

Section 3 Fuel, Emissions, and Exhaust

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FUEL SYSTEM DESCRIPTION

The fuel lift pump draws fuel from the 25 gallon (94.6 liter) fuel tank through the supply line and pumps it to the fuel filter/ water separator where any sediment or water is filtered out. The check valves prevent fuel from flowing backward toward the tank (Figure 3-1).

Fuel leaves the fuel filter/water separator and travels to the injection pump, which pressurizes the fuel and directs the correct amount to each fuel injector. The fuel injectors spray fuel directly into the pre-combustion chambers. Any unused fuel is directed back to the fuel tank through the fuel return lines.



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AIR CLEANER ASSEMBLY AND DUST UNLOADER MAINTENANCE

Removal

NOTE: To remove dust unloader only, perform steps 1 and 2.

- 1. Remove four screws and dust unloader cover from support brackets (Figure 3-2).
- 2. Loosen clamp and remove dust unloader from air cleaner assembly.
- 3. Loosen clamp and disconnect elbow from engine side of air cleaner assembly.
- 4. Disconnect vent line from elbow.
- 5. Loosen clamp and remove weathercap from air intake duct.
- 6. Remove three capscrews and washers from air intake duct.
- 7. Loosen three strap clamps around air cleaner assembly.
- 8. Raise air intake duct from air intake support, loosen clamp, and remove air intake duct and gasket from elbow and air intake support. Discard gasket.
- 9. Remove air cleaner assembly from support brackets.
- 10. Remove clamp and elbow from air cleaner assembly.
- 11. Remove elbow, adapter, and tube from air cleaner assembly.
- 12. Remove hood seal from air intake support.
- 13. Remove seal from air intake support.

Cleaning and Inspection

NOTE: Clean all components, examine for wear or damage, and replace if necessary.

- 1. Inspect hood seal and air intake support seal for cracks or breaks (Figure 3-2).
- 2. Inspect elbow and adapter for damaged threads or cracks.
- 3. Inspect all clamps for rust.

- 1. Install tube, adapter, and elbow on air cleaner assembly (Figure 3-2).
- Install dust unloader on air cleaner assembly. Tighten clamp to 44-53 lb-in. (5-6 N•m).
- 3. Install elbow and clamp on air cleaner assembly. Do not tighten clamp.
- 4. Position air cleaner assembly into air intake support and align elbow to top of air intake support.
- 5. Pull air cleaner assembly back several inches and tighten clamp on elbow to 44-53 lb-in. (5-6 N•m).
- 6. Position air cleaner assembly and strap clamps on support brackets and rotate until elbow clears air intake support.
- 7. Install air intake duct on elbow with clamp. Align screw holes of air intake duct with holes of air intake support.
- Install air intake duct on air intake support with three screws and washers. Tighten clamp to 45-53 lb-in. (5-6 N•m).
- 9. Install air cleaner assembly on support brackets with three strap clamps.
- 10. Install gasket and use clamp to connect elbow to engine side of air cleaner assembly.
- 11. Connect vent line to elbow on air cleaner assembly.
- 12. Install weathercap on air intake duct and tighten clamp to 45-53 lb-in. (5-6 N•m).
- 13. Install dust unloader cover on support brackets with four screws.
- 14. Install hood seal on air intake support.







Figure 3-2: Air Cleaner Assembly and Dust Unloader



AIR CLEANER FILTER ELEMENT SERVICE

Removal

- 1. Remove ring clamp, cover, and gasket from air cleaner (Figure 3-3).
- 2. Remove nut and washer assembly and filter element from air cleaner stud.



Figure 3-3: Air Cleaner Filter Element

Inspection

NOTE: Clean all components, examine for wear or damage, and replace if necessary.

- 1. Inspect filter element for tears or contaminants (Figure 3-3).
- 2. Inspect gasket.

Emergency Cleaning

CAUTION: To avoid damage to filter element, do not strike ends on a hard surface.

Hold filter element so neither end faces the ground. Remove dust or sand by gently tapping around filter element (Figure 3-3).

Detergent Cleaning

Gently hand-wash filter element in warm water with nonsudsing detergent. Rinse with warm water, and allow to air dry (Figure 3-3).

Air Cleaning

Remove oily dirt and dust from filter element by directing flow of compressed air from inside to outside of filter element. Hold nozzle 6 in. (15 cm) from filter element, and blow away loosened dirt or dust (Figure 3-3).

Installation

 Install filter element on air cleaner stud with nut and washer assembly. Tighten nut and washer assembly to 18-35 lb-in. (2-4 N•m) (Figure 3-3).

NOTE: To avoid damage to hood, ensure ring clamp bolt is between the three and six o'clock positions.

2. Install gasket, cover, and ring clamp on air cleaner assembly. Tighten ring clamp bolt to 27-35 lb-in. (3-4 N•m).

AIR HORN REPLACEMENT

Removal

NOTE: To avoid engine contamination, cover opening of intake manifold.

1. Loosen clamp and remove air intake elbow from air horn (Figure 3-4).



Figure 3-4: Air Horn

- 2. Remove two screws, washers, and rubber washers from air horn and intake manifold. Discard rubber washers.
- 3. Loosen clamp and remove air horn from air horn support bracket.
- 4. Remove gasket from intake manifold. Discard gasket.

Installation

Install gasket on intake manifold (Figure 3-4).

5. Install clamp on air horn.



- Apply elastomeric sealing compound to air horn mounting screws, and install air horn on intake manifold with two rubber washers, washers, and screws. Tighten screws to 44 lb-in. (5 N•m).
- Connect air intake elbow to air horn. Tighten clamp to 44-53 lb-in. (5-6 N•m).
- 8. Install air horn clamp on air horn support bracket. Tighten clamp to 44 lb-in. (5 N•m).

AIR INTAKE ELBOW REPLACEMENT

Removal

Remove air intake elbow from air horn and air cleaner assembly (Figure 3-5).



Figure 3-5: Air Intake Cleaner Elbow

Installation

Install air intake elbow on air horn and air cleaner assembly. Tighten clamps to 44 lb-in. (5 N•m) (Figure 3-5).

AIR HORN SUPPORT BRACKET REPLACEMENT

Removal

- 1. Remove air horn.
- 2. Remove nut, lockwasher, two clamps, and stud from air horn support bracket and cylinder head. Discard lockwasher (Figure 3-6).
- 3. Remove capscrew and air horn support bracket from cylinder head.



Figure 3-6: Air Horn Support Bracket

- 1. Install air horn support bracket on cylinder head with capscrew and stud. Tighten capscrew and stud to 40 lb-ft (54 N•m) (Figure 3-6).
- 2. Install two clamps, lockwasher, and nut on stud.
- 3. Install air horn.

WEATHERCAP REPLACEMENT

Removal

Remove clamp and weathercap from air intake duct (Figure 3-7).





Installation

Install weathercap on air intake duct with clamp. Tighten clamp to 44-53 lb-in. (5-6 N•m) (Figure 3-7).

DRAINAGE BRACKET REPLACEMENT

Removal

- 1. Remove air cleaner assembly.
- 2. Remove three screws and drainage bracket from body (Figure 3-8).

Installation

- 1. Install drainage bracket on body with three screws (Figure 3-8).
- 2. Install air cleaner assembly.



Figure 3-8: Drainage Bracket

AIR INTAKE VENT LINE REPLACEMENT

Removal

Remove air intake vent line from tee fitting and air cleaner fitting (Figure 3-9) and (Figure 3-10).

