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THERMO KING COMPRESSORS

The most important part of the refrigeration system is the compressor. Its function is to pump the low pressure gas out of the evaporator so that a rapid and continuous boiling action is maintained in the coil. The low pressure gas is compressed and forced into the condenser coil where it is cooled by air passing through the coil. The high pressure and reduced temperature causes it to reliquefy.

When any repairs or replacements are to be made on the compressor, it is very important that the parts used are clean and not nicked or scratched. During disassembly, parts should be cleaned and inspected; and if they are to be used in reassembly, they should be wrapped in a clean cloth to prevent marring the surface. Oil all parts with compressor oil during assembly, and be sure they are installed in the same position as they were before.

COMPRESSOR OIL INDICATIONS

Discoloration of the oil is an indication of a contaminated system and future problems. Following is a color code and suggested steps to help you diagnose the condition and correct it.

COMPRESSOR OIL COLOR CODE

BLACK OIL. Indicates carbonization caused by air in the system.

BROWN OIL. Indicates copper plating caused by moisture in the system.

GRAY OR METALLIC OIL. Indicates bearing wear or piston scoring.

A contaminated system will cause a failure if left uncorrected. The contaminate in the system will break down the refrigerant oil, causing excessive bearing wear and scoring of parts within the compressor. Copper plating and moisture will affect the valve plate reeds and break down the refrigerant and affect the capacity of the unit. Particles and bearing scale traveling with the refrigerant will plug the driers and expansion valves, causing erratic operation until the condition is corrected. Flushing with Refrigerant 11 or the use of suction and liquid line driers is recommended whenever a contaminated system is found. In some cases, the contaminated condition can be corrected by changing oil, refrigerant and drier. Use a recommended evacuation process before the unit is placed in service.

GENERAL INFORMATION

Before overhauling the compressor, pump down the system, and close the compressor suction and discharge service valves.

Although some parts of the compressor can be removed for inspection or disassembly with the clutch coil, pulley and damper attached, major repairs or complete overhaul may best be made by removing the mounting bolts, pressure connections and the crankshaft drive and supporting the compressor on a workbench.

Refer to Figures 1 through 5 for exploded views of the compressor.

1. Remove the compressor as explained previously under "Compressor Removal".
2. Relieve pressure from the system.
3. Drain oil from the crankcase if the unit is to be completely disassembled, or if repairs require removal of the handhole cover.
4. Be certain the immediate area in which the compressor is to be overhauled is free of dust and that pieces of cloth used for cleaning parts are lint free.
5. When removing, assembling or installing parts, handle the parts carefully.
6. Coat each part with refrigerant oil as it is removed to prevent rusting.
7. Before installing parts, clean each part with a refrigerant parts cleaner, then oil the part with clean (new) compressor oil.
8. Inspect each part for nicks, burrs, wear, breakage or evidence of copper plating. Refer to "Recommended Compressor Wear Rate Table" at the end of this section for tolerances and wear limits.
9. Use new gaskets and O-rings when assembling the compressor.
10. Lubricate all parts, especially the bearing surfaces before installing. This will help the compressor to run without seizure when it is first started up and before oil pressure is built up.
11. Always use torque wrench when tightening bolts or screws. Improper tightening can cause premature wear, stripped threads, or failure of a part. Refer to "Compressor Torque Specifications."

The compressor has been designed to permit replacement of many parts and subassemblies without having to disassemble the entire unit. For example, a cylinder liner can be replaced without having to remove the piston and rod.

The overhaul procedures that follow cover disassembly and assembly of the compressor in a logical sequence and to the extent recommended by Thermo King Corporation.

COMPRESSOR DISASSEMBLY

NOTE: To prevent damage to parts of the compressor and to help assure proper performance of the unit after assembly, follow the procedures given previously in "General Information" when disassembling or assembling the compressor.

Clutch Pulley and Damper Removal

Key numbers in the following text refer to Figure 1.

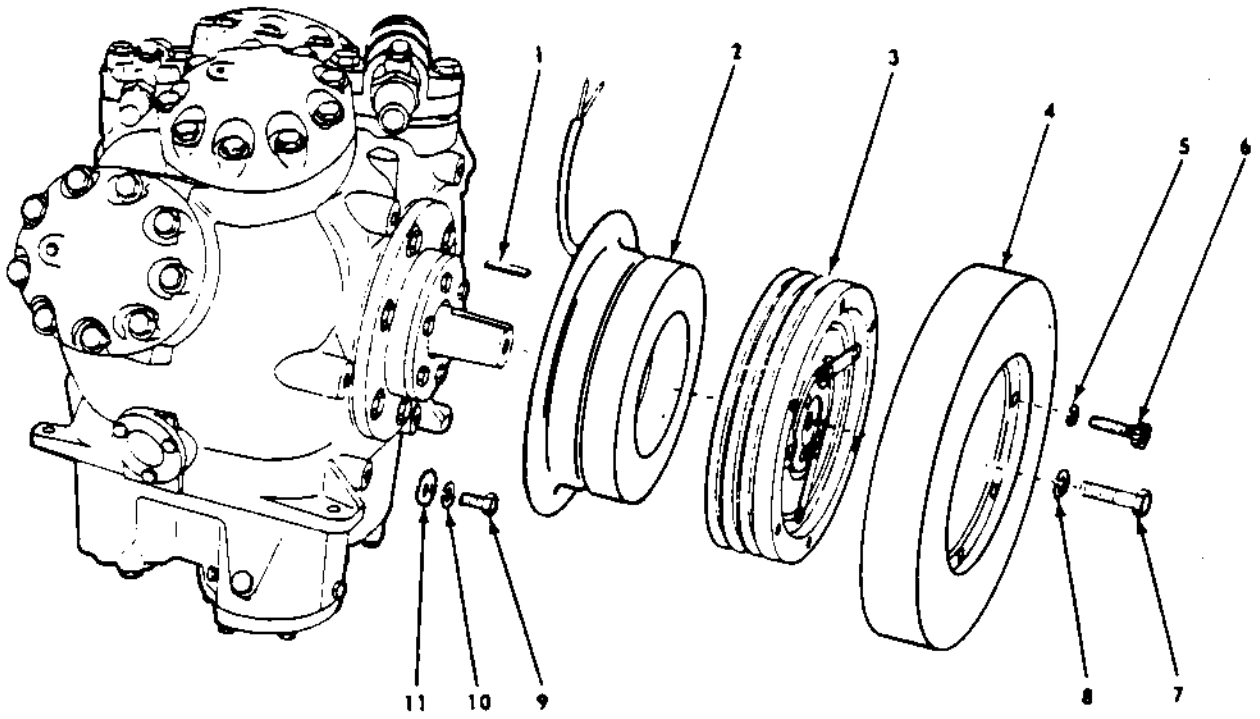
1. Separate the clutch coil wiring connector from the line connector.
2. Remove bolt (7) and washer (8) securing pulley (3) and crankshaft.
3. Using a puller bolt in pulley hub, separate pulley (3) and key (1) from the compressor shaft.
4. Remove bolts (9), washers (10), and retainers (11) which attach the clutch coil to the housing.
5. Remove bolts (6) and washers (5) which attach the damper to the pulley and remove the damper.

   NOTE: Viscous damper is applicable only on GM/TMC RTS Buses with very few exceptions.

Clutch Bearing Replacement

Key numbers in the text refer to Figure 6.

1. Remove outer and inner snap rings (1 and 2) from the clutch pulley (5) and pressure plate (6).
2. Support the pressure plate hub on the Hub Support Tool (Figures 7 and 8). Insert the Hub Removal Tool (Figure 9) through the holes in the pressure plate hub and press on the bearing inner race to separate the pressure plate assembly from the pulley and bearing.
3. Support the pulley at the open end of the bearing bore (Figure 10). Press Bearing Tool (Figure 11) against the bearing outer race to remove the bearing from the clutch pulley.
4. Thoroughly clean the pulley and pressure plate. Inspect parts for cracks or damage and replace if necessary.



1. Key
2. Clutch Coil (24-volt)
3. Clutch Pulley
4. Viscous Damper (GM & TMC RTS Only)
5. Lockwasher (0.250)
6. Allen Head Screw
7. Bolt (0.437-20x1.75") with Nylok Patch
8. Special Thick Washer (0.437)
9. Bolt (0.375-16x.75)
10. Lockwasher (0.375)
11. Retainer

Figure 1 — Compressor Clutch, Coil and Damper

5. Position the new bearing in the bore. Support the pulley as shown in Figure 12. Place the 3½" end of the Bearing Tool (Figure 11) against the bearing outer race and press the bearing into the bore until it is seated.

6. Support the pulley and bearing at the bearing inner race (Figure 13) using the Bearing Support Tool (Figure 8). Apply pressure on the hub, pressing until the pressure plate stops.

7. Replace the bearing retaining rings (Snap Rings 1 and 2 on Figure 6) in the clutch pulley and pressure plate hub.

Suction and Discharge Valve Removal

Key numbers in the text refer to Figure 2.

1. Reomve two bolts (1) which attach the discharge valve to the compressor. Remove valve (2) and gasket (3).

2. Remove two bolts (4) which attach the suction valve (5) to the compressor. Remove the valve, gasket (6) and strainer (7).

Cylinder Head and Discharge Valve Removal

Key numbers in the following text refer to Figure 3.

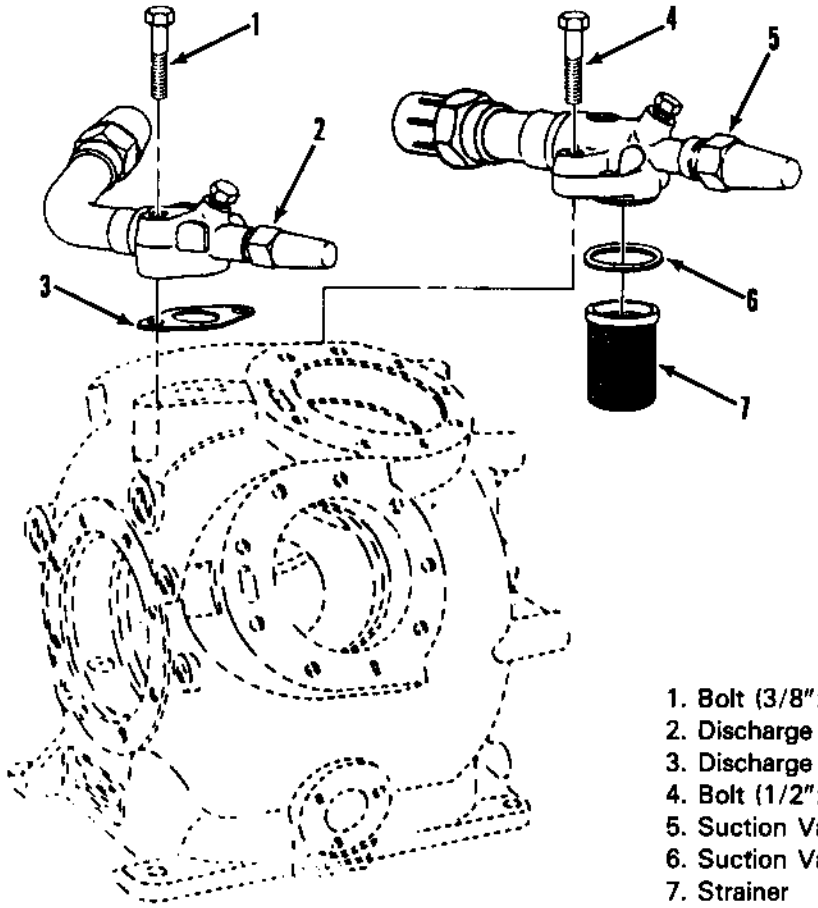
1. Loosen and remove all but two opposed cylinder head attaching bolts (1). Alternately loosen the remaining two bolts two or three full turns as shown in Figure 13.

   CAUTION: The cylinder heads are under spring tension. To help prevent being injured by the cylidner head, check cylinder head (3) to be sure it is following the heads of attaching bolts (1). If the head is not following the bolts, tap around the edge of the head with a plastic or rawhide hammer until head gasket (4) breaks loose.

2. Slowly and alternately loosen the two remaining cylinder head bolts to relieve tension of the cylinder head spring. When the last two bolts are turned all the way out, the spring should be fully extended.

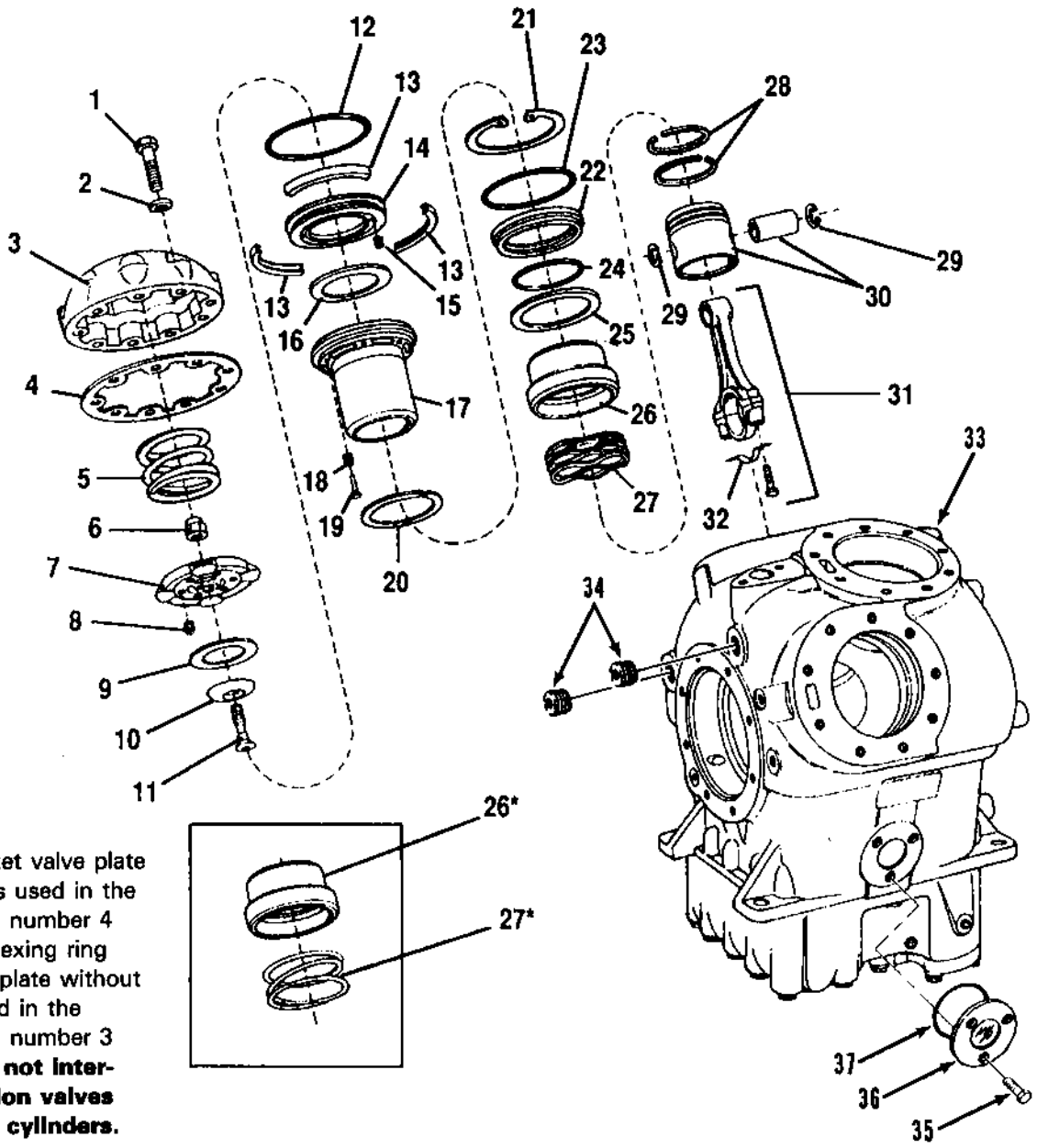
3. Remove the cylinder head, then lift off the cylinder head spring (5) and remove the head gasket (4).

4. Lift the discharge valve assembly from the compressor (Figure 14).



1. Bolt (3/8"x6x2") (Plated)
2. Discharge Valve
3. Discharge Valve Gasket
4. Bolt (1/2"x13x2") (Plated)
5. Suction Valve
6. Suction Valve Gasket
7. Strainer

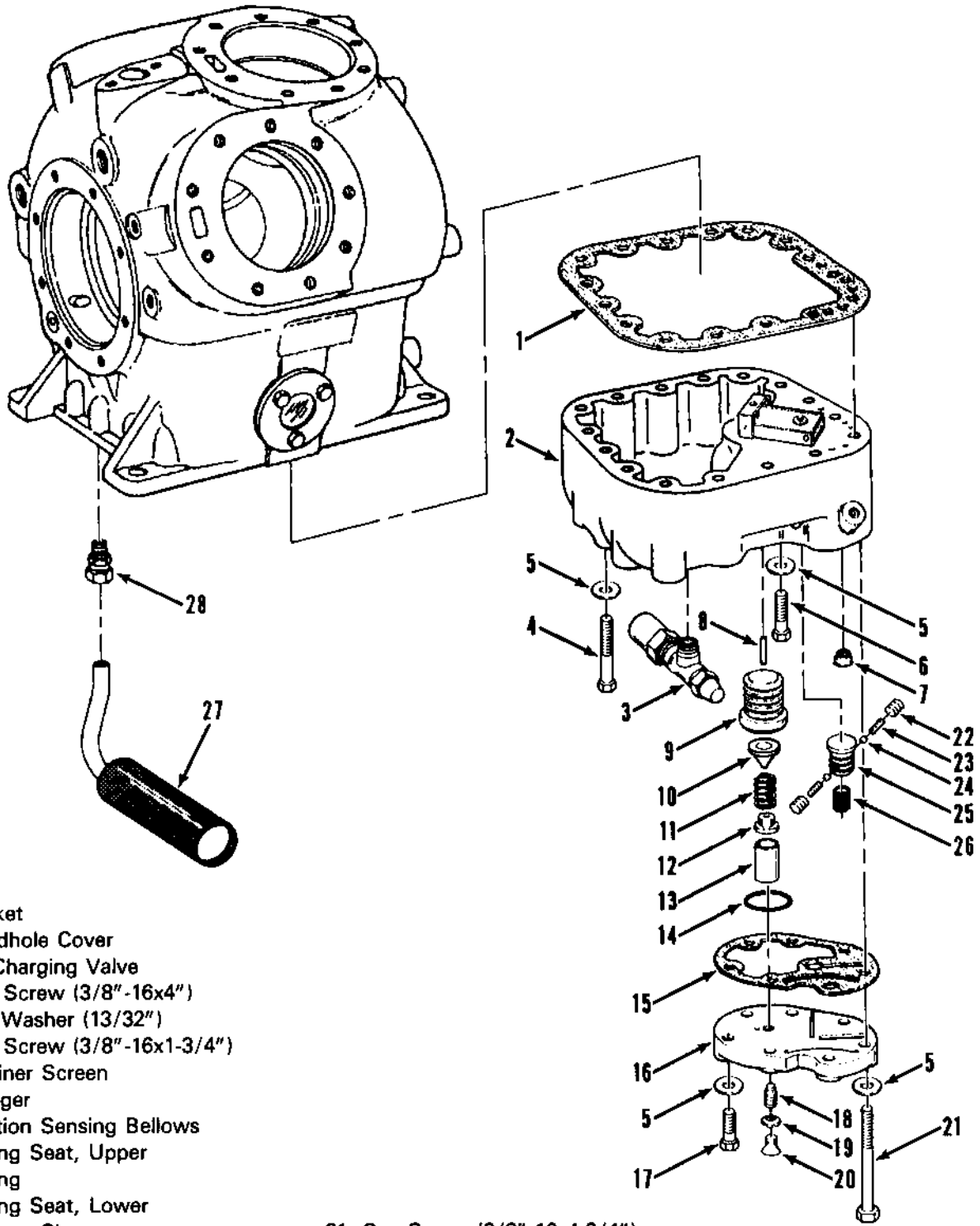
Figure 2 — Compressor Suction and Discharge Valves



* A spring pocket valve plate with springs is used in the number 1 and number 4 cylinders. A flexing ring suction valve plate without springs is used in the number 2 and number 3 cylinders. **Do not interchange suction valves within these cylinders.**

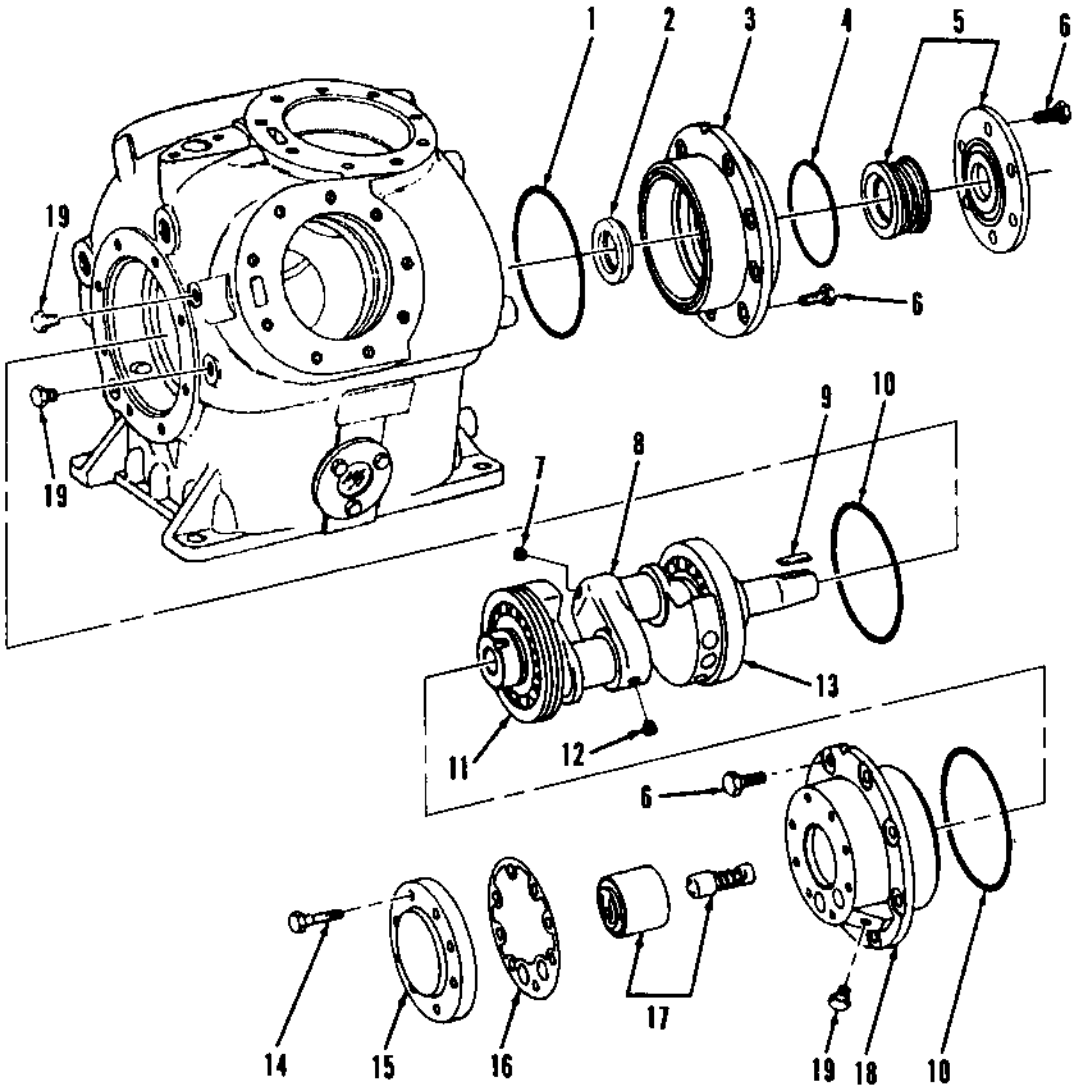
1. Bolt (3/8"-16x1-3/4")
2. Flat Washer (13/32")
3. Cylinder Head
4. Gasket
5. Cylinder Head Spring
6. Lock Nut
7. Valve Cage
8. Discharge Valve Spring
9. Discharge Valve
10. Discharge Valve Seat
11. Valve Cage Screw
12. O-ring
13. Retaining Rings
* 14. Valve Plate
* 15. Suction Valve Spring
* 16. Suction Valve
17. Cylinder Liner
18. Lift Pin Spring
19. Lift Pin
20. Take Up Ring
21. Retaining Ring
22. O-ring Retainer
23. Retainer to Housing O-ring
24. Retainer to Piston O-ring
25. Lower Retaining Ring
26. Unloader Piston
27. Unloader Spring
28. Compression Ring
29. Retaining Ring
30. Piston Head and Pin Assy.
31. Connecting Rod Assembly
32. Lock Strap
33. Compressor Housing
34. Pipe Plug
35. Cap Screw (1/4"-.20x5/8")
36. Sight Glass
37. O-ring

Figure 3 — Compressor Cylinder Head and Unloader Assembly



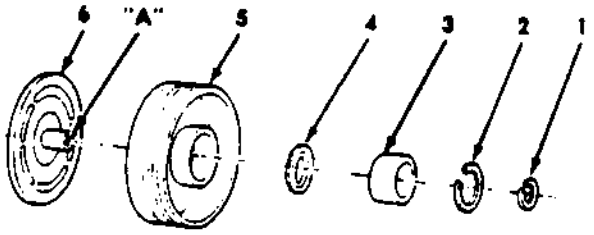
1. Gasket
2. Handhole Cover
3. Oil Charging Valve
4. Cap Screw (3/8"-16x4")
5. Flat Washer (13/32")
6. Cap Screw (3/8"-16x1-3/4")
7. Strainer Screen
8. Plunger
9. Suction Sensing Bellows
10. Spring Seat, Upper
11. Spring
12. Spring Seat, Lower
13. Bellows Sleeve
14. O-ring
15. Distributor Cover Gasket
16. Distributor Cover
17. Cap Screw (3/8"x1-1/4")
18. Adjusting Screw (5/16"-24x3/4")
19. Lock Washer
20. Flat Head Screw (5/16"-24x3/8")
21. Cap Screw (3/8"-16x4-3/4")
22. Detent Screw
23. Detent Spring
24. Detent Ball
25. Piston Actuator
26. Piston Actuator Spring
27. Oil Strainer Assembly
28. Adapter Fitting (1/2" O.D. x 3/8" NPTF)

Figure 4 — Compressor Handhole Cover and Strainer Assembly



1. O-ring, Bearing Head/Housing
2. Oil Seal
3. Seal End Bearing Head
4. Shaft Seal O-ring
5. Shaft Seal and Gland Plate
6. Screw (.375-16x1.00")
7. Plug (1/8 NPTF)
8. Crankshaft
9. Drive Key
10. Bearing Head to Housing O-ring
11. Pump End Roller Bearing
12. Magnetic Plug
13. Seal End Roller Bearing
14. Screw (.312-18x1.25")
15. Oil Pump Cover and Pin
16. Oil Pump Cover Gasket
17. Oil Pump and Valve Assembly
18. Pump End Bearing Head
19. Hex Head Plug (1/8 NPT)

Figure 5 — Compressor Crankshaft, Seal End and Pump End Assembly



1. Press Plate Snap Ring
2. Bearing Snap Ring
3. Clutch Bearing
4. Dust Shield
5. Clutch Pulley
6. Clutch Pressure Plate

Figure 6 — Clutch Pulley Assembly

Discharge Valve Cage Disassembly

Key numbers in text refer to Figure 3.

