Service and Maintenance Manual

CONTENTS

SAFETY CONSIDERATIONS

Installation and servicing of air-conditioning equipment can be hazardous due to system pressure and electrical components. Only trained and qualified service personnel should install, repair, or service air-conditioning equipment.

Untrained personnel can perform basic maintenance functions of cleaning coils and filters and replacing filters. All other operations should be performed by trained service personnel. When working on air-conditioning equipment, observe precautions in the literature, tags and labels attached to the unit, and other safety precautions that may apply.

Follow all safety codes, including ANSI (American National Standards Institute) Z223.1. Wear safety glasses and work gloves. Use quenching cloth for unbrazing operations. Have fire extinguisher available for all brazing operations.

It is important to recognize safety information. This is the safety-alert symbol ⚠. When you see this symbol on the unit and in instructions or manuals, be alert to the potential for personal injury.

Understand the signal words DANGER, WARNING, CAUTION, and NOTE. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which **will** result in severe personal injury or death. WARNING signifies hazards which **could** result in personal injury or death. CAUTION is used to identify unsafe practices, which **may** result in minor personal injury or product and property damage. NOTE is used to highlight suggestions which **will** result in enhanced installation, reliability, or operation.

⚠ WARNING

RISK OF PERSONAL INJURY

Before performing service or maintenance operations on unit, turn off main power switch to unit. Electrical shock could cause personal injury.

⚠ WARNING

RISK OF PERSONAL INJURY

Do not provide power to unit or turn-on compressor unless suction and discharge service valves are open.

⚠ WARNING

CONTENTS UNDER PRESSURE, RISK OF PERSONAL INJURY

Compressor contains oil and refrigerant under pressure. Pressure must be relieved before installation, servicing or opening any connections.

⚠ WARNING

RISK OF PERSONAL INJURY
HOT and COLD surface temperatures can occur during operation and can result in severe burns of frostbite.

⚠ WARNING

RISK OF PERSONAL INJURY
Exposed moving parts of the compressor drive can cause severe injury. Appropriate guards must be utilized. Guards must be in place before operating.

⚠ WARNING

RISK OF PERSONAL INJURY
Only approved refrigerants and refrigeration oils may be used.

⚠ WARNING

RISK OF PERSONAL INJURY
Use nitrogen or inert gas for tightness/pressure testing. DO NOT USE oxygen or other industrial gases.

⚠ WARNING

RISK OF PERSONAL INJURY
System strength/tightness test pressure should not exceed 440 psig on the high-side and 270 psig on the low-side. Close shutoff valves to isolate compressor if necessary.

⚠ WARNING

RISK OF PERSONAL INJURY
Charge only with refrigerant that conforms to AHRI Standard 700.

⚠ CAUTION

This compressor shipped without oil. Do not run without adding required lubricant.

IMPORTANT: Install all safety decals/labels that come with the compressor.

SCHEDULED MAINTENANCE

5F,H compressor and condensing units provide long life and dependable service when properly operated and regularly maintained. Establish a maintenance schedule based on factors such as operating hours, load conditions and water quality. Maintenance schedules listed in this section are offered as guides. Modify them as needed to satisfy individual machine requirements.

Check Lubrication System

Always check compressor oil level before starting unit. If oil is required, record date and amount added. See Fig. 1 for location of oil filter plug. Refer to Application guide 574-509 for specific oil types and quantities of oil.

Use of accessory oil separator requires additional oil. Oil level and separator float valve movement during initial compressor operation should agree with instructions furnished with the oil separator.

OIL FILTER MAINTENANCE

A bleed-type, high-pressure, disposable filter is available as an accessory for 5H40-86 compressors (see Fig. 1). Replace oil filter after the first 50 hours of operation, or whenever the oil is changed or becomes dirty.

Check yearly for clogged filter, indicated by a greater than normal difference between oil pressure ahead of filter and after filter (before orifice elbow). When this difference exceeds 5 psig, change filter as follows:

1. Close oil-line shutoff valves on each side of filter (see Fig. 1).
2. Disconnect oil lines at filter connections.
3. Loosen filter bracket; remove and replace filter body.

NOTE: Refer to Accessory Oil Filter Instructions for additional information.

IMPORTANT: The full-flow oil filter, on 5H120 and 5H126 compressors only, contains a replaceable cartridge. Replace the filter cartridge after the first 100 hours of compressor operation. After the initial filter change, check yearly for filter clogging. If the pressure difference across the filter exceeds 5 psig, pump down the compressor and then remove the cartridge. Fig. 2 illustrates complete filter assembly parts (cartridge not shown in Fig. 2).

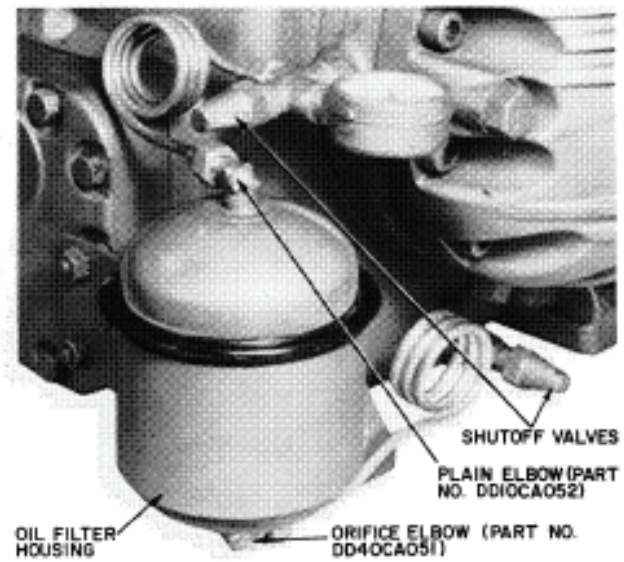


Fig. 1 — Oil Filter Accessory Package (5H40-5H86)

CHECK OIL AND SHAFT SEAL TEMPERATURE

The normal operating temperature of the oil in the crankcase ranges from 100°F to 135°F when fully loaded. Do not permit maximum oil temperature to exceed 150°F. Conditions under which such excessive temperatures could occur include situations where the compressor operates in a fully unloaded condition for an extended period, because the compressor would not be able to remove all of the heat generated by compression and friction. In such situations, use an oil cooler to maintain safe operating temperatures. Refer to 5F, H Application Data for more information.

When crankcase oil temperature falls within the 120°F to 135°F range, the shaft seal housing temperature should be approximately 140°F to 150°F. Shaft seal housing temperatures above 170°F may cause shaft seal to age rapidly, and harden and crack. Therefore:

If shaft seal housing temperature exceeds 170°F, STOP THE COMPRESSOR. DO NOT restart until the cause of overheating has been identified, and the condition corrected.

OIL COOLER USAGE

The accessory oil cooler maintains safe operating oil temperatures when:

1. Applying long stroke compressors (5H46, 66, 86 and 126). For added reliability, an oil cooler is recommended on all long stroke models regardless of operating range or type of refrigerant. Additional heat of friction from extended piston travel on long stroke models increases oil temperatures.
2. The suction gas becomes highly superheated.
   a. The compression ratio exceeds 5:1 on R-22 systems.
   b. Application data indicates the need for an oil cooler for R-134a systems. The compression ratio can be determined from the following formula:

$$\text{Compression Ratio} = \frac{\text{Absolute Discharge Pressure}}{\text{Absolute Suction Pressure}}$$

NOTE: Do not operate unloaders at saturated suction temperatures at or below 0°F without prior approval from Carlyle Engineering.

3. The compressor operates fully unloaded for prolonged periods. Under these conditions, suction gas levels may not suffice to remove the heat of compression and friction. This condition can occur in any application, but is most likely in low-temperature systems or variable volume applications that use hot-gas bypass to maintain specified conditions under low evaporator load. Refer to 5F, H Application Data for additional information.

Adjust water flow rate through oil cooler to maintain 100°F to 120°F oil temperature returning to compressor. Crankcase temperature must remain below 140°F; shaft seal temperature at the seal housing should not exceed 170°F.

Tables 1 and 2 list maximum working pressures for oil and water and estimated water flow rates for various oil cooler/compressor combinations. For additional information, see Accessory Oil Cooler Installation Instructions.

Table 1 — Oil Cooler Maximum Working Pressure

TYPE	PRESSURE
OIL	250 psig
WATER	150 psig

Table 2 — Oil Cooler Estimated Water Flow Rates

COMPRESSOR	GPM[a]
5F	1/4-1
5H4Q-66	1-2
5H80,86	11/2-3
5H120,126	2-4

NOTE(S):
a. Flow rate based on 80°F entering water.

Check Water-Cooled Heads

To prevent oil breakdown and sludge formation, the discharge gas temperature must remain below 275°F. Water-cooled cylinder heads are available as an accessory for this purpose. See Accessory Water-Cooled Head Package Installation Instructions for additional information.

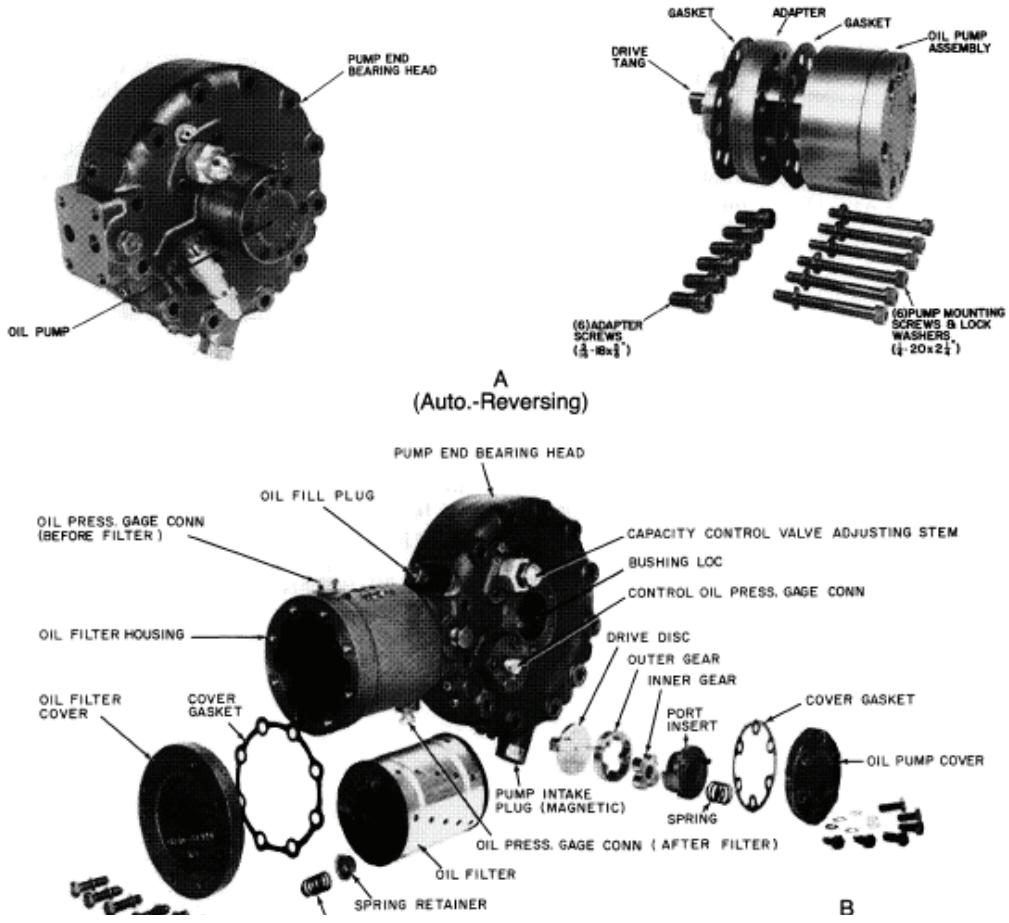


Fig. 2 — Oil Pump and Filter Assembly (5H120, 126)

SERVICE

Service and repair of reciprocating compressors and other refrigeration components should be performed only by fully trained and qualified personnel.

