Non-Aqueous Cooling

In all engines hot metal in contact with coolant causes localised boiling called nucleate boiling at critical metal temperature locations in the engine. Nucleate boiling is a very efficient way to remove heat, as the heat of vaporisation is so high. This boiling forms vapour which is later recondensed back into liquid when the vapour reaches the appropriate temperature. For ethylene glycol and water (EGW) systems, the recondensation of vapour takes place generally in the radiator. Since vapour by volume from a 50/50 solution of EGW is more than 98% water vapour under one atmosphere of gauge pressure (14.0 PSIG), the water will not recondense until the temperature of the coolant is below the boiling point of water at the system pressure. During moderate loads and ambient temperature conditions, that temperature is normally seen inside the radiator. As the temperature of the coolant rises under stressed conditions, that vapour does not recondense even inside the radiator. Most engine designers and test engineers are unaware that vapour is in fact being generated and recondensed continuously inside the engine cooling system.

As a result of localised boiling, there is a layer of vapour which can build up on the surface of the hot metal within the coolant jackets. That layer keeps the coolant from coming in contact with the hot metal surface. The temperature of the metal covered by the vapour pocket increases, causing a "hot spot". The hotter the spot, the more vapour produced, the larger the vapour pocket becomes, and the higher this critical metal temperature rises. These "hot spots" become so hot that they become secondary "spark plugs" or ignition points and are the cause of engine performance limitations (ignition instability) and emission problems.

Vapour, which is created from localised boiling, actually affects the cooling efficiency of the engine. Large amounts of vapour in the cooling system decrease the amount of liquid to metal contact throughout the cooling system, reducing the ability of the cooling system to remove heat. In addition as the engine and cooling system is used under stressed conditions or in higher ambient temperature locations, coolant temperatures typically rise above 220° F (104°C). As EGW coolant temperatures increase above 220° F, (104° C) the vapour which is generated cannot be recondensed efficiently inside the system and can be seen as cloudy coolant. Often at about 220° F (104°C) the pump starts to cavitate and the flow rate of the coolant starts decreasing, increasing further the temperature of the coolant. This results in additional cavitation and the loss of coolant through overflow vents.

In examining the vapour generation it is apparent that water is the reason for such a high amount of vapour production within the engine with resultant "hot spots". Water is the cause of cavitation. Water is the reason for requiring pressurised cooling systems to elevate the acceptable operating coolant temperatures above the boiling point of water. Even so the coolant temperatures cannot exceed 224°F (106°C) for pressurised water. Therefore the use of water as a coolant requires adding poisonous ethylene glycol to raise the pressurised boiling point to 250°(121°C) and decrease the freezing point. Water has been found to be the reason that additives used for corrosion deplete and "fall out", causing limited coolant life. Water is also the cause of corrosion of parts inside the cooling system and in some systems the resultant accumulation of high concentrations of lead and other heavy metals in the coolant after prolonged use. The solution is to remove the water from the coolant.

Evans NPG+ Non Aqueous Coolant

NPG+ is propylene glycol with proprietary additives. Of particular interest is that the coolant provides dramatic improvements in heat transfer and viscosity that make the new fluid a "pour-in," not requiring changes to cooling system components. Conversion to NPG+ waterless coolant from the use of conventional antifreeze and water coolant mixes, to take advantage of the benefits of non-aqueous engine cooling, is now simple to accomplish.

NPG+ waterless coolant virtually eliminates boil over in gasoline or diesel engines - the waterless coolant allows engines to tolerate running hotter, without boiling over, and allows the cooling system to run at very low or no pressure. Because there is no water in the system engines operating with NPG+ will be free from corrosion and electrolysis, and the engines will run well no matter how hard they are driven or how hot or cold the environment is.

A blend of non-aqueous ingredients, it is perfectly suited for the demands of any hard working engine, and there are no plumbing or pump changes needed to use this coolant. A cooling system according to Evans technology uses a non-water-based, high boiling point coolant (over 350ºF) or (190°C) and controls the temperature of the coolant substantially below its boiling point. This is in sharp contrast to conventional water based coolant systems which operate near the boiling point of the coolant. In conventional systems, locally generated coolant vapour may not condense but rather form an insulating barrier between the coolant jacket metal and the liquid coolant, causing hot spots to develop.

