CONTENTS

ILLUTRATIONS

1. FUEL SYSTEM DESCRIPTION

NOTE
For detailed service procedures and part replacement information, about Volvo D13 engine and engine-related components, consult ' Impact' available under Volvo's Premium Tech Tool Software.

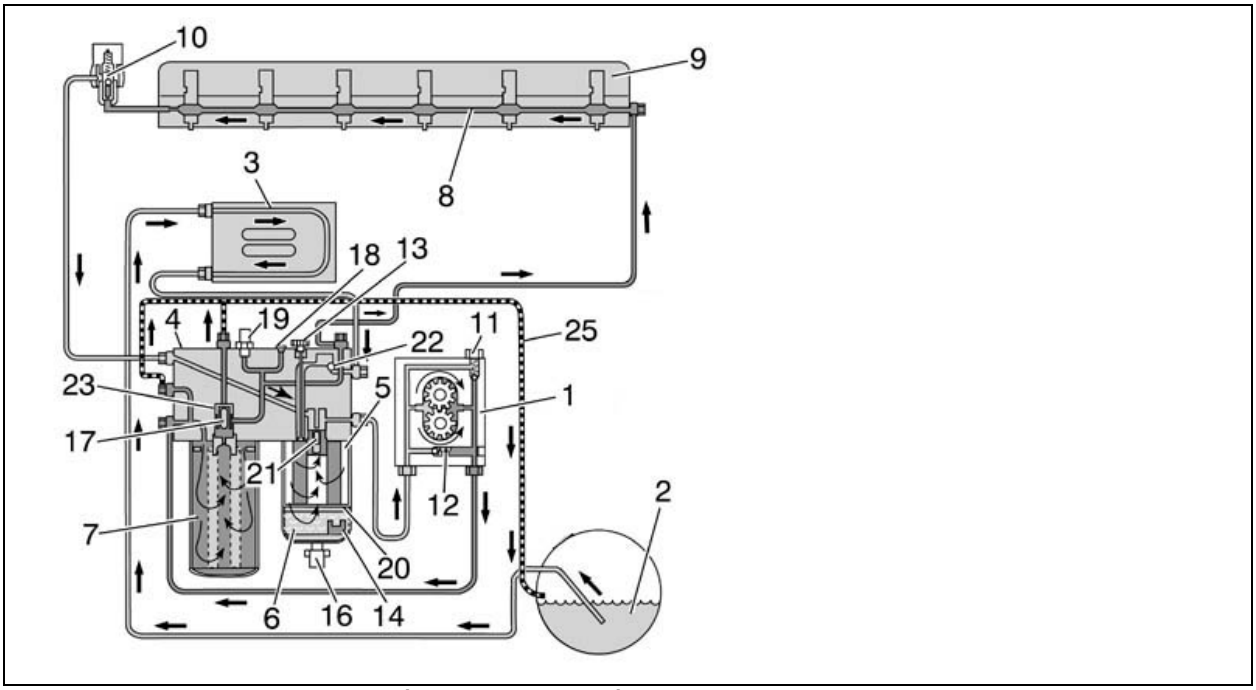


FIGURE 1: FUEL SYSTEM SCHEMATIC (VOLVO D13 ENGINE) 03086

Fuel is drawn up the fuel lines by the supply pump (1) through the pickup tube in the tank (2) and through the Engine Electronic Control Unit (EECU) cooling coil (3) and into the fuel filter housing (4). The fuel housing is equipped with a primary fuel filter (fuel/water separator) consisting of a filter cartridge and a water separation bowl.

The supply pump (1) forces the fuel into the fuel filter housing through the secondary filter (main) to a cylinder head longitudinal gallery (8). This channel supplies each unit injector (9) with pressurized fuel by a circular groove around each unit injector in the cylinder head. The overflow valve (10) controls the fuel supply pressure to the unit injectors.

The return fuel from the overflow valve (10) is returned back to the fuel filler housing and is mixed with the fuel from the fuel tank in a channel within the fuel filter housing (4).

Supply Pump Valves

Two valves are located in the supply pump (1). The safety valve (11) allows fuel to flow back to the suction side when the pressure becomes too high, e.g., if the fuel filter is blocked or is too restricted. The non-return valve (12) opens when the hand-priming pump is used.

Automatic Bleeding

If air gets into the system, it is bled when the engine starts. During bleeding, air is pressed out through the fuel filter housing over to the fuel tank through the return line (25). Bleeding for the filter replacement is controlled by valves (17) and (23).

Other

The fuel filter housing eliminates the need to drain the fuel when replacing the filter. The valve pegs (17) and (21) close when the fuel filter is removed. It is not necessary to bleed the fuel system after replacing the filter, since this is

performed automatically when the engine is started and runs for more than 2 minutes.

The plugged outlet (18) is fitted on the fuel filter housing. This outlet is used when measuring supply pressure after the fuel filter with an external pressure gauge. The pressure sensor (19) on the fuel filter housing monitors the supply pressure after the fuel filter. A fault code is displayed on the instrument cluster if the fuel supply pressure is less than the specified value.

Hand Priming Pump

The hand priming pump (13) is located on the fuel filter housing and is used to pump fuel (when engine is not running) after the fuel system has been drained for repair, etc. The non-return valve (22) for the hand priming pump is also located in the fuel filter housing.

1.1 FUEL VALVES

The manual shut-off valve on engine fuel-supply line is located on the R.H. side of engine compartment. A manual shut-off valve is located at the inlet side of the primary fuel filter.