AIR INTAKE VENT LINE



Figure 3-9: Air Intake Vent Line



Installation

Install air intake vent line on tee fitting and air cleaner fitting (Figure 3-9) and (Figure 3-10).



Figure 3-10: Air Cleaner Fitting

FUEL PUMP REPLACEMENT

Removal

- 1. Disconnect battery ground cable.
- 2. Disconnect connector from wiring harness (Figure 3-11).
- 3. Disconnect two hoses from fuel pump.
- 4. Remove clamp and pump from bracket.
- 5. Remove two adapters and O-rings from fuel pump. Discard O-rings.



- 1. Install two O-rings and adapters on fuel pump (Figure 3-11).
- 2. Install fuel pump on bracket with clamp.
- 3. Connect two hoses to fuel pump.
- 4. Connect connector to wiring harness.
- 5. Connect battery ground cable.
- 6. Start engine and check fuel pump and hoses for leaks.

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FUEL INJECTION PUMP BOOT REPLACEMENT

Removal

Remove clamp and injection pump boot from injection pump (Figure 3-12).



Figure 3-12: Fuel Injection Pump Boot

Installation

Install injection pump boot on injection pump with clamp (Figure 3-12).

FUEL TANK MAINTENANCE

Draining

- 1. Disconnect battery ground cable.
- 2. Remove fuel tank filler cap (Figure 3-13).
- 3. Remove fuel tank drainplug and drain fuel completely (Figure 3-14).

NOTE: Avoid overtightening drainplug. Sharp edge of drain hole may cut rubber drainplug.

4. Install and tighten drainplug until flush with bottom of hole.







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Removal

- 1. Remove rear propeller shaft (Section 5).
- 2. Disconnect vent line from fill tube (Figure 3-15).
- 3. Remove locknut, washer, capscrew, washer, and clamp securing vent line to body. Discard locknut.
- 4. Remove locknut, washer, capscrew, washer, and clamp securing fill tube to body. Discard locknut.
- 5. Remove fill tube hose from fill tube.
- 6. Remove two locknuts, washers, capscrews, and lower straps from fuel tank support straps. Discard locknuts (Figure 3-16).
- 7. Disconnect fuel supply and return lines from hoses.



Figure 3-16: Fuel Supply Lines

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- 9. Remove capscrew, clamp, and vent line from body (Figure 3-17).
- 10. Disconnect vent line from tee.



Figure 3-19: Vent Valve

11. Lower fuel tank and disconnect vent line from fuel tank fitting (Figure 3-18).





Disassembly

NOTE: Clean outside of fuel tank thoroughly before disassembling.

- 1. Disconnect fuel supply and return lines from fuel supply and return tubes (Figure 3-20).
- 2. Remove capscrew, clamp, fuel supply and return lines, and shield from fuel tank.
- 3. Remove two locknuts, washers, clamps, and jumper harness from access cover. Discard locknuts.
- 4. Disconnect jumper harness leads from fuel level sender.
- 5. Remove ten locknuts, washers, access cover, gasket, and retainer from fuel tank. Discard locknuts and gasket.
- 6. Remove fuel strainer from fuel supply tube.
- 7. Mark positions of fuel supply and return tubes, and remove tubes from access cover.
- 8. Remove vent valve and grommet from access cover.
- 9. Remove vent line from tee.
- 10. Remove fuel level sending unit from access cover.
- 11. Remove fill tube hose from fuel tank.

Cleaning and Inspection

NOTE: Clean all components, examine for wear or damage, and replace if necessary.

- 1. Clean the following parts with solvent: (Figure 3-20)
 - Access cover
 - Fuel supply line
 - Fuel return line
 - Fuel supply tube
 - Fuel return tube
 - Inside of fuel tank
- 2. Inspect the following parts for cracks, wear, or breaks:
 - Access cover
 - Fuel supply line
 - Fuel return line
 - Fuel supply tube
 - Fuel return tube
 - Strainer
 - Tee
 - Fitting
 - Vent valve
 - Grommet

Assembly

NOTE: Use fittings from old fuel tank if installing new fuel tank. Apply pipe sealant to all vent line and fuel line connector threads.

- 1. Install vent line on tee (Figure 3-20).
- 2. Install fill tube hose on fuel tank.
- 3. Install and align fuel supply and return tubes on access cover.
- 4. Install grommet and vent valve on access cover.
- 5. Install fuel strainer on fuel supply tube.
- Apply adhesive to locknut threads and install retainer, gasket, and access cover on fuel tank with ten washers and locknuts. Tighten locknuts to 71 lb-in. (8 N•m).
- 7. Connect jumper harness leads to fuel level sender.
- Apply adhesive to locknut threads, and install jumper harness on access cover with two clamps, washers, and locknuts. Tighten locknuts to 71 lb-in. (8 N•m).
- 9. Connect fuel supply and return lines to supply and return tubes.
- 10. Install shield and supply and return lines on fuel tank with clamp and capscrew.





Figure 3-20: Fuel Tank



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- 1. Position fuel tank under vehicle.
- 2. Connect jumper harness leads to body wiring harness (Figure 3-22).
- 3. Insert jumper harness into clamp on frame. Bend clamp close around jumper harness.
- 4. Install vent line on vent valve and fuel tank with clamp, washer, and locknut. Tighten locknut to 6 lb-ft (8 N•m).
- Connect vent line to fuel tank fitting (Figure 3-21). Install capscrew, washer, locknut, and rear strap on strap bracket. Tighten locknut to 23-27 lb-in. (2.6-3.1 N•m) (Figure 3-23).
- 6. Raise fuel tank, and install fuel tank support straps on lower straps with two capscrews, washers, and locknuts. Do not tighten locknuts.
- 7. Connect vent line to tee (Figure 3-24).
- 8. Secure vent line to body with clamp and capscrew.
- 9. Connect fuel supply and return lines to hoses (Figure 3-23).



Figure 3-21: Vent Line and Fuel Tank Fitting





11. Connect vent line to errow on hin tube (Figure



Figure 3-24: Vent Line Tee Connection

NOTE: Tighten the fuel tank retainer straps to 23-27 lbin. (2.6-3.1 N•m). There should not be metal-to-metal contact. If there is contact (strap-to-strap), replace with new straps.

10. Tighten locknuts securing upper and lower support straps to 27 lb-in. (3 N•m) (Figure 3-23).



Figure 3-25: Fuel Fill Tube and Hose

- 12. Install vent line on body with clamp, washer, capscrew, washer, and locknut.
- 13. Install fill tube into hose.





- 14. Install fill tube on body with clamp, washer, capscrew, washer, and locknut. Tighten locknut to 6 lb-ft (8 N•m).
- 15. Install rear propeller shaft (Section 5).
- 16. Connect battery ground cable.
- 17. Fill fuel tank and check for leaks.

CHECK VALVE REPLACEMENT

Removal

CAUTION: Cover or plug all openings immediately after disconnecting to prevent system contamination.

NOTE: Clean all components before disconnecting.

There are three fuel line check valves: fuel supply, and one fuel return at the fuel tank, and fuel supply at the fuel filter. Perform steps 1-3 for the fuel tank check valves, and steps 4-8 for the fuel filter check valve.