Coolant Vapour Condenses Immediately

In Evans' waterless systems, any locally generated vapour is immediately condensed back to liquid coolant and an insulating layer of vapour can't develop.
Another advantage is that cooling system pressure is minimal, prolonging the life of hoses and other components, which lowers replacement and related maintenance costs.
NPG+ works well with liquid-to-liquid oil coolers and radiators. It is important to remember that although the thermal conductivity of water is great, conversely for water vapour it is about zero. Although not a requirement, engines running with NPG+ can be operated, by choice, at higher coolant temperatures while control of metal temperatures is maintained. This fact permits the selection of higher fan control temperatures and less fuel robbing parasitic drag.

Efficiency at Higher Temperatures

Engines run more efficiently when they're hot. But up until recently, inefficient cooling has limited how hot you can run a gasoline or diesel engine before serious damage occurs. Conventional coolants containing water boil (vaporise) around 225ºF (107°C) near sea level. Cooling systems are pressurised to raise the average coolant boiling point, to around 250ºF (121°C), but that doesn't solve the real cooling problem, which occurs inside the water jackets of an engine.

NPG Coolant Cures Many Problems!

The anti-corrosion additives in NPG are stable and remain in solution for the life of the coolant (at least 500,000 miles) and no SCAs (supplementary coolant additives) are necessary. NPG also has almost no electrical conductivity, eliminating the damage to metals, hoses and gaskets caused by electrolysis.
NPG+ is used as pure coolant - no water added. The non-aqueous solution boils at 375ºF (190°C) (NPG+), greatly reducing vaporisation and eliminating vapour problems. Both coolants bathe the entire cooling jacket (permanent surface "wetting"), and significantly improve coolant surface effectiveness. Heat transfers more efficiently from the metal to the liquid coolant, and is carried off to the radiator for more effective elimination. Furthermore, any vaporised coolant recondenses while still in the engine, so the coolant continues to absorb damaging heat on its way to the radiator.

Run Hotter with No Trapped Air

When you eliminate trapped engine heat in the cooling system, you can run hotter, which increases your engine's efficiency. And with Evans NPG+ Coolant, no cooling system modifications are needed to allow the vehicle operator to raise an engine's operating temperature and thus its power output and fuel efficiency.
This isn't theory - it's in actual use by diesel truck fleets and owner/operators who report gains of up to 1.5 miles per gallon fuel savings in engines modified to take advantage of Evans NPG Coolant's increased cooling efficiency.
Because Evans NPG and NPG+ Coolants don't "after-boil" (boil over or vent) in the operational temperature range of a gasoline or diesel engine cooling system, you can change to a low-pressure or no-pressure cooling system (0.0 to 7.0 PSIG). While anyone servicing a cooling system must remain cautious around hot liquids, the danger of an explosive discharge of coolant from accidental cap removal or component rupture is minimised or eliminated. Low or no-pressure systems also enjoy reduced hose and gasket leakage, and longer cooling system component life. NPG+ Coolant is safe for use with all metals and totally non-corrosive to many.

Lifetime Coolants

NPG+ is virtually "lifetime" coolant. Conventional coolant must be flushed and changed at regular intervals to eliminate contaminants and renew its effectiveness. But the limit of Evans NPG+ Coolant is yet to be reached - it contains no water and only a few lifetime additives. The elimination of water virtually stops corrosion, water pump and cylinder cavitation. This means major maintenance savings to all forms of operators.
Evans NPG+ Coolant out-performs conventional coolant in freezing weather too. A 50/50 mix of conventional coolant and water typically freezes around -40ºF(-40°C). Evans NPG+ Coolant - pure, with

no water - remains liquid until -40ºF (-40°C), when it contracts slightly and merely turns into a light viscous slurry. It will not freeze solid and expand.