Lubrication System

OIL PUMPS

5F compressors. See Fig. 3 and 7.

5H40-86 compressors. See Fig. 3 and 8.

5H120,126 compressors, with automatically reversing oil pump. Refer to Fig. 2 (A) and Table 3.

5H120,126 compressors, with manually reversing oil pump. Refer to Fig. 2 (B), 4 and Table 3.

Service Notes

1. Compressor components are shown in normal order of removal from compressor. See Fig. 5-8.
2. For replacement items, use Carlyle specified parts. See Carlyle 5F, H Specified Parts list for compressor part interchangeability.
3. Before servicing compressor, pump down the refrigerant as follows:
   a. Start compressor, close suction service valve, and reduce crankcase pressure to 2 psig. Bypass low pressurestat with jumper.
   b. Stop compressor; close discharge service valve to isolate it from system.
   c. Recover or reclaim any residual refrigerant. Drain oil if necessary.
4. After disassembly, clean all parts with solvent. Use mineral spirits, white gasoline or naphtha.
5. Before assembly, coat all parts with compressor oil and clean and inspect all gasket surfaces. Replace all gaskets with new, factory-made gaskets, and lightly coat with oil. See Table 4 for torque values.
6. After reassembly, evacuate compressor and open suction and discharge valves. Restart compressor and adjust refrigerant charge.

Table 3 — 5H120 and 126 Compressor Oil Pump History Reference

TYPE[a]	FIG.	DATE MANUFACTURED	SERIAL NO. BREAK
Auto-Reversing	2	1960-1968 and Starting March 1986	From 0447119 to A901765 and Starting 1086J01967
Manually Reversing	2	Starting 1969 and Ending March 1986	Starting A901765 and Ending 1086J---

NOTE(S):
a. By itself, the automatic reversing oil pump cannot be installed in place of the manually reversing oil pump or vice versa. The complete bearing head assembly with the oil pump (auto or manual) is interchangeable as a complete assembly.

MANUALLY REVERSING OIL PUMP

Oil Pump Inspection

Refer to Fig. 2, 7, 9 for 5F and 5H manually reversing oil pumps. Also refer to 5H120, 126 section "AUTO REVERSING OIL PUMP" on page 10.

Drain oil below level of pump-end bearing head. Remove bearing head. Complete end-bell assembly must be removed to access bearing head assembly with oil pump on 5H40-86 models. Check oil pump rotor for end play. Maximum allowable movement of rotor is 0.0025. If there is excessive end play, reposition oil pump bushing in bearing head as described below.

Tum rotor. If there is more than a slight drag, remove pump cover and disassemble oil pump checking all parts for wear and damage. Inspect oil pump bushing for scoring. Replace bushing if scored. If bearing head is scored, replace complete bearing head and oil pump assembly.

Oil Pump Bushing Installation

See Fig. 3 and 4. Position the bushing oil groove at top (running from 12:00 to 6:00) when the bearing head is installed. Press new bushing into the pump-end bearing head from the inner side of the head with the chamfered end entering first.

Oil Pump Bushing Position

1.
   a. **5F20-60 and 5H40-86:** Place 0.001 in. circular field fabricated shim against bushing and install pump. Shim between bushing and oil pump rotor. Complete assembly of oil pump with gasket and cover. See Fig. 3.
   b. **5H120, 126:** Place 0.015 in. (1/64 in.) shim between port insert and oil pump cover. Complete assembly of oil pump and pump cover without using pump cover gasket. See typical arrangement shown Fig. 4.
2. Tap bushing with suitable cylindrical positioning tool to seat it against shim. See typical arrangement shown in Fig. 3.

⚠ WARNING

Oil pump assembly must be flush with coverplate surface, but must not protrude beyond bearing head surface.

   a. **5F20-60 and 5H40-86:** Disassemble oil pump and remove shim. Reassemble oil pump. Check for binding. (See Fig. 3.)
   b. **5H120, 126:** Remove oil pump cover and shim. Reassemble pump cover with gasket. Check for binding.
3. Install bearing head on compressor. Line up tang on oil pump rotor shaft with slot in end of crankshaft. Check oil pump for proper direction of rotation.
4. Refill compressor oil to proper level. Observe oil pressure when starting compressor. Correct oil pressure should be 45 to 55 psig above suction pressure.

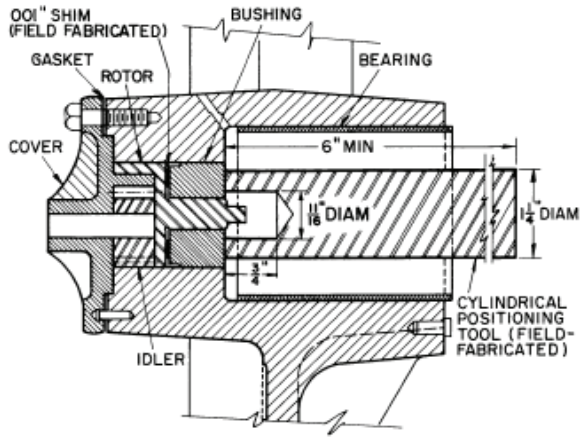


Fig. 3 — Setting Oil Pump Bushing (Typical 5F20-60 and 5H40-86 5F40 Bearing Head Shown)

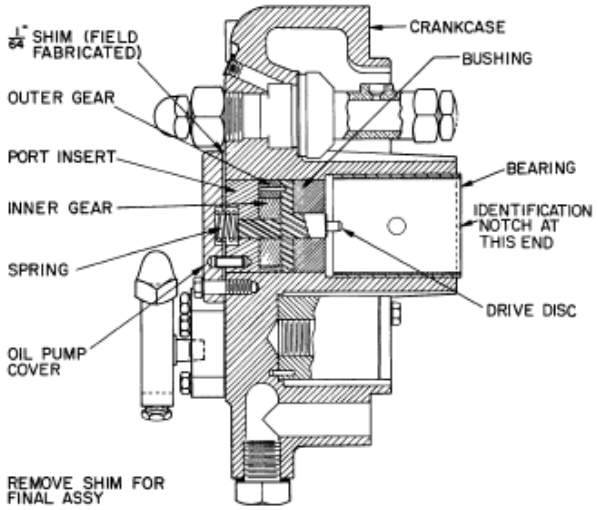


Fig. 4 — Setting Oil Pump Bushing (Typical 5H120, 126)

