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ILLUSTRATIONS

1. ENGINE

This vehicle is powered by a 6-cylinder, four-cycle, Detroit Diesel series 60 engine, equipped with an electronic control system (DDEC IV).

Series 60 engines come in either of two displacement volumes: 11 liters or 12.7 liters. Summary information on the Electronic Control System is given in this section.

Complete maintenance and repair information on the engine will be found in the current DDEC IV Service Manual #6SE483. This maintenance manual covers engine accessories, controls and related components.

Procedures for engine removal and installation are given at the end of this section. The DDEC system is self-diagnostic. It can identify faulty components and other engine-related problems by providing the technician with a diagnostic code. Refer to DDEC Troubleshooting Guide #6SE492 published by Detroit Diesel for more complete information on diagnosis of components and system problems.

DDEC IV (**D**etroit **D**iesel **E**lectronic **C**ontrol) controls the timing and amount of fuel injected by the electronic unit injectors (EUI). The system also monitors several engine functions using electrical sensors, which send electrical signals to the Electronic Control Module (ECM). The ECM computes the electrical signals and determines the correct fuel output and timing for optimum power, fuel economy and emissions. The ECM also has the ability to display warnings or shut down the engine completely (depending on option selection) in the event of damaging engine conditions, such as low oil pressure, low coolant level, or high oil temperature.

Two categories divide system components: engine-mounted components and engine-related components.

2. ENGINE-MOUNTED COMPONENTS

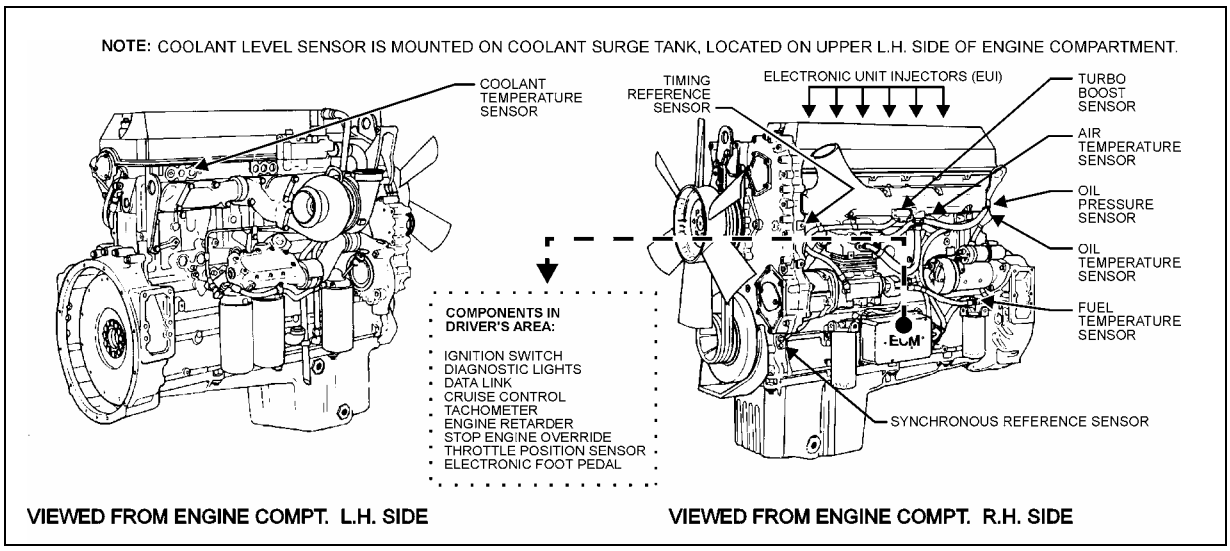

FIGURE 1: DETROIT DIESEL SERIES 60 ENGINE (TYPICAL) 01015

Engine-mounted components are as follows:

- Electronic Control Module
- Electronic Unit Injector
- Synchronous Reference Sensor
- Timing Reference Sensor
- Turbo Boost Pressure Sensor
- Coolant Temperature Sensor
- Fuel Temperature Sensor
- Air Temperature Sensor
- Oil Pressure Sensor
- Oil Temperature Sensor

2.1 ELECTRONIC CONTROL MODULE

The Electronic Control Module is mounted, on the starter side of the engine (Fig. 2). Considered the *"Brain"* of the DDEC IV system, it provides overall monitoring and control of the engine. It does so by comparing input data from the various sensors to a set of calibration data stored in the EEPROM (**E**lectrically **E**rasable, **P**rogrammable, **R**ead-**O**nly **M**emory) within the Electronic Control Module. After comparing the input data with the calibration data, the ECM sends high-current command pulses to the Electronic Unit Injectors (EUI) to initiate fuel injection. The ECM also receives feedback regarding the start and end of injection for a given cylinder. The EEPROM within the Electronic Control Module is factory programmed by Detroit Diesel. Reprogramming must be done at a Detroit Diesel authorized service center. However, some changes may be performed to the cruise control and road speed limiter using a diagnostic data reader (see paragraph "DDEC IV Diagnostic Codes" in this section).

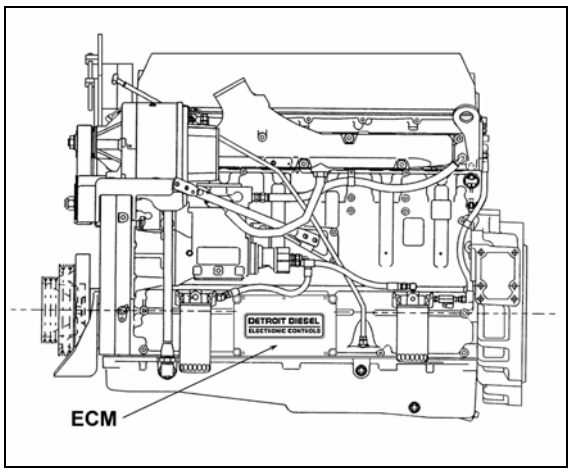

FIGURE 2: ELECTRONIC CONTROL MODULE (ECM)

2.2 ELECTRONIC UNIT INJECTOR

The Electronic Unit Injector is a compact device that injects diesel fuel directly into the combustion chamber (Fig. 3). The amount of fuel injected and the Electronic Control Module (ECM) determines the beginning of injection timing. The ECM sends a command pulse, which activates the injector solenoid. The EUI performs four functions:

- Creates the high-fuel pressure required for efficient injection;
- Meters and injects the exact amount of fuel required to handle the load;
- Atomizes the fuel for mixing with the air in the combustion chamber;
- Permits continuous fuel flow for component cooling.

