

DETROIT DIESEL

Series 53 and 71



Engine Operator's Guide

SAFETY IS YOUR BUSINESS

safety, based on technical skill and years of experience, has been carefully built into your Detroit Diesel engine. Time, money and effort have been invested in making your diesel engine a safe product. The dividend you realize from this investment is your personal safety.

It should be remembered, however, that power-driven equipment is only as safe as the person operating the controls. You are urged, as the oper-

ator of this diesel engine, to keep your fingers and clothing away from the revolving "V" belts, gears, fan, drive shafts, etc.

Throughout this guide "Cautions" and "Notes" regarding personal safety will appear. They appear most often in the engine maintenance section where some equipment checks require running the engine. Help prevent accidents by observing these instructions.

Keep With Vehicle or Engine Installation at All Times. Contains Important Operating and Maintenance Instructions.

TO THE OPERATOR

This manual contains instructions on the operation and preventive maintenance of your Detroit Diesel engines used in non-marine applications. For marine applications refer to Detroit Diesel Marine Engine Operators Guide, form 6SE 501. Maintenance instructions cover routine engine services such as lube oil and filter changes in enough detail to permit self-servicing, if desired.

Whenever possible, it will pay to rely on an authorized *Detroit Diesel Service Outlet* for all your service needs from maintenance to major parts replacement. Authorized service outlets in the U.S. and Canada stock factory original parts and have the specialized equipment and

personnel with technical knowledge to provide skilled and efficient workmanship.

The operator should familiarize himself thoroughly with the contents of the manual before running an engine or carrying out maintenance procedures.

The information and specifications in this publication are based on the information in effect at the time of approval for printing. Generally, this publication is reprinted annually. It is recommended that users 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 form entitled **WARRANTY INFORMATION on DETROIT DIESEL ENGINES**, available from authorized Detroit Diesel Service Outlets.

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ENGINE MODEL AND SERIAL NUMBER DESIGNATION

The engine serial number and model number are stamped on the cylinder block in the following locations:

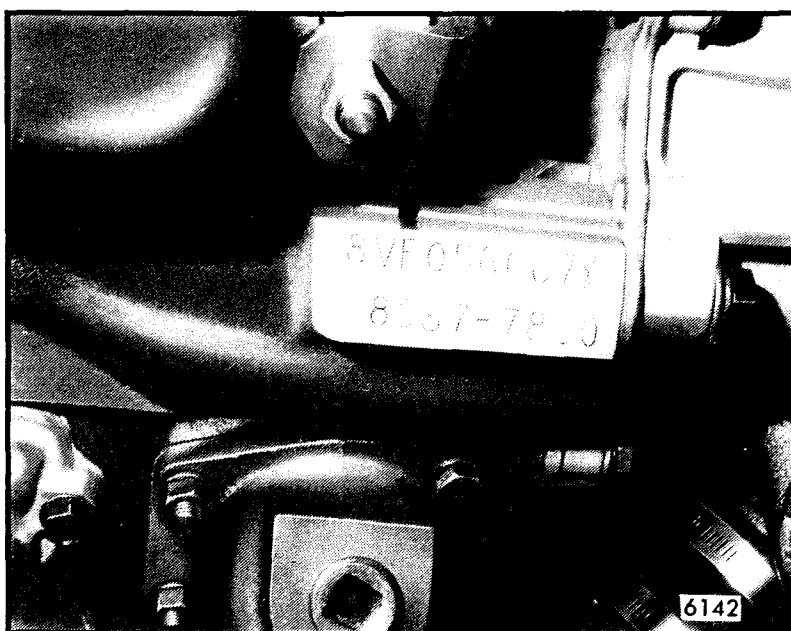
Inline 53: right side, upper rear corner

V-53: right side, upper front corner

Inline 71: left side, upper front corner

6V, 8V-71, 92: left side, upper front corner

12V, 16V-71, 92: right side, upper rear corner



Typical 8V-92 Engine Serial Number and Model Number

computerized, paper laminate engine option labels are attached to the valve rocker cover(s). These labels contain the engine serial number and model number and, in

given. In addition, if a type number is shown on the option label covering the equipment required, this number should also be included on the parts order.

0153 AIR BOX DRAIN 0711 F/W HOUSING 0848 FLYWHEEL 0703 OIL PAN 0024 OIL PRESS REG 0781 OIL COOLER 0369 OIL FILTER 0113 C/S COVER 0358 C/S PULLEY UNIT 08VF128476 S.O.	0180 ENG LIFT BKT 0115 VIB DAMPER 0376 CONN ROD/PSTN 0132 OIL PUMP 0219 OIL UIST 0852 DIPSTICK 0748 VENT SYSTEM NONE FAN 0238 WATER PUMP 8A41339 MODEL 80877899	THIS ENGINE DESIGNED TO OPERATE AT 0445 HP AT 02100 RPM INJ. TIMING 1.458 VALVE LASH .016 STARTING AID 454 THRTOLY/FMOD .594 MAX RPM NL 02250 STD GT RET CAM SPEC 1323200	DETROIT DIESEL CORPORATION USA L18257
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1988 FEU	IMPORTANT ENGINE INFORMATION THIS ENGINE CONFORMS TO U.S. EPA REGULATIONS APPLICABLE TO 1988 MODEL YEAR NEW HEAVY DUTY DIESEL ENGINES. THIS ENGINE HAS A PRIMARY INTENDED SERVICE APPLICATION AS A HEAVY HEAVY DUTY DIESEL ENGINE. FUEL RATE AT ADV. HP 89.5 MM3/STROKE ADV. HP 445 AT 2100 RPM INITIAL INJECTION TIMING 16 DEG. BTC VALVE LASH .016 INCHES ENGINE FAMILY J000736FWHX CID 736 MIN. IDLE 600 RPM MODEL BV 921A MFG. DATE SEPT 1988 UNIT 08VF128476 CONFORMS TO AUSTRALIAN DESIGN RULE 30	DETROIT DIESEL CORPORATION USA L18257
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Typical 8V-92 Option Label

In addition, list any optional equipment used on the engine. On-highway vehicle engines carry an additional label which contains engine certification information.

With any order for parts, the engine model and serial number must be

Power takeoff assemblies, torque converters, hydraulic marine gears, etc may also carry their own name plates. The model and serial number information on these plates is useful when ordering parts for these assemblies.

ENGINE OPERATION

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 (at each shift), see **Daily Operations** in the **Lubrication and Preventive Maintenance chart (Page 18)**.

Cooling System

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 cooling system vents, if the engine is equipped with them.
3. On marine engines, loosen the water return line near the top of the turbocharger (if used).
4. Remove the radiator or heat exchanger pressure control cap and fill with clean, soft, properly inhibited water. If the engine will be exposed to freezing temperatures, fill with an ethylene glycol base antifreeze solution. Refer to **Coolant for Detroit Diesel Engines**, form 7SE 298, available from Detroit Diesel Distributors. Keep the coolant level about two (2) inches below the filler neck to allow for fluid expansion.
5. After filling the cooling system, close the vents (if used).
6. On marine units, tighten the tur-

bocharger water supply and return lines, prime the raw water pump, and open any sea cocks in the raw water pump intake line. Prime the raw water pump by removing the pipe plug or electrode provided in the pump outlet elbow and pouring water into the pump. Replace the plug or electrode.