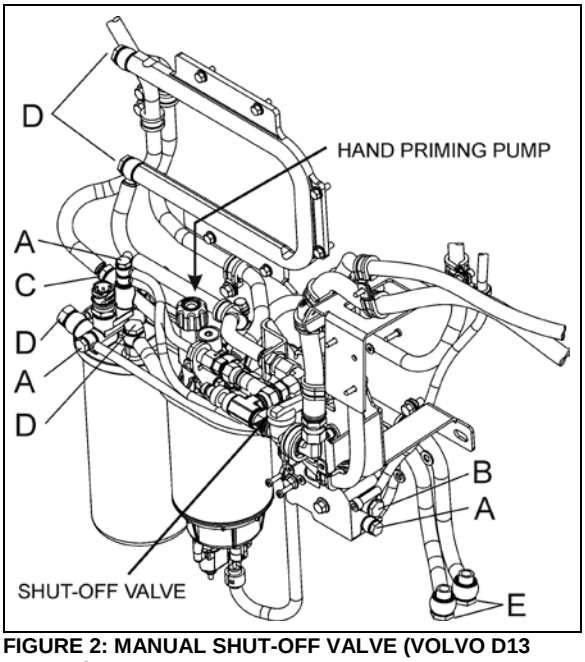


FIGURE 2: MANUAL SHUT-OFF VALVE (VOLVO D13 ENGINE) 03088

Shut-off valve is designed to prevent loss of fuel prime. No manual valve is required on preheater fuel-supply line, since the positive-displacement fuel pump (located close to the fuel tank) prevents fuel flow when not activated.

FUEL LINE FITTINGS – VOLVO D13 ENGINE	
A	13 ± 2 ft-lb (18 ± 3 Nm)
B	20.5 ± 3 ft-lb (28 ± 4 Nm)
C	22 ± 3 ft-lb (30 ± 4 Nm)
D	26 ± 4 ft-lb (35 ± 5 Nm)
E	29.5 ± 4 ft-lb (40 ± 5 Nm)
F	35 ± 4 ft-lb (48 ± 5 Nm)

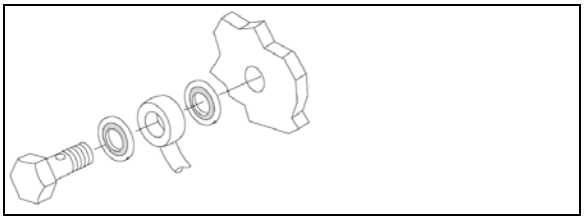


FIGURE 3: FUEL LINE COMPRESSION FITTING

CAUTION

Always replace the fuel line compression sealing washers when troubleshooting for fuel aeration or performing any service procedure that requires the removal of engine fuel lines.

1.2 FUEL FILTERS

A primary fuel filter is installed on the engine. This filter consists of a filter cartridge, a water separation bowl with a drain valve. It is used to prevent water from entering the fuel system.

MAINTENANCE

The primary and secondary fuel filters are of a spin-on type and must be replaced at **every engine oil change**.

The primary fuel filter should be drained periodically or when the telltale light on the dashboard illuminates if equipped with this system. To drain water, loosen the drain valve below the separator. Place an appropriate container under the filter. Close the drain valve when finished.

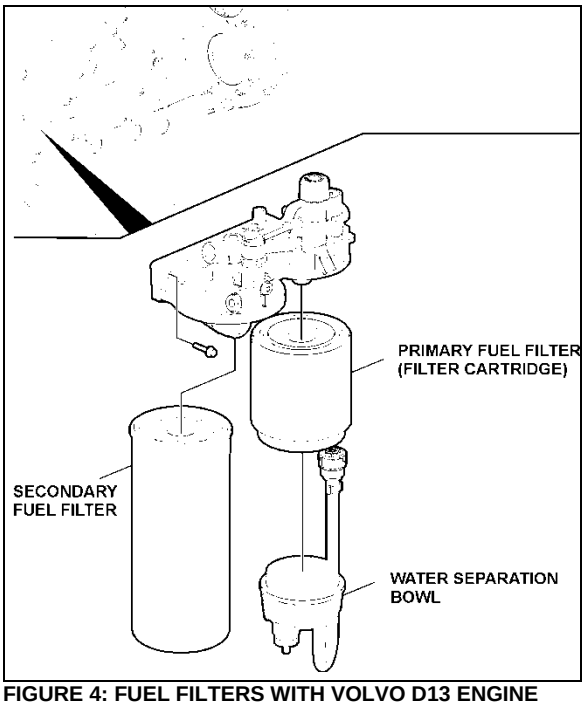
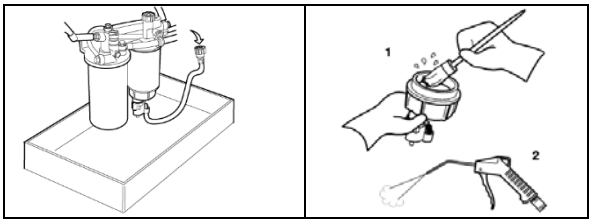


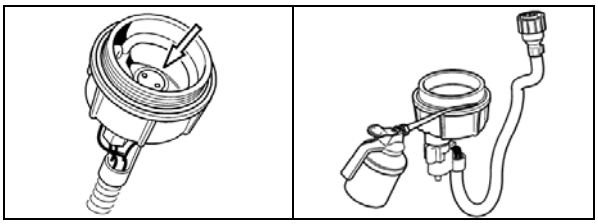
FIGURE 4: FUEL FILTERS WITH VOLVO D13 ENGINE
03085

