



An Oshkosh Corporation Company

Special Instruction

Reference: SI 1105

September 30, 2011

Troubleshooting the Air Conditioning System on certain Caterpillar Branded Telehandlers.

Introduction:

This special instruction provides troubleshooting guidelines for identifying and correcting problems that may occur in the air conditioning (A/C) system.

Applicable to:

These troubleshooting guidelines are applicable to Caterpillar Branded Telehandlers with the following serial numbers:

Model	Applicable Serial Number Range
TH336	TDE00100 – Up
TH337	TDF00100 – Up
TH406	TBX00100 – Up
TH407	TBY00100 – Up
TH414	TBZ00100 – Up
TH514	TBW00100 – Up
TH417	TBT00100 – Up

Topics:

In order to start troubleshooting it is necessary to understand the locations and specifications of key components, and the layout of the electrical circuit. The headings below will provide a better understanding of the A/C system and the components included:

- 1) A/C Component Locations.
- 2) System Specifications.
- 3) Electrical Schematic.
- 4) Refrigerant Flow.
- 5) Troubleshooting Procedures.

Before you troubleshoot the A/C system, perform a visual inspection of the machine and the installation itself. Specific checks and tests may be necessary in order to identify the root cause of any subsequent issues. Refer to Special Instruction SI 1104 for A/C specification details.

1) A/C Component Locations

Overview of electrical components

The Power Distribution Board (PDB) is located inside the cabin behind the right dash panel.

