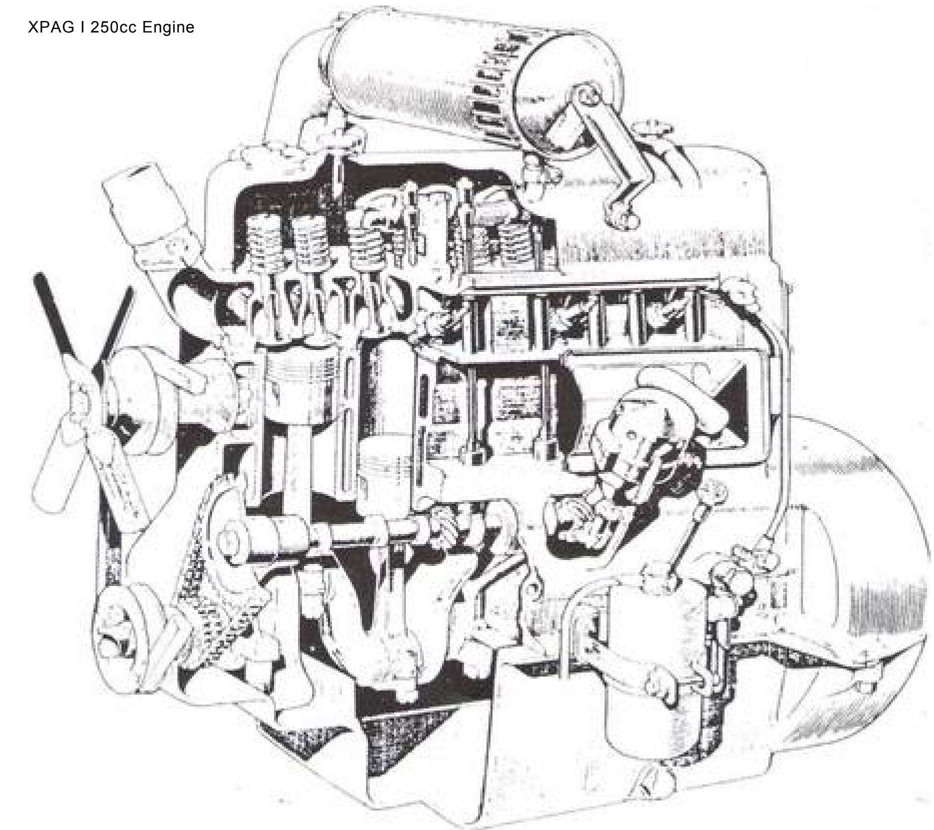
XPAG I 250cc Engine

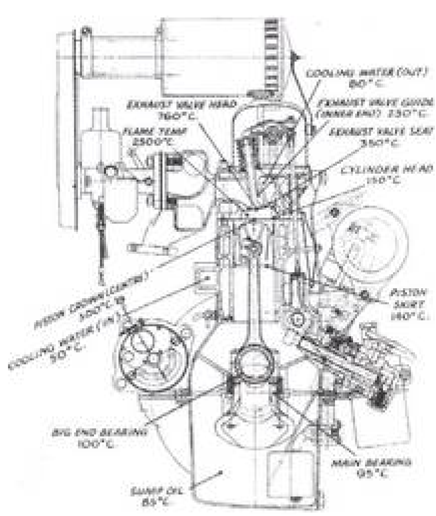


The Short-Stroke Morris Ten Engine's Cooling

By Neil Cairns

Back in the mid-1930s the Morris Engines Branch were busy re-designing a little 10HP overhead valve (ohv) engine. Like the majority of companies they did not use a clean sheet of paper but updated and modified an existing unit. This unit was the rather poor conversion of the original side-valve (sv) engine into an ohv then in use in the 1935 Morris Ten/4. Morris engines were also used in other vehicles of the same company, mainly Wolseley and MG. The engine being updated by one Claud Bailey, a Morris Engines employee in the drawing office, was the MPJM of 1292cc. Keen MG enthusiasts will recognise that engine size, as it was the same unit fitted to the TA Midget of 1936, then called the MPJG. Claud did a good job of improving the engine, so well in fact the series was given its own new code, they were the 'X' Series. The 1140cc XPJM (X for the Series; P for pushrod; J for the 63.5mm bore; M for Morris) had a shorter stroke than the MPJM, so it was dubbed 'The Short-Stroke Morris Ten Engine' by the factory. As it had much better breathing than the older unit, it was soon eyed up by the MG people, who got Claud to strengthen it in a few places and give it a bigger bore; and this engine was to be called the XPAG (X Series engine; P for pushrod; A for its 66.5mm bore; G for MG). Now, it is very important to remember the origin of this 1250cc MG engine (that was also used in 30,000 1950s Wolseleys) is as a mass produced, 10HP family saloon with the technology of the 1930s. About 190,000 'X Series' engines were built in various sizes for lots of different uses and MG used only about 45,000 of them. The XPAG is not a special engine only made for MG by MG; it is a Morris engine adapted for MGs use.

