KEITH PRODUCTS, L.P.

ENVIRONMENTAL SYSTEMS

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AIR CONDITIONING SYSTEM INSTALLATION SERVICE MANUAL FOR Beech Bonanza F33A, V35/35A/35B, 36/A36/A36TC

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A	3-25-99	Updated title page to include Rev Date. Updated revision page to current format. Pg. 2: Removed reference to "para. 2" Pg. 7: Refrigerant qty WAS "2.8", added note to C. 3). Pg. 8: CAUTION: added "air inlet" Pg. 9: Added de-ice and idler pulley bearing to table. Pg. 13: Added "air inlet" and changed "diagnoses" spelling.	MAK	CSH
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INTRODUCTION

1. PURPOSE

   The purpose of this System Service Manual is to provide detailed instructions for the servicing, troubleshooting, checking and maintaining of the Beech Bonanza models F33A, V35/35A/35B, 36/A36/A36TC with Keith Products, Inc. air conditioning system installed. The System Service Manual supplements the Maintenance Manual supplied by Beechcraft for your particular aircraft.

2. SCOPE

   The scope of the System Service Manual provides the maintenance technician with detailed information covering:

   - Overall system level description and theory of operation.
   - Component level description and theory of operation.
   - System level checking and troubleshooting procedures.
   - Procedures for servicing the air conditioning system refrigerant.
   - The identification of special equipment to accomplish the specific tasks.

3. ARRANGEMENT

   This System Service Manual is arranged similar to Air Transport Association (ATA) Specification 100 and provides general servicing and maintenance instructions.

4. GLOSSARY

   Nonstandard abbreviations and symbols used in the Maintenance Manual are described below.

A/C	-	Air Conditioning
A/R	-	As Required
Assy	-	Assembly
Comm. Avail.	-	Commercially Available
Evap	-	Evaporator
Gnd	-	Ground
GPU	-	Ground Power Unit
SW	-	Switch
VDC	-	Volts Direct Current

AIR CONDITIONING SYSTEM - SYSTEM DESCRIPTION

1. AIR CONDITIONING SYSTEM DESCRIPTION

The Keith Products vapor cycle air conditioning system uses liquid refrigerant R134a to cool the aircraft cabin. The major components for the R134a air conditioning system consist of a receiver/dryer, expansion valve, evaporator, compressor and condenser to cool the aircraft cabin. The compressor on Keith Products Bonanza air conditioning system is driven by the engine. Figure 1 shows an operational schematic of the air conditioning system.

The receiver/drier stores liquid R134a refrigerant under pressure. The drier portion of the assembly removes any traces of moisture that may have accumulated in the system. Liquid refrigerant flows from the receiver drier through the expansion valve where the refrigerant pressure is reduced, allowing it to spray into the evaporator. At the same time, air is passed over the evaporator by a blower driven by a 14VDC or 28VDC motor. This air is cooled since heat is removed from the air by the evaporation of the refrigerant in the evaporator. The evaporator produces water due to condensation. This water drains overboard through a line attached to the evaporator cover.

The refrigerant leaves the evaporator as a gas. This gas is pumped by the compressor, raising its pressure and temperature. This high temperature gas then flows to the condenser. Cooling air, driven by another 14VDC or 28VDC blower motor, passes through the condenser, cooling and therefore condensing the refrigerant to a liquid. The liquid refrigerant then enters the receiver/drier, repeating the process.

The plumbing which connects the compressor, condenser and the evaporator, consists of rubber based hoses with a nylon barrier. The fittings are permanently swaged onto the hoses. Fittings are "o-ring" type connections. Refrigerant oil is used on the fitting mating surfaces to prevent refrigerant leaks. Two R134a service valves are sized differently to avoid incorrect cross-connecting when gaining access to the plumbing for system recharging.

The entire air conditioning refrigerant loop is protected against over pressure conditions by two separate safety devices. The first device is a binary high/low pressure switch. This switch will open at approximately 350 PSIG and will interrupt power to the compressor clutch at which point the system pressures will drop. The switch will also interrupt power to the compressor clutch under low pressure conditions. The second overpressure safety device is a fuse plug which will vent the system refrigerant in the event of a system pressure in excess of 425PSIG. It is located on the receiver/drier.

