



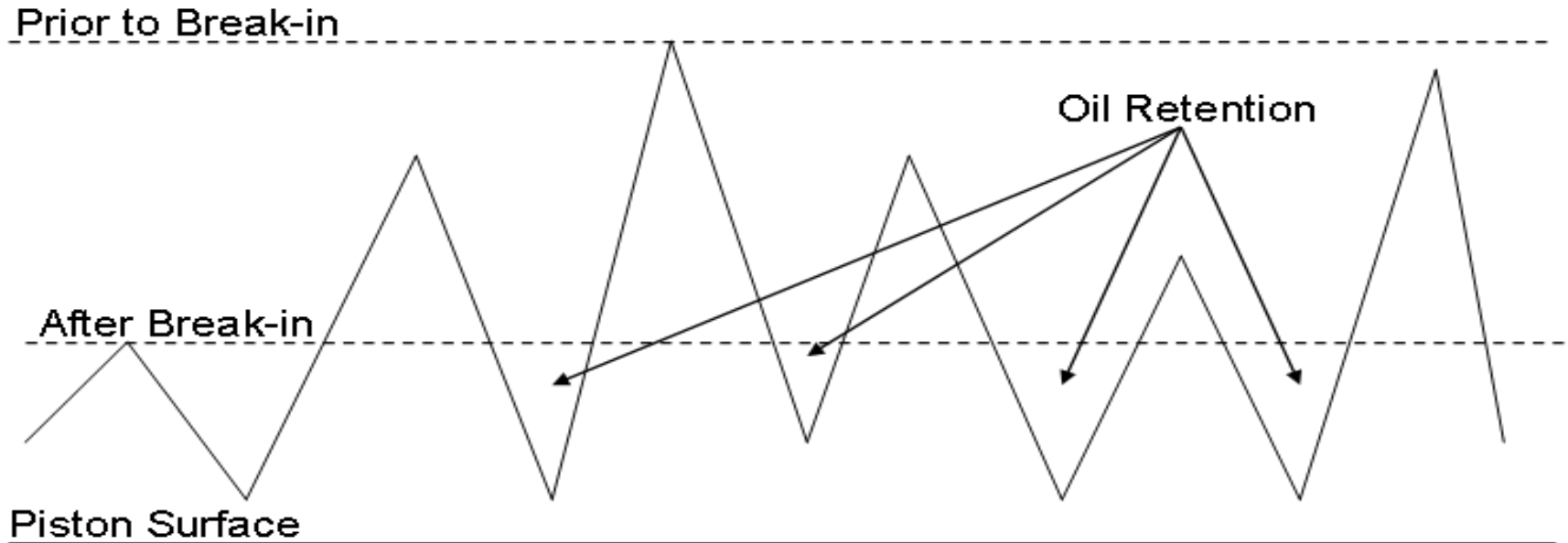
Introduction To Abradable Powder Coatings Part 2

Epartrade Webinar #444

March 27, 2024



Two dimensional side view of APC

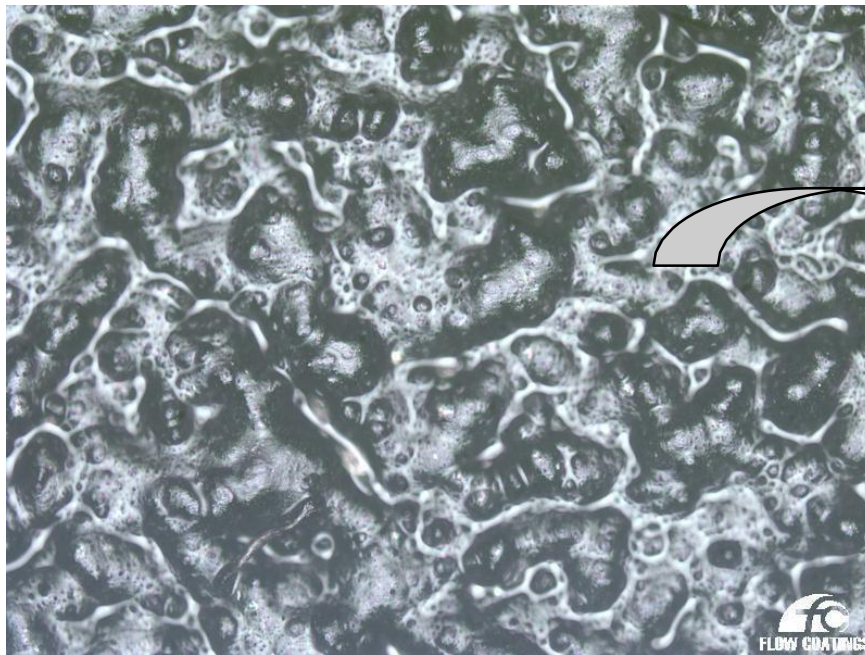


Self-polishing, AAPCs are 'rough / fuzzy' as applied. They wear into the shape of the mating surface upon initial operation. Lasting geometric refinements of components improve fit, efficiency and durability. Applications: lubricated/dry, hot/cold, sacrificial/permanent.

