

Under extreme operating conditions
in one of the world's toughest
work environments, Mobil Delvac 1™
does the unexpected:

It extends oil change intervals
while extending engine life.

And that's just the beginning.

Energy lives here™



Mobil Delvac 1. Unique high-tech synthetic diesel engine oils for heavy duty engines.

Created for off-highway vehicles operating in extreme work environments and demanding heavy load conditions.

Mobil Delvac 1™ ESP can extend oil drain intervals¹ while extending engine life.

It provides exceptional all-around performance that prolongs the life of equipment, increases productivity, reduces downtime and saves you money by:

- helping prevent oxidation/rust and corrosion
- keeping engines clean by keeping contaminants in suspension, thereby reducing buildups of deposits, sludge and soot
- reducing friction to protect against wear (especially valvetrains, PRLs and bearings)
- retaining TBN and viscosity in temperature extremes so you get:
 - better stability at high temperatures
 - faster pumping and cranking for cold-weather starts
 - reduced oil consumption
 - potentially improved fuel economy²

1 Results may vary based on vehicle/engine condition as well as driving and environmental conditions. Consult your OEM before implementing extended ODI, especially if the equipment is under the OEM's warranty.

2 Compared to an equal grade of conventional engine oil. Actual savings are dependent upon vehicle/engine type, outside temperature, driving conditions and your current engine oil viscosity.



Delivering 90 years of proven protection



Extending oil drain intervals as well as engine life with Mobil Delvac 1.

How Mobil Delvac 1™ is helping an oil sands mining company extend oil drain intervals by 25% and engine teardown intervals by 20%.¹

Equipment: A 797F haul truck with C175-20 engine manufactured by Caterpillar Inc. subjected to severe duty cycles working around the clock, seven days a week, since July 22, 2013.

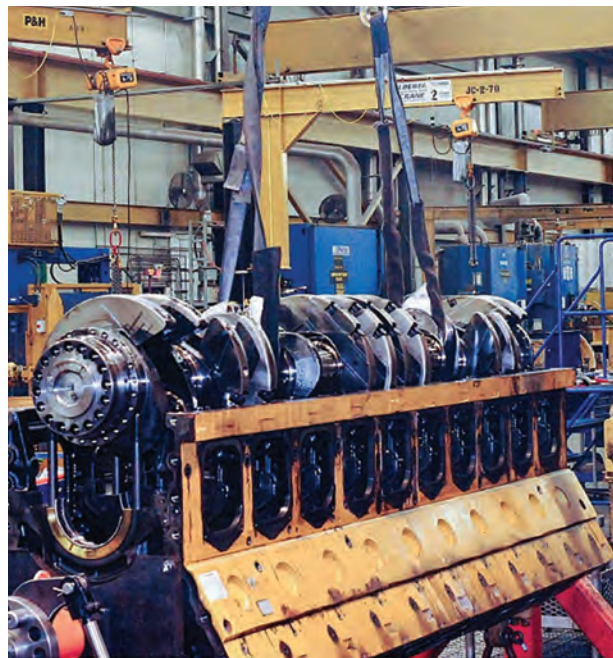
Application: Oil sands mining company, northern Alberta

Situation: Having already extended its haul truck fleet's oil drain intervals from 500 Service Maintenance Unit (SMU) hours to ~750 SMU hours by using Mobil Delvac 1 synthetic engine oil, the company wanted to know if it could also safely extend the interval between engine teardowns from the OEM's benchmark of 15,000 hours to 18,000 hours.

Recommendation: Steve Avis, an ExxonMobil technical expert, concluded that it was possible to do so based on his evaluation of engine parts during a teardown after 18,282 hours. "Considering the engine's extreme duty cycle and the temperatures it must operate under, its cleanliness was at least as good as or better than some over-the-road engines I have evaluated." (See Steve's descriptions of the condition of critical engine parts on the following two pages.)

Results: After seeing the report, the company believes that they left money on the table by pulling this engine out early. The plan is to start transitioning to less frequent engine rebuilds going forward. (See photographs of the condition of typical parts examined during the engine teardown on the following two pages.)

Other Results with Mobil Delvac 1: The same company has gone through a complete review of their engine oil drain intervals on all their support equipment. Their D11 dozers have gone from 250 hours to 600 hours, increasing productivity while reducing oil consumption and oil drain waste by 15,000 litres a year for estimated annual savings of CAD \$150,000.



The 18,000 hour C175 engine teardown, June 20, 2016.

¹ This Proof of Performance is based on the experience of a single customer. Actual results can vary depending upon the type of equipment used and its maintenance, operating conditions and environment, and any prior lubricant used.

Observations during engine teardown after 18,282 hours

Considering the engine's extreme duty cycle and the temperatures it must operate under, its cleanliness was at least as good as or better than some over-the-road engines I have evaluated.

