To ensure satisfactory operation and to prevent potentially costly damage to the compressor, the installation prestart-up, checkup and start, as well as the maintenance, must be done by a qualified/authorized refrigeration mechanic.

See page 2 for initial start information.

It is not the intent of this manual to provide complete compressor specifications, only to deliver information necessary to guard against some common installation/operation problems. Only when specifically referring to warnings and cautions will this manual take precedence over instructions supplied by the manufacturer of the unit.

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</tr>
</tbody>
</table>

**NOTICE:** This manual contains specific warnings and cautions that must be observed to insure proper operation and life of the compressor. Failure to observe these instructions will void the compressor warranty.
RECEIVING AND STORAGE

The compressor, whether received as a part of a unit or as bare compressor must be checked in the presence of the carrier’s REPRESENTIVE for any evidence of shipping damage. Any damage or missing item must be immediately documented with the carrier. Should the carton or skid show definite signs of being dropped, such damage must be reported since it may cause internal damage to the compressor. A damage claim must be filed by the purchaser against the delivering carrier, since all shipments are made at the purchasers risk.

NOTE: COVER PLATES SENT ON THE REPLACEMENT COMPRESSOR MUST BE USED ON THE COMPRESSOR TO BE RETURNED.

COMPRESSOR STORAGE

During storage a large screw compressor (LSC) must be maintained under a positive pressure. A gauge and weekly inspection log are required and must be verifiable for warranty purposes. The LSC has a normal charge of dry refrigerant, or nitrogen, of 25 PSIG (.172mPa). A minimum charge of 5 PSIG must be maintained. Dry air is not allowable in the compressor under any circumstances. The torque should be checked on all plugs and suction and discharge service valves. For prolonged storage, it is recommended that a plastic cover be placed over the entire compressor to protect the compressor from dust and other atmospheric contaminants.

SEASONAL STORAGE ON A PACKAGE UNIT

Dunham-Bush recommends the following procedures be completed, to reduce any potential startup problems.

1. Oil should be checked for acid content with a field test kit (See Figure-1 for kit part numbers), which can be ordered from Dunham-Bush Customer Service. If the readings are less than satisfactory, an oil sample should be taken to a laboratory for full analysis.

OIL KIT ANALYSIS PART NUMBERS

Figure-1

<table>
<thead>
<tr>
<th>Compressor Type</th>
<th>Dunham-Bush Part Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Drive Compressors</td>
<td>053507A1</td>
</tr>
<tr>
<td>Hermetic Compressors</td>
<td>053507A2</td>
</tr>
</tbody>
</table>
3. If the moisture indicator of the system shows less than dry condition, an immediate change of dryer cores should be made. A dryer change may be made several hours after start up if the indicator continues to show less than a dry condition. A drier change should be made before completion of each start-up.

4. If the system has lost its entire refrigerant charge, the system must be re-evacuated after the leak has been corrected. After start up several changes of the dryer should be made to insure minimum moisture levels.

INSTALLATION

1. HOLDING CHARGE

The LSC compressor is shipped with a positive pressure (approximately 25 PSI/.172 mPa) holding charge of dry gas to protect the LSC compressor from moisture and other contamination.

2. LIFTING

There are lifting holes placed throughout on various locations of the compressor, the main rotor housing, plate assembly, inlet housing, and cover to the outlet end, and transition housing. Proper lifting procedures must be followed to insure safety to the technician and the LSC compressor.

APPROXIMATE COMPRESSOR WEIGHTS

<table>
<thead>
<tr>
<th>Model</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>1610</td>
<td>905</td>
</tr>
<tr>
<td>1615</td>
<td>1025</td>
</tr>
<tr>
<td>2010</td>
<td>1275</td>
</tr>
<tr>
<td>2015</td>
<td>1435</td>
</tr>
<tr>
<td>2018</td>
<td>1550</td>
</tr>
<tr>
<td>2510</td>
<td>2100</td>
</tr>
<tr>
<td>2512</td>
<td>2250</td>
</tr>
<tr>
<td>2515</td>
<td>2400</td>
</tr>
<tr>
<td>2516</td>
<td>2575</td>
</tr>
<tr>
<td>2519</td>
<td>2850</td>
</tr>
</tbody>
</table>
3. Lifting eye bolts (not supplied) are 5/8 - 11 x 1" placed in the lifting holes as mentioned in line 2, proper location is shown in figure 1-1. For best results place the lifting eye bolts on the inlet housing, and 2 locations on the rotor housing, if there is a optional transition housing an additional eye bolt is required. The eye bolt is placed in the transition housing.

![Figure 1-1](image)

**REMOVING THE HOLDING CHARGE**

1. Keep openings closed until just prior to making individual connections.

2. Remove the holding charge via the schraeder fitting beside oil injection port.

3. Ensure dry nitrogen is flowing from the compressor when brazing or welding is required on the lines when it is connected to the compressor.

4. Ensure that there is no water introduced into the compressor while cooling of the joints, make sure all line and fittings are cleaned and that there are no solid contaminants introduced.

**EVACUATION**

1. Open all the package shut off valves and control the isolation valves to a front seat position (DO NOT BACKSEAT).

2. Connect a vacuum line to the most convenient available fitting that is equipped with a shut off valve.

3. Pull a vacuum in the system to a minimum of 300 microns.

4. Shut off the vacuum pump and observe the loss of vacuum for 30 minutes, if the holding vacuum reading rises within 30 minutes to 800 microns, the process must be repeated.

5. In case of a leak repeat the process is not successful the loss a vacuum again exceeds 800 microns inspect the unit, including compressor for leaks and check possibility that a major amount of water is trapped somewhere in the system.

6. If there is more than one compressor that is piped into the same system, multiply the same time allowed by the number of compressors, but use the same vacuum limits.

**NOTE**: No compressor should be started or operated until the proper evacuation procedure has been successfully completed.
**Typical Piping Connection Locations 163mm E and F**

Note: This drawing depicts typical piping for all 'E', 'F' and some 'D' 163 compressors. Piping may vary from application to application - consult factory.

### Table: Connection Description and Locations

<table>
<thead>
<tr>
<th>CONNECTION</th>
<th>DESCRIPTION</th>
<th>LOCATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td>Plug - Bleed - Alt Suction Press Port</td>
<td>Female Slide of Inlet Housing</td>
</tr>
<tr>
<td>C3</td>
<td>Plug - Bearing Oil Feed</td>
<td>Between Suction and Bal. Piston Cover on Inlet Housing</td>
</tr>
<tr>
<td>C4</td>
<td>Plug - Main Oil Port</td>
<td>Inlet Cover Male Side - On large Boss</td>
</tr>
<tr>
<td>C5</td>
<td>Plug - Unloader Port</td>
<td>Top of Balance Piston Cover</td>
</tr>
<tr>
<td>C6</td>
<td>Plug - Main Oil Injection Pot</td>
<td>Outside Diameter, Male Side of Piston Cover</td>
</tr>
<tr>
<td>C8</td>
<td>Plug - Seal Oil Supply</td>
<td>Outside Diameter of Discharge Plate Male Side</td>
</tr>
<tr>
<td>C10</td>
<td>Plug - Shaft Seal Oil Port</td>
<td>Discharge Housing, Boss Male Side</td>
</tr>
<tr>
<td>C11</td>
<td>90 DEG Elbow Seal Weapage Drain</td>
<td>Seal Housing - Drive Rotor</td>
</tr>
<tr>
<td>C12</td>
<td>Plug - Unloader Oil Supply Port</td>
<td>Center of Balance Piston Cover</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Internal Oil Version</td>
</tr>
<tr>
<td>C13</td>
<td>Plug - Liquid Injection Port</td>
<td>Female Side - Outlet End Housing</td>
</tr>
<tr>
<td>C14</td>
<td>Plug - Discharge Pressure Port</td>
<td>Discharge Rotor Boss</td>
</tr>
<tr>
<td>C15</td>
<td>Plug - Oil Failure Port</td>
<td>Rotor Housing - Male Side</td>
</tr>
<tr>
<td>D1</td>
<td>Plug - Loading Oil Port (dbl Act Only)</td>
<td>Male Side of Unloader Piston Flange</td>
</tr>
<tr>
<td>D2</td>
<td>Plug - Atmosphere Drain</td>
<td>Boss - Bottom of Unloader Cover</td>
</tr>
<tr>
<td>V1</td>
<td>Plug - Vapor Injection Port</td>
<td>Female side of rotor housing</td>
</tr>
</tbody>
</table>
## TYPICAL PIPING CONNECTION LOCATIONS 204mm E AND F

**Diagram:**
- Cam Actuated Unloader Controller used on all 'E' compressor models
- Seal Oil Cooler option used with C13-Liquid Inj. option below
- P.R.V.
- C4-Int. Tee
- C5 - 'E' only
- C8 - CV
- C10
- C11
- C14
- D2 Air vent
- C3
- C13 - Liquid Inj. option used with Seal Oil Cooler option - see below
- C2 - Int.
- C6
- CV
- C15

**Note:** This drawing depicts typical piping of 204 'E', 'F' & some 'J' version compressors. Piping may vary for each application. 'C' locations and piping sizes may vary slightly for clarity. If locations and sizes are in question, consult factory.