1. Remove the discharge valve as explained under "Cylinder Head and Discharge Valve Removal" previously.
2. Remove the locknut (6) from the valve cage bolt (11).
3. Remove the bolt (11) and valve seat (10) from valve cage (7).
4. Separate the discharge valve six springs from the valve cage (Fig. 16).
5. Disassemble, inspect and assemble the discharge valve before proceeding to other parts of the compressor.

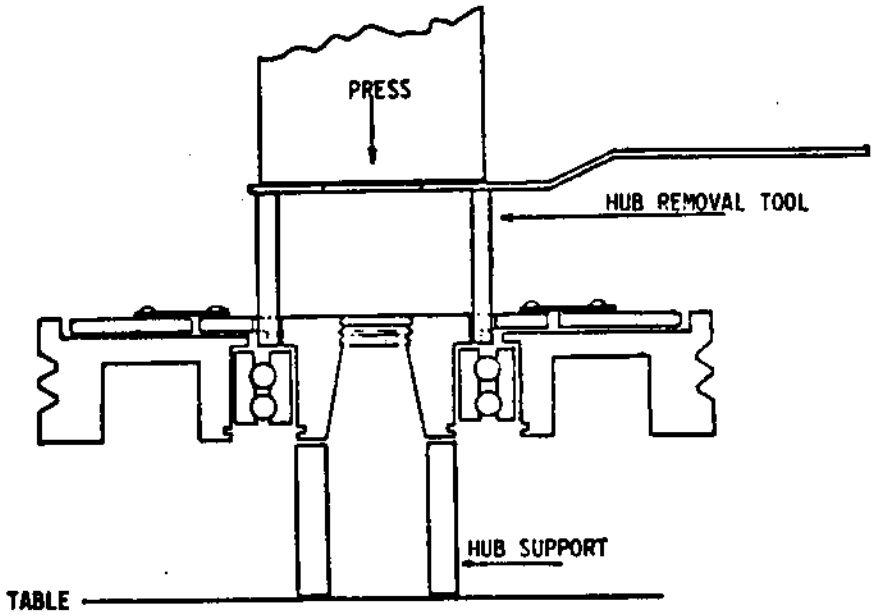


Figure 7 — Pressure Plate Assembly/Pulley Separation

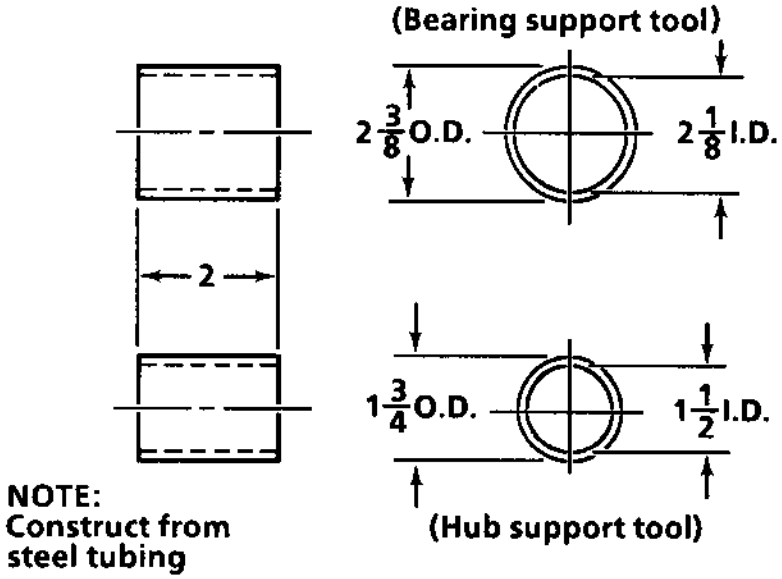


Figure 8 — Hub and Bearing Support Tools

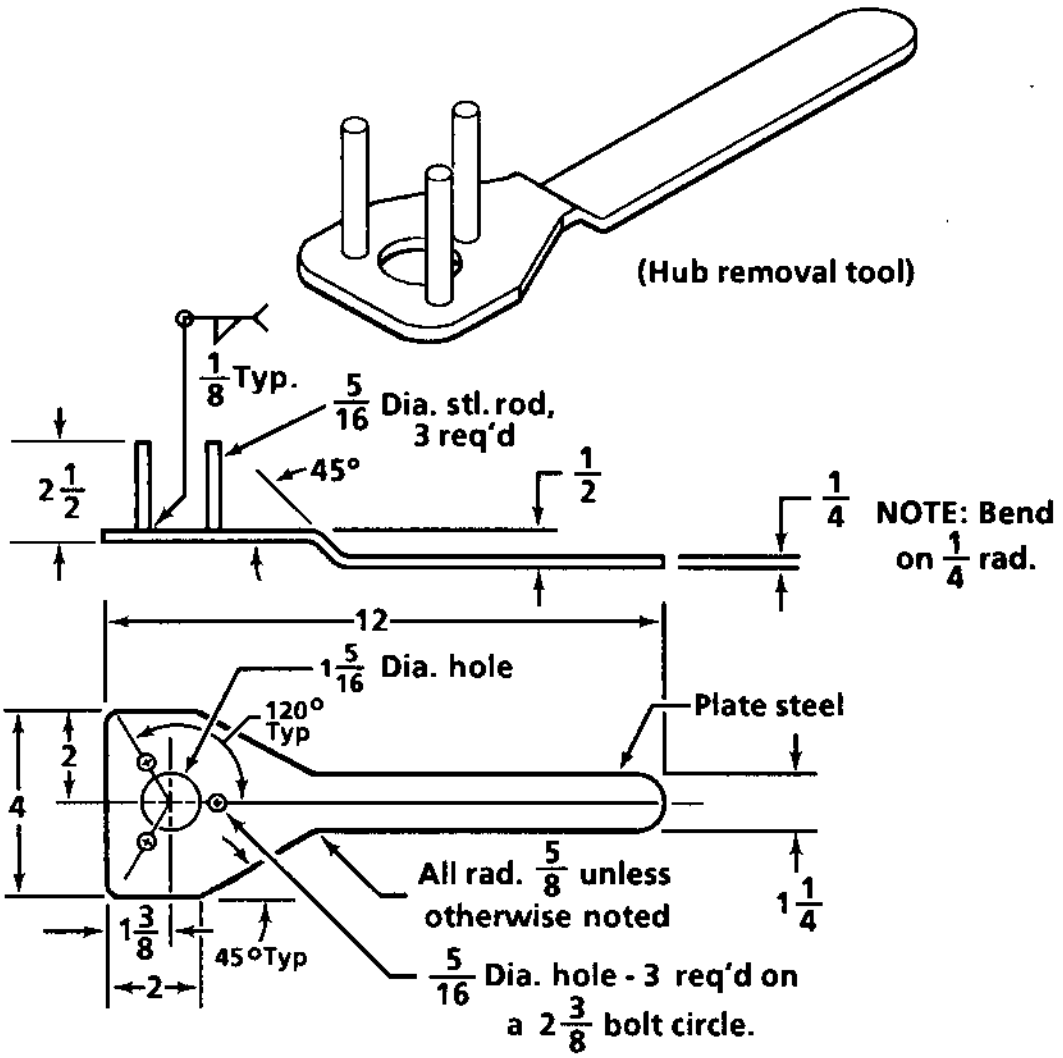


Figure 9 — Hub Removal Tool

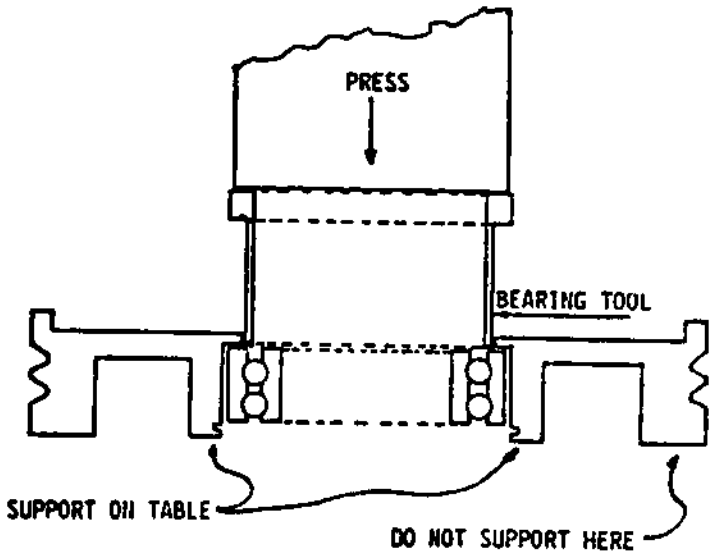


Figure 10 — Bearing Removal From Pulley

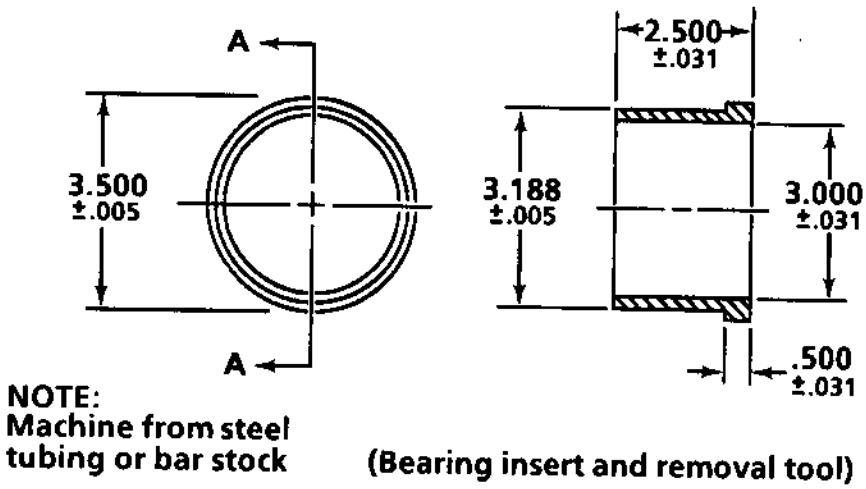


Figure 11 — Bearing Insert and Removal Tool

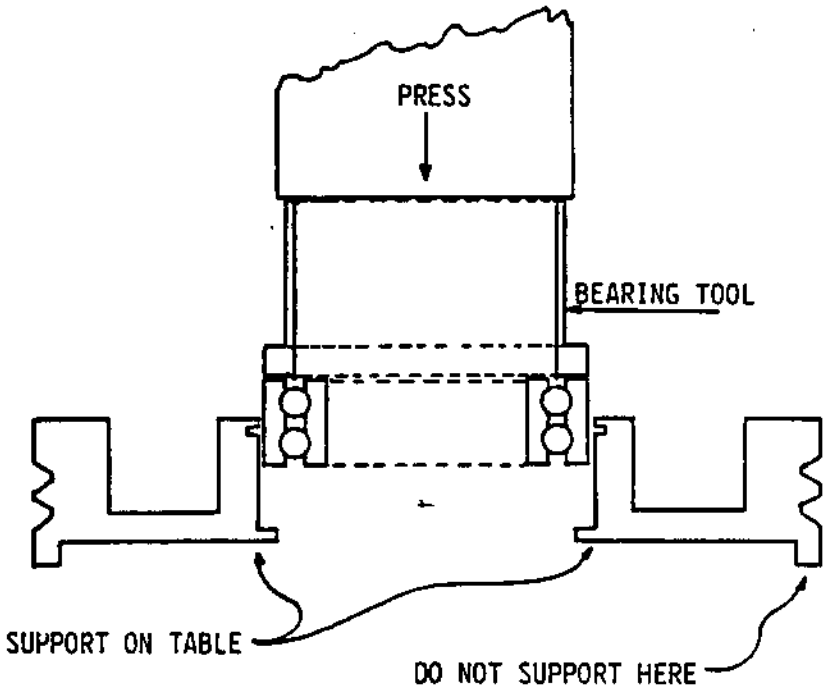


Figure 12 — Bearing Insertion to Pulley

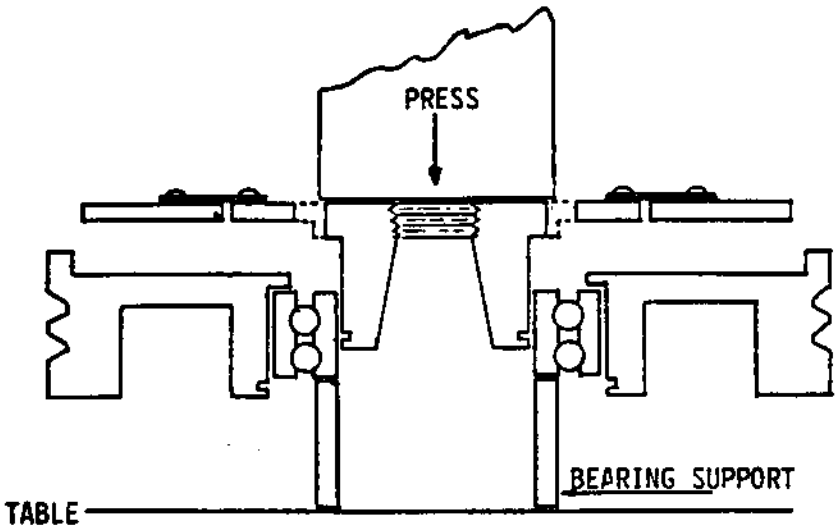


Figure 13 — Pressure Plate/Bearing Reassembly

Discharge Valve Inspection

Examine valve surfaces and replace the valves if there is evidence of copper plating, liquid slugging or wear approaching limits listed in the "Wear Rate Table" at the end of this section. Whenever the compressor is opened for servicing, replace the small valve springs if the compressor has operated for more than 5000 hours.

Discharge Valve Assembly

Key numbers in text refer to Figure 3.

1. Place the valve springs into the valve cage spring pockets and lay the valve ring on top of the springs (Figure 17). Insert valve seat (10) and bolt (11) through valve cage (7).
2. Work valve ring (9) up and down to make sure it moves freely (Figure 18).
3. Install locknut (6) and tighten to 24 foot-pounds (33 N·m) torque.

Cylinder Liner Removal

Key numbers in the text refer to Figure 11.

1. Remove the cylinder head and discharge valve as explained under "Cylinder Head and Discharge Valve Removal" previously.
2. Suction valve plate (14), attached to the top of the liner, is tapered inward at the top. Make a wood, plastic or soft metal puller block to dimensions shown in Figure 19 to fit inside the liner.
3. Rotate the crankshaft until the piston head is about two inches below the top surface of the suction valve plate.
4. Place the puller block in the cylinder so that the tapered ends engage the suction valve plate taper (Figure 19).
5. Rotate the crankshaft to drive piston head (30) up against the puller block thereby forcing cylinder liner (17) and suction valve plate (14) out of the housing.

   NOTE: To prevent damaging the piston, do not bump the piston against the block. Use an even pressure. If the piston cannot be used to force the liner out, a tapped hole in the pullery block can be used with a puller bolt to pull the liner out.
6. After suction valve plate O-ring (12) has cleared the housing, pull the assembly out by hand as shown in Figure 20. Support the piston through the liner so that the piston does not bump against the compressor housing when the liner comes off the piston. If the liner has an unloader, the unloader lift pins, springs, and take-up ring will come out with the liner.

   NOTE: DO NOT remove more than one cylinder liner without removing the piston and connecting rod. The piston and piston rings will be damaged if the crankshaft is rotated with one liner removed from the piston.
7. If a liner was removed from a cylinder equipped with an unloader assembly, work take-up ring (20) off bottom of the liner. Remove lift pins (19) and springs (18).

Suction Valve Disassembly

Key numbers in the text refer to Figure 3.

1. The suction valve assembly is secured to the liner with three 120-degree retainers (13).
2. Place the liner and valve assembly on a flat surface as shown in Figure 21 and pry the retainers outward to remove. Do not move the liner around on top of the valve assembly.
3. Cylinders 2 and 3 have a flexing ring valve plate not equipped with springs. Cylinders 1 and 4 have a spring pocket valve plate with springs. Do not mix valves between these cylinders. Lift liner away from the valve assembly and remove the valve (16), spring (15) and o-ring (12) as shown in Figure 22. Keep the valve plate with the liner until time of assembly.

   NOTE: Cylinders 2 and 3 prior to S/N J1015J3158 (April 1981) also have a spring pocket valve plate. These units can be updated.

Cylinder Unloader Removal

Key numbers in the text refer to Figure 3.

1. The unloader assembly (Figure 23) is held in the cylinder by retaining ring (21).
2. Remove the cylinder head, discharge valve, suction valve and the cylinder liner as explained previously.
3. Reach inside the cylinder with large snap ring pliers and remove retaining ring (21).
4. Pull the unloader assembly and spring (items 22 thorugh 27) out the cylinder.
5. Remove O-ring retainer (22), lower retaining ring (25) and O-rings (23 and 24) from the unloader piston (26).

   NOTE: If the unloader assembly sticks in the compressor housing, a jet of low pressure air directed into the oil line which suplies the unloader at the handhole cover access port will separate the assembly from the cylinder housing. Normally there is no particular preparation needed to "catch the unloader." Since it is light weight and has a very short cylinder stroke, minimal inertia force is applied to the piston assembly.

Handhole Cover Removal and Disassembly

Key numbers in the text refer to Figure 4.

If only the cylinder liner is to be removed, it is not necessary to remove the handhole cover. Refer to "Cylinder Liner Removal" in this section.

1. The handhole cover on the bottom of the compressor contains the capacity control actuator which is an integral part of the cover.

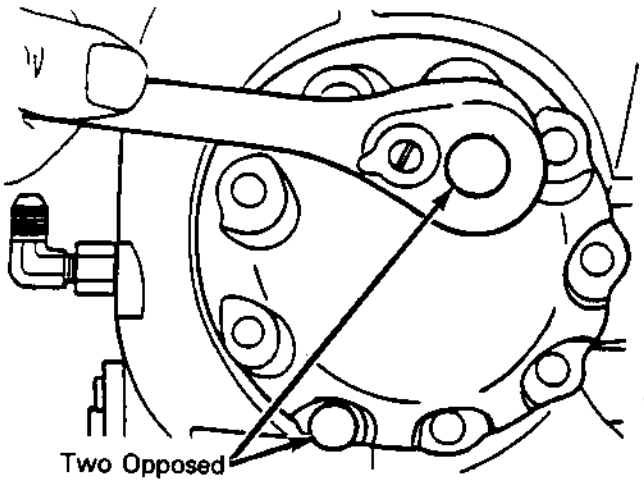


Figure 14 — Removing Cylinder Head Cover

NOTE: DO NOT attempt to adjust or remove the orifice screw and nut on the actuator orifice lever and bracket assembly (Figure 24). These parts have been factory set to control the orifice opening of the capacity control. If the setting is changed, a special factory test fixture is required to correct the setting.

2. Remove the cover attaching bolts (4, 6 and 21). Tap around the edge of the cover with a plastic or rawhide hammer to loosen cover (2), then remove the cover and cover gasket (1).
3. Disconnect oil strainer (27) by loosening compression fitting (28) on the oil supply line. Remove the oil strainer (Figure 25).
4. The capacity control distributor cover (16) is attached to the bottom of the handhole cover. Disassemble the capacity control assembly only to the extent covered below:
   a. Referring to Figure 26, remove four cap screws which attach the distributor cover (16) to the handhole cover (2). It may be necessary to jar the cover to break the gasket seal. Remove the cover and cover gasket (15).