- Piston deposits were minimal, as was bore polish/distress on skirts and liners.
- Camshafts showed negligible wear, good contact patterns and only trace pitting on some lobes.
- Several valves showed some recession but this is a known issue with this engine.
- Main and cam shaft bearings were in excellent condition.

- Upper rod bearings showed some distress restricted mainly to the lead outer layer with no copper exposed.
- Most upper rod bearings showed signs of cavitation erosion.
- All gears and associated bushing were in excellent condition.

– Steve Avis, ExxonMobil

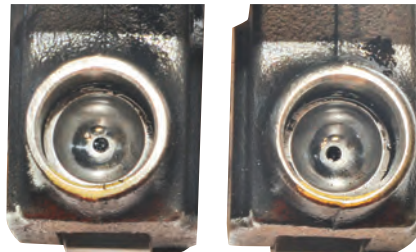
Outcome: The company is transitioning to extended oil drain intervals (500 SMU hours to ~750 SMU hours) and less frequent engine teardowns (18,000 hours, up from 15,000).



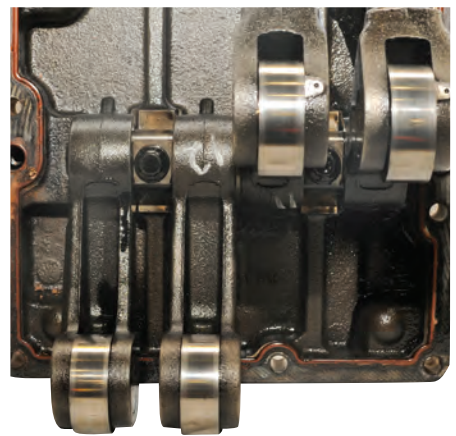
Camshaft lobes: Trace wear, some pitting on several but no worse than trace. No wear step was detectable on any lobe surface.



Pushrod ends: No signs of distress; trace wear on socket end.



Rocker pushrod sockets: No signs of distress or wear.



Cam roller followers: No visible distress, trace scratches, no pitting.



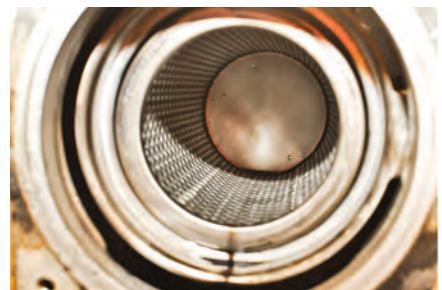
Exhaust/intake rocker bushings: No visible distress noted on any of the rocker arms. Bushing wear as follows: Average overlay removed: injector 20%; intake and exh <5% w/trace to light wear.



Thrust bushing: Light wear and scratching.



Cam bearings: No signs of distress or wear.



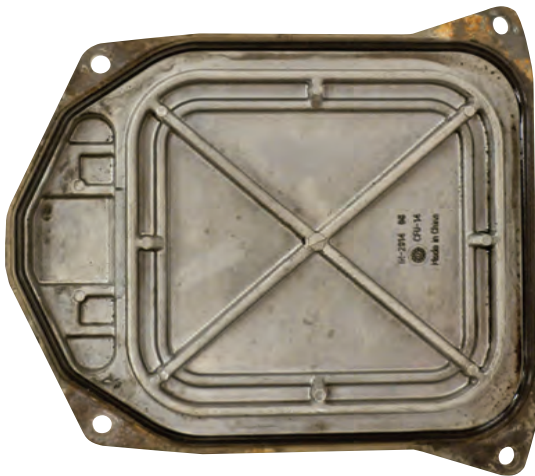
Oil screen cleanliness: 9.90/10



Oil screen: No plugging or debris.



Pistons, rings and liners: Trace scratches on liners with some staining. Minimal bore polish (<5%) on liners. No signs of scoring on thrust or anti-thrust sides.



Crankcase access cover cleanliness: 9.65/10



Rocker/valve cover cleanliness: 9.85/10



Upper main bearings: Light scratching, 0-20% overlay removed.



Upper rod bearings: Light to medium scratching with cavitation, except for two that had no cavitation.



Lower main bearings: Light to medium scratching except in two that had heavy scratching w/ <1% and ≤10% exposed copper.



Lower rod bearings: Trace to light scratching.

