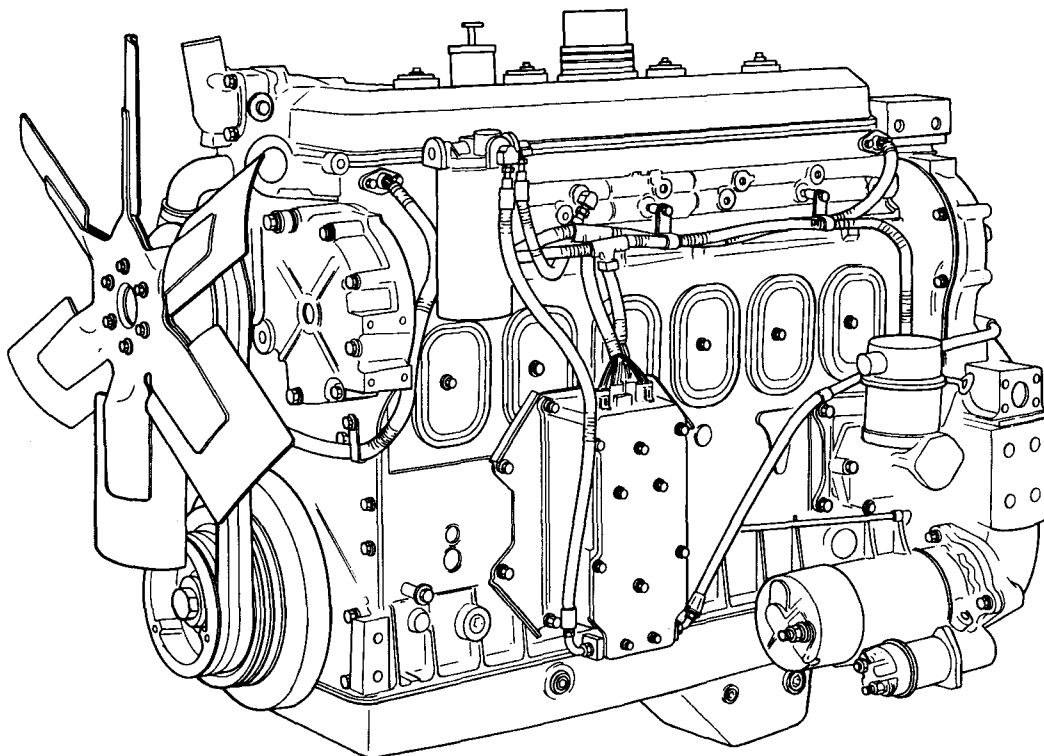


# **DETROIT DIESEL**

---

## **Inline 71**



### ***Engine Operator's Guide***

---

## To the Operator

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.

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.

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

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

Whenever possible, it will benefit you to rely on an authorized Detroit 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 for Series 53, 71 and 92 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.**

## Table of Contents

Subject	Page
ENGINE MODEL AND SERIAL NUMBER DESIGNATION .....	1
Option and Certification Labels .....	1
OPERATING INSTRUCTIONS.....	3-9
Preparations for Starting the Engine the First Time .....	3
Starting the Engine.....	6
Running the Engine.....	7
Stopping the Engine .....	8
Emergency Jump Starting .....	9
DDEC OPTIONS.....	10-15
ENGINE SYSTEMS .....	16-17
Fuel System.....	16
Lubrication System .....	16
Air System .....	16
Cooling System .....	17
Electrical System.....	17
Exhaust System.....	17
INLINE 71 ENGINE VIEWS .....	18-19
ENGINE MAINTENANCE SCHEDULES.....	20-25
LUBRICATION AND PREVENTIVE MAINTENANCE INTERVALS.....	26-39
"HOW TO" SECTION .....	40-54
How to Select Lubricating Oil .....	40
When to Change Oil.....	42
How to Replace the Lube Oil Filter .....	43
How to Select Fuel Oil.....	45
How to Replace the Fuel Filter and Strainer .....	48
Engine Out of Fuel—How to Restart .....	50
How to Select Coolant.....	50
How to Drain and Flush the Cooling System .....	53
BASIC TROUBLESHOOTING .....	55-58
SERVICE PUBLICATIONS.....	59
CUSTOMER ASSISTANCE .....	60-61
SPECIFICATIONS .....	62-63

## **ENGINE MODEL AND SERIAL NUMBER DESIGNATION**

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

Machined plate on the left side, upper front corner just below the fire deck.

## **Option Labels**

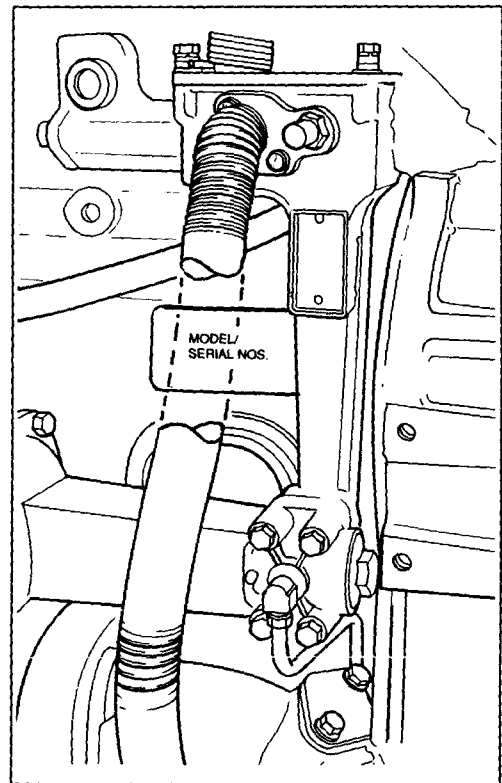
Computerized engine option labels are attached to the valve rocker cover. These labels contain the engine serial number and model number and, in addition, list any optional equipment used on the engine. Labels also include required tune-up information (injection timing, valve lash, max. no-load RPM,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

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.

## **Certification Labels**

If required, a certification label is attached to the valve rocker cover. This 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.



*Location of Engine Serial and Model Numbers*

IMPORTANT ENGINE INFORMATION  
 1993 THIS ENGINE CONFORMS TO U.S. EPA  
 CAL REGULATIONS APPLICABLE TO 1993 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 72.6 MM3/STROKE ADV. HP 270 AT 2100 RPM  
 INITIAL INJECTION TIMING 14 DEG. BTC CID 426  
 ENGINE FAMILY NDD0426FZK5 MIN. IDLE 600 RPM  
 MODEL 6L 71TA DDEC COACH ALCC MFG. DATE MAY 1993  
 UNIT 06A0468591

**DETROIT DIESEL**  
 CORPORATION  
 U.S.A.



FEL BSP 0.35  
 L12157

0374 CYL BLOCK	0252 AIR BOX DRAIN	THIS ENGINE DESIGNED TO OPERATE AT 0270 HP AT 02100 RPM INJ. TIMING 1.520 VALVE LASH .016 STARTING AID .000 THRDTLY/FMOD .000 MAX RPM NL 02225 STD GT RET CAM
0002 ENG LIFT BKT	0784 F/W HOUSING	
0175 VIB DAMPER	0726 FLYWHEEL	
0436 CONN ROD/PSTN	0848 OIL PAN	
0018 OIL PUMP	0610 OIL DIST	
0182 OIL FIL TUBE	1220 OIL COOLER	
1249 DIPSTICK	0899 VENT SYSTEM	
0107 C/S COVER	0445 C/S PULLEY	
0275 WATER PUMP	0465 WATER CONN	
UNIT 06A0468591 S.O. 3A28395 MODEL 10672B22 SPEC 87 0377		

**DETROIT DIESEL**  
 CORPORATION  
 U.S.A.



L12157

0156 WAT PUMP CVR	0403 THERMOSTAT	0466 WAT BY PASS
0331 THERMOSTAT	0442 EXH MFLD	0175 FUEL PUMP
0263 INJ DDEC	0677 BLOWER	1330 TURBOCHARGER
1897 FUEL LINES	0861 AIR INLT HSG	0224 INJ CONT ELEC
0195 HYD PUMP DRV	0761 CAM/GR TRAIN	0415 VALVE MECH
0322 ROCKER COVER	0294 ACC DRIVE	0424 ACC DRIVE

**DETROIT DIESEL**  
 CORPORATION  
 U.S.A.



L12157

UNIT 06A0468591 S.O. 3A28395 MODEL 10672B22 SPEC 87 0377

THIS ENGINE IS CERTIFIED FOR USE IN AN URBAN BUS AS DEFINED AT 40  
 CFR 86.091 2.

**DETROIT DIESEL**  
 CORPORATION  
 U.S.A.



UNIT 06A0468591

L12157

Typical Engine Option and 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 Engine Maintenance charts (pages 20-25).

**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

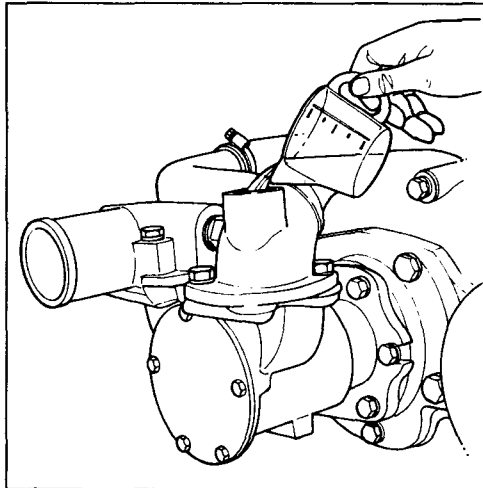
1. Make sure all the drain cocks in the cooling system are installed (drain cocks are often removed for shipping) and are closed tightly.
2. Open the petcock near the top of the water-cooled turbocharger (if used), and any other petcocks, if so equipped.
3. Remove the radiator or heat exchanger pressure 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 50).

4. After filling the cooling system, close all petcocks. Fill the coolant recovery bottle (if equipped) to the "full cold" level.
5. Entrapped air must be purged after filling the cooling system. To do this, refer to "Inspection-Cooling System" under "Running the Engine" (page 7).
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 with a *new* gasket.

**NOTICE:** Failure to install a new gasket and tighten cover bolts securely can result in pump leakage at start-up.

- 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.

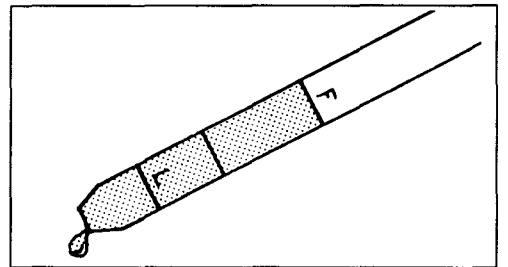
### **Lubricating System Checks**

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 ensure an immediate flow of oil to all bearing surfaces at initial engine start-up, the engine lubrication system should be charged with a

commercially available pressure pre-lubricator. 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 40) for lubricant requirements.

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



*Check Lube Oil Level Before Starting*

### **Fuel System Checks**

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 45) for fuel recommendation. Make sure the fuel supply shutoff valve (if used) is open.

To ensure 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 inlet of 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. Plunger and bushing assemblies 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. Detroit Diesel recommends installation of a fuel/water separator wherever water contamination is a concern.

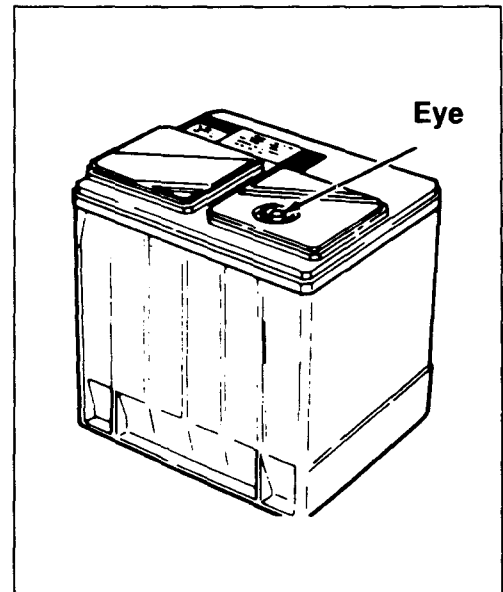
### Other Checks

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. Check the hydrometer "eye" of maintenance-free batteries for charge. If lead-acid or low maintenance batteries

are used, make sure battery electrolyte level is normal.

