Some thoughts on cooling a blown PB

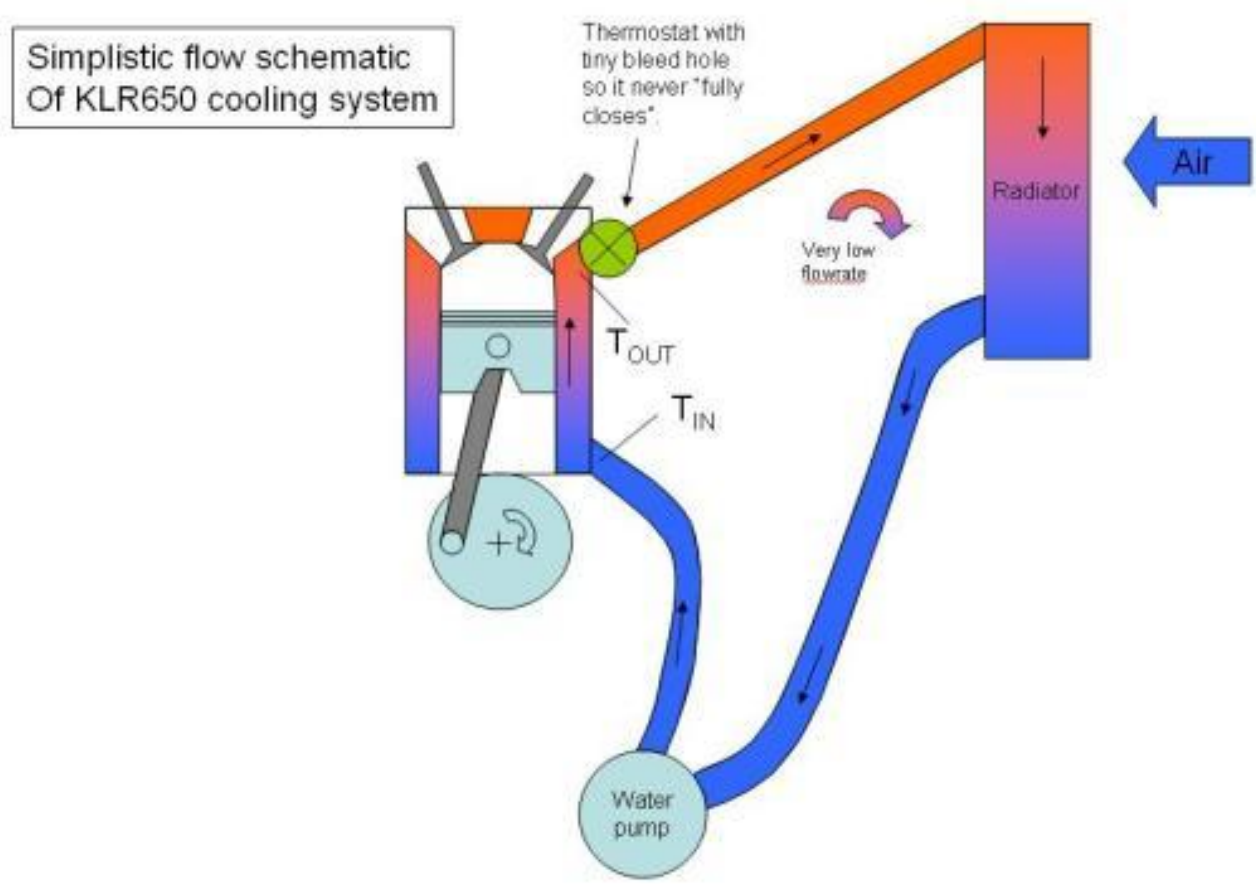
The cooling system design of the PB (and most of the MMM models?) suffer from poor circulation in the head, particularly around the exhaust valves.

