

SECTION 03: FUEL SYSTEM

CONTENTS

| | |
|---|-----------|
| 1. FUEL SYSTEM WITH VOLVO D13 ENGINE | 3 |
| 1.1 DESCRIPTION..... | 3 |
| 1.2 FUEL VALVES..... | 4 |
| 1.3 FUEL FILTERS..... | 5 |
| 1.3.1 Primary Fuel Filter Replacement..... | 5 |
| 1.3.2 Secondary Fuel Filter Replacement..... | 6 |
| 1.4 PRIMING THE FUEL SYSTEM | 6 |
| 1.5 FUEL PUMP REMOVAL AND INSTALLATION..... | 7 |
| 2. DAVCO FUEL PRO 382..... | 7 |
| 3. FUEL LINES AND FLEXIBLE HOSES..... | 9 |
| 4. PREHEATER FUEL FILTER..... | 9 |
| 5. FUEL TANK..... | 9 |
| 5.1 TANK REMOVAL | 9 |
| 5.2 TANK INSTALLATION | 10 |
| 5.3 FUEL TANK VERIFICATION | 11 |
| 5.4 POLYETHYLENE FUEL TANK REPAIR..... | 11 |
| 6. FUEL SPECIFICATIONS | 11 |
| 6.1 FUEL TYPE..... | 11 |
| 6.2 BLENDING | 12 |
| 6.3 BIODIESEL FUELS | 12 |
| 6.3.1 Biodiesel fuels and auxiliary heaters..... | 12 |
| 6.3.2 Biodiesel fuels and the engine | 12 |
| 7. AIR CLEANER (DRY TYPE) | 12 |
| 7.1 PRE-CLEANER SERVICING | 13 |
| 7.2 AIR CLEANER SERVICING | 13 |
| 7.3 GENERAL RECOMMENDATIONS | 13 |
| 7.4 AIR CLEANER RESTRICTION INDICATOR..... | 13 |
| 8. FUEL PEDAL | 13 |
| 8.1 FUEL PEDAL ADJUSTMENT | 13 |
| 8.2 POTENTIOMETER REPLACEMENT..... | 14 |
| 9. SPECIFICATIONS | 15 |

ILLUSTRATIONS

FIGURE 1: FUEL SYSTEM SCHEMATIC (VOLVO D13 ENGINE) 030863
FIGURE 2: MANUAL SHUT-OFF VALVE (VOLVO D13 ENGINE) 030884
FIGURE 3: MANUAL SHUT-OFF VALVE LOCATION WITH DAVCO FUEL PRO 382 (VOLVO D13 ENGINE) 030874
FIGURE 4: FUEL LINE COMPRESSION FITTING –4
FIGURE 5: FUEL FILTERS WITH VOLVO D13 ENGINE 030855
FIGURE 6: HAND PRIMING PUMP6
FIGURE 7: FUEL PUMP REMOVAL7
FIGURE 8: FUEL PUMP DRIVE AXLE.....7
FIGURE 9: DAVCO FUEL PRO 382 INSTALLATION 030328
FIGURE 10: DAVCO FUEL PRO 382 EXPLODED VIEW 030768
FIGURE 11: 235 US GALLONS FUEL TANK 03048.....10
FIGURE 12: 208 US GALLONS FUEL TANK 03094.....10
FIGURE 13: FUEL TANK RETENTION 0301910
FIGURE 14: FUEL TANK REPAIR 0301411
FIGURE 15: RESTRICTION INDICATOR 01052.....13
FIGURE 16: ELECTRONIC FOOT PEDAL ASSEMBLY 03035.....14

1. FUEL SYSTEM WITH VOLVO D13 ENGINE

1.1 DESCRIPTION

NOTE

For additional information concerning Volvo D13 engine components or engine-related components, consult Volvo Trucks Canada or Volvo Trucks North America Web Site under: Parts & Service. On Volvo web site, you will find detailed service procedures for parts replacement, repair and maintenance.

