DETROIT DIESEL

Lubricating Oil, Fuel, and Filters

Engine Requirements

Trademark Information

TABLE OF CONTENTS

1 INTRODUCTION 1- 1

2 LUBRICATING OIL REQUIREMENTS 2- 1
2.1 FOUR-STROKE CYCLE ENGINES 2- 1
2.1.1 API CJ-4 VERSUS API CI-4 PLUS 2- 1
2.1.2 APPROVED OILS — *POWER GUARD* OIL SPECIFICATION 2- 2
2.1.3 LOW AMBIENT TEMPERATURE STARTING 2- 2
2.1.4 MONOGRADE OILS 2- 3
2.2 TWO-STROKE CYCLE ENGINES 2- 4

3 LUBRICATING OIL ADDITIONAL INFORMATION 3- 1
3.1 SAE VISCOSITY GRADE SELECTION 3- 1
3.2 HIGH TEMPERATURE/HIGH SHEAR VISCOSITY 3- 2
3.3 SULFATED ASH AND TOTAL BASE NUMBER 3- 3
3.4 UNIVERSAL OILS 3- 3
3.5 SYNTHETIC OILS 3- 3
3.6 LUBRICANT SELECTION OUTSIDE NORTH AMERICA 3- 3
3.7 TYPICAL PROPERTIES 3- 4
3.8 THE USE OF SUPPLEMENTAL ADDITIVES 3- 4
3.9 PURCHASING BULK ENGINE OIL 3- 5
3.10 WASTE OIL DISPOSAL AND REREFINED OILS 3- 5

4 OIL DRAIN INTERVALS 4- 1
4.1 OIL DRAIN INTERVALS SERIES 60 EPA07 ON-HIGHWAY ENGINES 4- 1
4.2 OIL DRAIN INTERVALS FOR MBE 900 AND MBE 4000 EPA07 ON-HIGHWAY ENGINES 4- 2
4.3 OIL DRAIN INTERVALS SERIES 60, MBE 900, AND MBE 4000 PRE-2007 ON-HIGHWAY ENGINES 4- 3
4.4 ALTERNATE OIL DRAIN INTERVALS MBE 900 ON-HIGHWAY ENGINES 4- 4
4.5 EXTENDING OIL DRAIN INTERVALS 4- 4
4.5.1 GUIDANCE FOR EXTENDING OIL DRAIN INTERVALS 4- 5
4.6 USED LUBRICATING OIL ANALYSIS 4- 6

5 DIESEL FUEL 5- 1
5.1 QUALITY AND SELECTION 5- 1
5.1.1 FUEL LUBRICITY 5- 3
5.1.2 PREMIUM DIESEL FUEL 5- 3
5.1.3 BIODIESEL FUELS 5- 3
5.2 DIESEL FUEL PROPERTIES 5- 3
5.2.1 DISTILLATION 5- 4
5.2.2 95% BOILING POINT 5- 4
5.2.3 CETANE NUMBER 5- 4
5.2.4 FUEL STABILITY 5- 4
5.2.5 FUEL SULFUR CONTENT 5- 5
5.2.6 FUEL OPERATING TEMPERATURE AND VISCOSITY 5- 5

5.3 FUEL ADDITIVES 5- 5
5.3.1 WATER CONTAMINATION 5- 5
5.3.2 FUEL ADDITIVES THAT ARE NOT ALLOWED 5- 6
5.3.3 EVALUATION OF SUPPLEMENTAL FUEL ADDITIVES 5- 6
5.4 DIESEL FUEL STORAGE 5- 8

6 FILTRATION 6- 1
6.1 FUEL AND LUBRICATING OIL FILTERS 6- 1
6.2 BOSCH/DELPHI FUEL FILTRATION SYSTEMS 6- 4
6.3 AFTERMARKET FILTRATION SYSTEMS 6- 4
6.4 GENUINE DETROIT DIESEL MAINTENANCE PRODUCTS 6- 5

7 STATEMENT OF DETROIT DIESEL WARRANTY 7- 1

8 SUPPLEMENTAL INFORMATION 8- 1

APPENDIX A: APPROVED LUBRICANTS ..... A- 1

A.1 APPROVED LUBRICANTS FOR S60, MBE 4000, MBE 900 EPA07 ENGINES EQUIPPED WITH EGR AND AFTERTREATMENT DEVICES ..... A- 1

A.2 APPROVED LUBRICANTS FOR S60, MBE 4000, MBE 900 PRE-2007 ENGINES ..... A- 3

A.3 APPROVED LUBRICANTS FOR S60, MBE 4000, MBE 900 FOR NON-EGR ENGINES A- 6

1 INTRODUCTION

This publication specifies the type of lubricants, fuels, filters, and related maintenance intervals required for the diesel-fueled engines manufactured and marketed by Detroit Diesel®. The information in this publication applies to Series 60, Series 50, Series 55, Series 40, MBE 900, MBE 4000, and two-stroke cycle engines used in On-Highway applications.

NOTE:
For Off-Highway engine lubricating oil, fuel, and coolant requirements, refer to MTU Technical Publication, *Fluids and Lubricants, Specification*, A001061/31E. This bulletin is available from authorized Detroit Diesel distributors.

For information on fuels, lubricants, and filters required for Detroit Diesel engines using alternate fuels (other than diesel fuel) and other engine products not covered in this publication, refer to the specific publications for those engines.

Selection of the proper quality of fuel, lubricating oil, and filters in conjunction with required oil and filter maintenance is required to achieve the long and trouble-free service which Detroit Diesel engines are designed to provide. Operation with improper fuels, lubricants, and filters can degrade engine performance and may void the manufacturer's warranty.

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2 LUBRICATING OIL REQUIREMENTS

In general, lubricating oil selection for Detroit Diesel engines is based on viscosity grade and service category as defined by industry standards and is displayed in the API symbol shown in the following section. Oils identified by this system and licensed by API provide adequate service in most applications. In 2002, Detroit Diesel initiated additional criteria to these requirements through the use of *POWER GUARD*® Oil Specifications (PGOS) which resulted in a listing of preferred oils for Detroit Diesel engines. For further information about these oils, refer to section 2.1.2.

2.1 FOUR-STROKE CYCLE ENGINES

The lubricating oil requirements for Series 50, Series 55, Series 60, MBE 900, and MBE 4000 four-stroke cycle engines are outlined in this section.

See Figure 2-1 for the API symbol of four-stroke cycle engine oils.

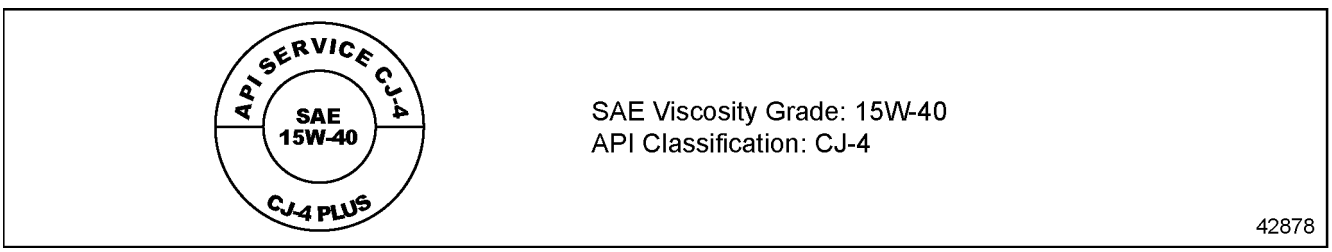

Figure 2-1 API Symbol: Four-Stroke Cycle Engine Oils

2.1.1 API CJ-4 VERSUS API CI-4 PLUS

API Service Category CJ-4 oils are designed primarily for use with EPA07 compliant engines equipped with cooled EGR and exhaust aftertreatment devices operating on Ultra-Low Sulfur Diesel (ULSD) fuel (15 ppm). These oils are designed with reduced ash and phosphorous content to minimize degradation of aftertreatment devices while providing complete wear, deposit, and soot control. API- CJ-4 oils may also be used in all diesel engines operating with ULSD fuel.

API Service category CI-4 oils were designed primarily for use with 2002 EPA emission compliant engines equipped with cooled EGR operating on low sulfur fuel (500 ppm). These oils are formulated with higher ash and phosphorus contents and were not intended for use in engines with aftertreatment devices. Their use in EPA07 engines may cause premature aftertreatment filter plugging.

Detroit Diesel recommends compliance with PGOS 93K218 on all On-Highway engines operating on ULSD fuel. The use of CJ-4 is not recommended in engines operating on low sulfur fuel (500 ppm) without a reduction in oil drain intervals. Since January 2007, 80% of fuel marketed for On-Highway diesel engines must be ULSD fuel.

2.1.2 APPROVED OILS — *POWER GUARD* OIL SPECIFICATION

In 2002, Detroit Diesel issued its first listing of approved oils based on PGOS. These specifications represented an enhanced performance level beyond the industry-based service category system. Oils meeting these specifications undergo additional review of performance claims, include added performance requirements for Detroit Diesel's international family of engines compared to API certified engine oils. The added confidence in performance of these oils allows Detroit Diesel customers to extend oil drain intervals beyond those permitted with industry-based engine oils, refer to Chapter 4.

Three Detroit Diesel-approved oil specifications exist for different applications. The list of oils meeting these specifications may be viewed at: http://www.detroitdiesel.com/Support/On-Highway/Manuals/Lubricants_Fuels_Coolants/index.asp. Listed in Table 2-1 is a summary of the three oil specifications and their intended applications.

