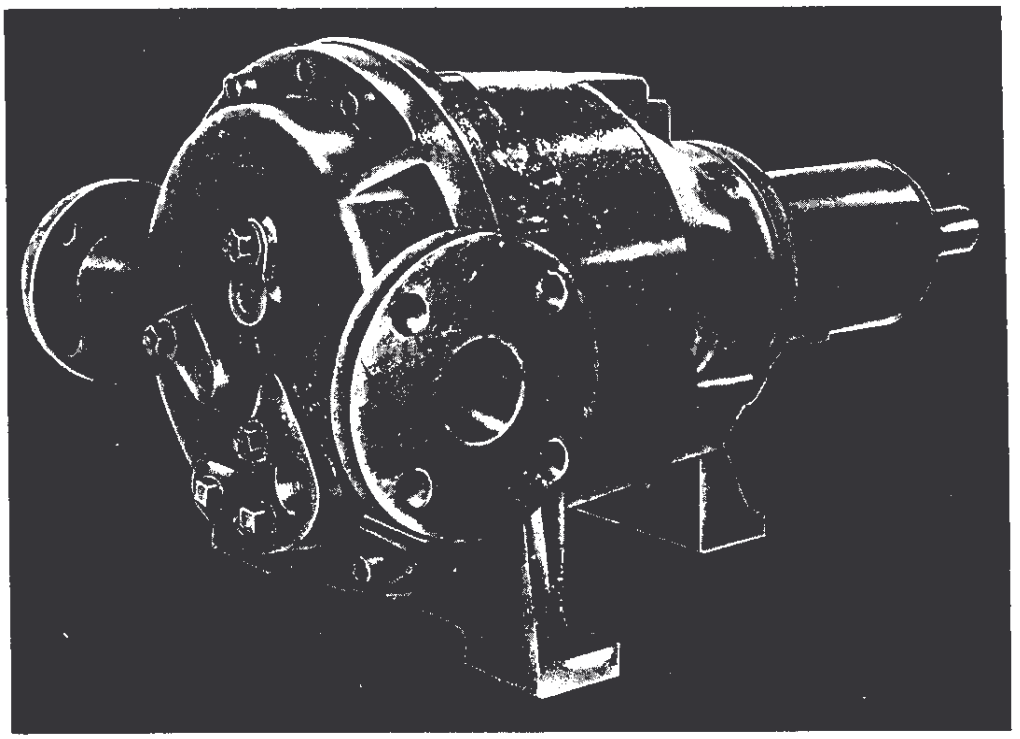
BULLETIN No. 640-A

OPERATION
AND
MAINTENANCE

NASH COMPRESSOR
SIZE AD-74



NASH® ENGINEERING COMPANY
NORWALK, CONN. 06856

W A R N I N G

Do not operate until compressor is initially primed and connected to constant supply of clean compressant liquid. **IF RUN DRY, COMPRESSOR WILL BE DAMAGED.** Always use strainer to prevent sand and scale entering pump with liquid.

Certain operating conditions in combination with water hardness may result in excessive lime deposits within the compressor, causing it to bind. Should this condition be evident, flush compressor with a solvent at regular intervals.

This compressor has been drained and flushed with a water-soluble lubricant prior to shipment. After compressor has been in service, do not store without draining as specified in Paragraph 4-2. Compressor can be damaged by freezing.

Base must be mounted to a leveled foundation and final coupling alignment done during installation. (Refer to Bulletin 642, Installation Instructions, Nash Vacuum Pumps and Compressors.)

N O T I C E

SERVICE AND PARTS

SERVICE AND PARTS FOR NASH COMPRESSORS ARE ASSURED THROUGH A WORLDWIDE NETWORK OF SALES AND SERVICE OFFICES LISTED ON THE BACK COVER OF THIS BULLETIN. ANY REQUEST FOR INFORMATION, SERVICE AND PARTS SHOULD BE DIRECTED TO NEAREST NASH FIELD OFFICE.

WHEN ORDERING REPLACEMENT AND SPARE PARTS, TEST NUMBERS AND COMPRESSOR SIZES MUST BE PROVIDED. Test number and compressor size are located on nameplate fastened to body of compressor. If nameplate has been destroyed, test number will be found stamped on top of body near pedestal body. Parts must be identified by index number and part name. Refer to compressor exploded view and legend, Figures 5-25 and 5-26.

If location of nearest office is unknown, information may be secured direct from The Nash Engineering Company, Norwalk, Connecticut, 06856, U.S.A. Telephone number is 203/852-3900, TELEX Number 96-5968, Cable HYTOR.

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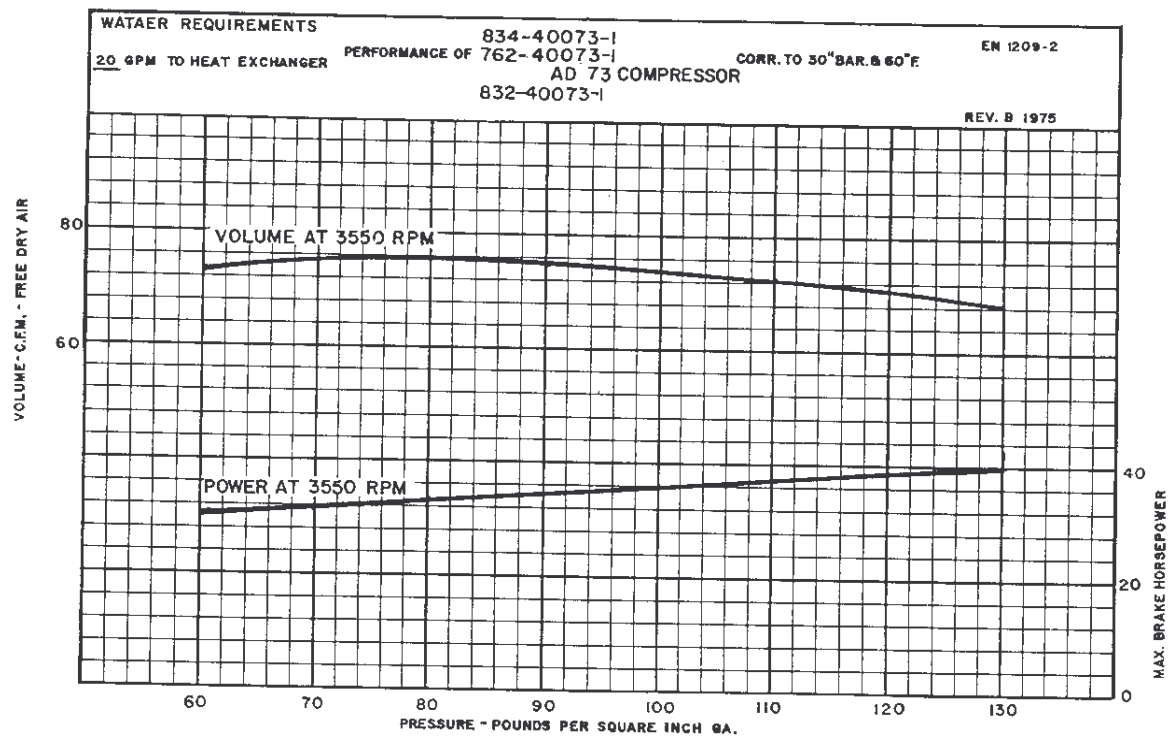
PUMPS—SIZE 73



Section 1
DESCRIPTION

1-1 ABOUT THIS BULLETIN

This bulletin contains information for owners and operators of Nash Size AD-74 Compressors and Packages. This information includes a description of how to operate and maintain the compressor and package.

NOTE

The compressor is built using English units of measure. Metric SI conversions (shown in parentheses) are included for reference only; use the English unit values when performing maintenance procedures. The metric conversions for pressure, expressed in kilopascals (kPa), are in absolute pressure units for all pressures above and below atmospheric pressure.

1-2 HOW THE PACKAGE WORKS

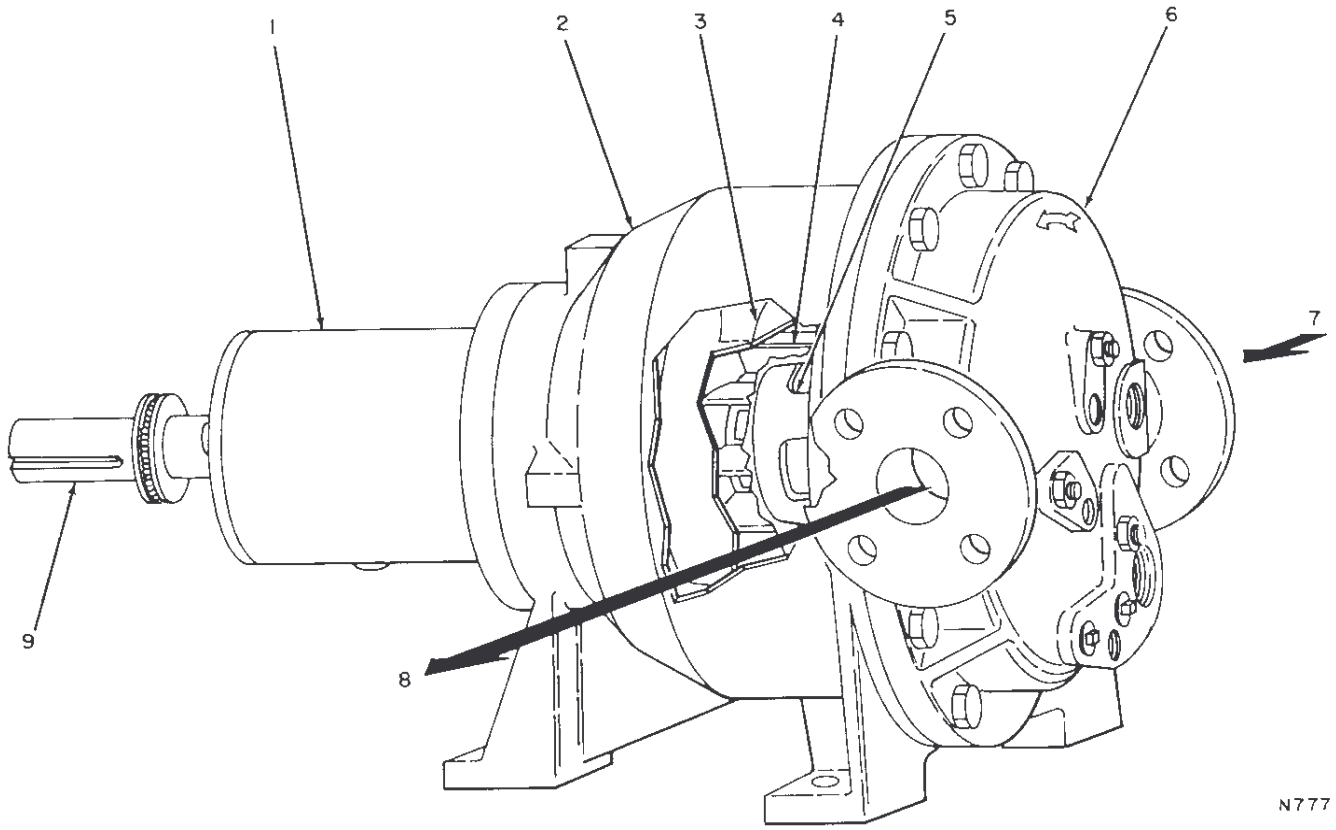
1-3 Compressor Operation

The main functional assemblies of a Nash Size AD-74 compressor are shown in Figure 1-1. A rotor in the compressor is turned by an external electric motor that is coupled to a shaft rotating in bearings that are supported within the body and the bracket. The rotor lies within a chamber formed by the casing of the lobe.

The operation of the compressor is shown in Figure 1-2. A rotor (5) revolves without metallic contact in an elliptical casing (8) that contains a liquid compressant (2) (usually water). The rotor (5) is a circular casting consisting of a series of blades that project from a hollow cylindrical hub which is keyed to the compressor shaft. These blades are shrouded at the sides and form a series of chambers. The curvature of these blades is in the direction of rotation.

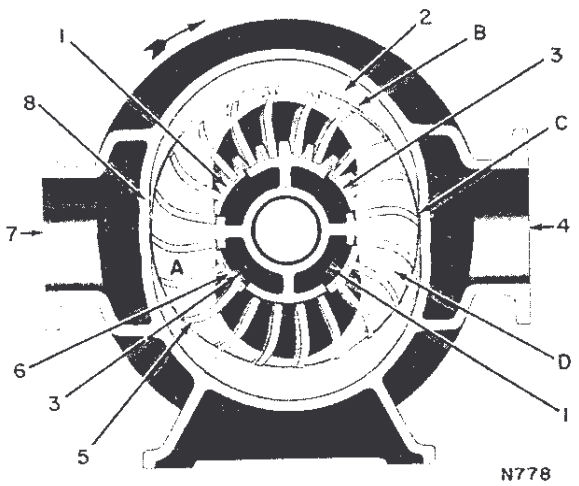
Starting at point A of Figure 1-2, the chambers of the rotor are filled with liquid compressant. This liquid rotates with the rotor, but follows the contour of the casing (8) because of centrifugal force. The liquid (2), which entirely fills the rotor chamber at point A, recedes into the casing as the rotor advances, until at point B, the rotor chamber is empty.

The converging casing forces the liquid back into the rotor chamber, until at point C, the chamber is again full. This cycle occurs twice during each revolution of the rotor. As liquid recedes from the rotor chamber at point D, the liquid is replaced by gas drawn through an inlet port in a conical casting (6) that connects to the gas inlet (7). As the rotor turns



1. Bracket
2. Body
3. Lobe
4. Rotor
5. Cone
6. Head
7. Gas Inlet
8. Gas and Liquid Discharge
9. Shaft

Figure 1-1. Functional Elements of Size AD-74 Compressor



1. Internal Inlet Port
2. Liquid Compressant (Seal Liquid)
3. Internal Discharge Port
4. Gas and Liquid Discharge
5. Rotor
6. Conical Casting
7. Gas Inlet
8. Elliptical Casing

Figure 1-2. Compressor Operation

through 360 degrees and liquid is forced by the casing back into the rotor chamber, the gas that has filled the chamber is forced through discharge ports in the conical casting (6) to the gas and liquid discharge (4).