NOTICE:

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

Lubrication System

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

To ensure an immediate flow of oil to all bearing surfaces at initial engine startup, the engine lubrication system should be charged with a commercially available pressure pre-lubricator **or** rocker covers should be removed and clean lubricating oil should be poured over the rocker arms. The oil should be the same weight and viscosity as is used in the crankcase. Authorized Detroit Diesel service outlets are properly equipped to perform these services.

Air Cleaner

If the engine is equipped with an oil bath air cleaner, make sure air cleaner oil cups are filled to the proper level with clean engine oil. **Do not overfill.**

Transmission

Make sure the transmission case, marine gear, or torque converter supply tank are filled to the proper level with the fluid recommended by the gear manufacturer.

Fuel System

Fill the tank with the recommended fuel. Refer to **Lubricating and Fuel Oil for Detroit Diesel Engines**, Form 7SE270 available from Detroit Diesel Distributors. Make sure fuel supply shutoff valves (if used) are open.

To ensure prompt starting and even running, the fuel system must be purged of air and full of fuel from the supply tank to the restricted fitting at the fuel return line. Priming is accomplished by connecting a manual or electric priming pump to the secondary fuel filter. Authorized Detroit Diesel service outlets are properly equipped to perform this service.

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

NOTICE:

Prolonged use of the starter motor and engine fuel pump to prime the 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 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 can be damaged from lack of lubrication and cooling.

NOTICE:

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

Drive Belts

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

Storage Battery

Make sure cable connections to the battery are clean and tight.

STARTING

Before starting the engine the first time, perform the operations listed under **Preparation for Starting the Engine the First Time**.

Before a routine start, see Daily Operations in the Lubrication and Preventive Maintenance Chart (Page 18).

If the engine has a manual or automatic shutdown system, make sure the control is set in the **open** position before starting the engine. The blower will be seriously damaged if operated with the air shutdown in the **closed** position. On units with dual air shutdown housings, both air shutoff valves must be

in the open position before starting the engine.

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

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

CAUTION:

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

Initial Engine Start (Electric)

Start an engine equipped with an electric starting motor as follows:

1. 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. On hydraulic governors, make sure the stop knob is pushed all the way in.
2. Press the starter switch firmly.

NOTICE:

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

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

Initial Engine Start (Air starter)

Because of the limited volume in most storage tanks and the relatively short duration of the crank 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 storage tank. If necessary, add air to bring the pressure up to at least the recommended minimum for starting.
2. Press the starter button firmly and hold until the engine starts.

RUNNING

Oil Pressure

Observe the oil pressure gauge immediately after starting the engine. If there is no oil pressure indicated within 10 to 15 seconds, stop the engine and have the engine lubricating oil system checked.

The minimum oil pressure should be at least 25 psi (172 kPa) at 1200 rpm or 30 psi (207 kPa) at 2100 rpm. The oil pressure at normal operating speed should be 50-70 psi (345-483 kPa).

Warm-Up

Run the engine at part throttle and no load for about five (5) minutes to allow it to warm up before applying a load.

Inspection

While the engine is running at operating temperature, check for coolant,

fuel, or lubricating oil leaks. If any are found, shut down the engine immediately and have connections retightened **after** the engine has cooled.

Engine Temperature

In general, the normal engine operating temperature is 160-185°F (71-85°C) for off-highway units, 170-195°F (77-90°C) for on-highway units, or 170-187°F (77-86°C) for certain Series 53 turbocharged industrial units. For exact operating temperature range, contact a Detroit Diesel distributor. Provide him with engine model and serial number.

Crankcase

If the engine crankcase was refilled, 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. Add oil, if necessary, to bring it to the proper level on the dipstick.

Use only the heavy-duty oils specified in the "Lubrication and Preventive Maintenance" section of this publication.

Cooling System

The radiator or heat exchanger pressure control cap may be removed to check the coolant level **after** the engine has cooled.

CAUTION:

Do not remove the pressure control cap from the radiator or heat exchanger 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.

The coolant level should be near the top of the opening. If necessary, add clean, soft inhibited water or an ethylene glycol base antifreeze solution.

Turbocharger

Make a visual inspection of the turbocharger for oil leaks (and coolant leaks on marine engines) and excessive noise or vibration. Stop the engine immediately if a leak or unusual vibration or noise is detected.

Do not restart the engine until the cause of the concern has been corrected. Authorized Detroit Diesel Distributors are properly equipped to perform this service.

Avoid Unnecessary Idling

During long engine operating periods, the engine coolant temperature will fall below the normal operating range. The incomplete combustion of fuel in a cold engine will cause crankcase dilution, formation of lacquer or gummy deposits on the valves, pistons, and rings, and rapid accumulation of sludge in the engine. When prolonged engine idling is necessary maintain at least 800 rpm.

STOPPING

Normal Stopping

1. Release the load and decrease the engine speed. Put all shift levers in the **neutral** position.
2. Allow the engine to run at idle with no load for four (4) or five (5) min-

utes (to allow the engine to cool) then move the stop lever to the **stop** position to shut down the engine.

Emergency Stopping

NOTICE:

Never use the emergency shutdown system, except in an emergency. Use of the emergency shutdown can cause oil to be sucked past the oil seals and into the blower housing.

To stop an engine equipped with the spring-loaded, one screw design injector control tube, pull the governor stop lever to the **stop** position. This control cuts off the fuel to the engine. Do not try to restart again until the cause of the malfunction has been corrected.

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

Fuel System

If the unit is equipped with a fuel valve, close it. Fill the fuel tank. A full tank reduces condensation.

Cooling System

If the cooling system is not protected with antifreeze and freezing temperatures are expected, drain the cooling system. Leave the drains open. Open the raw water drains of a heat exchanger cooling system.

Crankcase

Allow the oil to drain back into the crankcase for about twenty (20) minutes and check the oil level. Add oil, if necessary, to bring it to the proper level 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 a DDC distributor for the cause. Fuel or coolant dilution of lube oil can result in serious engine damage.

Service as Required

Any difficulties which become apparent to the operator should be corrected **before** the engine is serviced again. **Authorized Detroit Diesel service outlets** are properly equipped and have trained personnel to make repairs and perform all service functions.

ENGINE SYSTEMS

Detroit Diesel engines incorporate four basic systems which direct the flow of fuel, lubricating oil, air, and coolant.

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.

Fuel Strainer and Filter Bolt-on Type

A replaceable element type fuel strainer and filter are used in the fuel system to remove impurities from the fuel. The strainer removes the larger foreign particles, and the filter removes the smaller particles. Replace elements as follows:

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 nut is loosened slightly.

Support the shell, unscrew the cover nut, and remove the shell and element.

Remove the element and gasket. Dispose of them in an environmentally approved manner according to state and/or federal (EPA) regulations.

Clean the shell with fuel oil and dry it with a clean, lintless cloth or compressed air.

CAUTION:

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

Place a new element which has been thoroughly soaked in clean fuel oil over the stud and push it down on the seat. Close the drain cock and fill the shell approximately two-thirds full with clean fuel oil.

Using a new shell gasket, place the shell and element in position under the cover and start the cover nut on the shell stud.

Tighten the cover nut just enough to prevent fuel leakage.

Remove the plug in the strainer or filter cover and fill the shell with fuel. Fuel system primer J 5956 (if available) may be used to prime the fuel system.

Start and operate the engine and check the fuel system for leaks.

