

Engine oils tested and analysed

Most technically inclined gearheads understand the value of real world, motor oil "load carrying capacity/film strength" testing. The results show us how various oils compare when it comes to wear protection. And we can use that information to make an informed decision as to which oil we want to select for our engines.

Though, there are some folks who are extremely set in their beliefs about what they've always been told and read, regarding high zinc oils providing excellent wear protection. But, the truth is, like all things in life, motor oils are NOT all created equal. And some oils are simply better than others, no matter what their zinc levels are. Anyone would have to be delusional to think otherwise. And "Wear Testing", RATHER THAN ZINC LEVELS ALONE, can show us how various oils stack up against each other regarding wear protection capability, as you will see in the real world test data below.

Some folks, who REALLY believe the notion that more zinc in their oil will provide more wear protection, often throw a tizzy fit and get very nasty when test data shows a low zinc oil providing better wear protection than a high zinc oil. But, the fact is, behavior like that will NOT change the facts regarding what oils provide excellent wear protection and what oils do not. However, to keep everyone's blood pressure down this time, we'll look at ONLY HIGH ZINC OILS here. That way, all the oils are on an even playing field. However, true zinc lovers will no doubt be disappointed, because not all high zinc oils tested well, even though they all have plenty of zinc.

And keep in mind for comparison with the oils below, that earlier oil industry testing has found that above 1,400 ppm, ZDDP INCREASED long term wear, even though break-in wear was reduced. And it was also found that ZDDP above 2,000 ppm, started attacking the grain boundaries in the iron, resulting in camshaft spalling. So, no matter what zinc fans might "believe", there is such a thing as "too much of a good thing".

The following group of 40 oils have zinc levels above 1100 ppm, and are ranked according to their "load carrying capacity/film strength", or in other words, their "wear protection capability", at 230°F. The tests were repeated multiple times for each oil, and even though all the results for each oil were consistent within a few percent, those results were averaged to arrive at the most accurate and representative final psi numbers shown below. And every single oil was tested EXACTLY THE SAME, so they all had the same opportunity to perform as well as their chemical formulation would allow.

But, before we get into the ranking list of those 40 oils, let's take a closer look at one of those oils in particular. The oil is:

10W40 Summit Racing Premium Racing Oil, API SL conventional
The bottle makes some bold claims, such as:

- * Double the zinc for superior flat tappet cam protection.

- * The additive package contains 1800 ppm ZDDP, providing levels of protection unattainable from conventional motor oil. Provides excellent protection from metal to metal contact.

Problem is, this oil fell FAR SHORT of living up to that inflated boasting. These claims were obviously created by the Marketing Department with no regard for what this oil can actually do. This oil ranked a pathetic 85th out of the 94 new oils I've tested so far. And it ranked only 34th out of the 40 oils examined here. Once again, here is an oil with high levels of zinc that DID NOT help it perform very well, even among other high zinc oils. Buyer beware. Motor oils are among the worst products for false advertising.

Now let's consider the claim on its bottle of 1800ppm ZDDP. Since Oil Companies typically don't publish the ZDDP values of their oil, I sent this oil to Professional Lab, ALS Tribology in Sparks, Nevada, to see just what is really in it, and to see how that claim of 1800ppm ZDDP compares to reality. Here are the results that came back:

zinc = 1764 ppm
phos = 1974 ppm

NOTE: Most of the time, an oil's zinc level is higher than its phos level, but the phos level here is greater than the zinc level. That is NOT a typo. That is how this oil's results came back from the Lab. I've seen phos levels higher than zinc levels in approximately 40% of all the oils I've sent in for component level Lab Testing. So, it varies and just depends on a particular oil's formulation. And the values listed below are all just the way they came back from the Lab.

If you average the zinc and phos values of this Summit Racing Oil, you come up with 1869 ppm. And that value is of course more than the 1800 ppm ZDDP claimed, so it appears they've averaged the values and then rounded down to the nearest 100 ppm, to be on the conservative side.

And since the ZDDP values are not usually available for most oils, we'll calculate the ZDDP values for all the oils below, in the same manner as this oil, which should get us very close, if not right on target. But, for quick and dirty mental calculations, you can just figure the ZDDP value as approximately half way between the zinc and phos levels.

Here's the ranking list:

Wear protection reference categories are:

- *** Over 90,000 psi = OUTSTANDING protection

- *** 75,000 to 90,000 psi = GOOD protection

*** 60,000 to 75,000 psi = MODEST protection

*** Below 60,000 psi = UNDESIREABLE

The higher the psi number, the better the wear protection.

