

SECTION 6C1

FUEL SYSTEM

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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AIR CLEANER

DESCRIPTION

The function of the air cleaner assembly is to prevent dirt and water from entering the engine. Air enters the air cleaner assembly and hits a helical ramp that is around the air filter. This causes the air to spin. Centrifugal force separates the dirt and water from the intake air. A rubber ejector valve is placed in the bottom of the assembly to eject dirt and water from the air cleaner assembly.

Air cleaners should be inspected and serviced at intervals listed in the Maintenance Schedule, or more often under severe dust conditions.

Under adverse conditions or long periods of time

on dusty or sandy roads, the unit should be cleaned every day. Air cleaners on vehicles operating in dust storm areas should be cleaned immediately after such storms occur.

NOTICE: In addition to its function of filtering air drawn into the engine, the air cleaner also acts as a flame arrester in the event the engine backfires. Because backfiring may cause fire in the engine compartment, the air cleaner should be installed at all times unless temporary removal is necessary during repair or maintenance of the vehicle.

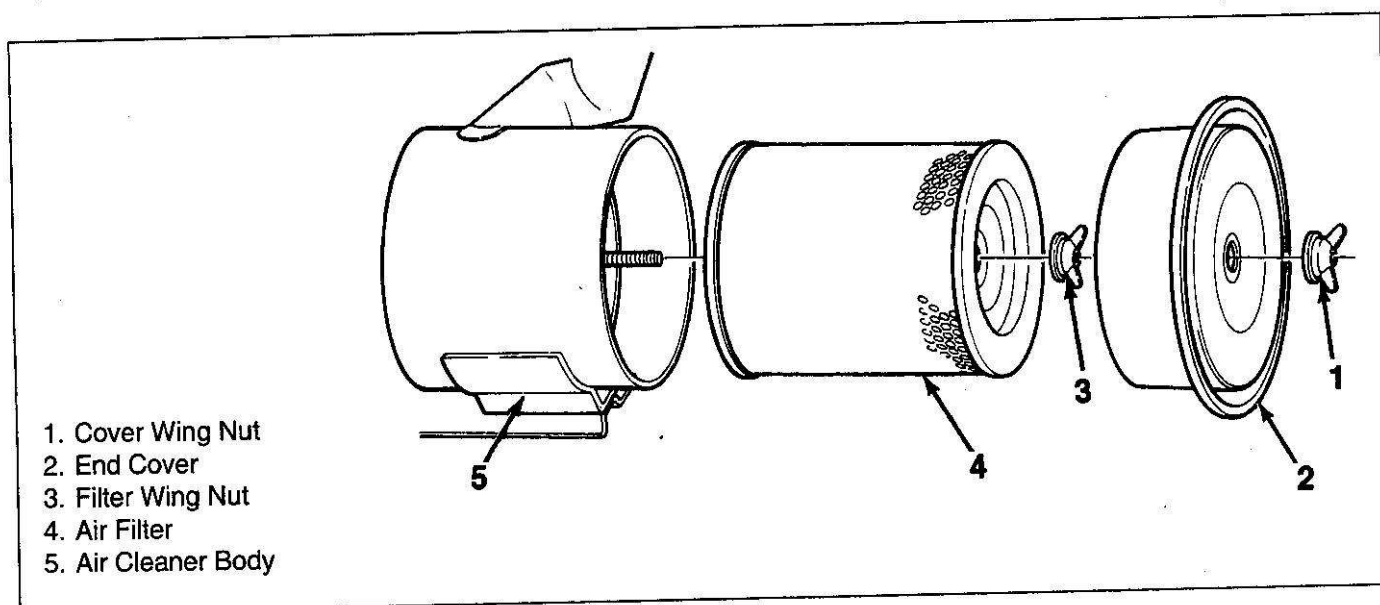


Figure 1. Air Cleaner Assembly

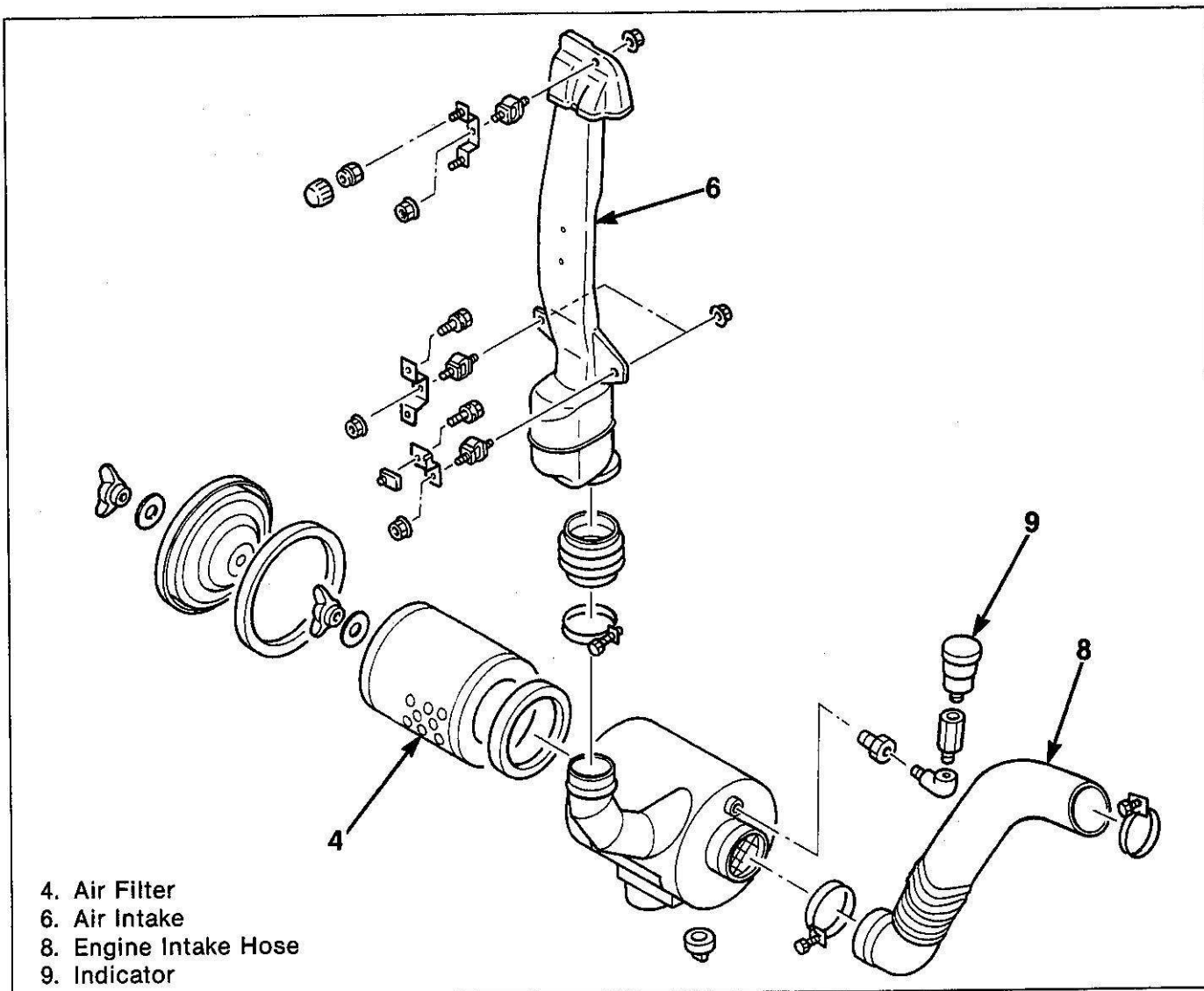


Figure 2. Air Cleaner Assembly

AIR FILTER REPLACEMENT

← Remove or Disconnect (Figures 1 and 2)

1. Cover wing nut (1).
2. End cover (2).
3. Filter wing nut (3).
4. Air Filter (4).

☑ Clean (Figure 3)

- Wipe out the inside of the air cleaner assembly.
- Wipe off the cover.

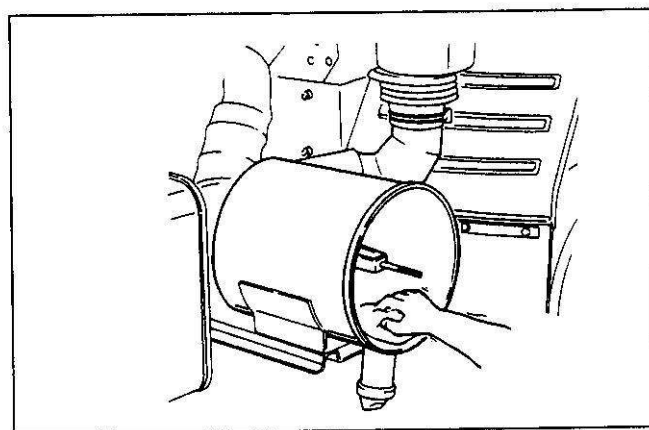


Figure 3. Cleaning the Air Cleaner Assembly

🔍 Inspect

- The air filter with a light for tears or holes (figure 4).
- Ejector valve.

Install or Connect (Figures 1 and 2)

1. Air filter (4).
2. Filter wing nut (3).
3. End cover (2).
4. Cover wing nut (1).

AIR FILTER CLEANING

Air filter cleaning is not recommended, but where conditions require it, carefully follow the instructions below.

During cleaning, use extreme care not to puncture or damage the air filter. The air filter can be cleaned by either of two methods as follows.

Direct dry, clean air up and down pleats on the clean air side of air filter. Use caution that air pressure does not exceed 689 kPa (100 psi). Maintain a reasonable distance between nozzle and air filter.

