2CV API GL-4 GEARBOX OIL

Revision 3

By Graeme Dennes

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Um, whaaat?? This is a brief discussion on the reasons why we should use a service classification grade GL-4 (Gear Lubricant-4) oil in the 2CV gearbox. Specifically, it relates *directly* to the operational life of the yellow metal synchromesh components!

American Petroleum Institute (API)

The API was founded in March 1919 and oversees the certification of industry standards for the petroleum industry in the USA. API Specifications are used worldwide by vehicle manufacturers.

API GL Classifications

Some confusion can occur with API Gear Lubricant (GL) classifications. It is often presumed that an API GL-5 oil may be used wherever an API GL-4 requirement has been specified. Although this may be true for a *gear* oil, i.e., the oil which lubricates rolling/rotating *steel* gears, API GL-5 oils are not suitable for gearboxes which contain soft yellow metal alloys such as brass and bronze which are typically the metals used in synchromesh components in manual gearboxes. Further, neither the API GL-4 nor GL-5 classifications discuss the lubrication requirements of synchromesh components.

Background

In earlier days, additives based on lead compounds were used in gear oils to reduce wear in highly loaded steel gears. However, lead is not very user friendly and was later replaced by a sulphur/phosphorus mixture. Gear oils for steel gears used the sulphur/phosphorus mixture to form a strongly bonded iron sulphide layer on the surface of the steel gear teeth which is a *strong sacrificial layer* designed to be worn off or peeled off over the service life of the gear oil, thus protecting the gears from high loads, shock loads and abrasive wear. This is the basis of the protection provided for steel gears.

Unfortunately, although the steel gears were being protected, it resulted in a problem in that the sulphur being used was active and caused corrosion of yellow and other soft metals inside gearboxes, typically the synchromesh components of manual gearboxes. This happens because active sulphur reacts with some metals and metal alloys, especially those such as brass and bronze which contain high percentages of copper, forming metal sulphides which corrode the yellow and other soft metals.

A generation ago, de-activated or buffered sulphur was developed. When this was combined with the phosphorous, it continued to provide the protective and sacrificial layers for the steel gears inside gearboxes as before, but without the corrosive damage to the brass, bronze and other metal alloys used in gearbox components. Today, de-activated sulphur is widely used in vehicle transmission oils and gear oils and the corrosion issue with yellow metals was resolved.

However, another problem remains for the yellow metals. Oils ain't oils! A GL-5 grade oil is a high EP (extreme pressure) formulation. EP gear oils contain additives to prevent metal surfaces from cold welding under the extreme pressure conditions found in situations where boundary lubrication prevails.

At the high local temperatures associated with metal-to-metal contact, EP additives combine chemically with the metals *to form a surface film* that is ductile enough to prevent the welding of opposing surfaces and to prevent scuffing or scoring that is destructive to sliding surfaces under high loads.

The main difference between GL-4 and GL-5 gear oils is in the *amount* of EP additives included. Sulphur/phosphorus products are used as the EP additives to prevent the occurrence of micro-welds on the gear flanks at the high local temperatures which prevail in EP circumstances (temperatures well in excess of 800°C).

GL-5 gear oil has roughly *twice* the amount of EP additives compared to GL-4 gear oil, which is why a GL-5 oil is often specified for use in high-pressure situations such as in front and rear axle differentials to provide the *maximum protection possible* for the steel gears. Yes, perfect for *steel* gears.

So what's all the fuss then Baldrick? Under normal operation, the sulphur/phosphorous additives in the GL-5 gear oil create a black sacrificial coating on all gears and all other metal surfaces inside the gearbox, including the synchromesh parts. As the gears turn, the sacrificial coating formed from the EP additives is reduced by being slowly peeled off or worn off the gears. This is normal and acceptable *for all steel gears* and is at the heart of the protection provided. But here is the rub. When one or more of the coated surfaces in the gearbox is brass or other soft metal, the bond strength between the sacrificial coating and the soft metal *is much stronger* than the inherent strength *within* the soft metal itself, so instead of the protective coating being *slowly* peeled off or worn off, the protective coating itself is removed, and it takes with it (strips off!) a few microns of the softer metal, such is the bond strength between the sacrificial coating and the softer metal. Yes, material is being removed from the brass synchromesh components on every gear change. $$Ouch!!

As already noted, a GL-4 gear oil of any given viscosity has about half the level of sulphur/phosphorous additives that would be in a GL-5 product, so the bond strength between the sacrificial coating and the soft metal surfaces inside the gearbox is not as strong with the GL-4 oil, and therefore the sacrificial coating can be peeled off *without* peeling off a layer of the soft metal. This means that although the GL-4 product provides a little less extreme pressure protection for the steel gear components than is provided by a GL-5 oil, the GL-4 oil results in less wear (metal removal!) of the yellow metal components. *In the end, this is a trade-off to save the synchromesh parts.*

Further, when a GL-5 oil is used in a gearbox with synchromesh, a used oil analysis will show that it can contain up to four times the amount of (peeled-off) copper when compared to a GL-4 oil. Using a GL-5 oil, the yellow metal *synchromesh parts* will eventually wear to the point where they become ineffective in that they no longer make contact with the other half of the cone, bottoming out before stopping the opposing gear, yet the *steel gears* may be perfectly fine due to the higher level of EP additives in the GL-5 oil. Challenging indeed.

In summary, the EP additives in GL-5 gear oil bond more strongly to the brass synchromesh parts than the metallic brass does to itself, causing a small layer of the brass to be stripped off with every gear change. To prevent this, oil which meets *only the GL-4 classification* should be used in your 2CV gearbox to minimise the wear on the synchromesh components. Your 2CV will thank you for using a GL-4 oil by providing a longer operating life for the gearbox! Change the gearbox oil every two years.

Conclusion

For your 2CV, use a gearbox oil which has *only* a GL-4 classification. *Don't use a GL-5 classified oil.* This is also in accordance with the advice received by the writer from the Burton Car Company in the writer's article, *2CV Oils and Maintenance Advice from Burton*.

Reference:

Gear Oil Industry Specifications:

https://penriteoil.com.au/knowledge-centre/Gear-Oil-Industry-Specifications/83/What-is-the-difference-between-API-GL-4-and-API-GL-5-Gear-Oils/1036

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