Diagnostic Troubleshooting Repair

RTAA

CHHB Compressor Troubleshooting

Order Number: **RTAA-SVD01A-EN** Date: January 2004

Introduction

Outlined in this bulletin are troubleshooting procedures for testing the slide valve/ piston assembly and the solenoid valves.

NOTICE: Warnings and Cautions appear at appropriate sections throughout this literature. Read these carefully.

⚠ **WARNING:** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ **CAUTION:** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

CAUTION: Indicates a situation that may result in equipment or property-damage only accidents.

Discussion

The RTAA units have 2, 3 or 4 compressors all of which have a slide valve for modulating capacity. If the unit is experiencing repeated high pressure cutout trips, low oil flow diagnostics and/or low evaporator refrigerant temperature diagnostics use the procedures outlined below to determine if the problem is associated with the compressor.

The microprocessor controls the load and unload solenoid valves in response to varying demands for capacity. On an increased demand for capacity, the load solenoid valve is energized (pulsing 110 VAC). When the load solenoid is energized, it allows oil

pressure to pressurize the piston/cylinder section. The oil pressure moves the piston. The piston is attached to the slide valve via the slide valve shaft. As the oil pressure increases the slide valve covers the compressor rotors to load the compressor.

On a decreased demand for capacity, the unload solenoid valve is energized (pulsing or constant 110 VAC, depending on the mode of the microprocessor controls). When the unload solenoid is energized, it relieves the oil pressure built up in the piston/cylinder section. As the pressure decreases in the piston cavity the piston retracts to unload the compressor.

On a hold demand for capacity, both the load and unload solenoid valves remain de-energized which maintains the position of the piston and slide valve.

Why Does The Slide Valve Move?

There are several forces that act upon the slide valve/piston assembly. See Figure 1. To help explain Figure 1, refer to the algebraic equation noted below.

Note: CHHB compressors do not use a spring to assist in unloading.

To Hold:

For the piston to remain in the "hold" position, the forces on both sides of the piston/slide valve assembly must be equal.

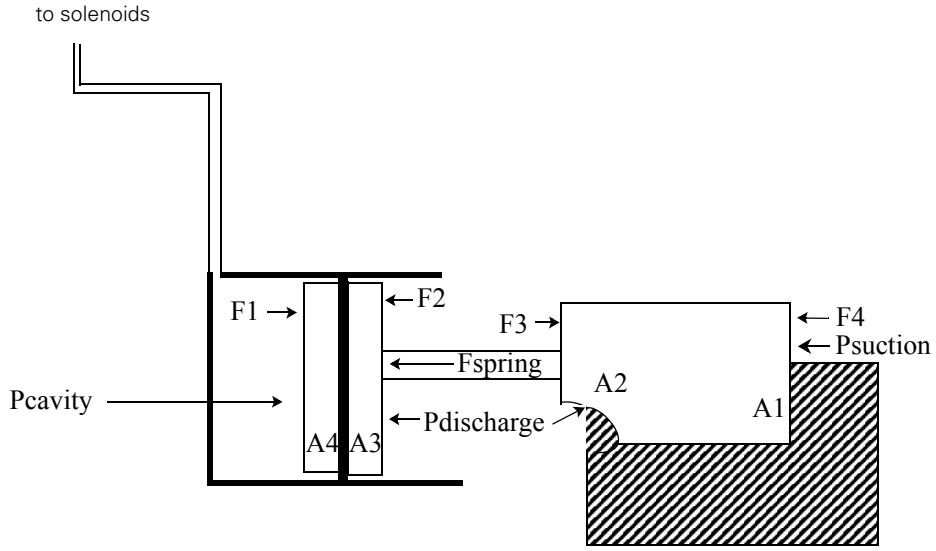
$$(P_{cavity} \bullet A4) + (P_{discharge} \bullet A2) = (P_{discharge} \bullet A3) + F_{spring} + (P_{suction} \bullet A1)$$

To Load:

Assuming A3 = A2

$$P_{cavity} > \frac{F_{spring} + (P_{suction} \bullet A1)}{A4}$$

Figure 1 Piston/Slide Valve Forces Balance



Piston Cavity Pressure

It is the oil pressure behind the piston, known as the piston cavity pressure, that ultimately determines the position of the slide valve when the compressor is operating properly. The oil pressure supply to the load solenoid valve is tapped from the bearing and rotor injection oil supply line. Due to pressure drop of the oil cooler, angle valve, oil filter, master solenoid valve, etc., the oil pressure supply to the load solenoid valve is approximately 20 - 30 PSIG below compressor refrigerant discharge pressure. The differential pressure switch will trip if the pressure drop across the oil system is greater than 50 psid, creating a "Low Oil Flow Diagnostic".

