Robison on Rovers

Diagnosis of overheating in a V8 Petrol Land Rover

Welcome to the 11th installment of Robison on Rovers in the Rovers North News.

Many of you have read my posts on the Rovers North and DiscoWeb bulletin boards, and some have corresponded with me on various topics. For those who don't know me – I manage J E Robison Service – on the web at www.robisonservice.com – an independent Land Rover specialist shop in Springfield, Massachusetts. I've worked continuously with Land Rovers since their re-introduction to North America some fifteen years ago. In my column, I can answer your questions at greater length than is possible on the bulletin boards. Each issue, I will take on a few of the interesting questions I receive or will address a topic of interest to Land Rover owners.

I am a longtime Land Rover owner. I've had many Land Rovers over the years, and currently have a 2000 Range Rover P38A, a 1996 Discovery I, and a 1966 Series. My father has a 1995 Range Rover Classic, and my brother has a 2003 Discovery II. So we're a Land Rover family.

If you have questions or issues you'd like discussed email: robison@robisonservice.com

So, you say your Land Rover overheats? In this article, we're going to cover the steps to diagnose a variety of overheating problems. Some are trivial, and others will require a complete engine overhaul. Overheating is a problem whose repair cost can range from zero to what seems like infinity.

Land Rover V8 engines are mostly aluminum with some steel and iron components. Aluminum engines are very susceptible to damage from overheating. Before we begin, I need to warn you – if you haven't been warned already – not to ever drive a Land Rover with the temp gauge in the red, not even a short distance. Driving an overheated Rover half a mile down the highway could cost you an engine.

Let's begin our diagnosis by opening the hood and having a look. If the truck is steaming hot, leave it and return when it's cooled off. Otherwise, there's a risk of scalding yourself. Is the fan belt in place? Is the fan tight when you wiggle it? A loose fan is a sign of a failed water pump or fan clutch.

On some Rover models, it is possible to route the serpentine belt wrong, so the water pump spins backward. If your overheating follows a belt replacement, check the routing.

When you look at the fan, make sure none of the plastic blades are damaged. If you see any cracks or chips or broken blades, replace the fan. We have seen damaged fans explode with enough force to go right through the hood. Not only will a fan with a broken blade explode . . . it will also cause a heavy vibration that can ruin a good water pump in less than 100 miles.

Is there any coolant in the radiator or expansion tank? A slow leak can allow coolant to leak out until one day, there's not enough and the truck overheats. A fast leak can cause the coolant to blow out in a matter of seconds. Look for a blown hose, cracked radiator, or expansion tank. Slow leaks often leave a trace of sediment where the coolant emerges and evaporates.

Slow leakage is a particular problem with the newer Discoveries, because they don't have a warning light and, being British, they leak.

The radiator must be filled with clean coolant of the correct type. Filthy old coolant should be flushed before proceeding with diagnosis. If the coolant is contaminated with oil, you need to find the reason before proceeding. The most common cause in a Land Rover is leakage from the oil cooler into the radiator. Occasionally oil will mix with the coolant as a result of an internal engine problem but that's rare.

Putting the wrong coolant in a late model Rover can cause overheating problems. Putting the traditional green coolant into a vehicle made for the orange Dex-Cool can result in sediment formation, and that sediment can clog the cooling system.

There are three coolants used in Land Rover products.

RTC7601 is traditional green ethylene glycol coolant. It's used in all older Land Rover models. All Series Land Rovers, all US market Defenders, all Range Rover Classics, and all P38A Range Rovers up to 1999 use this coolant. If you have a 1999 Range Rover and you're not sure which coolant to use . . . .if the last digits of your VIN are YA4444891 or lower, your truck uses ethylene glycol. If your VIN is higher, you should use Dex-Cool.

With the arrival of the Bosch engine management system in the Discovery II and the 1999 Range Rover Land Rover changed to Dex-Cool, otherwise known as OAT coolant. Land Rover stocks that coolant under part number LRN 2279. The Freelander models also use OAT.

The 2003 and newer Range Rovers use BMW's Glysantin G48 coolant. It's distinctive because it's bright blue in color. Land Rover sell that as LRNG48.

