EuroV MBE 900 Operators Manual

Models: MBE 900 EuroV

DDC-SVC-MAN-0207, ()

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1. Forward

1.01 Introduction

This manual is intended for use by the operator of a Detroit™ engine used in On-Highway Vehicle applications.

1.02 Non-Genuine and Rebuilt Component Quality Alert

Maintenance procedures must be followed in order to continue satisfactory engine performance and durability and to ensure engine coverage under the manufacturer's warranty. Many of these maintenance procedures ensure that the engine complies with applicable emissions standards. Proper maintenance procedures, using specific components engineered to comply with emissions regulations, may be performed by an authorized Detroit™ distributor or dealer, an independent outlet or the operator / owner. The owner is responsible for determining the suitability of components to maintain emissions compliance during the engine's useful emission life.

Detroit™ cautions that the indiscriminate rebuilding of precision components, without the benefit of specifications, specialized equipment, and knowledge of the electronic operating system, will jeopardize performance or lead to more serious problems, and can take the engine outside of emissions standards.

There are several other components in an engine, such as turbocharger, that are specifically designed and manufactured to exacting standards for emissions compliance. It is important that these components, if replaced, modified or substituted, can be verified to ensure that the engine remains in compliance with emissions standards. The use of inadequately engineered, manufactured or tested components in repair or rebuild of the engine may be in violation of emissions standards regulations.

Furthermore, modern engines exhibit operating parameters which require the use of proper fluids, such as fuel, coolant and lubricating oil, to maintain long engine life. The use of fluids that do not meet Detroit™ specifications may result in premature wear or engine failure.

1.03 Personnel Requirements

Work on the engine should be carried out only by skilled technicians who have been instructed in the specific skills necessary for the type of work being performed.

1.04 Engine Conversions and Modifications

The function and safety of the engine could be affected if unauthorized modifications are made to it. Detroit™ will not accept responsibility for any resulting damage.

Tampering with the fuel injection system and engine electronics could also affect engine power output or exhaust emission levels. Compliance with the manufacturer's settings and with statutory environmental protection regulations cannot then be guaranteed.

1.05 Acronyms and Abbreviations

Term	Meaning	Term	Meaning
ATF	Automatic Transmission Fluid	**m**	Meter
CAC	Charge Air Cooler	**MCM**	Motor Control Module
CAN	Controller Area Network	**MIL**	Malfunction Indicator Lamp

Table 1, Acronyms and Abbreviations

Term	Meaning	Term	Meaning
CARB	California Air Resources Board	**mpg**	Miles per Gallon
CEL	Check Engine Light	**mph**	Miles per Hour
CPC	Common Powertrain Controller	**NOAT**	Nitrited Organic Acid Technology
DDC	Detroit Diesel Corporation	**NOx**	Nitrogen Oxide
DDEC	Detroit Diesel Electronic Controls	**OAT**	Organic Acid Technology
DTC	Diagnostic Trouble Code	**OBD**	On Board Diagnostic
ECM	Electronic Control Module	**OEM**	Original Equipment Manufacturer
ECT	Engine Coolant Temperature	**oz**	Ounce
EGR	Exhaust Gas Recirculation	**psi**	Pounds per Square Inch
ELC	Extended Life Coolant	**PTO**	Power Takeoff
EPA	Environmental Protection Agency	**qt**	Quart
FMCSA	Federal Motor Carrier Safety Administration	**rpm**	Revolutions per Minute
GAWR	Gross Axle Weight Rating	**SAE**	Society of Automotive Engineers
GVWR	Gross Vehicle Weight Rating	**SCA**	Supplemental Coolant Additive
HEST	High Exhaust System Temperature	**SCR**	Selective Catalyst Reduction
in.	Inch	**SEL**	Stop Engine Light
inH2O	Inches of Water	**SEO**	Stop Engine Override
inHg	Inches of Mercury	**S/N**	Serial Number
ISO	International Organization for Standardization	**SRS**	Synchronous Reference Sensor
k	Kilo (1000)	**SRT**	Standard Repair Time
kg	Kilogram	**TCM**	Transmission Control Module
km	Kilometer	**TDC**	Top Dead Center
km/h	Kilometers per Hour	**TPS**	Throttle Position Sensor
kPa	Kilopascal	**TRS**	Timing Reference Sensor
kW	Kilowatt	**VIN**	Vehicle Identification Number
L	Liter	**VSG**	Variable Speed Governor
lb	Pound	**VSS**	Variable Speed Sensor

2. To the Operator

2.01 To the Operator

This manual contains instructions on the safe operation and preventive maintenance of your Detroit™ engine used in vehicle applications. Maintenance instructions cover routine engine services such as lubricating oil and filter changes in enough detail to permit self-servicing, if desired.

The operator should become familiar with the contents of this manual before operating the engine or carrying out maintenance procedures.

Power-driven equipment is only as safe as the person operating the controls. You are urged, as the operator of this diesel engine, to keep fingers and clothing away from the revolving belts, drive shafts, and pulleys on the engine installation.

Throughout this manual **CAUTIONS** and **WARNINGS** regarding personal safety and **NOTICES** regarding engine performance or service life will appear. To avoid personal injury and ensure long engine service life, always heed these instructions.

Whenever possible, it will benefit you to rely on an *authorized* Detroit™ service outlet for all your service needs from maintenance to major parts replacement. Authorized service outlets worldwide stock factory-original parts.

The information and specifications in this publication are based on the information in effect at the time of approval for printing. Contact an authorized Detroit™ service outlet for information on the latest revision. The right is reserved to make changes at any time without obligation.

Detroit™ engines are built in accordance with sound technological principles and based on state-of-the-art technology.

Despite this, the engine may constitute a risk of damage to property or injury to persons if it is not used for its intended purpose.

The engine should not be modified or converted in an incorrect manner or the safety instructions included in this manual disregarded.

Keep this Operator Manual with the engine installation at all times. It contains important operating, maintenance, and safety instructions.

NOTICE

Failure to maintain the cooling system at required concentrations will result in severe damage to the engine cooling system and related components. Refer to the "Coolant Selections and Maintenance" section.

WARRANTY
The applicable engine warranty is contained in the booklet “Warranty Information for Detroit™ Engines,” available from authorized Detroit™ service outlets.

Chapter 3 Caution Summary 3.0

3. Caution Summary

3.01 Caution Summary

The following cautions must be observed by the operator of the vehicle or equipment in which this engine is installed and/or by those performing basic engine preventive maintenance. Failure to read and heed these cautions and exercise reasonable care for personal safety and the safety of others when operating the vehicle/equipment or performing basic engine preventive maintenance may result in personal injury and engine and/or vehicle/equipment damage.

Engine Operation

Observe the following cautions when operating the engine.

WARNING:

PERSONAL INJURY

To avoid injury from loss of vehicle/vessel control, the operator of a DDEC equipped engine must not use or read any diagnostic tool while the vehicle/vessel is moving.

WARNING:

HOT EXHAUST

During parked regeneration the exhaust gases will be extremely HOT and could cause a fire if directed at combustible materials. The vehicle must be parked outside.

CAUTION:

LOSS OF VEHICLE CONTROL

To avoid injury from the loss of vehicle control, do not use cruise control under these conditions:

- When it is not possible to keep the vehicle at a constant speed (on winding roads, in heavy traffic, in traffic that varies in speed, etc.).
- On slippery roads (wet pavement, ice-or snow-covered roads, loose gravel, etc.).

WARNING:

PERSONAL INJURY

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING:

PERSONAL INJURY

To avoid injury from engine shutdown in an unsafe situation, ensure the operator knows how to override the stop engine condition on a DDEC-equipped unit.

CAUTION:

LOSS OF VEHICLE CONTROL

To avoid injury from loss of vehicle control, do not activate the Engine Brake system under the following conditions:

- On wet or slippery pavement, unless the vehicle is equipped with ABS (anti-lock braking system) and you have had prior experience driving under these conditions.
- When driving without a trailer (bobtailing) or pulling an empty trailer.
- If the tractor drive wheels begin to lock or there is fishtail motion after the Engine Brake is activated, deactivate the brake system immediately if this occurs.

WARNING:

BODILY INJURY

To avoid injury from an explosion, do not use ether or starting fluid on engines equipped with a manifold (grid) heater.

Preventive Maintenance

Observe the following cautions when performing preventive maintenance.

WARNING:

PERSONAL INJURY

To avoid injury when working near or on an operating engine, remove loose items of clothing and jewelry. Tie back or contain long hair that could be caught in any moving part causing injury.

WARNING:

PERSONAL INJURY

To avoid injury when working on or near an operating engine, wear protective clothing, eye protection, and hearing protection.

WARNING:

HOT OIL

To avoid injury from hot oil, do not operate the engine with the rocker cover(s) removed.

WARNING:

FIRE

To avoid injury from fire, contain and eliminate leaks of flammable fluids as they occur. Failure to eliminate leaks could result in fire.

CAUTION:

USED ENGINE OIL

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

WARNING:

PERSONAL INJURY

To avoid injury when using caustic cleaning agents, follow the chemical manufacturers usage, disposal, and safety instructions.

WARNING:

PERSONAL INJURY

To avoid injury from hot surfaces, wear protective gloves, or allow engine to cool before removing any component.

WARNING:

PERSONAL INJURY

To avoid injury, use care when working around moving belts and rotating parts on the engine.

WARNING:

FIRE

To avoid injury from combustion of heated lubricating-oil vapors, stop the engine immediately if an oil leak is detected.

WARNING:

PERSONAL INJURY

To avoid injury from contact with rotating parts when an engine is operating with the air inlet piping removed, install an air inlet screen shield over the turbocharger air inlet. The shield prevents contact with rotating parts.

WARNING:

HOT COOLANT

To avoid scalding from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Wear adequate protective clothing (face shield, rubber gloves, apron, and boots). Remove the cap slowly to relieve pressure.

WARNING:

FIRE

To avoid injury from fire, do not smoke or allow open flames when working on an operating engine.

WARNING:

FIRE

To avoid injury from fire from a buildup of volatile vapors, keep the engine area well ventilated during operation.

WARNING:

PERSONAL INJURY

To avoid injury from rotating belts and fans, do not remove and discard safety guards.

WARNING:

PERSONAL INJURY

To avoid injury from slipping and falling, immediately clean up any spilled liquids.

Compressed Air

Observe the following cautions when using compressed air.

WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

Cooling System

Observe the following cautions when servicing the cooling system.

WARNING:

HOT COOLANT

To avoid scalding from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Wear adequate protective clothing (face shield, rubber gloves, apron, and boots). Remove the cap slowly to relieve pressure.

WARNING:

PERSONAL INJURY

To avoid injury from slipping and falling, immediately clean up any spilled liquids.

Electrical System

Observe the following cautions when jump starting an engine, charging a battery, or working with the vehicle/application electrical system.

WARNING:

ELECTRICAL SHOCK

To avoid injury from electrical shock, do not touch battery terminals, alternator terminals, or wiring cables while the engine is operating.

WARNING:

BATTERY EXPLOSION AND ACID BURN

To avoid injury from battery explosion or contact with battery acid, work in a well ventilated area, wear protective clothing, and avoid sparks or flames near the battery. If you come in contact with battery acid:

- Flush your skin with water.
- Apply baking soda or lime to help neutralize the acid.
- Flush your eyes with water.
- Get medical attention immediately.

WARNING:

PERSONAL INJURY

To avoid injury from accidental engine startup while servicing the engine, disconnect/disable the starting system.

Air Intake System

Observe the following cautions when working on the air intake system.

WARNING:

PERSONAL INJURY

To avoid injury from hot surfaces, wear protective gloves, or allow engine to cool before removing any component.

WARNING:

PERSONAL INJURY

To avoid injury from contact with rotating parts when an engine is operating with the air inlet piping removed, install an air inlet screen shield over the turbocharger air inlet. The shield prevents contact with rotating parts.

Lubricating Oil and Filters

Observe the following cautions when replacing the engine lubricating oil and filter.

WARNING:

PERSONAL INJURY

To avoid injury from slipping and falling, immediately clean up any spilled liquids.

WARNING:

FIRE

To avoid injury from combustion of heated lubricating-oil vapors, stop the engine immediately if an oil leak is detected.

WARNING:

FIRE

To avoid injury from fire, do not smoke or allow open flames when working on an operating engine.

WARNING:

FIRE

To avoid injury from fire from a buildup of volatile vapors, keep the engine area well ventilated during operation.

Fuel System

Observe the following cautions when fueling the vehicle or working with the fuel system.

WARNING:

FIRE

To avoid injury from fire, keep all potential ignition sources away from diesel fuel, including open flames, sparks, and electrical resistance heating elements. Do not smoke when refueling.

WARNING:

PERSONAL INJURY

To prevent the escape of high pressure fuel that can penetrate skin, ensure the engine has been shut down for a minimum of 10 minutes before servicing any component within the high pressure circuit. Residual high fuel pressure may be present within the circuit.

WARNING:

FIRE

To avoid increased risk of a fuel fire, do not mix gasoline and diesel fuel.

WARNING:

FIRE

To avoid injury from fire caused by heated diesel-fuel vapors:

- Keep those people who are not directly involved in servicing away from the engine.
- Stop the engine immediately if a fuel leak is detected.
- Do not smoke or allow open flames when working on an operating engine.
- Wear adequate protective clothing (face shield, insulated gloves and apron, etc.).
- To prevent a buildup of potentially volatile vapors, keep the engine area well ventilated during operation.

Aftertreatment System

Observe the following cautions when servicing the Aftertreatment System (ATS). Be advised that these two labels are attached to the Aftertreatment Device (ATD).

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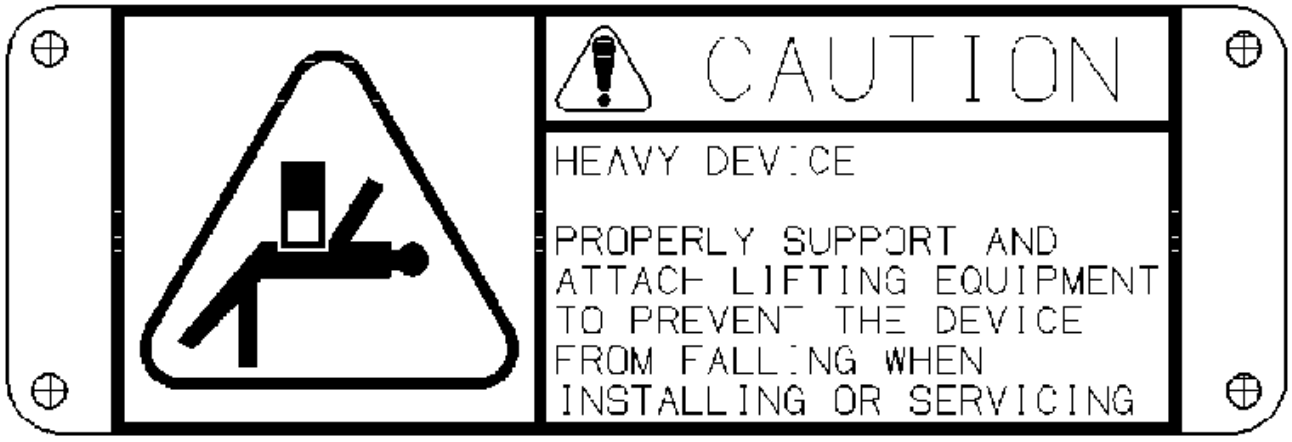

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4. First Time Start Preparations

4.01 System Checks

Perform the following system checks before starting.

4.01.01 Checking the Cooling System

Check the cooling system as follows:

1. Make sure all drain cocks in the cooling system are installed (drain cocks are often removed for shipping) and are closed tightly.
2. Fill the coolant overflow surge tank with Detroit™ Genuine Coolant until coolant level stays between the low and full coolant marks on the tank.
3. Entrapped air must be purged after filling the cooling system. To do this, allow the engine to warm up with the pressure cap removed. With the transmission in neutral, increase engine speed to 1000 rpm and add coolant to the surge tank as required.
4. Check to make sure the front of the radiator and charge air cooler (if equipped) are unblocked and free of debris.

4.01.02 Checking and Monitoring the Oil Level

Check the oil level as follows:

WARNING:

PERSONAL INJURY

To avoid injury from slipping and falling, immediately clean up any spilled liquids.

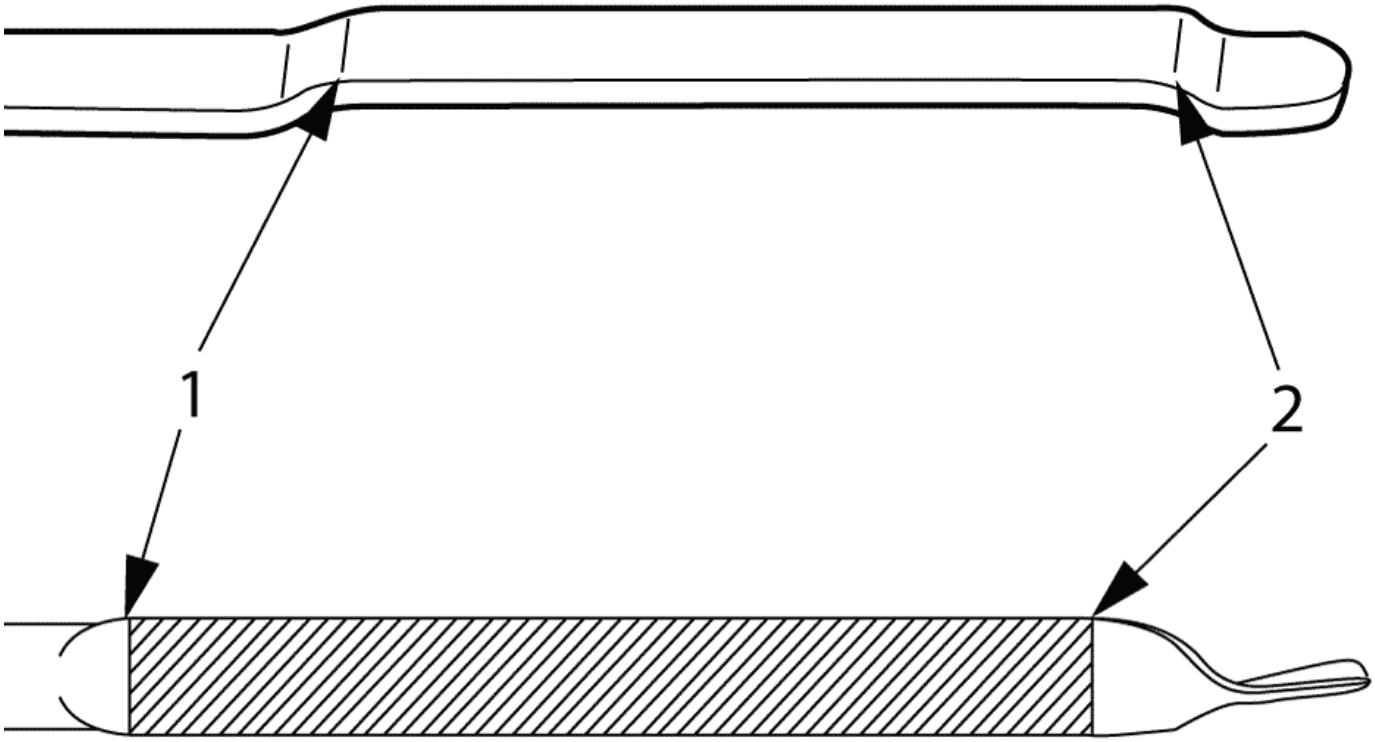
NOTICE

Do not add oil if the oil reading is in the crosshatch area on the dipstick. There are approximately 4.0 L (4.2 qt) from the fill mark to the full mark. Overfilling the oil pan can cause engine damage.

