

Articles

a. Engine Oil for Vintage Corvettes

By Duke Williams

[Editor's note: *This article was originally published in the *The Corvette Restorer*, Vol. 35 No. 1, Summer 2008, published by The National Corvette Restorers' Society. This updated version is reprinted here with permission from the author and publisher. The advice is applicable to all vintage engines with sliding surface valve trains.*

- *Thanks to Joe Raine for coordinating with Duke to get permission for this article]*

There is probably more chatter about engine oil than any other automotive subject. Entire Web sites are dedicated to the subject, but a good 90-plus percent of what you read and hear is based on myth, misinformation, and marketing hype.

For well over half a century the automotive and petroleum industries have promulgated engine oil standards through the American Petroleum Institute (API). The result: Engine oil is a generic product, but different generic engine oil products are offered depending on the type of service. The current API service category system dates back to 1969, and there are two basic categories. Current, past, and obsolete service categories that begin with "S" are intended primarily for spark ignition (gasoline) engines and "C" categories are intended primarily for compression ignition (diesel) engines. The second letter indicates the revision, and the service categories have evolved to the current SN (which replaced SM in late 2010) and CJ-4 ("-4" refers to four-stroke cycle) based on the requirements of currently produced engines, and I emphasize currently. SM and SN are not the best engine oils for vintage gasoline engines for reasons that I will explain.

As a general rule both C and S-category performance requirements have significantly increased over the years, but recent changes have reduced the concentration of anti-wear

additive due to evidence that its combustion byproducts reduce catalyst life; and EPA requirements for tighter emission controls and longer emission control system warranties are one reason for the reduction. A second reason is that modern engine design details have reduced the need for anti-wear additive.

Additives, which are critical to proper engine performance and longevity include detergents, dispersants, and corrosion, foaming, and wear inhibitors. The most effective anti-wear additive going back over 50 years is zinc dialkyldithiophosphate, commonly known as ZDDP. This additive is critical to preventing sliding surface wear, and, in particular, vintage engines have many sliding surfaces in the valve train such as flat-faced valve lifters and plain bearing rocker arms/shafts or stamped rocker arms/balls as used on vintage Chevrolet V-8 engines. Most modern valve trains, both pushrod and overhead cam types, have roller lifters and roller trunnion rocker arms, which means they don't need as much ZDDP as vintage engines!

From the 1950s to 2004 when the SL specification was adopted, many engine oils were dual rated, carrying both the then current gasoline and diesel engine service categories. The primary service category was listed first and was often a marketing decision since the major marketers have spent years building various brand names specifically targeted at either diesel or gasoline engine owners. The typical level of ZDDP in these oils based on the mass fraction of phosphorous (symbol "P" on the Periodic Chart of Elements) evolved to about 0.12%, which can also be expressed as 1200 ppm (parts per million, 0.10% equals 1000 ppm). Over the years this level has proved to be ideal for sliding surface

protection. Significantly less can allow more rapid sliding surface wear, but more than 0.14% over the long run can have negative effects such as certain corrosion mechanisms. More is not necessarily better, and there is absolutely no need to use any supplemental ZDDP-rich additives with CJ-4 other than GM EOS being optional for initial engine break-in. Field oil analyses usually reveal the Zn (zinc) concentration, and sometimes marketers specify it. As a general rule, the Zn concentration will be 100-200 ppm higher than the P concentration.

To promote long catalyst life, SM and SN oils with winter viscosity ratings of 10W or less are limited to 0.08% P. (The SL limit was 0.10%.) This is sufficient for modern “roller everything” gasoline engines, but may not be sufficient to prevent accelerated wear on vintage engine sliding valve train components. SM and SN oils with winter viscosity ratings above 10W have no P limitation, but this does not mean that 20W-50 SM or SN oils have more because only as little as 0.06% P is required to pass the SM or SN specifications and test suites. As a result, most current S-category oils cannot pass some of the C-category tests. The current CJ-4 specification also limits P due to the addition of catalysts to 2007 and later over-the-road heavy-duty diesel engines, but the limitation is 0.12% - 50 percent greater than SM and SN - and 0.12% is about the same as earlier S and C-category oils before any P limits were adopted. Typical CJ-4s analyze at 0.11-0.12% P, and this level of ZDDP is necessary to pass the tougher CJ-4 anti-wear test suite. As a general rule, past and present, C-category test suites are a higher hurdle than S-category test suites. Thus, CJ-4 is the best commonly available oil for vintage engines because you are essentially guaranteed a near ideal amount of ZDDP for maximum protection of vintage engine sliding surface components. If you happen across a (first listed service category)

CI-4, it is perfectly acceptable. CI-4 has no P limitation, but the typical concentration is at or slightly above the 0.12% CJ-4 limit – not enough to be of material difference, so there is absolutely no need to seek out CI-4 in lieu of CJ-4.

