Troubleshoot Air Conditioning

by Larry Carley

A/C COOLING PROBLEM?

The most likely cause of an automotive air conditioner cooling problem is no refrigerant in the system. If the refrigerant has escaped past a leaky compressor or O-ring seal, leaked out of a pinhole in the evaporator or condenser, or seeped out through a leaky hose, the leak needs to be identified and repaired before the system is recharged.

On many systems, the compressor will not turn on if the refrigerant is low because the "low pressure safety switch" prevents the compressor clutch from engaging if system pressure is low. This protects the compressor from possible damage caused by a lack of lubrication.

One of the first things you should check, therefore, is compressor engagement. If the compressors magnetic clutch is not engaging when the A/C is turned on, the problem may be a blown fuse or a wiring problem. If the fuse is blown, replacing it may restore cooling temporarily. But the underlying reason for the fuse blowing in the first place needs to be identified and corrected to prevent the same thing from happening again.

If the magnetic clutch is receiving voltage but is not engaging the compressor, the clutch is defective and needs to be replaced. If there is any evidence of leakage around the compressor shaft seal, the seal should also be replaced.

If the clutch works but fails to turn the compressor (the belt may squeal in protest!), the compressor has seized and needs to be replaced.

Cooling Problems with Variable Displacement Compressors

On some late model vehicles, the A/C compressor does not have a clutch to cycle it on and off. The compressor runs all the time when the engine is running, and it uses **Variable Displacement** to increase or decrease the volume of refrigerant it pumps through the system.

With this type of setup, the climate control module or PCM monitors the temperature inside the vehicle and changes the displacement of the compressor as needed to

increase or decrease cooling. Inside the variable displacement compressor is a swash plate that changes the stroke of the pistons as they move back and forth. Increasing the stroke increases the volume of refrigerant pumped through the system for more cooling. Decreasing the stroke reduces the volume of refrigerant pumped through the system to reduce cooling.

If there is a fault in the control system that prevents the compressor from increasing its displacement when more cooling is needed, there may not be enough cooling output to keep the driver and/or passengers comfortable. Such problems would might include one or more faulty interior temperature sensors, a fault in the compressor control module or wiring between the module and compressor, or a problem with the swash plate inside the compressor.

A scan tool that can read climate control data can be used to verify the operation of the A/C interior temperature sensors. If the indicated temperature reading does not match the actual temperature inside the vehicle, the problem is a bad temperature sensor.

If the temperature sensors are reading correctly, the scan tool can also be used to verify whether or not the A/C compressor is receiving the correct commands to change displacement as the temperature does up or down. No commands to change displacement would indicate a bad control module or a problem in the wiring circuit between the module and compressor. If the compressor is receiving commands but is not changing displacement, the problem would be a bad compressor.