The actions described above cause a low pressure (vacuum) to be formed in the lines connected at the compressor inlet and compressed gas to be forced out of the compressor discharge. The liquid compressant also serves to seal clearances between the rotor and the cone and is referred to as seal liquid.

1-4 Overall Package Operation

AD-74 compressors are operated in compressor packages that provide the proper distribution and control of the gas being compressed and of the seal liquid used in the compression of the gas. A recirculated-seal arrangement is used to distribute the seal liquid. In a recirculated-seal arrangement, the seal liquid that mixes with the gas during compression is separated, cooled, and then returned to the seal liquid inlet in a closed system loop. Fresh make-up seal liquid is supplied from a seal liquid source.

Two basic controls are available: air unload or bypass control. Air unload control is used when it is desirable to minimize power consumption. Typical package arrangements are shown in pictorial schematic form on Figure 1-3. Electrical power is stepped down to 120-volt control power by the transformer in the starter panel. With the control switch in the control panel in an AIR UNLOAD position (Figure 1-3, Sheet 1), the 120 volts is fed through the A contacts of the switch to the coil in the starter panel. The magnetic starter is energized, its contacts close, and three-phase power is connected to the drive motor. The drive motor turns and rotates the drive shaft of the compressor.

Rotation of the compressor drive shaft creates suction that draws inlet gas through a filter-silencer and an inlet check valve into the gas inlet of the compressor. As described in Paragraph 1-3, gas drawn into the compressor is compressed. Initially, seal liquid is fed to the compressor through cone seal lines from the seal liquid inlet via a strainer, when a globe valve in the inlet line is opened.

The gas-liquid mix at the outlet of the compressor is routed to a separator. The liquid in the gas-liquid mix drops to the bottom of the separator whereas the compressed gas rises. The rising compressed gas is fed through an air filter and a gas outlet check valve to the receiver.

Liquid at the bottom of the separator flows to the inlet of a heat exchanger shell due to the pressure in the separator. Liquid in the heat exchanger shell has its heat drawn off by a flow of cooling water that passes through heat exchanger tubes. Cooled liquid at the outlet of the heat exchanger shell is fed through a strainer, flow control valve, and a check valve to cone seal connections of the compressor. The same liquid also flows through an orifice union and a check valve to a compensated seal connection of the compressor. The cone seal and compensated seal connections are shown in Figure 1-4.

While pressure is building in the receiver, the contacts of an unloaded pressure switch in the control panel are closed. As a result, a current path is completed through normally closed contacts of a lobe pressure switch to the coil of a solenoid air unload valve. This solenoid air unload valve is located in an air line connected between the separator and the gas inlet pipe. With the current path completed, the coil of the solenoid air unload valve is energized, closing the valve. Closing the valve isolates the suction at the air inlet from the separator. This isolation permits loading to occur.

When receiver pressure rises to a preselected value [130 psig (997 kPa)], pressure in an air line feeding the unload pressure switch causes the switch contacts to open. (See Figure 1-3, Sheet 2.) The energizing path for the solenoid air unload valve coil is interrupted and the solenoid air unload valve opens, permitting the pressure in the separator to drop to approximately 10 to 15 psig (170 to 205 kPa) (unloading the system). As soon as the lobe pressure in the compressor exceeds the pressure in the separator, the check valve connected between the heat exchanger and the compressor in the compensated seal line closes. The flow of seal liquid to the compressor is then reduced to a rate that is sufficient to cool the unloading compressor. Simultaneously, the check valve between the separator and the compressor in the liquid unload line opens to unload the compressor of excess liquid pressure.

As gas is used in the system, the receiver pressure drops. When the drop falls below the preselected operating value [120 psig (929 kPa)] for the unload pressure switch, the switch contacts close. The solenoid air unload valve is energized as before, isolating the suction and separator to resume loading as shown in Sheet 1 of Figure 1-3.

If the control switch in the control panel is moved to the TIMED STOP position, the load-unload cycle is performed in the same manner as described for the AIR UNLOAD switch setting. However, an additional feature is added; that is, the drive motor is stopped, if the unloading operation extends beyond a timed interval.

Whenever receiver pressure is low enough to maintain the unload pressure switch in the normally closed position, a time delay relay coil is energized at the same time that the solenoid air unload valve is energized. Contacts of this relay are switched in the energizing path for the magnetic starter when the control switch A contacts are in the TIMED STOP position. With the unload pressure switch contacts

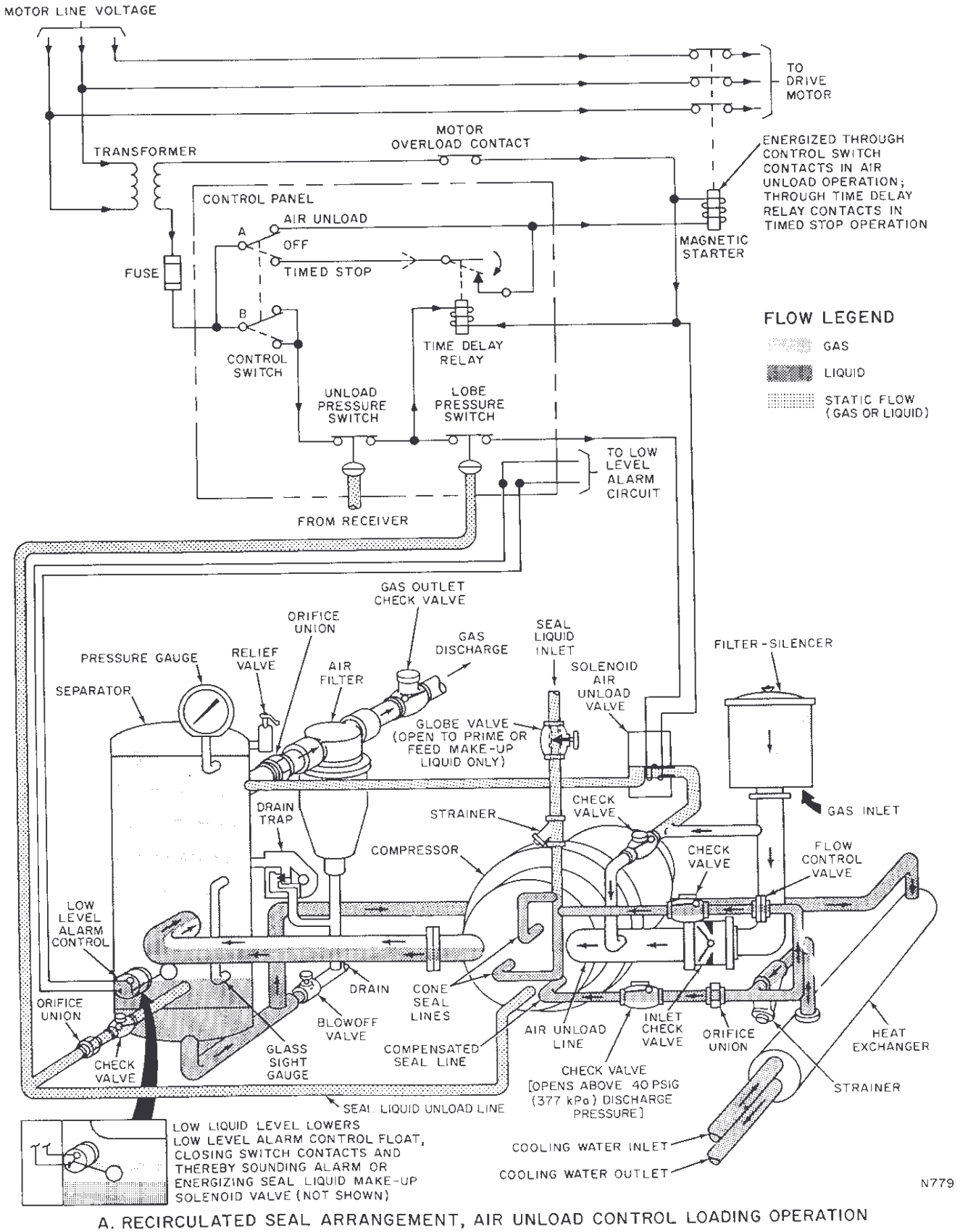
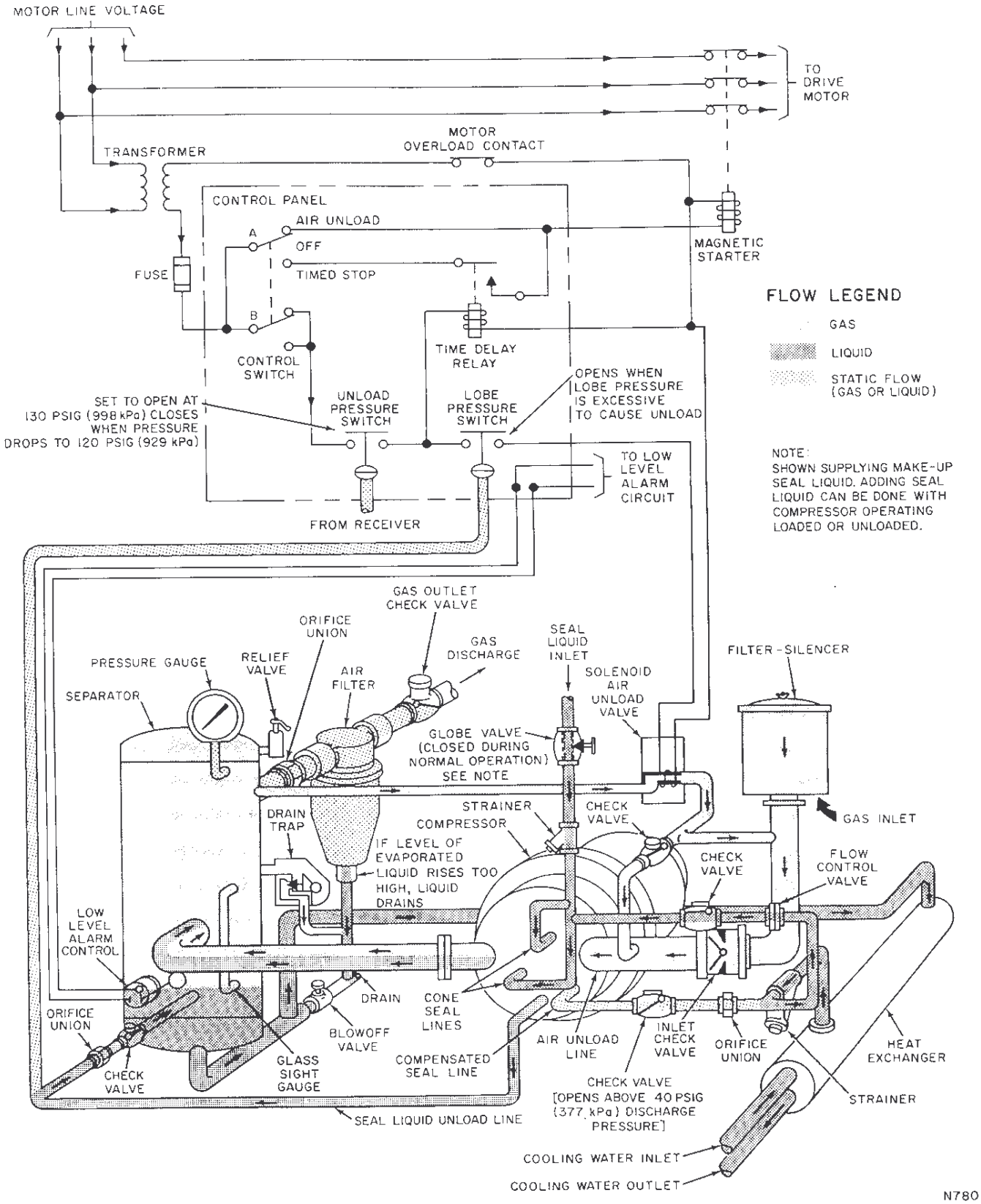
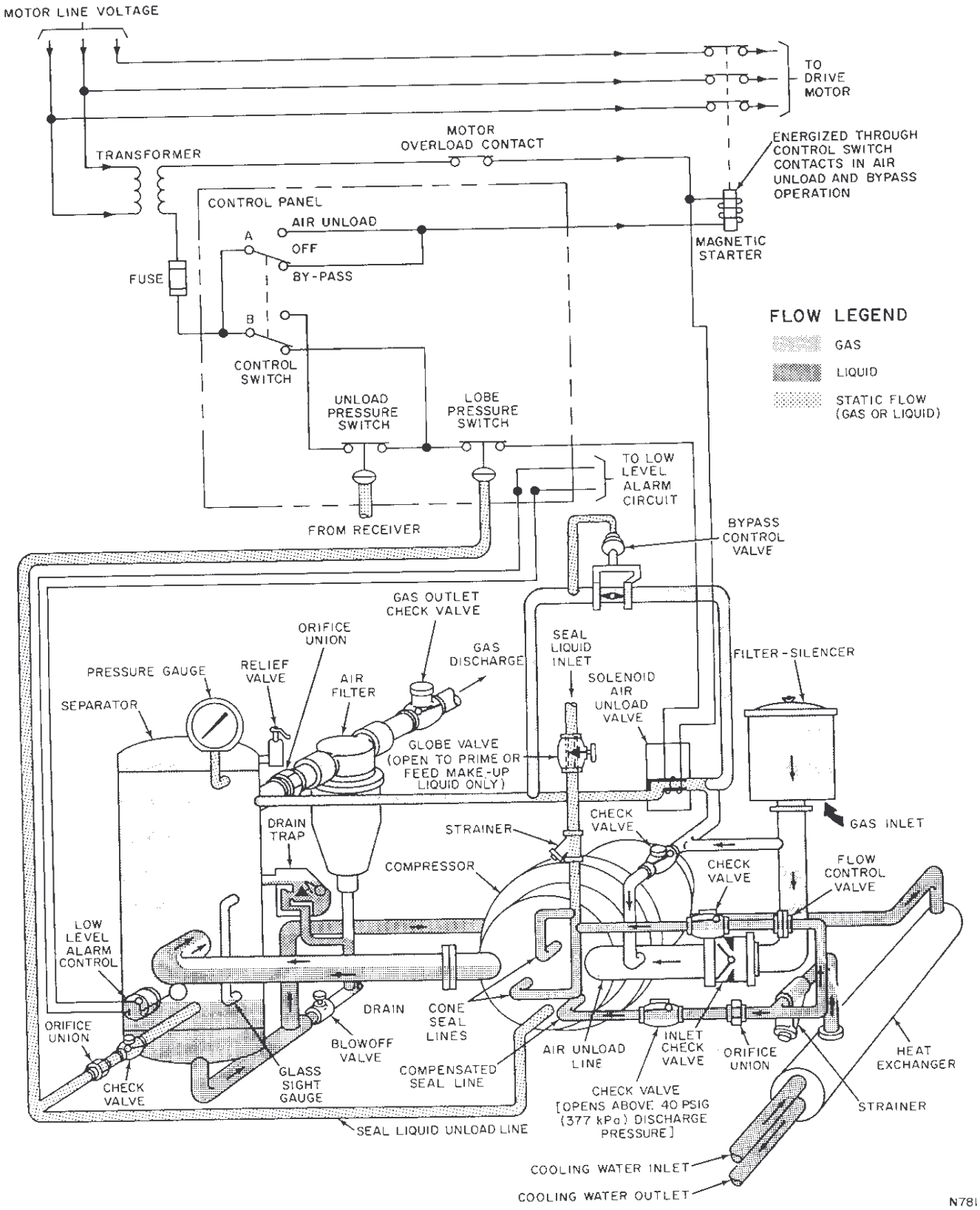