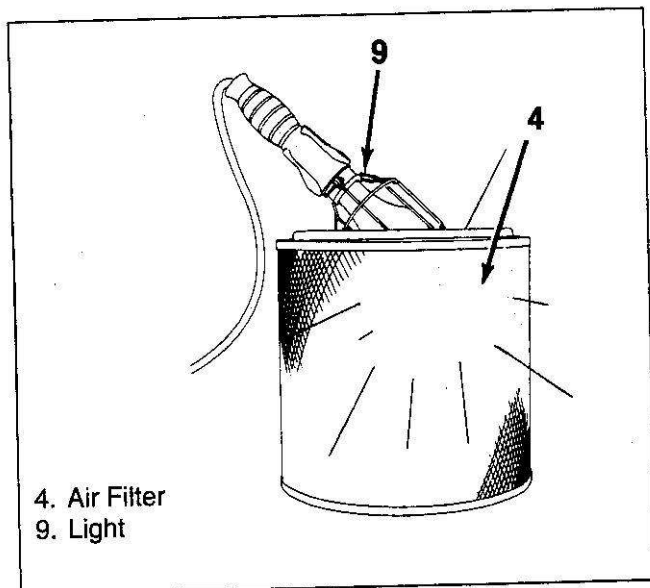


Figure 4. Checking the Air Filter



Figure 5. Dry Cleaning the Air Cleaner

Washing Method

Washing is especially effective for oily or soot-laden filters. Prepare a solution of commercial non-sudsing detergent. Soak air filter for 15 minutes to several hours to ensure all dirt has been soaked away, then rinse with clean water and air dry completely. **DO NOT HEAT** air filter to hasten drying. Inspect by placing a bright light inside air filter.

Tapping or pounding dust out of air filter can damage them severely. Air filters must be cleaned with care. Never use gasoline or solvent to clean air filters.

FUEL FILTERS

DESCRIPTION

The purpose of the fuel filters is to clean the fuel of any dirt particles that can cause wear on the fuel injection nozzle's sliding surface; and to separate any water from the fuel, which is ever-present from the condensation in the fuel tank. The pre-fuel filter (water separator) is located between the fuel tank and the injection pump (figure 6). The secondary fuel filter is located between the fuel pump and the injection pump (figure 7).

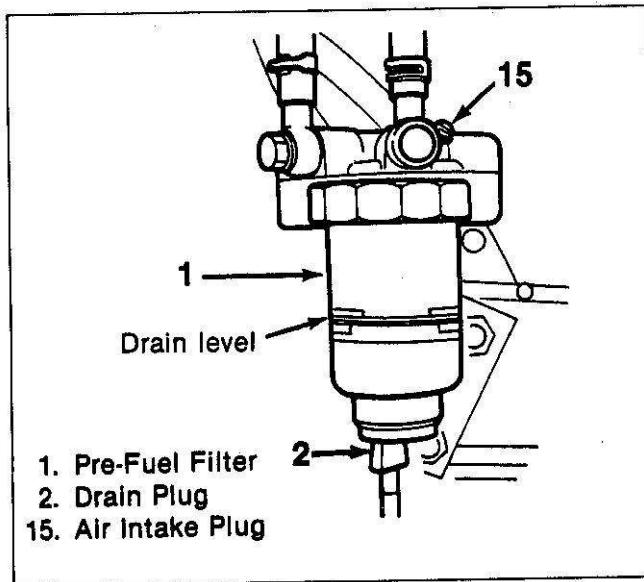


Figure 6. Pre-Fuel Filter

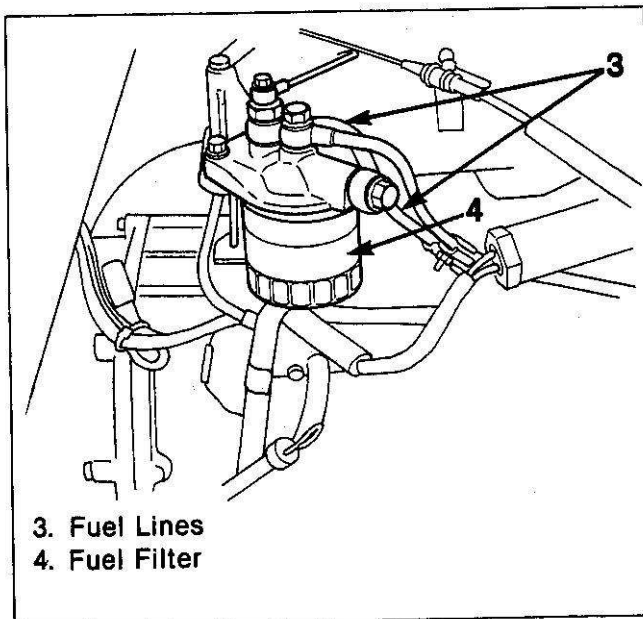


Figure 7. Fuel Filter

Pre-Fuel Filter

When the condensed water in the pre-fuel filter (water separator) comes to the warning level indicated on its plastic body, drain the fluid immediately from the drain plug located bottom of water separator.

Fuel Filter

The fuel filter is spin-on cartridge-type. The filter should be replaced. Never try to clean it. For the replacement interval refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

DRAINING THE PRE-FUEL FILTER

1. Loosen the air intake plug (15) and drain plug (2) by turning them counterclockwise (figures 6 and 8).
2. Drain approximately 0.1 liters (3.4 oz) of water.
3. Securely tighten the drain plug and air intake plug.
4. Operate the primer pump on the fuel pump to bleed the fuel system. Refer to FUEL INJECTION SYSTEM (SEC. 6C3).
5. Start the engine and check to be sure no fuel is leaking from the drain plug.

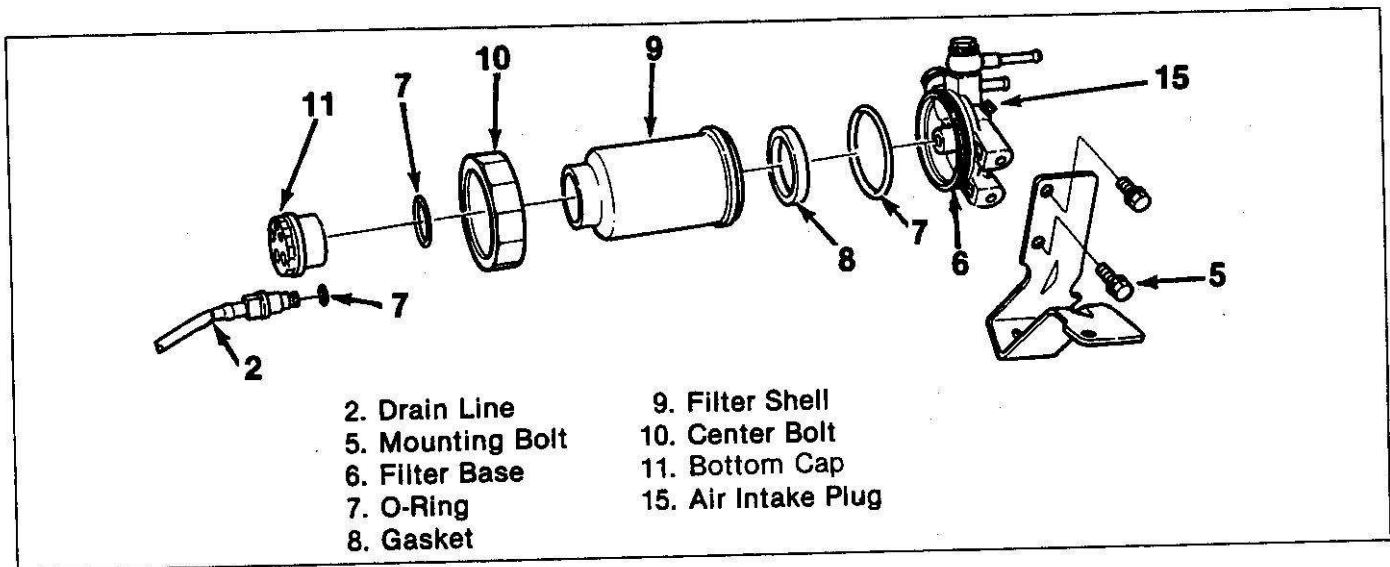


Figure 8. Pre-Fuel Filter Components

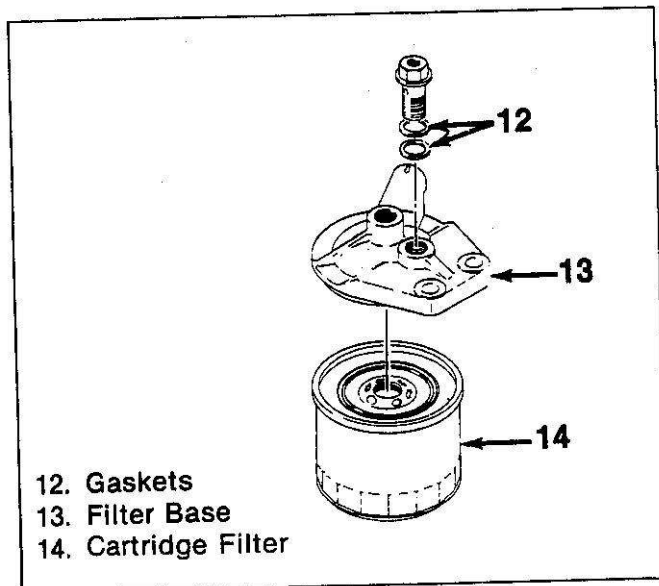


Figure 9. Fuel Filter Components

FUEL FILTER REPLACEMENT

Remove or Disconnect (Figures 7 and 9)

- The filter using a filter wrench.

Clean

- The filter base.

