

Automotive Heating And Air Conditioning

Eighth Edition

Automotive
**Heating
and
Air Conditioning**
Eighth Edition
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Chapter 15

A/C System Diagnosis
and Repair

ALWAYS LEARNING

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Learning Objectives (1 of 2)

15.1 Prepare for the ASE Heating and Air Conditioning (A7) certification test content area "A" (A/C System Service, Diagnosis, and Repair).

15.2 Describe the eight-step diagnostic procedure for an A/C system.

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Learning Objectives (2 of 2)

15.3 Explain how to perform a visual inspection of an A/C system.

15.4 Discuss how to perform an A/C performance test.

15.5 Describe how to determine the root cause of the problem in an A/C system.

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The Diagnostic Procedure (1 of 2)

- STEP 1 Verify the Customer Complaint (concern).
- STEP 2 Perform a Thorough Visual Inspection.
- STEP 3 Check for Diagnostic Trouble Codes (DTCs).
- STEP 4 Check for Related Technical Service Bulletins (TSBs).

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The Diagnostic Procedure (2 of 2)

- STEP 5 Perform an A/C Performance Test.
- STEP 6 Determine the Root Cause.
- STEP 7 Repair the System.
- STEP 8 Verify the Repair.

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Step 1 Verify the Customer Concern

- Understand the exact fault
 - Higher than normal outside air (ambient) temperature
 - High humidity level
 - A new vehicle that is larger or has more glass area than the customer's previous vehicle
 - A new vehicle that is black or dark in color compared with their previous vehicle that was a lighter color such as white or silver. A light-colored vehicle reflects light and the heat from the sun instead of being absorbed as with a dark-colored vehicle.

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Step 2 Visual Inspections (1 of 6)

- A visual inspection of the underhood items includes the following:
 - Check the condition of the A/C compressor drive belt.
 - Check the tension of the A/C compressor drive belt and the automatic tensioner.
 - Inspect the refrigerant hoses and lines for signs of oily residue and damage.

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Step 2 Visual Inspections (2 of 6)

- While checking the hoses and lines, determine if the system uses a thermal expansion valve system (TXV) or an orifice tube (OT) system and if a variable displacement compressor is used.
- Check that the compressor mounting bolts are tight.
- Check to make sure that the air gap of the A/C compressor clutch is correct.

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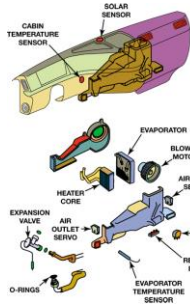
Step 2 Visual Inspections (3 of 6)

- Check the electrical wires to the clutch, blower motor, and any A/C switches for good, tight connections, and possible damage.
 - SEE FIGURE 15–1.
- Check the condition of any vacuum hoses between the intake manifold and bulkhead, if equipped.

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FIGURE 15–1 A visual inspection checks all of the visible, underhood components for possible wear or damage. The underdash components are checked for noise and proper airflow.



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Step 2 Visual Inspections (4 of 6)

- Check the faces of the condenser and radiator core for restriction to airflow caused by debris and clean as needed.
- With the engine off, the in-vehicle checks include:
 - Operate the blower switch through its various speeds while listening to the fan and motor for unusual noises.

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Step 2 Visual Inspections (5 of 6)

- Move the temperature lever of mechanically operated doors to both ends of its travel. It should move smoothly and stop before making contact at the ends.
- With the engine running, the underhood checks include:
 - Make sure the compressor clutch is engaged and the compressor is running. Listen for any signs of improper compressor operation.

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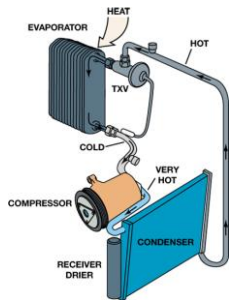
Step 2 Visual Inspections (6 of 6)

- Turn off the A/C clutch to make sure it releases smoothly. With the clutch released, listen for proper clutch bearing operation.
- Feel the temperature of the A/C lines and hoses.
- Feel the temperature of the heater hoses.
- Check the engine cooling fan operation (if running). The fan should be turning smoothly, with good airflow.
- Check the evaporator drain.

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FIGURE 15-2 When a system is operating properly, the suction line to the compressor should be cool, and the discharge line should be hot to very hot. The liquid lines should also be hot.



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Step 3 Check Diagnostic Trouble Codes (1 of 2)

- Most HVAC-related trouble codes will be “B”, “C” or “U” codes
- There are some that are Powertrain-related P-codes including:
 - P0645 A/C Clutch Relay Control Circuit
 - P0646 A/C Clutch Relay Control Circuit Low
 - P0647 A/C Clutch Relay Control Circuit High

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Step 3 Check Diagnostic Trouble Codes (2 of 2)

- P0691 Fan 1 Control Circuit Low
- P0692 Fan 1 Control Circuit High
- P0693 Fan 2 Control Circuit Low
- P0694 Fan 2 Control Circuit High

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Step 4 Check for Technical Service Bulletins

- Technical service bulletins (TSBs) are issued by vehicle and aftermarket manufacturers to inform technicians of a situation or technical problem and give the corrective steps and a list of parts needed to solve the problem.
- Any diagnostic trouble codes should be retrieved before looking at the technical service bulletins because many bulletins include what DTCs may or may not be present.

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FIGURE 15-5 After checking for stored diagnostic trouble codes (DTCs), the wise technician checks service information for any technical service bulletins that may relate to the vehicle being serviced.