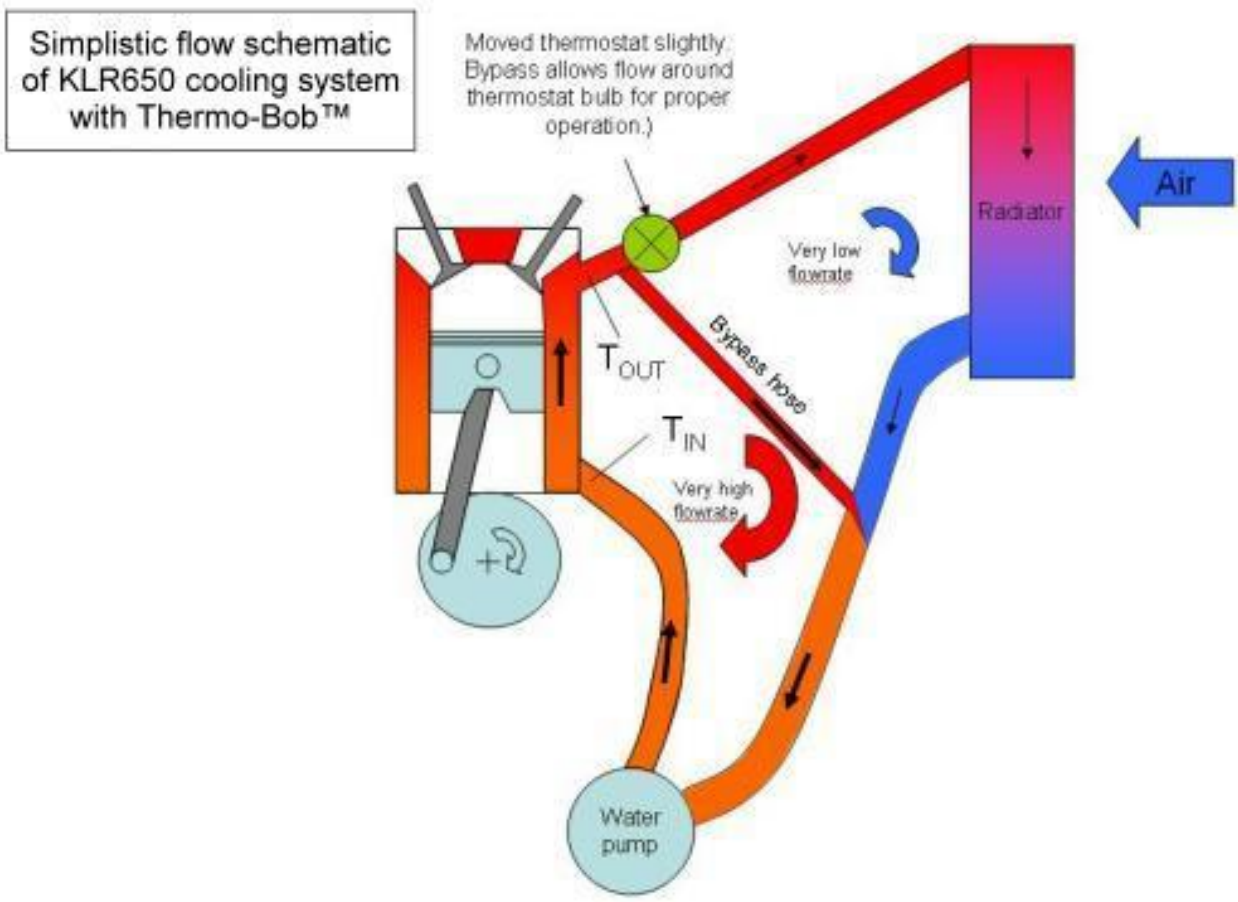
If the block, head and radiator are free of corrosion products the water temperature on a hot day will be around 90C. In cold weather this can drop to about 70C, which is far from ideal. Given the above conditions the addition of a water pump will improve cooling and leads to the fitting of an in-line thermostat in the top hose with one or two 3 to 4mm holes to allow bypass during warm up and to maintain a constant cooling temperature in the top hose.