So with that firmly established we will look at how it is cooled. The first diagram, No.1, is of the Morris Ten Series 'M' engine and it shows at what temperatures each part has to cope with. Whilst you study this remember that water boils at 100 degrees C. There are five ways the engine gets rid of excess heat, I) by radiating it from the surface of the engine castings, 2) some soaks into the gearbox via the bell-housing, 3) the oil system and sump, 4) the cooling water and, finally, 5) the exhaust. The average internal combustion engine is only about 23 efficient, so that simply means that only 23 of the heat produced to expand the petrol/air mixture gets turned onto power to move the car and overcome all the internal friction of the mechanics. So a massive 77 of the heat has to be got rid of before it all seizes up. About 50 goes out of the exhaust pipe, 5 by radiation and soaking, which leaves 22 divided between the oil and water. They get about half each and it is surprising just how many people

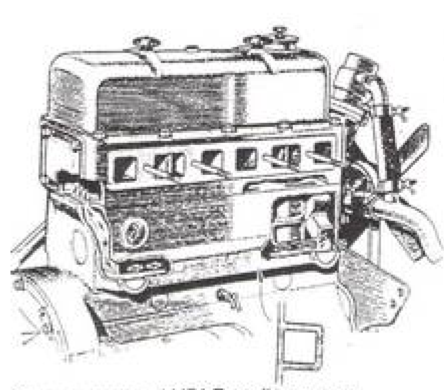


XPAG cooling diagram

have no idea just how important the cooling effect of the oil is to the engine. Anyone who has tuned one will know that an oil cooler is mandatory for any real increase in power. The most critical part to cool is the exhaust valve and its seat, the seat originally being made of only cast iron. In the diagram the exhaust valve is running at 760 degrees C and the seat in the head at 350 degree C. So the cooling system is designed to control these parts at a temperature that will not cause any damage. The piston crown runs at 300 degree C but it gets a massive flow of oil thrown up underneath it to cool it, hence the oil doing much of the necessary cooling and why MG put cooling ribs in the cast aluminium sump. Morris did not need to do this as their 1 140cc version produced less power, so less heat. Some cooling is done to the inlet side of things by the incoming charge so there is a huge temperature difference between the inlet and exhaust valves and their respective seats. Note also

XPAG water pump

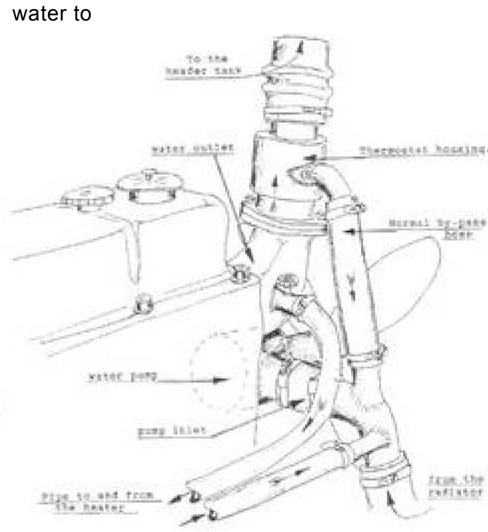
how the heat soak and friction inside the big end bearings reaches a temperature of 100 degree C, again the oil carries some of this heat away.
The oil will be at its peak performance at around 80 to 90 degree C and the water is best kept at about 80 degree C. To do this the water is sent through a heat-exchanger, called a radiator, Now, if you accelerate your engine to near its maximum rpm, say from 2,000rpm to 4,000rpm, you have just more than doubled the work the cooling system has to do, Why more than doubled? Because internal friction of the engine itself needs power as well as the fact that to double the speed of the car requires about four times the power (caused by drag-air friction), Now, as the original XPJM Morris 10HP engine was designed with 1930s ideas of technology, it does not have a 21st century system, The Morris used a thermo-syphon cooling system, pump assisted, Thermo-syphon is simply that hot water rises at it becomes less dense (less heavy) and the cooler water sinks, This is why old, between the wars, cars had such tall radiators towering well above their little sv engines, The hot water rose up through the engine, up to the radiator header tank, then once cooled it would fall down to the lower tank and be drawn back into the bottom of the block This would only just cope with the lower power of these engines that often boiled if worked hard, The XPAG of the MG has the Morris pump-assisted, thermo-syphon system, Starting at the water pump as shown in the flow diagram No,2 you will see that it is situated after the radiator so it pumps cool water, This is good for a longer life of the water pump and its seals, The pump is only a 'centrifugal type', it is not a 'positive-displacement' one like the oil system uses, The water pump's impeller is quite a crude, rough casting and not very efficient. The water pump, driven by the fan belt, assists the water to flow along the cast in tunnel that runs underneath the manifolds. It then enters the rear of the cylinder block to then be diverted up into the cylinder head. The main cooling flow through the X Series engine is through the head, from the back to the front. This was a very marked departure from the then current water feed into the bottom of the block, for the water to then rise up through the head to the radiator, very necessary in a thermo-syphon (no water pump, so cheaper to produce) system, So the XPAG has this more modern flow and the reason is important. It is the rear cylinder that always runs hottest so by feeding in the cooled water from the radiator there first helps to keep the temperatures even across the head, Secondly, the water in the block around the cylinder bores is static so to speak, it rises by thermo-syphon so again the block is kept very near to the head's temperature, This evening out of temperature throughout the engine keeps stress low in the castings and evens out expansion, reducing wear in places like cylinder bores (back then the 'thermo-syphon' Ford Eight and Ten required re-boring at 30,000 miles), I said this some years ago in another MG magazine and had lots of emails telling me I was wrong, So please study diagram No.2 issued by the company themselves of the original Morris Ten Series 'M' water flow, Where people became confused was because they found holes drilled through into the water core around the cylinders, I doubt few of