Figure 1-3. Typical Compressor Package Operation, Pictorial Schematic (Sheet 1 of 3)



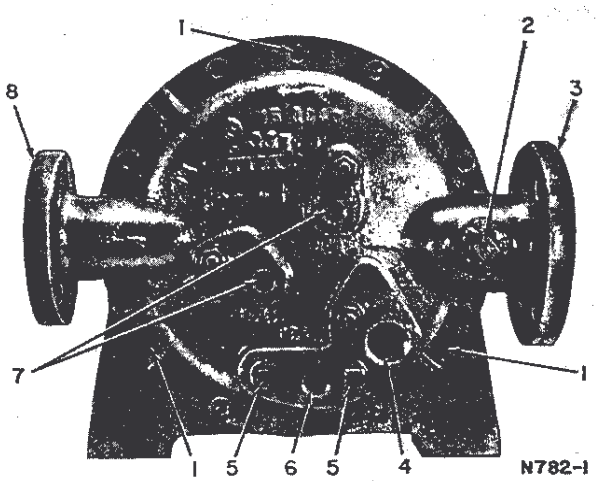
B. RECIRCULATED SEAL ARRANGEMENT, AIR UNLOAD CONTROL UNLOADING OPERATION

Figure 1-3. Typical Compressor Package Operation, Pictorial Schematic (Sheet 2 of 3)



C. RECIRCULATED-SEAL ARRANGEMENT, BYPASS CONTROL BYPASS OPERATION

Figure 1-3. Typical Compressor Package Operation, Pictorial Schematic (Sheet 3 of 3)



1. Threaded Holes (For Disassembly Only)
2. Air Unload (Blowdown) Connection
3. Gas Inlet
4. Compensated Seal Connection
5. Drain Plug
6. Seal Liquid Unload Connection
7. Cone Seal Connections
8. Gas and Liquid Outlet

Figure 1-4. Compressor Piping Connections

open to accomplish an unloading operation, the energizing path for the time delay relay is interrupted. The contacts of the relay do not open immediately, however, but remain closed for a period of time that lasts from 6 to 10 minutes. (The actual time period is selected in accordance with the horsepower of the drive motor.)

If the unloader time exceeds the delay period selected for the time delay relay, the contacts of the time delay relay open and interrupt the energizing path for the magnetic starter, stopping the drive motor, and shutting down the compressor. The compressor remains shut down until receiver pressure drops to the pressure value at which loading resumes.

If the pressure in the lobe area of the compressor rises above 90 psig (772 kPa) (an overload condition known as a high-pressure liquid stall), a sensing line connected from the compressor opens lobe pressure switch contacts in the control panel. Opening these contacts causes an unloading operation that continues until the lobe area pressure drops to 60 psig (515 kPa).

If seal liquid loss caused by leakage and evaporation drops the seal liquid level in the separator excessively, a float on a low level alarm control drops and closes an electrical contact. Closing this contact completes a circuit path for a low level alarm circuit. In some recirculated seal installations, the low level alarm circuit is used to open a solenoid valve connected in the seal liquid inlet line. In those installations, make-up seal liquid is added until the low level alarm control float rises to the point at which the electrical contact is opened. A glass sight gauge on the side of the separator provides a means of visually checking the liquid level.

A drain trap located on the separator is used to prevent the liquid level in the separator from rising above the separator connection to the outlet of the compressor. If the liquid collected in the drain trap rises too high, a float in the drain trap rises, permitting flow to the drain. A second drain trap, which is located in the air filter, removes whatever liquid collects in the air filter. A blow off valve that also feeds to drain is used to flush the separator during preventive maintenance procedures. (Refer to Paragraph 4-1.) An air relief valve vents the separator if gas pressure rises too high. Separator pressure can be monitored on a pressure gauge.

Figure 1-3, Sheet 3 shows a typical recirculated-seal arrangement that uses bypass controls. Bypass control is employed when system demand is nearly equal to compressor capacity or when compressor action is infrequently required, but TIMED STOP operation is undesirable. A compressor operating with bypass control continuously supplies gas to the system only. When system pressure reaches the setting of the bypass control valve [125 psig (963 kPa)], the bypass control valve opens and vents excess gas to the inlet. The bypass control valve continues to regulate the air pressure at 125 psig (963 kPa). When demand from the system drops the pressure below 125 psig (963 kPa), the bypass control valve closes. A compressor with bypass control can also be selected to operate in an AIR UNLOAD mode.

Note

Selecting the AIR UNLOAD modes causes the compressor to load and unload between 110 and 120 psig (860 and 929 kPa) rather than between 120 and 130 psig (929 and 998 kPa).

Section 2
OPERATION

2-1 PREPARATION FOR INITIAL START-UP

Note

Contact your Nash Representative for start-up assistance.

2-2 Liquid Compressant (Seal Liquid) and Cooling Water

Piping connection must be made to a seal liquid supply to initially prime the package and to provide make-up seal liquid if the liquid level in the separator drops below the minimum required. (See Figure 1-3.) *Seal liquid which is used as the liquid compressant MUST be provided to the compressor BEFORE THE COMPRESSOR IS STARTED.*

Piping connection to a cooling water supply with a flow rate of 20 US GPM at 85°F (76 l/min at 29°C) must be made to the heat exchanger.

2-3 Double Mechanical Seal Liquid

When a double mechanical seal is furnished, a clean supply of liquid (usually water) must be piped to the

mechanical seal flush inlet nipple at the top of the compressor with the mechanical seal flush outlet line connected to the nipple at the side of the compressor. The liquid should be supplied at a flow rate of 1/2 US GPM (1.9 l/min) with the stuffing box pressure maintained at 20 psig (239 kPa) above the compressor discharge pressure.

Valves should be incorporated in the mechanical seal flush outlet line to regulate the pressure. Flow measuring devices should be located in the flush inlet line.

2-4 Flushing and Draining

Before starting the compressor and upon completion of alignment (as specified in Bulletin 642, Installation Instructions, Nash Vacuum Pumps and Compressors), remove the drain plugs from the compressor. (See Figure 5-25 or 5-26 for the location of these plugs.)

Turn on the seal liquid supply and open the globe valve in the seal liquid inlet line. (See Figure 1-3.)

Manually turn the compressor drive shaft without shutting off the seal liquid supply. Allow liquid to flow until there is a clear flow from all drains.

Close the globe valve in the seal liquid line and turn off the seal liquid supply. Replace the drain plugs using a pipe thread compound.

2-5 START-UP AND OPERATING CHECKS

Note

Refer to Troubleshooting, Section 3, if any operating difficulties occur when performing the following steps.

The starting procedures is determined by the type of package arrangement installed. The following procedures should always be performed.

a. Manually turn the shaft of the compressor at least one full revolution in the direction of the rotation arrow cast in the head. Make certain that there is no binding or rub.

b. Turn on seal liquid supply, open the globe valve in the seal liquid inlet line and allow water to flow until the separator is filled to the centerline (visible on the separator glass sight gauge) on recirculated-seal arrangements. Close the globe valve.

c. Turn on the cooling water source to the heat exchanger on recirculated-seal arrangements.

d. Position the selector switch on the control panel to the desired mode of operation to excite the drive motor. Check that the compressor drive shaft is turning in the proper direction.

e. Observe the pressure gauge on the separator. A vacuum should be observed within 15 seconds. If no pressure is indicated, shut off the drive motor immediately and determine the cause. At normal operating conditions, observe operation, bearing and liquid temperatures, noise, and vibration. If there is excessive noise or vibration, shut down the compressor immediately and determine the cause. Maintain a constant check on the head temperature; if temperature rises rapidly or is 50°F (28°C) or more above the inlet gas and liquid compressant temperature, shut down the compressor immediately and determine the cause.

f. Remove power from the drive motor. The compressor should unload and come to a stop.

g. On packages with air unload control, check the package TIMED STOP mode of operation by placing the control switch on the control panel in the TIMED STOP position. Close off the receiver downstream of the unload pressure switch sensing line. Start the drive motor and let the compressor build up pressure until it unloads. If the unload pressure switch fails to actuate at 130 psig (998 kPa), adjust the setting of the switch as specified in the switch manufacturer's instructions. Time the interval that begins when the unload pressure switch is actuated and ends when the drive motor cuts off. As determined by the horsepower of the drive motor the measured time period should be as follows:

Motor Horsepower (kw)	Time Period (Minutes)
40 (30)	6
50 (37)	6-1/2

Note

If the time period is incorrect, adjust the setting of the time delay relay on the control panel as specified in the relay manufacturer's instructions.

h. Check the package AIR UNLOAD mode of operation by placing the control switch in the control panel in the AIR UNLOAD position. Start the drive motor. Check that the compressor unloads at the pressure value at which the unload pressure switch in the control panel is set. Check the stability, temperatures, and general operation of the package. Bleed down the receiver. The package should load and resume compression. If necessary, readjust the setting of the unload pressure switch as specified in the switch manufacturer's instructions.

i. On packages with bypass control, check the package BYPASS mode of operation, by placing the control switch on the control panel in the BYPASS position. Start the drive motor. Check that the bypass control valve is open, holding a constant pressure on the pressure gauge of the separator. If necessary, adjust the setting of the bypass control valve as specified in

Section 3
TROUBLESHOOTING

3-1 LOCATING TROUBLES

The AD-74 compressor requires little attention other than checking the ability of the compressor to obtain full volume or maintain constant discharge pressure. Some typical symptoms of possible troubles and their probable causes are as follows:

a. *Failure to Get Discharge Pressure When Discharge of Compressor is Throttled.* Probable causes are:
   1. Restricted air inlet.
   2. Air unloader solenoid valve or bypass control hung in open position.
   3. Check valves in seal liquid lines hung in open or closed position.
   4. Restrictions in cooling water piping or heat exchanger.
   5. Drain trap hung open.

b. *Compressor Surging When Compressor Builds to High Pressure and Falls Back Approximately 20 psig (239 kPa).* Probable causes are:
   1. Restricted seal liquid flow.
   2. Wrong liquid level in separator.

c. *Compressor Stalling.* Compressor stalling can be recognized by a high-pitched, screeching noise. Probable causes are:
   1. Exceeding maximum recommended operating pressure.
   2. Malfunction of lobe pressure switch or check valves.
   3. Improper seal liquid flow.
   4. Throttling of suction or pressurization of inlet.
   5. Excessive clearance in compressor.

d. *Change in Operating Temperature, Noise or Vibration.* Probable causes are:
   1. Insufficient seal liquid or cooling water flow.
   2. Wrong liquid level in separator.
   3. Coupling misalignment.
   4. Bearing lubrication failure in compressor and/or drive motor.
   5. Poor bearing condition in compressor and/or drive motor.

Note

If the trouble is not located through checks of these probable causes, **call your Nash Representative** before dismantling the compressor. He will assist in locating and correcting the trouble.

3-2 ADJUSTING COMPRESSOR END TRAVEL

Note

This adjustment procedure applies to all bronze (bronze rotor and bronze cone) compressors only.

If the discharge pressure starts to fall off and the probable cause is not determined in Paragraph 3-1, continued use of the compressor over a long period of time may have caused the internal rotor-to-cone clearance (end travel) to change. Adjust the end travel as follows:

a. Shut down package.
b. Remove coupling guard and disconnect coupling halves.
c. Loosen three bracket screws (310-1, Figure 5-25 or 5-26) and three outer bearing cap nuts (309-1).
d. Pull bracket (310) back from body (301) enough to remove *one* laminated shim (4) from each side of compressor.
e. Peel two or three 0.002-inch (0.05-mm) laminations from each laminated shim.
f. Replace one laminated shim prepared in step e at each side.
g. Tighten three outer bearing cap nuts and three bracket screws.
h. Rotate compressor shaft by hand and listen for rubs. There should be no metal to metal contact.