As the compressor loads, the piston cavity pressure increases, as well as, the compressor RLA. This also increases the head pressure of the system. As the head pressure increases, the refrigerant and oil travel at higher velocities through the lines. The increased velocities will create higher pressure drops across system components (i.e.: angle valves, solenoids and filters), even if no restriction is present.

To obtain piston cavity pressure, attach a gauge set to the schrader valve mounted on the discharge end of the compressor. Oil pressure at the schrader valve is not proportional to the position of the slide valve, however, monitoring this pressure can help determine if there is a problem with the compressor. Several of the checkout procedures will reference the piston cavity pressure.

Compressor Checkout

Several things can fail in the compressor, causing erratic control leading to diagnostics such as High Pressure Cutout, Low Oil Flow, and Low Evaporator Refrigerant Temperature. To check the operation of the compressor , several components must be checked. This checkout will cover testing of the solenoids, piston, pill filters and the lip seal.

⚠ WARNING

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

⚠ WARNING

Contains Refrigerant!

System contains oil and refrigerant under high pressure. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or refrigerant additives.

Failure to follow proper procedures or the use of non-approved refrigerants, refrigerant substitutes, or refrigerant additives could result in death or serious injury or equipment damage.

Load/Unload Solenoids

Normal Operation

1. Check the wiring between the solenoids to the compressor module. The unload solenoid is the solenoid closest to the discharge end of the compressor.
2. Use a small screwdriver to detect if the load and unload solenoids are being energized.

   NOTE: The unload solenoid will remain energized for 1 hour after a compressor stop.
3. If there appears to be an electrical problem with either of the solenoids or the MCSP modules, refer to RTAA-SB-5, page 41 for the complete controls checkout procedure.
4. If the solenoid valves are functioning properly electrically, the mechanical portion of the solenoid valves must be tested.
5. Shut down the unit.
6. Attach one end of a manifold gauge set to the schrader on the discharge plate, for monitoring the piston cavity pressure.
7. Attach the other end to the suction side but keep the gauge set closed on start-up.
8. Be prepared to monitor the compressor RLA and the piston cavity pressure on start-up.
9. Start the compressor.
10. The piston cavity pressure should be close to suction (20-25 pounds above suction for the first 30 seconds) at start-up and gradually increase as the load solenoid is pulsed. The compressor RLA should gradually increase along with the piston pressure.

Solenoid Checkout

1. Connect a gauge to the piston cylinder access Schrader valve and start compressor.
2. Apply constant power to load solenoid valve coil. Leave unload solenoid valve coil attached to microprocessor.

   Important: This may cause the unit to trip on 198, 199, 19A or 19B if the compressor loads faster the fans can stage on. Fans may need to be jumpered on to control head pressure during the test.
3. Pressure should rise to within 20-30 PSIG of condenser pressure, provided microprocessor does not energize unload solenoid valve, due to a limit or temperature control. If pressure fails to rise, suspect one of the following:

   Clogged oil filter

   Plugged load solenoid valve

   Leaking unload solenoid valve
4. Disconnect power from both solenoid valve coils. Pressure should maintain. If pressure drops, suspect a leaking unload solenoid valve.

Important: Do not just take to coils off the solenoid. This will cause the coil to burn up. Disconnect the wires at the module.

5. Energize unload solenoid valve, until pressure drops to about halfway between suction and condenser pressures.
6. Ensure that power is not applied to both valves. Pressure should maintain. If pressure rises, suspect a leaking load solenoid valve.
7. If pressure drops, suspect a leaking unload solenoid valve.
8. Put constant power to unload solenoid valve coil. Disconnect power to load solenoid valve coil. Pressure should drop near suction pressure, if pressure does not drop, suspect a plugged unload solenoid valve or pill filter. The pill filters are located under the solenoid valved on some compressors.