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



*Check "Eye" of Maintenance-Free Batteries*



## Starting the Engine

Before starting the engine the first time, perform the operations listed under **Preparations for Starting the Engine the First Time** (pages 3-5).

If the engine has an emergency manual or automatic shutdown system, make sure the control is set in the *open* position before starting.

**NOTICE:** The turbocharger may be seriously damaged if the engine is cranked with the air shutdown in the *closed* position.

If the unit is located in a closed room, start 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 Non-DDEC Engine

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. Press the starter switch firmly.

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

**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. (Most air starter-equipped vehicles have a dash-mounted pressure gauge.) 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.

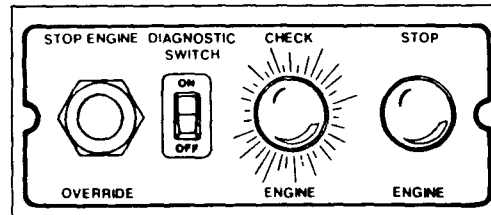
### Starting Tip—Non-DDEC Electric Start Engines:

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 15 seconds). This will preheat the cylinders and reduce white smoke at start-up.

### Initial Engine Start DDEC Engine

1. With the transmission in neutral or park, turn the ignition key on.  
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.



*Typical Shutdown Override Switch and Engine Lights*

2. With foot OFF the foot pedal, start the engine *after* the lights go out. Start the engine by pressing the starter switch firmly.

**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.

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

If the engine fails to start within 15 seconds, release the starter switch and allow the starting motor to cool for 15 seconds before trying again. If the engine fails to start after four attempts, an inspection should be made to determine the cause.

## 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 does not fall within these guidelines, it should be checked with a manual gauge.

**CAUTION:** To avoid personal injury from the hot oil, do not operate the engine with rocker cover 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

**Transmission, Marine Gear**—While the engine is idling, check the transmission or marine gear for proper oil level and add oil as required. 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.

**Cooling System**—Entrapped air **must** be purged after the cooling system is filled. To do this, allow the engine to warm up without the radiator or heat exchanger pressure cap installed.

With the transmission or marine gear in neutral, increase engine rpm above 1000 rpm and add coolant as required. On marine engines vent the petcock on the water return line at the water-jacketed turbocharger (if used) until a steady stream of coolant (no air) comes out. Install the pressure cap after the coolant level has stabilized at the bottom of the radiator or heat exchanger filler neck. Refill the recovery bottle as needed if coolant is drawn into the engine.

If all of the coolant is drawn out of the recovery bottle when the engine cools, remove the pressure cap from the radiator or heat exchanger and check to make sure the coolant level is at the bottom of the filler neck. Add coolant as required and replace the pressure cap. Fill the recovery bottle to the "Full Cold" level, or no more than one-quarter of its volume.

**NOTICE:** Failure to properly fill the cooling system and purge it of air can result in engine overheating and serious engine damage.

Do not overfill the recovery bottle, since this can result in spillage as the coolant expands during engine operation.

**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 40) 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.

**CAUTION:** To avoid personal injury or turbocharger damage, do not remove, attach, or tighten turbocharger air intake ducting while the engine is operating or operate the engine with the ducting removed.

### **Avoid Unnecessary Idling**

During long engine idling periods with the transmission 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 oil 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 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 1,000 rpm with no load for four (4) or five (5) minutes. This allows the engine to cool and permits the turbocharger 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 to the bearings.

### **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 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.

**NOTICE:** If the emergency air shutdown is used to stop the engine in an emergency situation, always have the shutdown checked for damage and for proper operation before the vehicle, vessel, or machine is returned to service. This is especially important if shutdown is made at high engine rpm. To ensure positive valve closure should another emergency shutdown be required, the shutdown **must** be checked and required repairs or adjustments made at this time. **Failure to observe this precaution may permit engine run-on when the emergency shutdown is activated.**

### **Emergency Jump Starting**

Before attempting to jump start the engine, make sure jumper cables are connected properly (positive to positive, negative to negative) and in the proper sequence (negative to negative ground *last*).

**NOTICE:** Failure to observe this precaution can result in alternator and/or equipment damage.

**CAUTION:** Reversing battery polarity can also result in personal injury caused by the sudden discharge of electrolyte from the battery vents and/or the sudden rupture of the battery case caused by explosion of internal hydrogen gas.

### **DDEC Engines**

The DDEC electronic control system operates on 12 volts DC. Normal operating voltages at the ECM (electronic control module) are 11 to 16 volts. **If an engine with an electric starting motor requires emergency jump starting, do not exceed 16 volts DC or attempt to use a 24-volt system to start the engine.**

**NOTICE:** Jump starting with voltages greater than 16 volts or reversing polarity will damage the ECM.

## DDEC OPTIONS

Engines having Detroit Diesel Electronic Controls (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/shutdown 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 and turn the ignition key on.

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.

With foot OFF the foot pedal, 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.

**The DDEC engine is equipped with an electronically controlled fuel injection system.**

**DDEC engines have the ability to perform diagnostics for self-checks and continuous monitoring of other system components.** Depending on application, DDEC can also monitor oil temperature, coolant temperature, oil pressure, fuel spill 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.

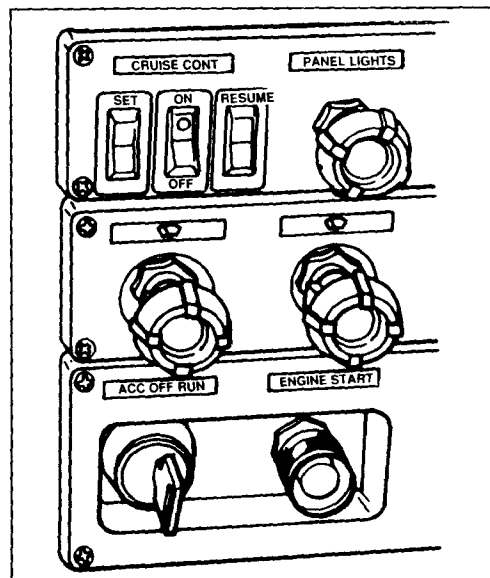
**NOTICE:** If the engine is equipped with the power-down/shutdown option, there will be a system override button or switch which may be used to allow engine operation for a short period of time. If the shutdown override button is not used, the shutdown will occur in 30 seconds.

**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.

### Cruise Control

A DDEC-equipped vehicle 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 30 or 35 mph (depending on vehicle specifications) 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.

**NOTICE:** When descending a hill with cruise control "on" or "off," do not allow the engine to exceed 2300 rpm under any conditions. Failure to observe this precaution can result in overspeeding and serious engine damage.

**CAUTION:** To avoid the possibility of vehicle damage and/or personal injury, Detroit Diesel 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 (Electronic Foot Pedal Assembly) 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 destination when the "Check Engine" light (or CEL) 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 shut down the engine to avoid serious damage.

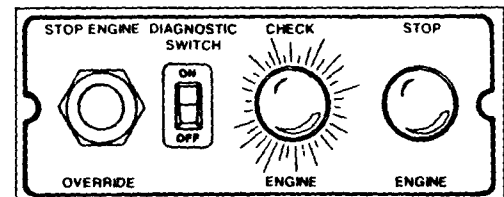
The "Stop Engine" malfunction is recorded in the Electronic Control Module. With the 30 second shutdown option, the engine will begin a 30 second, stepped, power down sequence until it shuts down completely.

**"Stop Engine" Override**—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 very 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.**



*Typical Shutdown Override Switch and Engine Lights*

**The "Immediate Speed Reduction" option** will bring engine rpm back to a predetermined speed, but will not shut down the engine.

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

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

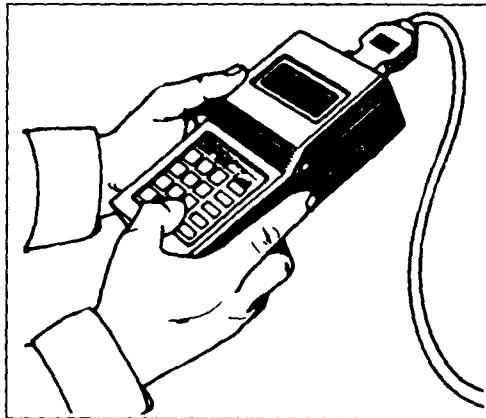
- Loss of coolant
- High oil temperature
- Low oil pressure
- Auxiliary shutdown

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 (Diagnostic Data Reader, or "DDR") is available that can be plugged into the engine computer memory to extract information related to the cause of the problem.



*Diagnostic Data Reader J38500*

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

The DDR can distinguish between codes now active and those stored in the historic code memory.

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

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 working satisfactorily.

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 chart (page 14).

**NOTICE:** 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.

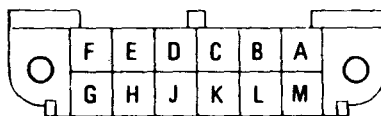
### **Welding Precaution**

**NOTICE:** To prevent damage to the DDEC electronic control system, disconnect battery power and ground cables and the 6-pin power connector at the ECM (electronic control module) before welding. **Failure to isolate the DDEC system from high current flow can result in severe ECM damage.**



## Diagnostic Codes

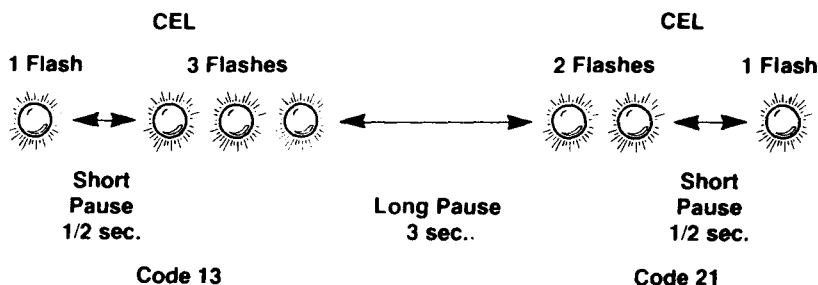
### Diagnostic Connector



**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	Power Take-off Sensor Lo Volt	43	Low Coolant Level
12	Power Take-off Sensor 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
21	Throttle Pos Sensor Hi Volt	51	EEPROM Error
22	Throttle Pos Sensor Lo Volt	52	ECM - A/D Fail
23	Fuel Temp Sensor Hi Volt	53	EEPROM Memory Fails
24	Fuel Temp Sensor Lo Volt	54	Vehicle Speed Sensor
25	No Codes	55	Proprietary Comm. Link
26	Power Control Enabled	56	ECM - A/D Fail
31	Fault on Auxiliary Output	58	Cruise Ctl/Press Gov Ctl Switch
32	ECM Backup System Fail	61-68	Inj Response Time Long
33	Turbo Bst Sensor Hi Volt	71-78	Inj Response Time Short
34	Turbo Bst Sensor Lo Volt	84	Crankcase Pressure Hi
35	Oil Prs Sensor Hi Volt	85	Engine Overspeed
36	Oil Prs Sensor Lo Volt	86	Press Gov Ctl - Hi Volt
37	Fuel Prs Sensor Hi Volt	87	Press Gov Ctl - Lo Volt
38	Fuel Prs Sensor Lo Volt		
41	Timing Reference Sensor		
42	Synchronous Ref Sensor		

### CEL EXAMPLES



**NOTE:** The CEL flashing gives both active and historic codes

**CAUTION:** The operator of a DDEC-equipped engine should know the extent of the warning system on his vehicle, 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. This information may also be obtained at any authorized Detroit Diesel service outlet.