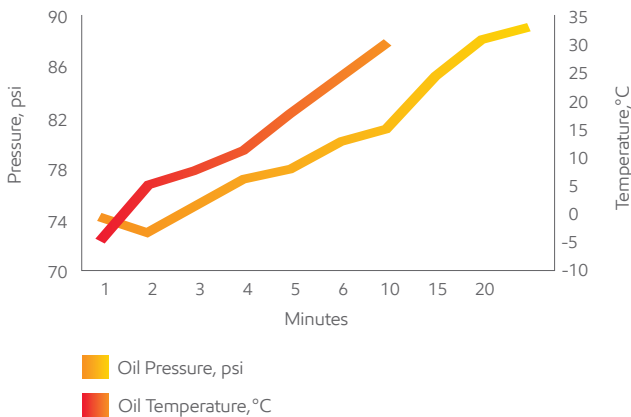
Cold weather performance, extended oil drains, savings with Mobil Delvac 1.

Cold weather productivity, extended oil drain with Mobil Delvac 1™ enhances overall productivity, reduces human-equipment interaction.^{1, 2}

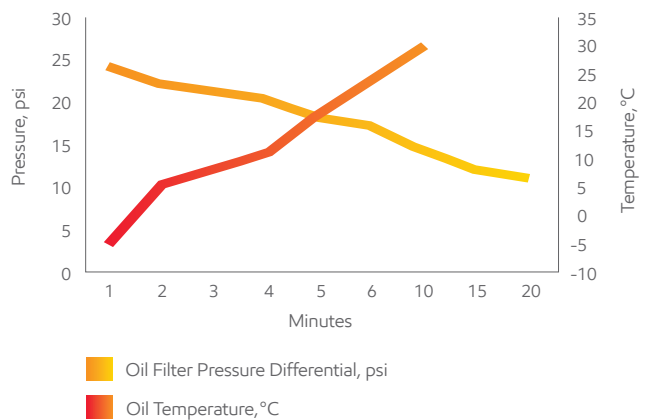
Problem: Cold starts can be a significant challenge to mining operations, reducing productivity and increasing risks of premature engine wear. Mobil Delvac 1 synthetic engine oil is designed to help extend engine life, provide exceptional low temperature pumpability and long drain intervals.

Solution: The graphs show how Mobil Delvac 1 builds oil pressure quickly and flows well through filters even at low temperatures after a 5-month trial at an Alberta oil sands mine.

Exceptional cold weather start-up in sub-zero conditions



Smoothly flowing oil after start-up due to a lower pour point at all viscosities



Extended drains, better cold weather performance helped achieve significant savings at an open pit mine in Western Canada.^{1, 2}

Northern BC hard rock mine increased equipment availability and enhanced productivity while lowering costs.

Problem: In temperatures below -15°C, the company was experiencing trouble getting their equipment to start. They also wanted to increase equipment uptime by extending oil drain intervals on their 793F and 789C haul trucks manufactured by Caterpillar Inc. and Terex MT4400C fleet.

Solution: Moved to Mobil Delvac 1 synthetic engine oil.

- Results:**
- Significantly reduced cold start issues
 - Extended drains by 100 hours to 600 hours
 - Reduced equipment interaction by more than 360 hours per years
 - Estimated annual savings of CAD \$975,000^{1, 2}

¹ This Proof of Performance is based on the experience of a single customer. Actual results can vary depending upon the type of equipment used and its maintenance, operating conditions and environment, and any prior lubricant used.

² As compared to a conventional engine oil.

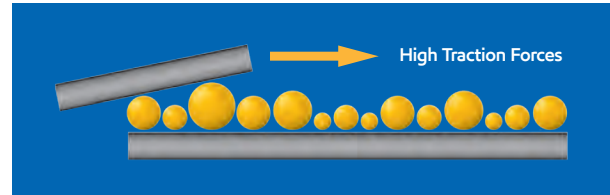
Fuel efficiency and Mobil Delvac 1: in the lab.

How Mobil Delvac 1™ contributes to improved fuel economy.^{1,2}

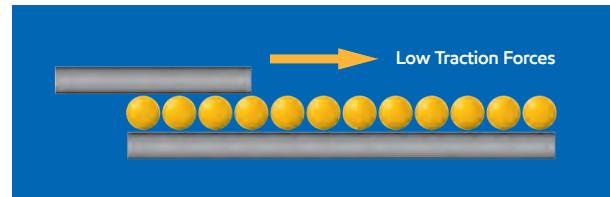
Mobil Delvac 1 synthetic engine oil has the capability to improve fuel economy in the use of large off-highway engines through its synthetic base stock, higher viscosity index and careful additive selection, compared to mineral and semi-synthetic-based 15W-40 diesel engine oils.

Base stock selection

Synthetic base stock selection reduces traction forces between moving surfaces and the engine due to greater uniformity in molecule size and shape.



