D-A®
LUBRICANT COMPANY

PERFORMANCE ENGINEERED LUBRICANTS SINCE 1919

PENNGRADE®
HIGH PERFORMANCE OIL
The Original Green Oil.

PERFORMANCE & PROTECTION.
REVOLUTIONIZED.

100 YEARS 1919 D-A 2019 LUBRICANT COMPANY
TESTED • TRUSTED

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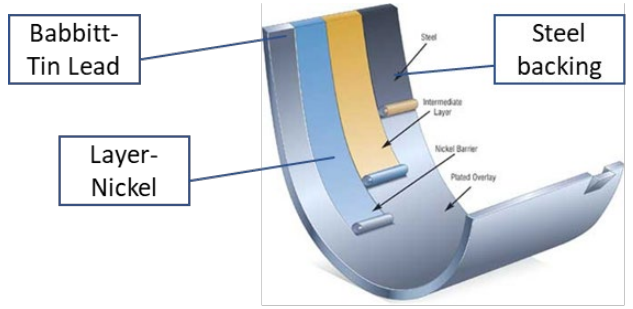
Performance Engineered Lubricants Since 1919

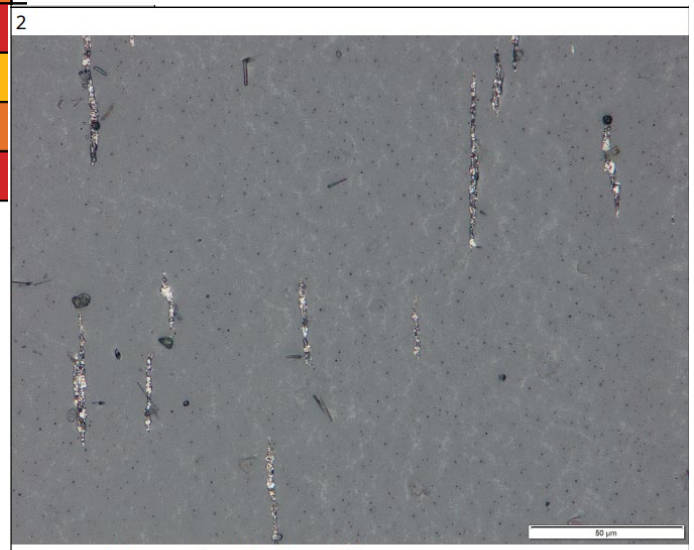
Racing Oil Sample Analysis

Why Is Racing Oil Analysis Different

- Usually, trends over several samples identify a problem.
- This one shows lots of copper plus lead and tin (Babbitt) over time and is cause for alarm.
- We suspected break-in wear. Ultra high copper is usually solubilized copper etching off new copper lines.
- Sure enough, Analytical Ferrography shows the actual wear debris.
- Anything of size is normal iron rubbing wear. Not copper.
- The Ferrogram confirms the engine is in good shape.
- Good news for this expensive diesel engine!

	Wear Metals (ppm)						
Sample #	Iron	Chromium	Nickel	Aluminum	Copper	Lead	Tin
11	38	1	0	2	81	9	8
12	11	0	0	3	29	3	3
13	35	1	0	3	127	9	9
14	53	1	0	2	**697**	10	**12**
15	17	0	0	3	167	5	4
16	22	0	0	0	64	5	7
17	60	1	0	3	316	**15**	**15**





