

PC-11
(HDEO)

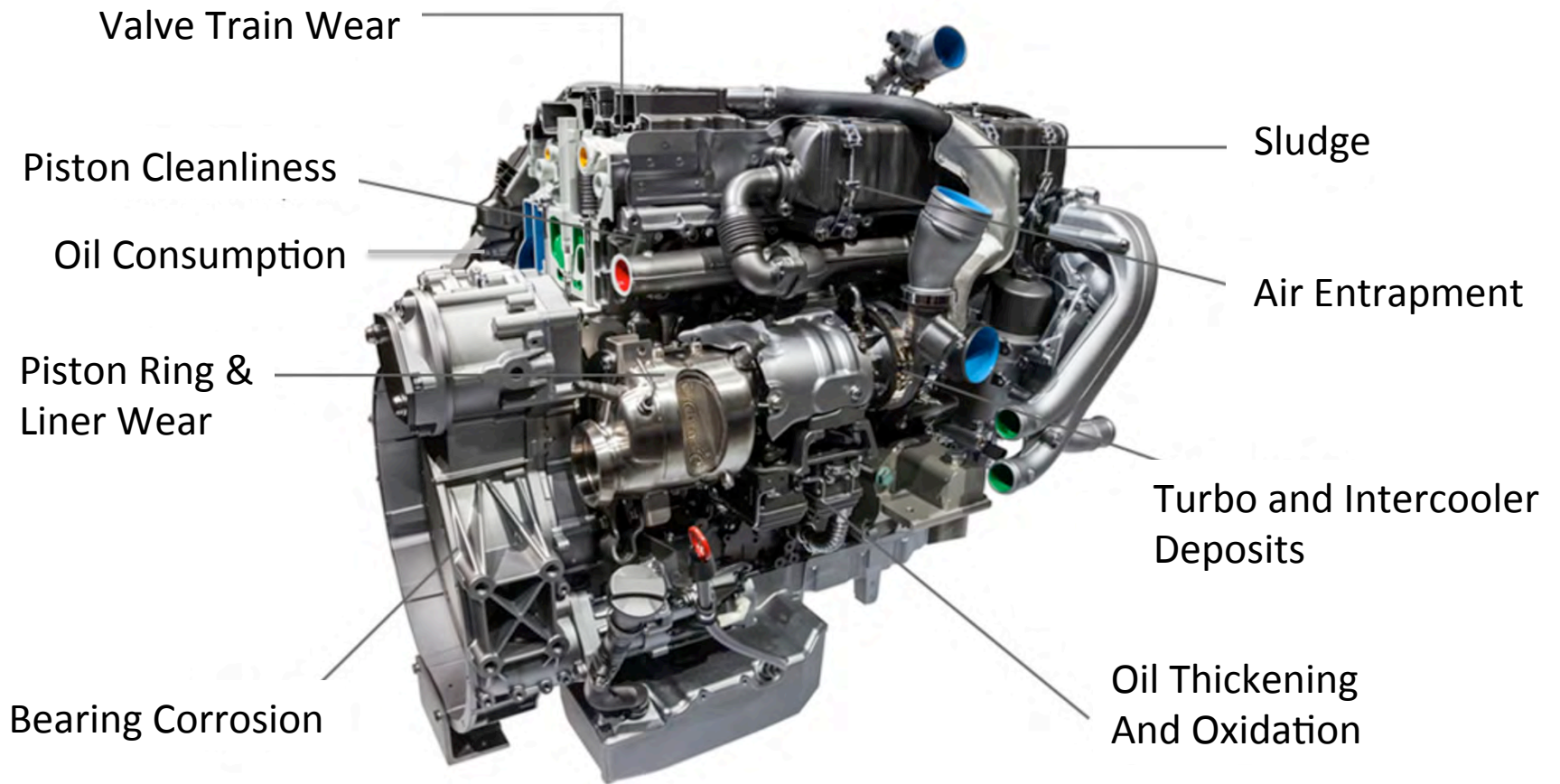


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WHAT DOES DIESEL ENGINE OIL DO?



