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Transmission Lubrication

What type of oil to use to lubricate your transmission can be a controversial topic. Ask ten different people for their opinion and you are likely to get ten different answers.

This article focuses on early Porsche transmissions that use the Porsche style synchronizers and can be found in cars such as the early 911 and 914. The article is not designed to recommend a single oil, but rather to discuss the type of oil that works well in these transmissions. To first understand why certain type of oils work well in these transmissions, you need to understand the factors that are specific to these transmissions that impact the type of lubrication that you should use.

Porsche vs. Borg Warner Synchronizer Design

The 901, 915 and 930 series transmission uses the Porsche sychronizer design (aka "Balk Ring"). This design was created by Porsche and was used not just by Porsche, but by many different manufactures for a number of years under license from Porsche. At a later date, Borg Warner created an improved and simpler synchronizer design (aka "Cone") that is used on most modern cars today. This Borg Warner style is used in the G50 series and later Porsche transmissions. Generally speaking the consensus is that the Porsche design relies upon significant friction between various parts to work properly. If you use a lubricant that is particularly "slippery", you may find you are more likely to "grind" gears. This is because with the reduced friction of the more "slippery" lubricant, the synchronizer rings in the Porsche design are not able to match the speeds between the two sets of dog teeth adequately before they mesh. If the speeds are not matched, then the teeth clash (grind) as they mesh. Conversely, with the Borg Warner design, you may find better shifting with a more "slippery" oil.

Hypoid Ring and Pinion Gears

The transmissions used in the 911 and 914 are more properly called a "Transaxles" as they include not just the main gears, but also the differential gears. In these transmissions the same oil is use to lubricate both the main gears and the differential ring and pinion gears. The ring and pinion gears in these transmissions are different from the other gears in that they use a "Hypoid" design. A hypoid gear is a type of spiral bevel gear in which the axis of rotation of the two gears do not intersect. Because they do not intersect, there is a sliding action between the ring and pinion gear teeth faces that is not found in the other gears. This sliding action creates a significant potential for wear, so hypoid gears have special lubrication needs.

Clutch type Limited Slip Differential (LSD)

It is a rare feature, but some transmissions left the factory with a ZF clutch type LSD. In general a LSD tries to limit the difference, but still allow some, rotation between the drive wheels. With a clutch type LSD a series of clutch discs are stacked and via friction, are used to try to limit the difference in rotation. If your lubrication is not particularly slippery, you may experience a shuddering or chattering as the discs grip and release.

Friction Modifiers and Anti-wear (AW) and Extreme Pressure (EP) Additives

From the information above, you can see that there are a number of requirements placed upon the lubricant. It must provide adequate friction for the Porsche synchronizers, but at the same time it must not have so much friction that it causes clutch type LSD to shudder or chatter. Friction modifiers are chemical compounds that are added to try to balance these requirements. If an oil has frictions modifiers specifically for a LSD it typically mention it on the packaging. The lubricant also must provide it's primary function of lubricating the moving parts preventing wear and tear. Anti-wear (AW) compounds are added to help prevent wear. These AW compound typically have a temperature and pressure ceiling. The hypoid design ring and pinion is a perfect example of a high pressure, shearing and temperature environment. Extreme Pressure (EP) compounds are added to help prevent wear in these extreme situations. These chemical compounds are heat activated and react with the metal surfaces to create protective layers on the metal where needed.

Mineral (aka Dino) vs. Synthetic Oil

Oils that are commonly used for lubrication broadly fall into two different categories. These are "Mineral" and "Synthetic". Mineral oils are created by refining crude oil, with crude oil being the result of the application of heat and time to ancient organic material. Due to the source being ancient organic mater, these oils are commonly called "Dino Oil" with "Dino" being short for Dinosaur. Synthetic oils are artificially made vs. being refined from crude oil. Synthetic oils by design have a number of technical advantages over standard mineral oils such as better high and low temperature performance. However in some scenarios they do not outperform standard Mineral oils. The use of mineral or synthetic is probably the most hotly contested topic of this entire articles. For some, mineral vs. synthetic is nearly a religious discussion.

Does the "W" in Multi-Grade Oil Specification Stand for "Weight"?

No it does not. While people commonly think this means "Weight" it stands for "Winter" (cold weather rating). So a multi-grade oil that is listed as 80W-90 means that it has a viscosity rating of 80 in cold temperatures and a viscosity rating of 90 in hot (operating) temperatures.

What is "GL-5" Specification Oil?