Install or Connect (Figures 7 and 9)

- Lightly oil the filter O-ring.
- Fill the filter with clean fuel.
 1. Filter by hand until the O-ring contacts the filter base.
 - Use a filter wrench to further tighten the filter 1/3 to 2/3 of a turn.
 2. Bleed the fuel system. Refer to FUEL INJECTION SYSTEM (SEC. 6C3) in this manual.

ACCELERATOR LINKAGE AND HAND THROTTLE

DESCRIPTION

The accelerator linkage consists of a pedal assembly and cable (figure 11). Be sure that the cable is not kinked when installed.

The hand throttle consists of a knob assembly and a cable that connects to the accelerator pedal assembly. When making any idle adjustment, be sure the hand throttle is completely "off."

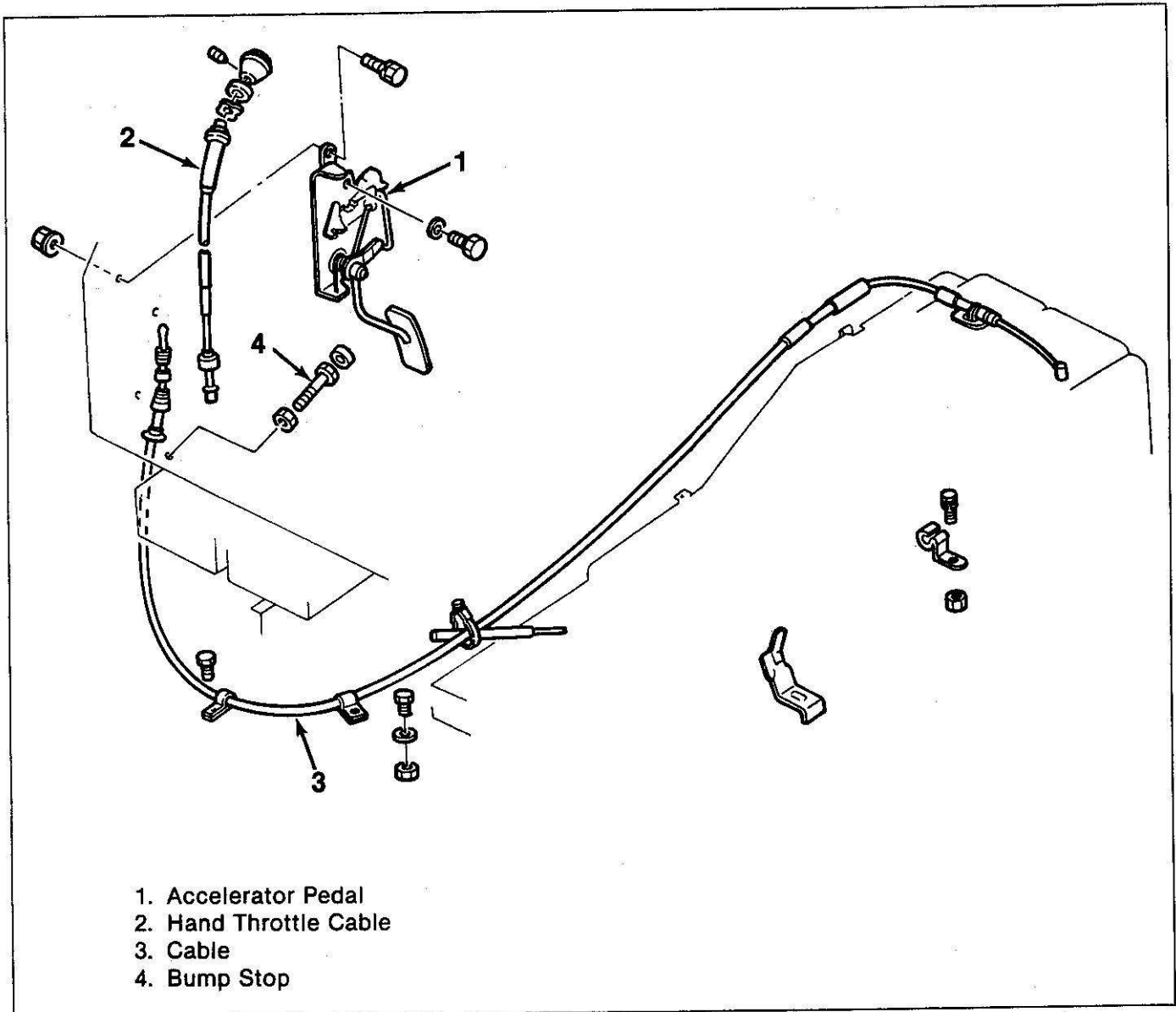


Figure 11. Accelerator and Hand Throttle Components

ACCELERATOR LINKAGE ADJUSTMENT

Adjust (Figure 12)

- Be sure the hand throttle control knob is in the "off" position.
- 1. Tilt the cab.
- 2. Loosen the bolt (6) on the cable bracket (figure 12).
- 3. Hold the accelerator lever (5) in the fully closed position and remove slack from the cable (3) by pulling in the direction of the arrow.
- 4. Tighten the bolt (6).
- 5. Check the cable and pedal assembly for free movement.
- 6. Lower the cab.

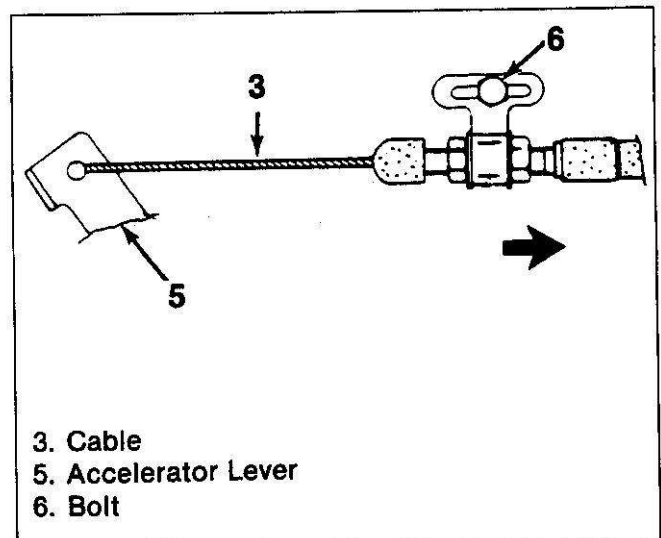


Figure 12. Accelerator Linkage Adjustment

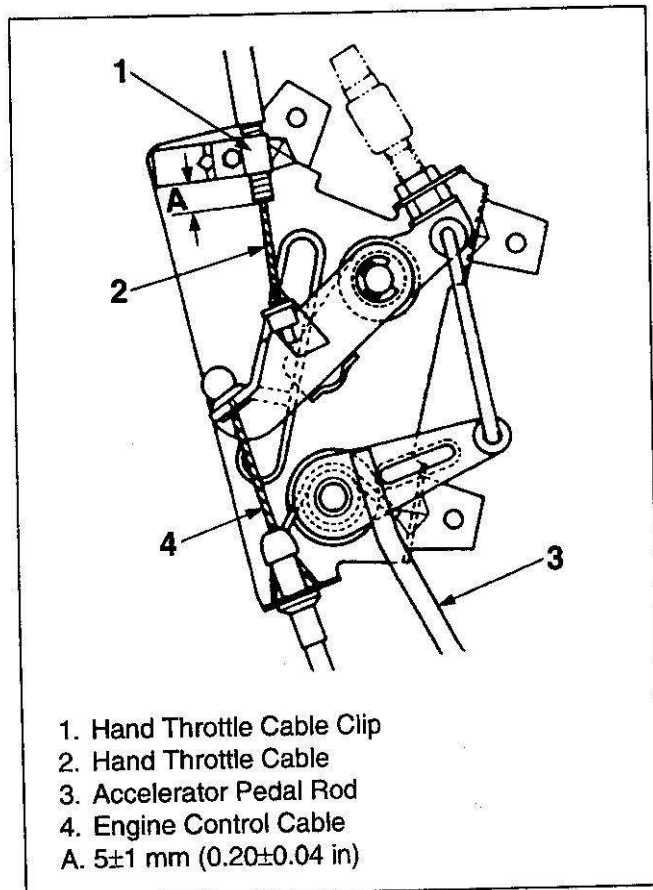


Figure 13. Hand Throttle Adjustment

HAND THROTTLE ADJUSTMENT

Before adjusting the hand throttle cable be sure the accelerator linkage and engine idle speed are adjusted correctly.

Adjust (Figure 13)

1. Position the hand throttle control knob in the "off" position.
2. Loosen the clip (1) and adjust the cable (2) so that there is 5 ± 1 mm (0.20 ± 0.04 in) clearance (A) between the clip and the outer cable end.
3. Tighten the clip (1) to hold the cable in position.
4. From the position above, confirm that the accelerator pedal begins to move when the hand throttle control knob is turned 2.5 times.

FAST IDLE SYSTEM

Fast idle system consists of fast idle actuator, vacuum switching valve (VSV), vacuum pump, rubber hoses connecting there-between and electric circuit including thermo switch.

FUNCTION OF THE SYSTEM

1. When engine coolant temperature is below 40°C (104°F):
QOSIII controller sends "ON" signal to VSV, making the vacuum generated by vacuum pump lead to fast idle actuator, functioning control

lever of injection pump for promote of engine warm-up ability.

2. When engine coolant temperature comes up beyond 40°C (104°F):
QOSIII controller sends "OFF" signal to VSV, cutting the vacuum, as the result of that the engine speed return to the idle mode.
This system operates when air conditioning switch is turned to "ON" position too, functioning for compensating for engine speed drop at idle attributable to the increase of compressor load.