1. 10W30 Lucas Racing Only synthetic = 106,505 psi

zinc = 2642 ppm

phos = 3489 ppm

ZDDP= 3000 ppm

NOTE: This oil is suitable for short term racing use only, and is not suitable for street use.

2. 10W30 Valvoline NSL (Not Street Legal) Conventional Racing Oil = 103,846 psi

zinc = 1669 ppm

phos = 1518 ppm

ZDDP = 1500 ppm

NOTE: Due to its very low TBN value, this oil is only suitable for short term racing use, and is not suitable for street use.

3. 10W30 Valvoline VR1 Conventional Racing Oil (silver bottle) = 103,505 psi

zinc = 1472 ppm

phos = 1544 ppm

ZDDP = 1500 ppm

4. 10W30 Valvoline VR1 Synthetic Racing Oil, API SL (black bottle) = 101,139 psi

zinc = 1180 ppm

phos = 1112 ppm

ZDDP = 1100 ppm

5. 30 wt Red Line Race Oil synthetic = 96,470 psi

zinc = 2207 ppm

phos = 2052 ppm

ZDDP = 2100 ppm

NOTE: This oil is suitable for short term racing use only, and is not suitable for street use.

6. 10W30 Amsoil Z-Rod Oil synthetic = 95,360 psi

zinc = 1431 ppm

phos = 1441 ppm

ZDDP = 1400 ppm

7. 10W30 Quaker State Defy, API SL semi-synthetic = 90,226 psi

zinc = 1221 ppm

phos = 955 ppm

ZDDP = 1000 ppm

8. 10W30 Joe Gibbs HR4 Hotrod Oil synthetic = 86,270 psi

zinc = 1247 ppm

phos = 1137 ppm

ZDDP = 1100 ppm

9. 15W40 RED LINE Diesel Oil synthetic, API CJ-4/CI-4 PLUS/CI-4/CF/CH-4/CF-4/SM/SL/SH/EO-O = 85,663 psi

zinc = 1615 ppm

phos = 1551 ppm

ZDDP = 1500 ppm

10. 5W30 Lucas API SM synthetic = 76,584 psi

zinc = 1134 ppm

phos = 666 ppm

ZDDP = 900 ppm

11. 5W50 Castrol Edge with Syntec API SN, synthetic, formerly Castrol Syntec, black bottle = 75,409 psi

zinc = 1252 ppm

phos = 1197 ppm

ZDDP = 1200 ppm

12. 5W30 Royal Purple XPR (Extreme Performance Racing) synthetic = 74,860 psi

zinc = 1421 ppm

phos = 1338 ppm

ZDDP = 1300 ppm

13. 5W40 MOBIL 1 TURBO DIESEL TRUCK synthetic, API CJ-4, CI-4 Plus, CI-4, CH-4 and ACEA E7 = 74,312 psi

zinc = 1211 ppm

phos = 1168 ppm

ZDDP = 1100 ppm

14. 15W40 CHEVRON DELO 400LE Diesel Oil, conventional, API CJ-4, CI-4 Plus, CH-4, CF-4,CF/SM, = 73,520 psi
zinc = 1519 ppm
phos = 1139 ppm
ZDDP = 1300 ppm

15. 15W40 MOBIL DELVAC 1300 SUPER Diesel Oil conventional, API CJ-4, CI-4 Plus, CI-4, CH-4/SM, SL = 73,300 psi
zinc = 1297 ppm
phos = 1944 ppm
ZDDP = 1600 ppm

16. 15W40 Farm Rated Heavy Duty Performance Diesel, CI-4, CH-4, CG-4, CF/SL, SJ (conventional) = 73,176 psi
zinc = 1325ppm
phos = 1234 ppm
ZDDP = 1200 ppm

17. 15W40 "NEW" SHELL ROTELLA T Diesel Oil conventional, API CJ-4, CI-4 Plus, CH-4, CF-4,CF/SM = 72,022 psi
zinc = 1454 ppm
phos = 1062 ppm
ZDDP = 1200 ppm

18. 0W30 Brad Penn, Penn Grade 1 (semi-synthetic) = 71,377 psi
zinc = 1621 ppm
phos = 1437 ppm
ZDDP = 1500 ppm

19. 15W40 "OLD" SHELL ROTELLA T Diesel Oil conventional, API CI-4 PLUS, CI-4, CH-4,CG-4,CF-4,CF/SL, SJ, SH = 71,214 psi
zinc = 1171 ppm
phos = 1186 ppm
ZDDP = 1100 ppm