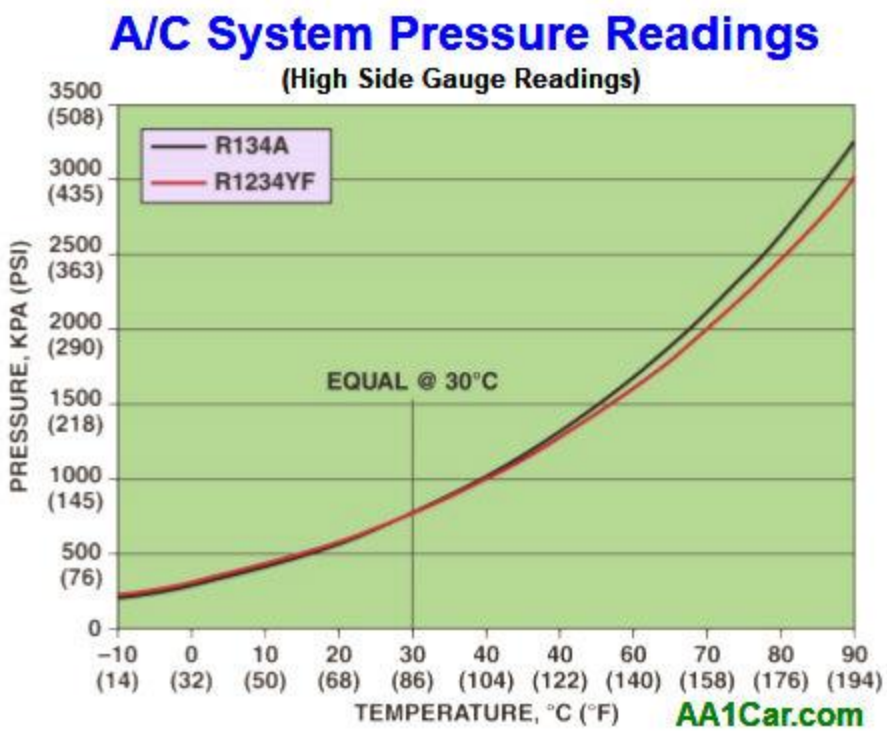
A/C Compressor Failures

Compressor failures are usually the result of loss of lubrication, which in turn may be due to low refrigerant in the system, a blockage (such as a plugged orifice tube which prevents refrigerant and oil from circulating to the compressor), loss of lubricant due to leaks or improper service procedures (not adding oil to the system to compensate for oil lost through leakage or component replacement), or use of the wrong type of lubricant.

Older (pre-1996) R-12 systems require mineral oil while R-134a systems (1996 and newer) require various types of PAG oil or POE oil. R-1234yf A/C systems in many 2015 and newer vehicles also require their own unique type of PAG oil. Using the wrong lubricant in an A/C system can damage the compressor. Always follow the vehicle or lubricant manufacturers compressor oil recommendations.

Pressure Checks

The next thing you should check when troubleshooting a no cooling problem is system pressure. For this, you need a set of A/C service gauges. Attach your service gauges to the high and low service fittings. If both the high and low side pressure gauges read low, the system is low on refrigerant and the system needs recharging. But before any refrigerant is added, check for leaks to find out where the refrigerant is going.