If your Rover uses Dex-Cool, you have to be sure to keep the system full all the time. Running the engine, while low on coolant, will cause damaging sediments to form.

At this point, I think we should have a word on the subject of "full." When we say "make sure the cooling system is full" what does that mean, exactly? You should make sure the radiator is filled to the top, there is no air in the system, and the coolant level in the expansion tank is where it should be, looking at the level indicator molded into the tank. Air in the system can cause overheating and it can be a real problem to remove it on some trucks. Many shops use a vacuum pump to remove all the air from the cooling system before filling to avoid this situation.

If you overfill the system, it will spit the excess coolant onto the ground. Don't mistake coolant expelled from the overflow line at the expansion tank for a leak.

Once your vehicle is full of clean correct coolant, we can proceed. If it does not overheat anymore after flushing your, radiator is probably mostly clogged. A like-new radiator has enough cooling capacity that the temperature gauge won't budge from the midpoint, even on a hot summer day. If your Rover improves with flushing, that means its radiator is pretty clogged and you just made it a bit better. I'd suggest you remove it and have it re-cored or replaced. If that solves your problem, congratulations, you're done.

If your truck still overheats, you'll need to keep going. The next step should be a test to determine if your engine is really overheating. I suggest measuring the temperature of the engine with an infrared thermometer. Measure the upper radiator hose where it exits the motor as that's near where the sender for the gauge is located. The top of the white area on your temperature gauge should be about 220 degrees, on the thermometer. If your gauge is at the top and the infrared thermometer is showing 190-200 degrees you've got a gauge problem and not an overheating problem. If you have a real overheating problem, read on . . .

When the truck is warmed up feel the hoses . . . are they hard or soft? Soft hoses indicate a system that's not building up pressure. Check and find the cause of pressure leakage. Some possibilities are a bad cap, leaking hoses, or cracked expansion tanks.

If the hoses are really hard, that is a sign of excessive cooling system pressures. Excessive pressures often result from combustion gases leaking into the coolant passages and over-pressurizing the system.

If you find that, you should check for combustion gases in the coolant. There are two ways to do this. Auto parts jobbers sell a kit consisting of a glass tube and test liquid. You place the tube over the radiator filler hole and run the vehicle. If the liquid changes color there are combustion gases escaping through the coolant.

Another method of testing is to sniff the radiator filler with an exhaust gas analyzer. The analyzer is more likely to pick up small leaks that won't color the test liquid.

If your truck passes both the above tests you probably do not have internal engine problems.

Overheating under load, no combustion gas in coolant

Overheating under load may be a sign that your radiator is clogged. The tubes in the radiator become lined with hard deposits as the radiator ages. These deposits will significantly reduce the radiator's ability to remove heat from the coolant.

I suggest removing the radiator and having it checked for clogging. When you remove the radiator, look for debris blocking its surface. Also check for debris blocking the AC condenser and oil coolers. A leak from an oil cooler can leave a film of oil that collects dust like a magnet, leading to complete air blockage of large parts of the radiator. If air flow is restricted, the vehicle will overheat under load.

You should also check the engine driven fan, if you have one. It has a viscous coupling that allows it to freewheel in cold weather and be tightly coupled in hot weather. If the fan freewheels on a hot day, it won't cool adequately.

The electric fans are controlled by temperature and/or A/C operation. In some cases, the fans are turned on whenever the air conditioner is running. In other cases, the fans come on when a threshold engine temperature is reached. In either case, the electric fans need to work to keep the motor cool in summer.

In a few cases, we have seen overheating caused by separation of the water pump impeller from the

shaft. This is more of an issue with BMW and Jaguar cars that use plastic impellers pressed onto a steel shaft. The only way to check this is by removing the pump.

Here are some other causes of overheating that you should check:

• If the radiator cap is bad (not holding pressure) or if the cooling system has other air leaks the cooling system will boil and overheat.

• A stuck thermostat will cause overheating all the time (stuck closed) or cold running all the time (stuck open.)

• A Rover may overheat in hot weather if the fan shroud is missing or damaged.