***POWER GUARD* Oil Specification**	**Intended Application**
93K218	All four-stroke cycle series engines with an aftertreatment system, EPA07 and older (including legacy engines), operating on ULSD fuel. These oils are similar to API CJ-4
93K214	Cooled EGR-equipped engines without aftertreatment devices, operating on low sulfur fuel (below 500 ppm). These engines meet 2002 to 2006 model year emission requirements. These oils are similar to API CI-4 Plus
93K215	Non-EGR-equipped engines, operating on fuel below 5000 ppm sulfur fuel. These oils are similar to API CH-4

Table 2-1 Approved *POWER GUARD* Oil Specifications

2.1.3 LOW AMBIENT TEMPERATURE STARTING

At ambient temperatures below -10°C (14°F), SAE 5W-30, 10W-30, 5W-40, or 10W-40 oils may be used, provided they are API CJ-4 and have demonstrated field performance in Detroit Diesel engines, refer to section 3.1. These oils must possess a High Temperature / High Shear (HT/HS) Viscosity of 3.7 cP minimum. For more information on HT/HS Viscosity, refer to section 3.2.

2.1.4 MONOGRADE OILS

Monograde oils, irrespective of API service category, should not be used in On-Highway applications in any Detroit Diesel four-stroke cycle engines.

2.2 TWO-STROKE CYCLE ENGINES

The lubricating oil requirements for On-Highway applications of Series 53, Series 71, and Series 92 two-stoke engines are outlined in this section.

See Figure 2-2 for the API Symbol of two-stroke cycle engine oils.

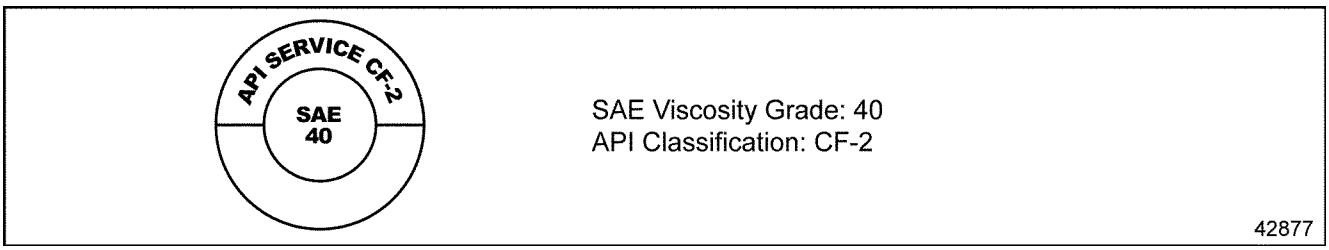

Figure 2-2 API Symbol: Two-Stroke Cycle Engine Oils

Lubricating oil for On-Highway applications for two-stroke cycle engines must meet the following requirements:

- 1.0% Ash Maximum as measured by ASTM D874
- 7.0 TBN minimum as measured by ASTM D2896
- 700 ppm zinc minimum as measured by ASTM D5185

At ambient temperatures below freezing (0°C [32°F]), sufficient starter cranking speed may not be achieved to start the engine with SAE 40 grade oils. Where starting aids are not available or at very cold temperatures (-18 to -32°C [0 to -25°F]) even if starting aids are available, the use of multigrade SAE 15W-40 or monograde lubricant SAE 30 will improve startability. These lubricants must possess a HT/HS Viscosity (measured by ASTM D 4741 or equivalent) of 3.7 cP minimum. These oils must be replaced with monograde SAE 40 lubricants as soon as ambient conditions permit.

3 LUBRICATING OIL ADDITIONAL INFORMATION

Selection of lubricating oil that meets the proper criteria is necessary for proper engine lubrication. Additional information which may be used to select an appropriate engine oil are provided in the following sections.

3.1 SAE VISCOSITY GRADE SELECTION

Viscosity is a measure of an oil's resistance to flow at various temperatures. The SAE Viscosity Grade system is defined in SAE Standard J300 that designates a viscosity range with a grade number. Lubricants with two grade numbers separated by a “W,” such as 15W-40, are classified as multigrade, while those with a single number are monograde. The higher the number, the higher the viscosity.

The viscosity requirements associated with each SAE viscosity grade are listed in Table 3-1. This information is important in selecting the best viscosity grade for the anticipated ambient temperature range at which the engine will start and operate. It should be used only as a guideline, since actual operating conditions of the engine may determine the lowest practical temperature at which an engine will start and operate. Note that grades designated with a “W” are required to meet both low temperature and high temperature viscosity requirements.

SAE Viscosity Grade	Viscosity (cP) at Temp. (°C), Max		Viscosity (cSt) ASTM D 445 (100°C)		High Temperature High Shear Rate Visc @ 150°C & 10^5 sec
	Cranking ASTM D 5293	Pumping ASTM D 4684	Min	Max	
0W	6200 at -35	60,000 at -40	3.8	—	—
5W	6600 at -30	60,000 at -35	3.8	—	—
10W	7000 at -30	60,000 at -30	4.1	—	—
15W	7000 at -20	60,000 at -25	5.6	—	—
20W	9500 at -15	60,000 at -20	5.6	—	—
25W	13,000 at -10	60,000 at -15	9.3	—	—
20	—	—	5.6	9.3	>2.6
30	—	—	9.3	12.5	>2.9
40	—	—	12.5	16.3	>3.7
50	—	—	16.3	21.9	>3.7
60	—	—	21.9	26.1	>3.7

Table 3-1 SAE Viscosity Grades for Engine Oils (SAE J300, December 1999)

For standard temperature limits of each viscosity grade; see Figure 3-1.

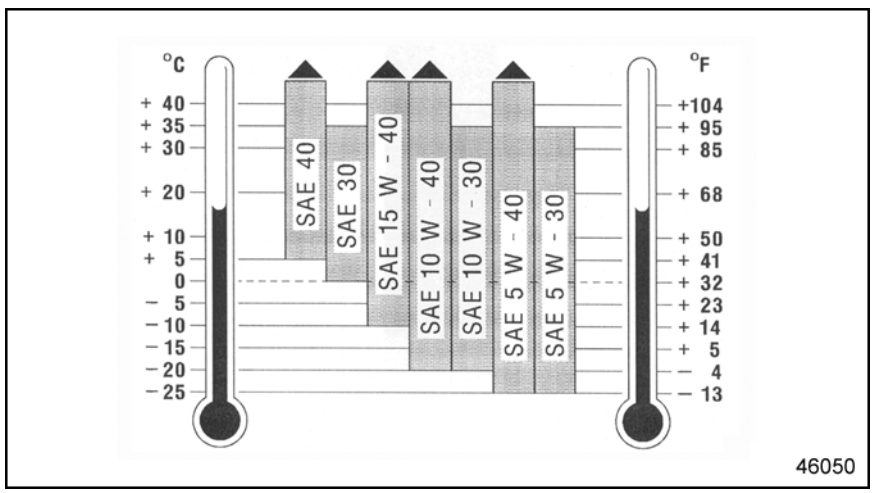

Figure 3-1 Operating Ranges for SAE Viscosity Grades

3.2 HIGH TEMPERATURE/HIGH SHEAR VISCOSITY

High Temperature / High Shear (HT/HS) Viscosity is measured at 150°C (302°F) under shear stress conditions similar to very thin film lubrication areas such as those found at the piston ring-to-cylinder wall interface. The value obtained from this test provides an indication of temporary shear stability of the viscosity index improver used in multigrade oils. An HT/HS viscosity below 3.7 cP indicates that the oil will not perform as a 40 grade oil at engine operating conditions.

3.3 SULFATED ASH AND TOTAL BASE NUMBER

Sulfated ash is a lubricant property measured by a laboratory test (ASTM D 874) to determine the potential for formation of metallic ash. The ash residue is related to the oil's additive composition and is significant in predicting lubricants which may cause valve distress, cylinder kit scuffing, or exhaust catalyst plugging under certain operating conditions. CJ-4 approved oil cannot exceed 1.0 wt% of sulfated ash, and CI-4 Plus approved oil cannot exceed 2.0 wt%. Total Base Number (TBN), which measures an oil's alkalinity and ability to neutralize acid using a laboratory test (ASTM D 2896 or D 4739), is related to sulfated ash level and plays an important role in controlling deposits in four-stroke cycle diesel engines. Typically a quality engine oil will have a fresh TBN over 8.0 mg KOH/g.

3.4 UNIVERSAL OILS

Universal Oils are designed for use with both gasoline and diesel engines and provide an operational convenience in mixed engine fleets. These products are identified with combination API category designations such as SL/CF or CJ-4/SM. Although such products can be used in Detroit Diesel engines (provided they satisfy all Detroit Diesel requirements), their use is not as desirable as lubricants formulated specifically for diesel engines and having API CJ-4 or CF-2 designations. When selecting a universal oil, select one with the **"C" category *first,*** as this should be primarily intended for diesel service.

3.5 SYNTHETIC OILS

Synthetic oils may be used in Detroit Diesel engines provided they are a PGOS approved oil. For two-stroke cycle engines; only synthetic oils which do not contain viscosity improver additives may be used. The use of synthetic oils does not necessarily ensure the extension of the recommended oil drain intervals beyond the limits.

3.6 LUBRICANT SELECTION OUTSIDE NORTH AMERICA

Engine Oils meeting *POWER GUARD* Oil Specification (PGOS) 93K215 are preferred for all Detroit Diesel four-stroke cycle engines outside North America. If these lubricants are not available, lubricants meeting European ACEA E2-96, E3-96 (or current Euro and ACEA approved oils), or E5-99 *and* CH-4 or CI-4/CI-4 Plus (preferred) may be used at the specified oil drain intervals. Oils of lower performance may only be used at a 50% oil drain interval reduction, refer to Chapter 4.

Oils meeting API CF may be used in Detroit Diesel On-Highway two-stroke cycle products, provided they also meet military specification MIL-L-2104F. Contact Detroit Diesel for further guidance.

3.7 TYPICAL PROPERTIES

Listed in Table 3-2 are the typical chemical and physical properties of a lubricating oils marketed today. This table is for information purposes only. It should neither be construed as being a specification, nor used alone in selection of an engine lubricant.