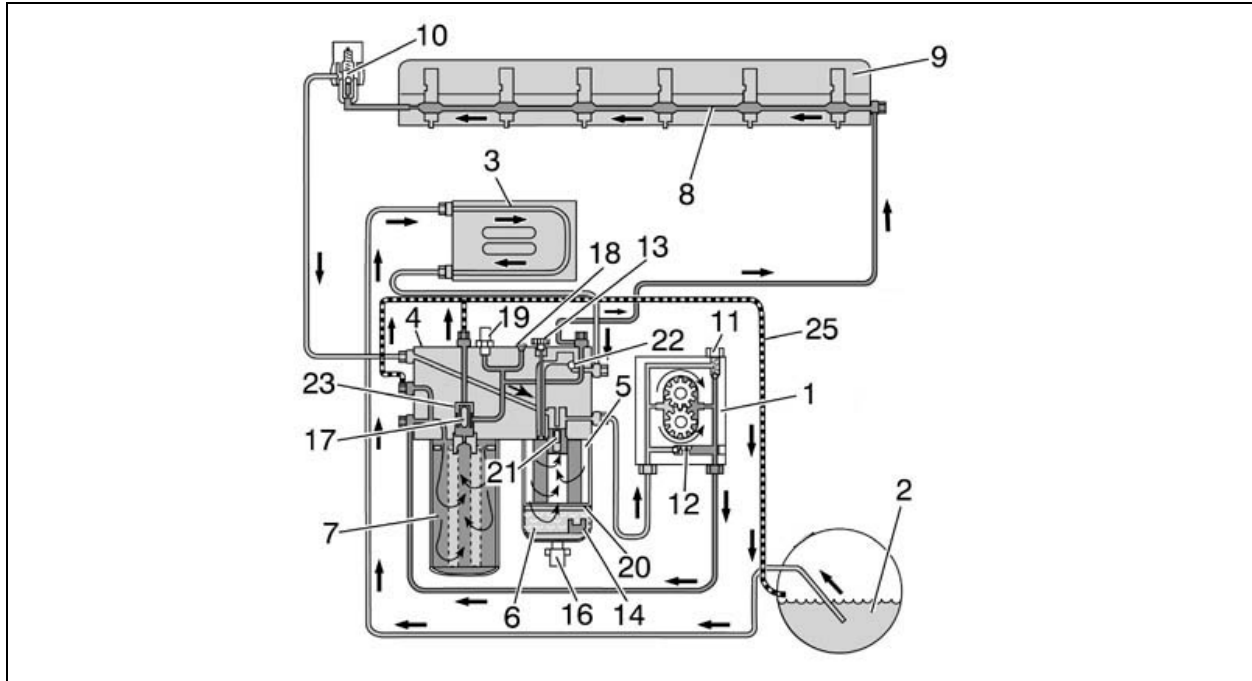


FIGURE 1: FUEL SYSTEM SCHEMATIC (VOLVO D13 ENGINE) 03086

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

Section 03: FUEL SYSTEM

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.

1.2 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 or at the inlet side of Davco Fuel Pro 382 fuel filter.