• A clogged catalytic converter will cause substantial heat buildup under the hood and can lead to overheating and serious loss of power.

Overheating under load, combustion gas in coolant

If you have combustion gas in the coolant your motor has one of three problems:

• One of the head gaskets has failed;

• One of the heads, a cylinder liner, or the block has cracked;

• Or one of the cylinder liners in the block has moved.

In some cases, you may see steam and smell a sweet odor from the exhaust. That's a sure sign of coolant entering the combustion chamber and exiting via the tailpipe. Much of the time, though, the leak goes the other way – combustion gases going into the coolant, and there may be no visible evidence.

The first step in finding out what went wrong is to remove the cylinder heads. When you do this, you'll have a chance to check for sludge under the valve covers and intake. If you have a lot of sludge, I suggest engine removal and a complete teardown and cleaning. If the engine is sludge-free you may or may not be able to repair it in the car, depending upon what you find.

The head gaskets should be examined carefully. You may see tracks where gas leaked from the combustion chamber to a coolant gallery. Tiny cranks in the ring that seals the combustion chamber are a sign of pre-ignition. You can check for localized overheating by measuring the gasket thickness. A spot that ran hot will have a thinner gasket – something you can pick up with comparative micrometer measurements. An experienced machinist will be able to spot many head gasket failures.

Failed head gaskets are the most common reason for combustion gases getting into the coolant. But, it's important to understand that you can't fix a head gasket failure by just slapping on a new gasket and bolting it together. Doing so, will usually result in a repeat failure at some future date. You need to find and fix the underlying problem. That means, repairing mating surfaces that are not perfectly flat, repairing the cause of the pre-ignition, or fixing the cause of localized overheating. Localized overheating is often a result of injector or ignition troubles on one cylinder and it can be difficult to find but it's an insidious killer. Left alone, it will overheat a single cylinder until the liner loosens in the block and even greater damage ensues.

The heads are checked for flatness with a straightedge. Aluminum heads should be flat within .002 inch. They are checked for cracks by applying air pressure while bolted to a jig, or by application of liquid crack detection chemicals that highlight cracks under black light. Cracked heads can usually be repaired by welding. Warped heads can be surfaced on a milling machine or specialized cutter. Rover heads should not be surfaced more than .005 of an inch, because the compression ratio increases as the heads are shaved.

If coolant was entering the combustion chamber, you will see one or more cylinders scoured spotlessly clean by the steam. Pay particular attention to those cylinders if you see them because they are the ones that have failed. If you see this, or if you see milky oil in the engine, you should pull the oil pan and check for lower end damage because coolant is getting into the oil. Coolant mixed with oil will damage bearings.

The steel cylinder liners are pressed into the block and milled flush with the top. If you see any liners that have moved downward that's a sure sign of failure. If you do not see any signs of movement in the liners, you must make a decision to remove and test the block or take your chances and refit the heads.

The block is tested by bolting plates over the cylinder head mating surfaces and applying pressure to the oil and coolant galleries to check for leaks. Leakage indicates a loose liner or the presence of a crack.

The block can also be checked for flatness on the cylinder head mating surface. As with the head, the surface must be flat within .002 inch. I have seen a number of instances where shops replaced head gaskets, experienced a subsequent failure, and assumed the block had a bad liner when in fact the deck surface was warped. It's important to figure out what went wrong if you are to have a lasting repair.

A block with a dropped liner can be repaired by removing the liner and pressing in a slightly larger replacement that is flanged at the top so it can't move. A block whose cylinder head mating surfaces have warped can be surfaced in a process called decking. If the cylinder head mating surface has warped, there is a good chance the crankshaft bore is warped also. In that case, the block will need the main bearing journals line bored after it's been decked.

The traditional method of fixing liner and deck problems in Rovers was to replace the engine block. With the increased costs for new blocks, repair is now becoming a better option.

I hope the tips in the article above will allow you to diagnose your overheating trouble. In the case of engines with combustion gases in the coolant, there is usually some other problem that led to the internal engine failure. Before you count the job done, you should find that problem and fix it.

Finding those problems – things that cause internal engine failures - will be the subject of a future article.

See you next time.
John