Prior to Break-In

Magnifications
~150X

After Break-In

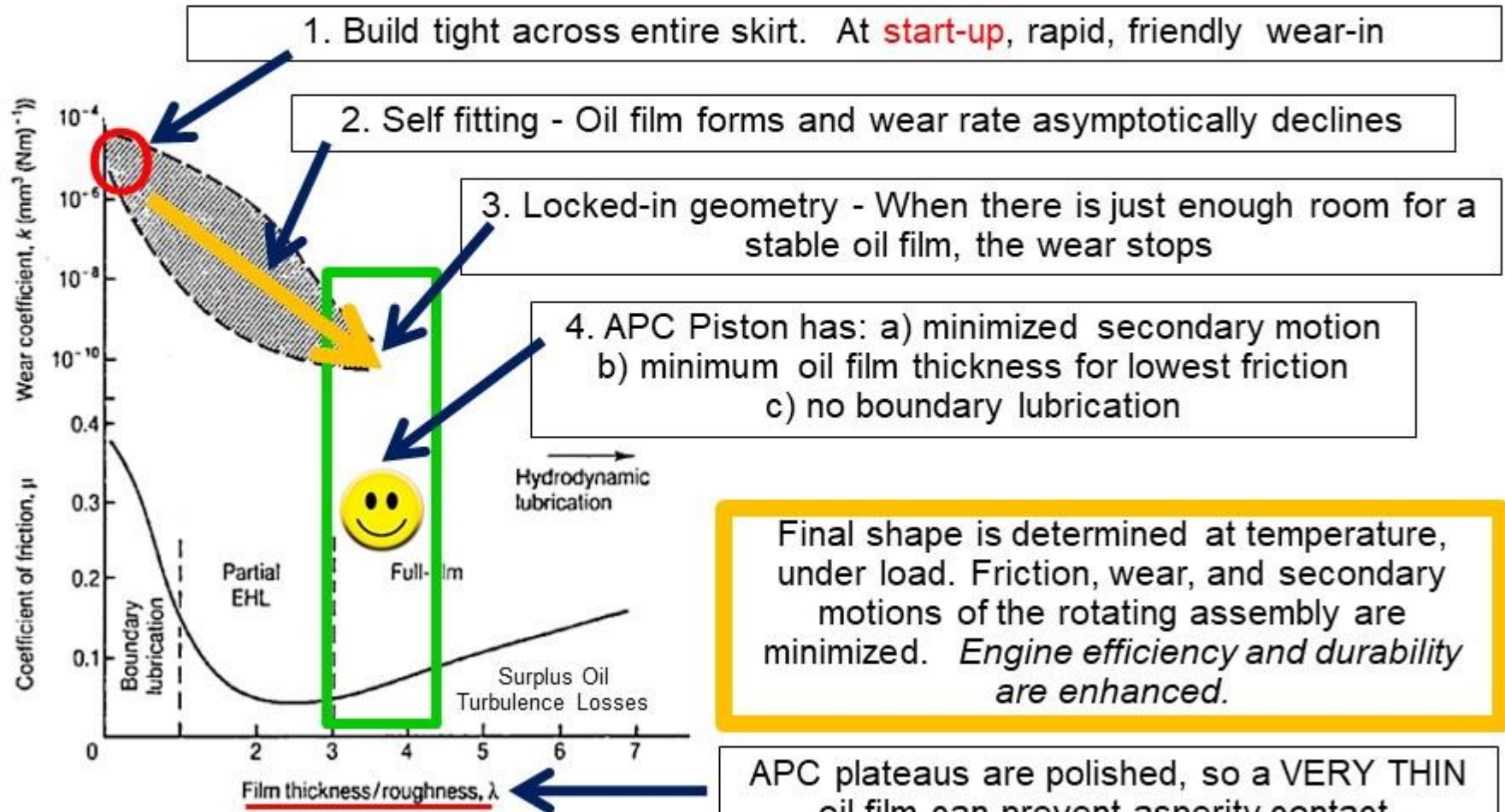


Initially, surface texture provides quick wear-in, followed by asymptotic decline in wear rate

Long term - ideal tribological surface has:

- Polished Plateaus (Low RpK)
- Random Crevices (High RvK)

Stribeck-Hutchings Fitting – Oiled Applications



Original Figure from: Tribology: Friction and Wear of Engineering Materials, Ian Hutchings, Elsevier Science, 1992.
Figure Modified by Suman 2013.

Liquid Coatings (Scuff Resistant)

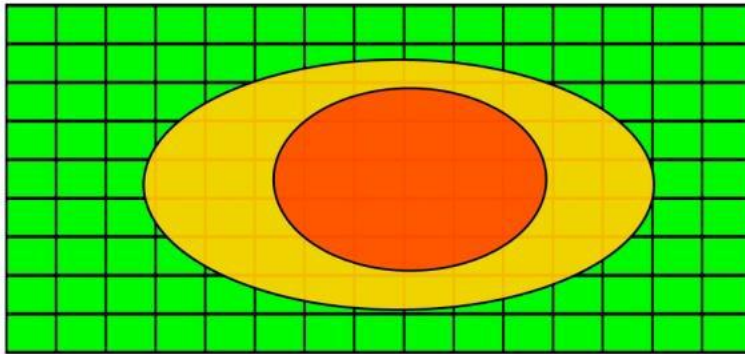


Figure 4A

Orange area is high stress on oil film, usually at the gage point. Pressure gradient between colors pushes oil out, sometimes allowing asperity contact between piston and bore. This creates friction and wear

Powder Coatings (Abradable Mechanism)

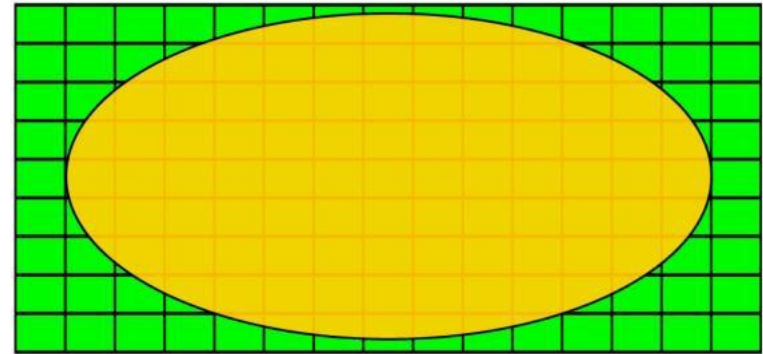


Figure 4B

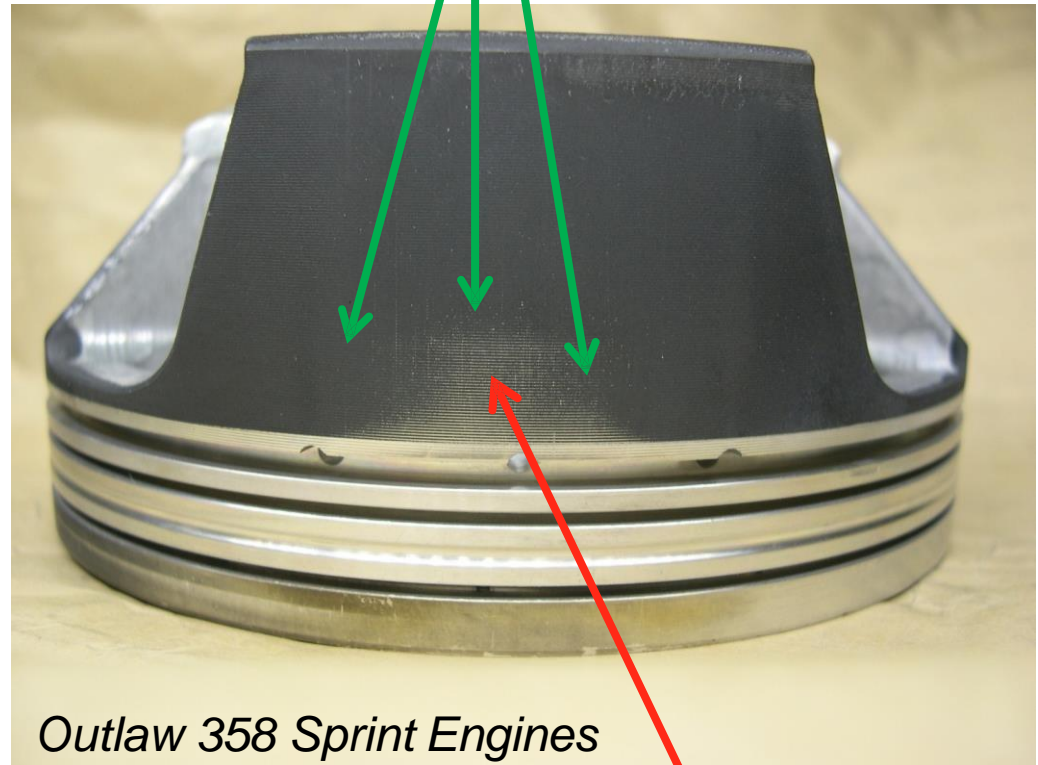
Self-fitting Abradable Coating wears more at the gage point, and ultimately creates a larger footprint with ideal oil film thickness. Load is transferred from peak area to adjacent areas. Uniform oil film pressure maintains stable oil film. Minimum friction and no wear after break-in.