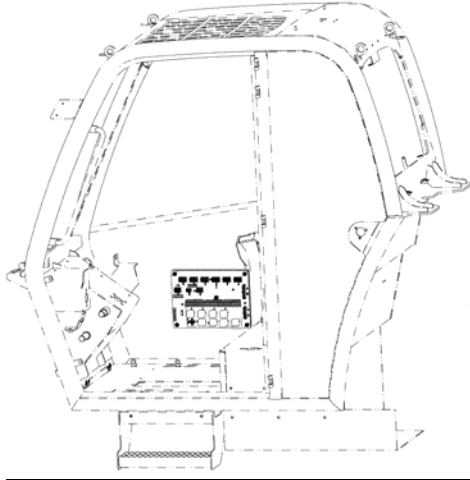


Illustration 1 Power Distribution Board

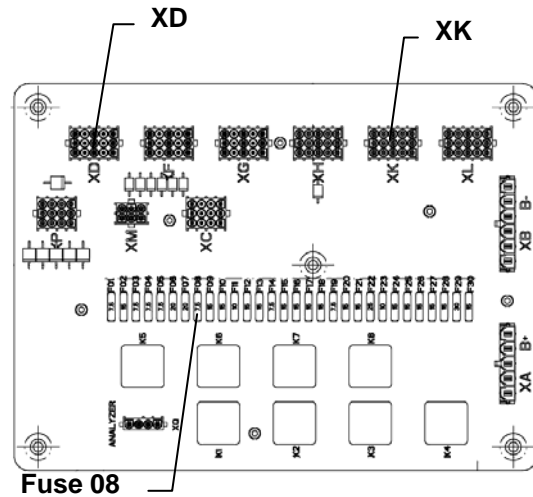
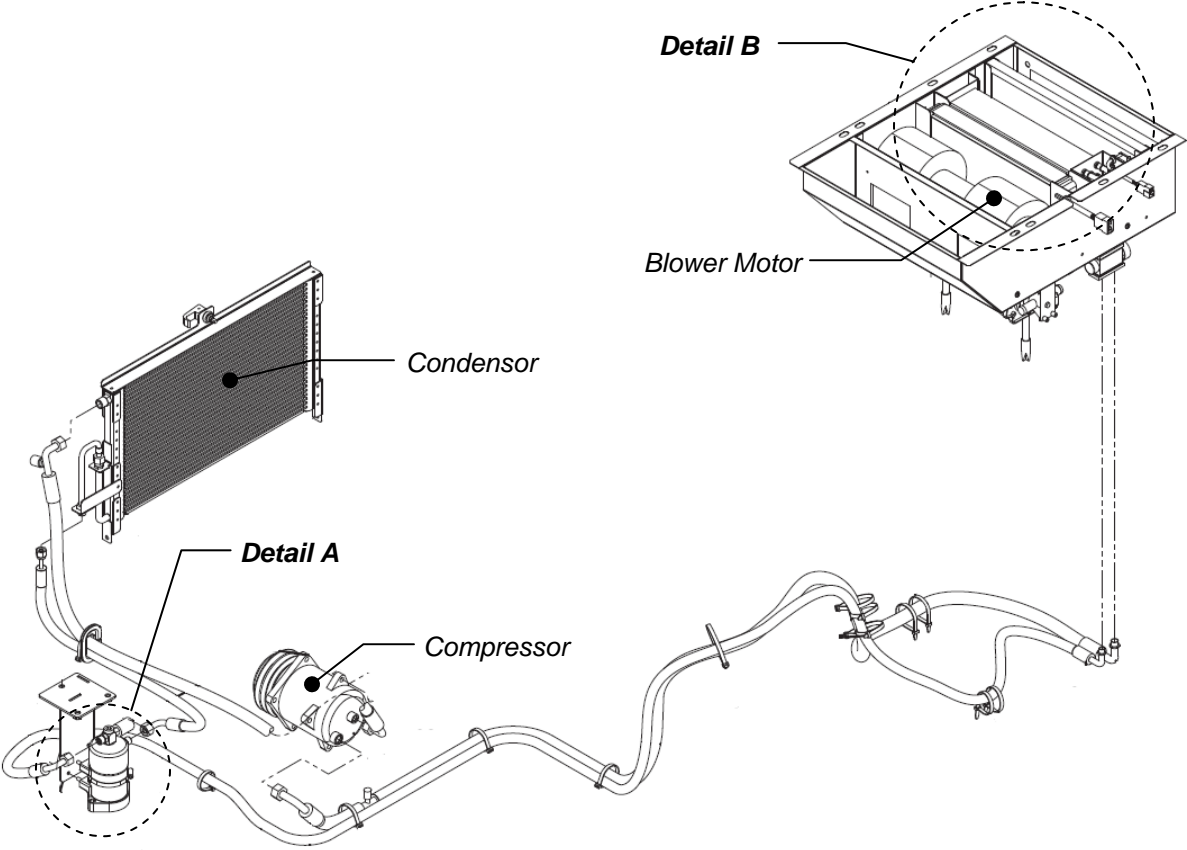


Illustration 2 Power distribution Board Connector Locations

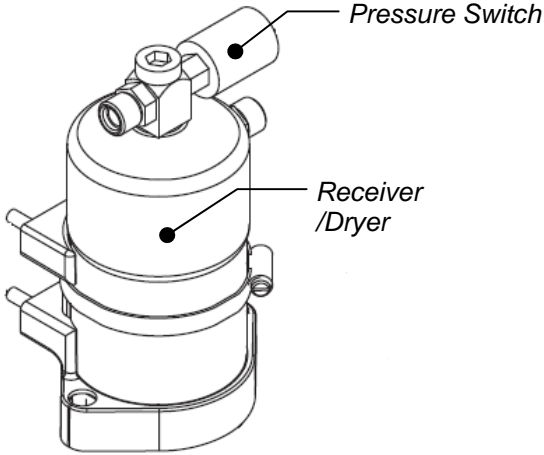
The A/C is powered through the PDB. Power is on connector XD pin 9 for the switch in the cabin and pin 8 for the compressor. Ground is on connector XK pin 6. The system is secured with a 7.5 amp fuse on position 8.

NOTE: Use the **146-4080** Digital Multimeter or an equivalent for the measurements in this procedure.