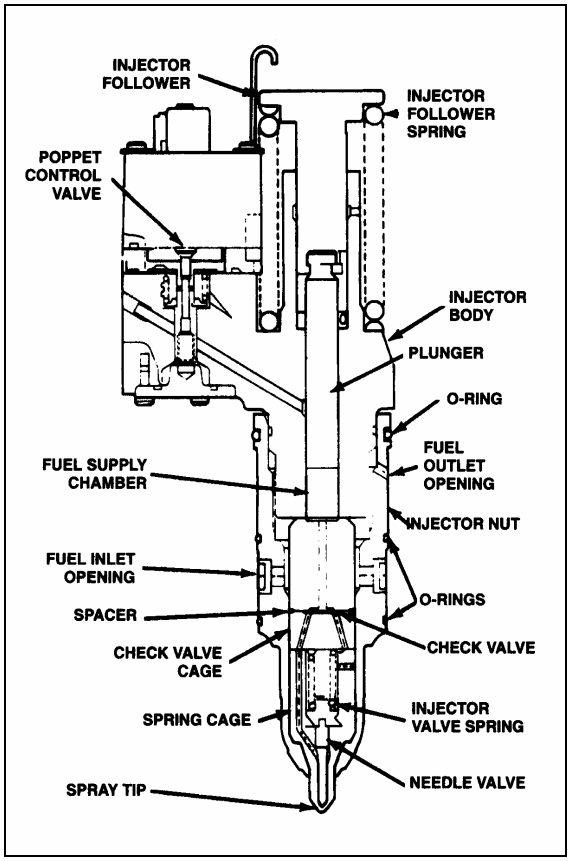

FIGURE 3: UNIT INJECTOR CROSS SECTION 01019

3. SYNCHRONOUS REFERENCE SENSOR

The Synchronous Reference Sensor (SRS) is an electronic component, mounted to the rear of the gear case (Fig. 4). The SRS senses a raised metal pin on the rear of the bull gear and sends a signal to the ECM via a black connector wire. The SRS sensor extends through a hole in the gear case. It is positioned near the rear of the bull gear. A bolt, inserted through a hole in the SRS bracket, secures the SRS assembly to the gear case.

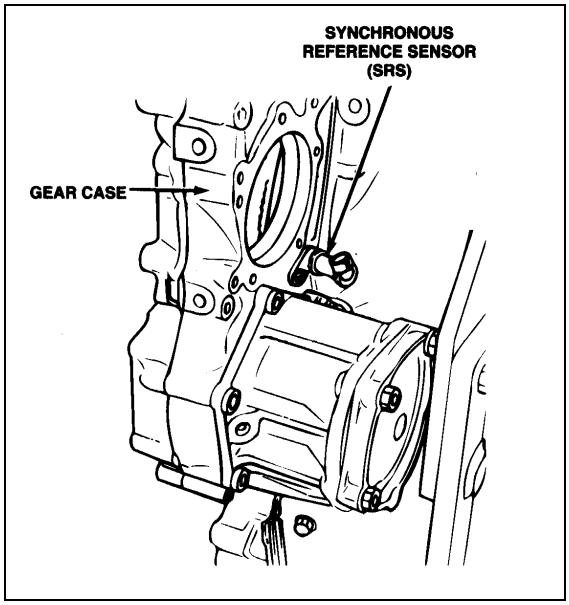

FIGURE 4: SRS LOCATION 01020

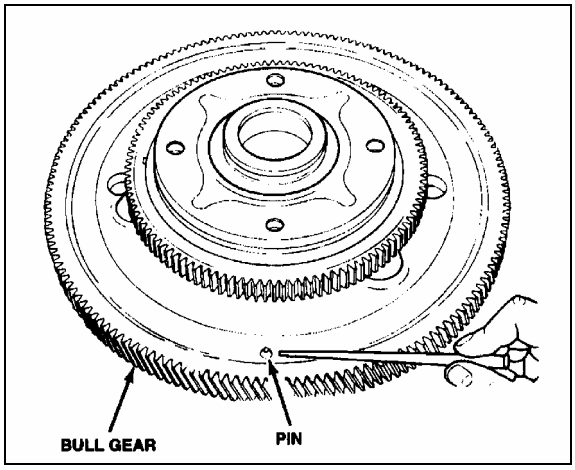

FIGURE 5: BULL GEAR 01021

The bull gear pin passes by the SRS as piston number one crank pin reaches 45° before Top-Dead-Center. The ECM uses this information to determine engine speed.

The SRS is non-serviceable and must be replaced as a unit. No adjustment is required.

3.1 TIMING REFERENCE SENSOR

The Timing Reference Sensor (TRS) is an electronic component mounted on the left side of the gear case (right side of coach), near the crankshaft centerline. The TRS sensor, positioned near the timing wheel gear teeth, extends through an opening in the gear case. A bolt, inserted through a hole in the TRS bracket, secures the TRS assembly to the gear case. The TRS connector is gray. The TRS sensor sends a signal to the ECM. The TRS senses a series of evenly spaced special teeth on the timing wheel. A tooth passes by the TRS as each cylinder crank pin reaches 10° before Top-Dead-Center.

The ECM uses these signals to determine injector solenoid operation time. The TRS is non-serviceable and must be replaced as a unit. No adjustment is required.

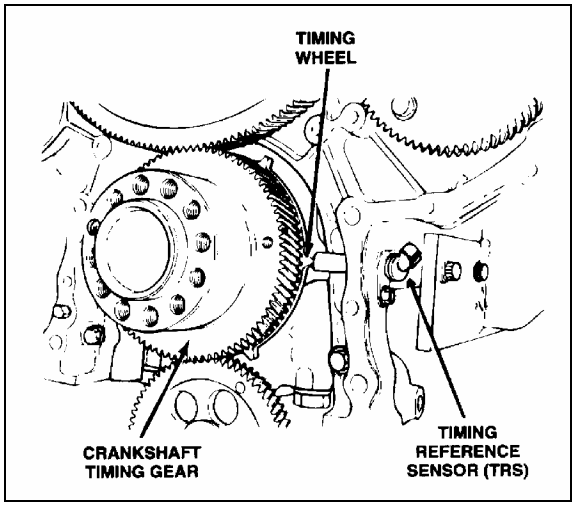

FIGURE 6: TIMING GEAR 01022

3.2 TURBO BOOST PRESSURE SENSOR

Two bolts mount the Turbo Boost Pressure Sensor to the intake manifold. A rubber O-ring seals the sensor to the manifold (Fig. 7). This device is a pressure sensor that sends an electrical signal to the ECM. The ECM uses this information to compute the amount of air entering the engine. Turbo boost sensor information regulates fuel supply to control engine exhaust.

The turbo boost sensor is non-serviceable and must be replaced as an assembly. No adjustment is required.

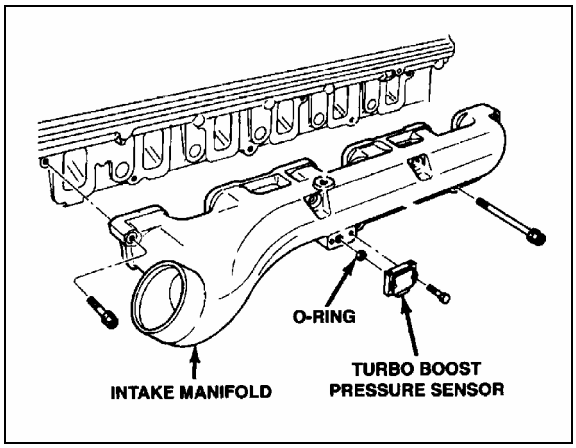

FIGURE 7: **TURBO BOOST PRESSURE SENSOR** 01023

3.3 COOLANT TEMPERATURE SENSOR

The coolant temperature sensor is mounted on the engine's right side (vehicle's left side). The sensor helps protect the engine against overheating by sensing coolant temperature.