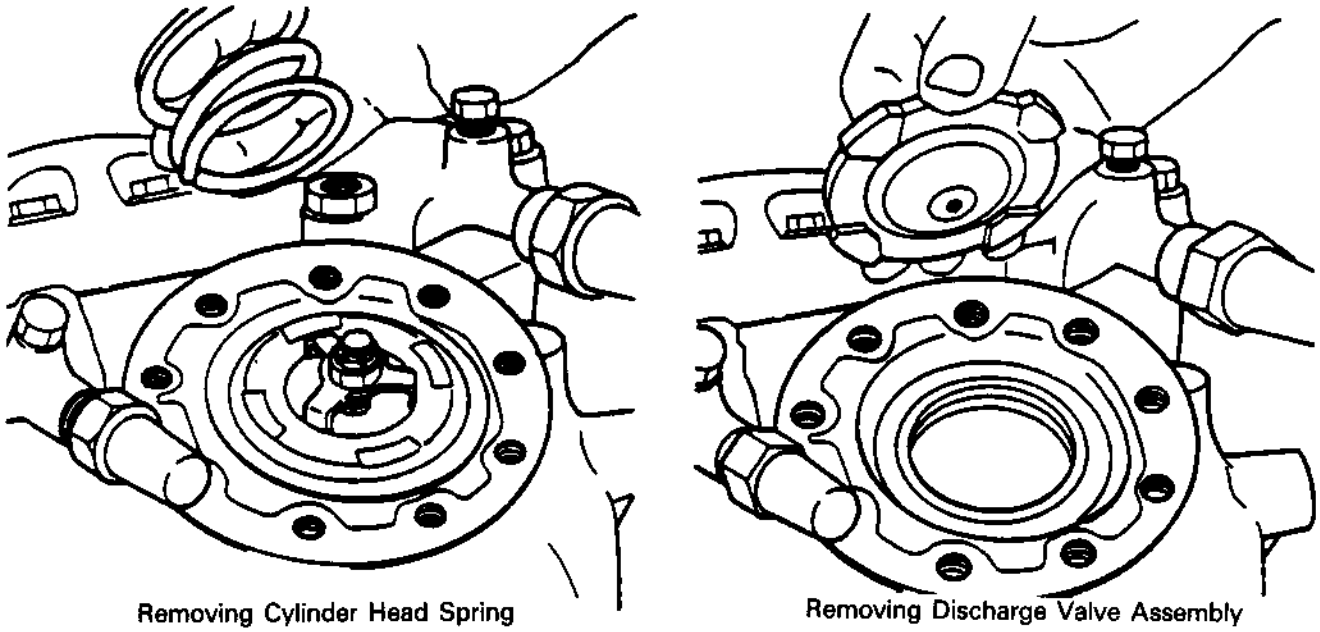


Figure 15 — Removing Cylinder Head Spring and Discharge Valve

b. Remove plunger (8), bellows (9), spring (11), lower and upper spring seats (10 & 12), sleeve (12) and o-ring (14) from the distributor cover.

c. Remove oil strainer screen (7) from the handhole cover and clean with refrigerant parts cleaner.

d. Remove plugs, detent ball screws, detent balls, springs and piston (22-26). Clean with refrigerant parts cleaner. Cleaning is required to free up parts seized due to foreign materials (metallic or other residue from failed parts, etc.). Complete cleaning assures unloader operation upon completion of the compressor overhaul.

e. Remove orifice, bracket and lever assembly as required to clean and polish piston bore (Figure 26). **Do not mix bracket/orifice assemblies or disturb orifice adjustment screw.**

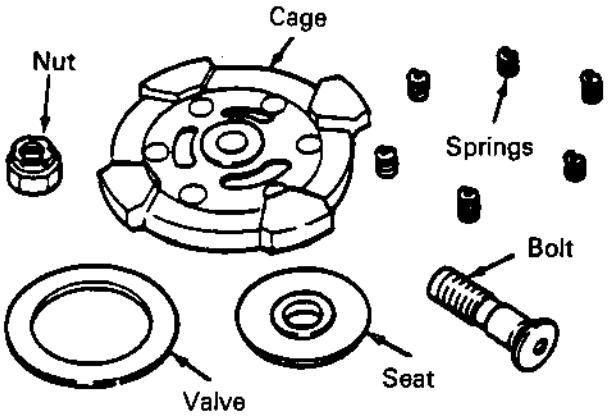


Figure 16 — Discharge Valve Components

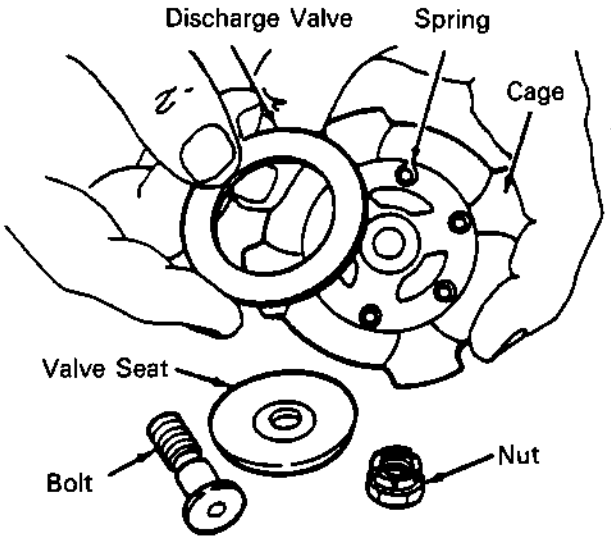


Figure 17 — Installing Discharge Valve Components

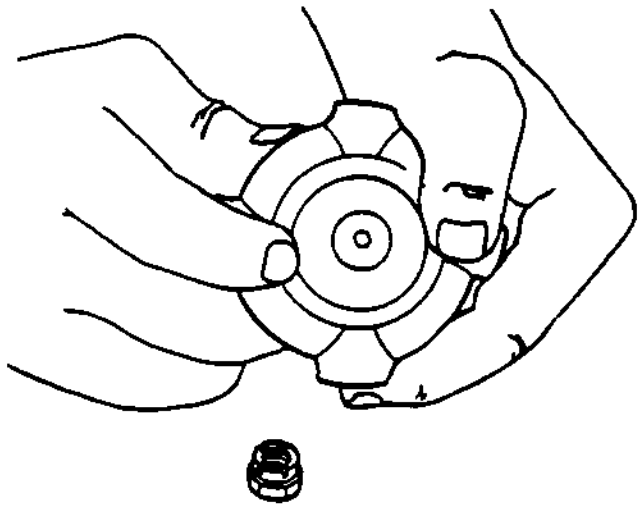
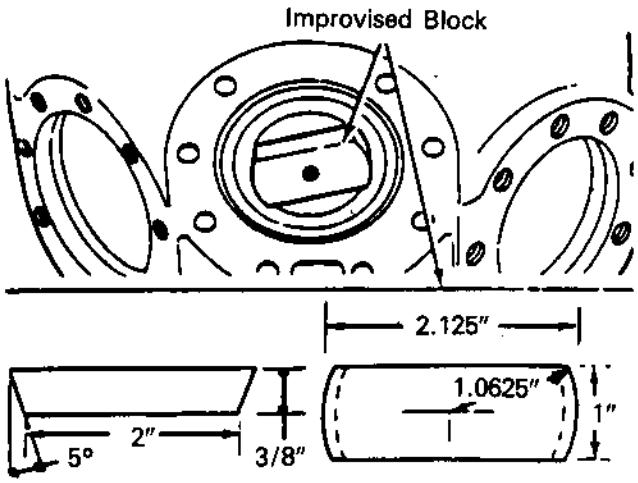


Figure 18 — Checking Discharge Valve Movement



Soft Material — Wood, Plastic, Brass, or Aluminum

Figure 19 — Using Improvised Block to Remove Suction Valve Liner

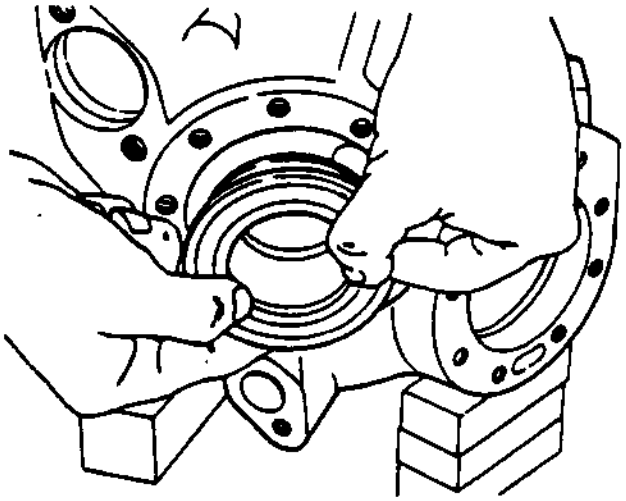


Figure 20 — Pulling Liner Off Piston

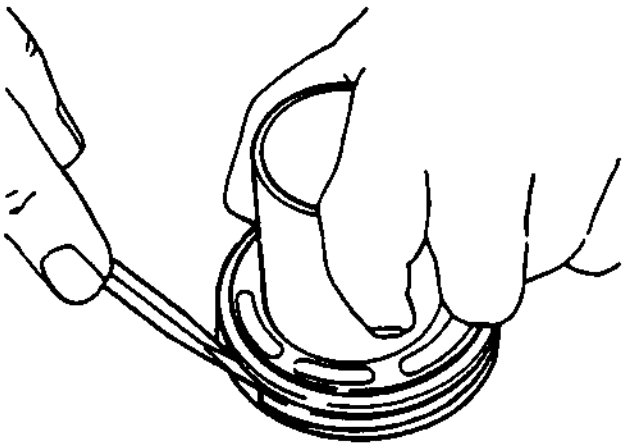
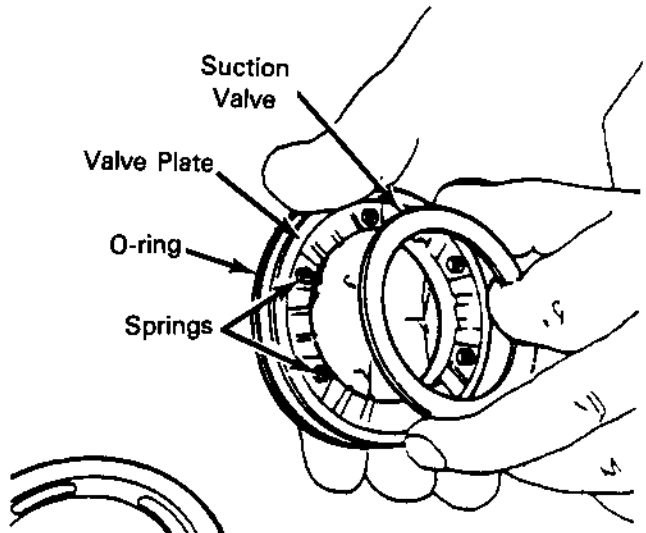


Figure 21 — Removing Suction Valve Retaining Ring



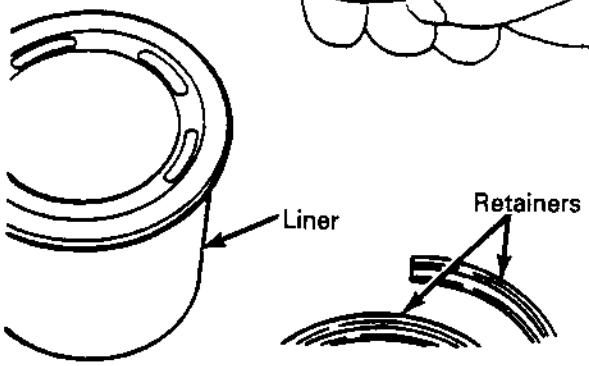


Figure 22 — Removing Suction Valve Components

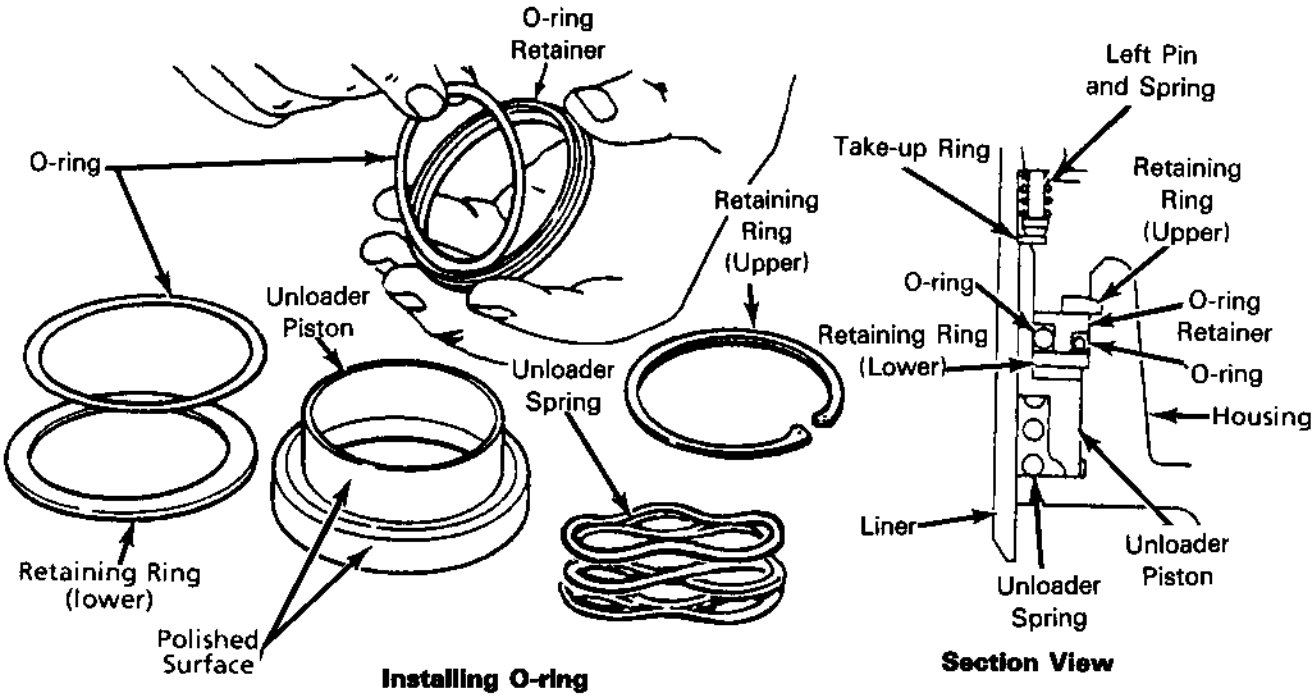


Figure 23 — Cylinder Unloader Components

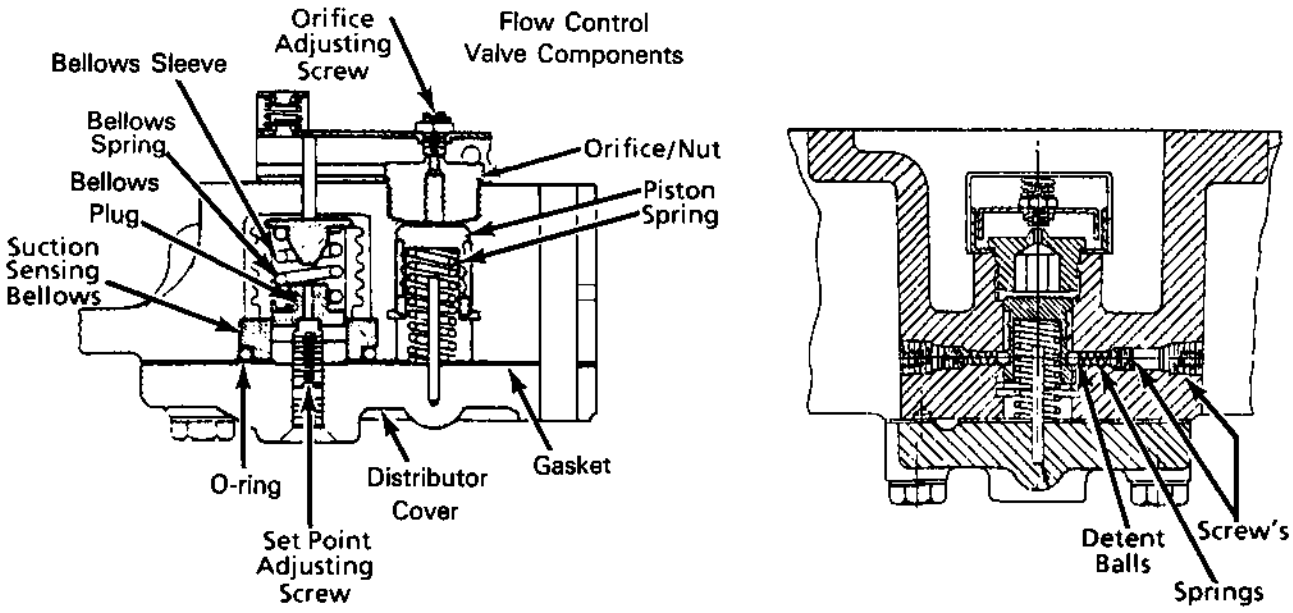


Figure 24 — Sectional Views of Capacity Control Actuator

Piston and Connecting Rod Removal

Key numbers refer to Figure 3.

1. Remove the cylinder head, discharge valve, cylinder liner and suction valve, and the handhole cover as explained previously.
2. Remove the oil strainer (21, Figure 4) by loosening compression fitting (22, Figure 4).
3. Rotate the crankshaft until the connecting rod cap bolts are accessible through the handhole cover opening.
4. Open tabs on connecting rod bolt lock strap (32) shown in Figures 27 and 28, then remove the cap bolts. Remove cap from bottom of the connecting rod.
5. Carefully pull the piston and rod assembly out through the top of the cylinder housing. Keep all liner, piston and rod assemblies separate and mark them in relation to the bore from which they were removed.

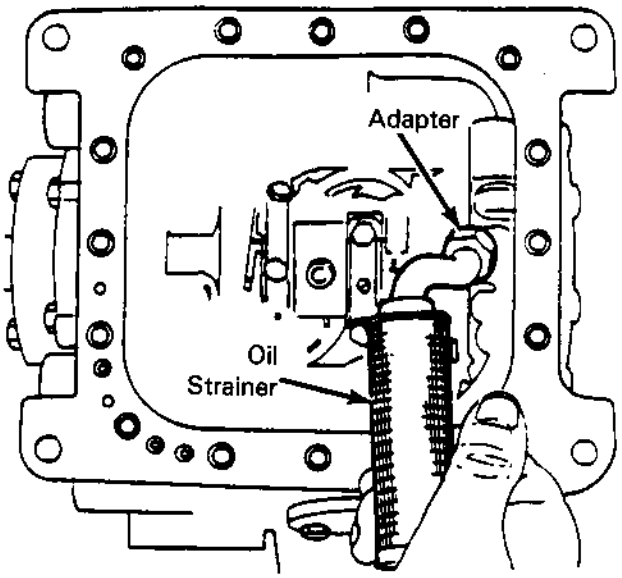


Figure 25 — Removing Crankshaft Oil Strainer

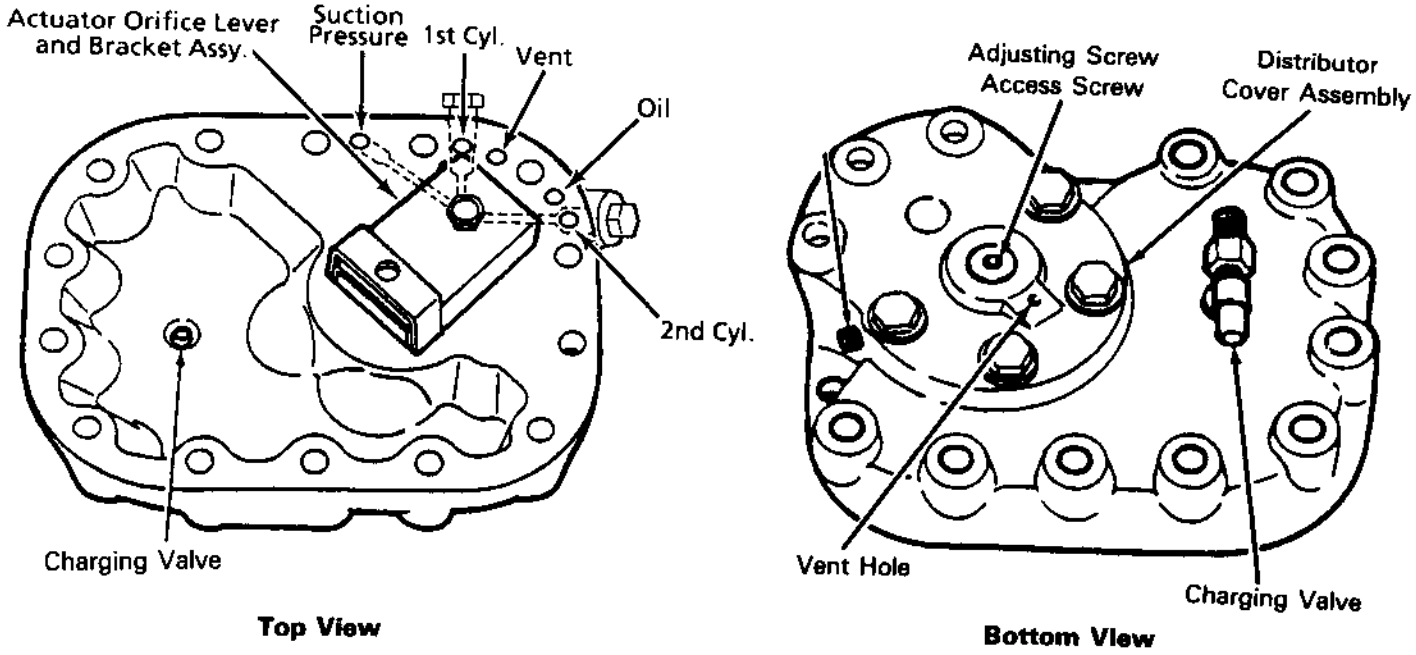


Figure 26 — Handhole Cover Assembly Views

Piston and Connecting Rod Disassembly

Key numbers refer to Figure 3.

1. Rings (28) are removed from the piston using a piece of thin shim stock inserted between the rings and the piston. Carefully work the rings out of the groove and slide them over the shim stock and off the piston. Rings (28) are not reused at overhaul.
2. Using Tru-Arc pliers, remove snap rings (29) from ends of the piston pin. Drive the pin from the piston pin using a brass driving rod or wood dowel. Be careful not to nick or damage the piston, rings, or distort the wrist pin hole. Figure 27 shows the piston and rod components.

Compressor Shaft Seal Removal

Key numbers in the text refer to Figure 5. Figure 29 shows compressor shaft seal replacement.

1. Loosen and remove all but two opposite cap scews (6) which attach the seal cover to the seal end bearing head (3). Slowly and alternately, loosen and remove the remaining two cap screws from the cover. If the cover does not follow the two cap screws, tap the rim of the cover lightly with a plastic hammer to free the cover from the bearing head.

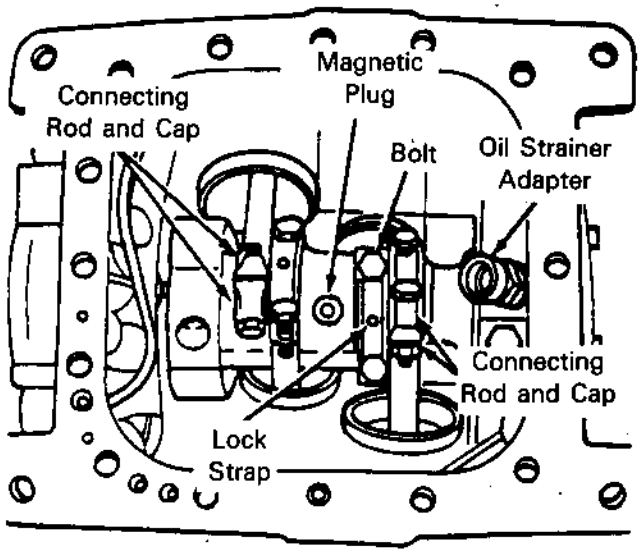


Figure 27 — Connecting Rod Cap Bolts Installed

NOTE: Be sure the cover is removed evenly so as not to distort the seal and cause breakage of the carbon ring within the seal. Also, do not pry on the cover with a screwdriver.

2. Remove gland plate O-ring (4) from groove in the seal end bearing head and discard. Install a new O-ring prior to installing the cover.
3. Carefully, work the shaft seal assembly off the end of the shaft using two screwdrivers. Use care when handling the carbon nose ring. It can be broken or damaged very easily. Be careful not to scratch the crankshaft.