Engine Type	Four-Stroke Cycle			Two-Stroke Cycle	
Viscosity Grade API Service	**15W-40 CH-4, CI–4 Plus PGOS 93K214 / 215**	**15W-40 CJ-4 PGOS 93K218**	**10W-30 CJ-4**	**30 CF-2**	**40 CF-2**
Viscosity, Kinematic, cSt: 40°C	95 – 115	95 – 115	75 –85	100–120	130–150
Viscosity, Kinematic, cSt: 100°C	12.5 – 16.3	12.5 – 16.3	9.3 – 12.5	9.3 – 12.5	12.5 – 16.3
HT/HS, cP 150°C	3.7 Min	3.7 Min	3.7 Min	—	—
Viscosity Index	130	130	130	95	95
Pour Point °C, Max	-23	-23	-30	-18	-15
Flash Point °C, Min	215	215	205	220	225
Sulfated Ash, % Mass	2.0 Max	1.0 Max	1.0 Max	1.0 Max	1.0 Max
Total Base Number	Above 8	Below 10.0	Below 10.0	7.0 – 10.0	7.0 – 10.0
Sulfur, ppm	Above 2000	Below 4000	Below 4000	Below 4000	Below 4000
Phosphorous, ppm	Above 800	800 – 1000	800 – 1000	800 – 1000	800 – 1000
Zinc, ppm	Above 800	800 – 1000	800 – 1000	800 – 1000	800 – 1000

Table 3-2 Typical Properties of Detroit Diesel Recommended Engine Oil

3.8 THE USE OF SUPPLEMENTAL ADDITIVES

Lubricants meeting PGOS outlined in this publication contain a carefully balanced additive treatment. The use of supplemental additives, such as break-in oils, top oils, graphitizers, and friction-reducing compounds in these fully formulated lubricants are not necessary and can upset the oil's formulation, causing a deterioration in performance. These supplemental additives may be marketed as either oil treatments or engine treatments and should not be used. Their use will not void your Detroit Diesel product warranty; however; engine damage resulting from the use of such materials is not covered. The use of such additives is at the customer's risk. Detroit Diesel will not provide statements relative to their use beyond this publication.

3.9 PURCHASING BULK ENGINE OIL

To ensure continuing quality of engine oil purchased in bulk quantities, procurement specifications should include a requirement that the supplier follow *API Recommended Practice 1525* for handling bulk engine oils. This voluntary practice contains guidelines for quality control tracking within the supplier's process. In addition, customers are advised to obtain a control sample to be used as a reference for acceptance of bulk shipments.

3.10 WASTE OIL DISPOSAL AND REREFINED OILS

⚠ CAUTION:

USED ENGINE OIL

To avoid injury to skin from contact with the contaminants in used engine oil, wear protective gloves and apron.

Detroit Diesel favors the recycling of waste oil and permits the use of rerefined oils in all engine product lines, provided the rerefined oil meets the SAE Viscosity and API specifications previously mentioned. Several processes are used to rerefine oil. The only true rerefining process is one which treats the used oil as a crude oil, subjecting it to the same refinery processes normally used for geological crude, such as dehydration, vacuum distillation, and hydrogenation. Waste oil provides a more consistent feedstock, compared to the geological crudes that a refinery typically processes. As a result, the finished oil should also be consistent in properties and quality.

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4 OIL DRAIN INTERVALS

During use, engine lubricating oil undergoes deterioration from combustion by-products and contamination by the engine. In addition, certain components in a lubricant additive package are designed to deplete with use. For these reasons, regardless of the oil formulation, regular oil drain intervals are required.

NOTE:
The use of oil sampling and analysis to validate all drain intervals is highly recommended.

4.1 OIL DRAIN INTERVALS SERIES 60 EPA07 ON-HIGHWAY ENGINES

The oil drain intervals listed in Table 4-1 for Series 60 EPA07 On-Highway engines are based on engines operating with Ultra-Low Sulfur Diesel (ULSD) fuel (below 15 ppm) meeting the properties listed in Table 5-1 “Diesel Fuel Properties” with a *POWER GUARD* Oil Specification (PGOS) 93K218 approved oil. These intervals should be considered as maximum and should not be exceeded.

Service Application	Long Haul	Short Haul	Severe
Operating Condition			
Fuel Economy, mpg*	6.0 to 7.5	5.6 to 6.0	4.5 to 5.5
GVW, lbs	<80,000	70,000 — 80,000	>80,000
Idle Time, %*	0 to 25	25 to 35	>35
Load Factor %*	40 to 45	45 to 50	>55
Oil Drain Interval	30,000 miles (48,000 km)	20,000 miles (32,000 km)	15,000 miles (24,000 km)

* Based on CPC Data

Table 4-1 Maximum Oil Drain and Filter Change for Series 60 On-Highway Truck Applications using PGOS 93K218 Approved Oils with ULSD Fuel

4.2 OIL DRAIN INTERVALS FOR MBE 900 AND MBE 4000 EPA07 ON-HIGHWAY ENGINES

The oil drain intervals for MBE 900 and MBE 4000 EPA07 On-Highway engines listed in Table 4-2 are based on engines operating with ULSD fuel (below 15 ppm) meeting the properties listed in Table 5-1 “Diesel Fuel Properties” with a PGOS 93K218 approved oil. These intervals should be considered as maximum and should not be exceeded.

Service Application	Long Haul *	Short Haul †	Severe ‡
Engine Series			
MBE 900	20,000 miles (32,000 km)	The shorter of: 15,000 miles (24,000 km), 500 h, 6 months	6,000 miles (9, 600 km)
MBE 4000	30,000 miles (48,000) miles		10,000 miles (16,000 km)

***** **Long Haul** service (over-the-road transport) applies to vehicles that annually travel more than 60,000 miles (100,000 km) with minimal city stop-and-go operation. Examples of Long Haul service are: Regional delivery that is mostly freeway mileage, interstate transport, and any road operation with high annual mileage.

† **Short Haul** service applies to vehicles that annually travel up to 60,000 miles (100,000 km) and operate under normal conditions. Examples of Short Haul service are: Primary operation in cities and densely populated areas, local transport with infrequent travel, and travel with a high percentage of stop-and-go operation.

‡ **Severe** service is for vehicles that annually travel up to 6,000 miles (10,000 km) operate under severe conditions. Examples of Long Haul service are: Operation on extremely poor roads or in areas of heavy dust accumulation; operation with constant exposure to extreme hot, cold, salt-air, or other extreme climates; frequent short-distance travel; construction-site operation; city operation (fire truck and garbage truck); and farm operation.

Table 4-2 Maximum Oil Drain and Filter Change Intervals for MBE 4000 and MBE 900 in On-Highway Truck Applications using PGOS 93K218 Approved Oils with ULSD Fuel

4.3 OIL DRAIN INTERVALS SERIES 60, MBE 900, AND MBE 4000 PRE-2007 ON-HIGHWAY ENGINES

The oil drain intervals for MBE 900 and MBE 4000 Pre-2007 On-Highway engines listed in Table 4-3 are based on engines operating with ULSD fuel (below 15 ppm) with API licensed API CJ-4 or CI-4 Plus oil. These intervals should be considered as maximum and should not be exceeded.

Service Application	Engine Series	Oil Drain Interval
Highway Truck, Motor Coach	50, 55, 60*, 71, 92	15,000 miles (24,000 km)
	MBE 900	20,000 miles (32,000 km)
	MBE 4000	25,000 miles (40,000 km)
City Transit Coach	50†, 55, 60, 71, 92	6,000 miles (9,600 km)
	50‡	3,000 miles (4,800 km)
Fire Fighting, Crash Rescue	50, 60	6,000 miles (9,600 km) 300 h or 1 year
Pick-Up & Delivery	50, 53, 71	12,000 miles (19,200 km)
	MBE 904, MBE 924, MBE 906, MBE 926	15,000 miles (24,000 km)
Stop & Go, Short Trip	50	6,000 miles (9,600 km)

* The oil drain interval for engines with EGR may be 22,500 miles (36,200 km) if the oil used is from the Detroit Diesel approved list.
† All models except 6047MK1E
‡ Model 6047MK1E

Table 4-3 Maximum Oil Drain and Filter Change Intervals for Series 60, MBE 4000, and MBE 900 in On-Highway Truck Applications using PGOS Approved Oils with ULSD Fuel

4.4 ALTERNATE OIL DRAIN INTERVALS MBE 900 ON-HIGHWAY ENGINES

To determine alternate oil drain intervals for those listed in Table 4-2, see Figure 4-1.

NOTE:
The oil drain interval are based on engine hours and fuel consumption.