3.4 FUEL TEMPERATURE SENSOR

The Fuel Temperature Sensor (FTS) is installed on the secondary fuel filter (Fig. 8).

The FTS sends an electrical signal to the ECM indicating fuel inlet temperature. The ECM uses this information to calculate fuel consumption.

The FTS is non-serviceable and must be replaced as a unit. No adjustment is required.

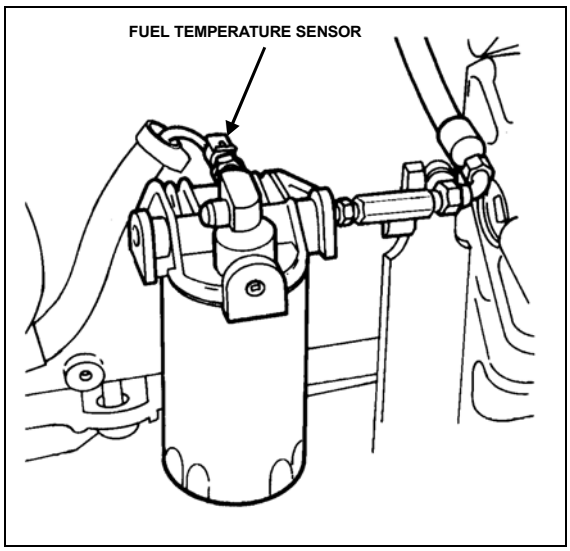

FIGURE 8: FUEL TEMPERATURE SENSOR 01024

3.5 AIR TEMPERATURE SENSOR

The Air Temperature Sensor (Fig. 1) located on the engine (starter side) near the intake manifold provides input data to vary hot idle speed and injection timing. This helps to improve cold starts and reduces white exhaust smoke.

3.6 OIL PRESSURE SENSOR

The Oil Pressure Sensor (OPS) is installed in the main engine-oil gallery. A typical location is the left rear corner of the cylinder block (Fig. 9). The OPS sends an electrical signal to the ECM indicating the engine oil pressure at any given speed. A low oil pressure signal exceeding seven seconds is used by the ECM to begin the stop engine or warning function. The OPS is non-serviceable and must be replaced as a unit. No adjustment is required.

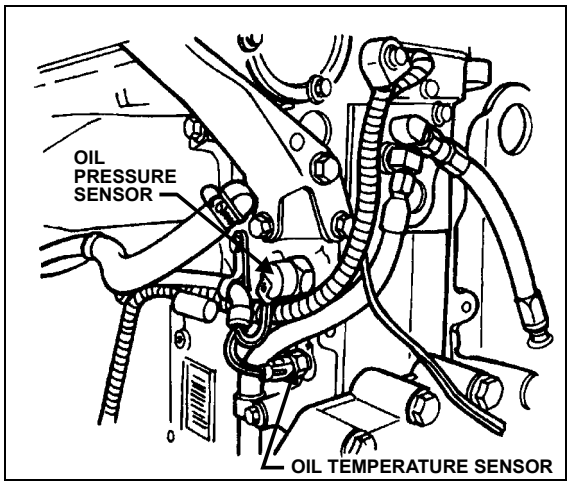

FIGURE 9: CYLINDER BLOCK 01025

3.7 OIL TEMPERATURE SENSOR

The Oil Temperature Sensor (OTS) is installed on the main engine-oil gallery. A typical location is the left rear corner of the cylinder block as shown in Figure 9. The OTS sends an electrical signal to the ECM indicating engine oil temperature. The ECM uses this information to modify engine speed for better cold weather starts and faster warm-ups. Oil temperatures exceeding engine specifications for two seconds or more will illuminate the Check Engine Light.

The OTS is non-serviceable and must be replaced as a unit. No adjustment is required.

4. ENGINE-RELATED COMPONENTS

Engine-related components include:

- Coolant Level System (CLS)
- Electronic Foot Pedal Assembly (EFPA) and Throttle Position Sensor

- Cruise Control Switch (CCS)
- Diagnostic System Accessories (DSA)

4.1 COOLANT LEVEL SYSTEM (CLS)

The coolant level system consists of a conductivity probe mounted in the surge tank and an electronic interface module located inside the rear junction box. Coolant level is determined by the change in impedance of the probe and its brass mount when immersed in coolant. The electronic device in the module conditions the signal to levels compatible with DDEC. A low coolant level will trigger the engine warning functions.

The probe and electronic interface module are non-serviceable items and should be replaced as units, if found defective. No adjustment is required.

4.2 ELECTRONIC FOOT PEDAL ASSEMBLY (EFPA) & THROTTLE POSITION SENSOR

The Electronic Foot Pedal Assembly (EFPA) connects the accelerator pedal to a Throttle Position Sensor (TPS). The (TPS) is a device, which sends an electrical signal to the Electronic Control Module (ECM). The TPS varies in voltage depending on how far the pedal is depressed. The system is installed in the space normally occupied by a mechanical foot pedal. The (EFPA) has maximum and minimum stops that are built into the unit during manufacturing (Fig. 10). The (TPS) converts the operator's foot pedal input into a signal for the ECM. The (EFPA) is shown in Figure 10.

When installed by the equipment manufacturer, the TPS should not require adjustment. If the TPS is suspected of being misadjusted, confirm that the sensor is installed in accordance with the manufacturer's specifications. It is recommended that the idle count be at 50 or higher with a full throttle count of up to 200.

The TPS is self-calibrating and therefore has no optimum closed throttle or wide open throttle count value. If the counts are within the 50 to 200 range, the sensor is properly set.

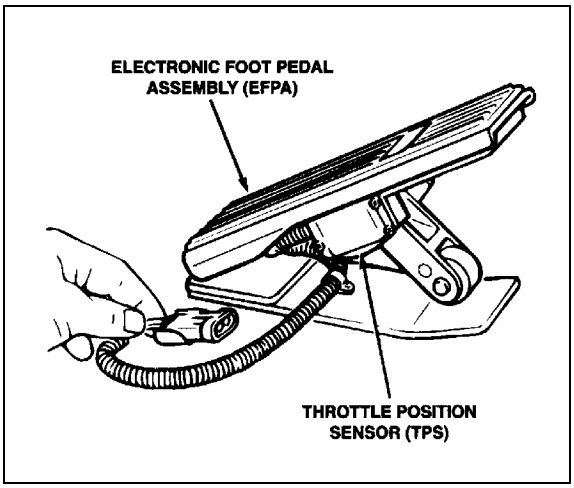

FIGURE 10: ELECTRONIC FOOT PEDAL ASSEMBLY 01026

Monitor the (TPS) as the controls move it through its full stroke. Be sure there is no misalignment or obstruction preventing the smooth movement of the TPS through the full stroke. Using a diagnostic data reader, check that the idle and full throttle position counts do not fall within the error zones. The error zones occur when the idle position is less than 14 counts, or when the full throttle position is more than 233 counts. Should these conditions occur, the ECU will signal diagnostic codes of 21-12 for idle error and 21-23 for wide-open throttle error.