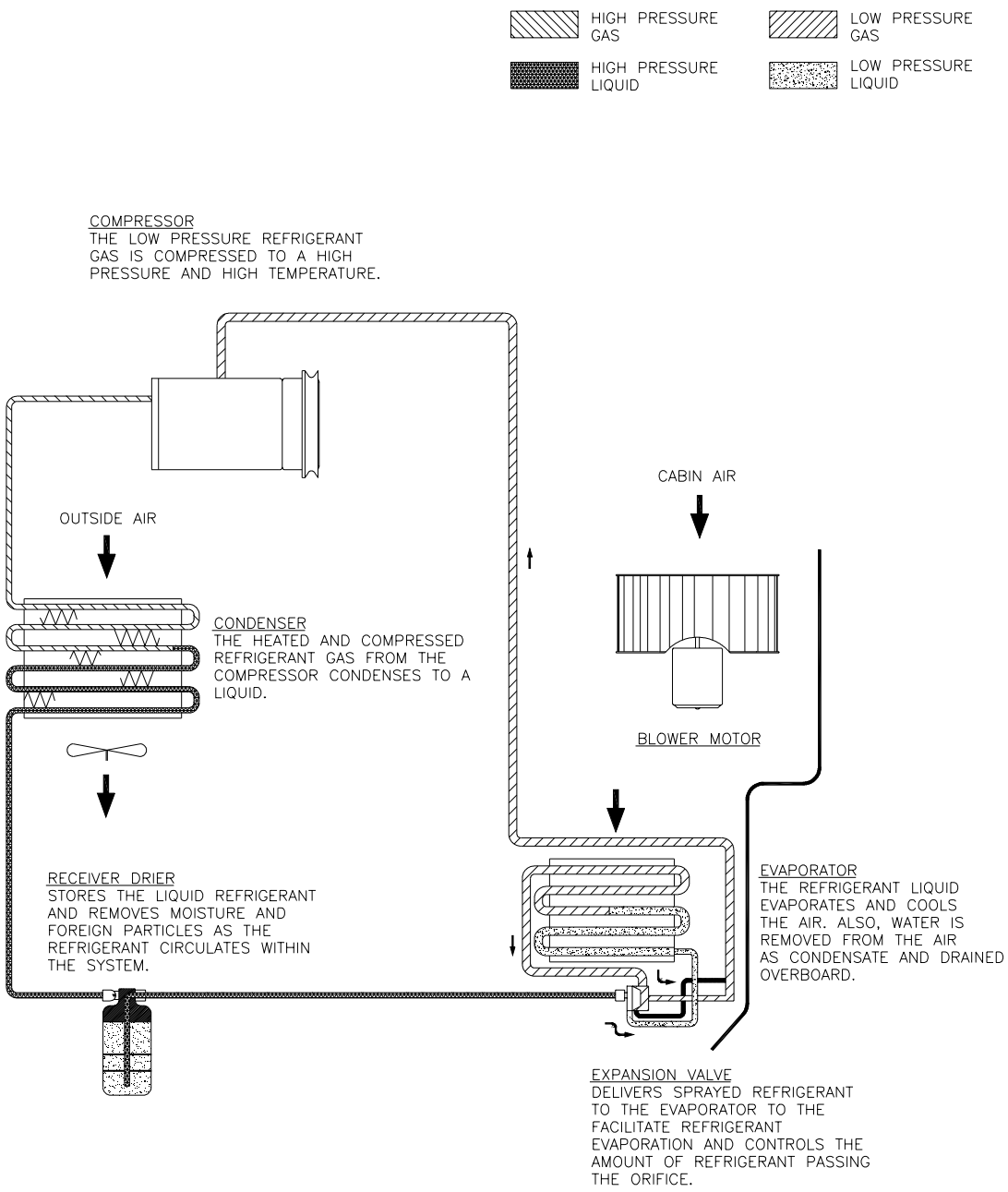

Figure 1. Air Conditioning Vapor Cycle System

2. SYSTEM OPERATION

The air conditioning system is operated with the engine operating and the aircraft electrical system providing 14VDC or 28 VDC to the main buss. To operate the system proceed as follows:

1) Position the bowden cable so that the butterfly valve in the aft-most-part of the ducting allows only air conditioning air to blow through the ducting. Incorrect positioning of the valve will result in warm outside air mixing with air conditioned air.
2) Turn on air conditioning system by placing the upper-left hand control switch in the AIR COND position.
3) For maximum cooling, place the FAN control knob in the HI position, place the CABIN COOLING control knob in the MAX position, and close cabin and baggage doors.
4) Turn off air conditioning system by placing the upper-left hand control switch in the OFF position.
5) Airflow may be varied by switching the FAN control switch between the LO and HI positions.
6) Cabin air cooling may be varied by rotating the CABIN COOLING control knob between the MIN and MAX positions.
7) Cabin air may be re-circulated without the air conditioning system operating by placing the upper-left hand control switch in the FAN position.

REFRIGERANT SERVICING

1. GENERAL

   The air conditioning system uses refrigerant R134a and the compressor lubricating oil used is Polyolester Oil viscosity grade (ISO) 68. No other refrigerant or compressor oil should be used.

   Refrigerant R134a is non-explosive, non-flammable, non-corrosive, has practically no odor, and is heavier than air. Although R134a is classified as a safe refrigerant, certain precautions must be observed to personnel and property when working with R134a refrigerant.

WARNING:

A. Liquid R134a, at normal atmospheric pressure and temperature, evaporates so quickly that it tends to freeze anything that it contacts. Care must be taken to prevent any liquid refrigerant from coming into contact with skin.

B. Always wear safety goggles when servicing any part of the refrigerant system to prevent refrigerant from coming into contact with the eyes.

C. To avoid explosion, never weld, use a blow torch, solder, steam clean, or use excessive amounts of heat on, or in, the immediate area of the air conditioning system, or refrigerant supply tank, full or empty, while they are closed to atmosphere.

D. The refrigerant service cart/container has a safe strength. However, if handled incorrectly, it will explode. Therefore, always follow the instruction on the label. In particular, never store it in a hot location (above 126/F, 52/C) or drop it.

CAUTION: Do not operate air conditioning system with condenser air outlet blocked.

2. DISCHARGING SYSTEM

   A. General
   The air conditioning system refrigerant must be discharged prior to disconnecting or removing and components in the refrigerant loop. Federal law prohibits discharging refrigerant into the atmosphere. Use only an R134a compatible recycling/recovery unit when discharging the air conditioning system.

B. Tools and Equipment

Designation	Ref. No.	Qty	Remarks
R134a Compatible Recycling/Recovery Unit	Comm. Avail.	1	None

C. Discharging Procedure
1) Connect R134a compatible recycling/recovery unit to the R134a service valves on the aircraft's air conditioning system. If recovery unit does not have pressure gauges, connect service pressure to air conditioning system.
2) Discharge the air conditioning system in accordance with the recovery unit's instructions.
3) Disconnect recovery unit when discharging is complete.

3. EVACUATING SYSTEM

A. General
The air conditioning system must be evacuated prior to charging the system with refrigerant. Evacuating the system removes any moisture that may be in the system. Use only an R134a compatible recycling/recovery unit when evacuating the air conditioning system.

B. Tools and Equipment

Designation	Ref. No.	Qty	Remarks
R134a Compatible Recycling/Recovery Unit	Comm. Avail.	1	None

C. Evacuating Procedure
   1) Connect R134a compatible recycling/recovery unit to the R134a service valves on the aircraft's air conditioning system. If recovery unit does not have pressure gauges, connect service pressure to air conditioning system.
   2) Evacuate the air conditioning system in accordance with the recovery unit's instructions for a minimum of 15 minutes.
   3) Once the air conditioning system has been evacuated, it is then ready for charging with new/recycled R134a refrigerant.