Spin-on Type

The spin-on type fuel strainer and filter is used on certain engines. The spin-on filter cartridge consists of a shell, element, and gasket combined

into a unitized replacement assembly. No separate springs or seats are required to support the filters.

The filter covers incorporate a threaded sleeve to accept the spin-on filter cartridges. The word "Primary" is cast on the fuel strainer cover, and the word "Secondary" is cast on the fuel filter cover. A one-inch diameter, 12-point nut on the bottom of the cartridge is provided to facilitate removal and installation.

No drain cocks are provided on spin-on filters or strainers. Where water is a problem, a fuel/water separator should be installed. Replace spin-on cartridges as follows:

1. Unscrew the filter or strainer. Dispose of it in an environmentally approved manner according to state and/or federal (EPA) regulations.
2. Fill a new replacement cartridge about two-thirds full with clean fuel oil. Coat the seal gasket lightly with clean fuel.
3. Install the new filter assembly and tighten it to one-half a turn beyond gasket contact.
4. Start the engine and check for leaks.

NOTICE:

*To improve starting of DDEC engines, have replacement filters filled with fuel and ready to install **immediately** after used filters are removed. This will prevent possible fuel siphoning, causing fuel system aeration.*

NOTICE:

If the engine fails to start after replacement of the fuel filter element(s), the fuel system will require priming with tool J 5956, or equivalent. Authorized Detroit Diesel service

outlets are properly equipped to perform this service.

Fuel Tank

Refill the fuel tank at the end of each day's operation to prevent condensation from contaminating the fuel.

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 strainer, filter, and damage the fuel pump and injectors.

Engine Out of Fuel

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) to the tank.
2. Remove the fuel strainer 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. Check the filter and strainer for leaks.

NOTICE:

*To improve starting of DDEC engines, have replacement filters filled with fuel and ready to install **immediately** after used filters are removed. This will prevent possible siphoning, causing fuel system aeration.*

NOTICE:

If the engine fails to start after replacement of the fuel filter element(s), the

fuel system will require priming with tool J 5956, or equivalent. Authorized Detroit Diesel service outlets are properly equipped to perform this service.

LUBRICATION SYSTEM

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

Oil Filters

Engines are equipped with a full-flow type lubricating oil filter. If additional filtering is required, a bypass type oil filter may also be installed.

Replace Oil Filter Element

Replace the element in the full-flow or bypass type oil filter assembly each time the engine oil is changed as follows:

1. Remove the drain plug from the filter shell or the filter adaptor or base and drain the oil into a suitable container.
2. Back out the center stud and withdraw the shell, element, and stud as an assembly. Dispose of the oil, element, and shell gasket in an environmentally approved manner according to state and/or federal (EPA) regulations.
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 the element retainer seal and dispose of in an environmentally approved manner. Install a new seal.

6. Clean the filter shell and the 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 stud) through the filter shell.
8. Install a new shell gasket in the filter adaptor or base.
9. Position the new filter element carefully over the center stud and within the shell. Then place the shell, element, and assembly in position on the filter adaptor or base and tighten the stud to 50-60 lb-ft (68-81 N•m) torque.
10. Install the drain plug.
11. Start and run the engine for a short period and check for oil leaks. After any oil leaks have been corrected and the engine has been stopped long enough for the oil from various parts of the engine to drain back to the crankcase (approximately 20 minutes), add sufficient oil to bring it to the proper level 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 a DDC distributor for the cause. Fuel or coolant dilution of lube oil can result in serious engine damage.

Replace Spin-on Filter

1. Remove the oil filter using strap wrench tool J 29917 (or equivalent) which must be used with a 1/2" drive socket wrench and extension.
2. Dispose of the used oil and filter in an environmentally approved manner according to state and/or

federal (EPA) regulations.

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:

Mechanical tightening will distort or crack the filter adaptor.

6. Start and run the engine for a short period and check for leaks. After any oil leaks have been corrected and the engine has been stopped long enough for oil from various parts of the engine to drain back to the crankcase (approximately 20 minutes), add sufficient oil to raise the oil 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 a DDC distributor for the cause. Fuel or coolant dilution of lube oil can result in serious engine damage.

AIR SYSTEM

In the air system used on Detroit Diesel two-cycle engines, outside air drawn into the engine passes through the air filter or air silencer (marine units) and is pulled into the turbocharger, where it is compressed. It then moves through the blower, where it is further compressed, and flows into the cylinders, where it mixes with atomized fuel oil from the injectors.

Air Cleaners

Several kinds of oil bath and dry element type air cleaners are available for use on Detroit Diesel engines. Maximum protection of the engine against dust and other forms of air contamination is possible if the air cleaner is serviced at regular intervals or when the maximum allowable air restriction has been reached.

Oil Bath Type

Service the **light-duty** oil bath air cleaner as follows:

1. Loosen the wing nut and remove the air cleaner from the air inlet housing. Separate the cleaner into its two sections. The upper (body) assembly contains the filter element, and the lower section consists of the oil cup, removable inner cup or baffle, and the center tube.
2. Soak the body assembly and element in fuel oil to loosen the dirt. Then flush the element with clean fuel oil and allow it to drain and dry thoroughly, removing all the fuel oil. This is necessary to eliminate a possible external source of fuel which could result in engine overspeeding.
3. Pour out the old oil, separate the inner cup or baffle from the oil cup, remove the sludge, and wipe the baffle and outer cup clean.
4. Push a lint-free cloth through the center tube to remove dirt or oil.
5. Clean and check all gaskets and sealing surfaces to ensure air-tight seals.
6. Refill the oil cup to the oil level mark only, install the baffle, and reassemble the air cleaner.
7. Before reattaching the air cleaner, check the air inlet housing. The inlet will be dirty if air cleaner ser-

vice has been neglected or if dirty air has been seeping past the air cleaner to the air inlet housing seals.

8. Install the air cleaner, making sure that it is seated properly on the inlet housing and that the seal is installed correctly. Tighten the wing nut until the air cleaner is securely mounted.

Service the **heavy-duty** oil bath air cleaner as follows:

1. Loosen the wing nuts and detach the lower portion of the air cleaner assembly.
2. Remove the detachable screen by loosening the wing nuts and rotating the screen one-quarter turn. Clean the screen in solvent or similar washing solution. When a clean screen is held up to the light, an even pattern of light should be visible. If an excessive amount of fibrous material ("lint") remains trapped in the screen after cleaning, the screen **must** be replaced.
3. Pour out the old oil, separate the inner cup or baffle from the oil or outer cup, remove the sludge, and wipe the baffle and outer cup clean.
4. Clean and inspect the gasket and sealing surfaces to ensure an air-tight seal.
5. Reinstall the baffle in the oil cup and fill to the proper oil level with the same grade of oil used in the engine.
6. Remove the hood and clean by brushing or by blowing out with compressed air.

CAUTION:

To prevent possible personal injury, wear adequate eye protection and

Do not exceed 40 psi (276 kPa) air pressure.

Push a lint-free cloth through the center tube to remove dirt or oil from the walls.

Inspect the lower portion of the air cleaner body and center tube each time the oil cup is serviced. If there are any indications of plugging, the body assembly should be removed from the engine and cleaned by soaking and then by flushing with clean fuel oil. Allow the unit to drain and dry thoroughly, removing all the fuel oil. This is necessary to prevent a possible external source of fuel which could result in engine overspeeding.