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Step 5 Perform A/C Performance Test (1 of 3)

- STEP 1 Install pressure gauges to the service ports.
- STEP 2 Start the engine, set the parking brake, and raise the idle to 2000 RPM.
- STEP 3 Measure ambient temperature 3 inches (80 mm) in front of the condenser and measure the humidity.

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Step 5 Perform A/C Performance Test (2 of 3)

- STEP 4 Place a thermometer in the air conditioner center vent.
- STEP 5 Set the air conditioner for maximum cooling.
- STEP 6 Open the doors and set the blower speed to high, which applies the maximum load on the system.

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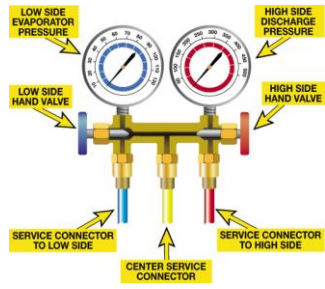
Step 5 Perform A/C Performance Test (3 of 3)

- STEP 7 Allow the system to operate for another five minutes before recording the gauge readings.

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FIGURE 15-6 The center, yellow hose is used to connect the air conditioning system to a vacuum pump or refrigerant cans. When the hose is not being used, it should be attached to the blanks fitting to seal the system.



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Step 6 Determine the Root Cause (1 of 4)

- Temperature and pressure are directly related in A/C systems.
- High-side pressure
- Low-side pressure

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Step 6 Determine the Root Cause (2 of 4)

- Test for heat transfer at the evaporator and the condenser.
 - Temperature change across the evaporator
 - Temperature change across the condenser

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Step 6 Determine the Root Cause (3 of 4)

- If the A/C system is low on a charge of refrigerant, the sources of the leak should be found and corrected
 - Electronic leak detector
 - Dye in the refrigerant

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FIGURE 15–12 A partially restricted orifice tube should be replaced if discovered during service.



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Step 6 Determine the Root Cause (4 of 4)

- Addressing System Odors
 - “Dirty socks/gym locker” odor, which has an organic cause
 - “Refrigerator, cement, or dusty room” odor, which is caused by chemicals

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Step 7 Repair the System

- What is the purpose of any repair?
- Many repairs require the proper identification, recovery, evacuation, and charging of the refrigerant.
- After the repairs, the system should function and operate as designed and the repair should be performed according to established industry and vehicle manufacturer's recommendations.

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Step 8 Verify the Repair

- Operate the system
 - After the repairs or service procedures have been performed, verify that the system is working as designed.

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Summary (1 of 3)

- When diagnosing a heating and air-conditioning system problem, most vehicle manufacturers recommend that the following steps be performed.
 - STEP 1 Verify the customer complaint (concern).
 - STEP 2 Perform a Thorough Visual Inspection.

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Summary (2 of 3)

- STEP 3 Check for Diagnostic Trouble Codes (DTCs).
- STEP 4 Check for Related Technical Service Bulletins (TSBs).
- STEP 5 Perform an A/C Performance Test.
- STEP 6 Determine the Root Cause.
- STEP 7 Repair the System.
- STEP 8 Verify the Repair.

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Summary (3 of 3)

- Sometimes the A/C system is functioning normally for the conditions which could include any of the following:
 - Higher than normal outside air (ambient) temperature
 - High humidity level

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1 The lack of cooling was diagnosed using a leak detector which showed the evaporator was leaking when tested at the condensate drain.



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2 The recovery process was started by connecting an RRR machine to the high-side fitting.



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3 The low-side fitting was connected and the recovery was begun.



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4 Very little refrigerant was left in the system (0.1 pound) but it was recovered.



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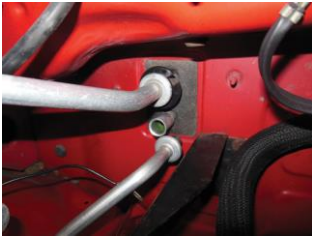
5 The lines to the accumulator were removed.



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6 The lines to the evaporator were disconnected using a quick connect tool to release the fitting.



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7 The retaining nuts were removed that held the HVAC case to the bulkhead from under the hood. In one case, the entire stud came out instead of just the nut.



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8 Before going into the passenger compartment, the negative battery cable was disconnected from the battery.



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9 The dash assembly is being removed and this process includes disconnecting the airbag wiring connectors.



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10 The driver/passenger side of the dash is removed to gain access to the additional fasteners.



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11 The two retaining fasteners that hold the steering column to the dash are removed and the steering column lowered into the seat, which is protected using a fender cover.



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12 The entire dash assembly is being gently removed.



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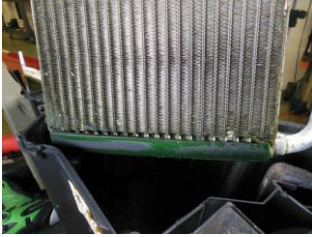
13 The HVAC case is being disassembled after being removed from the vehicle.



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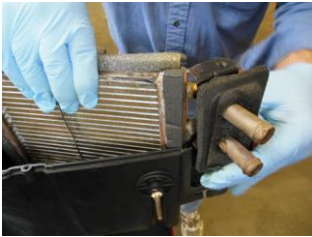
14 The evaporator is removed and it shows signs of leaking. The root cause of the lack of cooling has been found.



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15 The heater core was also removed and replaced at the same time as insurance against possible future leaks from this unit.



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16 The reassembled HVAC case is now being installed back into the vehicle.



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17 A new accumulator is installed.



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18 The system was evacuated and charged to the specified amount and the pressure gauge and temperature reading indicated that the system was restored to like-new performance.



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