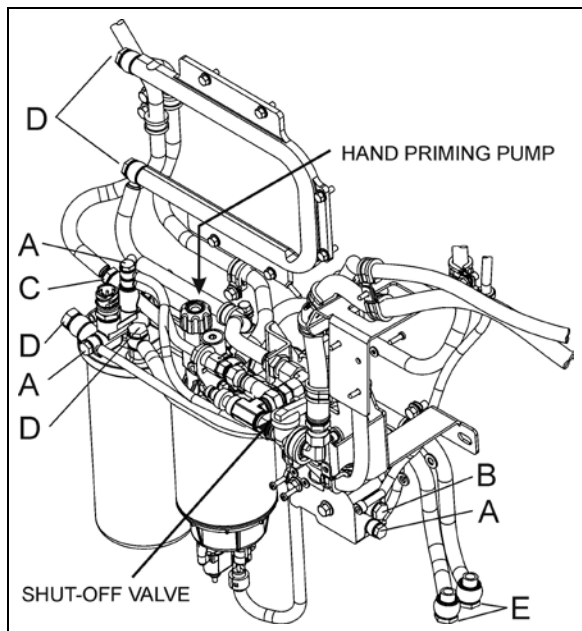


FIGURE 2: MANUAL SHUT-OFF VALVE (VOLVO D13 ENGINE)
03088

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) |

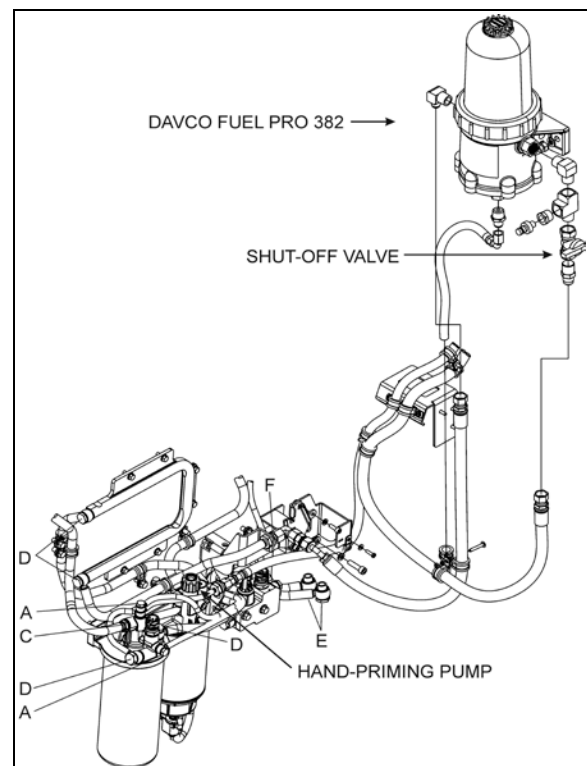


FIGURE 3: MANUAL SHUT-OFF VALVE LOCATION WITH DAVCO FUEL PRO 382 (VOLVO D13 ENGINE)
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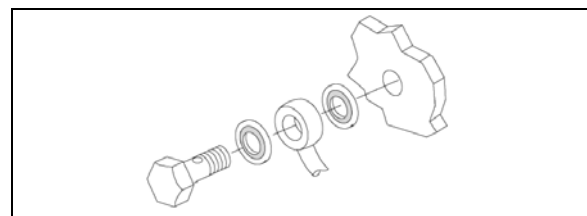


FIGURE 4: FUEL LINE COMPRESSION FITTING –



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.

1.3 FUEL FILTERS



MAINTENANCE

The primary and secondary (aka pre-filter and main filter) 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.

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.

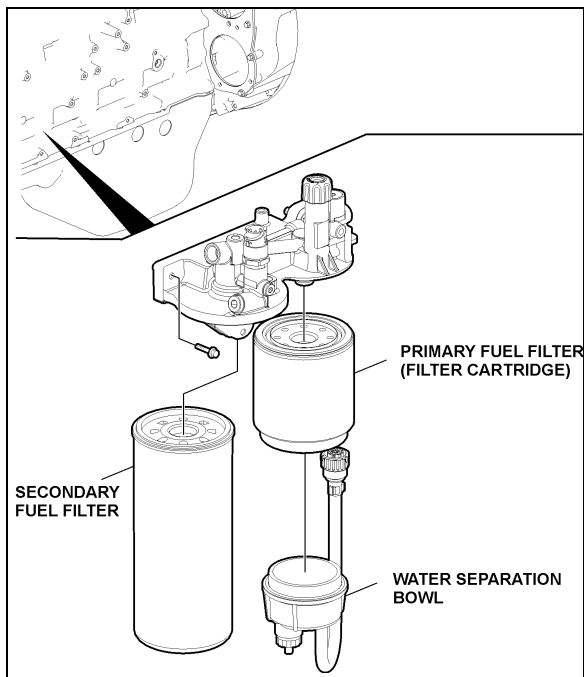
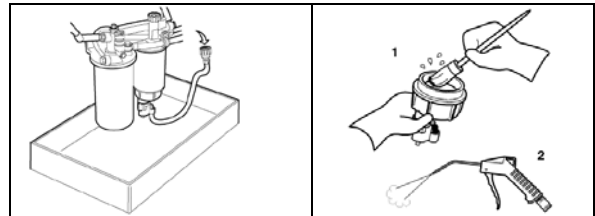


FIGURE 5: FUEL FILTERS WITH VOLVO D13 ENGINE
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1.3.1 Primary Fuel Filter Replacement

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.

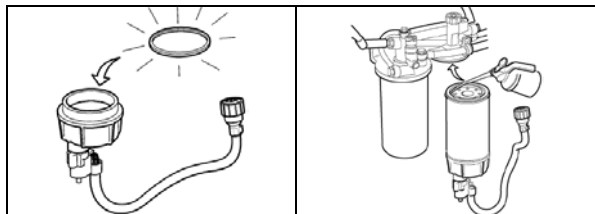
3. Disconnect the fuel/water separator indicator electrical connector.



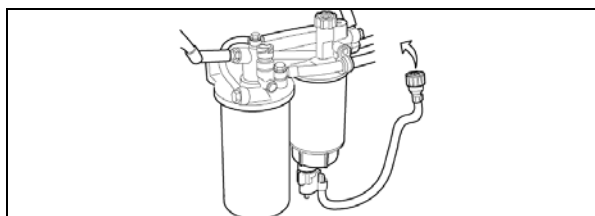
4. Unscrew and remove the primary fuel filter from the fuel filter housing. Drain filter.
5. Unscrew and remove the separation bowl from the filter cartridge.
6. Remove and discard the old gasket from the water separation bowl. Clean the bowl thoroughly and then blow dry with filtered compressed air.



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 1/2-3/4 turn.



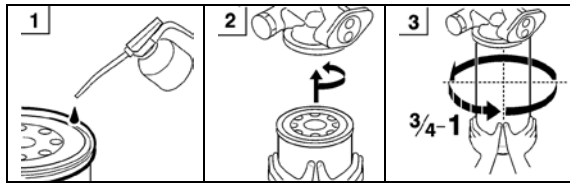
11. Connect the electrical connector for the water/fuel separation bowl indicator.

Section 03: FUEL SYSTEM

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.