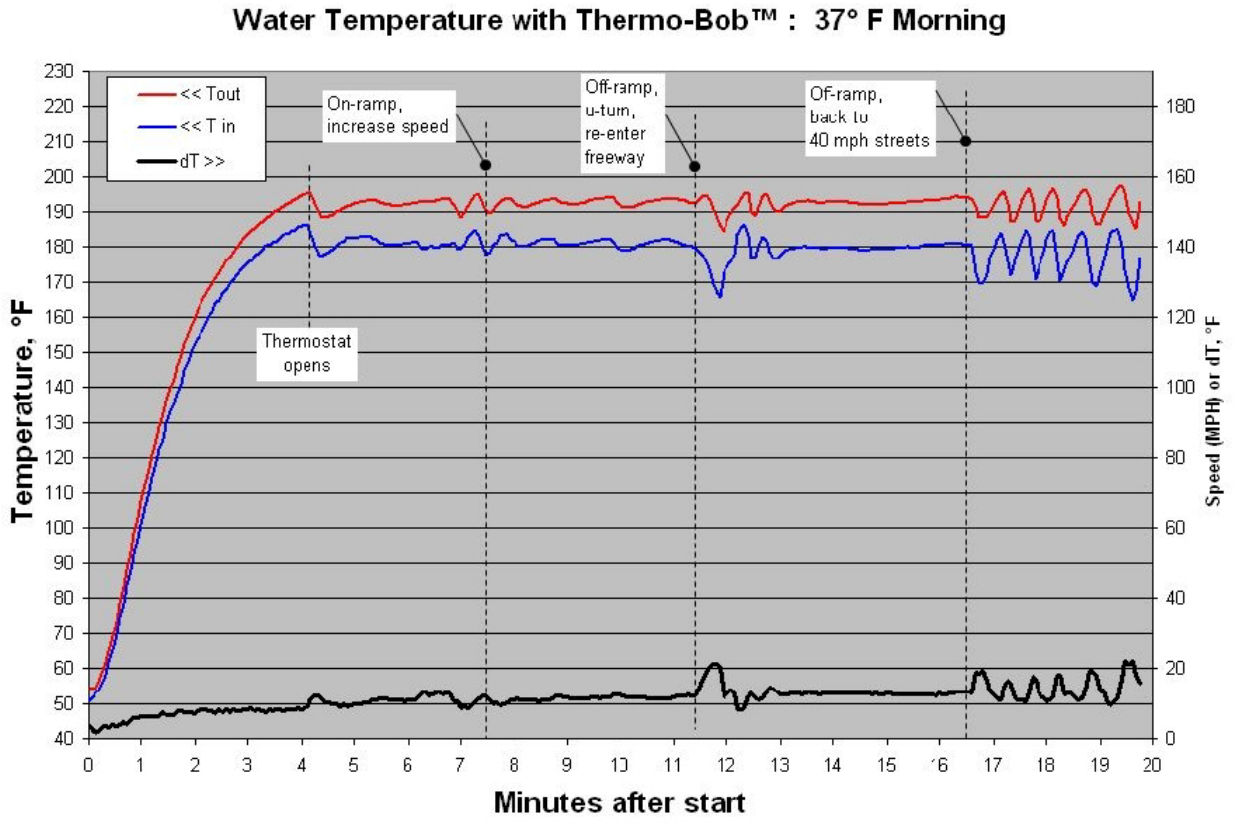
This has been reported by many owners as working to their satisfaction.

I have some reservations on this approach. Research of Google shows many discussions on the need to reduce thermal gradients in the engine to reduce the thermal strains that can lead to cracking and head gasket problems. Indeed this was the case with the K series engine in the Freelander and early MGF's.

