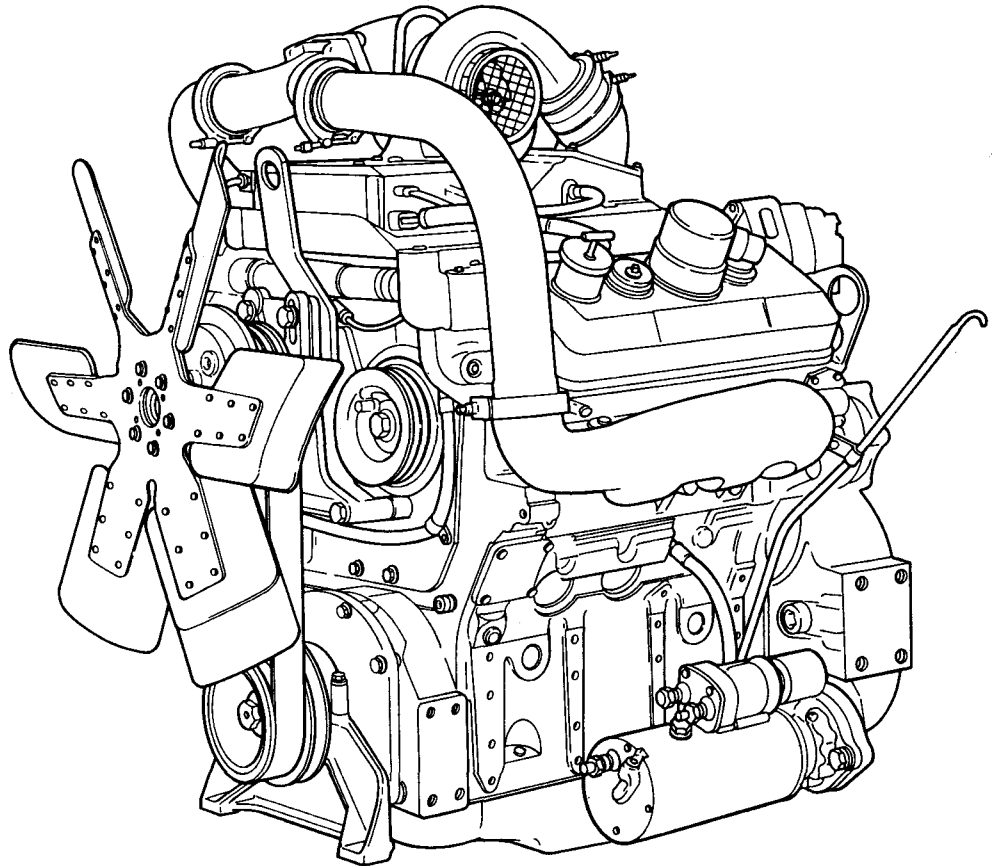


DETROIT DIESEL

Series 92



Engine Operator's Guide

To The Operator

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, etc. on the engine installation.

This guide contains instructions on the safe operation and preventive maintenance of your Detroit Diesel engine. Maintenance instructions cover routine engine services such as lube 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.

Throughout this guide CAUTIONS regarding personal safety and NOTICES regarding engine perfor-

mance or service life will appear. To avoid personal injury and insure long engine service life, always heed these instructions.

Whenever possible, it will benefit you to rely on an authorized Detroit Diesel service outlet for all your service needs from maintenance to major parts replacement. Authorized service outlets worldwide stock factory original parts and have the specialized equipment and experienced, trained personnel to provide prompt preventive maintenance and skilled engine repairs.

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 Diesel service outlet for information on the latest revision. The right is reserved to make changes at any time without obligation.

WARRANTY

The applicable engine warranty is contained in the booklet entitled "Warranty Information on Detroit Diesel Engines," available from authorized Detroit Diesel service outlets.

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

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ENGINE MODEL AND SERIAL NUMBER DESIGNATION

The engine serial number and model number are stamped on the cylinder block in the following locations (as viewed from the flywheel end):

5V, 8V-92 Right side, upper front corner



12V, 16V-92 Right side, upper rear corner

Option Labels

Computerized paper laminate engine option labels are attached to the valve rocker covers. These labels contain the engine serial number and model number and, in addition, list any optional equipment used on the engine. Labels also include required tune-up information (injector timing, valve lash, max. no-load RPM, etc.).

With any order for parts, the engine model and serial number must be given. If a type number is shown on the option label covering the equipment required, this number should also be included on the parts order.


Marine gears, transmissions, and power take-offs generally carry their own name plates. The model and serial number information on these plates is useful when ordering parts for these assemblies.


0315 CYL BLOCK	0161 AIR BOX DRAIN	THIS ENGINE DESIGNED TO OPERATE AT 0450 HP AT 02100 RPM INJ. TIMING 1.520 VALVE LASH .016 STARTING AID .000 THRTOLY/FMOD .000 MAX RPM NL 02225 STDGT DDEC CAM SPEC 7606 7057	DETROIT DIESEL <small>CORPORATION</small> 	L11029
0137 CYL HEAD	0242 ENG LIFT BKT			
0618 F/W HOUSING	0112 VIB DAMPER			
0848 FLYWHEEL	0431 CONN ROD/PSTN			
0810 OIL PAN	0186 OIL PUMP			
0028 OIL PRESS REG	0203 OIL DIST			
1233 OIL COOLER	1028 DIPSTICK			
0595 OIL FILTER	0752 VENT SYSTEM			
0048 BAL WT COVER	1690 FAN			
UNIT 08VF144123 S.O.	1A17215 MODEL 80877845			
0378 C/S PULLEY	0212 C/S PUL BELT	0272 WATER PUMP 0462 EXH MFLD 0578 BLOWER 0643 FUEL FILTER 0197 INJ CONT ELEC 0780 CAM/GR TRAIN 0125 OIL FIL CAP 2156 BATT CHRG GEN	DETROIT DIESEL <small>CORPORATION</small> 	L11029
0411 WAT BY PASS	0390 THERMOSTAT			
0177 FUEL PUMP	0324 INJECTOR			
1303 TURBOCHARGER	0068 FUEL MFLD CON			
1798 FUEL LINES	0747 AIR INLT HSG			
0648 ENGINE MOUNTS	1252 AIR COMP			
0386 VALVE MECH	0357 ROCKER COVER			
0727 VENT SYSTEM	0180 ACC DRIVE			
0340 STARTING MTR	0535 TACH DRIVE			
UNIT 08VF144123 S.O.	1A17215 MODEL 80877845			

Typical 8V-92 On-Highway Truck Engine Option Labels

Certification Labels

If required, a certification label is attached to one of the valve rocker covers. This paper laminate label certifies that the engine conforms to federal and certain state emissions regulations for its particular application. It also gives the operating conditions under which certification was made.

IMPORTANT ENGINE INFORMATION		DETROIT DIESEL CORPORATION 
1991 FED	THIS ENGINE CONFORMS TO U.S. EPA REGULATIONS APPLICABLE TO 1991 MODEL YEAR NEW HEAVY DUTY DIESEL ENGINES. THIS ENGINE HAS A PRIMARY INTENDED SERVICE APPLICATION AS A HEAVY HEAVY DUTY ENGINE.	
FUEL RATE AT ADV. HP 104.7 MM3/STROKE ADV. HP 500 AT 2100 RPM		
INITIAL INJECTION TIMING 13 DEG. BTC CID 736		
ENGINE FAMILY MDD0736FZH2 MIN. IDLE 600 RPM		FEL BSP 0.37
MODEL 8V 92TA DDEC MFG. DATE JAN 1991		L11029
UNIT 08VF144123		

THIS ENGINE IS NOT CERTIFIED FOR USE IN AN URBAN BUS AS DEFINED AT 40 CFR 86.091 2. SALE OF THIS ENGINE FOR USE IN AN URBAN BUS IS A VIOLATION OF FEDERAL LAW UNDER THE CLEAN AIR ACT.	DETROIT DIESEL CORPORATION 
UNIT 08VF144123	L11029

Typical 8V-92 On-Highway Truck Certification Labels

OPERATING INSTRUCTIONS

Preparations for Starting the Engine the First Time

When preparing to start a new or newly overhauled engine or an engine which has been in storage, perform all of the operations listed below. Failure to follow these instructions may result in serious engine damage. Before a routine start, see "Daily" checks in the Lubrication and Preventive Maintenance chart (pages 17-18).

CAUTION: When working near the engine, always remove loose items of clothing or jewelry that could get caught in a moving part of the engine and cause personal injury. Safety glasses and hearing protection must also be worn.

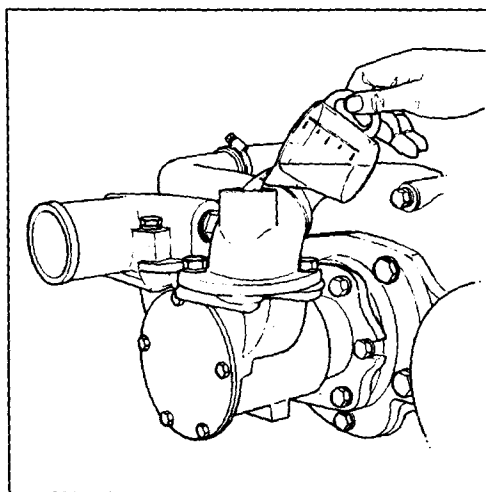
Cooling System Checks

1. Make sure all the drain cocks in the cooling system are installed (drain cocks are often removed for shipping) and are closed tightly.
2. Open the petcock near the top of the turbocharger (if used), and any other petcocks, if so equipped.
3. Remove the radiator or heat exchanger pressure control cap and fill with an ethylene glycol-base antifreeze solution in the required concentration. In extremely hot environments, clean, soft, **properly inhibited** water may be used in the summer. Keep the coolant level at the bottom of the filler neck to allow for

expansion of the coolant. For more detailed coolant recommendations, refer to **How to Select Coolant** (page 39).

4. After filling the cooling system, close all petcocks.
5. Entrapped air must be purged after filling the cooling system. To do this, allow the engine to warm-up with the pressure cap off. With the transmission or marine gear in neutral, increase engine speed above 1000 RPM and add coolant as required. Vent the petcock on the water return line at the water-jacketed turbocharger periodically. Install the pressure cap after the coolant level has stabilized at the bottom of the radiator or heat exchanger tank filler neck.
6. On industrial and off-highway units, check to make sure the front of the radiator is unblocked and free of debris.
7. On marine units, perform these additional steps:
 - Check sea water strainers and remove any accumulations of seaweed or debris. Strainers act as filters between the intake through-hull fittings and the raw water pump(s) and are easily fouled. Make sure all thru-hull valves, other valves in the cooling system, and raw water sea lines are open.
 - Remove the cover from the raw water pump. Visually inspect the impeller for signs of damaged or broken vanes. Replace the impeller if damaged. Reinstall the cover.

- Before starting the engine, prime the raw water pump by removing the pipe plug or zinc provided in the pump outlet elbow and pouring at least a pint of water into the pump. Reinstall the plug or zinc.



Prime the Raw Water Pump (Marine Engines)

NOTICE: Failure to prime the raw water pump may result in damage to the pump impeller and engine overheating.

Lubricating System Checks

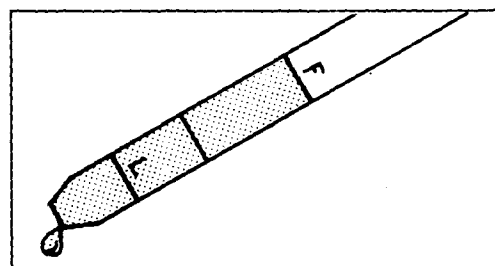
The lubricating oil film on the rotating parts and bearings of a new or newly overhauled engine, or one which has been in storage for six months or more, may be insufficient when the engine is started for the first time. Insufficient lubrication at start-up can cause serious damage to engine components.

To insure an immediate flow of oil on all bearing surfaces at initial engine start-up, the engine lubrication system should be charged with a commercially available pressure pre-lubricator. If this is impractical, rocker

covers should be removed and clear lubricating oil should be poured over the rocker arms. The oil should be the same weight and viscosity as that used in the crankcase. After pre-lubricating, add additional oil to bring the level to the proper mark on the dipstick. Refer to **How to Select Lubricating Oil** (page 29) for lubricant recommendation.

Make sure the transmission or marine gear is filled to the proper level with the fluid recommended by the gear manufacturer.

Fuel System Checks



Check Lube Oil Level Before Starting

Fill the tank 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 chances for microbe (black slime) growth. Refer to **How to Select Fuel Oil** (page 33) for fuel recommendation. Make sure fuel supply shutoff valves (if used) are open.

To insure prompt starting and even running, the fuel system must be primed if air has entered the fuel system. Priming is done by connecting a manual or electric priming pump to the secondary fuel filter. Authorized Detroit Diesel service outlets are properly equipped to perform this service.

Priming is not normally necessary if the filter elements are filled with fuel when installed and the manifolds are not drained of fuel.

NOTICE: Prolonged use of the starting motor and engine fuel pump to prime the fuel system can result in damage to the starter, fuel pump, and injectors, and cause erratic engine operation due to the amount of air in the lines and filters from the supply tank to the cylinder head.

Engines equipped with starting devices dependent on compressed air or gas reservoirs should always be primed before initial startup. Otherwise, reserve pressure can be exhausted and injectors may be damaged from lack of lubrication and cooling.