1.3.2 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 $\frac{3}{4}$ 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.

1.4 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.

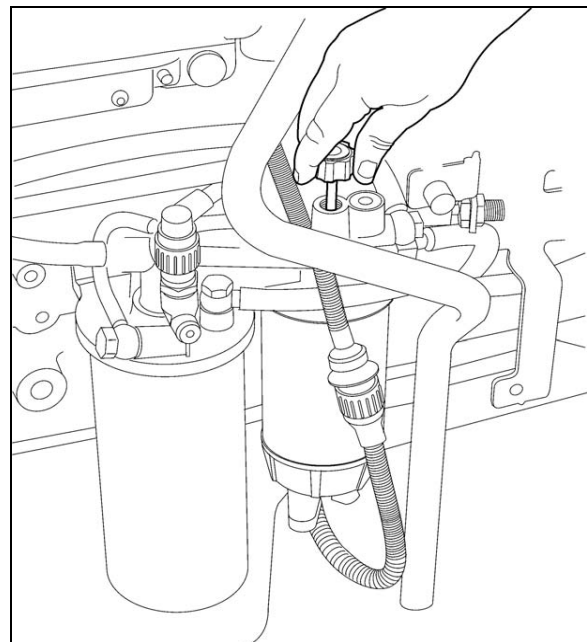


FIGURE 6: HAND PRIMING PUMP

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.

1.5 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.

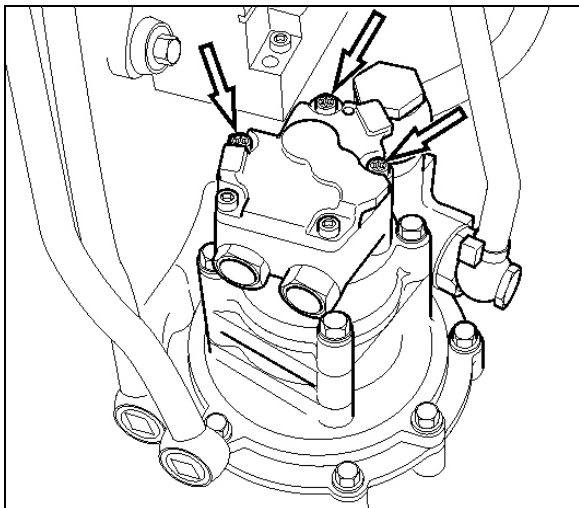


FIGURE 7: FUEL PUMP REMOVAL



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

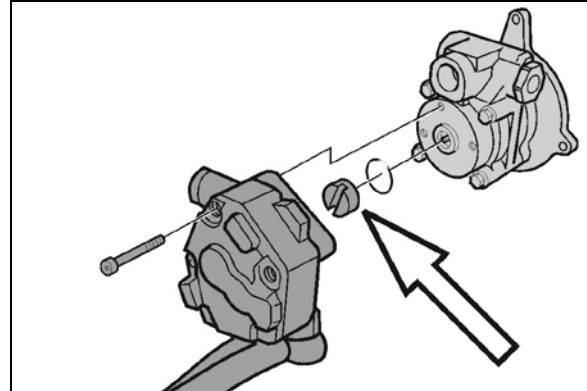


FIGURE 8: FUEL PUMP DRIVE AXLE

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. DAVCO FUEL PRO 382

The optional Fuel Pro 382 diesel fuel filter system consists of a permanently mounted fuel processor, a replaceable filter element, a filter element cover and collar and a fluid filter base assembly. This system is installed between the fuel tank and the fuel pump. The filter serves as a water separator as well as a fuel filter (Figure 9).

The filter fibers used in the Davco Fuel Pro 382 element may cause the fuel level to read artificially high when the filter is first installed. Over the first few days, the filter fibers eventually become fully saturated and the fuel level will drop to normal levels. Do not be concerned about an abnormally high fuel level when a new Davco element is installed.

Fuel level rises as dirt collects on the filter from the bottom up. Restriction remains consistently low because fuel always flows through clean, new media.



MAINTENANCE

Replace Fuel Pro 382 filter element when the fuel level in the see-thru filter cover reaches the top of the filter element or after one year of service, whichever comes first.