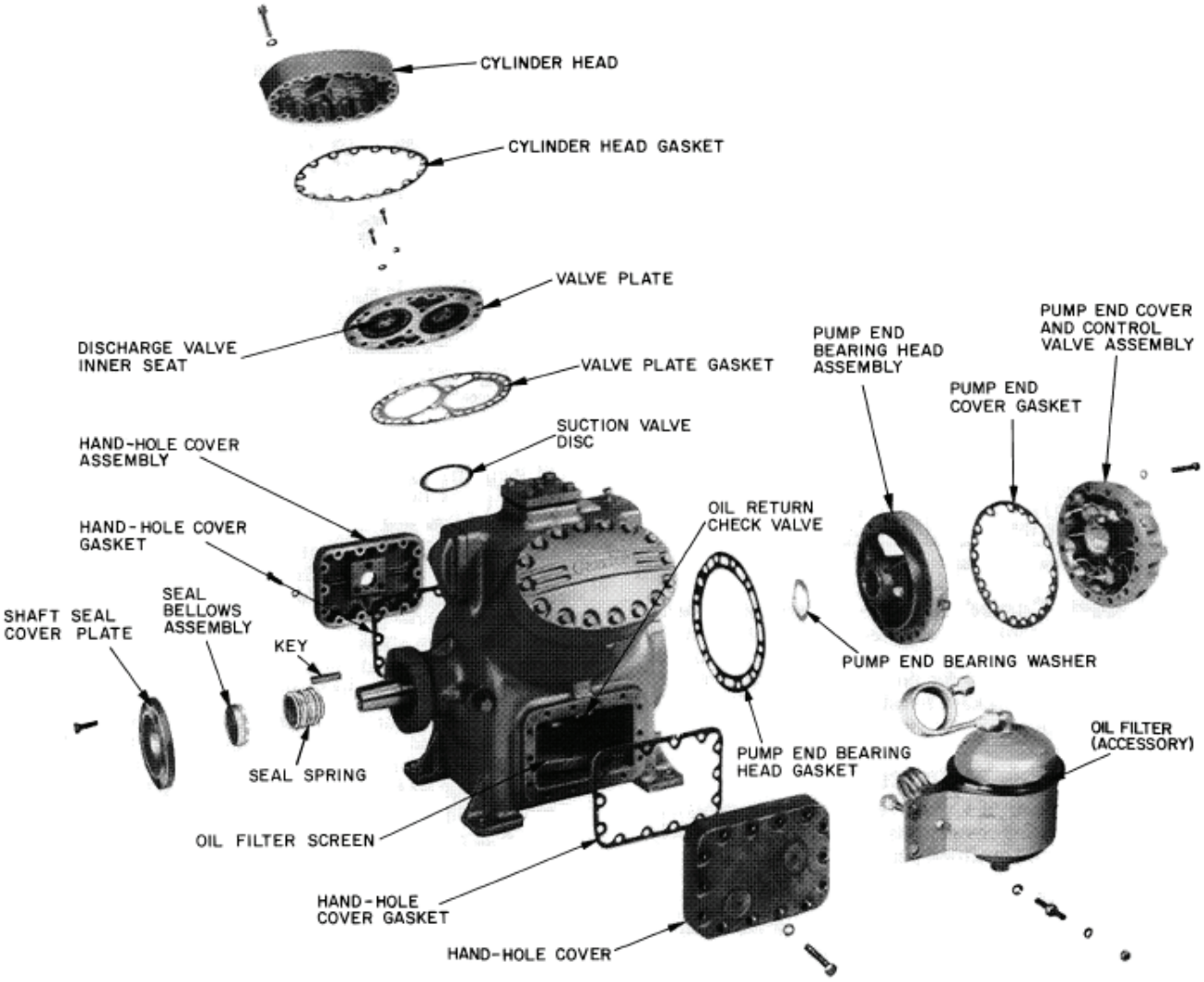


Fig. 5 — 5H Compressor External Components

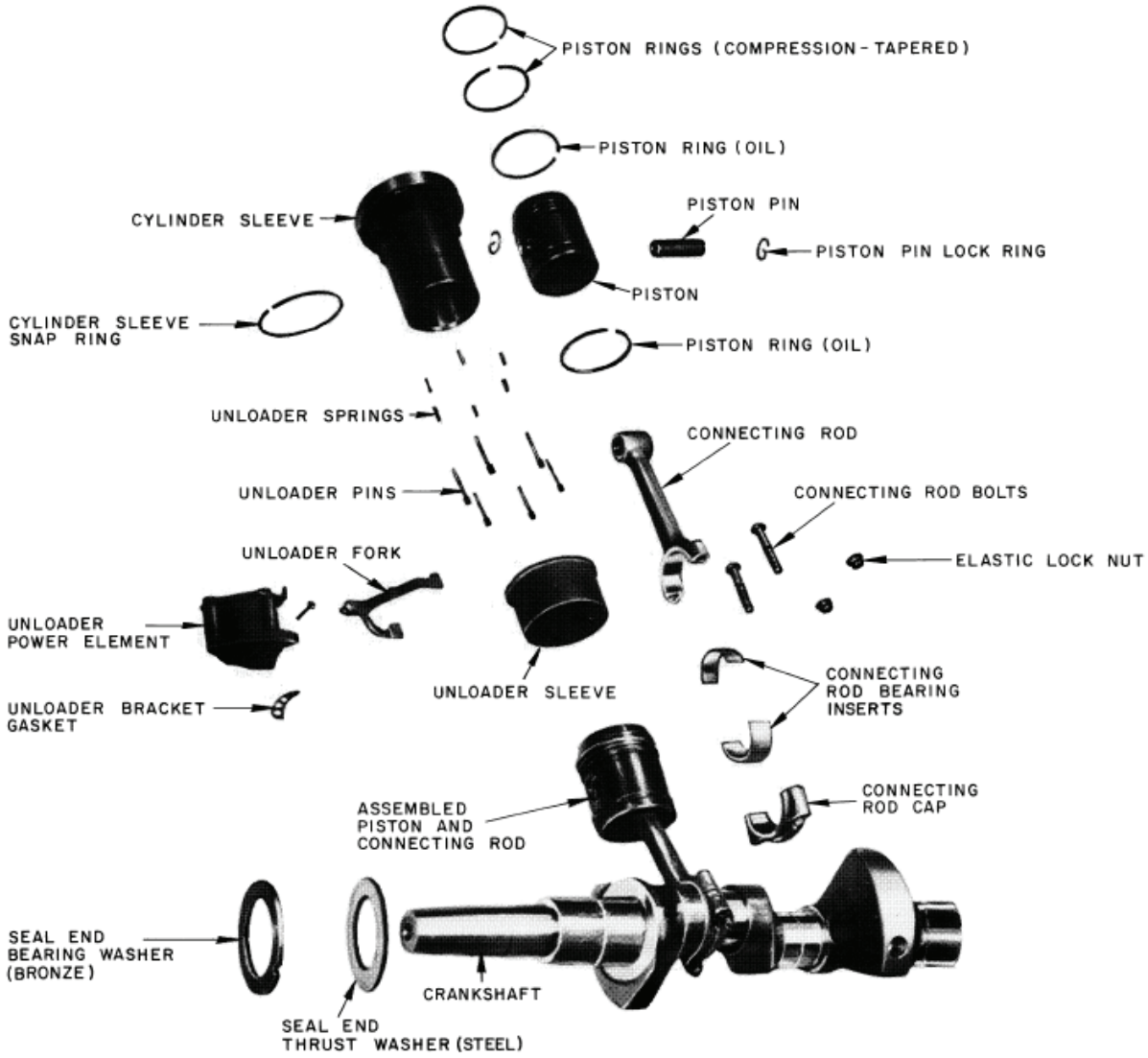


Fig. 6 — 5H Compressor Internal Components

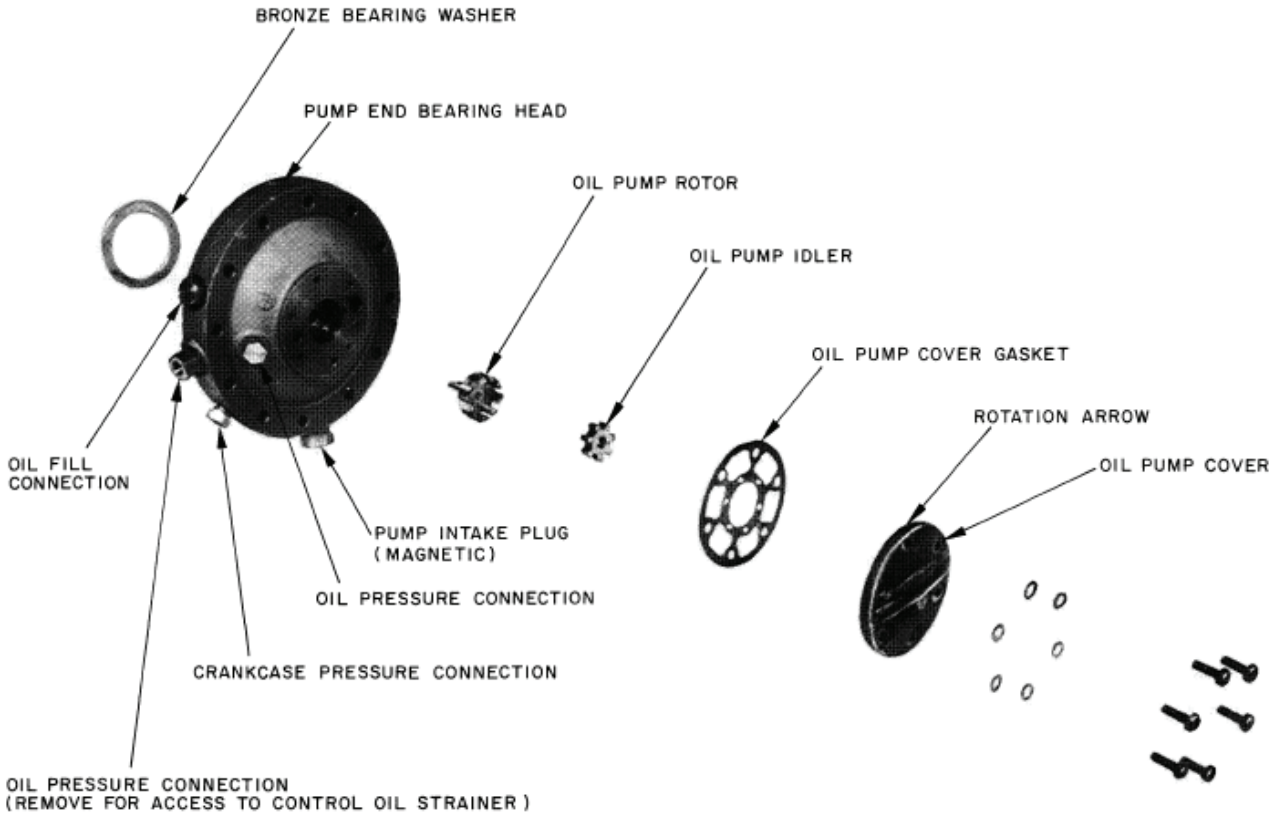


Fig. 7 — 5F Oil Pump Assembly

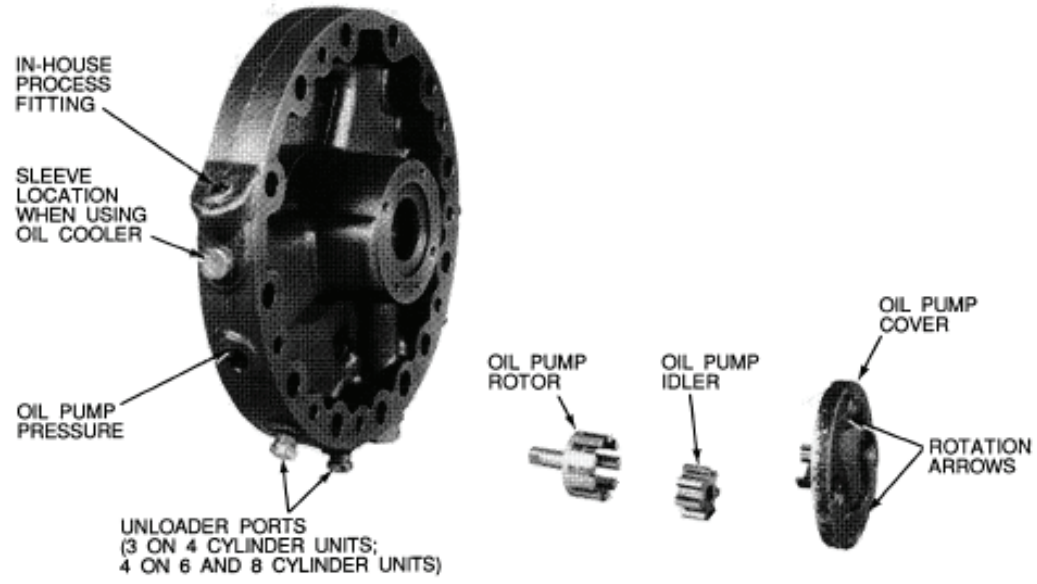


Fig. 8 — 5H40-86 Oil Pump Assembly

Table 4 — Torque Values

5F UNITS			
SIZE DIA (in.)	**THREADS (per in.)**	**RANGE (lb-ft)**	**USAGE**
1/4	Pipe	20-25	Pipe Plug - Pump End Bearing Head
		20-25	Pipe Plug - Crankshaft
		20-25	Pipe Plug - Suction and Discharge Manifold Cover
1/4	28 NF	10-15	Unloader Power Element Assembly - Crankcase
		10-15	Unloader Cylinder Cover Plate - Unloader Cylinder Bracket
		12-15	Discharge Valve Cap Screw - Inner Seat
		12-15	Discharge Valve Guide Assembly - Valve Plate
		12-15	Oil Pump Cover - Pump End Bearing Head
		10-12	Auxiliary Control Valve Cover - Valve Body
5/16	24 NF	22-25	Connecting Rod Bolt - Locknut
		15-20	Capacity Control Valve - Hand-Hole Cover
3/8	Pipe	30-35	Pipe Plug - Pump End Bearing Head
3/8	16 NC	25-29	Cylinder Head - Crankcase
		25-29	Shaft Seal Cover Plate - Crankcases
		25-29	Bottom Plate - Crankcase
		25-29	Suction and Discharge Manifold Cover - Crankcase
		25-29	Pump End Bearing Head Assembly - Crankcase
		25-29	Hand-Hole Cover - Crankcase
		25-29	Suction Manifold - Crankcase
3/8	24 NF	45-50	Flywheel Screw - Crankshaft
7/16	20 NF	25-30	Oil Return Check Valve Assembly - Crankcase
1/2	13 NC	80-85	Suction Service Valve - Crankcase
		80-85	Discharge Service Valve - Crankcase
5/8	11 NC	120-130	Suction Service Valve - Suction Manifold
5/8	18 NC	60-75	Magnetic Plug - Crankcase
		60-75	Magnetic Plug - Pump End Bearing Head
		60-75	Oil Bypass Plug - Pump End Bearing Head
		60-75	Modulating Valve Adapter - Pump End Bearing Head
		60-75	Lock Screw - Pump End Bearing Head
		18-22	Oil Regulator Valve Assembly - Crankcase
		50-60	Cap-Oil Regulator Valve Assembly
3/4	10 NC	70-80	Flywheel Locknut Crankshaft
1-1/2	18 NEF	34-45	Sight Glass Clamping Gland - Hand-Hole Cover
No. 6	32	8-10	Auxiliary Control Valve Cover - Valve Body

NOTE(S):
a. Steel Rod.

LEGEND

NC — National Coarse
NEF — National Extra Fine
NF — National Fine

Table 4 — Torque Values (cont)

5H UNITS			
SIZE DIA (in.)	**THREADS (per in.)**	**RANGE (lb-ft)**	**USAGE**
1/16	Pipe	10-15	Pipe Plug - Auxiliary Control Valve Body
1/8	Pipe	15-20	Pipe Plug - Pump End Bearing Head
1/4	Pipe	20-25	Pipe Plug - Crankcase
		20-25	Pipe Plug - Pump End Cover
		20-25	Pipe Plug - Crankshaft
1/4	28 NF	12-16	Oil Pump Cover - Pump End Bearing Head
		8-12	Auxiliary Control Valve Cover - Valve Body
		8-12	Special Cap Screw - Auxiliary Control Valve Body
1/4	20 NC	8-10	Oil Pump - Bearing Head (12 cylinder)
5/16	18 NC	16-20	Oil Pump Cover - Pump End Bearing Head
		16-20	Capacity Control Valve - Pump End Bearing Head
		16-20	Auxiliary Control Valve - Pump End Bearing Head
		16-20	Manifold Cover Plate - Crankcase
		18-24	Oil Pump Adapter (12 cylinder)
5/16	24 NF	18-22	Unloader Power Element - Crankcase
		18-22	Capacity Control Valve - Pump End Cover
		18-22	Discharge Valve Guide Assembly - Valve Plate
		18-22	Discharge Valve Guide - Inner Seat
		18-22	Cylinder Bracket
3/8	Pipe	30-35	Pipe Plug - Pump End Bearing Head
		30-35	Pipe Plug - Crankshaft
3/8	16 NC	25-29	Capillary Tube Assembly - Pump End Bearing Head
		28	Connecting Rod Bolt (Aluminum Rod)
7/16	14 NC	35-60	Suction and Discharge Manifold Cover - Crankcase
		55-60	Discharge Manifold - Cylinder Heads
		55-60	Valve Plate - Crankcase
		55-60	Cylinder Head - Crankcase
		53-60	Hand-Hole Cover - Crankcase
		55-60	Shaft Seal Cover
		55-60	Pump End Cover and Pump End Bearing Head - Crankcase
7/16	20 NF	40-45	Connecting Rod Bolt - Locknut[a]
1/2	Pipe	35-50	Pipe Plug - Crankcase
		35-40	Pipe Plug - Pump End Bearing Head
		30-35	Pressure Relief Valve - Suction and Discharge Manifold Cover
		30-35	Pressure Relief Valve - Crankcase
1/2	13 NC	80-90	Suction and Discharge Manifold - Crankcase
		80-90	Suction Manifold Cover - Crankcase
		80-90	Pump End Bearing Head - Crankcase
		80-90	Oil Filter Housing - Bearing Head
5/8	11 NC	140-150	Suction Manifold Cover and Suction Manifold - Crankcase
5/8	18NF	60-75	Magnetic Plug - Pump End Bearing Head
		60-75	Modulating Valve Adapter - Crankcase
		60-75	Oil Bypass Plug - Crankcase
		60-75	Oil Bypass Plug - Pump End Bearing Head
		60-75	Oil Bypass Plug - Pump End Cover
		80-90	Hollow Lock Screw - Pump End Cover and Center Main Bearing Housing
		18-22	Oil Pressure Regulator Valve - Crankcase
		80-90	Cap-Oil Pressure Regulator Valve Assembly
7/8	14 NF	60-75	Seal Plug - Pump End Bearing Head
		18-22	Oil Pressure Regulator Valve - Crankcase
3/4	Pipe	45-50	Pipe Plug - Crankcase
1	Pipe	50-55	Pipe Plug - Crankcase
1-1/2	18 NEF	35-45	Sight Glass Clamping Gland - Hand-Hole Cover
No. 6	32	8-10	Auxiliary Control Valve Cover - Valve Body