1.2.1 Primary Fuel Filter Replacement

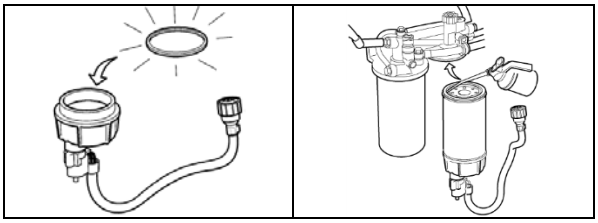
1. Stop engine, close the fuel supply line shut-off valve.
2. Place an appropriate container under the fuel filter housing, then drain the water from the water separation bowl.
3. Disconnect the fuel/water separator indicator electrical connector.



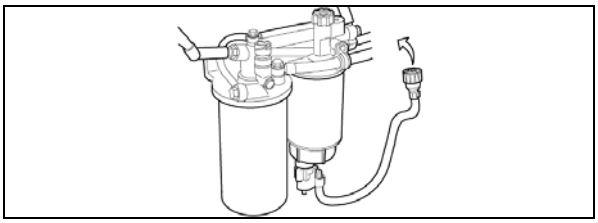
4. Unscrew and remove the primary fuel filter from the fuel filter housing. Drain filter.
5. Unscrew and remove the separation bowl from the filter cartridge.
6. Remove and discard the old gasket from the water separation bowl. Clean the bowl thoroughly and then blow dry with filtered compressed air.



7. Check that the drainage hole in the water separator bowl is not blocked.
8. Apply a thin coating of clean engine oil to the surface of the water separation bowl.



9. Install a new gasket to the water separation bowl and then reinstall the separation bowl to the new primary fuel filter cartridge.
10. Apply a thin coating of clean engine oil to the surface of the primary fuel filter, install the primary fuel filter to the fuel filter housing, then tighten the primary fuel filter ½-¾ turn.

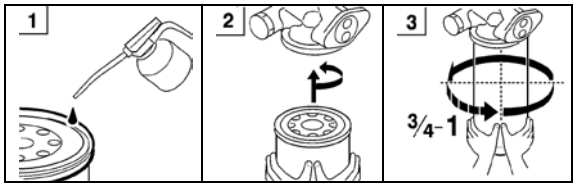


11. Connect the electrical connector for the water/fuel separation bowl indicator.
12. Open the fuel supply line shut-off valve.
13. Purge air from the filter by operating the priming pump to draw fuel and fill the filter. When using the hand priming pump, approximately 100 strokes will be required.
14. Start the engine and carry out a fuel-tightness check. Let the engine run for about 5 minutes to remove air pockets from the fuel system.

1.2.2 Secondary Fuel Filter Replacement

1. Stop engine, close the fuel supply line shut-off valve. Place an appropriate container under the fuel filter housing.

2. Clean around sealing area on fuel filter and housing.
3. Unscrew and remove the secondary fuel filter from the fuel filter housing.
4. Apply a thin coating of clean engine oil to the gasket of the secondary fuel filter. Screw the fuel filter into position. Tighten the filter ¾ to 1 turn after the gasket makes contact with the fuel filter housing.



CAUTION

Fuel in the old filter **must absolutely not** be poured into the new filter. This kind of contaminated fuel can damage the unit injectors.

5. Prime the fuel system by pumping the hand priming pump on the fuel filter housing until resistance is felt indicating that the system is full of fuel.
6. Start the engine and carry out a fuel-tightness check. Let the engine run for about 5 minutes to remove air pockets from the fuel system.

1.3 PRIMING THE FUEL SYSTEM

The fuel system will need to be bled if:

- The vehicle has run out of fuel.
- The engine has not been running for an extended period of time.
- Service work has been done on the fuel system, (tank, fuel lines, filters, valves, etc.) for example cleaning or replacing fuel filter cartridges.
- The engine is new or rebuilt.

CAUTION

When priming the system, movement of the primer pump should be as up and down as possible. Avoid putting any side load on the pump or causing a binding condition. Failure to follow these instructions could prematurely damage the primer pump.

NOTE

When the fuel system is empty, 200 or more pump strokes may be needed to properly prime system. There are no bleed nipples to be opened to prime the fuel system.

1. Stop engine;
2. Unlock the hand pump by turning the handle counterclockwise.
3. Prime the system by moving the primer pump in an up and down pumping motion. Avoid putting any side load on the pump or causing a binding condition.

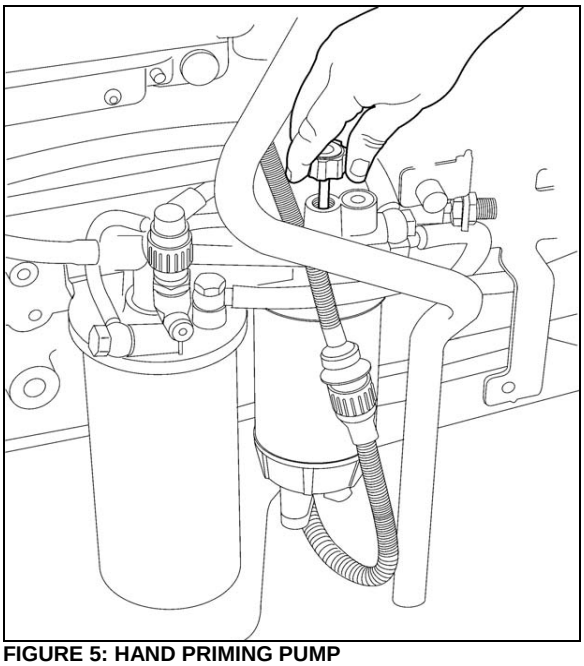


FIGURE 5: HAND PRIMING PUMP

4. Lock the hand primer pump by retracting it into the housing and turning it clockwise.
5. Start the engine and run it at an increased idle speed for approximately 5 minutes to remove any remaining air in the system. Check the fuel system for leaks.