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

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

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

## **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 fuel system on DDEC engines also includes electronic fuel system controls and a cooling plate for the electronic control module (ECM).

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 relief and regulator valves at the lube oil pump.

### **Air System**

In the air system used on Inline 71 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 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. Certain generator set appli-

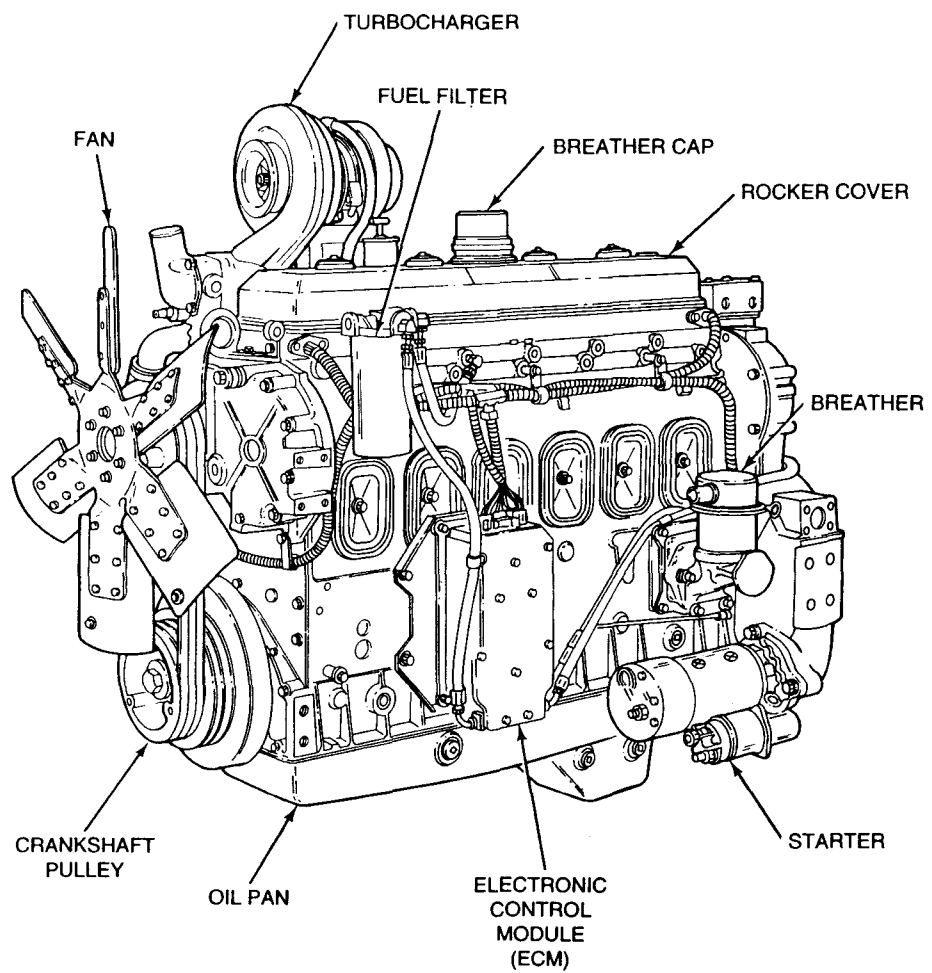
cations may also use heat exchangers. Each system has a centrifugal type fresh water pump to circulate coolant within the engine. Each system also incorporates thermostats to maintain normal engine operating temperature.

### **Electrical System**

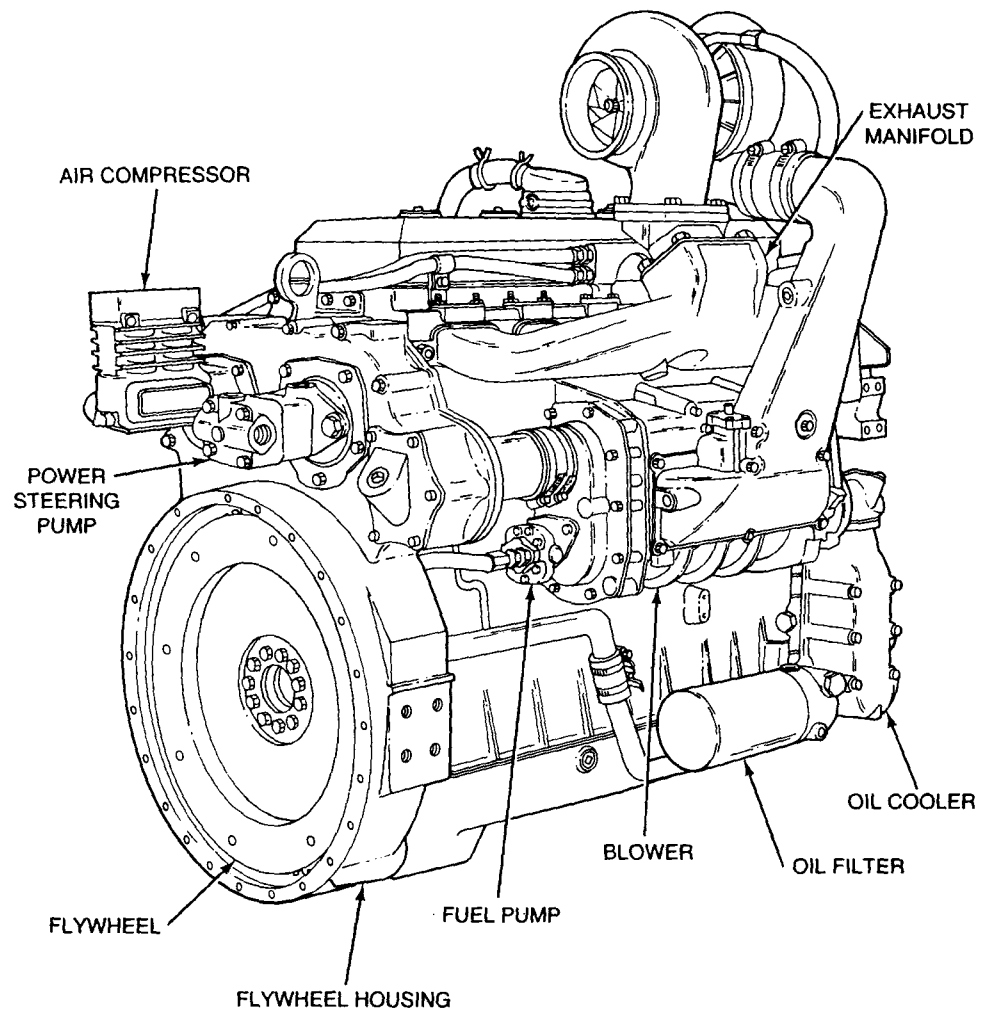
The electrical system generally consists of a starting motor, starting switch, battery-charging alternator, storage batteries, and the necessary wiring.

### **Exhaust System**

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



**TYPICAL INLINE 71 ENGINE**

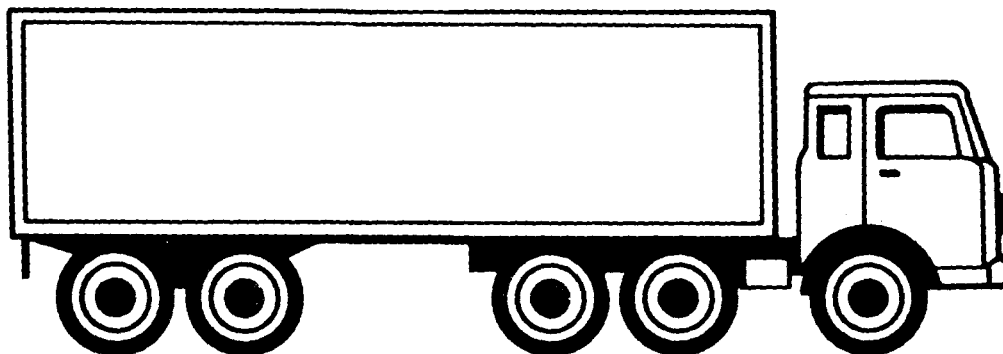


**TYPICAL INLINE 71 ENGINE**

## VEHICLE ENGINE MAINTENANCE

<b>DAILY</b>		<b>SERVICE RECOMMENDATIONS VEHICLE ENGINES (Continued Next Page)</b>
Lubricating Oil (1)	①	
Fuel Tank (2)	①	
Fuel Lines and Flexible Hoses (3)	①	
Cooling System (4)	①	
Turbocharger, Exhaust Conns. (5)	①	
<b>3000 MILE INTERVAL</b>		
Battery* (6)	①	
<b>6000 MILE INTERVAL</b>		
Drive Belts* (8)	①	
Air Compressor* (23)	①	
Throttle Controls* (24)	①	
<b>15,000 MILE INTERVAL</b>		
Fuel Tank* (2)	①	
Overspeed Governor* (28)	①	
Dry Type Air Cleaner* (7)	①	
Lubricating Oil* (1)	Ⓡ	
Lubricating Oil Filter* (9)	Ⓡ	
<b>Codes</b>		
*See Item in Text	① Inspect, Service, Correct, Replace (If Necessary)	Ⓡ Replace

NOTE: Numbers after each item refer to the lubrication and preventive maintenance intervals section which follows.



## VEHICLE ENGINE MAINTENANCE

MONTHS	6	12	18	24	30	36	42	48	54	60	120
MILES 1000 X	10	20	30	40	50	60	70	80	90	100	200
Fuel Filters (10)	(R)	(R)	(R)	(R)	(R)	(R)	(R)	(R)	(R)	(R)	
Water Pump* (11)	(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* (23)		(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)* (34)		(I)		(I)		(I)		(I)		(I)	
Radiator* (26)		(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* (31)		(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/Conditioner* (11)											
Fuel Lines, Flex Hoses* (3)		(I)		(I)		(I)		(I)		(R)	
Air Box Drain Tube* (25)			(I)			(I)			(I)		
Air Shutdown Valve* (12)		(I)		(I)		(I)		(I)		(I)	
Shutter Operation* (27)		(I)		(I)		(I)		(I)		(I)	
Throttle Delay/Fuel Modulator* (29)					(I)					(I)	
Air Box Check Valves* (25)										(I)	
Fan Hub* (30)		(I)		(I)		(I)		(I)		(I)	
Blower Screen* (32)			(I)								
Engine Tune-Up* (17)	AS REQUIRED										
Codes											
*See Item in Text	(I) Inspect, Service, Correct, Replace (If Necessary)					(R) Replace					

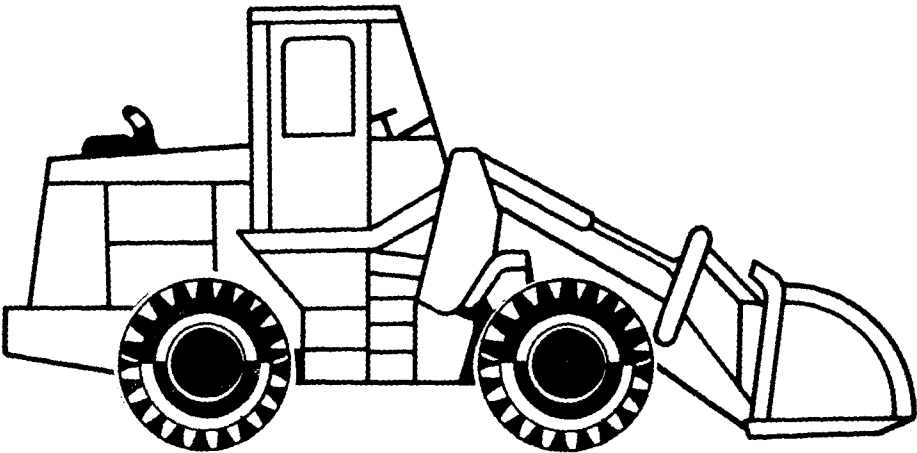
NOTE: Numbers after each item refer to the lubrication and preventive maintenance intervals section which follows.