NOTE(S):
a. Steel Rod.

LEGEND

NC — National Coarse
NEF — National Extra Fine
NF — National Fine

AUTO REVERSING OIL PUMP

Oil Pump Inspection

Refer to Fig. 2 and Table 3 for 5H120 and 126 for automatic reversing oil pumps.

1. Drain oil below level of pump-end bearing head.
2. Remove bearing head from compressor.
3. Remove oil pump and adapter from bearing head.
4. Check all parts for wear and damage.

Pump Installation

1. Using a new gasket, mount bearing head on compressor. Tighten the 1/2-13 cap screws to 80 lb-ft.
2. Put a drop of thread sealing compound (Loctite 601 or equivalent) on each of the 5/16-18 adapter mounting screws and on threads of each mounting hole in bearing head. Position one of the supplied gaskets over holes in adapter and assemble the adapter loosely to bearing head.

Be sure there are no nicks or burrs on oil pump or bores in adapter and bearing head. Slide oil pump through adapter and into bearing head bore, allowing enough clearance to tighten adapter mounting screws with an Allen wrench.

NOTE: The clearance between oil pump housing and bores in adapter and bearing head is very close. This is necessary. *DO NOT USE FORCE and do not attempt to change the clearance.*

3. Hold pump with one hand and rotate it while equally tightening adapter mounting screws. *Proper alignment between pump and bearing head bore is extremely important. THERE MUST BE NO BINDING.*
4. When adapter is secure, remove pump assembly and place second gasket on pump housing. Insert two 1/4-20 mounting screws and lock washers, one on either side of the word TOP on pump end cover, and position gasket on screws. *For remaining operations, be sure the word TOP is at the top.*
5. Turn pump shaft to align drive tang with slot in end of crankshaft. Holding pump assembly with thumbs on the 2 screws, slide assembly into bearing head until tang engages slot. A slight rotation should align screws with tapped holes in adapter. Start screws to hold alignment and then install balance of screws and lock washers. Torque all screws (1/4-20) to 8 to 10 ft-lb.
6. Start compressor and check oil pressure. This oil pump operates in either direction of rotation. The correct oil pressure for compressors using this pump is 45 to 55 psig above suction pressure.

OIL PRESSURE REGULATING VALVE (NON-ADJUSTABLE)

The regulating valve is located on the side of compressor adjacent to seal housing. Regulator maintains correct oil pressure and ensures satisfactory unloader operation. See Fig. 9.

Fig. 9 — Oil Pressure Regulating Valve (Nonadjustable)

Unscrew regulator from crankcase; use 5/16 in. Allen wrench on all compressors except 5H120, which requires 1/2 in. Allen wrench. Regulator must not be clogged and plunger must not be stuck. Check drillings to regulator for fouling.

The non-adjustable oil pressure regulator is interchangeable on all current 5F, H compressors except 5H120 and 126 models. 5H120 and 126 units have larger, non-adjustable regulators. Early 5F, H compressors were equipped with an adjustable-type oil-pressure regulator. When an adjustable-type regulating valve needs replacing, use a non-adjustable regulator.

OIL RETURN CHECK VALVE (5F20-60, AND 5H40-86)

The return check valve allows oil to return from the suction manifold to crankcase. This normally open valve closes when crankcase pressure becomes higher than suction pressure. See Fig. 10.

Two disc-type check valves on 5F20 and 30 compressors are located beneath partition between suction manifold and crankcase, one on each side of compressor. Remove check valves through bottom cover or pump end of compressor.

Leaf-type check valve on 5F40, 60 and 5H40-86 compressors is accessible through, and located at top center of, hand-hole cover opening.

Remove check valves and check to see that flutter valve or leaf does not stick, and that it seats tightly.

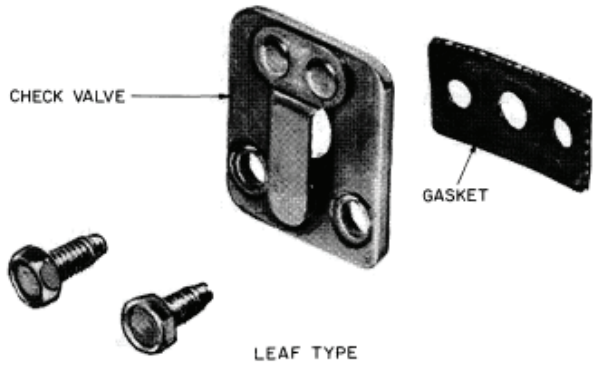


Fig. 10 — Oil Return Check Valves

CENTRIFUGAL OIL SEPARATOR

The centrifugal oil separator is on 5H120 and 126, mounted on crankshaft (see Fig. 11), returns oil to compressor crankcase. To remove or replace oil separator, see “Crankshaft Inspection and Service” on page 16.

OIL FILTER SCREEN

The oil filter screen in the compressor crankcase is accessible through hand-hole cover or bottom plate. Remove and inspect it for holes, then clean it with solvent and replace. (Refer to Fig. 5.)

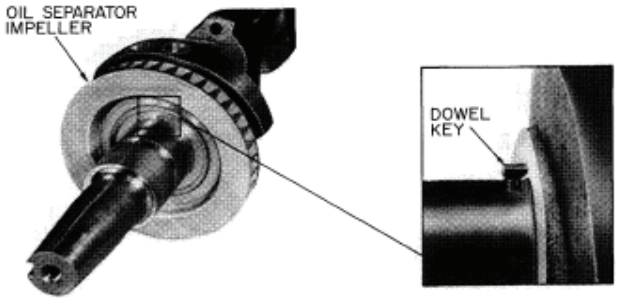


Fig. 11 — Centrifugal Oil Separator Impeller

Pressure-Relief Valves

When pressure differential between high and low-pressure sides exceeds 350 ± 35 psi (5F60: 400 ± 40 psi), pressure-relief valve bleeds refrigerant from high to low side.

Check relief valves for evidence of leaking. Change if defective or if valve has ever opened due to excessive pressure.

5F60 COMPRESSORS

Internal relief valve screws into crankcase and projects up through left cylinder-bank valve plate, (see Fig. 12). Use a standard socket type screwdriver to remove and replace valve.

5H40, 46, 80, AND 86 COMPRESSORS

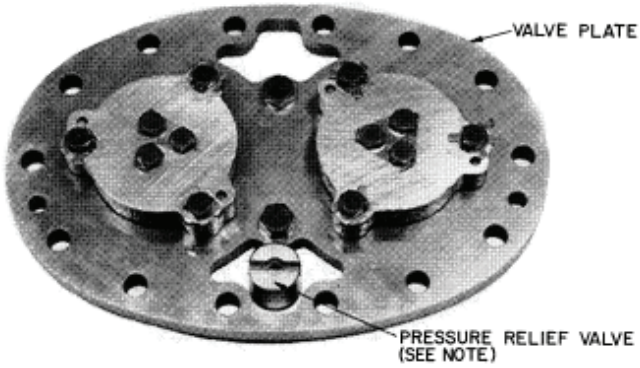
Pressure-relief valve is located on suction and discharge manifold cover (see Fig. 13).

5H60 AND 66 COMPRESSORS

Relief valve is located in wall between suction and discharge manifolds. Remove discharge manifold for access to relief valve. Use a standard 1-1/2 in. socket to remove and install the valve.

5H120 AND 126 COMPRESSORS

The 5H120 and 126 compressors are equipped with external relief valve mounted on bypass line between suction shutoff valve and discharge manifold. To remove valve, remove bolts from flanges on either side of valve.



NOTE: The pressure-relief valve is not part of the valve plate assembly. The valve mounts in the crankcase in the left side cylinder deck (looking at pump end). The valve plate opening outlined slips over the pressure-relief valve when assembled.

Fig. 12 — Pressure Relief Valve (5F60)

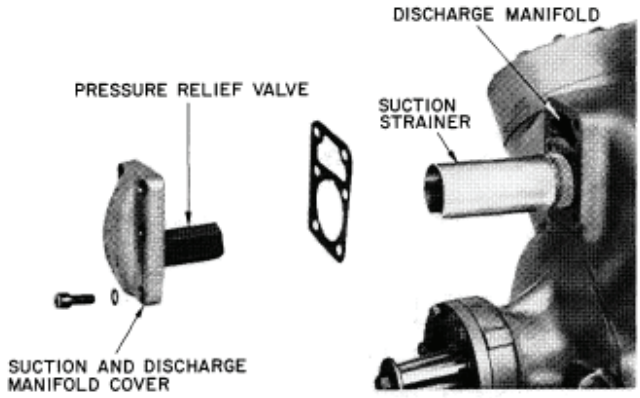


Fig. 13 — Pressure Relief Valve and Suction Strainer (5H40, 46, 80, and 86)

Suction Strainer

To withdraw strainer on 5F20, 40 and 5H40, 46 compressors, remove suction and discharge manifold cover on seal end of compressor.

On 5F30 compressor, remove suction service valve. On 5F60 and 5H60, 66 compressors, remove suction manifold and withdraw 2 strainers. On 5H80 and 86 compressors, remove suction manifold cover.

On 5H120 and 126 compressors, remove one suction manifold plate at a time so as not to disturb position of detachable suction manifold and suction line. Withdraw 2 suction strainers.

Clean strainer with solvent or replace if broken or corroded. When replacing suction strainer, do not damage it.

On 5H120 and 126 compressors, positioned manifold cover plate must compress strainer bail. If bail is too short, grasp on sides and elongate it enough to be compressed by manifold cover. Position bail between the 2 bosses on inside of manifold cover to prevent strainer from turning.

⚠CAUTION

If a felt sock filter is installed, remove and inspect it after 50 hours of operation. Clean filter if required and replace it for another 50 hours. Clean the suction strainer whenever the felt sock is removed. Remove sock when system is clean. (Not applicable for 5F20 and 30 compressors.)

Cylinder Head and Valve Assemblies

CYLINDER HEAD INSPECTION

Remove cylinder heads and check heads for warping, cracks and damage to gasket surfaces.

VALVE INSPECTION

Disassembly

Remove cylinder head. Loosen cap screws holding discharge valve seat to discharge valve guide, and cap screws holding valve guide to valve plate. Remove cap screws holding valve plate to cylinder block. Remove valve plate from cylinder block and discharge valve guide from valve plate. (See Fig. 14.)