- Place the removable screen in the body assembly. Install the body if it was removed from the engine for servicing.

- Install the outer cup and baffle assembly. Be sure the cup is tightly secured to the body assembly.

All oil bath air cleaners should be serviced as operating conditions warrant. At no time should more than 1/2" of sludge be allowed to form in the oil cup or the area used for sludge deposit. Never fill the oil cup above the oil level mark.

Dry Type

The dry type air cleaner consists of a removable cover attached to the air cleaner body. The body contains a replaceable paper filter cartridge and a dust cup. Air entering the air cleaner is centrifugally pre-cleaned by a turbine-type vane assembly. Air rotates at high speed around the filter element, throwing the dust to the outside where it flows down the wall of the body and is ejected into a dust cup. The dust cup is baffled to pre-

vent the reentry of the dust. The pre-cleaned air passes through the paper filter element and enters the engine. Some air cleaners are equipped with a restriction indicator which aids in determining the servicing intervals.

Most dry type air cleaners must be discarded and replaced with new elements when the maximum allowable air cleaner restriction has been reached, or at specified hour or mileage intervals. **Before attempting to clean or reuse a dry type element, follow the manufacturer's recommendations regarding reuse and follow his prescribed cleaning, drying, and inspection guidelines carefully.** This information is available from the manufacturers or distributors of the elements.

Air Box Drains

During normal engine operation water vapor from the air charge, as well as a slight amount of fuel and lubrication oil fumes, condenses and settles on the bottom of the air box. This condensation is removed by airbox pressure through air box drain tubes mounted on the side of the cylinder block. The drain tubes may also include check valves.

The air box drains must be open at all times. With the engine running, a periodic check is recommended for air flow from the air box drain tubes. If no air flow is detected, a drain tube may be plugged and liquid may be accumulating on the bottom of the air box. Such accumulations should be removed and the drain tubes cleaned thoroughly. **Authorized Detroit Diesel service outlets are properly equipped to perform this service.**

COOLING SYSTEM

A Detroit Diesel engine uses one of three different types of cooling system. **Radiator and fan cooling systems** are used on vehicle engines, generator sets, and in industrial applications. **Heat exchanger/raw water pump systems** and **keel cooling systems** are used on marine engines. Each system has a centrifugal type fresh water pump to circulate coolant within the engine. Each system also incorporates thermostats to maintain normal engine operating temperature. In general, the temperature is 160-185°F (71-85°C) for off-highway units, 170-195°F (77-90°C) for on-highway units, or 170-187°F (77-86°C) for certain Series 53 turbocharged industrial units. For exact operating temperature range, contact a Detroit Diesel distributor. Provide him with engine model and serial number.

Engine Coolant

As heat is generated by the combustion process in the engine cylinders, the engine coolant absorbs the heat from the component parts such as the exhaust valves, cylinder liners, and pistons which are surrounded by water jackets. In addition, the heat absorbed by the oil is also removed by the engine coolant in the oil-to-water oil cooler.

Coolant Requirements

Coolant solutions must meet the following basic requirements:

1. Provide for adequate heat transfer.
2. Provide a corrosion-resistant environment within the cooling system.
3. Prevent formation of scale or sludge deposits in the cooling

system.

4. Be compatible with cooling system hose and seal materials.
5. Provide adequate freeze protection during cold weather operation and boil-over protection in hot weather.

The first four requirements are satisfied by combining a suitable water with reliable inhibitors. When freeze protection is required, a solution of suitable water and an antifreeze containing adequate inhibitors will provide a satisfactory coolant.

A corrosion inhibitor is a water-soluble chemical compound which protects the metallic surfaces of the cooling system against corrosive attack. Some of the more commonly used corrosion inhibitors are chromates, borates, nitrates, nitrites and soluble oil. (Soluble oil is not recommended as a corrosion inhibitor.) Depletion of all types of inhibitors occurs through normal operation. Therefore, strength levels must be maintained by adding inhibitors as required after testing the coolant.

Test Methods

Test kits and test strips are commercially available to check engine coolant for corrosion inhibitor strength level. Coolant should be tested to determine the need for corrosion inhibitor supplements and the amount required. Do not use one manufacturer's test to measure the inhibitor strength level of another manufacturer's product. Always follow the manufacturer's recommended test procedures.

Antifreeze

Ethylene glycol base antifreeze solu-

solutions meeting GM Specification 199M and 6038 are recommended for year-round use in Detroit Diesel engines. An inhibitor system is included in this type of antifreeze and no additional inhibitors are required on initial fill if a minimum antifreeze concentration of 30% by volume is used. Solutions of less than 30% concentration do not provide sufficient corrosion protection. Concentrations over 67% adversely affect freeze protection and heat transfer rates.

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 at 600 hour or 20,000 mile (32,186 km) intervals.

A cooling system properly maintained and protected with supplemental corrosion inhibitors can be operated up to two years, 200,000 miles, or 6000 hours, whichever comes first. At this interval the antifreeze should be drained and the cooling system cleaned thoroughly. The cooling system should then be replenished with an ethylene glycol-base antifreeze/water solution in the required concentration.

NOTICE:

Failure to maintain inhibitors at proper levels can result in damage to the cooling system and its related components. Conversely, overinhibiting antifreeze solutions can cause silicate dropout. Always follow the supplier's recommendations on inhibitor usage and handling.

For more detailed recommendations, refer to **Coolant for Detroit Diesel Engines**, form 7SE298, available from Detroit Diesel distributors.

Draining and Flushing the Cooling System

The draining and flushing operation should be performed as follows:

CAUTION:

Do not remove the pressure control cap from the radiator or heat exchanger 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. Drain the previous solution from the engine and radiator or heat exchanger.
2. Refill the cooling system with soft clean 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 (15) minutes to circulate the solution thoroughly.
4. Drain the cooling system completely.
5. Refill the cooling system with clean, soft water, operate the engine for 15 minutes, and drain the cleaner residue from the system.
6. Refill the system with proper mix of antifreeze and clean, soft water.

NOTICE:

If the engine overheats and the fan belt tension and water level are satisfactory, the entire cooling system may require cleaning with a descaling solvent and backflushing. Authorized Detroit Diesel service outlets are

properly equipped to perform these services.

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

The cooling system hoses should be inspected and any hose that shows obvious signs of damage or feels abnormally soft or hard should be replaced. All external leaks should be corrected as soon as detected.

The fan belt must be checked and adjusted, if necessary, to provide the proper tension. The fan shroud must be tight against the radiator core to prevent recirculation of air, which may lower fan cooling efficiency.

Raw Water Pump

Jabsco raw water pumps are used on marine engine heat exchanger systems. A raw water pump seal malfunction is readily noticeable by the leakage of water from the openings in the pump housing. These openings, which are located between the pump mounting flange and the inlet and outlet ports, must remain open at all times. Leaky seals require replacement. Authorized Detroit Diesel service outlets are properly equipped to perform this service.

OTHER SYSTEMS

Electrical System

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

CAUTION:

avoid possible personal injury

and/or engine damage from accidental engine startup, always disconnect the battery before servicing the electrical system.

Starting Motor

The electric starting motor is permanently lubricated at time of manufacture and does not require servicing.

Starter Switch

To start the engine, a starter switch is used to energize the starting motor. Release the switch immediately after the engine starts.

Alternator

The battery-charging alternator provides a source of electrical current for maintaining the storage battery in a charged condition and for supplying sufficient current to carry any other electrical load requirements up to the rated capacity of the alternator.