4.3 CRUISE CONTROL SWITCHES (CCS)

The four cruise control switches are located in the driver's area on the L.H. side control panel.

1. **Cruise:** This is the main switch that actuates the ECM memory in order to use the speed-regulating mode.
2. **Set:** This switch is used to set the cruise control speed or to decrease the set speed by 2 MPH at each application.

***Note*:** *Cruise control system will not accept speed settings, nor will the "Resume" switch operate below 20 mph (32 km/h) and the engine speed must be above 1100 RPM.*

3. **Resume:** Each time this switch is actuated, the speed will be increased by 2 mph (3,5 km/h). This switch allows the driver return to the last regulated speed following a brake or *"DECEL"* switch application.

***Note**: On-off switch must be in the "ON" position in order to return to the last regulated speed.*

4. **DECEL:** Will cancel the cruise temporarily and let the vehicle coast. Set speed is still in memory for resume.

For additional information, see the "Operator's Manual" or the "Owner's Manual".

4.4 DIAGNOSTIC SYSTEM ACCESSORIES (DSA)

The DDEC IV engine Diagnostic System Accessories include the following:

- Check Engine telltale light;
- Stop Engine telltale light;
- Stop Engine Override switch;
- Diagnostic Data Link (DDL) connectors.

4.4.1 Check Engine Telltale Light

The Check Engine telltale, mounted on the telltale light panel indicates that a problem has been detected and that a code has been stored in the ECM memory. This light also has a 5-second bulb check when the ignition is first turned on. The Check Engine telltale illuminates when the temperature at coolant sensors exceeds 217°F (103°C) and the temperature at oil sensors exceeds 260°F (127°C). When sensors reach those temperatures, DDEC starts to decrease engine power linearly.

4.4.2 Stop Engine Warning Light

This light, also mounted on the telltale light panel, illuminates to indicate that a major engine problem is occurring (with the exception of a 5-second bulb check when the ignition is first turned on). The Stop Engine Light illuminates when the temperature at coolant sensors exceeds 222°F (106°C) and the temperature at oil sensors exceeds 239°F (115°C). When sensors detect such temperatures, DDEC shuts the engine down after a 30 seconds grace period. This 30-second delay may be extended another 30 seconds (if absolutely necessary) by using the STOP ENGINE OVERRIDE switch.

Note: *Once engine is stopped, it can not be restarted until the malfunction is corrected.*

4.4.3 Stop Engine Override Switch

This switch, mounted on the dashboard, may be used to extend the 30-second delay period before engine shutdown when the Stop engine telltale light is illuminated. This switch can be repeatedly depressed in order to move the vehicle out of traffic.

Note: *The stop engine override switch will be operative only if it has been depressed before the end of the 30 second delay period.*

Caution: *The OVERRIDE switch must be used only in emergency cases, such as to move the vehicle out of traffic. Excessive use of this switch can cause serious damage to the engine.*

This switch is also used for DDEC diagnostic code requests. Press this switch with the engine at idle or off but with the ignition in the "ON" position and active codes will be flashed on the CHECK ENGINE and STOP ENGINE telltale lights alternately. Refer to “DDEC IV DIAGNOSTIC CODES” in this section for more information.

4.4.4 Diagnostic Data Link (DDL) Connectors

A connector is mounted on the L.H. footwell wall. Another connector is located in the rear electric compartment. They allow the connection of the Diagnostic Data Reader (DDR) to read the codes or to access pertinent data on the condition of the engine. This enables a more complete analysis of any defect found in the DDEC system operation. For more information, see Detroit Diesel Troubleshooting Guide #6SE492.

5. DDEC IV DIAGNOSTIC CODES

5.1 READING DIAGNOSTIC CODES, FLASH METHOD:

DDEC IV makes use of two types of codes: Active and inactive. The difference between the two types of codes is as follows:

Active Codes: Codes that are currently keeping the Check Engine or Stop Engine telltale light illuminated. Active codes are flashed via the Stop Engine Light when checked with the stop-engine-override switch.

Inactive Codes: These are all the codes logged in the ECM (whether or not they are currently turning on the Stop or Check Engine Light). Inactive codes are flashed via the Check Engine telltale light when checked with the stop-engine-override switch. In most instances, only the DDR

can provide the information necessary for a quick diagnosis of the problem. If you just need to read out codes, however, and do not have a DDR available, the following procedure will let you read out codes. Make sure the rear-starting switch (located in the engine compartment) is in the normal position. With the ignition ON, the engine idling or engine shut-off, momentarily depress the Stop Engine Override switch. Active codes will be flashed on the stop engine telltale, followed by the inactive codes being flashed on the check-engine telltale panel. The cycle repeats itself until the operator depresses the stop engine override switch again. A code "43" consists of four flashes, followed by a short pause, then three flashes in quick succession.

Refer to DDEC Troubleshooting Manual 6SE497 for more information and SAE codes.

Note: *Active codes are flashed in ascending numerical flash code order. Inactive codes are flashed in most recent to least recent order.*

Note: *Fault codes can only be cleared using the DDR.*

DDEC Code Number (Flashed)	DESCRIPTION	DDEC Code Number (Flashed)	DESCRIPTION
11	Variable speed governor sensor input voltage low	12	Variable speed governor sensor input voltage high
13	Coolant level sensor input voltage low	14	Oil, coolant or intercooler temperature sensor input voltage high
15	Oil, coolant or intercooler temperature sensor input voltage low	16	Coolant level sensor input voltage high
17	Bypass or throttle valve position sensor input voltage high	18	Bypass or throttle valve position sensor input voltage low
21	TPS input voltage high	22	TPS input voltage low
23	Fuel temperature sensor input voltage high	24	Fuel temperature sensor input voltage low
25	No active codes	26	Auxiliary shutdown #1 or #2, input active
27	Air inlet or intake air temperature sensor input voltage high	28	Air inlet or intake air temperature sensor input voltage low
31	Auxiliary high side output open circuit or short to ground	32	Check Engine Light or Stop Engine Light short to battery (+) or open circuit
33	Turbo boost pressure sensor input voltage high	34	Turbo boost pressure sensor input voltage low
35	Oil pressure sensor input voltage high	36	Oil pressure sensor input voltage low
37	Fuel pressure sensor input voltage high	38	Fuel pressure sensor input voltage low
41	Too many SRS (missing TRS)	42	Too few SRS (missing SRS)