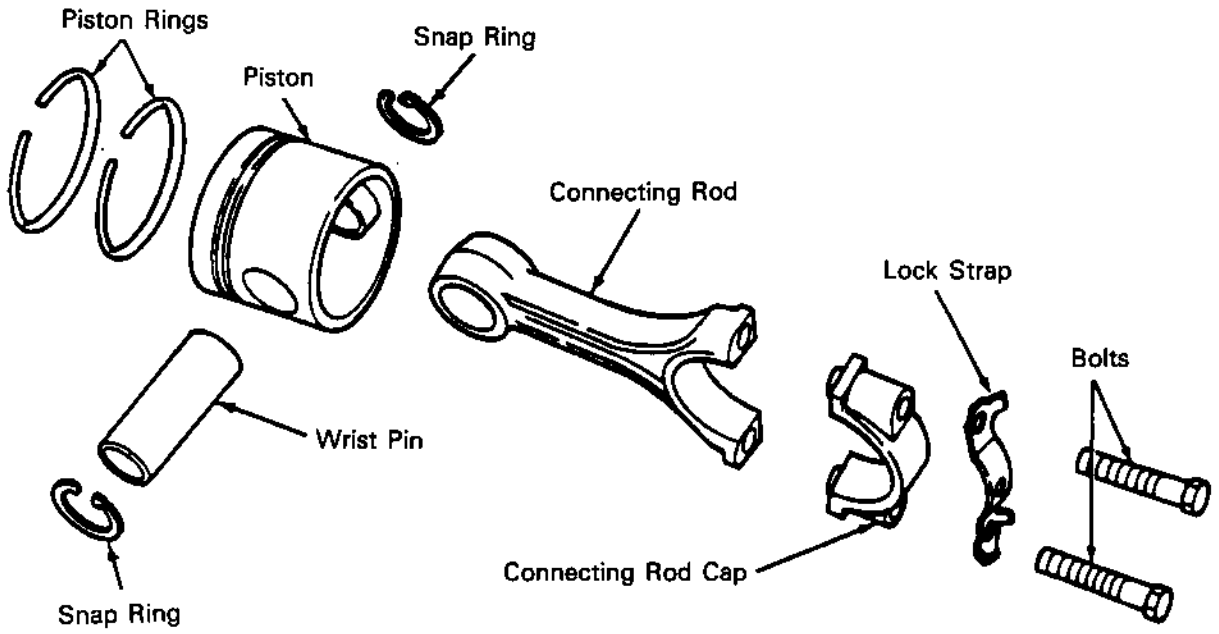


Figure 28 — Piston and Connecting Rod Components

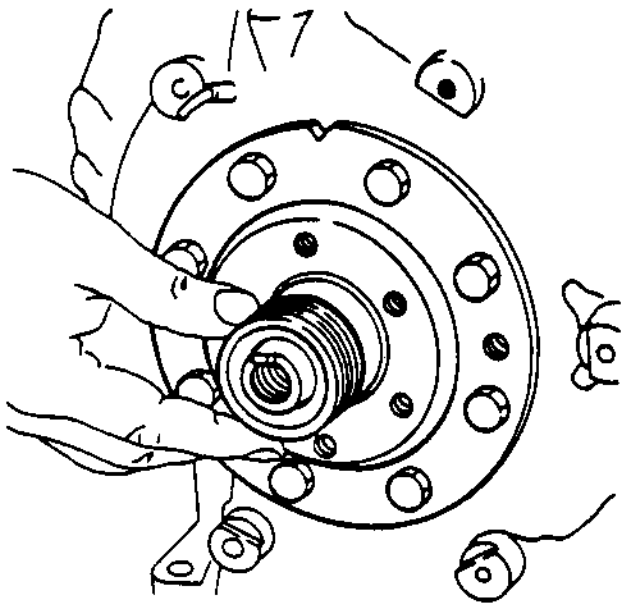


Figure 29 — Compressor Shaft Seal Replacement

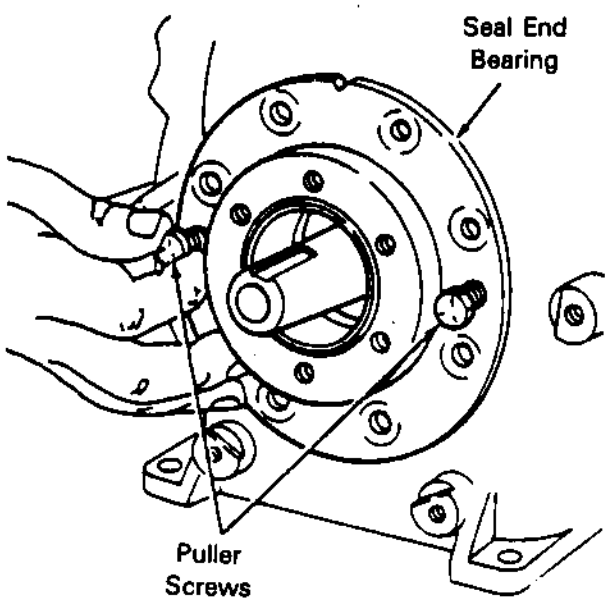


Figure 30 — Removing Seal End Bearing

Seal End Bearing Head Removal

Key numbers in the text refer to Figure 5.

1. Remove the compressor shaft seal as explained previously under "Compressor Shaft Seal Removal."
2. Remove the cap screws (6) from the seal end bearing head.
3. Insert two bearing head screws into the tapped holes in the bearing head (Figure 30). Tighten the screws alternately and evenly to force bearing head (3) out of the compressor housing until the bearing head moves freely, then pull the bearing head out of the housing. It may be necessary to tap the seal end of the crankshaft with a plastic hammer to slip the roller bearing out of the seal and bearing head.
4. Support the seal end of the crankshaft to prevent damage to the bearing outer face or housing.
5. Remove O-ring (1) and oil seal (2) from the housing.

Oil Pump Removal

Key numbers in the text refer to Figure 5.

1. Loosen and remove all but two opposite cap screws (14) which attach the oil pump cover (15) to the pump end bearing head (18). Slowly and alternately loosen and remove the remaining two cap screws from the cover to release pressure from the pressure relief valve assembly. If the cover does not follow the bolts, tap the cover with a plastic hammer to break it loose. Remove the oil pump cover and gasket (16) from the pump end bearing head.
2. Inspect the cover plate stop roll pin. If damaged, remove by gripping with pliers or in a vice and rotating plate pin while pulling to remove from cover.
3. Remove the oil pump and valve assembly (17) from the pump end bearing head (Figures 31 and 32). A pump cover screw inserted in the plunger (Figure 33) will aid in removing the plunger and spring assembly.

Pump End Bearing Head and Crankshaft Removal

Key numbers in the text refer to Figure 5.

1. Remove the oil pump and seal end bearing head from the compressor as explained previously.
2. Remove the piston and connecting rod assemblies as explained previously under "Piston and Connecting Rod Removal."
3. Remove the cap screws (6) which attach the pump end bearing head (18) to the compressor.
4. Thread two puller screws into tapped holes in the bearing head flange (Figure 34). Support the seal end of the crankshaft and remove the pump end bearing head and crankshaft from the housing (Figure 35). Grip the crankshaft through the handhole cover opening until it is out of the housing.
5. Remove the crankshaft from the bearing head by holding them in a vertical position. With the bearing head end down, tap around the bearing head flange with a plastic hammer.

Crankshaft Bearing Removal

Key numbers in the text refer to Figure 5.

The pump end roller bearing (11) and the seal end roller bearing (13) are slip on bearings. However, proper tooling should be used to remove the bearings from the crankshaft (8). Tooling may be manufactured locally (see Figure 36) or commercially available tools may be used (such as Owatonna Tool Co. Puller #1002 and Center #625-3). In any case, a proper center on the crankshaft must be used to prevent damage to the ends of the crankshaft.

CLEANING AND INSPECTION

Cleaning

1. Clean all the compressor components with refrigerant compressor parts cleaner. DO NOT USE CARBON TETRACHLORIDE, NAPTHA or GASOLINE. Use a stiff bristle brush if necessary to loosen foreign particles. Direct air through all passages in castings.

   CAUTION: DO NOT use abrasive cleaning pads, wire wheels, etc. on critical finish surfaces, particularly unloaded pistons. Disturbing the polished finish contributes and/or causes piston seizure in the O-ring.

2. Being careful not to gouge the flange surfaces, scrape all gasket flange surfaces to make sure all gasket and sealing material is removed.
3. Clean the crank shaft bearings (11 and 13, Figure 5) thoroughly with refrigerant parts cleaner and blow dry with air. DO NOT spin the bearings with air; revolve them slowly with your fingers as air is directed at right angles to the balls. Examine the bearings for pits and scores, then oil them with clean compressor oil.

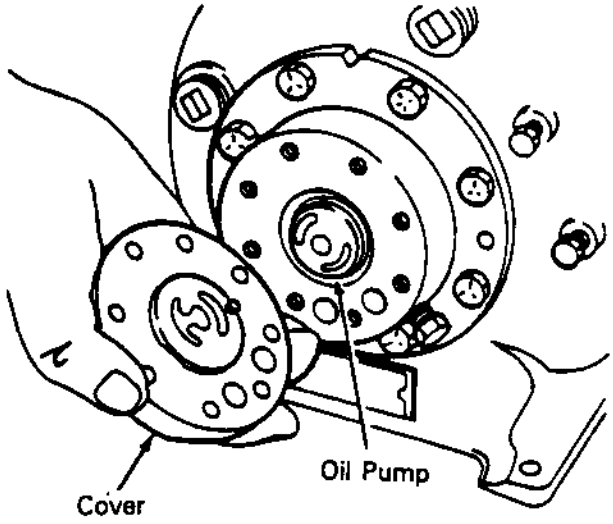


Figure 31 — Oil Pump Cover Removed

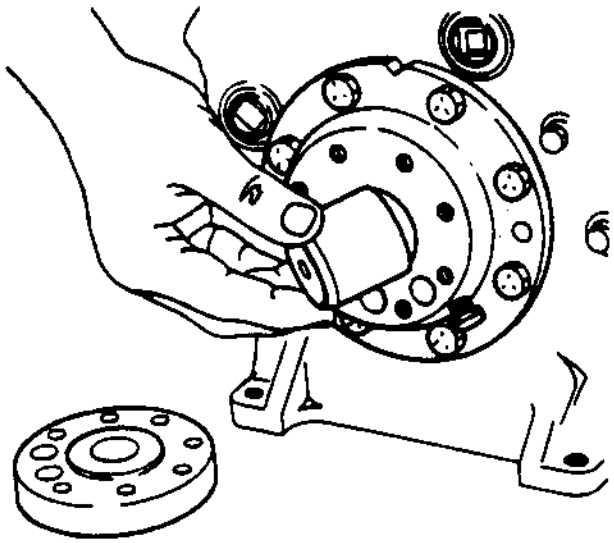


Figure 32 — Removing or Installing Oil Pump

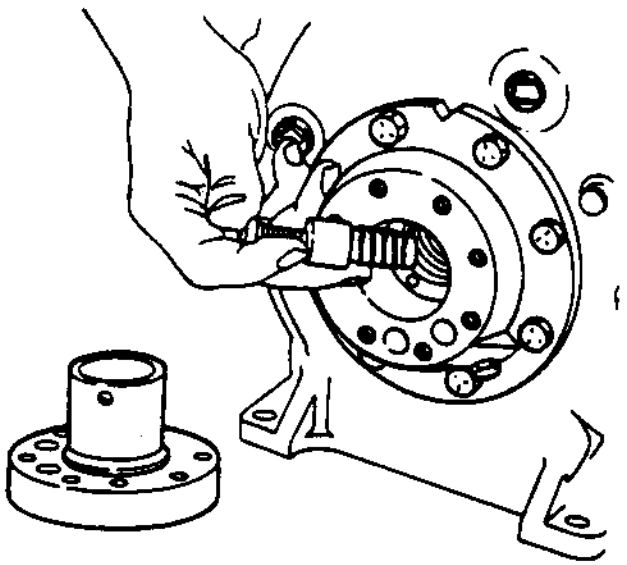


Figure 33 — Removing Plunger and Spring Assembly

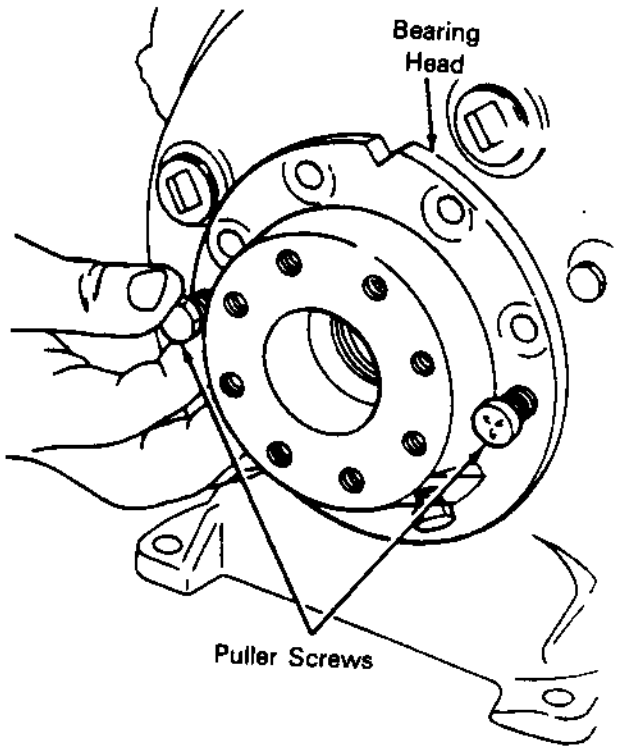


Figure 34 — Removing Pump End Bearing Head

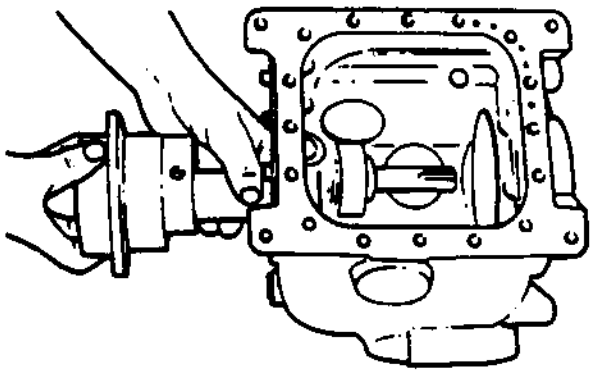


Figure 35 — Removing or Replacing Crankshaft and Pump End Bearing Head

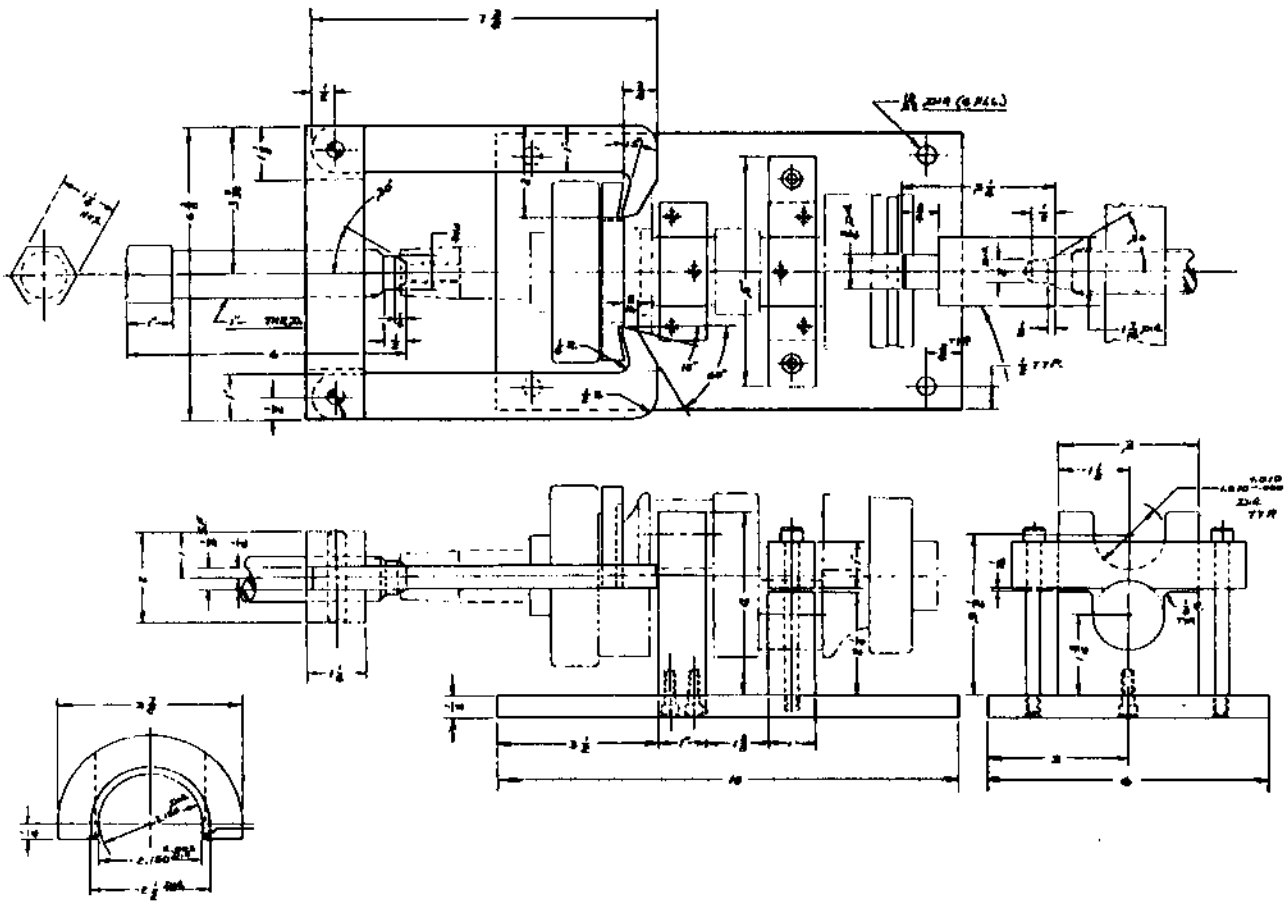


Figure 36 — Crankshaft Bearings Removal Tool

Inspection

1. Inspect the compressor housing and cylinder head sealing surfaces for general appearance. They should be smooth, flat and contain no grooves, nicks or burrs. Check tapped holes for crossed threads or damage.

2. Check the components of the compressor for wear to dimensions shown in "Recommended Wear Limits and Tolerances" at the end of this section.

3. Check cylinder head springs (5, Figure 3) and replace if there is evidence of severe overheating or if the length is less than that shown in "Recommended Wear Limits and Toleances" at the end of this section.

4. Examine the valve seat surfaces of the suction and discharge valve components. Check the suction and discharge valve seats on valve cages and restore by lapping, if necessary. Seats must be restorable to a flat square surface without pits, scoring or chipping. Replace the valve rings if there is evidence of copper plating, liquid sluging or when wear exceeds the limits listed under "Recommended Wear Limits and Tolerances" at the end of this section. Replace the small valve springs used in cylinders 1 and 4 (8 and 15, Figure 3) if the compressor has operated more than 5000 hours.

5. Examine the cylinder liner (17, Figure 3) and replace if there is evidence of excessive wear or scoring on the inside wall. Refer to "Recommended Wear Limits and Tolerances" at the end of this section. If the cylinder is to be reused, deglaze with cylinder hone. Check the suction valve seats machined on the cylinder liner flange and restore by lapping if necessary. Seats must be restorable to a flat square surface with no pits, scoring or chipping.

6. Examine the take-up rings, lift pins and spring (18, 19, and 20, Figure 3). Replace the springs and/or lift pins if they are less than the length listed in "Recommended Wear Limits and Tolerances" at the end of this section. Check take up ring end gap (spec. is .000 to .025 in.). The gap must not exceed .025 in.; otherwise the lift pin can work through the gap, seizing the unloader (see Figure 37).

7. Inspect piston (30, Figure 3) for scoring, cracks or damage. Check oil control holes on the piston head to be sure they are open. Check both sides of the piston head and wrist pin bore and replace if there is evidence of wear, grooving or copperplating on the bearing surfaces. Refer to "Recommended Wear Limits and Tolerances" at the end of this section.

8. Check fit of rings (28, Figure 3) in the piston ring grooves. Use the back edge of a ring to check the fit (Figure 38). Roll the back edge of the rings in the grooves to make sure the rings move freely in the piston grooves.

9. Examine the seal mounting surface on the crankshaft. It must be clean and smooth without nicks or burrs. If damaged, replace or rework the surface to spec. Do not reuse the shaft seal due to probablity of microscopic defects that will cause failure/leaks. Also, the drive band area will probably have vulcanized to the shaft causing bellows damage upon removal.

10. Examine the seal end and pump end bearing head surface for nicks or burrs. If necessary, clean the bearing head oil passages. Replace the oil lip seal (2, Figure 5) with a new seal.

11. Examine the crankshaft journals and bearing surfaces for wear or damage. Remove plugs (7 and 12, Figure 5) from the crankshaft. Clean the plugs, blow out passages in the crankshaft, then replace the plugs. Refer to "Recommended Wear Limits and Tolerances" at the end of this section. Check to be sure that the oil orifice passage at the seal end main journal chamber is open. Oil flow is necessary to ensure oil supply for lubrication and cooling of seal cavity.

12. Examine crankshaft roller bearings (11 and 13, Figure 5) for damage, chips or excessive radial play. Examine connecting rod journals for damage or copperplating. Examine the shaft seal area of the crankshaft for a clean, smooth surface for the seal.

13. Examine flow control (actuator) piston for excessive wear and scaring of sealing surfaces and cleanliness of orifice slot machined in periphery of piston (closed end). Do not alter depth or width of this slot (oil control orifice). Sealing surfaces may be polished with 600 grit or finer abrasive as required, taking care not to remove any measurable material. Replace if damaged or worn. Refer to "Recommended Wear Limits and Tolerance" at the end of this section.

14. Examine flow control (actuator) piston bore on hand hole cover for excess wear, scoring, burrs that might contribute to poor sealing or piston seizure. Polish or deburr as required. Do not alter finish spec. Use only 600 grit or finer abrasive. Refer to "Recommended Wear Limit and Tolerances" at the end of this section.

15. Check orifice bracket to lever hinge for excess free play. Normal is .006 in. free play at hinge pin/lever. Excess play can contribute to erratic unloader operation and finally cause inoperative unloaders.

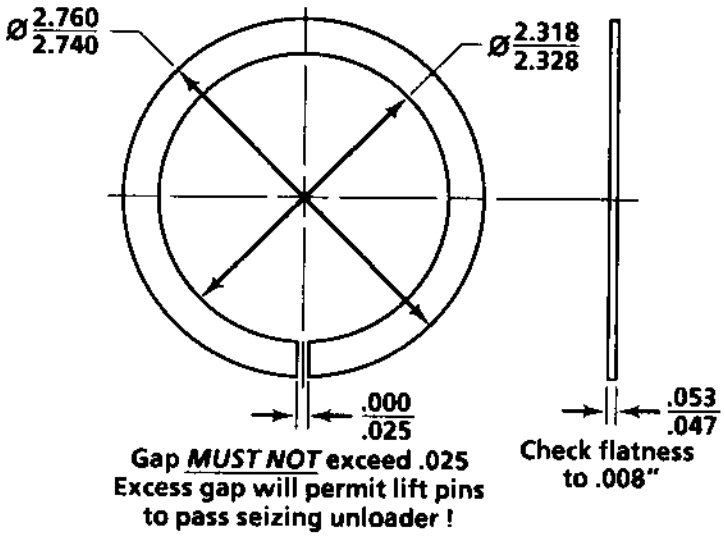


Figure 37 — Checking Take Up Ring End Gap and Flatness

16. Examine the oil pump cover plate for wear, scoring at the pump thrust surface and wear on the roll pin. Check the thrust surface height above gasket surface—maximimum allowable wear down to .118 in. from new spec of .125 in. See Figure 39. Replace plate or pin as required.

    NOTE: Do not disturb finish or dimensional tolerances. To do so will affect oil pressure relief valve spring tension setting and therefore the oil pressure.

17. Examine inner and outer gear rotor for wear and/or scoring on lobes (see Figure 40). Examine gear to shaft surface for wear, looseness or scoring. Examine port/thrust plate for wear on thrust surface and at roll pin engagement surface. Check drive pin/screw for looseness in housing. Normal roll pin surface wear pattern is 1/4 moon shape. Replace oil pump as required.

18. Examine oil piping for flattened or broken pipes. Check for loose pipes in housing drillings. Replace as required.

    NOTE: Loose and leaking pipes will contribute to low oil pressure in the loaded mode.

19. Check and clean housing suction cavity to sump oil drain orifice/hole (see Figure 41). Later housings have precision drilled holes. Earlier housings have "T" drilled fitting threaded into housing. DO NOT leave "T" drilled fitting out of early housings or attempt to thread and install in later housing with precision drilling.

Seal End Bearing Head

Key numbers in the text refer to Figure 5.

1. Install oil lip seal (2) in the bearing head with sealing lip towards gland plate end as shown in Figure 42. Tap the seal in place using a plastic hammer.
2. Install new O-ring (1) on bearing head (3) flush with flange.
3. Lubricate the oil seal, O-ring and bearing head with clean compressor oil.
4. Slide the bearing head into the housing with the notch on the bearing head at the top (Figure 30).
5. Install the two cap screws at opposite sides of the bearing head and tighten evenly and alternately to draw the bearing head into the housing. Install remaining cap screws (6) in bearing head (3) and tighten to 24 foot-pounds (33 N·m) torque.

