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# 1 INTRODUCTION

This publication specifies the type of lubricants, fuels, filters, and related maintenance intervals required for the natural gas-fueled engines manufactured and marketed by Detroit Diesel®. The information in this publication applies to Series 60G, Series 50G, and Series 30G On-Highway and Off-Highway applications.

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## 2 LUBRICATING OIL

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## 2.1 LUBRICATING OIL REQUIREMENTS

Lubricants formulated for Detroit Diesel engines fueled by natural gas or propane must provide adequate engine lubrication, minimal thermal oxidation, and good deposit control. Only engine oils meeting Detroit Diesel *POWER GUARD*® Oil Specification (PGOS) 93K216 and listed on the PGOS 93K216 approved oils list are acceptable for use in Detroit Diesel Series 50G, Series 60G and Series 30G natural gas-fueled engines in both On-Highway and Off-Highway applications.

View PGOS 93K216 as follows:

1. Go to: <http://www.DDCSN.com>
2. Select the *Literature* tab.
3. Select the *Lubricants / Fuels / Coolants* category.
4. Select the *Natural Gas POWER GUARD Oil Spec* bullet.

## 2.2 OIL DRAIN INTERVALS

During engine operation, lubricating oil undergoes deterioration from combustion by-products and contamination. Oil drain intervals may vary in length depending on engine operation, fuel quality, and lubricant quality. The oil drain intervals are listed in Table 2-1 and Table 2-2 and should be considered a maximum.

Application	Oil Drain Interval
Highway Truck, Motor Coach	15,000 miles (24,000 km)
City Transit Coach	6,000 miles (9600 km) or 3 mon*
Pick-up and Delivery, Stop and Go, Short Trip	6,000 miles (9600 km) or 3 mon*
Stationary Units:	
Full Time	150 h or 1 mon*
Stand-by	150 h or 3 mon*

\* Whichever comes first.

**Table 2-1 Maximum Oil Drain and Filter Change for Series 50G and Series 60G Engines using PGOS 93K216 Approved Oils**

Application	Oil Drain Interval
Pick-up and Delivery, Stop and Go, Short Trip, School Bus	8,000 miles (12,800 km) or 3 mon*

\* Whichever comes first.

**Table 2-2 Maximum Oil Drain and Filter Change for Series 30G Engines using PGOS 93K216 Approved Oils**

## 2.3 USED LUBRICATING OIL ANALYSIS

An oil analysis program such as Detroit Diesel’s Genuine Oil Analysis Program is recommended for monitoring crankcase oil in all engines. The application of a used oil analysis program on natural gas-fueled engines can help to identify contamination from excessive wear metals and foreign substances and monitor oil degradation through oxidation. If any abnormal conditions are identified, the oil should be changed immediately and the cause of these conditions investigated. Refer to Detroit Diesel *Used Lube Oil Analysis Technician’s Guide*, DDC-SVC-MAN-0047, for further guidance. Warning Limits for several oil analysis parameters are listed in Table 2-3. These limits are based on oil samples taken at oil drain using the recommended oil drains listed in Table 2-1 and Table 2-2.

Oil Analysis Parameter	Test Method	Warning	Critical	
Viscosity, cSt @100 °C	ASTM D445			
		Minimum	13.0	12.5
		Maximum	16.0	17.0
Total Base Number, Minimum	ASTM D4739	2.5	1.5	
Total Acid Number, Maximum	ASTM D664	2.5	3.5	
Iron, ppm Maximum	ASTM D5185	15	25	
Copper, ppm Maximum	ASTM D5185	15	25	
Lead, ppm Maximum	ASTM D5185	10	20	
Chromium, ppm Maximum	ASTM D5185	10	15	
Aluminum, ppm Maximum	ASTM D5185	10	15	
Glycol, Maximum	ASTM D2982 DIN 51375	Negative		
Water, ppm Maximum	ASTM D203 modified	3000		
Oxidation, abs/cm, Maximum	ASTM D7214-06	15	25	
Nitration, abs/cm, Maximum	ASTM D7214-06	15	25	

**Table 2-3 Single Sample Used-Oil Analysis Warning Limits**

An engine should not be considered “worn out” or “distressed” on the basis of a single oil analysis result. Instead, a trend line of successive oil analyses for the engine in question should be examined to determine if current test results are outside the normal variation. If it is determined that the oil analysis is indicating an abnormal condition, it should be confirmed through mechanical diagnosis before any engine disassembly is undertaken.

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## 3 FUEL COMPOSITION

The characteristics listed in Table 3-1 identify the minimum quality recommended by Detroit Diesel for use in natural gas-fueled engines. Users of this recommended specification are advised to review SAE J1616, *Compressed Natural Gas Vehicle Recommended Practice* for additional information.