- 1. Loosen eight clamps.
- 2. Remove four hoses from fuel lines (Figure 3-26).
- 3. Remove four hose barbs and hoses from two check valves and lines. Discard hose barbs and hoses.
- 4. Remove two sections of spiral wrap (Figure 3-27).
- 5. Loosen four clamps.
- 6. Remove hose from fuel pump.
- 7. Remove hose from fuel filter supply line.
- 8. Remove two hose barbs and hoses from check valve. Discard hose barbs and hoses.





Installation

NOTE: Perform steps 1-3 for fuel tank check valves and steps 4-6 for fuel filter check valve.

- 1. Install four new hose barbs on two check valves (Figure 3-26).
- 2. Install four new hoses on hose barbs.
- Install four hoses on fuel lines with clamps. Tighten clamps to 10-20 lb-in. (1-2 N•m).
- Install two new hoses on hose barb with clamps (Figure 3-27).
- 5. Install two hoses on fuel pump and fuel filter with clamps.
- 6. Install spiral wrap on two hoses.
- 7.



Figure 3-27: Fuel Lines and Hose Barbs

FUEL TANK SUPPLY AND RETURN LINES REPLACEMENT

Removal

- 1. Remove right engine splash shield.
- 2. Loosen clamps, and disconnect fuel tank return and supply lines from hoses and hose barbs (Figure 3-28) and (Figure 3-29).



Figure 3-28: Fuel Lines and Front Body Bracket

- 3. Remove two locknuts, capscrews, washers, clamps, and return and supply lines from front and rear body brackets. Discard locknuts (Figure 3-28) and (Figure 3-29).
- 4. Remove return and supply lines and three clips from vehicle (Figure 3-29).

- 1. Install fuel tank return and supply lines on front and rear body brackets with two clamps, washers, capscrews, and locknuts (Figure 3-28) and (Figure 3-29).
- 2. Connect return and supply line hoses to hose barbs.
- 3. Secure return and supply lines with three clips (Figure 3-29).
- 4. Install right engine splash shield.
- 5. Fill fuel tank and check for leaks.





Figure 3-29: Fuel Lines and Rear Body Bracket



FUEL TANK VENT LINE AND FILTER REPLACEMENT

Removal

NOTE: To remove fuel tank vent line filter only, perform steps 6 and 7.

- 1. Remove fuel tank.
- 2. Remove clip and fuel tank vent line hose from vent line (Figure 3-30).



Figure 3-30: Fuel Tank Vent Lines

- 3. Remove two capscrews, four clamps, and two vent lines from brackets.
- 4. Remove tiedown strap securing fuel tank vent line and vent line to fuel lines. Discard tiedown strap.
- 5. Disconnect fuel tank vent line from elbow (Figure 3-31).



Figure 3-31: Fuel Tank Vent Line Filter

- 6. Remove fuel tank vent line from vent line filter and elbow.
- 7. Remove locknut, washer, capscrew, clamp, and vent line filter from body bracket. Discard locknut.

Installation

NOTE: To install fuel tank vent line filter only, perform steps 1 and 2.

- 1. Install vent line filter on body bracket with clamp, capscrew, washer, and locknut (Figure 3-31).
- 2. Install fuel tank vent line on vent line filter and elbow.
- 3. Connect fuel tank vent line to elbow.
- 4. Secure fuel tank vent line and vent line to fuel lines with tiedown strap (Figure 3-30).
- 5. Install two vent lines on brackets with four clamps and two capscrews.
- 6. Secure fuel tank vent line and vent line with clip.
- 7. Install fuel tank.

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FUEL TANK FILLER CAP AND SPOUT MAINTENANCE

Removal

- 1. Drain fuel tank.
- 2. Detach filler cap chain clip and remove filler cap from fill tube (Figure 3-32).
- 3. Disconnect vent line from fitting.
- 4. Remove three locknuts, six washers, and three capscrews securing fill tube mounting ring to body. Discard locknuts.
- 5. Remove locknut, two washers, capscrew, clamp, and fill tube from body. Discard locknut.
- 6. Remove fill tube from hose.
- 7. Remove fill tube mounting ring.
- 8. Remove fitting from fill tube.
- 9. Using handle, remove screen from fill tube.

FILLER CAP HAIN CLIP BODY FITTING FITTING VENT LINE HOSE FILL TUBE FILL TUBE FILL TUBE

Figure 3-32: Fuel Tank Filler Cap and Spout

Cleaning and Inspection

NOTE: Clean all components, examine for wear or damage, and replace if necessary.

Inspect screen for damage, debris, or blockage (Figure 3-32).

Installation

- 1. Apply teflon sealing compound to fitting, and install fitting on fill tube (Figure 3-32).
- 2. Using handle, install screen into fill tube.
- 3. Place fill tube and mounting ring in approximate vehicle location.
- 4. Install fill tube on hose.
- 5. Secure fill tube mounting ring to body with three washers, capscrews, washers, and locknuts.
- 6. Install fill tube on body with clamp, washer, capscrew, washer, and locknut. Tighten locknut to 6 lb-ft (8 N•m).
- 7. Apply teflon sealing compound to fitting, and connect vent line to fitting.
- 8. Install filler cap chain clip on fill tube, and install filler cap on fill tube.
- 9. Fill fuel tank and check fill tube for fuel leaks.

Fuel Tank Fill Tube Vent Line Replacement

Removal

- 1. Drain fuel tank.
- 2. Remove rear propeller shaft.
- 3. Disconnect vent line from fuel fill tube fitting (Figure 3-33).



Figure 3-33: Fuel fill tube Fitting

- 4. Remove locknut, washer, capscrew, washer, clamp, and vent line from body. Discard locknut.
- 5. Disconnect vent lines from tee (Figure 3-34).





Figure 3-34: Vent Lines and Tee

- 6. Remove capscrew, clamp, and vent line from body.
- 7. Loosen two fuel tank strap retaining nuts to allow access to fuel tank elbow (Figure 3-33) and (Figure 3-35).
- 8. Disconnect vent line from fuel tank elbow, cut vent line, and remove from crossmember.



Figure 3-35: Fuel Tank Elbow

Installation

NOTE: Apply elastomeric sealing compound to all vent line connector threads.

- 1. Install vent line on fuel tank elbow (Figure 3-35).
- 2. Install vent line on body with clamp and capscrew.
- 3. Route vent line through crossmember, and connect to tee.
- 4. Connect vent line to tee.
- Install vent line on body with clamp, washer, capscrew, washer, and locknut. Tighten locknut to 6 lb-ft (8 N•m) (Figure 3-33).
- 6. Connect vent line to fill tube fitting.
- 7. Install rear propeller shaft (Section 5).
- 8. Fill fuel tank and check for leaks.

Fill Tube Hose Replacement

Removal

- 1. Drain fuel tank.
- 2. Remove fill tube hose from fuel tank and fill tube (Figure 3-36).

- 1. Install fill tube hose on fuel tank and fill tube (Figure 3-36).
- 2. Fill fuel tank and check for leaks.



Figure 3-36: Fill Tube Hose



FUEL TANK HANGERS REPLACEMENT

Removal

- 1. Remove fuel tank.
- 2. Remove two locknuts, washers, screws, and rear hangers from supports. Discard locknuts (Figure 3-37).
- 3. Turn two front hangers one-quarter turn and remove from supports.



Figure 3-37: Fuel Tank Hangers

Installation

NOTE: Be sure the front hangers are placed in the detents of the supports to assure fuel tank cannot shift inward and make contact with the rear propeller shaft.