4. CHARGING SYSTEM

A. General
Use only R134a refrigerant when charging air conditioning system. Federal law prohibits discharging refrigerant into the atmosphere. Use only R134a compatible recycling/recovery unit when charging the air conditioning system.

B. Tools and Equipment

Designation	Ref. No.	Qty	Remarks
R134a Compatible Recycling/Recovery Unit	Comm. Avail.	1	None
R134a refrigerant	Comm. Avail	1.8 lbs.	None
Polyolester Oil	Comm. Avail	5 fl. oz.	Viscosity ISO 68

C. Charging Procedure
   1) Connect R134a compatible recycling/recovery unit to the R134a service valves on the aircraft's air conditioning system. If recovery unit does not have pressure gauges, connect service pressure gauges to air conditioning system.
   2) Add new polyolester oil, viscosity grade (ISO) 68 to the compressor oil fill port. (only if the oil has been previously drained)
   3) Charge the air conditioning system in accordance with the recovery unit's instructions, until the sight glass just clears of bubbles. (System must be operating for the sight glass bubble inspection to be performed)

GENERAL SERVICING

1. GENERAL

   General service procedures are provided to keep the air conditioning system operating at peek efficiency. Procedures are provided for general maintenance tips, inspection intervals, maintenance of the plumbing system, to repair hoses, and to clean coils. Procedures are also provided for removal and installation of the expansion valve.

CAUTION: Do not operate air conditioning system with condenser air inlet and outlet blocked.

2. INSPECTION INTERVALS

   A. General

      Periodic inspections of the air conditioning system will keep the system operating at peek efficiency. The inspections are simple visual inspections requiring a minimal amount of time.

   B. Inspection Intervals

ITEM	INSPECT FOR	INTERVAL	ACTION
Air Conditioning System Components	Dirt , Damage	Every 100 hours or 3 months	Clean or replace component as necessary
Compressor Belt	Tension, Wear	Within 5 hours of installing new belt, then every 100 hours or 3 months	Tension or replace as necessary
Sight Glass	Proper refrigerant level	When problem is suspected	Discharge/charge as necessary
Evaporator and condenser coils	Dirt	Every 100 hours or 3 months	Clean as necessary
Compressor Installation	cracks, contact with cylinders or crankcase	Every 100 hours or 3 months	Replace as necessary
Propeller O-ring	Cracks, signs of Pinching, improper seating	Every time the propeller is removed	Immediately replace

ITEM	INSPECT FOR	INTERVAL	ACTION
De-ice (if applicable)	Resin cracking and crazing Brush contact per Beech service manual	Every 100 hours or 3 months	Immediately replace or adjust brush contact
Idler pulley bearing	Resistance to rotation and any abnormalities	Every time the propeller is removed	Immediately replace
Condenser Install.	Run the cond. fan with battery pwr. and inspect for closed loop system air leaks.	Every 100 hours or 3 months.	Immediately seal or replace components. Any leaks could result in carbon monoxide entering the cabin.

3. PLUMBING SYSTEM MAINTENANCE PROCEDURES

A. General

The following procedures are used to perform typical maintenance on the air conditioning system plumbing. Procedures are provided for hose or fitting replacement. Keith Products air conditioning systems use swaged hose fittings with "o-ring" type connections.

B. Tools and Equipment

Designation	Ref. No.	Qty	Remarks
R134a Compatible Hose Swaging Kit	Available from Keith Products	1	None
Sharp Knife	Comm. Avail.	1	None
Impact Wrench	Comm. Avail.	1	None
Light Machine Oil	Comm. Avail.	A/R	None
Polyolester Oil	Comm. Avail.	A/R	Viscosity ISO 68

C. Hose or Fitting Replacement

NOTE: If it is found that a hose or fitting has a leak, it will be necessary to replace the entire hose assembly. Follow the Hose Swaging Instruction below:

1. Hose should only be cut with a sharp knife. (**Note:** Use of serrated blades or saws to cut hose will leave particles that can contaminate system.)
2. Insert the proper size die in the swaging tool.
3. Insert fitting in swaging tool so that it is centered in the die and hand tighten.
4. Insert hose in fitting until it bottoms (**Note:** Indicating hole is in base of fitting).
5. Using impact wrench, tighten nut until die housings contact. (**Note:** It is important to keep hose pushed into fitting while swaging).
6. Reverse impact and back off nut until housing contacts rubber stops.