Section 03: FUEL SYSTEM

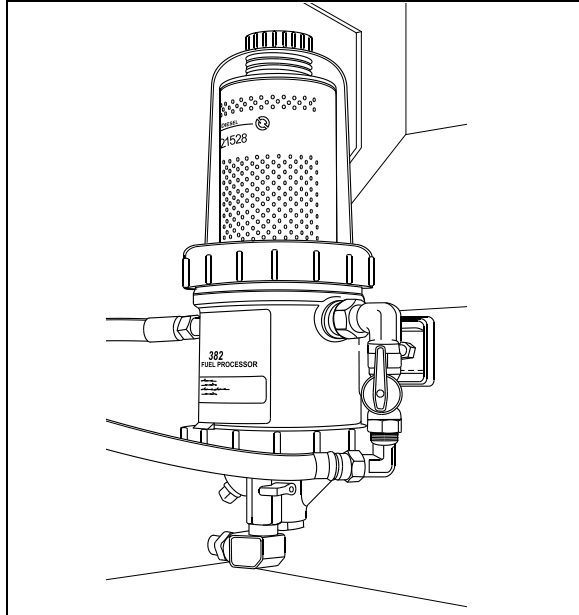


FIGURE 9: DAVCO FUEL PRO 382 INSTALLATION 03032

Filter replacement:

1. Stop engine;
2. Place a suitable container under the fuel processor;
3. Close the shut-off valve on the discharge side of the fuel filter;
4. Open the drain valve at the base of the fuel processor and drain the fuel until it is below the level of the filter;
5. Untighten upper collar, remove cover, filter spring, filter element and cover seal;
6. Dispose of used filter element;
7. Ensure the filter grommet is included in the base of the new filter element and then install the element onto the center stud;
8. Ensure the filter spring is installed at the top of the cover. If missing, the spring must be replaced to insure proper filter operation.
9. Wipe the cover lid and seal clean. After ensuring the seal is properly positioned at the base of the cover, install the cover and collar onto the fuel processor. Tighten the collar by hand until secure;
10. Fill the cover full of clean fuel through spin off cap located on top of cover. Install vent cap seal and then reinstall the cap and tighten by hand only;
11. Open the shut-off valve;
12. Start engine, raise rpm for 2-3 minutes, hand tighten collar again.

13. After the air is purged and with the engine still running, slowly loosen the vent cap on the filter cover. The fuel level in the cover will start falling. When the fuel level falls to the top of the collar, tighten the vent cap quickly by hand.

14. Shut down the engine and hand-tighten the collar again.

NOTE

Fuel Pro 382 also accepts standard secondary spin-on fuel filters.

ENVIRONMENTAL NOTICE

Diesel fuel is an environmentally hazardous product. Dispose in an environmentally friendly manner.

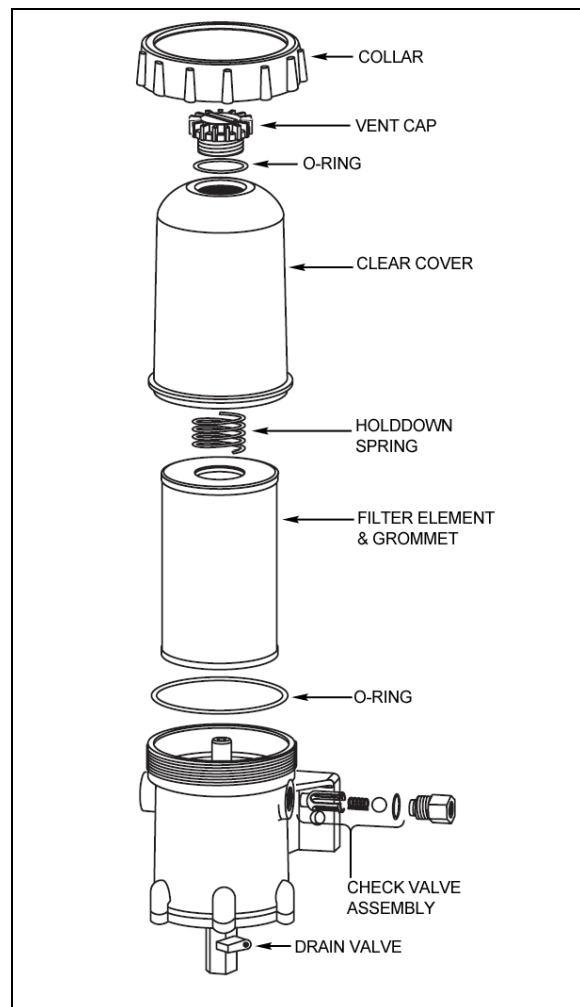



FIGURE 10: DAVCO FUEL PRO 382 EXPLODED VIEW


03076

3. 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.

| |
|--|
|  <h3 style="margin: 0;">MAINTENANCE</h3> |
| <p>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.</p> |


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 1).

| |
|---|
|  <h3 style="margin: 0;">CAUTION</h3> |
| <p>Oil level above the dipstick full mark or a decrease in lube oil consumption may indicate internal fuel leaks. Check oil level frequently.</p> |

4. PREHEATER FUEL FILTER

On H3 series vehicles, the preheater fuel filter is located beside the preheater in the dedicated compartment above the rear wheelhousing, on the L.H. side of vehicle.