WHAT DOES ENGINE OIL DO?

Reduce Friction and Wear

- Engine oil forms a fluid film between two moving surfaces (like cam lobes and lifters or crankshafts and bearings), keeping them apart and preventing direct contact that can cause friction and wear.

Clean

- Engine oil cleans unwanted deposits from specific engine parts and also suspends contaminants and debris so that they can literally be “taken out of circulation” when they pass through the oil filter.

WHAT DOES DIESEL ENGINE OIL DO?

Cool

- Engine oil plays a crucial role in reducing temperatures of key engine parts by absorbing and removing some of the excess heat in internal engine hot spots.

Prevent Corrosion

- Engine oil is designed to avoid corrosion caused by exposure to acidic byproducts of combustion, which triggers oxidation

WHAT ARE IN DIESEL ENGINE OILS?

- HD Engine oil is composed of a base oil and a mix of additives that provide a range of benefits.
- The base oil is either mineral-based (“conventional” oil), full synthetic, or a combination of the two (semi-synthetic or synthetic blend).
- The unique blend of additives is crucial in determining the protection and performance properties of modern engine oil.
- Additives typically account for less than 25% of the physical volume of any Heavy Duty Engine Oil (HDEO) but determine nearly all of the protection properties.

WHAT ADDITIVES ARE IN DIESEL ENGINE OILS?

VISCOSITY MODIFIERS

- Special temperature-dependent polymers that in simple terms make the oil thick when hot and thin when cold, thus enabling multi-grade oils that can protect engines across a wide temperature range.

ANTI-WEAR AGENTS

- Thermally activated agents that form a solid protective layer at local hot spots, thereby reducing metal-to-metal wear. These are particularly important when operating under high loads or during engine start-up

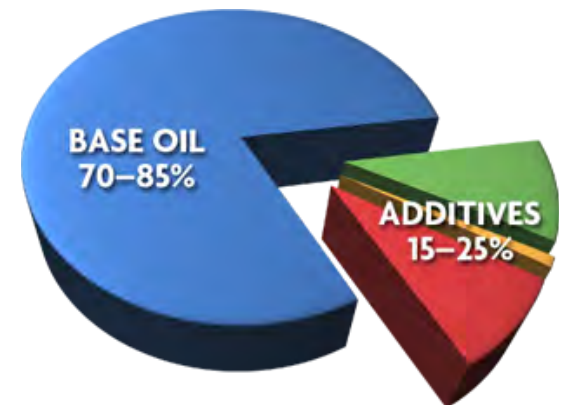
WHAT ADDITIVES ARE IN DIESEL ENGINE OILS?

DETERGENTS

- Detergents keep your engine clean and neutralize the corrosive acids that form as fuel is burned.

DISPERSANTS

- Dispersants remove soot and sludge and suspend it in the engine oil. This dirt can then be removed from your engine by the oil filter or at the next oil change.



WHAT ADDITIVES ARE IN DIESEL ENGINE OILS?

ANTI-OXIDANTS

- Help to delay the natural degradation of your engine oil, thereby protecting your engine more effectively for longer.

POUR POINT DEPRESSANTS

- Enable the oil to keep flowing at low temperatures, such as starting an engine in sub-freezing weather.

