

SECTION 03: FUEL SYSTEM

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1. FUEL SYSTEM

1.1 Description

A schematic of the fuel system is shown in figure 1. Fuel is drawn from the fuel tank through a manual shut-off valve, the primary fuel filter or a fuel filter/water separator (optional) and enters the fuel pump. Leaving the pump under pressure, the fuel flows through the secondary fuel filter and a shut-off valve, then to cylinder head. The fuel flows to injectors in the cylinder head through passages integral with the head. Surplus fuel exits at the rear of the head just above the inlet, through a restrictive return fitting which maintains fuel pressure in the system. Finally, the fuel flows through the fuel cooler and the check valve then returns to the fuel tank. Two preheaters are available: 40 000 BTU or 80 000 BTU. If the vehicle is equipped with the 40 000 BTU preheater, the fuel is drawn from the tank through the fuel pump to the preheater. If the vehicle is equipped with the 80 000 BTU preheater the fuel is drawn from the fuel tank through a fuel filter to the preheater. Excess fuel returns to the fuel tank.

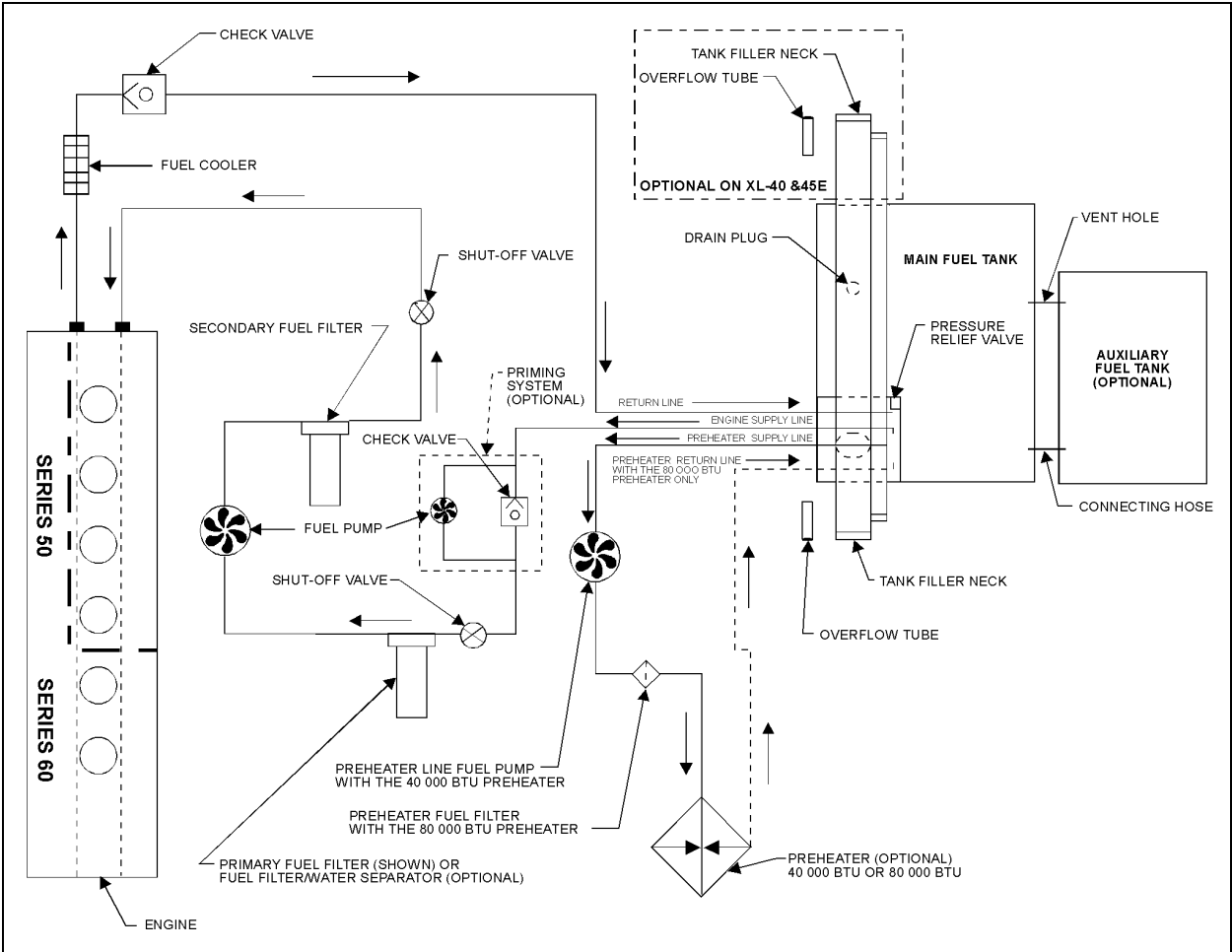


FIGURE1: FUEL SYSTEM SCHEMATIC

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2. FUEL LINES AND FLEXIBLE HOSES

