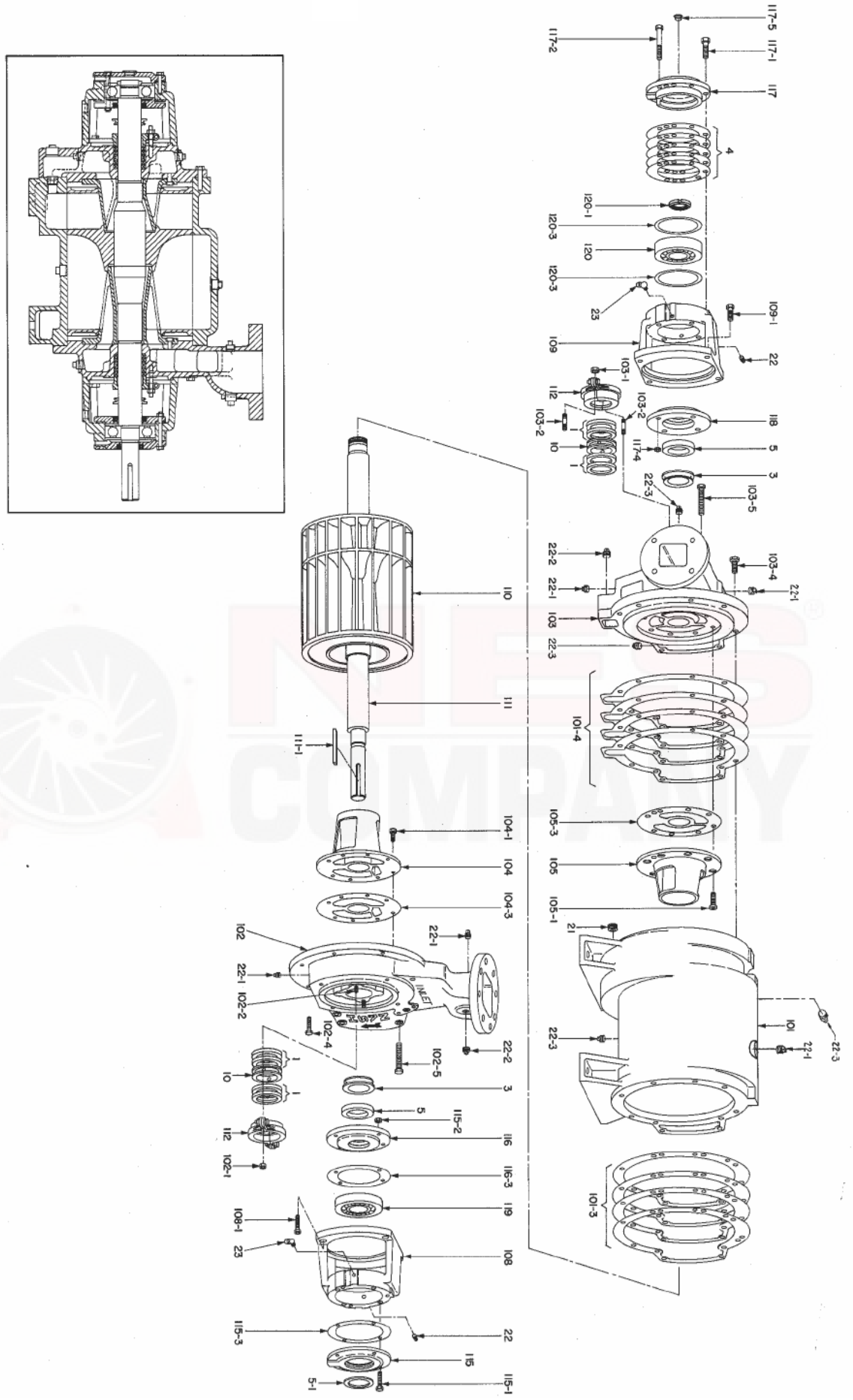
w. Align four holes in floating bearing inner cap, bearing bracket and outer cap and secure caps with four screws (115-1) and nuts (115-2).

x. Install new packing (1), lantern glands (10) and gland assemblies (112) at floating and fixed bearing ends as specified in Paragraph 4-5.

Note

Before placing the pump back into service, align coupling or V-belt drive as specified in Bulletin No. 642, Installation Instructions, N.E.S. Vacuum Pumps and Compressors.

Typical NTC Two-Stage Vacuum Pump, Exploded View



Legend for Expanded View					
Index No.	Qty	Part Name	Index No.	Qty	Part Name
*1	8 rings	Packing	105	1	Fixed Bearing End Cone
*3	2	Slinger	105-1	8	Cone Screw
*4	AR	Shim	*105-3	1	Cone Gasket
*5	2	Lip Seal	108	1	Floating Bearing Bracket
*5-1	1	Lip Seal	108-1	4	Floating Bearing Bracket Screw
*10	2	Lantern Gland	109	1	Fixed Bearing Bracket
21	1	Orifice Plug	109-1	4	Fixed Bearing Bracket Screw
22	2	Pipe Plug	110	1	Rotor
22-1	7	Pipe Plug	111	1	Shaft
22-2	2	Pipe Plug	111-1	1	Floating Bearing End Shaft Key
22-3	4	Pipe Plug	112	2	Gland Assembly
23	2	Grease Fitting	115	1	Floating Bearing Outer Cap
101	1	Body	115-1	4	Outer Cap Screw
*101-3	4	Floating Bearing End Body Gasket	115-2	4	Outer Cap Nut
*101-4	4	Fixed Bearing End Body Gasket	*115-3	1	Outer Cap Gasket
102	1	Floating Bearing End Head	116	1	Floating Bearing Inner Cap
102-1	2	Gland Nut	*116-3	1	Inner Cap Gasket
102-2	2	Gland Stud	117	1	Fixed Bearing Outer Cap
102-4	4	Floating Bearing End Head Screw	117-1	3	Outer Cap Screw
102-5	6	Floating Bearing End Head Screw	117-2	4	Outer Cap Screw
103	1	Fixed Bearing End Head	*117-3	1	Outer Cap Gasket
103-1	2	Gland Nut	117-4	4	Outer Cap Nut
103-2	2	Gland Stud	117-5	1	Outer Cap Nameplate
103-4	4	Fixed Bearing End Head Screw	118	1	Fixed Bearing Inner Cap
103-5	6	Fixed Bearing End 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 Ring Gasket
AR = As required. *Minimum recommended spares.					