Under no circumstances should a starting aid such as ether be used to run the engine until the fuel system is primed. **Injector damage will occur if this method is used.** The heat generated by the external fuel source will cause the injector tips to be damaged when the fuel cools them. The plunger and bushing can be scored from running without lubrication.

If the engine is equipped with a fuel/water separator, drain off any water that has accumulated. Water in fuel can seriously affect engine performance and may cause engine damage. DDC recommends installation of a fuel/water separator on marine units and wherever water contamination is a concern.

Other Checks

Check drive belts to make sure they are in good condition (not cracked, torn, worn, or glazed) and are properly adjusted.

Make sure cable connections to the storage batteries are clean and tight and battery electrolyte level is normal.

Check turbocharger(s) for signs of oil, coolant, or exhaust leaks. Leaks should be corrected before starting the engine. Check engine mounting bolts for tightness. Retighten, if necessary.

Starting the Engine

Before starting the engine the first time, perform the operations listed under **Preparations for Starting the Engine the First Time** (pages 3-4).

If the engine has an emergency manual or automatic shutdown system, make sure the control is set in the *open* position before starting. The blower and turbocharger may be seriously damaged if the engine is cranked with the air shutdown in the *closed* position. On units with dual air shutdown housings, both shutdown valves must be in the *open* position before starting the engine.

If the unit is located in a closed room, start the room ventilating fan or open the windows, as weather conditions permit, so ample air is available for the engine.

The engine may require the use of a cold weather starting aid if the ambient temperature is below 40°F (4°C).

CAUTION: Starting fluid used in capsules is highly flammable, toxic, and possesses sleep-inducing properties.

Initial Engine Start

1. Position the transmission or marine gear in park or neutral.
2. Set the speed control lever at part throttle, then bring it back to the desired no-load speed. In addition, make sure the stop lever on the cover of mechanical governors is in the **run** position.
3. Start DDEC-equipped vehicles with foot *off* the foot pedal.

Electric Starter- Start an engine equipped with an electric starting motor as follows:

1. Press the starter switch firmly.

NOTICE: To prevent serious starting motor damage, do not press the starter switch again after the engine has started.

2. If the engine fails to start within 30 seconds, release the starter switch and allow the starting motor to cool a few minutes before trying again. If the engine fails to start after four attempts, an inspection should be made to determine the cause.

Air Starter- Because of the limited volume of most storage tanks and the relatively short duration of the cranking cycle, it is important to make sure the engine is **ready to start** before activating the air starter. Start an engine equipped with an air starter as follows:

1. Check the pressure in the air storage tank. If necessary, add air to bring the pressure up to at least the recommended minimum for starting.
2. Press the starter button firmly and hold until the engine starts.

Starting tip: Some white smoke is normal at start-up when the engine is cold and will clear up shortly after the engine warms. However, if you experience excessive smoke at cold start-up, depress the stop button or cable at the same time you press the starter button and crank the engine for a few seconds. Release the stop button or cable and continue to crank the engine until it starts (but not longer than 30 seconds). This will preheat the cylinders and reduce white smoke at start-up.

Running the Engine

Oil Pressure

Observe the oil pressure gauge immediately after starting the engine. A good indicator that all of the moving parts are getting lubrication is when the oil pressure gauge registers pressure (5 psi - 34.5 kPa at idle speed). If there is no oil pressure indicated within 10 to 15 seconds, stop the engine and check the lubricating system. The pressure should not fall below 28 psi (193 kPa) at 1800 rpm, and normal operating pressure should be higher. If pressure fails to fall within these guidelines, it should be checked with a manual gauge.

CAUTION: To avoid personal injury from the hot oil, do not operate a Series 92 engine with rocker covers removed for any reason.

Warm-up

Run the engine at part throttle for about five (5) minutes to allow it to warm up before applying a load.

Inspection

While the engine is idling, check the transmission or marine gear for proper oil level and add oil as required. On marine units check to make sure that water is flowing out the exhaust pipe or raw water discharge pipe. Look for coolant, fuel, or lubricating oil leaks at this time. If any are found, shut down the engine immediately and have leaks repaired after the engine has cooled.

Crankcase- If the engine oil was replaced, stop the engine after normal operating temperature has been reached. Allow the oil to drain back into the crankcase for approximately twenty (20) minutes, and check the oil level. If necessary, add oil to bring the level to the proper mark on the dipstick. Use only the heavy-duty oils recommended in **How to Select Lubricating Oil** (page 29) in this guide.

Turbocharger- Make a visual inspection of the turbocharger for oil leaks, coolant leaks, exhaust leaks, excessive noise or vibration. Stop the engine immediately if a leak or unusual noise or vibration is noted. **Do not restart the engine until the cause of the concern has been investigated and corrected.** Authorized Detroit Diesel service outlets are properly equipped to perform this service.

Transmission, Marine Gear- Check transmission or marine gear oil level. Add recommended oil as required.

Avoid Unnecessary Idling

During long engine idling periods with the transmission or marine gear in neutral, the engine coolant temperature may fall below the normal operating range. The incomplete combustion of fuel in a cold engine will cause crankcase dilution, formation of lacquer or gummy deposits on the valves, pistons, and rings, and rapid accumulation of sludge in the engine. When prolonged idling is necessary, maintain at least 800-1000 rpm. On coach engines equipped with Delco 50 DN alterna-

tors, the optimum low idle speed settings with full accessory load and the transmission in neutral are as follows:

6V-92 DDEC II—600-700 rpm
6V-92 — 650 rpm
8V-92 with Mech.
Unit Inj. — 550 rpm
8V-92 DDEC II — 600 rpm

Stopping the Engine

Normal Stopping

1. Decrease engine speed back to normal idle and put all shift levers in the neutral position.
2. Allow the engine to run between idle and 1000 rpm with no load for four (4) or five (5) minutes. This allows the engine to cool and permits the turbocharger(s) to slow down. After four or five minutes, shut down the engine.

NOTICE: Stopping a turbocharged engine immediately after high speed operation may cause damage to the turbocharger as it will continue to turn without an oil supply.

Emergency Stopping

The emergency shutdown should be used only when the engine does not respond to the normal stop engine procedure. To shut down the engine, simply activate the emergency shutdown control. This is an electrical switch or mechanical lever which is normally identified as such on the control panel.

NOTICE: Never use the emergency shutdown system, except in an emergency. Use of the emergency shutdown can cause lubricating oil to be sucked past the oil seals and into the blower housing and may also cause turbocharger damage.

The air shutdown, located in the air inlet housing, must be reset by hand and the **"emergency stop"** knob pushed in before the engine is ready to start again.

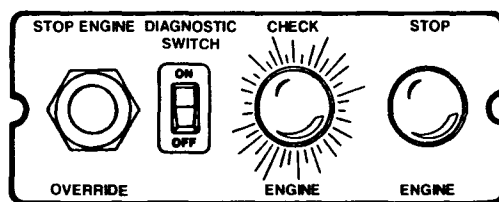
DDEC OPTIONS

Engines having the Detroit Diesel Electronic Control (DDEC) can be equipped with a variety of options designed to warn the operator of an engine malfunction. The options can range from "Check Engine" and "Stop Engine" panel lights to automatic reduction in engine power followed by automatic engine shutdown. The power-down/shut-down option may be activated by low coolant level, low oil pressure or high engine oil or coolant temperature.

To start a DDEC engine be sure the transmission is in neutral or park, turn the ignition key on and, with foot OFF the foot pedal, start the engine.

You will notice that both the "Check Engine" and "Stop Engine" lights will come on. This is the result of the DDEC computer diagnosing the system to ensure everything is functional, including the light bulbs for the "Check Engine" and "Stop Engine" warning lights. If everything is okay, both lights will go out in approximately five seconds. Start the engine *after* the lights go out.

NOTICE: If the warning lights stay on, or if they do not come on momentarily after starting the engine, consult with a DDEC technician. Operating the engine under these circumstances may result in engine damage.



Typical Shut-Down Override Switch and Engine Lights

The DDEC engine is equipped with an electronically controlled fuel injection system. There are no control racks or mechanical linkage to adjust. This system not only helps to improve fuel economy and vehicle performance, it also helps to reduce cold starting time and increase initial idle speed for fast engine warm-up and virtual elimination of cold smoke.

The DDEC engine has no mechanical governor. Engine horsepower, torque, idle, and engine speed are contained in the internal electronics. Therefore, there are no mechanical governor spring adjustments for idle and high speed control.

There is no need for a throttle delay either, since emission control is performed through the Electronic Control Module or ECM.

When DDEC is used, the electronic foot pedal assembly, or EFPA, eliminates the need for any throttle linkage and, as a result, there is no linkage to go out of adjustment.

DDEC engines have the ability to perform diagnostics for self-checks and continuous monitoring of other system components. Depending on the application, DDEC can also monitor oil temperature, coolant temperature, oil pressure, coolant level, and remote sensors (if used). This diagnostic system is connected to the "Check Engine" and "Stop Engine" lights to provide a visual warning of a system malfunction.

The DDEC engine can be equipped with an engine protection system that 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 temperature, or low coolant level.

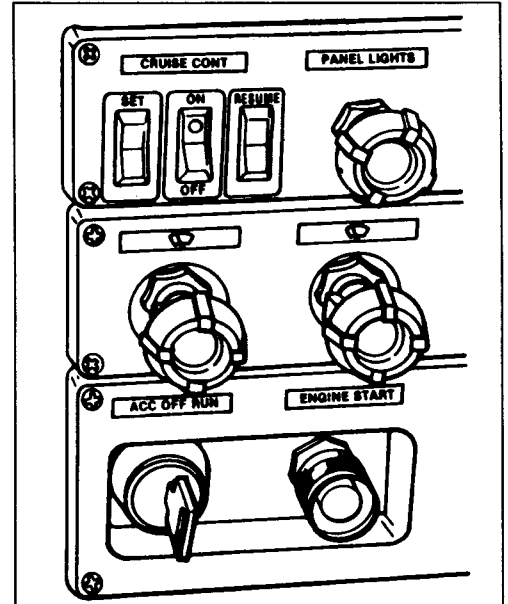
NOTICE: If the engine is equipped with the power-down/shutdown option, there will be a system override button or switch which may be used to allow engine operation for a short period of time. This will allow the operator to move the vehicle to a safe location. If the shutdown override button is not used, the shutdown will occur in 30 seconds.

DDEC engines may also have an optional 3-100 minute idle shutdown system. The purpose of this system is to conserve fuel by eliminating excessive idling and to allow for a turbocharger cool down period. To activate the shutdown the transmission must be in neutral, with the engine in idle or PTO mode and the parking brake on.

Cruise Control

A DDEC-equipped engine may have cruise control. Cruise control is available at either a road speed or engine speed setting. The driver has switches to activate and deactivate the system, and a slight depression of the brake or clutch pedal deactivates the system as well. The minimum speed at which cruise control can be used is 35 mph and 1200 rpm.

The cruise control may also be programmed to permit fast idle using the cruise control switches. With the engine at normal idle, transmission in neutral and service brake on, turn on the cruise control "on/off" switch, and use the "set" switch. The engine rpm should increase to a pre-defined rpm. The rpm can be raised or lowered from this point using the "set" and "resume" switches.



Typical Cruise Control Switches

The cruise control option will maintain the set speed under normal road and load conditions. It cannot limit vehicle speeds on down grades if available engine braking effort is exceeded, nor can it maintain speed on upgrades if power requirements exceed engine power capability.

CAUTION: To avoid the possibility of vehicle damage and/or personal injury, DDC does not recommend using cruise control under the following 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).

On engines equipped with Jacobs Engine Brakes, the "Jake Brake" circuit can be activated by releasing the EFPA completely to the idle position. The "Jake Brake" will then operate the same as on engines with mechanical governors. To return the vehicle to cruise speed after brake or clutch application, simply activate the "Resume" switch. Each subsequent touch of the "Resume" switch will increase cruise speed by 1 mile (1.6 km) per hour.

DDEC Operation

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.

At reduced voltage, the electronic control system will detect a malfunction. When this occurs the "Check Engine" light will come on.

At this point, the Electronic Control Module will go into "Back Up Control." You should then notice a change in engine operation, and at this time certain DDEC options, such as cruise control, smoke control, and automatic shutdown, will not function.

The engine will operate only at reduced rpm. You will be able to operate the vehicle at reduced voltage until the battery voltage has reached a point where it will no longer function and the engine will shut down.

You can still operate the vehicle and proceed to your designation when the "Check Engine" light comes on. However, a report should be made to a DDEC technician as soon as possible.

NOTICE: When the "Stop Engine" light comes on, the computer has detected a major malfunction in the engine that requires immediate attention. It is the operator's responsibility to safely pull the vehicle off the road as quickly as possible and shut down the engine to avoid serious damage.

Since many trucks are equipped with the DDEC engine protection system, the "Stop Engine" malfunction is recorded in the Electronic Control Module. With the 30 second shutdown option, the engine will begin a 30 second, stepped, power down sequence until it shuts down completely.

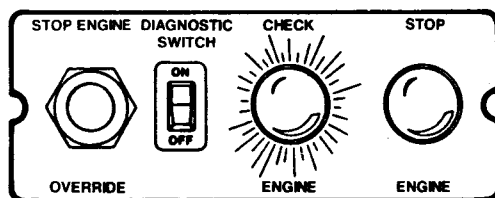
To allow for the possibility of the "Stop Engine" automatic shutdown function being activated while the vehicle is operating in a critical situation, an override is provided.