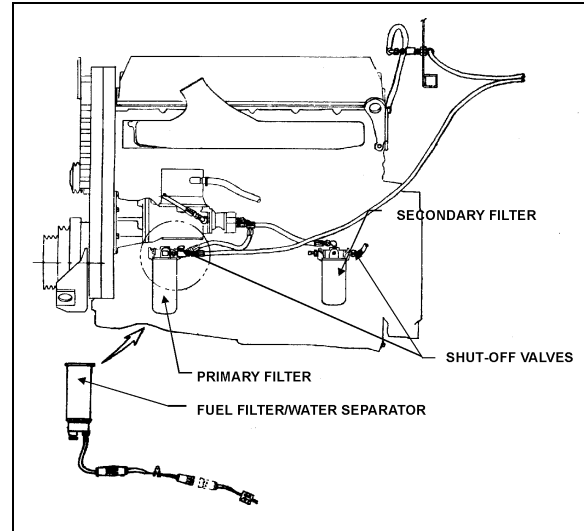
Make a visual check for fuel leaks at all engine-mounted fuel lines and connections and at the fuel tank suction and return lines. Since fuel tanks are susceptible to road hazards, leaks in this area may best be detected by checking for accumulation of fuel under the tanks. Engine performance and auxiliary equipment is greatly dependent on the ability of flexible hoses to transfer lubricating oil, air, coolant and fuel oil. Diligent maintenance of hoses is an important step in ensuring efficient, economical and safe operation of engine and related equipment.

Check hoses daily as part of the pre-start-up inspection. Examine hoses for leaks and check all fittings, clamps and ties carefully. Make sure that the hoses are not resting on or touching shafts, couplings, heated surfaces, including exhaust manifolds, any sharp edges or other obviously hazardous areas. Since all machinery vibrates and moves to a certain extent, clamps and ties can fatigue with age. To ensure continued proper support, inspect fasteners frequently and tighten or replace them as necessary. Refer to the schematic diagram of the fuel system (Fig. 1).

Caution: Oil level above the dipstick full mark or a decrease in lube oil consumption may indicate internal fuel leaks. Check oil level frequently.

3. FUEL VALVES

Manual shut-off valves on engine fuel supply line are located on the R.H. side of engine compartment (Fig. 2). A manual shut-off valve is located at the inlet side of the primary fuel filter (fuel filter/water separator, if vehicle is so equipped) under the air compressor. Another manual shut-off valve is located at the outlet side of the secondary fuel filter, under the starter. No manual valve is required on preheater fuel supply line, since the positive-displacement fuel pump (located close to the fuel tank) will shut off line when it is not activated.



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FIGURE 2: LOCATION OF MANUAL SHUT-OFF VALVES

4. FILTERS AND WATER SEPARATOR

The fuel system is equipped with primary and secondary fuel filters for additional protection of the injectors. A fuel filter/water separator may be installed in primary fuel filter location, to prevent water infiltration in engine fuel system (Fig. 2). It should be drained periodically, or when the water separator indicator lamp lights on dashboard. To drain, loosen self venting drain below separator, and tighten after water has been flushed out.

Note: The service intervals of the filter/water separator element and the secondary fuel filter cartridge are determined by the operating conditions and cleanliness of type of fuel used.

4.1 Fuel Filter/Water Separator Servicing

The fuel filter/water separator is located on the starter side of the engine, below the air compressor. The water separator must be drained periodically or when the indicator light on the dashboard illuminates.

Replace the water separator element as follows:

1. Drain the fuel filter/water separator as stated previously.
2. With engine "OFF" and engine fuel supply line valves closed, remove the filter element from mounting head with bowl connected (For valve location, see "3. FUEL VALVES" in this section).
3. Remove bowl from filter element. Clean bowl and O-ring gland.