NOTE: If the engine operating temperature is below 60°C (140°F), the engine must be on a level surface and then shut down for 60 minutes for an accurate oil level reading. Otherwise, the engine must be brought up to an operating temperature of 60°C (140°F), parked on a level surface and then shut down for 20 minutes for an accurate oil level reading.

1. Check the oil level daily with the engine stopped and on a level surface. If the engine has just been stopped and is warm, wait approximately 20 minutes to allow the oil to drain back into the oil pan before checking.
2. Add oil to maintain the correct level on the dipstick. Use only the heavy-duty oils recommended in the "How to Replace the Lubricating Oil and Oil Filter" section in this manual.
3. Remove the dipstick from the guide tube. Use a shop rag to wipe off the end of the dipstick.
4. Wait 15 seconds to allow any crankcase pressure to dissipate through the guide tube and let the oil level settle in the oil pan.
5. Reinstall the dipstick and make sure it is fully inserted into the guide tube.
6. Remove the dipstick and read the oil level dipstick.

7. The figure shows a comparison between the bends on the dipstick and a crosshatch pattern on a conventional dipstick. Note the exact area noted on the bends. For example, the 'maximum' oil level will be at the BOTTOM of bend (1). For the 'minimum' oil level, it is noted at the TOP of bend (2). If the oil level is below the 'minimum' bend, add oil to bring it up the 'maximum' level. Do NOT fill beyond the maximum fill level on the dipstick, since overfilling may result in high oil consumption and possible severe engine damage.



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4.01.03 Fuel System Checks

Make sure the fuel shutoff valve (if used) is open. Fill the tanks with the recommended fuel. Keeping tanks full reduces water condensation and helps keep fuel cool, which is important to engine performance. Full tanks also reduce the chance for microbe (black slime) growth. For fuel recommendations, Refer to section "How to Select Diesel Fuel".

NOTICE

Prolonged use of the starting motor and engine fuel pumps to prime the fuel system can result in damage to the starter, fuel pumps, and injectors.

If the shutoff valve is even partially closed, it may cause erratic engine operation due to an inadequate supply of fuel to the fuel pump.

NOTICE

NEVER use ether as a starting aid to run the engine. Doing so will result in injector damage.

If an external starting aid is used, such as a starting fluid, the heat generated by the external fuel source will cause the injector tips to be damaged when the fuel cools them. The injector piston and bushing can be scored from running without lubrication.

To ensure prompt starting and even running, the fuel system must be primed if air has entered the fuel system. Priming is done by operating the manual hand priming pump located on the frame-mounted fuel filter or connecting an external priming pump to the priming port on the fuel filter module. Authorized Detroit™ service outlets are properly equipped for this type of service.

Priming is required if the fuel system has been serviced.

Drain off any water that has accumulated. Water in fuel can seriously affect engine performance and may cause engine damage.

4.01.04 Adding Fuel

When adding fuel, pay attention to the following:

NOTICE

Always use Ultra-Low Sulfur Fuel (ULSF) with 15 PPM sulfur content or less, based on ASTM Standard D2622 test procedure. Higher sulfur levels will damage the engine Aftertreatment System (ATS).

- Add winter or summer grade fuel according to the season of the year.
- Work in the cleanest conditions possible.
- Prevent water from entering the fuel tank.

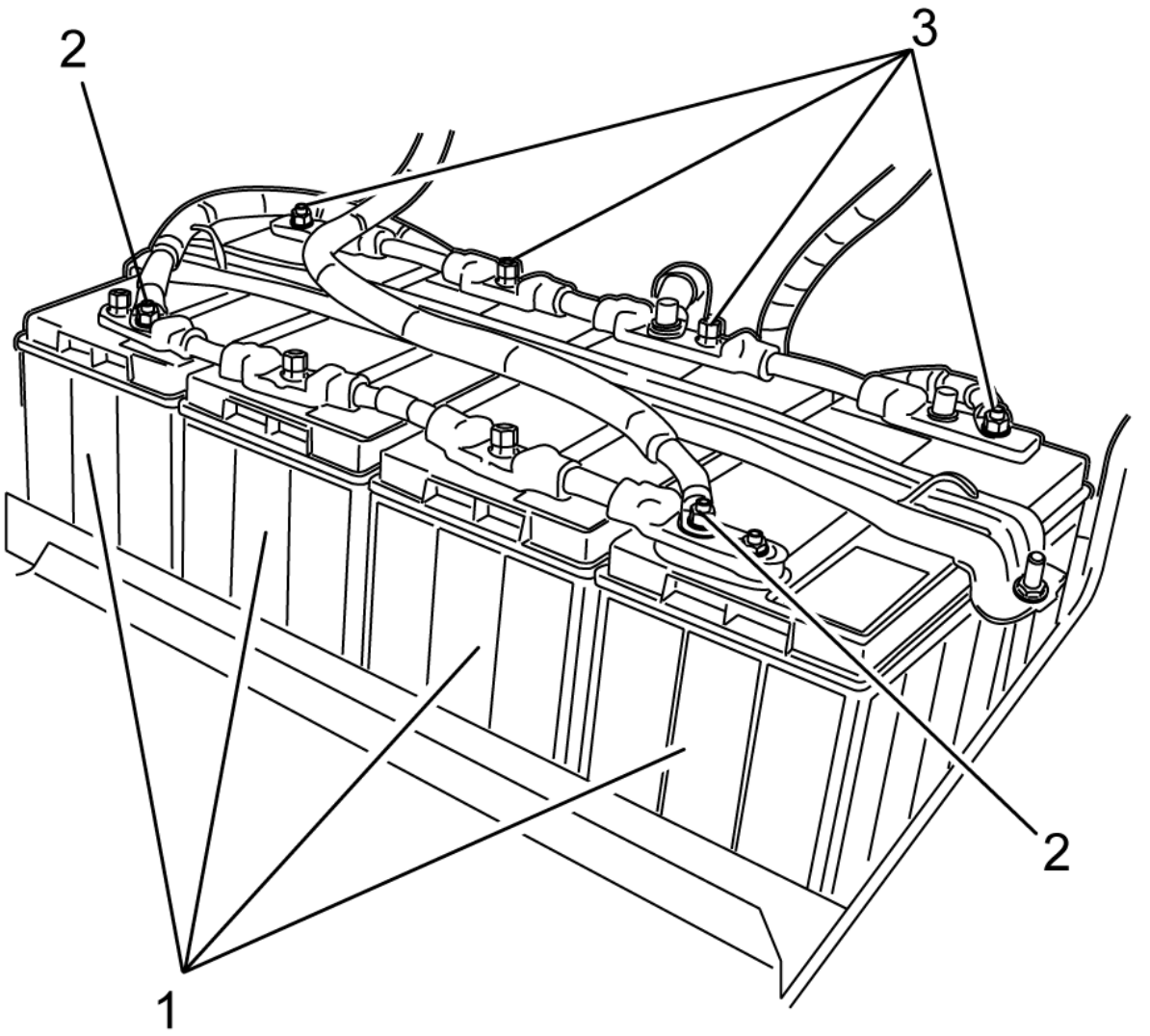
For further information, Refer to Section "How to Select Diesel Fuel".

4.01.05 Checking Other Engine and ATS Related Parts

Check the engine compartment as follows:

- Make sure the transmission is filled to the proper level with the fluid recommended by the gear manufacturer. Do not overfill.
- The Diesel Exhaust Fluid (DEF) must be checked and filled regularly with DEF meeting Detroit™ quality specification.
- Make sure cable connections to the storage batteries are clean and tight.

- Check for cracks in the battery cases (1), for tightness of the cable clamps (2) at the terminals, and for corrosion of the terminals (3). Service or replace as needed.



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- To provide corrosion protection, apply dielectric grease liberally to the terminal pads.

4.02 Starting the Engine

1. Place the transmission in neutral, and set the parking brake.
2. Turn on the ignition switch.
3. Wait for the engine system indicator lights on the instrument panel to go out.
4. With foot off the accelerator pedal, start the engine.
5. If the engine does not start after 20 seconds, stop. Try again after waiting about 60 seconds.

6. Monitor the oil pressure gauge immediately after starting the engine.

4.03 Cold Weather Operation

Special precautions must be taken during cold weather. To protect your engine, special cold weather handling is required for fuel, engine oil, coolant, and batteries.

NOTICE

To avoid engine damage, DO NOT use any type of aerosol spray, e.g., ether, starting fluid or brake cleaner to aid in starting the engine.

For engines with a grid heater:

WARNING:

BODILY INJURY

To avoid injury from an explosion, do not use ether or starting fluid on engines equipped with a manifold (grid) heater.

Temperatures below -20°C (-4°F) may require a block heater and oil pan heater.

4.03.01 Winter Fronts

Winter fronts on Detroit™ engines are seldom necessary due to the modern design of the engine cooling system. The coolant thermostat is on the outlet side of the cooling system on the Detroit™ engine and regulates coolant flow to the radiator into the engine. The thermostat regulates coolant flow to control the temperature of the coolant within the coolant circuit. The following benefits are a result from regulating the coolant at the inlet temperature side of the engine:

- Reduced thermal cycling of the engine
- Operating temperature is reached faster
- Improved vehicle heating because of better temperature regulation

Further information on the thermostat function may be found in the Coolant Thermostat section of the*EuroV MBE900 Workshop Manual* (DDC-SVC-MAN-0206).

Use of a winter front on a Detroit™ engine, particularly those that are fully closed, **will** cause performance issues and is not recommended on Detroit™ engines. Winter fronts can result in the following:

- Excessive fan run time due to higher Charge Air Cooler (CAC) outlet temperatures resulting from low air flow through the CAC
- Increased fuel consumption
- Failure of the DEF system heaters to turn on when needed due to incorrect temperature calculations resulting in fault codes, poor performance of the Aftertreatment System, and power reduction
- Failure of critical emission equipment that will result in vehicle speed inducement to a maximum of 5 mph

Use of a winter front should be avoided as this has been shown to cause false fault codes with the engine and aftertreatment system. This has also been linked to specific component failures that will cause vehicle downtime and lost productivity.

There are two specific situations where a winter front may be temporarily needed:

- To improve cab heating while idling under extreme cold ambient temperature
- When the ambient temperature remains below -30°C (-22°F) **and** the engine is unable to maintain running coolant temperature of 80°C (175°F) during normal over-the-road operation

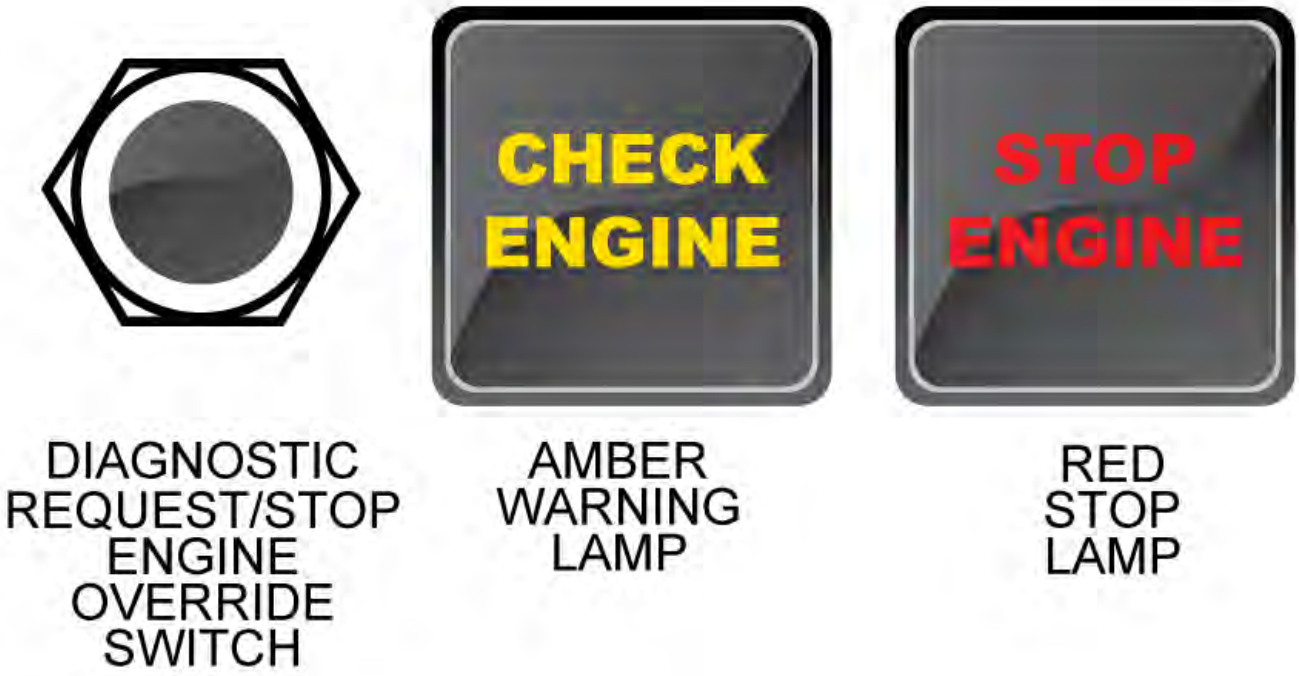
If either of the above situations is encountered, then a winter front may be temporarily used. A minimum of 25% of the grill must be open in sectioned stripes that run perpendicular to the charge air cooler tube flow direction. This assures even cooling across each tube and reduces header-to-tube stress and possible failure.

5. Detroit Diesel Electronic Control System Operation

5.01 Detroit Diesel Electronic Control System Operation

NOTE: This engine is equipped with DDEC software. This software generally assures optimal engine performance. The installation of software upgrades may cause minor changes in features and engine performance.

Since the DDEC system is electronic, a battery is required to operate the computer. The system operates at 12 volts. However, in the event of a power supply malfunction, the system will continue to operate at reduced voltage. When this occurs, the AWL (Check Engine) will come on.



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The engine will only operate at reduced rpm until the battery voltage reaches a point where the MCM will no longer function and the engine shuts down.

Should the AWL (Check Engine) come on for any reason, the vehicle can still be operated and the driver can proceed to the required destination. *This condition should be reported to an authorized Detroit™ distributor or dealer.*

NOTICE

When the RSL (Stop Engine) comes on, the system has detected a major malfunction in the engine that requires immediate attention. **It is the operator's responsibility to shut down the engine to avoid serious damage.**

The "Stop Engine Override" feature can be activated in the case where the vehicle is operating in a critical location.

5.01.01 Stop Engine Override Switch

This feature allows the operator to override the automatic Stop Engine sequence.

This is done by pressing the Stop Engine Override Switch every 15 to 20 seconds to prevent engine shutdown from occurring.

NOTE: Continuously holding down the Stop Engine Override Switch will not prevent the engine shutdown sequence. You must continue to reset the automatic shutdown system by pressing the Stop Engine Override Switch at intervals of approximately 15 to 20 seconds.

It takes 30 seconds from the time the automatic shutdown sequence begins until engine shutdown. Therefore, the operator **must** press the override switch just prior to engine shutdown and continue to do so until the vehicle can be brought to a stop in a safe location.

5.01.02 Immediate Speed Reduction

The immediate speed reduction option will bring engine rpm back to a predetermined speed, but will not shut down the engine.

The engine should not be restarted after it has been shut down by the engine protection system, unless the problem has been located and corrected.

5.01.03 Red Stop Lamp

The conditions that will cause the RSL (Stop Engine) to come on are:

- High coolant temperature
- Loss of coolant
- High oil temperature
- Low oil pressure
- Auxiliary shutdown

Whenever the AWL (Check Engine) or the RSL comes on, the DDEC system will determine where the problem is and will then store this information in its memory.

If the malfunction is intermittent, the lights will come on and go off as the computer senses the changing engine condition.

6. Detroit Diesel Electronic Control System Features

6.01 Changing the Idle Speed

The idle speed can be variable if the parameters in the CPC are set to the default range. Change the idle speed as follows:

1. Turn the cruise control switch to the ON position.
2. To increase the idle speed, push the RSM/ACC switch until the idle reaches the desired rpm.
3. To decrease the idle speed, push the SET/CST switch until the idle reaches the desired rpm.

6.02 Stop Engine Override Option

The Stop Engine Override Option is used for a momentary override. The electronic engine control system will record the number of times the override is activated after an engine fault occurs.

6.03 Engine Protection

The electronic engine control protection system monitors all engine sensors, electronic components, and recognizes system malfunctions. If a critical fault is detected, the AWL (Check Engine) and RSL (Stop Engine) illuminate. The malfunction codes are logged into the MR2's memory.

The standard parameters which are monitored for engine protection are low coolant level, high coolant temperature, low oil pressure, and high oil temperature.

WARNING:

PERSONAL INJURY

To avoid injury from engine shutdown in an unsafe situation, ensure the operator knows how to override the stop engine condition on a DDEC-equipped unit.

NOTICE

Engines equipped with the power down/shutdown option have a system override button or switch to allow engine operation for a short period of time. Using the override button so the engine does not shut down in 30 seconds but operates for an extended period may result in engine damage.

This system features a 30-second, stepped-power shutdown sequence, or an immediate speed reduction without shutdown in the event a major engine malfunction occurs, such as low oil pressure, high oil or coolant temperature, or low coolant level.

7. Engine Systems

7.01 Engine Systems

The engine systems are as follows:

Fuel System

The fuel system consists of DDEC control system, fuel injectors, unit pumps, fuel filter module, filter, injection nozzles, and the necessary connecting fuel lines.

Lubrication System

Clean, pressurized oil is fed to all components via passages in the engine block and cylinder head.

Air System

Outside air enters the engine through the air filter, is drawn to the turbocharger, is then compressed, forced through the air-to-air charge cooler (heat exchanger) and is cooled. Next, it flows to the intake manifold and into the cylinders, where it mixes with atomized fuel from the injectors.

For optimum engine protection from dust and other airborne contaminants, service the dry-type air cleaners when the maximum allowable air restriction has been reached.

Cooling System

A radiator/thermo-modulated fan cooling system is used on the engine. This system has a centrifugal-type coolant pump to circulate coolant within the engine. The thermostat controls the flow of coolant.

Electrical System

The electrical system consists of a starting motor, starting switch, battery-charging alternator, storage batteries, and necessary wiring.

Exhaust System

Hot exhaust gas from the exhaust manifolds is used to drive the turbocharger.

8. EuroV MBE900 Aftertreatment System

8.01 EuroV MBE900 Aftertreatment System

The Selective Catalytic Reduction (SCR) catalyst converts a mixture of nitrogen oxides and Diesel Exhaust Fluid (DEF) into nitrogen and water. DEF is pressurized by a pump and is then sprayed into the SCR.

9. Diesel Exhaust Fluid Information

9.01 Diesel Exhaust Fluid Information

Diesel Exhaust Fluid (DEF) is stored in the onboard DEF tank. DEF is pulled through the DEF tank header to the DEF pump. DEF is pumped to the dosing unit and is injected into the aftertreatment. DEF circulates back to the DEF tank from the dosing unit.