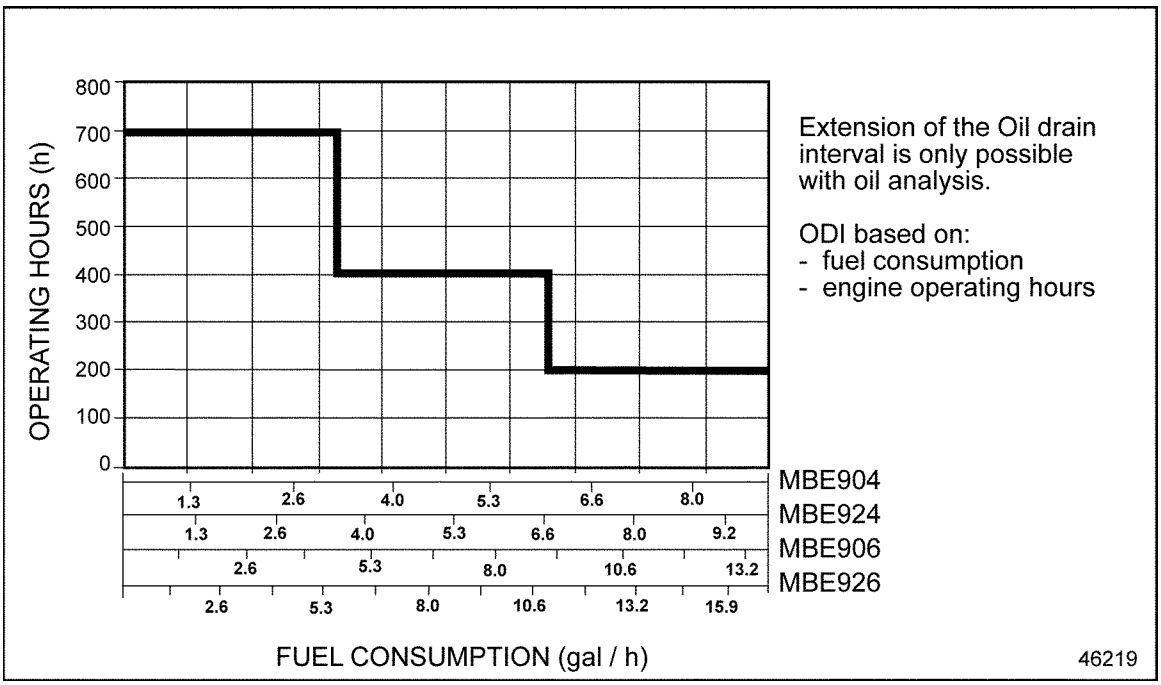

Figure 4-1 Oil Drain Interval in Hours for MBE 900 On-Highway Engines

4.5 EXTENDING OIL DRAIN INTERVALS

Changing engine oil and filters at regular recommended intervals removes contaminants in the oil and filter and replenishes expendable oil performance additives. The extension of oil change intervals necessitates that an engine can tolerate increased levels of contaminants such as soot, dirt, wear metals, fuel residues, and water. Extending oil filter change intervals requires that filters have sufficient increased capacity to continue collecting these contaminants at a sufficient rate to protect the engine. The engine oils must be formulated with additives capable of extended performance for wear, oxidation, dispersency, detergency, and filterability.

While the extension of oil drain intervals can provide owners and operators of diesel-powered equipment a cost savings in materials (oil and filters), maintenance-related downtime, and waste disposal, there can be a significant reduction of engine life to overhaul. **Currently marketed engine oils and filters are not designed to operate at extended service intervals. These products meet performance requirements of standardized industry tests that are intended to predict actual engine operation under the conditions of standard service intervals.**

4.5.1 GUIDANCE FOR EXTENDING OIL DRAIN INTERVALS

Detroit diesel recognizes the desire by some fleets to extend oil drain and filter change intervals beyond those listed in Table 4-1, Table 4-2, and Table 4-3. While Detroit Diesel has no formal program to extend these intervals, it will assist fleets in an advisory capacity to minimize equipment risks. Before a fleet embarks on an extended oil drain interval program, Detroit Diesel recommends:

- □ The fleet reviews its current maintenance program to ensure currents are performed properly and on time. A missed oil drain interval during an extended oil drain interval program will create a significant risk to the equipment.
- □ The fleet reviews the severity of the operation. High idling intervals, high load factors, and chronic mechanical problems are not conducive to extending the oil drain intervals.
- □ The fleet selects oil and filter suppliers who have the expertise and products to support the goals of such a program. They may include a field test results demonstration, formal program for extending oil and filter changes, and a warranty covering failure of their products in this service which resulted in premature engine wear out or failure.

Fleets are encouraged to review any drain extension program with Detroit Diesel before initiating the program. While Detroit Diesel will not provide approvals for these programs, they will provide feedback on the risk assessment.

Extending oil drain intervals will not void the Detroit Diesel product warranty. In the event of engine failure or premature wear out when running extended oil and filter change intervals, Detroit Diesel will make a determination as to the extent, if any, that their workmanship and materials were responsible. If Detroit Diesel determines that the failure or early wear out was related to workmanship or materials, warranty coverage of the repairs will apply. If the engine fails or wears out within the Detroit Diesel warranty period and Detroit Diesel determined it was the result of extending the oil drain intervals, any claim for reimbursement of expenses under the terms of the engine warranty will be denied.

4.6 USED LUBRICATING OIL ANALYSIS

Detroit Diesel's *POWER Trac*® used-oil analysis program is recommended for all engines. Oil analysis consists of laboratory tests to indicate conditions of the engine and/or the lubricant. The "Warning Limits" are listed in Table 4-4, "Single Sample Used-Oil Analysis Warning Limits." Oil analysis cannot completely assess the lubricating oil and should not be used to extend oil drain intervals. Oil should be changed immediately if contamination exceeds warning limits listed in Table 4-4.

Character-istics	ASTM or Other Methods	Conditions Measured	Four-Stroke Cycle Engine Series				Two-Stroke Cycle Engine Series
			40, 50, 60	55	MBE 900	MBE 4000	71, 92
Viscosity	D 445 DIN 51562	Engine & Oil	—	—	—	—	—
Kv100 °C, cSt, Min	—	—	12.5 SAE 15W-40	12.5 SAE 15W-40	12.5 SAE 15W-40	12.5 SAE 15W-40	12.5 SAE 40
Kv100 °C, cSt, Max	—	—	25.0 SAE 15W-40	25.0 SAE 15W-40	25.0 SAE 15W-40	20.0 SAE 15W-40	16.3 SAE 40
Soot, %*	TGA (E1131)	Engine Combustion	4.5†	4.5†	4.5†	4.5†	0.8
Total Base Number, Min	D4739	Oil	1/3 New		1/2 New		—
Total Base Number, Min	D2896 ISO 3717	Oil	1/3 New		1/2 New		—
Glycol, Max	D2982 DIN 51375	Engine	Negative			800 ppm	700 ppm
Water, Max	D1744	Engine	3,000 ppm				
Fuel Dilution, Max	D3524	Engine	2.5%			7%	
Iron, Max ‡	D5185	Engine Wear	200	200	200	200	150
Copper, Max‡	D5185	Engine Wear	30	20	20	20	25
Lead, Max‡	D5185	Engine Wear	30	40	20	20	10

* Infrared spectroscopy may also be used, provided it is calibrated to be equivalent to TGA.
† With PGOS approved oils
‡ These are general limits. Wear metal limits must be determined for specific application and oil used.

NOTE: These limits are intended as guidance when a single oil sample is tested and are based on the normal oil drain intervals listed in Table 4-1. Actual limits are dependent on engine, application, drain interval and oil type. Refer to Detroit Diesel Publication 7SE398 for determining warning limits specific to your application.

Table 4-4 Single Sample Used-Oil Analysis Warning Limits

5 DIESEL FUEL

The quality of fuel used is a very important factor in obtaining satisfactory engine performance, long engine life, and acceptable exhaust emission levels. For EPA07 exhaust compliant engines equipped with exhaust aftertreatment devices, the use of Ultra-Low Sulfer Diesel (ULSD) fuel is critical to the function and service life of these devices. Use of this fuel in pre-2007 engines will provide cleaner combustion, less soot, and fewer fuel-related deposits. The ultra-low sulfur content of 15 ppm in this fuel, compared to the current Low Sulfur Diesel Fuel levels of 500 ppm, will reduce EGR component corrosion and TBN depletion of the engine oil. ULSD fuel is recommended by Detroit Diesel for use in Series 60, Series 50, Series 55, MBE 900, MBE 4000, and two-stroke cycle engines

5.1 QUALITY AND SELECTION

For optimum engine operation and maximum service life, diesel fuels meeting the property requirements listed in Table 5-1 are recommended for use.

NOTE:
When prolonged idling periods or cold weather conditions below 0°C (32°F) are encountered, the use of 1-D fuel is recommended. However; note that transit coach engines are emission certified on either No. 1 or No. 2 fuel. To maintain emission compliance, only the correct certified fuel should be used.

Property	Test Method		On-Highway	
	ASTM	ISO	No. 1	No. 2
API Gravity, at 60°F Minimum Maximum	D 287	—	 40 43	 33 38
Specific Gravity, g/ml @ 60°F Minimum Maximum	D 1298	3675	 0.812 0.825	 0.830 0.855
Flash Point, °C Minimum *	D 93	2719	38	52
Viscosity, Kinematic cSt @ 40°C Minimum Maximum	D 445	3104	 1.3 2.4	 1.9 4.1
Sulfur, ppm (wt%) Maximum	D 2622	EN 24260	15 (0.0015)	15 (0.0015)
Cloud Point	D 2500	—	—	†
Filter Plugging Point	D 4359	309	—	‡
Cetane Number, Minimum	D 613	5165	43	43
Cetane Index, Minimum	D 4737	4264	40	40
Distillation % Vol. Recovery, °F (°C) IBP, Typical 10 %, Typical 50%, Typical 90%, Maximum 95%, Maximum Recovered Volume, % Minimum	D 86	3405	 325 (163) 360 (182) 425 (218) 490 (254) 540 (282) 98	 345 (194) 420 (216) 500 (260) 590 (310) 650 (343) 98
Water, % Maximum §	D 2709	—	0.02	0.02
Sediment > 1µm, mg/L Maximum	D 2276 or D 5452	—	10	10
Total Contamination, mg/kg Maximum	—	EN 12662	24	24
Ash, % mass Maximum	D 482	6245	0.01	0.01
Carbon Residue, on 10%, % mass	D 524	10370	0.15	0.35
Copper Corrosion, Maximum	D 130	2160	No. 3a	No. 3a
Accelerated Storage Stability mg/L, Maximum	D 2274	—	15	15
Reflectance at 150° C, Minimum (High Temperature Stability)	D 6468	—	70	70
Heat Content, Net, BTU/gal	D 4868	—	125,000 – 127,300	128,500 – 130,900
Lubricity Wear Scar, µm, Maximum	D 6079	—	460	460

* The flash point temperature is a safety-related property which must be established according to applicable local requirements.

† The cloud point should be 6°C (10°F) below the lowest ambient temperature to prevent clogging of fuel filters by wax crystals.

‡ The filter plugging point temperature should be equal to, or below the lowest expected fuel temperature.