# STATIONARY AND INDUSTRIAL ENGINE MAINTENANCE

DAILY		SERVICE RECOMMENDATIONS STATIONARY AND INDUSTRIAL ENGINES (Continued Next Page)
Lubricating Oil (1)	①	
Fuel Tank (2)	①	
Fuel Lines and Flexible Hoses (3)	①	
Cooling System (4)	①	
Turbocharger, Exhaust Conns. (5)	①	
Air Cleaner (Oil Bath) (7)	①	
100 HOUR OR 3,000 MILES		
Battery* (6)	①	
150 HOUR OR 4,500 MILES		
Lubricating Oil* (1)	Ⓡ	
Lubricating Oil Filter* (9)	Ⓡ	
150 HOUR OR 5,000 MILES		
Air Compressor* (23)	①	
200 HOUR OR 6,000 MILES		
Drive Belts* (8)	①	
Throttle Controls* (24)	①	
600 HOURS OR 18,000 MILES		
Water Pump (11)*	①	
Codes		
*See Item in Text	① Inspect, Service, Correct, Replace (If Necessary)	Ⓡ Replace

NOTE: Numbers after each item refer to the lubrication and preventive maintenance intervals section which follows.



## STATIONARY AND INDUSTRIAL ENGINE MAINTENANCE

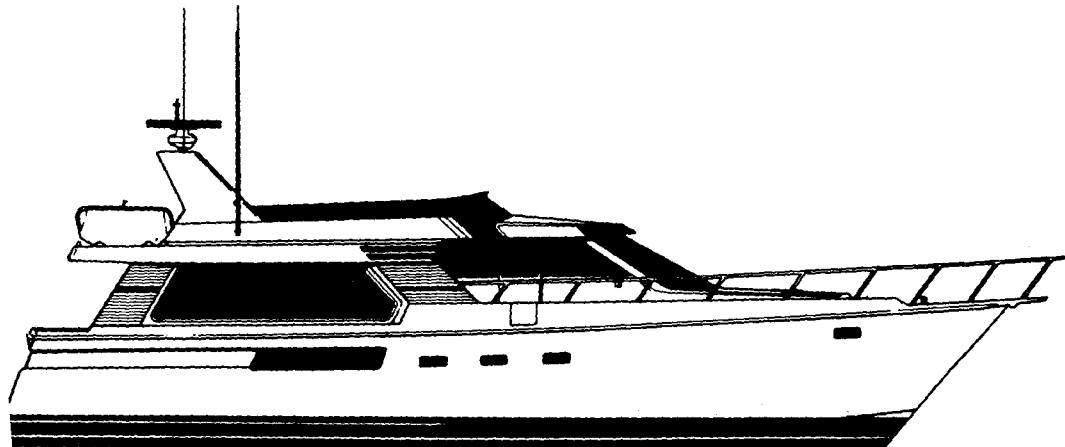
MONTHS	6	9	12	18	36	60	120
HOURS	300	500	700	1,000	2,000	3,000	6,000
Fuel Tank* (2)		Ⓘ	Ⓘ				
Fuel Lines and Flexible Hoses* (3)		Ⓘ			Ⓡ		
Cooling System* (4)			Ⓘ				
Drive Belts* (8)							
Air Compressor* (23)			Ⓘ				
Air Cleaner* (7)		Ⓘ	Ⓡ				
Fuel Filters* (10)							
Water Pump, Seal* (11)							Ⓡ
Tachometer Drive* (22)						Ⓘ	
Air System* (7)			Ⓘ				
Turbocharger, Exhaust Connections* (5)			Ⓘ				
Engine (Steam Clean)* (34)			Ⓘ				
Radiator* (26)			Ⓘ				
Oil Pressure* (13)			Ⓘ				
Battery Charging Alternator* (14)			Ⓘ				
Engine & Transmission Mounts* (15)					Ⓘ		
Thermostats & Seals* (31)							Ⓘ
Crankcase Breather* (16)				Ⓘ			
Crankcase Pressure* (16)				Ⓘ			
Blower Screen* (32)					Ⓘ		
Blower Bypass Valve* (21)						Ⓘ	
Coolant Filter/Conditioner* (11)							
Fuel Lines and Flexible Hoses* (3)						Ⓡ	
Air Box Drain Tube* (25)				Ⓘ			
Air Shutdown Valve* (12)		Ⓘ	Ⓘ				
Governor, Overspeed Governor* (28)		Ⓘ					
Shutter Operation* (27)			Ⓘ				
Raw Water System Zincs* (18)							
Throttle Delay/Fuel Modulator* (29)							
Air Box Check Valves* (25)						Ⓘ	
Fan Hub* (30)			Ⓘ				
Fuel and Boost Coolers* (35)							
Heat Exchanger* (36)							
Fuel Injectors* (37)							
Engine Tune-Up* (17)	AS REQUIRED						
Codes							
*See Item in Text	Ⓘ Inspect, Service, Correct, Replace (If Necessary)				Ⓡ Replace		

NOTE: Numbers after each item refer to the lubrication and preventive maintenance intervals section which follows.

## MARINE ENGINE MAINTENANCE

<b>DAILY</b>		<b>SERVICE RECOMMENDATIONS MARINE ENGINES (Continued Next Page)</b>
Lubricating Oil (1)	①	
Fuel Tank (2)	①	
Fuel Lines and Flexible Hoses (3)	①	
Cooling System (4)	①	
Turbocharger, Exhaust Conns. (5)	①	
Air System, Cleaners* (7)	①	
Fuel/Water Separator and Filter* (10)	①	
Oil Pressure* (13)	①	
Marine Gear* (20)	①	
Raw Water Pump* (19)	①	
<b>150 HOUR</b>		
Lubricating Oil* (1)	Ⓡ	
Lubricating Oil Filter* (9)	Ⓡ	
Drive Belts (Marine) (8)	①	
Cooling System* (4)	①	
Fuel/Water Separator and Filter (10)	Ⓡ	
Coolant Filter* (11)	Ⓡ	
<b>Codes</b>		
*See Item in Text	① Inspect, Service, Correct, Replace (If Necessary)	Ⓡ Replace

NOTE: Numbers after each item refer to the lubrication and preventive maintenance intervals section which follows.



## MARINE ENGINE MAINTENANCE

HOURS	150	300	500	1,000
Fuel Tank (2)				
Fuel Lines and Flexible Hoses* (3)			①	①
Cooling System (4)	①		①	
Drive Belts* (8)	①			
Air Cleaner* (7)			①	
Fuel Filters* (10)	Ⓡ			
Water Pump, Seal* (11)				
Tachometer Drive (22)		①		
Air Separators* (7)			Ⓡ	
Air System (7)				
Turbocharger, Exhaust Connections (5)*				
Engine (Steam Clean) (34)*				
Oil Pressure (13)*			①	
Battery Charging Alternator* (14)		①		
Engine & Transmission Mounts (15)*				①
Closed Crankcase Collectors* (16)				①
Thermostats & Seals* (31)				
Crankcase Breather* (16)				①
Crankcase Pressure* (16)				①
Blower Screen (32)				
Blower Bypass Valve (21)				
Coolant Filter/Conditioner* (11)	Ⓡ			
Fuel Lines and Flexible Hoses* (3)				
Air Box Drain Tube* (25)				①
Air Shutdown Valve* (12)			①	
Governor, Overspeed Governor (28)			①	
Raw Water System Zincs (18)				
Throttle Delay/Fuel Modulator* (29)				
Air Box Check Valves (25)*				①
Marine Gear* (20)				①
Fuel and Boost Coolers* (35)				
Heat Exchanger* (36)				
Fuel Injectors* (37)				Ⓡ
Engine Tune-Up* (17)	AS REQUIRED			
Codes				
*See Item in Text	① Inspect, Service, Correct, Replace (If Necessary)		Ⓡ Replace	

NOTE: Numbers after each item refer to the lubrication and preventive maintenance intervals section which follows.

## 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 Inline 71 engines. Intervals indicated on the chart are time (hours or mileage) of actual operation.

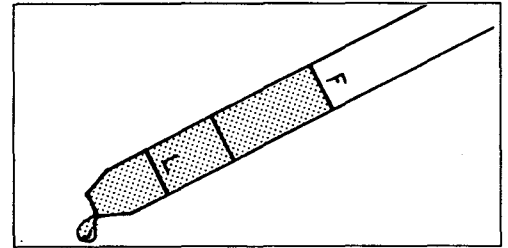
The intervals shown apply only to the maintenance functions described. These functions should be coordinated with other regularly scheduled maintenance.

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 (6SE164). 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.



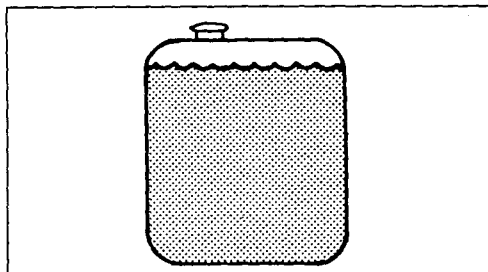
*Check Oil Level Daily*

**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 microorganisms that can clog fuel filters and restrict fuel flow. To prevent microbe growth add a biocide such as **Nalcool Fuel Prep (or equivalent)** to the fuel tank or primary fuel supply. Follow manufacturer's usage, handling, and safety recommendations.

Water accumulation, fuel gelling, or freeze-up can be controlled by mixing **Nalcool Winter Thaw or Winter Pow-R Plus (or equivalent)** into the fuel. Follow manufacturer's

usage, handling, and safety recommendations. **Detroit Diesel does not recommend adding Nalcool Winter Thaw or 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 (700 hours) or 20,000 miles (32,000 km) 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.**

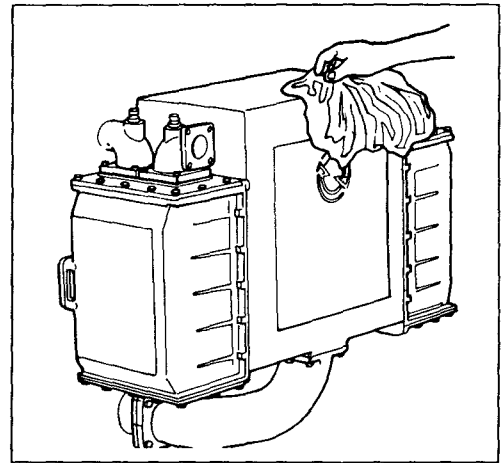
**Service life-** A hose has a finite service life. With this in mind, all hoses should be thoroughly inspected at least every 500 operating hours (1,000 hours for fire-resistant fuel and lubricating oil hoses) and/or annually. Look for cover damage and/or indications of twisted, worn, crimped, brittle, 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.**

**EXCEPTION:** Replace all cooling system hoses on pleasure craft marine engines after 1,000 hours of service, regardless of apparent condition.

Cooling system hoses on commercial marine engines do not require automatic replacement after 1,000 hours, but should be replaced at overhaul.

Fire resistant fuel and lube oil hose assemblies do not require automatic replacement after five years service or at major overhaul, but should be inspected thoroughly before being put back into service.



*Remove Heat Exchanger or Radiator 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.

#### **Item 4 - Cooling System**

Check the coolant level daily and maintain it near the bottom of the filler neck on the radiator or heat exchanger tank. On some installations 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 or 15,000 miles (24,000 km) (maximum) intervals or at maintenance intervals, whichever comes first.