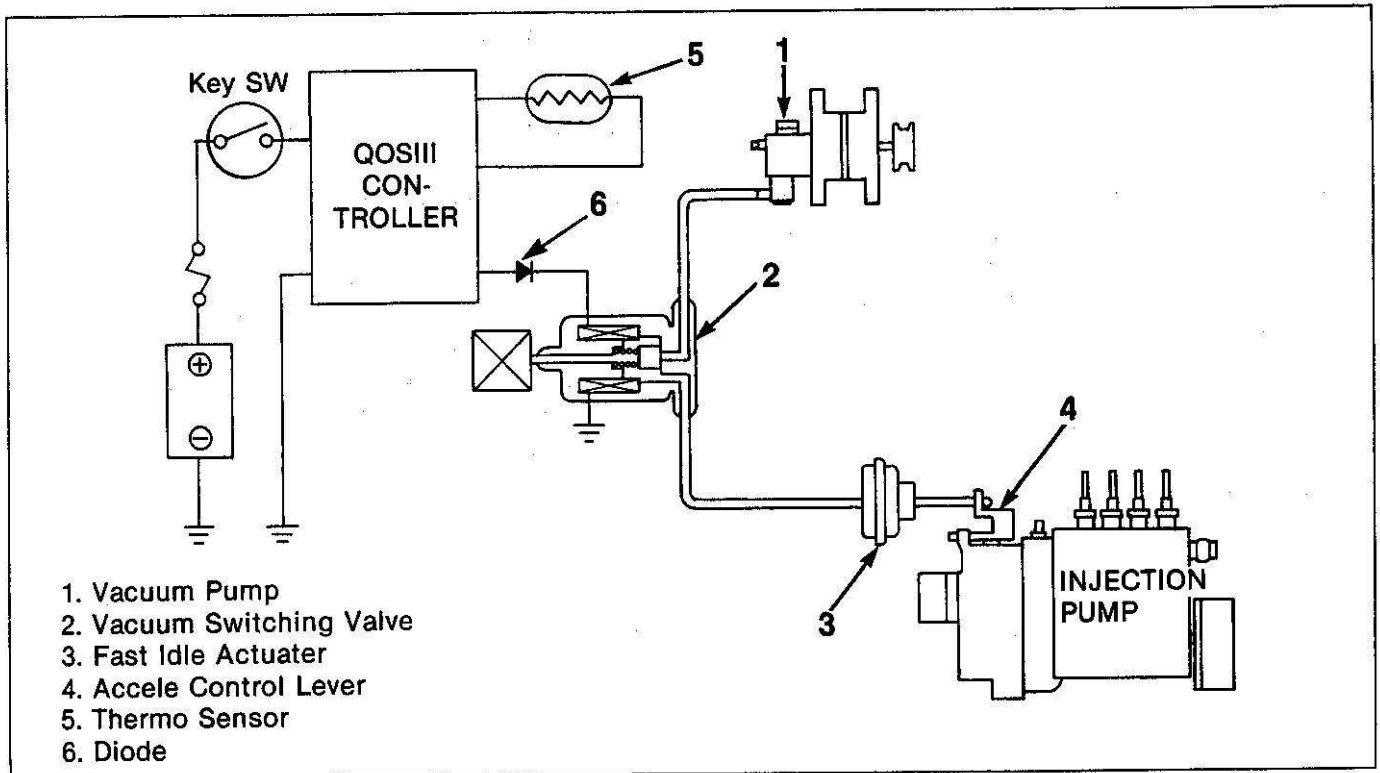


Figure 14. Diagram of Fast Idle System

FAST IDLE ADJUSTMENT

Before adjusting the fast idle actuator be sure the accelerator linkage and engine idle speed are adjusted correctly.

Adjust (Figure 15)

1. Apply the parking brake firmly.
2. Place the transmission in neutral.
3. Block the wheel.
4. Tilt the cab.
5. Start the engine and allow it to warm up.
6. Disconnect VSV (Vacuum Switching Valve) connector.
7. Loosen the fast idle fixing screws.
8. Apply battery voltage between VSV terminals (figure 15).
9. Set to fast idle speed 950 RPM.
10. Tighten fast idle fixing screws.

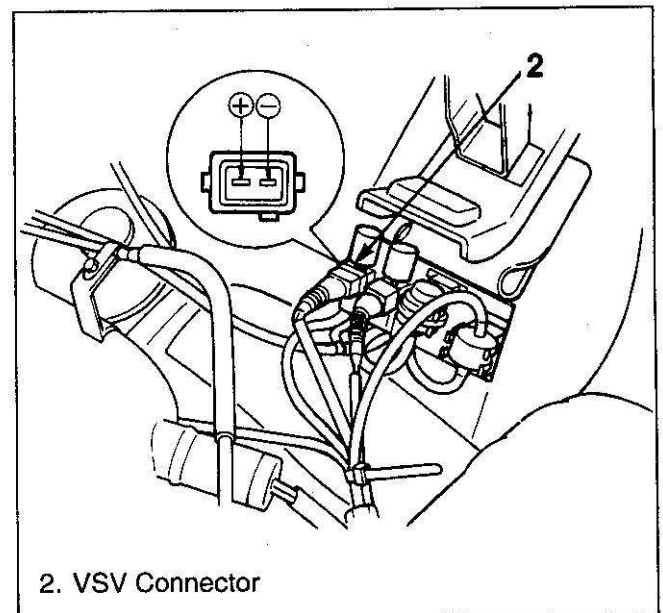


Figure 15. Fast Idle Speed Adjustment

ENGINE STOP LINKAGE

DESCRIPTION

The engine stop linkage consists of the engine stop motor assembly and cable. The engine stop cable is connected to the fuel cut lever of the injection pump governor. The engine is stopped smoothly by the engine stop motor by a simple key switch operation.

NOTICE: To turn on the fuel enrichment system, fully depress the accelerator pedal and then turn on the starter.

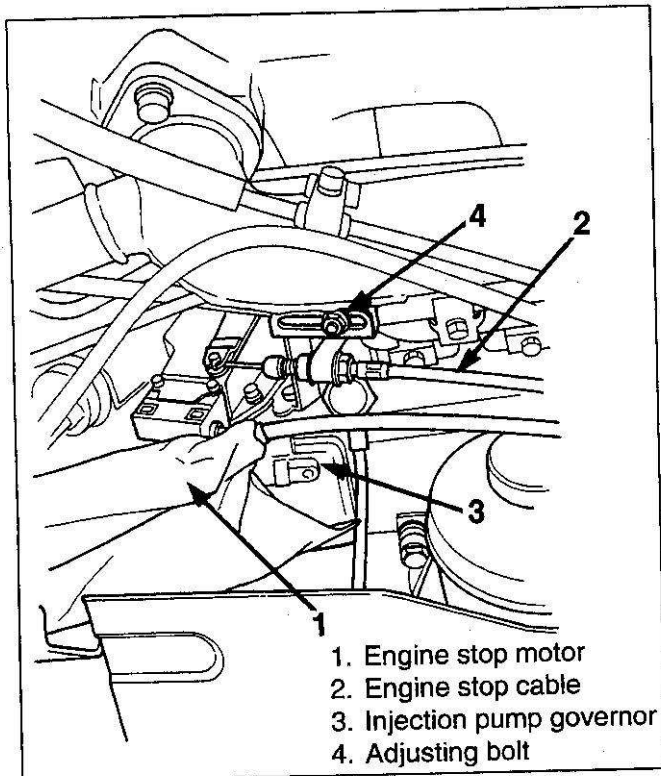


Figure 16. Engine Stop Linkage

ENGINE STOP LINKAGE ADJUSTMENT

Adjust (Figure 17)

1. Be sure that the key switch is in "Lock" position or removed from the key cylinder.
2. Loosen the adjusting bolt (A).
3. Hold the fuel-cut lever (C) in fully-pulled position and remove the slackness of the cable (B) by pulling it in the direction shown by the arrow.
4. Retighten the adjusting bolt (A).

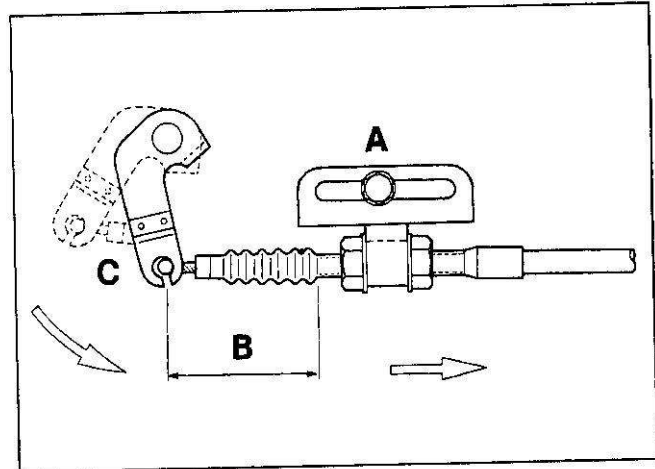


Figure 17. Engine Stop Cable Adjustment

FUEL TANK

DESCRIPTION

The fuel tank is mounted on the right frame rail and is supported by two brackets. The tank is attached to the bracket by a metal strap backed with a rubber cushion strip. A vent valve is installed at the top of the fuel tank to relieve excess pressure. A drain plug is located in the bottom of the tank for draining purposes. The fuel tank identification tag is located next to the filler cap.

FUEL TANK REPLACEMENT

NOTICE: To prevent possible accident when working on fuel system, disconnect the vehicle battery ground (-) cable(s) and provide the appropriate fire fighting and safety equipment in accordance with local fire and safety regulations.