On X3 series vehicles, the preheater fuel filter is located beside the preheater in the engine coolant heater compartment, and is accessible by opening the evaporator compartment door.

| |
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|  <h3 style="margin: 0;">MAINTENANCE</h3> |
| <p>Replace preheater fuel filter every 50,000 miles (80 000 km) or once a year, whichever comes first.</p> |


5. FUEL TANK

All H3 series vehicles are equipped with a high-density cross-link polyethylene fuel tank with a capacity of 235 US gallons (890 liters). The tank is located just forward of the last baggage compartment, between the A/C condenser and evaporator. Fuel filling access doors on both sides of vehicle provide direct access to filler necks; offering the added advantage of refueling from either side of vehicle.

X3 series are equipped with a high-density cross-link polyethylene fuel tank with a capacity of 208 US gallons (787 liters). The fuel filling access door is located on the R.H. side of vehicle providing easy fuel filling.

A pressure relief valve on the fuel tank connection-panel relieves high-pressure buildup and an overflow tube allows offset air in the tank to escape during filling. For 95% of the tank volume, 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.

5.1 TANK REMOVAL

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|  <h3 style="margin: 0;">WARNING</h3> |
| <p>Park vehicle safely, apply parking brake, stop engine and set battery master switch(es) to the OFF position before working on the vehicle.</p> <p>Before working under an air-suspended vehicle, it is strongly recommended to support the body at the recommended jacking points.</p> |

| |
|---|
| <h3 style="margin: 0;"><i>NOTE</i></h3> |
| <p><i>Before 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.</i></p> |

1. Open the condenser door and remove the fuel tank access panel. The rear baggage compartment fuel tank access panel may also be removed to facilitate access to components.
2. On H3 series vehicles only, unscrew clamps retaining L.H. side filler tube to the fuel tank, then disconnect tube and remove it.

Section 03: FUEL SYSTEM

3. Unscrew clamps retaining R.H. side filler tube to fuel tank and filler neck. Disconnect tube and remove it.
4. If applicable, unscrew preheater supply line, preheater return line, auxiliary return line and/or auxiliary return line from fuel tank connection-panel.
5. Unscrew engine supply and return lines from fuel tank connection-panel, identify them for reinstallation.
6. Disconnect electrical wiring from tank on connection plate.

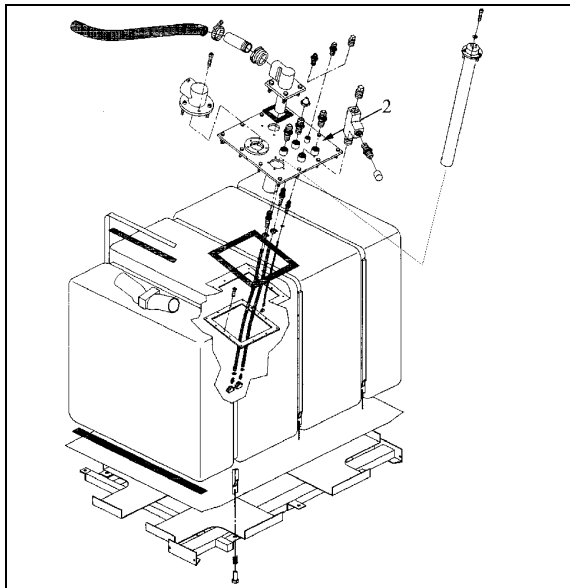


FIGURE 11: 235 US GALLONS FUEL TANK 03048

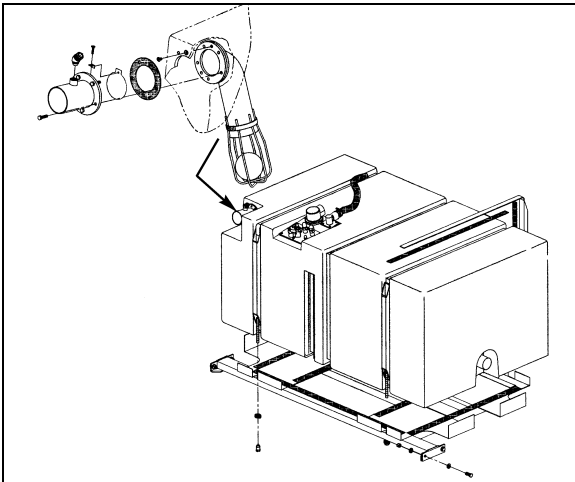


FIGURE 12: 208 US GALLONS FUEL TANK 03094



WARNING

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

7. From under the vehicle, on R.H. side, unscrew the 4 bolts (2 in front, 2 in back) retaining the tank support to the frame.
8. From under the vehicle, on the L.H. side, unscrew the 2 bolts (1 in front, 1 in back) retaining the tank support to the frame.
9. Carefully remove tank from under the vehicle.