### CONNECTION TABLE

<table>
<thead>
<tr>
<th>CONNECTION</th>
<th>DESCRIPTION</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2 ALT</td>
<td>Plug, Bleedoff and Suction Press Port</td>
<td>Bottom of Inlet Housing Boss</td>
</tr>
<tr>
<td>C2</td>
<td>Plug, Bleed- Alt Suction Press Port</td>
<td>Female Slide of Inlet Housing</td>
</tr>
<tr>
<td>C3</td>
<td>Plug, Bearing Oil Feed</td>
<td>Between Suction and Bal. Piston Cover on Inlet Housing</td>
</tr>
<tr>
<td>C4</td>
<td>Plug, Main Oil Port</td>
<td>Inlet Cover Male Side - On large Boss</td>
</tr>
<tr>
<td>C5</td>
<td>Plug, Unloaded Port</td>
<td>Top of Balance Piston Cover</td>
</tr>
<tr>
<td>C6</td>
<td>Plug, Main Oil Injection Pot</td>
<td>Outside Diameter, Male Side of Piston Cover</td>
</tr>
<tr>
<td>C8</td>
<td>Plug, Seal Oil Supply</td>
<td>Outside Diameter of Discharge Plate Male Side</td>
</tr>
<tr>
<td>C10</td>
<td>Plug, Shaft Seal Oil Port</td>
<td>Discharge Housing, Boss Male Side</td>
</tr>
<tr>
<td>C11</td>
<td>90 DEG Elbow Seal Weapage Drain</td>
<td>Seal Housing - Drive Rotor</td>
</tr>
<tr>
<td>C12</td>
<td>Plug, Unloader Oil Supply Port</td>
<td>Center of Balance Piston Cover</td>
</tr>
<tr>
<td></td>
<td>Internal Oil Version</td>
<td></td>
</tr>
<tr>
<td>C13</td>
<td>Plug, Liquid Injection Port</td>
<td>Female Side - Outlet End Housing</td>
</tr>
<tr>
<td>C14</td>
<td>Plug, Discharge Pressure Port</td>
<td>Discharge Rotor Boss</td>
</tr>
<tr>
<td>C15</td>
<td>Plug, Oil Failure Port</td>
<td>Rotor Housing - Male Side</td>
</tr>
<tr>
<td>D1</td>
<td>Plug, Loading Oil Port (dbl Act Only)</td>
<td>Male Side of Unloader Piston Flange</td>
</tr>
<tr>
<td>D2</td>
<td>Plug, Atmosphere Drain</td>
<td>Boss - Bottom of Unloader Cover</td>
</tr>
<tr>
<td>V1</td>
<td>Plug, Vapor Injection Port</td>
<td>Female side of rotor housing</td>
</tr>
</tbody>
</table>
## TYPICAL PIPING CONNECTION LOCATIONS 255mm E AND F

**Diagram Description:**
- Cam activated Unloaded Controller is used on all 'E' and 'F' 255 compressor models for 'C' location of 'C5' and 'C6' refer to drawing below.
- Liquid injection option at C13 port is used with Seal Oil Cooler option connecting part here.
- Refer to Oil Failure Switch conn. dwg. below for 2516 models only.
- Seal Oil Cooler option shown is used with Liquid injection option at C13 port.
- Check Valve is sometimes installed between C8 and C10 locations. Consult Factory. Additional information on 2516 models per oil failure connection see drawing below.

### Table: Connection Description and Locations

<table>
<thead>
<tr>
<th>CONNECTION</th>
<th>DESCRIPTION</th>
<th>LOCATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2ALT</td>
<td>Plug, Bleedoff and Suction Press Port.</td>
<td>Bottom of Inlet Housing Boss</td>
</tr>
<tr>
<td>C2</td>
<td>Plug Bleed- Alt Suction Press Port.</td>
<td>Female Slide of Inlet Housing</td>
</tr>
<tr>
<td>C3</td>
<td>Plug- Bearing Oil Feed</td>
<td>Between Suction and Bal. Piston Cover on Inlet Housing</td>
</tr>
<tr>
<td>C4</td>
<td>Plug - Main Oil Port</td>
<td>Inlet Cover Male Side - On large Boss</td>
</tr>
<tr>
<td>C5</td>
<td>Plug - Unloader Port</td>
<td>Top of Balance Piston Cover</td>
</tr>
<tr>
<td>C6</td>
<td>Plug - Main Oil Injection Port</td>
<td>Outside Diameter, Male Side of Piston Cover</td>
</tr>
<tr>
<td>C8</td>
<td>Plug - Seal Oil Supply</td>
<td>Outside Diameter of Discharge Plate Male Side</td>
</tr>
<tr>
<td>C10</td>
<td>Plug - Shaft Seal Oil Port</td>
<td>Discharge Housing, Boss Male Side</td>
</tr>
<tr>
<td>C11</td>
<td>90 DEG Elbow Seal Weapage Drain</td>
<td>Seal Housing - Drive Rotor</td>
</tr>
<tr>
<td>C12</td>
<td>Plug - Unloader Oil Supply Port</td>
<td>Center of Balance Piston Cover</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Internal Oil Version</td>
</tr>
<tr>
<td>C13</td>
<td>Plug - Liquid Injection Port</td>
<td>Female Side - Outlet End Housing</td>
</tr>
<tr>
<td>C14</td>
<td>Plug - Discharge Pressure Port</td>
<td>Discharge Rotor Boss</td>
</tr>
<tr>
<td>C15</td>
<td>Plug - Oil Failure Port</td>
<td>Rotor Housing - Male Side</td>
</tr>
<tr>
<td>D1</td>
<td>Plug - Loading Oil Port (dbl Act Only)</td>
<td>Male Side of Unloader Piston Flange</td>
</tr>
<tr>
<td>D2</td>
<td>Plug - Atmosphere Drain</td>
<td>Boss - Bottom of Unloader Cover</td>
</tr>
<tr>
<td>V1</td>
<td>Plug - Vapor Injection Port</td>
<td>Not Shown on Drawing - Refer to VI ADP for Location</td>
</tr>
<tr>
<td>V1 ADP</td>
<td>Adapter - Vapor Injection Port</td>
<td>Located, Female side of Rotor Housing</td>
</tr>
</tbody>
</table>
COMPRESSOR PIPING

COMPRESSOR PIPING INSTALLATION

1. Suction port piping should include a filter, and a check valve to prevent compressor reverse rotation when compressor shut-down occurs.

2. Oil piping and operation: Ref. see pages 4, 5, and 6. The oil is introduced into the compressor during the compression cycle, the compressor has no sump and therefore no oil is charged into the compressor. The oil is separated from the compressor discharge gas in an external oil separator with a sump. The oil must be cooled and filtered prior to reinjection into the compressor, see the data sizing sheet for the required entering temperature and cooler load. A 10 micron replaceable cartridge filter is required. Ports C4 and C3 require pumped oil at 55 PSI above discharge pressure, see sizing data for flow required. Port C6 is either injected oil not pumped, or pumped. See sizing data for flow required.

3. Port C15 is an oil pressure tap for the oil pressure switch.

4. Vapor injection port, usage optional by designer. The vapor injection feature, when utilized, increases the compressor capacity and power. The system consists of a heat exchanger, thermal expansion valve, strainer, and check valve. The basic principle is a small portion of the refrigerant liquid is fed through a thermal expansion valve to one circuit of a refrigerant to refrigerant heat exchanger. The liquid is evaporated by the remaining liquid refrigerant passing through the other circuit of the heat exchanger. The refrigerant gas is then injected into the compressor at an intermediate point in the rotor compression. This increases the subcooling of the liquid to the evaporator, resulting in an increase of the refrigerant effect.

5. Liquid injection/seal oil cooling - This system feeds refrigerant to the compressor (during the transfer phase of compression) through a thermostatic expansion valve, which maintains constant compressor discharge superheat. In addition, a solenoid valve, actuated by an oil temperature thermostat, controls the flow of refrigerant to the liquid injection expansion valve. The compressor shaft seal is provided with a separate direct expansion oil cooler, which insures a constant temperature and supply of oil during all phases of compressor operation.

COMPRESSOR SERVICE AND REPAIR

Request Form 6136 parts manual for all service and repair information.
COUPLING ALIGNMENT INDICATOR METHOD

1. To check angular misalignment (Figure B) mount an indicator (as shown on left flange) with stem on the face of the right flange. Rotate the left flange noting maximum and minimum indicator reading. Move the equipment as necessary to reduce the total indicator reading to that shown below (Figure 4).