10. Diesel Exhaust Fluid Tank

10.01 Diesel Exhaust Fluid Tank

The Diesel Exhaust Fluid (DEF) tank holds the DEF supply. The filler neck has a smaller diameter (19 mm) than the filler neck of the diesel fuel tank and is fitted with a magnetic insert so that diesel fuel cannot be mistakenly added to the DEF tank. The DEF you should use with your Detroit™ product will be API (American Petroleum Institute) certified and meet the specifications ISO 22241-1 and DIN70700. These are two widely accepted standards in use for qualifying DEF for use in exhaust aftertreatment systems. DEF (Diesel Exhaust Fluid) will be sold at over 2,500 locations throughout North America. These locations include:

- Detroit™ Distributors
- Freightliner® Truck Dealers
- Western Star® Truck Dealers
- Travel Centers of America® Truck Stops
- Petro® Stopping Centers
- Pilot Travel Centers®
- Additional Diesel Exhaust Fluid (DEF) sales locations can be found at www.afdc.energy.gov/afdc/locator/def/

If diesel fuel is added to the DEF tank or DEF is added to the diesel fuel tank, immediately contact your Certified Detroit™ Service Center for further instructions.

11. Aftertreatment Maintenance

11.01 Aftertreatment Maintenance

A high amount of black smoke emitting from the vehicle or illumination of the Amber Warning Lamp or Red Stop Lamp are indications of a system problem. Should this occur, consult your local Detroit™ Service Center.

Illumination of the Malfunction Indicator Lamp (MIL) Lamp indicates a failure of an emissions control device. The MIL may illuminate along with other ATS warning lamps. Call for service to repair the fault.

12. Instrument Panel Lamps

12.01 Instrument Panel Lamps

The instrument panel lamps are explained below:

Amber Warning Lamp

Lamp	Lamp Name	Description	Result
	Amber Warning Lamp (AWL)	Indicates a fault with the engine controls.	Vehicle can be driven to end of shift. Call for service.
Lamp Solid		**Lamp Flashing**	
• **At the start of every ignition cycle (bulb check**).		• Flashes last 90 seconds before idle shutdown if programmed for override.	
• **When an electronic system fault occurs. (Fault should be diagnosed as soon as possible.)**		• Flashes when idle shutdown or the optimized idle shutdown occurs.	

Red Stop Lamp

Lamp	Lamp Name	Description	Result
	Red Stop Lamp (RSL)	Indicates a major engine fault that may result in engine damage. Engine derate and/or shutdown sequence will be initiated.	Move the vehicle to the nearest safe location and shut down the engine. Call for service.
Lamp Solid		**Lamp Flashing**	
• **At the start of every ignition cycle (bulb check).**		• Flashes when engine protection shutdown occurs.	
• **A potential engine damaging fault is detected.**			

Malfunction Indicator Lamp

Lamp	Lamp Name	Description	Result
	Malfunction Indicator Lamp (MIL)	Yellow lamp Indicates a failure of an Emission Control device. May illuminate at the same time as the Amber Warning Lamp.	Vehicle can be driven to end of the shift. Call for service.
Lamp Solid		**Lamp Flashing**	

Lamp	Lamp Name	Description	Result
• **At the start of every ignition cycle (a bulb check).**		• Never flashes.	
• **For any emission related fault (light out when the fault is inactive).**			

13. Diesel Exhaust Fluid Level Warning Lamps

13.01 Diesel Exhaust Fluid Level Warning Lamps

A four light bar segment indicates the Diesel Exhaust Fluid (DEF) level in 25% increments. Low DEF levels will trigger a decrease in the engine's performance. The use of improper DEF fluid will trigger a decrease in the engine's performance. In an empty or an ignored state and the diesel fuel tank is filled without filling the DEF tank, the vehicle's speed will be limited to 5 mph until DEF is detected in the DEF tank.

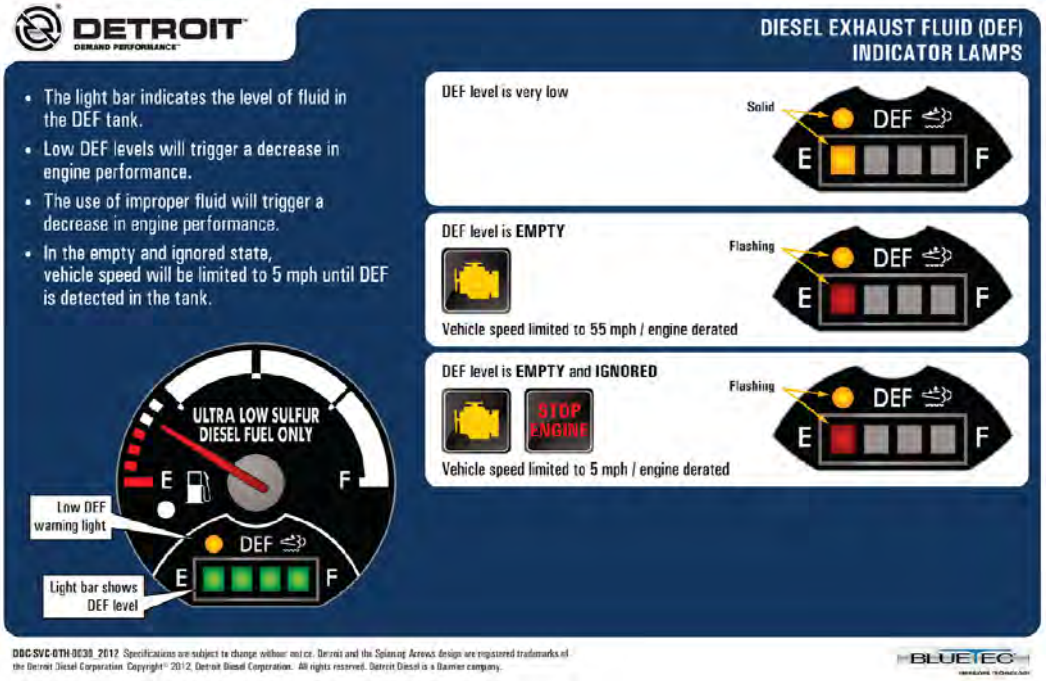


Fig 1, Driver Card

14. Maintenance

14.01 MBE 900 EuroV Preventive Maintenance Tables - 93K222(CK-4) and 93K218(CJ-4)

NOTE: **DFS 93K223(FA-4) oils should not be used in an MBE900 EuroV engine.**

NOTE: **Refer to DTNAConnect.com for most current information.**

DFS 93K222(CK-4) and 93K218(CJ-4) Oil Service Interval Definitions (applies to the following tables):

Long Haul Applies to vehicles that travel more than 100,000 kilometers annually, with an average fuel economy greater than 2.6 km/l, with load factor up to 44%, idle time up to 20%.

Examples: Long distance road service (interstate transport), minimum stop operation and city start.

Short Haul Applies to vehicles that travel annually from 48,000 to 100,000 kilometers, with average fuel economy between 2.2 and 2.5 km / l, with load factor greater than or equal to 45%, idle time between 25% -30%.

Examples: operation mainly in cities and densely populated areas, local transport with intermittent road trips, high percentage of stoppage and start operation.

Severe Applies to vehicles that travel annually up to 48,000 kilometers or that operate under severe conditions, with average fuel economy up to 2.1 km/l, load factor greater than 55%, idle time greater than 35%.

Examples:

- operating on roads that are unpaved or extremely damaged
- operating in an environment with a high accumulation of dust
- operating with constant exposure to extreme heat, cold, salt-air or other extreme climates
- operating on frequent trips of short distances
- operating on construction sites or farms

MBE 900: Maintenance Intervals

NOTE: Up to 50 ppm Sulfur Fuel is acceptable for this application.

EuroV Using DFS 93K222(CK-4) or DFS 93K218(CJ-4) Approved Oils DFS 93K223(FA-4) oils should not be used in an MBE900 EuroV engine			
Component	**Long Haul † Greater than2.6 km/l*** (6.0 to 6.9 mpg)**	**Short Haul † 2.2 to 2.5 km/l*** (5.1 to 5.9 mpg)**	**Severe † Up to 2.1 km/l*** (Up to 5.0 mpg)**
Oil Filter	Replace every 60,000 km	Replace every 45,000 km, 800 hrs or 12 months †	Replace every 30,000 km, 500 hrs or 12 months †
Lubricating Oil	Replace every 60,000 km	Replace every 45,000 km, 800 hrs or 12 months †	Replace every 30,000 km, 500 hrs or 12 months †
Engine Fuel Filter *	Replace every 60,000 km	Replace every 45,000 km, 800 hrs or 12 months †	Replace every 30,000 km, 500 hrs or 12 months †
Engine Fuel Filter * w/ Frame-Mounted Filter	Replace every 60,000 km	Replace every 45,000 km, 800 hrs or 12 months †	Replace every 30,000 km, 500 hrs or 12 months †

Table 2, MBE 900: Maintenance Intervals

Frame Mounted Fuel Filters ‡	Replace every 60,000 km	Replace every 45,000 km, 800 hrs or 12 months †	Replace every 30,000 km, 500 hrs or 12 months †
Valve Lash Adjustment	Adjust at first oil change, and then every other oil change thereafter.		
Coolant - Standard Life	Maintain every 60,000 km or 12 months Replace every 480,000 km or 24 months	Maintain every 45,000 km, 800 hrs or 6 months † Replace every 450,000 km or 24 months	Maintain every 30,000 km, 500 hrs or 3 months † Replace every 450,000 km or 24 months
Coolant - Extended Life	Maintain every 120,000 km or 12 months Replace every 960,000 km or 48 months	Maintain every 90,000 km, 1,600 hrs or 12 months † Replace every 900,000 km or 48 months	Maintain every 60,000 km, 1,000 hrs or 12 months † Replace every 900,000 km or 48 months
Belts	Inspect at oil change Replace every180,000 km	Inspect at Oil Change Replace every 135,000 km	Inspect at Oil Change Replace every 90,000 km
Air System	Inspect at oil change	Inspect at oil change	Inspect at oil change
Air Cleaner	See vehicle maintenance schedule		
Exhaust System	Inspect at oil change	Inspect at oil change	Inspect at oil change
Air Compressor	Inspect at oil change	Inspect at oil change	Inspect at oil change
DEF Pump Filter	Replace every 650,000 km	Replace every 475,000 km	Replace every 325,000 km

- †Whichever comes first.
- *Engine fuel filters should be changed at recommended service intervals, or when the "Fuel Filter Service Lamp" activates on the dashboard. For maximum life of fuel system components, it is not recommended to exceed 160k miles on engine fuel filters under any condition.
- ***Fuel Economy represents overall fuel economy (including idle time)
- ‡Currently, only Detroit™ Fuel Filter/Water Separator & Davco 482/485/487 are the only frame-mounted filtration systems compatible for Detroit™ Engines.
- Refer to "Routine Preventive Maintenance" and "How to Procedures" for a description of all items.

14.02 Scheduled Intervals

All service intervals and maintenance operations are based on the parts and accessories expressly approved for your engine.

The scope and frequency of maintenance work are determined by the engine's operating conditions: severe duty, short haul, long haul or operating hours vs. fuel consumption (oil drain interval only).

Evidence of regular maintenance is essential if a warranty claim has to be submitted.

If optional equipment is installed, be sure to comply with the maintenance requirements for these extra items.

Important: If the engine is stored for more than 18 months, the oil must be changed before the engine can be brought into service.

Maintenance Schedule Types

There are five types of maintenance schedule:

- Schedule I (Severe Service)
- Schedule II (Short Haul)

- Schedule III (Long Haul)
- Operating Hours vs. Fuel Consumption (Oil Drain Interval Only)

To determine which schedule to use, find the distance traveled by the vehicle in a year, regardless of vehicle type.

Severe Service

Applies to vehicles that annually travel up to 100,000 kilometers (60,000 miles) or that operate under severe conditions. Examples of Severe Service usage include: operation on extremely poor roads or where there is heavy dust accumulation; constant exposure to extreme hot, cold, salt-air, or other extreme climates; frequent short-distance travel; construction-site operation; city operation (fire truck, garbage truck); or farm operation.

Short-Haul

Applies to vehicles that annually travel up to 100,000 kilometers (60,000 miles) and operate under normal conditions. Examples of Short-Haul usage are: operation primarily in cities and densely populated areas; local transport with infrequent freeway travel; or high percentage of stop-and-go travel.

Long-Haul

Long Haul (over-the-road transport) is for vehicles that annually travel more than 100,000 kilometers (60,000 miles), with minimal city or stop-and-go operation. Examples of Long-Haul usage are: regional delivery that is mostly freeway miles; interstate transport; or any road operation with high annual mileage.

Operating Hours vs. Fuel Consumption (Oil Drain Interval Only)

Operating hours vs. fuel consumption is for operators who want an oil drain interval based on hours of operation instead of miles traveled.

Maintenance Schedule and Interval Operations

The three different schedules of vehicle usage (severe, short haul, and long haul) are listed. MBE 900 EuroV Preventive Maintenance Tables - 93K222(CK-4) and 93K218(CJ-4). For each schedule, the appropriate distance interval (in miles and kilometers) is given for performing and repeating each maintenance operation.

The descriptions of all maintenance operations, indicating all maintenance operation sets at which each operation must be performed are listed;MBE 900 EuroV Preventive Maintenance Tables - 93K222(CK-4) and 93K218(CJ-4)

Maintenance Intervals

The three maintenance interval tables show which maintenance operation must be performed at the actual distances (in miles or kilometers) for each maintenance operation (M1-M3). The schedule of actual distances is based on the intervals listed, MBE 900 EuroV Preventive Maintenance Tables - 93K222(CK-4) and 93K218(CJ-4).

The maintenance interval tables are:

- Maintenance Interval Table, Severe Service, MBE 900 EuroV Preventive Maintenance Tables - 93K222(CK-4) and 93K218(CJ-4)
- Maintenance Interval Table, Short Haul, MBE 900 EuroV Preventive Maintenance Tables - 93K222(CK-4) and 93K218 (CJ-4)
- Maintenance Interval Table, Long Haul, MBE 900 EuroV Preventive Maintenance Tables - 93K222(CK-4) and 93K218 (CJ-4)

14.03 Schedule Use

Before placing your new vehicle in service, determine the correct maintenance intervals that apply to your intended use of the vehicle. Refer to the Maintenance Schedule Table to determine the distance interval at which each maintenance operation must be performed to comply with your vehicle's schedule. A detailed description of maintenance operations can be found later in this section

When the vehicle reaches the actual distance given for an interval, refer to the Maintenance Interval Tables to find the Maintenance Operation Set that applies to that interval. Then perform the maintenance operations listed in the applicable Maintenance Interval Operation Table.

Complete each Maintenance Operation Set at the required interval. For example, when you have completed Maintenance Operation Set M3 under the 16th maintenance number listed in the Maintenance Interval Table, repeat the pattern. For the 17th maintenance, do Maintenance Operation Set M1, under the first maintenance number listed in the Maintenance Interval Table.

Note: For Severe Service, the pattern repeats after 15 maintenance numbers, not 16 (as for Short Haul and Long Haul).

14.04 Required Maintenance Operations

The following sections describe the required maintenance operations listed in Table "Required Maintenance Operations Sets, Schedule I" and "Required Maintenance Operations Sets, Schedule II and III."

Inspect the engine as follows:

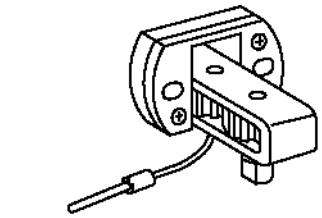
NOTE: More severe leaks, combined with a continual loss of oil, must be corrected without delay.

- Visually check the engine for signs of leakage. A slight dampness at the sealing points is no cause for alarm.
- Visually inspect all lines and hoses. Listen for any sound of leaking. Make sure all pipes and hoses are undamaged, correctly positioned to avoid chafing, and properly secured.

Valve Lash Checking and Adjusting

Visually inspect all lines and hoses. Listen for any sound of leaking. Make sure all pipes and hoses are undamaged, correctly positioned to avoid chafing, and properly secured.

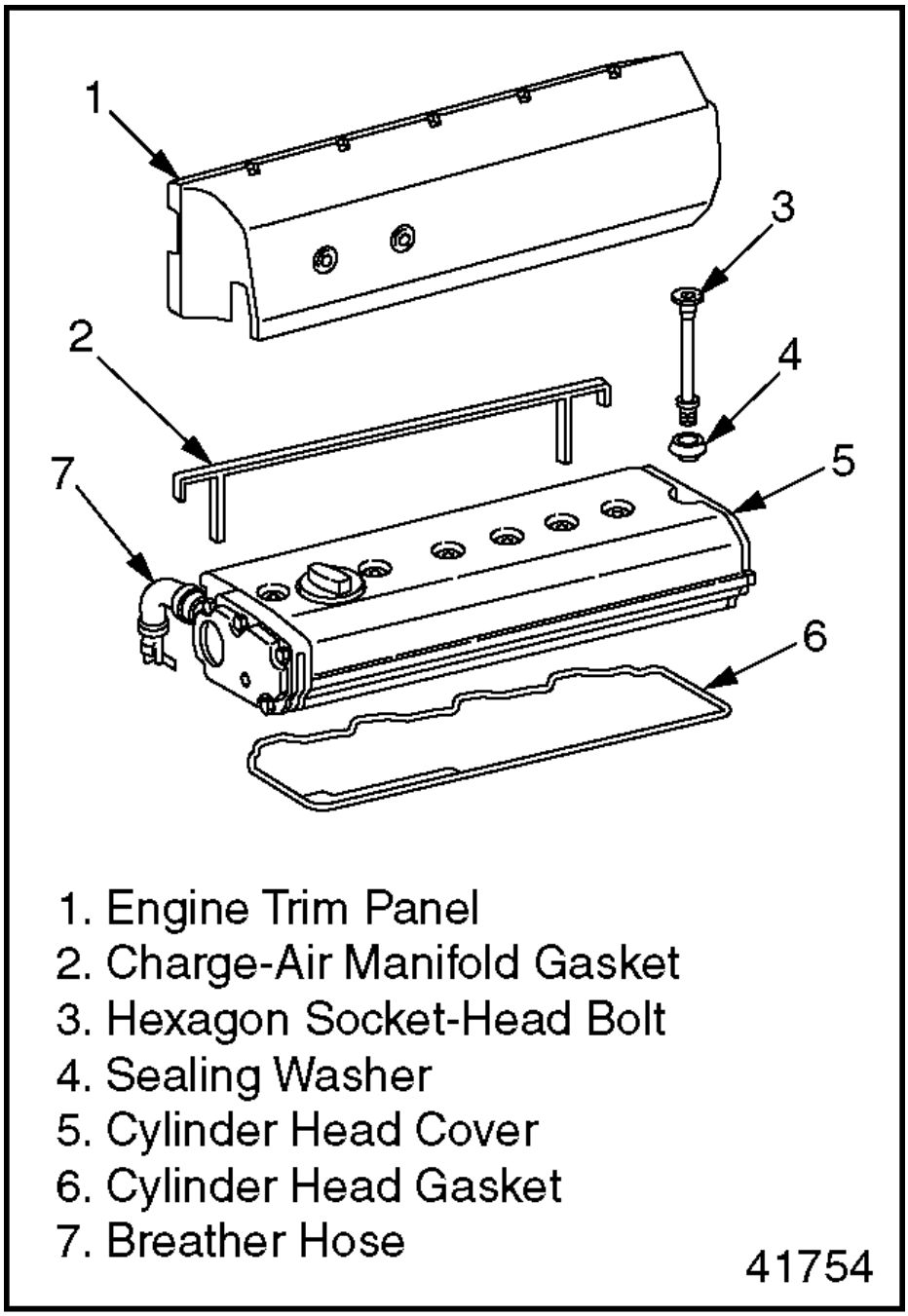
The special tool listed in Table 3,Service Tools Used in the Procedure is required for this procedure.