- 1. Insert two tees of front hangers into slots of supports and turn one quarter turn to secure in place (Figure 3-37).
- 2. Install two rear hangers on supports with screws, washers, and locknuts. Tighten locknuts to 37 lb-ft (50 N•m).
- 3. Install fuel tank.

FUEL FILTER MAINTENANCE

Removal

- 1. Disconnect fuel inlet and outlet hoses from fuel filter (Figure 3-40).
- 2. Disconnect drain hose from fuel filter.
- 3. Disconnect two connectors from wiring harness.
- 4. Remove two capscrews, washers, and fuel filter from bracket (Figure 3-38).



Figure 3-38: Fuel Filter Components





Disassembly

- 1. Remove retaining nut and filter element from filter body assembly. Drain fuel from filter body assembly. Discard filter element (Figure 3-38).
- 2. Remove two capscrews, connector, and O-ring from filter body assembly. Discard O-ring.
- 3. Loosen nut and remove fuel heater, O-ring, spring, and screw from filter body assembly .
- 4. Discard O-ring and screen.

Assembly

- 1. Install screen, spring, O-ring, and fuel heater on filter body assembly. Tighten nut (Figure 3-38).
- 2. Install O-ring and connector on filter body assembly with two capscrews.
- 3. Install filter element on filter body assembly with retaining nut.

Installation

- 1. Install fuel filter on bracket with two washers and capscrews (Figure 3-39).
- 2. Connect two connectors to wiring harness (Figure 3-39).
- 3. Connect drain hose to fuel filter.
- 4. Connect inlet and outlet hoses to fuel filter.



Figure 3-39: Fuel Filter Connections

Bleeding

- 1. Loosen fuel filter air vent screw one-half turn (Figure 3-38).
- 2. Disconnect run solenoid lead (Figure 3-40).



Figure 3-40: Run Solenoid Lead

CAUTION: To avoid starter damage, do not operate starter continuously for more than 20 seconds. Wait 10 to 15 seconds between periods of operation.

- 3. Crank engine until fuel exits from air vent (Figure 3-39).
- 4. Tighten air vent screw.
- 5. Connect run solenoid lead (Figure 3-40).
- 6. Start engine and check for fuel leaks.



FUEL FILTER ELEMENT REPLACEMENT

Removal

- 1. Loosen fuel filler cap to release pressure from fuel tank
- 2. Remove retaining nut and filter element from filter body assembly. Use oil filter-type strap wrench if necessary. Discard filter element (Figure 3-41).

NOTE: It is not necessary to drain the fuel from the filter body assembly to change the filter element. Fuel will remain in the filter body assembly cavity.



Figure 3-41: Fuel Filter Element

Installation

NOTE: Be sure filter element mating surface in filter body assembly is clean before installing filter element.

- 1. Align widest key of filter element with widest key slot of filter body assembly and install filter element in filter body assembly (Figure 3-41).
- 2. Install retaining nut on filter body assembly. Tighten retaining nut to 115-120 lb-in. (13-14 N•m).
- 3. Bleed air from fuel.



FUEL FILTER DRAIN HOSE AND VALVE REPLACEMENT

Removal

NOTE: To remove fuel filter drain valve only, perform steps 3 and 4.

- 1. Disconnect fuel filter drain hose from fuel filter (Figure 3-42).
- 2. Remove two tiedown straps and drain hose from transmission oil cooler lines.
- 3. Disconnect drain hose from drain valve.
- 4. Remove nut and drain valve from body

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Installation

NOTE: To install fuel filter drain valve only, perform steps 1 and 2.

- 1. Install drain valve on body with nut (Figure 3-42).
- 2. Connect drain hose to drain valve.
- 3. Connect drain hose to fuel filter.
- 4. Secure drain hose to transmission oil cooler lines with two tiedown straps.
- 5. Start engine and check for fuel leaks.



Figure 3-42: Fuel Filter Drain Hose And Valve

FUEL INJECTION RETURN HOSES REPLACEMENT

Removal

- 1. Remove engine access covers.
- 2. Remove air horn.
- Remove fuel drain-back hose from injection pump and 3. fuel drain-back tube (Figure 3-43).
- Remove tube-to-nozzle hose from fuel drain-back tube 4. and nozzle.
- Remove nozzle-to-nozzle hose from two nozzles 5. (Figure 3-44).
- 6. Remove nozzle cap from rear nozzle nipple.

- Install cap on rear nozzle nipple (Figure 3-44). 1.
- Install nozzle-to-nozzle hose on two nozzles. 2.
- Install tube-to-nozzle hose on fuel drain-back tube and 3. nozzle (Figure 3-43).
- Install fuel drain-back hose on fuel drain-back tube and in-4. jection pump.
- Install air horn. 5.
- Install engine access covers. 6.
- Start engine and check for fuel leaks. 7.







Figure 3-44: Fuel Injection Return Hoses





Removal

- 1. Remove air horn.
- 2. Remove nut, lockwasher, clamp, and engine wiring harness from stud. Discard lockwasher (Figure 3-45).
- 3. Remove stud, clamp, fuel supply line, clamp, and fuel drain-back tube from cylinder head.
- 4. Disconnect two hoses, fuel return hose, and fuel drainback hose from fuel drain-back tube.
- 5. Remove nut, washer, clamp, and fuel drain- back tube from valve cover stud.
- 6. Remove capscrew, washer, clamp, and fuel drain-back tube from front engine cover.

- 1. Position fuel drain-back tube in front of injection pump (Figure 3-45).
- 2. Connect fuel return hose, two hoses, and fuel drain-back hose to fuel drain-back tube.
- Install fuel drain-back tube on valve cover stud with clamp, washer, and nut. Tighten nut to 13-20 lb-ft (18-27 N•m).
- Install fuel drain-back tube on front engine cover with clamp, washer, and capscrew. Tighten capscrew to 40 lb-ft (54 N•m).
- 5. Install fuel drain-back tube, clamp, fuel supply line, clamp, and stud on cylinder head.
- 6. Install engine wiring harness on stud with clamp, lock-washer, and nut.
- 7. Install air horn.
- 8. Start engine and check for fuel leaks.



Figure 3-45: Fuel Drain-Back Tube

GLOW PLUG REPLACEMENT

Removal

- 1. Disconnect battery ground cable.
- 2. Disconnect connector from glow plug (Figure 3-46).
- 3. Remove glow plug from cylinder head.



Figure 3-46: Glow Plug

Installation

- Install glow plug on cylinder head. Tighten glow plug to 8-12 lb-ft (11-16 N•m) (Figure 3-46).
- 2. Connect connector to glow plug.
- 3. Connect battery ground cable.

FUEL INJECTION LINES BRACKET REPLACEMENT

Right Fuel Injection Lines Bracket Replacement

Removal

- 1. Remove engine access covers.
- 2. Remove air horn.
- 3. Remove two screw-assembled washers and three clamps from bracket (Figure 3-47).
- 4. Remove two nuts, washers, and bracket from valve cover studs.



- 1. Install bracket on valve cover studs with two washers and nuts. Tighten nuts to 13-20 lb-ft (18-27 N•m) (Figure 3-47).
- Install three clamps on bracket with two screw-assembled washers. Tighten screw-assembled washers to 3-4 lb-ft (4-5 N•m).
- 3. Install air horn.
- 4. Install engine access covers.