Inspection

Inspect suction and discharge valve discs and valve seats for cracks or excessive wear (see Table 5). Check cylinder-sleeve valve stops for uneven wear. Replace valves if cracked or worn. If valve seats are worn, replace complete valve plate assembly. If cylinder-sleeve valve stops are worn, replace sleeve.

Reassembly

Pistons must be below tops of cylinder sleeves. To position correctly, tum crankshaft or force pistons down.

1. Place suction valve springs in valve plate recesses. Large spring coil should be in full contact with bottom of recess.
2. Place suction valve disc on valve springs; press disc into valve plate recess. Slide valve retainer clips into place (see Fig. 15). Clips must not cover valve lifter springs or pins. Valve retainer clips 5F20-2061 (5F compressors) and 5H40-2061 (5H compressors) are field supplied.
3. Bolt valve plate to cylinder block. Remove valve clips.
4. Place discharge valve springs in discharge valve guide spring recesses.
5. Place discharge valve disc over springs, and fit inner spring in place over valve disc. Hand-tighten bolts holding inner seat to valve guide (valve guide assembly).

6. Place valve guide assembly on valve plate. Tighten all bolts and bend tabs on lock washer and lock plates. Replace cylinder head.

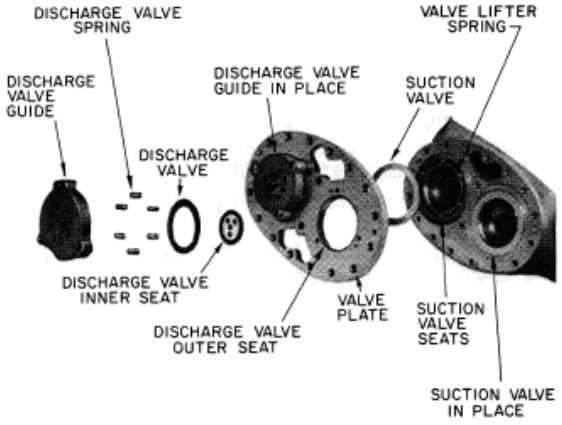


Fig. 14 — Suction and Discharge Valve Assembly

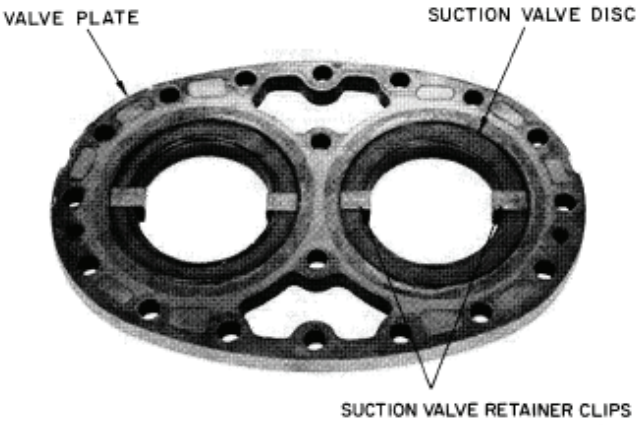


Fig. 15 — Valve Clips in Place Cylinder and Unloader Sleeves

DISASSEMBLY

Remove cylinder head, suction and discharge valve assembly, and pump-end bearing head. Whenever cylinder sleeve or valve plate is replaced, use a new suction valve disc. (See Fig. 16.)

1. Tum crankshaft until piston is in mid-position.
2. Insert a sleeve puller into cylinder and push it down onto top of piston.
3. Tighten nut on top of sleeve puller to expand puller in sleeve.
4. Tum crankshaft, forcing sleeve upward until it can be removed.
5. Remove unloader snap rings (5H compressors only). Disassemble un1oader sleeve, pins and springs.

INSPECTION

Examine bore of sleeve for wear. Check suction valve seats for scratches and wear. Check unloader sleeves, pins and springs for wear and freedom of movement. (See Table 5.)

REASSEMBLY

When new rings are being installed in a used cylinder sleeve, break the hard, glazed surface of cylinder sleeve to reduce wearing-in period of new rings. Clean sleeves thoroughly after breaking glaze.

To reassemble:

1. Rotate crankshaft to position piston at top center.
2. Lubricate piston rings and beveled surface at lower edge of cylinder sleeve.
3. Stagger ring gaps around piston.
4. With turning motion, work sleeve over piston and rings. Compress and align each ring with beveled edge of sleeve.
5. Seat sleeve in suction manifold partition and cylinder deck recess.
6. Rotate sleeve so that any 2 valve lifter-pin holes lie equal distances from longitudinal axis of compressor (see Fig. 16). In this position, lifter pins line up with suction valve springs.

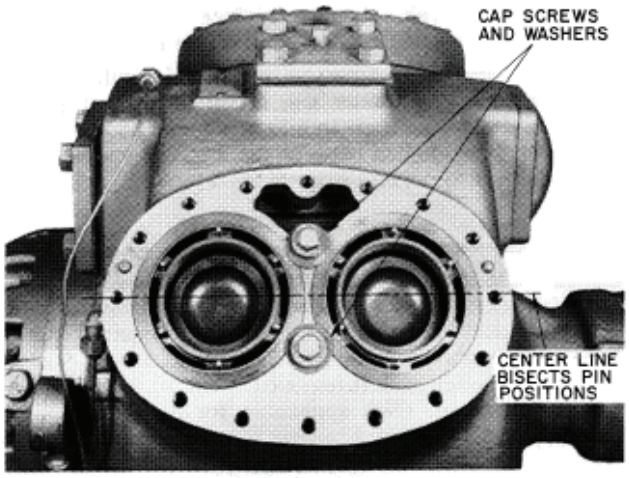


Fig. 16 — Position of Cylinder Sleeves

⚠CAUTION

Never operate compressor with heads or valve plate removed.

Table 5 — Wear Limits—5F, H Compressors

COMPRESSOR PART	COMPRESSOR					
	5F20,30,40,60			5H40,46,60,66,80,86,120,126		
	FACTORY TOLERANCES (in.)		MAXIMUM ALLOWABLE WEAR (in.)	FACTORY TOLERANCES (in.)		MAXIMUM ALLOWABLE WEAR (in.)[a]
	MAX	MIN		MAX	MIN	
SEAL END[b]						
Main Bearing Diameter — 5F20, 30	1.6264	1.6250	0.002	2.6264	2.6250	0.001
— 5F40, 60	2.0636	2.0618	0.001			
Journal Diameter — 5F20, 30	1.6240	1.6233	0.003	2.6235	2.6225	0.002
— 5F40, 60	2.061	2.060	0.002			
PUMP END[b]						
Main Bearing Diameter — 5F20, 30	1.6264	1.6250	0.002	2.2530	2.2502	0.001
(Assembled) — 5F40, 60	1.6264	1.6250	0.001	—	—	—
Journal Diameter	1.6240	1.6233	0.002	2.249	2.248	0.002
CENTER (5H80,86,120,126)[b]						
Main Bearing Diameter	—	—	—	2.6264	2.6250	0.001
Main Bearing Thickness	—	—	—	—	0.0942	0.001
Journal Diameter	—	—	—	2.6235	2.6225	0.002
CONNECTING ROD[b]						
Bearing Diameter	1.6255	1.6245	0.002	2.2505	2.2495	0.002
Bearing Thickness	—	0.06225	0.001	—	0.06225	0.001
Crankpin Diameter	1.6240	1.6233	0.003	—	2.248	0.002
Seal End Bearing Washer Thickness	0.131	0.129	[c]	0.188	0.186	[c]
Seal End Thrust Washer Thickness	0.157	0.155	[c]	0.188	0.186	[c]
Pump End Bearing Washer Thickness	0.131	0.129	[c]	0.188	0.186	[c]
CYLINDERS						
Bore	2.501	2.500	0.003	3.2515	3.2505	0.003
Piston Diameter — Steel, Standard Stroke — Aluminum, Long Stroke	—	2.4980	.003	3.2485	3.2480	0.003
Body	—	—	—	3.241	3.240	0.003
Ring Groove (OD)	—	—	—	3.235	3.232	0.003
Piston Pin Diameter	—	0.7498	0.001	—	0.9998	0.001
Piston Pin Bushing	0.7500	—	0.001	1.000	—	0.001
Piston Ring End Gap (compression and oil)[d]	.009	0.004	.030[d]	0.017	0.007	0.030[d]
PISTON RING SIDE CLEARANCE						
Compression Side	0.0015	0.0005	0.003	0.0015	0.0005	0.003
Oil Side	0.0012	0.0002		0.0012	0.0002	
OIL PUMP						
Axial Clearance	0.0015	0.0005	0.0025	0.0015	0.0005	0.0025
Drive Shaft Diameter	0.4361	0.4356	—	0.4361	0.4356	—
Drive Shaft Bushing Diameter (10)	0.4375	—	—	0.4375	0.4370	—
Drive Shaft Diameter (5H120 and 126)	—	—	—	0.6250	0.6240	—
Drive Shaft Bushing Diameter (ID — 5H120 and 126)	—	—	—	0.6270	0.6260	—
SUCTION VALVE						
Suction Valve Disc (depth of wear below face)	—	—	.005	—	—	0.005
Suction Valve Seat	—	.012	.002	—	0.012	0.002
DISCHARGE VALVE						
Discharge Valve Disc (depth of wear below face)	—	—	.005	—	—	0.005
Discharge Valve Seat	—	.012	.002	—	0.012	0.002

NOTE(S):

a. Same wear allowance applies to undersized shafts and bearings.

b. Re-manufactured service compressors can be built with undersized main bearings and connecting-rod bearings. Compressors with undersized bearings are identified by the letter A, B, or C stamped on the compressor nameplate after the model number, and on both ends of the crankshaft.
A = 0.010 in., B = 0.020 in., C = 0.030 in. undersized bearings.
Replacement bearing heads for compressors with undersized shafts must be field-modified with proper undersized bearing.

c. Replace thrust and bearing washers when end clearance exceeds maximum listed:

CRANKSHAFT END CLEARANCE (in.)	
5F20-5F60	0.011 to 0.035
5H40,46	0.010 to 0.036
5H60,66	0.011 to 0.037
5H80,86	0.014 to 0.042
5H120,126	0.014 to 0.044

d. Gap dimension increases (by up to 10%) when cylinder bores have been honed (if necessary) on 5F, H re-manufactured compressors.

LEGEND

OD — Outside Dimensions
ID — Inside Dimensions

Connecting Rods and Pistons

REMOVAL

Remove cylinder head, valve plate and hand-hole cover or bottom plate to gain access to rods and pistons.

Remove connecting rod caps (refer to Fig. 7). Label caps and rods so they may be reinstalled in same places on crankshaft. Remove cylinder sleeve, connecting rod and piston assembly as a unit by pushing assembly up through cylinder deck. Do not allow piston to come up through top of sleeve during removal process. Remove retaining rings and piston pins to disassemble connecting rods from pistons. Remove rings.

Keep each individual connecting rod and piston assembly together to aid reassembly. Check all parts and crankpin journals for wear. Refer to Table 5.

INSPECTION AND REPLACEMENT

Attach connecting rods to pistons with piston pins and lock in place with retaining rings. Piston pins are selectively fitted for a push fit; reassemble in the piston from which they were removed. Place piston pin retaining rings, with gap on side, on piston (see Fig. 17). They should be tight enough to inhibit rotation under finger pressure.