1.4 FUEL PUMP REMOVAL AND INSTALLATION

The pump is located underneath the air compressor and is accessible through the engine compartment R.H. access door.

To remove the pump, proceed as follows:

- Clean around the fuel pump and fuel lines. Position a container to catch any fuel that might drain from the pump or lines.
- Remove the fuel pump.

NOTE

Only unfasten the bolts marked with arrows.

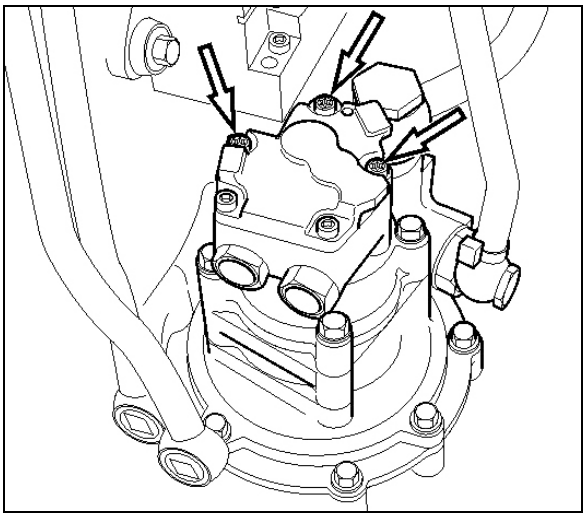


FIGURE 6: FUEL PUMP REMOVAL

CAUTION

Ensure to clean around the head of the bolts. Debris will prevent the tool from fitting properly and cause damage to the fasteners.

- Check that the adapter and fuel pump drive axle are not damaged.

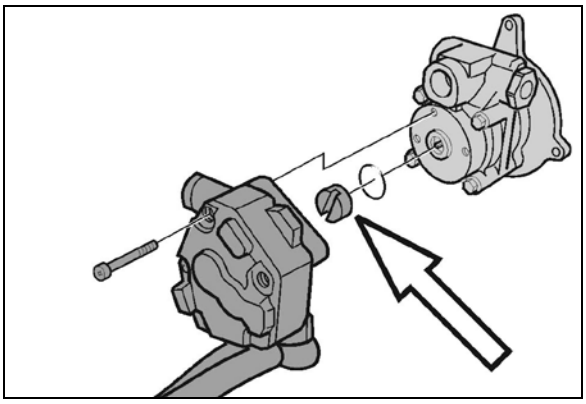


FIGURE 7: FUEL PUMP DRIVE AXLE

- Install the fuel pump. Torque-tighten bolt to specification.

NOTE

Use a new sealing ring. Check that the fuel pump drive axle sits correctly in the power steering pump.

- Using the hand primer on the fuel filter housing, prime the fuel system.
- Start the engine and let run for 5 minutes. Make sure that there are no leaks.

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 tank. 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.

MAINTENANCE

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, and 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 (Figure 2).

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 TANK

The X3-45 Commuter coach is equipped with a steel fuel tank with a legal capacity (corresponding to 95% of gross capacity) of 180 US gallons (681 liters) and 6.3 US gallons of unusable fuel.

The fuel filling access door is located on the R.H. side of vehicle providing easy fuel filling.

A Level Control Valve (LCV) on the fuel tank connection panel relieves pressure buildup and allows offset air in the tank to escape during filling. A whistle mounted at the LCV outlet can be heard as air escapes. During fueling, the LCV will close when the fuel reaches the level in the tank corresponding to 95% of the tank

volume, permitting a small build-up of pressure in the tank. When the back pressure reaches between 1.1and 1.5 psig it forces the filling nozzle to close automatically.

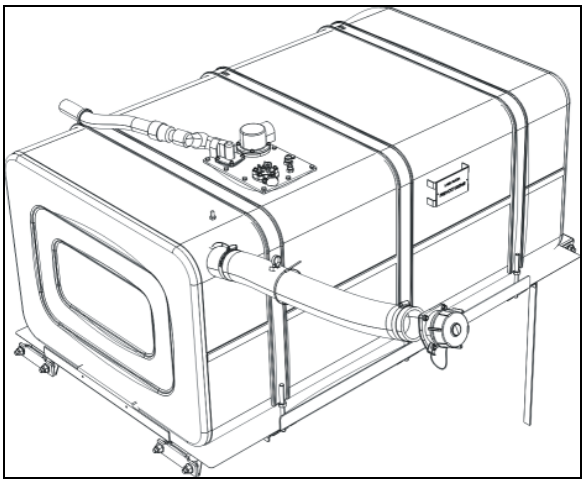


FIGURE 8: STEEL FUEL TANK ASSEMBLY

5% of tank inside space is kept filled with air with no exit opening, allowing for a fuel expansion safety margin. A drain plug, accessible from under the vehicle, is fitted at the bottom of the tank.