20. 10W30 Brad Penn, Penn Grade 1 (semi-synthetic) = 71,206 psi
zinc = 1557 ppm
phos = 1651 ppm
ZDDP = 1600 ppm

21. 15W50 Mobil 1, API SN synthetic = 70,235 psi
zinc = 1133 ppm
phos = 1,168 ppm
ZDDP = 1100 ppm

22. 30wt Edelbrock Break-In Oil conventional = 69,160 psi
zinc = 1545 ppm
phos = 1465 ppm
ZDDP = 1500 ppm

23. 10W40 Edelbrock synthetic = 68,603 psi
zinc = 1193 ppm
phos = 1146 ppm
ZDDP = 100 ppm

24. 15W40 LUCAS MAGNUM Diesel Oil, conventional, API CI-4,CH-4, CG-4, CF-4, CF/SL = 66,476 psi
zinc = 1441 ppm
phos = 1234 ppm
ZDDP = 1300 ppm

25. 10W30 Royal Purple HPS (High Performance Street) synthetic = 66,211 psi
zinc = 1774 ppm
phos = 1347 ppm
ZDDP = 1500 ppm

26. 10W40 Valvoline 4 Stroke Motorcycle Oil conventional, API SJ = 65,553 psi
zinc = 1154 ppm
phos = 1075 ppm
ZDDP = 1100 ppm

27. 5W30 Klotz Estorlin Racing Oil, API SL synthetic = 64,175 psi
zinc = 1765 ppm
phos = 2468 ppm
ZDDP = 2100 ppm

28. "ZDDPlus" added to Royal Purple 20W50, API SN, synthetic = 63,595 psi

zinc = 2436 ppm (up 1848 ppm)
phos = 2053 ppm (up 1356 ppm)
ZDDP = 2200 ppm

The amount of ZDDPlus added to the oil, was the exact amount the manufacturer called for on the bottle. And the resulting psi value here was 24% LOWER than this oil had BEFORE the ZDDPlus was added to it. Most major Oil Companies say to NEVER add anything to their oils, because adding anything will upset the carefully balanced additive package, and ruin the oil's chemical composition. And that is precisely what we see here. Adding ZDDPlus SIGNIFICANTLY REDUCED this oil's wear prevention capability. Just the opposite of what was promised. Buyer beware.

29. Royal Purple 10W30 Break-In Oil conventional = 62,931 psi

zinc = 1170 ppm
phos = 1039 ppm
ZDDP = 1100 ppm

30. 10W30 Lucas Hot Rod & Classic Hi-Performance Oil, conventional = 62,538 psi

zinc = 2116 ppm
phos = 1855 ppm
ZDDP = 1900 ppm

31. 10W30 Comp Cams Muscle Car & Street Rod Oil, synthetic blend = 60,413 psi

zinc = 1673 ppm
phos = 1114 ppm
ZDDP = 1300 ppm

32. 10W40 Torco TR-1 Racing Oil with MPZ conventional = 59,905 psi

zinc = 1456 ppm
phos = 1150 ppm
ZDDP = 1300 ppm

33. "ZDDPlus" added to O'Reilly (house brand) 5W30, API SN, conventional = 56,728 psi

zinc = 2711 ppm (up 1848 ppm)
phos = 2172 ppm (up 1356 ppm)
ZDDP = 2400 ppm

The amount of ZDDPlus added to the oil, was the exact amount the manufacturer called for on the bottle. And the resulting psi value here was 38% LOWER than this oil had BEFORE the ZDDPlus was added to it. Adding ZDDPlus SIGNIFICANTLY REDUCED this oil's wear prevention capability. Just the opposite of what was promised. Buyer beware.

34. 10W40 Summit Racing Premium Racing Oil, API SL conventional = 59,483 psi

zinc = 1764 ppm
phos = 1974 ppm
Claimed ZDDP level on the bottle = 1800 ppm

NOTE: Summit discontinued this line of oil, as of spring of 2013.

35. "ZDDPlus" added to Motorcraft 5W30, API SN, synthetic = 56,243 psi

zinc = 2955 ppm (up 1848 ppm)
phos = 2114 ppm (up 1356 ppm)
ZDDP = 2500 ppm

The amount of ZDDPlus added to the oil, was the exact amount the manufacturer called for on the bottle. And the resulting psi value here was 12% LOWER than this oil had BEFORE the ZDDPlus was added to it. Adding ZDDPlus SIGNIFICANTLY REDUCED this oil's wear prevention capability. Just the opposite of what was promised. Buyer beware.

