MGB Technical Tips - Engine Cooling (Part 2):

Water pumps:

Be aware when replacing your MGB water pump because there are several different pumps used depending on the age of the model and if it's a US specification with a bracket for the emissions air pump, if fitted. Not only do the various pumps have different size impellers, they could be longer or shorter from the impeller to the pulley. Also, the various water pump models have different mounting bolts lengths, ranging from 1" to 2" and every ¼" size in between.

On more than one occasion I've had to repair a leaking water pump by drilling out the thread in the engine block and fitting a Helicoil because a previous owner has tried to force a 1¾" long bolt into a 1¼" deep threaded hole, consequently stripping the thread in the block.

Try to avoid the temptation of purchasing a "cheapo" replacement water pump. Don't let your mechanic opt for the cheapest possible water pump either, just so they can make the largest amount of profit. I've heard stories of cheap (but not much cheaper) generic water pumps with impellers that are loose on the spindle and don't spin fast enough, if at all, or others that have seized bearings right out-of-the-box, amongst other issues.

Radiator shroud and radiator seals:

These are important features to improve the airflow through your MGB's radiator.
I don't personally have any experience of the aftermarket radiator fan shroud that's available for MGBs these days but I do know that having a close-fitting shroud across the radiator core which comes as close as possible to the ends of the radiator fan blades will dramatically increase the amount of air that passes across all of the radiator's cooling tubes.

It can be difficult to comprehend when you're able to see daylight through a radiator, but airflow through the radiator grille will attempt to take any possible path to get past the radiator without actually travelling through it. The radiator diaphragm panel has a circular hole just ahead of the carburettors to provide some cool air to them but apart from this, there should be no other point where the airflow from the grille is allowed to leak past without travelling through the radiator's cooling fins.

This means having the rubber seal that fits into the radiator diaphragm panel groove (just under the bonnet) in good condition, not perished and hard. It also means that there should be the factory fitted (on most models) foam seal glued between the radiator diaphragm panel and the top tank of the radiator. I've seen generic pieces of foam strips, hot water pipe foam lagging, and flat strips of rubber being used to seal this gap. It doesn't matter so much what material is being used, as long as something is there to prevent the airflow from getting around the radiator.

Make absolutely sure that whatever material is used for this seal, that it's glued, screwed, nailed! securely, because I know from experience that the pressurised air from the grille will try to force out the seal, rather than go through the radiator.

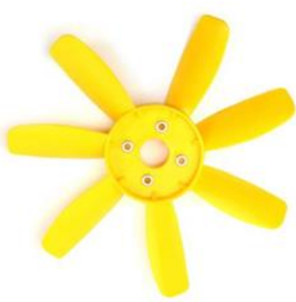
Radiator Fans:

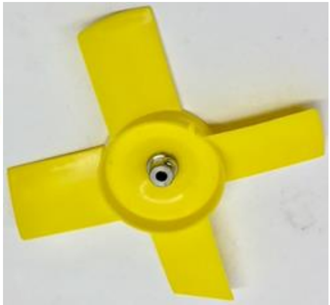
An internal combustion engine turns fuel into heat, of which, roughly 1/3 is converted to power which propels the vehicle, 1/3 of the heat is lost through the exhaust pipe, and the final 1/3 is lost into the coolant.
The more that you increase the power of your MGB the more heat it generates, which means that after a point, the cooling system will need to be upgraded.

The irony is that a standard, non-US specification, MGB engine which produces 95BHP at 5,000-5,500RPM, only produces 5-10BHP at idle speed. The heat produced by the engine while creating just 5-10BHP is significantly less that at its maximum BHP output, so a reasonable conclusion would be that the engine needs very little cooling while idling. This is true, except that there is a huge amount of residual heat in the engine and radiator from the previous period of driving before the car stops at traffic lights. The engine now needs to dissipate this excess heat while the car is stationary and air is no longer passing through the radiator at normal driving speeds.

On a standard, well-maintained MGB, the cooling fan is generally able to draw enough air through the radiator but it possibly won't be sufficient to cool an engine and radiator that isn't in optimum condition. The factory improved the radiator fans throughout the production life of the MGB. The early, 3-bladed metal fans that are bolted to the water pump were replaced from the 18GD series engines with a six bladed metal fan. Later on, a plastic, 7-bladed plastic fan was used for the US market, where most MGBs found homes in warmer climates, and these can be purchased to be retro-fitted to earlier engines.

