Inside an engine test cell at San Antonio’s Southwest Research Institute, which helped develop all three of the new engine tests that define the wear-performance parameters of the new PC11-A and PC-11-B oil-service categories for heavy-duty applications.

TWO OIL CATEGORIES ROLLING TO THE FINISH LINE

Both will better protect engines and one will improve fuel efficiency

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It’s not rocket science to split an API oil-service category. But it takes lots of chemical engineering to develop and bring to market not one, but two, new heavy-duty motor oil specs in a mere five years. It will take plenty of plain English to communicate what the resulting new oil products will be engineered to do and for which engines when they become available — starting just about 18 months from now.

To start at the beginning, what had been launched as the single PC-11 (“Proposed Category 11” in the initial stage, thus “PC-11”) was split into PC-11A and PC-11B categories once supplier stakeholders determined that two distinct API oil-service categories would be needed to address the operating parameters of the next generation of fuel-efficient engines as well as improving mpg and longevity for existing engines.

To meet the twin goals of decreased fuel consumption and reduced CO₂ emissions, many next-gen engines will run at higher temperatures, so the oil protecting them from wear factors will have to be formulated to withstand more heat. And with both engine and truck builders looking for any fuel mileage edge they can get, the category process put lowering oil viscosity under the scope, too.

The upshot is the yet unfolding tale of two oils. Back in late 2011, the industry was looking at putting a single new category in place by the start of 2016. “Consensus eventually put first licensing [of oils with API ‘donuts’] during 2017,” recalls Dan Arcy, Shell’s
Global OEM technical manager, who chairs the industry’s Heavy Duty Engine Oil Classification Panel. “But [engine] OEMs wanted to see that pushed into late 2016, likely December” and that’s where the goal now stands for launching products in both new API categories.

Shawn Whitacre, senior staff engineer, technology with Chevron, says he expects the actual category specs will be issued by this December, giving oil suppliers about a year for finalizing their formulations for API licensing. “The current naming convention being discussed is pretty final,” he advises. “PC-11A oil will logically be categorized, following as it does CJ-4, as CK-4. The lower-viscosity PC11-B oil will be designated FA-4. The ‘F’ perhaps to link it to fuel economy.”

The donuts will differ because the oils they will be stamped on will. Sam Bainbridge, ExxonMobil’s U.S. products technical advisor, explains the difference in laboratory terms: “PC-11 will be split into two distinct sub-categories — a historical High Temperature/High Shear viscosity and a low High Temperature/High Shear viscosity targeted for enhanced fuel economy. The aim is to ensure that engine durability is maintained with improvements in oxidation stability, aeration, and shear stability of the oil. The category also aims to offer engine oils (PC-11 B) that help to provide improved fuel economy through their lower HTHS viscosity.”

PC-11A oils will be formulated to directly replace CJ-4 oil, the most advanced API category now available. These products will conform to the new PC-11 wear-performance standards and will be offered in the same viscosity grades and oil types (conventional, full synthetic, synthetic blend) as CJ-4 oils. And it’s expected that engine builders will consider PC-11A oils as fully backwards-compatible, approving them for use in all current vehicles.

PC-11B oils will be formulated primarily to help boost the fuel-efficiency of next-generation engines while providing the same wear protection as will PC-11A oils. These products will be offered in lower viscosity grades than PC-11A oils. Because of their lower viscosity, the backwards compatibility — as determined by individual engine makers — of PC11-B oils may be limited, most likely back to a specific production year.

Backwards compatibility will be an issue — requiring some fleets to stock two oils until older trucks are traded out — simply because PC-11B oils will be less viscous. “The thinner oils may not perform satisfactorily in some older engines, operating in certain duty cycles,” says Shell’s Arcy. “In addition to lubricating the engine, the oil may perform additional functions, such as serving as a hydraulic medium for other operating systems of the engine. Basically, some [existing] engines were designed to operate on certain viscosity grades of oil. Use of the wrong viscosity grade could result in less than optimal engine performance.”

One OEM has commented that they believe PC-11B oils will be acceptable for their engines from 2007 emissions level to current,” he continues. “One OEM has said they are considering backward compatibility to 2013/2014. Others have not commented yet. I think more on backwards compatibility for on-highway engines will be forthcoming. Some off-highway OEMs have stated they’re only going to recommend PC-11A oils at this time.”

The main performance benefit of both categories will be greater oxidation stability, says Shell’s Whitacre. “Improved oxidation is what defines the performance of PC-11. It speaks to operating duty cycles and the way engines are now designed to meet modern emission standards … [PC-11A and B] oil is being engineered for existing and new engines out to 2017 hardware and beyond. These oils will also meet tests requiring improved aeration control and greater shear stability” for better engine protection as well.