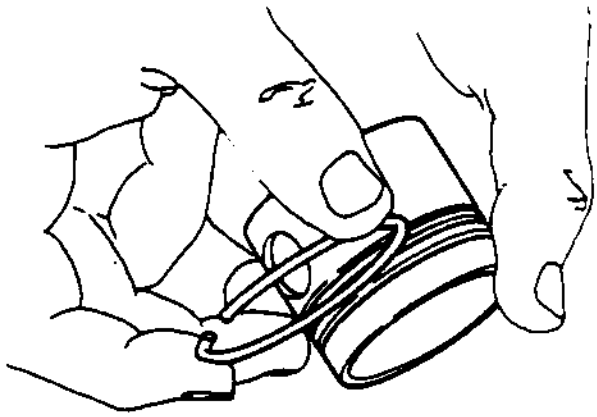


Figure 38—Checking Piston Ring Groove Clearance

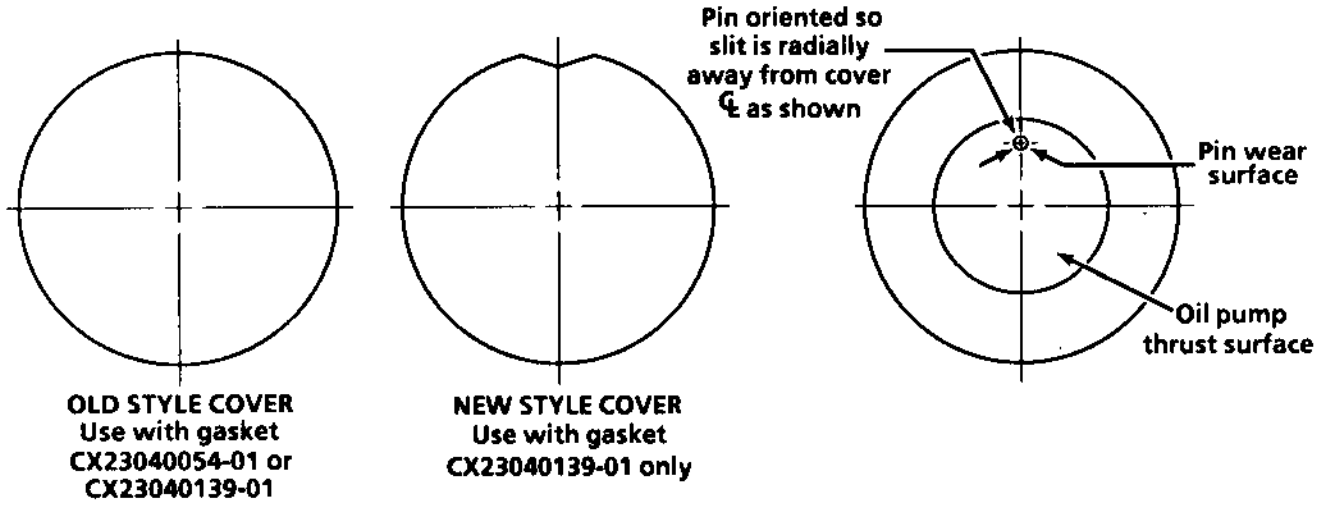
Compressor Assembly

NOTE: Before assembling the compressor, coat all parts, except the seal assembly, with clean, new compressor oil to provide initial lubrication and help prevent rusting. Use new O-ring seals and gaskets when assembling the compressor.

Crankshaft and Pump End Bearing Head

Key numbers in the text refer to Figure 5.

1. Press the pump end bearing (11) over the crankshaft making sure the bearing is not cocked. Bearing must be installed with press force exerted on inner race.
2. Press seal end bearing (13) on the crankshaft making sure the bearing is not cocked. Bearing must be installed with press force exerted on inner race.
3. Install a new O-ring (10) on the pump end bearing head (18).



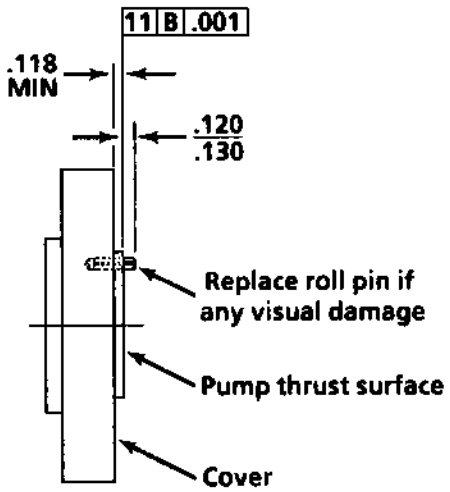


Figure 39 — Checking Cover Plate and Roll Pin for Wear

4. Align the bearing head with outer race of the bearing and tap lightly with a plastic hammer to slide the bearing head over the bearing.

5. Install a new O-ring (10) in groove in the compressor housing. Lubricate bearings (11 and 13), O-rings (10) and the bearing head with clean compressor oil.

6. Grip the pump end bearing head and the crankshaft as shown in Figure 36, then slide the pump end bearing head and crankshaft into the compressor housing. Reach though the handhole cover opening to support the crankshaft.

7. Align the seal end roller bearing (13) squarely with the bearing head and be sure the notch on the pump end bearing head is at the top (Figure 36).

8. Use a soft hammer to start the bearings and pump end bearing head into the compressor housing.

9. Install cap screws (6) in the bearing head (18) and tighten them evenly and alternately to 24 foot-pounds (33 N·m) torque.

Oil Pump

Key numbers in the text refer to Figure 5.

1. Clean and lubricate the oil pump plunger assembly.

2. Install spring assembly, cupped end first, and plunger into the end of the crankshaft. Check to be sure they bottom and that the plunger moves freely with spring compression.

3. Clean and lubricate the oil pump and cover (15). Check to be sure the drive screw on the oil pump is not cracked or damaged.

4. Align drive screw on the oil pump (shown in Figure 40) with the crankshaft slot (shown in Figure 5). Engagement of the drive screw in the crankshaft slot is easier if the slot is at the six o'clock position.

   NOTE: The oil pump will be damaged if the pump drive tab is not correctly positioned.

5. Press/drive a replacement stop roll pin in to the cover plate to a height of .120 in. to .130 in. (Figure 39).

6. Place the gasket (16) on the pump cover (15). Align pin in pump cover with recessed area on face of the pump as shown in Figure 31.

7. Position the pump cover on the bearing head so that the oil holes in the cover align with the two oil holes at bottom of the bearing head.

8. Start two bolts (14) into opposite sides of the cover. Push cover against bearing head by hand and tighten the bolts evenly and alternately until the cover is tight. Install the remaining bolts and tighten to 24 foot-pounds (33 N·m) torque.

Compressor Shaft Seal

NOTE: Check to be sure the seal end bearing is installed with the notch in the bearing head toward the top of the compressor. If notch is not properly positioned, seal cavity will not fill with oil, resulting in poor seal cooling/lubrication with reduced seal life.

1. Lubricate the seal bellows, carbon nose ring and seal surfaces on the crankshaft with clean compressor oil.

2. Clean the face of the cover (5, Figure 5) and matching flange on the bearing head. **Use only lint free wipes.**

   WARNING: Be sure to check for and remove any burrs from the keyway and use a* key sliver *in the keyway to protect the seal drive band from damage as it is moved over the keyway.

3. Hold the seal assembly and slide the seal assembly onto the crankshaft with the carbon washer toward the cover (Figure 43).

4. Lubricate the cover O-ring (4, Figure 5) with clean compressor oil and place it in the O-ring groove.

5. Place the seal over the crankshaft and against the carbon nose ring. Push the seal cover and seal into the compressor until the cover contacts the bearing head mounting flange. Insert and tighten two bolts on opposite sides of the cover hand tight (Figure 44).

   Install remaining bolts and tighten screws in criss-cross pattern in two stages (recommended to minimize possible gland plate warpage and to maximize carbon to plate sealing efficiency). First tighten each bolt to 12 ft-lb (16 N·m) and then tighten again to 24 ft-lb (33 N·m).

Cylinder Unloader

Key numbers in the text refer to Figure 3. Also refer to Figure 23 for disassembled and assembled views of the unloader components.

Lightly polish the unloader piston with a 400 wet or dry sandpaper (used dry).

CAUTION: DO NOT use abrasive coarser than 400 grit. To do so will modify the designed surface finish (to a rougher finish) which will contribute to O-ring gripping/seizing of the piston.

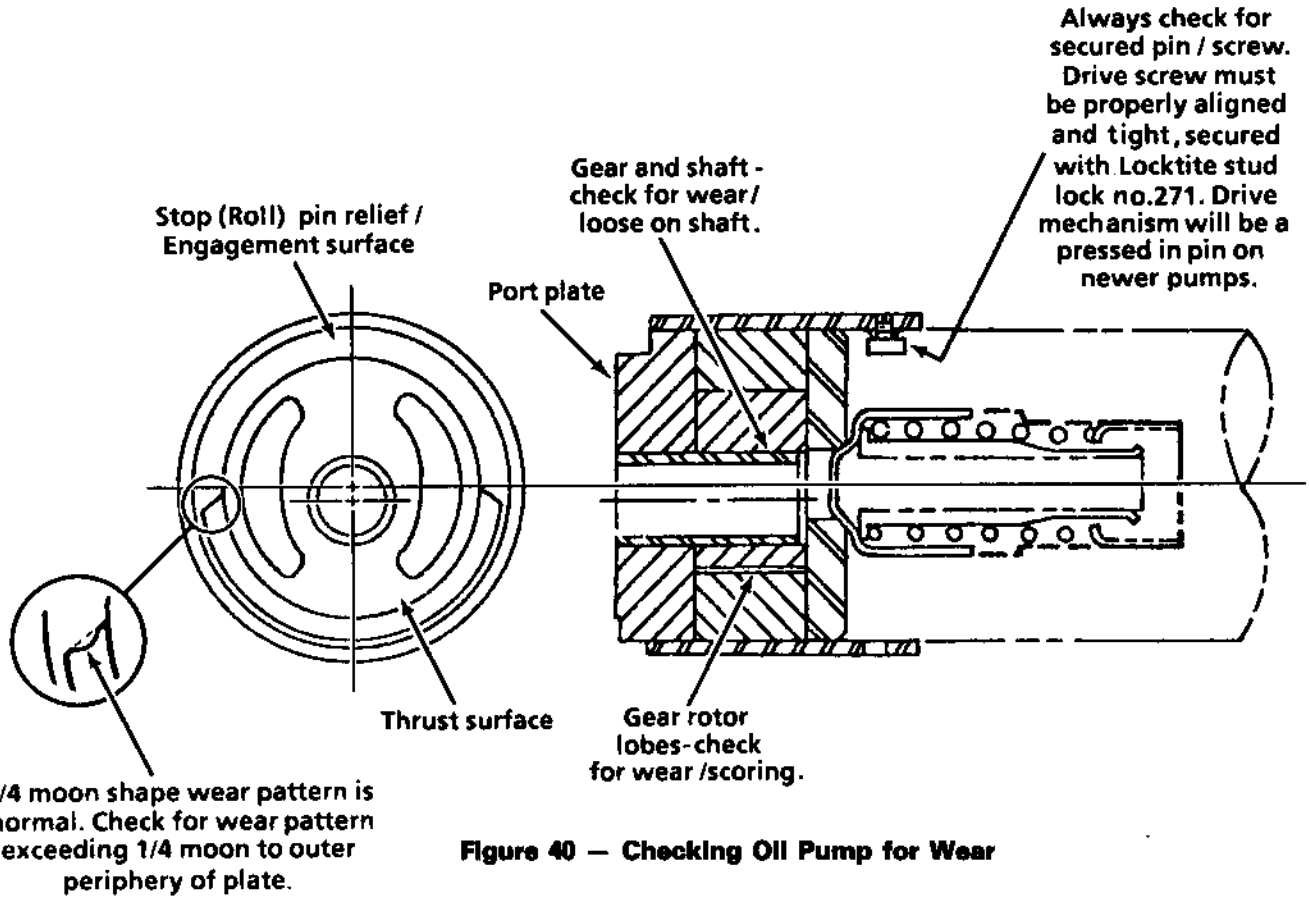
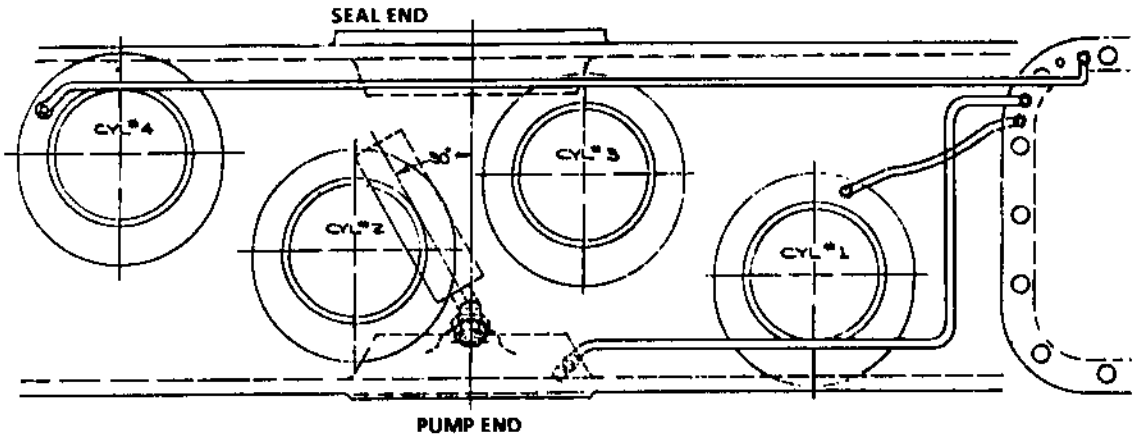


Figure 40 — Checking Oil Pump for Wear



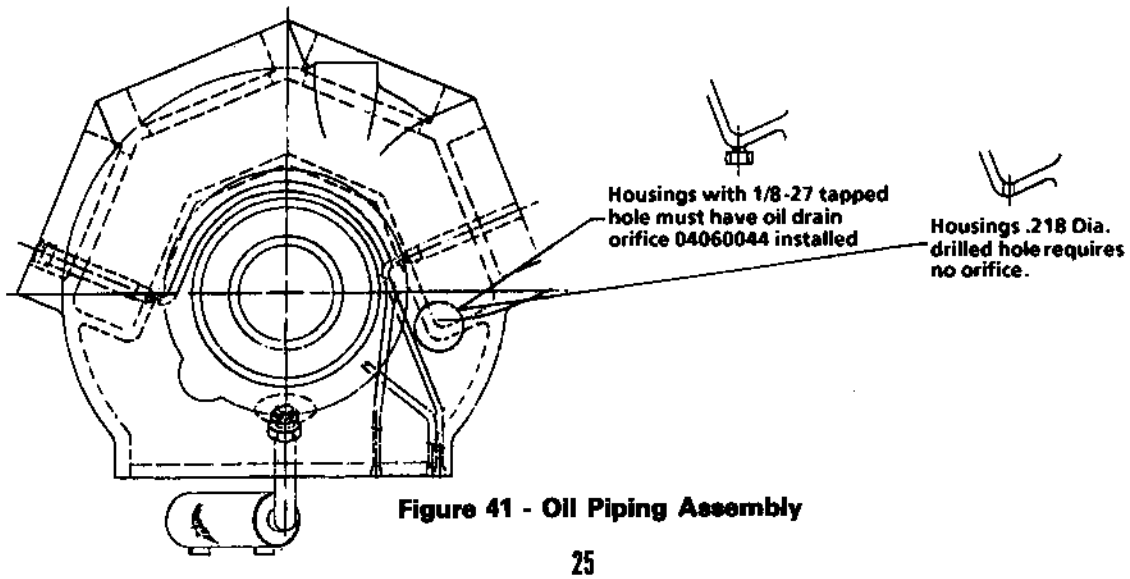


Figure 41 - Oil Piping Assembly

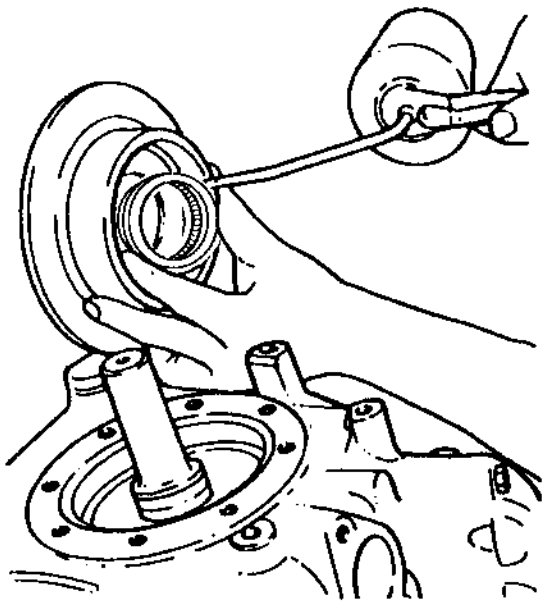


Figure 42—Installing Oil Seal in Seal End Bearing Head

Coat the sliding surfaces of the unloader piston and O-ring with a film of DowCorning Lubricant (881622-41), or equivalent. This is a molybdenum disulfide lubricant which will ensure the O-ring and piston are well lubricated during startup to prevent galling of the piston in the housing bore.

NOTE: Lubrication of the piston to housing aluminum surfaces is extremely important on startup, particularly if compressor is shelved for a long period before usage. If compressor is to be returned to service immediately after service, compressor oil should provide adequate lubrication.

Assemble O-rings (23 and 24), retaining ring (25) and O-ring retainer (22) with lower retaining ring down. Slide the assembly over unloader piston (26) seating it against the piston shoulder. Position the complete assembly with piston spring (27) down into the cylinder housing.

Using Tool L-75084-C (see Figure 45), compress the piston-retainer assembly against spring in housing bore. With snap ring pliers, secure the components in place with retaining ring (21).

NOTE: Use of Tool #L-75084-C in place of screwdriver and snap pliers provides for easier piston assembly installation and prevents damage to critical piston surfaces.

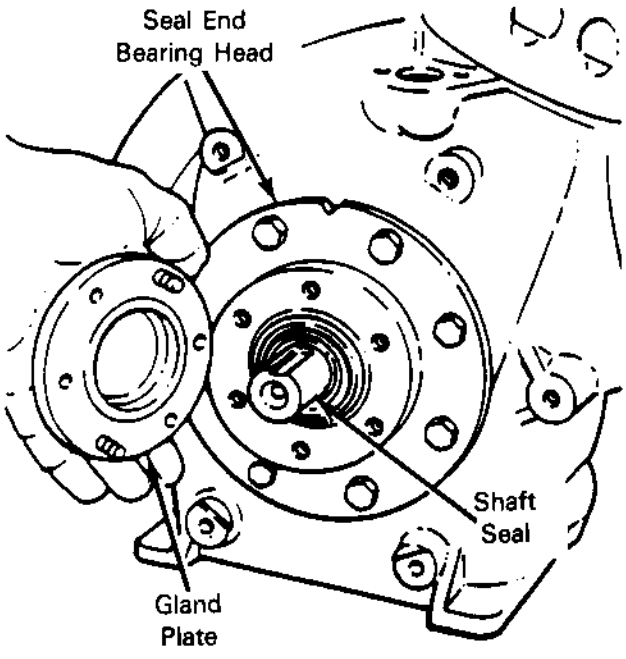


Figure 43 - Shaft Seal Positioned in Seal End Bearing Head

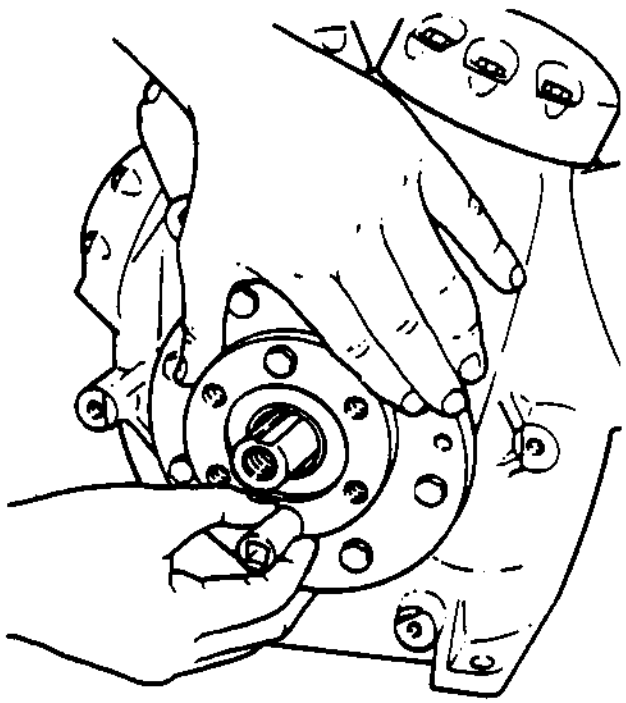


Figure 44 - Installing Shaft Seal Cover

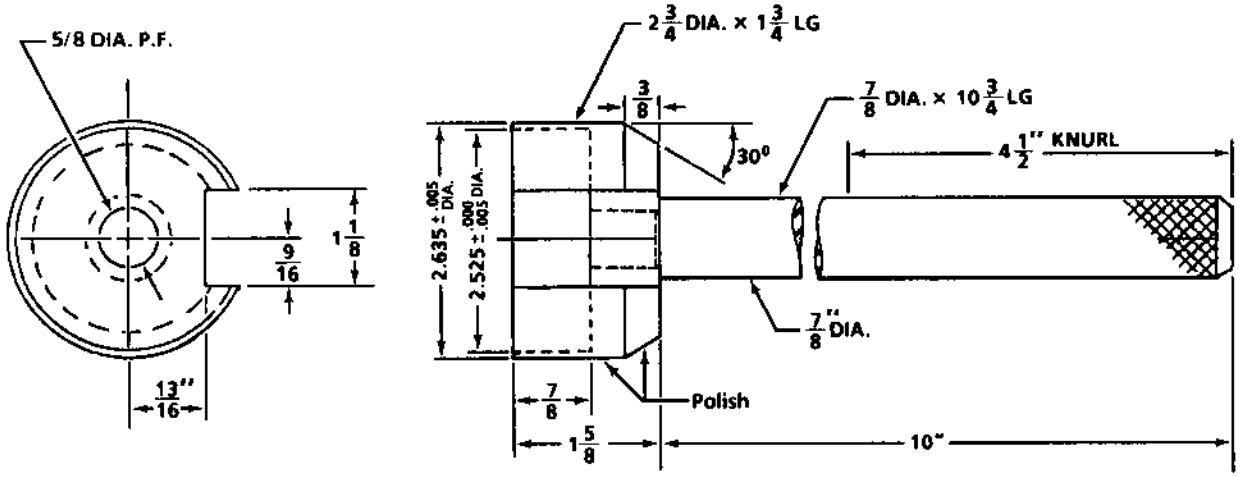


Figure 45 - Piston Assembly Tool

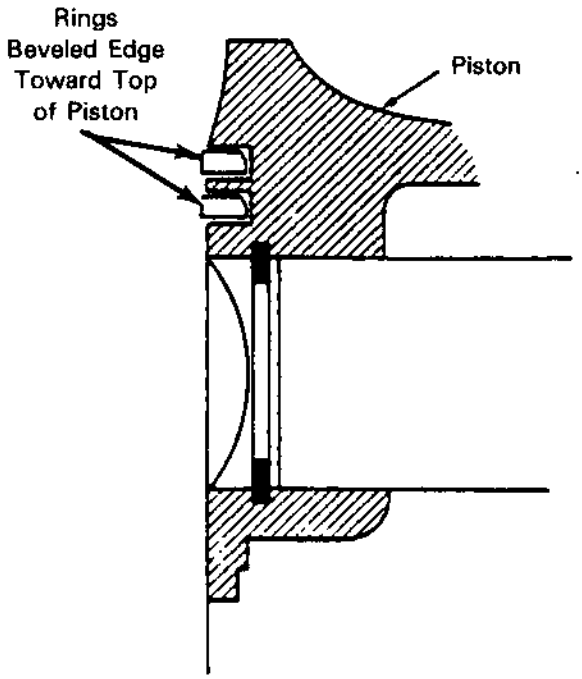


Figure 46 - Ring Position in Piston

Piston, Rings and Connecting Rod

Key numbers in the text refer to Figure 3.

1. Clean bearing surfaces on the connecting rod and crankshaft. Lubricate these surfaces with clean compressor oil.
2. Position connecting rod (31) in piston (30). Hand push the wrist pin through the piston and rod. Install two retaining rings (29) using Tru-Arc pliers.
3. Work the rings (28) carefully over the top of the piston with the beveled edge toward the top of the piston until the rings are in their respective grooves. A piece of shim stock will aid in moving the rings into position. Check to be sure the beveled edge of the rings are on top as shown in Figure 46 and that the rings are free in the grooves after installing.

Suction Valve, Liner and Unloader Mechanism

Key numbers in the text refer to Figure 3.

1. Place O-ring (12) in outer groove of valve plate (14) as shown in Figure 47.

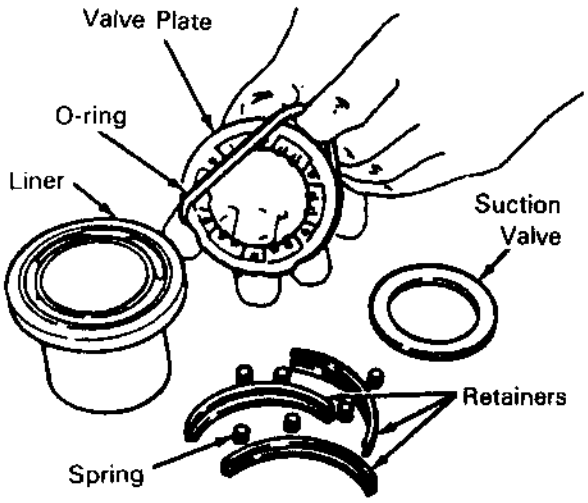


Figure 47 - Suction Valve Components Cylinders 1 & 4

2. a. For Cylinders 1 and 4 Only—Place six small valve springs (15) into the spring pockets in the valve plate, then place suction valve (16) over springs as shown in Figure 22.

   b. Cylinders 2 and 3 Only—Place suction valve ring (16) in valve plate register (Figure 48.).