Note

If rub exists, compressor must be disassembled to inspect for wear. **Contact your Nash Representative** before dismantling the compressor. He will assist in locating and correcting trouble.

i. If there is no rubbing, connect coupling halves and reinstall coupling guard.
j. Start compressor as specified in Paragraph 2-5 and check discharge pressure. If discharge pressure is still too low, repeat steps a through j.

Section 4
PREVENTIVE MAINTENANCE

4-1 PERIODIC MAINTENANCE

At Frequent Intervals

a. Measure and record the temperatures of the following items: the drive and compressor end bearings, measured at the bearing housings in the bracket and body; the head; and the seal liquid discharge. Shut down the compressor immediately and determine the cause if the temperatures rise rapidly or if stabilized temperatures exceed the limits specified below:
   1. Maximum bearing housing temperatures: 30°F (17°C) above head temperature.
   2. Maximum seal liquid discharge temperature: 130°F (54°C).

b. Monitor the pressure gauge on the separator to make certain that the discharge pressure is stable. If the discharge pressure is not stable, shut down the compressor and determine the cause. (Refer to Section 3.)

Hourly

a. Establish a schedule for adding make-up seal liquid to the recirculated-seal package. Check the make-up seal liquid requirements hourly during the first 100 hours of operation to determine the necessary make-up quantities and intervals.

b. Make certain that the number of start-stop cycles within each hourly period are within the limits specified by the motor and control manufacturers. As a rough guide, there should be a maximum of 5 start-stop cycles per hour. CHECK THE DRIVE MOTOR TEMPERATURE TO MAKE SURE THAT THE DRIVE MOTOR IS NOT OVERHEATING TO MAKE CERTAIN THAT THE NUMBER OF START-STOP CYCLES IS SATISFACTORY FOR YOUR INSTALLATION.

Weekly

a. Flush the separator as follows: open the seal liquid inlet globe valve and the separator drain simultaneously; allow the make-up liquid to flow until it runs clear from the separator drain while maintaining a constant liquid level in the separator; then close the seal liquid inlet globe valve.

Monthly

a. Check the strainer, inlet filter-silencer, screens and separator glass sight gauge for foreign material or damage. Clean or replace if required.

b. Check that the pressure drop across the air filter at the separator discharge does not increase.

c. Inspect the check valves to make certain that the valves are clean, open and close freely and seat properly. Overhaul or replace check valves if hinge pins, pivots, springs or clapper nuts are worn or if the clapper does not seat properly or sticks in the open or closed position.

Every 2 Years

a. Replace the drive and compressor end bearings and the mechanical seal with new parts specified in Table 5-1. Refer to Section 5 for the necessary disassembly and reassembly procedures.

4-2 SHUTDOWN PERIODS

If the compressor package must be taken out of service for more than two weeks, remove the drain plugs from the compressor, the separator, and the heat exchanger and drain *all* the seal liquid and cooling water. Replace the drain plugs using a pipe thread compound.

Rotate the compressor drive shaft by hand once every two weeks during the shutdown period.

When the compressor is to be put back into service, flush and drain as specified in Paragraph 2-4 and start the compressor in accordance with the procedures in Paragraph 2-5.

Section 5
DISASSEMBLY, INSPECTION AND REASSEMBLY

5-1 DISMANTLING COMPRESSOR

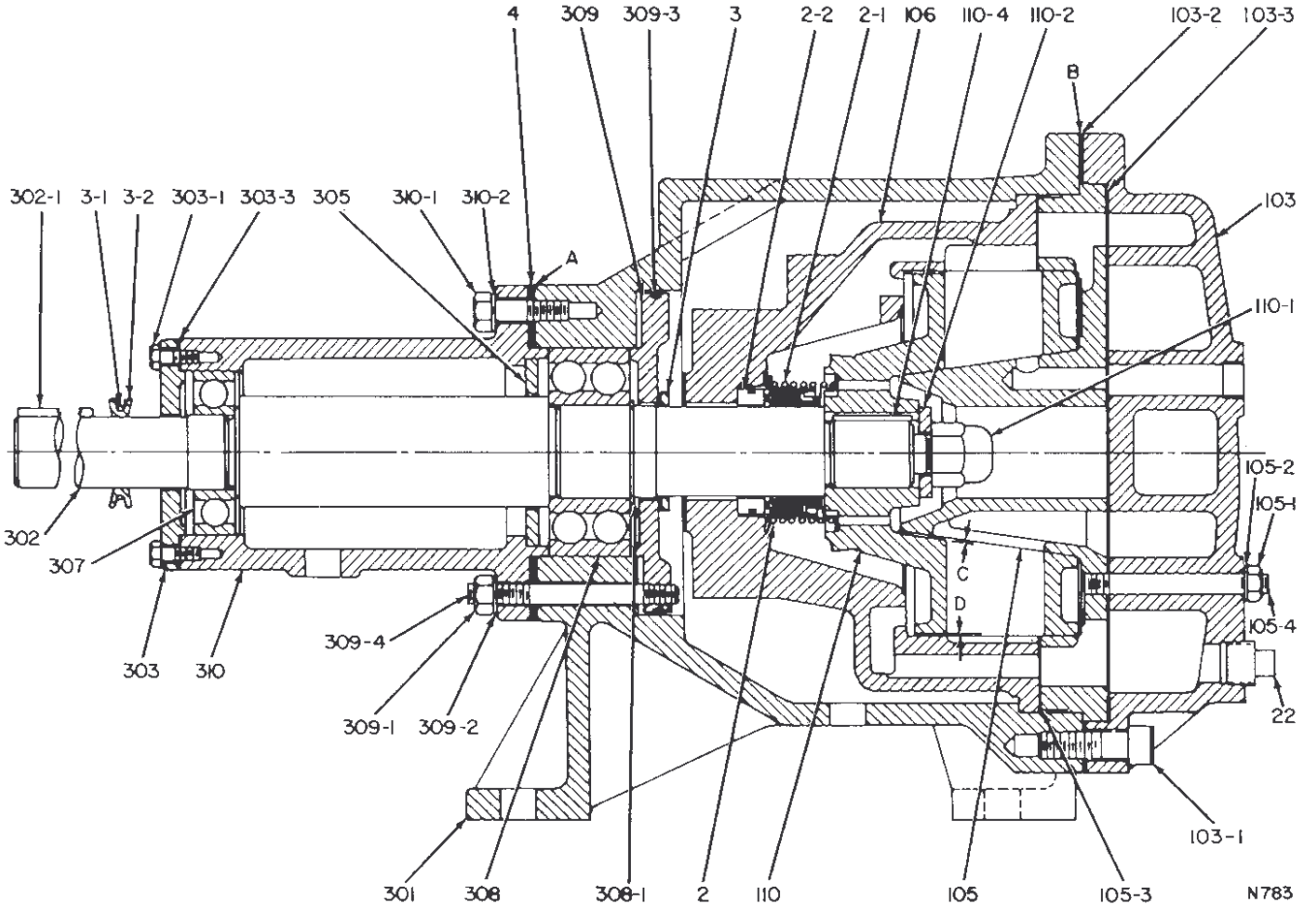
The compressor operates most efficiently when the rotor-to-cone clearance (end travel) is the same as that set by the factory. (Refer to Figure 5-1 and Table 5-1.) Continued use of the compressor over a long period of time may cause this internal clearance to change. If the discharge pressure starts to fall off, it may be necessary to dismantle the compressor to inspect for wear and if necessary to readjust this clearance. If wear has been uniform on the rotor and cone, clearance can be adjusted by removing shims that are located at gap "A" as specified in Paragraph 3-2. (See Figure 5-1.) If the need for dismantling is indicated, uncouple the drive motor from the compressor, disconnect all piping from the compressor and proceed as follows. Mark all parts as they become accessible to ensure that they can be reassembled in the proper position.

Note

All procedures apply to compressor with either single or double mechanical seal unless otherwise noted. See Figure 5-25 for exploded view of compressor with single mechanical seal and Figure 5-26 for exploded view of compressor with double mechanical seal.

5-2 Preparation for Disassembly

Disassembly of the compressor for inspection, adjustment of end travel, and/or replacement of



A. End Play Shim Gap
B. Head Shim Gap
C. Rotor-Cone Clearance
D. Rotor-Lobe Shroud Clearance

Figure 5-1. Compressor with Single Mechanical Seal, Cross Section

defective parts requires certain materials and common hand tools. Disassembly of compressor with double mechanical seal requires special tools that have to be fabricated. Materials and tools should be fabricated and collected and the setup procedure accomplished before disassembling the compressor. The items required as as follows:

Materials. Collect the following materials and parts before disassembling the compressor.

Note

The minimum recommended spares specified in the Legend for Figure 5-25 or 5-26 should be kept on hand at all times.

a. A set of replacement gaskets and O-ring. DO NOT REINSTALL USED GASKETS OR O-RINGS.
b. A set of replacement shims.
c. Replacement mechanical seal. (Refer to Table 5-1.)
d. Replacement drive end and compressor end bearings. (Refer to Table 5-1). DO NOT REINSTALL USED BEARINGS.
e. A cleaning solution, such as Oakite Swiff or equivalent.
f. Locquic Primer T
g. Loctite 242
h. Grease as specified in Table 5-2.
i. Yellow grease or vaseline
j. Clean light oil
k. Molykote G-n paste
l. Three 3/8-16NC threaded rods, 6 inches (152 mm) long and six nuts.
m. Three 1/2-13UNC-3B hex head screws, 2-1/2 inches (64 mm) long.
n. Two 1/2-13UNC-3B threaded rods, 4 inches (102 mm) long.
o. Section of 1-1/2-inch pipe, 5-1/2 inches (140 mm) long, with both ends filed smooth and square.
p. Section of 2-inch pipe, 7 inches (178 mm) long, with both ends filed smooth and square.
q. Wooden block, 2-1/2 inches (64 mm) square by 7 inches (178 mm) long.

Standard Tools. Make certain that the following standard tools are available.

a. Socket wrench set with shaft extension. In most cases, open-end or box wrenches can be substituted for socket wrenches.
b. Heavy [approximately 4-pound (2-kilogram)] lead or rubber mallet for installing tight fitting parts.
c. Hexagonal (Allen) wrenches.

Table 5-1. Compressor Data

Item/Part Name	Specification/Manufacturer's Part No.
End Travel	Bronze Rotor and Cone: 0.015 inch (0.038 mm) Bronze Rotor, St. Stl. Cone: 0.020 inch (0.51 mm) St. Stl. Rotor and Cone: 0.034 inch (0.86 mm)
Mechanical Seal: Single	John Crane Type 2 Code No. $BP_{66}1C1$ Shaft Diameter: 1.750 inch (44.45 mm) Drawing F-SD-3020
Double	John Crane Type 9T Code No. $QF_{51}1C1$** Shaft Diameter: 1.750 inch (44.45 mm) Drawing CF-SP-71100
*Bearing, Drive End	SKF Industries 6307 2Z
Bearing, Compressor End	SKF Industries 5309/CO
Part Name (See Figure 5-25 or 5-26.)	**Approximate Weight— Pounds (Kilograms)**
Head (103)	46 (21)
Cone (105)	22 (10)
Lobe (106)	30 (14)
Rotor (110)	19 (9)
Body (301)	66 (30)
Shaft (302)	12 (5)
Bracket (310)	13 (6)
Compressor Total Weight	225 (102)

* Bearing must be double shielded and prepacked by the manufacturer with NLGI No. 2, *water resistant* grease. Refer to Table 5-2 for a list of acceptable greases.

** Seal has carbon rotating seal face and solid ceramic stationary seal face; alternate seal Code No. $QF_{51}1D1$ has carbon rotating seal face and tungsten carbide stationary seal face.

Table 5-2. General Grease Specifications

GENERAL REQUIREMENTS:

A. *Premium quality,* industrial bearing grease.

B. *Consistency grade:* NLGI #2

C. *Oil viscosity (minimum):*
   @ 100°F (38°C) — 500 SSU (2316 cSt)
   @ 210°F (99°C) — 58 SSU (271 cSt)

D. *Thickener (Base):* Lithium, Lithium Complex or Polyurea for optimum WATER RESISTANCE.

E. *Performance characteristics* at operating temperature:
   1. Operating temperature range; at least 0° to 250°F (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

H. *Additives — Objectionable:*
   1. Extreme Pressure (EP)* agents
   2. Molybdenum disulfide (MoS_2)
   3. Tackiness agents

*Some greases exhibit EP characteristics *without* the use of EP additives. These EP characteristics are not objectionable.

NASH STANDARD GREASE RECOMMENDATIONS
(By Manufacturer):

The following is a list of some greases that exhibit the desired characteristics required by Nash.

Grease Manufacturer	*Product*
AMOCO	Rykon Premium #2
Atlantic Ridgefield (ARCO)	ARCO Multipurpose
Chevron Oil	*Chevron SRI-2
Exxon	Unirex N2
Gulf Oil	Gulfcrown No. 2
Mobil	Mobilux 2
Shell Oil	Alvania #2 or Dolium R
Texaco	Premium RB #2

*Nash Standard grease.

NOTE: This list is not an endorsement of these products and is to be used only for reference. A customer can have his local lubricant supplier cross reference these greases for an equivalent grease so long as it meets the General Requirements.

