Common causes for Compressor Clutch Failures

Clutch Slippage

Compressor clutch failure can occur due to the results of a clutch slipping which generates a tremendous amount of heat. A slipping clutch can reach a temperature of over 800 degrees Fahrenheit in less than 3 minutes and this heat can melt the grease in the clutch bearing, causing it to fail as well. The heat can also be transferred down the compressor shaft where it can damage the front shaft seal. The slipping doesn't usually occur because of anything wrong with the clutch itself, but rather because of one or more other problems which can exist in a system. The failed clutch is a symptom of a problem or sometimes a combination of problems. If the torque capacity of the clutch is exceeded or if there is an electrical problem which prevents the clutch from reaching its' torque capacity, slippage will result. If the clutch or compressor/clutch combination is just replaced without determining the root cause and repairing it, there will be another clutch failure.

The most common causes for clutch failures are examined below.

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.

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.

Low voltage is caused by voltage losses which occur as a result of high resistance in the clutch electrical circuit. The high resistance will usually occur at connections and in switches or relays. 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.

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.

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.

Malfunctioning pressure switches:
Malfunctioning pressure switches can cause rapid clutch cycling which can lead to premature clutch failure. Pressure cycling switches will generally disengage the compressor clutch at about 24 to 26 psig low side operating pressure and re-engage it at around 44 psig. Check the specs to determine the exact on and off pressures for these switches.

Low refrigerant charge:
Low charge due to system leaks or undercharging of the system are also responsible for clutch failure.
This is 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".

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. Lower ohms readings 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.

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Oil or fluid on the clutch hub and drive face:
Oil or fluid leaking from components on the engine or even from spillage when adding fluids can get on the clutch hub and drive face and cause clutch slippage. Care must be taken not to spill fluids and if there are components which are leaking fluids on the clutch, these leaks must be repaired.

Clutch Burnishing:
Clutch burnishing is a procedure similar to breaking in a new set of disc brake pads.
Burnishing can bring a new or remanufactured clutch up to its' operating torque capacity quickly and diminish the possibility of slippage during initial operation. To burnish a clutch, run the engine at about 1500 to 2500 RPM. Using the controls on the dash, cycle the clutch ON and OFF at a rate of 10 to 15 times per minute for a total of 40 to 50 cycles. This should bring the clutch up to its' operating torque capacity.

If the root cause of a clutch failure isn't diagnosed and repaired then another clutch failure is imminent.

COMPRESSOR CLUTCH AIR GAP CHART

Compressor Type/Model	Compressor Series	Air Gap Setting	Adjustment Type
Behr / Bosch	ALL	.016" - .028"	Shims
Chrysler	A590 - C171 - 6C17	.016" - .028"	Shims
Ford	FS6 - FX-15 - FS-10	.016" - .028"	Shims
Delphi / Harrison	A-6	.020" - .040"	Press Fit
Delphi / Harrison	R-4(LT) - DA6 - HD6 - HR6 - HR6HE - HT6	.020" - .030"	Press Fit
Delphi / Harrison	V5 - V7	.015" - .025"	Press Fit
Delphi / Harrison	CVC	.013" - .024"	Shims
Hadsys	RC17	.016" - .028"	Shims
Halla	ALL	.014" - .024"	Shims
Hitachi	ALL	.020" - .031"	Shims
Keihin	ALL	.012" - .024"	Shims
Matsushita / Panasonic	ALL	.016" - .024"	Shims
Mitsubishi	ALL	.015" - .023"	Shims
Nihon Radiator / Calsonic	NVR140S - CR-14 - CWV - CWS - V5-15C - SP-17	.012" - .024"	Shims
Nippondenso	6E - 6P - 6SE - 7SB - 7SE - 10P - 10PA - 10S - CSV - TV - TVS	.016" - .028"	Shims
Sanden	SD5 - SD7 - SD5H14 - SD7H13 - SD7H15 - SD7V16	.016" - .031"	Shims
Sanden	TRS - TRF - TRA - Scrolls	.013" - .025"	Shims
Seiko-Seiki	ALL	.018" - .026"	Shims
Tecumseh	HR980	.020" - .040"	Shims
York / Tecumseh *(Upright)*	ALL	.022" - .040"	Pre-Set
Zexel / Seltec / TAMA *(Diesel Kiki)*	TM - TS - TC - BM - BS - DCV - DCJ - DCW - ALL Rotary Vane	.012" - .022"	Shims

Images of Common Failure

Here are a couple of pictures that relate to clutch failure. The one on the left shows a clutch which has been overheated due to slippage. Notice the reddish brown discoloration on sections of the front hub. This is where heat caused the paint to blister and discolor.

The picture on the right shows what the surface of the pulley looks like that dives the front hub after it has experienced slippage. It got so hot that the grease in the bearing melted and leaked out and then the bearing failed. You do not always have bearing failure when this occurs. This is not actually from the compressor on the left but if you removed the front hub it would look similar.