Changes in the Diesel Market

New Synthetic 5W-40 Premium Diesel Oil Provides Superior Protection for 2007 and Newer Diesel Engines

Diesel engine emissions have been an ongoing environmental concern for the past few decades. Particulates and nitrogen oxides (NOx) associated with health problems and damaging smog and acid rain have been targeted by governments globally, and the United States, Europe and Japan have responded to demands to reduce these harmful emissions. NOx forms when atmospheric nitrogen in the power-cylinder oxidizes. Because peak cylinder temperature plays a key role in NOx formation, methods of reducing the temperature, including cooled exhaust gas recirculation (EGR) technology, have been targeted as solutions to reducing NOx emissions. Diesel particulates are composed of solid carbon (soot), sulfate, bound water and unburned fuel and oil. Because sulfur is key to particulate formation, the sulfur level in diesel fuel has been gradually decreased over the years.

In the U.S., particulate and NOx levels were first regulated in 1988, with regulations becoming increasingly stringent through the years. By 2010, diesel engines will be considered "clean," but getting there will require sulfur-free fuel, improved in-cylinder combustion, exhaust after-treatment, vehicle design changes and diesel oils that are compatible with after-treatment systems.

Fuel sulfur was successfully reduced by 90 percent in order to meet 1994 particulate targets, dropping from 5,000 ppm to 500 ppm in October 1993. Diesel fuel sulfur was most recently reduced even further in June 2006, dropping to 15 ppm in anticipation of 2007 particulate limits.

In order to meet 2002 NOx emission standards, most engine manufacturers introduced low levels (10-15%) of cooled EGR technology. EGR engines reduce NOx emissions by recirculating a portion of the exhaust to the engine's combustion chamber, lowering peak combustion temperature and NOx formation. Although EGR engines effectively reduce emissions, they also run hotter and introduce higher levels of soot and acid into the oil, leading to increased wear, increased oil viscosity and shorter oil drain intervals.

The API CI-4 diesel oil specification was introduced in December 2001 to protect against the higher temperatures and increased levels of acids, soot and oxidation associated with EGR engines. API issued an upgrade to its CI-4 specification, CI-4 PLUS, in September 2004 in order to provide improved oxidation resistance, shear stability, acid neutralization and soot dispersancy for EGR engines.



AMSOIL Synthetic Diesel Oils for Pre-2007 Diesel Engines

AMSOIL offers four premium quality synthetic diesel oils for 2006 and earlier EGR equipped and non-EGR equipped diesel vehicles. AMSOIL Synthetic 15W-40 Heavy Duty Diesel and Marine Motor Oil (AME), Series 3000 Synthetic 5W-30 Heavy Duty Diesel Oil (HDD), Synthetic 10W-30/SAE 30 Heavy Duty Diesel Oil (ACD) and Synthetic Blend 15W-40 Gasoline and Diesel Oil (PCO) surpass the most stringent diesel oil specifications for 2006 and earlier diesel engines, including API CI-4 PLUS. These oils offer superior protection and performance for extended drain intervals in non-EGR equipped engines, and drain intervals may be extended by oil analysis in pre-2007 EGR-equipped engines.

2007 Emission Standards

The next round of emission standards goes into effect in 2007, requiring even more stringent NOx and particulate emissions reductions in on-road diesel vehicles.

Because low levels of EGR technology were successfully applied in diesel engines to meet 2002 NOx emission standards, most manufacturers have incorporated increased EGR rates of 25-35% in their engines to meet 2007 NOx emission standards. Even Caterpillar, which used its Advanced Combustion Emissions Reduction Technology (ACERT) to meet previous emission standards, is incorporating EGR technology into its engines.

Increased EGR rates mean 2007 diesel engines run hotter than their predecessors, requiring diesel oils with improved oxidation resistance to prevent thermal runaway and maintain engine protection. Because synthetic base stocks have significantly better thermal stability than conventional base stocks, synthetic diesel oils are expected to become increasingly popular in the diesel market.

Further decreasing the level of sulfur in diesel fuel has been determined to be the most cost-effective way to decrease particulate emissions. The introduction of Ultra Low Sulfur Diesel (ULSD) fuel in June 2006 dropped diesel fuel sulfur levels from 500 ppm to 15 ppm in order to meet 2007 particulate limits, provide compatibility with NOx after-treatment systems and enable high EGR rates.