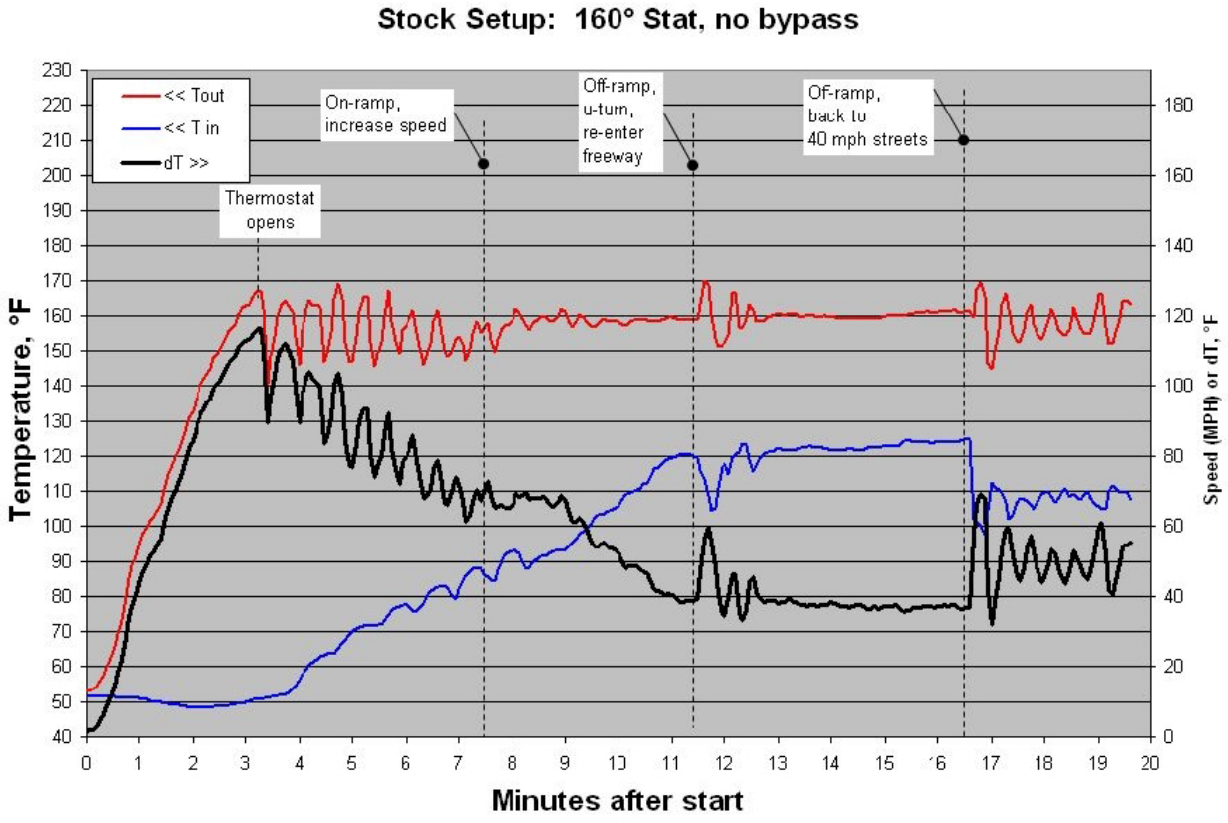
The website http://www.watt-man.com/uploads/TB_Testing.pdf contains interesting information on the effects of fitting a KLR 650 bike with a bypass cooling system and the subsequent reduction in temperature gradients. I reproduce below the salient technical details from instrumented trials.




Simplistic flow schematic of KLR650 cooling system with Thermo-Bob™
Moved thermostat slightly. Bypass allows flow around thermostat bulb for proper operation.)
Radiator
Air
Very low flowrate
Bypass hose
T OUT
T IN
Very high flowrate
Water pump


Water Temperature with Thermo-Bob™ : 37° F Morning
<< Tout
<< T in
dT >>
On-ramp, increase speed
Off-ramp, u-turn, re-enter freeway
Of-ramp, back to 40 mph streets
Thermostat opens
Temperature, °F
Speed (MPH) or dT, °F
Minutes after start

Compare now to this graph below, which is the STOCK KLR on the same drive (37°F morning). TOUT goes through much more pronounced swings at the beginning as it doesn't get a lot of flow across the thermostat's temperature bulb, and TIN is pretty cold for quite a while - after 8 minutes of riding, it was only up to 90°. The bottom of
the cylinder is cold, the top is hot. Get a load of where the black line is now - not a good design from a thermal stress standpoint.