In this situation the operator may elect to "override" the automatic stop engine sequence by pressing the "Stop Engine Override" switch, located on the instrument panel, until a safe stop can be made. The operator only needs to press the override switch every 15 to 20 seconds to prevent engine shutdown from occurring.

NOTICE: For some applications, holding the "Stop Engine Override" switch in 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.

An important thing to remember is that 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 safe stop.

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



Typical Shut-Down Override Switch and Engine Lights

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.

The conditions that will cause the "Stop Engine" light to come on are:

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

It is important to point out that whenever the "Check Engine" light or the "Stop Engine" light comes on, the DDEC computer will determine where the problem is, and will then store this information in its memory.

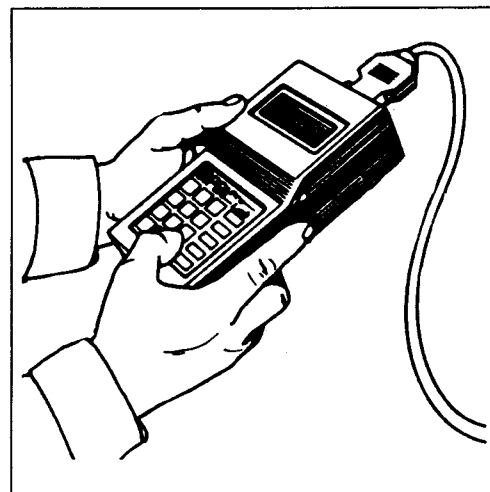
If the malfunction is intermittent, the "Lights" will come on and go off

as the computer senses the changing engine condition.

A special diagnostic tool is available that can be plugged into the engine computer memory to extract information related to the cause of the problem.

Once the malfunction has been corrected, the DDEC system will return the engine to normal operation.

The malfunction code recorded in the computer memory will remain until it is erased by a technician.

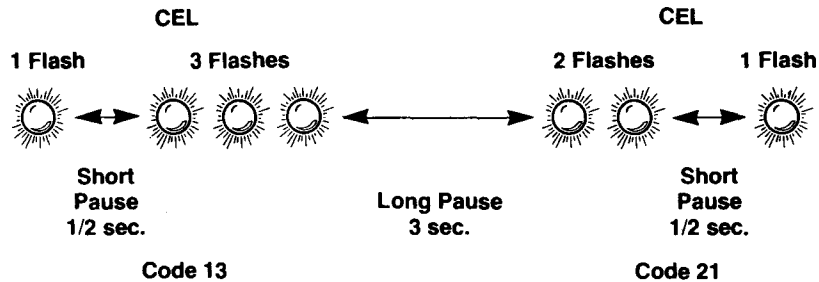


Diagnostic Data Reader J38500

The malfunction code can also be obtained by the operator. A "Diagnostic Request" switch may be provided which, when pressed, will cause the "Check Engine" light (or CEL) to flash a code number. It will, for example, flash twice...pause...flash five times...pause. In other words a code 25.

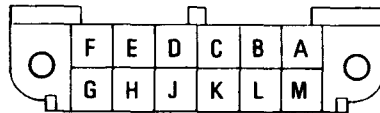
Code 25 indicates all systems are O.K.

CEL EXAMPLES



Diagnostic Codes (NON-MARINE ENGINES)

Diagnostic Connector



TO READ CODES: Use diagnostic data reader or short pin A to pin M. The latter method will flash codes at the CEL.

Error

Code

Description

11	Power Take-off Sensor Lo Volt
12	Power Take-off Sensor Hi Volt
13	Coolant Sensor Lo Volt
14	Eng Temp Sensor Hi Volt
15	Eng Temp Sensor Lo Volt
16	Coolant Sensor Hi Volt
21	Throttle Pos Sensor Hi Volt
22	Throttle Pos Sensor Lo Volt
23	Fuel Temp Sensor Hi Volt
24	Fuel Temp Sensor Lo Volt
25	No Codes
26	Power Control Enabled
31	Fault on Auxiliary Output
32	ECM Backup System Fail
33	Turbo Bst Sensor Hi Volt
34	Turbo Bst Sensor Lo Volt
35	Oil Prs Sensor Hi Volt
36	Oil Prs Sensor Lo Volt
37	Fuel Prs Sensor Hi Volt
38	Fuel Prs Sensor Lo Volt
41	Timing Reference Sensor
42	Synchronous Ref Sensor

Error

Code

Description

43	Low Coolant Level
44	Engine Overtemperature
45	Low Oil Pressure
46	Low Battery Voltage
47	Hi Fuel Pressure
48	Lo Fuel Pressure
51	EEPROM Error
52	ECM - A/D Fail
53	EEPROM Memory Fails
54	Vehicle Speed Sensor
55	Proprietary Comm. Link
56	ECM - A/D Fail
58	Cruise Ctl/Press Gov Ctl Switch
61-68	Inj Response Time Long
71-78	Inj Response Time Short
81	Crankcase Monitor - Hi Volt
82	Crankcase Monitor - Lo Volt
84	Crankcase Pressure Hi
85	Engine Overspeed
86	Press Gov Ctl - Hi Volt
87	Press Gov Ctl - Lo Volt

The codes will continue to flash and repeat as long as the check engine switch is held in the "On" position with the ignition on. Other diagnostic codes are shown in the charts.

CAUTION: If the vehicle is equipped with an OEM-supplied diagnostic switch, the switch must NOT be switched on when operating the vehicle. If this is done, the diagnostic mode line will be grounded, and the throttle will be forced to idle, affecting vehicle operation. The throttle will also go to idle if pins A and M in the Diagnostic Data Reader (DDR) connector are jumpered together. This condition will not occur when the Diagnostic Data Reader is used.

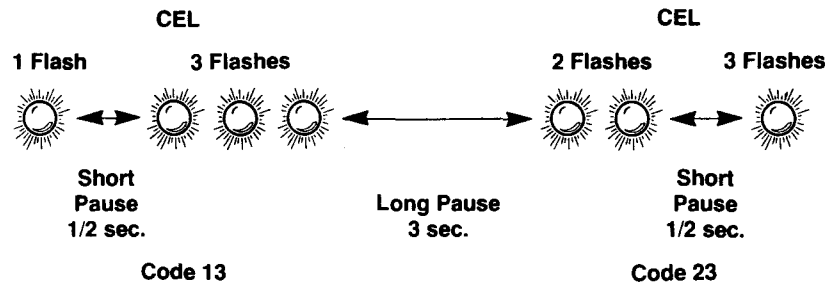
CAUTION: The driver or operator of a DDEC-equipped vehicle, vessel, or wheeled machine must not attempt to use or read a diagnostic data reader of any kind while the unit is operating. Doing so can result in loss of control, which may cause vehicle, vessel, or wheeled machine damage and may result in personal injury.

When engine or electronics system diagnosis is required on a DDEC-equipped vehicle, vessel, or wheeled machine, this must be done by a person other than the driver or operator. The operator must maintain control of the moving vehicle, vessel, or wheeled machine while the assistant performs the diagnosis.

CAUTION: The operator of a DDEC-equipped engine should know the extent of the warning system on his vehicle, vessel, or wheeled machine in order to bring it to a safe stop in the event of an engine malfunction. A description of the warning system and detailed instructions regarding its operation should be obtained from the owner, the seller or the manufacturer of the vehicle, vessel, or wheeled machine. This information may also be obtained at any authorized Detroit Diesel Corporation service outlet.

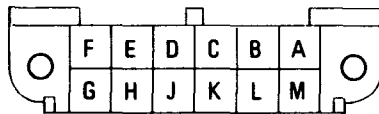
To be confronted with a power-down/shutdown situation without knowing how the system works could cause the vehicle, vessel, or wheeled machine to stop in an unsafe location, posing the possibility of damage to the vehicle and a threat to the safety of the operator.

CEL EXAMPLES



Marine Engine Diagnostic Codes

Diagnostic Connector



TO READ CODES: Use diagnostic data reader or short pin A to pin M. The latter method will flash codes at the CEL.

Error Code #	Description	Error Code #	Description
11	Hand Throttle Speed Adj Lo Volt	43	Low Coolant Level
12	Hand Throttle Speed Adj Hi Volt	44	Engine Overtemperature
13	Coolant Sensor Lo Volt	45	Low Oil Pressure
14	Eng Temp Sensor Hi Volt	46	Low Battery Voltage
15	Eng Temp Sensor Lo Volt	47	Hi Fuel Pressure
16	Coolant Sensor Hi Volt	48	Lo Fuel Pressure
23	Fuel Temp Sensor Hi Volt	51	ECM Calibration Memory Failure
24	Fuel Temp Sensor Lo Volt	52	ECM A/D Fail
25	No Codes	53	ECM Nonvolatile Memory Failure
26	External Warning Switch Enabled	54	Tach Sync Circuit Fault
31	Fault on ECM Output	55	Proprietary Data Link Circuit Fault
32	ECM Circuit Fail	56	ECM A/D Fail
33	Turbo Bst Sensor Hi Volt	57	To Be Determined
34	Turbo Bst Sensor Lo Volt	58	Auxiliary Switch Circuit Fail
35	Oil Prs Sensor Hi Volt	6X	Inj Response Time Long
36	Oil Prs Sensor Lo Volt	7X	Inj Response Time Short
37	Fuel Prs Sensor Hi Volt	81	Crankcase Monitor - Hi Volt
38	Fuel Prs Sensor Lo Volt	82	Crankcase Monitor - Lo Volt
41	Timing Reference Sensor	83	Reserved—Sensor Under Devel
42	Synchronous Ref Sensor	84	Crankcase Pressure Hi
		85	Engine Speed
		88	Reserved—Sensor Under Devel

ENGINE SYSTEMS

Fuel System

The fuel system consists of the fuel injectors, fuel pipes, fuel manifolds (integral with the cylinder head), fuel pump, fuel strainer, fuel filter, and the necessary connecting fuel lines.

The primary filter (marked "P") or combination filter and fuel/water separator removes large impurities from the fuel. The secondary filter (marked "S") removes the smaller particles.

Lubrication System

The lubricating oil system consists of an oil pump, oil cooler, full flow oil filter(s), bypass valves at the oil cooler and filter(s), and pressure regulator valves at the lube oil pump and in the cylinder block main oil gallery.

Air System

In the air system used on Series 92 engines, outside air drawn into the engine passes through the air filter or air silencer and is pulled into the turbocharger, where it is compressed. It then moves through the blower, where it is further compressed. An intercooler before the blower or an aftercooler beneath the blower may be used to further increase the density of the charge. The air then flows into the cylinders, where it mixes with atomized fuel from the injectors.

Dry type air cleaners are used on the majority of Detroit Diesel engines. For optimum protection of the engine from dust and other airborne contaminants, service these air cleaners when the maximum allowable air restriction has been reached, or annually, whichever occurs first.

Cooling System

Radiator/fan cooling systems are used on engines in on-highway, off-highway, industrial, and generator set applications. Heat exchanger/raw water pump systems and keel cooling systems are used on marine engines. Each system has a centrifugal type fresh water pump to circulate coolant within the engine. Each system also incorporates thermostats to maintain normal engine operating temperature.

Electrical System

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

Exhaust System

Hot exhaust gas flowing from the exhaust manifold(s) into the exhaust riser(s) is used to drive the turbocharger(s).