Precautions must be taken when working on or around an 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. Reversing connections can also cause damage.
3. Never disconnect the battery while the alternator is operating. Disconnecting the battery can result in damage to the 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 and can result in equipment damage.

- . If a booster battery is to be used, batteries must be connected correctly (negative to negative, positive to positive) to avoid equipment damage.
- . Never use a fast charger with the batteries connected, or as a booster for battery output.

Storage Battery

The lead-acid storage battery is an electrochemical device for converting chemical energy into electrical energy. The battery has three major functions:

- . It provides a source of electrical power for starting the engine.
- . It acts as a stabilizer to the voltage in the electrical system.
- . It can, for a limited time, furnish current when the electrical demands of the unit exceed the output of the alternator.

The battery is a perishable item which requires periodic servicing. A properly cared for battery will give long trouble-free service.

1. 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.
2. 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.
3. If the engine is to be out of service for more than 30 days, batteries should be removed and stored in a cool dry place. Keep the battery fully charged, if possible.
4. If standard lead-acid or low maintenance batteries are used, check the level of the electrolyte regularly. Add water if necessary, but **do not overfill**. Overfilling can cause poor performance or early failure.

DDEC Options

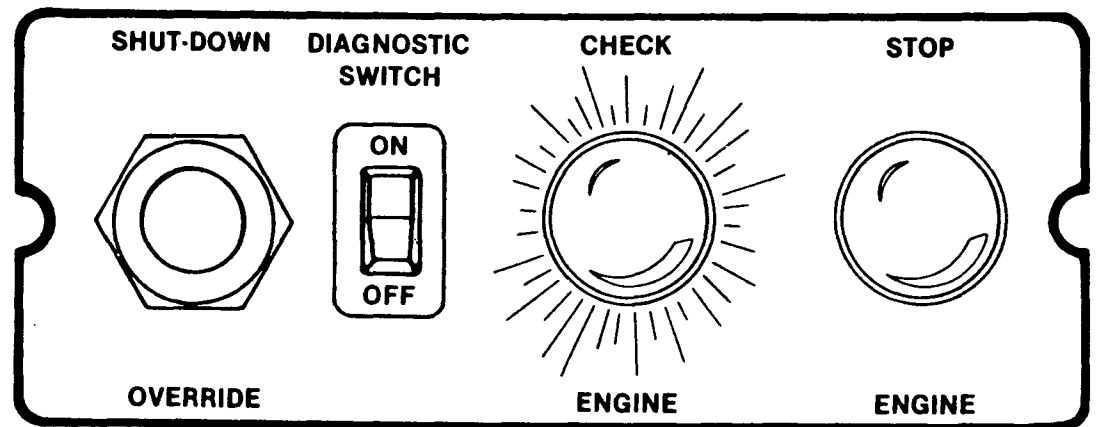
Engines having the Detroit Diesel Electronic Control (DDEC) can be equipped with a variety of options designed to warn the operator of an engine malfunction. The options can range from "Check Engine" and "Stop Engine" panel lights to automatic reduction in engine power followed by automatic engine shutdown.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

If the engine is equipped with the power-down/shutdown option there will be a system override button or switch which may be used to allow engine operation for a short period of time. This will allow the operator to move the vehicle to a safe location.

CAUTION:

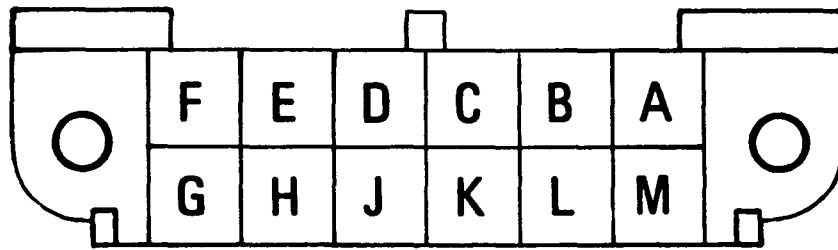
If the vehicle is equipped with an OEM supplied diagnostic switch, the switch must NOT be switched on when operating the vehicle. If this is done, the diagnostic mode line will be grounded, and the throttle will be forced to the idle position, affecting vehicle operation. The throttle will also go to idle if pins A and M in the Diagnostic Data Link (DDL) connector are jumpered together. This condition will not occur when the Diagnostic Data Link Reader J 36500 is used.

When the OEM supplied diagnostic switch is turned on or pins "A" and "M" of the DDL connector are jumpered together, the "check engine" light will illuminate in a series of flashes separated by a pause. These flashes indicate a trouble code.



TYPICAL SHUT-DOWN OVERRIDE SWITCH

DDL CONNECTOR



CODE #	DESCRIPTION	CODE #	DESCRIPTION
11	POWER TAKE OFF SENSOR — LO VOLT	32	ECM BACK-UP SYSTEM FAILURE
12	POWER TAKE OFF SENSOR — HI VOLT	33	TURBO BOOST SENSOR—HI VOLT
13	COOLANT SENSOR — LO VOLT	34	TURBO BOOST SENSOR—LO VOLT
14	ENGINE TEMP. SENSOR — HI VOLT	35	OIL PRESSURE SENSOR—HI VOLT
15	ENGINE TEMP. SENSOR — LO VOLT	36	OIL PRESSURE SENSOR—LO VOLT
16	COOLANT SENSOR — HI VOLT	41	TIMING REFERENCE SENSOR
21	THROTTLE POSITION SENSOR — HI VOLT	42	SYNCHRONOUS REFERENCE SENSOR
22	THROTTLE POSITION SENSOR — LO VOLT	43	LOW COOLANT LEVEL
23	FUEL TEMP. SENSOR — HI VOLT	44	ENGINE OVER TEMPERATURE
24	FUEL TEMP. SENSOR — LO VOLT	45	LOW OIL PRESSURE
25	NO CODES	46	LOW BATTERY VOLTAGE
26	POWER CONTROL ENABLED	51	EEPROM ERROR
31	FAULT ON AUX. OUTPUT	52	ECM—A/D FAILURE
		53	EEPROM MEMORY FAILURE
		54	VEHICLE SPEED SENSOR
		55	PROPRIETARY COMM. LINK
		56	ECM—A/D FAILURE
		58	CRUISE CONTROL SWITCHES
		61-68	INJ. RESPONSE TIME LONG
		71-78	INJ. RESPONSE TIME SHORT
		85	ENGINE OVERSPEED

CAUTION:

The operator of a DDEC-equipped engine should know the extent of the warning system on his vehicle in order to bring the vehicle 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 Corporation 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.

