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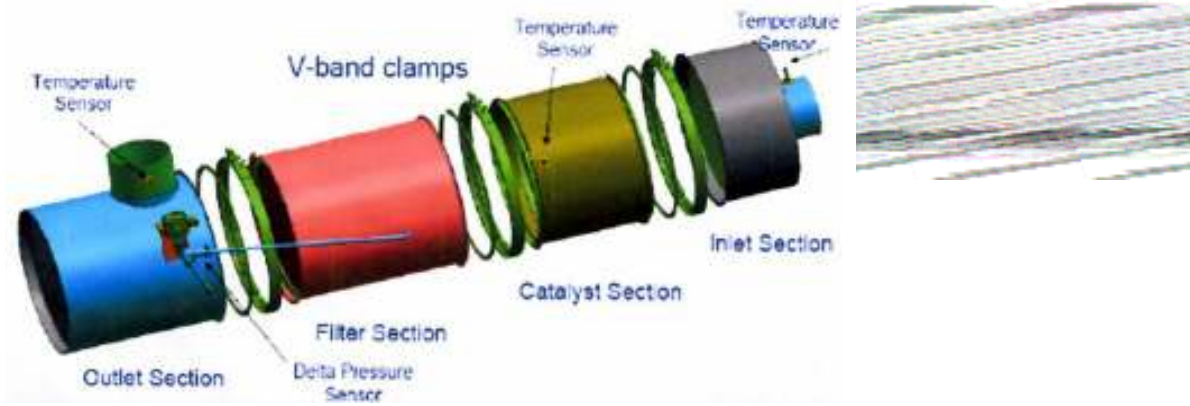
## **CJ-4 DIESEL – LOW ASH OILS ARE HERE TO STAY!**

With significant global pressure the U.S. Environmental Protection Agency (EPA) had determined new requirements to significantly reduce the levels of exhaust emissions produced by diesel engines was necessary. In 2007, the goal of these new regulations was to reduce the exhaust levels of NO<sub>x</sub> (Nitrogen Oxide) by 95% and particulate matter by 90%.

Across the globe, the European commission has also been busy. Heavy duty (HD) diesel engine emissions have been getting significantly cleaner as a result of legislation. A process beginning in 1992 with the introduction of the Euro 1 emissions limit, the Europeans have been progressively getting tougher with subsequent regulations. The current Euro IV regulations implemented in 2005 required significant reductions in both particulates and NO<sub>x</sub> over those achieved under Euro III, and now with Euro V on the horizon and due for implementation in 2008, requirements are set to change leaving particulate levels roughly the same but requiring another significant reduction in NO<sub>x</sub>.

Having exhausted design tweaks which included modified combustion chambers and EGR (exhaust gas recirculation) systems, manufacturers have had to develop new and improved engines which run at higher temperatures and do not burn off soot and other particles, as well as exhaust after-treatment technologies. Considered sensitive to the chemical composition of engine lubricants, these after-treatment technologies have forced oil companies to modify the way lubricants are formulated and manufactured. Traditional mineral base oils have been replaced with highly refined varieties and synthetics. These base oils require different manufacturing methods and are far more sophisticated than conventional mineral base oils. Manufacturing methods and base oils United Synthetic Specialists have specialised in for many years.

The addition of Diesel Particulate Filters (DPFs), larger EGRs and other after-treatment technologies although great for the environment are easily damaged with existing oils – even those meeting the API CI-4 or API CI-4 Plus standards. The latest standard by the American Petroleum Institute is the “Low Ash” CJ-4 standard for motor oil, specifically designed for new '07 emissions-compliant diesel engines as well as improving protection and reducing wear in older engines. To meet the certified CJ-4 standard, the motor oil must be able to handle high operating temperatures, produce fewer deposits and be able to deal with additional soot being processed through the engine, thanks to the redesigned exhaust gas recirculation system. The EGR systems on new 2007 turbo diesel engines are much more than a valve that routes spent gases into the intake. New heavy duty EGRs are up to twice as big and include heat exchangers to help cool gasses before they are routed back into the intake system.