Grease Compatibility Note: The above listed greases are compatible with the Nash Standard grease, Chevron SRI-2. To maximize a grease lubricant's performance, however, it is recommended that intermixing of different greases be kept to a minimum.

d. Propane torch and 350°F (177°C) temp stick.
e. Standard bearing puller.
f. Machinist's hammer.
g. Diagonal pliers.
h Leaf (feeler) gauge set for measuring shim gap and checking cone wear.
i. Straightedge for checking cone wear.
j. Machinist's dial indicator with suitable clamps and mounts. Used to check run-out and set end travel.
k. One-inch micrometer for measuring shim thickness.
l. Calibrated torque wrench for torquing cone nuts (105-1) to 120 inch-pounds (124 N·m).
m. Calibrated torque wrench for torquing rotor nut (110-1) to 75 foot-pounds (102 N·m).
n. Calibrated torque wrench, torque wrench socket adapter and hexagonal (Allen) stock to torque head socket head screws (103-1) from 20 to 55 foot-pounds (27 to 75 N·m).
o. Mill file

Fabricated Tools for Double Mechanical Seal. Disassembly and reassembly of the compressor requires the fabrication of some special tools. The tools listed below are described and illustrated at the point in the disassembly and reassembly procedures at which they are used.

a. Double mechanical seal pusher (Figure 5-12).
b. Double mechanical seal assembly sleeve (Figure 5-19).
c. Double mechanical seal compressor (Figure 5-20).
d. Double mechanical seal gland spacer (Figure 5-21).

5-3 Removing Head, Cone and Rotor

a. If compressor has been removed from base, secure compressor to work surface with one or more bolts inserted in feet of body (301, Figure 5-25 or 5-26).

b. Remove two drain plugs (22) from head (103) and allow all seal water to drain from compressor.

c. Using hexagonal (Allen) wrench, remove seven of eight socket head screws (103-1) that secure head to body; loosen and back off but do not remove eighth socket head screw.

d. Install three of removed socket head screws (103-1) in tapped holes in head flange located at 12, 4 and 8 o'clock. Alternately tighten socket head screws until head is jacked free.

e. Support head and remove eighth socket head screw (103-1). Then remove head and assembled cone (105), gasket (105-3) and head shims (103-2) from body. Discard gasket.

f. Wedge balled-up rag between rotor (110) and lobe (106). Turn rotor counterclockwise until rag is jammed and prevents rotor from turning.

CAUTION

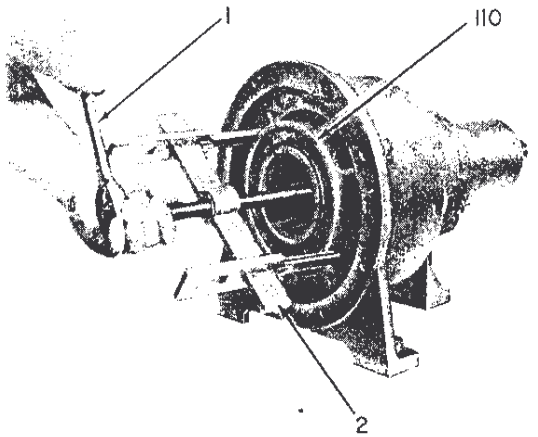
DO NOT ALLOW TEMPERATURE OF ROTOR HUB AREA TO EXCEED 350°F (177°C) WHEN PERFORMING FOLLOWING STEPS.

WARNING

USE PROTECTIVE GLOVES WHEN HANDLING HEATED PARTS.

g. Using propane torch and a 350°F (177°C) temp stick, heat rotor nut (110-1) to 300° to 350°F (149° to 177°C) to soften Loctite. Remove rotor nut by turning wrench in counterclockwise direction. Remove rotor washer (110-2).

h. Using propane torch, heat rotor hub to soften Loctite holding rotor key (110-4). Install bearing puller as shown in Figure 5-2. Take up on bearing puller until rotor (110) is free on shaft (302). Remove rotor.



N361-1

1. Socket Wrench — 110. Rotor

Note

On compressor with double mechanical seal, omit step i.

i. Slide seal spring (2-3) off shaft.

j. Pry rotor key from shaft.

k. Inspect parts that have become accessible as specified in Paragraph 5-9.

5-4 Separating Cone from Head

Note

Remove cone (105, Figure 5-25 or 5-26) from head (103) only if inspection of cone (Paragraph 5-9) indicates that cone must be repaired or replaced, or if cone studs (105-4) requires replacement.

a. Loosen three cone nuts (105-1), turn nuts until flush with ends of cone studs projecting through head.

b. Tap cone nuts with mallet to break fit of cone in head.

c. Remove three cone nuts (105-1) and washers (105-2). Lift head and head gasket (103-3) from cone. Discard gasket.

WARNING

USE PROTECTIVE GLOVES WHEN HANDLING HEATED PARTS.

d. If any cone stud (105-4) is damaged and must be replaced, heat base area of cone stud with propane torch to temperature of 300° to 350°F (149° to 177°C), using a 350°F (177°C) temp stick, to soften Loctite. Remove stud from cone.

5-5 Removing Lobe and Single Mechanical Seal

a. Install three 3/8-16NC threaded rods, 6 inches (152 mm) long, into threaded holes in drive end of body. (See Figure 5-3.) Install one nut on end of each rod and install second jam nut on each rod.

b. Alternately tighten threaded rods to jack lobe (106, Figure 5-25) toward compressor end of body (301).

CAUTION

MAKE CERTAIN THAT ROTATING SEAL (2-1) DOES NOT FALL OFF SHAFT (302) AND STATIONARY SEAL (2-2) DOES NOT STRIKE SHAFT. IF CERAMIC OR CARBON SEAL FACES ARE CHIPPED OR CRACKED, COMPLETE SINGLE MECHANICAL SEAL (2) WILL REQUIRE REPLACEMENT.

c. As soon as lobe flange is accessible, remove rotating seal (2-1) from shaft (302). Then grasp lobe flange and slide lobe off shaft.

d. If necessary for replacement, push stationary seal (2-2) out from drive end of lobe using wooden hammer handle or other suitable piece of wood.

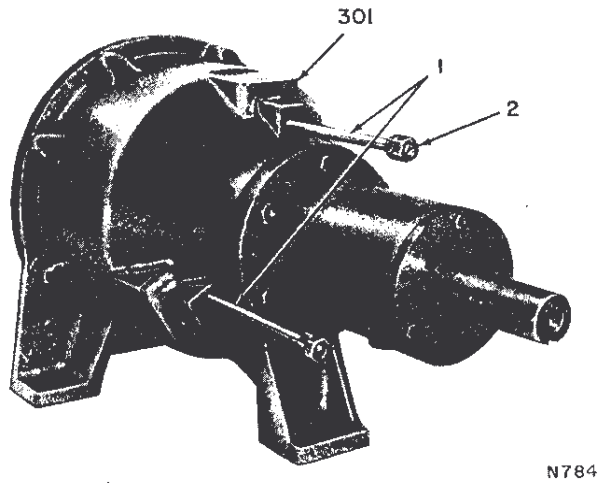
e. Remove three threaded rods from body.

f. If necessary, remove two dowel pins (105-5) from body.

g. Remove slinger (3) from shaft.

5-6 Removing Lobe and Double Mechanical Seal

a. Remove two nipples (50, Figure 5-26). Remove and



1. Threaded Rod
2. Nuts

301. Body

Figure 5-3. Removing Lobe from Body

c. Using care to avoid damaging stationary seal (2-2) in gland (113), slide gland and gasket (113-3) off shaft (302). Discard gasket.

d. Using hexagonal (Allen) wrench, loosen eight set-screws securing two rotating seals (2-1) to shaft.

e. Perform steps a and b, Paragraph 5-5.

CAUTION

MAKE CERTAIN THAT ROTATING SEALS DO NOT FALL OFF SHAFT AND STATIONARY SEAL IN LOBE DOES NOT STRIKE SHAFT. IF CERAMIC OR CARBON SEAL FACES ARE CHIPPED OR CRACKED, COMPLETE DOUBLE MECHANICAL SEAL (2) WILL REQUIRE REPLACEMENT.

d. As soon as jacking action pushes each seal element to end of seal journal reach in and remove rotating seals from shaft. Then grasp lobe flange and slide lobe off shaft.

e. If necessary for replacement, push stationary seal (2-2) out from lobe or stationary seal (2-2) from gland using wooden hammer handle or other suitable piece of wood. (See Figure 5-4.)

f. Perform steps e, f and g, Paragraph 5-5.

5-7 Removing Shaft, Bearings and Bracket

a. Remove coupling half from drive end of shaft (302, Figure 5-25 or 5-26).

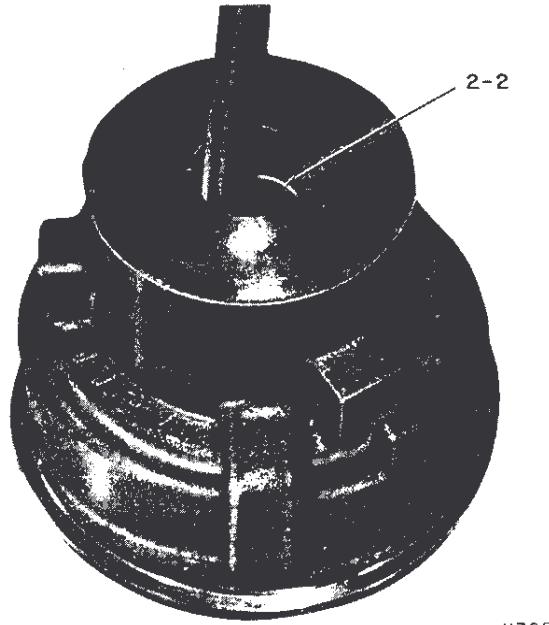
b. Pry shaft key (302-1) out of shaft keyway with screwdriver or diagonal pliers.

c. Remove slinger (3-2) and spring (3-1) from shaft.

d. Remove three bracket screws (310-1), washers (310-2), three outer bearing cap nuts (309-1) and lockwashers (309-2).

e. Slide bracket (310) back toward drive end of shaft, remove shims (4) from both sides and slide bracket off shaft.

f. If necessary, remove three drive end bearing cap screws (303-1), bearing cap (303) and gasket (303-3) from bracket. Discard gasket.



2-2. Stationary Seal

Figure 5-4. Removing Stationary Seal from Lobe

g. Alternately tap compressor end outer bearing cap studs (309-4) with mallet to push outer bearing cap (309) toward compressor end.

h. When outer bearing cap is free, push shaft with assembled drive end and compressor end bearings (307 and 308) and inner bearing cap (305) out of body. If necessary, tap drive end of shaft with mallet to break shaft loose.

i. Remove outer bearing cap from shaft. Remove and discard outer bearing cap O-ring (309-3).

j. If any outer bearing cap stud (309-4) is damaged and must be replaced, heat base area of outer bearing cap stud with propane torch to temperature of 300° to 350°F (149° to 177°C), using a 350°F (177°C) temp stick, to soften Loctite. Remove stud from outer bearing cap.

5-8 Removing Bearings from Shaft

CAUTION

DO NOT REMOVE BEARINGS FROM SHAFT UNLESS NECESSARY FOR REPLACEMENT. MAKE SURE THAT REPLACEMENT BEARINGS SPECIFIED IN TABLE 5-1 ARE AVAILABLE BEFORE PROCEEDING.

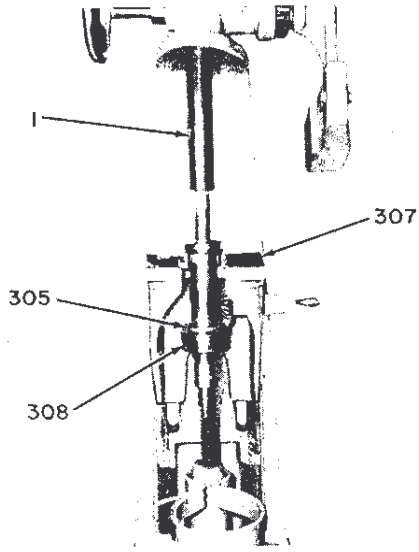
a. Remove compressor end bearing retainer (308-1, Figure 5-25 or 5-26) from shaft (302).

b. Position shaft in vertical arbor press as shown in Figure 5-5 and press shaft out of drive end bearing (307) inner race. Discard bearing.

c. Slide inner bearing cap (305) off shaft.

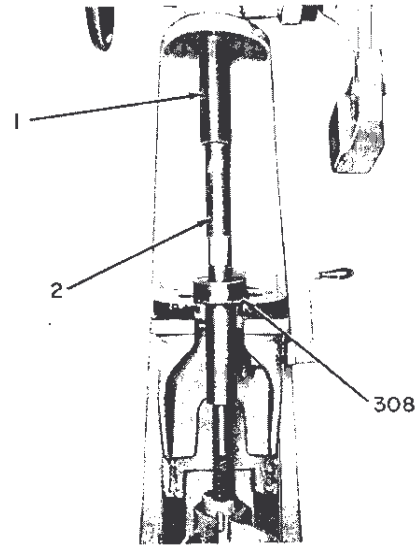
d. Install section of 1-1/2-inch pipe over drive end of shaft with machined face of pipe against shaft shoulder.

e. Position shaft and pipe section in arbor press as shown in Figure 5-6 and press shaft out of compressor end bearing (308) inner race. Discard bearing. This completes disassembly of compressor.



