

# Carl's Tech Tip #3: The Cooling System

## Rebuilding the 308 Cooling System

Today I am going to discuss the cooling system on the 308. This seems to be a most misunderstood part of the car. Many people claim that these cars will always run hot in traffic or on a warm day because the water pump is very small. Whilst the water pump is small, this is no excuse for the car to run hot. If your cooling system is operating as intended, your car will run a little warmer under the conditions above, but only by 5 to 10 degrees at most.

If your car runs hot at any time, here are some hints to get your cooling system running well. I have assumed that your water pump is healthy and not leaking or producing any nasty noises from the bearing. Its replacement will be covered in a separate article. The water pump/alternator belt should be tensioned so that it deflects about 1cm with a load of about 2kg. This is measured between the water pump and the alternator. Note that this is not as tight as what the factory suggest. You will find that at this setting, the water pump bearings will last longer and assuming the belt is in good condition, will not slip, or jump off the pulley. If you need to replace the belt, the genuine one is made by Gates. Its dimensions are: 7mm. by 975mm. This is for 308 GT/4 and GTB models only.

### Tools required:

Flathead screwdrivers. Drive socket set (metric).

7/16" ring spanner (for fan motor bearing).

30mm. open ended or open ended ring spanner. (to remove water temperature sender).

Multimeter.

Soldering iron and solder.

Bearing grease.

### Spare Parts:

Selection of stainless steel hose clamps.

Water hose. (see text).

Automotive wire (30 amp).

Temperature sender, Ferrari part no. 101507

Ferrari fuse box (black). part no. 60278702

Ferrari fuse box (white). part no. 50181007

Lucas fan motors (see text).

Rubber grommets for fan motor mounts (8 required, see text)

We need to examine both the cooling system and the electrical system to ensure your car runs cool. The problem with the Ferrari cooling system is not the water pump, or the radiator. It is the entry of air into the radiator. The two fans are responsible for maintaining airflow when the vehicle is stationary. We know this is the case because even on a very hot day, assuming you are moving faster than about 60km/h, your car will run at the correct temperature. If your system is in need of attention, as soon as you stop and idle the engine, the water temperature will skyrocket. Ferrari almost admit that airflow is a problem in the GT/4 manual by stating on page C-10.

„Warning: It is absolutely necessary to avoid the application to the front of the car any accessory which may restrict in any way the air intake to the radiator.“

We will look at the fans later but let us consider the airflow through the front of the car.

If you have a registration plate, driving lights or air horns in front of the radiator, remove them. The registration plate can be converted to a „slimline“ version at Vicroads for about \$95. These plates are about 9cm. high and mount unobtrusively below the radiator intake. They are also harder to read from a distance...

With the grill removed, check the condition of the radiator. If your car is fitted with air conditioning, the first radiator you will see is the air conditioning condenser. Check this radiator for impact damage from flying stones which causes the vanes to bend sideways and restrict air flow. Although this is the air conditioning radiator, any restriction of air here will determine how much air makes it to the radiator for the engine. The easiest way to do this is with a flat bladed screwdriver to evenly space the vanes. Notice how fragile they are. They are very easy to bend. If your car is original, you may wish to use a high pressure hose to remove years of road debris. Squirt the hose from the inside only to force the „gunk“ forward and out of the radiator. It is amazing the quantity of bugs that will wash out.

You will find the following easier if you jack the front of the car up and remove the bumper and the grill. If you have driving lights, they should be mounted at the extremities of the bumpers, under the indicator assembly. Ferrari also had a habit of mounting the air horns between the cooling fans. Whilst the area the horns occupy is very small, I did take the precaution of relocating the horns on the left hand side of the radiator, above the interior ventilation fan motor.