Note: *Bowl is reusable, do not discard.*

4. Lubricate O-ring with clean diesel fuel or motor oil and place it in bowl gland.

Caution: *Do not use tool to tighten bowl. Tighten by hand only.*

5. Screw bowl onto new filter element snugly by hand.
6. Lubricate filter to seal with clean diesel fuel or motor oil.
7. Fill filter element/bowl assembly with clean diesel fuel and attach onto mounting head. Hand tighten an additional 1/3 to 1/2 turn after full seal contact is made.
8. Open valves of the engine fuel supply line.
9. Run the engine and check for leaks.

Caution: *If the water separator continuously requires draining, it is possible that water or sediment is accumulated in the fuel tank. To correct this situation, open the drain plug under the tank when the fuel gauge indicates tank is 1/4 full in order to drain any contaminant.*

4.2 Fuel Filter Servicing (Primary and Secondary)

The primary and secondary fuel filters are located on the R.H. side of the engine. The primary filter is installed below the air compressor, and the secondary fuel filter is below the starter. They are of a spin-on type and must be replaced every 12,500 miles (20 000 km) or once a year, whichever comes first.

A method of determining when filters are plugged to the extent that they should be changed is based on the fuel pressure at the cylinder head fuel inlet fitting and the inlet restriction at the fuel pump. In a clean system, the maximum pump inlet restriction should not exceed 6 inches of mercury (20.3 kPa) and must not exceed 12 inches of mercury (41 kPa) with a dirty system.

At normal operating speeds and with the standard 0.080" restriction fittings, the fuel pressure at the cylinder head inlet is 50-75 psi (345-577 kPa). Change the fuel filters whenever the inlet restriction at the fuel pump reaches 12 inches of mercury (42 kPa) at normal operating speeds and whenever the fuel pressure at the cylinder head inlet fitting falls to the minimum fuel pressure given above.

Change the filter cartridge(s) as follows.

Note: *Use a suitable band wrench or filter wrench, such as J22775, to remove the filters.*

1. Stop engine, shut off the engine fuel supply line valves (For valve location, See "3. FUEL VALVES"). Unscrew and discard filters.
2. Fill new filter replacement cartridge(s) with clean fuel oil, about two thirds (2/3). Apply a thin coat of clean fuel oil on gasket.
3. Install new filters. Tighten until filter is snug against the gasket, with no side movement. Rotate an additional 1/2 turn by hand.
4. Open engine fuel supply line valves.

Caution: Mechanical tightening of the fuel filters is not recommended and may result in seal and/or cartridge damage. Tighten the fuel filters by hand only.

5. Start the engine and check for leaks.

Note: There is a fuel system shut-off valve on the discharge side of the secondary fuel filter. This check valve is designed to prevent loss of fuel at time of filter replacement.

4.3 Preheater Fuel Filter

The preheater fuel filter is installed only on vehicles with the optional 80 000 BTU preheater. The filter is located next to preheater: on XL-40 & 45E vehicles, the filter is installed on rear wheel housing and is accessible through engine curb side door - on XL-45 vehicles, the filter is located on rear wheel housing and is accessible through L.H. side rear service compartment. Replace the filter every 50,000 miles (80 000 km) or once a year, whichever comes first.

5. FUEL TANK

XL-40 & 45E vehicles are equipped with a welded stainless steel fuel tank with a capacity of 160 US gal (606 liters) and an optional 90 US gal (341 liters) auxiliary tank. XL-45 vehicles are equipped with a high density cross link polyethylene fuel tank with a capacity of 208 US gal (787 liters) and an optional welded stainless steel 90 US gal (341 liters) auxiliary tank. The main tank is located just forward of the rear baggage compartment, between Condenser and A/C and heating compartments. The auxiliary tank is located in baggage compartment just forward of main tank.

On XL-40 & 45E vehicles, fuel filler neck is accessible by opening a small door located amidships, on R.H. side of vehicle. On XL-45 vehicles, fuel filler necks (Qty=2) are accessible by opening a small door located amidships, on either R.H. or L.H. side of vehicle.

A pressure relief valve in the tank relieves high pressure buildup, and an air vent allows offset air in the tank to escape during filling. A drain plug, accessible from under the vehicle, is fitted at the bottom of the tank(s).

5.1 Tank Removal

Note: Prior to removal, the fuel tank should be completely drained by unscrewing the drain plug. Ensure that the container used has a capacity equal to the amount of fuel remaining in the tank(s).

For vehicles equipped with an auxiliary tank, drain it as well since it is directly connected to the main tank.