AAPC Reduces Peak Loads and Prevents Scuffing

- Enables stiff architecture to achieve the perfect fit
- ...with no risk of scuffing

Scuffing Epidemic Cured

AAPC redistributes load to adjacent areas



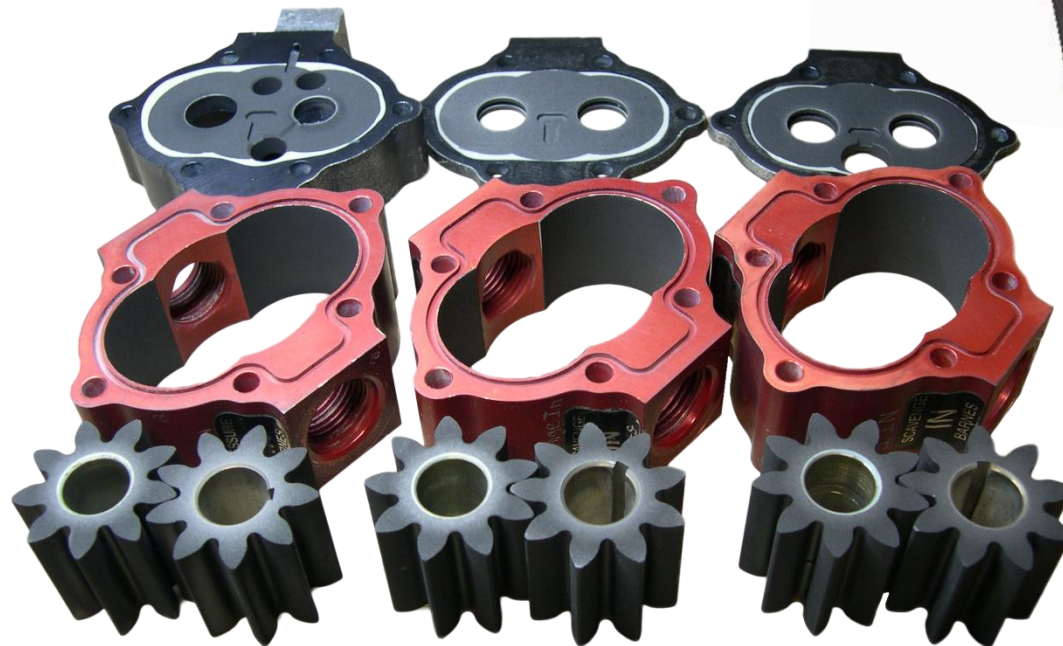
Outlaw 358 Sprint Engines