Cleverly arranged XPAG cooling system

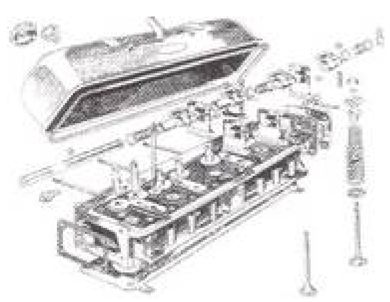
them had ever worked in a sand casting foundry, Your XPAG engine's cylinder block is a sand casting of molten grey cast iron, It is a complex casting that required a wooden 'pattern' for the outer shape and special sand 'cores' for the waterways and cylinder bores, All assembled in a 'box' the pattern and cores created a 'negative' of the block, a hollow void where the metal now is, Once cast the box was left to cool and then broken open, Sand from the outside of the block and through the bores is easy to remove, but not that sand core that is the internal waterway. To support this 'core' you will see 'core-plugs' now fitted in the holes; these have nothing whatsoever to do with letting freezing ice get out, they once held the water core in place and through them the sand was removed, Not all the sand would come out easily so the foundry men drilled holes through into the water jacket via the core plug holes and behind the water pump, simply to chisel out the hardened sand, It is these drilled holes people have assumed are part of the cooling system, But just remember the remark above about this engine being a mass-produced family saloon unit? A few extra holes drilled here and there inside the cooling system did not matter, it was no Rolls Royce after all, As long as it kept cool in a Morris Ten, all was OK, To make the core holes water-tight, steel plugs were fitted to the machined-out holes.

The water flows from the rear of the head to the front, where it meets a temperature-controlling device called a thermostat. This has two functions in life; the first to get the engine hot as soon as possible and second to control the engine's temperature when running, Originally Morris used their own thermostat that looks today like a Sputnik from outer space, Study the upper diagram of No,3 and see that when cold the thermostat permits water to



XPAG cooling hoses

only flow round into the water pump inlet. It has a by-pass sleeve fitted to the moving part of the thermostat that once the water heats up expands, The idea is that the water leaving the block goes straight back into the block so it heats up quickly, and all the extra water in the radiator has to wait until all is at a running temperature, This hot water caused the bellows of the thermostat to expand and moves the sleeve over the by-pass hole; this also opens the valve at the top to let the water up into the radiator header tank, Water now flows through the system as intended, (Ignore the 'waxstat' diagram for now.) Now look at No.4 and you can see the by-pass hose running from the thermostat housing down to the pump inlet. The XPAG cooling system takes about 5 litres; today similar units only have half that so heat up quicker and