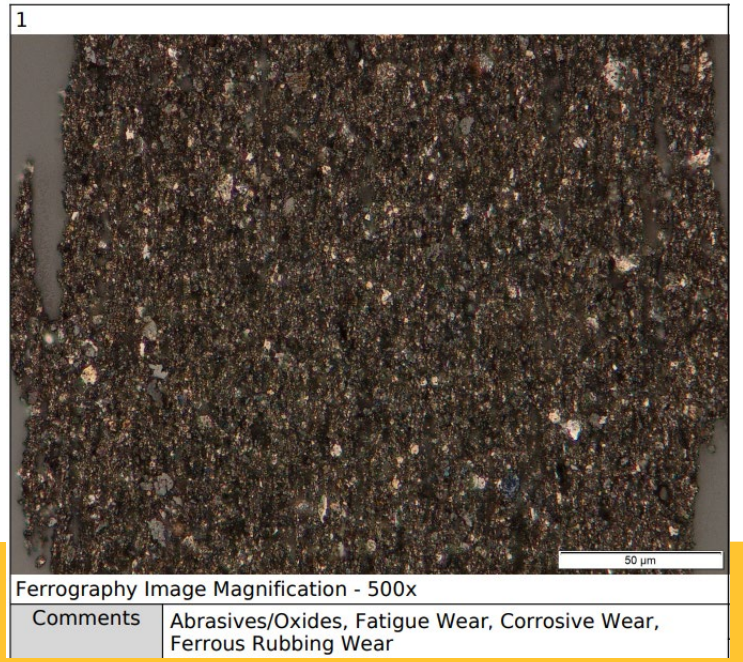
Ferrography Image Magnification - 500x

Comments	Rubbing Wear, Abrasives

Why Is Racing Oil Analysis Different

- But racing engines rarely run for thousands of hours and most change the oil very frequently.
- This is from an engine that failed quite rapidly. Pretty normal wear metals, yet the engine lost a piston / cylinder when the piston cooling jet became plugged.
- You can clearly see lots of wear debris in the Ferrogram but minimal wear metals with only 40 ppm iron and 20 ppm aluminum on the normal report!
- Why????

	Wear Metals (ppm)						
Sample #	Iron	Chromium	Nickel	Aluminum	Copper	Lead	Tin
BL	1	0	0	1	0	0	0
1	40	0	0	20	1	3	1



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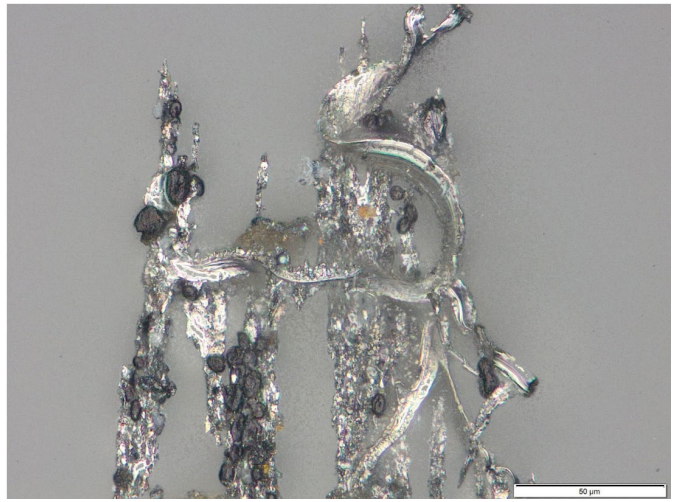
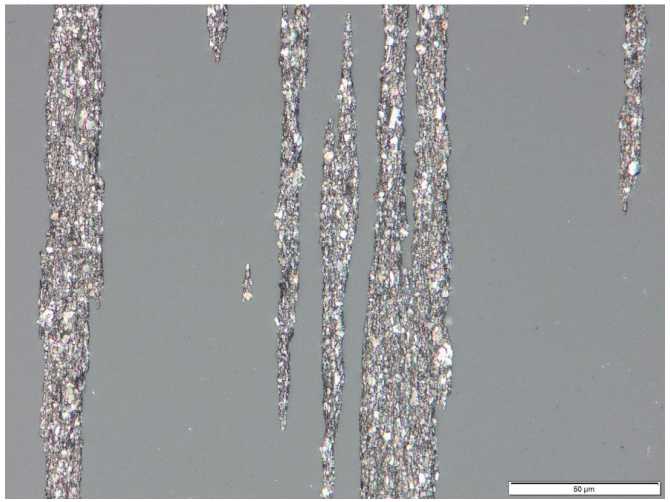
Oil Analysis- Metals

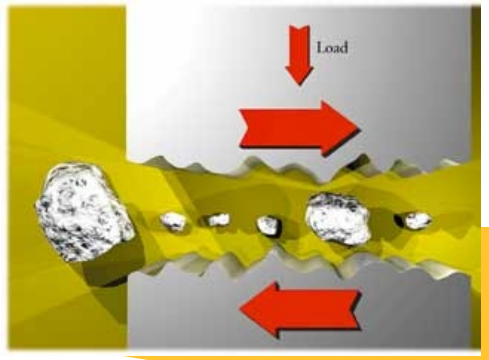
- 1 ppm (parts per million) = 1 second out of 11.5 days, 1 drop in 40 gallons
- The spectrograph (regular) test reports only the number of wear metal particles AND is **limited to particles 10 microns or smaller**
- So 1 micron particles show up very well but do little damage because they are so small.
- Particles larger than 10 microns do huge engine damage and are largely ignored by standard oil analysis.
- Ferrograms are too expensive to run every time so…..