After duty cycle, highly loaded, scuff prone area is visible



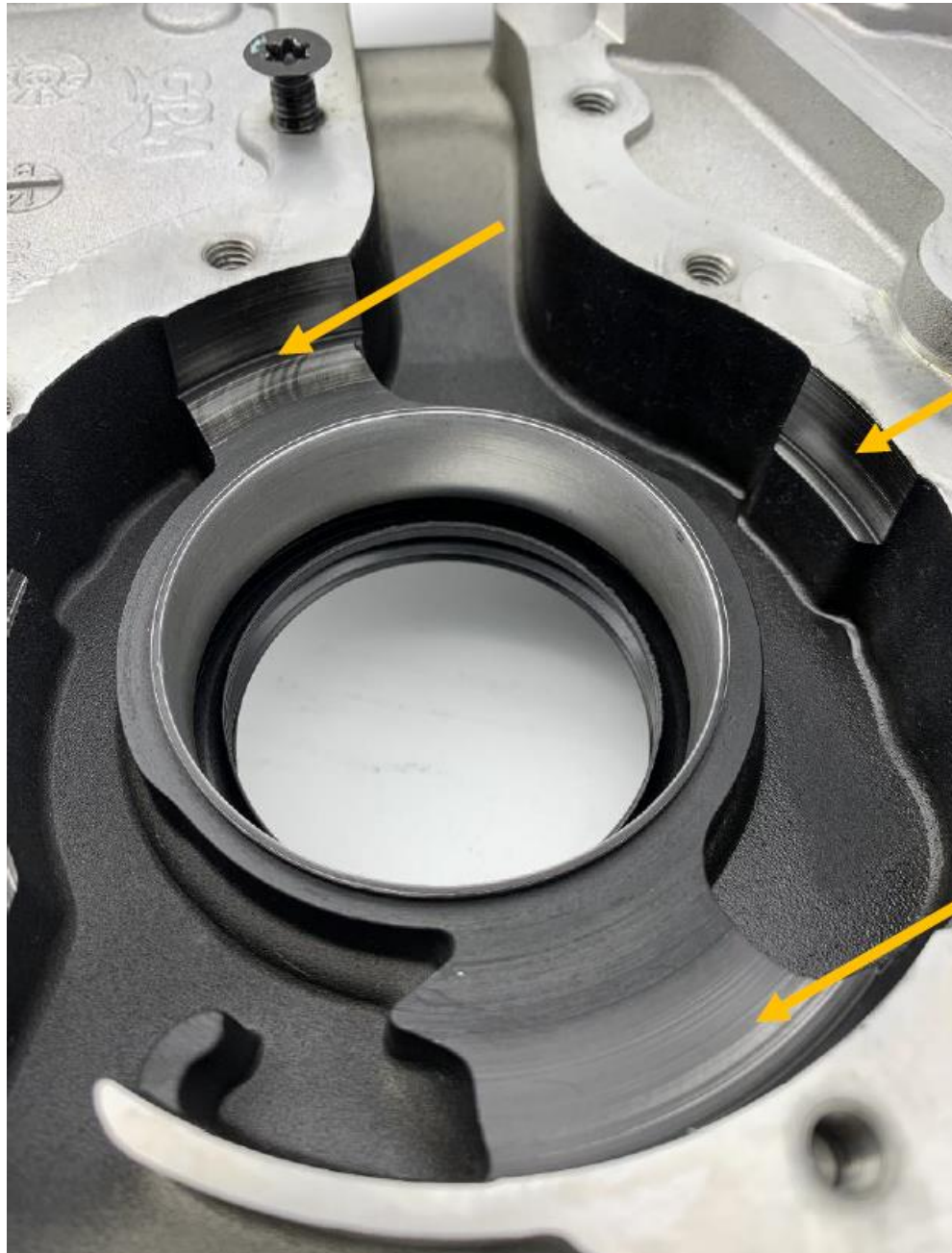




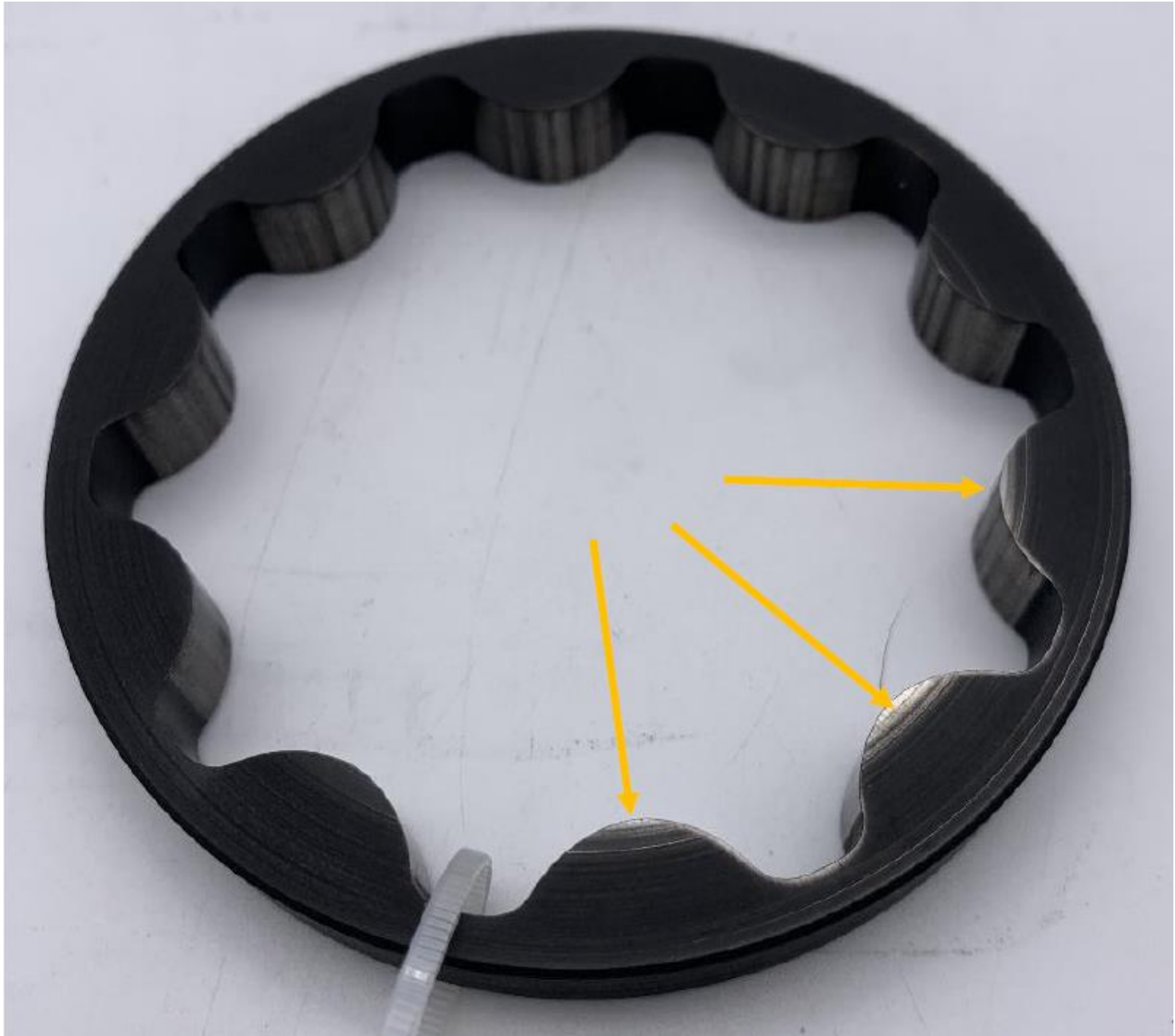




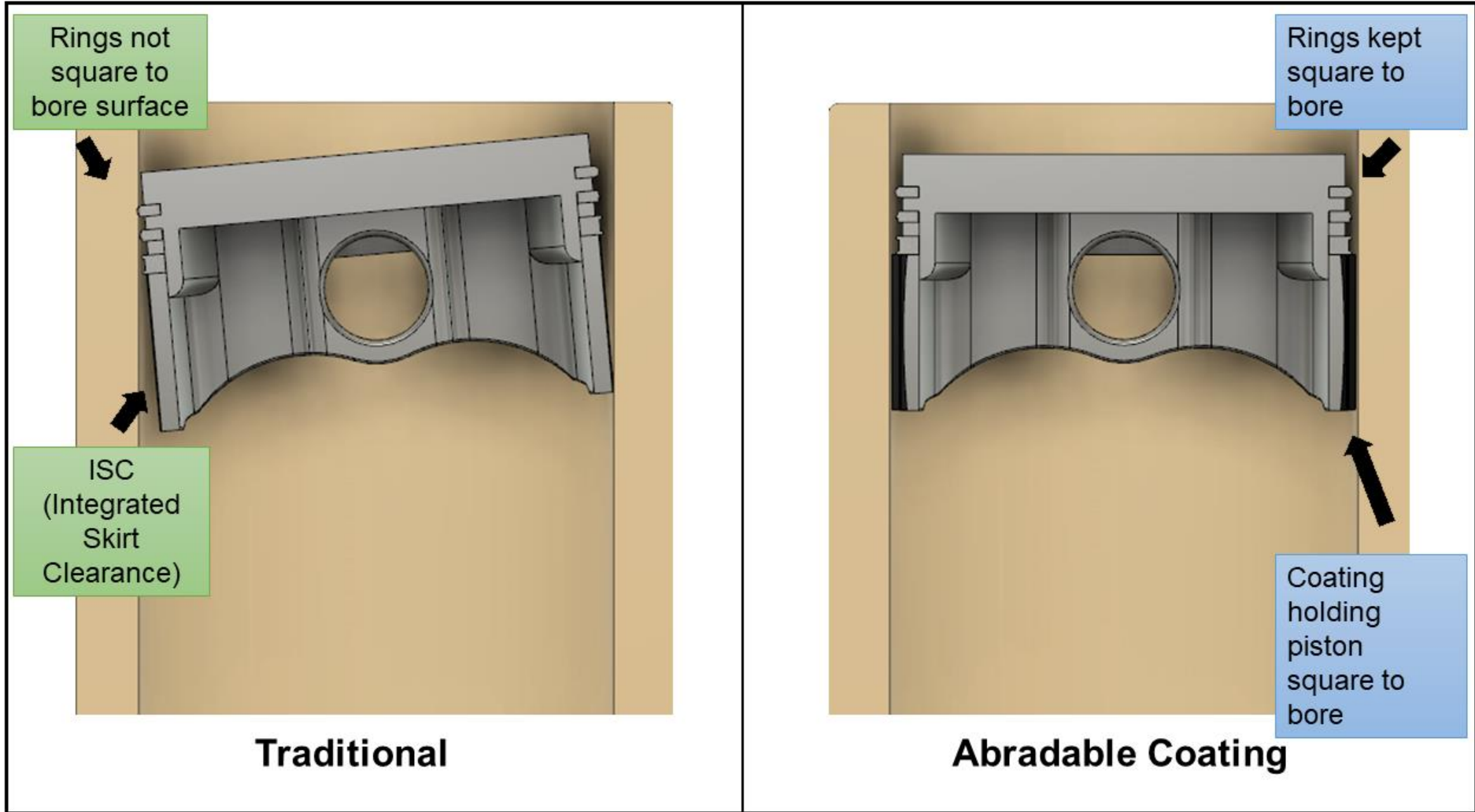
Any area that is still black after 250 hrs operation was a leak- built into in this modern, automotive oil pump.