Let's now drain the cooling system. We need to do this as replacing the water is imperative to the systems long term reliability. Take the car for a drive and open the heater valve to the fully open position. This will allow the normally stagnant water in the heating system to circulate. About 10 minutes should be enough. Let the engine cool for about 4-5 hours. Remove the cap on the header tank (figure 11). This allows the system to depressurise. Undo the drain valve at the bottom of the radiator (figure 8). This drain is very difficult to get to as the drain sits close to the spare wheel well. The water will run out the bottom of the front apron. Be careful that no water splashes onto the paintwork. Anti-freeze makes an excellent paint stripper. Next, undo the drain plug on the engine (Note, not all cars have this). It is located near the starter motor on the forward section of the engine. Loosen the air bleed screw on top of the radiator and the thermostat housing. (Again, some cars do not have the air bleed on top of the thermostat housing). By now, most of the water should have drained however, to make sure, remove the heater hose return line (figure 48). You can lift the front and rear of the car to make sure all the water has drained. If you are really keen, remove hose (figure 39) from the engine and connect it to your garden hose. This will force water through the heater system. The colour of the water should give you some indication of the condition of your cooling system. If it is green, you are in good shape. If the water is a pale milky white, your system has not received any attention for some time. This means it contains calcified deposits and corrosion. When the system is assembled, run some radiator cleaner through it. Be very careful to ensure the cleaner is compatible with Aluminium engines otherwise you can do serious damage. If you are nervous about this, you can use tap water under pressure to flush out the system.

I will assume that no ones engine is in such a poor state that it has blocked water galleries within the block. This is a very bad situation as the engine would have to be removed and stripped down. You may wish to flush the radiator by placing a hose in the top of the radiator and letting it run at high pressure until the water running out of the bottom is clear.

The first item to check are the cooling system hoses. With the engine at the rear and the radiator at the front there are plenty of them. Have a look under the car too, to check for any deterioration or perishing. Starting at the rear, check the junctions between the „V“ of the heads and the joins forward of the engine (both figure 23). These seem to be always overlooked on the cars I have seen. The hose from the thermostat housing to the header tank is also important (figure 30). If you don't use the correct hose, it will kink at the bend just above the water pump. If you are entering the concourse, use the genuine hose, however I do not think it is particularly good quality. The problem may be that because of its absurd price, it sits around in a warehouse perishing for a few years before it is sold. Don't forget to check the hoses

under the front of the car. Have a look at the top and bottom radiator hoses as well as the two junctions in figure 23 and 24. You will have to remove the belly pan to gain access to these last two. I found the „Pirtek“ franchises very helpful. There will be one near you, just check in the Yellow Pages. They sell just about every sort of hose available.

For the large junctions, I used the „Gates“ brand. It is identifiable by having either a green or white stripe running down its length. It will cost about \$50 for a one meter length. The internal diameter should be 39-40mm. The smaller 1/2“ and 3/4“ hoses can be replaced with high pressure hydraulic hose designed for hot oil under pressure. It will be harder to push on the junctions than the standard hose but it is very long lasting. If it is put on properly, this hose will never split or break under pressure.

One hose that should be inspected is figure 39. This hose supplies hot water to the heater valve at the front of the car. It is a real pain to replace. You have to remove the inspection plate in the left hand side front wheel well and feed the hose up to the valve. You also need to remove the rear wheel inner guard on the same side to pull the hose through. On some cars (like mine) you have to remove the left hand side fuel tank as the hose is clamped to the forward part of the tank. I can tell you that as a first timer this one hose alone took about 15 hours to replace!

We are now ready to fill the system. In Melbourne we are lucky with our relatively clean water but if you are really keen (or have bore water) use distilled water mixed with anti-freeze. I use a concentration slightly higher than what is recommended so that should the system ever need topping up, it will not become too dilute. The anti-freeze is used as a corrosion inhibitor. We don't really have a problem with water freezing here, we are using the anti-freeze for corrosion protection. This is very important as Aluminium engines are prone to corrosion if just water is used. You must also use anti-freeze with a phosphate free base. As anti-freeze deteriorates with age ie: the corrosion inhibitors stop working, it should be changed at least every two years.

After checking all the connections, close off the drain cocks but leave the bleed screw open on the top of the radiator and the thermostat housing (if you have one). Fill the header tank until full or until coolant runs out the bleed screws. You should have been able to pour in about 6 litres. Start the car and keep pouring in the water/anti-freeze mixture paying attention to the bubbles exiting the top of the thermostat housing. If your car is like mine and has no bleed screw on the housing, you will have to rely on the screw on the radiator. As the engine is warming up, keep topping up the header tank. When water dribbles from the bleed screws you can tighten them. Should you have the two bleed screws, it is best to shut off the radiator one last. Only when no air squirts out should the screws be tightened. You can check that your cooling system has pressure as the hose from the header tank to the engine (with the cap on) feels firm when squeezed. Keep an eye on the temperature gauge as well as the level in the tank. If you suspect something is wrong like the temperature gauge creeping up too high or not being able to put any more water in the tank after starting. Shut down the engine! Let it cool, and begin the topping up process again. If you are really stuck and the air will not bleed out of the system, remove the hose at the top of the thermostat housing and pour the water in directly until full, then seal it up, and begin the procedure again. After you have driven the car a couple of hundred kilometers, check all the hose clamps for tightness. Hoses do shrink a little when new.