Before removing the fuel tank to correct a leak, a careful inspection of the tank should be made to determine the actual source of the leak. "Seam

leaks” often turn out to be leaks at the filler neck, fuel line connections, or at the tank sending unit seal. In such cases, fuel runs down the side of the tank to the flanges and drips off at points along the seam giving a false indication of leaking seams. If careful inspection reveals that the tank is actually leaking, remove the tank for repairs as required.

A leaking fuel tank must be repaired or replaced immediately. In addition to increased operating expense, leaking fuel tanks represent a serious fire hazard. No leakage is allowed anywhere in the fuel system lines or tank.

↔ Remove or Disconnect (Figures 18 and 19)

1. Drain plug (5).
 - Place a container under the drain plug to catch the fuel.
2. Fuel lines (7).
3. Wires from the sending unit (1).
 - On vehicles where the top of the tank is not easily accessible, loosen the mounting strap (3) enough to rotate the tank and disconnect

the fuel lines and wires.

- Place a jack or suitable support under the fuel tank.
4. Nuts from the mounting strap stud bolts (4).
 5. Fuel tank (2) from vehicle.
 - Use a jack or suitable support.

↔ Install or Connect (Figures 18 and 19)

1. Fuel tank (2) onto the bracket (4).
2. Mounting strap (3) with the rubber cushion strips.
3. Fuel lines (7).
4. Wire to sending unit (1).
5. Drain plug (5).

NOTICE: See “NOTICE” on page 6C1-1 of this section.

⌚ Tighten

- Mounting strap (3) to 30 N·m (22 lb·ft).

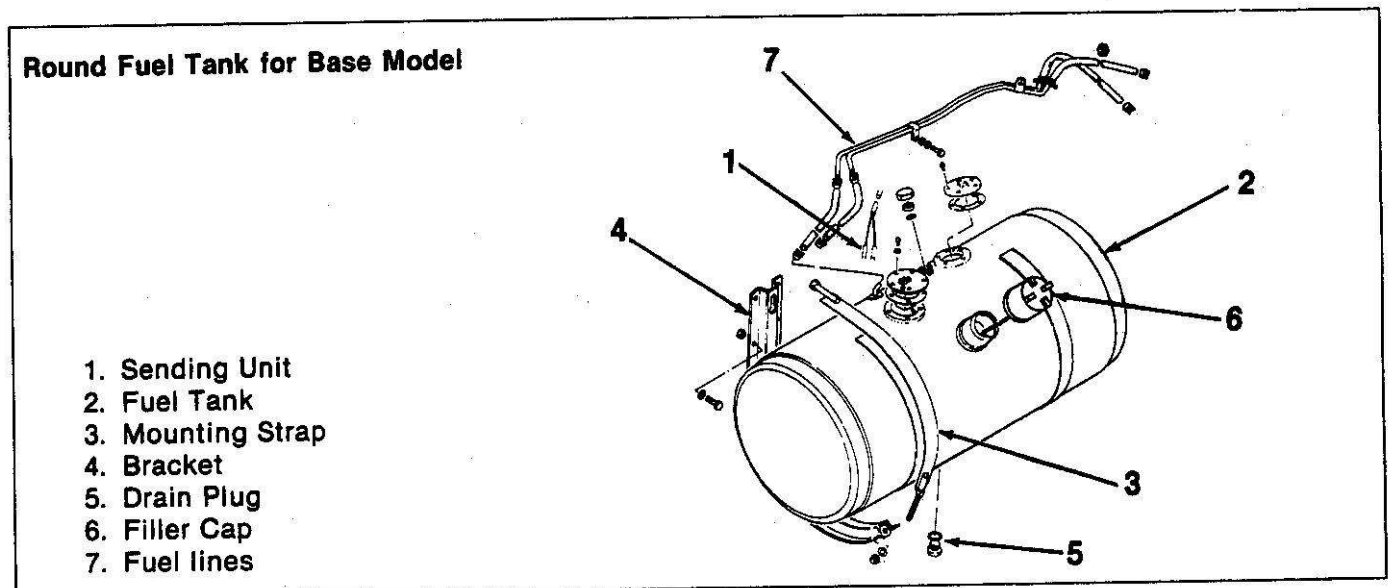


Figure 18. Fuel Tank Mounting and Components (1)

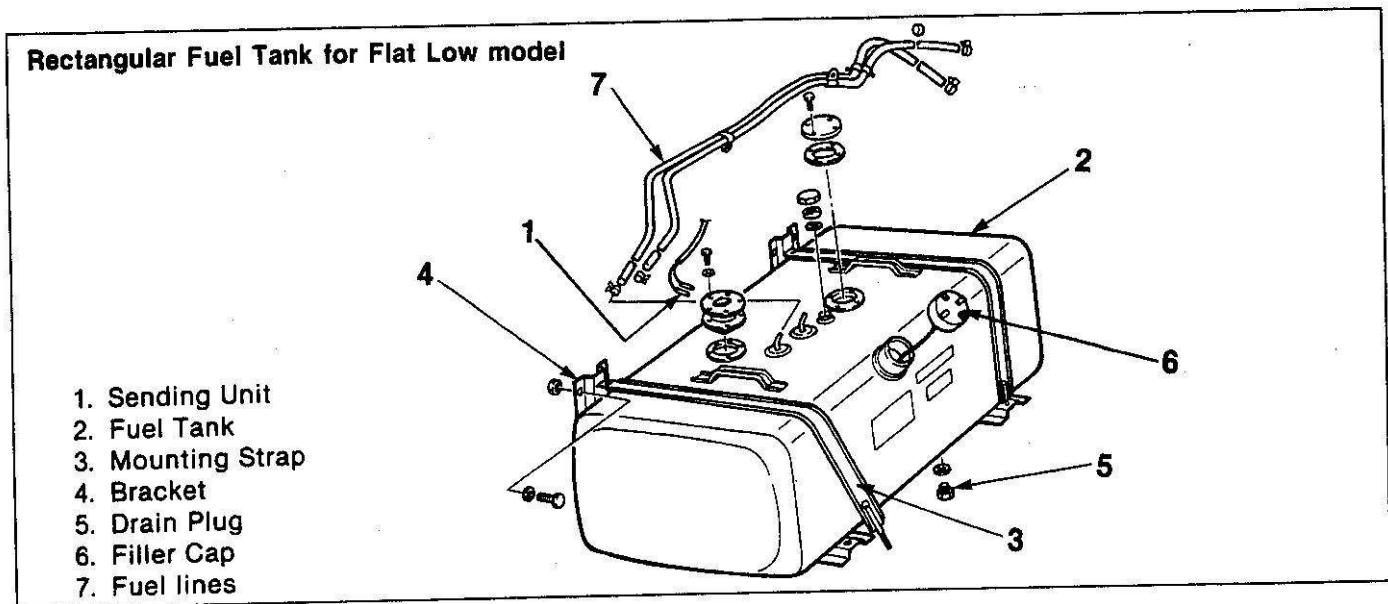


Figure 19. Fuel Tank Mounting and Components (2)

SENDING UNIT REPLACEMENT

The sending unit is a float-controlled variable resistor (rheostat). It is mounted on the top of the fuel tank and has a float arm extending inside the tank. The position of the float moves the float arm across the rheostat, thus determining the amount of current sent to the fuel gage in the vehicle. Some models use a protective top to shield the top of the sending unit.

If the tank sending unit or the dash fuel gage has become inoperative, the only remedy is to replace the inoperative unit.

For checking or diagnosis of fuel tank sending unit, refer to procedure under the heading of INSTRUMENTS AND GAGES (SEC. 8D) in this manual.

For dash gage replacement, refer to applicable heading under INSTRUMENTS AND GAGES (SEC. 8D) in this manual.

Remove or Disconnect (Figures 18 and 19)

1. Battery cable.

2. Fuel lines (7).
3. Wires from the top of the sending unit (1).
4. Mounting strap nuts.
 - Rotate the fuel tank (2)(Round type).
5. Sending unit (1).

Install or Connect (Figures 18 and 19)

1. Sending unit (1) into the fuel tank (2).
 - Rotate the fuel tank (Round type) to the correct position.

NOTICE: See "NOTICE" on page 6C1-1 of this section.

2. Mounting strap nuts.

Tighten

- Mounting strap nuts to 30 N·m (22 lb·ft).

3. Wires to the sending unit.
4. Fuel lines (7).
5. Battery cable.

SPECIFICATIONS

FASTENER TORQUES

Fuel Tank Mounting Strap Nuts30 N·m (22 lb·ft)

SECTION 6C3

FUEL INJECTION SYSTEM

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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FUEL INJECTION SYSTEM

DESCRIPTION

The fuel injection system includes a fuel tank, fuel hoses and lines, a fuel/water separator, fuel filters, a fuel pump, a Bosch-type in-line fuel injection pump with an internal governor, delivery valves, fuel injection lines and four fuel injection nozzles. The fuel pump, injection pump and the nozzles are manufactured by ZEXEL corporation, but serviced by Bosch.

Remove the injection pump and governor assembly as a unit to have it serviced. Do not open or break any seals on the pump or the warranty is void. The injection pump has an identification plate attached to the pump body.

SYSTEM OPERATION

The engine crankshaft drives the fuel injection pump which in turn, drives the fuel pump. The fuel pump draws fuel from the fuel tank, through the fuel/water separator and transfers it, by way of the secondary fuel filter, into the injection pump. The governor regulates the flow of fuel to the delivery valves. At the correct timing intervals, a plunger in the injection pump sends fuel, at high pressure, through a delivery valve to one of the fuel injection nozzles.

Fuel pressure causes a needle valve in the fuel injection nozzle to open. Fuel is then injected, through the injection nozzle, into the cylinder in a fine spray.