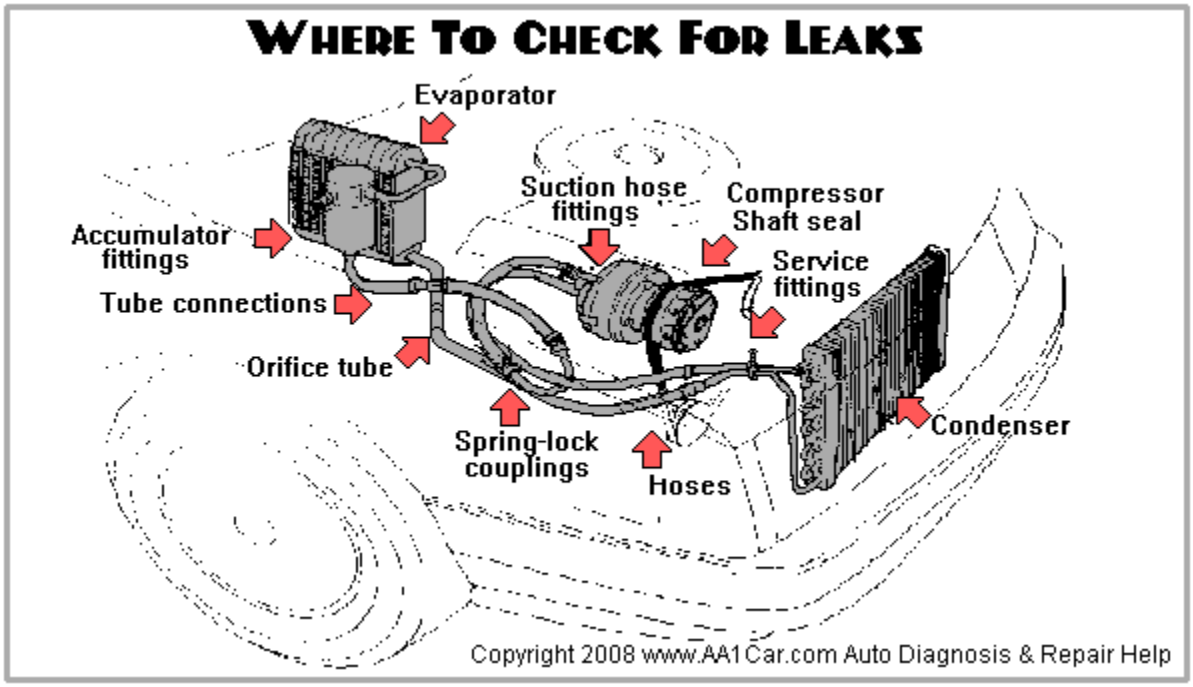
Refrigerant Leaks

All vehicles leak some refrigerant past seals and through microscopic pores in hoses. The older the vehicle, the higher the rate of seepage. Newer vehicles have better seals and barrier style hoses so typically leak less than a few tenths of an ounce of refrigerant a year. But system capacities also tend to be smaller on late model vehicles, so any loss of refrigerant will have more of an adverse effect on cooling performance.

Various methods can be used to check for leaks. The telltale oil stains and wet spots that indicate leaks on older R-12 systems are less apparent on the newer R-134a and R-12234yf systems because PAG lubricants are not as "oily" as mineral oil. This makes it harder to see leaks.

Leaks can be found by adding special dye to the system (available in pressurized cans premixed with refrigerant), an electronic leak detector, or plain old soapy water (spray on hose connections and watch for bubbles). If there is little or no refrigerant in your A/C system, you will first have to add some refrigerant to the system before you can pinpoint the leak. Add a can of refrigerant to the system while the engine is idling, If you are adding refrigerant that contains dye, it may take a few days for a small leak to reveal itself. Larger leaks like a bad hose or hose connection, leaky compressor shaft seal, or

a leak in the condenser should appear more quickly. An electronic leak detector can sniff out leaks instantly as they occur.



The hardest leaks to find are those that occur in an evaporator core. The evaporator is buried deep inside the HVAC housing under the dash so you can't observe it directly. Telltale signs of a possible leak in an evaporator include oily mist or fog on the inside of the windshield through the defroster ducts. An electronic leak detector works best for checking an evaporator core for leaks. Insert the tip of the probe into a cooling outlet duct and turn on the A/C. If the detector beeps or flashes, you have found the leak.

Once you've found a leak, repairs should be made prior to fully recharging the system. Most leak repairs involve replacing O-rings, seals or hoses. But if the evaporator or condenser are leaking, repairs can be expensive. Replacing a leaky evaporator core usually involves tearing apart the dash and disassembling the HVAC housing, a job that can take 8 to 12 hours depending on the application!

One repair option you might consider if you have a leaky evaporator, condenser, hose or pipe is to add a can of refrigerant that contains sealer to your A/C system. If the leak is small, sealer can often save you the cost and labor of having to replace an expensive component. However, there is some risk to using a sealer product because it might cause a blockage elsewhere in the system or cause the seals inside the compressor to swell too much. Most professional technicians do NOT recommend using A/C sealer products, yet many people have used these products successfully and have experienced no problems whatsoever. It's your choice.

POOR COOLING PERFORMANCE

Diagnosing an A/C cooling problem is best done by connecting a gauge set to the high and low pressure service fitting on the system. Though poor cooling is often due to a low charge of refrigerant, it can also be caused by many other factors (see chart above).

How to tell if your A/C system needs refrigerant: look at the LOW pressure gauge reading when the engine is OFF. On an 80 degree day, the LOW gauge should read about 56 psi or higher if the A/C system contains an adequate charge of refrigerant. On a 90 degree day, the LOW side reading should be about 70 psi or higher. If the LOW gauge reading is less than this, the A/C system probably needs some additional refrigerant. The actual pressure readings will vary depending on the type of refrigerant (R-134a or R-1234yf) that is in your A/C system.