§ No free water is visible.

Table 5-1 Diesel Fuel Specifications

5.1.1 FUEL LUBRICITY

It is recommended that all fuels used in Detroit Diesel engines meet the minimum lubricity requirements listed in Table 5-1, “Diesel Fuel Specifications.” Fuels not meeting the lubricity requirements may be additized to meet them.

5.1.2 PREMIUM DIESEL FUEL

Premium diesel fuels are not covered by any existing industry specification. It is recommended that the customer obtain additional information from the fuel marketer and compare properties to those listed in Table 5-1 before using.

5.1.3 BIODIESEL FUELS

Detroit Diesel strongly supports biodiesel as a renewable fuel. Biodiesel fuels are mono-alkyl esters of long chain fatty acids commonly referred to as Fatty Acid Methyl Esters (FAME) and are derived from renewable resources through a chemical process called transesterification. Detroit Diesel approves the use of biodiesel fuel blends up to 5% maximum by volume in petroleum diesel fuel provided the following three conditions are met:

- The biodiesel used in the blend must meet ASTM D6751 or EN 14214 specifications.
- The biodiesel used in the blend must be sourced from a BQ-9000 Accredited Producer.
- The finished blend must meet the fuel properties listed in Table 5-1 and either ASTM D975 or EN 590 specifications.

Detroit Diesel is responsible for the materials and workmanship of its engines. Failures attributed to the use of fuels which do not meet industry standards are not the fault of Detroit Diesel and will not be covered by Detroit Diesel product warranty. While Detroit Diesel supports the use of B5, the use of unacceptable quality fuel that does not meet industry standards can result in warranty evocation. Refer to chapter 7 for more details regarding Detroit Diesel’s warranty coverage.

5.2 DIESEL FUEL PROPERTIES

The boiling range indicates the temperature range over which the fuel turns to a vapor and is a very important property in consideration of diesel fuel quality. Lower boiling range fuels, such as No.1, have a higher volatility, while fuels, such as No. 2, are of lower volatility and higher temperature boiling range. Higher volatility fuels are preferred in conditions of prolonged idling, such as city coach applications or in cold temperatures. The determination of boiling range is made using ASTM Test Method D 86 or D 2887 (Gas Chromatography Test Method).

5.2.1 DISTILLATION

Although many specifications contain only a partial listing of the distillation results (Distillation Temperature at 90% Recovered, for example), this is not enough to determine the quality and suitability of the fuel for use in diesel engines. Diesel fuels are blended products which may contain high boiling constituents that can affect combustion. Only fuels with a minimum 98% recovery by distillation should be used. The full boiling range as listed in Table 5-1 should be used for proper selection.

5.2.2 95% BOILING POINT

Fuel can be burned in an engine only after it has been completely vaporized. The temperature at which the fuel is completely vaporized is described as the “End Point Temperature” in ASTM D 86*Distillation Test Method*. Since this temperature is difficult to measure with good repeatability, the fuel's 90% or 95% distillation point is often used. Detroit Diesel specifies the 95% temperature because it is closer to the end point than the 90% used by ASTM in D 975.

5.2.3 CETANE NUMBER

Cetane Number is a relative measure of the time delay between the beginning of fuel injection and the start of combustion. In a cold engine, a low cetane number will cause difficult starting and white exhaust smoke until the engine warms up. In engines with charge air cooling, a low cetane number fuel may also cause white exhaust smoke during light load operation. A minimum cetane number of 45 is specified for best engine performance. However, the cetane number alone should not be considered when selecting a quality fuel. Other properties, such as 95% distillation temperature and carbon residue, should also be considered.

Calculated Cetane Index is sometimes reported instead of Cetane Number. Cetane Index is an empirical property determined mathematically from boiling range temperatures and specific gravity of the fuel, whereas Cetane Number is determined through an engine test. Additives may be used by the fuel marketer to improve the cetane number; however, they have no effect on cetane index. Both properties should be evaluated when selecting diesel fuel.

5.2.4 FUEL STABILITY

Diesel fuel oxidizes in the presence of air, heat, and water. The oxidation of fuel can result in the formation of undesirable gums and black sediment. Such undesirable products can cause filter plugging, combustion chamber deposit formation, and gumming or lacquering of injection system components, with resultant reduced engine performance and fuel economy. Two tests are specified for fuel stability, ASTM Test Method D 2274 which measures diesel fuel storage oxidative stability and the DuPont® Pad Test which measures high temperature stability. The DuPont Pad Test should be conducted at 150°C (302°F). The results of the DuPont Pad Test are based on a visual rating of the filter pad by the amount of light reflected from the filter pad. A 100% rating is a clean pad, while a 50% rating is very dirty. ASTM D 2274 is a weighed measure of the sediment filtered from the fuel after storage. Although the results of D 2274 may vary with actual field storage, it does measure characteristics that will affect fuel storage stability for periods of up to 12 months.

5.2.5 FUEL SULFUR CONTENT

Since January 2007, 80% of diesel fuel sold for On-Highway use must be ULSD fuel (15 ppm). Until the complete phase-in of ULSD fuel in 2011, dispensing pumps must be identified as with the sulfur level of the fuel being sold. If operating EPA07 compliant engines, or older engines with API CJ-4 oils, it is highly recommended that only ULSD fuel be used. Fuels with sulfur content above 15 ppm are not recommended for these engines due to poisoning of aftertreatment devices and the corrosion of EGR components. Engines, particularly EGR-equipped engines, operated on 500 ppm sulfur fuel and API CJ-4 oils will require a reduction in oil drain intervals.

5.2.6 FUEL OPERATING TEMPERATURE AND VISCOSITY

Since diesel fuel provides cooling of the injection system, the temperature of the fuel may vary considerably due to engine operating temperature. As fuel temperature increases, fuel viscosity decreases along with the lubrication capabilities of the fuel. Maintaining proper fuel temperatures and selecting fuels with the viscosity ranges listed in Table 5-1, “Diesel Fuel Specifications”, will ensure the injection system functions properly.

When operating with reduced fuel viscosity or elevated fuel temperatures, the injectors will operate at reduced internal clearances. As a result, dirt and smaller particulate material may cause injector durability concerns. Filters on Detroit Diesel On-Highway engines should be changed to those specified for “Severe Duty Service.” Installing a fuel cooler or operating with fuel tanks above half full may also help eliminate the concern.

5.3 FUEL ADDITIVES

Detroit Diesel engines are designed to operate satisfactorily on a wide range of diesel fuels. The regular use of supplemental fuel additives is not required or recommended. Some additives may be beneficial in addressing **temporary** fuel quality problems, but should not replace proper fuel selection and handling.

5.3.1 WATER CONTAMINATION

Some fuel additives provide temporary benefit when fuel is contaminated with water. They are not intended to replace good fuel handling practices. Where water contamination is a concern, the fuel system should be equipped with a fuel/water separator that should be serviced regularly. In marine and other environments where microbe growth is a problem, a fungicide such as Biobor® JF (or equivalent) may be used. Microbial activity may be confirmed with commercially available test kits. Follow the manufacturer's instructions for treatment. Avoid the use of fungicides containing chlorine, bromine, or fluorine compounds, since these may cause fuel system corrosion. When small amounts of water are present, supplemental additives containing methyl carbitol or butyl cellusolve are effective. Follow the manufacturer's instructions for their use. The use of isopropyl alcohol is no longer recommended due to its negative effect on fuel lubricity.

5.3.2 FUEL ADDITIVES THAT ARE NOT ALLOWED

The following fuel additives are NOT allowed:

⚠ CAUTION:

USED ENGINE OIL

To avoid injury to skin from contact with the contaminants in used engine oil, wear protective gloves and apron.

- **Used Lubricating Oil –** Detroit Diesel specifically prohibits the use of drained lubricating oil in diesel fuel. Used lubricating oil contains combustion acids and particulate materials, which erode injector components, resulting in loss of power and increased exhaust emissions. In addition, the use of drained lubricating oil will increase maintenance requirements due to filter plugging and combustion deposits. Refer to section 3.10, "Waste Oil Disposal and Rerefined Oils," for recommendations on proper used oil disposal.
- **Gasoline -** The addition of gasoline to diesel fuel will create a serious fire hazard. The presence of gasoline in diesel fuel will reduce the fuel cetane number and increase combustion temperatures.

Tanks that contain such mixtures should be drained and cleaned as soon as possible. Detroit Diesel will not be responsible for any detrimental effects which it determines resulted from the use of used lubricating oil or gasoline in the diesel fuel.

5.3.3 EVALUATION OF SUPPLEMENTAL FUEL ADDITIVES

Many supplements available today are intended to be added to the fuel by the customer. These include a variety of independently marketed products which claim to be:

- Cetane Improvers
- Emission Control Additives
- Detergents
- Combustion Improvers
- Smoke Suppressants
- Cold Weather Flow Improvers

Should a customer decide that a supplemental additive is **temporarily** required, the following is intended to provide guidance to the customer in evaluating potential safety hazards and deleterious engine effects.

- A Material Safety Data Sheet (MSDS) should be carefully reviewed for special handling instructions and hazardous material content. Additives containing hazardous materials should not be used due to personal safety risk.
- A detailed compositional analysis should be provided by the supplier. Ash forming metallic elements and corrosive elements must not be present. Additives containing calcium, barium, zinc, phosphorous, sodium, magnesium, iron, copper, and manganese are known to cause combustion ash deposits that can foul fuel injectors and create deposits which may adversely affect cylinder life. Halogenated compounds containing chloride, fluoride, and bromide are corrosive, as are some sulfur- containing compounds. The use of additives with these components should be avoided.
- Many commercial diesel fuels today contain performance additives, particularly those marketed as premium diesel fuel. Any supplemental additive being considered must be compatible with the fuel it is to be used in. A mixture containing twice the recommended concentration of additive should be evaluated for compatibility to represent an overdosage condition, using the tests listed in Table 5-1, “Diesel Fuel Specifications”.
- Performance evaluation of a fuel supplemental additive should be conducted in customer equipment for a minimum of six months. Testing should be a side-by-side comparison with and without the additive to verify performance claims. Testimonials are not substantial claims of performance.