Tool Number	Tool Name	Tool Graphic
J-46392	Engine Cranking Tool	

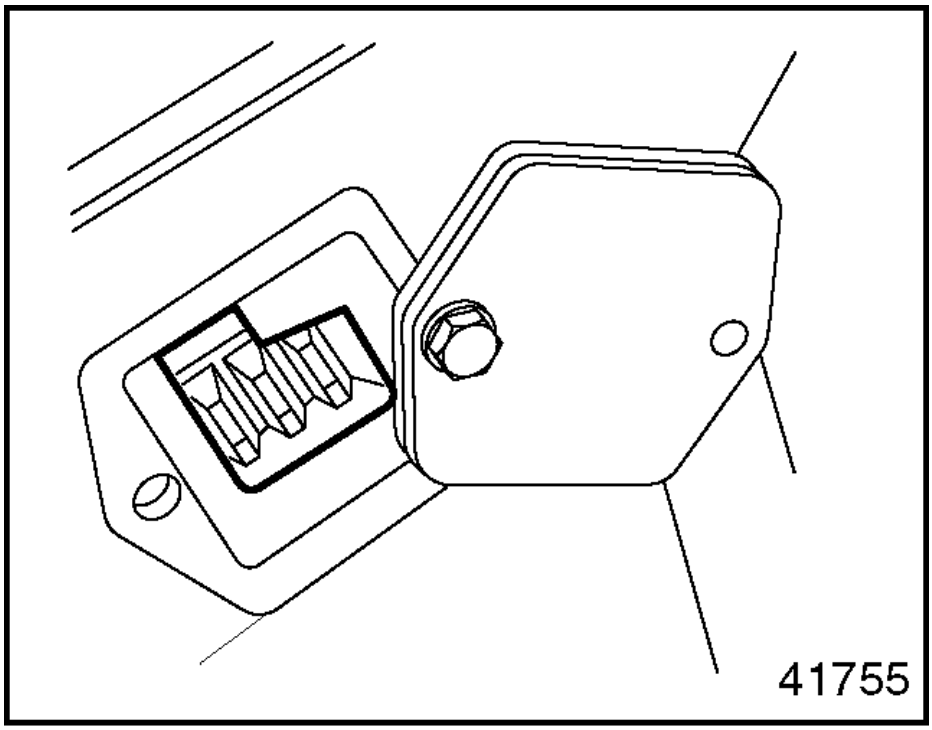
Gaining Access to the Valves

Gain access to the valves as follows:

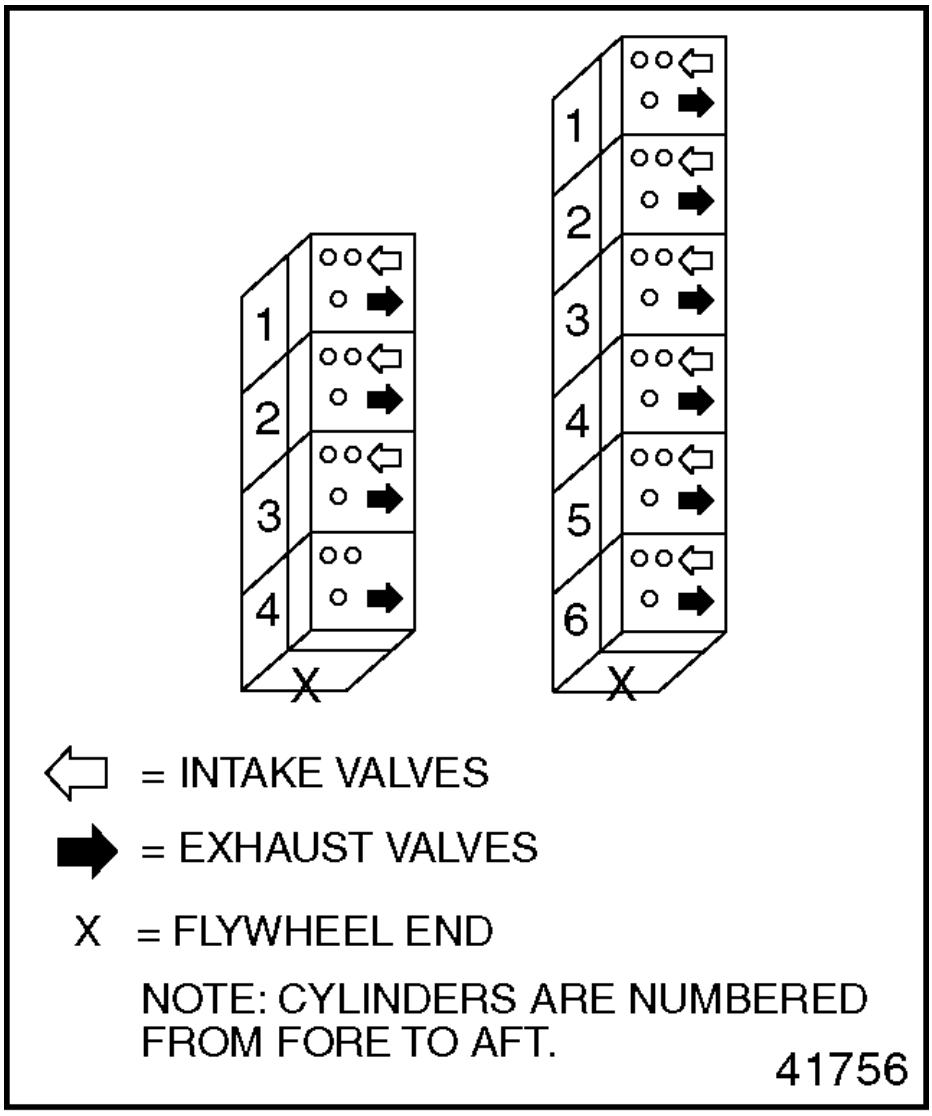
1. Remove the cylinder head cover.



2. Remove the inspection cover on the timing case.
3. Fit the cranking device into the inspection hole on the timing case.



4. Select a method for adjusting the valve lash for the valve layout on both four- and six-cylinder engines. There are two acceptable methods for adjusting valve lash:
   - In order, according to the timing sequence used for fuel injection ("Method One")
   - By type of valve, depending on crankshaft position ("Method Two")



14.04.01 Method One: Adjust Each Cylinder In Firing Order

Method One allows you to adjust each cylinder in the order in which fuel is injected. The crankshaft must be repositioned after each cylinder is adjusted.

1. For each cylinder, use the cranking device to rotate the crankshaft until the piston is exactly at top dead center (TDC) in the compression stroke. The valves must be closed and it must be possible to turn the push rods without effort.

2. Check each valve and adjust it (if necessary), using the procedures under the headings "Checking Valve Lash" and "Adjusting Valve Lash" in this section.

Valve Adjustment — Method One

Engine	Crankshaft Position	Cylinders					
4-cylinder	Ignition Sequence	1	3	4	2	NA	NA
	Valve Overlap	4	2	1	3	NA	NA
6-cylinder	Ignition Sequence	1	5	3	6	2	4
	Valve Overlap	6	2	4	1	5	3

Table 1, Valve Adjustment - Method One

14.04.02 Method Two: Adjust All Valves Using Two Crankshaft Positions

Method two allows you to adjust all the valves using just two crankshaft positions.

1. Using the cranking device, turn the crankshaft until cylinder #1 is at the ignition TDC position (all valves are closed) and cylinder #6 (cylinder #4 on the four-cylinder engine) is at the valve overlap position (all valves are open).
2. Check the valves listed in Table "Valve Adjustment - Method Two" in the "Ignition TDC" row and adjust them (if necessary), using the procedures under the headings "Checking Valve Lash" and "Adjusting Valve Lash."
3. Using the cranking device, turn the crankshaft until cylinder #6 (cylinder #4 on the four-cylinder engine) is at the ignition TDC position (all valves are closed) and cylinder #1 is at the valve overlap position (valves are open).
4. Using the same procedure, check the valves in the "Valve Overlap" row and adjust them (if necessary), using the procedures under the headings "Checking Valve Lash" and "Adjusting Valve Lash."

Valve Adjustment — Method Two

Engine	Cylinder #1 Crankshaft Position	Cylinders/Valve Types					
		1	2	3	4	5	6
4-cylinder	Ignition TDC	Intake/ Exhaust	Intake	Exhaust	–	NA	NA
	Valve Overlap	–	Exhaust	Intake	Intake/ Exhaust	NA	NA
6-cylinder	Ignition TDC	Intake/ Exhaust	Intake	Exhaust	Intake	Exhaust	–
	Valve Overlap	–	Exhaust	Intake	Exhaust	Intake	Intake/ Exhaust

Table 2, Valve Adjustment - Method Two

14.04.03 Checking Valve Lash

Check valve lash as follows:

1. For each valve, measure the valve lash with a feeler gauge between the rocker arm and valve stem (exhaust valve) or valve bridge (intake valve). It should be possible to pull the feeler gauge through with no more than light resistance.
2. If the value measured is within the range listed in Table "Valve Lash Checking and Adjustment" in the "Check For" column, check the next valve.

3. If the value measured is within the range listed in Table "Valve Lash Checking and Adjustment" in the "Check For" column, check the next valve.

14.04.04 Adjusting Valve Lash

Adjust valve lash as follows:

1. If adjustment is needed, loosen the locknut. See figure below for intake valves and exhaust valves. Use the exact settings listed in "Valve Lash Checking and Adjustment" table in the "Adjust To" column.

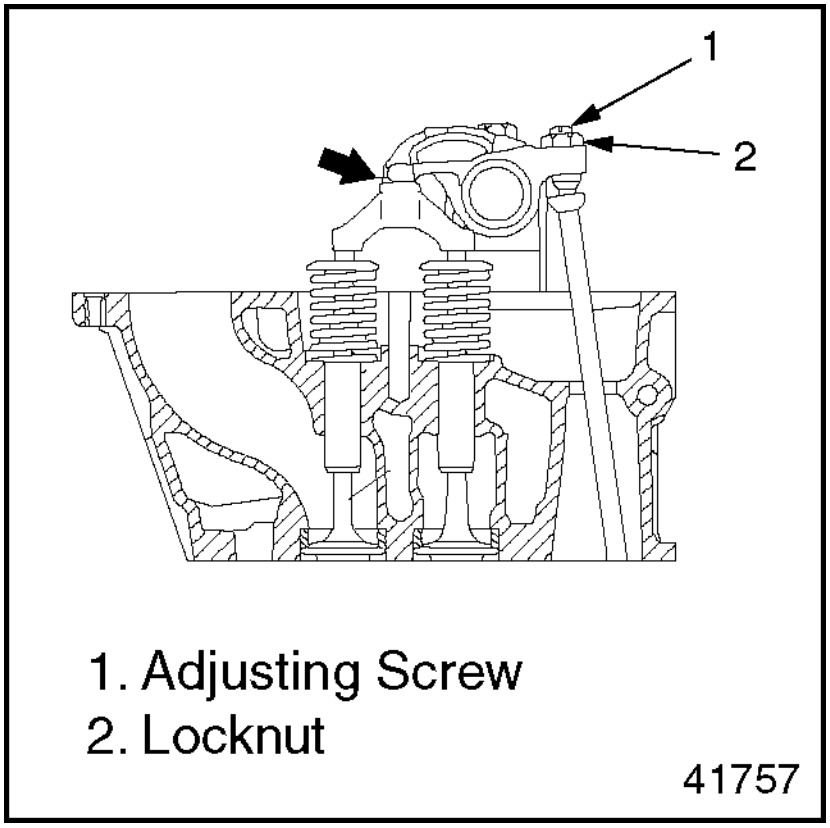


Fig 2, Intake Valves

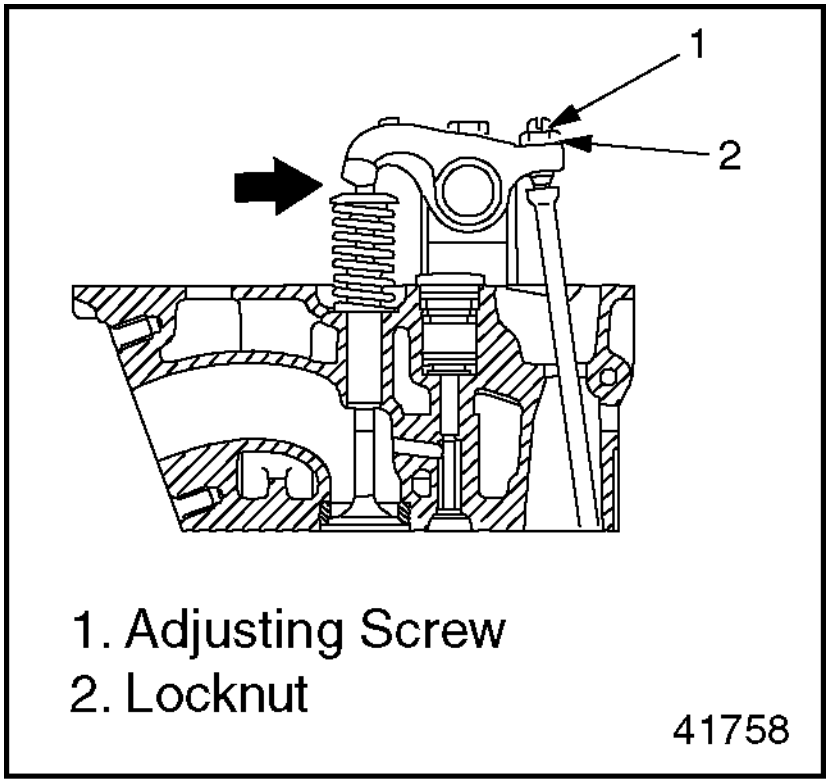


Fig 3, Exhaust Valves

Valve Lash Checking and Adjustment

Valve Type	Check For:	Adjust to:
Intake	0.30 to 0.60 mm (0.012 to 0.024 in.)	40 mm (0.016 in.)
Exhaust	0.50 to 0.80 mm (0.020 to 0.032 in.)	60 mm (0.024 in.)

Table 3, Valve Lash Checking and Adjustment

2. Turn the adjusting screw until the valve lash is correct using the exact settings listed in "Valve Lash Checking and Adjustment" table, above. Use the range only for checking adjustment.
3. Tighten the locknut 25 N·m (18 lb·ft).
4. Check the valve lash again. Adjust again if necessary.

14.04.05 Restoring The Vehicle To Operating Condition

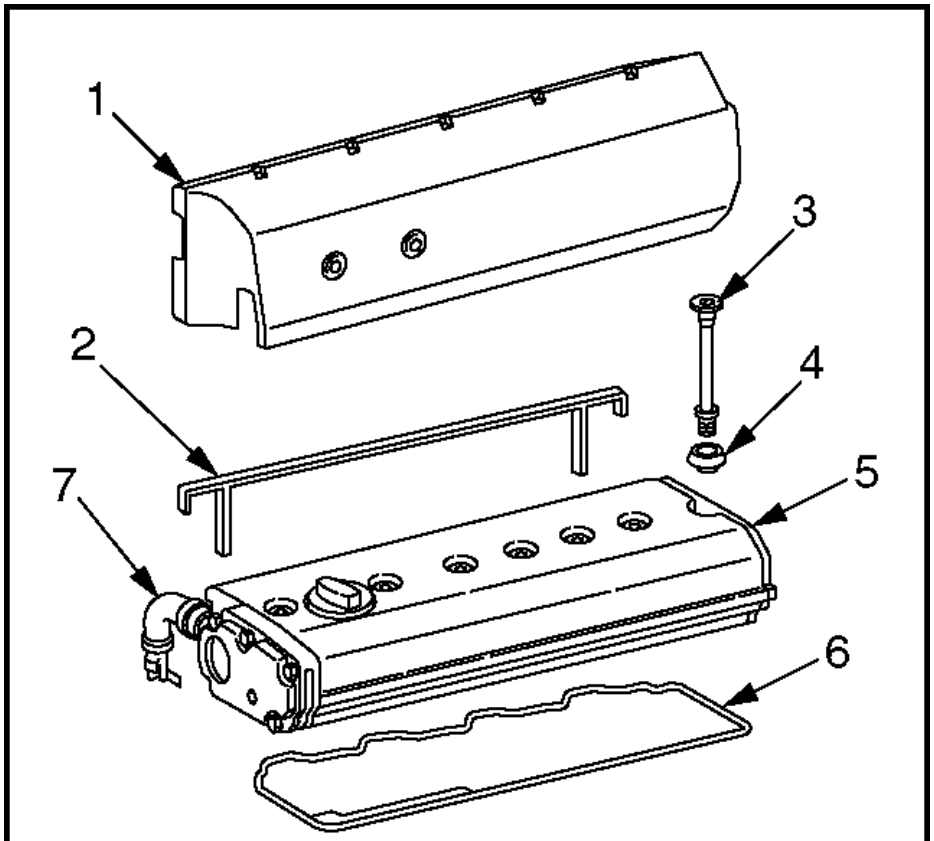
Restore to operating condition as follows:

1. Install the cylinder head cover. Removal of the Cylinder Head Cover.
2. Remove the cranking device from the inspection hole in the timing case.
3. Replace the end cover on the inspection hole and tighten the bolts 25 N·m (18 lb·ft).

14.05 Fuel Prefilter Element Cleaning

Clean the fuel prefilter element as follows:

1. Open the fuel filler cap to release pressure in the fuel system. Replace and tighten the cap.
2. Clean the outside of the prefilter housing. Keep fuel away from hoses or pipes located beneath the filter



1. Engine Trim Panel
2. Charge-Air Manifold Gasket
3. Hexagon Socket-Head Bolt
4. Sealing Washer
5. Cylinder Head Cover
6. Cylinder Head Gasket
7. Breather Hose

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Fig 4, Cylinder Head Cover

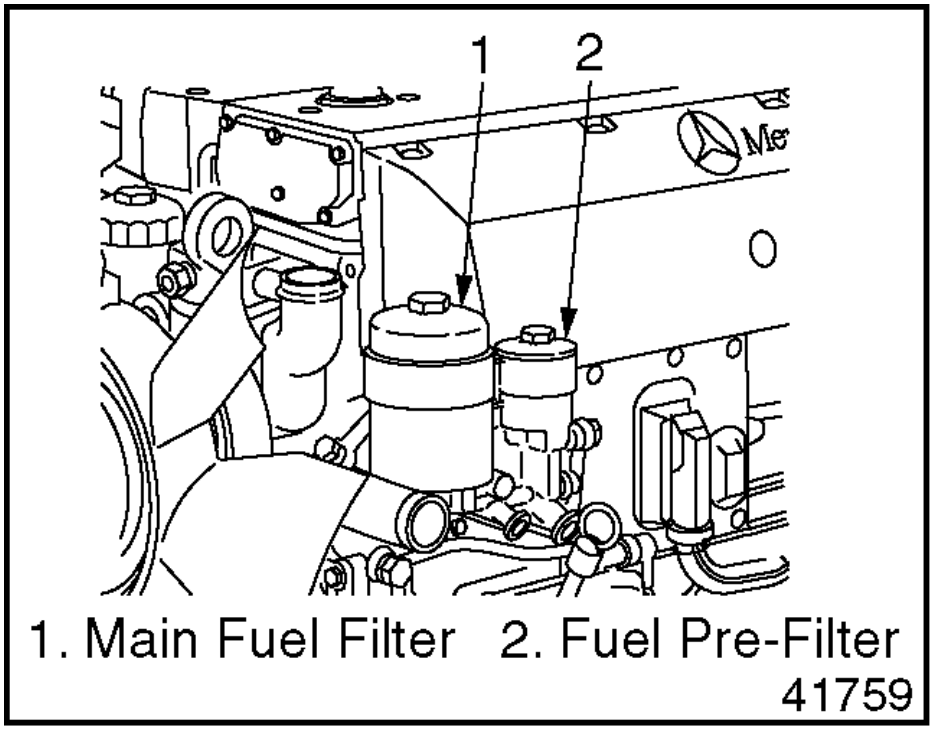


Fig 5, Fuel Filters

3. Unscrew the cap on the fuel prefilter. Pull the cap and filter element out of the prefilter housing.
4. Clean the cap and the filter element. If the filter element is heavily soiled or damaged, replace it.
5. Check the O-ring on the cap and replace it if necessary.
6. Insert the filter element into the prefilter housing and screw the cap onto the housing. Tighten the cap 25 N·m (18 lb·ft).