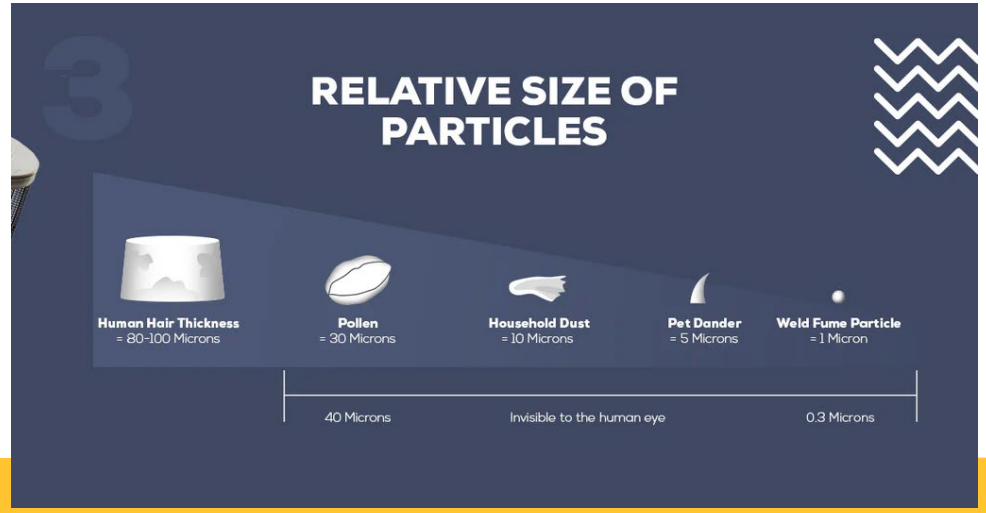


Catastrophic wear, >10 micron
Undetected



Normal wear, <10 micron
Detected and reported in ppm





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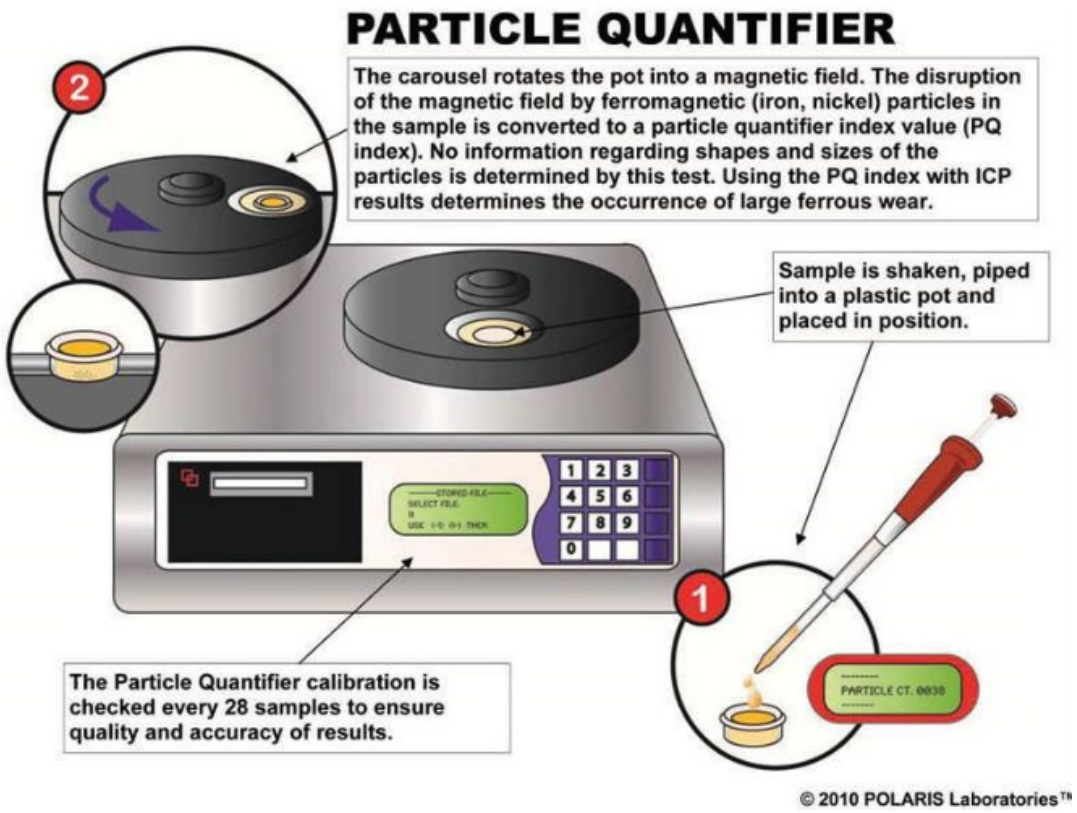
PQI- Quickly and efficiently finding larger wear debris.