2. To check the parallel misalignment (Figure C) set indicator stem on the outer surface of flange. Rotate equipment noting maximum and minimum indicator reading. Move equipment as necessary to reduce indicator reading to that which is shown below. Be careful not to disturb the setting of Step 1.

3. Repeat Step 1 and 2 as necessary.

4. Coupling hubs should be spaced to dimension C. (Figure A)

5. This coupling should be rotated several revolutions to make sure no "endwise" unconnected shafts is measured.

6. Tighten all bolts as shown in Table A below.

7. When operating at full speed, both laminated rings should have defined appearance - not blurred when viewed from the top and side.

NOTE: If the unit been previously aligned and doweled it may be necessary to redrill and taper ream dowel holes and use next larger size taper dowel pins.

Table A

<table>
<thead>
<tr>
<th>THOMAS COUPLING SERIES</th>
<th>FORM-FLEX COUPLING SERIES</th>
<th>BOLT TORQUE FT. LB</th>
<th>BOLT TORQUE FT. LB</th>
<th>MISALIGNMENT</th>
<th>DIM. C</th>
</tr>
</thead>
<tbody>
<tr>
<td>163 DBZ-B</td>
<td>-</td>
<td>13</td>
<td>-</td>
<td>.003 TIR .003 TIR</td>
<td>2.7/16 &quot;</td>
</tr>
<tr>
<td>201 DBZ-B</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>.005 TIR .005 TIR</td>
<td>2 15/16 &quot;</td>
</tr>
<tr>
<td>226 DBZ-B</td>
<td>AK30</td>
<td>43</td>
<td>40</td>
<td>.005 TIR .005 TIR</td>
<td>3 13/16 &quot;</td>
</tr>
<tr>
<td>263 DBZ-B</td>
<td>AK35</td>
<td>63</td>
<td>40</td>
<td>.007 TIR .007 TIR</td>
<td>4 5/16 &quot;</td>
</tr>
<tr>
<td>301 DBZ-B</td>
<td>AK40</td>
<td>95</td>
<td>80</td>
<td>.007 TIR .007 TIR</td>
<td>4 7/8 &quot;</td>
</tr>
<tr>
<td>351 DBZ-B</td>
<td>AK45</td>
<td>175</td>
<td>80</td>
<td>.007 TIR .007 TIR</td>
<td>5 7/8 &quot;</td>
</tr>
</tbody>
</table>

NOTE: 1. ALL DIMENSIONS AND TOLERANCES ARE IN INCHES.
2. CONSULT FACTORY FOR COMPLETE ENGINEERING SPECIFICATIONS
### APPROVED REFRIGERANTS AND OILS

<table>
<thead>
<tr>
<th>REFRIGERANTS</th>
<th>SATURATED TEMP RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCFC22</td>
<td>-40 F to +60 F</td>
</tr>
<tr>
<td>NH3</td>
<td>(-40 C to +16 C)</td>
</tr>
<tr>
<td>HFC-134a*</td>
<td>+20 F to +60 F</td>
</tr>
<tr>
<td></td>
<td>(-7 C to +16 C)</td>
</tr>
<tr>
<td>R502, R507*</td>
<td>-40 F to 0 F</td>
</tr>
<tr>
<td>R404A*</td>
<td>(-40 C to -18 C)</td>
</tr>
</tbody>
</table>

*SYNTHETIC OILS ARE REQUIRED FOR HFC-134a, R507 and R404a.

2. Approved Refrigerant Oils

Several readily available refrigerant oils have been approved. Oils cannot be mixed. Any oil used must be refrigerant quality, with maximum moisture content not to exceed 25 PPM napthenic base only, synthetic oils 100 PPM.

### REFRIGERANTS

<table>
<thead>
<tr>
<th>Evaporator Temp.</th>
<th>Condenser Temp.</th>
<th>HCFC-22</th>
<th>NH-3</th>
<th>HFC-134a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above 20°F</td>
<td>115°F &amp; below</td>
<td>Oil 4</td>
<td>Oil 4</td>
<td>CPI Solest 120</td>
</tr>
<tr>
<td>Above 20°F</td>
<td>above 115°F</td>
<td>054324A1</td>
<td>N/A</td>
<td>CPI Solest 120</td>
</tr>
<tr>
<td>20°F &amp; below</td>
<td>115°F &amp; below</td>
<td>Oil 3</td>
<td>Oil 4</td>
<td>CONSULT DBC</td>
</tr>
<tr>
<td>20°F &amp; below</td>
<td>above 115°F</td>
<td>CONSULT DBC</td>
<td>CONSULT DBC</td>
<td>CONSULT DBC</td>
</tr>
</tbody>
</table>

### REFRIGERANT OILS

- **OIL 3 NAPTHENIC BASE SUNISO 3GS**
  - Viscosity SUS @ 100°F: 150-160 SUS
  - Pour Point: -40°F
  - Flash Point: 330° DEG F
  - Acid No. mg KOH/g: 0.03 MAX
  - Water Content PPM: 25 MAX

- **OIL 4 NAPTHENIC BASE SUNISO 4GS**
  - Viscosity SUS @ 100°F: 300 SUS
  - Pour Point: -30°F
  - Flash Point: 340° DEG F
  - Acid No. mg KOH/g: 0.03 MAX
  - Water Content PPM: 25 MAX

- **054324A1 500 NAPTHENIC BASE**
  - Viscosity SUS @ 100°F: 500 SUS
  - Pour Point: -15°F
  - Flash Point: 340° DEG F
  - Acid No. mg KOH/g: 0.03 MAX
  - Water Content PPM: 25 MAX

- **OIL 14 300 SUS SYNTHETIC HYDROCARBON**
  - Viscosity SUS @ 100°F: 290-340 SUS
  - Pour Point: -65°F
  - Flash Point: 450°F MAX
  - Neutralization No. mg KOH/g: 20 MAX
  - Water Content PPM: 25 MAX

Mixing of these oils is not recommended. All kinds of oils use proprietary additives, the reaction of which when mixed is unknown. If an oil, different from the factory charge, must be added to a unit, the old oil should be completely drained from the unit before a new charge of approved replacement oil is added.
APPROVED SYNTHETIC REFRIGERANT OILS

APPROVED SYNTHETIC OIL FOR HFC-134a*

<table>
<thead>
<tr>
<th>SYNTHETIC OIL CPI SOLEST-120</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO Viscosity Grade</td>
</tr>
<tr>
<td>Pour Point, °F</td>
</tr>
<tr>
<td>Flash Point, °F</td>
</tr>
<tr>
<td>Acid No., mg KOH/g</td>
</tr>
<tr>
<td>Water Content, PPM</td>
</tr>
</tbody>
</table>

APPROVED SYNTHETIC OIL FOR HCFC-22*

<table>
<thead>
<tr>
<th>SYNTHETIC OIL CPI CP-4214-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO Viscosity Grade</td>
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<td>Pour Point, °F</td>
</tr>
<tr>
<td>Flash Point, °F</td>
</tr>
<tr>
<td>Acid No., mg KOH/g</td>
</tr>
<tr>
<td>Water Content, PPM</td>
</tr>
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</table>

APPROVED SYNTHETIC OIL FOR HCFC-22*

<table>
<thead>
<tr>
<th>SYNTHETIC OIL CPI CP-4214-150</th>
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<td>ISO Viscosity Grade</td>
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<tr>
<td>Pour Point, °F</td>
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<tr>
<td>Flash Point, °F</td>
</tr>
<tr>
<td>Acid No., mg KOH/g</td>
</tr>
<tr>
<td>Water Content, PPM</td>
</tr>
</tbody>
</table>

APPROVED SYNTHETIC OIL FOR HCFC-22*

<table>
<thead>
<tr>
<th>SYNTHETIC OIL CPI CP-4214-320</th>
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<tr>
<td>Flash Point, °F</td>
</tr>
<tr>
<td>Acid No., mg KOH/g</td>
</tr>
<tr>
<td>Water Content, PPM</td>
</tr>
</tbody>
</table>

* Compressors built prior to 7/92 must have all gaskets & seals changed

USING INTEGRAL OIL PUMPS

The integral oil pump, is offered as an option on male and female driven compressors. The oil flow is established at startup of compressor. A small prelube pump is required.

When using an integral oil pump, the unloader must be unloaded before stopping.

SEQUENCE OF OPERATION FOR EXTERNAL MOUNTED OIL PUMP

1. Prior to starting of the LSC compressor the oil pump must be energized, either by the control panel or other type of controlling interface, this will pump oil to C4 and C3 oil ports.

2. The slide valve must be in an unloaded position, this is accomplished by opening the unloader solenoid valve, and with the load solenoid valve is open to the drain connection, and using the oil pump pressure to move the slide valve to a unloaded position. To insure the compressor is fully unloaded, a micro-switch will be activated when the compressor is fully unloaded.