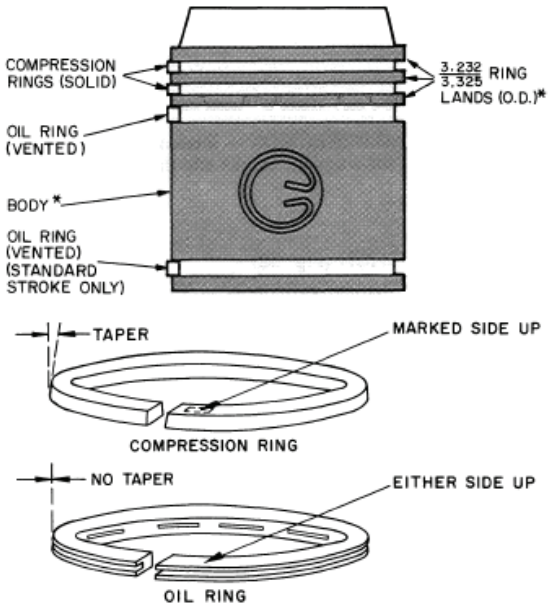
Check Rings

1. Check ring gap by inserting each ring separately in cylinder approximately % in. from top. Ring gap should be between 0.007 and 0.017 in.
2. Install compression rings on piston with marked side up (see Fig. 17) toward piston head. Install oil rings either side up.
3. Stagger ring gaps around piston.
4. Measure side clearance between ring and piston (approximately 0.001 in.). Check rings for free action.

Check Rod Bearing Inserts

If bearing inserts are damaged and crankshaft is not worn, it is only necessary to replace inserts. Do not file bearing caps. Place the inserts in connecting rod and connecting rod caps so knobs on inserts fit into notches on rod cap. Lubricate insert bearing and crankpin freely before installing caps. (Refer to Fig. 6.)

Install cylinder sleeve, connecting rod and piston assembly at the same time. Turn connecting rod, and install cap so chamfered sides are against radius of crankpin. (Small knobs on rod and caps must be on same side of journal.)



*Refer to Table 5 for piston diameters.

Fig. 17 — Piston and Rings

Unloaded Operation

A drop in suction pressure decreases pressure against control valve bellows. Range adjustment spring presses against the push pins, compressing the valve spring. This moves the needle valve off the seat.

Control oil bleeds from hydraulic relay and control valve to crankcase, relieving oil pressure on hydraulic pistons. The piston retracts, preventing transmission of pressurized oil to controlled cylinder power element(s), and the oil drains to crankcase.

As oil pump pressure on power element drops, the piston moves downward. Lifting fork(s) pivot(s) upward, moving lifting pins upward; suction valves rise from their seats and controlled cylinder(s) unload(s). It should be noted that a minimum of 33 to 35 lbs of oil pressure is required for proper unloader operation.

Capacity Control Inspection and Service

UNLOADER POWER ELEMENT REMOVAL

Remove cylinder head, valve plate, connecting rod, piston and cylinder sleeve. Remove Allen head cap screws (2) holding unloader power element in position.

Remove power element (see Fig. 22) and disassemble. Check all parts for wear or damage.

POWER ELEMENT REPLACEMENT

Check unloader fork height (see Fig. 18) of new or assembled power element.

Attach power element to internal suction manifold. Replace cylinder sleeve piston, connecting rod, valve plate, cylinder head, and hand-hole cover. See Fig. 19.

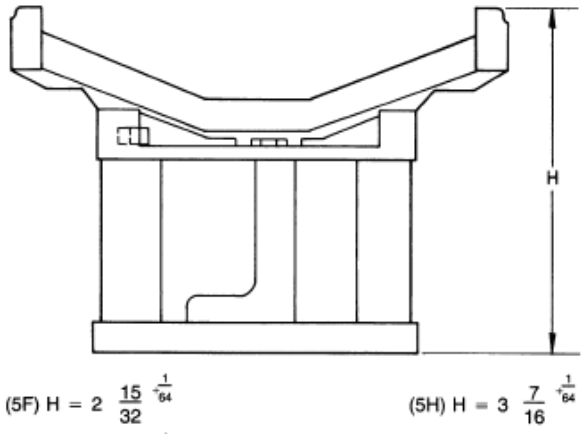


Fig. 18 — Unloader Fork Height (5F and 5H Units)

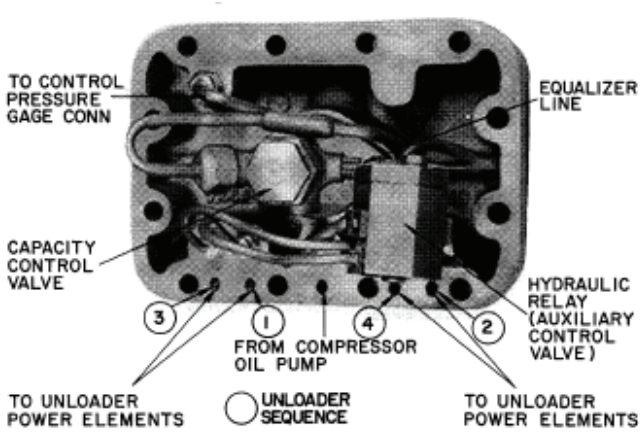


Fig. 19 — Compressor Hand-Hole Cover and Assembly (5F40 and 5F60)

EXTERNAL ADJUSTING STEM REMOVAL

Loosen hex nut at valve stem base and remove adjusting stem assembly. It does not require compressor to be pumped down.

REMOVAL OF CAPACITY CONTROL VALVE AND HYDRAULIC RELAY

Assembly is located in pump-end cover (see Fig. 20) of 5F40 and 5H40-86 units; in pump-end cover (see Fig. 21) of 5H40-86 units; and in pump-end bearing head (see Fig. 21) of 5H120 and 126 units.

Remove capacity control valve and hydraulic relay.

NOTE: It is not practical to remove hydraulic relay from 5H40-5H86 compressors.

Inspect parts for wear, damage, or evidence of leaking or sticking.

A new hand-hole cover, pump-end cover, or pump-end bearing head with control valve assembly and hydraulic relay may be installed. However, capacity control valve (and hydraulic relay on 5H120 and 126 units) is available as a separate parts item for installation on original hand-hole cover, pump-end cover, or pump-end bearing head.

INSPECT CONTROL OIL STRAINER

On 5F compressors, the control oil strainer is located on the side of the pump-end bearing head (refer to Fig. 7).

Strainer is located behind the control oil pressure gauge connection block on the 5H120 and 126 units (refer to Fig. 2) and on pump-end cover (see Fig. 20) of all other 5H compressors.

Remove strainer and inspect it for holes and dirt. Clean it with solvent and replace.

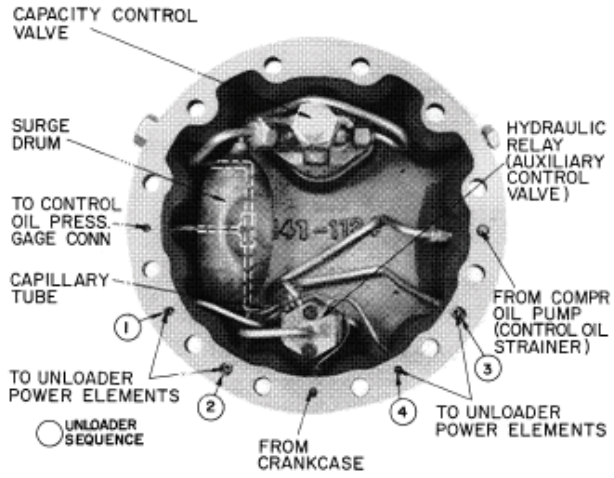


Fig. 20 — 5H Pump-End Cover and Control Assembly (5H40-86)

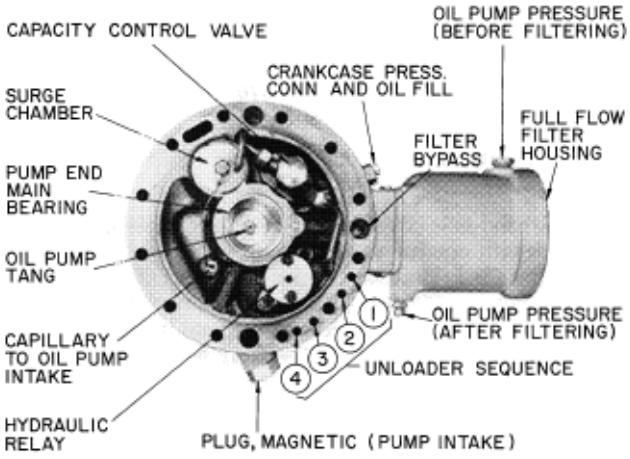


Fig. 21 — 5H120 and 126 Pump-End Bearing Head

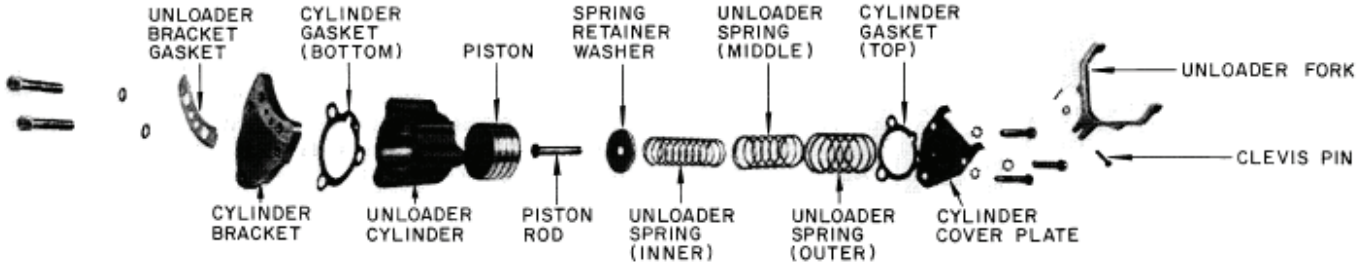


Fig. 22 — Unloader Power Element (Typical)

Crankshaft Inspection and Service

DISASSEMBLY

Remove cylinder heads, valve plates, connecting rod and piston assemblies, and pump-end main bearing head.

On 5H80-126 units, remove hollow-center main bearing lock screw located beneath plug (see Fig. 23) and loosen hollow-cup setscrew (see Fig. 24) until center main bearing can be slid from its support. On 5H86, 120, and 126 units, disconnect oil line to center main bearing. Remove crankshaft through pump-end opening.

Normally it is not necessary to remove the oil separator impeller (Refer to Fig. 11) from the 5H120 or 126 shaft. If impeller must be removed for any reason, however, immerse it in hot water or oil until heated to 180°F or more. Remove all traces of water before reassembly. Do not heat impellers with torch.

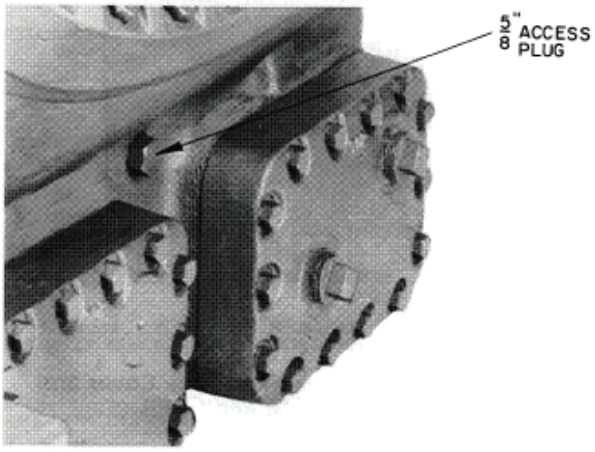


Fig. 23 — 5H80-126 Center Main Bearing Housing Setscrew Location

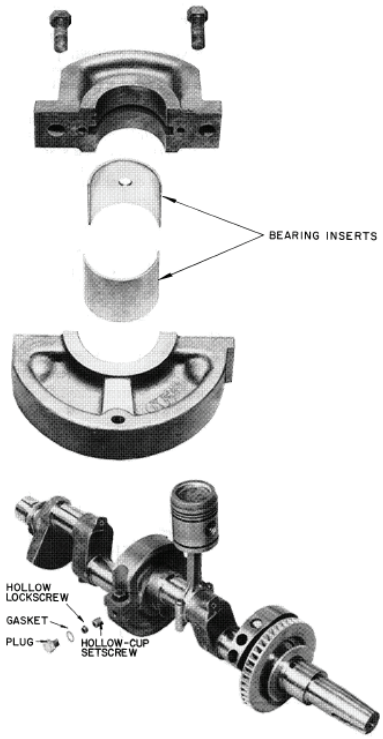


Fig. 24 — Center Main Bearing (5H120 and 126)

INSPECTION

Check crankshaft journals for wear and tolerances (refer to Table 5). Remove crankshaft plugs, check oil passages and clean if clogged.