36. "Edelbrock Zinc Additive" added to Royal Purple 5W30, API SN, synthetic = 54,044 psi

zinc = 1515 ppm (up 573 ppm)
phos = 1334 ppm (up 517 ppm)
ZDDP = 1400 ppm

The amount of Edelbrock Zinc Additive added to the oil, was the exact amount the manufacturer called for on the bottle. And the resulting psi value here was a whopping 36% LOWER than this oil had BEFORE the Edelbrock Zinc Additive was added to it. Adding Edelbrock Zinc Additive SIGNIFICANTLY REDUCED this oil's wear prevention capability. Just the opposite of what was promised. Buyer beware.

37. 10W30 Comp Cams Break-In Oil conventional = 51,749 psi

zinc = 3004 ppm
phos = 2613 ppm
ZDDP = 2800 ppm

38. "Edelbrock Zinc Additive" added to Lucas 5W30, API SN, conventional = 51,545 psi

zinc = 1565 ppm (up 573 ppm)
phos = 1277 ppm (up 517 ppm)
ZDDP = 1400 ppm

The amount of Edelbrock Zinc Additive added to the oil, was the exact amount the manufacturer called for on the bottle. And the resulting psi value here was a "breath taking" 44% LOWER than this oil had BEFORE the Edelbrock Zinc Additive was added to it. Adding Edelbrock Zinc Additive SIGNIFICANTLY REDUCED this oil's wear prevention capability. Just the opposite of what was promised. Buyer beware.

39. "Edelbrock Zinc Additive" added to Motorcraft 5W30, API SN, synthetic = 50,202 psi
zinc = 1680 ppm (up 573 ppm)
phos = 1275 ppm (up 517 ppm)
ZDDP = 1400 ppm

The amount of Edelbrock Zinc Additive added to the oil, was the exact amount the manufacturer called for on the bottle. And the resulting psi value here was 22% LOWER than this oil had BEFORE the Edelbrock Zinc Additive was added to it. Adding Edelbrock Zinc Additive SIGNIFICANTLY REDUCED this oil's wear prevention capability. Just the opposite of what was promised. Buyer beware.

40. 30wt Lucas Break-In Oil conventional = 49,455 psi
zinc = 4483 ppm
phos = 3660 ppm
ZDDP = 4000 ppm

So, as you saw above, the highest ranking high zinc oil that provided the BEST WEAR PROTECTION of this group of 40 high zinc oils, had 3000 ppm ZDDP. But, the lowest ranking high zinc oil had one third MORE ZDDP at 4000 ppm. Even though this lowest ranked oil had far more zinc in it, it provided LESS THAN HALF AS MUCH WEAR PROTECTION, making it by far the worst of all 40 oils tested. Then the 4th place oil had only 1100 ppm ZDDP, and the 7th place oil had only 1000 ppm ZDDP.

So, the results above show 2 distinct things:

1. My tester and test procedure have no problem at all showing excellent performing high zinc oils. Therefore, no one can justifiably argue that my testing somehow works against high zinc oils. The absolute fact is, my oil testing performs worst case torture testing on motor oil. So, an oil HAS TO BE GOOD to produce good results. And we saw many high zinc oils with excellent results here. So, when the naysayers slam the value of my testing, they're also saying at the same time, that high zinc oils are no good, since my testing shows excellent high zinc oils to provide excellent protection. They can't have it both ways.

2. This is ABSOLUTE PROOF that not all high zinc oils have equal wear protection capabilities, which is the whole point I've been making for well over a year now. And why would anyone think that all high zinc oils are good? Not all tires are good. Not all cylinder heads are good. Not all camshafts are good. The world just doesn't work that way. Some high zinc oils are quite good and provide excellent wear protection, while other high zinc oils are not good at all, and provide rather poor wear protection. It just depends on the particular oil in question. And that makes it totally clear here, that you simply CANNOT predict an oil's wear protection capability by looking only at its zinc level. Life is just NOT that simple. If you only look at zinc levels, that is no better than guessing. So, if anyone tells you that you need high levels of zinc for more wear protection, even if it comes from a Cam Company, don't believe a word of it. Because as you can see above, they have no idea what they are talking about. Would you really want to use the 40th ranked last place oil simply because it has more zinc than the number one ranked oil here? That is just what you'd be doing if you believed the incorrect advice about only looking at zinc levels. The ONLY way to know for sure how much wear protection any given oil can provide, is to look at "dynamic wear testing under load" results, such as I have provided above.

My oil testing data is very similar in concept to dyno testing an engine. An engine dyno test is also dynamic testing under load. For the guys who just want to look at a motor oil zinc level reference chart, that is like looking at an engine's build sheet instead of its dyno print out. You can decide for yourself which provides more meaningful information.