With the introduction of the MGB GT V8 in 1973, and the cooling issues to be expected by fitting a large engine in a small engine bay, the factory wisely used two, small electric fans to keep the V8 cool. Then, from 1976 onwards, 4-cylinder MGBs were fitted with an electric radiator fan, which was one of the pair that was fitted to the V8.





An electric fan is the only way to have enough air passing through the radiator of a performance tuned engine while the car is at a standstill for an extended length of time. A mechanical fan will spin at a lazy 700-850RPM when the MGB is at idle speed, which is nowhere near enough to draw sufficient air for a modified MGB engine that's stuck in traffic on a 40°C day. It's probably fine for a "sweltering" 26°C day at the height of an English summer.

An electric fan consumes a small amount of engine power through the additional load placed on the alternator to drive the fan, but the mechanical losses are greater for the mechanical fan bolted to the water pump. It also stops the engine from revving so freely when accelerating, so removing the metal fan has the same effect as lightening the engine's flywheel.

Be advised though that I don't necessarily recommend using an electric fan on an early MGB fitted with a generator (dynamo), because the fan's electrical power consumption might overwhelm anything but a reasonably sized alternator.

More about fans:

In a well-maintained, standard MGB you don't even need to have a fan fitted at all when you're driving along. The fan is only required while stationary, or while the engine is under load when the car is travelling slowly, especially up steep roads.

So when a belt driven fan is shifting the most air, it actually doesn't need to shift any at all, and while the engine is idling and no air is being forced through the radiator by the movement of the car, the mechanical fan is doing next to nothing. Hopeless!

When retro-fitting an electric fan, use the largest fan that will fit, and mount it as close to the radiator so that it almost touches it. This is crucial. Most people aren't aware of how hard it is to get the airflow to pass through a radiator core. You can visibly see through the radiator cooling fins if you shine a light through, but belief me, the airflow will do whatever it possibly can to avoid passing through the radiator, especially if it's a thicker, uprated core radiator.
Using an air speed meter, I found that with my electric fan switched on there was more air bouncing off the radiator and blowing away from the perimeter of the fan than was actually making it through the radiator. This was with the fan about a ¼" away from the cooling fins, which just isn't close enough.

Due to the high current draw of electric fan motors, it's advisable to install a relay in the wiring and to have a manual switch along with an automatic, thermostatic switch.

Radiator cap:

Allowing an engine to run too hot is going to be detrimental to longevity of the engine, and also for its performance.

I regularly advocate fitting a higher pressure radiator cap than the factory specified item; on MGBs with healthy engines and cooling systems. An overheating engine is damaged not so much by the temperature, but by the consequences of the coolant boiling.

When coolant boils inside an engine, air pockets are created just like the bubbles in a boiling kettle. In most engine designs, these air pockets are most likely to accumulate inside the casting of an engine block and cylinder head, right where there is the greatest need to remove heat from the cast iron as efficiently as possible. Air is a poor conductor of heat, hence the air gap in double-glazed windows, so having air pockets inside the water jacket of an engine can lead to disastrous consequences.

The region where an air pocket can form inside your engine is most likely to be in the cylinder head, adjacent to the exhaust valves. This is a critical area for cooling, but now there's no coolant in contact with casting inside the cylinder head which just causes this hot spot to get even hotter, until the head cracks, while all the time, it's possible for the temperature gauge to be giving a normal (safe) reading because the coolant elsewhere inside the engine isn't overly hot, just the super-heated air pockets inside possible traps in the casting. Note that this boiling of the coolant inside the engine doesn't necessarily mean that the coolant is boiling over from the radiator.

By using a higher pressure radiator cap, the coolant won't boil until it reaches a higher temperature than it usually would, which reduces the risk of air pockets being formed inside the engine casting.