Connecting-rod bearing inserts and main bearings are available for crankshafts reground from 0.010 in., 0.020 in., or 0.030 in. undersized. Factory-reground crankshafts are stamped on both ends with an A (0.010 in. undersized), B (0.020 in. undersized), or C (0.030 in. undersized).

IMPORTANT: Regrind crankshafts for 5H46, 66, 86, and 126 compressors in the field. Replace shafts with scored journals.

All instructions for field grinding apply only to standard stroke crankshafts.

On crankshafts reground locally, hold throw to 1.001 in. for 5F compressors and to 1.376 in. on 5H compressors. Stamp A or B on crankshaft and pump-end bearing head next to oil pressure gauge connection.

To determine maximum and minimum journal diameters for undersized shafts, subtract the amount (in.) that the shaft will be ground undersize from factory from the tolerances specified in Table 5. For example, the factory tolerance for 5H40 seal-end journal is 2.6225 in. to 2.6235 in. Tolerance for a crankshaft reground to 0.010 in. undersize should therefore be held between 2.6125 in. and 2.6135 in.

IMPORTANT: When regrinding the seal-end journal on 5H120 crankshaft, do not grind in the area of the oil separator impeller. This is not journal area, and must remain intact or the oil separator impeller will not fit properly.

REASSEMBLY

If 5H120 or 5H126 oil separator has been removed (see Step 2), read impeller paragraph below before installing crankshaft.

When regrinding crankshaft, remove crankshaft plugs and clean oil passages as well. Before replacing crankshaft, insert and tighten plugs, and reinstall the 5H120 and 126 oil separator impeller:

1. Insert dowel key (refer to Fig. 11) with axis parallel to axis of crankshaft. Position key so chamfered edge is toward radius of crankshaft journal.
2. Immerse oil separator impeller in oil or hot water to heat it to 180°F or more. If water is used, remove all traces before reassembly. Install impeller on crankshaft with dowel key lined up with impeller keyway. Impeller must fit key snugly.
3. Check that seal-end thrust washer is in place on dowel key in crankcase.

Insert crankshaft and install pump-end bearing head, connecting rod and piston assemblies, valve plate and cylinder heads. On 5H80-126 units, insert center main bearing setscrew and lock screw. On 5H86, 120, and 126 units, reconnect oil line to center main bearing.

Pump-End Main Bearing

DISASSEMBLY AND INSPECTION

On 5H40-86 units, remove pump-end cover. Remove pump-end bearing head on all units. Inspect bearing for tolerances shown in Table 5. If a pump-end main bearing is worn, remove bronze bearing washer, and chisel out bearing. Inspect bearing housing for wear (see Table 5) and damage. Remove any burrs. See Fig. 25.

REASSEMBLY

1. Lubricate outside of new bearing with heavy grease.
2. Line up hole in bearing with oil port in housing.
3. Press bearing into place using a puller shoulder (see Table 6 and Fig. 26 and 27) and jack screw or bearing press.
4. Place bearing washer on bearing with notch in washer properly positioned around dowel pin (see Fig. 25).

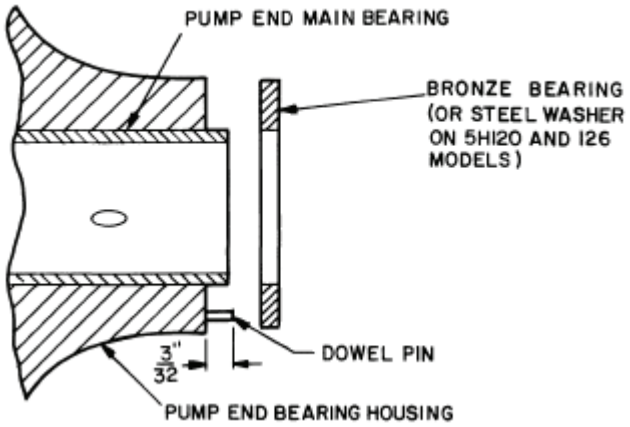


Fig. 25 — Pump-End Main Bearing Position

Table 6 — Main Bearing Puller Sizes[a]

COMPRESSOR	PULLER SIZE
5F20, 5F30	5F20
5F40,5F60	5F40
5H40, 46, 60, 66, 80, 86, 120,126	5H140

NOTE(S):
a. Bearing pullers can be ordered through Carlyle or Totaline Parts.

Center Main Bearing

For size 5H80-126 compressors have a center main bearing and housing.

DISASSEMBLY AND INSPECTION

On 5H86, 120, and 126 compressors:

1. Disconnect oil line to center main bearing.
   NOTE: 5H80 center main bearings are fed through the shaft.
2. Remove plug on compressor crankcases (refer to Fig. 23). Then remove hollow lock screw beneath the plug (refer to Fig. 24). Next, loosen hollow-cup setscrew until center main bearing assembly can be slid from its support. Remove crankshaft and bearing assembly.
3. Disassemble bearing (refer to Fig. 24) and inspect for proper tolerances (refer to Table 5).

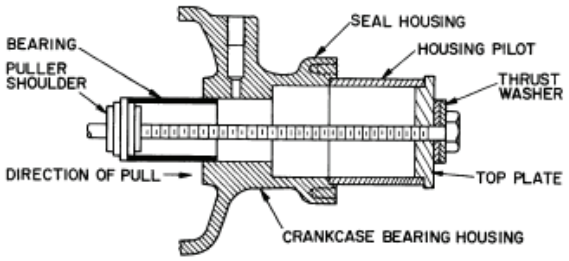


Fig. 26 — Seal-End Main Bearing (5F40, 60)

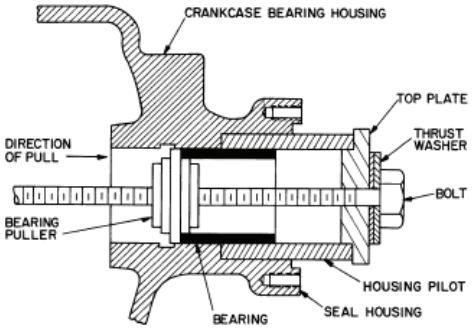


Fig. 27 — 5H Seal-End Main Bearing

REASSEMBLY

Install the new bearing inserts. Assemble bearing housing on crankshaft, but do not tighten the hollow-cup setscrews. Install crankshaft, center main bearing and housing, and pump-end main bearing assembly. Tighten bolts holding the pump-end main bearing assembly. Rotate crankshaft while tightening setscrew on center main bearing housing. Setscrew should tighten fully without any binding of crankshaft. If binding occurs, shim the opposite side of bearing housing, using 0.001 in. shim stock.

Seal-End Main Bearing

DISASSEMBLY AND INSPECTION

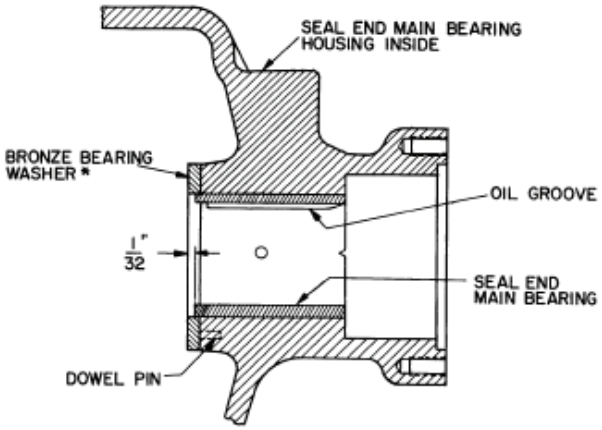
With crankshaft removed, use a bearing puller with a shouldering device to remove and install seal-end main bearings. (Refer to Fig. 26 and 27). Bearing pullers can be ordered through Carlyle or Totaline Parts.

Inspect bearing and bearing housing for tolerances shown in Table 5.

REASSEMBLY

Remove any burrs and clean bearing housing before replacing bearing. Lubricate outside of bearing with heavy grease.

1. Position bearing so chamfered edge enters bearing housing first, oil holes in bearing and housing are aligned and bearing relief groove is at top.
   NOTE: On size 5H 120 and 126 compressors oil hole in bearing and housing will not be aligned.
2. Pull bearing into housing (see Fig. 28). Edge of bearing should be 1/32 in. below surface of bronze bearing washer.
3. Look through oil pressure regulator opening to check oil passage for blockage.
4. Blow out oil groove in bearing housing and oil lines (if any) to it.



*Steel washer on 5H120 and 126 models.

Fig. 28 — Seal-End Main Bearing Positioning

Crankshaft Seal Inspection and Replacement

The crankshaft seal in all current 5F, H compressors is a rotating, bellows-type seal. This seal is the service replacement for all earlier seal assemblies. Figure 29 shows Types I and II of this design (5H40-5H126 compressors). Refer to Fig. 29 and 30.

IMPORTANT: Do not attempt to repair or replace seal components. Replace complete seal assembly with current rotating-bellows-type assembly. Do not disassemble bellows assembly of service replacement seal.

BEFORE INSTALLING SEAL

1. Pump-end bearing head must be in place for proper positioning of seal on crankshaft.
2. Be sure shaft extension and edges of keyway are free of sharp edges and nicks. Shaft must be clean and free of rust. Polish shaft with crocus cloth.
3. Check seal assembly for proper bellows placement and cleanliness.
4. Apply compressor oil to seal assembly and crankshaft, completely saturating bellows and carbon ring.

INSTALLATION

Refer to Fig. 30 for procedure.