3.1 FUEL TANK DRAIN PLUG

NOTE

For faster emptying, it is recommended to siphon fuel through the opening left on the connection panel once the pressure relief valve is removed.

Apply **Loctite 567 Thread Sealant** on drain plug. With any sealant, the first one or two threads should be left uncovered to avoid system contamination.

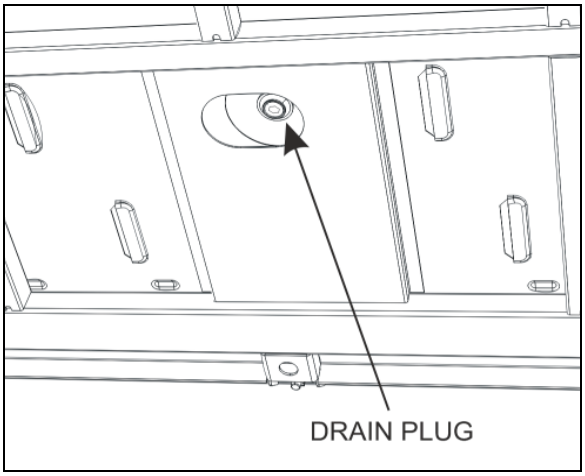


FIGURE 9: FUEL TANK DRAIN PLUG

The proper method of assembling this tapered threaded drain plug is to screw it to the finger tight position and then wrench tighten further 2-3 turns. If leakage persists, check for damaged threads.

3.2 TANK REMOVAL

DANGER

Park vehicle safely, apply parking brake, stop engine and set battery master switch(es) to the OFF position prior to working on the vehicle.

Before working under an air-suspended vehicle, it is strongly recommended to support the chassis at the recommended jacking points.

NOTE

Before removal, the fuel tank should be completely emptied by unscrewing the drain plug. For faster emptying, it is recommended to siphon fuel through the opening left on the connection panel once the pressure relief valve is removed.

Ensure that the container used has a capacity equal to the amount of fuel remaining in the tank.

1. Open the condenser door.
2. Unscrew clamps retaining R.H. side filler tube to fuel tank and filler neck. Disconnect tube and remove it.
3. Unscrew engine fuel supply and return lines from fuel tank connection panel.
4. Disconnect the fuel level sender electrical wires (3wires). Prior disconnecting, identify the wires and proper terminal on the fuel level sender as reference for reinstallation (Figure 10).
5. Using mobile column lifts, raise the vehicle to gain access to the fuel tank support from underneath.
6. Before removing the bolts securing the tank support to the chassis, lower the vehicle and make sure the tank support is adequately supported with jack stands or wood blocks. Failure to do so could result in injury as well as damage to the tank.

DANGER

Before removing the bolts securing the tank cradle to the frame, make sure the tank cradle is adequately supported with jack stands. Failure to do so could result in injury as well as damage to the tank.

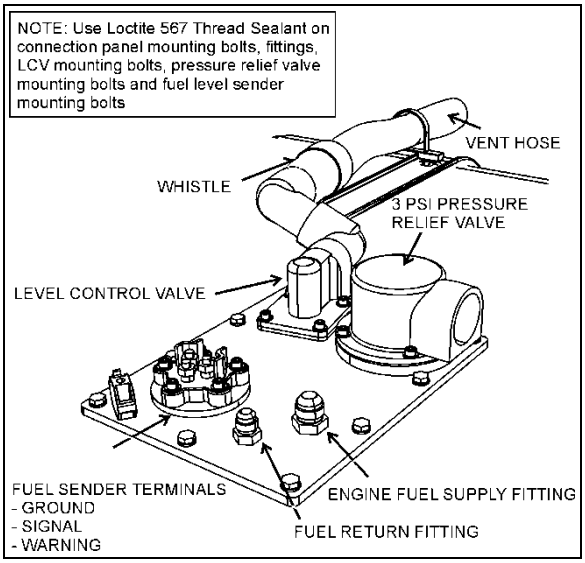


FIGURE 10: FUEL TANK CONNECTION PANEL

7. Once properly supported, unscrew the bolts (6) holding the fuel tank support to the vehicle chassis.
8. Lift the coach until it is high enough to clear the fuel tank. The fuel tank will rest on the floor.

3.3 TANK INSTALLATION

To install tank, simply reverse the "Tank Removal" procedure. Apply Valvoline anti-corrosion compound on retainer strap studs, nuts and fuel tank cradle mounting bolts.