3. There must be adequate oil pressure which will flow to the main bearing, this is proven by insuring that there is oil pressure on the gauge connected to C5 port.

REQUIRED OIL PRESSURE

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>MINIMUM OIL PRESSURE</th>
<th>FULL LOAD OIL PRESSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>All application 115 deg F Cond. Temperature and less.</td>
<td>25 PSI</td>
<td>50 PSI</td>
</tr>
<tr>
<td>All applications above 115 deg F Cond. Temperatures.</td>
<td>35 psi</td>
<td>65 PSI</td>
</tr>
</tbody>
</table>

4. The recommended oil temperature in the oil return line must be a minimum of 90 deg F this will prevent the LSC compressor from undergoing a "cold start situation". See Figure 3

Recommended oil temperature entering C4 port measured in the supply line within one foot of the compressor port.

Figure 3

COMPRESSOR RUNNING
Minimum Temp. 90 ° Deg F
Maximum Temp. 130 ° Deg F

PRE-LUBE CYCLE
60 ° Deg F
160 ° Deg F
OPERATION OF THE UNLOADER ASSEMBLY

OPERATION OF THE UNLOADER CAPACITY CONTROL

The compressor load controller (furnished by OEM customer) supplies power to the load and unload solenoid valves to control the position of the compressor slide valve. The control signal can be either by temperature, pressure or electric motor power input (such as amperage). The unloader control assembly will continually adjust the slide position to match and to balance the compressor capacity with the system load, maintaining stabilized unit operation.

COMPRESSOR LOADING

When energized, the load solenoid valves open and high pressure pushes the slide valve position towards the full load position, forcing oil out the opposite end of the cylinder through the bleed line to the suction housing. Piston speed is controlled by the adjustable throttle valve in the oil line.

COMPRESSOR UNLOADING

When energized, the unload solenoid valves open. The high oil pressure on the slide valve piston will move the slide valve towards the unload position, forcing oil out of the compressor end of the cylinder, through the bleed line to the suction housing, piston speed is controlled by the adjustable throttle valve located in the oil line.

COMPRESSOR PART LOAD

The compressor will remain in a part load position as long as no new load or unload signals are received by the unloader assembly. Load and unload solenoid valves will be closed, no oil will flow and the piston will be stationary at a part load condition.

SINGLE ACTING UNLOADER

LSC Compressors are supplied with a double acting unloader. There are 4 ports, each port is engineered to use oil pressure to adjust the unloader assembly to a loaded or a unloaded position, a single acting unloader uses D1 and C2 ports in a parallel configuration as shown on page 12, and uses 2 solenoids to control the action of the unloader.

DOUBLE ACTING UNLOADER

A double acting unloader is supplied on all LSC compressor unless specified other wise, there is extra piping involved in a double acting unloader when compared to a single. It uses oil pressure to supply to C5 or D1 port depending on the load of the LSC compressor compared to a single acting, the oil pressure is used to adjust the slide valve in either direction and venting oil pressure to the suction cavity of the compressor.
PIPING DETAILS OF A SINGLE ACTING UNLOADER

PIPING CONNECTIONS AND DETAILS

C2 : SUCTION PRESSURE PORT
C5 : UNLOAD OIL PORT, USED IN BOTH SINGLE ACTING AND DOUBLE ACTING
C12 : LOADING OIL SUPPLY PORT TO LOAD, USED IN A SINGLE ACTING AND A
      DOUBLE ACTING UNLOADER.
D1 : OIL SUPPLY PORT TO LOADING SYSTEM

NOTE : ALL UNLOADER PIPING IS RECOMMENDED PIPED IN STEEL TUBING.

UNLOADING POSITION SINGLE ACTING APPLICATION

1. C12 SUPPLIES OIL TO C5 PORT, SOLENOID 2 NORMALLY OPEN, FEEDS OIL PRESSURE
   TO SLIDE PISTON CAVITY
2. D1 PORT DRAINS OIL TO C2 SUCTION PORT, SOLENOID 1 IS NORMALLY CLOSED.
   CAUSING OIL NOT TO FEED BACK TO C5 PORT.

LOADING POSITION SINGLE ACTING APPLICATION

1. SOLENOID 1,2, BECOME ENERGIZED BY THE TLC CONTROL PANEL
2. SOLENOID 2 IS ENERGIZED TO A CLOSED POSITION , SOLENOID 1 ENERGIZES
   TO A OPEN POSITION.
3. WITH SOLENOID 1 OPEN AND SOLENOID 2 CLOSED C5 PORT CAN DRAIN THE OIL PRESSURE
   PRESSURE TO ENTER D1 AND C2 PORT CAUSING OIL PRESSURE TO FILL THE
   SUCTION AND SLIDE PISTON CAVITY.
PIPING DETAILS OF A DOUBLE ACTING UNLOADER

DOUBLE ACTING UNLOADER

PIPING CONNECTIONS AND DETAILS

C2 : SUCTION PRESSURE PORT
C5 : UNLOAD OIL PORT, USED IN BOTH SINGLE ACTING OR DOUBLE ACTING
C12 : LOADING OIL SUPPLY PORT TO LOAD, USED IN BOTH SINGLE
       AND DOUBLE ACTING UNLOADER.
D1 : OIL SUPPLY PORT TO LOADING SYSTEM

NOTE : ALL UNLOADER PIPING IS RECOMMENDED PIPED IN STEEL TUBING.

---

**Solenoid Actuation Table**

<table>
<thead>
<tr>
<th>Valve No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>E</td>
<td>-</td>
<td>E</td>
<td>-</td>
</tr>
<tr>
<td>Hold</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Unload</td>
<td>-</td>
<td>E</td>
<td>-</td>
<td>E</td>
</tr>
</tbody>
</table>

E= Energized
- = Not Energized
TEMPERATURE LOAD CONTROLLER

The unloader assembly is controlled by the Temperature Load Controller (TLC) the load and the unload solenoid valves control the position of the compressor slide valve piston. The fast unload solenoid permits the compressor to start under a minimum load when pressure drops below the suction pressure switches preset the unloader to a minimum unload setting.

TROUBLESHOOTING

1. To insure the operation of the unloader slide valve is operating properly according to load capacity if the LSC is equipped with the Barber Coleman CP 8141-701 Chiller Controller the slide valve can be controlled by placing the Electric Chiller Control in the manual position, which is located on the chiller package.

2. The slide valve can be checked by placing the ECC controller selector switch in the load position, this will drive the unloader pad to a loaded position, the unloader industrial dial readout indicator (IDR) will indicate 100 %.

3. To check the unloader in a unload position, place the ECC Controller selection switch to the unload position, this can be the verified by the industrial dial readout indicator (IDR) will indicate 0 %.

4. All producers can be checked by a visual inspection by operator.

OPERATION OF INDUSTRIAL DIAL READOUT INDICATOR (IDR)

The industrial Dial readout indicator (IDR) transforms the reciprocating motion of the slide valve into a rotary motion to provide a analog output signal (0 to 1000 ohms) and/or actuation of micro-switches. The micro-switch has various set points, utilizing fully adjustable cams.

The device also provides visual dial indication of the slide valve position.

The industrial dial readout indicator (IDR) is adaptable to customer design requirements. In addition to the microprocessors use, the industrial dial readout indicator (IDR) can be configured to send a remote signal or to interface with pneumatic control applications.
# COMPRESSOR DESIGN LIMITATIONS

Design limitations unless otherwise noted

<table>
<thead>
<tr>
<th>Models</th>
<th>1610M</th>
<th>1610F</th>
<th>2010-</th>
<th>2510-</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1615M</td>
<td>1615F</td>
<td>2018</td>
<td>2519</td>
</tr>
<tr>
<td>Drive rotor speed, Max</td>
<td>4000</td>
<td>2850</td>
<td>4000</td>
<td>3600</td>
</tr>
<tr>
<td>Min</td>
<td>2000</td>
<td>1000</td>
<td>2000</td>
<td>1750</td>
</tr>
<tr>
<td>Rotation (from drive unit)</td>
<td>ccw</td>
<td>cw</td>
<td>ccw</td>
<td>ccw</td>
</tr>
<tr>
<td>Max outlet temp °F</td>
<td>212</td>
<td>212</td>
<td>212</td>
<td>212</td>
</tr>
<tr>
<td>Max outlet pressure, psig</td>
<td>350</td>
<td>350</td>
<td>275/210*</td>
<td>325</td>
</tr>
<tr>
<td>Max press diff.</td>
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<td>275</td>
<td>275</td>
<td>275</td>
</tr>
<tr>
<td>Max inlet press, psig</td>
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<tr>
<td></td>
<td>4.15 VI</td>
<td>80</td>
<td>80</td>
<td>80(3.6 VI)</td>
</tr>
<tr>
<td></td>
<td>5.4 VI</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Max inlet temp, °F</td>
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<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Min inlet temp, °F</td>
<td>-50</td>
<td>-50</td>
<td>-50</td>
<td>-50</td>
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<tr>
<td>Min discharge gas superheat</td>
<td>50° F</td>
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<td></td>
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</tr>
<tr>
<td>Max oper sum/sep outlet oil temp</td>
<td>200° F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max allowable oil sump temp</td>
<td>220° F</td>
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<tr>
<td>Max seal oil inlet temp</td>
<td>130° F</td>
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<tr>
<td>DISCH PR above 300 PSIG</td>
<td>120° F</td>
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</tr>
</tbody>
</table>