It is possible to drain both tanks through only one plug, but the other tank will not drain completely since the connecting hose is not on the bottom.

5.1.1 Main Fuel Tank

1. Open the rear baggage compartment and remove the fuel tank access panel (Fig. 3).

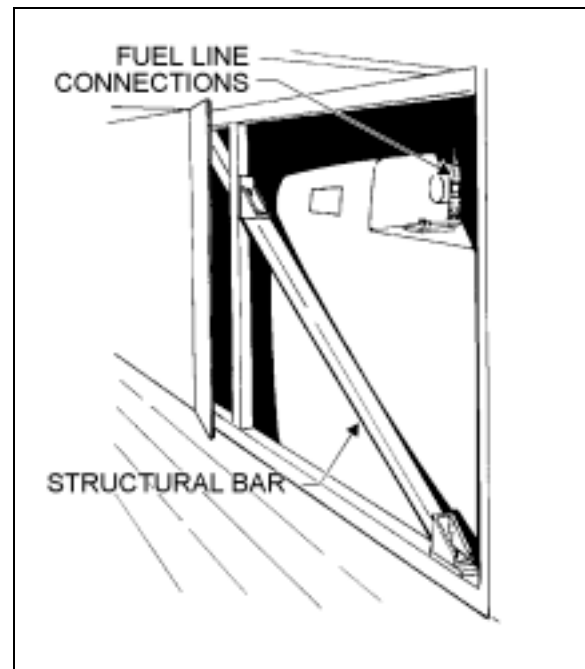


FIGURE 3: ACCESS TO MAIN FUEL TANK

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2. Remove the structural bar fastened to the frame with four (4) bolts, then locate the fuel tank line connections.
3. disconnect all fuel and air vent lines, alarms and fuel gauge connectors.

Note: On XL-45 vehicles, disconnect components through fuel tank access panel inside condenser compartment.

Note: For vehicles equipped with an auxiliary tank, the two hoses joining tanks should be disconnected.

4. From underneath vehicle, unscrew the four (4) bolts (two (2) on each side) retaining the tank straps.
5. From inside the rear baggage compartment, slightly raise both straps and pull out main fuel tank.

Caution: Protective cushions or rags should be placed on the baggage compartment floor to prevent it from being scratched by the fuel tank during removal.

5.1.2 Auxiliary Fuel Tank (if so equipped)

1. Open the baggage compartment just forward of condenser compartment, disconnect the two (2) hoses previously joining the tanks.
2. From underneath vehicle, unscrew the two (2) bolts retaining the tank strap (one on each side).
3. From inside the baggage compartment just forward of condenser compartment, slightly raise the strap and pull out auxiliary fuel tank using the same care as for the main fuel tank.

5.2 Tank Installation

To install Main and Auxiliary Fuel Tanks, simply reverse the "Tank Removal" procedure.

Warning: For proper assembly, check connections and fasteners for tightness.