   Important: The compressor must be isolated and evacuated before servicing the solenoids
9. If either a leaking load or unload solenoid valve is suspected as a problem, a piece of shim stock should be placed between the valve and the gasket, sealing off the ports of the valve. This will essentially isolate the valve from the system, to confirm diagnosis of a leaking solenoid valve.
10. If either a plugged load or unload solenoid valve is suspected, replacement of valve is required to confirm diagnosis.

Slide Valve Movement

If the load/unload solenoid valves operate properly, but the compressor motor amperage fails to rise, or fall, in response to commands from the load/unload solenoid valves, the slide valve piston could be hesitant to move. This usually happens when the compressor is first put into service, and the rings on the piston have not been "broke-in" yet.

To move slide valve, perform the following sequence:

1. The discharge pressure can be increased to acquire more pressure to move the slide valve. Disconnect wiring to several condenser fan motor contactor coils, in order to achieve 350-370 PSIG condenser pressure. Typically, this will provide sufficient power to move a "hesitant" slide valve piston.
2. If the slide valve still fails to move, an extra 20-30 PSIG that is lost, via the oil cooler circuit, can be acquired by de-energizing the load solenoid valve, and temporarily connect a refrigerant service gauge set, between the compressor refrigerant discharge Schrader valve and the Schrader valve for the piston/cylinder assembly. The valve on the gauge set can be used to simulate the load solenoid valve.
3. If the slide valve still fails to move, access to the top of the piston can be gained, through the Schrader valve piston/cylinder access port, by using the following procedure:

Access to Piston

Important: Using the UCM lockout the affected circuit.

1. Isolate compressor via compressor suction and discharge service valves.

   Important: Energize the load and unload solenoids during recovery.

2. Relieve pressure on compressor.

3. Remove complete piston/cylinder access Schrader valve. (Note: The threads on this valve is sealed with loctite. Care must be taken to not damage, or break valve off when removing).

4. Insert a smooth rod (to prevent damage to pipe threads), that has a diameter of no more than 5/16" (i.e.,Philips screwdriver). If slide valve is in the unloaded piston, insert the rod (approximately 3/4") to make contact with the piston. Next, push on the piston and the slide valve should move to the loaded position. Table 1 lists the stroke lengths of the various compressors and slide valves. A slight tap with a hammer may be required to get the piston moving.

Compressor	Slide Valve Stroke Length
CHHB 070	3 inches
CHHB 085	3.25 inches
CHHB 100	3.5 inches

5. To return the piston to the unloaded position, add nitrogen pressure to the compressor, via the suction service valve. This pressure will be on the back side of the piston, thus causing its movement back to the unload position.

6. Repeat steps 4 and 5 to ensure free movement of the slide valve/piston assembly.

7. If the piston still appears to stick or leak, replace the piston. See RTAA-SVB12A-EN

8. Evacuate the compressor.

9. Open service valves and put compressor back into operation.

Lip Seal

The 70 to 100 ton compressors are unloaded via internal porting in the compressor. The lip seal is used to isolate a cavity behind the bearings that is ported to suction. This creates a path from the unload solenoid to suction which relieves the pressure from behind the piston. If the lip seal develops a leak, internal porting is not large enough to vent the additional discharge gas back to suction. As the bearing cavity increases in pressure, the piston can no longer unload.

The lip seal cannot be replaced in the field but the porting of the unload solenoid can be routed externally without any adverse affect on the compressor. Do not re-route the porting of the unload solenoid until all other components used in unloading the compressor have been verified as operational.