Excess fuel is directed back to the fuel tank by means of the fuel return lines.

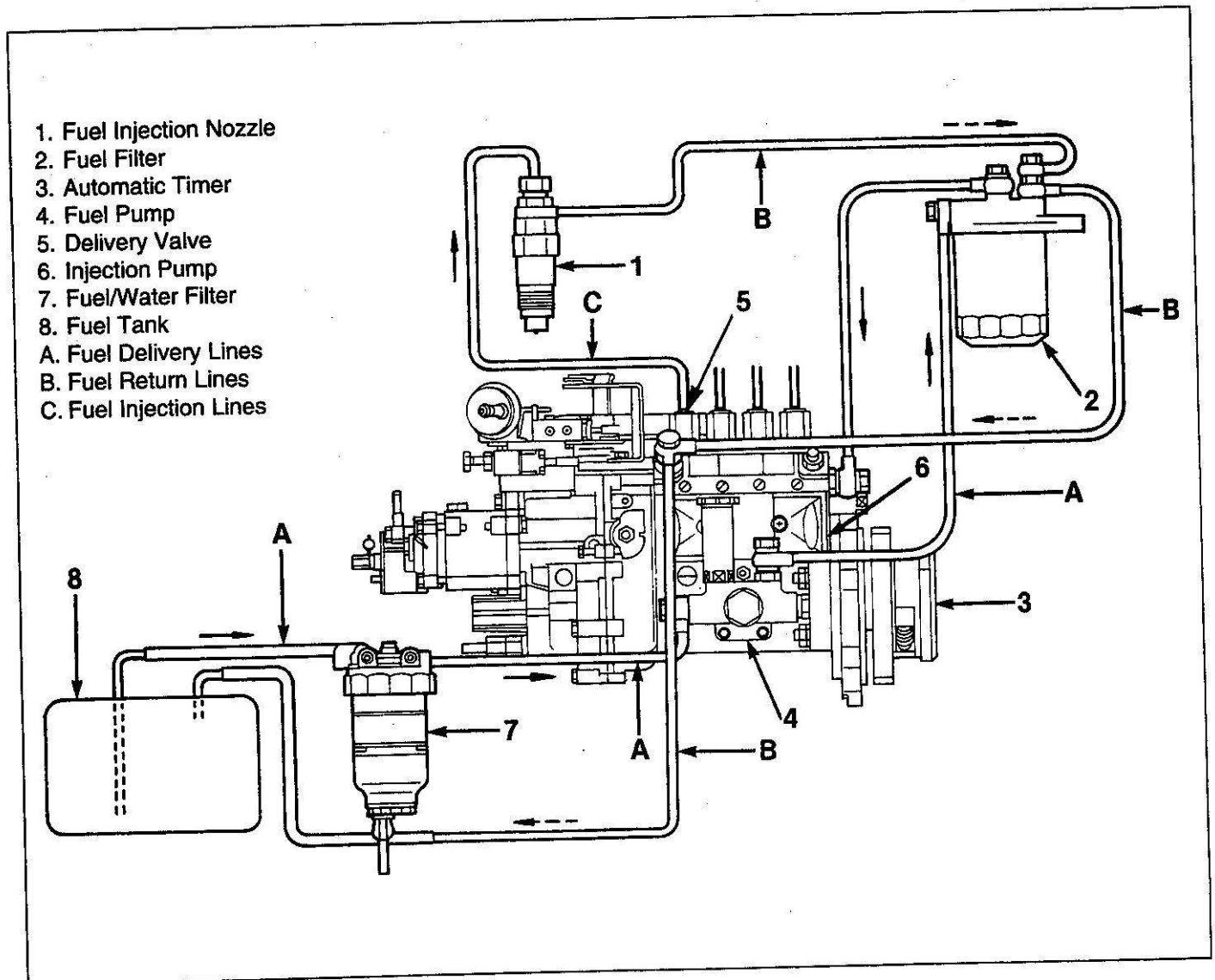


Figure 1. Fuel Injection System

ANEROID COMPENSATOR FUNCTION

The bellows in the aneroid compensator is provided with an initial set force by the aneroid compensator spring (10) and is compressed by the push rod C (11). As the atmospheric pressure drops, the bellows (9) begins to expand against the force of the aneroid compensator spring (10), which in turn causes the push rod B (13), through the push rod C (11) and the boost compensator lever (12), to move to the left.

Then the push rod B (13) comes into contact with

the U-shaped lever (16) and, as the expanding bellows overcome the force of the cancel spring installed on the U-shaped lever (16), causes the U-shaped lever to turn clockwise. Because the bottom of the sensor lever (15) is in touch with the torque cam (51), the torque cam (51) then works as a pivot on which the top of the sensor lever (15) moves to the right together with the U-shaped lever (16). At the same time, the control rack (19), which is hooked on the sensor lever (15), moves toward the governor to reduce fuel injection.

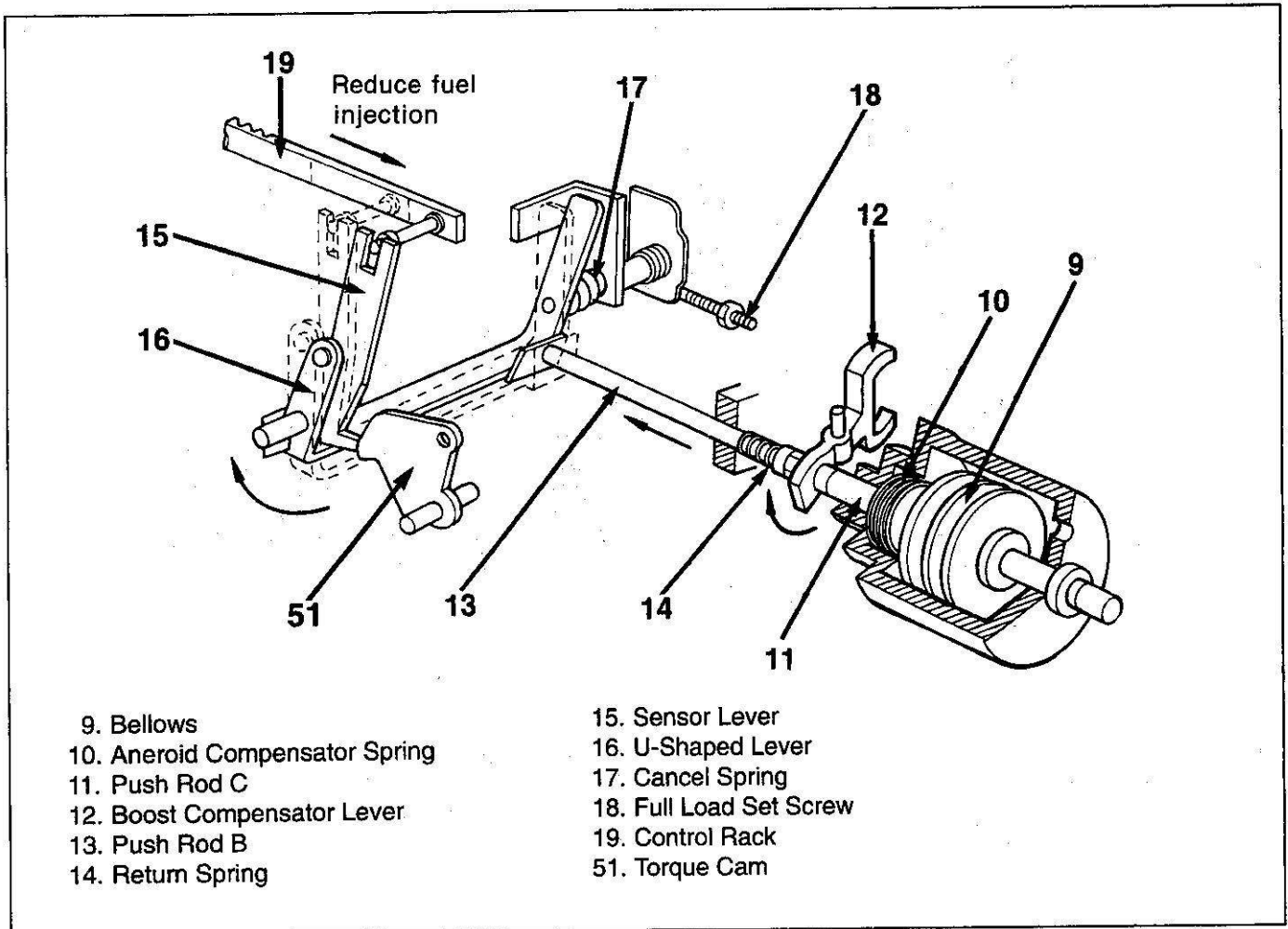


Figure 2. Link Motion when Aneroid Compensator is Functioning

6C3-4 FUEL INJECTION SYSTEM

BOOST COMPENSATOR FUNCTION

As engine speed builds, the boost pressure (compressed air) that develops inside the turbocharger is directed through a pipe to the pressure chamber of the boost compensator. As the boost pressure overcomes the set pressure of the boost compensator spring (20), it begins to push the push rod A (22), which moves integrally with the diaphragm (19), toward the left in the figure. As the push rod A (22) moves, the lever (12) is rotated counterclockwise and the push rod B (13) begins to

be moved with the boost compensator lever (12) to the right by the force of the return spring (14).

At the same time, the U-shaped lever (16) inside the governor housing turns counterclockwise together with the push rod B (13) by the force of the cancel spring (17).

Since the bottom of the sensor lever (15) is in contact with the torque cam (51), the center pivot of the sensor lever (15) moves left with the motion of the U-shaped lever (16), which in turn causes the control rack (18) to move away from the governor to increase fuel injection.