**VI: BUILT IN VOLUME RATIO**

Each compressor has a specific VI which is predicated upon the volume ratio for the conditions originally specified by the designer. Use of the compressor at conditions seriously beyond the original conditions will result in poor efficiency and could cause internal damage. Generally the VI is designed as follows:

- Suction temp 55 °F to 20 °F, condens 105° F \( \text{VI} = 2.4 \)
- Suction temp 20 °F to 0 °F, condens 105° F \( \text{VI} = 3.6 \) or \( 4.15 \)
- Suction temp 0 °F to -40 °F, condens 105° F \( \text{VI} = 5.4 \)
MECHANICAL SHAFT SEAL

OPERATION OF SHAFT SEAL

The shaft seal used on the LSC compressors are mechanical seal assemblies of the process type. This seal operates in an oil flooded chamber that is created by the seal housing and the shaft seal ring. In the operation the finely lapped rotating carbon ring is loaded against the ground and lapped stationary seat by a combination of spring pressure, hydraulic and gas pressure. The seal is partially balanced so that the operating face pressure changes with compressor operating discharge conditions. The two surfaces are separated by a hydrodynamic oil film which varies in thickness. Also since the seal is operating between compressor discharge pressure and atmospheric pressure there is a considerable pressure difference involved, as compared to the low side seal applications. In some case this differential can approach 300 psid, as in the case of air cooled condensing applications. It is the effect of the high pressure differential and the finite oil film thickness that separates the rotating carbon face from the stationary ring that allows the seal to exhibit a slight amount of weepage.

INSTALLATION

1. A properly operating LSC compressor shaft seal will exhibit slight oil weepage. During the first few hours of operation this weepage can be as high as 10 cc/hr. after the seal runs-in it usually drops to 0.5 to 2.0 cc/hr. Laboratory tests have shown that this slight oil weepage is not accompanied by a significant amount of refrigerant leakage.

2. A connection is provided on the seal housing to which a drop tube can be attached so that the slight oil weepage may be collected in suitable container and not mark the appearance of the unit.

3. For shaft seal installation and removal refer to Form Number. 6136-1R.

OIL KARE PROGRAM

Dunhan-Bush recommends that an oil sample be taken from each compressor on a quarterly basis and sent to a lab for analysis. In others words, four samples should be taken per year for annual operation and three samples per year seasonal operation such as air conditioning. The oil sample will be analyzed for wear metal concentrations, contaminants, moisture, acid and viscosity.

SHAFTE SEAL LEAKAGE

14 cc/hr
12 cc/hr
10 cc/hr
8 cc/hr
6 cc/hr
4 cc/hr
2 cc/hr
0 cc/hr

RUNNING TIME, ( HRS )
WARRANTIES

NOTE: Large Screw Compressor may not be opened or tampered with in the field. Such action terminates our warranty obligations without special notification.

Warranty: We agree that the apparatus manufactured by Seller will be free from defects in the material and workmanship for a period of one year under normal use and service and when properly installed and our obligation under the agreement is limited solely to repair or replacement at our option, at our factories, of any part or parts thereof, which shall, within 1 year from date of original installation or 18 months from date of shipment from factory to original purchaser, whichever date may come first occur, be returned to us with transportation charges prepaid which our examination shall disclose to our satisfaction to have been defective. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION HEREOF. We neither assume nor authorize any person to assume for us any liability or obligation in connection with the sale of our apparatus, except said repair or replacement of defective part as set forth above. Our liability does not include any labor charges for replacement or parts, adjustments, repairs, or any other work done outside our factories and our liability does not include any consequential or resulting damage to persons, property, equipment, goods, merchandise, profits, good will or reputation arising out of any defect in or failure of our apparatus. Our obligation to repair or replace shall not apply to any apparatus which shall have been repaired or altered outside of our factory in any way, or which has subject to negligence, to misuse, or to pressure in excess of stated limits. On parts not manufacture, such as oil pumps, controls, etc. we extend only the same warranties given to Seller. Our agreement hereunder runs only to the immediate purchasers and does not extend, expressly or by implication, to any other person. Nothing in the above warranty provisions, however, shall impose any liability or obligation of any type, nature or description upon Dunham-Bush, if Dunham-Bush has not received payment in full for the apparatus in question.


SPECIAL RIGGING COSTS

Installation must be accessible and facilities provided by the customer in the event that the compressor, or any other major component, requires replacement.

Component manufacturers warranty obligations do not cover any SPECIAL RIGGING expenses resulting from inaccessibility.

Information on the size and weight of compressors, is available and should be considered as major factors in design and the location of the unit.

No charges or claims will therefore be considered for special rigging on any in or out of warranty component replacement.
Screw compressors over the years have been manufactured with different types of shaft seals designated 8-1, 8B1 and 9B. It has now been determined that the 9B shaft seal can be used in all 163 mm, 204 mm and 255 mm compressors. There are a total of three combinations of compressor housing covers and seal housings for these compressors. Drawings showing the assembly of shaft seals for these combinations can be found on pages 7 & 8. Two combinations are for the 255 mm compressors and the other is for the 163 mm and 204 mm compressors. When replacing the shaft seal follow the procedure designated for your compressor.

163 mm and 204 mm COMPRESSORS

A. REQUIRED SPECIAL TOOLS

Prior to disassembly of the seal the following items should be obtained or fabricated: (A) seal replacement kit; (B) two jackbolts 3/8 - 16 x 3-1/2" long with two nuts; (C) two pull rods manufactured from rod 1/8" dia. approximately 15" long. Bend one end 3/8" long at an angle of 90°, the other end 2" long bent at an angle of 90° in the opposite direction.

B. REMOVAL OF SEAL HOUSING

1. Remove the socket head seal housing screws from the seal housing.
2. With nuts backed to the heads of the jackbolts (B), screw the jackbolts into the tapped holes of the seal housing until they bottom out.
3. Turn the jackbolts (B) in evenly, this will force the seal housing out of the compressor cover. Slide the seal housing off the shaft and remove the jackbolts.

255 mm COMPRESSORS

A. REQUIRED SPECIAL TOOLS

Prior to disassembly of the seal the following items should be obtained or fabricated: (A) seal replacement kit; (B) two jackbolts 3/8 - 16 x 3-1/2" long with two nuts; (C) two pull rods manufactured from rod 1/8" dia. approximately 15" long. Bend one end 3/8" long at an angle of 90°, the other end 2" long bent at an angle of 90° in the opposite direction; (D) two 15" rods threaded for #8-32 UNC28 with a 2" 90° bend at the opposite end.

B. REMOVAL OF SEAL HOUSING

1. Remove the socket head seal housing screws from the seal housing.
2. With nuts backed to the heads of the jackbolts (B), screw the jackbolts into the tapped holes of the seal housing until they bottom out.
3. Turn the jackbolts (B) in evenly, this will force the seal housing out of the compressor cover. Slide the seal housing off the shaft and remove the jackbolts.
REPLACING SCREW COMPRESSOR SHAFT SEALS

163 mm and 204 mm COMPRESSORS
See Figure A Page 7 for Parts Location
C. REMOVAL OF SEAL HEAD
The seal head and carbon ring are now visible on the shaft.
1. With your hand push on the carbon ring axially at various points to free the seal head from the shaft.
2. Insert the pull rods (C) into the body holes of the seal head and slowly pull it off the shaft. Do not discard it.

D. REMOVAL OF SEAL DRIVE RING
If a seal drive ring and spring pin are included in the new seal kit they must be replaced.
1. Wipe the shaft clean with a lintless cloth. Using your fingers and a pair of needle nose pliers to grip the spring pin, pull the seal drive ring evenly off the shaft. Use care to prevent damage to the shaft.

E. CLEANING THE ROTOR SHAFT
Clean the shaft area of foreign matter and check the seal area for minor scratches. If necessary polish with a crocus cloth and wipe clean. Shafts with major damage may not be salvageable without major rework.

255 mm COMPRESSORS
See Figures B & C Page 8 for Parts Location
C. REMOVAL OF SEAL HEAD
The seal head and carbon ring are now visible on the shaft.
1. With your hand push on the carbon ring axially at various points to free the seal head from the shaft.
2. Insert the pull rods (C) into the body holes of the seal head and slowly pull it off the shaft. Do not discard it.