5.2 TANK INSTALLATION

Tank installation is the reverse of removal.

NOTE

Fastening of rubber flap must always be on top, in line with clamp screw.

NOTE

Insert check valve assembly in right-side filler hose, use hose clamp to fix it. Repeat with left side filler hose on H3 series vehicles.

NOTE

When reinstalling lines, use Loctite 567 type thread sealant on line fittings.



WARNING

For proper assembly, check connections and fasteners for tightness.

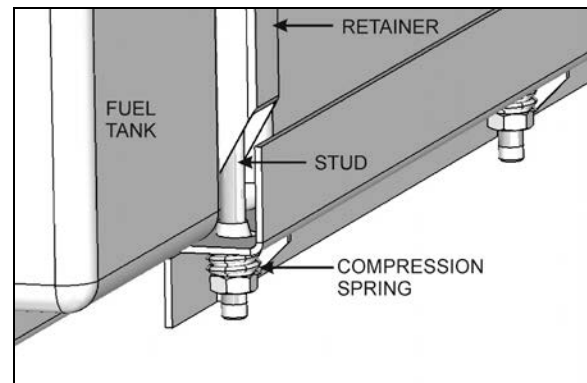


FIGURE 13: FUEL TANK RETENTION 03019

For each fuel tank retainers (Figure 13):

1. Clean nuts and stud threads.
2. Apply a Loctite 242 type thread adhesive on stud threads.

Fix the retainers to the tank platform. Tighten the nuts to compress the spring completely and then loosen 3 turns.

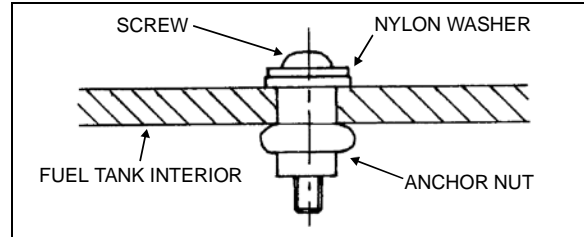



FIGURE 14: FUEL TANK REPAIR

03014


5.3 FUEL TANK VERIFICATION

Inspect fuel tank from under vehicle for leaks or fuel traces. If a leak is detected, repair immediately as per "Polyethylene Fuel Tank Repair" in this section.

| |
|---|
|  WARNING |
| <p>Park vehicle safely, apply parking brake, stop engine and set battery master switch(es) to the OFF position before working on the vehicle.</p> <p>Before working under an air-suspended vehicle, it is strongly recommended to support the body at the recommended jacking points.</p> |

5.4 POLYETHYLENE FUEL TANK REPAIR

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| <i>NOTE</i> |
| <p><i>Fuel level must be lower than perforation to carry out this procedure.</i></p> |

| |
|---|
|  WARNING |
| <p>Park vehicle safely, apply parking brake, stop engine and set battery master switches to the OFF position before working on the vehicle.</p> |

1. Locate perforation on fuel tank.
2. If necessary, remove fuel tank as per instructions in this section.
3. Drill perforation with a 23/64" bit. Make sure drill hole is perfectly round.
4. Insert a screw (Prevost #500196) and a washer (Prevost #5001244) into anchor nut (Prevost #500331).
5. Place assembly in drilled hole. Tighten screw by 10 complete turns. Refer to Figure 14.
6. Apply sealant on head plug (Prevost #507300) and seal hole with the head plug.

6. FUEL SPECIFICATIONS

The quality of fuel 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.

6.1 FUEL TYPE

EPA-10 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 |
| <p>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.</p> |

Section 03: FUEL SYSTEM



CAUTION

Owners of 2010 and later model year 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.

NOTE

Engine and vehicle manufacturers expect ULSD fuel to be fully compatible with the existing fleet, including 2006 and earlier model year vehicles. In some instances, the introduction of ULSD fuel to older vehicles may affect fuel system components or loosen deposits in fuel tanks. As part of a good maintenance program, owners and operators of existing cars, trucks and buses are encouraged to monitor their diesel-powered vehicles closely for potential fuel system leaks or premature fuel filter plugging during the change-over to ULSD fuel.

NOTE

*Like Low Sulfur Diesel fuel, ULSD fuel requires good lubricity and corrosion inhibitors to prevent unacceptable engine wear. As necessary, additives to increase lubricity and to inhibit corrosion will be added to ULSD fuel **prior** to its retail sale.*

6.2 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.

6.3 BIODIESEL FUELS

Biodiesel up to a maximum of 20% blend (B20) may be used and will not affect the manufacturers' 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.

Additional maintenance care must be carried-out for the following systems:

6.3.1 Biodiesel fuels and auxiliary heaters

For operation of the auxiliary heater with biodiesel, a retrofit is mandatory. Refer to the guidelines outlined in the Spheros Workshop Manual for Thermo 230, 300, 350 (doc P/N 9003656D), available on the publications DVD and in the technical manuals section of the Prevost technical publications website.