#### **Coolant Drain Interval**

**Detroit Diesel recommends replacing coolant with genuine Detroit Diesel Power Cool antifreeze or equivalent permanent type antifreeze annually.** However, a cooling system properly maintained and protected with supplemental corrosion inhibitors can be operated up to these intervals:

- On-Highway, Industrial, Gen Set – Two years, 200,000 miles (320,000 km) or 4,000 hours\*
- Commercial Marine – Two years or 4,000 hours\*
- Pleasure Craft Marine – One year or 1,000 hours\*

\*Whichever comes first

At these intervals, the coolant *must* be drained and the cooling system cleaned thoroughly. The cooling



system should then be replenished with **Power Cool** or equivalent ethylene glycol-base antifreeze/water solution in the required concentration and required genuine Detroit Diesel Maintenance Product cooling system inhibitors should be added. In extremely hot environments, clean, soft, properly inhibited water may be used in place of antifreeze. If water is used, supplemental coolant additive levels should be increased from 3% to 6% by volume.

**Coolant Filter/Conditioners.** These are used on certain engines to filter impurities such as scale or sand for 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 six months or 10,000 miles (16,000 km) whichever comes first. On marine units they should be replaced every 150 hours, or annually, whichever comes first.

**Cooling System Hoses-** All cooling system hoses should be inspected at least every 500 hours for signs of deterioration and replaced, if necessary, refer to item 3.

**Water Cooling System-** Drain the end of each boating season.

**Strainers-** Inspect sea strainers daily. Clean sea strainers at least daily. Clean more often if surface weed growth or water contamination levels are fairly high.

### **5 - Turbocharger, Fuel Connections**

Regularly inspect the mountings, and exhaust ducting and connections for leaks daily. Check the oil 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 (32,000 km), 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.

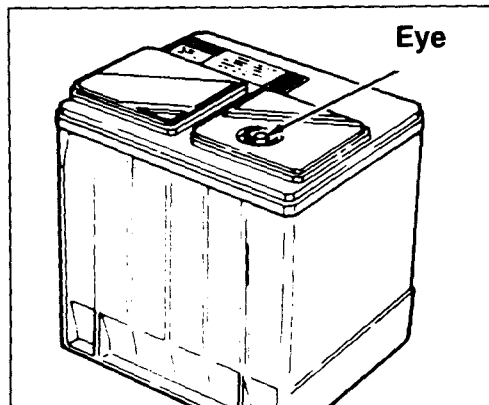
Check heat-insulating exhaust system blankets for damage daily. Torn, matted, crushed, oil-soaked, or otherwise damaged insulation blankets *must* be replaced immediately.

**CAUTION:** To avoid personal injury or turbocharger damage, do not remove, attach, or tighten turbocharger air intake ducting while the engine is operating or operate the engine with the ducting removed.

### **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 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



*Check "Eye" of Maintenance-Free Batteries*

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.

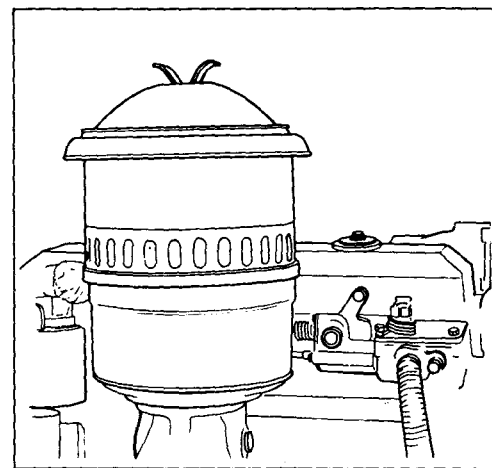
Periodically check battery connections for corrosion and tightness. If necessary, remove connections and wire brush any corrosion from terminals and cable ends. Replace damaged wiring.

### **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.

**Do not allow air inlet restriction to exceed 20 inches of water (5.0 kPa) under any operating conditions.**



*Oil Bath Air Cleaner (Light Duty)*

**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.

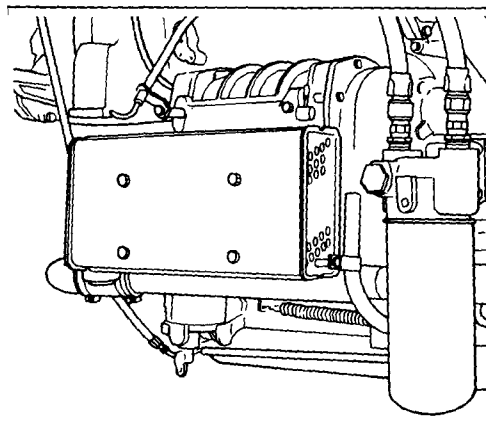
**Dry Type.** The air cleaner element should be inspected every 15,000 miles (24,000 km) for vehicle engines, 150 hours for non-vehicle engines, or more often if the engine is operated under severe dust conditions. Replace the element if necessary. Check the

gaskets for deterioration and replace, if necessary. If the dry type air cleaner is equipped with an aspirator, check for aspirator damage or clogging. Clean and repair as necessary.

**Dry-type air cleaner elements used in on-highway applications should be discarded and replaced with new elements after one year or when the maximum allowable air inlet restriction has been reached, whichever comes first.** No attempt should be made to clean or reuse on-highway elements after these intervals.

**Dry-type elements used in industrial applications should be discarded and replaced with new elements after one year of service or when the maximum allowable air intake restriction has been reached, whichever comes first.** No attempt should be made to clean or reuse elements.

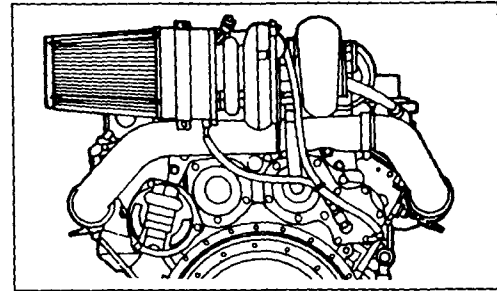
Inspect the entire air system for leaks daily. Look especially for torn air inlet piping or boots and loose or damaged clamps. Have worn or damaged parts repaired or replaced, as required. Retighten any loose connections.



*Typical Air Silencer Installation*

**For Silencers.** Inspect mounting bands and clamps for tightness

daily. Clean or replace polyurethane foam elements (socks ) annually.



*Typical Air Separator Installation*

**Air Separators (Closed Crankcase Vapor Collectors).** Replace or clean the filter and the vacuum limiter when the air inlet restriction indicator turns **red**. This indicates the maximum allowable system restriction has been reached. Replace filter elements after one year or 500 hours of engine operation, whichever comes first. Replace vacuum limiters every 1000 hours of engine operation or every two years, whichever comes first.

**Cleaning.** If cleaned, filters must be cleaned and recoated with fluids specially designed for this purpose. Authorized Detroit Diesel service outlets are properly equipped to perform these services.

## **Item 8 — Drive Belts**

New standard V-belts will stretch after the first few hours of operation. Run the engine for 10 to 15 minutes at 1200 rpm to seat the belts, then readjust the tension. Check the belts and tighten the fan drive, battery-charging alternator and other accessory drive belts after 1/2 hour or 15 miles and again after 8 hours or 250 miles (402 km) of operation. Thereafter, check the tension of the drive belts every 200 hours (150 hours on marine units) or 6,000 miles (9,600 km) and adjust, if necessary.

Belts should be neither too tight nor too loose. Belts that are too tight impose excess loads on the crankshaft, fan and/or alternator bearings, shortening both belt and bearing life. Excessively overtightened belts can result in crankshaft breakage. A loose belt will slip and may cause damage to accessory components.

**Drive belts (V and Poly-V) should be replaced every 2,000 hours or 100,000 miles (160,000 km).**

**EXCEPTION:** Replace belts on pleasure craft marine engines every 1,000 hours of operation, regardless of condition.

**Replace ALL belts in a set when one is worn.** Single belts of similar size should not be used as a substitute for a matched belt set. Premature belt wear can result because of belt length variation. All belts in a matched belt set are within .032" of their specified center distances.

Use a Belt Tension Gage, such as Kent-Moore tool J 23600-B, or equivalent, and adjust the belt tension as follows:

FAN DRIVE		
	ONE BELT	2 OR 3 BELTS
3,4-71	80-100 lbs	50-60 lbs
6-71	80-100 lbs	60-80 lbs
ALTERNATOR BELTS 2-1/2"		
One wide belt	One 1/2" Belt	Two 3/8" or 1/2" Belts
40-50 lbs	50-70 lbs	40-50 lbs
Note: For 3-point or triangular drives use a tension of 90-125 lbs		
AIR COMPRESSOR		
Belt tension for a single, premium, high capacity belt. (.785" wide) is 50-70 lbs.		

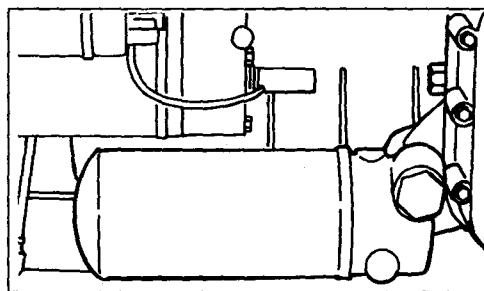
If a belt tension gauge is not available, adjust the belt tension so that a firm push with the thumb, at a point

midway between the two pulleys, will depress the belt .500"-.750" (12.70-19.05 mm).

**When installing or adjusting an accessory drive belt, be sure the bolt at the accessory adjusting pivot point is properly tightened, as well as the bolt in the adjusting slot.**

### Item 9 - Lubricating Oil Filter

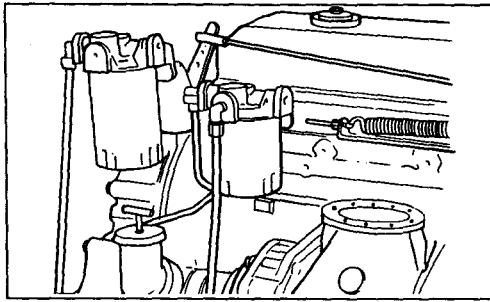
Lubricating oil filters should be changed whenever the engine oil is changed. For oil change intervals, refer to "When to Change Oil" in the **How To** section of this guide. Before changing filters, refer to "How to Replace the Lube Oil Filter" in the **How To** section of this guide. Refer to the **Specifications**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



*Lubricating Oil Filter-Horizontal Mount*

### Item 10 - Fuel/Water Separator, Filters

Drain water from fuel/water separator daily or as required. Primary and secondary fuel filters should be replaced every 10,000 miles (16,000 km) 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.



*Typical Primary and Secondary Fuel Filters*

### **Item 11 - Water Pump and Coolant Filter/Conditioner**

**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 (16,000 km), whichever comes first.

**EXCEPTION:** On marine units replace the element every 150 hours of operation or annually, whichever comes first.

For additional information on coolant filters and inhibitor packages, refer to the publication, "Coolant Selections for Engine Cooling Systems," form 7SE298, available from authorized Detroit Diesel service outlets.

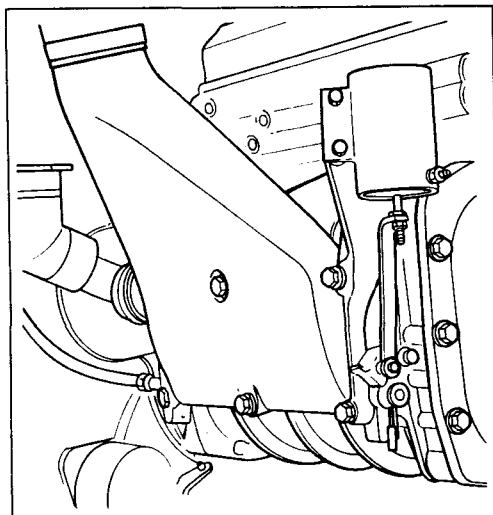
### **Item 12 - Air Shutdown Valve**

Air shutdown assemblies, whether electrical or manual (pull cable-actuated), **must** be tested for proper operation (with the engine at idle) at least once a year or after 700 hours of engine operation (500 hours on marine units), whichever comes first. The valve should be reset in the open position after the check has been made.