DDEC Code Number (Flashed)	DESCRIPTION	DDEC Code Number (Flashed)	DESCRIPTION
43	Coolant level low	44	Oil, coolant, intercooler or intake air temperature high
45	Oil pressure low	46	ECM battery voltage low
47	Fuel, air inlet or turbo boost pressure high	48	Fuel or air inlet pressure low
52	ECM A/D conversion fault	53	ECM non volatile memory fault
54	Vehicle speed sensor fault	55	J1939 data link fault
56	J1587 data link fault	57	J1922 data link fault
58	Torque overload	61	Injector response time long
62	Auxiliary output short to battery (+) or open circuit or mechanical fault	63	PWM drive short to battery (+) or open circuit
64	Turbo speed sensor input fault	65	Throttle valve position input fault
66	Engine knock sensor input fault	67	Coolant or air inlet pressure sensor input voltage fault
68	TPS idle validation switch open circuit or short to ground	71	Injector response time short
72	Vehicle overspeed	73	Gas valve position input fault or ESS fault
74	Optimized idle safety loop short to ground	75	ECM battery voltage high
76	Engine overspeed with engine brake	77	Fuel temperature high
81	Oil level, crankcase pressure, dual fuel BOI or exhaust temperature voltage high	82	Oil level, crankcase pressure, dual fuel BOI or exhaust temperature voltage low
83	Oil level, crankcase pressure, exhaust temperature or external pump pressure high	84	Oil level low or crankcase pressure low
85	Engine overspeed	86	External pump or barometer pressure sensor input voltage high
87	External pump or barometer pressure sensor input voltage low	88	Coolant pressure low

TABLE X-X: FLASH CODES AND DESCRIPTION

6. ENGINE OIL LEVEL

Check the oil level daily with the engine stopped. If the engine has just been stopped and is warm, wait at least 10 minutes to allow the oil to drain back to the oil pan before checking. Wipe the dipstick clean then check oil level. The level should always be within the safe range on the dipstick (Fig. 11). Add the proper grade of oil to maintain the correct level on the dipstick. All diesel engines are designed to consume some oil, so a periodic addition of oil is normal.

***Warning**: Touching a hot engine can cause serious burns.*

Caution: *Do not overfill. Oil may be blown out through the crankcase breather if the crankcase is overfilled.*

***Caution**: Clean end of tube before removing the dipstick to prevent oil contamination.*

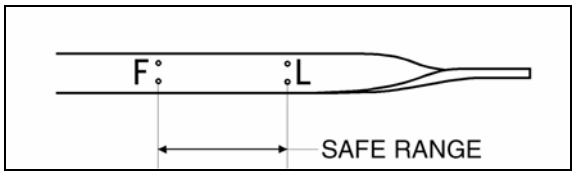

FIGURE 11: ENGINE OIL LEVEL DIPSTICK 01027

***Caution:** 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.*

The vehicle is provided with an oil reserve tank in the engine. To adjust oil level, open the oil reserve tank valve and allow oil to discharge into the engine until the "Full" mark on the dipstick is reached then close the valve. Check oil reserve tank level and pour oil in the reserve tank if necessary (Fig. 12).

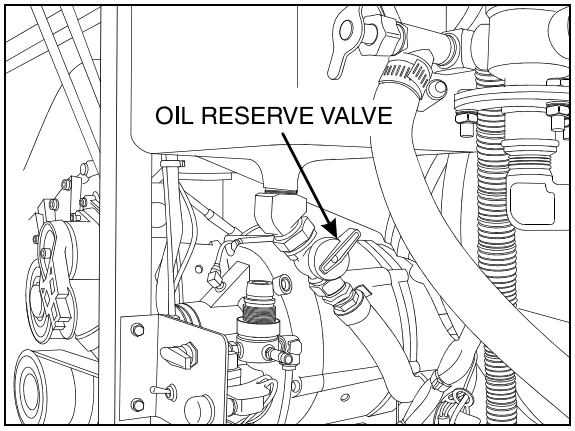

FIGURE 12: ENGINE COMPARTMENT 01028

7. ENGINE OIL AND FILTER CHANGE

Both the oil and filter should be changed every 12,500 miles (20,000-km) or once a year, whichever comes first. However, changes that are more frequent may be required when the engine is subject to high levels of contamination and/or overheating. Change intervals may be decreased or gradually increased with experience on specific lubricants until the most practical service condition has been established. Always refer to the lubricant manufacturer's recommendations (analysis of drained oil can be helpful).

***Caution*:** *Do not use solvents to dilute the engine oil when draining. Dilution of fresh oil can occur which may be detrimental to the engine.*

Change engine oil with the vehicle on a flat and level surface and with the parking brake applied. It is best to drain the oil when the engine is still warm.

1. From under the vehicle, remove the engine drain plug on the oil pan. Allow oil to drain (Fig. 13).

***Warning:** Hot engine oil can cause serious burns. Wear coveralls with sleeves pulled down and gloves to protect hands.*

2. Reinstall the drain plug.

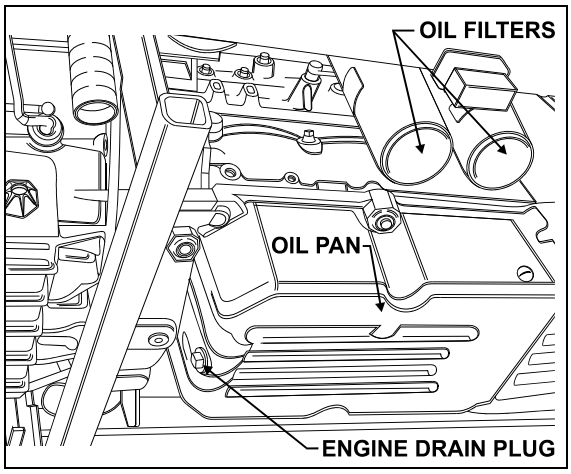

FIGURE 13: UNDER VEHICLE VIEW 01029

3. Remove the spin-on filter cartridge using a 1/2" drive socket wrench and extension.
4. Dispose of the used oil and filter in an environmentally responsible manner in accordance with state and/or federal (EPA) recommendations.
5. Clean the filter adapter with a clean rag.
6. Lightly coat the filter gasket (seal) with clean engine oil.
7. Install the new filter on the adapter and tighten manually until the gasket touches the mounting adapter head. Tighten full-flow filters an additional two-thirds of a turn manually. Then, manually tighten bypass filter one full turn.

Caution: *Overtightening may distort or crack the filter adapter.*

8. Remove the engine-oil filler cap and pour oil in the engine until it reaches the "FULL" mark on the dipstick (Fig. 11).
9. Start and run the engine for a short period and check for leaks. After any leaks have been corrected, stop the engine long enough for oil from various parts of the engine to drain back to the crankcase (approximately 20 minutes).
10. Add oil as required to bring the level within the safe range on the dipstick (Fig. 11).

8. RECOMMENDED ENGINE OIL TYPE

To provide maximum engine life, lubricants shall meet the following specifications: SAE Viscosity Grade: 15W-40 API Classification: CH-4

Note: *Monograde oils should not be used in these engines regardless of API Service Classification.*

Note: *The use of supplemental oil additives is discouraged from use in Detroit Diesel Engines.*

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 previously. Synthetic oils do not permit extension of recommended oil drain intervals.

Lubricant Selection World Wide Oils meeting API CD or CC specifications may be used if they also meet military specification MIL-L-2104 D or E. Oils which meet European CCMC D4 specifications may also be used.

