Antifreeze coolants and their use in MGBGTV8 engines

Concerns over the effects new types of antifreeze have on older engines have been raised and here Tony Lake provides a useful summary. A more detailed article is available on the V8 website at www.v8register.net/antifreeze.htm

Antifreeze has a prewar origin, it was first marketed commercially in 1937. It became very popular but also carried with it the risk of internal corrosion which prompted the development of inhibitors to protect the water side of an engine from attack. Anti-foaming additives and scale reducing chemicals followed which created a product which we use pretty well universally today.

Coolant is the description of the mixture of antifreeze and water present in the radiator, engine and cabin heater. It is designed to be used all year round. Coolant is circulated round an engine by a water pump to control temperatures in critical components that become very hot; like the cylinder bore, piston, rings and cylinder head, particularly around the exhaust valve and spark plug. It is important that the correct physical and chemical properties are maintained for coolant to fulfil its heat transfer and corrosion inhibiting functions at extremes of low and high ambient temperature.

How much heat? Combustion of a petrol and air mixture produces horsepower at the flywheel along with exhaust gas and heat that is absorbed by coolant; all in approximately equal amounts. So cruising at say 60mph let's assume it takes 50bhp at the flywheel to maintain that speed on a level road whilst 50bhp disappears down the exhaust pipe and the remaining 50bhp in the form of heat is absorbed by the coolant. That equates to 37kw or a dozen 3KW electric fires all on together, so it is pretty important to have a robust cooling system. It's equally important to have a clear airflow to the radiator as a badly positioned number plate, badge bar, auxiliary lights and even a large rally plaque can all contribute to restricted air flow,. Overheating follows and even with a sound pressure cap coolant is rapidly dumped.

Types of corrosion Atmospheric Corrosion or Oxidation can occur in the presence of moisture and air, typically a coolant leak onto an aluminium surface adjacent to a hose. Galvanic Corrosion: occurs where dissimilar metals, like aluminium and steel in contact with each other, are covered by an electrolyte and effectively become a battery. Crevice Corrosion: can occur where bolts, gaskets, hoses, clips and crevices which can be described as dead ends combine to create a local spot where coolant may be static so the beneficial properties are consumed. Cavitation Corrosion (sometimes called Erosion) occurs where the coolant operating pressure is below its vapour pressure causing bubbles to form, local boiling is actually occurring.

Antifreeze properties. The Traditional antifreeze (A/F) feature is provided by Mono Ethylene Glycol (MEG); when mixed with water at a concentration of 10% the freezing point is -4° C falling to -35° C at a 50% concentration. A 50/50 mixture is recommended for the Rover V8 engine. Typical MEG concentration in undiluted A/F is 95%. The remaining 5% consists of inhibitors that provide corrosion protection for aluminium alloys, cast iron, steel, brass, copper and lead solder. Traditional A/F formulations are also known as **Inorganic Additive Technology** or IAT. The same coolant provides enhanced summer time performance.

Effects of radiator pressure cap. At a 50% A/F concentration with a 15psi radiator pressure cap, the boiling point is 129° C at sea level, raw water boils at 121°C at sea level with a 15psi pressure cap.

Branded products will comply with BS (British Standard) 6580-1992 which states all the values for physical properties. BS6580-2010 has an identical technical specification and in addition requires a bittering agent where MEG exceeds 25%, and a child proof container closure. MEG is poisonous if ingested hence it is made to taste awful. Coolant has a finite life, just like lubricating oil or brake fluid. The inhibitors deplete because they attach to engine components to limit corrosion. The other main causes of additive depletion are leaks and associated top up practice. It is vital to top up with a coolant mixture of the same concentration that was used for the initial fill. Keep a can of 50/50 A/F and water in the car; don't use raw water for top-up as that simply dilutes the beneficial chemicals in the basic antifreeze as well as raising freezing point and lowering boiling point.