D. Connection to Components - O-Ring Replacement
1. Place the appropriate o-ring over the tube "O" end of the fitting.
2. Lubricate o-ring with polyolester oil or sealant prior to assembly.
3. Apply sealant to all fitting mating surfaces prior to assembly.

Recommended Standard Torque Specifications-
O-Ring Connections.

Thread Size	Ft-Lb	N-M
5/8”	11-13	15-18
3/4"	15-20	20-27
7/8”	21-27	29-37
1 1/16”	28-33	38-45

E. Receiver/Drier Replacement
1. Replace receiver/drier whenever the compressor is replaced or when the air conditioning system plumbing is left open to the atmosphere for a period of time greater than one (1) hour.

4. COIL CLEANING MAINTENANCE PRACTICES

A. General

The following procedure is used for cleaning either evaporator or condenser coils.

B. Tools and Equipment

Designation	Ref. No.	Qty	Remarks
Vacuum Cleaner	Comm. Avail.	1	None
Coil Cleaner	Comm. Avail.	A/R	Non-acid based

C. Coil Cleaning Procedure

1. Use vacuum cleaner to remove large debris from upstream and downstream coil faces.
2. Spray coil cleaner on both coil faces. Wash off with water.
3. Allow coil to dry thoroughly prior to additional maintenance.

5. EXPANSION VALVE REMOVAL AND INSTALLATION

A. General

The following procedure is used to remove or install the air conditioning system expansion valve, located on the inlet side of the evaporator coil.

B. Tools and Equipment

Designation	Ref. No.	Qty	Remarks
Sealant	ES49000-3	A/R	None
Polyolester Oil	Comm. Avail.	A/R	Viscosity ISO 68

C. Expansion Valve Replacement

1. Discharge system in accordance with recovery equipment's instructions.
2. Disconnect liquid line from inlet of expansion valve, and cap. Remove the thermal sense bulb from its clamp located on the suction tube of the evaporator and carefully remove insulation covering bulb.
3. Disconnect the fitting that connects the valve to the coil and plug coil fitting.
4. Install new expansion valve and o-ring (for o-ring fitting systems) in the reverse order.
5. Lubricate o-ring with polyolester oil or apply sealant to fitting mating surfaces prior to assembly.
6. Install the thermal sense bulb such that it makes contact with the suction tube along its entire length. Insulate the bulb thoroughly with insulation.

TROUBLESHOOTING

1. GENERAL

The procedures below present troubleshooting charts for the air conditioning system and the compressor. A diagnosis chart is presented for insufficient air conditioning system cooling. The performance characteristics of an aircraft's particular system is dependent upon the design parameters of the systems components. The performance of any one particular system varies with ambient temperature and humidity. The information below presents possible air conditioning system problems and solutions.

CAUTION: Do not operate air conditioning system with condenser air inlet and outlet blocked.

2. AIR CONDITIONING SYSTEM DIAGNOSIS CHART

Figure 2 shows a procedure for diagnosing air conditioning system problems. Following this procedure will expedite the troubleshooting process.