1. Cycle the unit off line.

2. Attach an amp meter to the one of the main leads to the compressor.

3. Monitor and record the actual RLA at start-up.

4. Determine if the compressor is starting loaded.

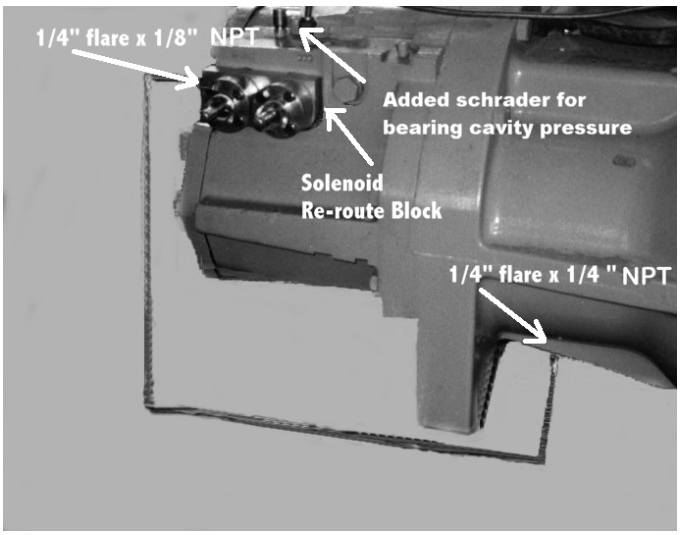
   NOTE: The high head pressure from starting loaded increases the pressure drop across the oil line which could be enough to generate a low oil flow diagnostic. Starting loaded can also cause pressures to rise quick enough to open relief valves and or trip the unit on high pressure diagnostic.

5. To measure the bearing cavity pressure, a schrader valve must be added to the top of the compressor.

6. To add the schrader valve, isolate the compressor by closing the suction service valve, discharge service valve and the oil line angle valve. Manually energize the master solenoid. Relieve the pressure from the backseat port of the suction service valve.

7. Remove the plug from the on top of the compressor, adjacent to the unload solenoid. Refer to Figure below.

Figure 2 Compressor with Re-route Block Installed



NOTE: At times, it is difficult to determine the exact cause of the loading problems. The only way to verify that the problem is NOT associated with the solenoids is to insert block-off (shim stock) under both the unload solenoid and the load solenoid and verify the pressure in the piston cavity. The shims can be added under the solenoids while the compressor is isolated. If the shims are added, the compressor will need to be manually loaded and unloaded with a gauge set for the remainder of the test.