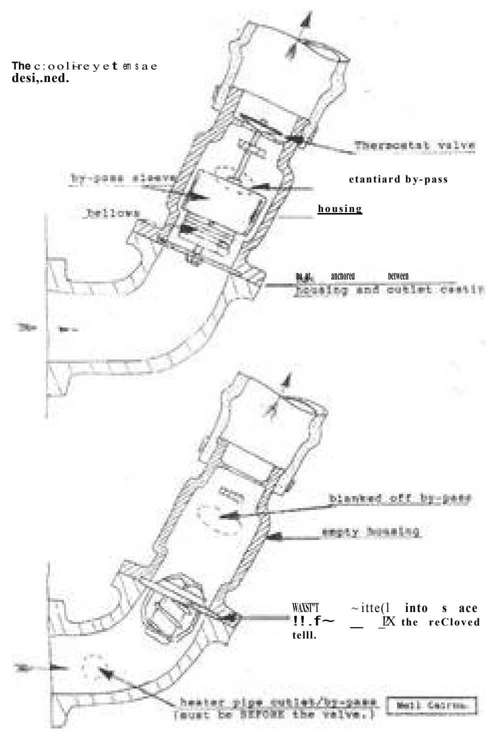


have forced circulation in high pressurised systems, Only the TF and 4/44 X Series were ever pressurised at about 4psi. Today this is over 22psi and permits a much higher boiling point; raising the pressure raises the boiling point of water.

Because the MG owner wanted more and more power, eventually Morris had to modify the XPAG units cylinder head in around 1952 (by now Morris cars no longer used the 1140cc engine, they had gone back to cheap sv units in the MO Series) by increasing the water flow around the exhaust valve seat. To do this they made the water ways bigger round the seat so making that bit of the head thicker, this led to the need for long-reach spark plugs, They also changed the shape of the holes between the head and block; the old type being oval and the later type round, Today there will be such a mixture of round hole heads fitted to oval hole blocks, and vice versa it is important the correct head gasket is used, If both round use gasket part No 168423, if either is oval holed use X2448I, see diagram No 5 Round hole blocks have a casting number 168421 and round hole heads casting number 168422 (later Wolseley 4/44 round hole heads are casting number 168425),

Now we come to the 21st century and overheating XPAG engines, The causes are numerous, First the little pipes in the radiator core may be furred up with lime, this can be shifted with something like Holts RadFlush, If it is blocked you may need to have the radiator re-cored, Secondly, the pipes in the radiator core may be copper, but the horizontal vanes are mild steel, These rust and swell up with age stopping the air from getting through, Check by using a torch under the bonnet whilst you peer through the core from outside, Sometimes the blockage is just years of dead flies and insects which need a good soak with a hose and blasting out forwards, from within the engine bay. Third is fitting too many badges to the radiator grill stopping the air flow, fourth is a heavy build up of rust inside the block that requires all the core plugs removing and a good flushing out. Fifth is the fitting of a modern thermostat (now look at the waxstat diagram in No 4) without blocking off the by-pass hole, If you fail to block it off, the water will take the easy route and ignore the radiator all together and shoot round the short way to the water pump, This way it never gets cooled, though the thermo-syphon may Just cope for a while until you have a hot day, or get stuck in a traffic jam, That is why some people who have not blanked off the by-pass have coped so far, But now that petrol burns hotter than the original post-war 80 octane, sooner or later it will boil, Fit an aluminium gasket that has a tiny hole in it to relieve air locks on the thermostat housing where the old by-pass hose fits with two screws, The sixth way to overheat is to tune the engine to a point where the heat it needs to get rid of is outside the ability of the old 1930s technology, i.e. fit an oil cooler with a thermostat, a more efficient water pump and a radiator with and extra core layer in it (i.e. a thicker radiator) and an automatic-thermostatically controlled electric fan, Get the exhaust away as fast as possible with a gas-flowed extractor system and modify the radiator to take a pressurised filler cap,

The original I 140cc Morris Ten series 'M' engine, the 1935 XPJM, produced just 37bhp, In the MG Y Type and Wolseley 4/44 the XPAG produced 46bhp; in the TD 54bhp; the TD Mk2 57bhp and the TF



XPAG Cooling diagram,

1500 63bhp, All have the basic early XPJM cooling system ORIGINALLY designed for just 37bhp, That is why your poor engine overheats if not in tip-top condition, and modified if you have tuned it. The TF was pressurised to assist it to cope along with the round-hole improved cylinder head, but it must have been working very near the limit of the design,

Finally, a warning about fitting temperature sensors, The 4/44 had a temperature sensor for its water temp gauge, fitted to the header tank, Once the water level dropped below the sensor it measured the air temperature only, You were not aware of any problem until the bonnet burst out with lots of steam, So do not fit a sensor up that high, The best place is at the exit from the head, in the thermostat housing, The temperature will rise if you accelerate and drive fast as the hot water is propelled past the sensor. It is shifting the extra heat up into the radiator, Normal driving should see a steady 75-85 degree C if a 80 degree thermostat is fitted (though the book says use a 72 degree one), If the temperature keeps rising when you drive fast, find out why and modify/clear out the cooling system to cope, Most often if the system is in good condition, a more efficient water pump will help, You will be surprised just how crude the standard cast iron impeller is,

If you want to know more about casting numbers and how to identify what you have, go to www.mgccyregister.com and go to the XPAG pages,