Cooling System

Last updated 03-Jan-2012

Coolant by Bob Muenchausen

Boiling Points of Ethylene Glycol solutions in water at various pressurizations							
System Pressure >>>	0 PSI	4 PSI	8 PSI	12 PSI	16 PSI	20 PSI	24 PSI
Plain Water	212 F	225 F	233 F	242 F	252 F	260 F	265 F
33% Solution	220 F	230 F	240 F	253 F	260 F	268 F	273 F
44% Solution	224 F	234 F	245 F	257 F	265 F	272 F	279 F
50% Solution	226 F	236 F	248 F	259 F	267 F	275 F	280 F
60% Solution	231 F	241 F	253 F	264 F	273 F	280 F	285 F

Pints of Anti-Freeze to add to MGB Cooling System (12 pts) to produce various solutions vs. freezing points of Coolant.							
Pints to add >	1	2	3	4	5	6	7
New Freezing Point >	+26 F (8.3%)	+19 F (17%)	+10 F (25%)	0 F (33%)	-15 F (41%)	-34 F (50%)	-57 F (58%)

Electric Fans

4-cylinder and V8 cooling fan schematics.

V8 cooling is always a bit marginal and although I have a high-efficiency rad (looks the same but has 25% more tubes) which improved matters slightly I'm always on the lookout for a bit more.

My 'Otter' switch (so-called because it switches on the fans when the water gets 'otter) was getting a bit 'late' (the normal switch-on point is about mid-way between 'N' and the red, or 90C/194F degrees F) and erratic so I bought a replacement (BHA5252) from SU Burlen. This is a copy that actually switches on slightly earlier than the original which is no bad thing in itself, and also has the side-effect that hot oil pressure after idling for a while with the fans cycling on and off is noticeably higher. However it has a much higher hysteresis than the original, which means that once switched on the temp has to fall further before they switch off again, i.e. the fans run for much longer than they used to. At least, most of the time it does. Very occasionally, when I am stuck in traffic, it will cycle on and off much more frequently such that the temp gauge only varies slightly at a point between N and H. Why, I have no idea, but there it is, and I wish it were like this all the time. At the time of writing (February 2011) I see Brown & Gammons also have the switch, it's quite a bit more expensive than Burlen, but if it is an original Otter I would opt for that one. There may also be other sources.

I also decided to investigate the voltages in the fan circuit as they draw a high current and any resistance in wiring and connectors causes a significant volt-drop. I was quite surprised to find I was losing 0.3 volts in various connectors in the brown circuit, 0.8 volts in the relay, and 0.7 volts in the grounds - nearly two volts altogether. A PO had added some crimped connectors in the brown circuit and omitted to solder them so I rectified that, the relay was also getting very hot in use so I replaced it, and I added some grounds from the fan connectors to terminals bolted between the fan brackets and the bonnet slam panel. Got rid of most of the volt drops (some in the wiring is inevitable) and the fans are now audibly faster and cool quicker.

I have also been looking at the possibilities of fitting some additional puller fans - they would have to be very slim and of a small diameter to clear the water pump. However, after having seen some fans of this type used in pusher mode I am very unimpressed. Despite having a shroud I don't think they are as effective as the factory fans, which really is saying something. The most noticeable difference is just how long the fans continue to spin after the power is switched off, which says to me they aren't pumping very much air, backed up by feeling how much (little) air is pumped through the rads when they **are** running. They have 'spiral' blades, which one fan manufacturer claims they tried, and promptly dumped them. At a minimum of £60 each I think I'll give them a miss and look further at fitting shrouds to the existing fans.

The latest enhancement was to run a heavy-gauge brown wire from the unused output spade on my alternator direct to the fan relay, which happened to have a second spade on that terminal. This has made another notable improvement in fan speed and rate

of cooling, subsequently I shut it in the garage (exhaust piped outside) on a 30 degree day and left it fast-idling to see what happened. The air going into the grill was being recirculated from the engine bay rather than being 'fresh' air at ambient and actually got up to 41 degrees, but still the temp gauge never got more than two-thirds the way from N to H. Travelling through France to LeMans and back in 2002, which was very warm, I was able to keep the needle on Normal at all times even in the hottest conditions. Auxiliary fans no longer required.

Added October 2008:

Unlike mechanical fans which can only turn one way with the engine (clockwise when viewed from the front of the car), electric fans will usually change direction according to how the motor is connected, these are motors that have a permanent magnet stator. If you should have a motor with a wound stator reversing the polarity to the motor as a whole will have no effect. Starter motors are like this, and early heater fan motors were the same, but all motors you are likely to find for cooling fan applications will almost certainly have the potential (ho ho) to run backwards. So the first thing to do with a new fan motor, or if you have cooling problems, is to check which way the air is blowing when the fan is running. The fan should rotate anti-clockwise (i.e. opposite to the mechanical fans) when viewed from the front of the car to push air through the radiator. Note that turning the blades over on the motor spindle will **not** affect air direction, only changing the motor polarity will. However as with mechanical fans the blades are 'handed' which means they move air more effectively one way round than the other, and this is where turning the blades over may be required. An old fan from my V8 has an arrow on one side of the boss of the blades showing the direction is should spin. This is on the side facing the motor so you have to squint down the gap between motor and fan boss to see it. If you can't see an arrow, or other marking indicating direction (one person has reported that his fan has 'B' on one side for 'Blow' and 'S' on the other for 'Suck' but that may just be BS ...) you will have to look at the tips of the blades. These should resemble a wing profile, and have be relatively blunt on one edge and tapered on the other. Just like an aircraft wing the blunt edge is the leading edge, and the tapered the trailing. See the accompanying photos (click thumbnail) for examples of the direction arrow and profile.

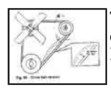
Update October 2010

Haydn Davies has written to me saying he understands the theory, but several sources show the fans being the other way round relative to the motor. Looking at the drawings in the Parts Catalogue the orientation of the motor and fan **is** incorrect according to my V8, on which the slot for the grub-screw is on the side of the blades facing away from the motor. If you look carefully, the blades at top, bottom and right in the drawing have the concave side facing the motor which is incorrect for a pusher an, the thicker edge will also be trailing for a motor that spins anti-clockwise when looking from the back of the motor through the blades at the radiator which is also incorrect, and the blade on the left has the concave side facing the other way to the others which is obviously incorrect! With the exception of this blade everyuthing else would be correct if the fan were facing the other way. My Leyland and Haynes workshop manuals don't show the fan itself, but various online parts catalogues with exploded drawings show the same motor and fan to the Parts Catalogue (identical at Moss, mirror image at MGOC), even to the extent of showing the three blades with the concave side facing the motor and the odd one away! These are obviously cribs from the Leyland Parts Catalogue, and have consequently repeated the error.

Fan Belt *Added December 2009*

Adjustment: At the moment I'm going to restrict this to the main water pump and alternator drive belt, and not get into the additional belts used on North American spec cars with air-pumps let alone air-conditioning.