D. REMOVAL OF SEAL DRIVE RING
1. Look along the shaft into the compressor cover bore to check the seal drive ring. This ring has a lip seal located on its circumference which must be replaced.
2. Wipe the shaft clean with a lintless cloth, screw the threaded rods (D) into the tapped holes on the seal drive ring and slowly pull the seal drive ring and lip seal off the shaft.

3. Remove the lip seal from the seal drive ring by tapping it off with a drift punch. Remove the spring pin if the old one is damaged.
F. REPLACING SEAL DRIVE RING

1. Be sure the drive pin on the shaft is in the 12 o'clock position, if not turn the shaft until it is.

Coat the shaft with clean refrigerant oil and by using fingers and needle nose pliers, slide the new seal drive ring with spring pin into place. Be sure the seal drive ring engages the drive pin.

3. The engagement of the seal drive ring with the drive pin can be verified by checking the distance from the seal drive ring face to the compressor cover face. It must be equivalent to dimension 'A'. The 'A' dimension for the 163 mm compressor is 2-1/8", for the 204 mm compressor it is 2-7/8".

G. REPLACING SEAL DRIVE RING

1. Screw the threaded rods (D) into the seal drive ring.

2. Be sure the drive pin on the shaft is at 12 o'clock, if not turn the shaft until it is.

3. Coat the shaft with clean refrigerant oil and slide the seal drive ring onto the shaft. Be sure that the seal drive ring is shouldered against the shaft and that the notch in the seal drive ring engages the drive pin.

4. Remove the threaded rods (D) from the seal drive ring.
G. SALVAGING THE OLD SEAL HEAD
Take the old seal head and remove the snap ring, carbon ring, teflon wedge and springs. The seal head retainer is now a tool used in installing the new seal head.

H. INSTALLATION OF SEAL HEAD
1. Take the new seal head and, with the tape in place, over the clips, securely tie a two foot length of twine or fine wire to each of the spring retaining clips.
2. Lubricate the teflon wedge on the seal head and coat the shaft with refrigerant oil. Slip the seal head onto the shaft.
3. Tie ends of the twine or fine wire to be sure they do not fall into the compressor. Carefully remove the tape holding the clips without disturbing the clips.

4. Push the seal head, by hand, into the cavity. Be sure that the spring pin on the seal drive ring engages the seal head drive hole.
5. Slip the salvaged seal head retainer, with the closed end toward you, onto the shaft and over the carbon seal to contact the new seal head retainer.
6. Using your hand, press against the salvaged head retainer with an axial force, and with a long thin screw driver disengage the spring retaining clips. Disengage the clips in an 'X' pattern. Do not release pressure until all clips are disengaged.

J. INSTALLATION OF SEAL HEAD
1. Take the new seal head and, with the tape in place, over the clips, securely tie a two foot length of twine or fine wire to each of the spring retaining clips.
2. Lubricate the teflon wedge on the seal head and coat the shaft with refrigerant oil. Slip the seal head on the shaft.
3. Tie ends of the twine or fine wire, to be sure they do not fall into the compressor. Carefully remove the tape holding the clips, without disturbing the clips.

5. The engagement of the seal drive ring with the drive pin can be verified by checking the distance from the seal drive ring face to the compressor cover face. It must be equivalent to dimension 'A', which is 3".
REPLACING SCREW COMPRESSOR SHAFT SEALS

163 mm and 204 mm COMPRESSORS

7. Remove the clips from the compressor. Before removing the salvaged head retainer, exert pressure on it to be sure that the seal head is properly shouldered.

8. The engagement of all parts can be verified by checking the distance from the carbon ring face on the seal head to the compressor cover face. It must be equivalent to dimension 'B'. When measuring, use care to prevent damage to the shaft and carbon ring. Do not touch the carbon ring face with metal.

<table>
<thead>
<tr>
<th>Compressor</th>
<th>Dimension 'B'</th>
</tr>
</thead>
<tbody>
<tr>
<td>163 mm</td>
<td>3/16”</td>
</tr>
<tr>
<td>204 mm</td>
<td>23/32”</td>
</tr>
</tbody>
</table>

9. Clean the carbon face with a lint free cloth and flush it with oil.

J. REMOVAL OF SEAL SEAT

If you are using the old seal housing remove all 'O' rings, seals and the seal seat. The seal seat can be removed by tapping it using a drift punch and hammer. Clean the seal housing and remove all nicks and burrs.

K. INSTALLATION OF SEAL SEAT

1. Check the seat anti-rotation pin to be sure that it is not damaged. Replace if necessary. If a new seal housing is used insert the pin, and install the oil fitting on the circumference of the flange.

2. Oil the 'O' ring on the seal seat.

3. Be sure that the seal seat is in line with the anti-rotation pin, and install it in the housing bore.

4. Press the seal seat in by hand as far as possible. Tap the seal seat into place with a hammer and soft wood block. Use cardboard or some other soft medium to protect the face of the seal seat. The seat should be parallel with the housing flange.

L. INSTALLING THE LIP SEAL

Lubricate the new lip seal and install it in the seal housing.

NOTE: The spring on the seal must not be visible.

M. INSTALLATION OF 'O' RINGS

Lubricate the seal housing 'O' rings and install them in their grooves on the circumference of the seal housing.

255 mm COMPRESSORS

6. Using your hand, press against the salvaged head retainer with an axial force, and with a long thin screw driver disengage the spring retaining clips. Disengage the clips in an 'X' pattern. Do not release pressure until all clips are disengaged.

7. Remove the clips from the compressor. Before removing the salvaged head retainer exert pressure on it to be sure that the seal head is properly shouldered.

The engagement of all parts can be verified by checking the distance from the carbon ring face on the seal head to the compressor cover face. It must be equivalent to dimension 'B', which is 3/4 of an inch. When measuring, use care to prevent damage to the shaft and carbon ring. Do not touch the carbon ring face with metal.

9. Clean the carbon face with a lint free cloth and flush it with oil.

K. REMOVAL OF SEAL SEAT

If you are using the old seal housing remove all 'O' rings and the seal seat. The seal seat can be removed by tapping it, using a drift punch and hammer. Clean the seal housing and remove all nicks and burrs.

L. INSTALLATION OF SEAL SEAT

1. Oil the seal seat 'O' ring and install it in the seal housing.

2. Examine the new seal seat to identify the operating face, which is the most highly finished surface. The operating face is opposite the face with the chamfer.

3. With the operating face toward you, press the seal seat in by hand. Tap the seal seat into place with a hammer and soft wood block. Use cardboard or some other soft medium to protect the face of the seal seat. The seat should be parallel with the housing flange.
REPLACING SCREW COMPRESSOR SHAFT SEALS

163 mm and 204 mm COMPRESSORS

N. INSTALLATION OF SEAL HOUSING
1. Flush the carbon face of the seal and the operating face of the seal seat with refrigerant oil.

2. Install the seal housing on the shaft. **Use care – Do Not hit the seat face on the end of the shaft.** Push the seal housing on until the ‘O’ ring starts to engage in the compressor housing bore.

3. Position the seal housing with the drain fitting in the lower left quadrant at approximately 7 o'clock. All the bolt holes in the seal housing should now line up with those in the compressor housing cover.

4. Install the jackbolts (8) in the bolt holes, 180° apart, until they bottom out. Flood the seal housing with refrigerant oil, then turn the nuts on the jackbolts in evenly until the seal housing is forced up to the compressor housing cover.

255 mm COMPRESSORS

M. INSTALLATION OF ‘O’ RINGS
Lubricate the seal housing ‘O’ rings and install them in their grooves on the circumference of the seal housing.

N. INSTALLATION OF SEAL HOUSING
1. Flush the carbon face of the seal and the operating face of the seal seat with refrigerant oil.

2. Install the seal housing on the shaft. **Use care – Do Not hit the seat face on the end of the shaft.** Push the seal housing on until the ‘O’ ring starts to engage in the compressor housing bore.

3. Position the seal housing with the drain fitting in the lower left quadrant at approximately 7 o'clock. All the bolt holes in the seal housing should now line up with those in the compressor housing cover.

4. Install the jackbolts (8) in the bolt holes, 180° apart, until they bottom out. Flood the seal housing with refrigerant oil, then turn the nuts on the jackbolts in evenly until the seal housing is forced up to the compressor housing cover.
REPLACING SCREW COMPRESSOR SHAFT SEALS

163 mm and 204 mm COMPRESSORS

5. Insert the socket head screws and partially tighten them. Remove the jackbolts (B) and install the remaining screws and torque them to 45 ft. lbs.