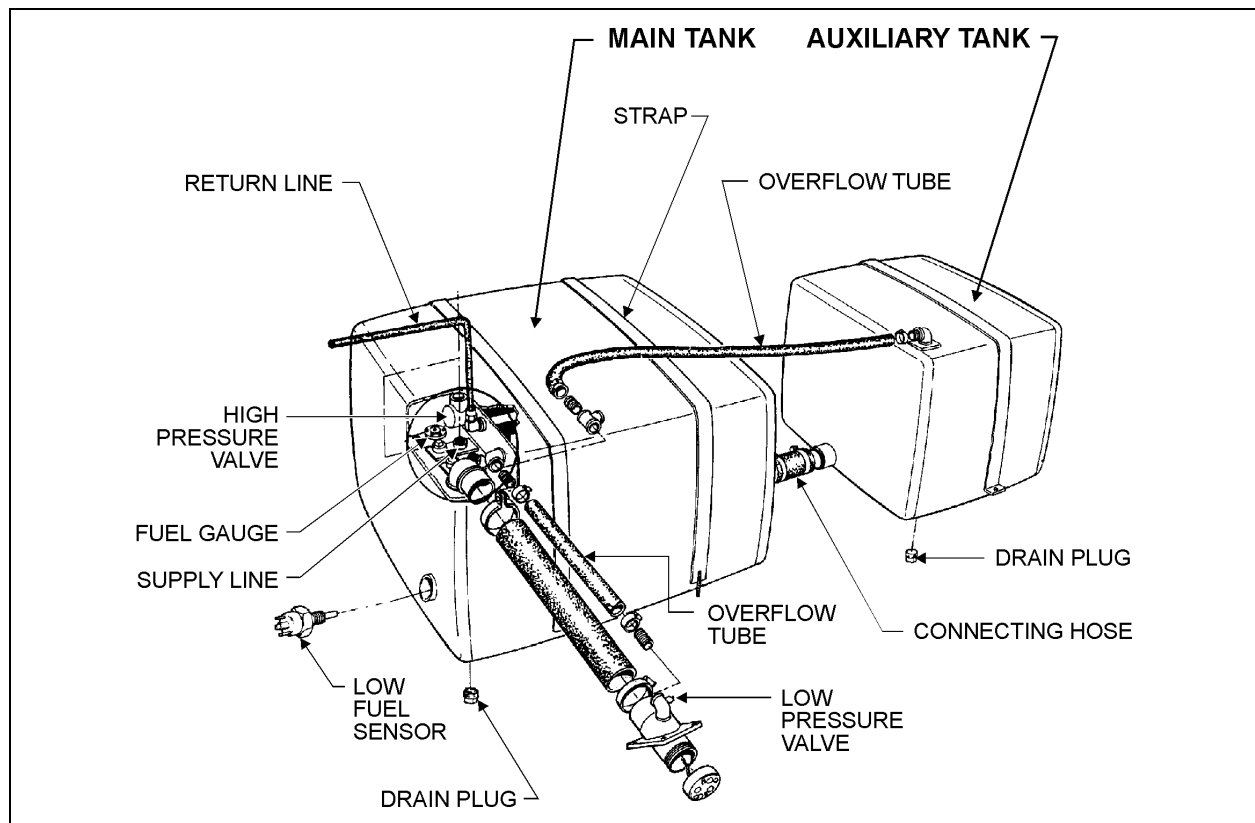


FIGURE 4: FUEL TANKS

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6. PRIMING FUEL SYSTEM

The problem with restarting a diesel engine that has run out of fuel, is that after the fuel is exhausted from the tank, it is pumped from the primary fuel filter or the fuel filter/water separator, if vehicle is so equipped, and sometimes partially removed from the secondary filter resulting in an insufficient fuel supply to sustain engine firing. The primary fuel filter or fuel filter/water separator and secondary filter must be free of air in order for the systems to provide adequate fuel for the injectors. When the engine runs out of fuel, the following operations must be performed before restarting.

Fill fuel tank with the recommended fuel oil. If only partial filling is possible, add a minimum of 10 gallons (38 liters) of fuel.

If the vehicle is equipped with an optional priming pump see Figure 1.

Start the priming pump. The switch is located in the engine compartment on rear junction box just below "Rear Start" push-button switch. Start the engine and check for leaks.

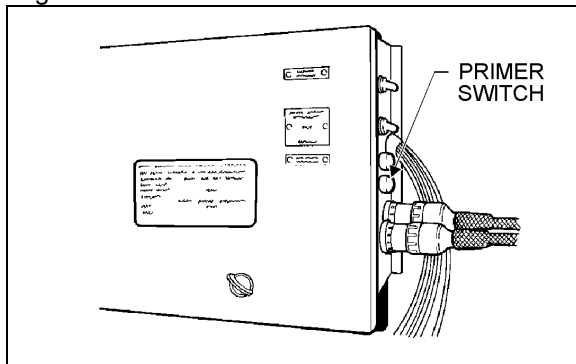


FIGURE 5: PRIMER SWITCH LOCATION

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If the vehicle is not equipped with a priming pump.

1. Unscrew the cap on the priming valve located on the secondary filter.
2. Direct fuel under pressure 25 psi (172 kPa) to the priming valve using a quick coupling.
3. Start the engine and check for leaks.

7. FUEL PUMP INSTALLATION

The fuel pump is attached to a drive assembly mounted on the rear side of the gear case.

1. If removed, install inlet and outlet fittings in the cover of the fuel pump.

Note: *New fittings have sealant already applied. If reusing fittings, coat the threads lightly with Loctite Pipe Sealant, Detroit Diesel number J 26558-92, or equivalent, before installing. To prevent sealant from entering fuel system, do not apply it to the first two (2) threads of the fitting. Do not use teflon tape or paste on the fittings.*

2. Install drive coupling in drive hub of the fuel pump. Install a new gasket to the mounting flange of the pump.
3. Align the drive coupling with the coupling on the fuel pump drive assembly pump mounting bolt holes with those in the fuel pump drive assembly.