6.3.2 Biodiesel fuels and the engine


Use an oil sampling method to establish the appropriate oil drain interval for your application.

Fuel filter change intervals should be analyzed and adjusted accordingly.

7. 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 an intake duct on the R.H. side of the rear cap, next to the last window. It then flows through a pre-cleaner and finally through the air cleaner. The pre-cleaner removes dust and moisture by means of a discharge tube at the bottom of the element. It is in series with a replaceable impregnated paper filter element (air cleaner).

7.1 PRE-CLEANER SERVICING

| |
|---|
|  <h2 style="margin: 0;">MAINTENANCE</h2> |
| <p>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.</p> |

7.2 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.

7.3 GENERAL RECOMMENDATIONS

The following maintenance procedures will ensure efficient air cleaner operation:

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

**CAUTION**

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

8. Store new elements in a closed area free from dust and possible damage.

7.4 AIR CLEANER RESTRICTION INDICATOR

A resettable restriction indicator may be 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. Reset by pressing on the indicator's extremity.

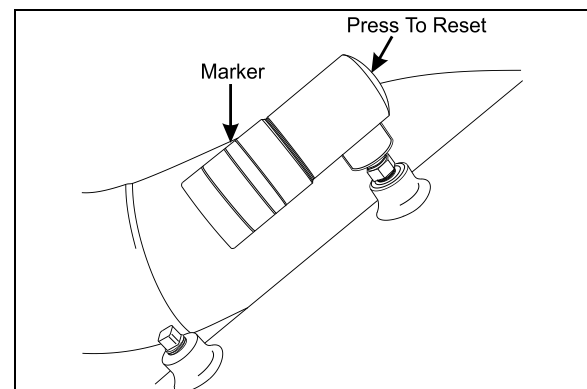


FIGURE 15: RESTRICTION INDICATOR

01052

8. 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.

8.1 FUEL PEDAL ADJUSTMENT

The EFPA contains a throttle position sensor that varies the electrical signal sent to the ECM.

Section 03: FUEL SYSTEM

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.

8.2 POTENTIOMETER REPLACEMENT

1. Disconnect cable harness connector.
2. Loosen the two screws and remove potentiometer. Retain for re-assembly.
3. Discard potentiometer (Figure 16).



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.

4. 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 16) and tighten just enough to secure potentiometer lightly. Tighten screws to 10 - 20 lbf-in (1.13 – 2.26 Nm).
5. 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.

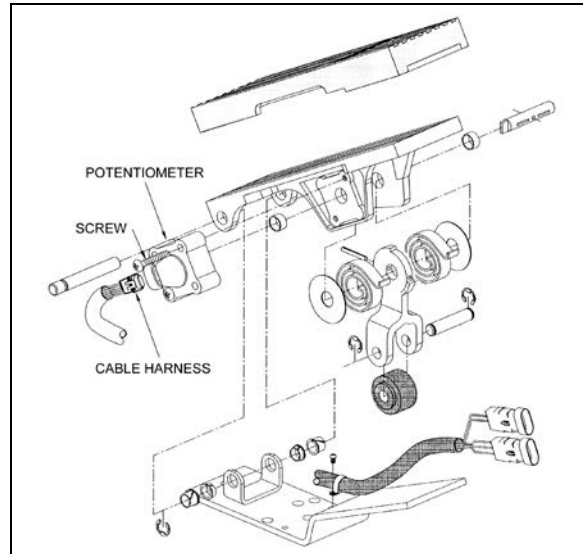


FIGURE 16: ELECTRONIC FOOT PEDAL ASSEMBLY 03035

9. SPECIFICATIONS

Davco Fuel Pro 382 Fuel Filter / Water Separator Element

Max Fuel Flow 180 US gal/h (681 l/h)
Water removal @ 25 microns99.6%
Dirt holding capacity @ 25 microns..... 110 g

Primary Fuel Filter (Fuel/Water Separator)

Filter type Spin-on cartridge
Filter change interval Every oil change
Filter drain interval Dashboard telltale light warning
Filter torque..... ½-¾ turn after gasket contact

Secondary Fuel Filter (Main)

Filter type Spin-on cartridge
Filter change interval Every oil change
Filter torque..... ¾- 1 turn after gasket contact

Fuel tank Capacity

H3 series vehicles235 US gal (890 liters)
X3 series vehicles..... 208 US gallons (787 liters)

Air Cleaner

Filter type Dry-type replaceable element
Filter change interval Red marker on restriction indicator

Preheater Fuel Filter

Heater type Thermo 300 High pressure atomizer
Heater power104000 btu/h
Pump flow1.05 US gal/h (4 l/h)