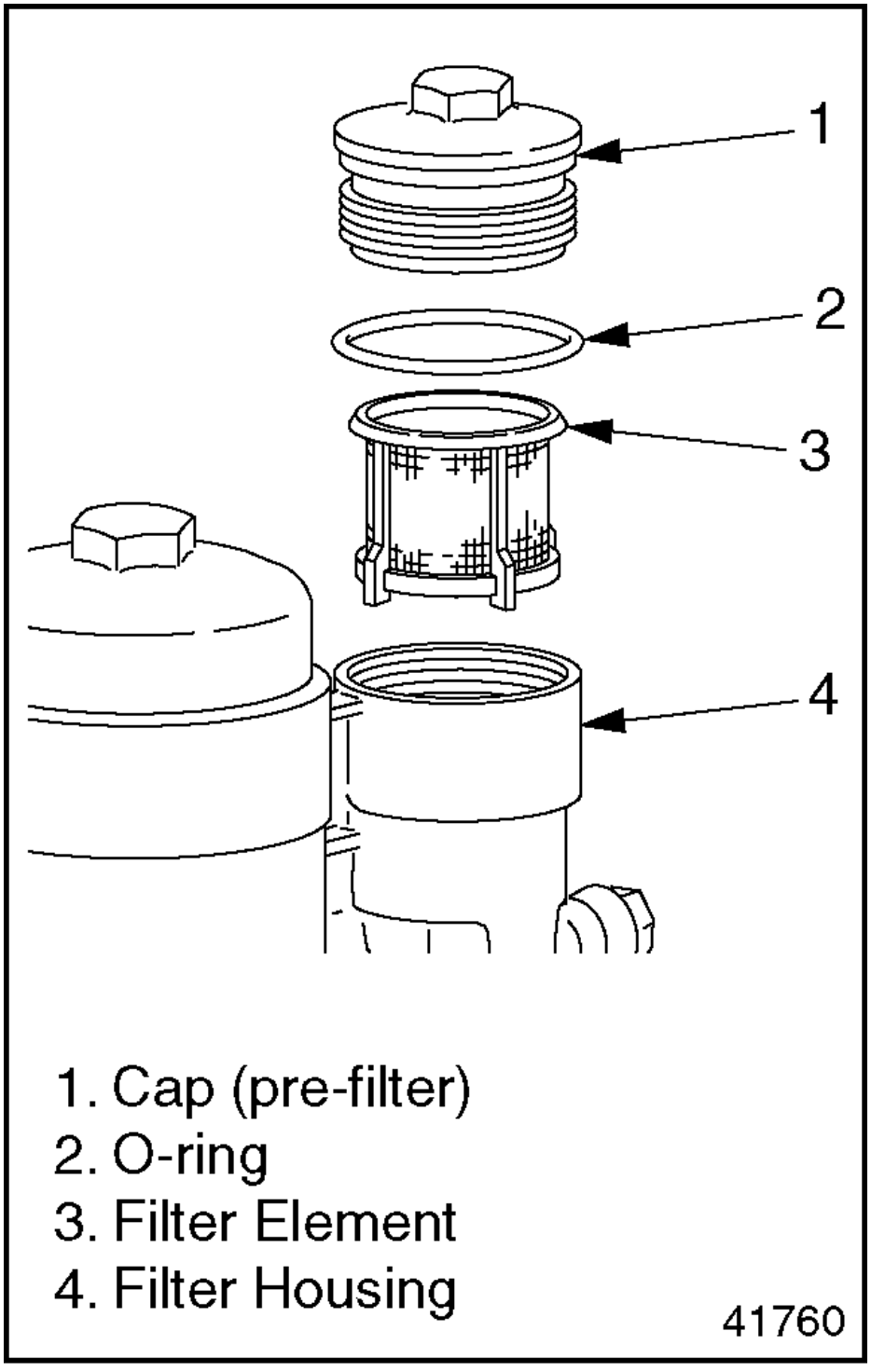


Fig 6, Fuel Prefilter

7. To bleed the fuel system, make sure that all high-pressure lines have been tightened to 25 N·m (18 lb·ft) and all banjo bolts to 40 N·m (30 lb·ft).
8. If equipped with a hand pump on the fuel/water separator, work the hand pump 50 times.

9. Crank the engine for 30 seconds at a time, but no longer. Before cranking the engine again, wait at least two minutes. The engine should start within four 30-second attempts.

14.06 Main Fuel Filter Element Changing

Change the main fuel filter element as follows:

1. Open the vehicle fuel tank filler cap to release pressure in the fuel system. Replace and tighten the cap.
2. Clean the outside of the fuel filter housing. See figure below.
3. Using a 36-mm socket wrench insert, unscrew the cap on the fuel filter and remove it, along with the filter element. Pull both the cap and the filter element a short distance out of the filter housing. See figure below. Allow the fuel to drain off the filter into the housing.
4. Remove the cap with the filter element. To release the filter element, twist the lower edge of the filter element to one side.
5. Pull the dirt collector out of the filter housing using the tabs on either side.

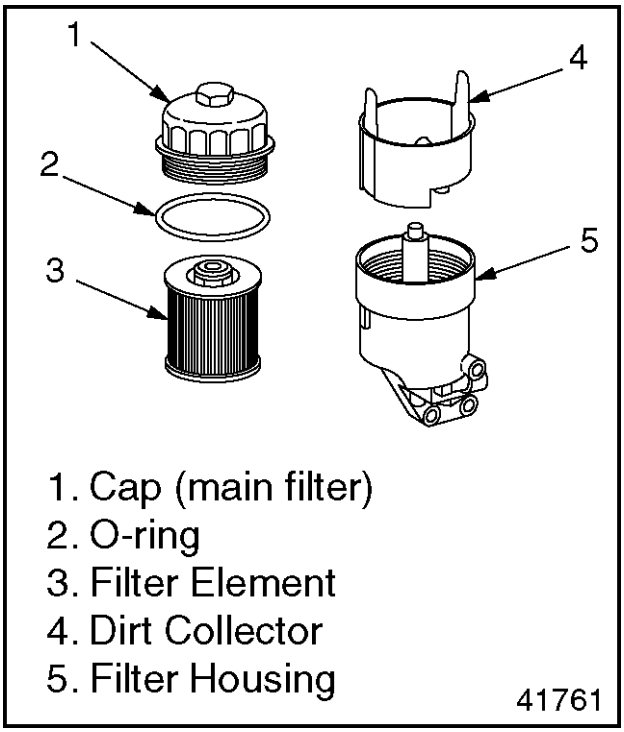


Fig 7, Main Fuel Filter

6. Clean the cap and the dirt collector.
7. Replace the O-ring.
8. Install the new filter element in the cap. Make sure the filter element is securely in place.
9. Insert the dirt collector into the filter housing. Make sure the dirt collector is positioned properly in the filter housing.
10. Screw on the cap with the filter element. Tighten the cap 25 N·m (18 lb·ft).
11. To bleed the fuel system, make sure that all high-pressure lines have been tightened to 25 N·m (18 lb·ft) and all banjo bolts to 40 N·m (30 lb·ft).

12. If equipped with a hand pump on the fuel/water separator, work the hand pump 50 times.
13. Crank the engine for 30 seconds at a time, but no longer . Before cranking the engine again, wait at least two minutes. The engine should start within four 30-second attempts.
14. Start the engine. Check the fuel filter for leaks.

14.07 Engine Oil and Filter Changing

WARNING:

FIRE

To avoid injury from fire, keep open flames, sparks, electrical resistance heating elements, or other potential ignition sources away when draining lubrication oil. Do not smoke when draining lubricating oil.

NOTE: Select the SAE class (viscosity) on the basis of the average air temperature for the season. View the temperature ranges for the various SAE classes as guidelines which can be exceeded for only a short time.

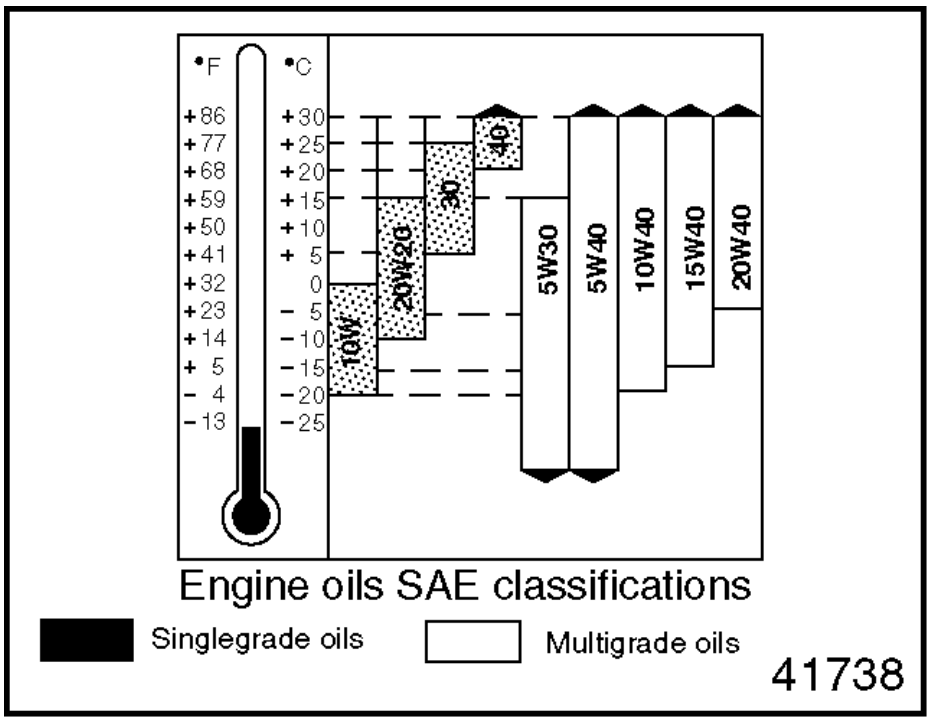


Fig 8, SAE Oil Viscosity Classes

To insure the engine is protected and the oil stays clean until the next oil change, use only oils of API classification CI4.

The six-cylinder EGR engines have an oil centrifuge and an oil filter. Non-EGR engines have only an oil filter.

NOTICE

Both the primary lube oil filter (front of engine) and the oil centriguge cartridge (side of engine) must be replaced at each oil drain interval.

Change the oil filter as follows:

1. Chock the tires, place the transmission in neutral, and set the parking brake.

2. Using a 36-mm socket, unscrew the oil filter cap.

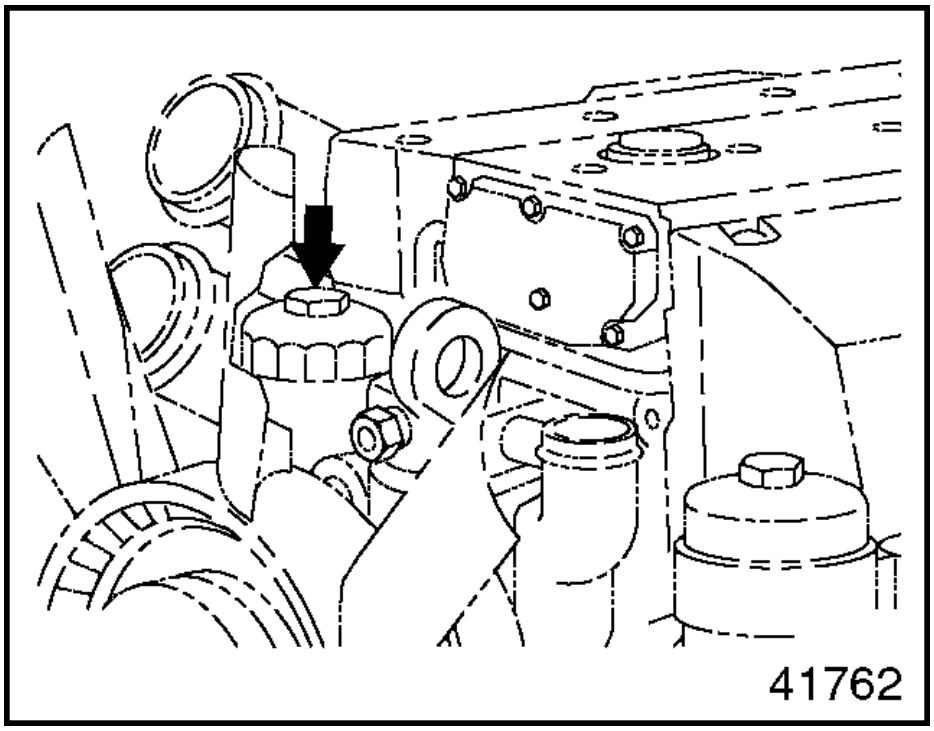


Fig 9, Oil Filter Cap

3. Place a suitable receptacle beneath the oil drain plug on the underside of the oil pan. Carefully unscrew the oil drain plug on the oil pan and allow the oil to drain out. Discard the O-ring on the oil drain plug.

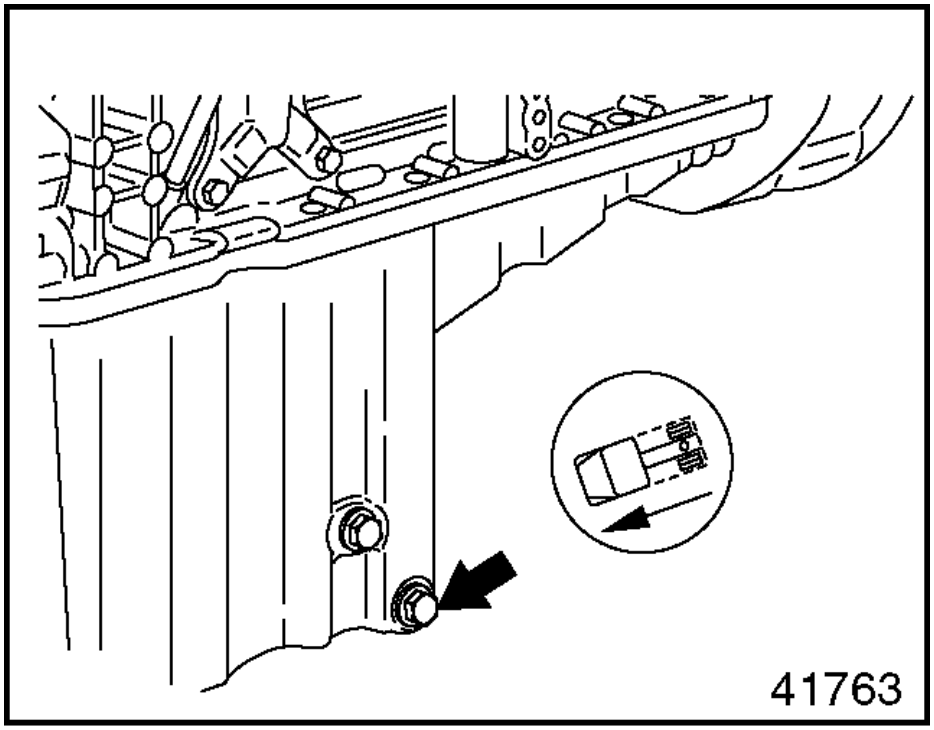


Fig 10, Engine Oil Drain Plug, Oil Pan

4. Remove both the filter cap and the filter element. To release the filter element, twist the lower edge of the filter element to the side.

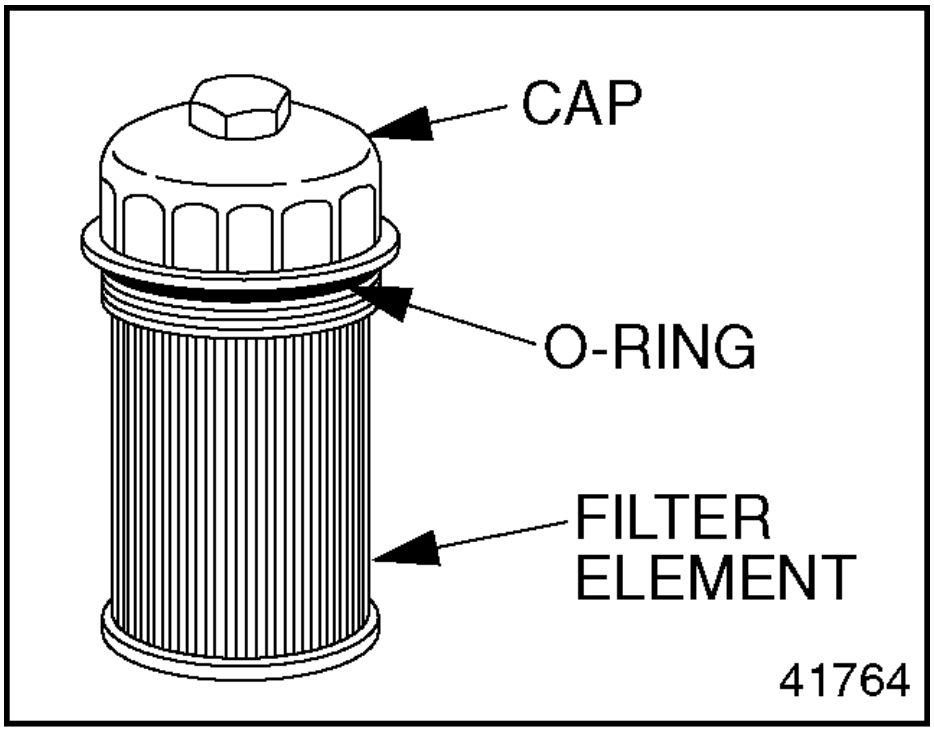


Fig 11, Cap with Oil Filter Element

5. Replace the O-ring on the cap. See figure above.
6. Install the new filter into the cap. Make sure the filter element is securely in place.
7. Screw the cap onto the oil filter housing. Tighten the cap 25 N·m (18 lb·ft).
8. Install the oil drain plug, using a new O-ring. Tighten the plug 65 N·m (48 lb·ft).
9. Add new engine oil through the oil fill.