For years I've checked my belt tension by seeing how far the middle of the longest run can be deflected from its 'at rest' position to or from the other side of the loop with light-ish finger pressure, and set it to about 1/4"-1/2". I've never had belt squealing in 40 years, and only had to replace a water pump once each on two cars quite soon after coming to me after many miles with other owners. Some manufacturers are a little more precise and state a deflection with a particular force, and others require two marks to be made on the belt a certain distance with no tension, and the alternator adjusted to cause those marks to move apart to another certain distance, i.e. the belt is stretched in use. The Leyland Workshop Manual in the Cooling section states for both dynamo and alternator systems it should be possible to move the belt laterally in the middle of its longest run by no less than one inch! Is that in one direction which seems a helluva lot? Or a total in both directions i.e. 1/2" each way which seems more reasonable? The Electrical section just says to "remove any undue slackness". Haynes in its cooling section says there should be a **sideways** deflection in the middle of the longest run of 1/2" on 'early' models, and 1/4" under an applied load of 7.5 to 8.2 lbf. Both 'lateral' and 'sideways' imply to me to be pushing or pulling it towards the front or rear of the car, and not towards or away from the other side of the loop which is always the way I have done it. Also is it in one direction or both? It seems likely that when using a spring-balace to apply the stated force for later models it would be in one direction only. The distance for that is half that for 'early' models, so do the early ones have twice the play? Or is theirs in terms of total deflection in both directions? And for that matter what is the definition of 'early' and 'late'? (Dynamo vs Alternator?). FWIW my 1967 Mini Workshop Manual also quotes an inch in the longest run, but an 80s Metro Manual quotes a much smaller deflection of 3/16" and in the **shortest** run i.e. between alternator and water pump pulleys. It also shows it being pressed down towards the crank pulley i.e. not sideways, and only in one direction from rest. Interestingly it also quotes a torque wrench value of 11 to 11.5 lbf when applied to the alternator pulley nut to produce slip, which is perhaps the most useful and relevant approach.



The Lucas Fault Diagnosis Manual has this drawing, which is repeated with the same deflection distance for dynamos and alternators, and shows 1/2" to 3/4" (13-19mm) in **one** direction, and towards the opposite side of the loop. The V8 Workshop Manual Supplement specifies "1/2" (13mm) total deflection on longest run".

Size Considerations *Added September 2010:* I've been asked a question about fanbelts widths for different alternator types, in particular how those for the higher output Lucas 20ACR and 25ACR compare to the 18ACR, so did a little research.

It will depend on the pulley. As the same alts definitely have different **diameter** pulleys for different applications in theory you should be able to swap them round i.e. between different 18ACRs from different cars. That implies a common size of spindle, but whether this extends to different models of alternator I don't know. Differemt **makes** of alternator do seem do have different spindle diameters, one site claims 15mm for Lucas and 18mm for Bosch. My roadster has an alternator with an alloy end plate and not plastic like the originals, I don't actually know what model it is, but the standard belt fits fine. I have a Lucas A115-45 from a wrecked 80s Metro which I have trial fitted to the roadster. The pulley is a different **diameter** (which gives a lower output at idle but is fine when driving) but the same belt fits just fine, so I keep it as an emergency spare. With a V-belt and pulley as long as the belt isn't sitting on the bottom of the vee (and hence no pressure on the sides) but is being wedged into the vee of the pulley, it shouldn't really matter unless the belt is **so** wide that the top of the belt is above the top of the vee and hence only part of the vee of the belt is engaging with the vee of the pulley.

The clue may be in the belt number. I know many indicate the length, and Goodyear for example say the first two digits of their belt numbers indicates the width as well as the last four indicating the length.

This site gives **codes** for widths, and the examples in the image could well contain width as well as length info printed on them like the Goodyear.

This Triumph (I know, "wash my mouth out") site says 15ACR and 18ACR were used with no A/C, or 20ACR and 25ACR with, you would have to compare pulley and belt numbers. But one thing occurs to me concerning A/C and higher-rated alternators, and that is that the more current any alternator delivers, the harder it is to turn, which puts more load on the fan-belt. It could be that higher current alternators **do** have a bigger (wider? deeper?) belt because of this. It would only be an issue if you were going to **use** the extra current, but then a bigger belt would impact on the water pump and crank pulleys as well!

So what size belt is required for **standard** alternators on 4-cylinder engines? The Parts Catalogue quotes:

Engine	Width	Length
GFB103 for 18G and 18GA (3-bearing) engines, and 18GB 4-bearing engines	10mm	900mm
GFB176 for 18GD to GK engines, 18V engines (except as below) and those for Germany and Switzerland from 1975 on	10mm	900mm
GFB205 for 18V 797/798 and 18V 846/847	10mm	950mm
GFB255 for all engines and all markets from 77 on	10mm	950mm

Modern equivalents are the GCB10900 and GCB10950 which are direct replacements for those in the above table, the first two digits signifying the width (10mm) and the last three the length (900mm and 950mm respectively). You may well get slightly longer ones to fit, or maybe even slightly shorter ones, it depends what pulleys have been used, which may not be original. A tip on changing is to get the belt over the crank and alt pulleys first as they wrap furthest round these, and the water pump last - having got it over the mechanical fan blades first of course! If the belt is still slightly too short then try removing the adjuster bolt altogether which may get the alternator that bit closer to the block.

For the V8 the original was specified as GFB 148, recoded as GCB 11125 i.e. 10mm wide (although shouldn't that be GCB 101125?) and 1125mm long. However some have reported problems with that belt too long on both conversions and factory cars, and mine is right at the end of the adjuster but could still do with a little more tension. A shorter belt would be preferable, GVB 11088 has been mentioned i.e. 1088mm, but then the problem is then getting the alternator down far enough to get the belt on as it hits the rocker cover way before the inner end of the adjuster is reached. Maybe something between the two would be better, i.e. 1100mm, although with that someone has reported the adjuster bracket fouling the alternator fan! To repeat the tip above, try fitting a short belt over the crank and alternator pulleys first, and the water pump last.

In any event any belt you buy as a spare should be trial fitted when you get it, it should be kept in the car and not the garage(!), along with the tools to change it, and you always **should** be carrying a spare, even if only by the Law of Sod to guarantee you will never need it!

Hoses *was 'V8 Bottom Hose Guard', amended April 2009*

Both Bee and Vee came to me with old hoses of course. Bee's top hose showed slight signs of surface cracking, so I replaced it as a precaution, only for the new one to look the same after a couple of years. Replaced that with a Kevlar, and that does seem to be lasting better, although contrary to what I originally thought it isn't a Kevlar 'sleeve' embedded in the rubber like the earlier fabric reinforced hoses have, but apparently just chips of Kevlar embedded in the rubber. They may resist some abrasion in the short-term, but it is the quality of the rubber that will determine longevity. By contrast Bee's bottom hose remains unchanged and still pliable and crack-free, after 20 years and 50k miles just in **my** ownership - "They don't make them like they used to".