1. Arbor Press Moving Column
305. Inner Bearing Cap
307. Drive End Bearing
308. Compressor End Bearing

Figure 5-5. Pressing Shaft Out of Drive End Bearing

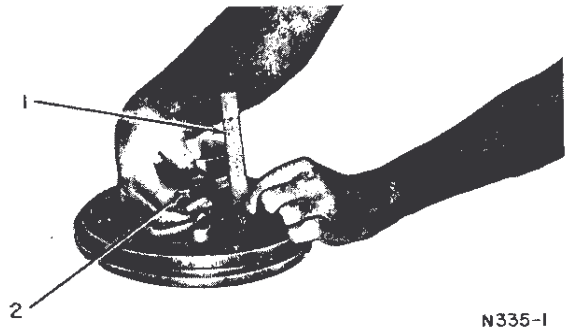


1. Arbor Press Moving Column
2. 1-1/2-inch Pipe Section
308. Compressor End Bearing

Figure 5-6. Pressing Shaft Out of Compressor End Bearing

5-9 INSPECTION OF DISASSEMBLED PARTS

With the compressor disassembled, inspect parts for wear. A straightedge and feeler gauge can be used to check for uneven wear of the cone as shown in Figure 5-7. Normally, tapered surfaces of this diameter section of the cone should be smooth, requiring only cleaning and light filing around ports and tip of cone; however, if foreign material has entered the compressor inlet or seal connection during operation,



1. Straightedge 2. Feeler Gauge

Figure 5-7. Checking Cone for Wear

circular score marks may be noticed around the outside of the taper diameter of the cone.

If the score marks are not more than 0.008 inch (0.20 mm) deep and 1/16 inch (1.59 mm) wide, they can be smoothed over by light filing which will remove the high area at the edge of score marks. If the scoring is deeper, it may be necessary to remove the scored surface; take a light cut not exceeding 0.008 inch (0.20 mm) on the total diameter to remove most of the score marks.

If this light machining cut does not reduce the depth of the scoring to 0.008 inch (0.20 mm) maximum, replace the cone.

The same limits hold true for the rotor cone bore. If the rotor is scratched or nicked during the removal procedure, file smooth with a fine file or emery cloth. Measure and record rotor OD and lobe shroud bore. If the total shroud clearance (dimension D, Figure 5-1) between the rotor outside diameter and lobe shroud bore exceeds 0.060 inch (1.52 mm), **contact your Nash Representative** to determine which parts must be replaced.

5-10 REASSEMBLING COMPRESSOR

Following the repair or replacement of compressor parts, reassemble the compressor in accordance with the applicable instructions in the following paragraphs. Reassembly must be performed in the sequence specified.

Note

All procedures apply to compressor with either single or double mechanical seal unless otherwise noted. See Figure 5-25 for exploded view of compressor with single mechanical seal and Figure 5-26 for exploded view of compressor with double mechanical seal.

5-11 General Loctite Application Procedures

Whenever preparation for Loctite and application of Loctite are specified in the reassembly procedures in Paragraphs 5-14 through 5-25, use the following procedure to ensure a proper adhesive bond.

a. Using Locquic Primer T, thoroughly clean and degrease *all* mating surfaces on *all* parts to be bonded. Apply and remove primer until mating surfaces are clean.

b. Apply thin coat of Locquic Primer T to *all* mating surfaces and allow primer to dry for three to five minutes.

c. Apply Loctite 242 to surfaces specified and assemble parts.
d. Thoroughly wipe off any excess Loctite 242.

5-12 Inspection and Preparation of Parts

Prior to reassembly, inspect and prepare all parts as follows:

a. Inspect new parts for shipping or handling damage.
b. Remove all old gasket material from mounting surfaces.
c. Remove burrs from mating surfaces and mounting faces.
d. Degrease parts, if required, with clean Oakite Swiff or equivalent.

5-13 Lubricating Compressor End Bearing

CAUTION

EXERCISE EXTREME CARE TO MAINTAIN BEARING AND GREASE CLEANLINESS WHEN HANDLING. *LUBRICATE THE BEARINGS IN A CLEAN AREA.*

Note

The bearings are sometimes damaged during disassembly. Install new replacement bearings as specified in Table 5-1 when reassembling the compressor.

a. Remove new compressor end bearing from its carton and protective wrapping. Put protective wrapping back in carton. *Do not remove protective oil film from new bearing.*
b. Using grease specified in Table 5-2, hand-pack bearing from both sides, adding grease until grease fills all bearing cavities.
c. Rewrap bearing in protective wrappings as protection against contamination and store wrapped and packed bearing in the carton until bearing is to be installed.

Note

Drive end bearing is double shielded, prepacked with grease, and does not require lubrication.

5-14 Installing Bearings on Shaft

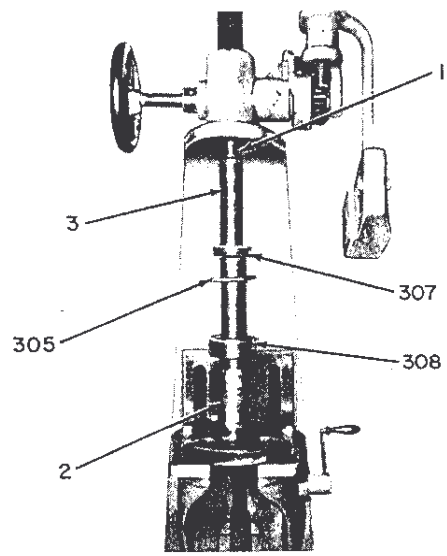
a. Clean shaft (302, Figure 5-25 or 5-26), removing all dirt and grease.
b. Apply small amount of Molykote G-n paste to drive end and compressor end bearing journals on shaft.
c. Slide inner bearing cap (305) onto largest diameter section of the shaft.
d. Remove new compressor end bearing (308), lubricated as specified in Paragraph 5-13, from its carton and protective wrapping. Slide compressor end bearing over threaded end of shaft into place against bearing journal.
e. Remove new drive end bearing (307) from its carton and wrappings. Slide drive end bearing over drive end of shaft into place against bearing journal.
f. Slide section of 2-inch pipe over threaded end of shaft until machined face of pipe is seated on inner race of compressor end bearing.
g. In a similar manner, slide section of 1-1/2-inch pipe over drive end of shaft against inner race of drive end bearing.
h. Install assembled parts in vertical arbor press with 2-inch pipe section at bottom as shown in Figure 5-8.
i. Press on pipe section until drive end and compressor end bearings are seated against shaft shoulders.
j. Remove shaft with assembled bearings from arbor press and slide pipe sections (2 and 3) off shaft.
k. Install compressor end bearing retainer (308-1) in groove in shaft.

5-15 Assembling Shaft, Compressor End Outer Bearing Cap and Bracket to Body

a. If studs (309-4, Figure 5-25 or 5-26) have been removed, prepare for and apply Loctite 242 as specified in Paragraph 5-11 to threads of replacement studs and threaded holes in compressor end outer bearing cap (309). Install three studs in face of outer bearing cap which has lip.
b. Coat replacement outer bearing cap O-ring (309-3) with light oil and install in groove in compressor end outer bearing cap.
c. Place body (301) in horizontal position and clamp or bolt body feet to work surface.
d. Apply small amount of Molykote G-n paste to bearing bore in body.
e. Install shaft with assembled bearings into body from side on which bracket (310) mounts. Insert shaft until compressor end bearing (308) is inside bearing bore approximately 1/2 inch (13 mm) beyond bracket mounting face of body.

CAUTION

STUDS (309-4) ARE LOCATED SO THAT COMPRESSOR END OUTER BEARING CAP (309) CAN BE INSTALLED IN ONLY ONE POSITION. DO NOT USE FORCE WHEN PERFORMING FOLLOWING STEP.



1. Arbor Press Moving Column
2. 2-inch Pipe Section
3. 1-1/2-inch Pipe Section
305. Inner Bearing Cap
307. Drive End Bearing
308. Compressor End Bearing

Figure 5-8. Pressing Drive End and Compressor End Bearings on Shaft

f. Install compressor end outer bearing cap over threaded end of shaft into body, aligning studs (309-4) with mating holes in body. Tap outer bearing cap with wooden handle of mallet or other suitable piece of wood to ensure that outer bearing cap is seated in bore of body.

g. Slide slinger (3) over theaded end of shaft up to outer bearing cap.

h. Slide inner bearing cap (305), installed in Paragraph 5-14, step c, up to drive end bearing (307).

i. Coat bearing bore and flanged face of bracket (310) with Molykote G-n paste.

j. Slide flanged end of bracket over drive end of shaft and drive end bearing until inner bearing cap can be pushed into seat in bracket. Tap inner bearing cap into place using wood dowel to ensure that inner bearing cap is seated in bracket and will not touch drive end bearing.

k. Slide bracket up to body, aligning holes in bracket with three outer bearing cap studs (309-4). Studs are positioned so that bracket can be installed in only one position.

l. Start bracket into bore in body (301) by tapping drive end of bracket evenly. Make certain that drive end bearing is centered so that it will slide into bearing bore of bracket. Once bracket is started in bore of body, install three bracket screws (310-1) and tighten screws evenly until bracket is seated against face of body.

m. Install three outer bearing cap lockwashers (309-2) and nuts (309-1) on studs (309-4) and tighten nuts evenly to clamp compressor end bearing (308).

n. Mount dial indicator on threaded end of shaft as shown in Figure 5-9.

o. Place foot of dial indicator (4) on inner face (2) of body as shown in Figure 5-9.

Note

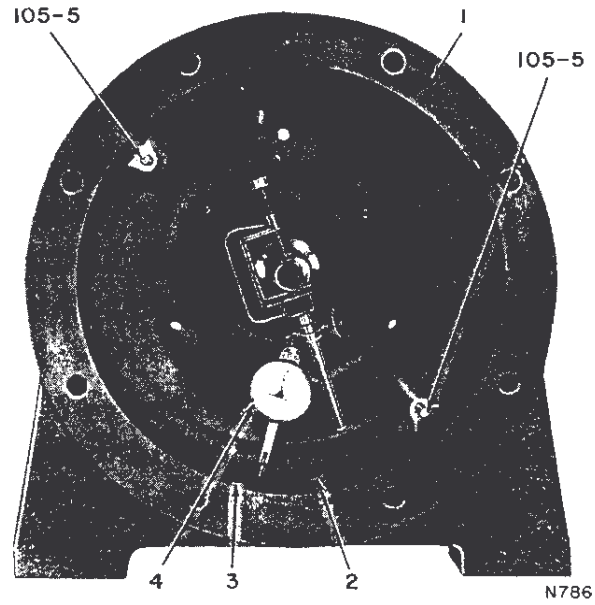
If cone dowel pins (105-5) are installed, check runout of inner face (2) by positioning dial indicator (4) against one of cone dowel pins. Zero dial indicator and rotate shaft until dial indicator contacts opposite cone dowel pin. Loosen and move dial indicator to other side of second cone dowel pin, secure and zero dial indicator and rotate shaft until dial indicator contacts opposite cone dowel pin to complete one revolution.

p. Zero dial indicator (4) and rotate shaft through one full revolution. Total variation in readings during rotation shall not exceed 0.002 inch (0.05 mm) T.I.R.

q. If variation exceeds 0.002 inch (0.15 mm), remove three bracket screws (310-1), and outer bearing cap nuts (309-1) and lockwashers (309-2). Install three 1/2-13UNC-3B jack screws in tapped holes in flange of bracket and tighten screws to remove bracket from body. Remove jack screws and check bracket and body for burrs and debris. Remove burrs, clean parts, assemble as specified in steps k, l and m and check runout by repeating steps n, o and p. If variation in readings is still excessive, **contact your Nash Representative** to determine if parts must be replaced.

r. Repeat step p with foot of dial indicator (4, Figure 5-9) on rabbet ID (3) of body. Repeat step q if necessary.

s. Repeat step p with foot of dial indicator (4) on outer face (1) of body. Repeat step q if necessary.



1. Outer Face
2. Inner Face
3. Rabbet ID
4. Dial Indicator

105-5. Cone Dowel Pin

Figure 5-9. Checking Shaft Run-Out

5-16 Installing Lobe and Single Mechanical Seal

WARNING

MAKE CERTAIN THAT SURFACE OR MEMBER TO WHICH BODY (301, FIGURE 5-25) IS SECURED IN FOLLOWING STEP IS RIGID ENOUGH TO TAKE WEIGHT OF ENTIRE COMPRESSOR WITHOUT SHIFTING OR TIPPING OVER.

a. Lift assembled body (301), shaft, and bracket using hoist as shown in Figure 5-10 and clamp or bolt feet of body to vertical surface with shaft extension down.

b. If they have been removed, install two cone dowel pins (105-5) in body.

Note

Perform steps c through f if replacement mechanical seal (2) is to be installed. If original stationary seal (2-2) is still in lobe, proceed to step g.

c. Position lobe (106) on flat surface with large diameter end up.

d. Remove replacement mechanical seal (2) from its wrappings. Retain cardboard shipping disc to protect seal faces.

e. Apply small amount of clean light oil (*not* grease) to O-ring on stationary seal (2-2) and seal recess in lobe.

f. Place stationary seal, shiny face up, in recess in bottom of lobe. Place cardboard shipping disc on face of stationary seal and tap stationary seal into lobe recess using wooden block and hammer until stationary seal is firmly seated. (See Figure 5-11.) Remove cardboard shipping disc. Clean and oil shiny face of stationary seal using clean light oil (*not* grease). Turn lobe over and make certain that stationary seal is fully and evenly seated.