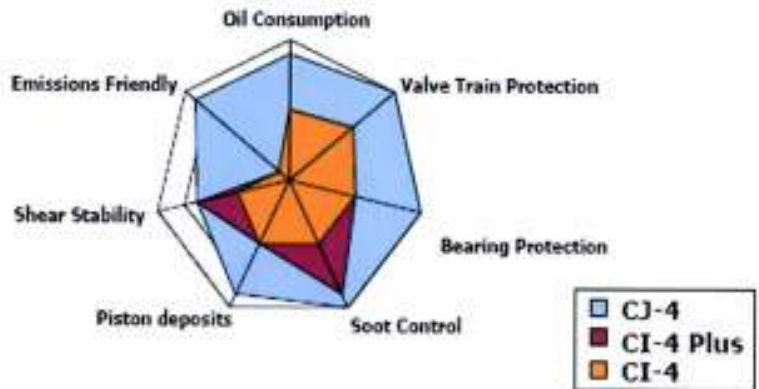


**DIESEL PARTICULATE FILTER (DPF)**

“Low Ash” refers to the amount of solid material that is left behind when the oil burns. By reducing the ash content, lubricant manufacturers have cut down the amount of deposits left in the engine to clog DPFs, but also diminishing wear and reducing emissions.

The development of low ash oils comes from the lubrication needs of the new cleaner versions of the Power Stroke, Cummins and Duramax engines which hit the streets in 2007. United estimates it would take more than 55 of these new trucks idling to equal the emissions of 1 idling truck from 1988.

Having manufactured and supplied United DX2 CJ-4 to the marketplace throughout 2007 United Synthetic Specialists have re-refined and evolved our “DX2” product to the brand new “**ECOMAX Diesel CJ-4**” motor oil. Certified and particularly formulated to reduce particulates, NOx and CO2 gases. **ECOMAX Diesel CJ-4** basically improves emissions in all diesel engines post 1993. Clearly demonstrated in the following graph are the different performance capabilities of the last 3 diesel motor oil performance standards. A dramatic leap forward has been made with the introduction of the CJ-4 specification.



**ECOMAX** offers ‘Top Shelf’ protection and reliability for both old and new engines, utilising an advanced additives package and super refined base stock for unmatched soot related viscosity control, low temperature liquidity, protection from thermal and oxidative breakdown, improved wear protection, high temperature protection, advanced deposit and oil consumption control. The following table illustrates the differences between typical API CJ-4 and API CI-4 engine oils.

	<b>API CJ-4 LIMITS</b>	<b>API CI-4 LIMITS</b>
<b>ASH</b>	<b>1.0%</b>	<b>1.2 – 1.5%</b>
<b>SULFUR</b>	<b>0.4%</b>	<b>No Limit</b>
<b>PHOSPHOROUS</b>	<b>0.12%</b>	<b>0.14%</b>
<b>VOLATILITY</b>	<b>13.0%</b>	<b>15.0%</b>



Only lubricant manufacturers certified and independently tested to comply with these new CJ-4 specifications are assured to meet the latest performance standards. With the complexity and sensitivity of modern emissions control systems it would be crucial to fleet operators to have an assured supply of correctly formulated CJ-4. Any oil supplier can issue itself a quality seal or stamp. But if this seal or stamp has been self issued what does this really mean for a consumer and how is this any guarantee of quality? No oil supplier will voluntarily admit their oil is inferior and in fact their objective is to try to convince you its not.

Insist on seeing your oil suppliers Independently issued supportive documentation to be certain the oil you are tipping into your fleet has been independently tested and certified to meet the marked specifications (all certified oil suppliers can supply Independently issued supportive documentation substantiating performance claims on demand). Whilst many manufacturers in the US and abroad comply with and are certified, it cannot be assumed name sakes in Australia comply with the same requirements or standards.

You will be surprised to learn that most oil suppliers in Australia cannot supply Independent supportive documentation and have not been certified, including some of Australia's biggest names.

Would you allow an unlicensed mechanic to work on your vehicle or an unlicensed plumber work on your home? No. So why buy engine oil from an unlicensed oil supplier.

## **FLEET OWNER**

### **Time to choose: One oil or two**

*BY SEAN KILCARR, SENIOR EDITOR*

*Nov 1, 2006 12:00 PM*

On the surface, it seems like a simple decision to make: Do we go with one oil or two next year? The '07-compliant low-emission engines need the new CJ-4 engine oil in order to preserve the integrity of their exhaust aftertreatment systems, which play a key role in reducing engine emissions sufficiently to meet EPA's '07 standards. Specifically, this includes a 50% reduction in oxides of nitrogen (NOx) and 90% reduction in particulate matter (PM). While CJ-4 oil can also be used in pre-'07 engines, it's not necessary.

In the first scenario, a fleet would use CJ-4 in all its vehicles, whether they were spec'd with '07 engines or not. In the second, a fleet would use CJ-4 only in those vehicles with '07 engines, and use CI-4 and CI-4 Plus in everything else.