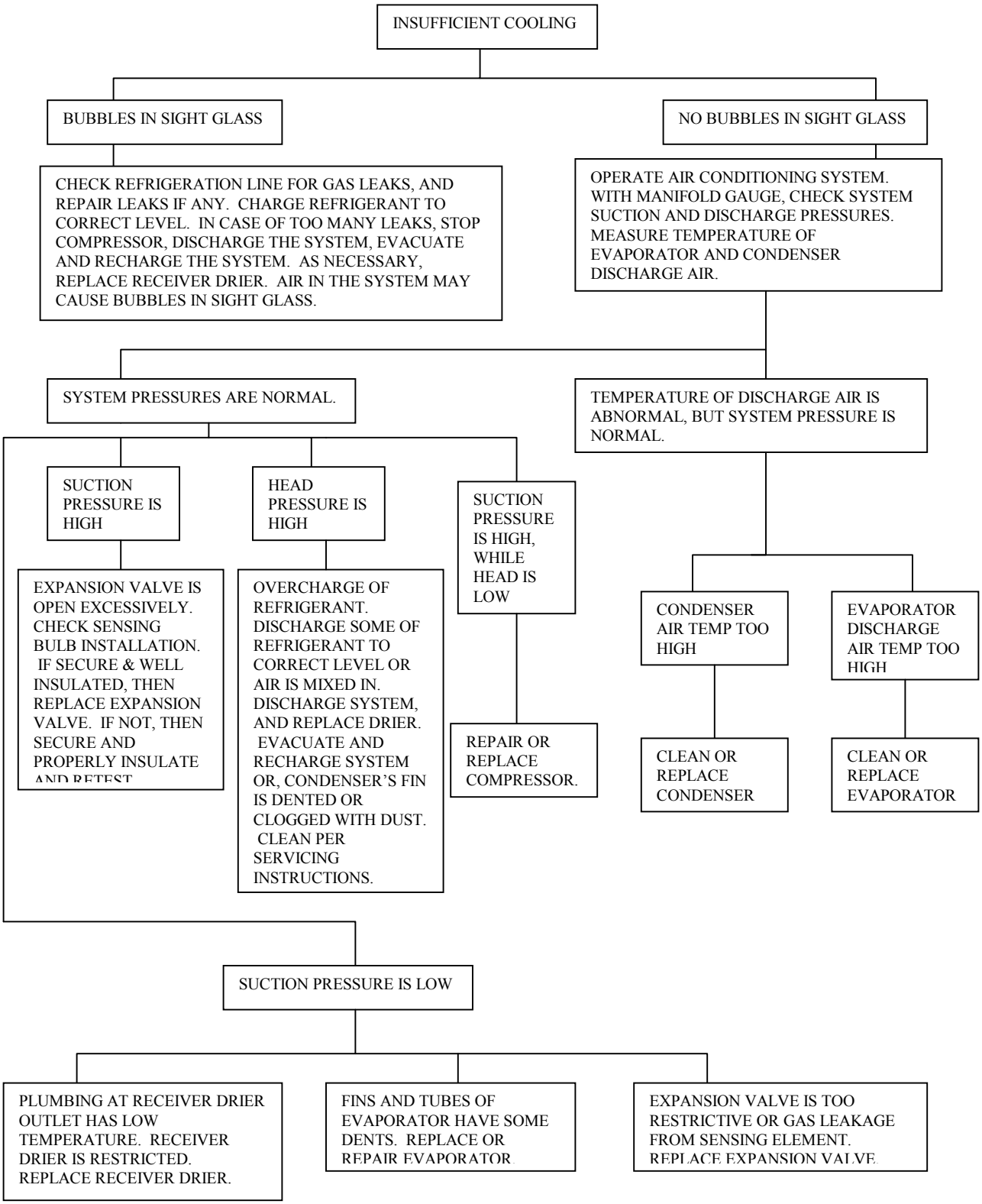

Figure 2: Air Conditioning System Diagnosis Chart

3. AIR CONDITIONING SYSTEM TROUBLESHOOTING

CONDITION	SERVICE PRESSURE GAUGE READING	PROBABLE CAUSE	CORRECTIVE ACTION
INSUFFICIENT REFRIGERANT CHARGE Insufficient cooling. Bubbles appear in sight glass.	SUCTION PRESSURE: below normal DISCHARGE PRESSURE: below normal	Refrigerant is low, or leaking a little.	1. Leak test. 2. Repair leak. 3. Charge system. Evacuate as necessary and recharge system.
ALMOST NO REFRIGERANT No cooling action. A lot of bubbles or something like mist appears in sight glass.	SUCTION PRESSURE: much below normal DISCHARGE PRESSURE: much below normal	Serious refrigerant leak.	Stop compressor immediately. 1. Leak test. 2. Discharge system. 3. Repair Leak(s). 4. Replace receiver drier, if necessary. 5. Check oil level. 6. Evacuate and recharge system.
FAULTY EXPANSION VALVE a) Slight cooling. Sweating or frosted expansion valve outlet.	a) SUCTION PRESSURE: below normal DISCHARGE PRESSURE: below normal	a) Expansion valve restricts refrigerant. Or, expansion valve is clogged. Or, expansion valve is inoperative. Or, valve stuck closed. Thermal bulb has lost charge.	a) Replace expansion valve.
b) Insufficient cooling. Sweated suction line.	b) SUCTION PRESSURE: above normal DISCHARGE PRESSURE: above normal	b) Expansion valve allows too much refrigerant through evaporator. Sensing element on suction line not well insulated or properly attached to line.	b) 1. Check valve for operation. If suction side does not show a pressure decrease, replace valve. 2. Check security and insulation on sensing element.
c) No cooling. Sweating or frosted suction line.	c) SUCTION PRESSURE: above normal DISCHARGE PRESSURE: below normal	c) Faulty expansion valve.	c) 1. Discharge system. 2. Replace valve. 3. Evacuate and replace system.

CONDITION	SERVICE PRESSURE GAUGE READING	PROBABLE CAUSE	CORRECTIVE ACTION
AIR IN SYSTEM Insufficient cooling. Sight glass shows occasional bubbles.	SUCTION PRESSURE: above normal DISCHARGE PRESSURE: above normal	Air mixed with refrigerant in system.	1. Discharge system. 2. Replace receiver drier. 3. Evacuate and charge system.