There are a number of “boutique” oil companies that market engine oil to the racing and vintage car communities claiming their oils are “better” than off-the-shelf oils, and these products are often several times the price of off-the-shelf oils. Some of these oils are not API certified (which is a multi-million dollar process for all the required laboratory and field tests), so you have to be genuinely knowledgeable about engine oil formulation and reliably know the analysis of these oils to rationally determine whether they are even the equals of API certified oils. Otherwise, a slick sales pitch can scare you into believing that your precious vintage engine will disintegrate into a pile of dust if you don’t use their oil.

The next question is invariably: What brand? I refuse to name brands because it doesn’t make any difference! There is no “best brand!” As long as the label (usually the label on the back side of the package) has the API Service Symbol (sometimes called the “donut”) with “CJ-4”(or CI-4) as the first listed service category, the product, within reasonable tolerance, is essentially the same as any other API CJ-4 or CI-4.

There are scores of C-category oils on the market, but you will typically run across three national brands marketed by major oil companies like Chevron-Texaco, Exxon-Mobil, and Royal Dutch Shell and often “house brands”. The general motoring public is totally ignorant of the API service category system and even most “car guys” of my acquaintance seem to know little or nothing about the subject, so start your education by reading some labels. The tip-off on the front label may be words like “diesel” “Delo”, “Delvac”, “Rotella”, “universal motor oil”, “fleet oil”, and

“15W-40”; and don’t be afraid to buy a house brand C-category oil from a reputable retailer like Walmart or the major auto parts chains. The contents are certified C-category oil packaged by an API licensed company under contact to the retailer with their house label. Retailers usually shelf C-category oils together, but they may be in a different section than S-category oils. I never fail to see a selection of C-category oils at any auto parts or big box store I visit.

The commonly available 15W-40 viscosity range is suitable for cold starts down to about 10-15 degrees F (or around -10 C) and will likely meet the needs of 99-plus percent of vintage car owners. If cold starts below this range will be common, use the 5W-40 “synthetic” version, which is blended with more higher viscosity index Group II and Group III hydroprocessed base stocks; 10W-30 is also available in some brands, but may not be commonly stocked at automotive retailers, particularly in warmer climates. Most national brand Web sites have product data sheets on all their engine oils that include available viscosity grades and chemical analysis. Google is your friend.

Once CJ-4 certification is achieved, certain secondary categories may be listed, however, the marketer may choose not to do so. You may find other C-categories and a S-category listed after the primary C-category because if the primary service category - the first listed service category - is “C”, the S-category phosphorous limitation does not apply, so CJ-4/SM is common; however, the use of more than one S-category is prohibited regardless of the primary category. “CI-4 Plus” indicates a formulation with enhanced soot handling capabilities for diesel engines. Since soot is not an issue in spark ignition engines you can be indifferent to CI-4 Plus. See the accompanying examples of acceptable (primary) CJ-4 service category symbols.

These subtle and somewhat confusing details can be gleaned from the API 1509 document that is referenced below. If secondary categories confuse you, ignore them and only pay attention to the first listed service category, which is the primary service category, and you want it to be CJ-4 or CI-4.

It is relatively easy to become your own oil expert and make your own sound engine oil choices rather than trying to sort through all the myths and misinformation or listening to salesmen or “experts” who may have absolutely no technical/professional background in the automotive or petroleum industries. The first thing you should do is take the “Fundamentals of Lubrication” and “CJ-4” courses at www.lubricantsuniversity.com

Do you know the difference between boundary lubrication and hydrodynamic lubrication? If not, you need to take these courses, which will take about an hour.

Also, download and print the API Engine Oil Guide:

http://www.api.org/certifications/engineoil/pubs/upload/EngineOilGuide_March2010.pdf

Another good information source on engine oil and other automotive lubricants is:

<http://lubricants.s5.com>

For further information including an explanation of the five engine oil base stock Groups and why the term “synthetic” is meaningless as it relates to motor oil, download and read the 129 page pdf document – API 1509 Engine Oil Licensing and Certification System along with Appendices E and F that you will find at:

<http://www.api.org/certifications/engineoil/pubs/index.cfm>

For a couple of hours effort you will know more about engine oil than 99-plus percent of the self-proclaimed “experts”, and you will be able to make intelligent and economical engine oil choices for all your vehicles.

[Caption for figure containing three API CJ-4 certification symbols]



Typical primary category CJ-4 API service category symbols with various acceptable secondary categories.
(Symbols courtesy of The American Petroleum Institute)

About the Author:

Duke Williams is a retired automotive and aerospace engineer and holds a Master's Degree in Mechanical Engineering from the University of Wisconsin Engine Research Center. He is the original owner of a 340 horsepower 1963 Corvette Coupe and a 1976 Cosworth Vega and has been involved with restoration and racing since he was a teenager. He resides in Redondo Beach, California and is a member of the National Corvette Restorers' Society, Southern California Chapter and the Cosworth Vega Owners' Association