ENGINE MAINTENANCE

DAILY		SERVICE RECOMMENDATIONS (VEHICLE ENGINES)											
Lubricating Oil (1)	(I)												
Fuel Tank (2)	(I)												
Fuel Lines and Flexible Hoses (3)	(I)												
Cooling System (4)	(I)												
Turbocharger, Exhaust Conns. (5)	(I)												
3000 MILE INTERVAL													
Battery* (6)	(I)												
6000 MILE INTERVAL													
Drive Belts* (8)	(I)												
Air Compressor (24)	(I)												
Throttle Controls (25)	(I)												
15,000 MILE INTERVAL													
Fuel Tank (2)	(I)												
Overspeed Governor (29)	(I)												
20,000 MILE INTERVAL													
Lubricating Oil* (1)	(R)												
Lubricating Oil Filter* (9)	(R)												
	MONTHS	6	12	18	24	30	36	42	48	54	60	120	
	MILES 1000	10	20	30	40	50	60	70	80	90	100	200	
Fuel Filter Strainer (10)	(R)	(R)	(R)	(R)	(R)	(R)	(R)	(R)	(R)	(R)	(R)		
Water Pump* (11)	(I)	(I)	(I)	(I)	(I)	(I)	(I)	(I)	(I)	(I)	(I)	(I)	
Fuel Tank* (2)		(I)		(I)		(I)		(I)		(I)			
Cooling System* (4)		(I)		(I)		(I)		(I)		(I)			
Air Compressor (24)		(I)		(I)		(I)		(I)		(I)			
Air System, Cleaners (7)		(I)		(I)		(I)		(I)		(I)			
Turbochargers, Exhaust Conns.* (5)		(I)		(I)		(I)		(I)		(I)			
Engine (Steam Clean)		(I)		(I)		(I)		(I)		(I)			
Radiator and Air-to-Air Intercooler (27)		(I)		(I)		(I)		(I)		(I)			
Oil Pressure (13)		(I)		(I)		(I)		(I)		(I)			
Battery Charging Alternator* (14)		(I)		(I)		(I)		(I)		(I)			
Thermostats and Seals (32)		(I)		(I)		(I)		(I)		(I)			
Engine and Transmission Mounts (15)						(I)							
Crankcase Pressure (16)						(I)							
Crankcase Breather (16)		(I)		(I)		(I)		(I)		(I)			
Blower Bypass Valve (21)											(I)		
Coolant Filter* (11)													
Fuel Lines, Flex Hoses* (3)		(I)		(I)		(I)		(I)		(R)			
Air Box Drain Tube* (26)			(I)			(I)				(I)			
Air Shutdown Valve (12)		(I)		(I)		(I)		(I)		(I)			
Shutter Operation (28)		(I)		(I)		(I)		(I)		(I)			
Throttle Delay/Fuel Modulator (30)						(I)					(I)		
Air Box Check Valves (26)											(I)		
Fan Hub* (31)		(I)		(I)		(I)		(I)		(I)			
Blower Screen (33)			(I)										
Engine Tune-Up* (17)		AS REQUIRED											
Codes													
*See Item in Text	(I) Inspect, Service, Correct, Replace (If Necessary)						(R) Replace						

ENGINE MAINTENANCE

DAILY		<div>SERVICE RECOMMENDATIONS (NON-VEHICLE ENGINES)</div>							
Lubricating Oil (1)	(I)								
Fuel Tank (2)	(I)								
Fuel Lines and Flexible Hoses (3)	(I)								
Cooling System (4)	(I)								
Turbocharger, Exhaust Conns.	(I)								
Air Cleaner (Oil Bath) (7)	(I)								
100 HOUR OR 3,000 MILES									
Battery* (6)	(I)								
150 HOUR OR 4,500 MILES									
Lubricating Oil* (1)	(R)								
Lubricating Oil Filter* (9)	(R)								
Drive Belts (Marine) (8)	(I)								
150 HOUR OR 5,000 MILES									
Air Compressor (24)	(I)								
200 HOUR OR 6,000 MILES									
Drive Belts* (8)	(I)								
Throttle Controls (25)	(I)								
600 HOURS OR 18,000 MILES									
Water Pump (11)*	(I)								
		MILES HOURS	9,000 300	15,000 500	20,000 700	30,000 1,000	60,000 2,000	100,000 3,000	200,000 6,000
Fuel Tank (2)				(I)	(I)				
Fuel Lines and Flexible Hoses (3)					(I)				
Cooling System (4)					(I)				
Drive Belts* (8)									
Air Compressor (24)					(I)				
Air Cleaner* (7)					(R)				
Fuel Filters (10)		(R)							
Water Pump, Seal* (11)									(R)
Tachometer Drive (23)								(I)	
Air System (7)					(I)				
Turbocharger, Exhaust Connections					(I)				
Engine (Steam Clean)					(I)				
Radiator and Air-to-Air Intercooler (27)					(I)				
Oil Pressure (13)					(I)				
Battery Charging Alternator* (14)					(I)				
Engine & Transmission Mounts (15)							(I)		
Fan Hub* (31)								(I)	
Thermostats & Seals* (32)									(I)
Crankcase Breather* (16)						(I)			
Crankcase Pressure* (16)						(I)			
Blower Screen (33)							(I)		
Blower Bypass Valve (21)								(I)	
Coolant Filter* (11)									
Fuel Lines and Flexible Hoses* (3)								(R)	
Air Box Drain Tube* (26)						(I)			
Air Shutdown Valve* (12)			(I)	(I)					
Governor, Overspeed Governor (29)			(I)						
Shutter Operation (28)				(I)					
Raw Water System Zincs									
Throttle Delay/Fuel Modulator* (30)									
Air Box Check Valves (26)								(I)	
Fan Hub* (31)				(I)					
Marine Gear*									
Engine Tune-Up* (17)									AS REQUIRED
		Codes							
*See Item in Text		(I) Inspect, Service, Correct, Replace (If Necessary)				(R) Replace			

LUBRICATION AND PREVENTIVE MAINTENANCE INTERVALS

The following is intended as a guide for establishing preventive maintenance intervals. The recommendations given should be followed as closely as possible to obtain long life and optimum performance from Series 92 engines. Intervals indicated on the chart are time (hours) of actual operation.

The intervals shown apply only to the maintenance functions described. These functions should be coordinated with other regularly scheduled maintenance.

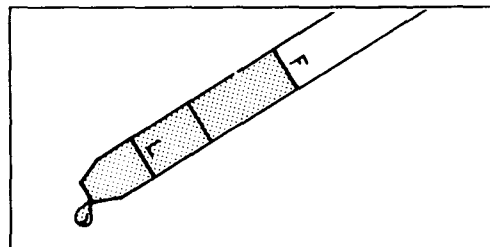
The "daily" instructions apply to routine or daily starting of an engine. They do not apply to a new engine or one that has not been operated for a considerable period of time. For new or stored engines, refer to the engine service manual (6SE379). Follow instructions given under **Preparations for Starting the Engine the First Time** (section 13.1).

Preventive maintenance other than the "daily" checks should be performed by authorized Detroit Diesel service outlets. These outlets have the trained personnel and special tools to properly perform all services.

Item 1 - Lubricating Oil

Check the oil level daily with the engine stopped. On coach engines equipped with running level dipsticks, this may be done with the engine at idle and at operating temperature. If necessary, add sufficient oil to raise the level to the proper mark on the dipstick. All diesel engines are designed to use some

oil, so the periodic addition of oil is normal.



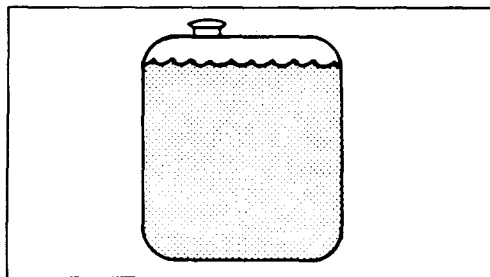
Check Oil Level Daily

NOTICE: If the oil level is constantly above normal and excess lube oil has not been added to the crankcase, consult with an authorized Detroit Diesel service outlet for the cause. Fuel or coolant dilution of lube oil can result in serious engine damage.

For lubricating oil change intervals, refer to "When to Change Oil" in the **How To** section of this guide. Before adding lube oil, refer to "How to Select Lubricating Oil" in the **How To** section.

Item 2 - Fuel and Fuel Tank

Keep the fuel tank filled to reduce condensation. Before adding fuel, refer to "How To Select Fuel Oil" in the **How To** section of this guide.



Keep Tank Filled to Reduce Condensation

Refill the tank at the end of each day's operation to prevent condensation from contaminating the fuel. Condensation formed in a partially filled tank promotes the growth of micro-organisms that can clog fuel filters and restrict fuel flow. To prevent microbe growth add a biocide to the fuel tank or primary fuel supply. Follow manufacturer's usage, handling, and safety recommendations.

Water accumulation can be controlled by mixing isopropyl alcohol (dry gas) into the fuel oil at a ratio of one pint (0.5 liter) per 125 gallons (473 liters) fuel (or 0.10% by volume). DDC does not recommend adding alcohol to fuel used in marine engines.

Open the drain at the bottom of the fuel tank every 500 hours or 15,000 miles to drain off any water and/or sediment.

Every 12 months or 20,000 miles (700 hours) tighten all fuel tank mountings and brackets. At the same time, check the seal in the fuel tank cap, the breather hole in the cap and the condition of the crossover fuel line. Repair or replace the parts, as necessary.

NOTICE: A galvanized steel tank should never be used for fuel storage, because the fuel oil reacts chemically with the zinc coating to form powdery flakes which can quickly clog the fuel filters and damage the fuel pump and injectors.

Item 3 - Fuel Lines, Flexible Hoses

Pre-Start inspection- Check hoses daily as part of the pre-start inspection.

Examine hoses for leaks, and check all fittings, clamps, and ties carefully. Make sure that hoses are not resting on or touching shafts, couplings, heated surfaces including exhaust manifolds, any sharp edges, or other obviously hazardous areas. Since all machinery vibrates and moves to a certain extent, clamps and ties can fatigue with age. To ensure continued proper support, inspect fasteners frequently and tighten or replace them as necessary.

Investigate leaks immediately to determine if fittings have loosened or cracked or if hoses have ruptured or worn through. Take corrective action immediately. Leaks are not only potentially detrimental to machine operation, but they can also result in added expense caused by the need to replace lost fluids.

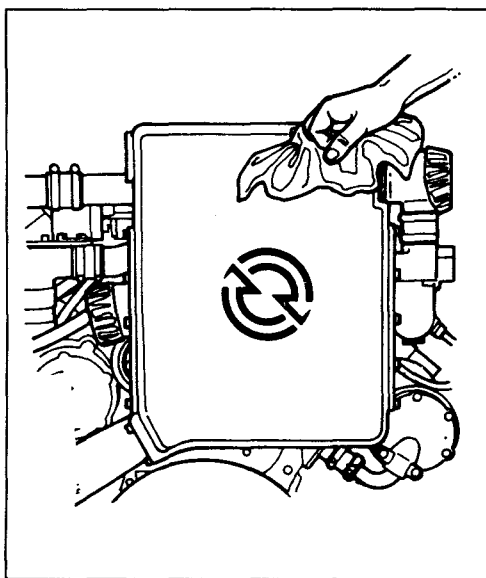
CAUTION: Personal injury and/or property damage may result from fire due to the leakage of flammable fluids such as fuel or lube oil.

Service life- A hose has a finite service life. With this in mind, all hoses should be thoroughly inspected at least every 500 operating hours (1,000 hours for fire-resistant fuel and lubricating oil hoses) and/or annually. Look for cover damage and/or indications of twisted, worn, crimped, brittle, cracked, or leaking lines. Hoses with their outer cover worn through or damaged metal reinforcement should be considered unfit for further service.

All hoses in and out of machinery should be replaced during major overhaul and/or after a maximum of

five years of service. Fire resistant fuel and lube oil hose assemblies do not require automatic replacement after five years service or at major overhaul.

Item 4 - Cooling System



Remove Heat Exchanger Pressure Control Cap with Caution

CAUTION: Do not remove the pressure control cap from the heat exchanger or radiator or attempt to drain the coolant until the engine has cooled. Once the engine has cooled, use extreme caution when removing the cap. The sudden release of pressure from a heated cooling system can result in a loss of coolant and possible personal injury (scalding, eye injury, etc.) from the hot liquid.

Check the coolant level daily and maintain it near the bottom of the filler neck on the radiator or heat exchanger tank. On some installa-

tions this is done by checking an overflow bottle or sight glass. Add coolant as necessary, but do not overfill. Before adding coolant, refer to "How to Select Coolant" in the **How To** section of this guide.

Make a daily visual check for cooling system leaks. Look for an accumulation of coolant when the engine is running and when it is stopped.

The inhibitors in antifreeze solutions should be replenished with a non-chromate corrosion inhibitor supplement when indicated by testing the coolant. Engine coolant should be tested for proper inhibitor levels at 150 hour intervals or maintenance intervals, whichever comes first.

Coolant drain interval- DDC recommends replacing coolant with permanent type antifreeze annually. However, a cooling system properly maintained and protected with supplemental corrosion inhibitors can be operated up to two years, 4000 hours, or 200,000 miles, whichever comes first. At this interval, the coolant *must* be drained and the cooling system cleaned thoroughly. The cooling system should then be replenished with an ethylene glycol-base antifreeze/water solution in the required concentration and required DDC-selected cooling system inhibitors should be added.

Cooling system hoses- All cooling system hoses should be inspected at least every 500 hours for signs of deterioration and replaced, if necessary.

Raw water cooling system- Drain at the end of each boating season.

Sea strainers- Inspect sea strainers daily. Clean sea strainers at least annually. Clean more often if surface seaweed growth or water contamination levels are fairly high.

Item 5 - Turbocharger, Exhaust Connections

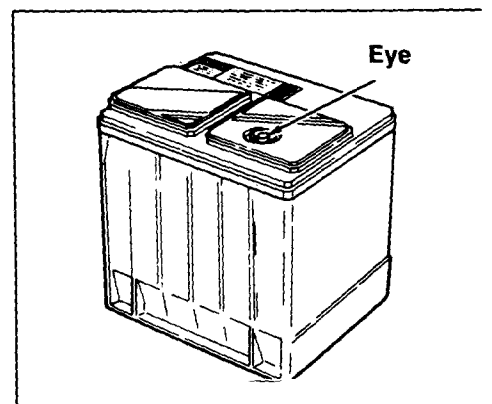
Visually inspect the mountings, intake and exhaust ducting and connections for leaks daily. Check the oil inlet and outlet lines for leaks or restrictions to oil flow. Check for unusual noise or vibration and, if excessive, stop the engine and do not operate until the cause is determined.

Every 12 months or 20,000 miles the exhaust manifold retaining nuts, exhaust flange clamp and other connections should be checked for tightness. Check for proper operation of the exhaust pipe rain cap, if one is used.

Check heat-insulating exhaust system blankets for damage daily. Torn, matted, crushed, oil-soaked, or otherwise damaged insulation blankets *must* be replaced immediately.