Travelling at speed on the motorway in Vee one day I became aware of a slight missfire when accelerating. It was raining so could have been road spray affecting the HT leads, but it had never happened before. The thought immediately occurred to me that it **could** be a coolant leak spraying onto the HT leads. If so I'd be in illustrious company - I had recently read about an MG record attempt where exactly that happened, although in that case it was very high cylinder pressures lifting the head and causing coolant to spurt out past the gasket! All the gauges were normal, and as I had just passed a service area I carried on keeping a close eye on things. At the next service area I pulled off and as I slowed to parking speeds could hear Vee hissing like a steam engine! Stopped and opened the bonnet to see steam issuing from what looked like a pin-hole in the bottom hose right by the fan-belt, together with what looked like a series of cuts in the same area. Wasn't carrying a spare hose (then, I do now!), so it was a job for the AA. They came in due course, no replacement hose of course, so it was a repair jobby with a special kit (I now carry one of those as well!). **Very** little coolant came out when the hose was removed, yet the temp and oil gauges had stayed on normal all the time. The repair got me up to Liverpool and back via Clive Wheatley for a replacement hose, but was beginning to weep the next day, when I replaced the hose.

With the hose removed and the pressure released I could see where the fan-belt flapping had worn right through

the hose in the one spot as well as reducing the thickness over a wider area. This hose is very soft and pliable even when cold so it's quite possible the pressure in the cooling system caused it to balloon out and press against the fan belt, whereas they usually harden and crack with age. Conversely there are those that claim that the action of the pump sucks the bottom hose flat, but they are usually Americans and I have no idea what happens on American cars. On the Rover V8 another cause of this damage is caused by the fan belt 'flapping' and hitting the hose on rapid deceleration from a high rpm.

Added August 2009:

Allan Reeling has reminded me of something I remember hearing about a long time ago, and that is some pumps have the pipe for the bottom hose pointing directly across the car, whereas it should be angled back very slightly, viewed against the line of the fan-belt, as in this picture. Pumps that have the port parallel to the fan-belt will put the hose very close to the belt further down.

Because of both factors I decided to fabricate a guard to fit between the hose and fan-belt. There were convenient mounting points on the bottom alternator mounting bolt and a stud and nut on the engine front cover, and by careful shaping I could get it to fit the curve of the hose so as to take up minimum space. Whilst the fan belt may now be flapping against the guard on deceleration, it has a smooth surface and so should cause minimal wear to the belt, but in any case it is easy to monitor the condition of the belt, and if the worst happens and it breaks it is much easier to replace at the roadside (I carry a spare one of those too!) than a hose.

Having had that hose fail I've always carried spares since in both cars. It was the fan belt that had cut through the bottom hose on Vee, apart from that it and the top hose were as pliable and crack-free as Bee's bottom hose. But after doing the top-end rebuild of the V8 in 2002 and having to disconnect all the hoses I decided to replace them all rather than refit unknown quantities. At the time my supplier Clive Wheatley warned me that the quality was poor and they were likely to only last a couple of years, but they were the best he could get at the time, and to keep an eye on them. I kept the old top hose as a spare as that was also still very pliable and crack-free. When checking the bearings last month I noticed that Vee's bottom hose was quite badly cracked, but typically only the bottom half, it looked fine from above! On the face of it seven years is quite a long time, but it has only done about 15-20k which is an average 2 years-worth so Clive was right! So I fitted my replacement, which has a Kevlar label on it, so hopefully better than the previous one. At the Stoneleigh spares show this February Clive said he had at last been able to source some quality hoses again, and they do feel much better - shiny black rather than dull grey like the poor quality ones. He also has silicone ones available, even blacker and shinier, but at several times the price!

Fitting the new bottom hose this time I noticed exactly the same thing as with the previous replacement. Even when the hose is pushed onto the radiator outlet as far as it will go, part of it is pressed up against the flange on the front oil hose coming off the pump, which is not a good thing as the two will be moving relative to one another and the flange will cut into the hose. It had only made a small dent in the old hose, but admittedly with only 15k miles. By contrast there is at least half an inch clearance between the bottom curve of the hose and the anti-roll bar, even though I have an uprated bar. So both times I have cut (despite the Kevlar in this case) 1/4" off the bottom end of the hose, which puts it closer to the anti-roll bar (but still 1/4" clear) and now only just touches the oil pipe. I'd move it in a bit more but the bottom bend is so near the end I'm concerned it wouldn't fit and seal properly to the straight outlet on the radiator. You also have to be careful not to move it so far forward that it comes too close to the fan-belt, unless you have a guard as I have.

Mechanical Fans *Added August 2007*

For details of which fans were used when see below.

Fans are usually 'handed' i.e. they have one side that should face the engine and a different side facing the radiator. Reversing it does not change the direction of air flow (only changing the direction of rotation can do that), but it does have an effect on efficiency i.e. how much air it moves at a given speed. Both metal and plastic types seem to have sculpted blades where one side is concave (i.e. slightly cup-shaped) and the other convex. The concave side should face the engine as it is more effective at pushing air towards the engine i.e. pulling it through the radiator. Metal types also seem to have one gently rounded corner and one tightly rounded on each blade. The gently rounded corner should be on the leading edge, probably for safety reasons if one gets one's fingers in the way. The individual blades of metal fans are attached to the stubs of the central boss on the engine side, with rounded rivets, both of which reduce turbulence and improve efficiency. Plastic fans often have the blades with an aircraft wing profile, with the blunter edge leading and the more finely tapered trailing.

That's the theory. However, after someone asking which way round the fan should go, and more than one of us saying basically the above, the next time I looked at my roadster it seemed to be the wrong way round. So I took it off and turned it round, and had only just started attaching it when I noticed that the blades were going to be **very** close to the crank pulley and alternator spindle, and significantly further away from the radiator than they were before. So I took it off again, laid it on a flat surface first one way up then the other, and measured how far away from the flat surface the centre of the boss was in each case (see pics). It was about 6mm one way round, and about 2.6mm the other! Mounted the 'wrong' way round the blades have a clearance of about 7/8" from the crank pulley and alternator spindle, and about 1 3/4" from the radiator. The right way gives virtually no clearance to the alternator and crank pulley and 2 3/4" to the radiator.

Now because the fan isn't shrouded, the further away it is from the radiator the more air will be drawn past the rear face of the radiator instead of through it, reducing cooling efficiency at slow road speeds or at a standstill. OTOH it wouldn't do to go too close to the radiator with a mechanical fan, as being mounted on the engine if the engine moves on its mounts i.e. under heavy braking of an impact it will chew through the radiator. But it then became apparent that the 3-bladed fan, common to both 18G and 18V engines at various times, needs a spacer (12H 3910) when fitted to the 18V, which is what mine is missing. Steve Loft was kind enough to respond to my questions and send me a comparative picture of his 74 engine, which clearly shows the boss mine is missing.

From the photographic evidence, the offset of the fan boss, and the relative distance of the fan blades from the alternator pulley on mine and Steve's engines, I reckon the spacer is about 1". These don't seem to be available from the bigger suppliers (and in any case need longer bolts) so I may make one in due course, but as the roadster has never given me a moments concern about overheating, even in very warm weather and with a rally plaque just in front of the radiator grille, I'm not in any rush. *Update September 2007:* I've located and obtained a 2nd-hand spacer from Andy Jennings, but unfortunately he couldn't supply the bolts (HZS 415) which need to be about 1 3/4" minimum length to go through the 7/8" spacer and the 1/2" (or so) distance piece inside the fan grommets. I'm wary about ordering them online or by phone as none of the online parts lists seem to differentiate between the two lengths of bolt, so I'll probably visit Leacy's sometime as I want some other heavy parts as well and it's cheaper to collect than pay postage.

