TECHNICAL BULLETIN
ZINC MYTHS AND LEGENDS

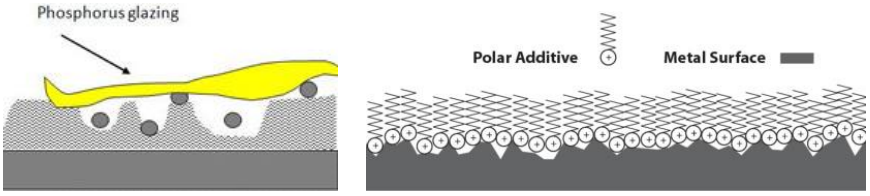
Issue: November 2014

There have been many articles and comments from various “expert” commentators regarding amounts of zinc needed in engine oils and its removal from more recent API specifications and the impact of this on older petrol engined vehicles. Unfortunately there is a lot of wrong and contradictory information as to what can and cannot be used in older vehicles.

There has been a big focus on zinc, also known as ZDDP (Zinc dialkyldithiophosphates) or ZDTP (zinc di-thiophosphate). For many years this has been the anti-wear additive of choice for many engine oils as it is the most cost effective (and one of the most effective) chemistries to use. It is sometimes incorrectly described as an extreme pressure additive with its primary role being a sacrificial anti wear agent to prevent wear in the rings and in the valve train (cams, tappets, valve stems etc) of the engine.

How does ZINC work?

Zinc is a polar molecule, so it is attracted to steel surfaces. Under heat and load, the Zinc reacts with the steel surface and creates a phosphate glass film that protects the steel surface by forming a sacrificial film that covers the peaks and fills in the valleys of the steel surface. However, zinc is not a lubricant until heat and load are applied. ZDDP must react with heat and load to create the sacrificial film that allows zinc to protect highly loaded engine parts.



History

ZDDP was developed in the 1940’s initially as a bearing corrosion inhibitor before being used as a sacrificial anti wear agent for engine oils. From the early 1920’s to the mid 1980’s petrol contained tetraethyl lead which contributed to the build up of lead & lead oxides in the engine. Lead scavengers were then introduced but these caused acidic by products in the crankcase that reduced the effectiveness of the ZDDP. To counteract this, higher ZDDP dosages were introduced often into the phosphorus range of 0.14 - 0.16%.

The introduction of the USA Clean Air Act in 1975 required a 75% decrease in emissions in all new model vehicles after 1975, a decrease to be carried out with the use of catalytic converters. In Australia this was introduced in 1986. Without catalytic converters, vehicles release hydrocarbons, carbon monoxide, and nitrogen oxide. These gases are the largest source of ground level ozone, which causes smog and is harmful to human and plant life. Therefore, with the introduction of catalytic converters to petrol engine vehicles and the introduction of unleaded petrol (Lead is a catalyst poison) for these vehicles, phosphorus levels were needed to be lowered as it is also a catalyst poison. Hence, maximum phosphorus levels were introduced on some API SH specification oils.

How much ZINC do you need in engine oils?

There are many and varying opinions on what levels of Zinc are needed to be an effective anti-wearing agent in engine oils. Owners of vehicles that have flat tappet camshafts, veteran & vintage owners and traditionalists may argue that the higher the level the better especially in vehicles that do not have catalysts. This is not always the case. As we saw above, ZDDP was increased in oils to combat the effects of lead scavengers not actually to increase the anti-wear protection.

In effect, an engine oil that contains about 1000ppm phosphorus (approx.1100-1200 PPM Zinc) or higher, will easily provide the required anti wear properties for older engines. General Motors experimented in the mid 1950’s with lower phosphorus and zinc levels and found that 0.08 percent phosphorus level (approx.1000 PPM ZINC) eliminated many wear issues. In fact, they also experimented with oils containing 0.6 percent phosphorus on mixed fleets in the 1970’s and found no wear problems.

So what is the optimum amount? This will always be a debateable point, depending on the application.

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API Specifications

When you add ZINC to an oil, you also add phosphorus and there have been limits on it since the days of API SH (1994) when a 0.12% (1200ppm) limit was imposed. Prior to that, in the days of API SG (1989) many manufacturers already had put a 0.10% (1000ppm) limit on phosphorus. So, "low" phosphorus has been with us for quite some time.

The step from API SH to API SL was accomplished by a combination of new additives or adding additional anti wear and anti-oxidant to existing blends. As an example, the Penrite HPR petrol oils and Pro upgrades from API SJ to API SL required the ***addition*** of these components to pass the relevant engines tests. These were not phosphorus based, but used organic molybdenum additives (*not* molybdenum disulphide) to keep phosphorus levels at 1000ppm. Many other companies followed similar routes but there was certainly no loss of protection, even if they started from scratch.