Arrows=>Silver areas are perfectly fitting with no room for coating, so coating wears through in a controlled fashion.

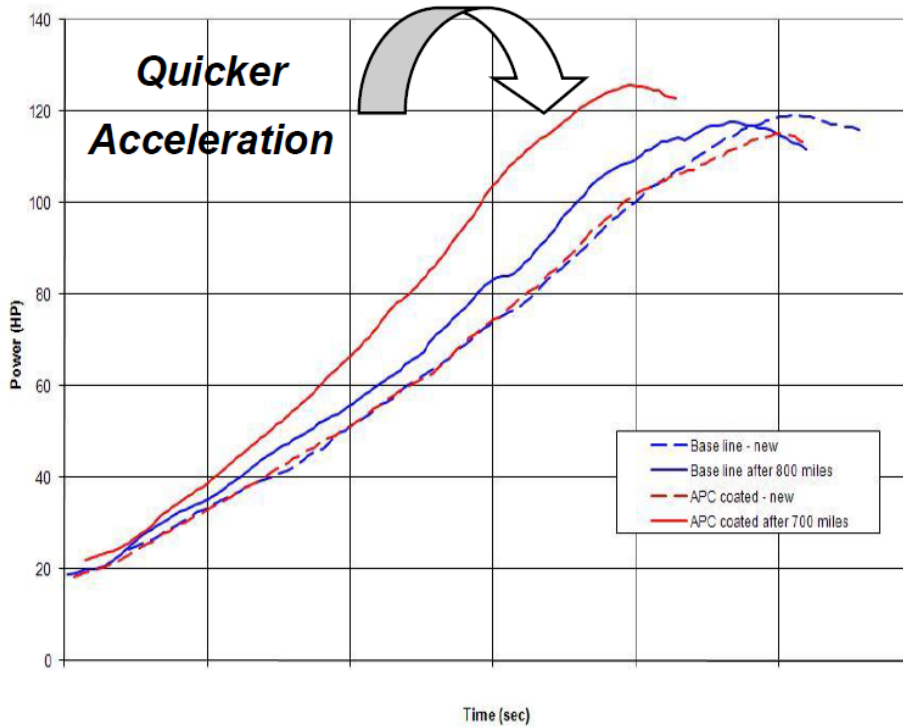




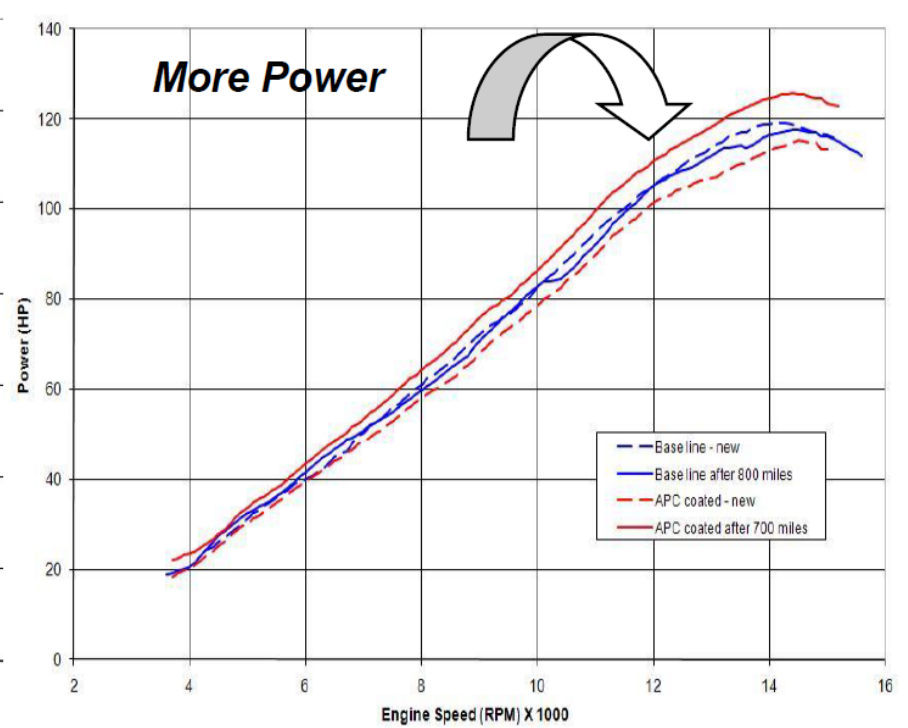


Safely Reduced ISC stabilizes piston and improves ring seal and ring life

WOT acceleration - stand



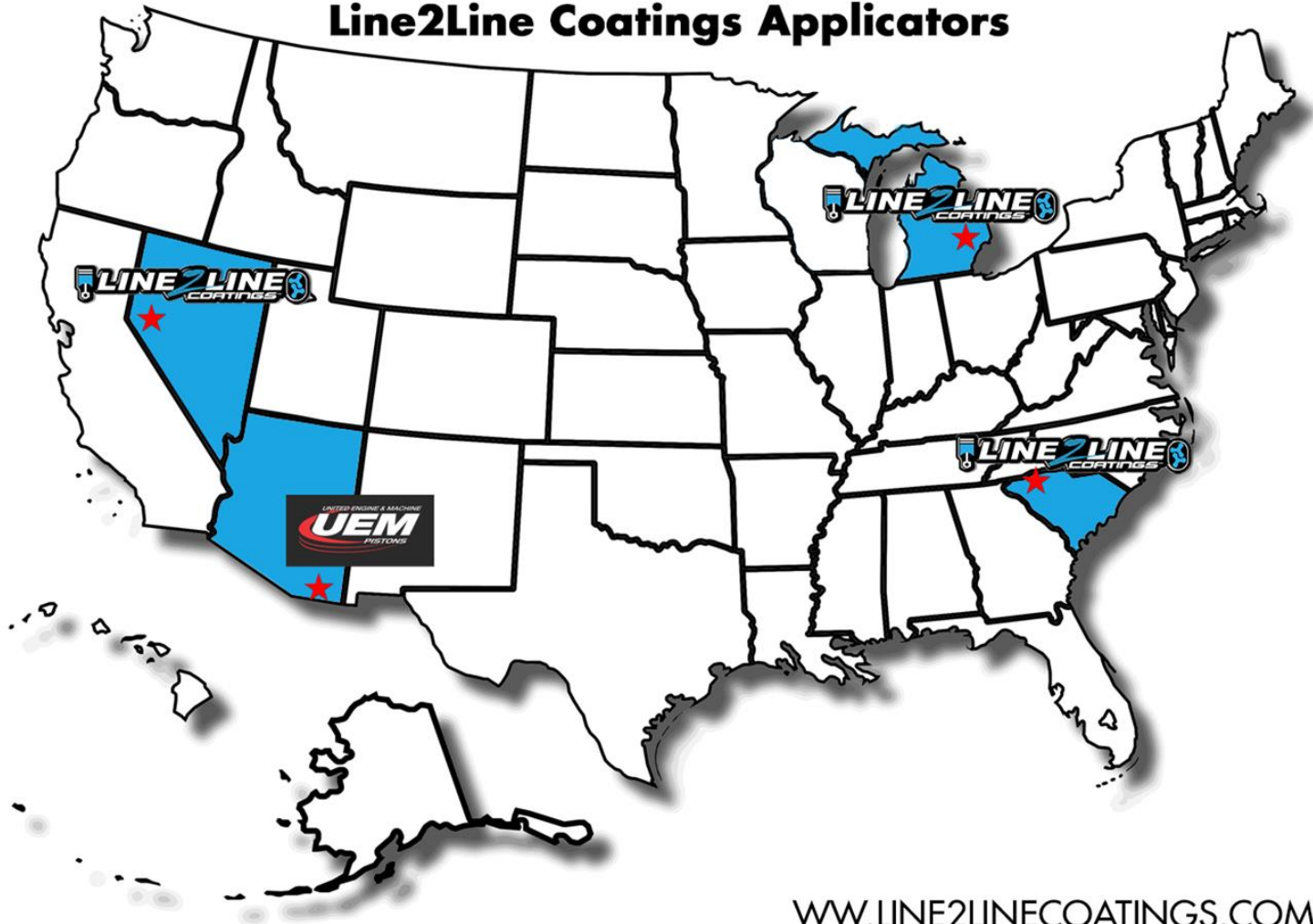
WOT acceleration - stand



A New Tool In Your Toolbox

- **DEVELOPMENT:** Witness marks, find shapes, protect components, reuse test parts
- **RACE:** Win - better fit with less friction, smooth operation, extreme use - rpm, heat
- **PRODUCTION:** Robust fitting, high precision because machines in place, high performance without scuffing/seizures, open machining specs,
- **RESTORATION:** Build up worn parts, fill in scratches, works many places, post machining is friendly