Spacer cleaned up, fan repainted, and fitted the right way round. Despite the marks on the spacer on the concave side which appear to have been made by the distance tubes going through the fan grommets, the logical way is the concave side facing the pulley and pump (as per the Parts Catalogue drawing) as it clears the pump nose, and the smaller diameter is closer to the pulley diameter than the larger. With an extra inch on the front of the pump I was wondering if the reduced space to the radiator would cause problems with the bolts and lock-strips. But I removed the two bottom bolts securing the radiator to the shroud and backed the top two right off, which allowed me to wedge the radiator itself an inch or so forward of the shroud. Despite the mini 'fan guard' at the top of the shroud still being in its original position I had plenty of room to access the bolts and lock-strips. Tip: Offer the spacer, fan, washers, lock-strips and bolts up to the pulley as a pre-assembled unit as you almost certainly won't be able to insert the bolts with the fan in position. Also decide which of the two 'ears' you are going to use on each end of each lock-strip (depending on where the blades are one is usually easier to get at than the other) and give that a little bend away from the washer underneath it to leave space to get a drift in and flatten it the rest of the way onto the nut flat. It won't interfere with getting a spanner on the nut, and without doing it you will probably need a sharp blade like a chisel to start it moving.

Update October 2007

David Bolton writes with an interesting idea from Newcastle-upon-Tyne for hot-country touring. He was planning to take a recently restored 72 roadster to Portugal and was a little concerned about engine cooling, even though it kept its cool in the UK 2006 temps of 35C. One source advised fitting an additional electric fan, which is quite a common change, whilst another suggested fitting the 6-blade cooling fan that was used on exports to hot countries. The less-intrusive 6-blade fan was more appealing and so one was sourced and fitted, as shown here. In the event in temps in the high 30s, road works, and the Picos de Europa the car still kept its cool. Now back in the UK David was wondering whether perhaps it was overcooling, as the temp gauge now doesn't get more than half-way from C to N. However the top hose is too hot to touch, so maybe it is a low gauge reading. As to keeping the 6-blade, on the face of it as long as the thermostat is able to maintain the correct engine temperature, the only down-side at the moment being be the greater noise and bhp losses. But if that means the thermostat is permanently restricting coolant flow through the engine, localised hot-spots could develop, which may cause other problems over time. And if the car is used in winter the much greater air-flow over the block and hoses etc. from the 6-blade fan could increase surface cooling beyond the point at which the thermostat can compensate, which wouldn't be good for the engine. So personally I felt that it would be better to revert to the 3-blade for UK use and keep the 6-blade for continental use, as by tilting the radiator forward instead of complete removal it should be possible to change it quite quickly and easily. There remains the question of what the coolant temperature actually is at that gauge reading, and whether the engine is **currently** overcooled (which shouldn't be possible if the thermostat is doing its job, except perhaps in very cold conditions with a high surface-cooling effect) or whether the gauge is reading low.

Update January 2010

The seven-bladed plastic is also handed. There is a flat side to the boss and a deeply dished side. It might seem logical that the dished side goes over the pulley, but it doesn't it faces forwards and the flat side goes up against the pulley. The blades also have one slightly curved edge and one straight edge, the curved edge is the leading edge and the fan rotates in a clock-wise direction when looking in from the front. With the fan the wrong way round the blades clearly foul several parts of the engine. In the accompanying photos the fan is fitted to a short-nosed pump without a spacer, I haven't checked the clearance to the radiator but the table in Pumps below does indicate one is required. This fan has its own metal insert for the bolt holes, so only the bolts and lock-tabs are required, not the spacer tubes or grommets.

Pumps (and fans) *added October 2009*

Water pumps are one of those things one changes when they go wrong, and generally what goes wrong is the seals wear and they leak, or the bearings wear which causes noise, wobble and also leaks. I have also heard of the impeller coming off the shaft, which will cause overheating of course. Bee's pump started leaking shortly after I bought her. At that time I wasn't aware of the variations between engines, but the proprieter of the MG parts supplier had a look and got the one that I needed, with a new gasket - or so I thought! When I came to fit it I found it was alloy instead of steel (probably a copy as I know now), one of the bolt holes was about half a hole out even though the gasket was correct (but being alloy was easy enough to file into an oval), and another had a thick boss which meant the bolt wouldn't engage with the threads. Fortunately also easily correctable. To add to all that shortly after fitting I noticed it had started weeping slightly during warm up! So I bought another, steel this time, but as it happens in all the miles and years since then the leak hasn't got any worse and water loss is negligible and I still have the steel one in the boot.

I've heard it said that there are at least two pumps with different impellers, both fit at least one of the engines, but the incorrect combination results in a low coolant flow rate and overheating. If that's true it can only be the pumps for the 3-bearing and 5-bearing engines that are incompatible, as all the other pump changes occured during productions runs of the various five-bearing pumps and so must be interchangeable - with a caveat.

The caveat is that the pumps changed from having a long nose to a short nose in August 71 for the 18V engines. Whilst the pumps themselves are interchangeable it has a knock-on effect on the pulleys and fan blades that can be used. Long-nosed pumps use a

deeply dished pulley, so of course a short-nosed pump will move the V-groove much closer to the engine and way out of line with the crank and dynamo/alternator pulleys. The fan bolts up to the pulley so that is also moved closer to the engine and in fact hits it. Short-nosed pumps used a shallower pulley to keep the correct V-groove alignment. The fan blades would still hit the engine of course, so a 7/8" spacer was fitted between the pulley and the fan. You can get away without the spacer if you have a 3-blade metal fan by turning the fan round the wrong way, because the blades are offset to the centre this actually puts the blades at almost exactly the right position between engine and radiator. They are turning the wrong way of course, but the difference in effectiveness is marginal, I ran Bee like this for many years before discovering it, and obtaining and fitting the spacer. In theory you can also use a deep pulley with the short-nosed pump, by putting the spacer between pump and pulley instead of pulley and fan, but I've not tried it. You need longer bolts when using the spacer in any configuration, of course.