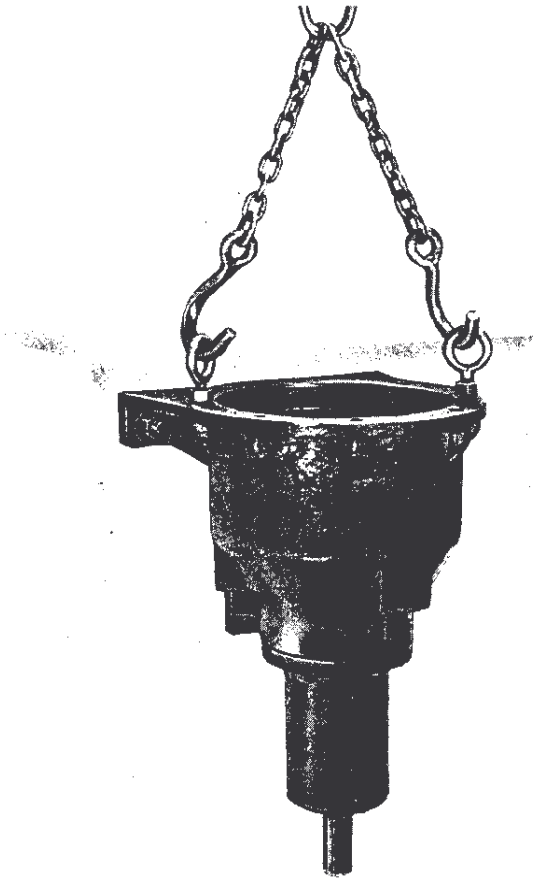


Figure 5-10. Mounting Body for Compressor Assembly

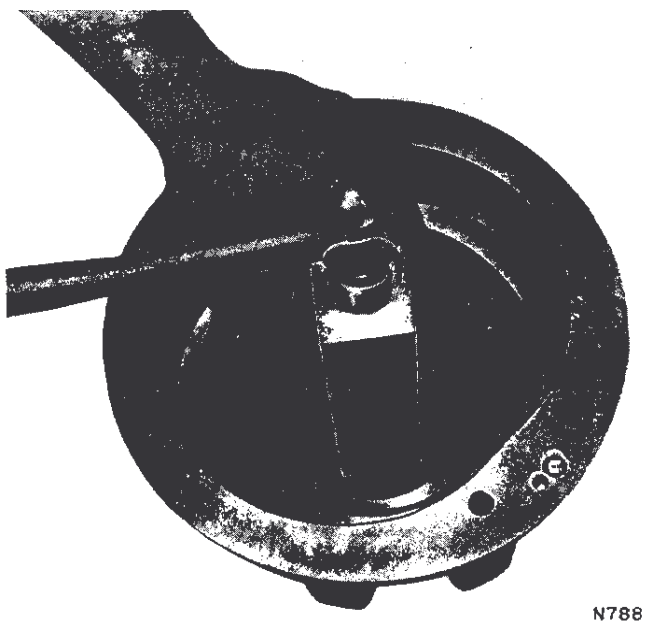


Figure 5-11. Installing Stationary Seal in Lobe

CAUTION

USE EXTREME CARE TO AVOID STRIKING CERAMIC STATIONARY SEAL (2-2) ON SURFACE OR SHOULDERS OF SHAFT (302) WHEN PERFORMING FOLLOWING STEPS. STATIONARY SEAL MUST BE REPLACED IF IT IS SCRATCHED, CHIPPED OR CRACKED.

g. Grasp lobe with both hands and slide it over shaft so that trench that runs to mechanical seal area of lobe is located 180 degrees from feet of body and mating holes in lobe are aligned with cone dowel pins.

CAUTION

LOBE (106) WILL FIT IN BODY (301) IN ONE POSITION ONLY. DO NOT USE FORCE WHEN PERFORMING FOLLOWING STEP.

h. Lower lobe into body and push on lobe flange until lobe is seated.

i. Lightly grease both sides of replacement cone gasket (105-3) and place cone gasket on flange of lobe, making certain that cutouts in gasket align with ports in lobe flange.

j. Apply small amount of clean light oil (*not* grease) to ID of rubber bellows of rotating seal (2-1) and shoulder and seal mounting surface of shaft. Clean and lightly oil face of rotating seal using clean light oil (*not* grease).

k. Carefully slide rotating seal over shaft with carbon face down and start seal over shaft shoulder. Continue pushing seal until carbon face of seal is touching ceramic face of stationary seal.

5-17 Installing Lobe and Double Mechanical Stationary Seal

a. Fabricate seal pusher as specified in Figure 5-12.

b. Perform steps a through d, Paragraph 5-16.

c. Apply small amount of clean light oil (*not* grease) to teflon cup on bottom of stationary seal (2-2, Figure 5-26) and seal bore in lobe (106).

d. Place stationary seal, shiny face up, in recess in lobe. Make certain that cutout in bottom of stationary seal aligns with dowel pin (113-2) or dowel pin hole in bottom of lobe recess. Place cardboard shipping disc on face of stationary seal and seat stationary seal in lobe recess using seal pusher (Figure 5-12).

e. If necessary, turn lobe over and install dowel pin (113-2).

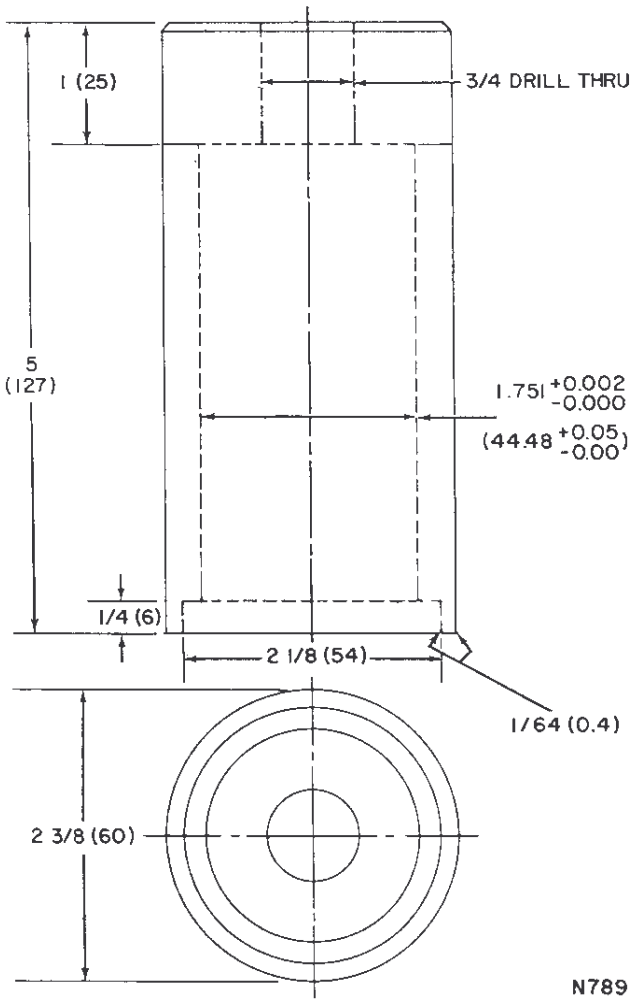
f. Perform steps g through i, Paragraph 5-16 and proceed to Paragraph 5-18.

5-18 Installing Cone in Head

a. If cone studs (105-4, Figure 5-25 or 5-26) have been removed or if new cone (105) is being installed, prepare for and apply Loctite 242 as specified in Paragraph 5-11 to threads of replacement cone studs and threaded holes in flat face of cone. Install three cone studs in flat face side of cone.

b. Place head (103) elevated on blocks on flat work surface. Make certain that holes in head which mate with cone studs are not covered by supporting blocks.

c. Lightly grease both sides of replacement head gasket (103-3). Place head gasket on head making certain that ports and stud holes in head gasket line up with ports and holes in head.



Note: Dimensions are in inches followed by equivalent in millimeters in parentheses.

Figure 5-12. Seal Pusher

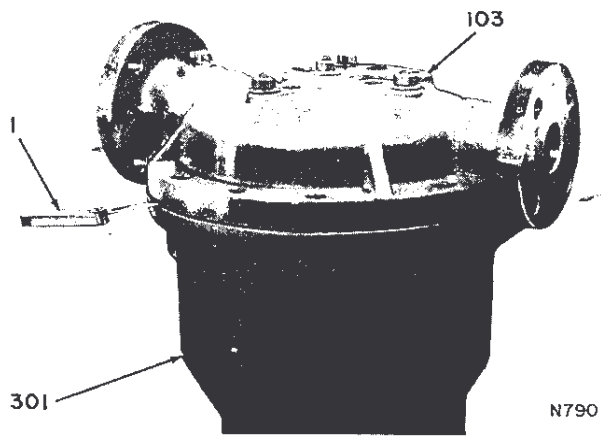
CAUTION

CONE STUDS (105-4) ARE LOCATED SO THAT CONE (105) CAN BE INSTALLED IN ONE POSITION ONLY. DO NOT USE FORCE WHEN PERFORMING FOLLOWING STEP.

d. Install cone (105) in head, aligning cone studs with holes in head. Tap cone around OD until cone is seated in head.
e. Turn head and cone over and place cone end on work surface.
f. Install three cone washers (105-2) and nuts (105-1) on cone studs. Torque nuts evenly to 120 inch-pounds (14 N·m).

5-19 Determining Head Shim Thickness

a. Install head (103, Figure 5-25 or 5-26) and cone (105) on the body (301) with cast rotation arrow on head 180 degrees from body feet. Tap head lightly to seat head into body and cone solidly against lobe.
b. Using leaf feeler gauge as shown in Figure 5-13, measure gap between head and body at four points



1. Feeler Gauge
103. Head
301. Body

Figure 5-13. Measuring Head to Body Gap

90 degrees apart. Add four measurements and divide by four to obtain average gap. Record average gap dimension.
c. Install three 1/2-13UNC-3B jack screws in tapped holes in head. Tighten jack screws evenly to remove head and cone.
d. Remove jack screws from head.
e. Using flat mill file, remove any burrs from body flange caused by jack screws.

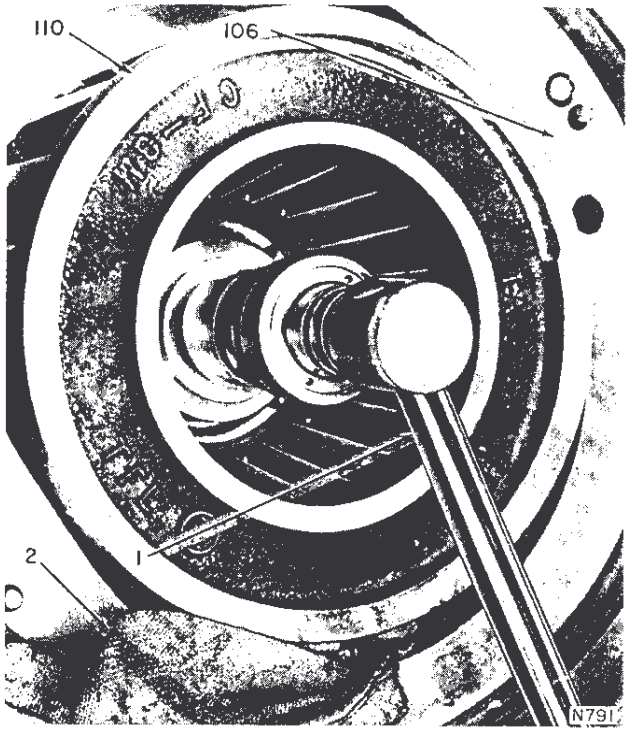
5-20 Installing Rotor and Checking Run-Out, Single Mechanical Seal

a. Prepare for and apply Loctite 242 to following parts as specified in Paragraph 5-11; keyways in threaded end of shaft (302, Figure 5-25) and rotor (110); and rotor key (110-4).
b. Install rotor key in keyway in shaft. Clean off any excess Loctite 242.
c. Install seal spring (2-3) over rotating seal (2-1).
d. Prepare for and apply Loctite 242 as specified in Paragraph 5-11 to threads of shaft and the rotor nut (110-1) so that Loctite 242 fills threads.

CAUTION

ROTOR (110) WILL SLIDE ONTO SHAFT (302). DO NOT USE ANY TOOLS TO STRIKE OR TAP ROTOR INTO PLACE.

e. Align rotor keyway with rotor key and push the rotor onto shaft, compressing seal spring, until rotor is seated against shaft shoulder.
f. Install rotor washer (110-2) over shaft against rotor hub.
g. Install rotor nut on shaft. If necessary push rotor down the shaft until the rotor nut can engage shaft threads.
h. Wedge balled-up rag between rotor and lobe. Turn rotor clockwise until rag is jammed and prevents rotor from turning. (See Figure 5-14.)
i. Torque rotor nut to 75 foot-pounds (102 N·m). Remove rag. Wipe off any excess Loctite 242 and allow Loctite 242 to cure for at least 1/2 hour before proceeding with step j.



1. Torque Wrench
2. Rag

110. Rotor
106. Lobe

Figure 5-14. Torquing Rotor Nut

j. Install dial indicator on flange of body as shown in Figure 5-15.

k. Place foot of dial indicator (3) on rotor taper bore (4) as shown in Figure 5-15.

l. Zero dial indicator and rotate shaft through one full revolution. Total variation in readings shall not exceed 0.004 inch (0.10 mm) T.I.R.

m. If variation exceeds limit, remove dial indicator and wedge balled-up rag between rotor and lobe. Turn rotor counterclockwise until rag is jammed and prevents rotor from turning. Remove rotor nut and washer, and rotor. Check shoulder of shaft and rotor rear face for burrs or debris. Remove any burrs and clean parts. Repeat steps d through k. If run-out is still more than limit specified, **contact your Nash Representative** to determine if parts must be replaced.

n. Repeat step l with foot of dial indicator (3) on rotor outer shroud face (1). Total variation in readings shall not exceed 0.003 inch (0.08 mm) T.I.R. Repeat step m if necessary.

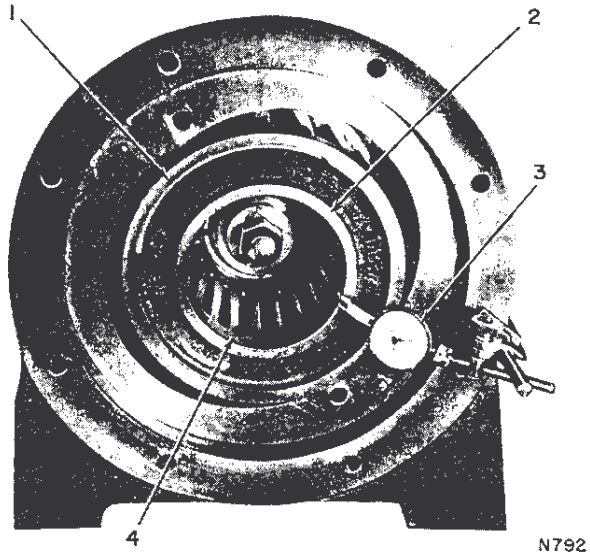
o. Repeat step l with foot of dial indicator on rotor inner shroud face (2). Total variation in readings shall not exceed 0.003 inch (0.008 mm) T.I.R. Repeat step m if necessary.