Left Fuel Injection Lines Bracket Replacement

Removal

- 1. Remove engine access covers.
- 2. Remove two screw-assembled washers and clamps from bracket (Figure 3-48).



3. Remove two screw-assembled washers and oil dipstick tube from bracket (Figure 3-49).



Figure 3-49: Oil Dipstick Tube and Bracket

4. Remove two nuts, washers, and bracket from valve cover studs (Figure 3-48).

- 1. Install bracket on valve cover studs with two washers and nuts. Tighten nuts to 13-20 lb-ft (18-27 N•m) (Figure 3-48).
- 2. Install oil dipstick tube on bracket with two screwassembled washers. Tighten screw-assembled washers to 3-4 lb-ft (4-5 N•m) (Figure 3-49).
- Install clamps on bracket with two screw-assembled washers. Tighten screw-assembled washers to 3-4 lb-ft (4-5 N•m) (Figure 3-48).
- 4. Install engine access covers.



Removal

1. Disconnect battery ground cables.

NOTE: If removing rear injection nozzle, perform steps 2 and 3.

- 2. Remove engine access covers.
- 3. Remove fuel return hose and cap from rear fuel injection nozzle (Figure 3-50).
- 4. Disconnect fuel return hoses from fuel injection nozzles (Figure 3-51).
- 5. Remove screw-assembled washer, clamp, and fuel injection lines from support bracket.
- 6. Disconnect fuel injection line nuts from fuel injection nozzles.
- 7. Using injection nozzle socket, remove fuel injection nozzle and gasket from cylinder head. Discard gasket.

Installation

NOTE: Apply antiseize compound to threads of injection nozzle and fuel return hose. Tighten rear fuel injection nozzles in accordance with step 2. Tighten rear fuel injection line nuts in accordance with step 4.

 Install gasket and fuel injection nozzle into cylinder head. Using injection nozzle socket, tighten nozzle to 44-60 lb-ft (60-81 N•m) (Figure 3-51).



Figure 3-50: Rear Fuel Injection Nozzle

NOTE: If installing rear injection nozzles, perform steps 2, 6, and 11.

- Using injection nozzle socket and 7/8-in. crowfoot wrench, tighten fuel injection nozzle to 44-60 lb-ft (60-81 N•m).
- 3. Install two fuel injection line nuts on fuel injection nozzles.
- 4. Using 19 mm crowfoot wrench, tighten fuel injection line nuts to 20 lb-ft (27 N•m).
- 5. Install clamp and fuel injection lines on support bracket with screw-assembled washer.
- 6. Install fuel return hose and cap on rear fuel injection nozzle (Figure 3-50).
- Connect two fuel return hoses to fuel injection nozzles (Figure 3-51).
- 8. Bleed lines.
- 9. Connect battery ground cable.
- 10. Start engine and check for fuel leaks.
- 11. Install engine access covers.



Injection Nozzles





FUEL INJECTION LINES MAINTENANCE

Removal

- 1. Remove intake manifold.
- 2. Remove fuel injection pump boot.
- 3. Disconnect eight fuel injection lines from fuel injection nozzles (Figure 3-52).



Figure 3-52: Fuel Injection lines

4. Remove screw-assembled washer, clamp, and fuel injection lines from support bracket.

NOTE: Tag fuel injection lines by cylinder number.

- 5. Disconnect fuel injection lines from fuel injection pump (Figure 3-52).
- 6. Remove clamp and two grommets from fuel injection lines.

Cleaning and Inspection

NOTE: Clean all components, examine for wear or damage, and replace if necessary.

- 1. Inspect fuel injection lines for cracks, bends, or damage (Figure 3-52).
- 2. Inspect grommets.

Installation

- 1. Install two grommets and clamp on fuel injection lines (Figure 3-52).
- 2. Install eight fuel injection lines on fuel injection pump and fuel injection nozzles (Figure 3-52).



Figure 3-53: Fuel Injection Lines Hookup

- Using 16 mm crowfoot, tighten fuel injection line nuts to 20 lb-ft (27 N•m) (Figure 3-52).
- Install clamp and fuel injection lines on support bracket with screw-assembled washer. Tighten screw-assembled washer to 3-4 lb-ft (4-5 N•m).

Bleeding

- 1. Loosen eight fuel injection line nuts at injection nozzles (Figure 3-53).
- 2. Disconnect run solenoid lead (Figure 3-52).

CAUTION: To avoid starter damage, do not operate starter continuously for more than 20 seconds. Wait 10 to 15 seconds between periods of operation.

- 3. Crank engine until fuel exits from all fuel injection lines.
- Using 19 mm crowfoot, tighten fuel injection line nuts to 20 lb-ft (27 N•m).
- 5. Connect run solenoid lead.
- 6. Install fuel injection pump boot.
- 7. Install intake manifold (Section 2).
- 8. Start engine and check for fuel leaks.



DIESEL FUEL INJECTION PUMP

Removal

- 1. Remove engine oil filler neck and cap.
- 2. Remove air horn and intake hoses at intake manifold.
- 3. Drain engine coolant.
- 4. Disconnect fuel lines at injectors. Then disconnect fuel line clamps and brackets from intake manifold and valve covers.
- 5. Remove intake manifold and gaskets. Discard gaskets as they are not reusable. Clean manifold and cylinder gasket surfaces
- 6. Remove clip attaching accelerator cable to pump lever (Figure 3-54).
- 7. Disconnect wires at kickdown switch, run solenoid, and cold advance solenoid (Figure 3-55). Then remove throt-tle position sensor.
- 8. Disconnect drainback and inlet hoses at injection pump (Figure 3-55).
- 9. Disconnect injector fuel lines at pump. Tag lines for assembly reference if desired.
- 10. Disconnect accelerator cable at pump throttle shaft.
- 11. Remove throttle return spring from throttle shaft lever.

12. Remove bolts attaching injection pump driven gear to pump. Remove bolts through oil filler neck opening in adapter plate. Rotate crankshaft to bring bolts into position for removal.



Figure 3-54: Cable Clip

 Remove pump attaching nuts and washers. Then remove pump by sliding it off front cover studs (Figure 3-56). Remove pump gasket afterward.



Figure 3-55: Fuel Injection Pump Connector





- 1. Install pump gasket on front cover studs. Then slide pump onto studs.
- 2. Align pin on pump shaft with slotted hole in pump driven gear.
- 3. Align timing marks on injection pump and front cover.
- 4. Install injection pump retaining washers and nuts. Tighten nuts to 20 lb-ft (25 N•m) torque. Be sure timing mark alignment is not disturbed as nuts are tightened.
- 5. Verify that timing marks on pump drive and driven gears are aligned. Also be sure slot at rear of driven gear is at 6 O'clock position (Figure 3-57).
- 6. Align pump driven gear and install gear attaching bolts. Tighten bolts to 17 lb-ft (23 N•m) torque.

- 7. Install throttle position sensor and connect solenoid wires.
- 8. Connect fuel drainback and inlet lines to pump.
- Connect fuel injector lines to pump and injectors. Tighten line fittings to 19 lb-ft (26 N•m) torque.
- 10. Install throttle return spring and connect accelerator cable to throttle lever.
- 11. Coat new intake manifold gaskets with Permatex High Tack and position gaskets on cylinder heads. Allow gasket material to set up for a few minutes before proceeding.
- 12. Install intake manifold. Tighten manifold fasteners to 31 lb-ft (42 N•m) torque.