IAT Antifreeze is also available with Mono Propylene Glycol (MPG) which is listed as safe in food products and is also widely used in the cosmetics industry. Mono Ethylene Glycol is poisonous to small animals. Mono Propylene Glycol is not as widely used in industrial products, is more expensive and is not as widely used as MEG. Both forms of IAT A/F have a life of 2 years or 30,000 miles.

All brands universally state that their product should not be mixed with any other brand. In the absence of detailed knowledge about formulation this advice should be followed.

Water properties. Water properties vary depending where one lives in the UK, east of a line roughly from Dorset to Northumberland water is classed as hard; or above 200 ppm calcium carbonate combined.

The alkaline properties of coolant are important for it to work successfully to prevent galvanic attack. Alkalinity is reported as ph, 7 is neutral, new coolant is typically alkaline in the range 8.5-10.5. An old coolant might be lower than ph 7 making it acidic or an electrolyte which supports galvanic corrosion described earlier, not desirable.

Organic Acid Technology. Modern coolants using Organic Acid Technology or OAT are regarded as less toxic than traditional A/F because their active corrosion inhibiting ingredients are bio-degradable. OAT products meet BS6580. The first US patents for OAT formulations were granted in 1955 and a British patent was issued in 1982, so the technology is not new. This product is aimed at modern engines and extended service intervals and does not seem necessary for MGBGTV8s.

Hybrid Organic Acid Technology or HOAT is also available and combines selected features of both IAT and OAT, marketed as long or extended life, they are already diluted with deionized water and ready to use straight out of the container. They are aimed at extended service intervals.

Antifreeze brands have not been mentioned or recommended by name because there are so many on the market, whatever you choose to use must meet BS6580 to be sure of good performance. It should say so on the container or in a data sheet. If you can't find a reference to BS6580 then don't use it. If you want to avoid OAT or HOAT formulations then don't use products that call themselves Long Life or Extended Life.

Corrosion inhibiting mechanism. Both kinds of A/F mixture depend on MEG or MPG for their low and high temperature properties but the corrosion inhibiting mechanism is quite different. Traditional IAT antifreeze coolant mixtures deposit their inhibitors on all cooling system surfaces so the depletion rate is faster than with OAT which is believed to inhibit a corrosion site in the engine after the corrosion has begun, hence its depletion takes longer.

Silicone hoses have been cited as being susceptible to attack by OAT coolant. A well respected manufacturer of such hoses has heard of failures and believes that some

Thermostat housing from a Rover V8, the elbow is at a different angle than the MG V8 uses. Unknown age or coolant treatment; but heavy corrosion in the hose bead/sealing area and some very deep pits inside the casting. It is unreasonable to expect any hose/clip combination to seal for long without leaking. Replace components in this condition.

hoses of inferior quality may be at risk because the silicone formulation is poor, low grade fillers can absorb coolant and leaks may follow. Their belief is that such a problem could occur with both IAT and OAT coolants. High grade polyester reinforced silicone hoses are just as robust and unlikely to leak as they ever were.

Colour. Coolant and antifreeze colour is another variable, the earliest brand was blue, now it is possible to find green, orange, pink and red as well as brands that change colour should a combustion leak to coolant occur. Colour is no guide to formulation, whether it is IAT, OAT or HOAT, it is best to read the information on the can or a data sheet to determine which type it is.

Specific gravity. It is possible to measure specific gravity with a hydrometer to determine concentration of A/F. Usually specific gravity is quoted at a normal temperature of 20° C, correction tables are used if the coolant temperature is not 20° C. I am not sure it is worth the trouble because one must first determine the specific gravity of the brand and calculate how much concentrated A/F to add to get back to 50/50. It's easier to fix the leaks and then top up with 50/50.

A refractometer is a service tool that measures the refractive index of coolant to determine A/F concentration, but again one needs to know the range of the coolant in question, so that is getting complicated. If good maintenance practice is followed then the concentration should not be in question, just don't use raw water for top-up whatever the temptation.

Filling practice. Always fill the cooling system through the radiator and then check and adjust the expansion tank level after the engine has been run to thermostat opening temperature. Don't open the pressure cap on the expansion tank until the engine has cooled down, hot coolant under pressure can hurt you. Radiator and expansion tank coolant level should always be checked when the engine is cold. The reason for this is that a 50/50 coolant has 3 times the expansion rate of water.