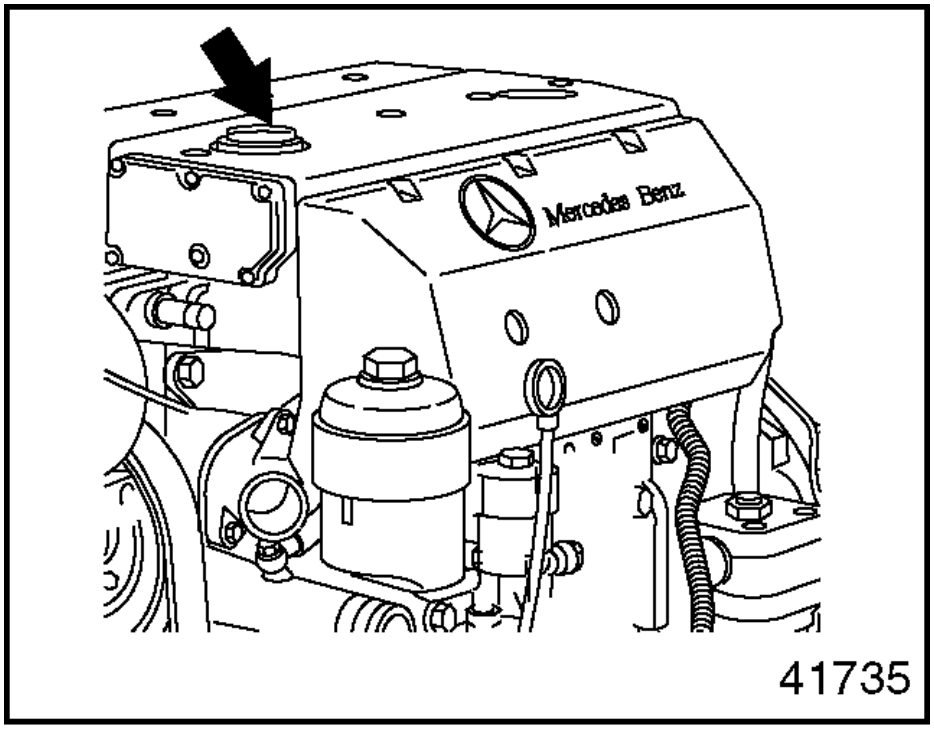


Fig 12, Oil Fill

WARNING:

PERSONAL INJURY

To avoid injury from slipping and falling, immediately clean up any spilled liquids.

10. Fill until the maximum fill level on the oil dipstick has been reached. Do not overfill.
11. Start the engine with the accelerator pedal in the idle position. Monitor the oil pressure gauge.
12. Check the filter and oil drain plug for signs of leakage.
13. Stop the engine.
14. Check the oil level again after approximately five minutes. If necessary, add oil up to the maximum fill level on the oil dipstick. Do not overfill.

14.07.01 Oil Centrifuge

The MBE six-cylinder engines (906/926) have an oil centrifuge.

NOTICE

Both the primary lube oil filter (front of engine) and the oil centrifuge cartridge (side of engine) must be replaced at each oil drain interval.

Change the oil centrifuge cartridge as follows:

1. Remove the cover of the oil centrifuge.

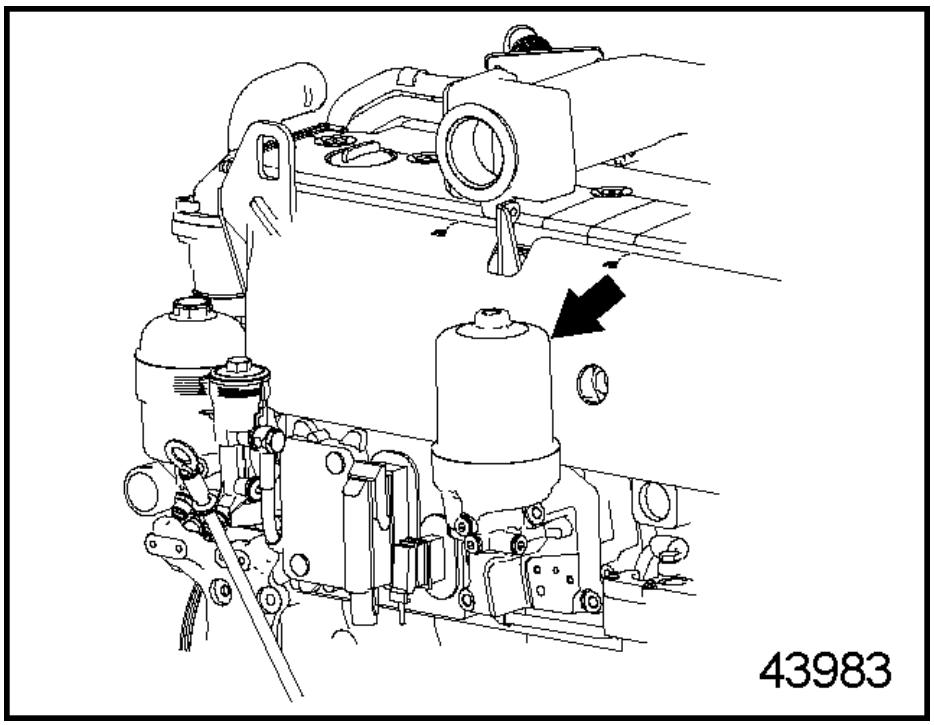


Fig 13, Oil Centrifuge

2. Lift out the dirty cartridge and replace it with a clean one.

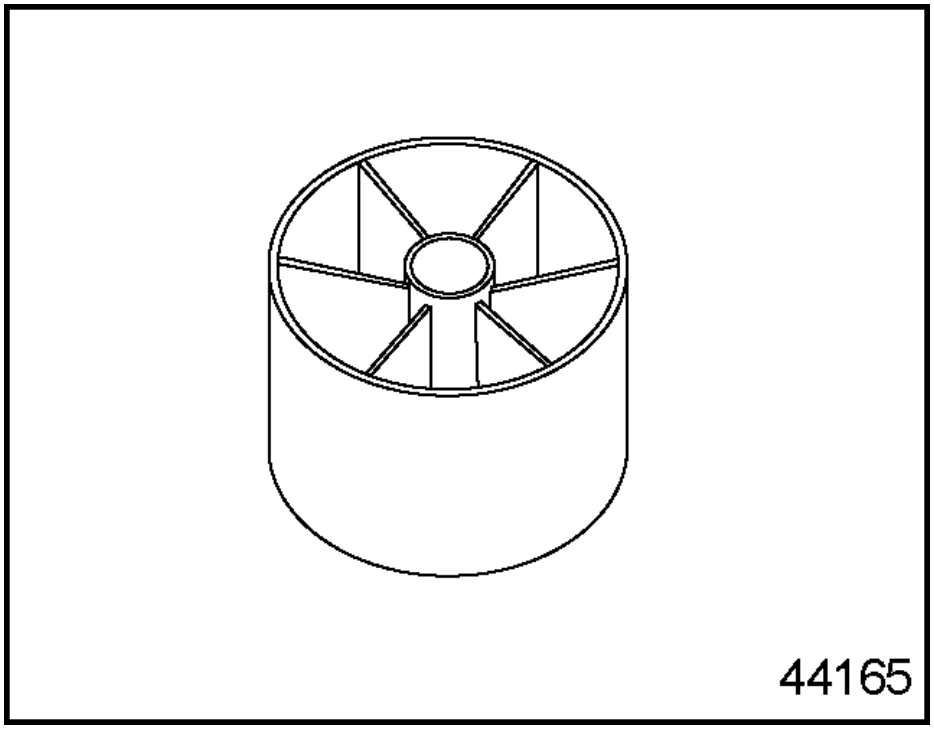


Fig 14, Centrifuge Cartdirge

3. Replace the centrifuge cover, tighten the cap 40 Nm (30 lb·ft).

14.08 Coolant Concentration Checking

Check coolant concentration as follows:

WARNING:

HOT COOLANT

To avoid scalding from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Wear adequate protective clothing (face shield, rubber gloves, apron, and boots). Remove the cap slowly to relieve pressure.

1. Open the cap on the surge tank slowly, to allow excess pressure to escape. Set the cap aside.

2. Before adding coolant, use a suitable tester to check the concentration of corrosion-inhibiting antifreeze. If the concentration is lower than 50% by volume, drain coolant/add antifreeze until the concentration is correct. The coolant mixing ratio is listed in Table 7,Coolant Mixing Ratio.

Antifreeze Protection Down to:	Water Percentage by Volume	Corrosion-Inhibiting Antifreeze Percentage by Volume
-37°C (-47°F)	50	50
-45°C (-49°F)	45	Maximum 55

3. Check the coolant level and add more coolant if necessary.
4. Close and tighten the cap on the surge tank.

14.09 Coolant Flushing and Changing

WARNING:

HOT COOLANT

To avoid scalding from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Wear adequate protective clothing (face shield, rubber gloves, apron, and boots). Remove the cap slowly to relieve pressure.

Flush and change the coolant as follows:

1. Open the cap on the surge tank slowly, to allow excess pressure to escape. Set the cap aside.
2. Open the water regulating valve for the heating system.
3. Drain the coolant from the engine. Coolant system capacity is listed in the "Coolant System Capacity" table below.
   3.a Place a receptacle underneath the coolant drain plug. Choose one that is large enough to hold the expected quantity of coolant.

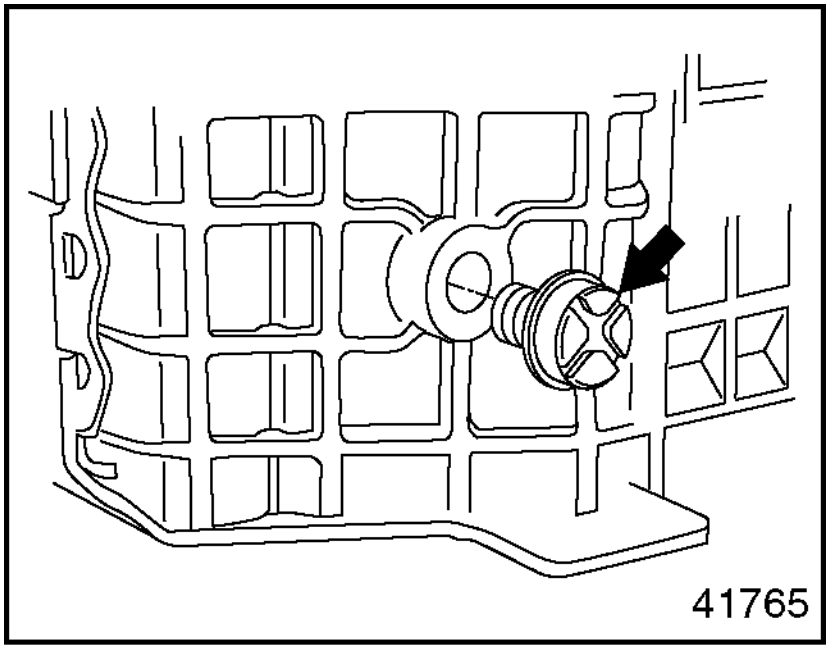


Fig 15, Coolant Drain Plug

3.b Open the coolant drain plug on the bottom of the radiator.

4. Flush the radiator, then attach a flushing gun nozzle to the radiator outlet.

4.a Run water in until the radiator is full.

WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

4.b Apply no more than 140kPa (20 psi) air pressure intermittently to help dislodge sediment buildup in the core.

5. Drain the radiator, and flush the radiator until clean water flows from the radiator. Remove the flushing gun.
6. When the coolant has drained, install the coolant drain plug on the radiator.
7. Add coolant in the specified concentration until the maximum mark on the surge tank is reached. Coolant system capacity is listed in Table 8,Coolant System Capacity.

Description	4-Cylinder	6-Cylinder
Engine Coolant Capacity (all vehicles) L (Qt)		
Engine capacity	8 (8.5)	12 (12.7)
Business Class Coolant System Capacity L (Qt)		
Total capacity	19.8 (21)	23.6 (25)
Antifreeze quantity at 50%	9.9 (10.5)	11.8 (12.5)
Antifreeze quantity at 55%	10.8 (11.5)	13.1 (13.8)

8. Start the engine and run it for about one minute at varying speeds to release air pockets in the cooling system. Make sure the heater valve is still open. Check the coolant level and add more coolant if necessary.
9. Shut down the engine.
10. Add coolant if necessary.

14.10 Cooling System Inspecting

WARNING:

HOT COOLANT

To avoid scalding from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Wear adequate protective clothing (face shield, rubber gloves, apron, and boots). Remove the cap slowly to relieve pressure.

NOTE: Before doing this inspection, make sure to do either maintenance operation, "Coolant Concentration Checking," or maintenance operation, "Coolant Flushing and Changing."

Inspect the cooling system as follows:

1. Inspect the radiator, the condenser, the coolant pump, the engine oil cooler, the freeze plugs, and the heat exchanger for damage and leaks.
2. Check all pipes and hoses in the cooling system for damage and leaks. Make sure all pipes and hoses are properly positioned to avoid chafing, and are securely fastened.
3. Check the outside of the radiator and condenser for blockage by dirt or debris. Make sure the fins are not damaged, and straighten them if necessary.

15. How-To Procedures

15.01 How to Procedures

This section covers the Detroit™ recommendations on how to select lubricating oil, diesel fuel, and coolant. Also included are basic engine maintenance procedures which can be performed by the operator.

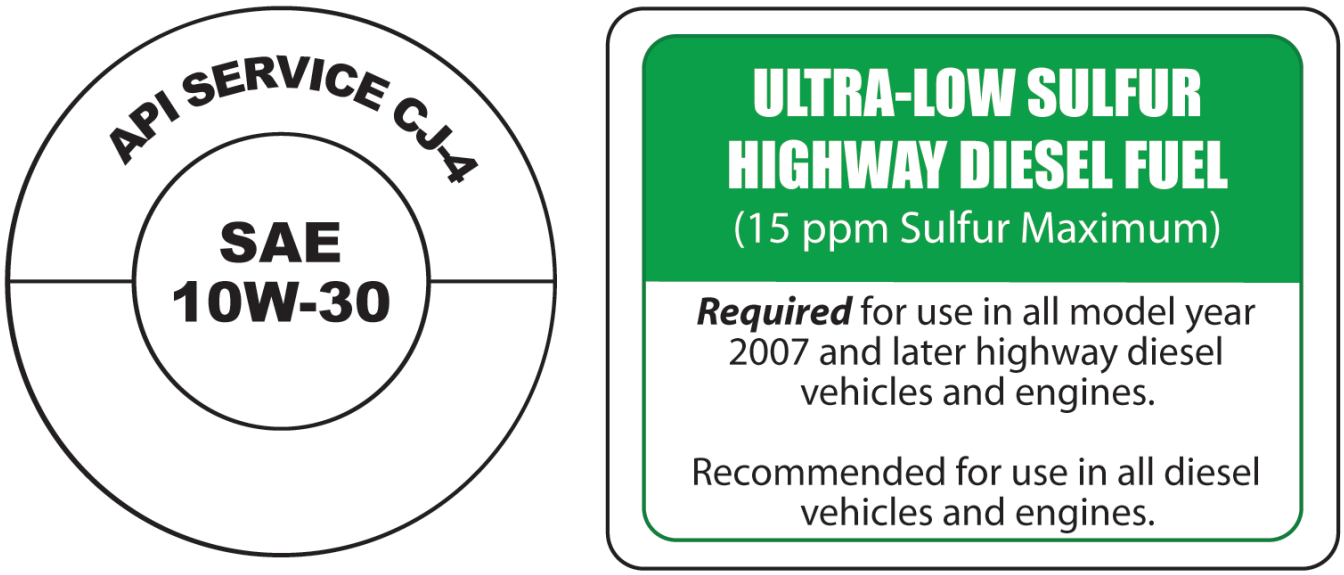
NOTICE

The manufacturer's warranty applicable to the engine provides in part that the provisions of such warranty shall not apply to any engine unit that has been subject to misuse, negligence or accident. Accordingly, malfunctions attributable to neglect or failure to follow the manufacturer's fuel or lubricating recommendations may not be within the coverage of the warranty.

15.01.01 How to Select Lubricating Oil

Refer to DDC-SVC-BRO-0001 for more information.

Detroit Fluids Specification (DFS) 93K222 (CK-4) and 93K128 (CJ-4) oils are recommended for use in the engine.



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15.01.02 How to Replace the Lubricating Oil and Oil Filter

The oil filter is an integral part of the lubrication system. Proper filter selection and maintenance are important to satisfactory engine performance and service life. The filter is designed to maintain a clean system. It is not capable of cleaning a contaminated system. The maintenance intervals for the appropriate duty cycle are listed in tables in 14.02 Scheduled Intervals in this manual.

If the used oil is contaminated by fuel or coolant, it may be necessary to take the vehicle to an authorized Detroit™ service outlet. All contaminated oil must be removed from the engine.

Change the engine oil when the engine oil temperature is approximately 60°C (140°F). Changing cold oil will result in extended drain times.

Replace the lubricating oil and oil filter as follows:

WARNING:

PERSONAL INJURY

To avoid injury, never remove any engine component while the engine is running.

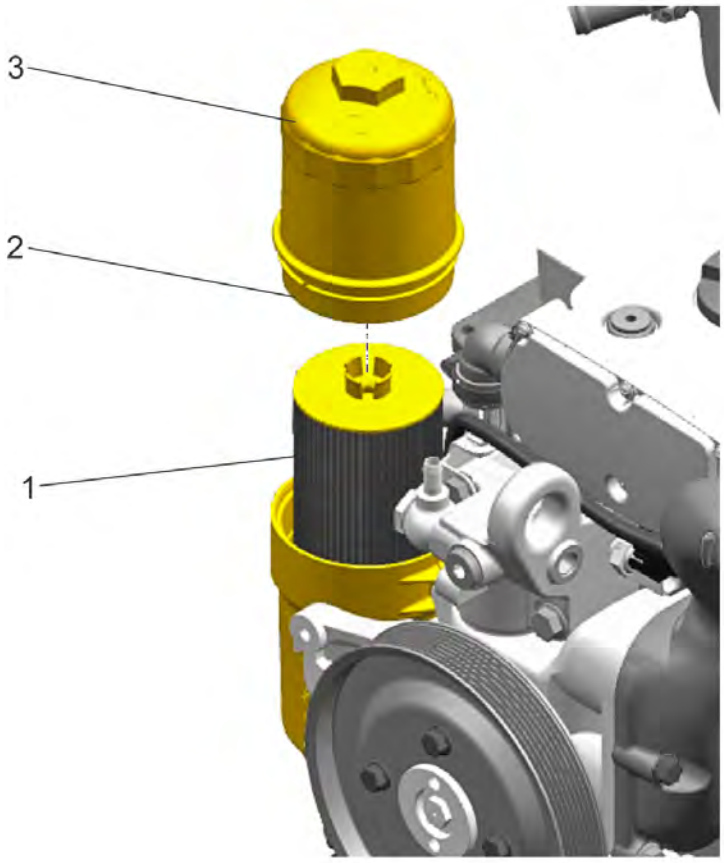
1. Shut off the engine, apply the parking brake, chock the wheels, and perform any other applicable safety steps.

CAUTION:

ELECTRICAL SHOCK

To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

2. Disconnect the batteries.
3. Open the hood.
4. Clean the outside of the oil filter housing.
5. Unscrew the cap (3) and filter (1), and allow the oil to drain into the housing. After draining is complete, remove the assembly from the housing. Pull straight up to avoid damage to the oil filter stand pipe and bypass valve.