Traditional mineral and semi-synthetic base stock: high traction forces



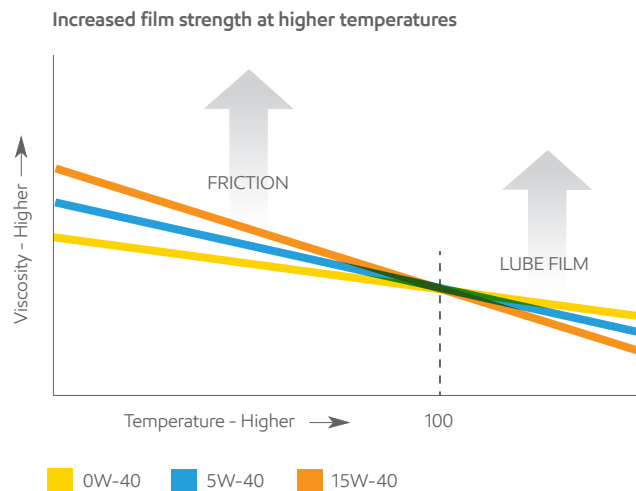
Synthetic base stock used in Mobil Delvac 1 ESP: low traction forces

Higher viscosity index

The higher viscosity index of Mobil Delvac 1 means less change in viscosity, less resistance to flow at lower temperatures and higher film strength at operating temperature all contributing to improved fuel economy.

Results: Testing conducted at two separate mines in North America (see next page) has shown fuel savings of up to 1.9% in both in-pit and bench testing.

Test method: Mobil engineers conducted a fuel economy study on the customer's engine using an engine dynamometer and high accuracy fuel meters with support of the Engine OEM dealer.



¹ This Proof of Performance is based on the experience of a single customer. Actual results can vary depending upon the type of equipment used and its maintenance, operating conditions and environment, and any prior lubricant used.

² As compared to a conventional engine oil.

Fuel efficiency and Mobil Delvac 1: on the job.

Taconite mine, Minnesota

With Mobil Delvac 1™, the mine improved fuel efficiency by an average of 1.9% and reduced engine emissions for estimated annual savings of USD \$556,938.¹

Operation: 48 production haul trucks with 3516 B HD EUI engines manufactured by Caterpillar Inc., each of them burning more than 378.5 litres of fuel per hour at full load.

Result: Dynamometer testing done at 30%, 60% and 90% load in 3516 B HD EUI engines. Average fuel economy savings of 1.9% was observed.²

Coal mine, British Columbia

With Mobil Delvac 1, the mine improved fuel efficiency by 1% for estimated annual savings of CAD \$2,000,000¹ and annual engine emission reductions of over 8,000 tonnes.¹

Equipment: Large fleet of Komatsu haul trucks operating Cummins QSK 60 engines, each of them burning more than 150 litres of fuel per hour at full load.

Result: Dynamometer testing conducted at idle, full load and retard load in Cummins QSK 60 engine. Average fuel economy savings of 1.0% was observed.²

Compatibility: Mobil Delvac 1 meets or exceeds a wide range of North American and European OEM and industry specifications, including API CJ-4/CI-4 PLUS/CH-4/SM/SL, ACEA E9/E7, Cummins CES 20081, Caterpillar ECF-3/ECF-2. It also delivers exceptional performance in modern

low emission engines, including those with Exhaust Gas Recirculation (EGR) and after-treatment systems with Diesel Particulate Filters (DPFs) and Diesel Oxidation Catalysts (DOCs).



¹ This Proof of Performance is based on the experience of a single customer. Actual results can vary depending upon the type of equipment used and its maintenance, operating conditions and environment, and any prior lubricant used.

² As compared to a conventional engine oil.

³ Fuel economy savings as expressed in this document does not guarantee fuel economy performance.

Extended oil drains, equipment life, savings with Mobil Delvac 1.

Extended drains with Mobil Delvac 1™ is helping Alberta coal mine save an estimated CAD \$1 million annually.^{1, 2}

Problem: In an effort to optimize its operations, the company approached Imperial Oil engineers for a lubricant solution capable of increasing equipment availability, enhancing fuel savings, reducing downtime, and extending equipment life on their mixed fleet of mobile equipment.

Results: Since transitioning to Mobil Delvac 1 synthetic heavy-duty diesel engine oil, the company has been able to extend oil drain intervals on its mobile equipment from 350, 450 and 500 hours to as much as 1,000 hours, using detailed oil analysis.

This has helped the mining company improve productivity and reduce employee-equipment interaction.

In addition to the projected CAD \$1M in annual savings,^{1, 2} the company also reports that Mobil Delvac 1 is helping them to:

- Decrease oil consumption by over 100,000 litres a year
- Increase equipment uptime by almost 4,000 hours a year
- Reallocate almost 4,000 hours of employee time a year



¹ This Proof of Performance is based on the experience of a single customer. Actual results can vary depending upon the type of equipment used and its maintenance, operating conditions and environment, and any prior lubricant used.

² As compared to a conventional engine oil.