System pressure. Under normal road running conditions it is pretty unlikely that the pressure in a V8 cooling system ever exceeds 6psi. This is because ambient temperature rarely exceeds 20° C, high engine load is rarely sustained for very long periods so the circumstances for stabilised conditions just don't exist for long enough to reach the very high temperatures needed to create high pressure. Plus, once 30mph is achieved, ram air passing through the radiator provides plenty of cooling air to reduce coolant temperature and therefore system pressure. The most likely high coolant temperature and pressure conditions in the UK are under light load in slow moving traffic or when idling at rest.

Coolant consumption. The V8 cooling system is pretty effective and robust so if you are experiencing high coolant temperature or high coolant consumption look at the easy items first. Fix leaks, you might need new parts if hose connection corrosion is severe. Check the thermostat is working, the top hose should start to get hot within a few minutes at idle. Check that the Otter switch is OK, if the cooling fans don't run on demand it does not take long to get into the red. Check that the pressure cap is sealing properly – it's not expensive to buy and carry one as a spare. Spend time venting the engine to get rid of trapped air, heater control must be set to hot, engine valve will then be wide open.

Life. Given the relatively low cost which is no more than a can of good 20/50 lubricating oil, then change Traditional IAT every 2 years. Fix leaks promptly and always top up with 50/50 as a routine part of maintenance. If you are uncertain about current coolant condition then definitely drain and refill with a 50/50 antifreeze and water mixture.

MGBGTV8 Drivers Handbook. The service information contained in MGBGTV8 Drivers Handbook AKD 8423 refers to A/F complying with BS 3150. This was published in 1959, and was the first BSI (British Standards Institution) attempt to link low temperature coolant performance with chemicals to provide corrosion protection. The other technical information about cooling system maintenance in the handbook is still valid today.

What goes wrong if coolant service and maintenance recommendations are not followed? The debris from corrosion accumulates, it then agglomerates to form large hard particles which with scale deposits from hard raw water will damage the water pump seal and cause leakage. The galvanized mild steel cylinder block core plugs can suffer badly from galvanic attack. This is because zinc is a good surface treatment in air but when in close contact with the aluminium block and depleted coolant becomes sacrificial and will corrode quickly. The external appearance, which can be quite good, is no guide to what has happened on the wet side, see the photo. The left hand plug shows typically good external appearance, the right hand example has corroded right through, remove engine to repair.

I spoke to several engine rebuilders who without prompting said that the V8 has the most robust cooling system of any engine

Core plug appearance - LH plug is in good condition but the RH plug seen from wet side is corroded right through.

that they work on. To quote “It is simple, the head gasket seals combustion pressure and coolant is transferred from the rear of the block to the cylinder head, similarly the coolant transfer ports behind the front cover and between the cylinder head and the intake manifold are sealed with robust gaskets, leakage rarely occurs and there is no corrosion at bolted joints or inside the water jacket if recommended coolant practice is followed.” So there you have it, a very strong system, so it pays to do the maintenance and service required to keep it that way

Summary of recommendations

- When changing coolant use a 50/50 mixture of Traditional Antifreeze and water. Select a brand that is suitable for classic cars, it will meet BS 6580, the main constituent will be either mono ethylene glycol or mono propylene glycol, properties will be shown on the can or in a data sheet.
- At subsequent checks with engine cold always top up through the radiator filler cap with the same mixture used for initial fill, check and adjust level in expansion tank. **Never top up with raw water**.
- Don’t mix different brands of antifreeze because formulations do vary and may not be compatible, so follow manufacturer’s advice.
- Change the coolant every 2 years or at the interval recommended on the can or in the data sheet.
- Replace defective hoses if they are cracked or perished. Troubleshoot leakage by examining connections, replace if badly corroded.
- Make sure that the expansion tank pressure cap is sound.
- Make sure air flow through the radiator is unimpeded.