CORROSION INHIBITORS

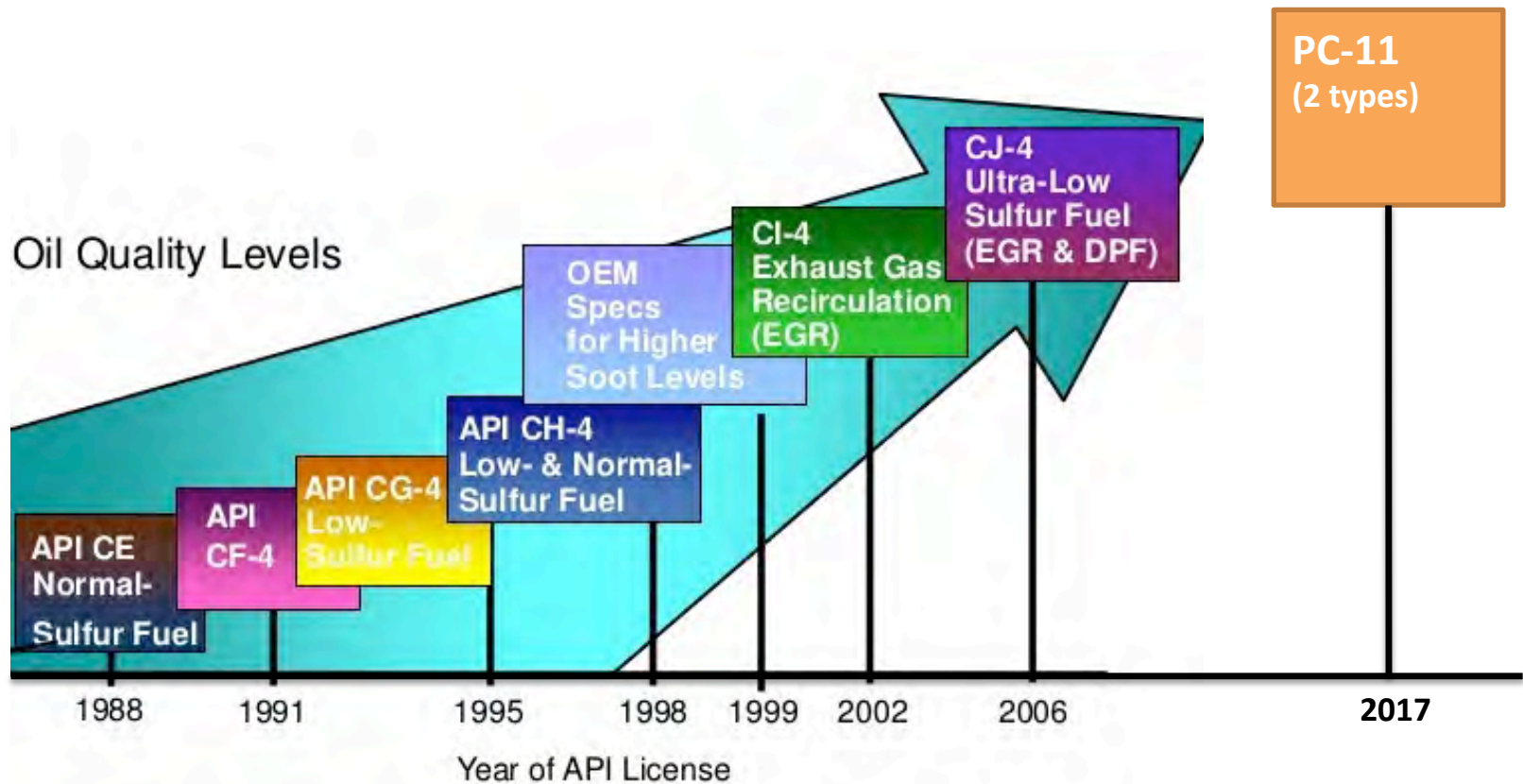
- Essential elements that prevent engine corrosion and rust inside the engine.

WHY DO WE NEED A NEW OIL STANDARD?

- Oil technology and engine technology go hand in hand.
- Changing regulatory limits challenge engine manufacturers to reduce emissions.
- As engine manufacturers begin to create a new generation of cleaner, more fuel-efficient diesel engines, they need a new generation of higher-performing diesel engine oils for compliance and to protect them.