Culled from various sources this is what I have managed to work out for the many combinations of engine, market, period, pump, fan, and the various bits and bobs to put them all together:

Engine	Market	Dates	Pump	Gasket	Bolts	Long/Short?	Pump Notes	Pulley	Spacer?	Fan	Bolts	Notes
18G, GA	All	May 62 - Oct 64	GWP 115	12H814	2xHBZ514, 2xHZS510	Long		12B174	N	12H1058	HZS408	3-blade metal
18GB	All	Oct 64 - Aug 67	12H 2267	88G430	2xHBZ514, 2xHZS510	Long	Replaced by and compatible with GWP 114	12B174	N	12H1058	HZS408	3-blade metal
18GB	All	Aug 67 - Nov 67	GWP 114	88G430	2xHBZ514, 2xHZS510	Long	Clausager indicates a further change in Jun 66 but this doesn't appear in the Parts Catalogue	12B174	N	12H1058	HZS408	3-blade metal
18GD, GG	not NA	Nov 67 - Aug 71	GWP 114	88G430	2xHBZ514, 2xHZS510	Long		12B174	N	12H1058	HZS408	3-blade metal
18GD Rc (Auto)	Not NA	Nov 67 - Oct - 68	GWP 114	88G430	2xHBZ514, 2xHZS510	Long		12B174	N	BHH1604	HZS408	6-blade metal
18GF, GH, GJ	NA	Nov 67 - Aug 70	GWP 114 with 2 spacers	88G430	2xHBZ514, 2xHZS510	Long		12H2452	N	BHH1604	HZS408	6-blade metal
18GG Rc (Auto)	not NA	Oct 68 - Aug 71	GWP114	88G430	2xHBZ514, 2xHZS510	Long		12B174	N	BHH1604	HZS408	6-blade metal
18GK	NA	Aug 70 - Aug 71	GWP 114 with 2 spacers	88G430	2xHBZ514, 2xHZS510	Long		12H2452	N	12H4230	HZS407	7-blade plastic
18V 581/582/583	not NA	Aug 71 - Nov 73	GWP 117	88G430	2xHZS511, 2xHBZ515	Short		12H3696	Y	12H1058	HZS415	3-blade metal
18V 584/585 18V 672 101-27269 18V 673 101-3644	NA	Aug 71 - Jan 74	GWP 117 with 2 spacers	62H350	2xHZS511, 2xHBZ515	Short	GWP 117 and GWP 123 must also be interchangeable	12H3700	Y	12H4230	HZS407	7-blade plastic
18V 779/780	not NA	Nov 73 - Feb 74	GWP 123	62H350	3xHZS508, 1xHBZ514	Short		12H3696	Y	12H1058	HZS415	3-blade metal
18V 779/780	not NA	Mar 74 - Sep 74	GWP 123	62H350	3xHZS508, 1xHBZ514	Short		12H3696	Y	12H4744	HZS415	7-blade plastic, metal inserts
18V 672 27270 on 18V 673 3645 on	NA	Jan 74 - Feb 74	GWP 123 with 1 long and 1 short spacer	62H350	3xHZS508, 1xHBZ514	Short	GWP 117 and GWP 123 must also be interchangeable	12H3700	Y	12H4230	HZS407	7-blade plastic
			GWP									

18V 672 27270 on 18V 673 3645 on	NA	Mar 74 - Sep 74	123 with 1 long and 1 short spacer	62H350	3xHZS508, 1xHBZ514	Short	GWP 117 and GWP 123 must also be interchangeable	12H3700	Y	12H4744	HZS416	7-blade plastic, metal inserts
18V 846, 847	Not NA	Sep 74 - Aug 76	GWP 130	62H350	3xHZS508, 1xHBZ514	Short		CHM56	Y	12H4744	HZS416	7-blade plastic, metal inserts
18V 797/798 18V 801/802	NA	Dec 74 - Jun 76	GWP 130	62H350	3xHZS508, 1xHBZ514	Short		BHH1864	Y	12H4744	HZS416	7-blade plastic, metal inserts
18V 797/798 18V 801/802	Germany, Switzerland	1975 to Aug 76	GWP 130	62H350	3xHZS508, 1xHBZ514	Short		BHH1864	Y	12H1058	HZS415	3-blade metal
18V 847	Not NA	Sep 76 - Oct 80	GWP 130	62H350	1xBH605151, 3xSH605081	Short		CHM56	N	Electric cooling fan		
18V 883/884 18V 890/891 18V 892/893	NA Japan	Jun 76 - Oct 80	GWP 130	62H350	1xBH605151, 1xSH605081, 2xBH605101	Short		1xCHM56, 1xCAM1392	N	Twin electric cooling fans		

Radiator Cap *New September 2008*

It is probably universally known that the radiator cap on the MGB allows the pressure in the cooling system to rise as the engine temperature rises, and this increase in pressure raises the boiling point of the coolant, so allowing the engine to run hotter without coolant loss which makes for greater efficiency, as well is delaying the point at which coolant loss might occur under extreme conditions. If the system pressure rises above that of the cap, the main seal in the cap will lift to release that pressure, which can lead to coolant loss and possibly boiling. But if this didn't happen and the pressure continued to rise, eventually something would give, possibly a hose bursting which is bad enough, but even worse if it should be the radiator which bursts. The main seal sits below the overflow pipe, which is unpressurised, and it is only when the main seal lifts and allows coolant past that coolant will run out of the overflow pipe.

What might be less well known as that as well as the main pressure seal there are two other seals or valves in the MGB cap:

The first is a spring-steel disc (the upper seal) that seals the top of the radiator filler orifice, i.e. above the overflow pipe. The main function of this is to allow coolant recovery from an overflow catch-bottle, if provided. Another function is a safety feature in that with sudden boiling and overflow very hot coolant is directed down the overflow pipe and not out from under the cap which could scald anyone working nearby at the time.

The second is the low-pressure valve below and in the middle of the main rubber pressure seal. This is on the pressurised side of the main seal and has a light spring keeping it closed, although coolant pressure will close it even tighter. This comes into play when the system is cooling down. If the system heats up, pressure rises, but the pressure doesn't reach the cap pressure and there are no leaks or other sources of pressure loss in the system, then when it cools down again the pressure will gradually drop to atmospheric again and no lower. But if the cap has vented any pressure or coolant, or there are other leaks in the system, then when the system cools down it will develop a **negative** pressure, or partial vacuum. If left then the next time the system heats up it will be at a lower pressure than before for a given engine temperature, which could result in boiling. Under these partial vacuum conditions the low-pressure valve will open and allow air back into the system, so that the next time the engine runs the pressure will be as before.

Under extreme conditions as mentioned earlier there can be coolant vented out of the overflow pipe, which is normally lost on the ground. Of course one could put a catch-bottle under the overflow pipe to catch it, then pour the expelled coolant back into the radiator when the system has cooled down again. But the two additional seals or valves in the radiator cap working together can cause this to happen automatically. If the catch-bottle is positioned such that the bottom of the overflow pipe reaches the bottom of the bottle, then as the system cools and draws air in through the low-pressure valve, the upper seal will ensure that this suction is applied to the overflow pipe, and hence will suck up any coolant the bottom of the overflow pipe is in contact with, and direct it back into the radiator automatically - a lost-coolant recovery system! This is an unpressurised catch-bottle, which must be open to atmospheric pressure, completely different to the remote pressurised reservoir (see below) used on MGCs, V8s, and 77 and later MGBs.

The above seems to be the case on all UK caps I have come across. But if **either** the upper seal is missing or faulty, or the low-pressure valve isn't present, this coolant recovery won't work. People in the USA often mention caps available there can't always do this, indicating they are to a different design rather than being faulty. One source indicates these caps have the upper seal to prevent scalding, but not the low-pressure valve. Without this valve, not only can lost-coolant recovery not be employed, but the cooling system can experience negative pressure on cooling down, which could cause boiling at the next run. Another source indicates that the low pressure valve is present to prevent the partial vacuum in the cooling system, but the upper seal is missing so coolant recovery cannot take place. Note that only under extreme conditions should lost-coolant recovery be required, if it is

happening at lower temperatures and lower loads as my V8 was doing, there is a fault which needs to be investigated and fixed.