- The PQI (Particle Quantifier Index) is a bulk magnetic index of the oil sample. The oil sample bottle is shaken and then placed in the instrument, which uses a magnetic field that is disturbed by any ferrous (magnetic) material in the sample, irrespective of size. The extent to which the magnetic field is disturbed is proportional to the total ferromagnetic content of the oil. The PQ is a unitless number, but it is quantitative and can be trended: the higher the number, the more ferrous debris present.
- Think of the PQI as the total amount of wear metal. If the regular analysis shows lots of wear metal and a high PQI then we likely found it all in the normal sample. However, if the PQI is high and regular analysis is low, we most likely have catastrophic wear taking place. This can trigger further analysis to determine the wear metal alloy and mechanism of wear, helping to pinpoint the problem.



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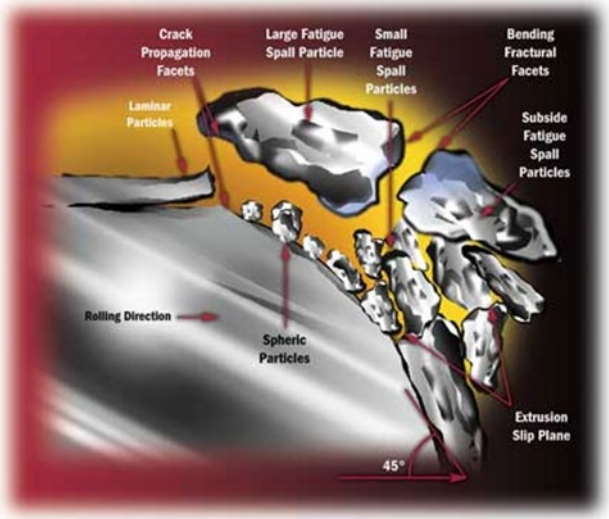
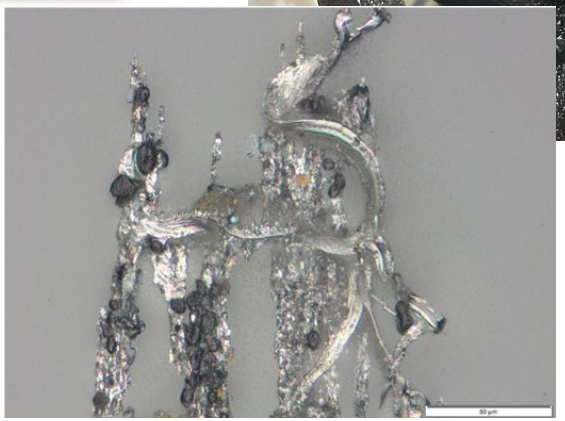
Why Is Racing Oil Analysis Different

- Racing engines run differently. Higher loads **tend to make larger wear metal particles**.
- Wear metal doesn't have much time to build up in the oil between changes.
- This failure happened in less than 6 seconds and **would not be spotted by regular oil analysis**.
- PQI identifies the potential problem which can be validated through Analytical Ferrography.
- **Problem can be solved knowing the mode of failure and the metals / alloys involved.**





Thank You From DA Lubricant!

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