**NOTE:**

Fuel composition requirements differ depending on engine model and application.

Property	Test Method	Requirements	
		All On-Highway*	All Off-Highway†
<b>Hydrocarbon</b>		<b>Mole Percent</b>	
Methane	ASTM D1944	74.4% minimum	88% minimum
Ethane		16.1% maximum	6% maximum
Propane		5.2% maximum	1.7% maximum
C4 and Higher		4.2% maximum	0.3% maximum
<b>Other Gaseous Species</b>			
Hydrogen	ASTM D1250	0.1% maximum	0.1% maximum
Carbon Dioxide + Nitrogen + Oxygen	ASTM D1945	4.5% maximum	4.5% maximum
Carbon Monoxide	ASTM D2650	0.1% maximum	0.1% maximum
<b>Other Species</b>			
Methanol	No Test Method	0% mass	0% mass
Sulfur, Total	ASTM D4468	22 ppm/v	22 ppm/v
<b>Performance Related Properties</b>			
Methane Number	ASTM D1945	64.8 minimum	64.8 minimum
Wobbe Number‡	ASTM D3588	1063 – 1400 Btu/scf	1290 – 1380 Btu/scf
<b>Contaminants§</b>			
Pressure Hydrocarbon Dew Point, Temperature, Maximum	ASTM D1141	Below which will form 1% condensate	Below which will form 1% condensate
Odorant	The natural gas at ambient conditions must have a distinctive odor potent enough for its presence to be detected down to a concentration in air of 1 % by volume.		

- \* On-Highway Applications include Models 6047TKG8, 6047MKG8, and 6047TKG6, but exclude Model 6047GKG8.
- † Off-Highway Applications include Models 6063GKG5, 6063TKG5, 6043GKG5, 6043TKG5, 6063TKG2, and 6047GKG8.
- ‡ Wobbe Index (WI), also known as Wobbe Number, is a measure of fuel energy flow rate through a fixed orifice under given inlet conditions. Numerically,  $WI = (\text{dry, higher heating value}) / (\text{specific gravity})$
- § The compressed natural gas shall not contain dust, sand, dirt, gums, oils, or other substances in an amount sufficient to be injurious to the fuel station equipment or the vehicle being fueled.
- || The water and hydrocarbon dew point at vehicle fuel storage container pressure shall be at least 100°F below the 99.0% winter design temperature, refer to 1989 ASHRAE Handbook — Fundamentals, Chapter 24, Table 1, "Climatic Conditions for the United States." Testing for water and hydrocarbon vapor shall be in accordance with ASTM D1142 utilizing the Bureau of Mines apparatus.

**Table 3-1 Compressed Natural Gas Fuel Quality Requirements**

The liquefied natural gas characteristics listed in Table 3-2 are recommended for use in all natural gas fueled engines and applications.

Property	Test Method	Limit, Mole Percent
Methane	ASTM D1945	98% minimum
Heavy Hydrocarbon (C4 and higher)		0.5% maximum
Inert Gas		2% maximum

**Table 3-2 Liquefied Natural Gas Fuel Quality Requirements**

## **GLOSSARY**

<b>ASTM D445</b>	Test Method for Kinematics Viscosity of Transparent and Opaque Liquids
<b>ASTM D664</b>	Test Method for Neutralization Number by Potentiometric Titration
<b>ASTM D1142</b>	Test Method for Water Vapor Content of Gaseous Fuels by Measurement of Dew Point Temperature
<b>ASTM D1744</b>	Standard Test Method for Determination of Water in Liquid Petroleum Products by Karl Fischer Reagent (Test Method Withdrawn 2000)
<b>ASTM D1945</b>	Standard Method of Analysis of Natural Gas by Gas Chromatography
<b>ASTM D2504</b>	Standard Test Method for Non-Condensable Gases in C2 and Lighter Hydrocarbon Products by Gas Chromatography
<b>ASTM D2982-07</b>	Standard Test Methods for Detecting Glycol-Base Antifreeze in Used Lubricating Oils
<b>ASTM D3588</b>	Standard Practice for Calculating Heat Value, Compressibility Factor and Relative Density (Specific Gravity) of Gaseous Fuels
<b>ASTM D4739</b>	Test Method of Base Number Determination by Potentiometric Titration
<b>ASTM D5185</b>	Determination of Additive Elements, Wear Metals, and Contaminants in Used Lubricating Oil by Inductively Coupled Plasma Atomic Emission Spectroscopy
<b>ASTM D5503</b>	The Determination of Sulfur Compounds in Natural Gas and Other Gaseous Fuels by Gas Chromatography and Chemiluminescence
<b>ASTM D7214-06</b>	Standard Test Method for Determination of the Oxidation of Used Lubricants by FT-IR Using Peak Area Increase Calculation