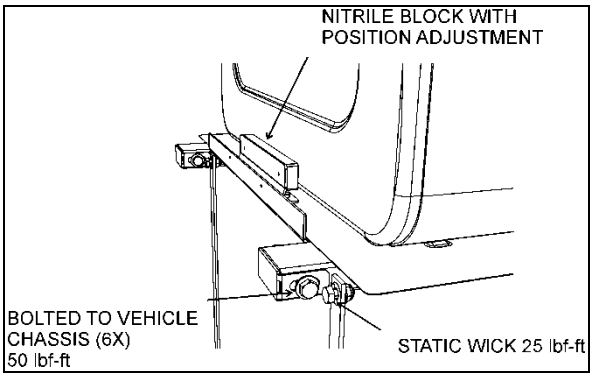


FIGURE 11: FUEL TANK SUPPORT MOUNTING BOLTS

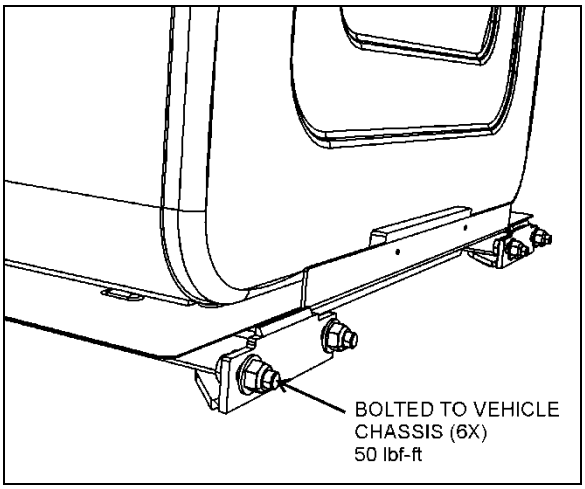


FIGURE 12: FUEL TANK SUPPORT MOUNTING BOLTS

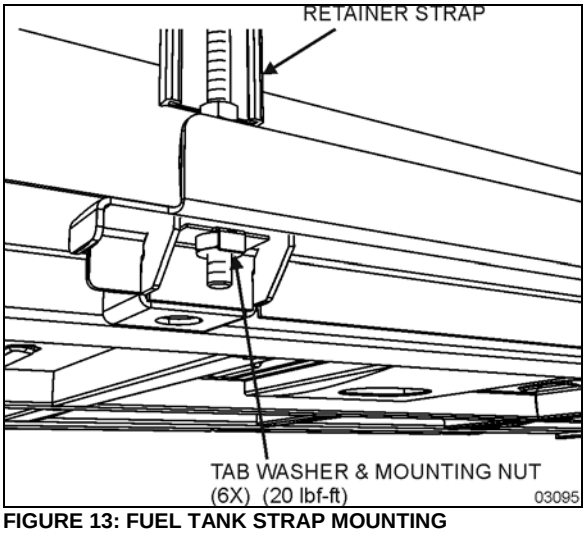


FIGURE 13: FUEL TANK STRAP MOUNTING

3.4 FUEL TANK YEARLY INSPECTION

Perform an external visual inspection of the fuel tank from under the vehicle to detect fuel traces or leaks.

Perform a visual inspection of the fuel tank connection panel. Make sure there are no loose connections. Investigate and correct the cause of any fuel leaks.

Inspect all fuel tank mountings and cradle attachment points. Inspect fasteners and replace them as necessary as described in the procedure that follows.

1. Raise the vehicle with safe lifting equipment and procedures.
2. Place jack stands under the fuel tank cradle.

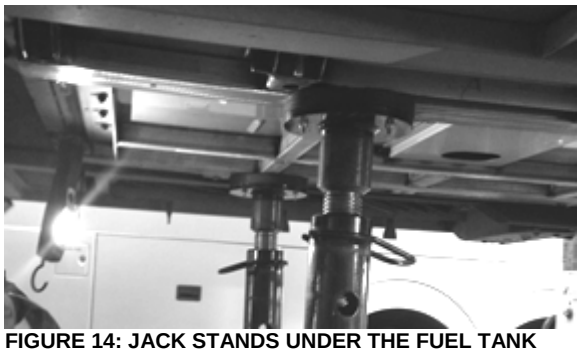


FIGURE 14: JACK STANDS UNDER THE FUEL TANK CRADLE

3. Carefully inspect fuel cradle mounting bolts, 6 locations (Figure 15).

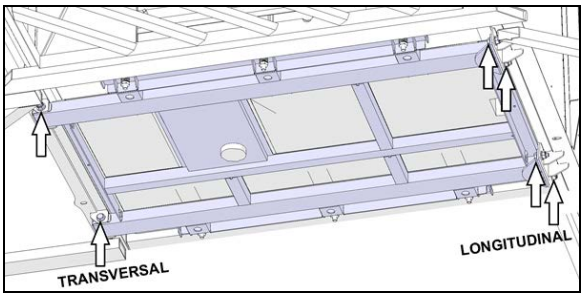


FIGURE 15: LOCATION OF MOUNTING POINTS

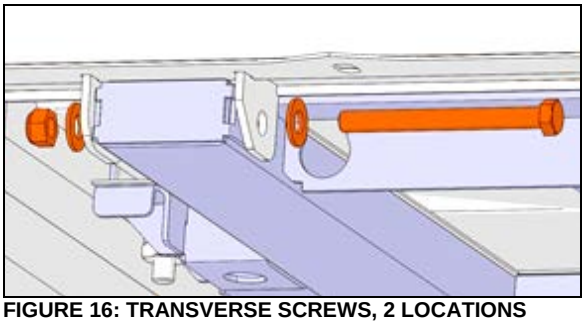


FIGURE 16: TRANSVERSE SCREWS, 2 LOCATIONS

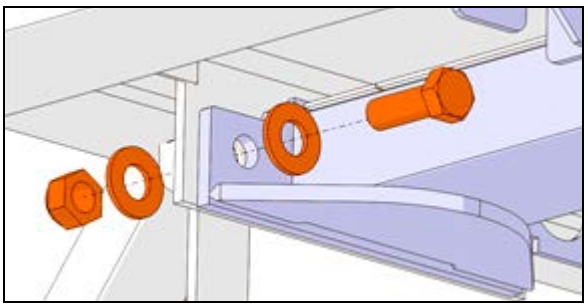


FIGURE 17: LONGITUDINAL SCREWS, 4 LOCATIONS

4. Replace any bolt showing **signs of wear** by new hardware. **DO NOT REUSE NUTS**. **Perform replacement one screw location at a time with appropriate support.** Apply torque seal mark.