If you overfill any MGB cooling system when cold it will expel the excess when it warms up. The correct level is about 1" above the tops of the tubes when cold in the Mk2 radiator to 76. The V8, 77 and later MGB and MGC remote reservoirs should be kept about half full when cold. The Mk1 radiator with the right-angle filler is the most awkward as you cannot see the tops of the tubes. You must keep coolant just visible from the filler neck or it could have dropped way down, but if you keep it too high in the filler neck it will keep expelling the excess. Probably best to check this when still warm (but not hot!) and if you can see coolant it should be fine, even if it drops out of sight when fully cold.

Remote reservoirs were necessary to allow the installation of a lower-profile radiator mounted further forward, without it the V8 and later MGBs would have needed a bonnet bulge, and the MGC would have needed a much bigger one. These remote reservoirs are pressurised, but the cap, overflow and potential for lost-coolant recovery are exactly the same as for the earlier MGBs. The pipe between the radiator and the remote reservoir is at the top of the radiator but the bottom of the reservoir, which ensures that any air in the radiator is pushed through into the reservoir as the system heats up, to be replaced by coolant as it cools down again. So even though the reservoir and radiator cap are below the top of the engine and radiator, the system is self-purging, getting rid of any air e.g. after a coolant drain and refill, over no more than a couple of heat-cool cycles.

Mk1 MGBs used a 7lb cap and radiator with rear-mounted right-angle filler.
Mk2 cars up to and including the 75 model year used a 10lb cap and radiator with top-mounted straight filler.
The 76 model year used a revised radiator (visually similar and exchangeable with the previous) and 13lb cap.
For the 77 model year and onwards, and all V8s, the forward mounted, lower-profile radiator with remote reservoir was used with a 15lb cap. 4-cylinder cars have a brass or plastic filler plug on top of the thermostat housing, V8s have it on the radiator itself, note a plug-spanner fits this.
The MGC was similar to this last MGB style but had two filler caps - one on the thermostat housing without a main pressure relief valve, and another on the remote reservoir rated at 10lb for the UK and 14lb for the USA. There was no filler plug on the radiator.

Radiator Diaphragm Seals

The roadster has always had the rubber strip across the top of the radiator diaphragm (mounting panel) which seals to the bonnet sound-deadening pads, but for many years never had the foam strips that seal the gap between the radiator and the diaphragm. As I mention above I've never had cooling problems with the roadster, but nevertheless after many years got round to buying and fitting one. It consists of two square-section lengths of foam glued side-by side slightly offset. You glue one face to the diaphragm across the top and down the sides a little way, and that is that.

Or so I thought. Shortly after fitting I had occasion to lift the bonnet again, to find the front strip that seals to the roadster had come away and was just lying there. Good job I spotted it, I wouldn't have been best pleased if I had lost it. There was virtually no adhesive between the two pieces, just one thin wavy line and that for only part of the length. Made a better job of gluing it than the manufacturer and since then it has been fine.

Also since then we have had some pretty warm weather, and I'm sure the readings on the gauge have been lower since fitting it. Unsealed there is a pretty large gap between the top of the radiator and the diaphragm allowing ram-air to bypass the radiator, whereas when sealed more will be forced through the radiator to cool the engine, enough to make a visible difference it seems.

Temp Gauge *Added September 2007*

Questions often come up about various aspects of the temperature gauge, occasionally where it would be useful to know what actual temperature is indicated by the later 'C-N-H' gauges. Clausager doesn't have any clear enough pictures, but I happened to take a photo of the speedo of the car that appears on the front of Lyndsay Porter's 'Guide to Purchase and DIY Restoration of the MGB' when I came across it recently (it lives quite near me) to show the odometer reading of (then, it has done over 400,000 now) 399,419 miles. The picture included the temperature gauge, and it was always a fiddle trying to locate the original picture in my files, so I have cropped it down to the temp gauge only and included it here hopefully easier to find. This is a UK Fahrenheit gauges, Centigrade versions were used in some other markets.

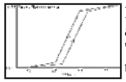
See here for details of the electric temperature gauges.

Thermostats and Coolant Temperature *Added January 2008*

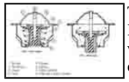
Thermostats:

The vast majority of us will need a thermostat to achieve a normal running temperature in as quick a time as possible, only cars in very hot climates may not need one, and see below regarding this. An engine runs more efficiently at it's correct temperature, choke - or more correctly in the case of the SU and Zenith carbs - 'mixture enrichment' will be needed for the shortest time saving fuel, reducing pollution, and giving full performance sooner.

The thermostat is a temperature-controlled valve between the head and the radiator. At less than its rated temperature it is closed, at more than its rated temperature it is open, and at around its rated temperature it can be open by varying amounts. In other words it is not like an electrical switch i.e. either fully on/open or fully off/closed, but variable like a water tap, taking typically 8 to 10 degrees to get from starting to open to fully open. Neither does the thermostat 'latch open' once it has reached its fully open temperature, and stay open until the engine has fully cooled down again.



If conditions are right i.e. descending a hill in cool ambient conditions it can start to close again even though the engine is still running. Clausager in 'Original MGB' talks about a 'latch-open' thermostat being fitted from 1967. What this means I don't know, certainly the thermostats available these days only have a 2 or 3 degree difference between just reaching fully open when warming up, and starting to close again when cooling down.



The type of thermostat fitted to MGBs has a metal cylinder containing wax, inside which is a rubber sleeve. Inside the rubber sleeve is a metal pin. When the wax is heated it expands, which presses on the rubber sleeve, which presses on the pin and forces it out of the rubber sleeve. In fact the pin is fixed and it is the metal cylinder that is forced down pulling the disc valve open with it (incidentally against pump pressure). As the coolant temperature is reduced the wax pellet contracts, and a large spring forces the metal cylinder back up and the disc valve closed. This construction and methodology would seem to be more likely to allow the thermostat to fail to open than to fail to close, but for some reason the reverse is true. The thermostat can actually be installed either way round in the head, but it must be installed such that the wax pellet is suspended in the head coolant. If it is installed upside down it won't open as the wax pellet will be on the cooler side of the valve.

The thermostat would normally be closed when filling the system with coolant, and this would lead to an air-lock, so the thermostat usually has a bleed hole of some kind. Sometimes there is just a hole in the flange, but this will allow some coolant to circulate via the radiator even when the thermostat is closed, which will extend the warm-up time a little. Others thermostats have a 'jiggle-pin' in this hole, which when in air hangs down to open the hole, but when in coolant a 'float' on the bottom of the pin lifts it up to block the hole. This gives a quick filling time with zero circulation during warm-up. Yet others are a 'cost reduced' version without a hole in the flange and hence no jiggle-pin, but do have a very small notch in the edge of the valve. This still allow air the bleed through and so prevent an air-lock, albeit fairly slowly, but allows for minimal circulation via the radiator during warm-up.