Overview of system components



Detail A



Detail B

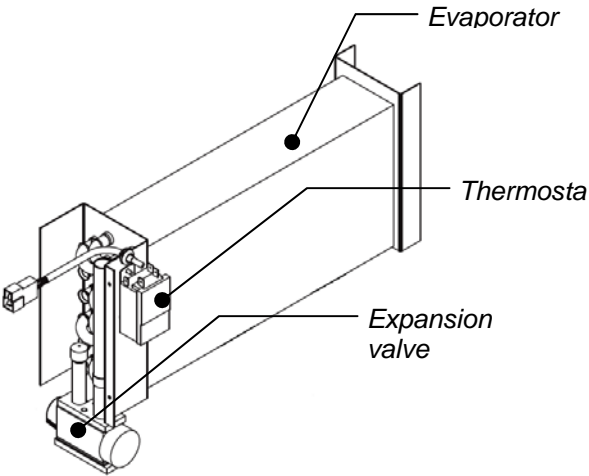


Illustration 3 System components

2) System Specifications

Pressure Switch

Part number: 329-3649
High Pressure: 14 – 22 bar (203-319 psi)

Thermostat

Part number: 322-5990
Cut out: $-1.0^{\circ}\text{C} \pm 0.6^{\circ}\text{C}$ ($30.2^{\circ}\text{F} \pm 1^{\circ}\text{F}$)
Cut in: $+2.2^{\circ}\text{C} \pm 0.6^{\circ}\text{C}$ ($36^{\circ}\text{F} \pm 1^{\circ}\text{F}$)

Dryer

Part number: 329-3650

Compressor

Part number: 323-7251
Oil amount pre-filled: 200 CC

Refrigerant

Type: R134a
Charge: 1100gram maximum charge

Oil Charge

Oil in system (cc): 140 cc

Pressure

Evaporation pressure: 1.8 bar (26 psi)
Discharge pressure: 16.3 bar (236 psi)

Note: pressures are at engine idling speed at ambient temp of 21°C (70°F) and for reference only.