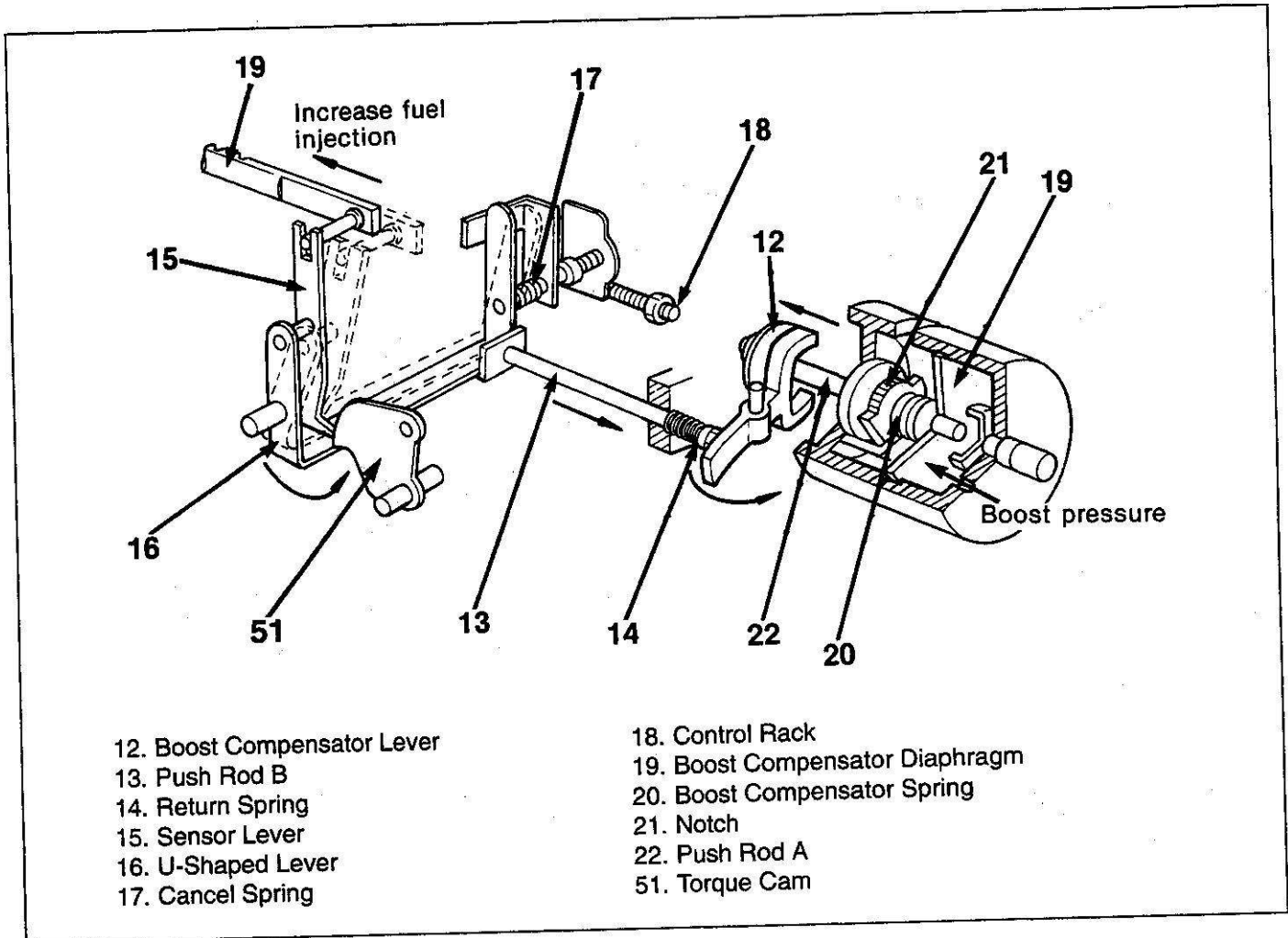


Figure 3. Link Motion when Boost Compensator is Functioning

FUEL LOW CUT FUNCTION

The fuel low cut system is designed to reduce the full load fuel flow rate to prevent engine overheating by sensing the engine coolant temperature (ECT) with the aneroid compensator.

This system consists of a thermo switch, (senses the ECT) vacuum switching valve (VSV), vacuum regulating valve (VRV), delay valve, and aneroid compensator (installed in the rear of the injection pump).

In this system, VSV turns "ON" when the ECT has risen above 98°C (208°F).

Then, the vacuum pressure is directed through this valve. This vacuum pressure is regulated by VRV and, going through the delay valve, causes the aneroid compensator to function to reduce the full load fuel rate by about 5%, which in turn reduces the amount of heat developed by combustion. At this time, the delay valve does not function so that the fuel rate can be cut immediately. On the other hand, when the ECT has risen above 98°C (208°F) and VSV has turned "OFF", the delay valve

functions to cancel the fuel cut gradually so that overheat due to instant rise in fuel flow can be avoided.