The head has a bypass port below the valve which allows coolant to return from head to block without going via the radiator. This is important to get an even heating of head and block during warm-up to avoid hot-spots which can cause unequal expansion, warping and head gasket failure. Incidentally the heater circuit performs the same function when the heater valve is open. The V8 has an additional bypass route, see the steam pipe below.

MGA stats had a cylindrical sleeve which moved as the stat opened to block this bypass port, and causes the vast majority of circulation to be via the radiator and virtually none via the bypass port. These are sometimes referred to as 'bellows' stats, however this refers to the technology used to open and close the stat, and not the presence or otherwise of this cylindrical sleeve. This type of stat is no longer available. Later wax-pellet stats as used in the MGB don't have this sleeve, meaning that some of the coolant still recirculates once the stat has opened. MGA engines are said to suffer from inadequate cooling in high ambient temperature conditions if a later wax-pellet stat is installed, but it doesn't appear to be a problem with MGBs.

Competition engines don't usually have a thermostat fitted, but then they are used under very different conditions to road cars. They are generally carefully warmed up before being driven, so any stat will be open anyway, and it is unlikely to close again during use. As stats can fail closed occasionally (which can cause severe overheating and engine damage) not having one in a competition engine is one less thing to go wrong. Usually these engines will have a cylindrical blanking sleeve fitted in place of the thermostat, which greatly restricts the bypass port as the sleeve only has two very small holes in the side. This gets maximum coolant flow through engine and radiator and minimum recirculation, hence maximum cooling. But on some engines even this can be a problem. If you scan around the web you will find recommendations that too much circulation can cause as much of a problem as too little, due to turbulence and local recirculation in the head and block, again leading to localised overheating. In these case it is recommended that a restrictor is fitted instead, to reduce the aperture to the same size as an open thermostat. The easiest way to achieve this is to remove the wax pellet, spring and moving disc from a standard stat. In some cases you might want to fit a blanking sleeve **and** a restrictor to get both minimum recirculation and turbulence.

The advice on what to do if not fitting a stat is very confused and confusing. Moss says "The thermostat can be removed to aid cooling but it is essential that a blanking sleeve is fitted in its place or the change in water flow may cause local overheating in the cylinder block" i.e. they are talking about the need for restriction. With a fully open stat and no blanking sleeve the bypass port is uncovered and so some coolant will be recirculating, and even an open stat results in a restriction to the main flow, both of which reduce the maximum cooling that can be achieved. But with a blanking sleeve and no stat the bypass-port is restricted so the whole of the coolant flow is via the radiator, the main coolant flow isn't restricted, both of which result in maximum cooling (assuming no turbulence and localised hot-spots due to the greater flow). Without either warm-up will be slightly quicker as there is some recirculation via the bypass which will reduce the likelyhood of localised hot-spots during warm-up, but maximum cooling will be slightly reduced for the same reason. Therefore having neither puts you somewhere between having a just stat on one hand, and just a blanking sleeve on the other, but closer to having just a blanking sleeve. Moss's statement doesn't make sense, and with a blanking sleeve you would have to be careful warming the engine up to make sure it did so evenly. This Mini site also says to fit a blanking sleeve in place of the thermostat, then describes and shows a restrictor. And this one says to fit a blanking sleeve, says it is necessary to prevent overheating in certain parts of the engine i.e. they are talking about the need for a restrictor, they show a blanking sleeve, but say to cap-off the bypass ports as well which has already been achieved by the blanking sleeve!

Bob Muenchausen has a comprehensive page on cooling and thermostats and reports that Neil Cotty in Australia fitted a standard wax-pellet stat **and** a blanking sleeve to a road car (although it's not clear which car this was done to) to get reduced circulation through the bypass port and slightly better cooling. Hopefully the reduced temperature difference between his ambient and normal running temperature eliminates the risk of hot-spots during warm-up. Neil professed himself happy with the result, but wondered if this arrangement in cooler countries would prevent the engine ever reaching its normal temperature. I can't see why that would be if a stat is fitted as seems to be the case. Bob in Idaho and its colder winters tried the same thing in his 68 MGB and reports

that it does take slightly longer, but as I say I can't see how, unless the blanking sleeve reduces recirculation so much it prevents the hottest coolant reaching the gauge sensor, i.e. there **is** uneven heating. But surely the fitting of a blanking sleeve in cooler countries is unnecessary anyway, and with the bigger temperature difference between ambient and normal you run the risk of damage from localised hot-spots for no gain.

Coolant Temperature too high:

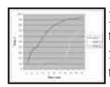
MGBs had hot weather testing during development, and many have been running in desert states in America and the Middle East for many years with no problems. If you are having cooling problems it is more likely that there is something wrong with your system - either the engine producing more heat than it should or the radiator failing to get rid of it, rather than any fundamental design problem requiring modifications or expenditure on after-market stuff. It may even be the temperature gauge over-reading, although this is more likely with electric gauges than capillary. Also don't forget that it is **normal** for the temperature gauge to show a higher reading when slogging up a hill in high temperatures than cruising on the flat in winter.

Updated May 2008: Early in 2008 there was a heated discussion about thermostats where one person insisted that the stat controlled the **maximum** temperature, whereas everyone else myself included said it controlled the minimum. On consideration I changed my view, but to one that says the thermostat maintains a **given** temperature, rather than a maximum **or** a minimum. But like **any** thermostat it can only do this between certain upper and lower limits. If the ambient temperature is below a certain point surface cooling of the block, sump, oil cooler and use of the heater will prevent the coolant getting hot enough to open the stat at all but the engine will still be running below temperature. This is when people in cold areas talk about 'blanking off the radiator'. And if the ambient temperature is above a certain point the radiator won't be able to dissipate as much heat as normal, the stat will be fully open, but the engine will still be hotter than normal. The fact is that more of us experience the latter i.e. higher temp gauge readings in summer than low readings in winter, which is why most people say it controls the minimum temperature. Even giving this interpretation the 'maximum' man refused to acknowledge it and stuck to his guns, so there it was left.

So under a wide range of ambient conditions the running temperature is set by the stat. Below the minimum is relatively easily dealt with by blanking off the radiator, but above the maximum will inevitably result in a higher temp gauge reading than normal. Even in a typical UK summer with temperatures in the high 70s and low 80s the temperature gauge will read higher than normal under some driving conditions. This isn't the end of the world, it just means that the coolant temperature will have to be higher than normal before the radiator can get rid of the usual amount of heat. Mid-way between N and H is no problem at all, and is actually about where the electric cooling fans cut in at 90C, whereas a standard stat is 82C. 'H' on the gauge represents about 110C/230F, which is above boiling point but you should be able to get right up to the H zone without any loss of coolant or steaming because of the pressurised system. Using a typical 33% anti-freeze solution a 12lb cap raise the boiling point to 123C/253F which is well above H on the gauge. I've seen my V8 inside the red zone without problems, other than for my nerves, although by that time you should be thinking about whether you are pushing it too hard for the conditions, or there might indeed be a problem. In either case turning on the heater full-blast can buy you a bit more time - at the expense of comfort!