6. Rotate the rotor shaft to seat the shaft seal.

7. Reconnect the drain to the drain fitting then wipe the exterior surfaces of the compressor free of oil.

P. STARTING THE COMPRESSOR

Start the compressor and after it has run approximately five minutes, shut it down and wipe the shaft and face of the compressor. Restart the compressor and check for leaks.

255 mm COMPRESSORS

5. Insert the socket head screws and partially tighten them. Remove the jackbolts (B) and install the remaining screws and torque them to 45 ft. lbs.

6. Rotate the rotor shaft to seat the shaft seal.

7. Reconnect the drain to the drain fitting then wipe the exterior surfaces of the compressor free of oil.

P. STARTING THE COMPRESSOR

Start the compressor and after it has run approximately five minutes, shut it down and wipe the shaft and face of the compressor. Restart the compressor and check for leaks.

REPLACEMENT PARTS FOR SCREW COMPRESSOR SHAFT SEALS
MODELS 163mm and 204mm COMPRESSORS

FIGURE 'A'

1. Housing Cover
2. Seal Housing
3. Shaft
4. Seal Head
5. Drive Ring
6. Drive Pin
7. Lip Seal
8. Spring Pin
9. Carbon Ring
10. Seal Seat
11. Seal Housing 'O' Rings
12. Seal Seat 'O' Ring
13. Drain Fitting
14. Anti-Rotation Pin
FIGURE 'B'
LONG HOUSING COVER W/SHORT SEAL HOUSING
1. Housing Cover
2. Seal Housing
3. Shaft
4. Seal Head
5. Drive Ring
6. Drive Pin
7. Lip Seal
8. Spring Pin
9. Carbon Ring
10. Seal Seat
11. Seal Housing 'O' Rings
12. Seal Seat 'O' Ring
13. Drain Fitting

FIGURE 'C'
SHORT HOUSING COVER W/LONG SEAL HOUSING
1. Housing Cover
2. Seal Housing
3. Shaft
4. Seal Head
5. Drive Ring
6. Drive Pin
7. Lip Seal
8. Spring Pin
9. Carbon Ring
10. Seal Seat
11. Seal Housing 'O' Rings
12. Seal Seat 'O' Ring
13. Drain Fitting
REPLACEMENT INSTRUCTIONS

FOR LSC BELLOWS SHAFT SEALS FOR 204mm COMPRESSORS

In 1997, Hartford Compressors began using a Bellows type shaft seal, replacing the earlier style 9B pusher type seal. This seal has proven to be more reliable and much easier to install. When installing a bellows seal, it is recommended that you read all of the instructions before beginning the installation.

A. PREPARATION

1. Transfer refrigerant from the compressor and store in the condenser or some other location that will allow the compressor to be opened. Use only approved methods for transferring refrigerant.

2. Open and lock compressor disconnect switch.

3. Unpack and inspect all components of seal kit. Do NOT touch the seal face or the mating ring face. The oil in fingers will damage the seal.

4. Place all components on a clean, lint free cloth. Place mating ring, face up on cloth.

5. Use only new, clean refrigerant oil for lubricating the seal during the assembly process. Use the oil that will be used in the system.

B. REQUIRED SPECIAL TOOLS

Prior to disassembly, the following special tools will be needed:

1. If removing 9B pusher seal, fabricate two pull rods from 1/8” or 1/4” diameter rod or tubing approximately 15” long (Fig. 1).
   a. Bend one end 3/8” long at an angle of 90°, the other end 2” long bent at an angle of 90° in the opposite direction (Fig. 1).

2. If removing a 9B drive ring, fabricate two pull rods from 15” long rod that are threaded 1/2” at one end with #8-32 UNC threads and a 90° bend 2” from the other end (Fig. 1).
C. REMOVAL OF SEAL HOUSING

1. Remove six socket head screws securing the seal housing.

2. Install three guide rods in housing bolt holes.

3. Insert two bolts into jacking holes (located at 3 and 9 o’clock) and loosen the seal housing by screwing in the bolts evenly (Fig. 2).

4. When the seal housing is loose, carefully remove the seal housing and store in a clean location.

5. When removing the bellows seal housing, extreme care must be used to be sure that the internal carbon mating ring does not bump against the shaft. The slightest bump will nick or crack the mating ring (Fig. 3).

D. REMOVAL OF SHAFT SEAL

1. Removing 9B “PUSHER” seal
   a. Clean up the shaft so the seal will not hang up on any dirt.
   b. Using the two special pull rods, engage the short ends into the sides of the seal and pull the seal off the shaft (Fig. 4).
   c. Screw the two 1/8” threaded rods into the drive ring and remove (Fig. 5).
D. REMOVAL OF SHAFT SEAL (cont.)

2. Removing Bellows Seal
   a. Loosen four set screws holding seal to shaft at least two full turns.
   b. Placing allen wrenches in two horizontal set screws, slowly pull seal out of housing until it is even with the end of shaft (Fig. 6).
   c. Remove allen wrenches and carefully remove the seal from the shaft. Use care to prevent damaging the seal.

E. COMPRESSOR PREPARATION

1. To avoid damage to the o-ring located on the inside diameter of the shaft seal assembly, the entire drive shaft diameter must be thoroughly cleaned and polished with fine emery cloth. Be especially careful to remove sharp edges along the edges of the keyway and the set screw indents (Fig. 7). Thoroughly clean the entire shaft with a clean, lint free cloth.

F. REPLACEMENT SEAL PREPARATION

**CAUTION**

Handle the new seal with care. Do not touch the seal face or the mating face. Use only clean lint free cloths. Use only new oil for lubrication.

1. Remove inner o-ring from seal. Clean the o-ring and the o-ring groove. Liberally oil the o-ring and the groove and re-install the o-ring.
2. Remove the four set screws from the small diameter of the seal.
3. Do not disturb the four set screws on the outside of the large diameter of the seal.

G. HOUSING PREPARATION

If replacing a 9B seal, a different housing will be used. Unpack the new housing and thoroughly clean and remove any preservative.

1. Insert an anti-rotation pin into the hole inside the housing until it bottoms out (Fig. 8).
2. If replacing a Bellows seal, the mating ring must be replaced. A new mating ring is included with the new bellows seal.
3. Place the housing on a clean surface with the flange up.
4. If replacing a Bellows seal, the mating ring must be replaced. A new mating ring is included with the new bellows seal.
G. HOUSING PREPARATION (cont.)

5. Place the housing on a clean surface with the flange up.
6. Using a screwdriver, gently tap around the upper edge of the mating ring to remove it from the housing.
7. Remove the old mating ring and the o-ring and thoroughly clean the inside of the housing.
8. Remove the outboard lip seal.
9. Remove the inboard lip seal.
10. Thoroughly clean all replacement parts with a clean, lint-free cloth.
11. Install a new outboard lip seal on outlet groove of housing. The flat outer face of the lip seal should be on the outside of the housing (Fig. 9).
12. Install new inboard lip seal. The flat side of the seal should be on the outside of the housing.
13. Liberally oil the inner o-ring groove and install the inner o-ring.
14. Oil the inside diameter of the housing.
15. When installing the new mating ring, do not touch the face of the new mating ring. Oil the face of the mating ring and use a clean, dry, lint-free cloth to push on the new mating ring.
16. Align the slot in the back of the mating ring with the anti-rotation pin in the housing.
17. Push the mating ring into the housing until it is seated.

DO NOT USE ANY FORCE OTHER THAN HAND PRESSURE TO SEAT MATING RING.

18. Liberally oil the outer o-ring grooves and install the two outer o-rings.
19. Install a drain fitting on outside edge of the housing.

H. SHAFT SEAL INSTALLATION

1. Check the location of the anti-rotation pin inside the seal cavity. Rotate the shaft until it is at the 12 o’clock position (Fig. 10). If the pin is bent, it must be removed. It is not necessary to install another pin. The set screws are sufficient to prevent the seal from rotating. The compressor outlet housing must be removed if this pin is to be removed or replaced.
2. Liberally oil the outside of the shaft and the inside of the seal. Do not allow oil to enter the set screw holes. Oil in the set screw holes will prevent the Loctite from adhering (See Section H-6).
3. Align the slot on the back face of the new seal with the anti-rotation pin in the shaft. Carefully install the seal into the seal cavity until it bottoms out.
H. SHAFT SEAL INSTALLATION (cont.)

4. Install two set screws loosely in the seal. Using allen wrenches, rotate the seal from side to side to ensure that the pin is engaged.

**DO NOT USE ANY FORCE OTHER THAN HAND PRESSURE TO INSTALL THE SEAL.**

5. Measure the distance from the outside of the seal to the face of the inlet housing. This measurement should be 7/16" ± 1/32". If this dimension is not achieved, remove seal and try again (Fig. 11).

6. Add Loctite 242 to the threads of the four set screws and tighten. Tighten all set screws evenly to keep the seal centered on the shaft. Tightening one set screw before the others can cause the seal to be cocked slightly on the shaft. Torque to 7 ft-lb (Fig. 12).

