Although the chemistry of coolants and seals is complex, it’s also well understood. The point, physical testing is still necessary to establish the exact effect a coolant will have on a seal. For instance, some coolants are harmful to Viton seals while others aren’t.

Most of us can probably remember problems in locally produced cars from coolant/valve mismatches years ago. Physical testing is the best confirmation that this won’t happen again. Some of the mechanical tests employed are for tensile strength, hardness, swelling, contraction and cracking. Ethylene glycol has a higher surface tension resulting in less leakage. Propylene glycol has demonstrated greater resistance to cavitation in some laboratory studies, probably because of its higher viscosity. However, that’s for pure glycols. Adding inhibitors can change things considerably and inhibited EG performs better than inhibited PG. In the end, though, the differences between EG and PG are pretty minor. It seems that each performs about as well as the other in engine testing. In the field it’s a matter of application and specific formulation. Propylene glycol is much less of a health hazard, although fish don’t like it because it absorbs oxygen from water. So spills can kill marine life. On the other hand, in some applications it’s actually a food additive in its pure form. It’s also used in cosmetics. Ethylene glycol on the other hand is very poisonous. Yet it’s the more common type because it’s cheaper, and glycol can be one of the most expensive components in a coolant.

The important point about all of this, as far as Australia is concerned, is that both ethylene and propylene glycols are anti freeze agents and therefore, not very relevant in this country.

But about the only time a car will experience sub-zero temperatures for long enough to turn its coolant into a block of ice is if it’s parked at the snow for a week in a decent season. So, under these, or similar conditions, a glycol-based coolant is necessary but in general, in Australia, coolant can function perfectly well without any glycol in it. It’s also widely understood that coolant raises the boiling temperature in an engine, which is very relevant in this country. Glycol-based coolants can raise the boiling point by up to nearly ten degrees in a 50/50 glycol/water mix. This is the most common mixing ratio recommended by car manufacturers. 66 per cent glycol is generally the maximum car manufacturers recommend before it becomes too viscous. Raising the boiling point through coolant formulation seems important when considered in isolation, but things aren’t as simple as that. Most of the increase in boiling temperature is due to the fact that cooling systems are closed and pressurised. While a glycol-based coolant does contribute something to an elevated boiling temperature, proportionally speaking it isn’t much, the main increase comes from higher pressure. But it’s not as simple as that either.

The thing about either ethylene or propylene glycol is that its thermal capacity is vastly inferior to that of ordinary water. In fact, glycol can only absorb about half as much heat as ordinary water.

Because of this, mechanical testing is necessary. The main thing one does in a modern steam engine is to get as much water out of the system as possible and allow the steam to do its thing. This gives steam engineers a choice: they can
either put twice as much coolant into the system, or circulate it twice as fast. Each approach reduces efficiency.

The critical function of coolant additives in Australia is to prevent corrosion, not inhibit freezing. So some sort of additive package is essential for all engines, even iron blocks. It’s just that most Australian coolants don’t really need to contain glycol. Fortunately, all manufacturers of engines and the industry isn’t going to change so glycol will continue to be used. None of this is to say that coolant additives in general are less important. After all, factory specifications suggest the additives that are necessary are absolutely vital. Leaving them out or using the wrong ones will destroy an engine surprisingly quickly.

There are two basic classes of coolant: older inorganic types and modern organic formulations.

There are also limits to the use of each. Conventional, inorganic inhibitors work by chemically interacting with corrosion in the same way phosphoric acid interacts with rust to turn it into a layer of iron phosphate and halt the corrosion. It’s a process of conversion. However the resultant protective layer can break away over time and expose more structural material to further corrosion. The active components will then react and the protection provided by the additives. Coolant should always be topped up with a mix of the same coolant already in the engine. If this means making up extra coolant:

factory specified. Only the corrosion inhibitors are needed. Pre-mixed or concentrated glycol-free (water-based) coolants can be appropriate replacements for glycol-based coolant. And they’re not only appropriate - they’re considerably cheaper.