Line2Line Coatings Applicators



WWW.LINE2LINECOATINGS.COM



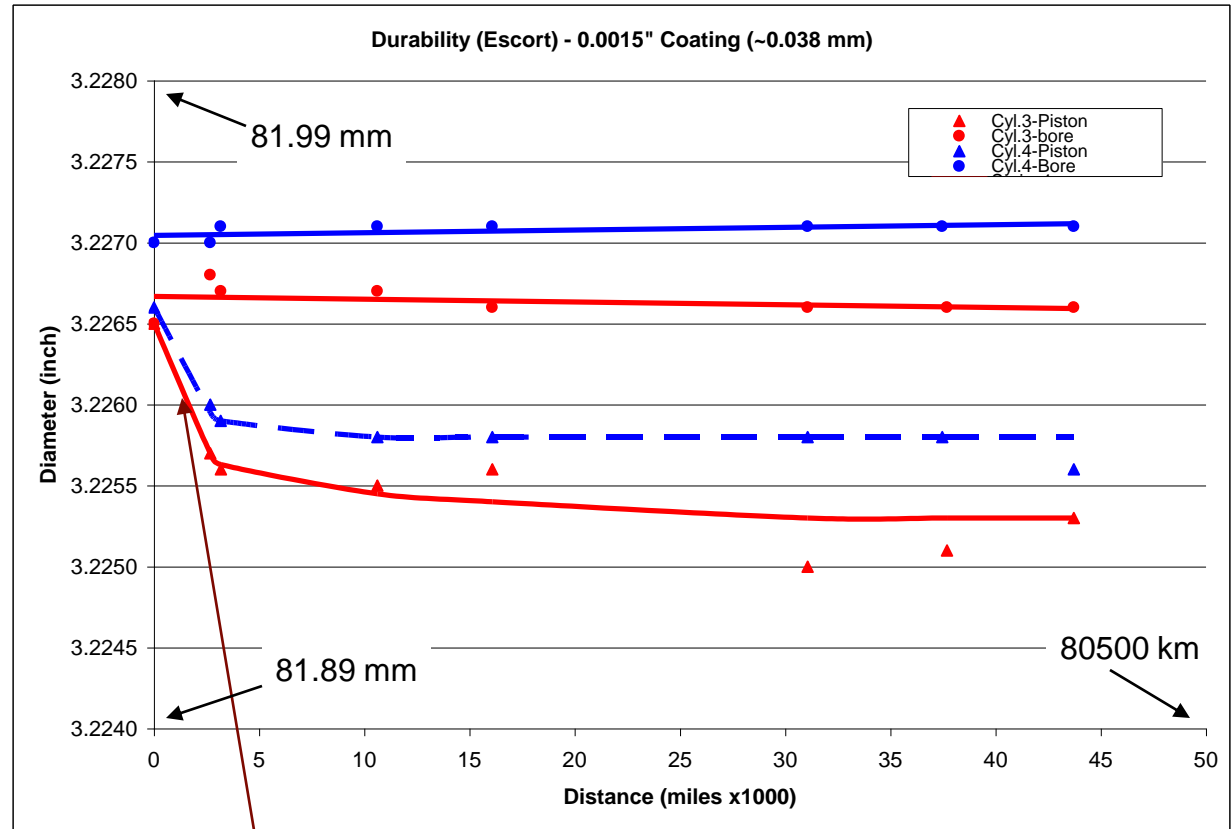
@ 10.6K miles



@ 16.2K miles



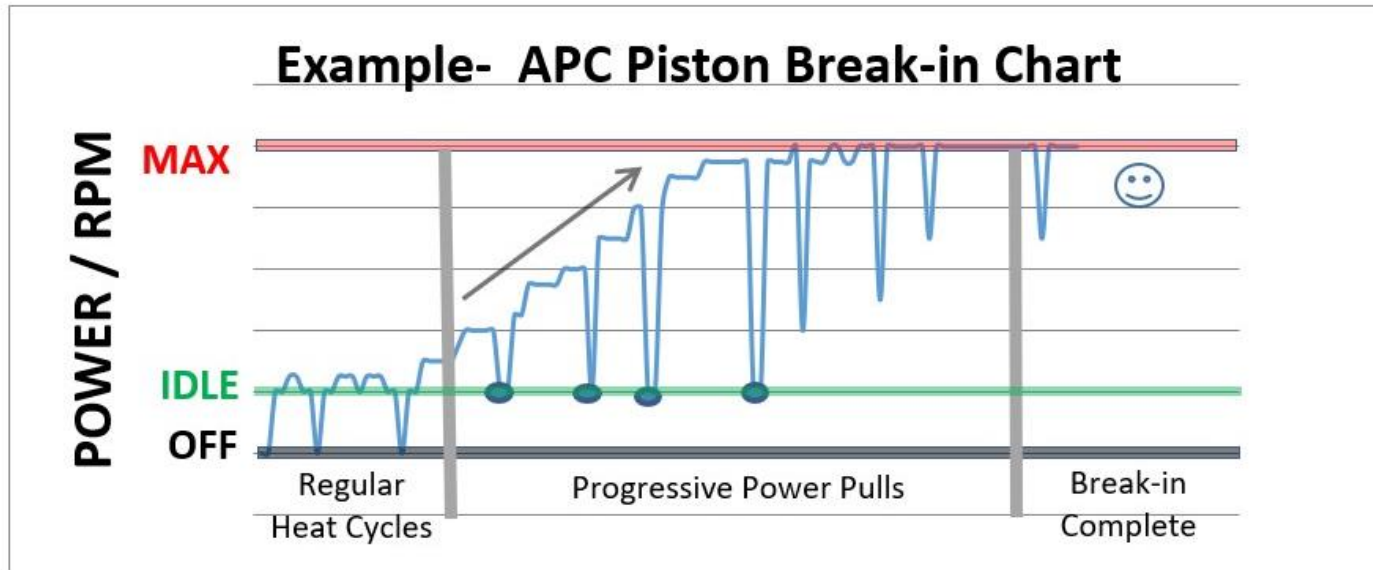