The need to reduce thermal strains led to the development of the dual action thermostats where one part progressively reduces the bypass flow during warm up whilst the other part opens up the cooling to the top of the radiator as the control temperature is reached.

With a radiator of enough capacity for the maximum heat generation conditions it becomes possible to ensure that the bottom of the radiator is kept as hot as possible if the water flow through the engine is large enough. Provided this condition is met then removing enough heat results in the minimum temperature difference between inlet and outlet to the radiator. In practice this means that under almost all running conditions there is hot bypass flow directly back to the water pump inlet. Thus the temperature gradient is at a minimum across the engine with the resulting reduction in thermal strains.

There are a number of steps that can be taken to improve floe through the head. In order of increasing effectiveness they are:

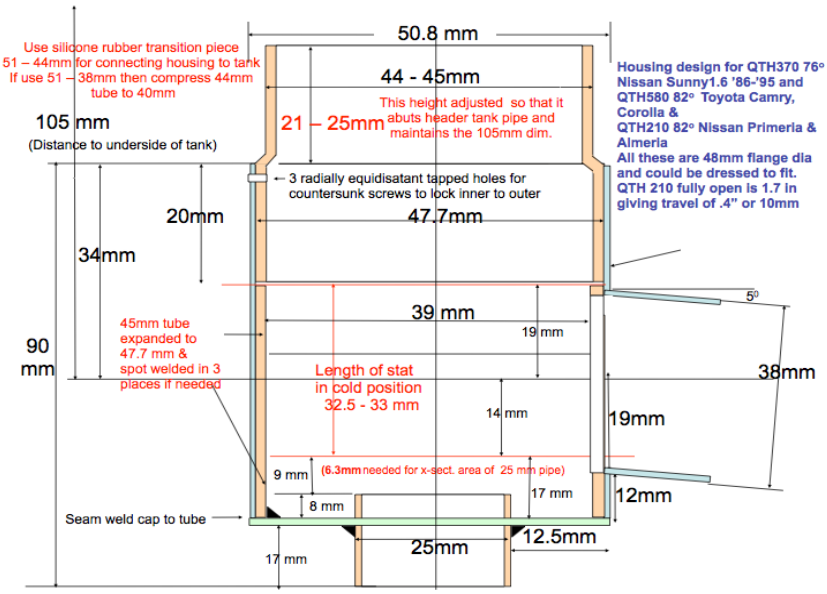
1. Water pump outlet connected to rearmost blanking plate on the block.
2. Split the flow so that most enters the cylinder head at the back through where a core plug is normally fitted.
3. Dry deck the head with no water flow through the gasket. Requires provision of new return system for water to the radiator.

In the limiting case water still gets hotter around the exhaust valve seat and this can manifest itself in localised micro-boiling whist the temperature at the radiator is still in the controlled field. Micro-boiling with further heat input leads to a local steam insulating blanket and rapidly becomes full scale boiling. Micro boiling can be suppressed by the use of non water based coolants often developed for diesel engines e.g. Evans NPG+. This has a higher boiling point and is normally good for 500,000 miles in diesel engines. It needs to be because it will cost you in excess of £100 to fill the radiator. It has been used in many vintage cars with Bentley people reporting reduced running temperatures.

I know people want to fit an "invisible" thermostat but considering that the K type had a bypass thermostat fitted I have no difficulty with using the principle.