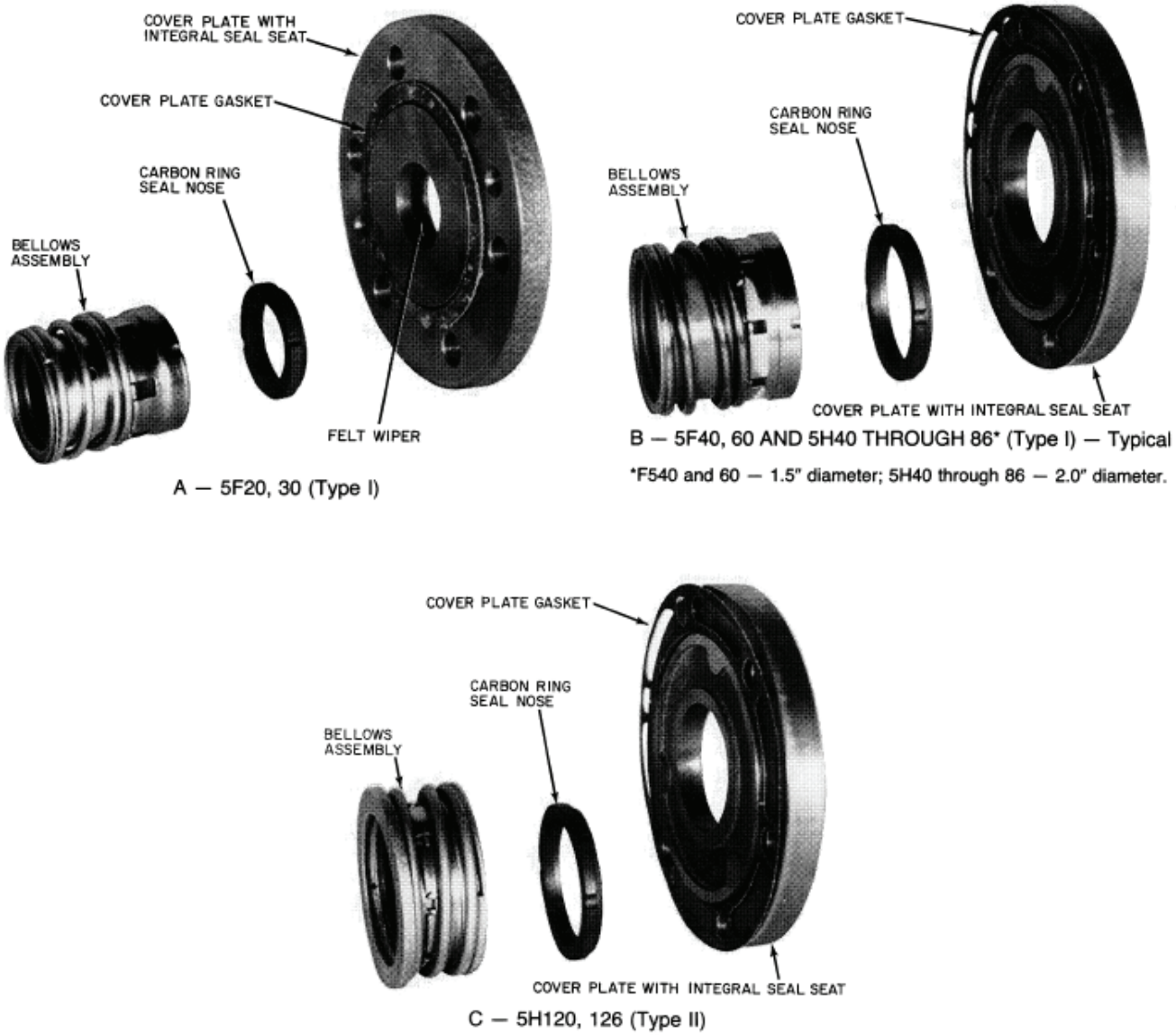
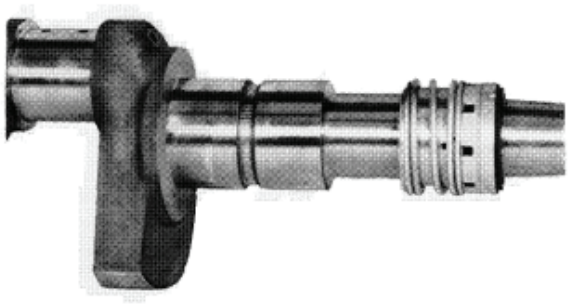
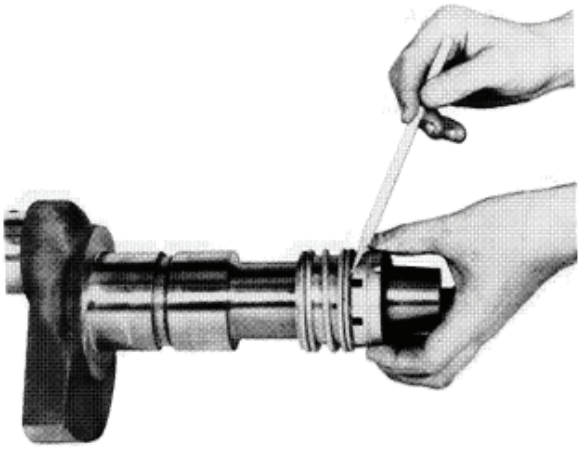


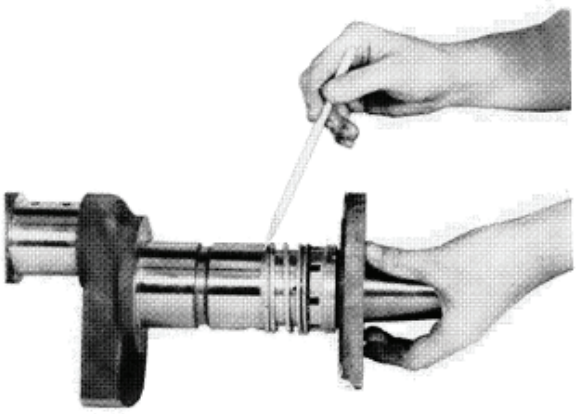
Fig. 29 — Service Replacement Seals



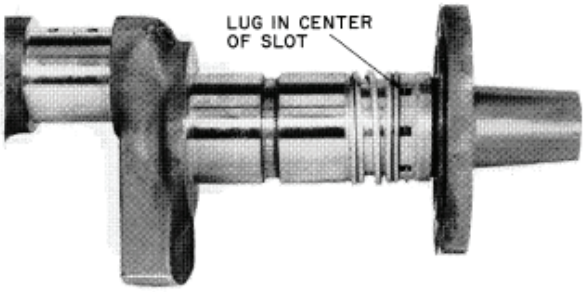
Step 1 - Lubricate the shaft and the neoprene bellows where it comes in contact with the shaft. Slide the seal assembly, as it is shipped from the factory, onto the shaft until the neoprene just starts to grasp the shaft.



Step 2 - Holding the sleeve and spring assembly, pull forward on the seal nose assembly at the same time, turning it so that the lugs on the driving band are out of the slots in the retainer shell and rest on the surface of the retainer shell as shown by the pencil. (This does not apply to the 5H120 Type II seal. Lugs are permanently fixed.)



Step 3 - Using the seal cover plate, push the seal assembly into its proper location on the shaft. DO NOT use cover plate bolts to push seal into position. The spring guide should be tight against the shaft shoulder as shown by the pencil. Remove the cover plate, being careful not to damage the carbon washer. GRASP THE SEAL NOSE ASSEMBLY AND TURN IT UNTIL THE LUGS ON THE DRIVING BAND DROPBACK INTO THE SLOTS IN THE RETAINER SHELL.



Step 4- Lubricate the carbon seal washer and seal seat. Reinstall the seal cover plate, drawing the bolts down evenly to prevent damage to the carbon seal nose. This view shoes the lugs of the driving band properly positioned m the center of the slots in the seal retainer shell. This is the correct position during operation. This prevents the seal from being used as a thrust washer under all operating conditions.

NOTE: The seal may leak slightly immediately after installation, but a short period of operation will correct the condition.

Fig. 30 — Installation of Sleeve-Type Rotary Seal

APPENDIX A — TROUBLESHOOTING

TROUBLE/SYMPTOM	PROBABLE CAUSE	REMEDY
Compressor will not start	Power off.	Check main switch, fuse and wiring.
	Thermostat set too high.	Reset thermostat.
	Thermal overload switch open.	Reset switch.
	Oil safety switch open.	Reset switch.
	Dirty contacts.	Clean all control contacts.
	Loose electrical connections or faulty wiring.	Tighten connections; check wiring and rewire.
	Compressor motor burned out.	Check and replace if defective.
	Liquid line solenoid valve closed.	Check for burned-out holding coil. Replace if defective.
	Evaporator fan off.	Check fuses, overload. Restart.
	Evaporative condenser or cooling tower fan or pump not operating.	Check fuses, overloads and controls. Restart.
Compressor cycles intermittently	Low-pressure switch erratic in operation.	Check for clogged tubing to switch. Check switch setting.
	Low refrigerant charge.	Add refrigerant.
	Capacity control setting incorrect.	Reset.
	Thermostat differential too narrow.	Reset.
	Suction valve closed or throttled.	Open up valve.
Compressor cycles on high pressurestat	Tubing to pressurestat restricted.	Check and clean tubing.
	Faulty pressurestat.	Repair or replace.
	Refrigerant overcharge.	Remove excess refrigerant.
	Insufficient condenser water flow or clogged condenser.	Adjust water regulating valve to condenser. Clean condenser.
	Discharge service valve not fully open.	Open valve.
	Air in system.	Purge air.
	Condenser water pump off.	Check pump and start.
High discharge pressure	Condenser inlet water temperature too high.	Increase water quantity by adjusting water regulating valve. Use colder water.
	Insufficient water flow through condenser.	Readjust water regulating valve. Increase size of water supply main to condenser.
	Plugged or scaled condenser tubes.	Clean tubes.
	Discharge service valve partially closed.	Open valve.
	Refrigerant overcharge.	Remove excess refrigerant.
	Air in system.	Purge air.
Low discharge pressure	Excessive water flow through condenser.	Adjust water regulating valve.
	Suction service valve partially closed.	Open valve.
	Leaky compressor suction valves.	Examine valve discs and valve seats. Replace if worn.
	Worn piston rings.	Replace.
Flooding	Defective or improperly set expansion valve.	Reset to 5°F-10°F superheat. Valve operation must be stable (no hunting).
Low suction pressure	Low refrigerant charge.	Add refrigerant.
	Excessive superheat.	Reset expansion valves.

APPENDIX A — TROUBLESHOOTING (CONT)

TROUBLE/SYMPTOM	PROBABLE CAUSE	REMEDY
System noises	Loose or misaligned coupling.	Check alignment and tightness.
	Insufficient clearance between piston and valve plate.	Replace defective parts.
	Motor or compressor bearing worn.	Replace bearings.
	Loose or misaligned belts.	Check alignment and tension (Belt slack should be at top).
	Loose holddown bolts.	Tighten bolts.
	Unit foundation improperly isolated.	Isolate foundation.
	Improper support or isolation of piping.	Use correct piping techniques and support piping with suitable hangers.
	Slugging from refrigerant feedback.	Check expansion valve setting. Check thermal bulb looseness and correct location. See Carlyle System Design Manual, Part 3 for standard piping techniques.
	Hydraulic knock from excessive oil in circulation.	Remove excess oil. Check expansion valve for floodback.
	Defective valve lifter mechanism (noise level varies with unloading).	Replace sticking filter pins. Check unloader fork for alignment. Check power element for sticking piston. Check for oil leakage at tube connection to power element. Check amount of valve pin lift above valve seat (0.33 in. for 5F; 0.125 in. for 5H).
	Piping vibration.	Support pipes are required. Check pipe connections.
	No muffler in discharge line or improperly located.	Install muffler. Move muffler closer to compressor.
	Hissing (insufficient flow through expansion valves, or clogged liquid line strainer).	Add refrigerant. Clean strainer.
Compressor will not unload	Capacity control valve not operating.	Repair.
	Unloader element sticking.	Repair.
	Hydraulic relay sticking.	Replace control cover assembly.
	Plugged pressure line to power element.	Clean line.
	External adjusting stem damaged.	Replace.
Compressor will not load	Low oil pressure (below 35 psig).	Check oil charge, switch settings.
	Capacity control valve stuck open.	Repair or replace.
	Unloader element sticking.	Repair.
	Plugged or broken pressure line to power element.	Clean or repair.
	External adjusting stem damaged.	Replace.
	Control oil strainer blocked.	Clean or replace.
	Control valve bellows leaking.	Remove thread protector and leak test.
		Replace valve body if bellows leaks.
	Pipe plug in pneumatic connection.	Remove pipe plug.
	Foaming in crankcase from refrigerant flooding.	Check expansion valve and piping.
	Hydraulic relay sticking.	Replace control cover assembly.
Rapid unloader cycling	Excessive fluctuation in suction pressure from oversized expansion valve.	Resize expansion valve.
	Partially plugged control oil strainer.	Clean or replace strainer.
	Low oil pressure.	See Trouble/Symptom - low oil pressure.
Low oil pressure	Low oil charge.	Add oil.
	Faulty oil gauge.	Check and replace.
	Defective oil pressure regulator.	Repair or replace.
	Clogged oil suction strainer.	Clean strainer.
	Broken oil pump tang.	Replace pump assembly.
	Clogged oil line.	Remove obstruction.
	Worn oil pump.	Replace pump assembly.
	Worn compressor bearings.	Replace.
Cold compressor	Liquid carryover from evaporator.	Check refrigerant charge and expansion valves.
Low crankcase oil level	Oil return check valve stuck closed.	Repair or replace check valve.
Cylinders and crankcase sweating	Refrigerant floodback.	Check refrigerant charge and expansion valves.
High crankcase temperature (should be 150°F to 160°F max. at seal housing)	Liquid line strainer clogged.	Clean strainer.
	Excessive superheat.	Reset expansion valves.
	Compression ratio too high.	Recheck design.
	Discharge temperature over 275°F.	Check unit application.
	Leaking suction or discharge valves.	Replace valves.