MOISTURE IN SYSTEM After operation for a while, pressure on suction side may show vacuum pressure reading. During this condition, discharge air will be warm. As warning of this, reading shows approx. 6 psi oscillation.	SUCTION PRESSURE: below normal DISCHARGE PRESSURE: above normal	Drier is saturated with moisture. Moisture has frozen at expansion valve. Refrigerant flow is restricted.	1. Discharge system. 2. Replace receiver drier (twice if necessary). 3. Evacuate system completely. (Repeat 30 minute evacuating three times.) 4. Recharge system.
FAULTY CONDENSER Insufficient cooling. Bubbles appear in sight glass of drier. Suction line is very hot.	SUCTION PRESSURE: above normal DISCHARGE PRESSURE: above normal	Condenser air or refrigerant flow is restricted.	Check condenser for dirt accumulation. Check for refrigerant overcharge. If pressure remains high in spite of all above actions taken, remove and inspect the condenser for possible oil clogging.
HIGH PRESSURE LINE BLOCKED Insufficient cooling. Frosted high pressure liquid line.	SUCTION PRESSURE: much below normal DISCHARGE PRESSURE: much above normal	Drier clogged, or restriction in high pressure line.	1. Discharge system. 2. Remove receiver drier and replace it. 3. Evacuate and charge system.

CONDITION	SERVICE PRESSURE GAUGE READING	PROBABLE CAUSE	CORRECTIVE ACTION
FAULTY COMPRESSOR Insufficient cooling.	SUCTION PRESSURE: much below normal DISCHARGE PRESSURE: much below normal	Internal problem in compressor, or damaged gasket and valve.	1. Discharge system. 2. Remove and check compressor. 3. Repair or replace compressor. 4. Check oil level. 5. Replace receiver drier. 6. Evacuate and charge system.
TOO MUCH OIL IN SYSTEM (Excessive) Insufficient cooling.	SUCTION PRESSURE: above normal DISCHARGE PRESSURE: above normal	Too much oil circulates with refrigerant, causing the cooling capacity of the system to be reduced.	Refer to Oil Level Check for correcting oil level.

4. COMPRESSOR TROUBLESHOOTING

A. General

The following procedures are used for troubleshooting the compressor.