3) Electrical Schematic

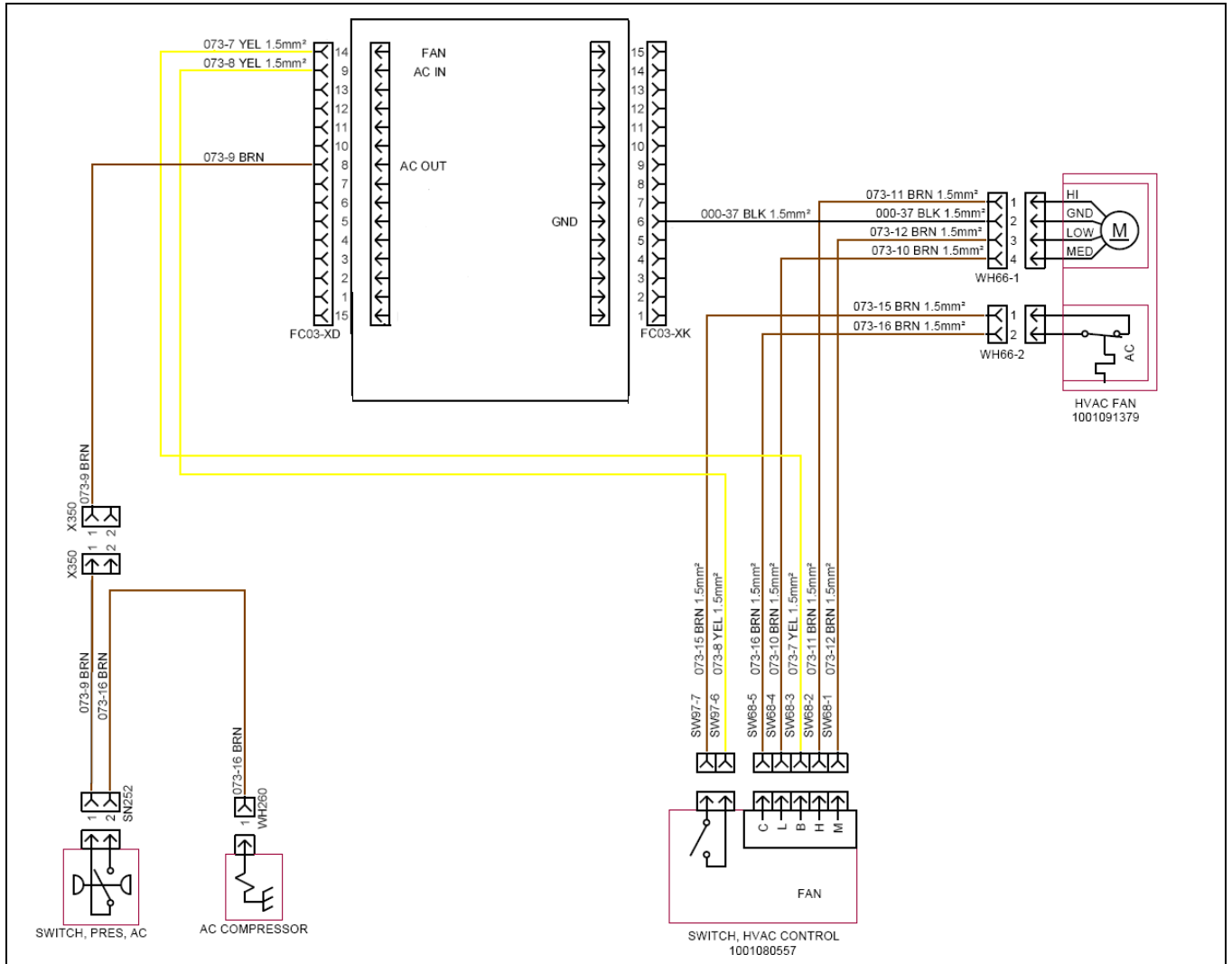


Illustration 4 Electric Schematic of the 12 volt system.

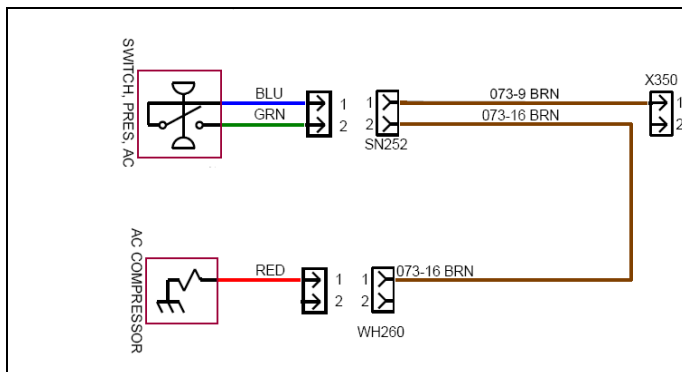


Illustration 5 Detail of the compressor harness.