In addition, in order to further reduce particulate emissions, diesel particulate filters (DPF's) have been incorporated into all 2007 American diesel engines, and diesel oils will be faced with the challenge of balancing engine protection with DPF life. Increased EGR, although effectively decreasing NOx emissions, results in less efficient combustion and increased levels of soot, and some of it finds its way into the engine oil. Detergents and dispersants within the oil are responsible for preventing soot from accumulating on internal engine components and increasing friction and wear, as well as preventing soot particles from agglomerating into larger particles that increase oil viscosity and clog oil filters. Traditionally, detergent additives in diesel oils have effectively prevented acid buildup, corrosive wear, piston deposit formation and oil consumption, while an additive known as ZDDP has effectively provided wear protection for the valve train system, front gear case, injector screws, push-rod ends and timing chains, as well as oxidation inhibition. The problem, however, is that ZDDP and many detergents contain ingredients that plug diesel particulate filters, including sulfated ash, phosphorus and sulfur.

Due to the negative effects of sulfated ash, phosphorus and sulfur on diesel particulate filters, ASTM agreed to accept limitations in these areas and incorporate new additive chemistry for diesel oil category CJ-4. Sulfated ash provides lubricity and alkalinity (TBN) to counteract acid formation during combustion. While most API CI-4 PLUS oils are composed of 1.50 percent ash, new API CJ-4 diesel oils are limited to 1.0 percent ash, dropping TBN levels from 10 to 14 with average CI-4 PLUS oils to 8 to 9 with CJ-4 oils. Lower sulfated ash, phosphorus and sulfur levels, as well as increased soot loading, affect an oil's ability to provide protection over extended drain intervals.



Synthetic 5W-40 Premium Diesel Oil (DEO)

AMSOIL Synthetic 5W-40 Premium Diesel Oil (DEO) is the premium choice diesel oil for model year 2007 and newer heavy-duty and pickup truck diesel engines requiring API CJ-4 emission quality oil standards. It delivers extraordinary lubrication in diesel engines found in commercial, fleet and personal vehicles. Formulated with the latest additive technology and the most advanced synthetic base oils, Synthetic 5W-40 Premium Diesel Oil exceeds the higher performance demands of modern engines. It withstands the stress of heat, soot and acids to help prevent deposits, corrosion and wear, and its broad viscosity range offers superior protection over a wide temperature range. Synthetic 5W-40 Premium Diesel Oil resists breakdown and is recommended for the longest service interval established by the engine, vehicle or equipment manufacturer. Drain intervals may be extended when monitored by oil analysis. AMSOIL Synthetic 5W-40 Diesel Oil is a low sulfated ash, phosphorus and sulfur formulation that meets and exceeds modern specifications for emission quality diesel oil. It is compatible with all exhaust treatment devices and is designed to extend the service life of particulate filters.

AMSOIL Synthetic 5W-40 Premium Diesel Oil replaces 5W-40, 10W-40 and 15W-40 viscosity oils. It is "backwards compatible" with pre-2007 diesel engines and recommended for newer and older diesel and gasoline engines and other applications requiring the following worldwide specifications:

• API CJ-4, CI-4+, CH-4, CF• API SM, SL, SJ... • ACEA E7• Mack EO-O Premium Plus• DDC Power Guard 93K218 • Caterpillar ECF-3, ECF-1 • Cummins CES 20081 • Volvo VDS-4 • MB 228.3 • MTU Type II

Synthetic 5W-40 Premium Diesel Oil *may* be used in pre-2007 diesel engines, but for increased protection and performance for extended drain intervals, AMSOIL continues to recommend Synthetic Heavy Duty Diesel & Marine Motor Oil (AME), Series 3000 Synthetic 5W-30 Diesel Oil (HDD) or Synthetic 10W-30/SAE 30 Diesel Oil (ACD).

Synthetic 5W-40 Premium Diesel Oil Data Bulletin

The new G-2245 Synthetic 5W-40 Premium Diesel Oil data bulletin, highlighting the features and benefits of Synthetic 5W-40 Premium Diesel Oil, is available for purchase.

Stock #	Qty.	U.S.	Can.
G-2245	25	2.80	3.50



Synthetic 5W-40 Premium Diesel Oil (DEO)

Stock No.	Pkg./Size	Wt. Lbs.	Comm. Credits	U.S. Dealer/ P.C.	U.S. Sugg. Retail	Can. Dealer/ P.C.	Can. Sugg. Retail
DEO-QT	(1) quart	2.1	4.05	5.70	7.45	7.05	9.25
DEO-01	(12) quarts	24.6	48.60	64.80	88.20	80.40	109.80
DEO-1G	(1) gallon	8.0	15.70	21.90	27.55	27.20	34.10
DEO-04	(12) gallons	31.8	62.80	83.40	108.60	103.60	134.80
DEO-30*	30 gallon drum	243.0	332.00	553.00	664.00	688.00	826.00
DEO-55*	55 gallon drum	435.0	527.00	957.00	1149.00	1192.00	1429.00

* Not stocked in all distribution centers. Call for availability.