Item 6 - Battery

CAUTION: To avoid possible personal injury and/or engine damage from accidental engine startup, always disconnect the battery before servicing the electrical system. To avoid alternator damage when removing battery connections, disconnect the negative (-) terminal first. Reconnect the negative terminal last.



Check "Eye" of Maintenance-Free Batteries

Check the hydrometer "eye" of maintenance-free batteries for charge. If lead-acid or low maintenance batteries are used, check the specific gravity of each cell every 150 hours. Check more frequently in warm weather due to the more rapid loss of water through evaporation. Maintain the electrolyte level according to the battery manufacturer's recommendations, but do not overfill. Overfilling can cause poor performance or early failure.

Keep the terminal side of the battery clean. When necessary, wash with a solution of baking soda and water. Rinse with fresh water. Do not allow the soda solution to enter the cells.

Inspect the cables, clamps, and hold-down brackets regularly. Clean and reapply a light coating of petroleum jelly when needed. Have corroded or damaged parts replaced.

If the engine is to be out of service for more than 30 days, remove the batteries and store in a cool, dry place. Keep batteries fully charged, if possible. Replace any battery that

fails to hold a charge.

Periodically check battery connections for corrosion and tightness. If necessary, remove connections and wire brush any corrosion from terminals and cable ends. Replace damaged wiring.

Item 7 - Air Cleaners

A clogged air cleaner element will cause excessive intake restriction and a reduced air supply to the engine. This, in turn, can result in increased fuel consumption, inefficient engine operation and reduced engine life.

Oil bath type. Air cleaner cups and center tubes should be removed, cleaned, and refilled with clean engine oil every 8 hours (or less, if operating conditions warrant). The frequency of servicing may be adjusted to suit local dust conditions. If heavy rain or snow is encountered, check the air cleaner for an accumulation of water.

The air cleaner element and baffle should be removed and cleaned annually. The body and fixed element in the heavy duty oil bath air cleaner should be serviced every 500 hours or as conditions warrant.

Dry type. Dry type air cleaner elements should be replaced with new elements after one year of service or when the restriction indicator or manometer shows that the maximum allowable air intake restriction has been reached, whichever comes first. Check restriction indicator daily.

If reusable elements are used, the maximum element service life is still one year. Cleaning, drying, and inspection before reuse must be done per the manufacturer's recom-

mendations.

Inspect the entire air system for leaks daily. Look especially for torn air inlet piping or boots and loose or damaged clamps. Have worn or damaged parts repaired or replaced, as required. Retighten any loose connections.

Air Silencers. Inspect mounting bands and clamps for tightness daily. Clean or replace foam rubber elements (socks) annually.

Item 8 - Drive Belts

Drive belt tension should be checked every 200 hours or 6000 miles and adjusted, if necessary. Check belts on marine units every 150 hours. Periodically inspect belts for splits, cracks and glazing. Replace as required.

Item 9 - Lubricating Oil Filter

Lubricating oil filters should be changed whenever the engine oil is changed. For oil change intervals, refer to "When to Change Oil" in the **How To** section of this guide. Before changing filters, refer to "How to Replace the Lube Oil Filter" in the **How To** section of this guide. Refer to the **Specifications** section of this guide for required filter part number.

Item 10 - Fuel/Water Separator, Filter

Drain water from fuel/water separator daily or as required. Primary and secondary fuel filters should be replaced every 10,000 miles or 6 months, whichever comes first (or sooner if plugging is indicated). Refer to the **Specifications** section

of this guide for required part numbers. Before changing filters, refer to "How to Replace the Fuel Filter and Strainer" in the **How To** section of this guide.

Item 11 - Water Pump and Coolant Filter

Water Pump. The water pump drain hole should be inspected for plugging every 600 hours and cleaned out, if necessary. Authorized Detroit Diesel service outlets are properly equipped to perform this service. The water pump seal should be replaced at engine overhaul or earlier, if leaking is found.

Coolant Filter. Coolant filter/conditioners are used on certain industrial, on-highway, and marine engines to filter impurities such as scale or sand from the coolant. Filter elements are treated with chemicals that soften water, maintain an acid-free environment, and act as a rust preventive.

If the cooling system is protected by a coolant filter/conditioner, the element should be changed every 6 months or 10,000 miles, whichever comes first. On marine units this should be done every 150 hours. For additional information on water filters and inhibitor packages, refer to the publication, "Coolant for Detroit Diesel Engines", form 7SE298, available from authorized Detroit Diesel service outlets.

Item 12 - Air Shutdown Valve

With the engine running at idle speed, the operation of the air shutdown valve should be checked for proper operation at least once a year or every 700 hours (every 500 hours on marine units), whichever comes first. The valve should be reset in the

open position after the check has been made.

Item 13 - Oil Pressure

NOTICE: Do not use the air shutdown for normal or routine engine stopping. Failure to observe this precaution can result in serious blower seal damage.

Under normal operation, oil pressure is noted each time the engine is started. If the engine is equipped with a warning light instead of a pressure gauge, have the oil pressure checked and recorded every 700 hours or 20,000 miles.

Item 14 - Battery Charging Alternator

Terminals should be checked for corrosion and loose connections and wiring inspected for damaged or frayed insulation. Have wiring repaired or replaced, as required.

Precautions must be taken when working on or around the alternator. The diodes and transistors in the alternator circuit are very sensitive and can be easily destroyed.

1. Avoid grounding the output terminal. Grounding an alternator's output wire or terminal (which is always hot, regardless of whether or not the engine is running) and accidentally reversing the battery polarity will result in equipment damage.
2. Do not reverse battery connections. This can also cause damage.

3. Never disconnect the battery while the alternator is operating. Disconnecting the battery can result in damage to the alternator diodes. In marine applications which have two sets of batteries, switching from one set to the other while the engine is running will momentarily disconnect the batteries. This can result in equipment damage.
4. If a booster battery is to be used, batteries must be connected correctly (negative to negative, positive to positive) to avoid equipment damage.
5. Never use a fast charger with the batteries connected or as a booster for battery output.

Item 15 - Engine, Transmission, and Marine Gear Mounts

Engine and transmission or marine gear mounting bolts and the condition of the mounting pads should be checked every 2,000 hours or 60,000 miles (whichever comes first) and tightened or repaired, as required.

Item 16 - Crankcase Breather, Pressure

The externally mounted crankcase breather assembly should be removed and the steel mesh pad cleaned in fuel oil annually (vehicle engines) or every 1,000 hours (5,000 hours on marine engines). The cleaning period may be reduced or lengthened depending on severity of service.

Some engines may use an additional crankcase breather collection device. If so equipped, the drain

should be checked every oil change period. Remove the oil reservoir and replace the filter element and gasket annually, or every 500 hours, whichever comes first.

These service intervals may be reduced depending on the severity of service.

Crankcase pressure should be checked and recorded every 2,000 hours or 60,000 miles. If an additional crankcase breather collection device is used, the crankcase pressure should be recorded with the unit attached and removed.

Item 17 - Engine Tune-up

There is no scheduled interval for performing an engine tune-up. As long as the engine performance is satisfactory, no tune-up should be needed. Minor adjustments in the valve and injector operating mechanisms, governor, etc. may be required periodically to compensate for normal wear on parts.

Item 18 - Raw Water System Zincs

Heat exchanger "zincs" should be checked initially every 60 hours, then as required or annually. Clean with a wire brush if serviceable. Replace if badly deteriorated. Electrodes are generally found in the heat exchanger assembly, the raw water pump elbows, and the engine/marine gear auxiliary coolers.

Item 19 - Raw Water Pump

A raw water pump seal malfunction is indicated by leakage of water from the openings in the pump housing. These openings, located between the pump mounting flange and the inlet and outlet ports, must remain open at all times. Leaky seals require replacement. The raw water pump body or liner should also be checked for cracks or wear and replaced, if necessary. Authorized Detroit Diesel service outlets are properly equipped to perform these services.

Item 20 - Marine Gear

Check marine gear oil level daily. Replace Allison marine gear lube oil and filter every 150 hours or every two years, whichever comes first.

Item 21 - Blower Bypass Valve

The blower bypass valve should be removed, cleaned in solvent (if necessary), and inspected every 100,000 miles or 3000 hours. The valve should be checked for free operation and for scoring on the piston, piston guide, or sleeve assembly. Have repaired or replaced, as necessary.

Item 22 - Tachometer Drive

The tachometer drive should be lubricated every 300 hours at the grease fitting. Use an all-purpose grease (No. 2 grade) at temperatures above 30°F (-1°C). At temperatures below this use a No. 1 grade grease.

DDC (TWIN DISC) MARINE GEAR LUBE OIL AND FILTER CHANGE REQUIREMENTS

Oil Service Class		
Use SAE-API service class CD engine oil which is certified by the oil company to pass TO-2 or C-3 Test Specification. Also approved is SAE-API service class CC oil, Mil-L-2104B.		
Oil Viscosity		
Sump Temperature, also Oil Temperature into Heat Exchanger		Recommended Oil Viscosity
During Start-up	Steady Operating Conditions	
	Below 150°F (66°C)	This operating condition is not approved.
32°F (0°C) Min.	150°—185°F (66-85°C)	SAE viscosity number 40 engine oil 1.12:1—2.54:1
32°F (0°C) Min.	150°—185°F (66-85°C)	SAE viscosity number 40 engine oil 3.10:1—4.95:1
32°F (0°C) Min.	175°—210°F (80-99°C)	SAE viscosity number 40 engine oil 3.10:1—4.95:1
	Above 210°F (99°C)	This operating condition is not approved.
Oil and Filter Change Interval		
First element filter change should take place after 10 hours and thereafter every 1000 hours of operation for both filter element and oil, or 6 months, whichever occurs first.		
Filter Screen		
Remove and clean after first 10 hours and thereafter every 1000 hours of operation, or 6 months, whichever occurs first.		

Item 23- Air Compressor

Inspect daily for loose fittings, damaged fittings, and coolant leaks.

The polyurethane sponge strainer parts should be removed and cleaned every 150 hours or 5000 miles, or replaced if not serviceable. (Contact a Bendix or Midland air compressor dealer for replacement parts.) If reusable, they should be washed in commercial solvent or a detergent and water solution. The element should be saturated in clean engine oil and squeezed dry before being reinstalled.

The air compressor mounting bolts should be tightened every 12 months or 20,000 miles. If belt driven, the belt should be checked for proper tension.

Item 24 - Throttle and Clutch Controls

Inspect daily for loose linkage and tighten as required.

Lubricate the throttle control mechanism every 200 hours (or 6000 miles). Use an all-purpose grease (No. 2 grade) at temperatures of 30°F (-1°C) and above. Use a No. 1 grade grease at temperatures below this. Lubricate all other control mechanisms, as required, with engine oil.

Item 25 - Air Box Drain Tube

Air flow from the air box drain tubes should be checked every 1000 hours or 30,000 miles with the engine running. If tubes are clogged they should be removed, cleaned, and reinstalled. Every 100,000 miles or approximately 3,000 hours the air box check valves should be removed, cleaned in solvent, and the lines should be blown out with compressed air. Inspect for leaks after servicing.

If the engine is equipped with an air box tank, drain the sediment at each oil change.

Item 26 - Radiator, Air-to-Air Charge Cooler

Inspect the outside of the radiator core and air-to-air charge cooler (if equipped) every 20,000 miles or 700 hours and, if necessary, clean with a quality grease solvent such as mineral spirits and dry with compressed air.

CAUTION: To avoid personal injury, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.

Do not use fuel oil, kerosene, or gasoline.

Clean the radiator more frequently if the engine is operated in extremely dusty or dirty areas.

Item 27 - Shutter Operation

Check the operation of the shutters and clean the linkage and controls.

Item 28 - Governor, Overspeed Governor

The idle speed and no-low speed should be checked and recorded. Have adjusted, as necessary.

An idle speed lower than recommended will cause the engine to be accelerated from a speed lower than the speed at which the engine was certified.

A no-load speed higher than recommended will result in a full-load speed higher than rated and higher than the speed at which the engine was certified.

If the overspeed governor is equipped with a hinge-type cap oiler or oil cup, lubricate with 5 or 6 drops of clean engine oil every 500 hours or 15,000 miles. Avoid excessive lubrication, and do not lubricate while the engine is running.

Item 29 - Throttle Delay, Fuel Modulator

Every 30 months or 50,000 miles the throttle delay or fuel modulator should be checked and adjusted (if required).

Item 30 - Fan Hub

If the fan bearing hub assembly is provided with a grease fitting, use a hand grease gun and lubricate the bearings with one shot of Texaco Premium RB grease, or an equivalent lithium-base multi-purpose grease, every 20,000 miles (approximately 700 hours).

Every 2,500 hours or 75,000 miles (vehicle engines) or 4,000 hours (non-vehicle engines) the fan bearing hub assembly should be cleaned, inspected, and repacked with the grease above.

The bearings in the fan hub assembly should be replaced with new bearings at major engine overhaul. The hub assembly should be packed with Texaco Premium RB grease or an equivalent lithium-base multi-purpose grease before installing.

Item 31 - Thermostats and Seals

Have the thermostats and seals checked at 5,000 hours (non-highway engines), 200,000 miles (highway engines) or once a year (preferably at the time the cooling system is prepared for winter operation). The thermostats and seals should always be replaced at overhaul.