INDUSTRIAL OFF HIGHWAY AND MARINE	HRS. MILES	TIME INTERVALS										
		DAILY	8	50	100	150	200	300	500	700	1,000	2,000
			240	1,500	3,000	4,500	6,000	9,000	15,000	20,000	30,000	60,000
1. — Lubricating Oil*		x				x						
2. — Fuel & Fuel Tank*		x							x	x		
3. — Fuel Lines and Flexible Hoses		x							x		x	
4. — Cooling System*		x								x	x	
5. — Turbocharger		x										
6. — Battery					x							
7. — Tachometer Drive					x							
8. — Air Cleaners*			x						x			
9. — Drive Belts*			x				x					
10. — Air Compressor						x				x		
11. — Throttle and Clutch Controls							x					
12. — Lubricating Oil Filter									x		x	
13. — Fuel Strainer and Filter								x				
14. — Coolant Filter and Water Pump*									x			
15. — Air System										x		
16. — Exhaust System										x		
17. — Air Box Drain Tube											x	
18. — Emergency Shutdown										x		
19. — Radiator										x		
20. — Shutter Operation										x		
21. — Oil Pressure										x		
22. — Overspeed Governor									x			
23. — Throttle Delay*												
24. — Battery-Charging Alternator*							x					
25. — Engine and Transmission Mounts												x
26. — Crankcase Pressure												x
27. — Air Box Check Valves*												
28. — Fan Hub*										x		
29. — Thermostats and Seals*												
30. — Blower Screen											x	
31. — Crankcase Breather											x	
32. — Engine Tune-Up*												
33. — Heat Exchanger Electrodes									x		x	
34. — Raw Water Pump		x										

*See Item

LUBRICATION AND PREVENTIVE MAINTENANCE

The **Lubrication and Preventive Maintenance Schedule** is intended as a guide for establishing a preventive maintenance schedule. The suggestions and recommendations given should be followed as closely as possible to obtain long life and optimum performance from Detroit Diesel Engines. The intervals indicated on the chart are time (hours) of actual operation.

Maintenance Schedule Explanation

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

The daily instructions pertain to routine or daily starting of an engine and not to a new engine or one that has not been operated for a considerable period of time. For new or stored engines, follow the instructions given under **Preparations for Starting the Engine the First Time** under **Engine Operation**.

Preventive maintenance other than the daily checks shown in column 1 should be performed by authorized Detroit Diesel service outlets. DDC outlets have the special tools and trained personnel to properly perform these services.

ITEM 1 — LUBRICATING OIL

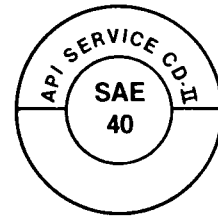
Check the oil level with the engine stopped. If necessary, add sufficient oil to raise the oil level to the proper mark on the dipstick.

NOTICE:

If the oil level is constantly above normal and excess lube oil has not been added to the crankcase, consult with a DDC distributor for the cause. Fuel or coolant dilution of lube oil can result in serious engine damage.

LUBRICANT RECOMMENDATION

API Symbol:



SAE Viscosity Grade: 40
API Classification CD-II
Military Spec.: Mil-L-2104D
Sulfated Ash: less than 1.0%

This is the only engine oil recommended for Detroit Diesel two-cycle engines. Lubricants meeting these criteria have provided maximum engine life when used in conjunction with recommended oil drain and filter maintenance schedules.

Certain engine operating conditions may require exceptions to this recommendation. They are as follows:

1. For continuous high temperature operation (over 100°F ambient or 200°F coolant out) the use of an SAE grade 50 lubricant in all series two-cycle DDC engines is recommended.
2. At ambient temperatures below freezing where starting aids are not available or at very cold temp-

eratures (0 to -25°F), the use of multiviscosity grade 15W-40 or monograde SAE 30 lubricants will improve startability. **Exception: Do not use these lubricants in two-cycle marine engines under any circumstances.**

3. The API category CD-II is relatively new and may not be fully in use at the time of this publication. API category CD may be used provided the recommended military specification is satisfied. Oils with API designation CE are not recommended in DDC two-cycle engines unless accompanied by CD-II.
4. When the use of high sulfur fuel is unavoidable, lubricants with a Total Base Number exceeding 10 are recommended. Such a lubricant may have a Sulfated Ash content above 1.0% mass. High sulfur fuels require modification to oil drain intervals.

SYNTHETIC OILS

Synthetic oils may be used in Detroit Diesel engines provided they meet the viscosity, performance classification and chemical recommendations listed for non-synthetic lubricants. Product information about synthetic oils should be reviewed carefully since lubricants are often claimed to be of monograde viscosity. Their use does not permit extension of recommended oil drain intervals.

USE OF SUPPLEMENTAL ADDITIVES

Lubricants meeting the Detroit Diesel recommendations 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, is generally unnecessary and can even be harmful. Never use a lubricant supplement to "fix" a mechanical problem, and be cautious of products purporting to prevent one. The best approach is to follow DDC's lubricant recommendations.

OIL CHANGE INTERVALS

During use, engine lubricating oil undergoes deterioration from combustion by-products and contamination. For this reason, regular oil drain intervals are necessary. These intervals however, may vary in length depending upon engine operation, fuel quality, and lubricant quality. The oil drain interval may be established on recommendations of a Detroit Diesel Oil Analysis Program until the most practical oil change interval has been determined. Under no circumstances, however, should the drain intervals in the chart be exceeded. All engine oil filters should be changed when the lube oil is changed.

Dispose of used lubricating oil, filter, and gasket in an environmentally approved manner.

MAXIMUM RECOMMENDED OIL DRAIN INTERVALS (Normal Operation)

SERVICE APPLICATION	ENGINE SERIES	OIL DRAIN INTERVAL
Highway Truck	71 & 92	20,000 Miles (32,000 km)
City Transit Coaches	53, 71 & 92	6,000 Miles (9,600 km)
Pick-up & Delivery, Stop & Go, Short Trip	53, 71 & 92	12,000 Miles (19,000 km)
Industrial, Agricultural and Marine	53, 71 & 92	150 Hrs.
Stationary Units:		
Full Time	53, 71 & 92	500 Hrs. or 1 Month
Standby	53, 71 & 92	150 Hrs. or 1 Year

Oil Change Intervals When Using High Sulfur Fuel

When the continuous use of high sulfur fuel (greater than 0.5%) is unavoidable, lubricant selection and oil drain interval must be modified. A lubricant with a Total Base Number (TBN per ASTM D 2896) above 10 is recommended. It is likely that such

a lubricant will also exhibit a sulfated ash above 1.0%. The proper oil drain interval must be determined by oil analysis when operating on high sulfur fuel. A reduction in TBN (D 2896) to one third of the initial value provides a general drain interval guideline.

MAXIMUM RECOMMENDED OIL DRAIN INTERVALS

FUEL SULFUR 0.5% TO 1.0%

Use a lubricant with TBN (ASTM D 2896) 10 to 30

SERVICE APPLICATION	ENGINE SERIES	OIL DRAIN INTERVAL	
		10-19 TBN	20-30 TBN
Highway Truck	71 & 92	15,000 Mi. (24,000 km)	20,000 Mi. (32,000 km)
City Transit Coaches	53, 71 & 92	4,000 Mi. (6,400 km)	6,000 Mi. (9,600 km)
Pick-up & Delivery Stop & Go, Short Trip	53, 71 & 92	8,000 Mi. (12,500 km)	12,000 Mi. (20,000 km)
Industrial, Agricultural and Marine	53, 71 & 92	100 Hrs.	150 Hrs.
Stationary Units:			
Full Time	53, 71 & 92	300 Hrs. (or 1 Month Max.)	500 Hrs.
Standby	53, 71 & 92	100 Hrs.	150 Hrs. (or 1 Year Max.)