Torque: 82 lbf-ft.

Hardware part number and description

 # 5001941 screw, cap hex M12x1.75x120 g10.9

 # 500806 screw, cap hex M12x1.75x35 g10.9

 # 500811 nut, hex sto M12-1.75 G10

 # 500958 flat washer ss .531x1.062x.095

 # 030082 U-shim 3.175mm thick (0.125 in)

 # 030083 U-shim 0.953mm thick (0.038 in)

5. On the transversal screw joints (Figure 18) any visible gap between cradle support tubing and vehicle frame mounting lugs is not acceptable.

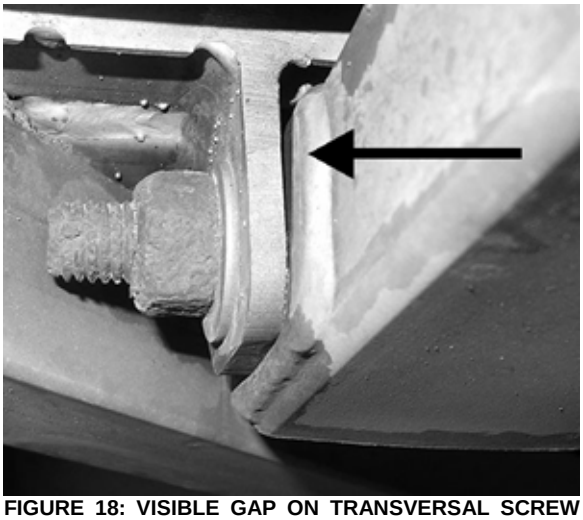


FIGURE 18: VISIBLE GAP ON TRANSVERSAL SCREW JOINT

6. If shims are not present, the visible gap should be shimmed using U-shims #030082 and/or #030083 as required.

7. Shim arrangement may vary and may be stacked on both sides (Figure 19).

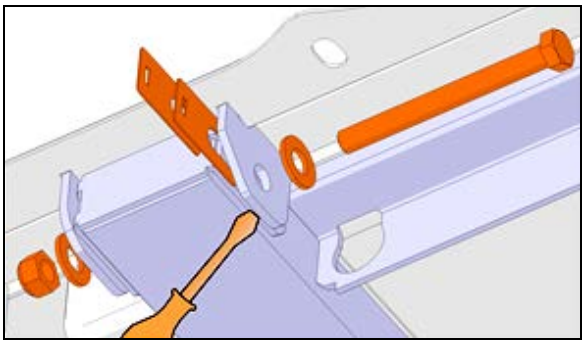


FIGURE 19: SHIM INSTALLATION, TRANSVERSE SCREW. ARRANGEMENT MAY VARY

4. FUEL 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 U.S. Environmental Protection Agency (EPA) has issued new standards to improve air quality by significantly reducing emissions through a combination of cleaner-burning diesel engines and vehicles.

To meet EPA standards, the petroleum industry produces **Ultra Low Sulfur Diesel** (ULSD) fuel, also referred to as S15, containing a maximum 15ppm (parts-per-million) sulfur.

On-highway diesel engines meeting 2010 emission regulations are designed to operate **ONLY** with ULSD fuel. ULSD fuel will enable the use of cleaner technology diesel engines and vehicles with advanced emissions control devices, resulting in significantly improved air quality.

4.1 FUEL TYPE

EPA-10 and later engines like the Volvo D13 are designed to run on **Ultra Low Sulfur Diesel** (ULSD) fuel, which can contain no more than 15 ppm sulfur.

Fuel used must meet engine manufacturer's specification. Refer to Volvo engine specifications.

CAUTION

ULSD fuel is necessary to avoid fouling the engine's Exhaust Aftertreatment System. Improper fuel use will reduce the efficiency of the engine's Aftertreatment System and may permanently damage the system.

CAUTION

Owners of 2010 and later model years on-highway diesel engine must refuel only with ULSD fuel.

NOTE

Burning Low Sulfur Diesel fuel (instead of ULSD fuel) in 2010 and later model year diesel engines is illegal and punishable with civil penalties.

4.2 BLENDING

Only ultra low sulfur kerosene – No.1 diesel with no more than 15ppm sulfur may be blended with ULSD fuel to improve cold weather performance. With so many kerosene formulations on the market, care must be taken to select kerosene with a maximum of 15ppm sulfur.

Blend rates remain the same as with Low Sulfur Diesel fuel.

4.3 BIODIESEL FUELS

Biodiesel up to a maximum of 20% blend (B20) may be used and will not affect the manufacturer's mechanical warranty as to engine and emissions system related components, provided the biofuel used in the blend conforms to ASTM D6751, B1 to B5 blends conform to ASTM D975, and B6 to B20 blends conform to ASTM D7467. Also, any engine performance problem related to the use of biodiesel fuel would not be recognized nor considered as Volvo or Prevost's responsibility.

However, Volvo engines are certified to comply with U.S. EPA and California emissions standards based upon the use of test fuels with specifications established by these regulatory agencies. Alternative fuels, including biodiesel, that are not substantially similar to the required test fuels may adversely affect engine emissions compliance. As a result, Volvo does not warrant the engine will conform to applicable Federal or California emissions limits when operated on biodiesel or other alternative fuels that are not substantially similar to specified test fuels used for certification.