**NOTICE:** If not adjusted properly, the valve may not close completely when activated, thus defeating its intended purpose to cut off air flow to the engine and shut it down during abnormal operating conditions.

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

**NOTICE:** If the emergency air shutdown is used to stop the engine in an emergency situation, always have the shutdown checked for damage and for proper operation before the engine is returned to service. This is especially important if shutdown is made at high engine rpm. To ensure positive valve closure should another emergency shutdown be required, the shutdown must be checked and required repairs or adjustments made at this time. **Failure to observe this precaution may permit engine run-on when the emergency shutdown is activated.**



*Typical Air Shutdown Assembly  
(Electrical)*

### **Item 13 - Oil Pressure**

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 (32,000 km).

### **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.

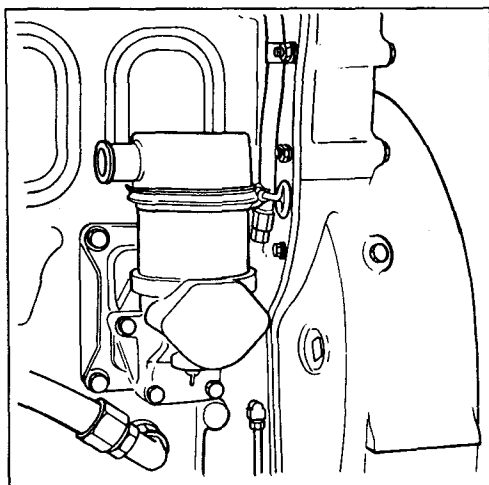
2. Do not reverse battery connections. This can also cause damage.

**CAUTION: Reversing battery polarity can also result in personal injury caused by the sudden discharge of electrolyte from the battery vents and/or the sudden rupture of the battery case caused by explosion of internal hydrogen gas.**

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 (96,000 km) (whichever comes first) and tightened or repaired, as required.



*Crankcase Breather Assembly*

#### **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.

**Air Separators (Closed Crankcase Vapor Collectors) on Marine Engines.** Change or clean the filter and the vacuum limiter when the inlet indicator turns red. Replace filter elements after one year or 500 hours of engine operation, whichever comes first. Replace vacuum limiters every 1000 hours of engine operation or every two years, whichever comes first. If cleaned, filters must be cleaned and oiled with fluids especially designed for this purpose. Consult with an authorized Detroit Diesel Distributor.

Crankcase pressure should be checked and recorded every 2,000 hours or 60,000 miles (96,000 km). If an additional crankcase breather collection device is used, crankcase pressure should be recorded with

the unit attached and removed.

**NOTE:** Crankcase pressure of up to 6" H<sub>2</sub>O is normal for marine engines equipped with closed crankcase collectors.

#### **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, the fuel and/or boost cooler, 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 be checked for cracks or wear and replaced, if necessary. Worn or brittle flexible impellers should also be replaced. Authorized Detroit Diesel service outlets are properly equipped to perform these services.

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

Oil Service Class		
Use API service classification CD, CD-II (CF-2 when available), CE, or CF-4 engine oil which is certified to pass TO2 or TO4 and C-4 specifications or meet the requirements of MIL-L-2104E. Engine oil may be used, provided it meets these requirements.		
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 20 - Marine Gear

Check marine gear oil level daily. Marine gear oil coolers should be replaced every 4 years or 4,000 hours, whichever comes first.

**Twin Disc:** Refer to the chart for Twin Disc requirements.

#### Item 21 - Blower Bypass Valve

The blower bypass valve should be removed, cleaned in solvent (if necessary), and inspected every 100,000 miles (160,000 km) or 3,000 hours. The valve should be checked for free operation and for scoring on the piston and piston bore. Also check for worn seals. Have components repaired or replaced as needed.

To ensure efficient operation, the piston **must** be lubricated every 100,000 miles (160,000 km) (3,000 hours) with Parker Super O-Ring Lube, or an equivalent high temperature silicone grease.

#### 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.

#### 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 5,000 miles (8,000 km), 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 (32,000 km). 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 6,000 miles (9,600 km). 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 (48,000 km) with the engine running. If tubes are clogged they should be removed, cleaned, and reinstalled. Every 100,000 miles (160,000 km) 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**

Inspect the outside of the radiator core every 20,000 miles (32,000 km) 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 to clean the radiator.**

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 every 20,000 miles (32,000 km).

#### **Item 28 - Governor, Overspeed Governor**

The idle speed and no-load 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 (24,000 km). 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 (80,000 km) 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 (32,000 km) or approximately 700 hours.

Every 2,500 hours or 75,000 miles (120,000 km) (vehicle engines) or 4,000 hours (non-vehicle engines) the fan bearing hub assembly should be cleaned, inspected, and re-packed 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**

Replace thermostats and seals every 240,000 miles (384,000 km) on vehicle engines. On non-vehicle engines replace every 4,000 hours or two years, whichever comes first, and at time of 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 (48,000 km) (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.

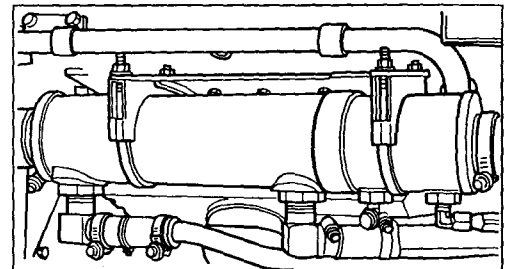
#### **Item 34 - Engine (Steam Clean)**

Steam clean the engine and engine compartment every 20,000 miles (32,000 km) or 700 hours.

**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.

#### **Item 35 - Fuel and Boost Coolers**

Replace fuel and boost coolers on marine engines every 4 years or 4,000 hours, whichever comes first. In some applications these are unitized into a single assembly.



*Typical Fuel/Boost Cooler Assembly*

#### **Item 36 - Heat Exchanger**

Replace tube and shell type heat exchanger on marine engines every 4 years or 4,000 hours, whichever comes first.

#### **Item 37 - Fuel Injectors**

Replace fuel injectors on pleasure craft marine engines every 1,000 hours of operation. Replace injectors on commercial marine engines every 5,000 hours of operation.

## "HOW TO" SECTION

This section covers Detroit Diesel's requirements for selecting lubricating oil, fuel oil, and coolant and includes basic engine maintenance procedures which can be performed by the operator.

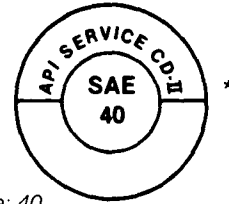
**NOTICE:** The manufacturer's warranty applicable to Inline 71 engines provides in part that the provisions of such warranty shall not apply to any engine unit that has been subject to misuse, negligence or accident. Accordingly, malfunctions attributable to neglect or failure to follow the manufacturer's fuel or lubricating recommendations may not be within the coverage of the warranty.

### A. How to Select Lubricating Oil

#### Lubricant Selection in North America

The selection of the proper lubricating oil is important to achieve the long and trouble-free service which Detroit Diesel 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 licensed to display the American Petroleum Institute (API) symbol shown should be used.

API Symbol:



SAE Viscosity Grade: 40  
API Classification: CD-II\*  
Sulfated Ash: Less than 1.0 mass%  
\*CF-2 when available

#### Lubricant Requirement

Lubricants meeting these criteria have provided maximum engine life when used in conjunction with recommended oil drain and filter maintenance schedules.

API Performance category CF-2 represents an enhanced level of lubricant performance over the CD-II category which it replaces. Lubricants meeting this new performance level may not be readily available for some time. During this interim period oils labeled as API CD-II may be used.

Only oils licensed by API should be used in Detroit Diesel engines. Certain engine operating conditions may require exceptions to these requirements:

1. For continuous high temperature operation (over 200°F or 94°C Coolant Out), the use of an SAE grade 50 lubricant in all two-stroke cycle engines is required.
2. At ambient temperatures below freezing (32°F or 0°C) sufficient starter cranking speed may not be achieved to start the engine with SAE 40 grade oils. Where starting aids are not available or at very cold temperatures (0 to -25°F or -18 to -32°C) even if starting aids are available, the use of multigrade SAE

15W-40 or monograde SAE 30 lubricants will improve startability. These lubricants must possess a High Temperature - High Shear Rate Viscosity (measured by ASTM D 4741 or equivalent) of 3.7 cP minimum. **These oils must be replaced with monograde SAE 40 lubricants as soon as ambient conditions permit.**

**EXCEPTION:** Do not use multigrade or SAE 30 grade lubricants in two-stroke cycle marine engines under any circumstances.

3. When the use of high sulfur fuel (greater than 0.5% mass) is unavoidable, the use of lubricants with higher alkalinity is recommended. Be aware that such lubricants may have a sulfated ash content above 1.0% mass. The use of high sulfur fuels also requires modification to oil drain intervals.
4. The use of multigrade and/or greater than 1% sulfated ash oils are exceptions for special circumstances. The use of such lubricants in the engine under normal circumstances may not provide satisfactory service life.

#### **Sulfated Ash and Total Base Number**

Sulfated ash is a lubricant property obtained by a laboratory test (ASTM D 874) to determine the potential for formation of metallic ash. The ash residue is related to the oil's additive composition and is significant in predicting lubricants which may cause exhaust valve distress under certain operating conditions. Sulfated ash is related to Total Base Number (TBN), also a laboratory test (ASTM D 2896

or D 4739) which measures an oil's alkalinity and ability to neutralize acid. As TBN increases, sulfated ash also increases to where lubricants with TBN's above 10 will likely have sulfated ash contents above 1.0% mass.

Total Base Number is important to neutralize the effects of high sulfur fuel in all diesel engines. For two-stroke cycle engines Detroit Diesel recommends lubricants with sulfated ash contents below 1.0% mass and TBN's between 6 and 10 for engines operating on less than 0.5% sulfur fuel.

When the use of a high ash oil is required, such as with high sulfur fuel, the oil selected should have the highest TBN (D 4739) to Ash (D 874) ratio possible. For example, an oil with a TBN of 10 and an Ash of 1.2% mass is less desirable than an oil with the same TBN and 1.0% Ash.

#### **Synthetic Oils**

Synthetic oils may be used in Detroit Diesel engines provided they are API licensed and meet the performance and chemical requirements of non-synthetic oils outlined in this publication. Synthetic oils offer improved low temperature flow properties and high temperature oxidation resistance. However, they are generally more costly than non-synthetic oils.

Product information about synthetic oils should be reviewed carefully. Performance additive systems often respond differently in synthetic oils. Only synthetic oils that do not contain viscosity improver additives may be used in Detroit Diesel two-stroke cycle engines. Their use does not permit extension of recommended oil drain intervals.

<b>INLINE 71 ENGINE MAXIMUM OIL DRAIN INTERVALS</b> <b>Fuel Sulfur Below 0.5 % (Normal Operation)</b>	
<b>Service Application</b>	<b>Lube Oil/Filter Change Interval</b>
Highway Truck & Motor Coach	15,000 Miles (24,000 km)
City Transit Coaches	6,000 Miles (9,600 km) or 3 months*
Pick-up & Delivery, Stop & Go, Short Trip	12,000 Miles (19,000 km)
Industrial, Agricultural & Marine	150 Hours
Stationary Units Continuous	300 Hours or 3 Months*
Stationary Units Standby	150 Hours or 1 Year*
*Whichever comes first	

### **The Use of Supplemental Additives**

Lubricants meeting the Detroit Diesel specifications outlined in this publication already contain a balanced additive treatment. The use of supplemental additives such as break-in oils, top oils, graphitizers and friction-reducing compounds, are generally not necessary and can even be harmful. These additives may be marketed as either oil treatments or engine treatments and are discouraged from use in Detroit Diesel engines. **Engine damage resulting from the use of such materials is not covered by your Detroit Diesel Corporation warranty.** Detroit Diesel will not provide statements beyond this publication relative to their use.