3. Set the liner down over suction valve (Figure 49) engaging cylinder valve seats with valve plate pilots and install the 120-degree retainers (13).

   NOTE: Retainers may be formed and crimped to fit snugly so as to secure valve to liner.

4. Work suction valve (16) to make sure it is not restricted or pinched within the assembly (Figure 50).

5. On Unloader Cylinders 1 and 4 equipped with spring operated valves, insert lift pins (19) with springs (18) as shown in Figure 51. Push take-up ring (20) down over the liner until it is engaged in the lift pin relief area, securing the lift pins (Figure 52). Work the take-up ring and lift pins up and down to be sure they are free to move and can raise and lower the suction valve (16).

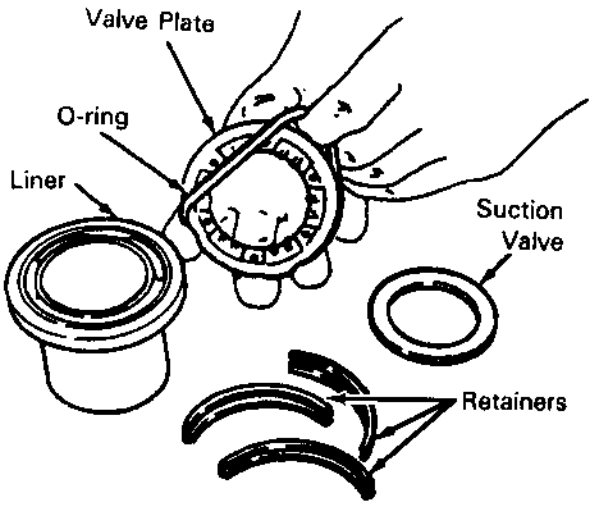


Figure 48 - Suction Valve Components Cylinders 2 & 3

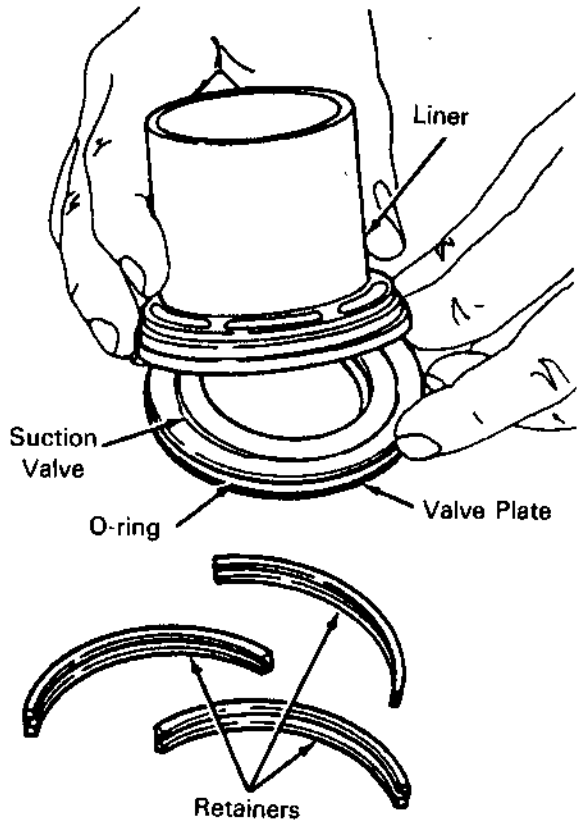


Figure 49 - Positioning Liner on Suction Valve

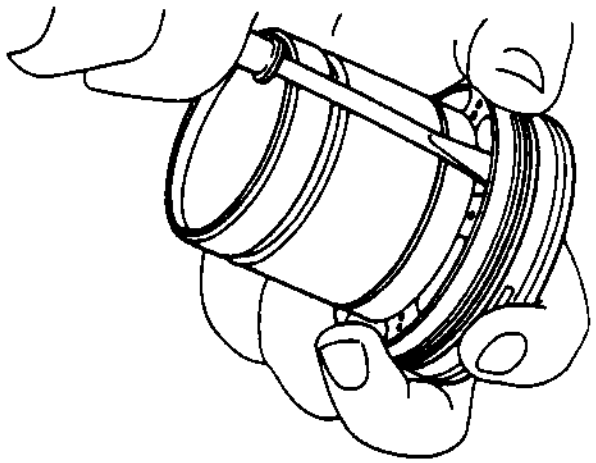
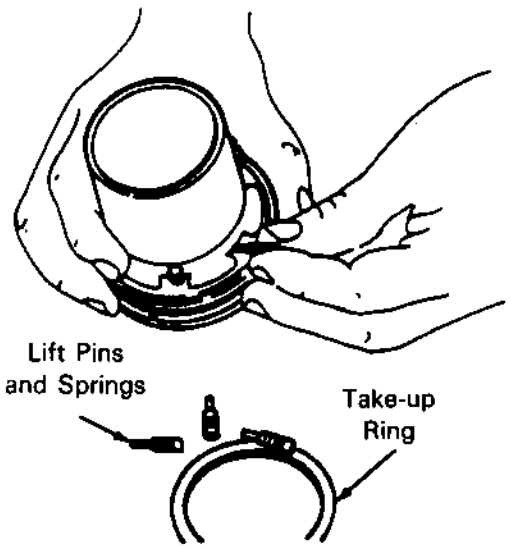


Figure 50—Checking Suction Valve Movement

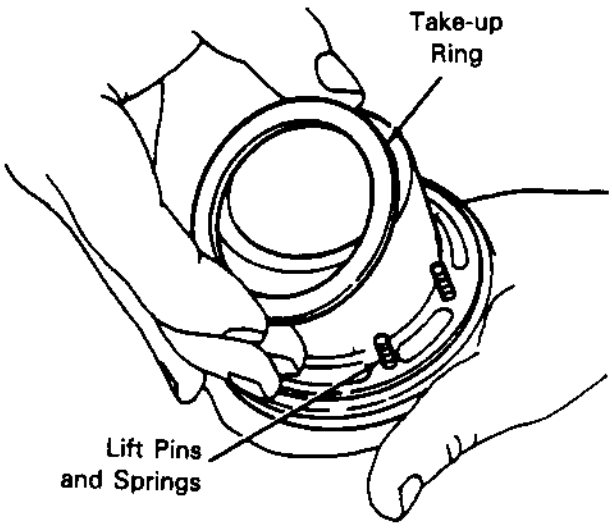
Connecting Rod, Piston and Liner

Key numbers in the text refer to Figure 3.

1. Clean bearing surfaces on the connecting rod, rod cap and crankshaft, then lubricate the piston and rings bearing surfaces with clean compressor oil.
2. Invert the cylinder liner and suction valve assembly on a soft surface. Stagger the piston ring gaps.
3. Work the piston head and rings down into the liner with a rocking motion (Figure 53). The inside edge of the liner skirt is tapered to assist the entry of the piston and rings.



Installing Lift Pins



Installing Take-up Ring

Figure 51—Installing Take-up Ring and Lift Pins

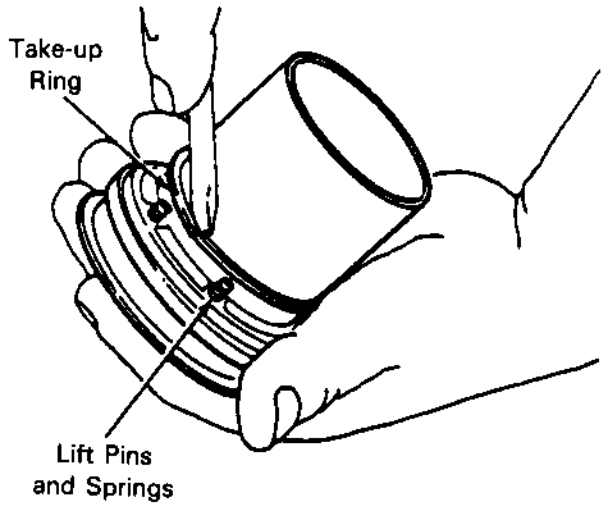


Figure 52—Installing Take-up Ring on Liner

4. After both rings have entered the liner, push the piston down until the top of the piston is even with the top of suction valve plate (14).

   NOTE: Each connecting rod and cap assembly has two matched marks which identify them as a matched unit. The cap and rod also have a chamfer which matches the fillet on the crankshaft journal. Be sure the chamfer matches the fillet.

5. Rotate the crankshaft until the journal is in position below the cylinder opening. Since there are two rods on each journal of the crankshaft, the rods must be installed with the flat surface upon which the match marks are stamped toward the inside or facing each other as shown in Figure 54. Lubricate the O-ring and then push the liner and connecting rod asembly down into the cylinder. Guide the rod by reaching through the handhole cover opening and make sure it seats properly on the crankshaft.

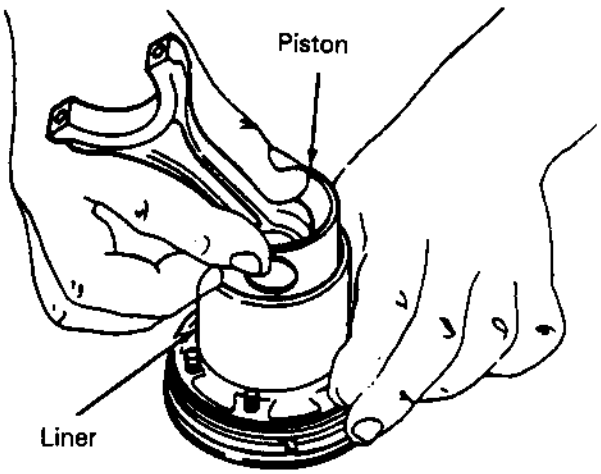


Figure 53—Installing Piston Assembly in Liner

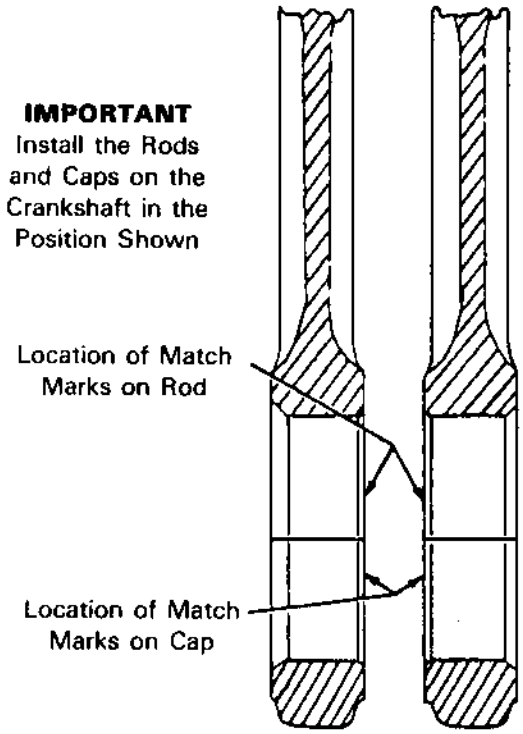


Figure 54—Match Marks on Connecting Rods

6. Press the liner and suction valve assembly all the way into the cylinder opening, then place the rod cap in position (chamfer to fillet) and install the rod bolts and new lock strap (32). Tighten the bolts to 6 foot-pounds (8 N·m) torque, then bend up tabs on the lock strap against heads of the bolts.

7. Rotate the crankshaft to be sure the rod is free and does not bind. Repeat the procedure as each rod is installed. Overtightening the connecting rod and cap bolts will distort the cap.

Discharge Valve and Cylinder Head

Key numbers in the text refer to Figure 3.

1. Place discharge valve assembly over piston (Figure 15).
2. Center safety head spring (5) on discharge valve assembly as shown in Figure 15.
3. Insert two cylinder head attaching bolts (1) with washers (2), on opposite sides, in cylinder head (3). Apply clean compressor oil to head gasket (4), the place gasket on the heads using the bolts as a guide.
4. Place the cylinder head with two bolts (two or three turns). Check to be sure the safety head spring (5) is properly positioned.
5. Tighten both cylinder head bolts (Figure 14) alternately to draw the head down evenly. Insert the remaining bolts and washers. Tighten all cylinder head bolts to 24 foot-pounds (33 N·m) torque.

Oil Strainer

Position oil strainer in the compressor housing 30° from center line as shown in Figure 41. Connect the strainer tube and tighten the compression fitting firmly (Figure 25).

Handhole Cover Unit

Key numbers in the text refer to Figure 4.

1. Place plunger (8), bellows (9), upper spring seat (10), sleeve (13), spring (11), and spring seat (12) in handhole cover (2). Place O-ring (14) over the bellows. Figure 24 shows the components installed.
2. Check fit of flow control piston (actuator) in handhole cover bore. Piston must operate freely along the full length of the bore. Lubricate and install piston (25) in the bore. Install detent balls (24), springs (23), screws (22) and plugs. See Figures 23 and 24 (view B-B). Install the bracket and orifice assembly in the same housing.
3. Place small strainer screen (7) into place in the handhole cover.

4. Make sure the flow control valve and spring (Figure 24) are in position, then install distributor cover (15) and a new cover gasket (14). Tighten four cover bolts (16) with washer (5) loosely at this time.

5. Apply clean compressor oil to the handhole cover gasket (1), then install gasket and handhole cover (2) to the housing. Install attaching bolts with washers finger tight, then tighten all bolts (4, 6, 16 and 20) evenly to 24 foot-pounds (33 N·m) torque.

Refrigerant Strainer Screen, Suction and Discharge Valve

Key numbers in the text refer to Figure 2.

1. Insert strainer screen (7) down into the suction valve port (Figure 55).

2. Using new valve gaskets (3 and 6), install bolts (1 and 4) to attach the suction and discharge valve to the compressor. Tighten the discharge valve bolts to 24 ft-lb (33 N·m) torque and tighten the suction valve bolts to 45 ft-lb (62 N·m) torque.

   WARNING: Take care to draw down the suction valve bolts evenly. Failure to do so will cock valve, causing leaks and possible housing damage.

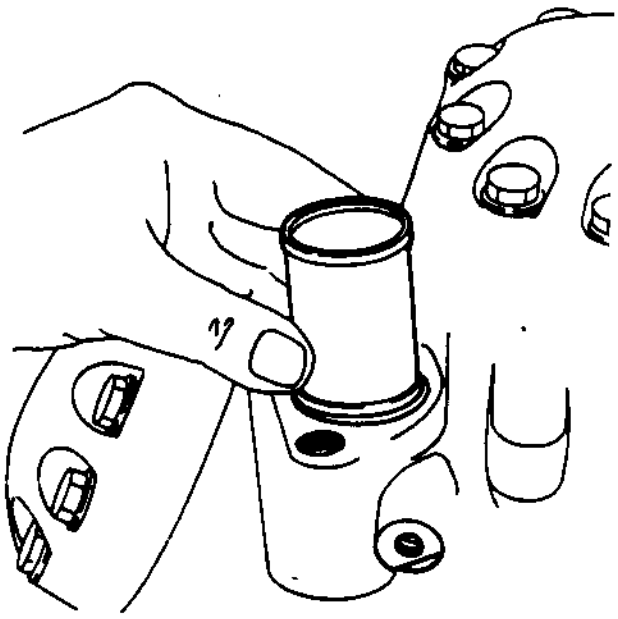


Figure 55 - Installing Suction Strainer Screen

Clutch Coil, Pulley and Damper

Key numbers in the text refer to Figure 1.

1. Remove grease and dirt from the crankshaft and clutch mating taper using an air drying compound such as trichlorethylene, trichlorethane, perchloroethylene, MED, acetone, alcohol. DO NOT use kerosene, gasoline, napha, fuel, oil, Varsol, or Stoddard solvents since they leave an oily film on the surface.

2. Apply a thin film of Loctite (RC 620) or equivalent to the clutch and crankshaft engagement areas. DO NOT apply the compound to bolt threads, the key or keyway. Allow the Loctite to cure for a minimum of one hour at room temperature before operating the clutch.

3. Insert a drive key (1) into slot in compressor crankshaft.

4. Position clutch coil (2) on the compressor and install retainer (11), washer (10) and bolts (9). Tighten the bolts to 24 ft-lb (33 N·m) using a hand torque wrench.

5. Position drive pulley (3) on the crankshaft. Install bolt (7) with washer (8) to attach the clutch to the compressor crankshaft. Tighten the bolt to 25 ft-lb (34 N·m) torque.

   NOTE: If the bolt is tightened too tightly, the inner race of the clutch bearing will be expanded.

6. Check the clutch bearing to assure an acceptable bearing drag.

   a. Attach an 11.70 oz. (330 gram) weight to a string and wind the string around the pulley groove.

   b. Gently start rotation of the pulley. If the pulley continues to rotate due to weight, the bearing clearance is adequate. If rotation stops, clearance is insufficient. The clutch assembly should be replaced to prevent excessive bearing wear.

7. Position damper (4) on the pulley and install bolts (6) with washers (5) to attach the damper to the pulley. Tighten the mounting bolts to 60 to 90 inch pounds (.7 to 1 kgm) torque.

8. Connect clutch coil wiring connector to the harness connector.

Oil Pipe Replacement

When a compressor experiences severe mechanical failure, it may be necessary to repair or replace the internal oil lines. When replacing oil lines, the following instructions should be used (see Figures 56, 57 and 58 for piping layouts and Figure 59 for tools used).

1. Remove old piping.
   a. To remove old piping, cut pipe next to housing and use a drift punch to drive the pipe/bushing through the drilling.
2. From the tubing. Use tube bender to keep tube straight. This will ease tube installation into housing hole.
   a. Form the new tubing according to the Figure provided for each compressor.
   b. Cut all tubing with a saw to avoid hardening.
3. Install the tubing.
   a. See Figures 46, 57 or 58 for proper sequence of installation.
   b. Insert the formed lines into the proper holes in the housing and extend them approximately 1/8 inch beyond the point where the 45 degree bevel starts as shown in Figure 60a.
   c. Keep all tubing away from moving parts.
   d. Be sure all lines will clear the capacity control actuator when the handhole cover is installed.
4. Preflare the tubing.
   a. Insert the preflaring tool into the tubing and, with a rotary motion (use slow speed drill motor) of the tool, expand the tubing enough to prevent it from being driven out of the housing during the actual flaring operation. See Figure 60b.
5. Finish flare the tubing.
   a. Select "Flaring Tool."
   b. Drive the tool into the preflared tubing to form a 45 degree flare of the tubing against the housing body. See Figure 60c.
6. Install the bushings.
   a. Select the bushing driver for installing the bushings.
   b. Insert the bushing into the housing or place it on the end of the tool and seat it against the flared tubing by driving it with the tool. See Figure 60d.
7. Stake the bushings.
   a. Select the "Bushing Expander."
   b. Insert the bushing expander into the bushing bore and strike moderately expanding the bushing into the housing bore. See Figure 60e.