Arcy says to keep in mind that while PC-11B oil will help increase mpg, PC-11A oil will retain the same fuel-economy benefit now derived.
from using CJ-4 oil. “For example, a PC-11A oil (with a HTHS viscosity rating of less than 3.5 cp) will have basically the same fuel economy improvement over a 15W-40 CJ-4. But a PC-11B oil, such as a 10W-30 (rated 2.9-3.2 cp HTTHS) will achieve an even greater fuel economy improvement over a current 15W-40 and a PC-11A 15W-40, PC-11B SAE 10W-30 oils will also provide a fuel economy improvement over a PC-11A 10W-30.  

“And each new API oil,” he adds, “no matter whether it is PC-11A or PC-11B, must meet the same wear performance requirements, which will include improved oxidation control vs. current CJ-4 oil.”

Daring to look down the road a piece at what may drive development of a PC-12 category, Shell’s Whitacre remarks that “it’s never too early to be thinking about that, as they take time. The stake in the ground is that the GHG rules will continue to become more stringent. Also, we’re seeing now that engine soot levels are lower than 15 or 20 years ago. So, maybe we will look at how much soot control in the oil is still needed.”

The media will be the message

Engine hardware changes being driven by the push to decrease GHG emissions and fuel consumption will increase the heat load on engine oil, points out David Cline, global oil filtration product manager for Parker Racor. “The new [PC-11] engine oils are being designed to protect the engine components from increased temperatures as well as the load, but they must also be lower in viscosity to meet the fuel economy requirements,” he points out.

“The new engine designs will challenge the current filter media efficiency and capacity requirements when it comes to component protection and oil drain intervals,” he continues. “Changes in the filter elements themselves will be needed to maintain clean lube oil for the engine manufacturers’ suggested drain intervals per application.”

Currently, he explains, oil filtration medium comes in many performance levels of cellulose, synthetic and glass fiber combinations, with the efficiency range rather narrow. In the future, he says these combinations will be tailored directly to the engine filtration requirements to maintain higher efficiency throughout the operating cycle and capacity needed to meet oil-drain intervals targeted by engine makers.

“Filteration must offer more capacity and tighter efficiencies to protect engines [given the] ever increasing demands on heavy trucks,” says Donald Chilton, vice president, product management, WIX Filters. “Our engineers are working on advanced filter-media designs in partnership with media manufacturers to meet new requirements. Fuel filters are already going to low micron/highly efficient media. Air filters are advancing the same way as well. Most of these products are already on the Tier 4 engine platforms.”

Roma Fatima, lube filtration product manager for Cummins Filtration, points out that lower-viscosity oils can affect how a filter does its job. “To take advantage of the lower flow restriction inherent with PC-11 oils,” she advises, “Cummins Filtration has begun configuring lube filters with our patented NanoNet nanofiber media. The design of these non-woven nanofibers features an increase of ‘void space,’ or pores, within the media structure, which allow more liquid to pass through than conventional media types.”

Fatima explains that the nanofiber media helps further lower the flow restriction created at the filter during cold starts as well as when oil oxidation occurs or when there is higher contamination due to extended service intervals. “But the low flow restriction is not sacrificed at the expense of particle removal, as NanoNet is very efficient at removing the particles most detrimental to an engine.”

“Media formulations have to be compatible with higher operating temperatures and lower viscosity means oil will be thinner,” says Veli Kalayci, director, engine liquid products for Donaldson. “As a result, smaller particles could have a greater impact, cause more damage and create increased wear. To that end, tighter, higher efficiency filtration will likely be needed to prevent this damage and wear.”

He also points out that the impact of new lower-viscosity oils on drain intervals will be determined as newer engines make their way into testing and eventually into use. “In filtration,” Kalayci explains, “it’s critical to offer the best balance between filtration efficiency, restriction across the filter and filter capacity/ life—all of which have to be managed under dynamic conditions and with the right compatibility between materials and the application environment.”

Kalayci notes that new media formulations will come into play. “For example, Donaldson’s Synteq XP is used in hydraulic, fuel and crankcase ventilation applications and it offers a new path for even higher performance for lube oil filtration.”

Cutaway of Fleetguard LF14000NN lube filter reveals that its NanoNet media consist of five layers. The nanofiber layer has the smallest fibers, which Cummins Filtrations says provides “the optimum in filtration efficiency, capacity and cold flow ability.”