Note: *When correctly positioned, the outlet fitting on the pump should be in approximately an 8 o'clock position when viewed from the rear, and the drain opening in the pump body facing down.*

4. Seat the pump squarely against the drive assembly. Install three (3) fuel pump mounting bolts and tighten them to 22-28 lbf•ft (30-38 N•m).
5. Connect the fuel inlet and outlet lines to the fuel pump and tighten.
6. Prime engine fuel system before starting engine to ensure pump seal lubrication and prompt engine starting.

8. FUEL OIL SPECIFICATIONS

The quality of fuel oil used for high speed diesel engine operation is a very important factor in obtaining satisfactory engine performance, long engine life and acceptable exhaust emission levels. The fuel oil should meet ASTM designation D 975. Grade 1-D is recommended, but grade 2-D is also acceptable.

Note: *These fuel grades are very similar to grade DF-1 or DF-2 of Federal Specifications VV-F-800. For detailed fuel recommendations, refer to publication "Engine Requirements-Lubricating Oil, Fuel, and Filters" #7SE270 available from Detroit Diesel Distributors.*

9. AIR CLEANER (dry type)

The vehicle is equipped with a dry-type replaceable element air cleaner, located in the engine compartment. Access to the air cleaner is through the engine R.H. side door. Engine air enters the air cleaner through two (2) intake ducts located just above engine side doors, then flows through a pre-cleaner and finally through the air cleaner. The pre-cleaner consists of a gallery air cleaner in series with a replaceable impregnated paper filter element (air cleaner). Dust and moisture is drained through discharge holes located at bottom of inlet air ducts.

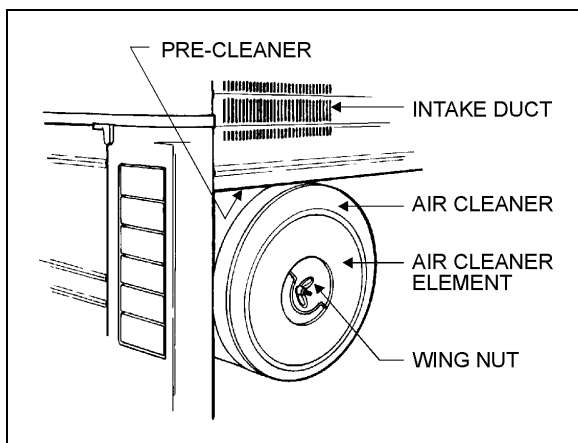


FIGURE 6: AIR CLEANER LOCATION

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9.1 Pre-Cleaner Servicing

The pre-cleaner is designed to be self-cleaning; however, it should be inspected and any accumulated foreign material removed during the periodic replacement of the impregnated paper filter element.

9.2 Air Cleaner Servicing

Stop the engine, open the R.H. side engine compartment door, and loosen the wing nut retaining the air cleaner element to the air cleaner. Remove the element by pulling on the handle in the center of the air cleaner element.

Install cleaner element as follows:

1. Inspect the gasket sealing surface inside the air cleaner. It must be smooth, flat and clean.
2. Install the air cleaner element.
3. Make sure that the element seals securely.
4. Inspect element cover gasket and replace if necessary.

Whenever it becomes necessary to remove the air cleaner assembly (dry type) for maintenance or other repair in this area, great care should be taken when installing air cleaner assembly.

The pre-filter should be installed snugly in the air duct and clamped tightly to the air cleaner inlet to prevent any dust infiltration into the air cleaner.

9.3 General Recommendations

The following maintenance procedures will ensure efficient air cleaner operation:

1. Keep the air cleaner housing tight on the air intake pipe.

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2. Make sure the correct filters are used for replacement.
3. Keep the air cleaner properly assembled so the joints are air-tight.
4. Immediately repair any damage to the air cleaner or related parts.
5. Inspect, clean or replace the air cleaner or elements as operating conditions warrant. Whenever an element has been removed from the air cleaner housing the inside surface of the housing must be cleaned with a soft clean cloth.
6. Periodically inspect the entire system. Dust-laden air can pass through an almost invisible crack or opening which may eventually cause damage to an engine.
7. Never operate the engine without an element in the air cleaner assembly.
8. Do not ignore the warning given by the air restriction indicator. This could result in serious engine damage.
9. Store new elements in a closed area free from dust and possible damage.