WHY DO WE NEED A NEW OIL STANDARD?



WHAT IS
PC-11?



WHAT IS PC-11?

- **PC-11** stands for Proposed Category 11. The new PC-11 Heavy Duty Engine Oils (HDEO) oils.
- Due in late 2016 or early 2017, PC-11 will surpass current CJ-4 oil technology.
- There will be two types of PC-11 oils. For now, they are called **PC-11A** and **PC-11B**.
- PC-11A oils will be a direct replacement for the oils you're using now.
- You'll be able to buy the same viscosity grades and oil types (conventional, full synthetic, synthetic blend), and they'll be backwards compatible to current vehicles.

WHAT IS PC-11?

- **PC-11A** and **PC-11B** lubricants will be distinguished by their high temperature high shear (HTHS) viscosity rates.
- PC-11A lubricants are defined as those with a minimum **3.5 HTHS**.
- PC-11B lubricants fall between **2.9 and 3.2 HTHS**.
- In a hot and turbulent engine environment, HTHS viscosity measurements more accurately reflect the behavior of an engine, and correlate with potential fuel economy benefits.
- As viscosity grades continue to trend lower, it's important to become familiar with HTHS, what it means and how it is used.

WHAT IS PC-11?

- Sufficient **HTHS** viscosity is critical in preventing engine wear in the critical ring/liner interface area by maintaining a protective oil film between moving parts.
- One method used to measure HTHS viscosity is ASTM D4683
- Basically, the oil has to be thick enough to maintain separation of the critical moving parts but thin enough to allow for fuel efficient operation.



WHAT IS PC-11?

- **PC-11A** is designed as a broad fit for existing trucks, and requires higher levels of protection and performance for end users than what was established by API CJ-4.
- While lubricants classified under PC-11A are backwards compatible, this category nevertheless represents a major step up in performance and meeting the new requirements.
- **PC-11A** lubricants will correlate with familiar kinematic viscosity grades as defined within API CJ-4, such as 15W-40, 10W-30, 5W-30, and so on.
- Once final, PC-11A is expected to be called **API CK-4** in keeping with traditional nomenclature of the category.

WHAT IS PC-11?

- **PC-11B** reflects the increasing adoption of lower viscosity lubricants in modern engine hardware, and will standardize these advanced products while maintaining protection and durability.
- These lubricants will mostly correspond with the kinematic viscosities 10W-30 and 5W-30, but will be referenced by their lower HTHS viscosity, to be distinguished from PC-11A.

WHAT IS PC-11?

- The new **PC-11B** oils will be offered in lower viscosity grades and designed to help maximize fuel economy with no compromise in durability.
- Because of their lower viscosities, **PC-11B** lubricants will primarily contribute to greater fuel economy gains in engines specifically designed to take advantage of lower viscosity lubricants.
- PC-11B lubricants may not be broadly backwards compatible.
- Once final, PC-11B is anticipated to be named **API FA-4**.

WHAT DOES
PC-11 MEAN
FOR YOUR
CUSTOMER?



WHAT DOES PC-11 MEAN FOR YOUR CUSTOMER?

Fleets –

- The opportunity to reduce fuel consumption and cut operating expenses.
- There are other potential benefits to PC-11 oils, including reduced engine wear and deposits, which could help reduce maintenance costs and downtime.
- Fleets who move from current 15W-40 (or even existing high HTHS 10W-30 oils) could see even greater fuel economy savings from future PC-11B (low HTHS) category oils.



WHAT DOES PC-11 MEAN FOR YOUR CUSTOMER?

Owner / Operator

- There is confidence that as an owner/operator they will be using oil that has passed strict tests for engine protection and performance.
- Over 30,000,000 miles of OEM testing
- Maximize engine protection over the long haul.
- There are potential fuel economy benefits as well.



WHAT DOES PC-11 MEAN FOR YOUR CUSTOMER?