MAXIMUM RECOMMENDED OIL DRAIN INTERVALS

FUEL SULFUR ABOVE 1.0%

Use a lubricant with TBN (ASTM D 2896) 10 to 30

SERVICE APPLICATION	ENGINE SERIES	OIL DRAIN INTERVAL	
		10-19 TBN	20-30 TBN
Highway Truck	71 & 92	7,500 Mi. (12,000 km)	15,000 Mi. (24,000 km)
City Transit Coaches	53, 71 & 92	2,000 Mi. (3,000 km)	4,000 Mi. (6,400 km)
Pick-up & Delivery Stop & Go, Short Trip	53, 71 & 92	4,000 Mi. (6,500 km)	8,000 Mi. (12,500 km)
Industrial, Agricultural and Marine	53, 71 & 92	50 Hrs.	100 Hrs.
Stationary Units: Full Time	53, 71 & 92	150 Hrs.	300 Hrs.
Standby	53, 71 & 92	50 Hrs.	100 Hrs. (or 6 Months Max.)

Lubricating Oil Filter Recommendation

Filter Type	Manufacturer	Filter No.
Full Flow	AC Spark Plug Div. GM	PF911L P/N 25013192

ITEM 2 — FUEL

Keep the fuel tank filled to reduce condensation. Select the proper grade of fuel in accordance with the following recommendations.

QUALITY AND SELECTION

The quality of fuel used is a very important factor in obtaining satisfactory engine performance, long engine life, and acceptable exhaust emission levels. DDC engines are designed to operate on most diesel fuels

marketed today. In general, fuels meeting the properties of ASTM Designation D 975 (grades 1-D and 2-D) have provided satisfactory performance. The ASTM D 975 specification, however, does not in itself adequately define the fuel characteristics necessary for assurance of fuel quality. The properties listed in the Fuel Oil Selection Chart have provided optimum engine performance.

FUEL OIL SELECTION CHART

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

Not specified in ASTM D 975

+ Differs from ASTM D 975

* No. 1 diesel fuel is recommended for use in city coach engine models. No. 2 diesel fuel may be used in city coach engine models which have been certified to pass Federal and California emission standards.

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

Note 2: When prolonged idling periods of cold weather conditions below 32°F (°C) are encountered, the use of 1-D fuel is recommended. Number 1-D fuels should also be considered when operating continuously at altitudes above 5000 ft.

DIESEL FUEL STORAGE

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

NOTICE:

Galvanized steel or sheet metal tanks and galvanized pipes or fittings should never be used 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 the filters and can cause engine damage.

FUEL ADDITIVES

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

Fuel additives specifically NOT recommended include:

- Used Lubricating Oil
- Gasoline

Detroit Diesel does NOT recommend the use of drained lubricating oil or gasoline in diesel fuel. Furthermore, Detroit Diesel Corporation will not be responsible for any detrimental effects which it determines resulted from this practice.

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

- Isopropyl Alcohol – 1 pint per 125 gallons of fuel for winter freeze up protection.
- Biocide – For treatment of microbe growth or black “slime”. Follow manufacturers’ instructions for treatment.

Other fuel additives are of questionable benefit. These include a variety of independently marketed products which claim to be:

- Cetane Improvers
- Combustion Improvers
- Cold Weather Flow Improvers

These products should be accompanied with performance data supporting their merit. It is not the policy of Detroit Diesel Corporation to approve or endorse such products.

For more detailed information, refer to "Lubricating Oil, Fuel Oil, and Filter Recommendations," form 7SE270, available from Detroit Diesel distributors.

ITEM 3 — FUEL LINES, FLEXIBLE HOSES

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.

A hose has a finite service life. With this in mind, all hoses should be thoroughly inspected at least every 500 operating hours (1000 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 service. Fire resistant fuel and lube oil hose assemblies do not require automatic replacement after five years service or at major overhaul.

ITEM 4 — COOLING SYSTEM

CAUTION:

Do not remove the pressure control cap from the radiator or heat exchanger 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.

Check the coolant level daily and maintain it near the top of the heat exchanger tank or radiator upper tank. Add coolant as necessary, but **do not overfill**.

Visually check for cooling system leaks. Look for an accumulation of coolant beneath a vehicle when the engine is running and when it is stopped.

A cooling system properly maintained and protected with supplemental corrosion inhibitors can be operated up to two years, 200,000 miles, or 6000 hours, whichever comes first. At this interval the antifreeze should be drained and the cooling system cleaned thoroughly. The cooling system should then be replenished with an ethylene glycol-base antifreeze/water solution in the required concentration. For more detailed recommendations, refer to **Coolant for Detroit Diesel Engines**, form 7SE298, available from Detroit Diesel distributors.

NOTICE:

Failure to maintain inhibitors at proper levels can result in damage to the cooling system and its related components. Conversely, overinhibiting

antifreeze solutions can cause silicate dropout. Always follow the supplier's recommendations on inhibitor usage and handling.

All cooling system hoses should be inspected at least once every 700 hours for signs of deterioration and replaced, if necessary.

ITEM 5 — TURBOCHARGER

Visually inspect the mountings, intake and exhaust ducting and connections for leaks. Check the oil inlet and outlet lines for leaks or restrictions to oil flow. Check for unusual noise or vibration and, if excessive, stop the engine and do not operate until the cause is determined. If so equipped, check heat-insulating turbo/exhaust system blankets for damage. Torn, matted, oil-soaked, or otherwise damaged blankets **must** be replaced immediately.

ITEM 6 — BATTERY

Check the "eye" of maintenance-free batteries for charge. If lead-acid or low maintenance batteries are used, check the specific gravity of each cell every 100 hours. Check more frequently in warm weather due to the more rapid loss of water thru evaporation. Maintain the electrolyte level according to the battery manufacturer's recommendations.

ITEM 7 — TACHOMETER DRIVE

The tachometer drive should be lubricated every 100 hours with an all-purpose grease at the grease fitting. Use a No. 2 grade grease at temperatures above 30°F (−1°C) and a No. 1 grade grease below this temperature.

ITEM 8 — 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 and inefficient engine operation.

Oil Bath Type

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

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

Dry Type

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

If reusable elements are used, the maximum service life of the element is still one year. Cleaning, washing, and inspection must be done per the manufacturer's recommendations.

ITEM 9 — DRIVE BELTS

Drive belt tension should be checked every 200 hours and adjusted, if necessary.

ITEM 10 — AIR COMPRESSOR

The polyurethane sponge strainer should be removed and cleaned or replaced every 150 operating hours. Air compressor mounting bolts should be tightened to the proper tension every 12 months or 700 hours, whichever comes first.

ITEM 11 — THROTTLE AND CLUTCH CONTROLS

The throttle control mechanism should be lubricated every 200 hours with an all purpose grease (No. 2 grade at temperatures above 30°F or -1°C, No. 1 below this). All other control mechanisms should also be lubricated with engine oil at this interval.

ITEM 12 — LUBRICATING OIL FILTER

Lubricating oil filters should be changed whenever the engine oil is changed. See Item 1 for recommended intervals. The following filter is recommended:

Filter Type	Manufacturer	Filter No.
Full Flow	AC Spark Plug Div. GM	PF911L P/N 25013192

ITEM 13 — FUEL STRAINER AND FILTER

Primary and secondary fuel filters should be replaced every 300 hours, or sooner if plugging is indicated. The elements below are recommended. Before replacing elements, consult with a Detroit Diesel distributor for required part numbers.