Supplemental fuel additives are not recommended due to potential injector system or engine damage. Our experience has been that such additives increase operating costs without providing benefit. The use of supplemental fuel additives does not necessarily void the engine warranty. However, repair expenses which result from fuel system or engine component malfunctions or damage attributed to their use will not be covered. These products should be accompanied with performance data supporting their merit. Detroit Diesel will not test or verify the performance of any supplemental additives and will not accept responsibility for use, selection, or hazards relating to the use of such products.

5.4 DIESEL FUEL STORAGE

Fuel oil should be clean and free of contamination. Storage tanks and stored fuel should be inspected regularly for dirt, water, and sludge. Tanks should be drained and cleaned, if contaminated. Diesel fuel tanks can be made of monel, stainless steel, black iron, welded steel, or reinforced (non-reactive) plastic.

NOTICE:
Do not use galvanized steel or sheet metal tanks and galvanized pipes or fittings in any diesel fuel storage, delivery, or fuel system. The fuel oil will react chemically with the zinc coating, forming a compound which can clog filters and cause engine damage.

6 FILTRATION

Filters make up an integral part of fuel and lubricating oil systems. Proper filter selection and maintenance are important to satisfactory engine operation and service life. Filters, however, should be used to maintain a clean system, not to clean up a contaminated system.

6.1 FUEL AND LUBRICATING OIL FILTERS

Filter performance and test specifications vary between manufacturers. These specifications are general in nature and do not reflect the actual performance of Detroit Diesel genuine filters. The user is also cautioned when comparing micron ratings between filter makes. Some filter makers may publish results from tests in which the SAE J1858 test procedure was not used. It is also important to note that capacity and efficiency (micron) ratings should not be the only criteria on which to judge filter performance. Many other important factors, including media strength, resistance to impulse failures, and burst strength, often differ greatly between filter makes and should enter into the filter selection process.

Finer filtration will generally provide increased engine service life, but may require shorter filter change intervals. Detroit Diesel specifies filter performance based on the optimum combination of filter micron rating, filter capacity, and mechanical requirements (assembly integrity).

The oil and fuel filter used must meet the minimum requirements as listed in Table 6-1 and Table 6-2.

Product	Description	Part Number	Efficiency Specification	Capacity Specification	Application Years
S60/S50	Detroit Diesel Genuine Full Flow Oil Filter	23530573	98% minimum on 23-27 micron particles at 25 gpm per SAE J1858	70 g minimum at 25 gpm and 25 psid terminal pressure per SAE J1858	1993 and newer
S60/S50	Detroit Diesel Genuine Full Flow Oil Filter	23530407	98% minimum on 28 micron particles at 25 gpm per SAE J1858	70 g minimum at 25 gpm and 25 psid terminal pressure per SAE J1858	Pre-1993
S60/S50	Detroit Diesel Genuine Fuel Spin-On Primary Filter	23530706	98% minimum on 23-27 micron particles at 100 gph per SAE J1858	48 g minimum at 100 gph and 10 psid terminal pressure per SAE J905	Pre-2004
S60/S50	Detroit Diesel Genuine Spin-On Primary Water/Fuel Separator Filter	23535985	98% minimum on 23-27 micron particles at 100 gph per SAE J1858 Water removal: 93% minimum emulsified per ISO 4020 at 125 lph	48 g minimum at 100 gph and 10 psid terminal pressure per SAE J905	All
S60/S50	Detroit Diesel Genuine Fuel Spin-On Secondary Filter	23530707	98% minimum on 7-9 micron particles at 100 gpm per ISO 4548-12	15 g minimum at 100 gph per and 10 psid terminal pressure per SAE J905	Pre-2004
S60	Detroit Diesel Genuine Fuel Spin-On Secondary Filter	23530645	87.5% minimum on 3-5 micron, 98.5% minimum on 5-10 micron, 99.4% minimum on 10-15 micron particles at 125 lph ISO TR 13353, 1994-10-1 (single pass, fine dust) Reference Bosch Application Guideline Y414 E20 022, dated 23.12.1999	23 g minimum at 100 gph per and 10 psid terminal pressure per SAE J905	2004 and newer
S60	Davco® Fuel Pro® 382 Elemax Fuel Cartridge	23533816	87.5% minimum on 3-5 micron, 98.5% minimum on 5-10 micron, 99.4% minimum on 10-15 micron particles at 125 lph ISO TR 13353, 1994-10-1 (single pass, fine dust) Reference Bosch Application Guideline Y414 E20 022, dated 23.12.1999 Water removal: minimum 95 % efficiency at both emulsified and free water per SAE J1488 and SAE J1839	58 g minimum at 100 gph, 4 psid terminal pressure per SAE J905	All

Table 6-1 Oil and Fuel Filter Minimum Requirements (1 of 2)

Product	Description	Part Number	Efficiency Specification	Capacity Specification	Applica-tion Years
MBE 4000	Fuel Filter	5410900151	69.3% on 4-6µm, 92.2% on 6-8µm, 98% on 8-10µm, 99.5% on 10-12µm, 99.8% on 12-15µm, 99.9% on 15-20µm, 100% on >20µm acc to ISO TR 13353	326 g minimum at 2.5 lpm acc to ISO TR 13353 (11.6 psid terminal differential pressure)	All
MBE 4000	Oil Filter	A0001802109	50% on 21µm, 70% on 25µm, 82,5% on 30µm, 88% on 35µm, 90% minimum on >40µm (ISO 4548-12)	100 g minimum at 125 lpm (ISO 4548-12) (25.4 psid terminal differential pressure)	All
MBE 900	Fuel Filter Primary (in-housing system with main filter)	000 090 1351	300 µm screen	Not applicable	All
	Fuel Filter Main (in-housing system)	000 090 1551	90 % minimum > 6micron particles according to ISO 4548-12 (Test report from Mahle® Filter System dated 17.12.2003	Minimum 75 minutes after ISO 4020 with test flow 75 lph or 34 g after ISO 19438, test flow 360 lph	All
			80% minimum on 5micron, 90% minimum on 6micron, 99% minimum >10micron particles initial efficiency according to ISO 19 438 (Test report from Mahle® Filter System dated 18.03.2005, MFP value 6,5 + 1 µm)		All
MBE 906/926	Oil Filter	000 180 1709	85 % minimum on > 23micron particles according to BN 2.21 in dependence on ISO 4548	–	All
MBE 904/924	Oil Filter	000 180 1609	85 % minimum on > 23micron particles according to BN 2.21 in dependence on ISO 4548	–	All

Table 6-2 Oil and Fuel Filter Minimum Requirements (2 of 2)

6.2 BOSCH/DELPHI FUEL FILTRATION SYSTEMS

The minimum requirements from the Bosch Application Guideline Y-414-E20-22 (December 23, 1999) for the Bosch unit injector and unit pump systems are illustrated in Figure 6-1. The initial retention efficiency must be minimum 85–90% for particles 3–5 micron. For applications in regions or applications where high particle contaminated fuels may be expected such as mining and fueling from drums, efficiency has to be adopted to meet the recommended >95% for particles 3–5 micron. See Figure 6-1.

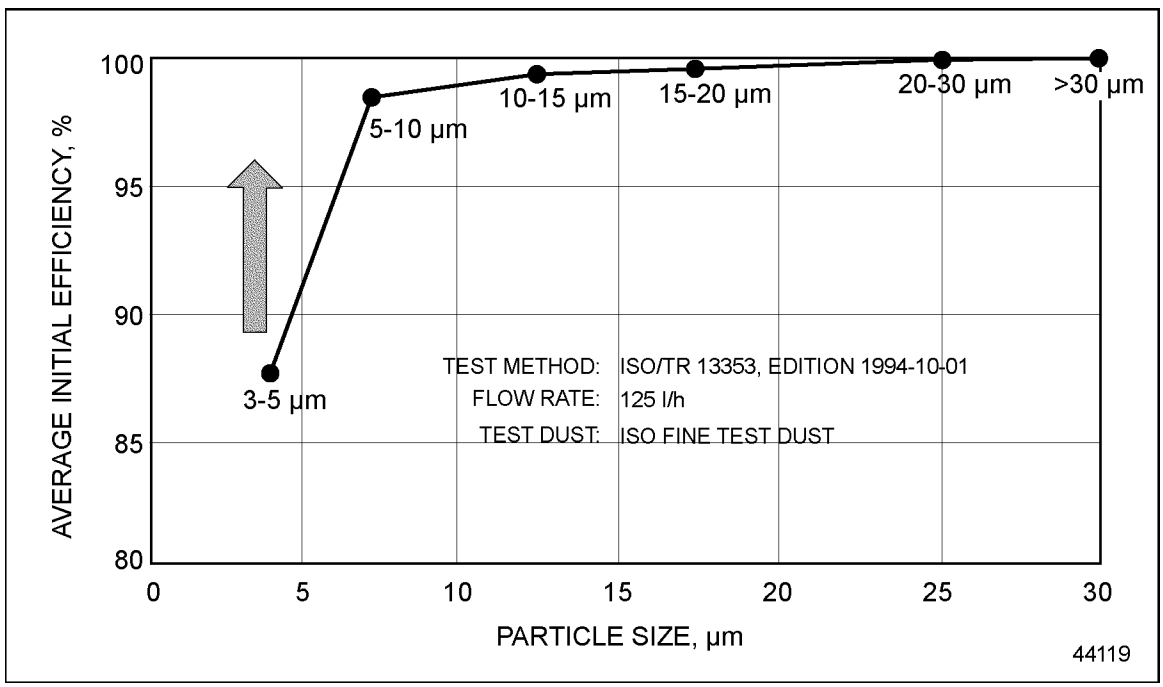

Figure 6-1 Bosch Unit Injector and Unit Pump Requirements

6.3 AFTERMARKET FILTRATION SYSTEMS

Aftermarket supplemental filtration systems may be used, provided they do not replace the factory-installed system or reduce fuel volumes, pressures, or flow rates delivered to the engine. The use of such systems does not address oil degradation from normal use and, therefore, does not permit extension of oil drain intervals. Fuel filters must be properly sized to provide the proper fuel flow to the engine. A fuel/water separator, if used, must be installed between the fuel tank and the inlet side of the engine fuel pump (>93% water separation at maximum flow per ISO-4020).