Off-Highway / Construction Vehicles-

- Improved protection and performance, even in the harsh conditions your vehicles operate in on a daily basis.
- To meet PC-11 requirements, these new oils will have to pass strict engine industry tests.
- The off-road or construction customer will have confidence they're getting the best protection they can buy.



WHAT DOES PC-11 MEAN FOR YOUR CUSTOMER?

Diesel Pick-ups

- Today's owners will have confidence, like the class 6, 7, & 8 tractors that the new diesel engine oils have passed strict tests for engine protection and performance, especially towing or hauling heavy loads.
- OEM approved
- Improved fuel economy
- Protection they'll appreciate now and in the years to come.



WHAT DOES PC-11 MEAN FOR YOUR CUSTOMER?

Future Vehicles

- The new PC-11B engine oils will be offered in lower viscosity grades and are designed primarily for the next generation of diesel engines, to help maximize fuel economy and performance.
- Per EPA request, these next-generation medium - and heavy-duty vehicles are expected to deliver between 6% and 20% better fuel economy, depending on the type of vehicle and usage.

ANTICIPATED
AS SOON AS
DECEMBER
2016



ANTICIPATED AS SOON AS DECEMBER 2016

- **PC-11** oils are being designed to tougher standards, like higher shear and oxidation stability and better resistance to aeration, adhesion wear and thermal breakdown.
- The main drive to develop oils with upgraded performance is so they can maintain effective protection at lower viscosities in hotter-burning, more fuel-efficient, lower-emissions diesel engines on the way.
- Thinner viscosity oil means less resistance on the engines' moving parts, and thus less fuel that'll need to be burned to move them.

ANTICIPATED AS SOON AS DECEMBER 2016

- As mentioned earlier, the high temperature high shear (HTHS) viscosity of engine oils is a critical property that relates to the fuel economy and durability.
- The main influences behind the lowering HTHS viscosity are new global governmental regulations to improve fuel economy (FE) and lower greenhouse gases (GHG) in new diesel vehicles.
- Lower HTHS viscosity tends to improve FE and lower GHG but higher HTHS viscosity affords better wear protection so a careful balance must be found when formulating.

ANTICIPATED AS SOON AS DECEMBER 2016

- PC-11 oils have a considerably higher performance limits than API CJ-4, and includes two new tests: the CAT C13 Aeration test and the Mack T13 oxidation test.
- Development of new oils that meet the performance requirements standardized by PC-11A and PC-11B will require significant investment, formulation expertise and advanced additive chemistry.
- It is expected that PC-11B oils will be challenged beyond that of PC-11A because they will need to demonstrate the same level of protective benefits but at a lower viscosity level.

ANTICIPATED AS SOON AS DECEMBER 2016

- What we've seen over time is that oils need to improved along with engines as new specifications, technologies and additives are available.
- The new PC-11 oils are going to be more robust and resistant to breakdown.
- Maintenance intervals and specific viscosities are still pretty much proprietary and under development by a number of oil companies in conjunctions with the OEM's.

ANTICIPATED AS SOON AS DECEMBER 2016

- **PC-11B**, particularly, helps deliver fuel efficient, lower viscosity lubricants that can stand up to the hotter, higher-pressure conditions of modern engine hardware.
- Additive lubricant technology continues to advance, allowing for thinner and more fuel efficient oils that provide excellent protective benefits.
- Modern heavy-duty hardware will be able to take full advantage of these lower viscosity lubricants, and will benefit everyone - federal regulators, OEMs, fleets, owner operators, diesel pick-ups, and future engine designs.

ANTICIPATED AS SOON AS DECEMBER 2016

- **PC-11** lubricants are expected to be available in the marketplace before the end of 2016 or early 2017.
- First licensing is expected to be December 1, 2016
- Lower viscosities are here to stay, and fuel economy gains are a must in today's marketplace.
- These oils will be balanced with durability and protection to achieve total efficiency.



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