@ 43.7K miles



Most of Break-in occurs within 5-10 miles

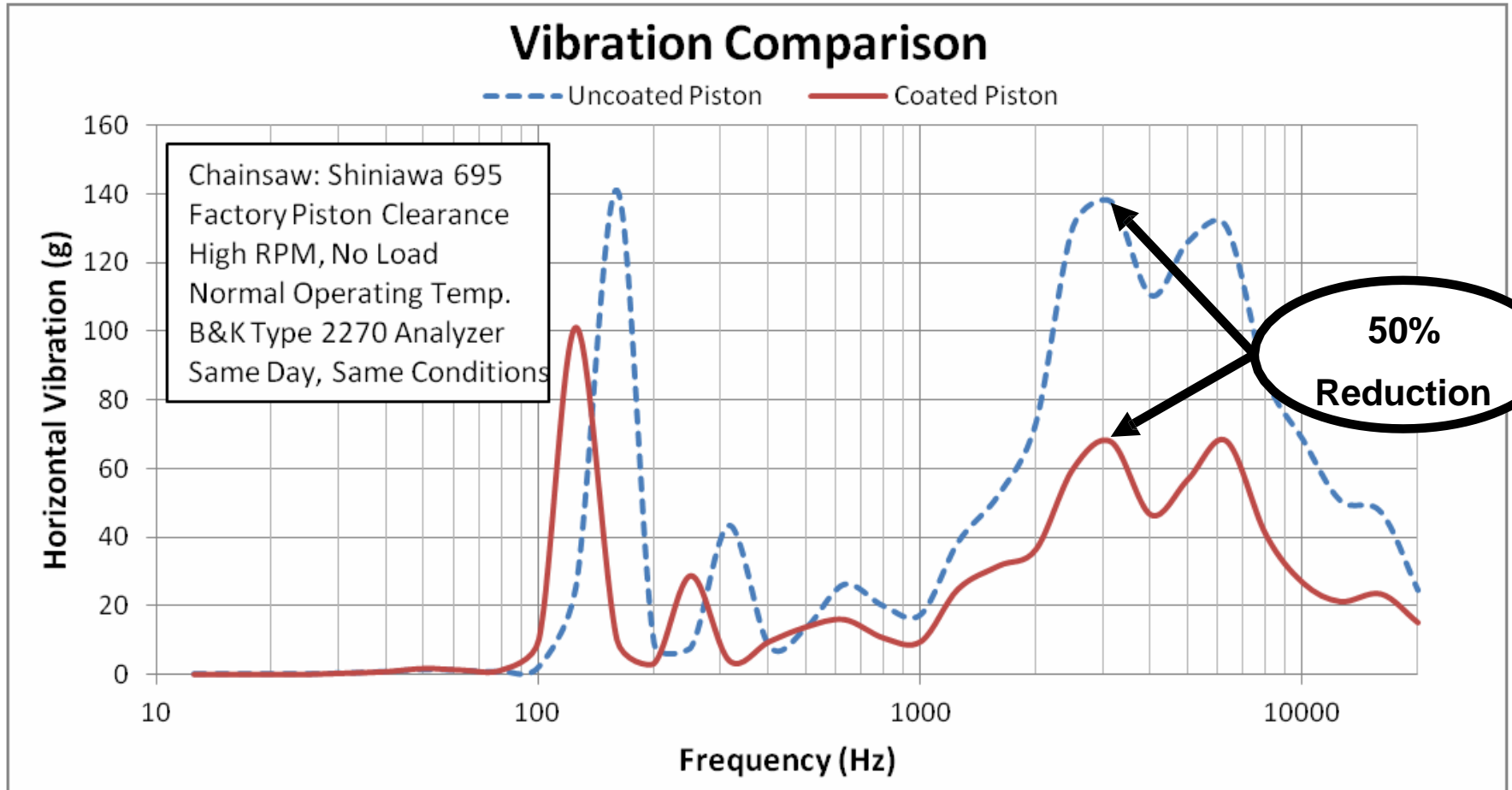
Asymptotic Wear Rate Decrease – Wear Stops