1. Oil Filter Element
2. O-ring
3. Oil Filter Cap

Fig 16, Oil Filter

6. Remove the filter element (1) by pressing and twisting the side and detaching it from the cap (3).
7. Remove the oil filter O-ring (2) and discard it. Lightly coat a new O-ring with clean engine oil and install it on the filter cap.
8. Check the filter housing for any debris and remove if necessary.
9. Insert a new oil filter element securely into the oil filter cap.
10. Insert the oil filter element and cap assembly into the housing. Torque to 25 N·m (18 lb·ft).
11. Place a suitable drain container beneath the oil drain plug on the oil pan.
12. Remove the oil drain plug (lowest plug on the oil pan), and allow the oil to drain out.
13. Install the oil pan drain plug with a new seal washer. Torque to 65 N·m (48 lb·ft).
14. Add new engine lubricating oil through the oil fill on the cylinder head cover. See 17.01 Engine Oil Capacities in this manual.
15. Verify the oil level reading is between the add mark and full mark on the oil dipstick.

CAUTION:

ELECTRICAL SHOCK

To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

16. Connect the batteries.

WARNING:

PERSONAL INJURY

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING:

PERSONAL INJURY

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

WARNING:

ENGINE EXHAUST

To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

17. Start the engine with the accelerator pedal released. Monitor the oil pressure gauge or indicator lamp. Keep the engine running at idling speed until oil pressure is present. Do not raise the engine speed until the proper oil pressure has been reached.
18. Check the oil filter housing for signs of leakage.
19. Stop the engine. Check the oil level. If necessary, add no more than 4.0 L (4.2 qt.) of oil at a time, until the oil level reaches the full level on the oil dipstick.

20. Close the hood.

15.01.03 How to Select Diesel Fuel

All Detroit ™ engines equipped with Selective Catalyst Reduction (SCR) are designed to operate on Ultra-Low Sulfur Diesel (ULSD) fuel. For optimal fuel system performance, Detroit Diesel recommends Top Tier Diesel (see figure below).

For fuel quality specifications and limits refer to DDC-SVC-BRO-0001, available through authorized Detroit™ service outlets.

Quality

NOTICE

Use only Ultra-Low Sulfur Diesel Fuel (ULSD) (15 PPM sulfur content maximum), based on ASTM Standard D 2622 test procedure. Using fuel other than ULSD will damage the Aftertreatment Device.

Fuel quality is an important factor in obtaining satisfactory engine performance, long engine life, and acceptable exhaust emission levels. **For fuel quality specifications and limits refer to DDC-SVC-BRO-0001.**

The fuels used must be clean, completely distilled, stable, and non-corrosive. For more information regarding the significance of these properties and selection of the proper fuel.

Fuel Contamination

Generally, fuel contamination occurs as the result of improper fuel handling. The most common types of contamination are water, dirt, and microbial growth "black slime". The formation of varnishes and gums resulting from poor stability or extended storage "stale fuel" also affects fuel quality. The best treatment for contamination is prevention by maintaining a clean storage system and choosing a reputable fuel supplier.

Supplemental 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.

Biodiesel General recommendations and guidelines

Detroit ® supports biodiesel as a renewable fuel. Biodiesel fuels are mono alkali 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 ® approves the use of biodiesel fuel blends as follows:

- DD Family of Engines - Biodiesel blends up to 5% are allowed
- MBE900/4000 Engines - Biodiesel blends up to 5% are allowed
- S60 Engines - Biodiesel blends up to 20% are allowed*

*Engines built prior to MY 2004 may contain materials that are not compatible with biodiesel blends. Biodiesel blends above 5% are not recommended.

For most recent information go to DTNAConnect.

Prohibited Additives

The following fuel additives are not allowed and MUST NOT be mixed with diesel fuel:

- **Used Lubricating Oil** Do not use fuel blended with used lubricating oil. Detroit™ specifically prohibits the use of used lubricating oil in diesel fuel. Used lubricating oil contains combustion acids and particulate materials which can severely erode fuel 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.
-

WARNING:

FIRE

To avoid increased risk of a fuel fire, do not mix gasoline and diesel fuel.

NOTICE

Detroit™ will not be responsible for any detrimental effects resulting from adding drained lubricating oil or gasoline to the diesel fuel.

GasolineThe addition of gasoline to diesel fuel will create a serious fire hazard. The presence of gasoline in diesel fuel will reduce fuel cetane number and increase combustion temperatures. Drain and clean tanks which contain a mixture of gasoline and diesel fuel as soon as possible.

- **Fuel Additives with Sulfur or Sulfated Ash** Do not use non-approved fuel additives containing sulfur or sulfated ash.

15.01.04 Engine Out of Fuel – How to Restart

Use the following procedure to prime the fuel system:

1. If equipped with a hand pump on the fuel/water separator, work the hand pump 50 times.
2. Crank the engine for 30 seconds at a time, but no longer. Before cranking the engine again, wait at least two minutes and work the hand pump 50 more times. The engine should start within four 30-second attempts.

15.01.05 How to Clean an Engine

Observance of all environmental protection regulations is required. Use high-pressure equipment as follows:

CAUTION:

EYE INJURY

To avoid injury from flying debris, wear a face shield or goggles.

NOTICE

To prevent damage to engine components, keep the water moving at all times while cleaning. Never direct water onto electrical components, plug connectors, seals or flexible hoses.

Information on suitable cleaning and protective products is available from any authorized dealer. Note the equipment manufacturer's operating instructions.

Use the following minimum working distance between the high-pressure nozzle and the surface being cleaned:

- Approximately 28 in. (700 mm) for circular pattern jets
- Approximately 12 in. (300 mm) for 25-degree flat jets and dirt cutters

Power clean the engine as follows:

1. Allow engine to cool down to room temperature before spraying the engine.
2. Thoroughly clean the entire engine using a steam cleaner or high pressure washer with mild soap and warm water.

WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

3. Once the engine is clean, blow the electrical connectors dry with compressed air to remove most of the standing water.
4. Allow the engine to dry completely before making any kind of repair.
5. When reassembling, ensure that there is no standing water in any electrical connectors before seating the plug.

15.01.06 Cleaning/Flushing the Cooling System

Collect the used coolant, cleaning solutions, and washing liquids and dispose of them in an environmentally responsible manner.

Degrease as follows:

WARNING:

HOT COOLANT

To avoid scalding from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Wear adequate protective clothing (face shield, rubber gloves, apron, and boots). Remove the cap slowly to relieve pressure.

1. First remove debris (such as dust, insects) from the fins of the radiator grille.

WARNING:

EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

2. Remove the debris by blowing them through with compressed air or spraying them out with water. Work from the rear of the radiator (in the opposite direction of the normal cooling air flow).
3. Drain the coolant when the engine is cold. Cooling System Drain Procedure. For detailed procedures, see the vehicle/chassis maintenance manual. For types of coolant,Coolant Selections and MaintenanceCoolant Selections and Maintenance for the listing of required intervals using the recommended coolants.
4. If the HVAC unit is connected to the cooling system, open the regulating valves all the way.
5. Fill the cooling system with a 5% solution (1.6 ounces per quart [50 grams per liter] of water) of a mildly alkaline cleaning agent. Coolant Selections and MaintenanceCoolant Selections and Maintenance.
6. Run the engine at moderate speed until the thermostat starts to open. The thermostat starts to open at 88°C (190°F) and is fully open at 95°C (203°F). Then run it for about five minutes longer. Shut down the engine and allow it to cool to approximately 50°C (112°F).
7. Drain all the cleaning solution.
8. Flush the cleaning solution from the cooling system.
   - 8.a Immediately after draining the cleaning solution, flush the system with clean water.
   - 8.b Once the clean water has drained, fill the system again with clean water.
   - 8.c Run the engine at moderate speed until the thermostat starts to open. The thermostat starts to open at 88°C (190°F) and is fully open at 95°C (203°F). Then run it for about five minutes longer. Shut down the engine and allow it to cool to approximately 50°C (112°F).
   - 8.d Drain the hot water.
9. Fill the cooling system with new coolant. For detailed procedures, see the vehicle/chassis maintenance manual. For types of coolant,Coolant Selections and MaintenanceCoolant Selections and Maintenance for the listing of required intervals using the recommended coolants.

15.01.07 Coolant Selections and Maintenance

Coolant Selections and Maintenance

This section covers selection of the required coolant for the engine.

Extended Life Coolants

Extended Life Coolant (ELC) contain Organic Acid Technology (OAT) which provide corrosion protection and inhibit liner cavitation. These coolants require less maintenance over the useful life of the engine.

ELC antifreeze coolants are commercially available from Detroit™ (recommended) and other manufacturers as either concentrated or pre-mixed formulations. Concentrated antifreeze coolants should be mixed at 50% (50% antifreeze/50% water). All ELC's used must also meet DFS 93K217 specification. Detroit™ requires that these types of coolants to be free of nitrite and phosphate. Detroit™ has found that ELC's containing nitrite may lead to a breakdown of the coolant and subsequent damage to the cooling system.
These types of coolants should not be mixed with Standard Life Coolants. If an ELC antifreeze coolant and SLC antifreeze coolants are mixed, damage may not result, but the long-life advantages of the ELC antifreeze coolant will be lost. In this event, the coolant should be re-inhibited with OAT inhibitors and confirmed by analysis or else it must be maintained as an SLC antifreeze coolant.

SLC Antifreeze Coolants

Standard Life Coolant (SLC) contain inhibitor salts, including nitrites, to prevent liner cavitation. These coolants require interval testing to maintain inhibitor concentration.

SLC antifreeze coolants are commercially available from Detroit™ (recommended) and other manufacturers as either concentrated or as pre-mixed antifreeze. Concentrated antifreeze coolants should be mixed at 50% (50% antifreeze/50% water). All fully formulated coolants used must also meet DFS 93K217 specification.

NOTE: Fully formulated antifreeze does not require a dosage of Supplemental Coolant Additive (SCA) at initial use.

15.01.08 Coolant Fill Options

Coolant Fill Options

The coolants recommended for use in Detroit™ engines are listed in the tables below. This publication will give a complete explanation of their use.

NOTICE

Required specifications for water, Ethylene Glycol (EG), Propylene Glycol (PG), inhibitor packages, and inhibitor concentration are included in the appendix of this publication. To avoid possible engine damage from inadequate or over-concentrated coolant, this publication should be read thoroughly before replacing or topping-off coolant.

Engine Series	Coolant Factory Fill Options	Service Fill Options
DD5, DD8, DD13, DD15, DD16	Extended Life Coolant (ELC) - Organic Acid Technology (OAT)	Detroit Power Cool Plus or refer to 93K217 list of approved coolants at DTNAConnect.com
	Standard Life Coolant (SLC) - Conventional	Detroit Power Cool or refer to 93K217 list of approved coolants at DTNAConnect.com

Table 4, DD5, DD8, DD13, DD15, and DD16 Coolant Fill Options

Engine Series	Coolant Fill Options	Service Fill Options
Series 50, Series 55, Series 60, MBE900, MBE4000	Ethylene Glycol based antifreeze coolant + SLC corrosion inhibitors	Detroit Power Cool or refer to 93K217 list of approved coolants at DTNAConnect.com
	Propylene Glycol based antifreeze coolant + SLC corrosion inhibitors	No Detroit™ product available. Refer to 93K217 list of approved coolants at DTNAConnect.com
	Water based coolant + SLC corrosion inhibitors[1]	Deionized Water + Detroit Genuine Coolant 3000
	Ethylene Glycol based antifreeze coolant + ELC inhibitors	Detroit Power Cool Plus or refer to 93K217 list of approved coolants at DTNAConnect.com
	Propylene Glycol based antifreeze coolant + ELC inhibitors	No Detroit™ product available. Refer to 93K217 list of approved coolants at DTNAConnect.com
	Water based coolant + ELC inhibitors[1]	Deionized Water + Detroit Genuine Coolant Plus 6000
[1] Water-only coolant systems offer no freeze protection and should not be used where ambient temperatures can fall to 0°C (32°F).		

Table 5, Legacy Engine Coolant Fill Options

Engine Series	Coolant Factory Fill Options	Service Fill Options
DD8	Silicated Organic Acid technology (Si-OAT)	Refer to 93K217 list of approved coolants at DTNAConnect.com.

Table 6, Freightliner EconicSD Coolant Fill Options

Additional approved coolant products can be found on the Detroit 93K217 list at the DTNA Portal.

15.01.09 Coolant Do's and Don'ts

Coolants for Detroit™ Engines

The intent of this bulletin is to provide the requirements, directions, and information required to ensure cooling system protection for Detroit™ engines. These recommendations are general rules and reflect years of experience, technology research, and product development. Specific concerns not covered by this publication should be addressed to your local Detroit™ representative. The coolant used in Detroit™ engines must meet **DFS 93K217 Specification** with the following basic requirements:

- Provide an adequate heat transfer medium.
- Protect against cavitation damage to both cylinder liners and water pumps.
- Provide a corrosion/erosion-resistant environment.
- Prevent formation of scale or sludge deposits.
- Be compatible with cooling system hose and seal materials.
- Provide adequate freeze protection.

The rest of this section will describe the requirements for the proper usage of the water, antifreeze, and corrosion inhibitors. It will also describe the coolants and additives that are not recommended by Detroit™ and have been proven harmful to Detroit™ engines.

Coolants NOT Permitted

The following coolants are not to be used in Detroit™ engines:

- **Automotive/Passenger car-type coolants** must not be used in Detroit™ engines because they offer no liner pitting protection. Also, these types of coolants generally contain high levels of phosphates and silicates.
- **Methyl alcohol-based antifreeze** must not be used in Detroit™ engines because of its effects on the nonmetallic components of the cooling system and its low boiling point.
- **Methoxy propanol-based antifreeze** must not be used in Detroit™ engines because it is not compatible with fluorocarbon elastomer seals found in the cooling system.
- **Glycol-based coolants formulated for Heating/Ventilation/Air Conditioning (HVAC)** must not be used in Detroit™ engines. These coolants generally contain high levels of phosphates, which will form deposits on hot internal engine surfaces, reduce heat transfer, and cause water pump seal leaks.
- **Waterless-type coolants** must not be used.
- **Nitrite Organic Acid Technology (NOAT)** must **not** be used in Detroit™ engines because with poor maintenance components become more vulnerable.

Non-Formulated Additives NOT Permitted

The following additives should not be used in Detroit™ engines:

- **Soluble Oils:** Soluble oil additives are not approved for use in Detroit™ engine cooling systems. A small amount of oil adversely affects heat transfer. For example, a 1.25% concentration of soluble oil increases the fire deck temperature 6%. A 2.50% concentration increases the fire deck temperature 15%. The use of soluble oil additives may result in engine overheating and/or failure.
- **Chromates:** Chromate additives are not approved for use in Detroit™ engine cooling systems. Chromate additives can form chromium hydroxide, commonly called “green slime.” This, in turn, can result in engine damage due to poor heat transfer. Cooling systems operated with a chromate-inhibited coolant must be chemically cleaned with Detroit™ Genuine Coolant **Twin Pack** cooling system cleaner/conditioner (or equivalent sulfamic acid/sodium carbonate cleaner) and flushed.
- **Phosphate Inhibitors:** Phosphate has tendency to form deposits on surfaces transferring high heat which ultimately affect cooling capabilities. Phosphate deposits on water pump seals will result in coolant leakage across seal faces.

15.01.10 Maintenance

Topping Off Coolant

NOTE: Topping off must be done while the vehicle is off and has had time to cool down. Topping off should never be done on a warm engine or a running vehicle.

The coolant level should be checked daily and at each service interval. If topping off is necessary, add coolant which is identical to the initial–fill coolant. Extended Life Coolants (ELC) also known as Organic Acid Technology Coolants (OAT) should be topped-off with a coolant of the same formulation; Standard Life Coolants (SLC) also known as Conventional should also be topped-off with a coolant of the same formulation.

Silicated Organic Acid technology (Si-OAT) should only be topped off with Silicated Organic Acid technology (Si-OAT) listed on DFS 93K217. Do not mix with other coolants even if they are the same color.

Coolant Maintenance Intervals

The following tables contain the coolant maintenance intervals.

Silicated Organic Acid Technology (Si-OAT) Coolant Additive Maintenance Procedures

Detroit™ recommends following the manufacturer's recommendations as to minimum and maximum limits.

Freeze Point Check

To best measure the quality of anti-freeze coolant, a check of the freeze point (glycol concentration), by refractometer, should be performed at each service interval to ensure anti-freeze levels are within specification. Detroit™ requires a freeze

point between -31°C and -42°C (-24°F and -44°F) to guarantee optimal engine protection. The exception would be certain regions that require a freeze point of (-51°C) -60°F to protect against colder climates.

Laboratory Testing

Laboratory testing is the best practice for determining Silicated Organic Acid technology (Si-OAT) coolant quality and will provide vital information regarding the engine performance.

Standard Life Coolant Additive Maintenance Procedures

The concentrations of SLC inhibitors will gradually deplete during normal engine operation. SCAs replenish the protection for cooling system components and must be added to the cooling system on an as needed basis. Below are test procedures that will assist in determining the inhibitor concentration.
Coolant Test Procedure

3-Way Test Strips

Nitrite concentration is an indication of the overall coolant inhibitor concentration in SLC formulations. These coolants must be tested for nitrite concentration at the regular intervals as listed in Table "Standard Life Coolant". Detroit™ Genuine Fluid Analysis 3-Way Test Strips (or equivalent) are recommended. Use these test strips to measure nitrite and glycol concentrations. Cavitation/corrosion protection is indicated on the strip by the level of nitrite concentration. Freeze/boil-over protection is determined by glycol concentration.

Laboratory Testing

As an alternative to the test strips, a factory coolant analysis program is available through authorized Detroit™ service outlets. To verify coolant acceptability, submit a sample for coolant analysis according to Table "Standard Life Coolant".

Standard Life Coolant Maintenance Intervals

Service Application / Engine Series	Efficient Long Haul[1]	Long Haul[2]	Short Haul[3]	Severe[4]	Action Required
Series 40, 50, 60	Not Applicable	Every30,000 miles (48,000 km) or 1 year[5]	Every 20,000 miles (32,000 km) or 500h, or 6 months[5]	Every 15,000 miles (24,000 km) or 300h, or 3 months[5]	Standard Life Coolant Additive Maintenance Procedures
MBE4000, MBE900	Not Applicable	Every 30,000 miles (48,000 km) or 1 year[5]	Every 15,000 miles (24,000 km) or 500h, or 6 months[5]	Every 10,000 miles 16,000 km) or 300h, or 3 months[5]	
DD13	65,000 miles (105,000 km)	55,000 miles (89,000 km) or 1 year[5]	40,000 miles (64,000 km), 895 hours or 1 year[5]	35,000 miles (56,000 km), 640 hours or 6 months[5]	
DD15	75,000 miles (121,000 km)	60,000 miles (97,000 km) or 1 year[5]	45,000 miles (72,000 km), 895 hours or 1 year[5]	35,000 miles (56,000 km), 640 hours or 6 months[5]	
DD16	Not Applicable	55,000 miles (89,000 km) or 1 year[5]	40,000 miles (64,000 km), 895 hours or 1 year[5]	35,000 miles (56,000 km), 640 hours or 6 months[5]	

1. Efficient Long Haul (over-the-road transport) service applies to vehicles that annually travel more than 60,000 miles (96,000 kilometers) and average greater than 7 miles per gallon with minimal city stop-and-go operation and minimum idle.

2. Long Haul (over-the-road transport) service applies to vehicles that annually travel more than 60,000 miles (96,000 kilometers) and average greater than 6 miles per gallon with minimal city stop-and-go operation.

3. Short Haul service applies to vehicles that annually travel up to 30,000 to 60,000 miles (48,000 to 96,000 km) and average between 5.1 and 5.9 miles per gallon.