Modification of drain interval may be necessary, depending on fuel quality. Contact Detroit Diesel Corporation for further guidance.

9. WELDING PRECAUTIONS

1. Cut off battery power (battery master switch) in rear electrical compartment.
2. Disconnect wiring harness connectors from ECM (Electronic Control Module). The ECM is mounted on the starter side of the engine.
3. For vehicles equipped with an automatic transmission, disconnect wiring harness connectors from ECU (Electronic Control Unit). The ECU is located in rear electrical compartment.
4. For vehicles equipped with ABS (Anti-Lock Brake System), disconnect wiring harness connectors from ABS Electronic Control Unit. The ABS Electronic Control Unit is located in the front service compartment.
5. Cover electronic control components and wiring to protect from hot sparks, etc.
6. Do not connect welding cables to electronic control components.
7. Do the appropriate welding on vehicle.
8. Connect ECM, ECU and ABS electronic control units.

10. POWER PLANT ASSEMBLY REMOVAL

To access the engine or engine-related components, the vehicle power plant assembly

must be removed as a whole unit by means of a slide-out cradle. The power plant assembly includes the engine, transmission (including retarder if so equipped), air compressor, alternator and transmission oil cooler.

Remove the power plant assembly as follows:

Caution: *Tag hoses and cables for identification before disconnecting in order to facilitate reinstallation. Plug all openings to prevent dirt from entering the system.*

Note: *No parts within the ECM are serviceable. If found defective, replace the complete ECM unit.*

1. Disconnect the battery or batteries from the starting system by removing one or both of the battery cables from each battery system. With the electrical circuit disrupted, accidental contact with the starter button will not produce an engine start. In addition, the Electronic Unit Injectors (EUI) will be disabled, preventing any fuel delivery to the injector tips.

Warning: *Due to the heavy load of the rear bumper assembly, it must be adequately supported before attempting to remove it.*

2. Remove the rear bumper assembly from the vehicle. Refer to Section 18, BODY, under "REAR BUMPER REMOVAL AND INSTALLATION".

3. Drain the engine cooling system. Refer to Section 05, COOLING under "DRAINING COOLING SYSTEM".

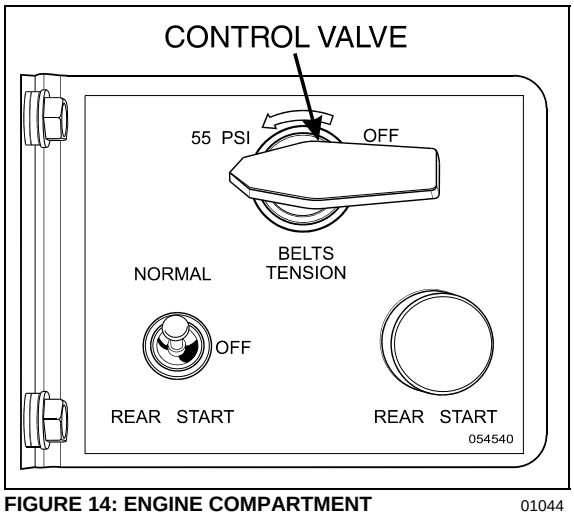

FIGURE 14: ENGINE COMPARTMENT 01044

4. Locate the belt tensioner control valve (Fig. 14). Turn handle counterclockwise in order to release pressure in belt-tensioner air bellows and loosen belts. Remove the belts.

5. Release all pressure from the air system. Refer to Section 12, BRAKES & AIR SYSTEM for instructions.

6. Disconnect and remove the engine-air intake duct mounted between air cleaner housing and turbocharger inlet (1, Fig. 15).

Caution: *To avoid damage to turbocharger, cover the turbocharger inlet opening to prevent foreign material from* entering.

7. Disconnect and remove the air intake duct mounted between the air cooler outlet and the engine intake (2, Fig. 16).

8. Disconnect and remove section of coolant pipe assembly mounted between the radiator outlet and the water pump inlet (3, Fig. 16).

9. Disconnect the coolant delivery hose located close to the water pump.

10. Disconnect the electric fan-clutch connector, close to the water pump (Fig. 15).

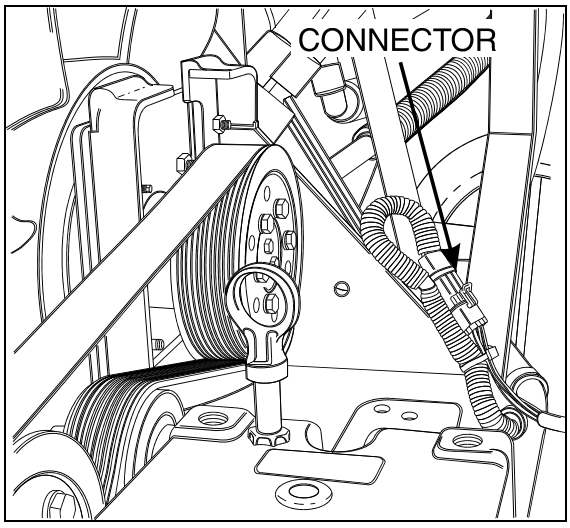

FIGURE 15: ENGINE COMPARTMENT 01056

11. Dismantle the air bellow from the upper bracket of the fan-drive assembly tensioner. Remove the upper bracket (4, Fig. 16).

12. If necessary, remove the fan drive from the motor compartment by removing the four retaining bolts, washers and nuts securing the fan drive to the floor.

13. Disconnect and remove the air intake duct mounted between the turbocharger outlet and the air cooler inlet (5, Fig. 16).
14. Disconnect two vent hoses from the thermostat housing and from the coolant pipe assembly.
15. Disconnect and remove a section of coolant pipe assembly mounted between the thermostat housings and the radiator inlet.
16. Disconnect and remove the small hose connected to the heater line valve and to the water pump.
17. Disconnect the small heater hose located on the cylinder head at the back of the engine.
18. Disconnect and remove the exhaust pipe mounted between the turbocharger outlet and the exhaust bellows. If necessary, refer to Section 04: EXHAUST SYSTEM under “Muffler Removal And Installation".

