

Causes of Premature Compressor Failure

Compressors have gone through some dramatic internal design changes since the early days of automotive air conditioning. Overall, they are built much smaller and lighter than the units that were used on the older systems and no longer contain oil pumps. As a result they have to depend on the flow of refrigerant carrying oil through the system to lubricate them. They also operate under more harsh conditions. Designs of late model engine compartments and higher engine temperatures contribute to higher compressor operating temperatures. In addition, R-134a tends to operate at higher pressures on the high side and the combination of the two puts the compressor under more stress.

Other design changes such as high-efficiency condensers which cannot be effectively flushed, systems with very small refrigerant capacities where the charge has to be totally and completely accurate, and problems with refrigerant cross-contamination and air contamination present new challenges for the modern day A/C technician. For this reason and others that will be discussed, it is imperative that proper procedures be followed when repair work is being done. Too many shops are trying to take short cuts and doing it the "old way" and as a result, they are experiencing a high rate of **premature compressor failures**.

To help prevent future cases of premature compressor failure, we have identified the major causes and steps to take to prevent these from occurring.

1. Contamination

- A. System contaminated with debris from previous compressor failure. This can cause internal restrictions that can starve the compressor of lubricant, create excessive high side pressure and cause compressor overheating.

Condenser contamination. Because of their location, (just downstream of the compressor) most of the debris that results from a compressor failure flows into the condenser and a lot of this material will remain there. Older 3/8 tube and fin condensers can be easily flushed to remove debris but successful flushing is much more difficult with the multi-flow and parallel flow condensers that are in common use today. As a result it is often necessary to replace a condenser rather than attempt to flush it

Dirty oil left in a system from a previous compressor failure. A technician would never consider re-using dirty motor oil that had been removed from an engine that had failed but frequently dirty contaminated oil is left in an A/C system and used with a replacement compressor. The system must be cleaned and sanitized, and the correct amount and type of oil must be used.

- B. Moisture contamination. Excessive moisture in an A/C system can saturate the desiccant in a drier and promote corrosion and cause degradation of the system lubricant. Recovery/recycling machine filters need to be replaced on a regular basis to prevent excessive levels of moisture in recycled refrigerant. A proper vacuum needs to be pulled on a system prior to recharging to remove air and possible residual moisture from the system. Most importantly, compressor warranty **requires** the replacement of the system drier or accumulator, anytime the system has been opened or exposed to the ambient air.
- C. Chemical contamination. Flush solvents that aren't approved for use in A/C systems, or are not properly removed from the system after flushing, can dilute and contaminate the fresh lubricant charge and will cause accelerated wear between moving parts in the compressor.

Excessive use of trace dyes. Trace dyes used for finding leaks can dilute system lubricant resulting in accelerated compressor wear. A quarter ounce of dye should be adequate for most automotive and small truck applications, including those with dual evaporator systems (dual air).

Causes of Premature Compressor Failure

- C. Ester based flush solvents. Ester based flush solvents, which are actually a very low viscosity ester oil, should not be used to flush because they do not evaporate. Ester flush remaining in a system will dilute and contaminate the system lubricant resulting in accelerated compressor wear.

Unapproved flushing agents. Unapproved flushing agents such as brake clean, WD-40, carburetor cleaner, paint thinner, mineral spirits, Simple Green, etc. should not be used to flush. These chemicals contain substances which can leave residues and attack elastomers which are used in o-rings, hoses, shaft seals, and other A/C components

- D. Contaminated Refrigerant. Refrigerant that is cross contaminated with another refrigerant or contaminated with air can cause excessive high side pressure and increase loads on the compressor, especially when operating at low speed conditions under high ambient temperatures. Recycled refrigerant should be checked for the presence of air (also called non-condensable gases) regularly. Refrigerant purity should be checked with a refrigerant identifier.

2. Lubrication Problems

- A. Use of wrong type of lubricant. All OE manufactures specify the use of PAG lubricant in R-134a systems. R-12 uses mineral oil. Do not use mineral oil in an R-134a system. PAG should not be used with R-12 unless it is a special double end capped PAG and the lubricant manufacturer specifically approves of its' use with R12. **ALL compressor manufacturers report an alarming amount of compressors being returned as defective that failed because they were serviced with the wrong type of lubricant!**
- B. Correct type of lubricant, but wrong viscosity. There are 3 common viscosities of PAG lubricant, 46, 100, and 150. It is imperative to use the one specified by the manufacturer.
- C. No lubrication. Some manufacturers ship their compressors dry while others ship them with varying amounts of lubricant. The correct type, viscosity and amount of lubricant must be used. **ALL compressor manufacturers report an alarming amount of compressors being returned as defective that were installed and failed because they were run without lubricant, or serviced with the wrong type of lubricant!**
- D. Leaks. As refrigerant leaks, lubricant leaks with it. If a leaking system is continually topped off without the lost lubricant being replaced, the system will suffer from lack of lubrication. The lubricant that is lost from a system needs to be replaced.
- E. Too much lubricant. If a system contains too much lubricant, the compressor can be damaged. In a system properly charged with refrigerant and lubricant, the lubricant enters the compressor in a mist-like form suspended in the gaseous refrigerant. In a system that contains too much lubricant, it enters in larger quantities and can bend or break reed valves. If there is any doubt about how much lubricant is in the system, the best thing to do is to remove it all (complete system flushing) and install the correct amount. Too much lubricant can also cause high head pressures and high duct temperatures.