Figure 3-56: Injection Pump Remove/Installation

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- 13. Install injector line clamps and clamp nuts. Tighten nuts to 19 lb-ft (25 N•m) torque.
- 14. Install air horn and air intake hoses.
- 15. Install oil filler neck and cap.
- 16. Fill and bleed cooling system.
- 17. Start engine and check operation. Bleed injectors if necessary.



Figure 3-57: Checking Injection Pump Driven Gear Slot Position

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FUEL INJECTION PUMP COVER MAINTENANCE

Removal

- 1. Disconnect battery ground cable.
- 2. Disconnect fuel drain-back hose from fuel injection pump (Figure 3-58).
- 3. Disconnect run and cold-advance solenoid leads from fuel injection pump.

CAUTION: Clean fuel injection pump body thoroughly before removing attaching components to prevent pump contamination. Keep work area clean, well-ventilated, and free from blowing dirt or dust.



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Figure 3-58: Fuel Drain-Back Hose Connection at Pump

 Remove three screws, lockwashers, washers, cover, and gasket from pump housing. Disconnect ground strap. Discard lockwashers and gasket (Figure 3-59).

NOTE: Perform step 5 only if cover is being replaced.

5. Remove check valve and O-ring from cover. Discard O-ring.

Cleaning and Inspection

NOTE: Clean all components, examine for wear or damage, and replace if necessary.

Inspect check valve (Figure 3-59).



Figure 3-59: Fuel Injection Pump Housing

Installation

NOTE: Perform step 1 only if cover was replaced.

- 1. Install O-ring and check valve in cover (Figure 3-59).
- 2. Install gasket and cover on fuel injection pump housing with three washers, lockwashers, and screws, and secure ground strap. Tighten screws to 35-44 lb-in. (4-5 N•m).
- 3. Connect fuel drain-back hose to fuel injection pump (Figure 3-58).
- 4. Connect battery ground cable.

CAUTION: If no clicking noise is present, the linkage may be jammed in the wide-open throttle position. Engine damage may result.

- Place keyed ignition in RUN position. Listen for a clicking noise when connecting and disconnecting run solenoid lead to fuel injection pump. If no clicking noise is present, remove and reinstall cover. If clicking noise is present, connect run and cold-advance solenoid leads to fuel injection pump.
- 6. Start engine and check for fuel leaks.

FUEL INJECTION PUMP RUN SOLENOID REPLACEMENT

Removal

NOTE: Keep work area clean, well-ventilated, and free from blowing dirt or dust.

- 1. Remove fuel injection pump cover (Figure 3-60).
- 2. Remove two locknuts, ground strap, terminal, two lockwashers, nuts, lockwashers, washers, and seals from two run solenoid studs. Discard locknuts and lockwashers.
- 3. Remove run solenoid from injection pump cover.



Figure 3-60: Fuel Injection Pump Run Solenoid

Installation

- 1. Install run solenoid in injection pump cover (Figure 3-60).
- Secure run solenoid to injection pump cover with two seals, washers, lockwashers, nuts, lockwashers, terminal, ground strap, and two locknuts. Tighten locknuts to 35 lbin. (4 N•m).
- 3. Install fuel injection pump cover.

FUEL INJECTION PUMP COLD-ADVANCE SOLENOID REPLACEMENT

Removal

NOTE: Keep work area clean, well-ventilated, and free from blowing dirt or dust.

- 1. Remove fuel injection pump run solenoid.
- 2. Remove fuel return fitting and O-ring from injection pump cover. Discard O-ring (Figure 3-61).
- 3. Remove locknut, terminal, lockwasher, nut, lockwasher, washer, and seal from cold-advance solenoid stud. Discard lockwasher, locknut, and seal.
- 4. Remove cold-advance solenoid from injection pump cover.

- Install cold-advance solenoid in injection pump cover (Figure 3-61).
- 2. Secure cold-advance solenoid to injection pump cover with seal, washer, lockwasher, nut, lockwasher, terminal, and locknut. Tighten locknut to 35 lb-in. (4 N•m).
- 3. Install O-ring and fuel return fitting in injection pump cover.
- 4. Install fuel injection pump run solenoid.









ENGINE IDLE SPEED ADJUSTMENT

Adjustment

Engine idle speed should be set to 625-675 rpm. To adjust idle speed, turn idle speed adjusting screw on throttle shaft lever (Figure 3-62). Turn adjusting screw clockwise to increase rpm, or counterclockwise to decrease rpm.



Figure 3-62: Idle Speed Adjusting Screw

FAST IDLE SOLENOID AND BRACKET REPLACEMENT

Removal

- 1. Disconnect battery ground cable.
- 2. Disconnect lead from top of fast idle solenoid (Figure 3-63).
- 3. Remove two capscrews, washers, solenoid, and bracket from accelerator cable bracket.

- 1. Install fast idle solenoid and bracket on accelerator cable bracket with two washers and capscrews (Figure 3-63).
- 2. Connect fast idle solenoid lead to top of solenoid.
- 3. Connect battery ground cable.





Figure 3-63: Fast Idle Solenoid and Bracket



ACCELERATOR PEDAL REPLACEMENT

Removal

 Remove cotter pin, washer, pin, accelerator pedal, and spring from accelerator rod. Discard cotter pin (Figure 3-64).

ACCELERATOR PEDAL ASSEMBLY REPLACEMENT

- 1. Disconnect the driver door check strap.
- 2. Remove the driver seat from the vehicle.
- 3. Remove the steering column closeout panel.
- 4. Disconnect the accelerator cable at the pedal connecting arm (Figure 3-65).





- 5. On models with CTIS, remove the CTI control knob.
- 6. Remove the parking brake and shift control panel. Move the parking brake lever and shift levers into an upright (vertical) position to allow panel removal.
- 7. Remove the right hand, inner front kick panel and seat belt latch.
- 8. Remove the bolts attaching the bellcrank pivot to the dash panel. On models where the bolts are secured by nuts, have a helper assist in bolt and nut removal. The nuts are accessible from under the vehicle.
- 9. Work the pedal rod and connecting arm through the hole in the dash and remove the pedal assembly from the vehicle.
- 10. Transfer the pedal, spring and pin to the replacement assembly.





- 11. Install the replacement accelerator pedal assembly. Tighten the bellcrank bolts to 10 lb-ft (14 N•m) torque.
- 12. Connect the accelerator cable to the pedal connecting arm with a new cotter pin.
- 13. Install the inner kick panel and seat belt latch.
- 14. Install the CTIS control knob, if equipped.
- 15. Install the parking brake and shift control panel.
- 16. Install the steering column closeout panel.
- 17. Install the driver seat.
- 18. Connect the driver door check strap.

Accelerator Cable Adjustment

- 1. Loosen two accelerator cable adjusting nuts on engine bracket (Figure 3-66).
- 2. Depress accelerator pedal, and hold throttle shaft lever in full throttle position.
- 3. Adjust accelerator cable adjusting nuts so cable end holds throttle shaft lever in full throttle position. Tighten adjusting nuts.
- 4. Release accelerator pedal. Ensure throttle shaft lever returns to idle position.
- 5. Install engine access covers.
- 6. Start engine and check for proper accelerator operation.