4. Severe service applies to vehicles that annually travel up to 30,000 miles (48,000 km) and average less than 5 miles per gallon or that operate under severe conditions. Severe service also applies to RV applications. Service applies to vehicles that annually travel up to 30,000 miles (48,000 km) or that operate under severe conditions. Only one of these conditions needs be met to categorize an application as Severe Service.

5. Whichever comes first.

Table 7, Standard Life Coolant (also known as Conventional) Maintenance Intervals:

Service Application / Engine Series	Efficient Long Haul[1]	Long Haul[2]	Short Haul[3]	Severe[4]	Action Required
DD5	Not Applicable	Every 50,000 miles (80,000 km) or 1 year[5]	Every 45,000 miles (72,000 km) or 3,000 hrs, or 1 year[5]	Every 35,000 miles (56,000 km) or 1,000 hrs, or 1 year[5]	Standard Life Coolant Additive Maintenance Procedures

1. Efficient Long Haul is not applicable to the DD5 engine.

2. Long Haul service (over-the-road transport) applies to vehicles that annually travel more than 60,000 miles (96,000 km) and average greater than 12.0 miles per gallon 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.

3. Short Haul service applies to vehicles that annually travel up to 60,000 miles (96,000 km) and average between 10.1 and 11.9 miles per gallon and operate under normal conditions. Examples of Short Haul service are: operation primarily in cities and densely populated areas, local transport with infrequent freeway travel, or a high percentage of stop-and-go travel.

4. Severe service applies to vehicles that average below 10.0 miles per gallon or that operate under severe conditions. Examples of Severe Service are: idle time over 40%, load factor over 55%, operation on extremely poor roads or under heavy dust accumulation; constant exposure to extreme hot, cold, salt-air, or other extreme climates; frequent short-distance travel; construction-site operation; or farm operation. Only one of these conditions needs be met to categorize an application as Severe Service.

5. Whichever comes first.

Table 8, Standard Life Coolant (also known as Conventional) Maintenance Intervals:

Service Application / Engine Series	Efficient Long Haul[1]	Long Haul[2]	Short Haul[3]	Severe[4]	Action Required
DD8	Not Applicable	Every 60,000 miles (96,000 km) or 2,000 hrs or 1 year[5]	Every 55,000 miles (88,000 km) or 1,800 hrs, or 1 year[5]	Every 45,000 miles (72,000 km) or 1,500 hrs, or 1 year[5]	Standard Life Coolant Additive Maintenance Procedures

1. Efficient Long Haul is not applicable to the DD8 engine.

2. Long Haul service (over-the-road transport) applies to vehicles that annually travel more than 60,000 miles (96,000 km) and average greater than 8.5 miles per gallon 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.

3. Short Haul service applies to vehicles that annually travel up to 60,000 miles (96,000 km) and average between 6.5 and 8.5 miles per gallon and operate under normal conditions. Examples of Short Haul service are: operation primarily in cities and densely populated areas, local transport with infrequent freeway travel, or a high percentage of stop-and-go travel.

4. Severe service applies to vehicles that average below 10.0 miles per gallon or that operate under severe conditions. Examples of Severe Service are: idle time over 40%, load factor over 55%, operation on extremely poor roads or under heavy dust accumulation; constant exposure to extreme hot, cold, salt-air, or other extreme climates; frequent short-distance travel; construction-site operation; or farm operation. Only one of these conditions needs be met to categorize an application as Severe Service.

5. Whichever comes first.

Table 9, Standard Life Coolant (also known as Conventional) Maintenance Intervals:

Engine Series	SLC
Series 60, 50, 40	300,000 miles (482,800 km) or 2 years

Table 15, Standard Life Coolant (also known as Conventional) Drain Intervals:

Engine Series	SLC
MBE4000, MBE900	
DD5, DD8, DD13, DD15, DD16	

Table 10, Standard Life Coolant (also known as Conventional) Drain Intervals:

Supplemental Coolant Additives (SCA)

Supplemental Coolant Additive (SCA) Solutions- for Ethylene or Propylene Glycol-based Antifreeze Coolants

The coolant must be maintained with the proper concentration of corrosion inhibitors. As the concentration of inhibitors deplete, additional SCA must be added to the coolant as indicated by a nitrite concentration of 900 PPM, or less. If the nitrite concentration is greater than 900 PPM, do not add additional SCA. If the nitrite concentration is above 3200 PPM, the system is over-inhibited. The system should be partially drained and filled with a 50/50 mix of water and EG or PG.

Supplemental Coolant Additive (SCA) Solutions - for Water-based Coolants (Legacy Engines Only)

In warm climates where freeze protection is not required, water only with corrosion inhibitors is approved for use. Water-only systems need to be treated with the proper dosage of corrosion inhibitors. Detroit™ approved conventional SCA or OAT corrosion inhibitors must be added to the water to provide required corrosion and cavitation erosion protection.

Need-Release Coolant Filters (STANDARD LIFE COOLANT ONLY[1])

Need-Release coolant filters are available for Series 50, Series 60 and pre-2016 DD series engines. Membranes in the filters release SCAs before the coolant approaches a corrosive condition, protecting the engine from corrosion. The need-release elements release the SCA charge as needed, as opposed to the maintenance SCA elements, which instantaneously release the SCA charge. Need-release coolant filter elements should be replaced after one year or 100,000 miles (160,000 km), or 3,000 operating hours, whichever comes first.

1. Need-Release filters are not to be used with ELC type coolants. Such use will cause serious damage to the engine.

15.01.11 Appendix A - Definitions

Appendix A - Definitions

Antifreeze:

A substance that is added to the water in a vehicle's cooling system that lowers the freeze point to prevent freezing. The two most common antifreezes are ethylene glycol (EG) and propylene glycol (PG).

Coolant:

A fluid that transfers heat from the engine by circulation.

Extended Life Coolant (ELC): AKA - Long-Life Coolant or Organic Acid Technology:

These types of coolants have been formulated to extend the service interval of the coolant. Example of ELC is Power Cool Plus.

Fully Formulated:

Antifreeze that contains all the necessary inhibitors to protect a diesel engine and does not, therefore, require a pre-charge of Supplemental Coolant Additive before its first use.

Initial-Fill:

The coolant that is used in a new or rebuilt engine, or used any time the cooling system is emptied and then refilled with new coolant.

Standard Life Coolant (SLC): AKA - Fully-Formulated or Conventional Coolant:

These types of coolants use supplemental coolant additives (SCA) to protect against corrosion or mechanical wear. Example of SLC is Power Cool.

Supplemental Coolant Additive:

An additive used in a preventive maintenance program to prevent corrosion, cavitation, and the formation of deposits.

15.01.12 Appendix B - General Coolant Information

Appendix B - General Coolant Information

SLC Antifreeze Coolants

These products are available as Fully Formulated and Phosphate-Free. They are commercially available from Detroit™ (recommended) and other manufacturers as either concentrated antifreeze or as pre-mixed antifreeze. The pre-mixed antifreeze is ready to use, while the concentrated coolant must be mixed with water prior to use. All fully formulated coolants used must also meet Detroit 93K217 specification.

NOTE: Fully formulated antifreeze does not require a dosage of Supplemental Coolant Additive (SCA) at initial use.

ELC Antifreeze Coolants

EG and PG based antifreeze coolants contain Organic Acid Technology (OAT). These coolants require less maintenance over the useful life of the engine.

ELC antifreeze coolants are available as either concentrated or pre-mixed formulations. Concentrated antifreeze coolants should be mixed at 50% (50% antifreeze/50% water). **These types of coolants should not be mixed with SLCs.** If an ELC antifreeze coolant and SLC antifreeze coolants are mixed, damage may not result, but the long-life advantages of the ELC antifreeze coolant will be lost. In this event, the coolant should be re-inhibited with OAT inhibitors and confirmed by analysis or else it must be maintained as an SLC antifreeze coolant.

Water-Only Coolants (Series 50, 55 and 60 only)

In warm climates where freeze protection is not required, water only with corrosion inhibitors is approved for use. Water-only systems need to be treated with the proper dosage of corrosion inhibitors. Detroit™-approved SCA or ELC corrosion inhibitors must be added to the water to provide required corrosion and cavitation erosion protection.

Mixing Ethylene Glycol or Propylene Glycol Antifreeze and Water

It is highly recommended to use a pre-mixed 50/50 antifreeze coolant. However, if a concentrated Ethylene Glycol or Propylene Glycol antifreeze is purchased, mix the antifreeze with water meeting the required quality standards and fill the cooling system. See water requirement below for quality standards. If a pre-diluted coolant is purchased, simply fill the cooling system.

For best overall performance, a coolant consisting of 50% concentration of antifreeze (50% antifreeze, 50% water) is recommended. An antifreeze concentration of over 60% (60% antifreeze, 40% water) is **not recommended** due to poor heat transfer, reduced freeze protection, and possible silicate dropout. An antifreeze concentration below 40% (40% antifreeze, 60% water) offers too little freeze and/or corrosion protection and is **not recommended**.

WATER REQUIREMENTS

Distilled or de-ionized water, which eliminates the adverse effects of minerals in tap water, is preferred. High levels of dissolved chlorides, sulfates, magnesium, and calcium in some tap water causes scale deposits, sludge deposits and/or corrosion. These deposits have been shown to result in water pump failures and poor heat transfer, resulting in overheating. If tap water is used, the mineral content in the water must be below the maximum concentration listed in the table below.

Minerals	Maximum Concentration	
	Parts per Million	Grains per Gallon
Chlorides	40	2.5
Sulfates	100	5.8

Table 16, Maximum Mineral Concentration in Water

Minerals	Maximum Concentration	
	Parts per Million	Grains per Gallon
Total Dissolved Solids	340	20
Magnesium + Calcium Content	170	10

Table 11, Maximum Mineral Concentration in Water

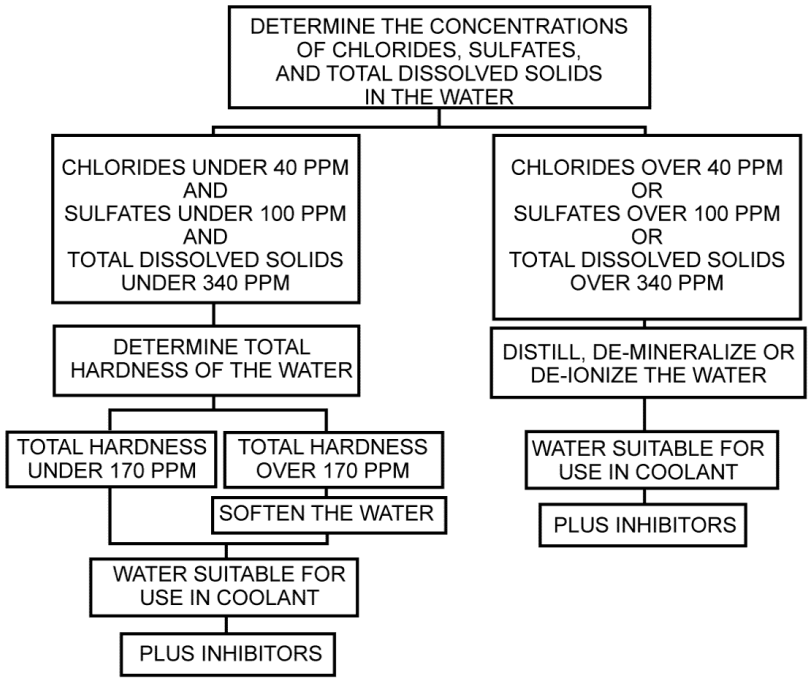


Fig 17, Procedure To Evaluate The Quality Of Water

Recycled Antifreeze

Antifreeze coolant made with ethylene or propylene glycol recycled by reverse osmosis, distillation, and ion exchange and properly re-inhibited to meet ASTM D6471 or D6472 requirements has been demonstrated to provide service equivalent to virgin antifreeze. Recycled antifreeze coolants of these types are preferred. However, suppliers of these recycled glycols must provide evidence the product is free of contaminates listed below:

- Acetates
- Acetone
- Ammonia
- Boron
- Ethanol
- Formates
- Glycolates
- Ketones
- Nitrate

- Nitrite
- Phenols
- Phosphorus
- Silicon
- Toluene

Other recycled coolants, especially coolants recycled through filtration processes, are **not recommended**.

15.01.13 Appendix C - Detroit™ Cooling System Maintenance Products

Appendix C - Detroit™ Cooling System Maintenance Products

Coolant Type	Part Number	Description
Concentrate	OWI 23539616	One Gallon Jug - 4 Per Case (Canada)
	OWI 23519397	One Gallon Jug- 6 Per Case
	OWI 23519394	55-Gallon Drum
Pre-Diluted (50:50)	OWI 2359617	One Gallon Jug - 4 Per Case (Canada)
	OWI 23519396	One Gallon Jug - 6 Per Case
	OWI 23519398	55-Gallon Drum
	OWI 2359084	275-Gallon Tote (Canada)

Table 12, Detroit™ Extended Life Coolant (Ethylene Glycol-based)

Coolant Type	Part Number	Description
IEG Detroit™ Genuine Coolant; Series 50 and Series 60	OWI 23519400	One Quart Bottle - 6 Per Case

Table 13, Detroit Genuine Coolant Plus Extender (for use with Detroit Genuine Coolant Plus)

Coolant Type	Part Number	Description
Concentrate	OWI 23539622	One Gallon Jug - 4 Per Case (Canada)
	OWI 23512138	One Gallon Jug - 6 Per Case
	OWI 23512139	55-Gallon Drum
	OWI 23513503	Bulk Delivery - 1000 Gallon min.
Pre-Diluted (50:50)	OWI 23539623	One Gallon Jug - 4 Per Case (Canada)
	OWI 23528203	One Gallon Jug - 6 Per Case

Table 19, Detroit™ Standard Life Coolant (Ethylene Glycol-based)

Coolant Type	Part Number	Description
	OWI 23518918	55-Gallon Drum
	OWI 23538603	275-Gallon Tote

Table 14, Detroit™ Standard Life Coolant (Ethylene Glycol-based)

Coolant Type	Part Number	Description
IEG Detroit™ Genuine Coolant	PIC 23507858	Pint Bottle - 12 Per Case
	PIC 23507860	5-Gallon Pail
	PIC 23507861	55-Gallon Drum

Table 15, Detroit™ Genuine Coolant 2000 Supplemental Coolant Additives (SCA)

Coolant Type	Part Number	Description
IEG Detroit™ Genuine Coolant	PIC 23507854	Pint Bottle - 12 Per Case
	PIC 23507855	Half Gallon Jugs - 6 Per Case
	PIC 23507856	5-Gallon Pail
	PIC 23507857	55-Gallon Drum

Table 16, Detroit™ Genuine Coolant 3000 SCAs

Coolant Type	Part Number	Description
IEG Detroit™ Genuine Coolant	23507545	4 Ounce (1 Pint Equivalent)
	23508425	8 Ounce (2 Pint Equivalent)
	23508426	12 Ounce (3 Pint Equivalent)
	23507189	16 Ounce (4 Pint Equivalent)
	23508427	32 Ounce (8 Pint Equivalent)
	23508428	53 Ounce (13 Pint Equivalent)

Table 17, Detroit Genuine Coolant 3000 SCA Filters (Series 50 and Series 60 Engines Only)

Coolant Type	Part Number	Description
All Types	PIC 201549	Twin pack - 2 Per Case
Standard Life Coolant Only	PIC 200164	One-Half Gallon Jug - 6 Per Case
	PIC 200105	5-Gallon Pail
	PIC 200155	55-Gallon Drum

Table 18, Detroit Genuine Coolant Cooling System Cleaners

Coolant Type	Part Number	Description
Standard Life Coolant	DDE 23516921	U.S. SLC Test Kit
Extended Life Coolant	DDE 23539088	U.S. ELC Test Kit

Table 19, Detroit Genuine Fluid Analysis Products

15.01.14 Checking the Hoses

Check the hoses as follows:

1. Inspect the cooling system hoses and replace any hose that shows obvious signs of damage or feels abnormally soft or hard.
2. Replace damaged clamps.
3. Correct all external leaks as soon as detected.
4. Check coolant inhibitor levels at the intervals listed in this manual.

   Current engine designs no longer use coolant filters. If you have a coolant filter, you may choose to remove the filter at your next maintenance interval. For more details reference bulletin 15TS-10Rev.

15.01.15 How to Service the Dry Type Air Cleaner

Maintain the air cleaner as follows:

1. Replace dry type air cleaner elements when the maximum allowable air cleaner restriction has been reached. Air cleaners are equipped with a restriction indicator which aids in determining the servicing interval.
2. Do not clean and/or reuse a dry paper-type air cleaner.

16. Detroit Genuine Coolanat Engine Products

16.01 Detroit Genuine Coolant Engine Products

Maintenance of the cooling system requires the chemical makeup of the system to be balanced.

Detroit Genuine Fully Formulated Inhibited Ethylene Glycol Coolants

The part numbers and sizes of concentrated and pre-blended 50:50 Detroit Genuine Coolants are listed in the following Tables.

Coolant Type	Part Number	Description
Concentrated	23512138	One Gallon Jug – 6 Per Case
	23512139	55 Gallon Drum
	23529295	330 Gallon Tote
	23512140	Bulk Delivery – 1,000 Gallon Min.
Pre-blended 50:50	23528203	One Gallon Jug – 6 Per Case
	23518918	55 Gallon Drum
	23528544	330 Gallon Tote
	23513503	Bulk Delivery – 1,000 Gallon Min.

Detroit Genuine Supplemental Coolant Additive Need Release Filters

Detroit Genuine Supplemental Coolant Additive Need Release Filters are shown below.

Coolant Type	Part Number	Description
Detroit Genuine Inhibited Ethylene Glycol Coolant	NF2091	For 0 – 8 Gallon Systems
	23516489	For 8 – 20 Gallon Systems

Detroit Genuine Cooling System Cleaners

Detroit Genuine Cooling System Cleaners are shown below.

Coolant Type	Part Number	Description
On-Line Cleaner	200164	One-Half Gallon Jug – 6 Per Case
	200105	5 Gallon Pail
	200155	55 Gallon Drum
Twin Pack	201549	Twin Pack – 2 Per Case

Detroit Genuine Fluid Analysis Products

Detroit Genuine Fluid Analysis Products are shown below.

Application	Part Number	Description
Indicates Nitrite, Molybdate & Glycol Levels	23519401	3-Way Coolant Test Strips (Single Foil Packs)
Indicates Nitrite, Molybdate & Glycol Levels	23519402	3-Way Coolant Test Strips (Bottle of 50)
Indicates Nitrite, Molybdate & Glycol Levels	23522774	3-Way Coolant Test Strips (Bottle of 10)
Complete Inhibited Ethylene Glycol Coolant Analysis	23516921	Coolant Analysis Bottle (Carton of 6)
Organic Coolant Analysis	23539088	Laboratory Coolant Analysis

17. Engine Oil Capacities

17.01 Engine Oil Capacities

The engine oil capacities for the MBE900 engines are listed in Table 29,Lubricating Oil Capacity.

NOTICE:

Do not add oil if the oil reading is in the normal operating range on the dipstick. There are approximately 4.0 L (4.2 qt.) from the "add" mark to the "full" mark. Overfilling the engine can cause engine damage.

Description	4-Cylinder Engines	6-Cylinder Engines
Oil Fill Capacity[1]	16.0 L (16.9 qt)	29.0 L (30.6 qt)

CONTACT INFORMATION

For questions, please create a Service Technical Request using the DTTS Application on the DTNA Portal.

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