3. Refrigerant Overcharge

- A. Unlike R-12 systems, R-134a systems are very sensitive to overcharge, and an overcharge results in higher than normal high side pressures. The combination of an overcharged system and high ambient temperatures can place a high load on a compressor and can cause the clutch to slip. With system charges steadily getting smaller and some systems now having a capacity of less than 1 pound, a couple of extra ounces can result in an overcharge. **Accurate charging on R-134a systems is very critical.** Charging equipment must be properly calibrated.

Causes of Premature Compressor Failure

4. Refrigerant Undercharge

- A. If a system is undercharged the compressor will operate at a higher than normal temperature and will not receive adequate lubrication. This is because the refrigerant both cools the compressor and carries the lubricant throughout the system. With system charges steadily getting smaller and some systems now having a capacity of less than 1 pound, an ounce or two low can result in an undercharge that can cause lubrication problems, and premature compressor failures.

5. Excessive High Side Pressure

- A. Excessive high side pressure causes temperatures to increase throughout the system. This puts more strain on the moving parts of the compressor and causes the lubricant to thin out and accelerate wear. **Excessive high side pressure is not caused by a malfunctioning compressor.**
- B. In addition to the internal restrictions, contaminated refrigerant, refrigerant overcharge and oil overcharge that were mentioned previously, increased high side pressure can be caused by any conditions that reduce airflow through the condenser, such as missing air dams, debris lodged in condenser fins, defective fan clutches and malfunctioning electric radiator cooling fans.

6. Compressor Clutch Failure

- A. Excessive high side pressure. Excessive high side pressure puts extra strain on the compressor clutch and can cause it to slip. Even though most vehicles now have high pressure cut-out switches, a clutch can experience slippage before the switch shuts the system down, particularly if there are any other problems in the clutch electrical circuit.
- B. Low voltage. Low voltage can cause clutch slippage leading to premature clutch failure. The voltage supplied to the clutch with the a/c system running should be within at least 1 volt of the electrical or charging system voltage (usually 13.5 to 14.4 volts). A clutch will engage with as little as 10 volts or even less but the coil may not generate enough magnetic force to properly clamp the hub and drive face together. As a result, the clutch may slip and a slipping clutch can reach a temperature of over 800 degrees in as little as 3 minutes.

Voltage loss is caused by high resistance, poor connections and pitted contacts in relays and switches. The voltage to the clutch should be checked with the a/c system operating and after the vehicle has warmed up to normal running temperature. If low voltage is detected, it will be necessary to do voltage drop tests across each connection, relay and switch in the clutch circuit to determine where the loss is occurring and what needs to be repaired and replaced.

- C. Poor ground. A poor ground to the clutch has the same effect as low voltage. Instead of all the voltage being used to energize the clutch, part of it is used to overcome the high resistance caused by the poor ground. A voltage drop test from the clutch ground terminal to the negative battery post will indicate if there is a ground problem. A voltage drop of 1 volt or greater is cause for concern and if encountered additional voltage drop tests across each connection should be conducted to isolate the problem.
- D. Clutch air gap. Clutch air gaps are set at the factory but rough handling during shipping can change them. Clutch gaps should always be checked prior to compressor installation and adjusted if not within specs.
- E. Malfunctioning pressure switches. Malfunctioning pressure switches can cause rapid clutch cycling which can lead to premature clutch failure. Check the specs to determine the on and off pressures for the switches. Pressure cycling switches will generally disengage the compressor clutch at 24 to 26 psig low side operating pressure.

Causes of Premature Compressor Failure

- F. Low refrigerant charge rates. Low charge rates due to system leaks or undercharging of the system are also responsible for clutch failure due to lack of lubricant being returned to the compressor thereby increasing internal load or friction on the various compressor components and increasing “drag” on the clutch driver or “hub”.
 - G. High coil resistance. High resistance in the clutch field coil will also cause clutch failure. Normal resistance readings should be 3 to 6 ohms at ambient or operating temperatures. Below ohms usually indicates a “short” circuit in the coil, whereas 6 ohms or greater would indicate “high” resistance. Either condition will cause or prevent proper clutch engagement.
- 7. Failure To Diagnose And Repair The Root Cause**
- A. There is a reason for every compressor failure and most can be traced to one or a combination of the reasons outlined above. If a compressor is just replaced and the cause of the failure not identified and repaired, another failure will be imminent.