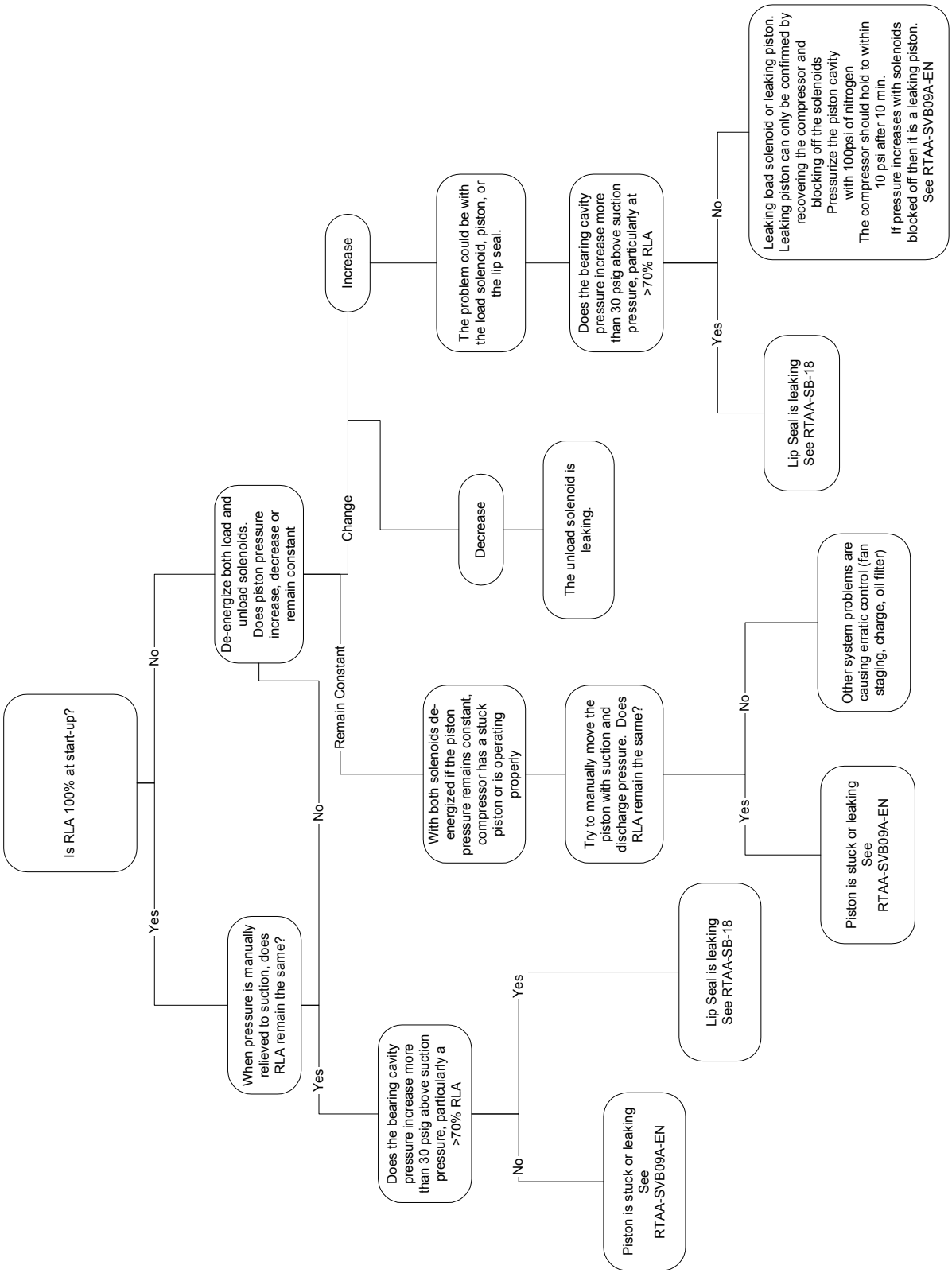
8. The bearing cavity pressure gradually increase to not more than 30 psi above suction. If the lip seal is leaking this pressure will increase to approximately discharge, particularly when RLA is above 70%.

NOTE: As the bearing cavity pressure rises above piston pressure, the compressor will begin to load when the unload solenoid is pulsed. If the lip seal leak is severe enough, the unload solenoid will no longer hold in reverse, causing the compressor to go fully loaded continuously.

9. If it is determined that the lip seal is leaking. See RTAA-SB-18.

First Start Syndrome

This is a phenomenon that is seen on older compressor on the first start of the day. The compressor will start loaded the first start only or after the compressor has been off for at least 8 hours and then compressor will operate normally. This may cause High Pressure Cutout and/or Low Oil Flow Trips. This happens as the seal ring on the piston begins to wear. This can be corrected by simply replacing the piston.


Is RLA 100% at start-up?
Yes
No
When pressure is manually relieved to suction, does RLA remain the same?
Yes
No
Does the bearing cavity pressure increase more than 30 psig above suction pressure, particularly a >70% RLA
Yes
No
Lip Seal is leaking See RTAA-SB-18
Piston is stuck or leaking See RTAA-SVB09A-EN
De-energize both load and unload solenoids. Does piston pressure increase, decrease or remain constant
Change
Increase
The problem could be with the load solenoid, piston, or the lip seal.
Does the bearing cavity pressure increase more than 30 psig above suction pressure, particularly at >70% RLA
Yes
No
Lip Seal is leaking See RTAA-SB-18
Leaking load solenoid or leaking piston. Leaking piston can only be confirmed by recovering the compressor and blocking off the solenoids Pressurize the piston cavity with 100psi of nitrogen The compressor should hold to within 10 psi after 10 min. If pressure increases with solenoids blocked off then it is a leaking piston. See RTAA-SVB09A-EN
Decrease
The unload solenoid is leaking.
Remain Constant
With both solenoids de-energized if the piston pressure remains constant, compressor has a stuck piston or is operating properly
Try to manually move the piston with suction and discharge pressure. Does RLA remain the same?
Yes
No
Piston is stuck or leaking See RTAA-SVB09A-EN
Other system problems are causing erratic control (fan staging, charge, oil filter)

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