



**SynMax Performance Lubricants**

13759 Metric Drive, Roscoe, IL. 61073 (815) 389-9999 [www.synmaxperformancelubricants.com](http://www.synmaxperformancelubricants.com)

## **TECHNICAL BULLETIN – HOW MODERN CATALYTIC CONVERTERS WORK**

**1994 MODEL YEAR OR NEWER REQUIRES CURRENT OIL FORMULATIONS WITH ZINC (ZDDP) LEVELS OF 800 PPM OR .08% VOLUME BY WEIGHT OR LESS BECAUSE OF HOW THE MODERN USA CATALYTIC CONVERTER DESIGN FUNCTIONS AS FURTHER EXPLAINED:**

Heavy Duty & Hi-Performance / Racing Type oils that have percentage levels higher than 800 ppm or .08% volume by weight of zinc diorgano dithiophosphate (ZDDP) CAN be used within passenger car, pickup truck and SUV gasoline engines that are 1993 model year and OLDER.

This is because of the phosphorus content, which is contributed from the anti-wear additive named: **zinc diorgano dithiophosphate (ZDDP)**.

Beginning with most 1994 model years and subsequently in all makes and models beginning with the 1996 model year and since the passenger car, light truck and SUV OEMs were required by the United States EPA to use three way catalytic converters and on board emission diagnostic devices (OCBs) and emission control units (ECUs) to control and reduce hydrocarbon, nitrogen oxide and carbon monoxide emissions throughout the lifecycle of the vehicle.

The EPA requires the OEMs to certify these emission system components and to provide two types of emission system warranties.

### **The warranties the OEMs must provide for all 1995 and newer cars, trucks and SUVs are:**

**If a vehicle fails an emissions test, OEMs must cover the cost of repairs for:**

- **Major emission system components include catalytic converters, electronic emission control units (ECUs), and onboard diagnostic devices, (OCBs)**
- **Design and Defect Warranty**

**If the emissions system component is found to be defective in design or manufacture, OEMs must cover the cost of repairs for:**

- **Any component within the first 2 years or 24,000 miles of operation.**
- **Major components within the first 8 years or 80,000 miles of operation.**
- **Major emission system components include catalytic converters, electronic emission control units (ECUs), and onboard diagnostic devices, (OCBs)**



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Because of these aspects, engine oils that are designed to be used in passenger car, truck and SUV engines must be formulated to protect the emission control systems of vehicles. This has resulted in reductions in phosphorus levels beginning with the introduction of ILSAC GF-2 (the starburst symbol you see on the quart and gallon containers).

ILSAC GF-2 set phosphorus limits of 0.1% by weight (1000 ppm) maximum for engine oils used in passenger car, truck and SUV gasoline engines. By the 2004 model year and the introduction of ILSAC GF-4 specification (the latest API Starburst Classification) phosphorus levels were reduced to 0.06% (600 ppm) by weight minimum to 0.08% (800 ppm) by weight maximum with an additional requirement that engine oils that meet ILSAC GF-4.

These engine oil phosphorus limits starting with the API Service Classification ILSAC GF-2 and the subsequent ILSAC GF-4 and SM API Service Classifications were set to insure extended emissions system durability.

API Service Classification SM to contain a maximum sulfur levels of 0.5% by weight maximum for SAE 0W-XX and 5W-XX viscosity grades and 0.7% by weight maximum sulfur for SAE 10WXX viscosity grades, in order to protect the durability of the emission control systems.

Engine oils that meet the ILSAC GF-4 and API SM have less of a negative impact on the emissions systems and help them to continue to work properly over their lifecycle to reduce emissions.

Engine oils that meet these specifications are formulated with less sulfur and phosphorus.

***These components of the engine oil (phosphorus and sulfur) in previous additive formulation levels (800ppm or greater) can poison the emissions control systems, resulting in the prevention of harmful emissions from being converted or treated. Both of which can damage emissions systems, especially the three-way catalytic converter.***

A passenger car's, light truck's and SUV's three-way catalytic converter system is a device that helps to reduce harmful gaseous emissions by treating the exhaust gases created during the combustion process before they leave the vehicle and removes most of the harmful pollutants.