For a fleet that performs all of its own preventive maintenance, stocking two oils rather than one is more costly. And if a maintenance technician mistakenly re-fills an '07 engine with CI-4 oil, things really start to go downhill. The aftertreatment system, especially the sensitive diesel particulate filter (DPF), could be damaged, possibly invalidating the '07 engine warranty.

### **STAYING SINGLE**

According to Doug Pond, commercial vehicle lubricants product advisor for ExxonMobil, warranty invalidation is the biggest — and most costly — risk of embarking on a two-oil strategy. "Let's be clear on this. Using CI-4 in an '07 engine does not mean the engine is going to crater right away on you," he says. "It will have negative effects, such as plugging up the DPF and probably lowering fuel efficiency. But the real risk here is that the engine OEM can invalidate your warranty. At the extra cost fleets are going to pay for these engines, they'll have too much invested to risk losing their warranty coverage."

Most lubricant makers think fleets should switch over completely to CJ-4 for '07 and pre-'07 engines next year. Although such a move would cost fleets a little more, lubricant suppliers say there are several practical advantages to this one-oil strategy.

"CJ-4 is going to cover everything CI-4 Plus does [it will] probably do a better job than the previous oil classification," says Mark Betner, manager of heavy-duty products for Citgo

Petroleum. "There will be a slight increase in cost and some won't pay it if they don't have any '07 engines in their fleet. But the new oil will do a better job in all engines, '07 and pre-'07 engines alike."

"CJ-4 is the best choice; it's the highest performing engine oil you can get, you get the best level of wear protection, deposit control and soot handling — even if you don't have a '07 engine. It simply protects the engine better."

While Arcy concedes the benefits of using higher-performance oils can't easily be converted into dollars-and-cents savings, he's confident you'll see tangible benefits from oil that helps reduce engine wear by 30%.

"If you get less wear, you can assume you'll get longer life from your engine," he says. "That translates into longer service intervals, less maintenance over its life cycle, and perhaps extends your trade-in cycle."

According to Mike Dargento, global manager of commercial sector brand oils for Chevron Corp., there's no question that fleets will benefit from using CJ-4 in older engines".

"The economy of trucking is such that fleets must watch every penny. However, simplicity of management is another key to cost control," adds Citgo's Betner. "It simply costs more to stock two oils. Yet fleets might be able to get longer drain intervals with the new oil because it's more robust than the previous category."

## **NEW REALITY**

Context is also important in understanding the potential of CJ-4. Betner says that in the past, conventional wisdom was "the higher the better" in terms of an oil's total base number (TBN). "We've had to drop the TBN in CJ-4 to reduce ash-causing materials. That looks like a decrease in protection," he points out. "But in reality it's not, because the sulfur content in diesel fuel is much lower now." Less sulfur in fuel means less degradation of engine oil, allowing it to last longer.

ExxonMobil's Pond concurs. "Our research shows that using CJ-4 in either '07 or pre-'07 engines in combination with 15-ppm ultra-low-sulfur diesel (ULSD) fuel can result in longer drain intervals," he explains. "TBN retention is now more important than overall TBN. Our CJ-4 oil has a TBN of 10.5...compared to the 10 to 13 TBN seen in CI-4 blends. But the key is CJ-4 retains that TBN for a longer time."

If you consider only the purchase price of the oil, stocking two is less expensive. If you look at the big picture, however, it's not that simple. "You're talking about installing a second bulk tank or extra drums, dedicating more precious maintenance real estate to oil storage, and potential confusion for technicians," Betner says.

"When I think of a large fleet with multiple maintenance facilities, say six to ten around the country, those costs start to up," adds Arcy.

"At a minimum, you'll also need to color-code or ID your '07 trucks somehow to make sure technicians use the correct oil," he continues. "That's the real concern: CI-4 getting into an '07 engine."

"It's also going to be difficult when trucks come in for service; extra downtime may be an issue as technicians may need extra time to double check what oil is required," he continues. "And are you going to add cost to pipe in an extra bulk oil line or take a time penalty for a tech to walk across the bay to get CJ-4 in bottle or drum storage?"

Pond points out that the extra space could be put to better use. "Why stock two oils when you can use space to stock vital engine parts?"

"Look at the complexity of investment required for two oils," says Reginald Dias, director, ConocoPhillips Lubricants, 76 Lubricants and Conoco brands. "You are talking two storage tanks instead of one, two separate inventory costs, and your potential for mix-up is far greater. So the overall savings of stocking two oils versus switching to a slightly more expensive CJ-4 may be washed out."