When API SM was introduced - for the first time, the limit on phosphorus was from 0.06-0.08%. (600-800ppm). There were industry concerns about the applicability of these oils in older engines. However, the limit only applies to 0W-20, 0W-30, 5W-20, 5W-30 and 10W-30 oils (so called "ILSAC" grades). Any other grades were exempt from this. When HPR 10, 15 and 30 initially went to API SM technology, they maintained their phosphorus levels of approximately 1000ppm (about 1100ppm zinc). None of the viscosity grades for these products are bound by the 800ppm upper limit.

Therefore blanket statements about API SM oils were incorrect and further research will be needed by the end user. The latest API SN specification has the same limits and ACEA C1 to C4 are also low zinc oils.

There is one other factor with non-ILSAC oil grades. If they also have the European ACEA A2/A3 with B2/B3 or B4 performance levels, phosphorus levels will also be at 0.10 % to 0.12% as their tests have been more severe than the API for some time. Hence an oil that is SL (SM)/CF/A3/B3 also well exceeds the anti-wear requirements for older engines.

The irony is that API SF and SG oils formulated in recent years usually have phosphorus contents of around 0.08% (usually 0.1% maximum) anyway due to other advances in technology, unless the blender chooses to add extra additive.

Currently, our traditional HPR 30, 40 and 50 products are all full zinc. In fact there is no HPR grade (petrol, gas or diesel) with a zinc level of less than 1000ppm, regardless of its API rating.

We also have range of oils (Shelsley, Classic, Heritage) that are designed specifically for older motor vehicles that feature full zinc anti-wear additive packs.

Diesel Engine Oils

Currently, there are no phosphorus limits outside of grades that are API CJ-4 or ACEA E6 (which have limits) – as such many people recommend them for older cars, even though many others say that the detergent levels are too high and the engine will use oil. Well, you cannot have it both ways. This one originated from the USA and hence did not take into account European ACEA A/B standard petrol engine oils, which are easy to find in Australia, NZ and Europe, but a lot harder to find in North America.

Yes, the engine may use oil, but only until the cleaning period is complete – unless you are unlucky enough to move a deposit that is stopping oil leaks that is. However, an engine in good internal condition will run quite happily on diesel oils as long as the SAE viscosity is correct.

Synthetic Engine Oils

This leaves Synthetic oils. Many people say they are too "slippery" for older cars, and can cause wear and oil consumption. Well, wear protection has little to do with the base oil type and everything to do with the additive (all else being equal). If the wrong anti wear additive is used then it does not matter how good the rest of the oil is, wear will occur. Hence, the right type of synthetic oil is quite OK in an older car, but unless it is fully reconditioned and then correctly run in, then there is no real benefit to the end user. It is true that synthetic oils (especially the PAO type) have lower friction, as their chemical structure allows the molecules to slide over one another more easily than a mineral oil, but if the correct additives are used, then this becomes a benefit, not a detriment.

The choice of the correct oil for older cars comes down to various factors such as:

- Original Viscosity Specified
- Condition of engine (leaks, sludge)
- How often the engine is run
- How the vehicle is to be used
- Oil consumption
- Current oil used

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ZINC Additives

Penrite does not recommend the use of “Zinc Additives” to any of its engine oil ranges. Penrite engine oils are a carefully balanced blends of base oils and additive packages designed to provide outstanding engine protection in all conditions, climates and applications. Adding another product to an engine oil alters its balance for its intended function and may impede its ability to provide the engine protection for which it was originally blended to do. Users of aftermarket additives such as “Zinc Additives” should be aware that adding these products to an engine oil, waivers the users rights to any warranty on the original product. This is the case with most engine oil manufacturers.

Blanket statements are not useful to anyone, be it the vehicle owner or the oil industry. If you have any doubt as to what oil you should use, contact the Penrite Technical Help Line on (AUS) 1300 PENRITE (736 748).

On our web pages (www.penriteoil.com) are listings for both post 1970 vehicles and also another section for pre 1970. In both cases, we have chosen the correct oil in our range that would suit the vehicle shown, basis the condition we would expect the vehicle to be in and how we expect it to be operated.

Click Here to visit the Penrite Pre-70’s product guide.

Click Here to visit the Penrite Recommendation Guide, which will ensure you receive the correct oil for your vehicle

Click Here to view a complete Automotive Engine Oil Summary of all the popular Penrite brands.

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