A/C Diagnosis Chart

Low Side	High Side	Duct Temp	Possible Cause
Low	Low	Warm	Low refrigerant charge
High	High	Warm	Overcharge of refrigerant
High	High	Some Cool	Air in the system or Overcharge
Normal	Normal	Warm	Moisture in the system
Low	Low	Warm	Expansion valve stuck closed
Low	Low	Warm	Orfice tube plugged
Low	Low	Warm	High side restriction
High	Low	Warm	Compressor or control valve failed

Refer to the vehicle manufacturer specifications for normal system operating pressures, and the total refrigerant capacity of the system. Most newer passenger car A/C systems do not hold much refrigerant (14 to 28 oz.), so you don't want to add too much if the system is low. Overcharging your A/C system with refrigerant will actually DECREASE cooling performance, not improve it.

AIR CONDITIONER PROBLEM: INTERMITTENT COOLING

An A/C system that blows cold air for awhile then warm air is probably freezing up. This can be caused by air and moisture in the system that allows ice to form and block the orifice tube.

Evacuating the system with a vacuum pump will purge it of unwanted air and moisture. Evacuation should be done with a vacuum pump that is capable of achieving and holding a high vacuum (29 inches) for at least 30 to 45 minutes.

For best performance, an A/C system should contain less than 2% air by weight. For every 1% increase in the amount of air that displaces refrigerant in the system, there will be a corresponding drop of about one degree in cooling performance. More than 6% air can cause a very noticeable drop in cooling performance, and possibly cause evaporator freeze-up.

Air can get inside a system through leaks, by not evacuating the system prior to recharging it, and/or by recharging the system with refrigerant that is contaminated with air. Recovery equipment can suck air into the recycling tank if an A/C system contains air or if the system has a leak. For this reason, the refrigerant recovery tank on recycling equipment must be checked and purged daily. On some equipment, this is done automatically. But on equipment that lacks an automatic purge cycle, tank pressure and temperature has to be measured and compared to a static pressure reference chart.

Some refrigerant identifier equipment can detect air in the system as well as other contaminants. An identifier should be used to check the refrigerant before the system is serviced to prevent cross-contamination of recovery and recycling equipment.

Possible causes of intermittent cooling in a manual A/C system that might be caused by an electrical problem include:

Faulty low pressure cutout switch. This switch prevents the compressor from running if the refrigerant level is low. If the cutout switch is not reading correctly, it can prevent the compressor from coming on.

Faulty compressor clutch. The magnetic clutch on the compressor requires full battery voltage to engage. If the voltage to the clutch is low, or the clutch coils have too much resistance, or the air gap in the clutch is too great, the clutch may not engage to drive the compressor.

Faulty compressor clutch relay. Check to see if the relay is receiving voltage when the A/C is turned on. Also check the relay wiring and ground connections. If bypassing the relay with a jumper wire or routing battery voltage directly to the compressor clutch makes the A/C work, the relay is probably bad.

Faulty A/C control switch. The switch may be worn and not making good contact when it is turned on.

Some possible causes of intermittent cooling (or no cooling) on automatic A/C systems include all of the above, plus:

A problem in the control module or control head (this usually requires using a dealer scan tool to read fault codes and perform self-diagnostics).

A bad temperature sensor (an ambient air temperature sensor, interior air temperature sensor, evaporator temperature sensor, or sunload sensor). Again, a factory scan tool is usually required to perform diagnostics on the system.

AIR CONDITIONING PROBLEM: NOISE

Noise from the compressor usually means the compressor is on its way out. But noise can also be caused by cross-contaminated refrigerant (operating pressure too high), air in the system or the wrong type of compressor lubricant.

Noise can also be caused by hoses or other parts rattling against other components in the engine compartment. Check the routing of the hoses, support brackets, etc., to pinpoint the noise.

TROUBLESHOOTING AIR CONDITIONING ODOR

If a vehicles air conditioner blows out air that smells like the inside of old gym sneaker when the A/C is turned on, microbes are growing on the evaporator. Mold likes damp, dark places. Bacteria can also thrive under such conditions. Besides smelling bad, it can be unhealthy to breathe (ever hear of Legionnaires Disease?).