9.4 Air Cleaner Restriction Indicator

A resettable restriction indicator is installed on the engine air intake duct near the turbocharger, to constantly monitor the level of vacuum between the air cleaner and engine in order to detect and indicate an abnormal increase in vacuum due to a dirt-laden and therefore restricted air cleaner element.

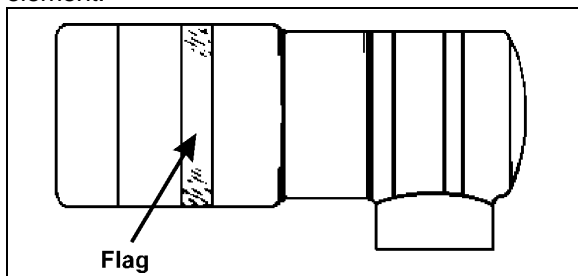


FIGURE 7: AIR CLEANER RESTRICTION INDICATOR
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When the red signal flag locks in full view, the air cleaner element must be inspected and replaced if necessary. Press down on indicator to reset flag (Fig. 7).

10. FUEL COOLER

The fuel cooler serves to cool the surplus diesel fuel after it has exited the cylinder head, on its way back to the fuel tank. It is accessible through engine L.H. side door and is located just in front of radiator.

11. FUEL PEDAL

The EFPA (Electronic Foot Pedal Assembly) connects the accelerator pedal to a potentiometer (a device that sends an electrical signal to the ECM which varies in voltage, depending on how far down the pedal is depressed). The EFPA is installed in the space normally occupied by a mechanical foot pedal. It has maximum and minimum stops that are built into the unit during manufacture.

11.1 Fuel Pedal Adjustment

The EFPA contains a throttle position sensor that varies the electrical signal sent to the ECM. The sensor must be adjusted whenever an EFPA is serviced. In addition, the sensor should be adjusted any time codes 21 and 22 are flashed.

With the ignition "ON" and the proper diagnostic tool (DDR) (for information regarding the DDR, see "01 ENGINE" in this manual), check the throttle counts at idle and full throttle positions. Proper pedal output should be 20/30 counts at idle and 200/235 at full throttle. If adjustment is necessary, remove the potentiometer cover, loosen the retaining screw and rotate the potentiometer clockwise to increase counts or counterclockwise to decrease. When correct output is confirmed, tighten retaining screws and reinstall the potentiometer cover.

11.2 Potentiometer Replacement

1. Remove the electronic foot pedal assembly from the vehicle.

Caution: Note the routing and clamping locations of the cable before disassembly. Proper cable routing and fastening is critical to the operation of this system. Marking the foot pedal assembly to record cable routing is recommended.

2. Discard screws (item 1) and cable clamps (item 2) securing wire.
3. Loosen the three (3) screws and remove potentiometer cover. Retain for reassembly.
4. Discard potentiometer (item 3), screws (item 4), washers (item 5) and grommet (item 6).
5. Position new potentiometer (item 3) with flat side towards you. Press potentiometer onto the potentiometer shaft (item 7), matching cutouts in shaft

to drive tangs of potentiometer. Apply hand pressure until potentiometer has bottomed out in housing. Install new screws and washers (items 4 & 5) and tighten just enough to lightly secure potentiometer. Rotate potentiometer counterclockwise as far as possible. Tighten screws to 10/20 lbf•in (1.1/2.2 N•m).

7. Install new cable clamps and screws (items 1 & 2), making sure new potentiometer's wire harness is routed in the same manner as the original harness. Tighten screws to 34/45 lbf•in (3.7/5 N•m).
8. Connect electronic foot pedal assembly's cable harness to the ECM connector. Then, Potentiometer calibration is now necessary (see "11.1 FUEL PEDAL ADJUSTMENT" in this section). When correct output is confirmed, install the pedal assembly in its proper location.

Caution: Make sure the cable harness is routed correctly, and securely installed so that it does not become pinched, stretched, or otherwise damaged during vehicle operation.