When the system of plain water will dilute coolant. Doing so will weaken the protection provided by the additives. Coolant should always be topped up with a mix of the same coolant already in the engine. If this means making up extra coolant:

in water, on the general hardness of water, on the total dissolved solids and, of course, on the pH. The more remote a location, the more likely it is that bore water will be used. The calcium and magnesium ions in these hard waters can form a scale over the cooling system elements reducing heat transfer. The problem is worse at elevated temperatures. These films can also break off and become circulating solids that degrade seals and generally clog up a system. Where conditions like those outlined are prevalent, the best solution is to use a premixed coolant and top up systems when necessary using more of the same.

Maintaining coolant strength and consistency is another good reason for using a premixed coolant. Any engine in which coolant strength has been reduced from topping up is susceptible to corrosion. In iron, the result is rust and particles. In aluminium, it’s aluminium oxides. It’s worth remembering that abrasives are made from aluminium oxides and having these circulate through a cooling system is obviously bad and causes coolant pump seal abrasion, soft metal corrosion and rust-in-liner pitting.

If a system has had the above-mentioned problems it should be flushed out, de-scaled and then filled with the appropriate coolant. When a vehicle or other engine-driven equipment is under warranty factory- supplied coolant will likely be the type used. That’s all well and good but operators running different types and brands of equipment may have the annoying problem of purchasing, organising, storing and using different types of coolant to match a range of manufacturer specifications.

Filling an engine with the wrong coolant by mistake can lead to expensive damage. Under these circumstances, utilising the same coolant across a range of engines could simplify things considerably. PtitMax says that this is a typical need in many mining operations. The company also says that there have been no deleterious effects from using a single coolant in compatible engines provided that the equipment in question has been properly maintained at sites with good work practices. It’s worth noting that many of PtitMax’s mining customers are in the hotter regions of Asia and Australia.

Newer organic coolants are made of carboxylates, which are salts of carboxylic acids. These inhibitors remain effective over a wide pH range from slightly acidic to alkaline. Conventional or hybrid coolants have quite a high pH reading which must be maintained or they become acidic and the additives either won’t work or may even work in the wrong way. So, maintaining the correct acid/base balance is one of the important functions in formulating an effective coolant for a particular application.

The pH reading of a coolant can be reduced in a number of ways. For instance, PhituMax explains that corrosion processes lower the pH making coolant more acidic. Then, further corrosion will occur resulting in a rapidly spiraling degradation of the coolant.

The correct pH reading in an organic coolant is maintained by a chemical arrangement known as a buffer system. It provides an alkaline reserve in a complex but neat trick. Basically, a weak acid and a related base are added to the coolant and react to form alkaline metal salts and phosphates. These maintain the coolant in an alkaline condition by neutralizing acid products formed by deterioration of the coolant as well as by entry of combination products past a leaking cylinder head gasket, for example.

The current standard for coolants in Australia is AS 2108-2004. This defines Type A and Type B coolants. Type A is what’s generally known as anti-freeze and under the standard it must have a freezing point of less than -1.2°C. That temperature corresponds with 25 per cent EG. So, coolant containing 25 per cent or more EG is a Type A coolant, or anti-freeze. Type B coolant containing between 0 per cent and 25 per cent EG will have a freezing point between -1.2°C (or possibly less) and 0°C.

The Australian Standard only relates to passenger cars and light commercial vehicles. There are no Australian Standards for trucks and heavy equipment. For these, European and other world standards are reference points. They generally specify glycol because of freezing northern climates.

However, there is often provision in OEM specifications from these regions covering glycol-free formulations for use in temperate climates. In summary, make sure any coolant you use for passenger cars and light commercial vehicles is compatible with Australian Standard AS 2108-2004. OEM specifications will be your guide for heavy vehicles.

Anyone who might consider glycol-free coolant a risky proposition should understand that PhituMax has world standard knowledge and experience in the laboratory formulating coolant for the majors is a complex and technically detailed business and PhituMax in Melbourne is part of the ASTM D-15 Engine Coolants International Inter-laboratory Proficiency Testing Program. To translate, the PhituMax lab is evaluated, along with around 20 associated international labs, a couple of times a year for conformity with the International Standards. PtitMax knows how to formulate quality coolants.


PtitMax is also producing the world’s first carbon neutral certified coolants. This program is certified and audited by the Carbon Reduction Institute in Sydney. So, that’s pretty cool.