6.4 GENUINE DETROIT DIESEL MAINTENANCE PRODUCTS

Regular and optional genuine Detroit Diesel service spin-on fuel filters for most Detroit Diesel engines are listed in Table 6-3. Fuel Pro filters are listed in Table 6-4, and Sea Pro® marine engine fuel filters are listed in Table 6-5. Cartridge-type fuel filters are listed in Table 6-6. genuine Detroit Diesel spin-on lubricating oil filters are listed in Table 6-7. *POWER Trac* oil analysis kits are listed in Table 6-8.

Engine	Primary Fuel Filter		Secondary Fuel Filter		
	Qty	Part No.	Qty	Part No.	Higher Filtration Part No.
3-53	1	23530641	1	23530640	—
4-53	1	23530641	1	23530640	—
6V-53	1	23530706	1	23530707	23530645
3-71	1	23530641	1	23530640	—
4-71	1	23530641	1	23530640	—
6-71	1	23530706	1	23530707	23530645
6V-71	1	23530706	1	23530707	23530645
8V-71	1	23530706	1	23530707	23530645
12V-71	2	23530642	1	23530643	23530644
16V-71	2	23530642	1	23530643	23530644
6V-92	1	23530706	1	23530707	23530645
8V-92	1	23530706	1	23530707	23530645
12V-92	1	23530642	1	23530643	23530644
16V-92	1	23530642	1	23530643	23530644
8V-149	2	23530642	1	23530643	23530644
12V-149	2	23530642	2	—	23530644
16V-149	2	23530642	2	—	23530644
Series 40	—	—	1	1 820 479 C1 (6 in.)	—
Series 40	—	—	1	23531904	—
Series 50	1	23530706	1	23530707	—
Series 55	—	—	1	23530707	—
Series 60 (non-EGR, 2002 DDEC IV EGR)	1	23530706	1	23530707	—
Series 60 (2004 DDEC V EGR & later)	1	23535985	1	23530645	—

NOTE: A fuel/water separator assembly may be used in place of the primary filter assembly, but not together with it. For Series 50 and Series 60 engines the fuel/water separator filter number is 23535985.

Table 6-3 Genuine Detroit Diesel Spin-On Fuel Filter Elements

Filter Description	Part Number
Fuel Pro 230	23521527
Fuel Pro 232	23528565
Fuel Pro 380/382	23529168
Fuel Pro 40 Mega Filter™	23530646
Fuel Pro 382 (2004 Series 60 Engine)	23533816

Table 6-4 Fuel Pro Fuel Filter Elements

Filter Description	Micron Rating	Part Number
Sea Pro 50 / 100	30	23532245
Sea Pro 152 / 511	15	23521528
600	20	23530641
Water-in-Fuel Sensor Kit	—	23518182

NOTE: The numbers after the Sea Pro name indicate the Gallon Per Hour (GPH) flow capacity of the filter. (Does not apply to Fuel Pro filters.)

Table 6-5 Sea Pro Fuel Filter Elements

Engine Series	Primary Filter Element	Secondary Filter Element
	Part Number	Part Number
3-53	P550522	P553261
4-53	P550522	P553261
6V-53	P550552	P550540
3-71	P550522	P553261
4-71	P550522	P553261
6-71	P550552	P550540
6V-71	P550552	P550540
8V-71	P550552	P550540
12V-71	P550541	P551624
16V-71	P550541	P551624
6V-92	P550552	P550540
8V92	P550552	P550540
12V-92	P550541	P551624
16V-92	P550541	P551624
8V-149	N/A	N/A
12V-149	P550532	P551624
16V-149	P550532	P551624
MBE 904	N/A	0000901551
MBE 906	N/A	0000901551
MBE 4000	N/A	5410900151

Table 6-6 Cartridge Type Fuel Filter Elements

Engine Series	Qty	Part No.	Higher Filtration Part No.
3-53	1	23530409	—
4-53, 6V-53	1	23530407	23530408
3-71, 4-71, 6-71	1	23530407	23530408
6V-71, 8V-71, 12V-71, 16V-71	1	23530407	23530408
6V-92, 8V-92	1	23530407	23530408
12V-92, 16V-92	2 or 4	23530407	23530408
8V-149	3	—	23530408
12V-149, 16V-149	4 or 6	—	23530408
20V-149	6	—	23530408
DDC 500	2	23530412	—
Series 40	1	23529744	—
Series 50	2	23530573	—
Series 55	1	5241800310	—
Series 60	2	23530573	DELF3998
Series 60 (Pre-1993)	2	23530407	23530409
Series 60 (Pre-1993)	1	23530413	—
MBE 904	1	0001801609	N/A
MBE 906	—	0001801709	N/A
MBE 4000	—	0001802109	N/A

Table 6-7 Genuine Detroit Diesel Spin-On Lubricating Oil Filters

Part No.	Description
23515823	Standard Kit
23517267	Includes Extraction Kit
23520989	Includes Prepaid Test for TBN
23516922	Fuel Analysis Kit

Table 6-8 *POWER Trac* Oil Analysis Kits

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7 STATEMENT OF DETROIT DIESEL WARRANTY

Detroit Diesel is not responsible for the cost of maintenance or repairs due to the lack of performance of required maintenance services or the failure to use fuel, oil, lubricants, and coolants meeting Detroit Diesel-recommended specifications. Performance of required maintenance and use of proper fuel, oil, lubricants, and coolants are the responsibility of the owner. For full details, see the engine operator's guide for your engine.

A requirement of Detroit Diesel's service contract (Power Protection Plan) is that the customer uses the lubricants, fuels, and filters described in this publication in conjunction with a used-oil analysis program such as the Detroit Diesel *POWER Trac* oil analysis program.

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8 SUPPLEMENTAL INFORMATION

Specifications referred to in this publication and other related information may be obtained by contacting the following sources:

SAE Standards
Society of Automotive Engineers
Technical Publications
400 Commonwealth Drive
Warrendale, PA 15096-0001
www.sae.org

ASTM Annual Book of Standards, Section 5
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
www.astm.org

API Annual List of Licensees and Other Publications
American Petroleum Institute
1220 L Street Northwest
Washington, D.C. 20005
Directory of Licensees: www.eolcs.api.org

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APPENDIX A: APPROVED LUBRICANTS

Detroit Diesel maintains three lists of approved lubricants by company and product brand names. The lists are determined by the family of engines, use of EGR, and EPA certification.

A.1 APPROVED LUBRICANTS FOR S60, MBE 4000, MBE 900 EPA07 ENGINES EQUIPPED WITH EGR AND AFTERTREATMENT DEVICES

The approved brand name lubricants meeting *POWER GUARD* Oil Specification (PGOS) 93K218 are listed in Table A-1 and Table A-2. Access the Detroit Diesel website at www.detroitdiesel.com then select Support; On-Highway; Manuals; Lubricants, Fuels, & Coolants to view any updates or revisions to this list.

Company Name	Product Name	Vis Grade
Detroit Diesel	**Detroit Diesel Genuine Parts Engine Oil**	**15W-40**
Advanced Lubrication Specialties, Inc	Advantage® 15W-40 CJ-4 Premium Plus	15W-40
American Refining Group, Inc	BRAD PENN H.D. Premium Plus	15W-40
Benz Oil	Diesel XT	15W-40
Black Bear Company, Inc	SHDX Motor Oil	15W-40
CAM2 Oil Products Co	CAM2 Super HD Premium Plus (07) 15W-40 CJ-4/SM	15W-40
Castrol Ltd	Castrol Hypuron	15W-40
Castrol Ltd	Castrol Tection Extra	15W-40
Caterpillar, Inc	CAT® DEO-ULS 15W-40	15W-40
Chevron Global Lubricants	Chevron 400 LE SAE 15W-40	15W-40
Chevron Global Lubricants	Chevron RPM Heavy Duty Motor Oil	15W-40
Chevron Texaco Global Lubricants	Texaco® Ursa Premium TDX EC SAE 15W-40	15W-40
CITGO Petroleum Corporation	CITGARD 700 15W-40	15W-40
CITGO Petroleum Corporation	Mystik JT-8 EMT 15W-40	15W-40
ConocoPhillips	Fleet Supreme EC	15W-40
ConocoPhillips	Guardol ECT	15W-40
ConocoPhillips	Kendall Super-D XA	15W-40
D-A Lubricant Company	Reliant J-4	15W-40
Dennis K. Burke Inc	Fleetline® Superfleet	15W-40
Ford Motor Company	Motorcraft® SAE 15W-40 Super Duty Motor Oil	15W-40
Gulf Oil Limited Partnership	Super Duty Plus	15W-40
Imperial Oil Limited	Esso XD-3 Extra CJ-4	15W-40

Table A-1 PGOS 93K218 Brand Name Approved Lubricants (1 of 2)

Company Name	Product Name	Vis Grade
Kost USA, Inc	Toughinal® HD	15W-40
Lubricants USA	Fina Kappa SL	15W-40
Lubricants USA	Fina Kappa Premium	15W-40
Mack Trucks, Inc	Mack Bulldog EO-O Premium Plus	15W-40
Mobil Branded Lubricants, Exxon Mobil Corp	Mobil Delvac 1300 Super 15W-40	15W-40
Northland Products Company	Superline 15W-40	15W-40
Petro-Canada Lubricants	Duron-E	15W-40
Petro-Canada Lubricants	Duron-E XL Synthetic Blend	15W-40
Raloy Lubricantes, S.A. de C.V.	Raloy Diesel Extra Performance	15W-40
Safety-Kleen Corp	America's Choice XHD-3	15W-40
Safety-Kleen Corp	Performance Plus XHD-3	15W-40
Shell Canada Products	Shell Rotella T	15W-40
Shell International Petroleum Company	Pennzoil Long-Life Gold	15W-40
Shell International Petroleum Company	Rimula Super	15W-40
Shell International Petroleum Company	Rotella T	15W-40
Valvoline	All-Fleet Plus	15W-40
Valvoline	Premium Blue	15W-40
Volvo Trucks North America	Volvo Premium Motor Oil	15W-40

Table A-2 PGOS 93K218 Brand Name Approved Lubricants (2 of 2)

A.2 APPROVED LUBRICANTS FOR S60, MBE 4000, MBE 900 PRE-2007 ENGINES

The approved brand name lubricants meeting *POWER GUARD* Oil Specification (PGOS) 93K214 are listed in Table A-3, Table A-5, and Table . Access the Detroit Diesel website at www.detroitdiesel.com then select Support; On-Highway; Manuals; Lubricants, Fuels, & Coolants; DDC Power Guard Oil Specification (PGOS) to view any updates or revisions to this list.