As mentioned before there are two main reasons why coolant temperature can rise more than it should - either the engine is pushing out more heat than it should or the radiator isn't getting rid of it. In the former case this can be head gasket blown, timing too advanced or retarded, drag on the engine from tight bearings e.g. just after a rebuild all of which can result in a significant increase in heat output, binding brakes (usually accompanied by a smell of them burning), underinflated tyres (slight effect) etc. In the latter case the radiator can be partially blocked either eternally by debris or internally by sludge, restricted airflow through the grille from additional lights, rally plaque, number plate etc. Flow can also be reduced by a thermostat not fully opening, water pump vanes corroded away, and I understand there may be an incorrect combination of engine and pump that results in reduced coolant flow. There is also another possible cause of engine overheating where the coolant temperature coming out of it isn't necessarily raised, and possibly not even an indication on the gauge, and that is when there is sludge in the block and heads restricting coolant flow across parts of the metal surfaces resulting in localised overheating and possibly gasket or head warping problems. Internal sludge when still soft can often be shifted by repeatedly forward and reverse flushing of the engine and radiator until the water runs clear, but hardened deposits may not respond to this and still remain even though the water is clear. There are some DIY radiator flush additives around but they are probably of marginal benefit, both from the safety of DIY use point of view and attacking rubber and alloy parts. Still worth a try before the next step, though. Hard deposits are bad enough in the radiator, but at least this can have the header or footer tank removed, the tubes rodded-out and the tank resoldered, or at worst the radiator replaced. But in an engine often complete dismantling and 'hot-tanking' will be required Hot-tanking is dunking in hot chemical solution to hopefully dissolve any deposits before it dissolves the engine! These chemicals can be pretty caustic and not only dangerous to handle but often destructive to alloy parts.

Coolant Temperature too low:



If the thermostat is stuck open, or not even fitted, the engine won't reach normal temperature in anything other than hot weather. This is bad for the engine, the environment and your wallet as well as causing low heat output from the heater. You can check the stat by warming the car up from cold and periodically feeling the radiator. As the temp gauge rises the header tank should stay relatively cool. As the temp gauge gets near N the header tank should suddenly get very hot (!) as the stat opens, and this indicates a normally functioning stat. If the header tank gradually warms up as the temp gauge rises with no sudden increase there is no stat or it is stuck open. You can see this on the temp gauge as a **very** slow rise, probably not getting anywhere near 'N' until you are stopped in traffic. Don't forget a low temperature gauge reading may also be due to problems with the gauge (capillary and electric) or sender (electric).

In extremely cold conditions and even with a correctly functioning stat the temperature may never reach normal, due to the 'surface cooling' effect of freezing air passing over the sump, block, hoses, and use of the heater. As a point of interest it is this surface cooling that led to there being 'summer' and 'winter' thermostats. In winter a higher rated stat was fitted as more of the cooling would come from surface cooling of the block and sump. In summer a lower rated stat was fitted as the surface cooling effect would be lower. The effect of this surface cooling can be reduced by partially blocking the air-flow through the radiator and oil cooler. Contrary to popular belief this doesn't stop the coolant in the radiator from being cooled too much, as the thermostat closes anyway when the coolant temperature drops below the rated temperature, it simply reduces the amount of surface cooling.

Blanking-off will however make the coolant too hot if you blank off too much or the weather doesn't warrant it.

Michael Beswick has pointed out that the typical 13" x 6" (excluding the bump on the top) rally plaque frequently issued on organised runs in the UK tied on with string makes an excellent oil cooler blind for cold weather running, for those cars with the oil cooler above the apron at any rate.

NEW **Coolant Temperature Gradients:** *Added Septemper 2010*

I took the following set of comparative temperatures on the roadster, warming up at a fast idle on a day when the ambient temperature was a cool 9.5C (all temperatures in degrees C):

Time (mins)	Head	Thermo	Header	Middle	Footer
1	9.5	9.5	9.5	9.5	9.5
2	34	12	9.5	9.5	9.5
4	41	16	9.5	9.5	9.5
5	60	25	11	12	11
7	72	33	12	13	12
8	80	43	13	15	13
10	85	51	14	15	14
11	90	55	14	16	15
13	92	80	55	19	15
14	92	83	65	30	21
16	95	89	75	39	29

'Inlet' and 'Outlet' are on the header and footer tanks directly opposite the inlet and outlet ports. Note particularly the differential between these two. A large differential here, if your running temps are higher than they should be, can indicate slow flow through the rad. This will allow a lot of heat to be taken out of the coolant that **is** in the radiator, but not enough heat transfer from the engine to the radiator. This can be seen in the table where the thermostat has just started to open - the head temp only goes up from 90 to 92, the rad inlet jumps from 14 to 55, but the outlet takes longer to start rising at all, and then more gradually anyway. With low circulation the outlet will stay at a relatively low temperature. Low circulation can come from any restriction in the cooling circuit e.g. sludge or thermostat not fully opening, but can also be caused by a problem with the water pump i.e. heavily corroded vanes or even the incorrect pump. A low differential can indicate good flow, but either the engine is generating too much heat (e.g. timing or fuel issues) or the radiator isn't getting rid of it. This latter can be checked by scanning the surface of the rad with an infra-red thermometer looking for spots that are cooler than the surroundings, particularly where cool spots are **above** hotter areas, but it can also be caused by problems with the fan either of the wrong type, the wrong way round (still flows air through the rad but not as efficiently, or the wrong spacing to the radiator, see the sections on electric and mechanical fans.

V8 Temp Gauge Oscillation

Three different situations:
- Slight oscillation during warm-up
- Wild oscillations at any time
- V8 conversions

Slight oscillation during warm-up. My V8 had always done this before gradually settling on the 'N'. As the roadster does it too I took no notice. But after doing a top-end overhaul on the V8 I noticed that it no longer does it, but just rises slowly and gradually to 'N' then stops there. During the overhaul I did find the thermostat bypass pipe that is inside the inlet manifold (not the heater return pipe bolted to the bottom) choked with scale which I cleared maybe this was the cause. But then again, why did it **always** do it, even in the winter when the heater valve was open? Or maybe the thermostat has chosen the same time to start sticking open, we shall see (Update summer 2005: Apart from settling at a slightly lower point by N in winter compared to summer the temp gauge indicates the thermostat is working just fine, and the oscillations haven't returned).

Wild oscillations at any time. On a couple of occasions I have had wild oscillations, sometimes the temp needle getting up to 60psi on the oil gauge, during normal running as well as warming up. This was due to a blocked steam pipe that runs from the left-hand side of the inlet manifold immediately below where the carb adapter bolts to the thermostat housing on the radiator-side of the thermostat. The passages in the pipes on the thermostat cover and the inlet manifold are very small, they may need clearing out with a twist-drill as well as the hose replaced.

V8 conversions. Some conversions don't seem to have the above steam pipe, and on one of these I have seen similar oscillations when the heater temp control is turned to 'off'. Turning the control to on stops it. The heater control being switched on acts similar to the steam pipe, allowing coolant to circulate albeit not through the radiator. Several other people have commented on the same thing and talked about putting a small bore bypass pipe between the heater supply and return pipes **before** the heater control valve.