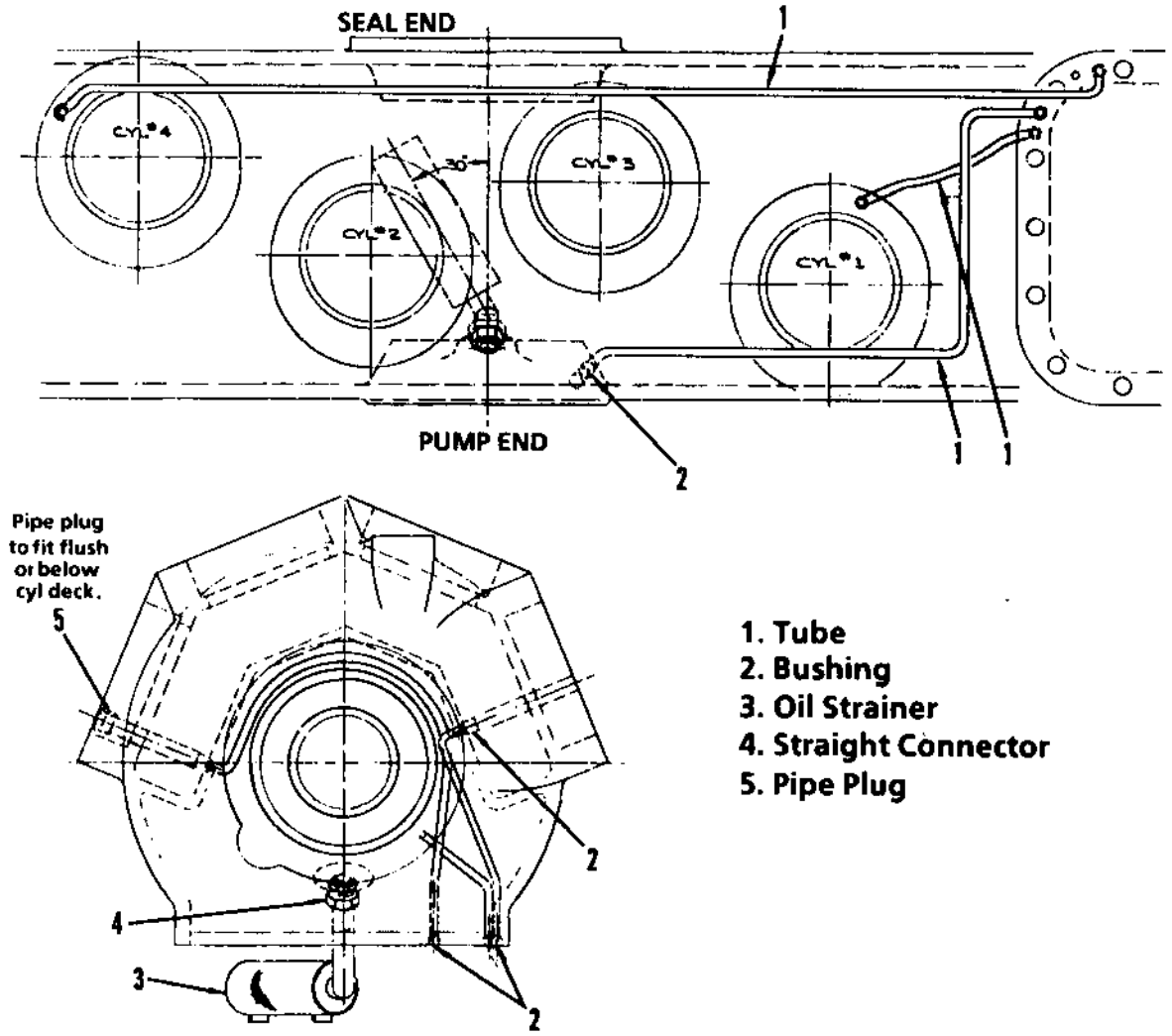


Figure 56 - Suction Sensing Oil Piping

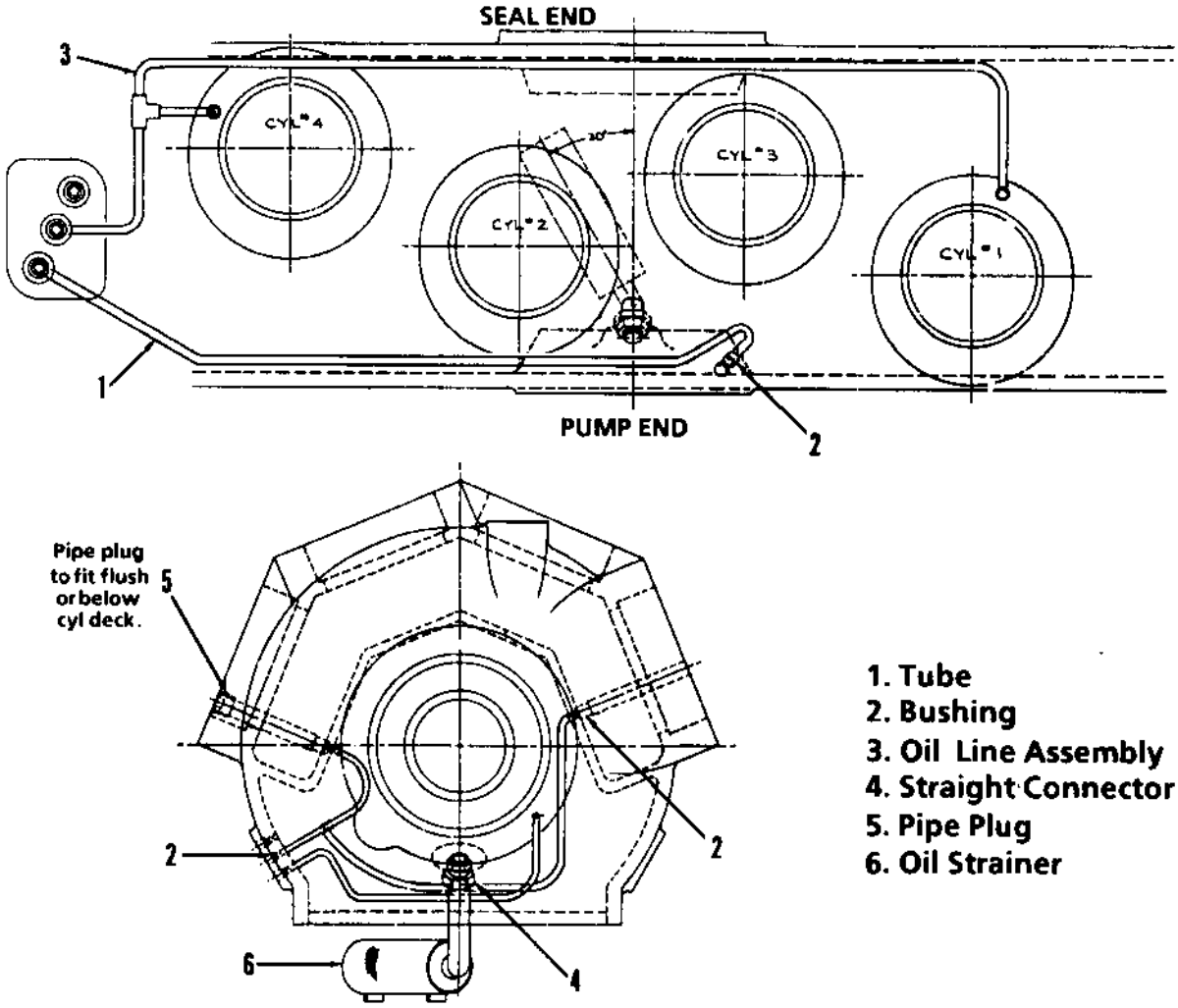


Figure 67 - Solenoid Unloading Oil Piping

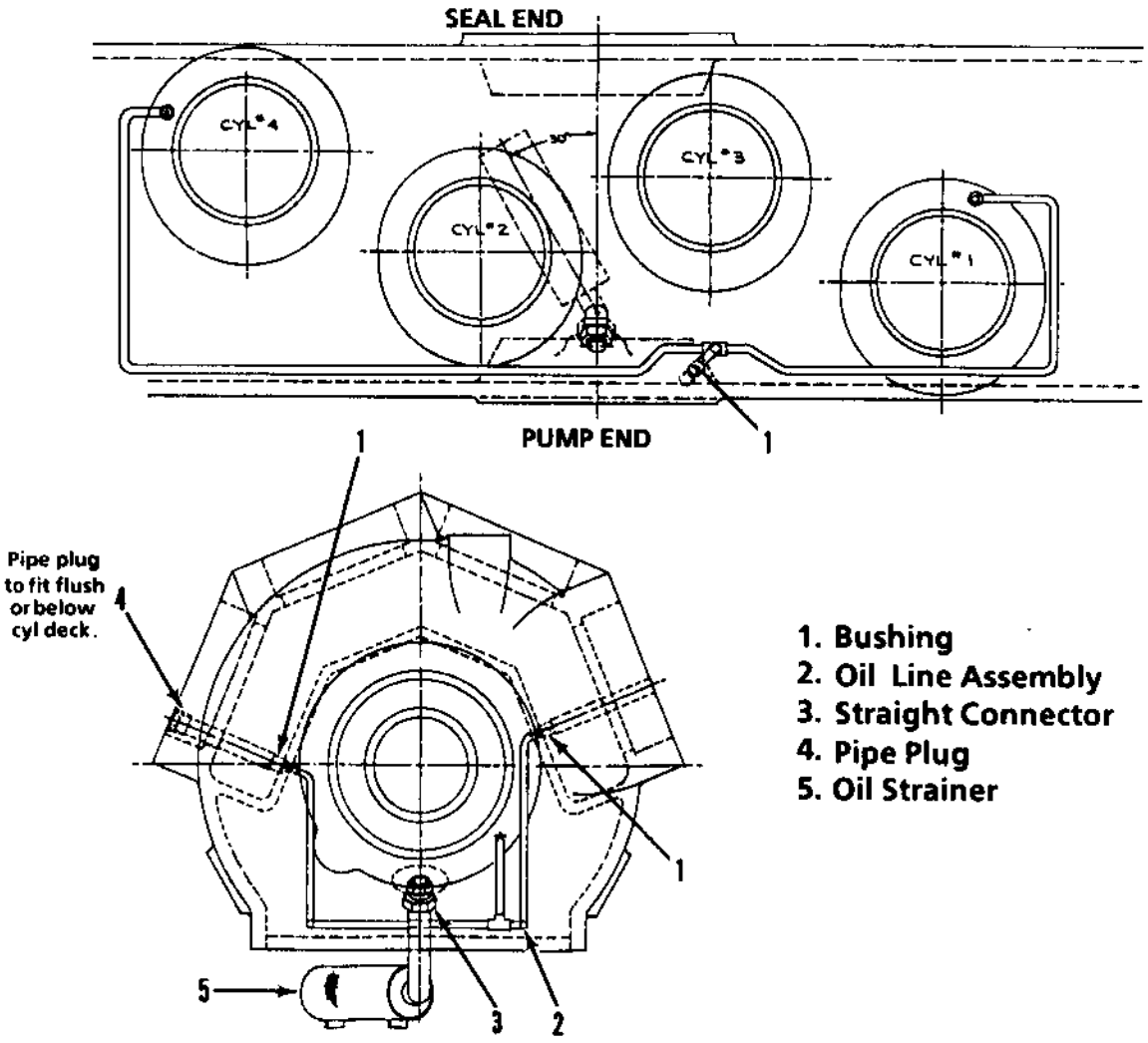
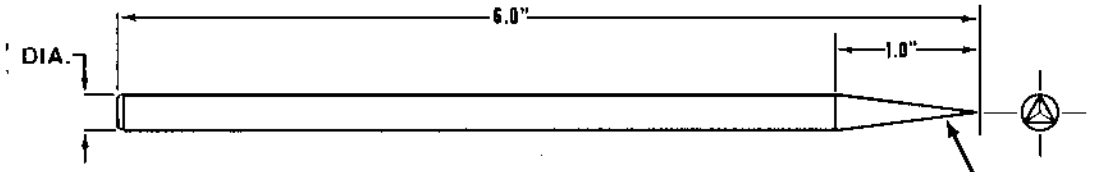
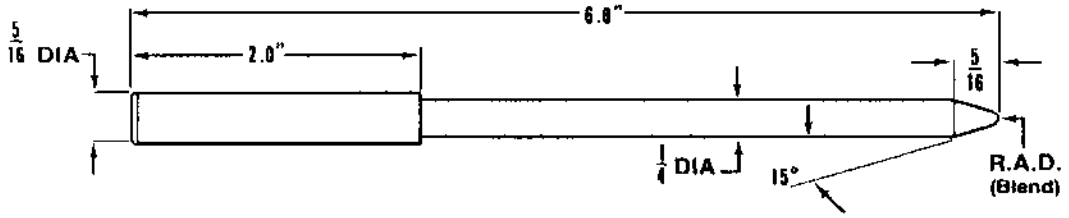


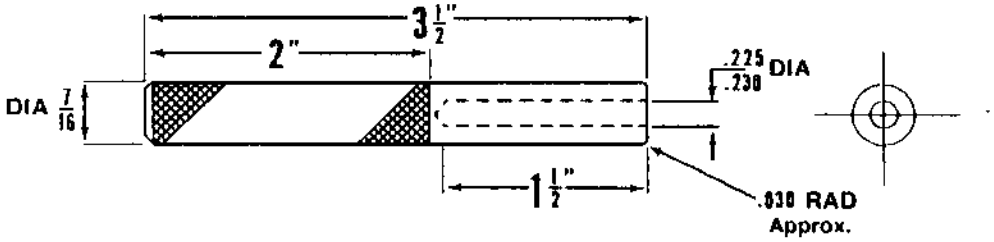
Figure 58 - Non-Unloading Oil Piping



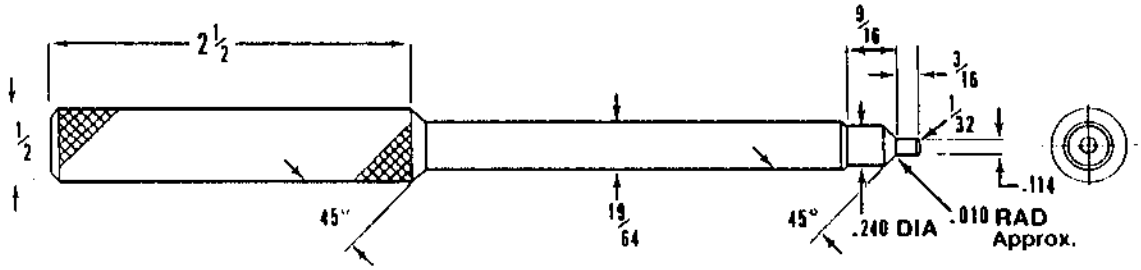
PRE - FLARING TOOL HDN 38-40 Rc
HY - TEN - B3X



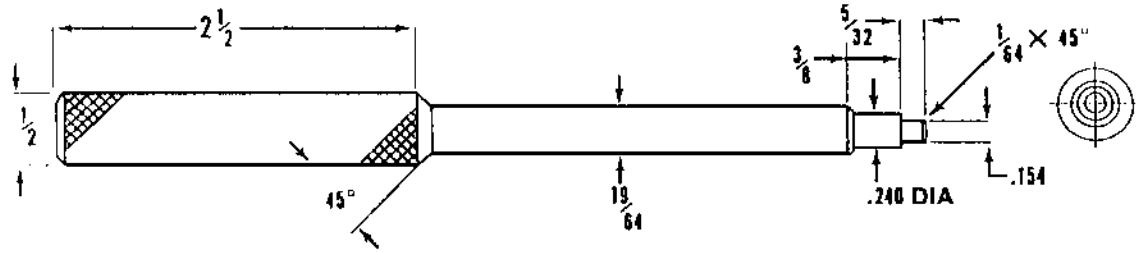
BUSHING EXPANDER HDN R/C 38-40



TUBE BENDER HDN R/C 38-40



HY TEN B-3X HDN TO ROCK C" 38-40 & GR
FLARING TOOL $^{3}/_{16}$ TUBE × .035 WALL



HY TEN B-3X HDN TO ROCK C" 38-40 & GR
BUSHING DRIVER

Figure 59 - Oil Piping Replacement Tools

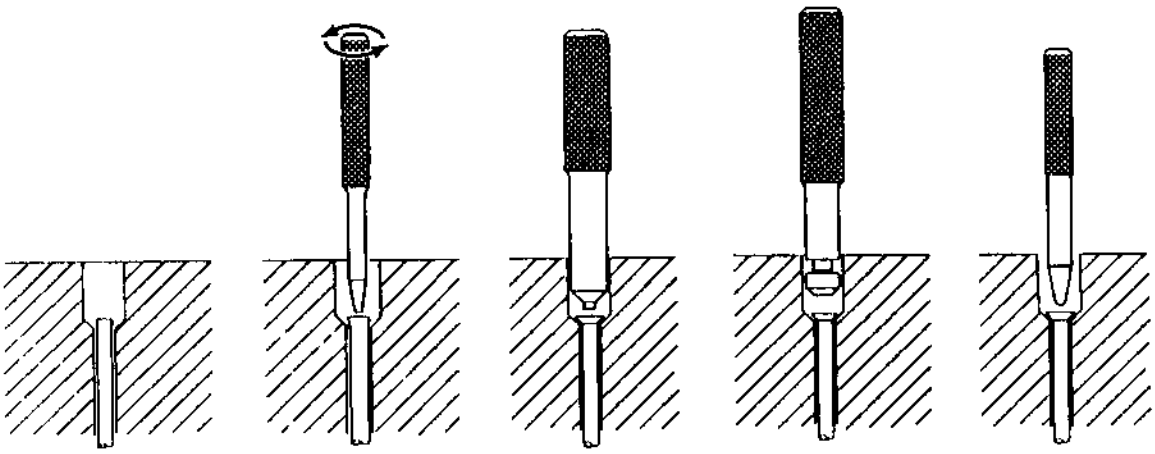


Figure 60A Figure 60B Figure 60C Figure 60D Figure 60E

Figure 60 - Installation of Oil Piping

Compressor Torque Specifications

Item	Torque (Foot Pounds)
Cylinder Head Bolts (3/8"-16 x 1-3/4")	24 (33 N·m)
Discharge Valve Cage Bolts (3/8" -24)	24 (33 N·m)
Handhole Cover bolts:	
(3/8" -16 x 3-1/4")	24 (33 N·m)
3/8" -16 x 2-1/2")	24 (33 N·m)
(3/8" 16 x 1-1/4")	24 (33 N·m)
Suction Service Valve Bolt	
(1/2" -13 x 2")	45 (62 N·m)
Actuator Cover Bolts (3/8" -16 x 1-1/4")	24 (33 N·m)
Connecting Rod Bolts (1/4" -20 x 1-1/2")	6 (8 N·m)
Oil Pump Bolts (5/16" -18)	14 (19 N·m)
Seal End Cover Bolts (3/8" -16 x 3/4")(3/8" -16 x 3/4")	First to 12 (16 N·m), then 24 (33 N·m)
Seal & Pump End Bearing Head Bolts (3/8" -16 x 1")	24 (33 N·m)
Discharge Service Valve Bolts (3/8" -16)	24 (33 N·m)
Sight Glass Bolts (1/4" -20)	50 Inch Pounds (.6 kgm)
Compressor Clutch to Crankshaft Bolt (1)	25 (34 N·m)
Compressor Damper Bolts (6)	60-90 Inch Pounds (.7 to 1 kgm)
Compressor Mounting Bracket Bolts (4)	30 (41 N·m)
Compressor to Support Bolts (1)	35 to 45 (48 to 61 N·m)
Compressor to Support Bolts (3)	23 to 30 (31.2 to 41 N·m)
Compressor Pivot Shaft Cap Bolt Nut (1)	35 to 45 (48 to 61 N·m)
Compressor Adjusting Arm Bolt (1)	50 to 60 (68 to 81 N·m)
Adjusting Turnbuckle Rod End Jam Nuts (2)	40 to 50 (54 to 68 N·m)
Adjusting Turnbuckle Rod End Mounting Bolt (1)	50 to 60 (68 to 81 N·m)
Compressor Drive Pulley Nut	250 to 275 (339 to 372 N·m)

Operational Specifications

Oil Pressure

Condition	Min.	Max.	RPM	Rotation
Worn (Hot)	35 psig		800-1750	CW & CCW
New/Rebuilt (Hot)	70 psig		810	CW & CCW
New/Rebuilt (Hot)		110 psig	1750	CW & CCW

Unloading

	Cylinder	Suction Pressure	Refrigerant
Suction Sensing Control	#4 (1st to Unload)	55 psig*	R-22
	#1 (2nd to Unload)	53 psig*	R-22
Electric Solenoid	#1 & 4	55 psig*	R-22

**See Specific System Specs for actual unloading setpoint.*

Recommended Wear Limits and Tolerances

Part Name	Original Specification		Recommended Limit		Recommended Maximum Oil Clearance	
	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters
Connecting Rod Crankpin	1.5000" - 1.5005"	38.1-3.8112	1.0530"	26.7462 Max.	0.007"	.1778
Crankshaft Crankpin	1.4985" - 1.4985"	38.0619-38.0619	1.4955"	37.9857 Min.		
Piston Pin	0.7497" - 0.7495"	19.0424-19.0424	.7490	19.0246 Min.	0.0011"	.0279
Connecting Rod Pin Bore	.7500" - .7503"	19.0500-19.0576	.7510"	19.0754 Max.		
Cylinder Liner	2.1250" - 2.1255"		2.1270"	54.0258 Max.		
Piston (Skirt Diameter)	2.1210" - 2.1205"	53.8734-53.8607	2.1190"	53.8226 Min.		
Piston Rings (Gap in 2.1250 Gauge)	0.003" - 0.008"	.0762-.2032	0.030"	Compression Rings		
Unloader Piston (Coil Spring Design)—Before March 1985						
Large Diameter	3.060-3.061		3.059			
Small Diameter	2.497-2.501		2.496			
Unloader Piston (Wave Washer Spring)—After April 1985 (J5C15L119)						
Large Diameter	3.058-3.059		3.057			
Small Diameter	2.497-2.501		2.496			
Suction Sensing Springs	1.095-1.080	27.8130-27.4320				
Valves—Suction						
Before May 1978	0.026-0.028 thick			0.005 Maximum Wear Depth*		
After May 1978 (J8E1502933)	0.030-0.032 thick			0.005 Maximum Wear Depth*		
Valves—Discharge	0.033-0.035 thick			0.005 Maximum Wear Depth*		
Valve Springs (All)	Whenever the compressor is disassembled for servicing, the valve springs should be replaced if the compressor has operated in excess of 5000 hours.					
Unloader Piston Spring						
Wave Washer Design	.073 Free Length					
Wire Coil Design	1.06 Free Length					
Cylinder Head Springs	1.613" - 1.573"	40.9702-39.9542 Free Length				
Unloader Lift Pin Springs	0.300" - 0.310"	7.6000-7.8740 Free Length				
Unloader Lift Pin Length	0.879-0.890					
Suction Sensing Spring (Bellows)	1.095" - 1.080"	27.8130-27.4320 Free Length				
Control Piston Spring	1.64 Free Length					
Shaft Seal	Replace when leaking or when compressor is overhauled.					
Piston (Flow Control Valve)	0.8115-0.8120		0.811		0.002	
Cylinder Bore (Flow Control Valve)	0.08125-0.8130					

NOTE 1: The above recommended wear limits are for individual parts. For mating parts, the maximum recommended oil clearance should predominate. In most cases, this means that each mating part should not be at the recommended limit.

NOTE 2: The above recommended limits are listed as good practice for normal service rebuilding of compressors which will be reliable when returned to service. It is not necessary to rebuild a compressor when these limits are anticipated.

*** Replace valve when seat groove wear depth exceeds 0.005 in. Valve may be used on both sides.***

APPENDIX A

Suction Actuator Controlled Unloader Operation And Testing/Adjusting Procedure

Cylinder Unloaders

(Figure A-1) Considering the pressure actuated unloaders first, a bellows assembly senses suction pressure from a location within the compressor crankcase. It responds to changes in suction pressure by operating a valving mechanism that either feeds pressurized oil to the cylinder unloader to load the cylinder or bleeds oil from the unloader to unload the cylinder.

In operation, sensing a rising suction pressure, indicating a rising system load, the bellows (B), within the sensing device (A), contracts. This is brought about by the atmospheric pressure, plus the pressure exerted by the adjustment spring within the bellows, being overcome by the rising suction pressure.

The contracting bellows causes the rod (C) to rise, moving it close to the oil bleed port of the valving mechanism (D).

Pressurized oil is fed into the valving mechanism by the compressor lubrication oil pump. Since the bypass of oil through the bleed port is being retarded by the valving rod, pressure is developed under the piston (E), forcing it upward.

As the valving rod moves closer to the bleed port, more and more pressure is developed under the piston, forcing it upward to load additional cylinders. Notice that the movement of the piston is limited to definite steps by a spring-loaded ball. This provides positive steps of cylinder loading.

As the oil from the valving mechanism enters the cylinder unloader (F), it forces the unloader piston (G) downward. The downward movement of the piston draws the piston pins away from the lower side of the cylinder suction valve, allowing the valve to seat normally. The cylinder is loaded.

(Figure A-2) A falling suction pressure produces the opposite action. Atmospheric pressure, plus the pressure exerted by the adjustment spring within the bellows (B), overcome the opposing suction pressure causing the bellows to expand. The expanding bellows moves the valving rod (C) away from the oil bleed port. The pressurized oil is now diverted directly back to the crankcase.

Since pressure cannot develop under the piston (E), it moves to its downward position. In this position, it valves-off oil from the unloader and allows oil within the unloader to flow back to the crankcase through the bleed line. With the oil pressure within the cylinder unloader relieved, the piston (G) is moved upward by springs. This causes the piston pins to raise the suction valve off of its seat, preventing this cylinder from pumping gas. This cylinder is unloaded.

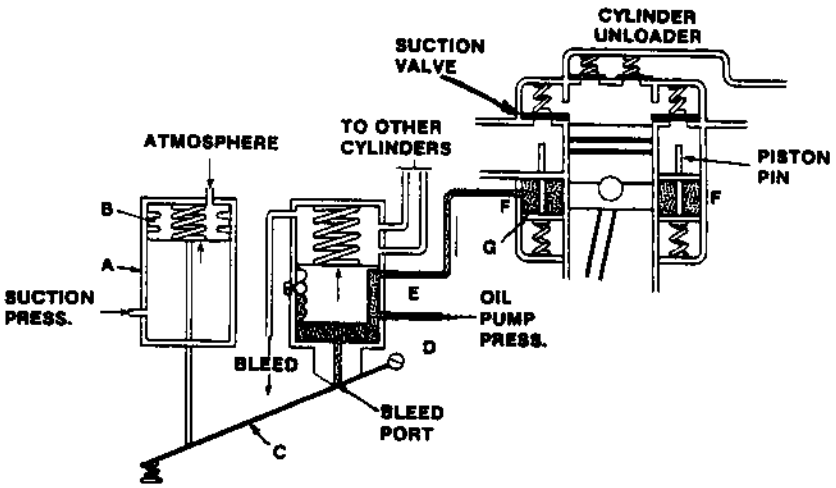


Figure A-1

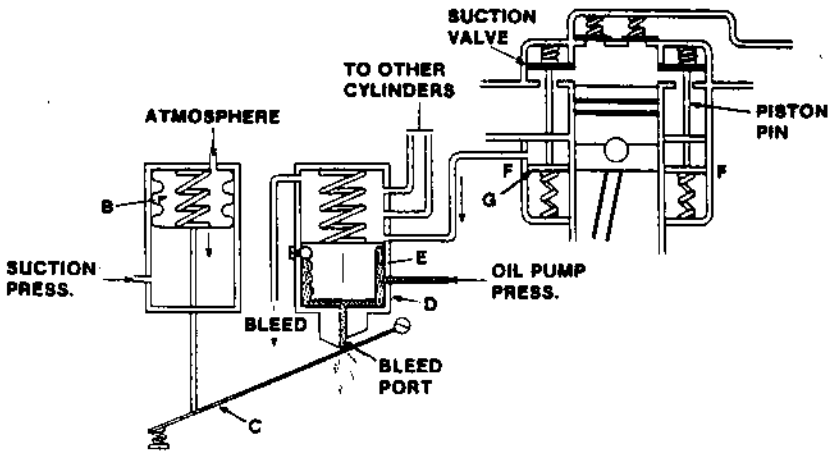


Figure A-2

Compressor Unloader Operation

CHECKING COMPRESSOR UNLOADING SETTING (ON COACH)

Two cylinders of compressor are permanently loaded and two unload individually in two-pound steps when refrigerant suction pressure lowers to 55 pounds. This function can be checked by observing suction pressure as follows:

1. Install test gauge low pressure line to low pressure test gauge service fitting.
2. Operate coach air conditioning system until reheat system is operating normally (approximately 75.0 F).
3. With four cylinders loaded as engine speed is gradually increased, suction pressure should drop down to approximately 55 pounds, then fluctate and raise to 57 to 60 pounds, indicating that No. 1 or outboard cylinder has unloaded.
4. As engine speed is increased further, suction pressure will lower to approximately 53 pounds and suction pressure will again raise rapidly as No. 4 or inboard cylinder has unloaded. Further increase in engine speed will pull suction down. If unloading pressures are off, correction can be made by adjustment at valve located on compressor handhole cover at bottom of compressor. Make adjustment as follows:
   a. Remove access screw from over unloader adjustment screw as shown in Figure A-3.
   b. Turn adjusting screw out or counterclockwise to load up cylinders when they are running unloaded and lower suction pressure point at which cylinders unload. Thus, if all cylinders are loaded below 55 pounds suction, screw should be turned in to unload. If cylinders are unloading above 55 pounds suction, screw should be turned out to load. After making adjustment, install access screw over valve adjustment screw. Tighten screw firmly.
5. If difficulty is encountered in definitely observing unloading on suction gauge, individual gauges can be used to determine performance of each unloader without question. Figure A-4 shows individual gauges installed.

   NOTE: If compressor is not already equipped with check valve connectors at compressor line ports, pump down system and install Schrader valved fittings.

   a. Right gauge is connected to No. 1 cylinder unloader which unloads first. Center gauge is connected to No. 4 cylinder unloader which unloads last. The left gauge registers the compressor oil pump pressure. Gauges will indicate suction pressure plus oil pressure when cylinders are loaded and suction pressure only when unloaded.