4) Refrigerant Flow

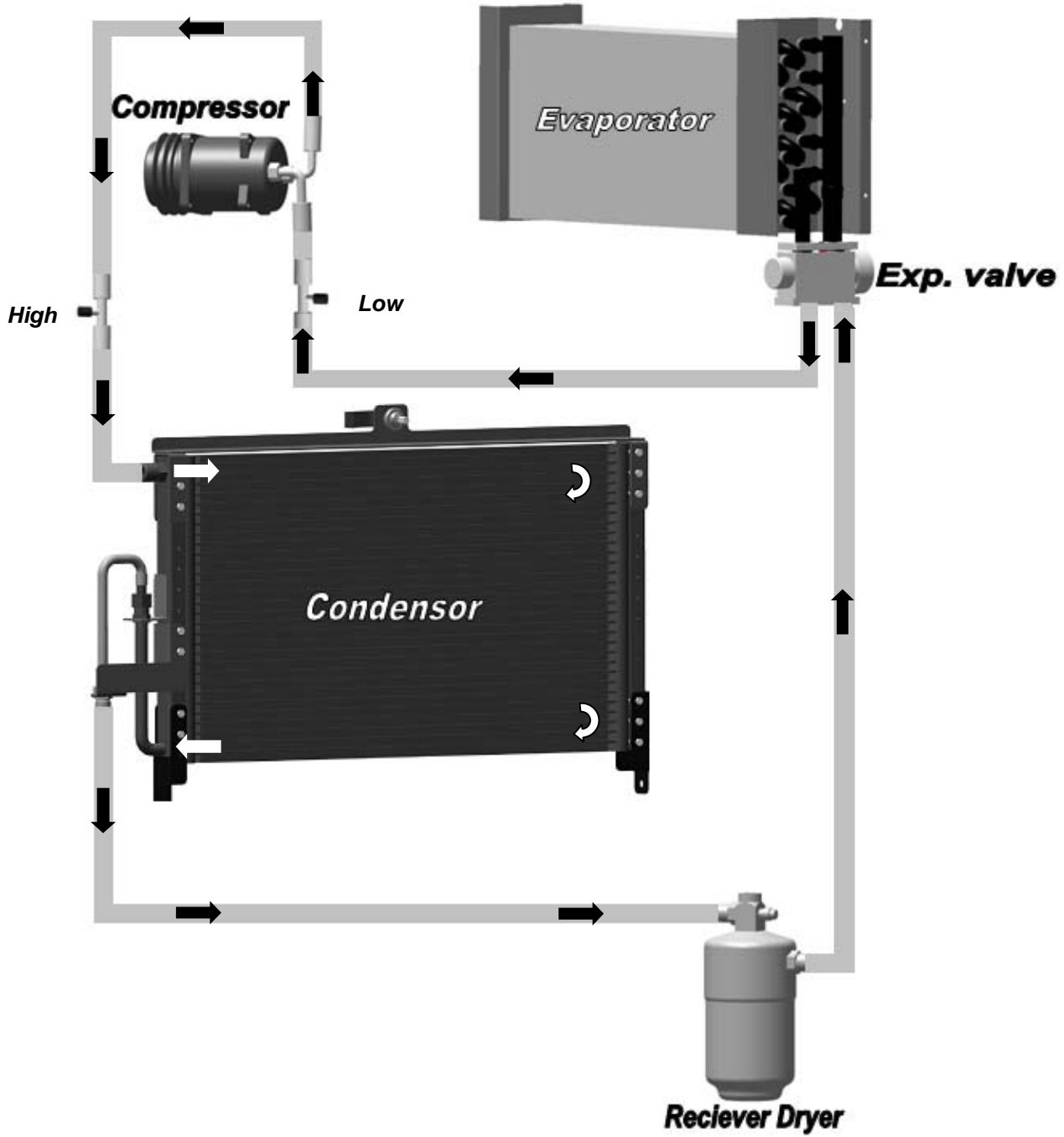


Illustration 6 Refrigerant Flow.

5) Troubleshooting Procedures

Introduction

The A/C system will not function in very low ambient temperatures, therefore troubleshooting should be carried out in a warm environment (20-35 °C / 68-95°F) .

The troubleshooting procedures are based on the system condition during the problem. Knowing the complete A/C system condition is important to make correct diagnosis of the problem.

It is recommended that, to locate faults in the system accurately and quickly, an electronic leak detector P/N **208-1374** and a refrigerant pressure gauge P/N **208-1341** (part of 1U-9690) should be used. However, leaks can be detected in the system by using soapy water applied to the suspected leak area.

Safety Warning

- Personal injury can result from contact with refrigerant.
- The A/C system is under pressure at all times, even if the engine is not running. Heat should never be applied to a charged system.
- Contact with refrigerant can cause frost bite. Keep face and hands away to help prevent injury.
- Protective goggles must always be worn when refrigerant lines are opened, even if the gauges indicate the system is empty of refrigerant.
- Always use caution when a fitting is removed. Slowly loosen the fitting. If the system is still under pressure, evacuate the system recovering the refrigerant before removing the fitting.
- Personal injury or death can result from inhaling refrigerant through a lit cigarette.
- Do not smoke when servicing air conditioners or wherever refrigerant gas may be present.
- Before any checks of the A/C system are made move the machine to a smooth horizontal surface. Lower all implements to the ground. Move the shifter into neutral and apply the parking brake. Keep all other persons away from the machine or where they can be seen.