Company Name	Product Name	Vis Grade
76 Lubricants Co	76 Guardol QLT® Motor Oil	15W-40
76 Lubricants Co	76 Royal Triton QLT® Motor Oil	15W-40
Amalie Oil Company	Amalie X-L-O® Ultimate	15W-40
Amalie Oil Company	Rallye® Extra Duty	15W-40
Amalie Oil Company	Xcel® Extra Duty	15W-40
American Agip Co, Inc	All Guard® Premium	15W-40
American Refining Group, Inc	BRAD PENN® H.D. Premium Plus Diesel Engine Oil	15W-40
American Refining Group, Inc	Gulf Super Duty Plus Engine Oil	15W-40
Amsoil Inc	PCO	15W-40
Bardahl	Super Diesel Oil	15W-40
Behnke Lubricants Inc	Titan Motor Oil	15W-40
Beijing Tongyi Petroleum Chemical Co, Ltd	Ji Ya Wang	15W-40
Black Bear Company, Inc	SHD 15W-40	15W-40
Black Bear Company, Inc	SHDX 15W-40	15W-40
Boss Lubricants	Boss EXQ Plus	15W-40
CAM2 Oil Products Co	CAM2® Super HD Premium Plus	15W-40
Castrol Ltd	Castrol Enduron S	15W-40
Castrol Ltd	Castrol Hypuron S®	15W-40
Castrol Ltd	Castrol Tection® Extra	15W-40
Champion Brands, LLC	CHAMPION HI-TECH LUBRICANTS CHAMPION ALL FLEET “T”®	15W-40
Champion Brands, LLC	CHAMPION HI-TECH LUBRICANTS CHAMPION ALL FLEET “T” TBN 13.2	15W-40
Chevron Texaco Global Lubricants	Caltex Delo® 400 Multigrade	15W-40
Chevron Texaco Global Lubricants	Chevron Delo 400 Multigrade	15W-40
Chevron Texaco Global Lubricants	Chevron® RPM Heavy Duty Motor Oil	15W-40
Chevron Texaco Global Lubricants	Texaco Ursa® Premium TDX	15W-40
Chevron Texaco Global Lubricants	Texaco Ursa Super Plus	15W-40

Table A-3 PGOS 93K214 Brand Name Approved Lubricants (1 of 3)

Company Name	Product Name	Vis Grade
CHS Inc	Cenex Superlube TMS®	15W-40
CITGO Petroleum Corporation	CITGO CITGARD® 600	15W-40
CITGO Petroleum Corporation	CITGO Mystik® JT-8 15W-40	15W-40
Commercial Importadora, S.A. de C.V.	Q S Super Series III	15W-40
Commercial Roshfrans, S.A. DE C.V.	Voltro Diesel+ API CI-4/SL	15W-40
Conoco, Inc	Conoco Hydroclear Power-D®	15W-40
D-A Lubricant Company	Excelon EBS M	15W-40
D-A Lubricant Company	Reliant M	15W-40
David Weber Oil Co	Gibraltar Super S-3	15W-40
Deere & Company	Plus 50®	15W-40
Exxon Branded Lubricants, Exxon Mobil Corp	Exxon XD-3 Elite®	15W-40
Exxon Branded Lubricants, Exxon Mobil Corp	Exxon XD-3 Extra®	15W-40
Federated Co-Operatives Limited	CO-OP D-MO (ADVANCED FORMULA)	15W-40
Federated Co-Operatives Limited	Sonic Master Blend	15W-40
Finning Canada	Surecraft	15W-40
Fuchs Lubricants Co	Titan Unimax Plus	15W-40
Growmark, Inc	Suprex Gold®	15W-40
Gulf Oil International	Gulf Supreme Duty LE 15W-40	15W-40
Hydrotex	HyFilm® MAX	15W-40
Imperial Oil	Esso XD-3 Extra	15W-40
Irving Oil	Cobra Diesel 15W-40	15W-40
Irving Oil	Harnois Diesel 15W-40	15W-40
Irving Oil	IDO Premium 15W-40	15W-40
Kendall Motor Oils	Kendall SHP® Diesel Engine Oil	15W-40
Kendall Motor Oils	Kendall Super-D® 3	15W-40
Kost USA, Inc	Kostgard® II MTX 15W-40	15W-40
Lubricants USA	Fina Kappa® DHD	15W-40
Lubricants USA	Fina Universal Plus XL	15W-40
Lubrication Engineers, Inc	Monolec® EGR Plus Engine Oil	15W-40
Mack Trucks, Inc	Bulldog®	15W-40
Marathon Ashland Petroleum	MultiPower®-3 Plus	15W-40
McCollister & Company	United Super Premium Plus	15W-40
McCollister & Company	Archer Premium Arpeco®	15W-40
Mobil Branded Lubricants, Exxon Mobil Corp	Mobil Delvac® MX Extra	15W-40
Mobil Branded Lubricants, Exxon Mobil Corp	Mobil Delvac 1®	5W-40
Mobil Branded Lubricants, Exxon Mobil Corp	Mobil Delvac 1300 Super	15W-40

Table A-4 PGOS 93K214 Brand Name Approved Lubricants (2 of 3)

Company Name	Product Name	Vis Grade
Newalta Corporation	Mohawk Ultra Plus 15W-40	15W-40
Northland Products Company	Superline® 15W-40	15W-40
Petro-Canada Lubricants	Duron®	15W-40
Petro-Canada Lubricants	Duron XL Synthetic Blend	15W-40
Phillips 66 Company	Phillips Super HD 3000 Synthetic Blend Motor Oil	15W-40
Pinnacle Resources, Inc	Special HDMO 15W-40 Plus	15W-40
Raloy Lubricantes	Raloy Diesel Extra Performance SAE 15W-40	15W-40
Royal Manufacturing Company, LP	Diesel Supreme Premium Plus 03	15W-40
Royal Purple	Long Rider® 15W-40	15W-40
Royal Purple	Royal Purple® 15W-40	15W-40
Safety-Kleen Corp	Americas Choice® PLD-3 15W-40	15W-40
Safety-Kleen Corp	Performance Plus® PLD-3 15W-40	15W-40
Searle Petroleum	Galco Plus 15W-40	15W-40
Shell International	Pennzoil Long-Life®	15W-40
Shell International	Rimula® Premium	15W-40
Shell International	Rotella® T	15W-40
Shell International	Rotella T Synthetic	15W-40
Texas Refinery Corporation	Pro-Spec® III Engine Oil	15W-40
The Valvoline Company	All-Fleet Plus®	15W-40
The Valvoline Company	Premium Blue®	15W-40
Ultramar Ltd	Odyssey XLD	15W-40
Warren Oil Company, Inc	Warren® 15W-40 CI-4 Plus	15W-40
Warren Oil Company, Inc	Lubriguard 15W-40 CI-4 Plus	15W-40
Warren-Unilube	Coastal® 15W-40 CI-4 Plus	15W-40

Table A-5 PGOS 93K214 Brand Name Approved Lubricants (3 of 3)

A.3 APPROVED LUBRICANTS FOR S60, MBE 4000, MBE 900 FOR NON-EGR ENGINES

The approved brand name lubricants meeting *POWER GUARD* Oil Specification (PGOS) 93K215 are listed in Table A-6. Access the Detroit Diesel website at www.detroitdiesel.com then select Support; On-Highway; Manuals; Lubricants, Fuels, & Coolants to view any updates or revisions to this list.

Company Name	Product Name	Vis Grade
CITGO Petroleum Corporation	Mystik JT-8 SHD	15W-40
CITGO Petroleum Corporation	Mystik PL Premium Fleet	15W-40
CITGO Petroleum Corporation	CITGARD 500	15W-40
CITGO Petroleum Corporation	CITGARD 600	15W-40
McCollister & Company	Premium Arpeco 15W-40	15W-40
McCollister & Company	Super Premium Arpeco 15W-40	15W-40
Petro-Canada Lubricants	Duron	15W-40
Petro-Canada Lubricants	Duron XL Synthetic Blend	15W-40
Petrobras Lubricants Australasia Pty Ltd	Motolub CS3 CI-4	15W-40
Petroliam Nasional Berhad	Lubrax® Top Turbo	15W-40
Schaeffer Mfg	#700 Supreme 7000 15W-40	15W-40
Shell International Petroleum Company	Rimula Super	15W-40
YPF S.A.	Repsol Extra Vida Plus	15W-40
YPF S.A.	YPF Extra Vida Plus	15W-40

Table A-6 PGOS 93K215 Brand Name Approved Lubricants