To get rid of the unwanted organisms, various chemicals can be sprayed on the evaporator directly or through the blower ducts or air intake. Products like Febreeze and air fresheners can mask or reduce the odor, but to eliminate the source you need to use something that actually kills microbes (like Lysol or similar disinfectants). Many replacement evaporators have a special chemical coating that inhibits the growth of mold and bacteria. The drainage tubes that carry condensation away from the evaporator should also be inspected and cleaned.

Also, most late model vehicles have a Cabin Air Filter (usually located behind the glove compartment or at the base of the windshield in the engine compartment) to filter outside air before it enters the passenger compartment. A dirty cabin air filter can provide the perfect breeding ground for odor-causing microbes. If the filter is more than two or three years old, it likely needs to be replaced. The best replacement filters also contain a layer of activated charcoal to absorb odors.

A/C FLUSHING

If the compressor has failed, or the system is full of sludge or contamination, the condenser, evaporator and hoses should all be flushed with an approved flushing chemical (such as Dura 141b) to clean the A/C system. Flushing can help prevent repeat compressor failures and system blockages by dislodging and cleaning out sludge and debris. Replacing badly contaminated parts such as the condenser, accumulator or receiver-drier and orifice tube or expansion valve is another way to get rid of these contaminants, but flushing is usually a more practical and economical choice. Regardless of which approach you use, the orifice tube or expansion valve should always be replaced when contamination is found.

NOTE: Some types of compressors can be very difficult to flush completely. These include "parallel" flow condensers and those with extremely small passageways. If contaminated, these types of condensers must be replaced to reduce the risk of a repeat compressor failure. Installing an in-line filter is also recommended for added insurance,

When a compressor fails, a lot of metallic debris is often thrown into the system. Most of this debris collects in the condenser where it can cause blockages that reduce cooling performance. If the debris is carried through the condenser and enters the liquid line, it can plug the orifice tube or expansion valve. This can block the flow of refrigerant and lubricating oil causing a loss of cooling and possible compressor damage. Debris can also migrate backwards from the compressor through the suction hose causing blockages in the accumulator or receiver-drier.

Another source of trouble can be debris from old hoses that are deteriorating internally. Tiny flakes of rubber can be carried along to the orifice tube or expansion valve and cause a blockage.

Sludge is usually the result of moisture-contamination. The blackish goo that results can damage the compressor and plug the orifice tube or expansion valve. The moisture-absorbing "desiccant" in the accumulator or receiver-drier is supposed to prevent this from happening. But the desiccant can only hold so much moisture. Once saturated, sludge begins to form. So you should also replace the accumulator or receiver-drier if the system is contaminated, has leaks or must be opened up for repairs.

Another reason for flushing is to remove residual lubricating oil from the system. This should be done when retrofitting an R-12 system to R-134a. It should also be done if the lubricating oil is contaminated or the system contains the wrong type of oil for the application. Flushing out the old oil can prevent oil overcharging, reduced cooling performance and/or lubrication incompatibility problems.

For added insurance after flushing, you can install a high side filter to protect the orifice tube or expansion valve from any residual debris that might still be in the system, and/or a second filter in the suction hose to protect the compressor.

More Air Conditioning Articles:

A/C Frequently Asked Questions

Air Conditioning Inspection Checklist

Troubleshoot Automatic Climate Control System

A/C Cooling Problem: Blows Warm Air Only No Cool Air

How To Recharge Your Car's Air Conditioner

A/C Service Equipment: What's Required To Service Today's Vehicles

Air Conditioning Service Best Practices (Procedures a repair shop should follow when servicing your A/C system)

MACS Recommended A/C Service Procedures (pdf file)

MACS A/C Technical Update

A/C Compressor Failures

PAG oil recommendations

A/C Condenser Flushing

How to Retrofit older R-12 system to R-134a

Alternative Refrigerants

R-1234yf Refrigerant