Some think that fleets should sit down with their lubricant provider to review the particulars of their operating environment before embarking on an '07 oil strategy.

## Making the switch

*So you've decided to switch your fleet over to CJ-4. If you use bulk storage tanks in your shop, you're now facing the challenge of making that change in the most economical manner possible, here are a few tips.*

- If your tank is no more than six months old, use up as much of the CI-4 remaining as possible, try to get it down to 2% or less and you won't need to clean it before adding the CJ-4.
- If the tank is older than six months, it's best to drain and clean it completely before putting in the CJ-4. This will get rid of any debris that has accumulated, as well as ensure that you have a moisture-free tank.
- If you live in a state that requires regular tank inspections, have it done before you switch to CJ-4.
- If you can't clean the tank, draw down the CI-4 level to 2% or less before adding the CJ-4.
- Pre-'07 engines can handle a mix of CI-4 and CJ-4 with no problem. If you need to top off with a quart on the road, you can add CJ-4 to an engine reservoir full of CI-4.

Association Technique de L'Industrie Europeenne des Lubrifiants, EEIG, Report March 2006

ATIEL/March06/emissions

## Impact of emissions legislation on engine lubricants

**Increased use of exhaust after-treatment technologies to meet tougher European emissions legislation has proved a major challenge in the development of heavy-duty diesel engine lubricants that maintain oil drain intervals and wear protection.**

Heavy-duty (HD) diesel engine emissions have been getting significantly cleaner as a result of legislation introduced by the European Commission. The process started in 1992 with the Euro 1 emissions limits and subsequent regulations have become progressively tougher.

The regulations are designed to reduce levels of particulates and NOx emissions from vehicle exhausts, due to their detrimental effect on air quality. In the past, OEMs have used a range of engine design measures to accommodate the emissions legislation, including modified combustion chambers and the use of EGR (exhaust gas recirculation). The introduction of the Euro IV regulations in 2005, however, required significant reductions in both particulates and NOx (see Figure1) beyond those already achieved under Euro III.

Having 'exhausted' the design tweaks under their control, the engine manufacturers have turned to exhaust after-treatment technology in order to comply with Euro IV. Since these after-treatment technologies are considered sensitive to the chemical composition of engine lubricants, this had major implications for the way lubricants are formulated and manufactured.

A typical engine lubricant incorporates a base oil and a package of additives that may include viscosity improvers, anti-wear compounds, friction modifiers, corrosion inhibitors, dispersants, anti-foaming agents, anti-oxidants and detergents. Together, through their chemical compositions, they contribute to the so-called SAPS (Sulphated Ash, Phosphorus and Sulphur) profile of the lubricant. While SAPS have no direct effect on emissions, they have been associated with a negative impact on the performance and longevity of the new after-treatment hardware.

The severity of the emissions standards requires the performance of after-treatment systems to be sustained over the life of the vehicle. As a result, lubricants for use with Euro IV after-treatment systems have had to be reformulated to lower the SAPS content.

In Europe, the SAPS content is specified by ACEA, the European Automobile Manufacturers Association, in its latest E6 specifications. Oil companies have invested significant time and resources in developing and testing new low SAPS lubricant formulations. By using their extensive formulation expertise, and careful selection of base oils and additive components,

they have managed to meet the stringent new SAPS limits without compromising engine integrity.

The reduction in sulphur (see Figure 2) has been achieved largely through the use of more sophisticated base oils. Traditional mineral base oils have been replaced with more highly refined varieties and synthetics. These base oils require different manufacturing methods and are inevitably more expensive, and so impact the price of finished lubricants. A major challenge for the industry is developing sufficient capacity to produce the volume of these base oils that is required both now and in the future. Euro V emissions regulations are already on the horizon. Due for implementation in 2008, Euro V leaves particulate levels roughly the same but requires another significant reduction in NOx.

Discussions between the oil industry, represented by ATIEL, and ACEA have already begun, due to the long industry lead times required to develop new lubricants. ATIEL's role in this process is to ensure that the industry has the products that they need in the future, while at the same time ensuring that any changes to specifications are based on sound technical arguments. These discussions will be critical to the development of future lubricants that continue to provide the performance and protection that heavy-duty diesel engines have enjoyed in the past.