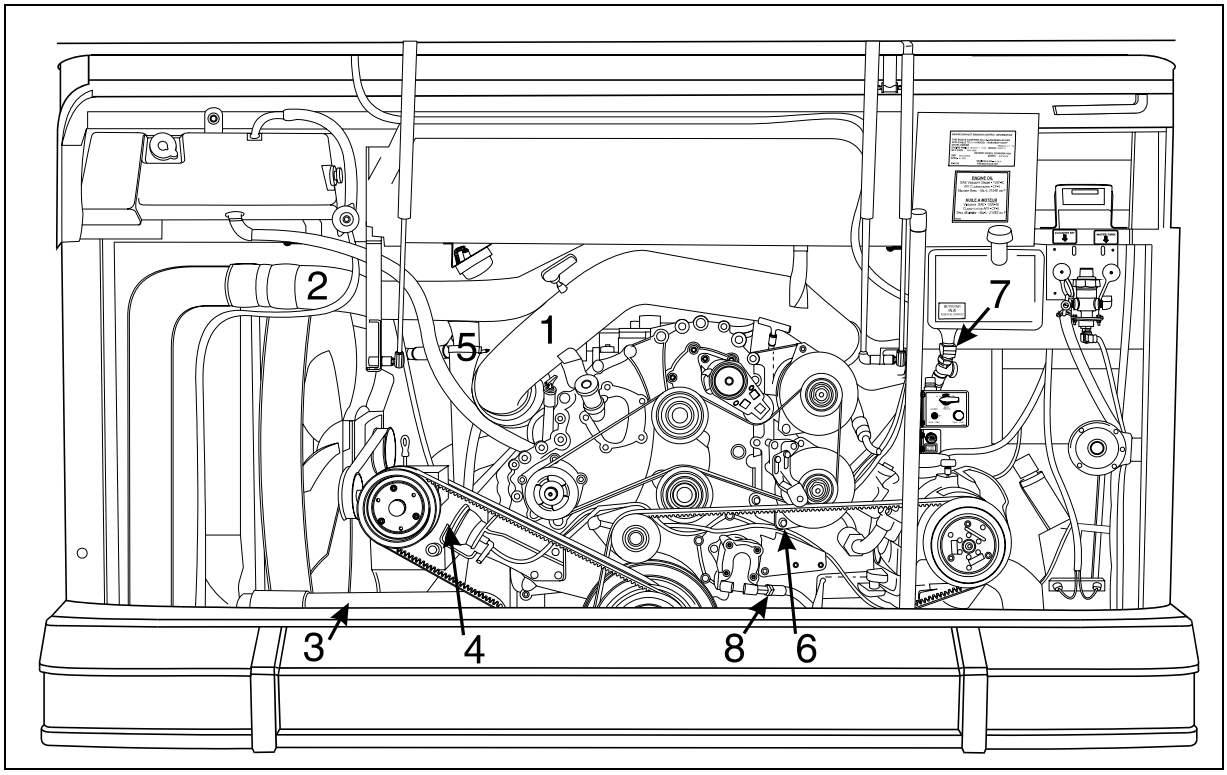

FIGURE 16: ENGINE COMPARTMENT 01057

Caution: *To avoid damage to turbocharger, cover the turbocharger outlet opening to prevent foreign material from entering.*

19. Disconnect the block heater connector above the power steering pump (6, Fig. 16).
20. Disconnect the steel-braided airline from the A/C compressor air bellows.
21. Disconnect the oil delivery hose from the valve located at the reserve tank drain (7, Fig. 16).
22. Disconnect the power steering pump supply and discharge hoses. Cap hose openings immediately to limit fluid loss. Remove retaining clips from cradle (8, Fig. 16).
23. Close engine fuel supply shutoff valve on primary fuel filter. Disconnect the fuel line connected to inlet port. On vehicles equipped with the optional water-separator-fuel-filter, disconnect the connector and remove cable ties from cradle.
24. Disconnect the air compressor discharge, governor steel-braided airlines and manual filling airlines from compressor. Remove retaining clips.
25. Disconnect the hose connecting the compressor head to the sump tank.
26. Disconnect ground cables from rear subframe ground-stud located close to the starter motor.

27. Disconnect positive cable (red terminal) from starting motor solenoid.
28. Disconnect the power plant wiring-harness main connectors from ECM and remove retaining clips from engine compartment backwall.
29. On vehicles equipped with an automatic transmission provided with a hydraulic output retarder, disconnect steel-braided airline from pressure regulator output. The pressure regulator is mounted in the upper section of engine compartment backwall and is accessible through the engine compartment R.H. side door.
30. Disconnect fuel return line from bulkhead fixed on engine cylinder head end.
31. On vehicles equipped with an electrically operated cold-starting aid, disconnect the delivery hose from the starting-aid cylinder solenoid valve. Remove cable ties securing hoses.
32. Disconnect turbo boost pressure gauge airline from engine air intake.
33. Only if the vehicle is equipped with a retarder, remove the transmission rubber-damper assembly above transmission by removing: nut, bushing, rubber damper, rubber damper guide, bolt and washer. Remove the rubber damper bracket from transmission
34. Disconnect connectors from transmission. On the left side: four on rear side with one close to yoke. On right side: close to the solenoid valve of the output retarder.
35. From under the vehicle, disconnect the propeller shaft as detailed in Section 09, under heading "Propeller Shaft Removal".

    Manual Transmission Only:

    - Disconnect gearshift linkage.
    - Remove clutch slave cylinder from transmission without disconnecting the hydraulic hose.
36. Inspect the power plant assembly to ensure that nothing will interfere when sliding out the cradle. Check for connections or hoses not mentioned in this list as some vehicles are equipped with special or aftermarket components.
37. Remove the six retaining bolts, washers and nuts securing the power plant cradle to the vehicle rear subframe (Fig. 18).

***Note**: Check if any spacer(s) have been installed between power plant cradle and vehicle rear subframe, and if so, note position of each washer for reinstallation purposes.*

38. Using a forklift, with a minimum capacity of 4,000 lbs (1 800 kg), slightly raise the power plant cradle.
39. Pull engine out slowly from the engine compartment. Make sure all lines, wiring and accessories are disconnected and are not tangled.

***Caution**: Due to the minimum clearance between the power plant equipment and the top of the engine compartment, extreme care should be used to raise the power plant cradle, just enough to free the cradle. Clearance between power plant cradle and mounting rail should range between 1/4" and 1/2" (6-12 mm).*

11. POWER PLANT ASSY. INSTALLATION

To install a power plant assembly, follow the same procedure as in "Power Plant Assembly Removal" except in reverse order, then proceed with the following:

1. Torque the power plant cradle mounting bolts to 113-144 lbf•ft (153-195 N•m).

- For vehicles is equipped with an automatic transmission and a retarder:

  a) Install transmission bracket (Fig. 17), tighten to 71-81 lbf•ft (96-110 N•m).

  b) Install the transmission's rubber damper assembly above transmission by assembling: bolt, washer, rubber damper guide, rubber damper, bushing nut.

  c) Respect damper tolerance of 58 mm (Fig. 17)

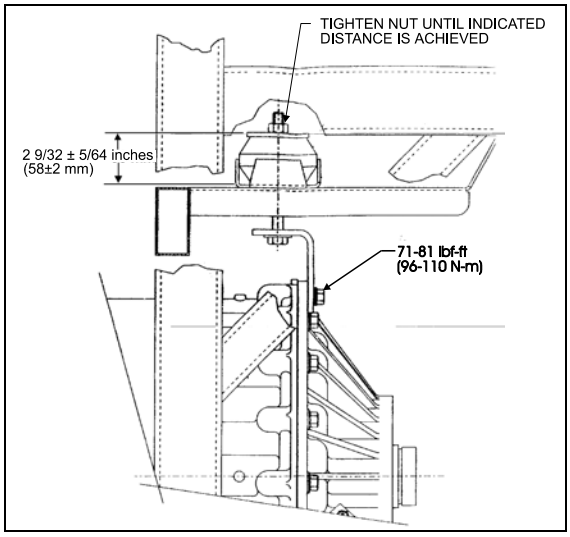

FIGURE 17: RUBBER DAMPER TOLERANCE 07014

2. If fan drive has been removed, reinstall and align as per Section 05, COOLING SYSTEM, under "FAN DRIVE ALIGNMENT".
3. Refill cooling system with saved fluid (refer to Section 05, COOLANT SYSTEM).
4. Once engine fuel system has been drained, it will aid restarting if fuel filters are filled with fuel oil (refer to Section 03, FUEL SYSTEM).
5. Start engine for a visual check. Check fuel, oil, cooling, pneumatic and hydraulic system connections for leakage. Test operation of engine controls and accessories.