5. Refer to **Example- APC Piston Break-in Chart**. After normal break-in, give the engine time to fit pistons at each power level, idle briefly, progressively raise power levels until happy at full power. **Please note that dyno sweeps may not provide enough time for complete break-in. It's better to hold progressive power levels for approximately 5 seconds and let off for a minute before increasing to the next power level. The idea is to pinch the coating for a short time and then let the oil get back in. Each power cycle laps each piston closer to its perfect geometry!**



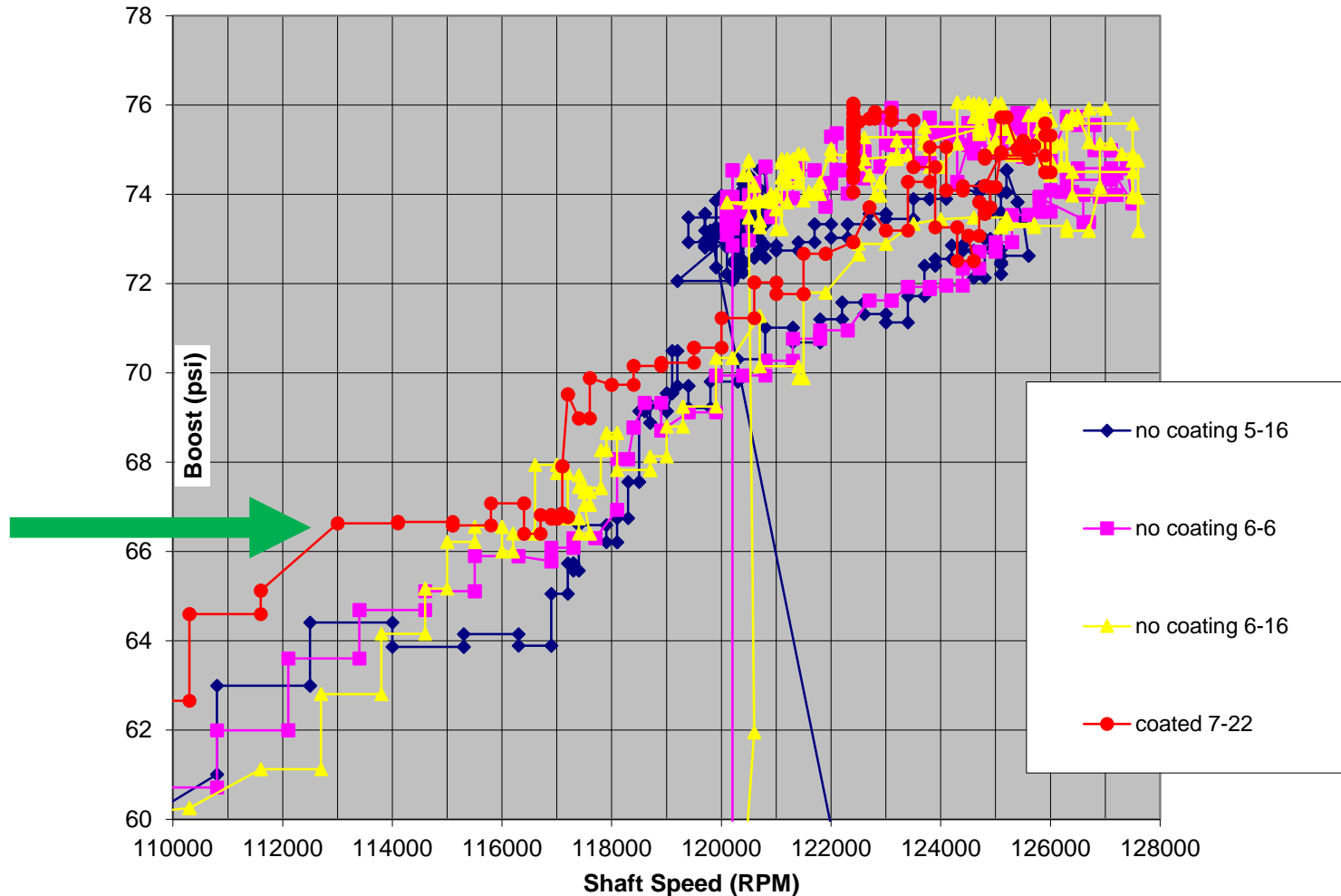
Disclaimer: Due to the nature of coating applications, L2L coatings are sold with no express warranty or implied warranty of merchantability or fitness for any particular purpose. Final decisions regarding the suitability, installation or use of L2L coatings for any application are solely the responsibility of the Customer. Line2Line, Inc. shall not, under any circumstances, be liable for any special, incidental or consequential damages related to the use of coated components.

AAPC Piston In A Chain Saw Engine - Vibration



Coating reduces vibration - Think Ring Seal

Turbo Field Data: Borg Warner Special 88mm Turbo



Achieved boost @ 2K-5K lower shaft speed (red shifted left)

Advantage compounds through each gear

Data Courtesy of Kevin Kwiatkowski, Kiggly Racing

Holset HD Diesel Turbocharger

- Rotor cuts perfect seal shape during operation
- Improves fuel economy
- Economical retrofit

Photos after 150K miles



OBSERVATIONS

A. THE TREATMENT TO THE PREVIOUS TURBO DEFINATELY INCREASED ITS RESPONSE TO CHANGES IN NEEDED POWER.

B. A FUEL MILEAGE INCREASE WAS DEFINATELY AQUIRED AS HIGH 6s AND LOW 7s WERE THE NORM. ABOUT 1/2 MILE PER GAL.

C. NO MECHANICAL PROBLEMS WERE ENCOUNTERED DURING THE USE OF THIS TURBO.

THIS TURBO WAS USED WHEN I PURCHASED IT, SENT IT TO YOU, INSTALLED IT AND NOW HAS ALMOST 200000 M, ON IT AND IS JUST WORN OUT.

I HOPE THIS NEW UNIT GIVES AS GOOD SERVICE.

Throttle Response - Abradable Seal Photos



- 150,000 miles on coating
- Driver perceived better throttle response
- Driver reported significant mpg savings on known route & load over 1.5 years
- All tips evenly polished
- Rotor 'bedded' into thick coating
- Convenient retrofit improvement

Value Fundamentals of AAPC - “A Perfect Fit Every Time”

- Improves efficiency
- Lifelong geometric improvement to components (typical thickness 20 μ to 200+ μ)
 - Build devices tight – causing light interference fit
 - Final geometry laps in during initial operation
- Eases challenges - tolerancing, stack-up, thermal expansion
- Reduces clearances
- Cuts NOISE



- Reduces friction - stabilizes oil film
 - Eliminates scuffing
 - Economical, scalable powder coating process
 - Environmentally friendly



Thank you!

www.line2linecoatings.com