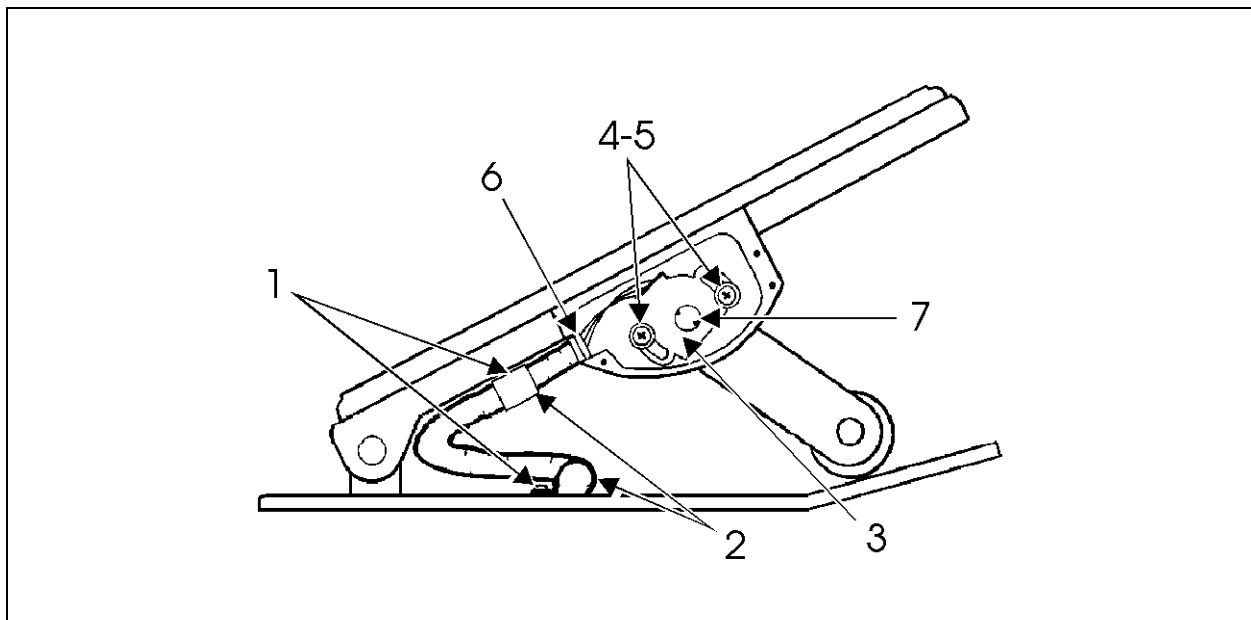


FIGURE 8: ELECTRONIC FOOT PEDAL ASSEMBLY

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12. SPECIFICATIONS

Primary Fuel Filter/Water Separator (optional)

(May be used instead of primary filter (never use with a primary filter).

Make..... Racor
Type Spin-on

ELEMENT

Supplier number..... S 3202
Prévost number..... 531390

BOWL

Supplier number..... RK30051
Prévost number..... 531389

DRAIN VALVE AND SEAL

Supplier number..... RK30058
Prévost number..... 531397

O-RING

Supplier number..... RK30076
Prévost number..... 531398

PROBE/WATER SENSOR

Supplier number..... RK21069
Prévost number..... 531391

Primary Fuel Filter

Make..... AC
Type Spin-on
Filter No..... T-915D
Service Part No..... 25014274
Prévost number..... 510137

OR

Service Part No (Type with Water Separator)..... 23512317
Prévost number..... 531407
Element torque..... 1/2 turn after gasket contact

Secondary Fuel Filter

Make.....AC
 Type Spin-on
 Filter No..... T-916D
 Service Part No..... 25014342
 Prévost number..... 510128
 Element torque..... 1/2 turn after gasket contact

Fuel tank(s) Capacity(ies)

Standard (XL-40 & 45E) 160 US gal (606 liters)
 Standard (XL-45) 208 US gal (787 liters)
 Optional (All XL vehicles)..... 90 US gal (341 liters)

Air Cleaner

Make..... Nelson
 Prevoist Number 53-0206
 Service Part No..... 7182 8N
 Supplier number (element cartridge)..... 70337N
 Prévost number (element cartridge)..... 530197

Air Cleaner Restriction Indicator

Make..... Donaldson
 Model..... RBX00-2220
 Indicates at 20" (508 mm) of water
 Prévost number..... 530161

Preheater Fuel Filter (80 000 BTU)

Make..... Webasto
 Supplier number..... 603.359
 Prévost number..... 871037

Preheater Line Fuel Pump

Make..... Espar
 Supplier number..... 25-1571-45-0000
 Prévost number..... 870973

Fuel Cooler

Make..... Berendsen
 Supplier number..... DB-1240
 Prévost number..... 950109