Non-Toxic to Mammals

NPG+ Coolant has been determined to be non-toxic in mammalian testing. Independent tests on laboratory rats exposed to Evans NPG+ Coolant showed no ill effects. The coolant is essentially non-toxic and non-hazardous in all EPA "GLP acute oral toxicity" tests because Evans has developed a proprietary formula based on a blending of chemicals called "DIOLS," including propylene glycol. An Environmental Protection Agency (EPA) ruling is being sought regarding an anticipated "safe" classification for the NPG+ Coolant.
The NPG controlling chemical, propylene glycol, is non-poisonous, and used in such products as pharmaceutical's, cosmetics, and even foods and therefore NPG is already classified as "safe".

Use of NPG+ unlocks a cooling system's "reserve capacity"

Excursions to higher temperatures, that would typically cause the failure of a water-based cooling system, are not a problem. Engine metal temperatures remain under control and the engine is not damaged. In heavy-duty applications, fans can be set to switch on at higher temperatures to reduce parasitic losses. Heat from an EGR cooling load can be accommodated without requiring a larger radiator.

NPG+ is non-toxic

Evans Cooling Systems, Inc. has filed for patents covering its discovery that certain combinations of ethylene glycol and propylene glycol are non-toxic. The report for an EPA acute oral toxicity range test on NPG+ proving its non-toxicity, conducted by an EPA-certified laboratory, is available for purchase from ECS. ECS awaits a ruling by the EPA that will certify that NPG+ is non-toxic.Q: What is NPG+ as compared with NPG?A: NPG+ contains a non-toxic blend of glycols rather than just propylene glycol. It exhibits improved heat transfer and viscosity characteristics as compared with NPG, while retaining all of the non-aqueous operational advantages of NPG. Both products are inhibited against corrosion.

A few NPG+ FAQs

Question: What is NPG+ as compared with NPG?
Answer: NPG+ contains a non-toxic blend of glycols rather than just propylene glycol. It exhibits improved heat transfer and viscosity characteristics as compared with NPG, while retaining all of the non-aqueous operational advantages of NPG. Both products are inhibited against corrosion.

Question: What is the practical meaning of the improved heat transfer and viscosity characteristics of NPG+?
Answer: In most cases changes to cooling system components (pumps, radiators, etc.) are not necessary to use NPG+.

Question: When should NPG+ be used instead of NPG?
Answer: NPG+ is preferred to NPG in all cases except where the ingredient ethylene glycol is specifically prohibited (e.g., use at certain race tracks).

Question: Evans offers a line of radiators, pumps, thermostats, and other specialty items for use with its cooling systems. Why would I need any of these items if I use NPG+?
Answer: In most cases you would not. However, for applications requiring the optimisation of the cooling system for increasing spark advance or increasing compression ratios in race cars, for example, the Evans ancillary products are appropriate. The Evans pumps, radiators, and other components improve cooling by increasing the coolant flow velocity through the engine and radiator.

COMPARISON OF COOLANT PARAMETERS

		Water	50/50 EGW	Evans NPG+
Boiling Point		121° C (250° F) (1 atm plus 15 psig)	129° C (264° F) (1 atm plus 15 psig)	191° C (375° F) (1 atm plus 0 psig)
Viscosity				
10° C (50° F)	cp	**1.2**	**5.0**	**58**
80° C (176° F)	cp	**.37**	**1.0**	**3.7**
100° C (212° F)	cp	**.28**	**0.7**	**2.3**
Density				
20° C (68° F)	spec grav	**1.00**	**1.066**	**1.091**
20° C (68° F)	lbs/gal	**8.32**	**8.87**	**9.08**
Specific Heat				
80° C (176° F)	Btu/lb/°F	**1.00**	**0.81**	**0.64**
100° C (212° F)	Btu/lb/°F	**1.01**	**0.82**	**0.66**
Heat of Vaporization	cal/mole	**9,700**	**9,800**	**12,050**
Vapour Pressure				
80° C (176° F)	mm Hg	**360**	**270**	**6**
80° C (176° F)	kPa	**475**	**360**	**8**
Surface Tension				
25° C (77° F)	dyn/cm	**72**	**56**	**44**