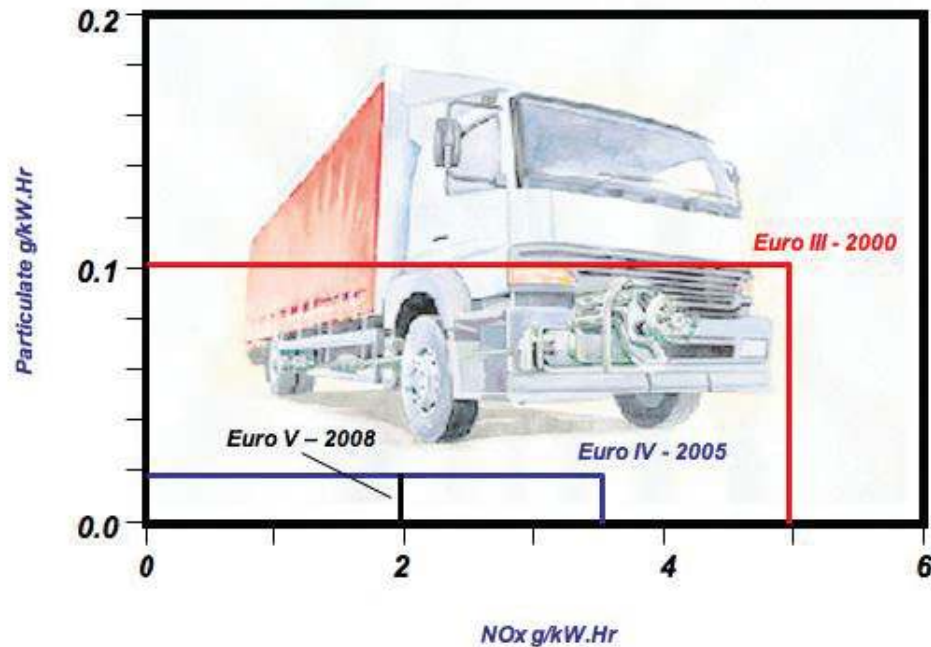


Figure 1

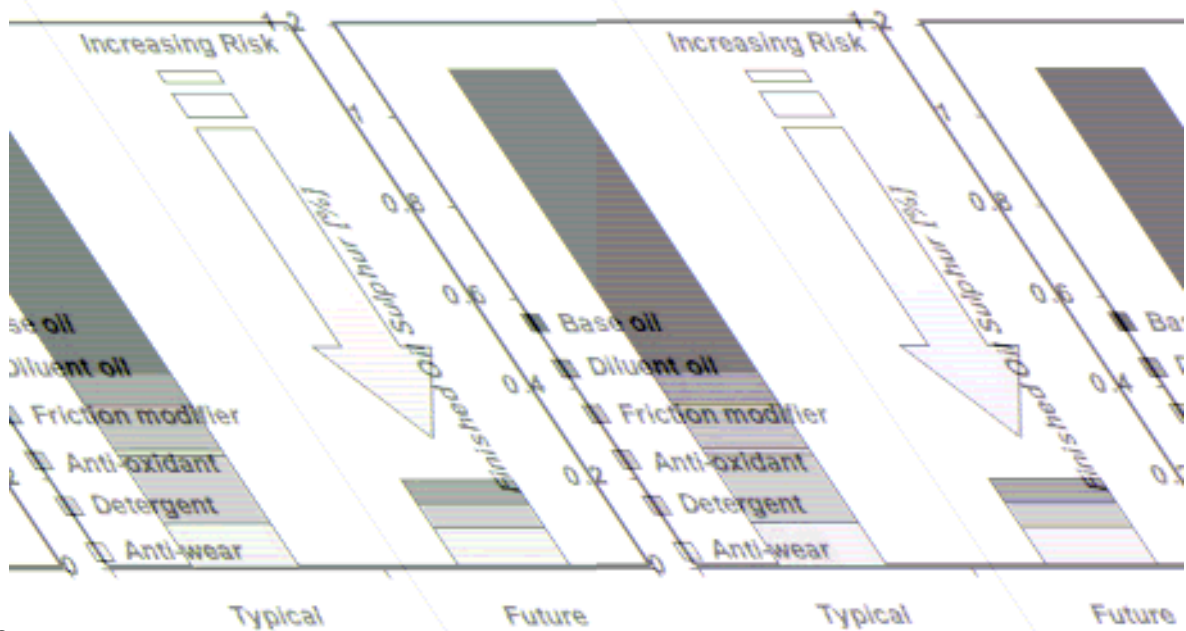


Figure 2