### **Lubricant Selection Outside North America**

Though the API service classification system is generally utilized worldwide, lubricants meeting Detroit Diesel requirements may not be marketed in all areas of the world. Selection of lubricants in these situations should be made based on viscosity grade first, ash content

second, and performance specification third. Oils meeting API CD or CC may be used if they also meet military specification Mil-L-2104 E or F. Modification of oil drain interval may be necessary, depending on fuel quality. Contact Detroit Diesel Corporation for further guidance.

### **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.

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 "Engine Requirements—Lubricating Oil, Fuel and Filters" (7SE270), 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.

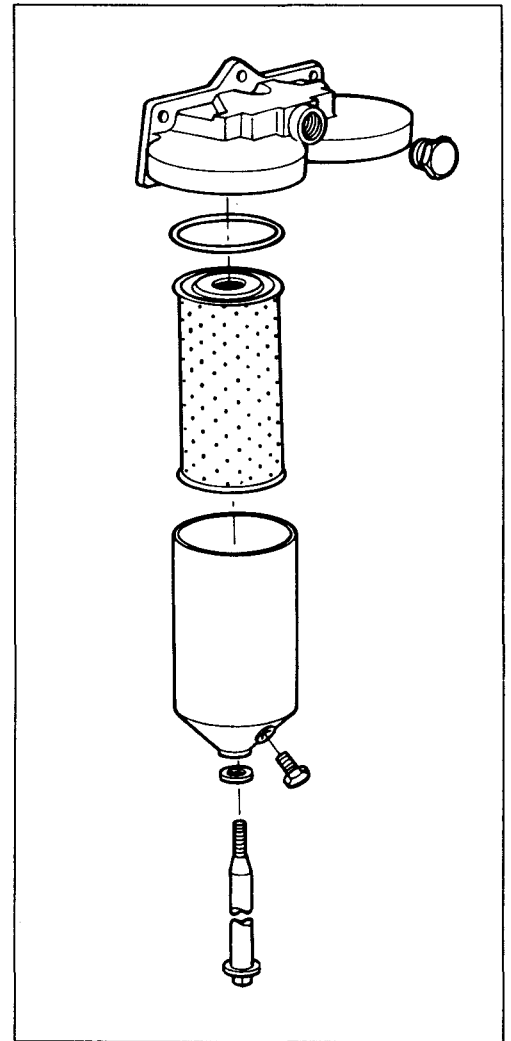
## C. How to Replace the Lube Oil Filter

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 62) for filter part number.

Inline 71 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 responsible 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.



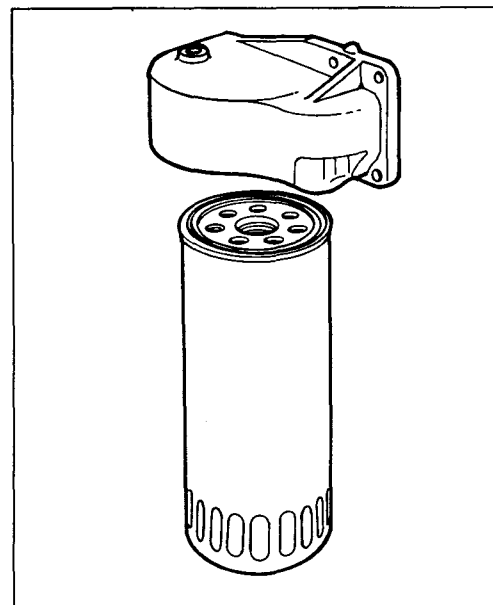
*Typical Canister (Bolt-On) Type Oil Filter Assembly*

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**

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 responsible



*Typical Spin-On Type Oil Filter*

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 min-

utes). 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 fuels used must be clean, completely distilled, stable, and non-corrosive. For more information regarding the significance of these properties and selection of the proper fuel, refer to publication "Engine Requirements—Lubricating Oil, Fuel, and Filters" (7SE270), available from authorized Detroit Diesel service outlets.

### **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. Increased fuel sulfur content may reduce engine life from 0.25% to 0.5%. 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 galvanized steel or sheet metal tanks and galvanized pipes or fittings in any diesel fuel storage, delivery, or fuel system. The fuel oil will react chemically with the zinc coating, forming a compound which can clog filters and cause engine damage.



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 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.

### **Fuel Additives**

Detroit Diesel engines are designed to operate satisfactorily on a wide range of diesel fuels. Some fuels may be marketed which contain performance additives and are identified as premium diesel fuel. Detroit Diesel engines do not require the use of such fuels; however, they may be used at the customer's discretion.

**The following fuel additives are NOT allowed:**

### **Used Lubricating Oil**

Detroit Diesel specifically prohibits the use of drained lubricating oil in diesel fuel. Used lubricating oil contains combustion acids and particulate materials which severely erode injector components, resulting in loss of power and increased exhaust emissions. In addition, the use of drained lubricating oil will increase maintenance requirements due to filter plugging and combustion deposits. Refer to "Disposing of Waste Oil" (page 43) for recommendations on proper used oil disposal.

### **Gasoline**

The addition of gasoline to diesel fuel will create a serious fire hazard. The presence of gasoline in diesel fuel will reduce fuel cetane number and increase combustion temperatures. Tanks which contain such mixtures should be drained and cleaned as soon as possible.

*Detroit Diesel Corporation will not be responsible for any detrimental effects which it determines resulted from the use of used engine oil or gasoline in the diesel fuel.*

### **Other Fuel Additives**

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

- **Nalcool Winter Thaw and Winter Pow-R Plus (or equivalent)** - For winter gelling, freeze-up protection.

- **Nalcool Fuel Prep (or equivalent)** - For treatment of microbe growth or black "slime." Follow manufacturers' instructions for treatment.

**Detroit Diesel does not recommend adding Nalcool Winter Thaw or alcohol to fuel used in marine engines.**

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

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

Supplemental additives are *not recommended* due to potential injector system or engine damage. Our experience has been that such additives increase operating costs without providing benefit.

*The use of supplemental fuel additives does not necessarily void the engine warranty. However, repair expenses which result from fuel system or engine component malfunctions or damage attributed to their use will not be covered.* These products should be accompanied with performance data supporting their merit. It is not the policy of Detroit Diesel Corporation to test, evaluate, approve, or endorse such products.

For more detailed information on fuel requirements, refer to "Engine Requirements—Lubricating Oil, Fuel, and Filters" (7SE270), available from authorized Detroit Diesel service outlets.

## E. How to Replace the Fuel Filter and Strainer

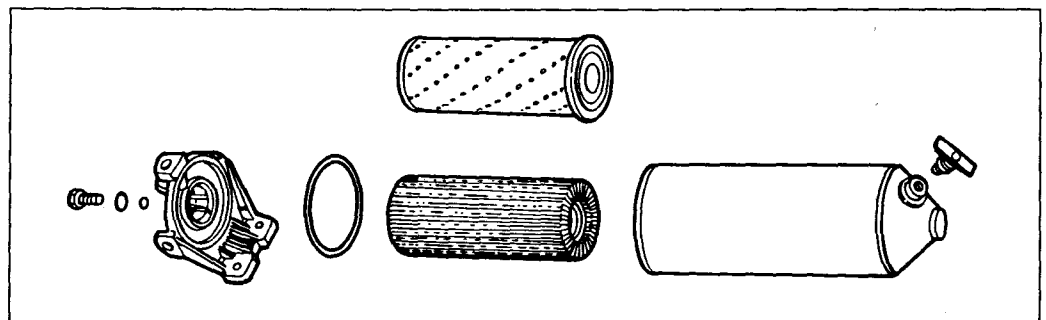
Filters are an integral part of the fuel system. Proper filter selection and maintenance are important to satisfactory engine operation and service life. Filters should be used to maintain a clean system, not to clean up a contaminated system. Refer to **Specifications** (page 62) for proper filter selection.

Two strainer/filter types are used on Inline 71 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, and 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.

### Replace Canister (Bolt-on) Type Filter Element

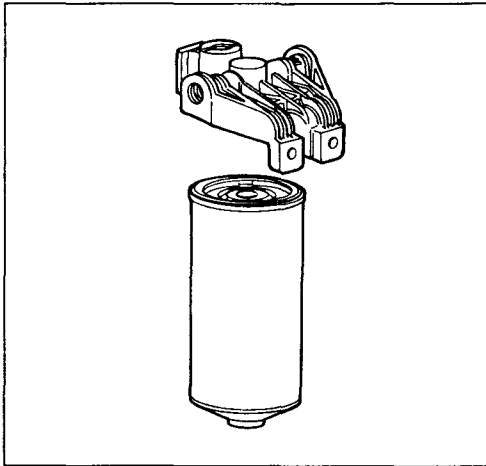
1. With the engine shut down, place a suitable container under the fuel strainer or filter and open the drain cock. The fuel will drain more freely if the cover bolt is loosened slightly.
  2. Support the canister shell, unscrew the cover bolt, and remove the shell and element.
  3. Remove the element and gasket. Dispose of them in an environmentally responsible 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.
- CAUTION:** To prevent possible personal injury when using compressed air, wear adequate eye protection and do not exceed 40 psi (276 kPa) air pressure.
4. Remove the paper, plastic, or cellophane wrapping from a new element. Soak the element thoroughly in clean fuel oil.



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 responsible 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.
3. Install the new cartridge and tighten by hand until the gasket touches the mounting adaptor head. Tighten an additional one-half turn.

**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 genuine Detroit Diesel Power Cool antifreeze or an equivalent 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 (see specifications page).

A 50% **Power Cool** 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 (see specifications page).

**Although some antifreezes contain inhibitor packages, all Inline 71 engines require that genuine Detroit Diesel Maintenance 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.

In extremely hot environments, clean, soft, properly inhibited water may be used if Detroit Diesel Maintenance Product supplemental corrosion inhibitors are also added in the right concentration. If water is used, supplemental coolant additive levels should be increased from 3% to 6% by volume.

**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 (24,000 km) 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 Detroit Diesel 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 Detroit Diesel engines because it is not compatible with fluoroelastomer seals found in the cooling system.

A cooling system properly maintained and protected with supplemental inhibitors can be operated up to these intervals:

- On-Highway, Industrial, Gen Set  
- Two years, 200,000 miles (320,000 km), or 4,000 hours\*
- Commercial Marine - Two years or 4,000 hours\*
- Pleasure Craft Marine - One year or 1,000 hours\*

\*Whichever comes first

At these intervals the antifreeze must be drained and disposed of in an environmentally responsible manner according to state and/or federal (EPA) recommendations, 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 recommended ethylene glycol-base antifreeze and water solution at the required concentration (see graph, page 52). Add required genuine Detroit Diesel Maintenance Product cooling system inhibitors. After filling, run the engine

until thermostat(s) open and top off the 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.

### **Detroit Diesel Maintenance Product Inhibitor Systems**

Detroit Diesel Maintenance 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 genuine Detroit Diesel Maintenance Product supplemental inhibitor be added to Inline 71 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 62) 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.

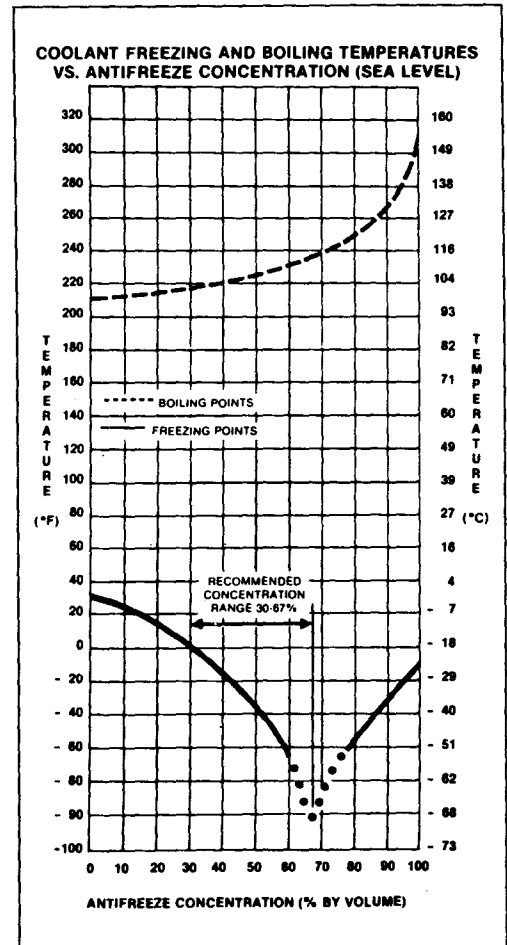
**Soluble oils and chromate inhibitors are not recommended for use in Detroit Diesel engine cooling systems.**

**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 Nalcool Products 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 authorized Detroit Diesel service outlets under part number 23508774.