As hypoid design gears have special lubrication requirements, a specification was created for this situation. This API specification is known as "GL-5". If a particular gear oil is designed to meet the GL-5 spec, it will list this on the labeling somewhere. GL-5 oils have an additive package designed to protect hypoid gears and has more AW and EP additives than GL-4. Some of these additives may not be 100% compatible with "yellow metals" such as bronze. With the higher amount of additives than in GL-4, you occasionally see concerns about using GL-5 in transmissions that contain yellow metals. The shift forks in the Porsche transmissions as well as the Borg Warner synchronizer design use yellow metals. Your priority is to protect the hypoid gears first and foremost, so don't let the concerns about compatibility with yellow metals prevent you from using GL-5. It has shown that over the years that these GL-5 additives have no apparent ill effect on the yellow metal shift forks in the Porsche transmissions.

What did the Factory Specify?

Porsche specified SAE 90 GL-5 gear oil.

Service Schedules

It may not be obvious, but the number one recommendation is to actually ensure you have oil in your transmission. These transmissions rely upon splash lubrication via the movement of the gears themselves and low levels of oil will prevent proper distribution of the oil. Low oil levels equates to a lower amount of oil. This allows heat to build up faster, and will break down the oil and reduce its effectiveness quicker. A lower amount of oil also equates to a lower amount of

AW and EP additives. All of these combined have a serious negative impact to the life of the transmission.
In addition to ensuring you have oil in your transmission, you need to replace it on a regular basis. A conservative service schedule would have your replacing your transmission fluid every 12,000 miles, or every 12 months whichever comes first. If your transmission lives in a harsh environment (such as a race or track car), you may want to replace your fluid more often.

Boutique Oils

In addition to oils from the regular well known brands, there are many boutique suppliers who typically tout some advantage over the commonly available brands. These oils may provide real alternatives and solutions to problems. An example might be that one of these oils might provide a unique additive package that improves the shift quality in your transmission. Or, conversely you may find that that in your transmission it has a negative effect. These oils typically cost significantly more than some of the well known brands. When factoring in a regular maintenance schedule, the cost of these oils can be quite expensive and may not bring much "bang for the buck". You need to be sure that you are getting real value before you use these oils. As always, your mileage may vary.

Conclusions and Recommendations

GL-5 is specified for these transmissions due to the hypoid ring and pinion gears and it is what you should use. Quality mineral (Dino) oil is inexpensive and works well with these transmission. Synthetic oil has its advantages but it tends to be more slippery than mineral oil and has a history of causing shift problems with the Porsche style synchronizers. Later transmissions that use the Borg Warner style synchronizers may benefit from the use of synthetic oils. Most gear oils these days are multi-grade and don’t list just a single viscosity. While Porsche originally specified single grade SAE 90, SAE 80W90 is a good modern multi-grade oil that can be used in place of single grade SAE 90. Each oil has it’s own unique formulation and corresponding additive packages. Differences in these packages (such as friction modifiers) can impact (both positive or negative) the shift quality. Your own shifting style may or may not expose some of these issues. Lastly, ensuing your oil level is correct and changing it on a regular schedule is much more important than one brand over another.

In short...

- Don’t run your transmission low on oil.
- Change your oil on a regular basis.
- Use good quality GL-5 mineral oil (aka Dino oil).
- SAE 80W90 is a good multi-grade replacement for SAE 90.
- Using expensive boutique brands is not a requirement.

Here are some examples (in no particular order) of acceptable gear oils...

- Valvoline HP 80W90 GL-5
- Valvoline HP 80W90 GL-5 LS (Limited Slip version)
- Castrol Hypoy C 80W90 GL-5
- Swepco 201 80W90 GL-5
- Red Line 75W90 NS GL-5 (Recommended for use in transaxles by manufacture.)

Examples of unacceptable gear oils...

- Red Line MT-90 GL-4 (Not GL-5 spec)
- Red Line MT-80 GL-4 (Not GL-5 spec)

Red Line MTL GL-4 (Not GL-5 spec)

Red Line 75W90 GL-5 (Not recommended for use in transaxles by manufacture. See "NS" version above.)

Links

http://en.wikipedia.org/wiki/Transaxle

http://en.wikipedia.org/wiki/Gear_oil

http://en.wikipedia.org/wiki/Spiral_bevel_gear

http://en.wikipedia.org/wiki/Limited_slip_differential

http://en.wikipedia.org/wiki/Synthetic_oil

http://en.wikipedia.org/wiki/Petroleum

http://www.bobistheoilguy.com

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