I. SHAFT SEAL HOUSING INSTALLATION

1. It is advisable to cover the sides of the keyway slot with plastic electrical tape to prevent the o-ring from being cut.

2. Liberally oil the seal face and the mating ring face in the housing.

3. Install the three guide rods (Fig. 13).

4. Align the seal housing on the shaft with the oil weepage drain located in the 6 o’clock position.

**EXTREME CARE MUST BE TAKEN TO ENSURE THAT THE MATING RING DOES NOT BUMP ON THE SHAFT.**

5. Slide the seal housing in the shaft until the first o-ring engages (Fig. 13).
I. SHAFT SEAL HOUSING INSTALLATION (cont.)

6. Remove the guide rods.

7. Slowly and evenly push the housing into the seal cavity (Fig. 14). Use caution that you do not slam the housing into the seal face.

8. Once the housing is seated against the seal install the six housing mounting bolts. Tighten the bolts in a crossing pattern and torque to 45-ft lb.

9. Rotate the compressor shaft several times to seat the seal faces.
REPLACEMENT INSTRUCTIONS
FOR LSC BELLOWS SHAFT SEALS FOR 255mm COMPRESSORS

In 1997, Hartford Compressors began using a Bellows type shaft seal, replacing the earlier style 9B pusher type seal. This seal has proven to be more reliable and much easier to install. When installing a bellows seal, it is recommended that you read all of the instructions before beginning the installation.

A. PREPARATION
1. Transfer refrigerant from the compressor and store in the condenser or some other location that will allow the compressor to be opened. Use only approved methods for transferring refrigerant.
2. Open and lock compressor disconnect switch.
3. Unpack and inspect all components of seal kit. Do NOT touch the seal face or the mating ring face. The oil in fingers will damage the seal.
4. Place all components on a clean, lint free cloth. Place mating ring, face up on cloth.
5. Use only new, clean refrigerant oil for lubricating the seal during the assembly process. Use the oil that will be used in the system.

B. REQUIRED SPECIAL TOOLS
Prior to disassembly, the following special tools will be needed:
1. If removing 9B pusher seal, fabricate two pull rods from 1/8" or 1/4" dia. rod or tubing approximately 15" long (Fig. 1).
   a. Bend one end 3/8" long at an angle of 90°, the other end 2" long bent at an angle of 90° in the opposite direction (Fig. 1).
2. If removing 9B drive ring, fabricate two pull rods from 15" long rod that are threaded 1/2" at one end with #8-32 UNC threads and a 90° bend 2" from the other end (Fig. 1).

C. REMOVAL OF SEAL HOUSING
1. Remove the six socket head screws securing the seal housing.
2. Install two guide rods in housing bolt holes at the 12 and 6 o'clock positions.
C. REMOVAL OF SEAL HOUSING (cont.)

3. Insert two bolts into jacking holes (located at 3 and 9 o’clock) and loosen the seal housing by screwing in the bolts evenly (Fig. 2).

4. When the seal housing is loose, carefully remove the seal housing and store in a clean location.

5. When removing the bellows seal housing, extreme care must be used to be sure that the internal carbon ring does not bump against the shaft. The slightest bump will nick or crack the mating ring (Fig. 3).

D. REMOVAL OF SHAFT SEAL

1. REMOVING 9B “PUSHER” SEAL

   a. Clean up the shaft so the seal will not hang up on any dirt.

   b. Using the two special pull rods, engage the short ends into the sides of the seal and pull the seal off of the shaft (Fig. 4).

   c. Screw the two 1/8” pull rods into the drive ring and remove (Fig. 5).
D. REMOVAL OF SHAFT SEAL (cont.)

2. REMOVING BELLOWS SEAL
   a. Loosen the four set screws that hold the seal to the shaft at least two full turns.
   b. Placing allen wrenches in two horizontal set screws, slowly pull seal out of housing until it is even with the end of the shaft (Fig. 6).
   c. Remove allen wrenches and carefully remove the seal from the shaft. Use care to prevent damaging the seal.

NOTE: On Bellows Seals shipped after late 2000, the seal o-ring is located in the small inside diameter. On seals supplied after late 2000, the o-ring is located in the large diameter of the seal. This will make no difference in the installation of the seal. It will only make installation easier since the o-ring will be less likely to be cut during installation.

E. COMPRESSOR PREPARATION

1. To avoid damage to the o-ring located on the inside diameter of the shaft seal assembly, the entire drive shaft diameter must be thoroughly cleaned and polished with fine emery cloth. Be especially careful to remove sharp edges along the edges of the keyway and the set screw indents (Fig. 7). Thoroughly clean the entire shaft with a clean, lint free cloth.

F. REPLACEMENT SEAL PREPARATION

CAUTION
Handle the new seal with care. Do not touch the seal face or the mating face. Use only clean lint free cloths. Use only new oil for lubrication.

1. Remove inner o-ring from seal. Clean the o-ring and the o-ring slot. Liberally oil the o-ring and the slot and re-install the o-ring.
2. Remove the four set screws from the small diameter of the seal.

G. HOUSING PREPARATION

1. If replacing a 9B seal, a different housing will be used. Unpack the new housing and thoroughly clean and remove any preservative.
2. Insert a drive pin in the hole inside the housing until it bottoms out in the hole (Fig. 8).
3. If replacing a Bellows seal, the mating ring must be replaced.
4. Place the housing on a clean surface with the flange up.
5. Using a screwdriver, gently tap around the upper edge of the mating ring to remove it from the housing.
G. HOUSING PREPARATION (cont.)

6. Remove the mating ring and the o-ring and thoroughly clean the inside of the housing.
7. Remove the outer lip seal and clean the surface.
8. Install a new outboard lip seal on outlet groove of housing. The flat outer face of the lip seal should be on the outside of the housing (Fig. 9).
9. Clean the seal housing with a clean lint free cloth. Liberally oil the o-ring groove and install the inner o-ring.
10. Oil the inside diameter of the housing.
11. When installing the new mating ring, do not touch the face of the new mating ring. Oil the face of the mating ring and use a clean, dry, lint-free cloth to push on the new mating ring.
12. Align the slot in the back of the mating ring with the drive pin in the housing.
13. Push the mating ring into the housing until it is seated.

DO NOT USE ANY FORCE OTHER THAN HAND PRESSURE TO SEAT MATING RING.

14. Install a drain fitting on outside edge of the housing at about the 6 o’clock position.

H. SHAFT SEAL INSTALLATION

1. Check the location of the anti-rotation pin inside the seal cavity. Rotate the shaft until it is at the 12 o’clock position (Fig. 10). If the pin is bent, it must be removed. It is not necessary to install another pin. The set screws are sufficient to prevent the seal from rotating. The compressor outlet housing must be removed if this pin is to be removed or replaced.
2. Liberally oil the outside of the shaft and the inside of the seal. Do not allow oil to enter the set screw holes. Oil in the set screw holes will prevent the Loctite from adhering.
3. Install two set screws loosely in the seal. Align the slot on the back face of the new seal with the anti rotation pin in the shaft. Using allen wrenches in the set screws, carefully push the seal into the seal cavity until it bottoms out.
4. Rotate the seal from side to side using the allen wrenches to ensure that the pin is engaged.

DO NOT USE ANY FORCE OTHER THAN HAND PRESSURE TO INSTALL THE SEAL.

5. Measure the distance from the outside of the seal to the face of the inlet housing. This measurement should be 3/8” ± 1/32”. If this dimension is not achieved, remove seal and try again (Fig. 11).
H. SHAFT SEAL INSTALLATION  (cont.)

6. Add Loctite 242 to the threads of the four set screws and tighten. Tighten all set screws evenly to keep the seal centered on the shaft. Tightening one set screw before the others can cause the seal to be cocked slightly on the shaft. Torque to 7 ft-lb (Fig. 12).

I. INSTALL SHAFT SEAL HOUSING

1. It is advisable to cover the sides of the keyway slot with plastic electrical tape to prevent the o-ring from being cut.
2. Liberally oil the seal face and the mating ring face in the housing.
3. Install the two guide rods at the 12 and 6 o’clock positions.
4. Align the seal housing on the shaft with the oil weepage drain located in the 6 o’clock position.
5. Slide the seal housing in the shaft until o-ring engages (Fig. 13).

EXTREME CARE MUST BE TAKEN TO ENSURE THAT THE MATING RING DOES NOT BUMP ON THE SHAFT.

6. Remove the guide rods.
7. Install bolts in the 2 and 8 o’clock positions. Slowly and evenly pull the housing into the seal cavity (Fig. 14).
8. Once the housing is seated against the inlet cover, remove the drive bolts and install the six housing mounting bolts. Tighten the bolts in a crossing pattern and torque to 45 ft-lb.
9. Rotate the compressor shaft several times to seat the seal faces.