That completes the maintenance of the water side of the cooling system.

For this next check, I suggest you remove the fuse for the fuel pump. It will stop your carburettors being primed with fuel unnecessarily. With the motor not running and cold, but with the ignition in the „run“ position, switch on the air conditioning. The right hand electric fan should come on. Now remove the two wires that fit on to the temperature sender at the base of the radiator. (figure 37) With the air conditioning still on, short out these two wires. The left hand fan should run. Now switch off the air conditioning but keep the two wires shorted. Both fans should still be running. If not, this is why your car will run hot when at a standstill. If the fans worked when the wiring was shorted but don't come on when the car is hot, then suspect the sender in the radiator. Remove it and check the continuity when the unit is placed in

boiling water. It should close circuit at 84 degrees c. and open at 75 degrees c. If the sender is OK it may just be a case of having a dirty connection.

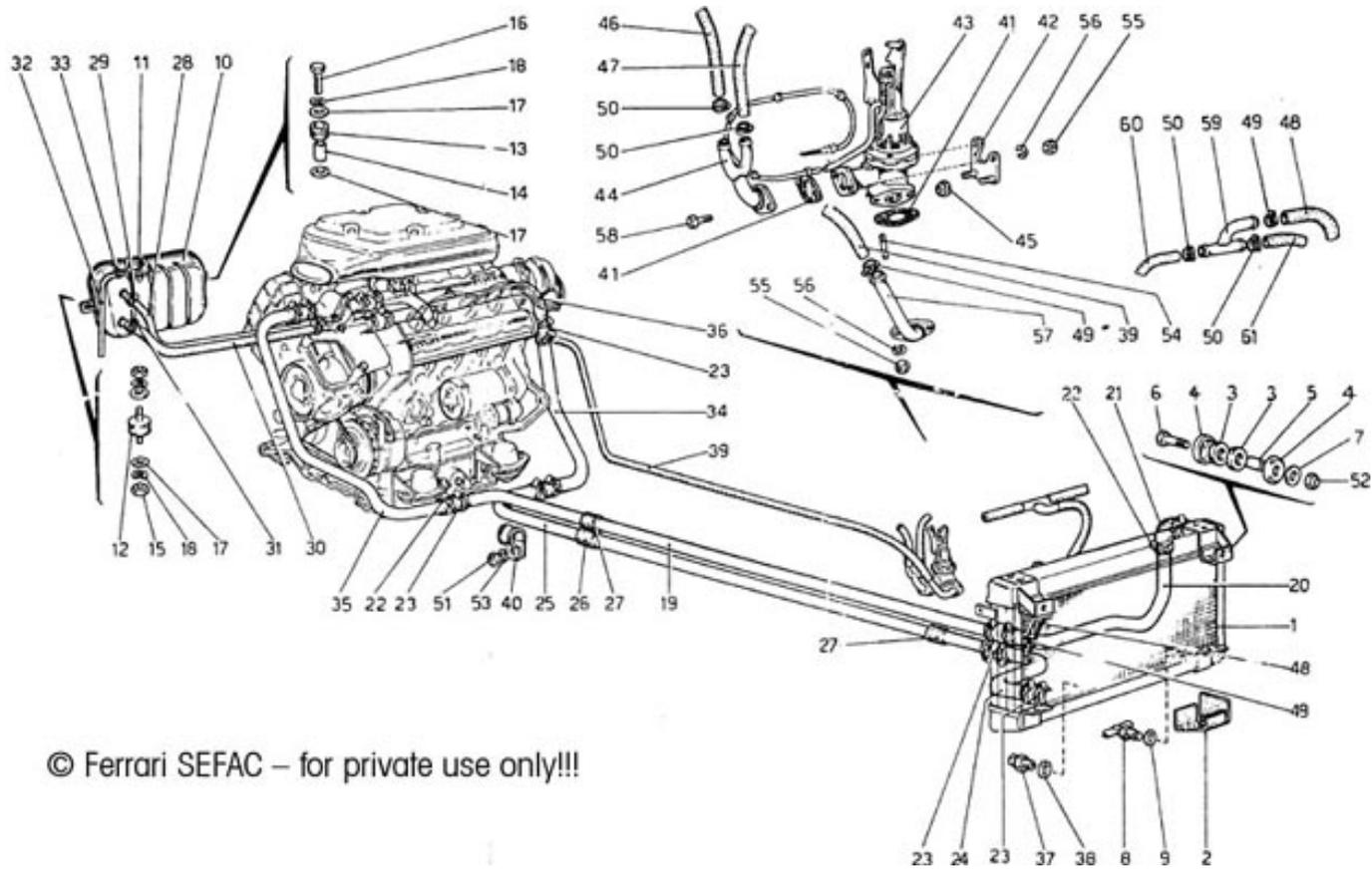
A word of caution. If your car has been involved in a collision at the front, chances are the wiring has been damaged and not repaired properly. The loom is quite vulnerable as it runs very close to the front chassis and an impact here will damage the wiring. Make sure the wiring is in good condition in this area. I have heard of cars that have been repaired and the fans wired up in reverse polarity, blowing air forward! Please check yours!