FAULT FINDING – Electrical and Mechanical

The following faults may be caused by electrical or mechanical failures in the A/C system. The troubleshooting guide on the following pages will examine each fault.

- No Cooling.
- Poor A/C performance.
- Warm or slightly cool air emitted from unit.
- A/C system works intermittent.
- A/C or Blower system noisy

Fault - No Cooling.

Symptoms/Indications	Possible Cause	Problem Solving
Electrical components of the system do not function.	Defective fuse.	Replace Fuse 08 (see 'Overview of Electrical Components', illustration 2).
	Open/short circuit.	Carry out a visual inspection of harnesses and connectors, repair or replace as required.
	Pressure switch defect.	Check pressure switch continuity. Replace if necessary.
Compressor clutch or magnet coil not working.	Disruption of the magnet coil of the compressor.	Check if electrical current is present at the compressor using an Ammeter. If current is present, replace compressor.
	Charred temperature contacts or thermostat defect.	Replace thermostat.
Blower motor does not work.	Disruption of the blower motor.	Check if electrical current is present at the blower motor using an Ammeter. Replace blower motor, if required.
Noise from engine compartment when activating A/C.	Compressor fan belt loose or torn/ripped.	Carry out a visual inspection of the fan belt, adjust belt or replace if necessary
Compressor not working	Compressor fan belt breaks.	Low or no oil in compressor adjust belt or replace if necessary
Low system pressure.	Leaks in the system due to disruption of the refrigerant lines and components.	Visually inspect all lines for breaks or tears. Test for leaks. Replace defective lines or components if required and discharge and recharge the system.
High pressure is low, suction pressure is high, evaporator overflowing	Expansion valve remains in open position.	Replace expansion valve, if necessary.
High pressure is normal, suction pressure is low	Expansion valve hangs.	Replace expansion valve, if necessary.
Evaporator iced, therefore no air can pass through	Thermostat sensor in wrong position.	Reposition sensor. Refer to service letter CAT1001 for details.

Fault – Poor A/C performance.

Symptoms/Indications	Possible Cause	Problem Solving
Noisy compressor.	Compressor clutch slips.	Carry out a visual inspection of the compressor and repair clutch or replace compressor if necessary.
Low air flow out of vents.	Disabled fan passage.	Search for blockage in air ducts and outputs, remove any blockages found
	Clogged Cabin Pre-cleaner.	Clean bowl of the pre-cleaner.
	Blocked/Clogged cabin filter.	Clean cabin air filter or replace if necessary.
	Air flow through the evaporator is too low: evaporator or cooling fins dirty.	Clean evaporator and/or cooling fins of the blower motor.
Cooling capacity is too low when ambient temperature is high	Recycle/fresh air switch not on cabin circulation.	Set switch on recycle and check operation.
Output temperature at vents lower than specifications.	Condenser matrix air flow restricted.	Clean or remove debris for condenser and air inlet grids of the engine compartment.

Fault - Warm or slightly cool air emitted from unit.

Symptoms/Indications	Possible Cause	Problem Solving
Constant stream of warm air from vents.	Evaporator not sealed properly.	Re-seal evaporator to ensure all ambient air passes through the evaporator
	Cable for the water valve is incorrectly adjusted.	Adjust cable at valve or HVAC controller for proper operation.
	Water valve is not installed in the correct flow direction.	Correct the flow direction. (Arrow on the water valve indicates flow direction).
	Water valve leaking internally.	Replace water valve if necessary.
	Expansion valve stuck open or closed.	Renew expansion valve.
High pressure gauge reading too low.	Refrigerant level too low.	Refill refrigerant until normal pressure is displayed.
	Moisture or no coolant in the system.	Empty A/C, replace collector dryer, empty and recharge.
Suction gauge reading abnormally high	Thermostat defective.	Replace thermostat.
Suction gauge reading abnormally low, dryer cold, possible frost build up	Collector dryer saturated.	Discharge A/C system; replace collector dryer, recharge A/C system.