5-21 Installing Rotor and Checking Run-Out, Double Mechanical Seal

a. Prepare the shaft (302, Figure 5-26) and rotor (110) as specified in Paragraph 5-12.

CAUTION

ROTOR (110) WILL SLIDE ONTO SHAFT (302). DO NOT USE ANY TOOLS TO STRIKE OR TAP ROTOR INTO PLACE.



1. Outer Shroud Face
2. Inner Shroud Face
3. Dial Indicator
4. Rotor Taper Bore

Figure 5-15. Checking Rotor Run-Out

b. Install rotor key (110-4) in shaft, align rotor keyway with rotor key and push rotor onto shaft until rotor is seated against shaft shoulder.

c. Install rotor washer (110-2) over shaft against rotor hub. Install rotor nut (110-1).

d. Wedge balled-up rag between rotor and lobe (106). Turn rotor clockwise until rag is jammed and prevents rotor from turning. (See Figure 5-14.)

e. Torque rotor nut to 75 foot-pounds (102 N·m). Remove rag.

f. Perform steps j through o, Paragraph 5-20, and proceed to Paragraph 5-22.

5-22 Installing Head and Cone

a. Subtract 0.013 inch (0.33 mm) from average gap dimension recorded in Paragraph 5-19, step b.

b. Select combination of head shims (103-2, Figure 5-25 or 5-26) equal to amount calculated in step a. Check total shim thickness with micrometer to make sure that it is correct.

c. Loosen three bracket screws (310-1) 1/4 inch (6 mm).

Note

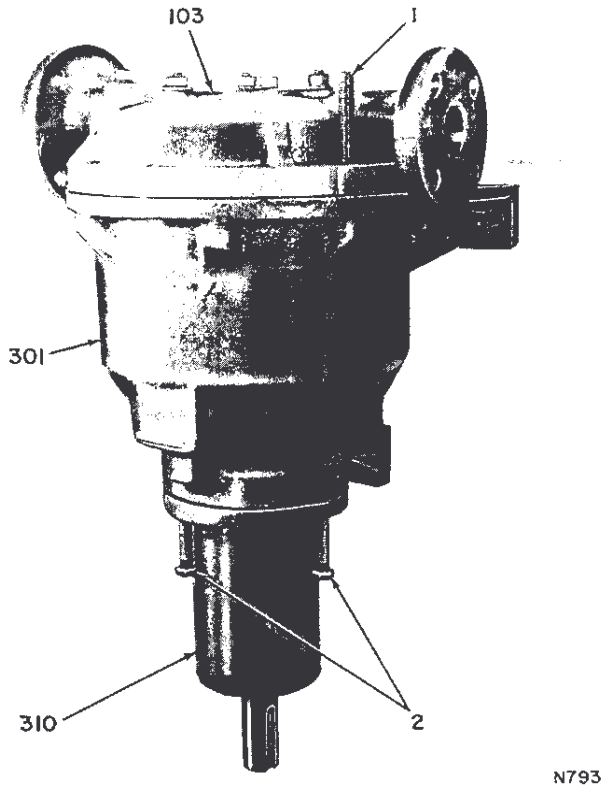
Do *not* loosen compressor end outer bearing cap nuts (309-1).

d. Install three 1/2-13UNC-3B jack screws in tapped holes in bracket. (See Figure 5-16.) Tighten jack screws to pull bracket toward drive end.

e. Screw two 1/2-13UNC-3B threaded rods, 4 inches (102 mm) long, into tapped holes 180 degrees apart in flange of body.

f. Install shims (103-2) selected in step b over threaded rods, making certain that slots in shims align with holes in body flange.

g. Install head and cone, using two threaded rods as guides, in position specified in Paragraph 5-19, step a. Remove two threaded rods.



1. Threaded Rod
2. Jack Screw

103. Head
301. Body
310. Bracket

Figure 5-16. Installing Head and Cone

h. Install eight socket head screws (103-1). Using piece of hexagonal stock, torque wrench adaptor and torque wrench, torque socket head screws in sequence shown in Figure 5-17 to 20 foot-pounds (27 N·m), then 40 foot-pounds (54 N·m) and then to 55 foot-pounds (75 N·m). Torquing sequence assures gradual and uniform compression of head shims (103-2) and cone gasket (105-3).

i. Retorque cone nuts (105-1) to 120 inch-pounds or 10 foot-pounds (14 N·m).

5-23 Setting End Travel and Final Assembly

a. Mount compressor in horizontal position and securely clamp or bolt feet of body to work surface or base.

b. Make sure that compressor end outer bearing cap nuts (309-1, Figure 5-25 or 5-26) are tightened.

c. *Gently* tap shaft extension toward the body to drive rotor up on the cone. Try to turn the shaft by hand. Continue tapping shaft until shaft cannot be turned by hand.

d. Using leaf feeler gauge as shown in Figure 5-18, measure gap between body and bracket at four points 90 degrees apart. Add four measurements and divide by four to obtain average gap. Add applicable end travel listed below to average gap and record total gap.

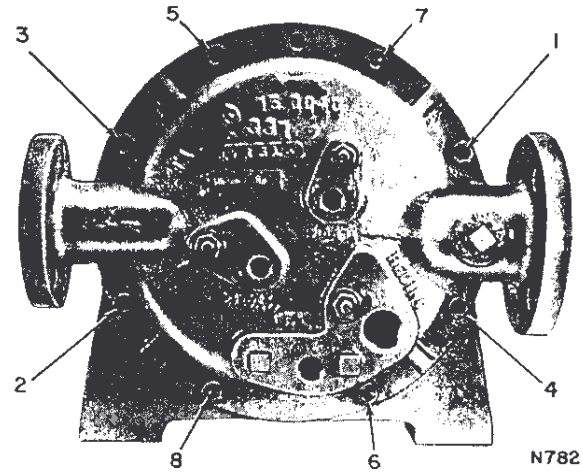
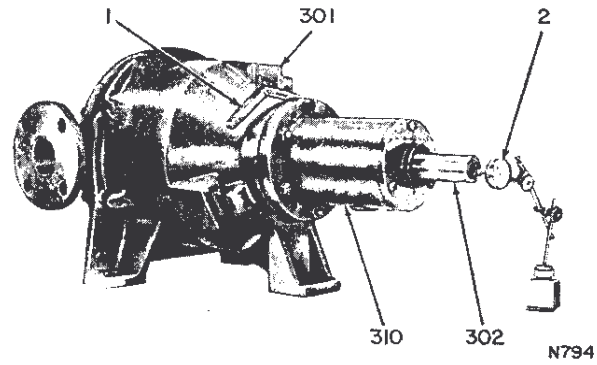


Figure 5-17. Torquing Sequence for Head Screws



1. Feeler Gauge
2. Dial Indicator

301. Body
302. Shaft
310. Bracket

Figure 5-18. Setting End Travel

Material		End Travel—
Rotor	Cone	inches (mm)
Bronze	Bronze	0.015 (0.38)
Bronze	Stainless Steel	0.020 (0.51)
Stainless Steel	Stainless Steel	0.034 (0.86)

e. Select two sets of laminated shims (4), each equal to thickness of total gap calculated in step d. Peel 0.002-inch (0.05-mm) laminations to achieve required thickness within ±0.002 inch (0.05 mm).

f. Loosen compressor end outer bearing cap nuts (309-1).

g. Install three 1/2-13UNC-3B jack screws in threaded holes in flange of bracket. Tighten jack screws until gap between bracket and body is large enough to easily install shims (4).

CAUTION

DO NOT FORCE SHIMS (4) INTO GAP. IF FIT IS TOO TIGHT, PULL BRACKET FARTHER AWAY FROM BODY. BE SURE TO REMOVE JACK SCREWS WHICH WILL INTERFERE WITH INSERTION OF SHIMS.

h. Remove jack screws. Insert one set of shims selected in step e at each side with split holes at top and bottom.

i. Remove three bracket screws (310-1). Install three bracket lockwashers (310-2) and screws (310-1). Tighten bracket screws evenly.

j. Repeat step c.

k. Mount dial indicator with foot of indicator on end of shaft as shown in Figure 5-18 and zero indicator.

l. Tighten three compressor end outer bearing cap nuts (309-1).

m. Compare dial indicator reading with end travel specified in step d. If reading is not same as specified end travel, add or remove thickness of shims equal to difference between reading and specified end travel by repeating steps f through m. Remove dial indicator.

n. Check that compressor shaft can be turned by hand and listen for rubs. There should be no metal to metal contact. If rub exists, repeat steps k, m and then steps f through m. If rub still exists, remove head and cone as specified in Paragraph 5-3, check for burrs and debris. Remove any burrs and clean parts. Reinstall head and cone as specified in Paragraph 5-22 and repeat steps a through n. If rub still exists, **contact your Nash Representative** to determine if parts must be replaced.

Note

On compressor with double mechanical seal omit steps o through q and proceed to Paragraph 5-24.

o. Apply small amount of grease to both sides of drive end bearing cap gasket (303-3) and install gasket on end of bracket. Install drive end bearing cap (303) and secure with three drive end bearing cap screws (303-1). Tighten screws evenly.

p. Install slinger (3-2) and spring (3-1) on shaft.

q. Install two drain plugs (22) in head. This completes reassembly of compressor.

5-24 Installing Double Mechanical Seal

a. Fabricate following special tools: seal assembly sleeve, Figure 5-19; seal compressor, Figure 5-20; gland spacer, Figure 5-21.

b. Mount compressor in vertical position as specified in Paragraph 5-16, step a.

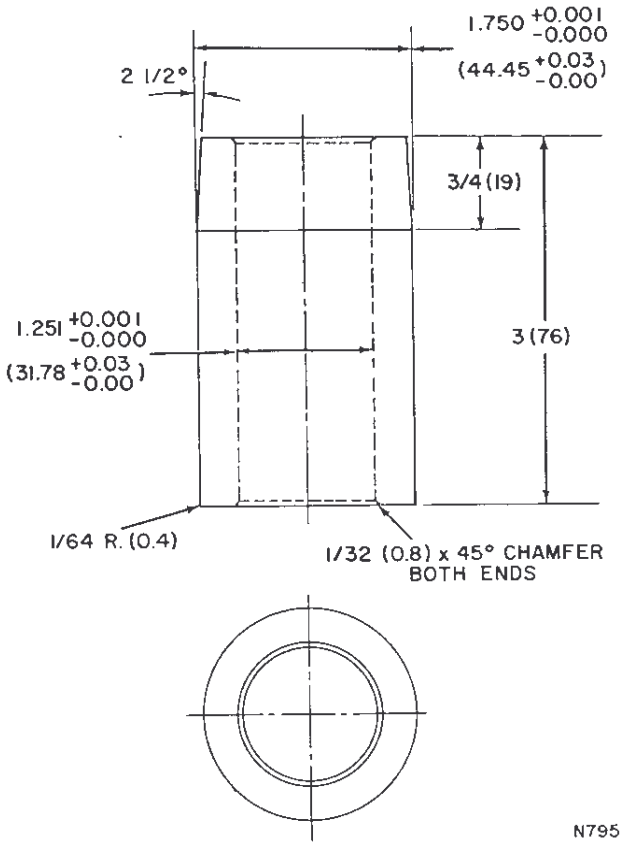
c. Remove eight socket head screws (103-1). Carefully remove assembled head (103) and cone (105). Remove and carefully set aside head shims (103-2).

d. Wedge balled-up rag between rotor (110) and lobe (106). Turn rotor counterclockwise until rag is jammed and prevents rotor from turning. Remove rotor nut (110-1), washer (110-2) and rotor from shaft.

e. Clean and apply small amount of clean light oil (*not* grease) to face of stationary seal (2-2) in lobe and carbon face of mating rotating seal (2-1).

f. Apply small amount of clean light oil (*not* grease) to ID of rubber wedge in rotating seal.

g. Install seal assembly sleeve (Figure 5-19) with tapered end toward threaded end of shaft. Slide rotating seal, carbon face down, over sleeve and onto shaft against stationary sleeve in lobe. Remove seal assembly sleeve.



Note: Dimensions are in inches followed by equivalent in millimeters in parentheses.

Figure 5-19. Seal Assembly Sleeve

h. Install seal compressor (Figure 5-20), large ID end first, over threaded end of shaft. Install rotor washer (110-2) and nut (110-1) on shaft. (See Figure 5-22.) Tighten rotor nut, compressing rotating seal springs until seal compressor is seated and will not move.

i. Using hexagonal (Allen) wrench with extension handle, tighten four seal setscrews to secure rotating seal to shaft.

j. Remove rotor nut and washer and seal compressor from shaft.

k. Install seal assembly sleeve (Figure 5-19) with tapered end toward threaded end of shaft.

l. Repeat step f for second rotating seal (2-1).

m. Cut hole in center of cardboard shipping disc or make cardboard disc with hole in center to fit over shaft. Install disc on carbon face of rotating seal and slide seal over shaft onto seal assembly sleeve with carbon face up.

n. Using seal pusher (Figure 5-12), push rotating seal onto shaft until it contacts rotating seal installed in step g. (See Figure 5-23.)

o. Remove seal pusher and seal assembly sleeve.

p. Using hexagonal (Allen) wrench, tighten four seal setscrews to secure second rotating seal to shaft.

q. Install stationary seal (2-2) in gland (113) in the same manner as specified in Paragraph 5-17, steps c through e. Make certain that dowel pin (113-2) is installed.