5. AIR CLEANER (DRY TYPE)

The vehicle is equipped with a dry-type replaceable element air cleaner, located in the engine compartment. Access the air cleaner through the engine R.H. side door. Engine air enters the air cleaner through one intake duct located just above engine R.H. side door.

5.1 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.

5.2 GENERAL RECOMMENDATIONS

The following maintenance procedures will ensure efficient air cleaner operation:

1. Keep the air cleaner housing tight on the air intake pipe;
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. Store new elements in a closed area free from dust and possible damage.

5.3 AIR CLEANER RESTRICTION INDICATOR

A resettable restriction indicator is installed on the engine air-intake duct, clearly visible from the rear engine compartment. The indicator monitors the vacuum level between the air filter and the engine. A red marker is displayed when the air filter is clogged and must be replaced, a warning light located on the rear control panel will also lights-up. Reset by pressing on the indicator's extremity.

CAUTION

Do not ignore the Warning given by the air restriction indicator. This could result in serious engine damage.

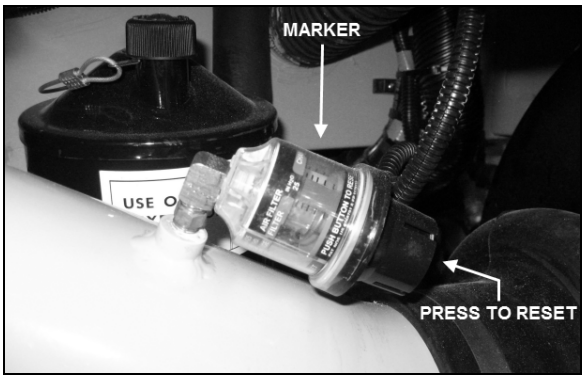


FIGURE 20: RESTRICTION INDICATOR 01052_1

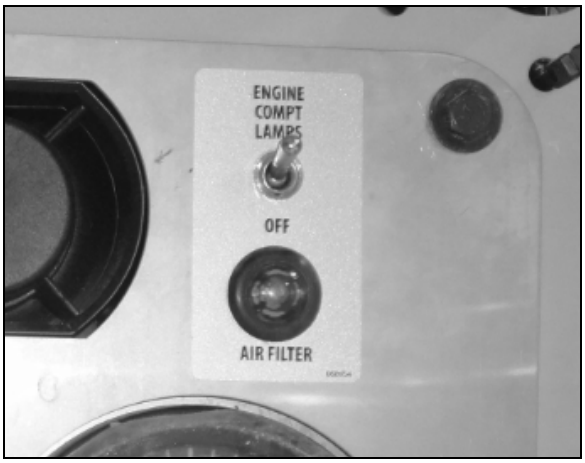


FIGURE 21: RESTRICTION INDICATOR LIGHT

6. 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 manufacturing.

6.1 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 retaining screws and rotate the potentiometer clockwise to increase counts or counterclockwise to decrease. When correct output is confirmed, tighten retaining screws.

6.2 POTENTIOMETER REPLACEMENT

1. Disconnect cable harness connector.
2. Loosen the two screws and remove potentiometer. Retain for re-assembly.
3. Discard potentiometer (Figure 22).

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. Position new potentiometer. Press potentiometer onto the potentiometer shaft, matching cutouts in shaft to drive tangs of potentiometer. Apply hand pressure until potentiometer has bottomed out in housing. Reinstall screws (Figure 22) and tighten just enough to secure potentiometer lightly. Tighten screws to 10 - 20 Lbf-in (1.13 - 2.26 Nm).
3. Reconnect electronic foot pedal assembly's cable harness to the ECM connector. If potentiometer calibration is necessary (see *"FUEL PEDAL ADJUSTMENT"* in this section).

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.

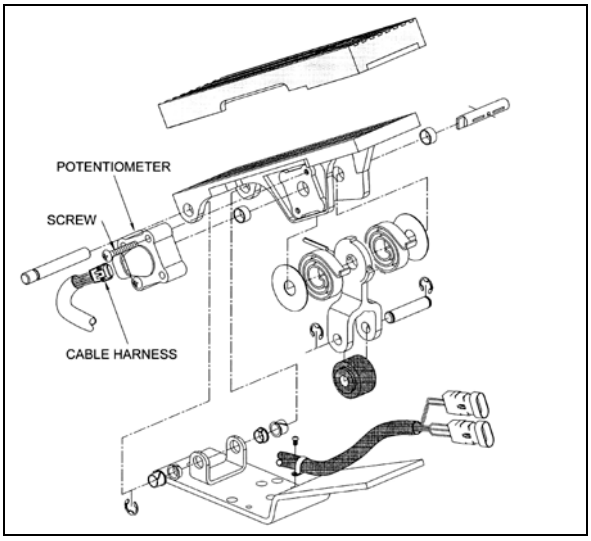


FIGURE 22: ELECTRONIC FOOT PEDAL ASSEMBLY 03035

7. SECTION CHANGE LOG

	DESCRIPTION	DATE
1	Fuel tank strap torque was 60 lb-ft, changed to 20 lb-ft	Oct 2016
2	Paragraph 3.4 Fuel Tank Yearly Inspection added	May 2018
3		
4		
5		
6		