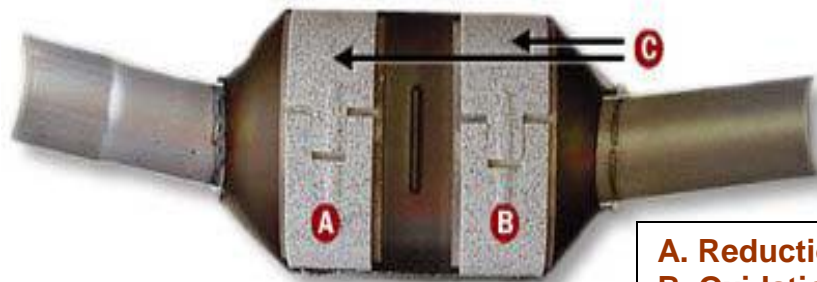


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How a three way converter functions is further described:



**A. Reduction Catalyst**  
**B. Oxidation Catalyst**  
**C. Honeycomb Catalyst Structure**

The three-way catalytic converters consist of **two types catalysts**; a **reduction catalyst** and an **oxidation catalyst**.

Both types of catalysts consist of a **ceramic structure that is coated with noble metals such as platinum, rhodium or palladium**.

- These catalysts are designed to reduce the three major engine pollutants carbon monoxide (CO), nitrogen oxides (NOX) and unburned hydrocarbons (HC).
- The reduction catalyst is the first stage of the catalytic converter process.
- It uses a ceramic structure coated with platinum or rhodium catalysts to reduce NOX emissions by converting the NOX to harmless nitrogen gas.
- The oxidation catalyst, which is the second stage of the catalytic converter, reducing carbon monoxide and hydrocarbon emissions by burning or oxidizing them over a platinum and palladium catalyst.
- The oxygen sensor, which is mounted upstream from the catalytic converter, monitors the exhaust to ensure there is enough oxygen present to burn off the hydrocarbons and carbon monoxide.
- The oxygen sensor tells the engine computer how much oxygen is in the exhaust.
- The engine computer can increase or decrease the amount of oxygen in the exhaust by adjusting the air-to-fuel ratio.



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- This control scheme allows the engine computer to make sure that the engine is running at close the stoichiometric ratio to insure that there is enough oxygen in the exhaust to allow the oxidation catalyst to burn any unburned hydrocarbons and carbon monoxide.

Products which are formulated for heavy duty diesel use, even though they may meet the API Service Classification SL can not be used in today's passenger car, light truck and SUV gasoline engines, which specify the use of an engine oil that meets not only the API Service classification requirements SL or SM but also the requirements for either ILSAC GF-3 or GF-4.

An engine oil that meets only the API Service Classifications SL and SM does not have any restrictions on phosphorus levels and sulfur levels and are primarily designed for use in off-road applications such as racing or on vehicles that do not contain three-way catalytic converter systems such as motorcycles and ATVs.

Current (2007) heavy-duty diesel engine oils generally have phosphorus levels of 1200 ppm or 0.12% volume by weight.

**The use of a heavy-duty diesel or competition racing oil with zinc diorgano dithiophosphate (ZDDP) additive levels higher than 800ppm or 0.80 volume by weight in passenger cars or vehicles with this type of catalytic converter emission system from 1994 to current model years can result in a compromise of the emissions control systems durability and performance due to the potential poisoning of these systems by the high phosphorus levels:**

- ***Extremely small amounts of engine oil can always come into contact with the emissions systems due to either to normal oil consumption or the engine oil's volatility characteristics.***
- ***This high amount of phosphorus in the heavy-duty diesel engine oil can deactivate the noble metal catalysts by coating and building up on the active catalyst sites, causing irreversible damage that accumulates over time.***
- ***As a result, increased levels of harmful emissions such as NOX, carbon monoxide and hydrocarbons pass through the catalytic converter unchanged and into the atmosphere.***

Engine oils that meet or is equally formulated to CI-4/SL, CI-4 Plus or just API Service Classification SH, SJ, SL or SM should be used in older engines or those gasoline engines such as off-road, ATV, motorcycle or track racing applications or those gasoline engines that specify just the use of the API service classifications SL or SM.

SynMax Performance Lubricants provides Street and Heavy Duty Motor Oils specifically designed for API Street applications use and requirements (5W20, 5W30, 10W30).