Item 32 - Blower Screen

Have the blower screen and gasket assembly inspected annually (vehicle engines) or every 1,000 hours or 30,000 miles (non-vehicle engines) and, if necessary, have the screen cleaned in fuel oil and dried with compressed air.

CAUTION: To avoid personal injury, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.

Item 33 - Power Take-off

Follow the power take-off manufacturer's lubrication and preventive maintenance recommendations at its suggested intervals.

Item 34 - Engine (Steam Clean)

Steam clean the engine and engine compartment.

NOTICE: Do not apply steam or solvent directly to the battery-charging alternator, starting motor, electrical or DDEC electronic components as damage to electrical equipment may result.

"HOW TO" SECTION

This section covers Detroit Diesel's recommendations on how to select lubricating oil, fuel oil, and coolant and includes basic engine maintenance procedures which can be performed by the operator.

These lubricating oil and fuel recommendations are for diesel-fueled engines. For methanol-fueled engines refer to publication "Lubricating Oil, Fuel, and Filter Recommendations for Methanol-Fueled Engines," form 7SE413, available from authorized Detroit Diesel Distributors.

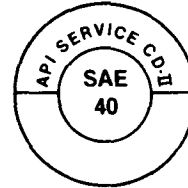
A. How to Select Lubricating Oil

Lubricant Selection

The selection of the proper lubricating oil is important to achieve the long and trouble-free service which Detroit Diesel Series 92 engines are designed to provide. The proper lubricating oil for all Detroit Diesel engines is selected based on SAE Viscosity Grade and API (American Petroleum Institute) Service designation. Only oils displaying the American Petroleum Institute (API) Symbol shown below are recommended. This symbol provides assurance that the lubricant meets the minimum performance levels necessary for proper engine performance and durability.

Lubricant Recommendation

API Symbol:



SAE Viscosity Grade: 40

API Classification: CD-II

Military Specification: Mil-L-2104E

Sulfated Ash: Less than 1.0 mass%

This is the only lubricating oil recommended for Detroit Diesel Series 92 Engines. Lubricants meeting these criteria have provided maximum engine life when used in conjunction with recommended oil drain and filter maintenance schedules. Certain engine operating conditions may require exceptions to this recommendation. They are as follows:

1. For continuous high temperature operation (over 200°F coolant out) the use of an SAE 50 viscosity lubricant is recommended.
2. When the use of high sulfur fuel is unavoidable, lubricants with a Total Base Number exceeding 10 are recommended. Such a lubricant may have a sulfated ash content above 1.0 mass %. High sulfur fuels require modification to oil drain intervals.
3. At ambient temperatures below freezing where starting aids are not available or at very cold temperatures (below 0°F or -17.8°C), the use of multi-viscosity grade SAE 15W-40 lubricants will improve startability. These lubricants must have a High Temperature/High Shear Rate Viscosity (measured by ASTM D 4741 or equivalent) of 3.7 cP minimum.

EXCEPTION: Do not use 15W-40 lubricants in Series 92 marine engines under any circumstances.

In addition to the CD-II designation, other letters may also be present in the API Symbol such as "SF," "SG," "CD," "CE," etc. These lubricants may be used provided CD II is included and the lubricants meet Detroit Diesel Corporation's additional requirements.

Additional Requirements

Although the API designation identifies the minimum desirable performance levels, Detroit Diesel has identified additional properties which further assure the best possible lubricants for Series 92 engines.

Mil-L-2104E

The military maintains a separate specification and approval system which requires presentation of potential candidate oils to a reviewing panel. Detroit Diesel participates in this panel and is, therefore, afforded an opportunity to review engine oils which may be used in Detroit Diesel engines.

Sulfated Ash

Through field experience and testing, Detroit Diesel has determined that engine oils with over 1.0 mass % sulfated ash will form excessive valve deposits which may lead to valve guttering and subsequent failure. Valve guttering is a high temperature chemical reaction which occurs between certain lubricant additive types and the valve alloy. Other factors including oil consumption and operating cycle also contribute.

Synthetic Oils

Synthetic oils are not recommended for use in Detroit Diesel engines. Synthetics offer advantages in cold temperature pumpability and high temperature oxidation resistance. However, synthetic lubricants have not proven to provide operational or economic benefits over conventional petroleum-based lubricants in Detroit Diesel two-cycle engines. Their use does not permit the extension of oil drain intervals.

Use of Supplemental Additives

Lubricants meeting the Detroit Diesel recommendations already contain a balanced additive treatment. The use of supplemental additives which are added to the lubricant by the customer are unnecessary and may be harmful. Detroit Diesel does not review, approve, or recommend such products.

For more information on lubricating oil selection, refer to publication 7SE270, "Lubricating Oils, Fuel Oils, and Filter Recommendations for Detroit Diesel Engines," available from Detroit Diesel Distributors.

B. When to Change Oil

Oil Drain Intervals

The length of time an engine may operate before an oil change depends upon the lubricant and fuel used, engine oil consumption, and the operating cycle. The following table lists the maximum interval which the engine may operate before the oil and filters must be changed. Oil analysis may be used to determine whether this interval should be shortened, but should not be used to lengthen the interval.

**SERIES 92 ENGINE MAXIMUM OIL DRAIN INTERVAL
(Fuel Sulfur Less Than 0.5 mass %)**

Highway Truck	15,000 Miles (24,000 km)*
City Transit Coaches	6,000 Miles (9,600 km) or 500 hours*
Industrial and Marine	150 Hours or 1 year*
Standby Generator	500 hours or 1 year*
*Whichever comes first.	

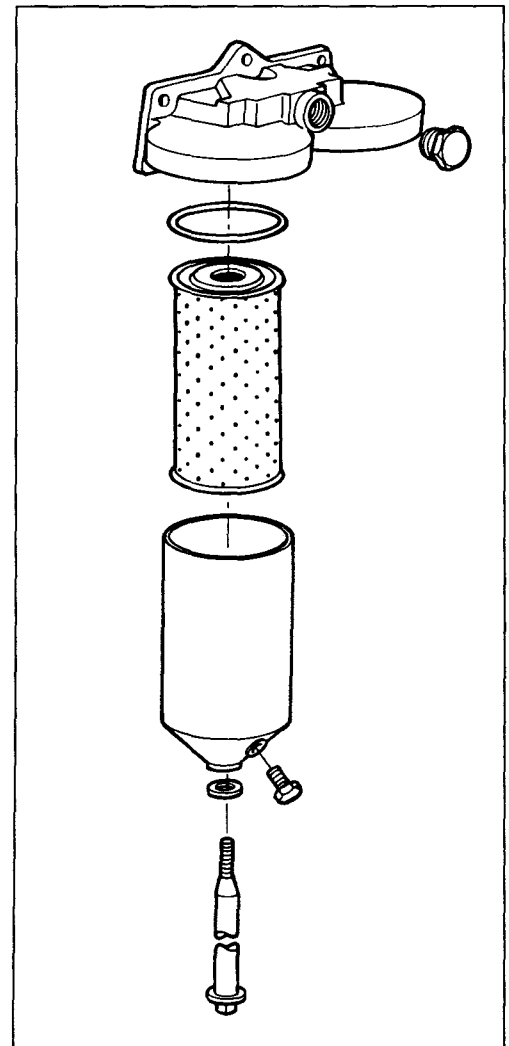
The use of fuels with sulfur content above 0.5 mass % will require a shortening of drain intervals and/or the use of a higher TBN oil. For details refer to publication 7SE270, "Lubricating Oil, Fuel Oil, and Filter Recommendations for Detroit Diesel Engines," available from authorized Detroit Diesel Distributors.

Disposing of Waste Oil

Dispose of used lubricating oil and filters in an environmentally responsible manner, according to federal (EPA) and/or state recommendations. The disposal of waste oil may be best addressed by the engine oil supplier, who may accept responsibility for proper disposal of this material as part of the business of providing lubricant.

C. How to Replace the Lube Oil Filter

Filters are an integral part of the lubricating oil system. Proper filter selection and maintenance are important to satisfactory engine operation and service life. Filters should be used to maintain a clean system, not to clean up a contaminated system. Refer to **Specifications** (page 47) for filter part number.



Typical Canister (Bolt-On) Type Oil Filter Assembly

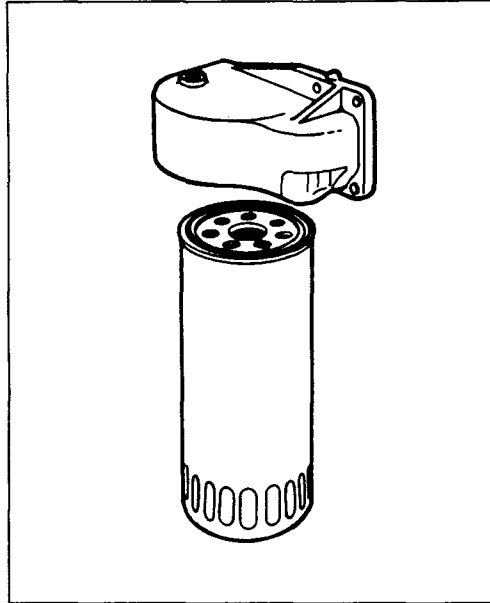
Series 92 engines may use either canister (bolt-on) type or spin-on type lube oil filters.

Replace Canister (Bolt-on) Type Oil Filter

1. Remove the drain plug from the canister shell or the filter adaptor or base and drain the oil into a suitable container.
2. Support the shell, unscrew the center stud, and withdraw the shell, element, and stud as an assembly. Dispose of the oil, element, and shell gasket in an environmentally approved manner according to state and/or federal (EPA) recommendations.
3. Remove the center stud and gasket. Retain the gasket, unless it is damaged and oil leaks occurred.
4. Remove the nut on the full-flow filter stud.
5. Remove and discard the element retainer seal. Install a new seal.
6. Clean the filter shell and adaptor or base.
7. Install the center stud gasket and slide the stud (with the spring, washer, seal and retainer installed on the full-flow filter stud) through the filter shell.
8. Install a new shell gasket in the filter adaptor or base. Before installing the gasket, make sure all old gasket material is removed from the shell and adaptor or base.
9. Remove the paper, plastic, or cellophane wrapping from a new filter element and position the element carefully over the center stud and within the shell. Place the shell/element/center stud assembly in position on the filter adaptor or base, and tighten the stud to 50-60 lb-ft (69-81 N•m) torque.
10. Install the drain plug in the adaptor or base.
11. Add oil as required to bring the level to the "full" mark on the dipstick.
12. Start and run the engine for a short period and check for oil leaks. After correcting oil leaks, stop the engine long enough for the oil from various parts of the engine to drain back to the crankcase (approximately 20 minutes). Add oil as required to bring the level to the proper mark on the dipstick.

NOTICE: If the oil level is constantly above normal and excess lube oil has not been added to the crankcase, consult with an authorized Detroit Diesel service outlet for the cause. Fuel or coolant dilution of lube oil can result in serious engine damage.

Replace Spin-on Type Oil Filter



Typical Spin-On Type Oil Filter

1. Remove the spin-on filter cartridge using strap wrench tool J 29917 (or equivalent) and a 1/2" drive socket wrench and extension.
2. Dispose of the used oil and filter in an environmentally approved manner according to state and/or federal (EPA) recommendations.
3. Clean the filter adaptor with a clean, lint-free cloth.
4. Lightly coat the filter gasket (seal) with clean engine oil.
5. Start the new filter on the adaptor and tighten by hand until the gasket touches the mounting adaptor head. Tighten an additional two-thirds turn.

NOTICE: Overtightening may distort or crack the filter adaptor.

6. Add oil as required to bring the level to the "full" mark on the dipstick.
7. Start and run the engine for a short period and check for leaks. After any leaks have been corrected, stop the engine long enough for oil from various parts of the engine to drain back to the crankcase (approximately 20 minutes). Add oil as required to bring the level to the proper mark on the dipstick.

NOTICE: If the oil level is constantly above normal and excess lube oil has not been added to the crankcase, consult with an authorized Detroit Diesel service outlet for the cause. Fuel or coolant dilution of lube oil can result in serious engine damage.

D. How to Select Fuel Oil

Quality- Fuel quality is an important factor in obtaining satisfactory engine performance, long engine life, and acceptable exhaust emission levels. Detroit Diesel engines are designed to operate on most diesel fuels marketed today.

In general, fuels meeting the properties of ASTM designation D 975 (grades 1-D and 2-D) have provided satisfactory performance. The ASTM D 975 specification, however, does not in itself adequately define the fuel characteristics needed for assurance of fuel quality. The properties listed in the fuel oil selection chart have provided optimum engine performance (see chart).

The fuels used must be clean, completely distilled, stable, and non-corrosive. A reputable fuel oil supplier is the only one who can assure you that the fuel you receive meets the property limits shown in the fuel oil selection chart. For more information regarding the significance of these properties and selection of the proper fuel, refer to publication 7SE270, "Lubricating Oils, Fuel Oils, and Filter Recommendations for Detroit Diesel Engines," available from Detroit Diesel Distributors.

Fuel Sulfur Content

The sulfur content of the fuel should be as low as possible to avoid premature wear of piston rings and liners, avoid excessive deposit formation, and minimize sulfur dioxide exhausted into the atmosphere. Limited amounts of sulfur can be tolerated, but the amount in the fuel and engine operating conditions can influence corrosion and deposit formation tendencies. The use of fuel containing greater than 0.5 mass % sulfur will require more frequent oil changes.