B. Tools and Equipment

Designation	Ref. No.	Qty	Remarks
Service Pressure Gauge	Comm. Avail.	1	None
14vdc or 28vdc Source (depends on model)		A/R	None

C. Compressor Troubleshooting Procedures

With the air conditioning system operating, check for any of the following conditions.

NOTE: Always attach a service gauge set to system prior to being trouble shooting to insure proper refrigerant charge is present.

Trouble	Probable Cause	Correction
1. Unusually high suction pressure with low discharge pressure.	Internal problem with compressor body.	Repair leak or replace compressor.
2. Unusually low suction and discharge pressure.	System or compressor Leak.	(a) Inspect/replace exhaust duct. (b) Discharge refrigerant until only occasional bubbles are present in sight glass.
3. High compressor discharge pressure.	(a) Air exhaust duct collapsed or restricted. (b) Refrigerant overcharge.	Replace compressor.
4. Rough running.	Internal compressor problem.	Replace compressor.

CHECKS

1. GENERAL

The following procedures are used to perform typical maintenance checks for air conditioning system refrigerant leaks, refrigerant charge and compressor oil level.

CAUTION: Do not operate air conditioning system with condenser air outlet blocked.

A. Tools and Equipment

Designation	Ref. No.	Qty	Remarks
Service Pressure Gage	Comm. Avail.	1	None
Electronic Leak Detector	Comm. Avail.	A/R	Type H-10G
Polyolester Oil	Comm. Avail.	A/R	Viscosity (ISO) 68

2. REFRIGERANT LEVEL CHECK

A. Select air conditioning system switch to AIR COND position.
B. Set the cabin temperature knob to the MAX position.
C. Set the fan speed knob to the HI position.
D. Run system for five (5) minutes minimum.
E. Check that the receiver/drier inlet and outlet fitting temperatures are the same. If the outlet is colder, the receiver/drier screen is clogged. Clean screen and re-start refrigerant level check.
F. Check sight glass for sufficient amount of bubbles.
NOTE: The refrigerant bubbles are more difficult to see at ambient temperatures below 65/F. Always re-check refrigerant level when ambient temperature is above 65/F for proper level.

3. REFRIGERANT SYSTEM LEAKAGE CHECK

   A. The system leakage check is to be performed in an area with an ambient temperature of 65/F or above.
   B. Install service pressure gage to low and high pressure R134a service valves.
   C. Check for system pressure of approximately 64 psig or above. The low pressure gage may be used to check system pressure. If system pressure is below 64 psig, a small amount of refrigerant R134a may be added to obtain the required pressure.
   D. On systems that have not been operated for 2 weeks or longer, operate the system for a minimum of 15 minutes. This will lubricate the compressor shaft seal and ensure a more accurate leakage check of the shaft seal.
   E. With the system off, and using a type H-10G electronic leak detector or equivalent, check all connections, compressor shaft seal, and fabricated components for leakage. No leakage is acceptable.

4. COMPRESSOR OIL LEVEL CHECK

   NOTE: It is not necessary to check the compressor oil level during routine maintenance. It only needs to be checked when a system component is replaced or when incorrect oil level is suspected. Only polyolester oil viscosity grade ISO 68 should be used.

   1. Operate air conditioning system for 10 minutes. This will collect as much oil as possible in the compressor.
   2. Discharge air conditioning system in accordance with Refrigerant Servicing instructions.
   3. Remove either discharge or suction port hose fitting.
   4. Remove oil drain plug and allow all oil to drain.
   5. Clean oil drain area and install drain plug. Torque to 6 - 9 ft-lbs.
   6. Add 5 ounces of oil to compressor.
   7. Install hose fitting.
   8. Charge air conditioning system in accordance with Refrigerant Servicing instructions.

5. COMPRESSOR DRIVE BELT ADJUSTMENT

    1. Adjust Idler pulley outboard left hand side to obtain moderate belt tension.

    2. Rotate propeller through 2 revolutions.

    3. Tension belt to deflect 0.18 inch with a 5 lb. Force applied at the mid-span location between the drive pulley and compressor pulley.

    4. Rotate propeller 2 revolutions, retention as required to obtain proper deflection.