Figure 3-66: Throttle Shaft Lever

ACCELERATOR CABLE MOUNTING BRACKET MAINTENANCE

Removal

1. Loosen two adjusting nuts and disconnect accelerator cable from engine bracket (Figure 3-67).



Figure 3-67: Accelerator Cable Mounting Bracket

- 2. Disconnect throttle return spring from engine bracket.
- 3. Remove cable clip and disconnect accelerator cable from throttle shaft.
- 4. Remove nut, washer, two capscrews, and bracket from fuel injection pump and stud (Figure 3-68).

Cleaning and Inspection

NOTE: Clean all components, examine for wear or damage, and replace if necessary.

Inspect throttle return spring (Figure 3-67).





Figure 3-68: Fuel Injection Pump And Bracket

- Install bracket on fuel injection pump and stud with two capscrews, washer, and nut. Tighten capscrews to 13 lb-ft (18 N•m) (Figure 3-68).
- 2. Position throttle shaft lever to full throttle position. Install accelerator cable on throttle shaft with cable clip (Figure 3-67).

3. Connect throttle return spring to engine bracket.

- 4. Install accelerator cable on engine bracket and tighten two adjusting nuts.
- 5. Adjust accelerator linkage.



FUEL SYSTEM CLEANING

Diesel Engine Fuel System Contamination

General

Diesel fuel systems are susceptible to fungi and other microorganism infestation when water is present. These fungi can grow into long strings or large globules anywhere in the fuel system. Due to the amount of water, the most prevalent location to find these fungi is in the fuel tank.

The growths appear slimy and may be black, green, or brown. These are introduced through refueling with an unfiltered or aged fuel source.

Fungi feed on the fuel and need only trace amounts of minerals and water. As they grow and multiply, they change fuel into water, sludge, acids, and products of metabolism.

The most common symptom is a loss of performance due to fuel filter clogging. Infestation can also show up as corrosion of metal parts such as injectors, fuel pumps, and steel lines.

Warning: To avoid personal injury do not come into physical contact with biocide agents, cleaners, or additives used to remove fungi or micro-organisms.

If fungi have caused fuel system problems, sterilize the system with a diesel fuel system biocide or cleaning agent. Follow manufacturer's instructions. Do not overdose the system.

Use of biocides while operating under heavy loads such as towing a trailer is not recommended. Such use is permissible, but no additional biocide should be used when refueling during such operations.

Contaminations that are severe or do not respond to biocides may require disassembly and steam-cleaning.

WARNING: Never drain or store diesel fuel in an open container due to the possibility of a fire or explosion.

Water Contamination

- 1. Disconnect battery to prevent accidental spark or prevent an attempt to start vehicle.
- 2. Remove fuel cap from filler tube.
- 3. Remove fuel tank drainplug, and drain fuel into appropriate container (Figure 3-69).



Figure 3-69: Fuel Tank

- 4. After fuel has drained, replace drainplug and tighten. Do not overtighten plug, as tank opening edges are sharp enough to damage drainplug if overtightened.
- 5. Remove fuel return line at engine and route into appropriate container (Figure 3-70).
- 6. Reconnect battery.
- 7. Add fresh fuel to tank.
- 8. Energize fuel pump by jumping oil pressure switch connector to flush fuel from filter and injection pump.
- 9. Allow fuel to flush for two minutes or until fuel appears clean and clear.
- 10. Remove jumper and reconnect oil pressure switch connection. Reconnect fuel return line.
- 11. Start engine and allow to idle for 10-15 minutes to bleed any air or water pockets from system.
- 12. Test drive vehicle to confirm proper performance.
- 13. Dispose of contaminated fuel properly.







Removal of Gasoline Contamination

Vehicle Runs

- 1. Follow procedure for draining tank detailed in Water Contamination.
- 2. Refill with fresh fuel and start engine. Allow to run at idle speed for 10-15 minutes to eliminate fuel in fuel filter and injection pump.

Vehicle Will Not Run

Completely drain and flush total system as detailed in Water Contamination.

System Cleaning and Flushing for Other Substances

- 1. Drain fuel tank as outlined for Water Contamination. Determine nature of contaminant if possible. If contaminant is soluble in solvents compatible with diesel fuel, flush with solvent, change fuel filter and flush with clean fuel to dilute solvent. If contaminant is not soluble in solvents compatible with diesel fuel, remove and clean or replace components as necessary.
- 2. After cleaning systems verify proper operation of vehicle fuel system by road test.



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Removal

- 1. Remove fuel tank.
- 2. Remove five screws, lockwashers, and fuel level sending unit from fuel tank. Discard lockwashers (Figure 3-71).
- 3. Remove gasket from fuel level sending unit. Discard gasket.

Installation

- 1. Install gasket on fuel level sending unit (Figure 3-71).
- 2. Install fuel level sending unit into fuel tank. Do not bend float arm.
- 3. Align fuel level sending unit holes. Float must be pointed in same direction as fuel tank filler neck.
- 4. Secure fuel level sending unit to fuel tank with five lockwashers and screws. Tighten screws to 35 lb-in. (4 N•m).
- 5. Install fuel tank.
- 6. Check fuel gauge for proper operation.

EXHAUST SYSTEM DIAGNOSIS AND TROUBLESHOOTING

Leaking Exhaust Gases or Exhaust Noises

- 1. Check for rusted-through or damaged exhaust system components (pipes and muffler). Replace any damaged parts.
- Check for loose or missing exhaust pipe fasteners. If fasteners are loose, torque to 37 lb-ft (50 N•m). Replace missing fasteners.
- 3. Check for leaking exhaust gaskets at crossover pipe and tailpipe. Replace leaking gaskets.
- 4. Check for leaking exhaust gases around exhaust manifolds. Replace any leaking exhaust manifold gaskets.



Figure 3-71: Fuel Level Sending Unit





MUFFLER

Muffler Replacement

Removal

- 1. Remove three locknuts, washers, capscrews, washers, muffler, and gasket from catalytic converter-to-muffler pipe assembly. Discard locknuts and gasket (Figure 3-72).
- 2. Remove four locknuts, washers, capscrews, washers, two retaining plates, muffler, and two reinforcements from insulators and mounting brackets. Discard locknuts.



Figure 3-72: Muffler and Mounting Bracket

Installation

- 1. Install two reinforcements, muffler, and two retaining plates on insulators and mounting brackets with four capscrews, eight washers, and four locknuts. Tighten locknuts to 10 lb-ft (14 N•m) (Figure 3-72).
- 2. Install gasket and muffler on catalytic converter-to-muffler pipe assembly with three capscrews, six washers, and three locknuts. Tighten locknuts to 26 lb-ft (35 N•m).

Muffler Insulator Replacement

Removal

- 1. Remove muffler.
- 2. Remove four locknuts, washers, capscrews, washers, reinforcement plate, muffler insulator, and reinforcement from muffler bracket. Discard locknuts (Figure 3-73).



- Install reinforcement, muffler insulator, and reinforcement plate on muffler bracket with four capscrews, eight washers, and four locknuts. Tighten locknuts to 10 lb-ft (14 N•m) (Figure 3-73).
- 2. Install muffler.

Muffler Bracket Replacement

Removal

- 1. Remove muffler insulator.
- 2. Remove four locknuts, washers, capscrews, washers, and muffler bracket from frame rail. Discard locknuts (Figure 3-74).





Installation

- 1. Install muffler bracket on frame rail with four capscrews, eight washers, and four locknuts. Tighten capscrews to 26 lb-ft (35 N•m) (Figure 3-74).
- 2. Install muffler insulator.