Top level racing cars will run cooling systems pressurised to 50psi which has the effect of keeping the coolant from boiling until it gets to more than 130°C. An MGB will begin to demonstrate a large power loss from the engine well before it reaches that sort of temperature, but the principle is still the same. The intention is to increase the temperature at which the coolant boils, to above the point that the loss of engine power becomes so noticeable to the driver that they have no choice but to allow the engine to cool down safely (slowly). (Never top up an over-heating engine that has boiled over, with cold water because the thermal shock of the temperature differential can (will) crack or warp the engine and/or head casting).

Just like the improved radiator fans, MGBs had different radiator caps fitted during its production life, as below;
1962-67 had a 7psi cap, 1968-76 had a 10psi cap, 1976 had a 13psi cap and 1976-80 had a 15psi cap.
The factory fitted higher and higher pressure rated radiator caps to increase the operating temperature of MGB engines (without them boiling over) because a hotter engine produces fewer noxious emissions, to suit Californian State regulations at the time.

I'll try to reinforce the point about radiator cap pressures. The important thing is not to be confused by boiling point and boiling over. We need to prevent coolant boiling over, because if any coolant is lost from the system it's more difficult for the remaining coolant to transfer enough heat from the engine until the lost coolant has been replaced. The boiling point temperature is less of an issue so long as no coolant is lost. This can be a difficult concept to grasp, so I'll try to explain it this way.

Unpressurised water freezes at 0° Celsius and boils at 100°C.
If water is pressurised then it can exceed 100°C temperatures without boiling.
The more that water is pressurised, then the higher and higher its temperature will reach before it boils.

Anything that absorbs heat from a car's engine and transfers that heat to the atmosphere via the radiator is known as a coolant.
Even though the green products that are commonly used in radiators are really just anti-freezes, they can still be called a coolant because they do a passable job of increasing the boiling point of the water that the Glycol is mixed with.
Penrite quote the following figures for a 50/50 Glycol mix; Freezing point at -38°C and Boiling point of 109°C. So a 38° protection against freezing but just a 9° protection against boiling.

This same temperature increase can be achieved by simply fitting a 13psi radiator cap to an MGB instead of the 7psi rated cap used on early models, and not using the expensive anti-freeze product. Using even higher pressure radiator caps will allow the engine to operate safely at increased temperatures before boiling over.

Generally speaking, an internal combustion engine operates most efficiently between 80°C and 90°C, with more power produced at the lower end of that range, but it's more fuel efficient at the upper end. To put this into context for Fahrenheit scale MGB temperature gauges, this equates to 176°F up to 194°F.

I was recently contacted about the concern that an MGB owner had about his temperature gauge reaching 200°F while idling in traffic. I assured him that 200°F is nothing to be worried about, especially when the temperature gauge tops-out at 230°F. I think that having a special graduation on the gauge of 212°F is more of a distraction for owners when it just represents the boiling point of plain water that's unpressurised, so 212°F (100°C) isn't relevant to the operation of a car. It's just a benchmark that people can recognise to have a comparison with.

Monaco is the second smallest country in the world but its city of Monte-Carlo takes an inordinately long time to drive through due to the horrendous overcrowding and subsequent traffic congestion. While driving my performance-tuned MGB there, I noticed that the engine was getting hot from being stuck in such heavy traffic, despite it being a very cold and foggy day. I later learned that there was a wiring issue with the electric fan, which was easily rectified, as soon as I was able to eventually find a place to park.

The needle on the temperature gauge moved passed 100°C (212°F), then it passed the highest calibration on the gauge of 110°C (230°F). Without being able to find a place to park, or a gap in the traffic to force air through the radiator at speed, the temperature needle climbed further, into the upper part of the dual gauge that displays the engine's oil pressure, continuing anti-clockwise past 100psi and as far as 80psi! Despite this dangerously high coolant temperature, my engine operated normally, without any problems. After a minute at 3rd gear speeds, the coolant temperature rapidly dropped back down from the oil pressure half of the gauge, which gave me the confidence to drive along the winding roads up the cliffs and out of Monaco. As soon as I finally found a place to get off the road and switch off the engine, the residual heat in the engine caused an immediate coolant boil over with a subsequent steam cloud erupting from under the bonnet. I re-connected the electric fan while the engine was slowly cooling down, and after topping up the radiator I was able to proceed on my journey around Europe without any further dramas.