A thermostat housing with bypass can be easily constructed and fitted direct to the inlet pipe of the radiator with a straight angled radial inlet pipe lining up with the standard engine water manifold and the bypass pipe running down directly to the water pump. (thermostats : QTH580 82C Toyota Camry, Corolla & QTH210 82C Nissan Primeria &Almeria are ideal and cheap).

The thermostat was constructed from stainless steel pipe sections and where necessary these were either hydraulically expanded or contracted to get the required sizes and shapes. I used my local bespoke exhaust pipe manufactures to supply offcuts of stainless steel pipe and to expand and where contraction went to a Pirteck hydraulics repair centre where we used their swaging machine to do the shrinking. A visit to a friendly fabrication shop got the necessary TIG welding done which cost £25.

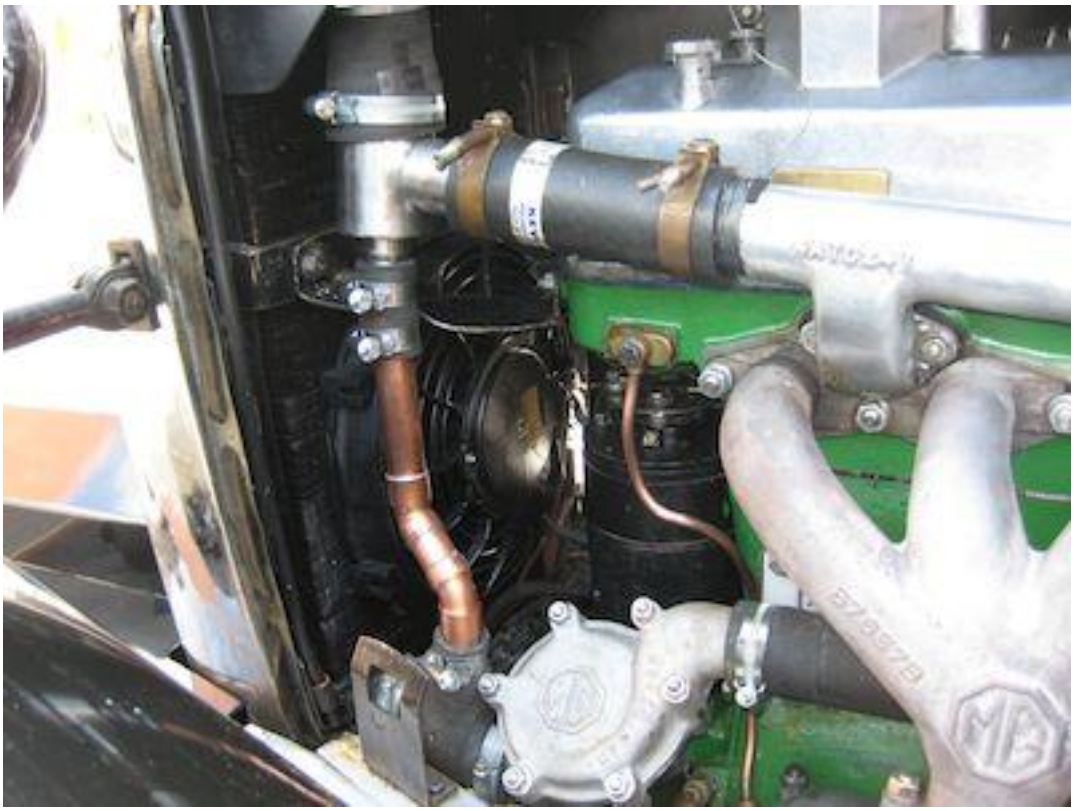


Drawing of thermostat housing: All that is needed is a different radiator to water pump hose with a moulded in pipe to receive the bypass flow.
I have now fitted this to my car and find it works very well. Heat up from cold is quick without the danger of stagnant water in the head until the thermostat to the radiator opens.
Photographs are attached.

View into inlet of housing showing unseated bypass valve

Top view without thermostat fitted

Mandrel for making silicon moulded pipe



Completed installation on PB showing thermostat housing