Cold Weather Operation

In cold weather, diesel fuel will form wax crystals which can restrict flow and clog filters. Fuel oil suppliers approach this problem several ways. Some provide a specially refined product, while others may use flow-improving additives or winter blends. Winter blended fuel will likely contain kerosene or 1-D fuel, which provide good cloud point temperatures, but result in a lighter fuel with a lower heat content. These fuels may be used, but they may result in reduced engine power and/or fuel mileage.

Fuel Cleanliness

Fuel should be clean and free of contamination. Storage tanks and stored fuel should be inspected regularly for dirt, water, or water-emulsion sludge, and cleaned if contaminated. Storage instability of the fuel can lead to the formation of varnish or sludge in the tank. The presence of these contaminants from storage instability must be resolved with the fuel supplier. If fuel is stored on site, the following is recommended:

1. Do not use a fuel storage tank or lines made from galvanized steel. The fuel oil will react chemically with the galvanized coating to form powdery flakes which will quickly clog fuel filters and cause damage to the fuel pump and injectors.
2. Keep the storage tank filler cap covered to prevent contamination by rain water.
3. Keep the tank clean especially around the filler cap and tap areas.
4. Position the tank so that it is tilted slightly toward the bottom drain. This will make draining of accumulated water and sediment a little easier.
5. Minimize condensation by keeping the tank reasonably filled at all times.
6. After filling the fuel storage tank, wait a few hours before filling equipment tanks to allow contaminants to settle.

Fuel Oil Selection Chart

General Fuel Classification	ASTM Test	No. 1 ASTM 1-D	No. 2 ASTM 2-D
Gravity, °API#	D 287	40 - 44	33 - 37
Flash Point Min. °F (°C)	D 93	100 (38)	125 (52)
Viscosity, Kinematic cST @ 100°F (40°C)	D 445	1.3 - 2.4	1.9 - 4.1
Cloud Point °F #	D 2500	See Note 1	See Note 1
Sulfur Content wt%, Max.	D 129	0.5	0.5
Carbon Residue on 10%, wt%, Max.	D 524	0.15	0.35
Accelerated Stability Total Insolubles mg/100 ml, Max. #	D 2274	1.5	1.5
Ash, wt%, Max.	D 482	0.01	0.01
Cetane Number, Min. +	D 613	45	45
Distillation Temperature, °F (°C) IBP, Typical # 10% Typical # 50% Typical # 90% + End Point #	D 86	350 (177) 385 (196) 425 (218) 500 (260) Max. 550 (288) Max.	375 (191) 430 (221) 510 (256) 625 (329) Max. 675 (357) Max.
Water & Sediment %, Max.	D 1796	0.05	0.05

Not specified in ASTM D 975

+ Differs from ASTM D 975

Note 1: The cloud point should be 10°F (6°C) below the lowest expected fuel temperature to prevent clogging of fuel filters by crystals.

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 Fuel Additives- Detroit Diesel engines operate satisfactorily on a wide range of diesel fuels without the addition of supplemental additives. Such additives increase operating costs without providing benefit.

Some fuel additives provide temporary benefits, but do not replace good fuel handling practices. Such additives are helpful when water contamination is suspected:

- Isopropyl Alcohol — 1 pint per 125 gallons of fuel for winter freeze-up protection. Do not use rubbing alcohol. Detroit Diesel does not recommend the use of isopropyl alcohol in marine engines.
- Biocide — For treatment of microbial growth or black "slime". Follow manufacturer's instructions for treatment. If treating contaminated fuel, frequent fuel filter changes will be necessary until the fuel system is purged.

Using Drained Lubricating Oil in Diesel Fuel

Detroit Diesel does NOT recommend blending engine drain oil into diesel fuel. This will adversely affect exhaust emissions, and will likely result in damage to the fuel injection system and the formation of excessive combustion deposits. Detroit Diesel will not be responsible for any detrimental effects which it determines resulted from this practice.

Statement of Policy on Supplemental Fuel and Lubricant Additives

"The Series 92 engine will operate satisfactorily on the commercial fuels and lubricants of good quality regularly provided by the petroleum industry through retail outlets. The regular and continued use of supplementary additives in fuels and lubricants is not recommended."

"Supplementary additives include all products marketed as fuel conditioners, smoke suppressants, masking agents, deodorants, tune-up compounds, top oils, break-in oils, graphitizers, and friction-reducing compounds."

NOTICE: The manufacturer's warranty applicable to Series 92 engines 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.

For more detailed information on fuel selection, refer to "Lubricating Oil, Fuel Oil, and Filter Recommendations for Detroit Diesel Engines," form 7SE270, available from authorized Detroit Diesel service outlets.

E. How to Replace the Fuel Filter and Strainer

Filters are an integral part of the fuel system. Proper filter selection and maintenance are important to satisfactory engine operation and service life. Filters should be used to maintain a clean system, not to clean up a contaminated system. Refer to **Specifications** (page 47) for proper filter selection.

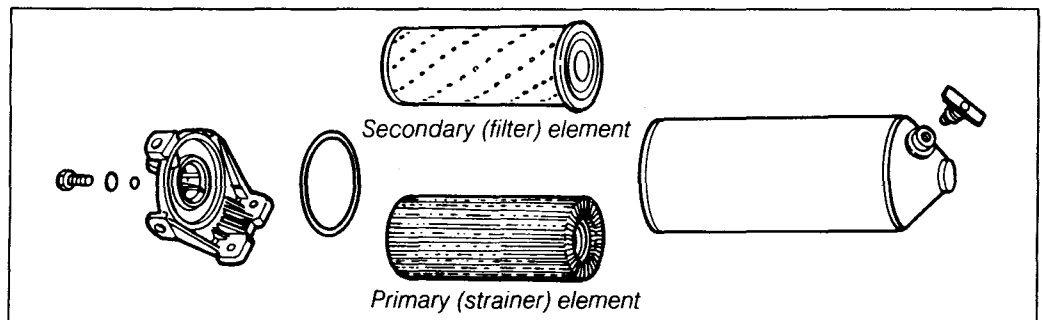
Two strainer/filter types are used on Series 92 engines:

- The canister (bolt-on) type consists of a replaceable strainer or filter element, a reusable shell (with draincock, element seat and spring), a replaceable shell gasket, a strainer or filter cover (with shell mounting bolt).
- The spin-on type consists of a shell, element, and gasket unitized into a single cartridge and a strainer or filter cover which includes a threaded sleeve to accept the spin-on filter cartridge. A one-inch diameter, 12-point nut on the bottom of the cartridge is provided for removal and installation.

Replace Canister (bolt-on) Type Filter Element

1. With the engine shut down, place a suitable container under the fuel strainer or filter and open the drain cock. The fuel will drain more freely if the cover bolt is loosened slightly.
2. Support the canister shell, unscrew the cover bolt, and remove the shell and element.
3. Remove the element and gasket. Dispose of them in an environmentally approved manner according to state and/or federal (EPA) recommendations. Clean the shell with fuel oil and dry with a clean, lintless cloth or compressed air.
4. Remove the paper, plastic, or cellophane wrapping from a new element. Soak the element thoroughly in clean fuel oil.

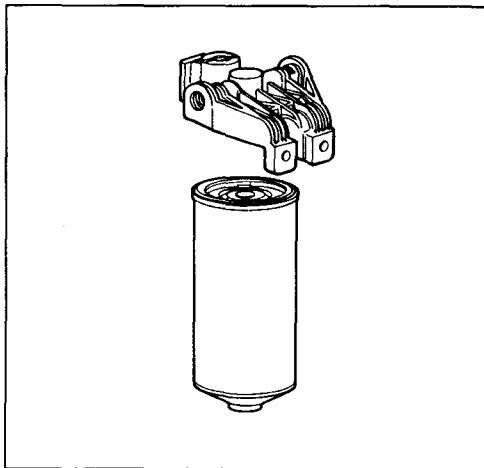
CAUTION: To prevent possible personal injury when using compressed air, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.



Typical Canister (Bolt-On) Type Fuel Filter or Strainer

5. Insert the element into the shell, pushing it down over the stud and onto the seat. Close the drain cock, and fill the shell about two-thirds full with clean fuel oil.
6. Using a new shell gasket, place the shell and element in position under the cover, and start the cover bolt onto the shell stud.
7. Tighten the cover bolt just enough to prevent leakage.
8. Remove the plug in the cover and fill the shell with fuel. Fuel system primer J 5956 (if available) may be used to prime the fuel system.
9. Start the engine and check the fuel system for leaks.

Replace Spin-on Type Filter Element



Typical Spin-On Type Fuel Filter or Strainer

1. With the engine shut down, place a suitable container under the strainer or filter and unscrew the cartridge. Dispose of the cartridge in an environmentally approved manner according to state and/or federal (EPA) recommendations.

2. Fill a new replacement cartridge about two-thirds full with clean fuel oil. Coat the seal gasket lightly with clean fuel oil. Coat the seal gasket lightly with clean fuel oil.
3. Install the new cartridge and tighten it to one-half a turn beyond gasket contact.

NOTICE: Overtightening may distort or crack the filter adaptor.

4. Start the engine and check for leaks.

NOTICE: To improve engine starting, have replacement elements filled with fuel and ready to install immediately after used elements are removed. This will prevent possible siphoning and fuel system aeration.

If the engine fails to start after replacement of the fuel strainer and/or filter elements, the fuel system will require priming with tool J 5956 (or equivalent). Authorized Detroit Diesel service outlets are properly equipped to perform this service.

NOTICE: Under no circumstances should the starting motor and fuel pump be used to prime the fuel filter and strainer. Prolonged use of the starting motor and fuel pump to prime the fuel system can result in damage to the starter, fuel pump, and injectors and cause erratic running of the engine due to the amount of air in the lines and filters.

F. Engine Out of Fuel— How to Restart

When an engine has run out of fuel, there is a definite procedure to follow when restarting it.

1. Fill the fuel tank with the recommended grade of fuel. If only partial filling is possible, add a minimum of 10 gallons (38 liters) of fuel to the tank.
2. Remove the fuel strainer/water separator from its cover, fill it with fuel, and reinstall it.
3. Remove the fuel filter from its cover, fill it with fuel, and reinstall it.
4. Start the engine, and check fuel filter and strainer for leaks.

If the engine fails to start after replacement of the fuel strainer and/or filter, the fuel system will require priming with tool J 5956 (or equivalent). Authorized Detroit Diesel service outlets are properly equipped to perform this service.

NOTICE: Under no circumstances should the starting motor and fuel pump be used to prime the fuel filter and strainer. Prolonged use of the starting motor and fuel pump to prime the fuel system can result in damage to the starter, fuel pump, and injectors and cause erratic running of the engine due to the amount of air in the lines and filters.

G. How to Select Coolant

Use an ethylene glycol antifreeze (low silicate formulation) that either meets the standard of the GM 6038-M formulation (GM 1899-M performance), or ASTM D 4985 requirements.

A 50% antifreeze/water solution is normally used as a factory fill. Concentrations over 67% are not recommended because of poor heat transfer capability, adverse freeze protection and possible silicate dropout. Concentrations below 30% offer little freeze, boilover or corrosion protection.

Although some antifreezes contain inhibitor packages, all Series 92 engines require that DDC-selected product supplemental inhibitors be added to the cooling system after an initial fill and that they be maintained at proper concentration.

Antifreeze solution should be used year-round to provide freeze and boil-over protection as well as a stable environment for seals and hoses.

Only non-chromate inhibitors should be used with antifreeze solutions.

Coolant and inhibitor concentration must be checked at each oil change (150 hours or 15,000 miles maximum). Adjust the concentration, if not at the proper protection level.

Mix antifreeze/water makeup solution at the proper concentration before adding to the cooling system. This should prevent over- or under-coolant concentration problems.

Methyl alcohol-based antifreeze is not recommended for use in DDC engines because of its effect on the non-metallic components of the cooling system and its low

boiling point. Methoxy propanol-based antifreeze is also not recommended for DDC engines because it is not compatible with fluoroelastomer seals found in the cooling system.

Coolant properly maintained and protected with supplemental inhibitors can be operated up to two years, 200,000 miles, or 4000 hours, whichever comes first. At this interval the antifreeze **must** be drained, discarded in an appropriate manner, and the cooling system thoroughly cleaned.

Over a period of time normal maintenance dosages of supplemental coolant additives (SCA's) and ethylene glycol can result in the total dissolved solids being raised to a level that may cause the cooling system to lose some of its efficiency.

Inspect all components that make up the cooling system and make necessary repairs at this time. Refill the cooling system with a recommended ethylene glycol-base antifreeze and water solution at the required concentration (see graph, page 41). Add required DDC-selected cooling system inhibitors. After filling, run engine until thermostat(s) open and top off radiator or heat exchanger to recommended full level. Reinstall fill/pressure cap.

NOTICE: Do not use sealer additives in the cooling system. The presence of the gumming and gelling material in stop-leak additives could cause plugging in the cooling passages, which will adversely affect the cooling system.

DDC-Selected Inhibitor Systems

DDC-selected product supplemental coolant inhibitors protect the metallic surfaces of the cooling system against corrosive attack.

- pH control chemicals are used to maintain an acid-free solution.
- Water-softening chemicals deter formation of mineral deposits.
- Cavitation suppression chemicals minimize the formation of vapor pockets, preventing erosion of cooling system surfaces.