FUEL FILTER RECOMMENDATION Regular Service

Filter Type	Manufacturer	Filter No.
Primary	AC Spark Plug Div. GM	T552 (5575032) T553 (5574961) T541 (5574980) T632 (6436874) T915 (25010776)* T958 (25011024)*
Secondary	AC Spark Plug	TP509 (5573261) TP540X (5574508) TP624 (6436719) TP916 (25010778)* TP959 (25011026)*

* Spin-on

Severe Duty Service

Filter Type	Manufacturer	Filter No.
Primary	Racor	B32002
Secondary	Pall Corp.	Head HH7400A12UPRBP Element HC7400SUP-4H
Secondary (Alternate)	AC Spark Plug	TP916L (25013261)* TP928L (25013273)* TP959L (25013535)*

* Spin-on

ITEM 14 — COOLANT FILTER AND WATER PUMP

the cooling system is protected by coolant filter and conditioner, the element should be changed every 1000 hours. For further recommendations, refer to **Coolant for Detroit Diesel Engines**, form 7SE298, available from Detroit Diesel Distributors.

The water pump drain hole should be inspected for plugging every 6 months and cleaned out, if necessary. Authorized Detroit Diesel service outlets are properly equipped to perform this service.

ITEM 15 — AIR SYSTEM

All connections in the air system should be checked to make sure they are tight. Hoses should be inspected for punctures or other damage and replaced, if necessary.

ITEM 16 — EXHAUST SYSTEM

The exhaust manifold retaining nuts, exhaust flange clamp, and other manifold connections should be checked for tightness. The exhaust pipe rain cap, if used, should also be checked for proper operation.

ITEM 17 — AIR BOX DRAIN TUBE

If the engine is equipped with an air-box drain tank, drain the sediment daily.

With the engine running, the air box drain tubes should be checked for flow of air every 1000 hours. If tubes are clogged, they should be removed, cleaned, and reinstalled.

ITEM 18 — EMERGENCY SHUTDOWN

With the engine running at **idle** speed, the operation of the emergency shutdown should be checked every 700 hours. The valve should be reset in the open position after the check has been made.

NOTICE:

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

ITEM 19 — RADIATOR

The outside of the radiator core should be inspected every 700 hours and, if necessary, cleaned with a quality grease solvent such as mineral spirits and dried with compressed air. Have it cleaned more frequently if the engine is operated in extremely dusty or dirty areas.

CAUTION:

To avoid possible personal injury, adequate eye protection should be worn and no more than 40 psi (276 kPa) air pressure used. Fuel oil, kerosene, and gasoline should not be used.

ITEM 20 — SHUTTER OPERATION

The operation of the shutters should be checked and the linkage and controls cleaned.

ITEM 21 — 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

guage, have the oil pressure checked and recorded every 700 hours.

ITEM 22 — OVERSPEED GOVERNOR

If the overspeed governor is equipped with a hinge type cap oiler or oil cup, have it lubricated with 5 or 6 drops of clean engine oil every 500 hours **with the engine stopped**. Avoid excessive lubrication.

ITEM 23 — THROTTLE DELAY

Have the throttle delay inspected and adjusted, if necessary, every 30 months.

ITEM 24 — BATTERY CHARGING ALTERNATOR

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

ITEM 25 — ENGINE AND TRANSMISSION MOUNTS

Engine and transmission mounting bolts and the condition of the mounting pads should be checked every 2000 hours and tightened or repaired, as required.

ITEM 26 — CRANKCASE PRESSURE

Crankcase pressure should be checked and recorded every 2000 hours.

ITEM 27 — AIR BOX CHECK VALVES

Every 3000 hours the air box check valves should be removed and cleaned in solvent. Drain lines should be blown out with compressed air.

CAUTION:

To avoid possible personal injury, adequate eye protection should be worn and no more than 40 psi (276 kPa) air pressure used.

ITEM 28 — FAN HUB

Every 700 hours fan hub bearings should be lubricated with one shot of Texaco Premium RB grease, or an equivalent lithium-base multi-purpose grease.

Every 4000 hours the fan hub bearing assembly should be cleaned, inspected, and refilled with the above grease. Bearings should be replaced and the hub packed with the same grease at major engine overhaul.

ITEM 29 — THERMOSTATS AND SEALS

Thermostats and seals should be checked at 5000 hours or once a year, preferably at the time the cooling system is prepared for winter operation. Thermostats and seals should always be replaced at engine overhaul.

ITEM 30 — BLOWER SCREEN

The blower screen and gasket assembly should be inspected every 1000 hours, cleaned if necessary, and reinstalled. The blower should be inspected for evidence of blower seal leakage when the screen and gasket assembly is removed.

TEM 31 — CRANKCASE BREATHER

The externally mounted crankcase breather assembly should be removed and the steel mesh pad cleaned in fuel oil every 1000 hours. This cleaning period may be reduced or lengthened according to severity of service.

TEM 32 — ENGINE TUNE-UP

There is no scheduled interval for an engine tune-up. As long as 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.

TEM 33 — HEAT EXCHANGER ELECTRODES AND CORE

Every 500 hours, or annually, the heat exchanger zinc electrodes should be removed and cleaned or replaced, as required.

The heat exchanger core should be inspected for scale or deposits every 1000 hours.

TEM 34 — RAW WATER PUMP

Check the prime on the raw water pump daily. The engine should not be operated with a dry pump. Prime the pump, if necessary, by removing the pipe plug provided in the pump inlet elbow and adding water. Reinstall the plug.

Other Service Publications

Service manuals covering the design and operation of Detroit Diesel Series 53, 71, and 92 engines and the DDEC II electronic engine control system (available on certain applications) are listed below. Also shown 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 distributor. Check the Yellow Pages under **Engines, Diesel** or refer to the **Worldwide Parts and Service Directory** (form 6SE280) for the distributor nearest you.

DESCRIPTION		FORM NO.
V-71	ENGINE SERVICE MANUAL	6SE193
71	ENGINE SERVICE MANUAL	6SE164
53	ENGINE SERVICE MANUAL	6SE202
92	ENGINE SERVICE MANUAL	6SE379
WORLDWIDE PARTS/SERVICE DIRECTORY		6SE280
DDEC II TROUBLESHOOTING GUIDE		6SE489
LUBE, FUEL, FILTER RECOMMENDATIONS		7SE270
COOLANT RECOMMENDATIONS		7SE298

CUSTOMER ASSISTANCE

The satisfaction and goodwill of the owners of Detroit Diesel engines are of primary concern to Detroit Diesel Corporation and its authorized service outlets.

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

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

We recognize however, that despite the best intentions of everyone concerned, misunderstandings may occur. Normally, any such 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 (check the Yellow Pages for the Detroit Diesel Corporation 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 problem originates with a Dealer, explain the matter to a management member of the Distributorship with whom the Dealer has his service agreement.

Step Two

When it appears that your problem cannot readily be resolved at the distributor level without additional assistance, contact the Detroit Diesel Corporation Regional Product Support 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.

Identify the U.S. regional area from the map on the following page.

Eastern Region Regional Product Support or Operations Manager

187 Monmouth Park Highway
West Long Branch, N.J. 07764
Phone: (908) 222-1888
Fax: (908) 222-3411

Southeastern Region Regional Product Support Manager

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

Step Three

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

Director, Reliability and Materials Engineering

Detroit Diesel Corporation
13400 Outer Drive, West
Detroit, MI 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 service outlet utilizing their facilities, equipment and personnel. Therefore, it is suggested that you follow the above steps in sequence when experiencing a problem.