Fault – A/C system works intermittently.

Symptoms/Indications	Possible Cause	Problem Solving
Clicking noise may be heard when indicating early shut off of the electro coil for the compressor clutch.	Power interruption, ground connection defective or loose contacts in the magnet compressor.	Visually inspect cables, repair or replace defect compressor.
Interrupted/intermittent operation of electrical components.	Fan switch, A/C switch or blower motor defective.	Replace defective part.
Noise from compressor during high pressure build up.	Compressor clutch slips.	Repair compressor or replace if necessary.
System intermittently freezes.	Icing of components in the high pressure refrigerant flow line.	Visually inspect all of the following: expansion valve, thermostat and collector dryer. If damage or fault is found, replace affected part as required.
No activation of the compressor.	High pressure above max operation range of the pressure switch.	Clean condenser.
Suction pressure observed to be abnormally low.	Defective Thermostat.	Replace Thermostat.

Fault – A/C or Blower system noisy

Symptoms/ Indications	Possible Cause	Problem Solving
V-belt slips and makes noise.	V-belt loose or excessively worn.	Tighten or replace V-belt.
Compressor clutch loud when switched on.	Compressor clutch slipping.	Repair or replace compressor clutch
Compressor is noisy, possibly with internal compressor parts knocked loose	Compressor bracket loose or broken, or defect internal components of the compressor.	Repair or replace compressor or bracket as necessary
Blower motor is very loud	Excessive wear on the blower motor	Replace blower motor.
Rumbling noise or vibration in the high pressure line, knocking in the refrigeration compressor or high and the suction pressures are higher than specification.	System overfilled.	Suction out refrigerant until the high pressure gauge is back to normal.
Hissing sound in the evaporator housing at the expansion valve, high pressure too low.	High pressure to low due to not enough refrigerant in the system.	Perform leak testing, fill up system.

FAULT FINDING- Refrigerant (with SYSTEM DIAGNOSIS TEST GAUGES)

- Procedure for reading system pressures.
- Pressure checkpoints.
- Readings for normal functioning A/C.
- Pressure reading diagnosis.
- Refrigerant circuit problems.

Procedure for reading system pressures

1. Install the manifold gauge set.
2. Ensure the engine is at normal operating temperature.
3. Run the engine at 1500 rpm.
4. Set temperature control switch at min position
5. Set recycling air switch to close position.
6. Ensure cab windows are closed.
7. Activate A/C switch.
8. Turn fan speed switch to maximum speed.
9. Operate the engine for a minimum of 10 minutes in order to stabilize the system.

Pressure check points.

Pressure checkpoints for the evaporation (low) pressure (1) and the discharge (high) pressure (2) are located inside the engine compartment, as indicated in illustration 7. To gain access to the low pressure check point, the bottom plate of the engine compartment may need to be removed.

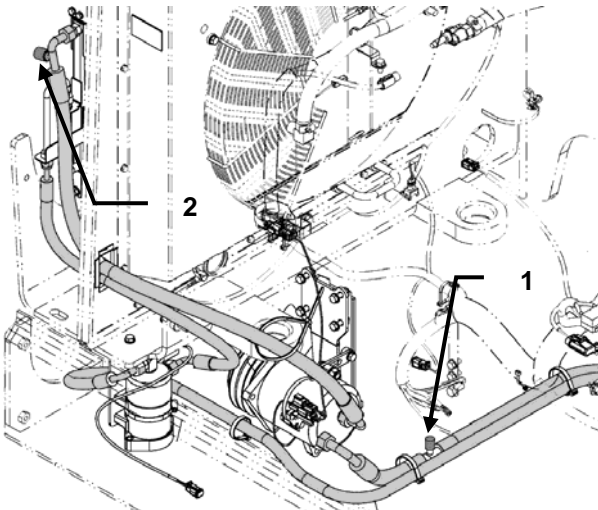


Illustration 7 Pressure check points

Readings for normal functioning A/C

Normal gauge readings will depend on system components and ambient conditions. The readings needs to be stable, and the system should have a full refrigerant charge.