12. VALVE COVER REMOVAL

The following instructions explain how to remove the valve cover for valve, injector or Jake Brake maintenance, without having to remove the engine:

1. Remove air intake duct (1, Fig. 16).
2. Remove the air intake duct mounted between the air cooler outlet and the engine intake (2, Fig. 16).
3. Disconnect ventilation pipe from valve cover.
4. Remove engine cover.
5. Adjust Jake Brake (if applicable), injectors and valves following instructions in the Detroit Diesel service manual for series 60 engines.
6. Verify engine cover gasket and replace if necessary.

***Note**: New gasket must be ordered directly from Detroit Diesel.*

7. Reinstall engine cover and tighten bolts to 18-22 Lbf·ft (25-30 N·m), in a criss-cross pattern.
8. Reconnect ventilation pipe to engine cover.
9. Reinstall air ducts.

13. JAKE BRAKE

Refer to both "The Jake Brake Troubleshooting and Maintenance Manual" and "Installation Manual for Models 760/760A/765 Engine Brakes" for troubleshooting and installation procedures. They are annexed at the end of this section.

14. ENGINE MOUNTS

The power plant assembly on a vehicle powered with a series 60 engine is mounted to the cradle by means of four rubber mounts.

Two rubber mounts are used at the front of the engine while two others are mounted on each side of the flywheel housing on vehicles equipped with automatic and manual transmissions (Fig. 18).

It is recommended that new rubber mounts be installed at each major overhaul.

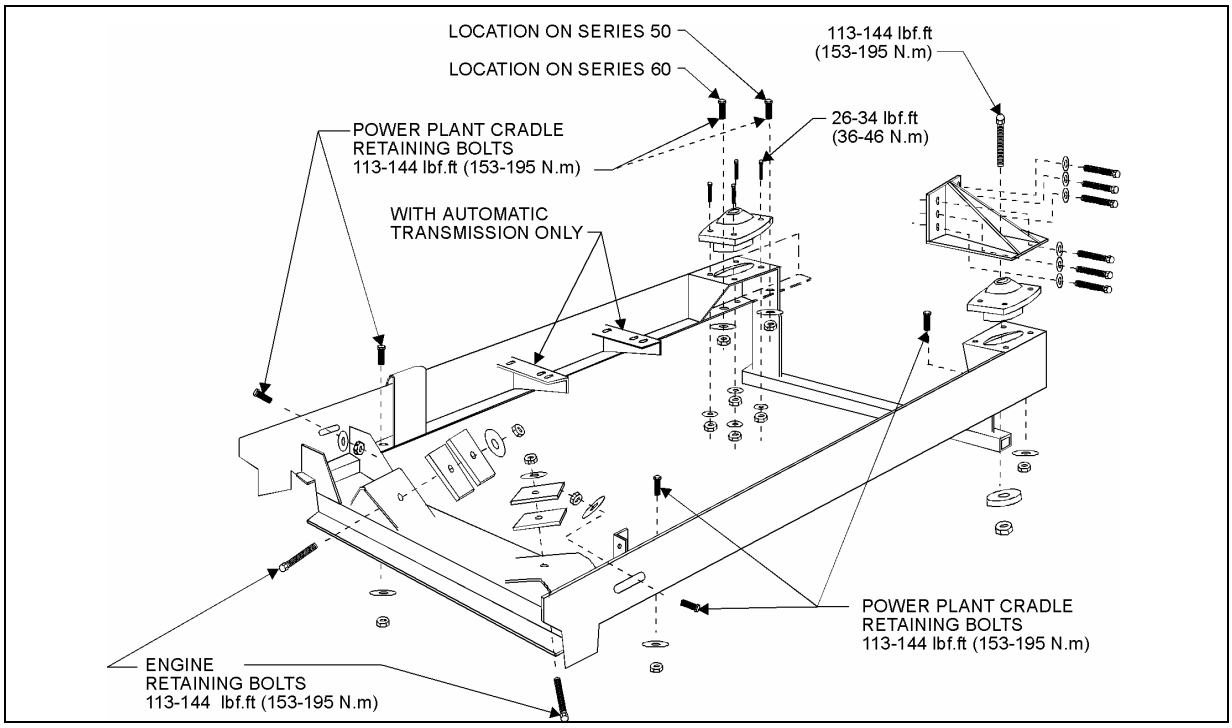

FIGURE 18: POWER PLANT CRADLE INSTALLATION 01032

15. SPECIFICATIONS

Series 60 Engine

Make ..... Detroit Diesel

Type ..... Diesel four cycle/in-line engine

Description ..... Turbo/Air to air charge cooled

No. of cylinders 6

Operating range ..... 1200-2100 RPM

Maximum RPM 2100

Displacement, 11.1 Liters:

Bore & Stroke ..... 5.12 X 5.47 in (130 X 139 mm)

Horsepower Range ..... 285 BHP, 350 BHP

Displacement, 12.7 Liters:

Bore & Stroke ..... 5.12 X 6.30 in (130 X 160 mm)

Horsepower Range ..... 360 BHP, 500 BHP

Lubricant

Heavy-duty engine oil SAE Viscosity Grade 15W-40, API Classification CH-4 and meeting MIL-L-2104 D or E specifications. Synthetic oil may be used if it meets the performance and chemical requirements of non-synthetic oils outlined previously. Some engine operating conditions may require exceptions to this recommendation.

***Caution**: To avoid possible engine damage, do not use single grade (Monograde) lubricants in Detroit Diesel four-cycle Series 60 engines, regardless of API classification.*

Capacity

Oil reserve tank ..... 10 US qts (9.5 L)

Engine oil level quantity

Oil Pan Capacity, Low Limit ..... 26 quarts/25 liters

Oil Pan Capacity, High Limit ..... 32 quarts/30 liters

Total Engine Oil Capacity with Filters ..... 41 quarts/39 liters

Lubricating oil filter elements

Make ..... AC Rochester Div. GMC # 25014505

Make ..... A/C Filter # PF-2100

Type ..... Full Flow

Prévost number 510458

Torque specification

Engine oil filter ..... Tighten 2/3 of a turn after gasket contact

Filters

Engine Air Cleaner Filter

Make.....Nelson # 70337-N

Prévost number 530197

Engine Coolant Filter/Conditioner

Make..... Nalco Chemical Company # DDF3000

Make.....Detroit Diesel # 23507545

Prévost number.....550630

Note: *For primary and secondary fuel filters, refer to Specifications in section 03.*