It is imperative that DDC-selected product supplemental inhibitor be added to all Series 92 engines. A pre-charge dosage must be used at the initial coolant fill and the maintenance dosage used at each service interval.

Refer to "Specifications" (page 47) for coolant filter precharge and maintenance elements.

All inhibitors become depleted through normal operation, and additional inhibitor must be added to the coolant as required to maintain original strength levels.

Soluble oils and chromate inhibitors are not recommended for use in DDC engine cooling systems.

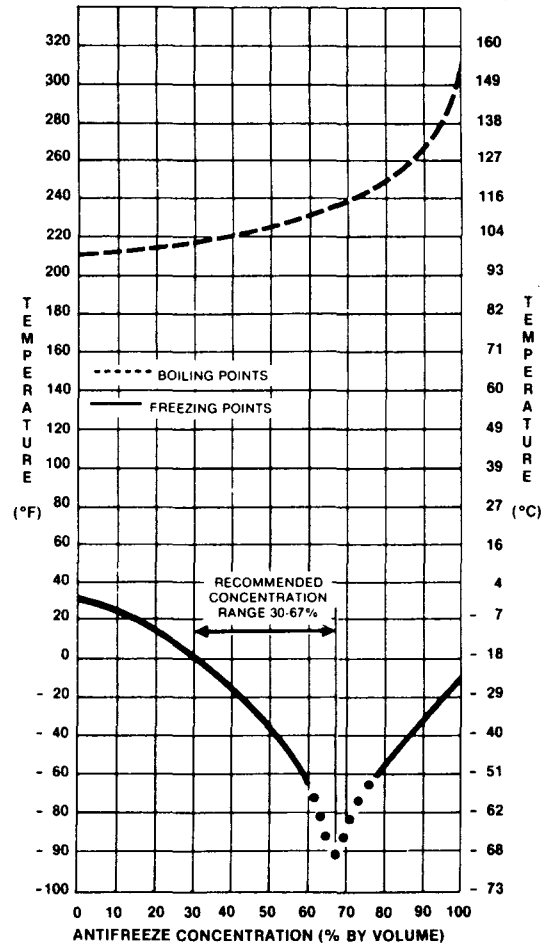
NOTICE: Overinhibiting with supplemental coolant additives or antifreeze solutions can cause additive dropout. Always follow the manufacturer's recommendations on usage and handling.

Inhibitor Test Procedures

Test kits and test strips are commercially available to check engine coolant for nitrite concentration. Coolants must be tested at each oil change (150 hours or 15,000 miles maximum) to ensure that inhibitor levels are maintained within the ranges shown on the chart below.

Use Nalco Chemical Company nitrite test kits (CO-318) to measure the nitrite concentration. Always follow the manufacturer's recommended test procedures. A factory coolant analysis program is also available through local DDC distributors under part number 23508774.

COOLANT FREEZING AND BOILING TEMPERATURES VS. ANTIFREEZE CONCENTRATION (SEA LEVEL)



SELECTED PRODUCTS SUPPLEMENTAL COOLANT ADDITIVE VALUES WITH GM6038-M OR ASTM D 4985

DDC Selected Products System

	<u>Min. PPM</u>	<u>Max. PPM</u>
Boron (B)	1000	1500
Nitrite (NO ₂)	800	2400
Nitrates (NO ₃)	1000	2000
Silicon (Si)	50	250
Phosphorous (P)	300	500
pH	8.5	10.5

NOTICE: Failure to maintain inhibitors at proper levels can result in damage to the cooling system and its related components. Conversely, overinhibiting anti-freeze solutions can cause "silicate dropout", which can plug oil cooler and aftercooler cores and/or cause hot spots in the engine. Always follow supplier's recommendations on inhibitor usage and handling.

For more detailed coolant recommendations, refer to "Coolant for Detroit Diesel Engines," form 7SE298, available from authorized Detroit Diesel service outlets.

H. How to Drain and Flush the Cooling System

CAUTION: Do not remove the pressure control cap from the heat exchanger tank or radiator or attempt to drain the coolant until the engine has cooled. Once the engine has cooled, use extreme care when removing the cap. The sudden release of pressure from a heated cooling system can result in a loss of coolant and possible personal injury (scalding) from the hot liquid.

1. With the engine cool, drain the previous solution from the engine and radiator or heat exchanger tank. Dispose of the solution in an environmentally responsible manner according to state and/or federal (EPA) recommendations.
2. Refill the cooling system with clean, soft water and a good radiator cleaning compound. If the engine is warm, fill slowly to prevent the rapid cooling and distortion of the metal castings.
3. Start the engine and operate it for fifteen minutes to circulate the solution thoroughly.
4. Stop the engine and allow it to cool.
5. With the engine cool, drain the cooling system completely.
6. Refill the cooling system with clean, soft water and operate it for fifteen minutes.

7. Stop the engine and allow it to cool.
8. With the engine cool, drain the cleaner residue from the cooling system.
9. Refill the system with the proper mix of antifreeze and clean, soft water.
10. Entrapped air must be purged after filling the cooling system. To do this, allow the engine to warm-up without the pressure cap installed. With the transmission or marine gear in neutral, increase engine speed above 1000 RPM and add coolant as required. Vent the petcock on the water return line at the water-jacketed turbocharger periodically. Install the pressure cap after the coolant level has stabilized at the bottom of the radiator or heat exchanger tank filler neck.

NOTICE: If the engine overheats and the coolant level is satisfactory, the cooling system may require cleaning with a descaling solvent and backflushing. Authorized Detroit Diesel service outlets are properly equipped to perform these services.

In addition to the cleaning procedure, other components of the cooling system should be checked periodically to keep the engine operating at peak efficiency:

Hoses. Cooling system hoses should be inspected and any hose that shows obvious signs of damage or feels abnormally soft or hard should

be replaced. Damaged clamps should be replaced. All external leaks should be corrected as soon as detected.

Coolant Filter/Conditioners. These are used on certain engines to filter impurities such as scale or sand from the coolant. Filter elements are treated with chemicals that soften coolant water, minimize scale deposits, maintain an acid-free environment, and act as a rust preventive. Coolant filter/conditioner elements should be replaced every 300 hours. On marine units they should be replaced every 150 hours, or annually, whichever comes first.

I. When to Service the Dry Type Air Cleaner

Most dry type air cleaner elements must be discarded and replaced with new elements when the maximum allowable air cleaner restriction has been reached, or annually. Some air cleaners are equipped with a restriction indicator which aids in determining the servicing interval.

Before attempting to clean or reuse dry type air cleaner elements, follow the manufacturer's recommendations on reuse and observe his prescribed cleaning, drying, and inspection guidelines carefully. This information is available from the manufacturer or distributor of the elements. Do not reuse damaged air cleaner elements.

SERVICE PUBLICATIONS

The service manual covering Detroit Diesel Series 92 engines is shown below. Also listed are reference works which may be of interest to the owner/operator.

To purchase a copy of any of these publications, contact an author-

ized Detroit Diesel service outlet. Check the Yellow Pages under "Engines, Diesel" or refer to the Worldwide Distributor and Dealer Directory (form 6SE280) for the distributor or service outlet nearest you.

Description	Form No.
Series 92 Engine Service Manual	6SE379
DDEC II Troubleshooting Guide	6SE489
Worldwide Distributor/Dealer Directory	6SE280
Lube Oil, Fuel, Filter Recommendations	7SE270
Coolant Recommendations	7SE298
Lube Oil, Fuel, Filter Recommendations For Methanol-Fueled Engines	7SE413

CUSTOMER ASSISTANCE

The satisfaction and goodwill of the owners of Detroit Diesel engines are of primary concern to Detroit Diesel Corporation and its distributor/dealer organization.

As the owner of a Detroit Diesel product you have a complete network of over 3,000 Detroit Diesel service outlets in the U.S. and Canada, plus many outlets worldwide that are prepared to meet your parts and service needs:

Identify the U.S. regional area from the map below:



EASTERN REGION

W. Long Branch, New Jersey
187 Monmouth Park Highway
W. Long Branch, NJ 07764
Phone: (908) 222-1888
FAX: (908) 222-3411

SOUTHEAST REGION

Atlanta, Georgia
100 Galleria Parkway, Suite 1170
Atlanta, GA 30339
Phone: (404) 953-3696
FAX: (404) 952-5482

CENTRAL REGION

Detroit, Michigan
13400 Outer Drive, West
Detroit, MI 48239-4001
Phone: (313) 592-5990
FAX: (313) 592-5158

SOUTHWEST REGION

Dallas, Texas
2711 LBJ Freeway, Suite 1036
Dallas, TX 75234
Phone: (214) 247-4313
FAX: (214) 247-4316

WESTERN REGION

Downey, California
10645 Studebaker Road
Downey, CA 90241
Phone: (213) 929-7016
FAX: (213) 864-0502

CANADIAN REGION

London, Ontario
Detroit Diesel of Canada Ltd.
150 Dufferin Ave., Suite 701
London, Ont. N6A 5N6, Canada
Phone: (519) 661-0149
FAX: (519) 661-0171

ASIA/PACIFIC REGION

Jurong Town, Singapore
7 Jurong Pier Rd.
Singapore, 2261
Phone: (65) 265-4697
Telex: RS20141 A/B DDC51N
FAX: (65) 265-9530

EUROPE, MIDDLE EAST,

AFRICA REGION

Northampton, England
Riverside House
Riverside Way
Northampton
England NN1 5NX
Phone: (44) 604-26169
Telex: 31329
FAX: (44) 604-24058

LATIN AMERICAN REGION

Coral Gables, Florida
2277 N.W. 14th Street
Latin America Building
Miami, FL 33125 U.S.A.
Phone: 305-637-1555
Telex: 408233 Detroit Diesel
FAX: (305) 637-1580

- Service by trained personnel.
- Sales teams to help determine your specific power requirements.
- In many areas, emergency service 24 hours a day.
- Complete parts support including reliable components.
- Product information and literature.

We recognize however, that despite the best intentions of everyone concerned, misunderstandings may occur. Normally, any situation that arises in connection with the sale, operation or service of your product will be handled by the authorized service outlet in your area (in the U.S. and Canada check the Yellow Pages for the Detroit Diesel service outlet nearest you).

To further assure your complete satisfaction, we have developed the following procedure to be followed in the event you have a problem that has not been handled satisfactorily.

Step One

Discuss your problem with a member of management from the authorized service outlet. Frequently, complaints are the result of a breakdown in communication and can quickly be resolved by a member of management. If you have already discussed the problem with the Sales or Service Manager, contact the General Manager. If your complaint originates with a dealer, explain the matter to a management member of the distributorship with whom the dealer has his service agreement.

Step Two

When it appears that your problem cannot readily be resolved at the distributor level without additional assistance, contact the Detroit Diesel Regional Product Support or Operations Manager responsible for your local distributor. You will be assisted by a member of the Manager's staff, depending upon the nature of your problem.

Prior to this contact, have the following information available:

- Name and location of authorized service outlet.
- Type and make of equipment.
- Engine model and serial number.
- Engine delivery date and accumulated hours of operation.
- Nature of problem.
- Chronological summary of engine's history.

Step Three

If you are still not satisfied, present the entire matter in writing or by phone to:

**Director,
Reliability and Materials Engineering**
Detroit Diesel Corporation
13400 Outer Drive, West
Detroit, Michigan 48239-4001
Phone: (313) 592-7357

When contacting the regional or home office, please keep in mind that ultimately your problem will likely be resolved at the distributorship or dealership, utilizing their facilities, equipment, and personnel. Therefore, it is suggested that you follow the above steps in sequence when experiencing a problem.

SPECIFICATIONS

LUBRICATING OIL FILTERS			
Filter Type	DDC Part No.	AC Part No.	Micron Rating
Full Flow	25013192	PF-911L	12

FUEL FILTERS			
Filter Type	DDC Part No.	AC Part No.	Micron Rating
<u>Spin-On</u> Primary	25010793	T-915	30
Primary w/separator	25011911	TP-1057	30
Secondary	25010778	TP-916	12
Primary (large can)	25011024	T-958	30
Secondary (large can)	25011026	TP-959	12
<u>Cartridge</u> Primary Secondary	6436075 5574533	T-552 TP-540X	30 12

COOLANT FILTERS			
Series	Cooling System Capacity (Gal)	DDC Precharge Element Part No.	DDC Maintenance Element Part No.
6V-92	13-22	23507189	23507545
8V-92	22-24	23508427	23508425
12V-92	40-50	23508428	23508426
16V-92	47	23508428	23508426

ADDITIONAL COOLANT INHIBITOR TREATMENT PRODUCTS		
Item	Size	DDC Part No.
NALCOOL 2000* -Liquid	Pint (12 per case)	23507858
	Half Gallon (6 per case)	23507859
	5 Gallon	23507860
NALCOOL 3000* -Liquid	Pint (12 per case)	23507854
	Half Gallon (6 per case)	23507855
	5 Gallon	23507856
NALPREP 2001* -Liquid On-Line Cleaner	Half Gallon (6 per case)	23507862
	5 Gallon	23507863
Nalco 2015* Twin Pac- Dry Chemical Cleaner/Conditioner	2 per case	23507867

*NALCOOL, Nalco, and NALPREP are registered trademarks of the Nalco Chemical Company.