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

#### Detroit Diesel Maintenance Products System

	<b>Min. PPM</b>	<b>Max. PPM</b>
Boron (B)	1000	1500
Nitrite (NO <sub>2</sub> )	800	2400
Nitrates (NO <sub>3</sub> )	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 Selections for Engine Cooling Systems," 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 recommended 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. If a water-jacketed turbocharger is installed, vent the petcock on the water return line at the turbocharger until a steady stream of coolant (no air) is seen. Then close the petcock.

Install the pressure cap after the coolant level has stabilized at the bottom of the radiator or heat exchanger tank filler neck. Fill the coolant recovery bottle (if equipped) to the "full cold" level or no more than one-quarter of its volume.



**NOTICE:** If all of the coolant is drawn out of the recovery bottle when the engine cools, remove the pressure control cap from the radiator or heat exchanger and check to make sure the coolant level is at or near the bottom of the filler neck. Add coolant as required to bring it to this level. Replace the pressure control cap and fill the recovery bottle to the "Full Cold" mark, or no more than one-quarter. Do not overfill the recovery bottle since this can result in spillage as the coolant heats and expands during engine operation. Failure to properly fill the cooling system and purge it of air can result in engine overheating and serious engine damage.

**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.

### Probable Causes:

55

## OBJECTIONABLE EXHAUST

### Probable Causes:

Damaged or dirty air cleaner  
 Improper grade of fuel  
 Excessive exhaust back pressure  
 Misfiring cylinders  
 Lubricating oil not burned in  
   cylinder (being burned in  
   exhaust manifold or turbocharger)  
 Faulty injector setting  
 Faulty oil control rings  
 Excessive installation angle  
 Excessive oil in crankcase  
 High ambient air temperature  
 Thin air (high altitude)  
 Cetane rating of fuel too low  
 Air in the fuel system

#### Black or Gray Smoke

#### Blue Smoke

#### White Smoke

X

X

X

X

X

X

X

X

X

X

X

X

X

## ABNORMAL ENGINE OPERATION

### Probable Causes:

Misfiring cylinder  
 Insufficient fuel  
 High return fuel temperature  
 Low compression  
 DDEC malfunction  
 High air inlet restriction/exhaust  
   back pressure  
 Engine application  
 High air inlet temperature  
 High altitude operation  
 Incorrect engine gear train timing  
 Low coolant temperature  
 Oil picked up by inlet airstream  
 Faulty injector operation  
 Incorrect injector height setting

#### Rough Running or Frequent Stalling

#### Low Power

#### Detonation

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

## ABNORMAL OPERATING CONDITIONS

### Probable Causes:

- Loose connections
- Cracked lines
- Damaged gaskets or seal rings
- \*Lube oil loss at breather tube
- \* Lube oil loss at dipstick tube

[\*Indicates high crankcase pressure]

- Leaking oil cooler
- Leaking valve stem seals
- Worn/broken oil control rings
- Scored liner and/or piston
- Excessive engine installation angle
- Crankcase overfilled
- Oil in air tanks (air compressor malfunction)
- Plugged crankcase breather
- Oil level low
- Improper engine oil viscosity (fuel in the oil)
- Faulty oil pressure regulator valve
- Worn crankshaft bearings
- Worn camshaft or connecting rod bearings
- Missing cup plugs in rocker arm shafts
- Faulty oil pressure relief valve
- Air leaks in oil pump (suction side)
- Worn or damaged oil pump
- Faulty oil pressure gage
- Faulty electrical components (for gage)
- Plugged oil orifice
- Obstructed oil line

## High Lubricating Oil Consumption

## Low Oil Pressure

X  
X  
X  
X  
X

X  
X  
X  
X  
X  
X  
  
X  
X

X
X X X
X
X X
X X X
X X X

## ABNORMAL COOLANT TEMPERATURES

### Probable Causes:

Restricted cooling system passages  
 Restricted radiator core passages  
 Slipping fan drive belts  
 Faulty temperature-controlled fan  
 Obstruction in front of radiator or intercooler  
 Low coolant level  
 Damaged hoses  
 Faulty thermostats  
 Faulty water pump  
 Faulty radiator pressure cap  
 Air in coolant  
 Thermostats not fully closed  
 Leakage around thermostat seals  
 Faulty temperature-controlled fan

#### Above Normal

#### Below Normal

X  
 X  
 X  
 X  
 X  
 X  
 X  
 X  
 X  
 X  
 X

X  
 X  
 X

## SERVICE PUBLICATIONS

The service manual covering Detroit Diesel Inline 71 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 authorized

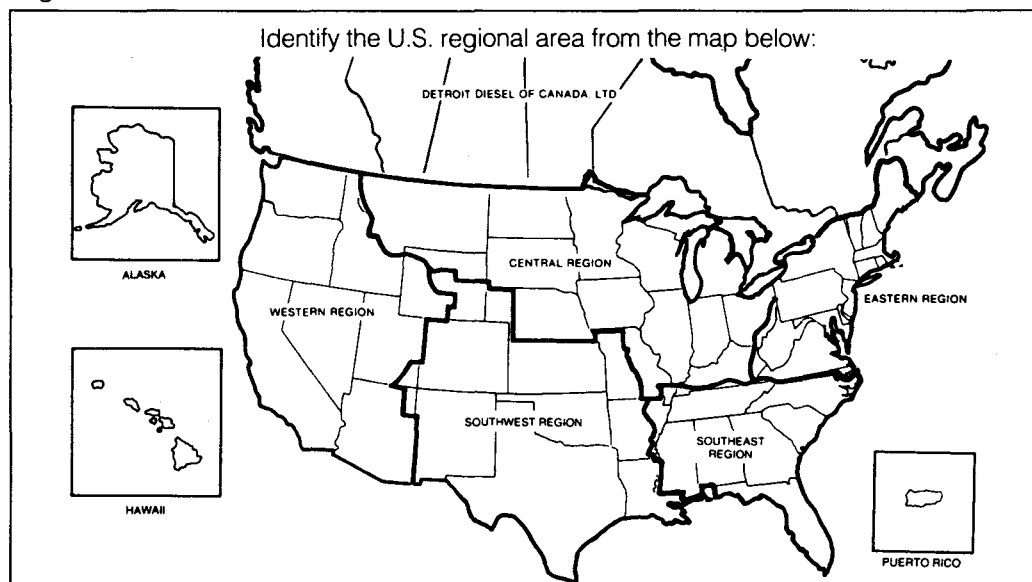
Detroit Diesel service outlet. Check the Yellow Pages under "Engines, Diesel" or refer to the Worldwide Distributor and authorized Dealer Directory (form 6SE280) for the distributor or service outlet nearest you.

Description	Form No.
Inline 71 Engine Service Manual .....	6SE164
DDEC II Troubleshooting Guide .....	6SE489
Worldwide Distributor/Dealer Directory .....	6SE280
Engine Requirements— Lubricating Oil, Fuel, and Filters .....	7SE270
Coolant Selections for Engine Cooling Systems .....	7SE298

## 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 organizations.

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:



### **EASTERN REGION**

**Long Branch, New Jersey**  
187 Monmouth Park Highway  
West Long Branch, NJ 07764  
Phone: (908) 222-1888  
Fax: (908) 222-3411

### **SOUTHEAST REGION**

**Jacksonville, Florida**  
5105 Bowden Road  
Jacksonville, FL 32245-6426  
Phone: (904) 448-8833  
Fax: (904) 448-2444

### **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: (310) 929-7016  
Fax: (310) 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

### **LATIN AMERICAN REGION**

**Miami, Florida**  
2277 N.W. 14th Street  
Latin American Building  
Miami, FL 33125, U.S.A.  
Phone: (305) 637-1555  
Fax: (305) 637-1580

### **ASIAN REGION**

**Singapore**  
7 Jurong Pier Rd.  
Singapore 2261  
Phone: (65) 265-4697  
Fax: (65) 265-9530

### **PACIFIC REGION**

**Australia**  
13 Lynette Ave.  
Beaumaris, Victoria 3193  
Australia  
Phone: (61) 3-5895181  
Fax: (61) 3-5893424

### **EUROPE, MIDDLE EAST, AFRICA (EMA) REGION**

**The Netherlands**  
Ridderpoort 9  
2980 GD Ridderkerk  
The Netherlands  
Phone: (31) 1804-10388  
Fax: (31) 1804-62062

### **MEXICO**

**Detroit Diesel-Allison de Mexico, S.A.**  
Reforma 2977  
Colonia, Cuajimalpa  
Mexico, D.F. 05000, Mexico  
Phone: (525) 626-5300  
Fax: (525) 626-5315

- Service by trained personnel.
- Sales teams to help determine your specific power requirements.
- In many areas, emergency service 24 hours a day.
- A complete line of genuine Detroit Diesel maintenance products.
- Complete parts support including **reliabilt**® 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 authorized Detroit Diesel 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:

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

**IMPORTANT:** Your engine serial number should be written on the line provided. It will identify your model and all service parts, plus provide warranty and extended coverage information.

### Step Three

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

**Director,  
Reliability and Service**  
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**  
**Detroit Diesel Maintenance Products**

LUBRICATING OIL FILTERS			
Filter Type	DDC Part No.	AC Part No.	Micron Rating @ 98% Single Pass Efficiency
Full Flow	25013192	PF-911L	12

FUEL FILTERS			
Filter Type	DDC Part No.	AC Part No.	Micron Rating @ 98% Single Pass Efficiency
<b><u>Spin-On</u></b>			
Primary			
3&4-71	25014371	TP936	25
6-71	25014274	TP915D	25
Secondary			
3&4-71	25010959	TP928	8
6-71	25014342	TP916D	8
6-71 DDEC	25013535	TP959L	5
<b><u>Cartridge</u></b>			
Primary			
3&4-71	5574961	T553	30
6-71	5575032	T552	30
Secondary			
3&4-71	5573261	TP509	12
6-71	5574508	TP540X	12

<b>COOLANT FILTER / CONDITIONERS</b>			
<b>Engine</b>	<b>Cooling System Capacity (Gal)</b>	<b>Detroit Diesel Precharge Element Part No.</b>	<b>Detroit Diesel Maintenance Element Part No.</b>
6-71	14	23507189	23507545

<b>ADDITIONAL COOLANT INHIBITOR TREATMENT PRODUCTS</b>		
<b>Item</b>	<b>Size</b>	<b>Detroit Diesel Part No.</b>
Power Cool Antifreeze/Coolant	Gallon	23512138
	(6 per carton) 55 Gallon Drum	23513139
NALCOOL 2000* -Liquid	Pint (12 per case)	23507858
	Half Gallon	23507859
	(6 per case) 5 Gallon	23507860
NALCOOL 3000* -Liquid	Pint (12 per case)	23507854
	Half Gallon	23507855
	(6 per case) 5 Gallon	23507856
NALPREP 2001* -Liquid On-Line Cleaner	Half Gallon	23507862
	(6 per case) 5 Gallon	23507863
Nalcool 2015* Twin Pac- Dry Chemical Cleaner/Conditioner	2 per case	23507867

\*NALCOOL and NALPREP are licensed trademarks of the Penray Companies.