This photo shows my MGB just about to enter the famous tunnel on the Monaco F1 Grand Prix street circuit, with the dual oil pressure / coolant temperature gauge circled in red. Note the temperature needle pointing towards "2 o'clock", or close to the 80psi mark on the oil pressure gauge. (The oil pressure reading, and the oil temperature, on the gauge above it are in the usual operating range).

Don't be afraid of the temperature needle touching 212°F / 100°C on the gauge while the car is stuck in traffic, this is perfectly acceptable in a healthy car, so long as you expect to be driving at 4th gear speeds soon, to be able to bring the engine temperature back down to the normal range.

I'm not advocating for MGBs to be driven while the engine is overheated because this can cause extreme damage to the engine, what I am saying, is that brief periods of idling in traffic with the temperature gauge reading above 212°F / 100°C before driving off, at low throttle openings, to once again get enough cooling air through the radiator is not a problem in a well-maintained MGB engine.

Over a period of time the radiator cap's rubber seal will wear thinner and/or the spring will lose its tension, both of which will reduce the radiator cap's ability to keep the engine coolant inside the car's cooling system, so if you're replacing the cap anyway, go for the same style of cap that's at least a few pounds higher in its pressure rating.

Note that by using a higher pressure radiator cap on your MGB, it won't make the engine run cooler but it will reduce the likelihood of super-heated air pockets inside the engine and will reduce the chance of coolant loss out of the system.

Coolant recovery system:

A radiator doesn't just overflow because the engine coolant boils, it also overflows because the coolant expands as it get hotter. Yes, a radiator will overflow if the coolant boils, but the coolant doesn't need to get as hot as that before it begins to overflow.

Early MGBs simply had a rubber pipe from the neck of the radiator running downwards to drain overflowing coolant onto the ground. This is a very simple solution to relieve excess coolant pressure before it causes a burst hose, or radiator, or head gasket. However, if the car has "green sludge" coolant in the cooling system which is then expelled through expansion onto the ground, it'll stain your driveway, make the road surface slippery, or poison your pets if they try to drink it.

Some owners fit an overflow tank, which is intended to capture any lost coolant to prevent it from spilling onto the ground and causing the above issues. This is still an open system, where coolant is lost, meaning that after the engine has cooled down the engine/radiator will now have a reduced level of coolant, which will need to be topped up.

Later model MGBs had a superior system, with a coolant "expansion tank", not to be confused with an "overflow" tank. An overflow tank is nothing more than a catchment receptacle. I've seen Coke cans and plastic drink bottles employed to catch coolant overspill. A true expansion tank has a pressure cap on it, and a plain cap without a spring (or a cap with a spring but also with a coolant return valve) on the radiator filler neck. As the coolant expands with heat inside the engine and radiator, it's allowed to flow (not overflow out of the system) into the expansion tank. The pressure cap on the expansion tank still operates to increase the boiling point of the coolant. Now, here's the clever part, as the coolant contracts when it cools, the coolant is drawn back into the radiator from the expansion tank. This is a "closed system" which should never be expected to lose any coolant, unless under extreme circumstances.

Another tip to avoid coolant loses due to expansion, is to avoid filling the radiator right up to the top of the filler neck. Follow the advice of the factory handbook and only fill the radiator until to coolant covers the top of the tubes inside the radiator at the bottom of the radiator's header tank.

Radiator hoses:

Perished radiator hoses occur over a period of time. They can also go hard, or even soft if the reinforcing fibres start to break inside the rubber hose material. The hoses can also split at the ends, where coolant can weep out.

Check the condition of your MGB's radiator and heater hoses and replace them before they fail while out on the open road. Also, try not to use cheap hose clamps. Use the type that has a smooth metal band in contact with the hose, not the type that has the worm-drive slots in the band which cut into the hose.

Fan belt:

Saving this one until last, check the condition and tension of the fanbelt. No cracking, fraying or glazing, and tensioned as per the workshop manual. A cause of overheating could simply be a loose fanbelt which isn't driving the water pump and radiator fan fast enough. No charge!

As always with my Technical Tips articles, the views expressed are opinions based on my own extensive knowledge of MGBs, racing an MGB and my research into the subject.

Nick Phillips