You could also try running the wiring directly from the battery. Should the fans run we need to delve into the fuse box and associated wiring. If they don't operate, it must be the motors (see below). Check for continuity between the fuse box, relays and the fans. If the wiring is good, check the relays. You should be able to hear them tripping when either the air conditioning is on, or when the temperature sender wiring is shorted. If not, try swapping the relays from the headlights (they are the same).

Check that the fan motors are operational. If there is voltage at the motor end but they are not running, then they are faulty. The fans may require a rebuild. The fans are made by Lucas and are not very well put together. It's a good idea to remove the fan motors to inspect them. The casing has a seam at its base which does not seal properly. This allows water to enter the motor assembly. A small amount of silicone sealant will cure this. Water can also enter through the bolts that hold the case on so make sure these have a watertight seal. If you take the casing off, make sure the brushes are in good condition and there is no corrosion inside. Grease the bearing at the opposite end to the fans and replace the case, being careful not to allow the armature to bang against the case due to the magnet. When replacing the casing, slacken off the bearing lock nut. (Note, as the motor is English, this nut is not metric, it's 7/16"). After the casing is replaced, rotate the fan whilst tightening the bearing adjusting screw. When the bearing begins to bind, just back it off about 1/4 turn until it is free then lock the adjusting screw with the nut. To even out the wear, the fan motors can be transposed left to right. This is because the right side always does more work as it always comes on with the air conditioning. These motors were fitted to many English cars in the 1970's so if yours are beyond repair, try a Rover or Jaguar specialist. I am sure there would be plenty of these in the wreckers yards!

If all is well with the circuit and the motors are OK, but the fans still will not run we need to check the fuse box. This area is the most common source of electrical problems in 308's. Unscrew the two screws that hold in the fuse box that applies to the fans. (The location will be in your owners manual). With a multimeter check the resistance across the fuse block. It must have no resistance. If it does, here is your problem. These fuse boxes have a design fault. The upper and lower contacts are riveted on. They should be soldered. This means that after the brass fuse strips have oxidised over time the resistance increases. The fuse strip now acts like a small bar radiator, melting the plastic base or worse, catching fire. Sometimes, the fuse strip when it begins to warm, will distort and go completely open circuit without warning. This is most exciting if it is the headlight circuit! You may wish to check all the connections on the fuse box. For a permanent fix, remove the fuse box and clean all the rivets on the fuse contacts. Make sure you check the back of the fuse box as well. Solder every rivet to the strip. Now your fuse box is fixed for life! If it is beyond repair, the genuine Ferrari fuse boxes are very expensive. Expect to pay about \$200 per side for a new one. If you don't care for originality, Hella make an excellent marine grade fuse box. I have never tried it, but it should work very well in a car.

One final note on the fans. Their efficiency can be dramatically improved by mounting them as close as possible to the radiator. The clamps that hold the fans are adjustable so move the assembly as close to the radiator as possible. I have mine only 3mm. from the radiator and have had no problems. I was careful to replace the flexible rubber grommets on the motor mount though, just in case. If you wish to mount your fans this close to the radiator, I suggest you do change these mounts. They are available from most stores that sell electrical wiring accessories for motor vehicles.



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