   NOTE: Rising and falling suction pressure may also be simulated by modulating flow at liquid line service valve(s).

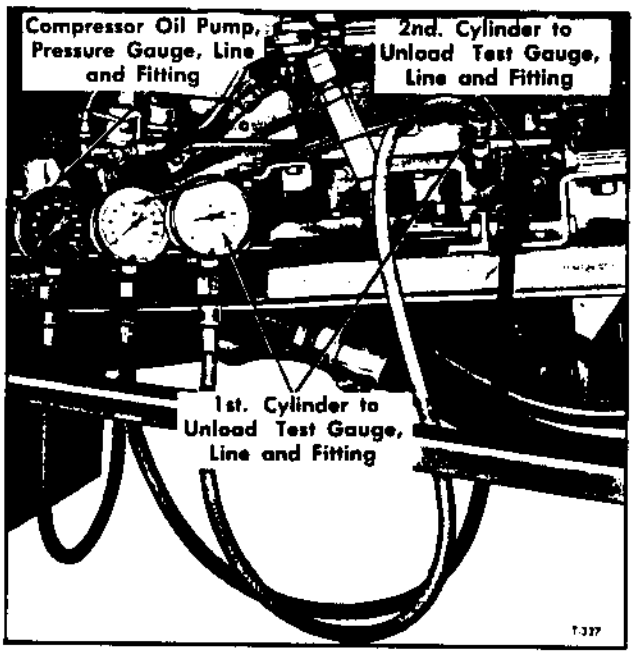


Figure A-4—Checking Cylinder Unloader Pressures

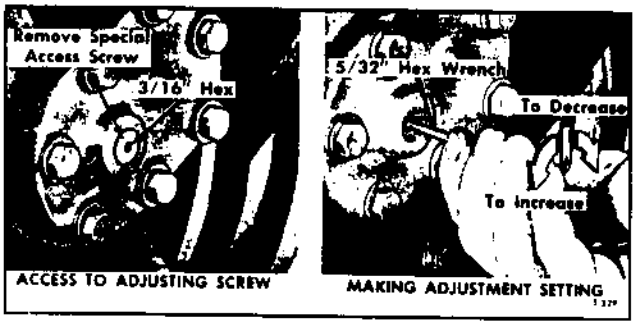


Figure A-3—Adjusting Unloader Settings

Checking Compressor Unloading Setting (On Bench Test)

Using Compressor Open to Atmosphere "Air Run In Test," same test can be performed by backing out adjustment screw (Figure A-3) to achieve unloader control operation of atmospheric/0 psig pressure. Then, the setpoint is recalibrated to 55 psig when compressor is reinstalled in system.

OR

The unloader setting may be recalibrated in the shop if a fixture is available to calibrate unloader control prior to handhole cover being installed. For this proceudre, see SEI Instruction No. 50140 to test unloader cylinder only (see following write-up).

UNLOADER PISTON TEST DURING AIR RUN-IN (From Trane SEI #50140)

A high percentage of Model G unloader actuators are out of adjustment when received by General Motors. This out of adjustment can be caused during the air run-in when the unloader adjusting screw is used to test the unloader piston response. Exact resetting is not possible.

NOTE: Previous procedure was to count turns on screw back out to 0 psig as mentioned on preceeding page and in following procedures (SEI 7-3.03).

Therefore, the unloader piston response test at the air run-in will be revised as follows:

1. Do not turn the unloader adjustment screw.
2. Install special fittings in each (2) of the 1/8 in. NPT holes (normally plugged) which intersect the passages which normally feeds oil from the actuator in the handhole cover to the unloader piston. These fittings must be such that they will supply oil pressure to the unloader piston and prevent significant oil flow to the actuator in the handhole cover.
3. Attach separate oil pressure supply lines (2) each with a shutoff valve, to connect the oil pump cover to the fittings installed in Item 2. These lines will supply oil pressure to the unloader pistons (when the valves are open).
4. During the air run-in, open each valve to test the response of the unloader pistons. Opening (and closing) each valve must produce a marked increase (or decrease) in air flow manometer deflection. Perform this test twice.

   NOTE: The screw (Item 17, A4331-5800) which locks the unloader adjusting screw should be installed during the assembly of the handhole cover.

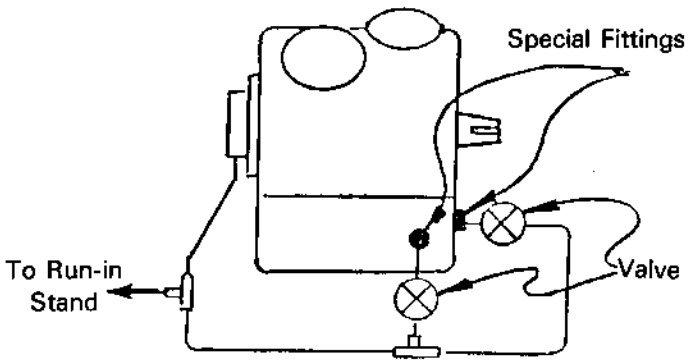


Figure A-5 - Unloader Piston Response Test Set Up

AIR RUN-IN TEST FOR MODEL G COMPRESSORS (From Trane SEI 7-3.03)

This procedure covers the air cycle run-in test used for Model G/CB Compressors. This procedure will confirm proper assembly of compressor parts.

Details:

1. Maximum air suction temperature 65.0 to 85.0 F.
2. Oil pressure (taken at completion of run-in; i.e., oil hot)

   Model G—45 psig minimum at 700 rpm; 100 psig maximum psig at 1750 rpm

   Model GB—70 psig minimum at 700 rpm; 110 psig maximum at 1750 rpm
3. Air discharge pressure — 7 psig
4. Minimum air pump down pressure (for leak back check) — 25 inches of mercury

Requirements

1. Air discharge temperature must not exceed 200 F (93.0 C).
2. Compressor air leak-back rate should not exceed 5 inches of mercury in 5 minutes. Excess leakage requires correction to valve seats and suction valve plate to housing O-ring.

Test Procedure

This is the preferred test procedure. This procedure requires that the handhole unloader actuator adjustments/testing have been performed on a test fixture (as in SEI 7-308 "Unloader Actuator Test" — see next writeup).

As noted in previous "Checking Unloader Setting" procedure, the only other alternative (on Bench Test) is to back out the adjusting screw to achieve unloader operation at 0 psig. This also requires counting screw turns to allow returning screw to its original position or recalibrating to the 55 psig setpoint when the compressor is installed in a system.

1. Do not turn the unloader adjustment screw.
2. Do NOT attempt to increase the oil pressure or unstick unloaders by restricting the compressor suction.
3. Install special fittings in each (2) of the 1/8 in. NPT holes (unloader actuator test port) which intersect the passage that feeds oil from the actuator in the handhole cover to the unloader piston. These fittings must be such that they will supply oil pressure to the unloader piston and prevent significant oil flow to the actuator in the handhole cover.

4. Attach separate oil pressure supply lines (2) each with a shutoff valve, to connect the oil pump cover to the fittings installed in Item 2. These lines will supply oil pressure to the unloader pistons (when the valves are open). (See previous writeup SEI #50140.)

5. Run compressors for 10 minutes at high speed to warm oil.

6. Test unloader function at approximately 810 RPM and 1750 RPM in both directions of rotation by opening both unloader oil pressure valves simultaneously. Both cylinders (1 and 4) must respond with a marked increase in air flow during this test. The compressor oil pressure must be the same in both the loaded and unloaded position to be acceptable. Test in forward direction (clockwise from oil pump end) first and reverse (counterclockwise from oil pump end) last.

7. Record oil pressures in the loaded and unloaded positions at 810 RPM and 1750 RPM in both directions of rotation. The maximum oil pressure is 110 psi, the minimum oil pressure is 70 psi. Correct any compressor which exhibits fluctuating oil pressure. Likely cause is air leaks at oil pump inlet ports/passages.

UNLOADER ACTUATOR TEST (From Trane SEI #7-308)

This procedure covers the testing of the compressor unloader actuator and the setting of the actuator. This procedure is intended to establish technical requirements and quality. This procedure applies to all standard production compressors. If there is a special requirement, a special handhole cover drawing will call out the procedure in detail.

1. With the unloader assembly on the test fixture, the oil pressure at 30 psig, the air pressure at 0 psig and the bellows adjustment screw backed out, slowly adjust the orifice adjustment screw until all cylinders are loaded; i.e. the pressure of the unloader gauges is equal to 30 psig. Adjust further to raise lever to be parallel with bracket assembly (approximately 1/4 turn). Now lock the orifice adjustment screw in place.

2. Set air pressure to 55 psig. Raise oil pressure to 90 psig.

3. Turn unloader adjustment screw clockwise until the first unloader gauge pressure drops to 0 psig.

4. Reduce air pressure until the second unloader gauge drops to 0. Air pressure reduction should be 1.5 to 2.5 psig.

5. Set air pressure to 57 psig. The pressure on both unloader gauges should increase to 90 psig.

6. Reduce air pressure to 55 psig. The pressure on the first unloader gauge should drop to 0. Reduce the air pressure to 53 psig. The pressure on the second unloader gauge should drop to 0.

7. Relieve pressures and remove cover assembly from stand.

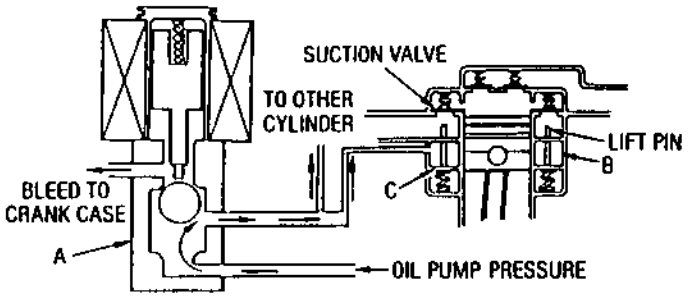
APPENDIX B

Electric Solenoid Controlled Unloader Operation and Testing

Unloader Operation

Solenoid Energized (Cylinder Loaded)

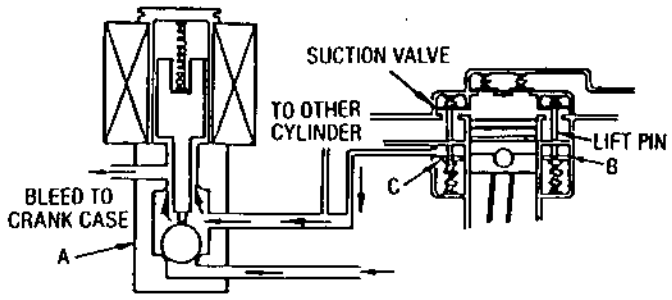
Pressurized oil is supplied to the unloader solenoid valve by the compressor lubricating oil pump. With the solenoid valve energized, pressurized oil is delivered through the solenoid valve (A) to the cylinder unloader (B) forcing the unloader piston (C) downward. This downward movement of the piston permits the lift pins to move away from the lower side of the cylinder suction valve, allowing the valve to seat normally. The cylinder is LOADED.



Solenoid Energized/Cylinder Loaded

Solenoid De-energized (Cylinder Unloaded)

With the solenoid valve (A) de-energized, it valves-off pressurized oil to the cylinder unloader (B) permitting oil within the unloader to flow back to the crankcase through the bleed port. With oil pressure in the cylinder unloader relieved, the piston (C) is moved upward by the unloader piston spring. This caused the lift pins to raise the suction valve off of its seat, preventing the cylinder from pumping gas. The cylinder is UNLOADED.



Solenoid De-energized/Cylinder Unloaded

Compressor Cylinder Unloader Testing

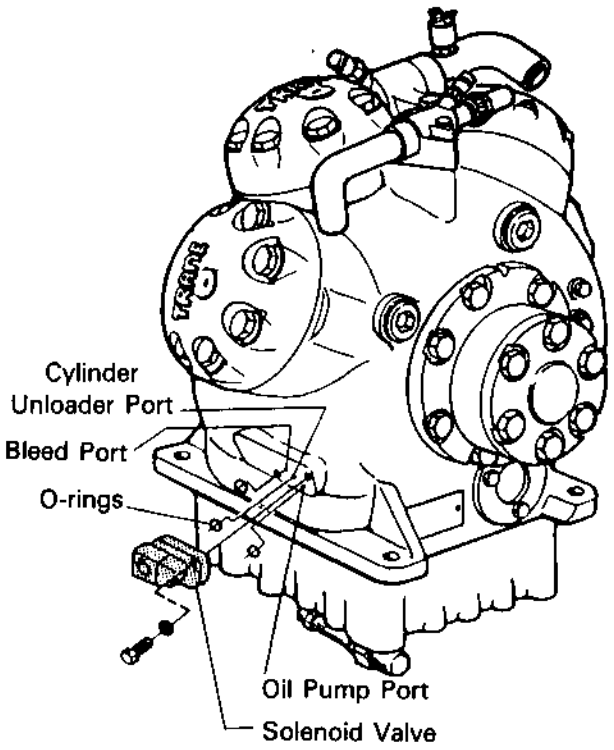
1. Install service gauge manifold set to the compressor suction and discharge service valve test ports.
2. With the air conditioning system operating:
   a. Energize the unloading solenoid, LOADING the cylinders.
   b. De-energize the unloading solenoid, UNLOADING the cylinders.
3. Observe the gauge while using the appropriate method in "2" above to simulate unloader operation. As the compressor is first loaded then unloaded, a distinct fluctuation of approximately 5 psi or more in suction pressure, as well as a corresponding change in discharge pressure should be evident as compressor capacity is first increased to full LOAD then UNLOADED.

   Failure to observe operating pressure fluctations between loaded and unloaded mode are an indication of unloader failure. Likely causes of failure are:
   a. Unloader solenoid coil.
   b. Unloader solenoid valve.
   c. Compressor oil pump pressure too low. Must have a minimum net oil pressure of 35 psi.
   d. Unloader pistons sticking.

Unloader Solenoid

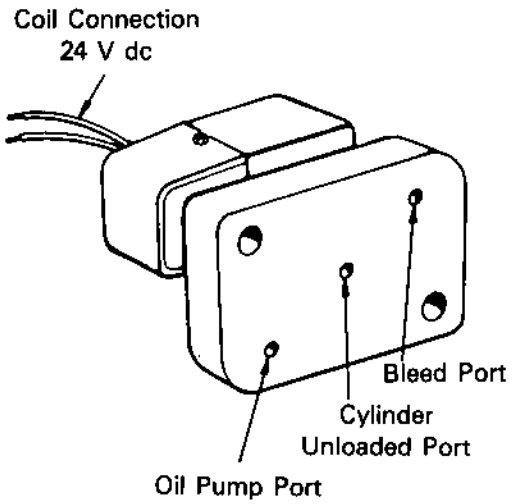
Removing

1. Remove two 1/4 x 20 capscrews mounting solenoid valve body to the compressor housing.
2. Separate from housing and discard O-rings sealing oil passages.



Testing

1. With the solenoid coil energized, apply air or oil pressure at the "oil pump port." Flow should be indicated out of the "cylinder port" only.



2. With the solenoid coil de-energized, apply air or oil pressure at the "oil pump port." No flow should exist at the "cylinder port" or "bleed port."

   Apply pressure at the "cylinder port." Flow should be indicated at the "bleed port."

3. Using a straight edge, check the solenoid base for flatness. A warped base will result in failure of O-rings to seal and a loss of oil.

   NOTE: Use only dehydrated air/gas or refrigerant oil to prevent contaminants from entering solenoid passages.

Installing

1. Clean mating surfaces and O-ring grooves in the compressor housing.
2. Using new O-rings, coat with refrigerant oil and place in grooves in compressor housing.
3. Position the solenoid valve with the mounting screw hole marked "DOWN" over the lower mounting screw hole in the compressor housing.

APPENDIX C
Compressor Efficiency and Oil Pressure Testing

Intake Stroke

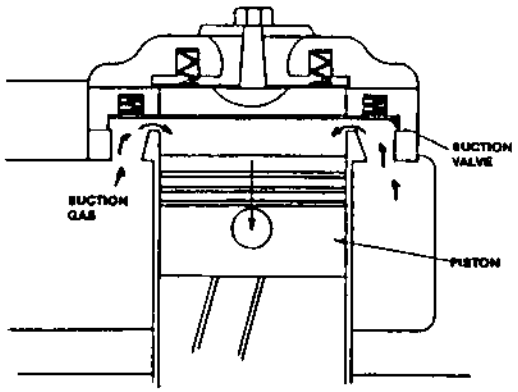


Figure C-1

(Figure C-1) On the intake stroke of the piston, the pressure within the cylinder is reduced below suction pressure. This pressure difference forces the suction valve open, permitting the suction gas to enter the cylinder.

(Figure C-2) The compression stroke of the piston increases the pressure within the cylinder. When the cylinder pressure exceeds the suction pressure, the pressure difference plus the pressure exerted by the valve springs causes the suction valve to close. This traps the gas between the top of the piston and the discharge valve.

Compression Stroke

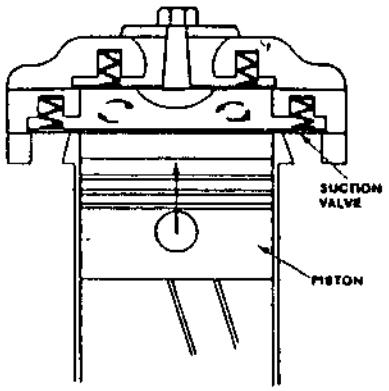


Figure C-2

Compression Stroke

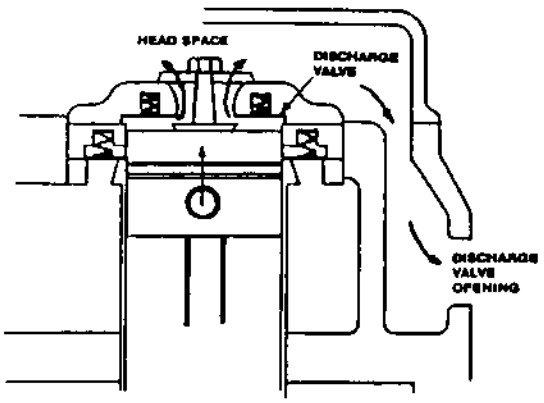


Figure C-3

(Figure C-3) When the pressure within the cylinder exceeds the head pressure, the discharge valve is forced open, allowing the compressed gas to enter the head space from where it leaves the compressor through the discharge opening.

COMPRESSOR PUMP DOWN (EFFICIENCY) TEST

Compressor efficiency is relative to the condition of the compressor discharge and suction valves. An inefficient compressor may result in poor cooling performance.

To test the compressor for valve leakage, perform the following tests.

PUMP DOWN TEST

1. Connect service gauge manifold to the compressor suction and discharge service ports. Be sure to purge gauge manifold of air.
2. Start the A/C system and operate until stabilized, approximately 30 minutes.

   NOTE: It is imperative that no liquid refrigerant remain in the crankcase and/or oil level be maintained at the proper level.

3. Temporarily disarm (jumper) the compressor low pressure switch (LPC) and low oil pressure switch (if applicable) to allow the compressor to operate in a vacuum.

4. With the compressor (A/C system) operating, front seat the compressor suction service valve.

   CAUTION: DO NOT front seat the compressor discharge service valve.

Observe the compressor's ability to reduce suction pressure below 0 psig as in the following examples.

Suction Pressure	Valve Cond.
20-25 vacuum	Very Good
15-20 vacuum	Good
10-15 vacuum	Fair
0-10 vacuum	Poor
0-10 psig	Very Poor

The lower the pressure achieved, the less the valve leakage rate. Failure to achieve the lowest possible pressure does not justify compressor replacement so long as the A/C system cooling capacity is adequate.

BACK LEAKAGE TEST

1. With the compressor suction service valve fully front seated and the compressor suction pressure at its lowest (as in "Pump Down Test," step 4), STOP the compressor.

   NOTE: As the compressor coasts to a stop, the suction pressure may increase slightly due to normal valve losses at very low speeds.

2. Observe for pressure rise on the suction service gauge as follows:

Suction Pressure	Valve Condition
A) Suction pressure holds at same low pressure	Discharge valves good
B) Suction pressure rises quickly to 0 psig and holds	Discharge valves good Housing leak indicated
C) Suction pressure rises quickly above 0 psig, at rate exceeding 1 pound/ 5 minutes	Discharge valve leak

NOTE: Failure to pass the back leakage test in step 2 may be due to:

1. Inadequate compressor running time for valves to seat (new and remanufactured compressors). If the pump down test, step number 4 is acceptable, then operate the compressor for several hours and repeat the back leakage test.

2. Failure to achieve stabilized system conditions, all liquid refrigerant not removed from compressor crankcase. Repeat step number 2, "Pump Down Test."

3. Failure to completely pump down the compressor, leaving refrigerant in the compressor crankcase. Repeat step number 4, "Pump Down Test," operating the compressor at the lowest pressure for a longer period of time.

4. Leaking compressor suction service valve. Test may be performed using the liquid line service valve, however care must be taken to insure liquid remaining in the evaporator coil is first pumped out to the high-side of the system.

OIL PUMP PRESSURE

To assure proper operation of the compressor and the compressor unloading mechanism, the compressor oil pump must supply the proper oil pressure. The oil pump pressure is checked by subtracting the refrigerant suction pressure reading from the pump pressure reading.

The minimum net oil pressure allowable is 35 psig.

NOTE: Higher pressures are commong.

1. Connect refrigerant pressure test gauge to the refrigerant low pressure gauge test port on the compressor.

   For this check it is not necessary to connect the gauge set high pressure line to the compressor discharge or high pressure test port.

2. Connect an oil pressure gauge with a range of 0 to 150 psig to the oil pump test port on the oil pump end bearing head (Figure C-4).

3. Start the A/C and operate until a stabilized operating condition is achieved, approximately 20 minutes. Failure to achieve a stabilized system may result in a false indication of low oil pressure due to liquid refrigerant in the crankcase at start-up. With the compressor operating, record suction pressure and oil pump pressure. To determine NET oil pressure (oil pump performance), subtract suction pressure from oil pressure.

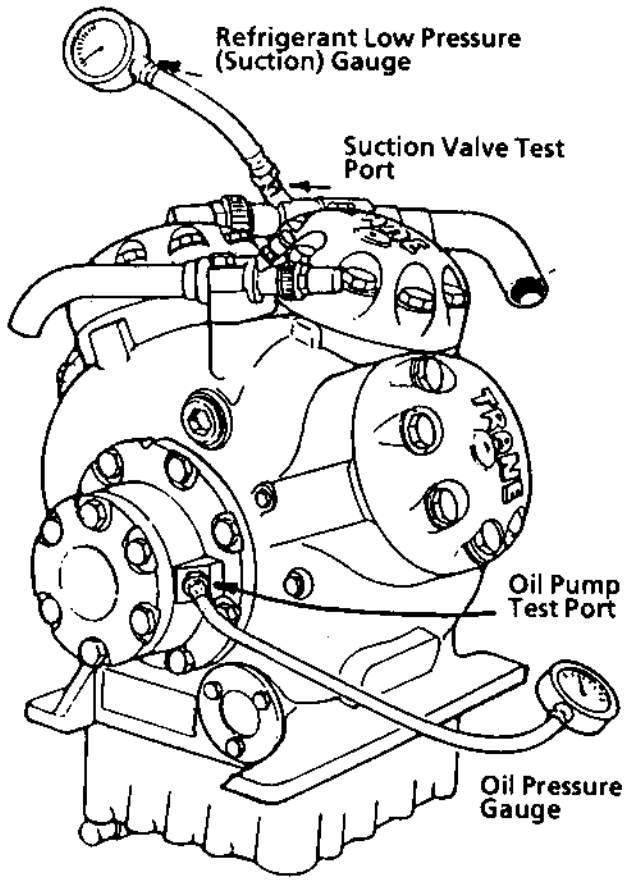


Figure C-4

4. If net oil pressure is below the minimum specified, worn oil pump or connecting rod bearings may be the cause. Because the oil pump is externally serviceable, inspect and/or replace the oil pump BEFORE removing the compressor for major repairs.

   Net oil pressure below 35 psig will contribute to sluggish unloader operation and/or the failure of the compressor to fully load up on demand of rising temperatures and suction pressure. See unloader operation for details.

EXAMPLE:

130 psig (oil pressure)
- 60 psig (suction pressure)

70 psig (net oil pressure)

NOTE: This would be a normal reading for net oil pressure.

90 psig (oil pressure)
- 65 psig (suction pressure)

25 psig (net oil pressure)

NOTE: This would be a low reading for net oil pressure. Minimum recommended presure is 35 psig.