CROSSOVER PIPE REPLACEMENT

Removal

- 1. Remove engine access covers.
- 2. Remove right exhaust manifold rear heat shield.
- 3. Remove three locknuts, washers, capscrews, washers, crossover pipe, and gasket from right exhaust manifold. Discard locknuts and gasket (Figure 3-75).
- 4. Remove three locknuts, washers, capscrews, washers, crossover pipe, and gasket from catalytic converter. Discard locknuts and gasket.
- 5. Remove three locknuts, washers, capscrews, washers, crossover pipe, and gasket from left exhaust manifold. Discard locknuts and gasket.



Figure 3-75: Crossover Pipe

- Install gasket and crossover pipe on left exhaust manifold with three capscrews, six washers, and three locknuts. Tighten locknuts to 26 lb-ft (35 N•m) (Figure 3-75).
- Install gasket and crossover pipe on catalytic converter with three capscrews, six washers, and three locknuts. Tighten locknuts to 26 lb-ft (35 N•m).
- 3. Install gasket and crossover pipe on right exhaust manifold with three capscrews, six washers, and three locknuts. Tighten locknuts to 26 lb-ft (35 N•m).
- 4. Start engine and check for exhaust leaks.
- 5. Install right exhaust manifold rear heat shield.
- 6. Install engine access covers.





CATALYTIC CONVERTER

Catalytic Converter Support Bracket Maintenance

Removal

1. Remove catalytic converter.

NOTE: To prevent changing torque or damaging transfer case seal, hold bolt heads on transfer case securely.

2. Remove two locknuts, washers, and support bracket assembly from transfer case. Discard locknuts (Figure 3-76).



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Install catalytic converter. 2.









Disassembly

- Remove two locknuts, washers, capscrews, four washers, 1. and mounting bracket from support plate. Discard locknuts (Figure 3-77).
- 2. Remove two insulators from mounting bracket.

Assembly

- 1. Install two insulators in mounting bracket (Figure 3-77).
- 2. Install mounting bracket and two washers on support plate with two capscrews, four washers and two locknuts. Tighten locknuts to 15 lb-ft (20 N•m).

Installation

NOTE: To prevent changing torque or damaging transfer case seal, hold bolt heads on transfer case secure.



Catalytic Converter Replacement

Removal

- 1. Remove two nuts, lockwashers, U-bolt, and clamp from mounting bracket. Discard lockwashers (Figure 3-78).
- 2. Remove four nuts, lockwashers, two U-bolts, heat shield, and two clamps from catalytic converter. Discard lock-washers.
- 3. Remove three locknuts, washers, capscrews, washers, catalytic converter, and gasket from crossover pipe. Discard locknuts and gasket.
- 4. Loosen clamp attaching exhaust heat shield to catalytic converter.
- 5. Remove two nuts, lockwashers, U-bolt, and clamp from support bracket on transfer case. Discard lockwashers.
- 6. Remove three locknuts, washers, capscrews, washers, catalytic converter, and gasket from catalytic converter-tomuffler pipe assembly. Discard locknuts and gasket.

- 1. Install gasket and catalytic converter on catalytic converter-to-muffler pipe with three capscrews, six washers, and three locknuts. Tighten locknuts to 26 lb-ft (35 N•m) (Figure 3-78).
- 2. Install catalytic converter on support bracket on transfer case with U-bolt, clamp, two lockwashers, and nuts.
- Install gasket and catalytic converter on crossover pipe with three capscrews, six washers, and three locknuts. Tighten locknuts to 26 lb-ft (35 N•m).
- 4. Wrap exhaust heat shield clamp around catalytic converter and tighten clamp securely.
- Install heat shield on catalytic converter with clamp, Ubolt, four lockwashers, and nuts. Tighten nuts to 10 lb-ft (14 N•m).
- 6. Install catalytic converter on mounting bracket with clamp, U-bolt, two lockwashers, and nuts.



Figure 3-78: Catalytic Converter

Catalytic Converter-to-Muffler Pipe Assembly Replacement

Removal

- 1. Remove three locknuts, washers, capscrews, washers, converter-to-muffler pipe assembly, and gasket from catalytic converter. Discard locknuts and gasket (Figure 3-79).
- 2. Remove three locknuts, washers, capscrews, washers, converter-to-muffler pipe assembly, and gasket from muffler. Discard locknuts and gasket.

Figure 3-79: Catalytic Converter-to-Muffler Pipe Assembly

Installation

- 1. Install gasket and converter-to-muffler pipe assembly on muffler with three capscrews, six washers, and three locknuts. Tighten locknuts to 26 lb-ft (35 N•m) (Figure 3-79).
- 2. Install gasket and converter-to-muffler pipe assembly on catalytic converter with three capscrews, six washers, and three locknuts. Tighten locknuts to 26 lb-ft (35 N•m).

Catalytic Converter Insulator Replacement

Removal

1. Remove two nuts, lockwashers, U-bolt, and clamp from lower mounting bracket. Discard lockwashers (Figure 3-80).

Figure 3-80: Catalytic Converter Insulator

- Remove four locknuts, washers, capscrews, washers, two reinforcement plates, and insulator from support bracket. Discard locknuts.
- 3. Remove two nuts, washers, capscrews, washers, reinforcement plate, and insulator from lower mounting bracket.

- Install reinforcement plate on insulator and lower mounting bracket with two capscrews, four washers, and two nuts. Tighten capscrews to 10 lb-ft (14 N•m) (Figure 3-80).
- 2. Install two reinforcement plates and insulator on support bracket with four capscrews, eight washers, and four lock-nuts.
- 3. Install U-bolt and clamp on lower mounting bracket with two lockwashers and nuts.

RIGHT EXHAUST MANIFOLD REAR HEAT SHIELD REPLACEMENT

Removal

- 1. Remove engine access covers.
- 2. Remove nut, lockwasher, washer, capscrew, washer, and rear heat shield from transmission dipstick tube clamp. Discard lockwasher (Figure 3-81).
- 3. Remove capscrew and rear heat shield from heat shield.

- 1. Install rear heat shield on heat shield with capscrew (Figure 3-81).
- 2. Install rear heat shield on transmission dipstick tube clamp with washer, capscrew, washer, lockwasher, and nut.
- 3. Install engine access covers.

Figure 3-81: Right Rear Heat Shield

RIGHT EXHAUST MANIFOLD HEAT SHIELD REPLACEMENT

Removal

- 1. Remove engine access covers.
- 2. Remove right exhaust manifold rear heat shield.
- 3. Loosen three capscrews securing heat shield and exhaust manifold to cylinder head (Figure 3-82).
- 4. Remove locknut, washer, capscrew, washer, and heat shield from crossover pipe and exhaust manifold. Discard locknut.

- 1. Position heat shield on crossover pipe and exhaust manifold (Figure 3-82).
- 2. Install heat shield and exhaust manifold on cylinder head and tighten capscrews to 25 lb-ft (34 N•m).
- 3. Install heat shield on exhaust manifold and crossover pipe with washer, capscrew, washer, and locknut. Tighten locknut to 37 lb-ft (50 N•m).
- 4. Install right exhaust manifold rear heat shield.
- 5. Install engine access covers.
- 6. Start engine and check for exhaust leaks.

Figure 3-82: Right Exhaust Manifold Heat Shield

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