Typically, the high pressure is 6-8 times the low pressure.

Normal pressures

Atmospheric temperature: 30-35°C (86°-95°F)
 Evaporation (low) pressure: 1.3 – 2.0 bar (18-28 psi)
 Discharge (high) pressure: 15 – 17 bar (213-242 psi)

Pressure reading diagnosis.

Use table 1 in order to diagnose indications from the pressure readings.

Table 1

	Too High Evaporation Pressure	Too High Discharge Pressure	Too Low Evaporation Pressure	Too Low Discharge Pressure	Fluctuating Pressures
Too much refrigerant charge.	X	X			
Too much oil in A/C system.	X				
Restriction on air side of the condenser.	X				
Restriction in high side of refrigerant circuit.	X				
Blocked or clogged condenser.	X				
System load to high (ambient higher than 43°C, high humidity, doors open).	X				
Air in the refrigerant circuit.	X				X
Thermostat faulty or incorrect positioned.		X			
Low refrigerant charge.			X	X	

Compressor fan belt slipping.			X		
Compressor clutch slipping.			X		
Restriction on low pressure side of refrigerant circuit.			X		
Leak in the refrigerant circuit.				X	
Moisture in the refrigerant circuit.					X
Blockage in the refrigerant circuit.					X

Refrigerant Circuit Problems.

Fault - Insufficient refrigerant

Gauge indications

- Low pressure reading is below normal.
- High pressure reading is below normal.

Probable cause

- Improper refrigerant charge.

Solution

- Inspect using a leak detector, repair leak and recharge the system to the required level.

Fault - Air in refrigerant circuit

Gauge indication

- Low pressure reading is normal.
- High pressure reading is bouncing or the reading is unsteady.

Probable cause

- Air in the system.

Solution

- Recover the refrigerant from the A/C system.
- Evacuate the A/C system.
- Recharge the A/C system.

Note: After prolonged operation with air in the system, the receiver dryer must be replaced

Fault - Excessive Refrigerant (Poor Condenser Radiation)

Gauge indication

- Low pressure reading is above normal.
- High pressure reading is above normal.

Probable cause

- Pressure increases due to excessive refrigerant.
- Insufficient condenser cooling.

Solution

- Recover the refrigerant from the A/C system.
- Evacuate the A/C system.
- Recharge the A/C system.
- Clean the condenser.

Fault - Defective Expansion Valve

Gauge indication

- Low pressure reading is above normal.
- High pressure reading is above normal.

Probable cause

- Improper refrigerant charge.
- Defective expansion valve.
- Improper thermostat installation.

Solution

- Verify refrigerant charge.
- Check thermostat and the position into the evaporator.
- If refrigerant charge and thermostat installation is correct, replace the expansion valve.

Fault - Insufficient Compressor Operation, (compression).

Gauge indication

- Low pressure reading is above normal.
- High pressure reading is below normal.
- Low and High pressures are equal when operation is stopped.

Probable cause

- Insufficient compression due to a defective compressor (gasket).

Solution

- Repair or replace compressor.

Fault – Moisture Intrusion

Gauge indication

- Low pressure reading alternates between a vacuum and normal.
- High pressure reading is normal.

Probable cause

- Moisture has frozen on the A/C system, clogging the expansion valve. When the ice melts, normal operation resumes.

Solution

- Replace receiver/dryer.
- Evacuate the system
- Recharge with refrigerant to the proper level.

Fault – Refrigerant does not circulate

Gauge indication

- Low pressure reading becomes vacuum.
- High pressure reading is between the 5 and 6 bar (72-85 psi).

Symptoms:

- Frost or condensation appears on the connections and lines towards the receiver/dryer.

Probable cause

- The A/C system is blocked by contamination or ice.
- The A/C system is shut off, by a defective thermostat.

Solution

- Stop operation and check for contamination or ice.
- If moisture is the problem, evacuate the system.
- Replace the receiver/dryer.
- Recharge with refrigerant to the proper level.

END