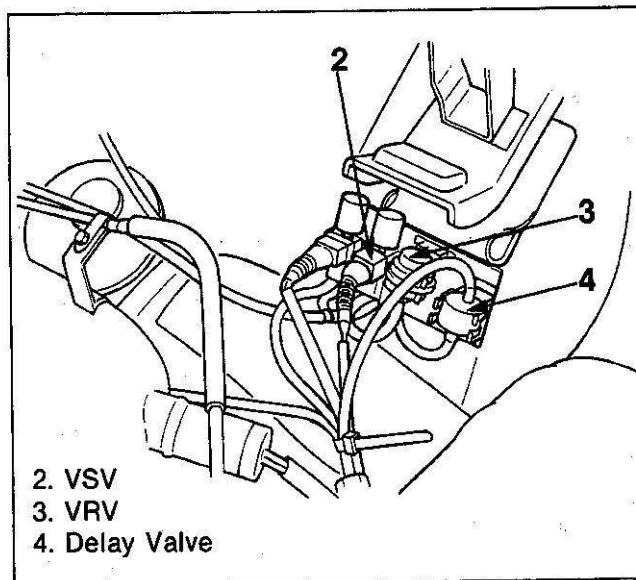


Figure 4. Location of Fuel Low Cut System Parts

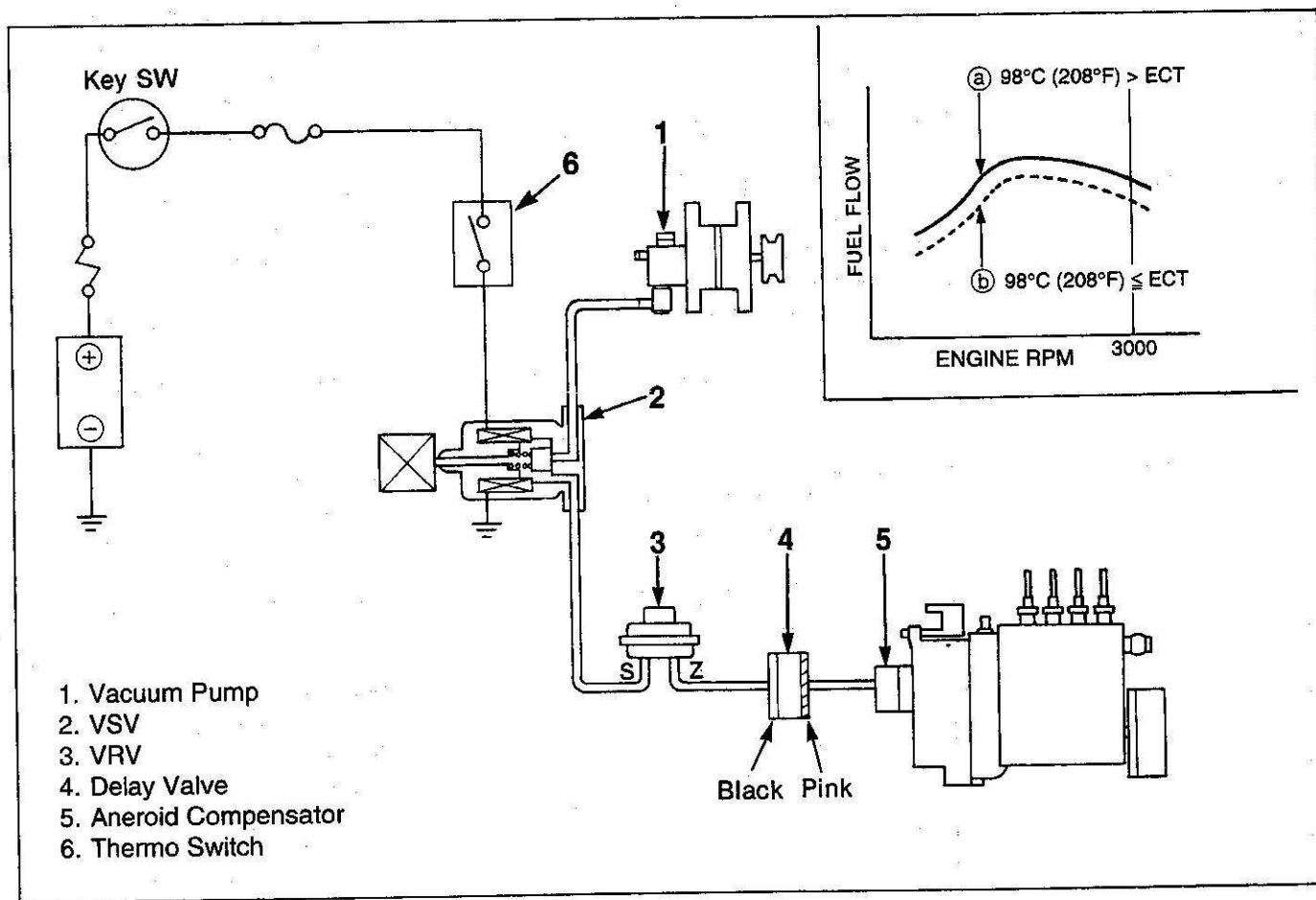


Figure 5. Diagram of Fuel Low Cut System

DIAGNOSIS OF FUEL INJECTION SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hard Starting	<ol style="list-style-type: none"> 1. Fuel tank empty. 2. Fuel vent blocked. 3. Air in the system. 4. Stop cable misadjusted. 5. Fuel filter plugged. 6. Restricted or broken injection lines. 7. Pump-to-engine timing incorrect. 8. Low compression. 9. Internal fuel injection pump 10. Engine valves. 11. Glow plugs. 	<ol style="list-style-type: none"> 1. Fill the tank and prime the fuel. 2. Clean fuel vent. 3. Bleed the fuel system. 4. Adjust cable. 5. Replace fuel filter. 6. Replace injection lines. 7. Retime the engine. 8. Run a compression test. 9. Remove pump and take to authorized service dealer. 10. Adjust valves. 11. Check for current flow.
Surge at Idle	<ol style="list-style-type: none"> 1. Fuel vent blocked. 2. Air in the system from loose connections. 3. Idle speed misadjustment. 4. Governor faulty/misadjusted. 5. Fuel injection pump faulty. 6. Cold engine oil affecting governor. 	<ol style="list-style-type: none"> 1. Clean the vent. 2. Repair the loose fittings. Bleed the fuel system. 3. Adjust idle speed. 4. Remove pump and take to authorized service dealer. 5. Remove pump and take to authorized service dealer. 6. Run engine until oil warms up.
Rough Idle	<ol style="list-style-type: none"> 1. Air in the fuel system. 2. Injector nozzle not working. 3. Wrong firing order/misrouted injection line. 4. Low or uneven engine compression. 5. Fuel injection pump misadjusted. 	<ol style="list-style-type: none"> 1. Bleed the fuel system. 2. Replace nozzle. 3. Correct to the right firing order. 4. Perform a compression test. 5. Remove pump and take to authorized service dealer.
Incorrect Idle Speed or No-Load High Idle	<ol style="list-style-type: none"> 1. Low idle not adjusted. 2. No-load high idle not adjusted. 3. Governor not working properly. 4. Accelerator linkage out of adjustment. 	<ol style="list-style-type: none"> 1. Adjust low idle. 2. Adjust no-load high idle. 3. Remove pump and take to authorized service dealer. 4. Adjust accelerator linkage.
Engine Misses Under Load	<ol style="list-style-type: none"> 1. Fuel vent blocked. 2. Air in the fuel system. 3. Fuel filter plugged. 4. Injection line plugged. 5. Incorrect pump-to-engine timing. 6. Injection nozzle not working. 7. Injection pump not working. 	<ol style="list-style-type: none"> 1. Clean vent. 2. Bleed the fuel system. 3. Replace fuel filter. 4. Replace injection line. 5. Time the engine. 6. Replace nozzle. 7. Remove pump and take to authorized service dealer.

DIAGNOSIS OF FUEL INJECTION SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Low Power	<ol style="list-style-type: none"> 1. Fuel filter plugged. 2. Injection lines restricted/leakage. 3. Incorrect pump-to-engine timing. 4. Injection nozzle not working. 5. Air filter restricted. 6. Incorrect firing order. 7. Fuel pump timing assembly gear not working. 8. Engine valves out of adjustment. 9. Injection pump not working. 10. Accelerator linkage not adjusted. 	<ol style="list-style-type: none"> 1. Replace fuel filter 2. Replace injection lines. 3. Time the engine. 4. Replace nozzle. 5. Replace air filter. 6. Correct firing order. 7. Replace timing assembly. 8. Adjust the valves. 9. Remove pump and take to authorized service dealer. 10. Adjust linkage.
Excessive Fuel Consumption	<ol style="list-style-type: none"> 1. Incorrect pump-to-engine timing. 2. Injection to nozzle/line leaking. 3. Air filter restricted. 4. Low idle. 5. Fuel pump timing assembly not working. 6. Governor not adjusted. 	<ol style="list-style-type: none"> 1. Time the engine. 2. Replace line/test nozzle. 3. Replace air filter. 4. Adjust low idle. 5. Replace timing gear. 6. Remove pump and take to authorized service dealer.
Black Smoke	<ol style="list-style-type: none"> 1. Air in the fuel system. 2. Injection line restricted/leaking. 3. Incorrect pump-to-engine timing. 4. Injection nozzle leaking. 5. Air filter restricted. 6. Incorrect firing order. 7. Timing gear in full advance. 8. Low compression. 9. Fuel injection pump or governor not adjusted properly. 10. Misadjusted engine valves. 	<ol style="list-style-type: none"> 1. Bleed the fuel system. 2. Replace injection line. 3. Time the engine. 4. Test and replace if necessary. 5. Replace air filter. 6. Correct firing order. 7. Replace gear. 8. Perform a compression test. 9. Remove pump and take to authorized service dealer. 10. Adjust valves.
White or Blue Smoke	<ol style="list-style-type: none"> 1. Air in the fuel system. 2. Fuel filter plugged. 3. Injection lines restricted/leaking. 4. Incorrect pump-to-engine timing. 5. Incorrect firing order. 6. Fuel pump timing gear assembly. 7. Injection pump or governor not adjusted properly. 8. Misadjusted engine valves. 	<ol style="list-style-type: none"> 1. Bleed the fuel system. 2. Replace fuel filter. 3. Replace injection line. 4. Time the engine. 5. Set firing order. 6. Replace gear. 7. Remove pump and take to authorized Bosch service dealer. 8. Adjust valves.

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FUEL INJECTION NOZZLE TEST

If diagnosis shows that the injection nozzle is not working. The injection nozzle must be removed from the engine and mounted on a nozzle tester and checked for:

1. Opening pressure
2. Spray pattern
3. Leakage
4. Chatter

To check for the mentioned areas, follow the instructions on the tester.

Leakage

Hold the tester handle to about 2070 kPa (300 psi) below the opening pressure. If no drops of fuel fall from the nozzle tip within 10 seconds, the nozzle is not leaking (figure 6).

Opening Pressure

Opening pressure is the point where the nozzle opens and starts to spray. Read the gage pressure and compare the reading with the specifications at the end of this section.

Spray Pattern

Spray pattern is the way the atomized fuel comes out of the injection nozzle. Check for proper spray angle (figure 7).

Chatter

An easily audible chatter at all pump lever speeds should be heard.

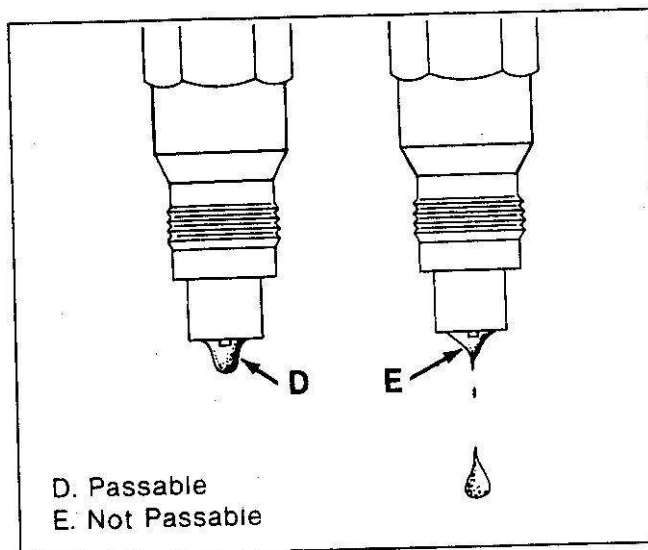


Figure 6. Fuel Injection Nozzle Leakage

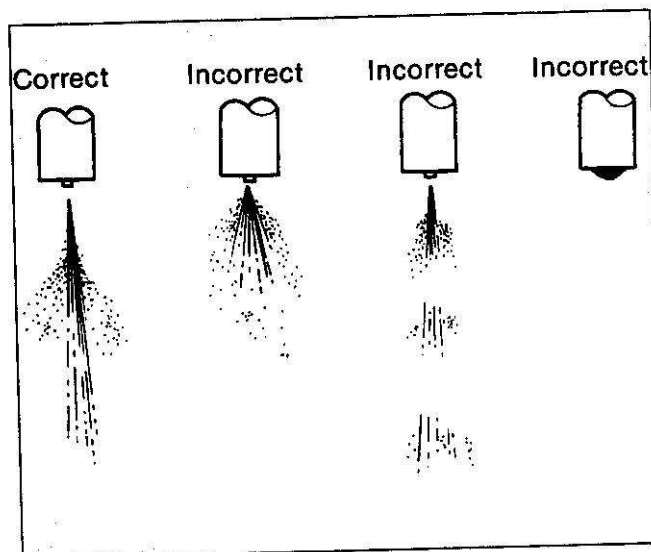


Figure 7. Fuel Injection Nozzle Spray Pattern

ON-VEHICLE SERVICE

FUEL PUMP

The fuel pump is mounted on the side of the fuel injection pump. A primer pump for fuel system bleeding is also located on top of the pump (figure 8).

FUEL PUMP REPLACEMENT

Remove or Disconnect (Figure 8)

- Tilt the cab.
 1. Fuel line from the fuel pump.
 2. Mounting stud nuts.
 3. Fuel pump and gasket.

Install or Connect (Figure 8)

1. New gasket to the fuel pump.
2. Fuel pump to the side of injection pump.
3. Fuel line.
4. Bleed the fuel system.

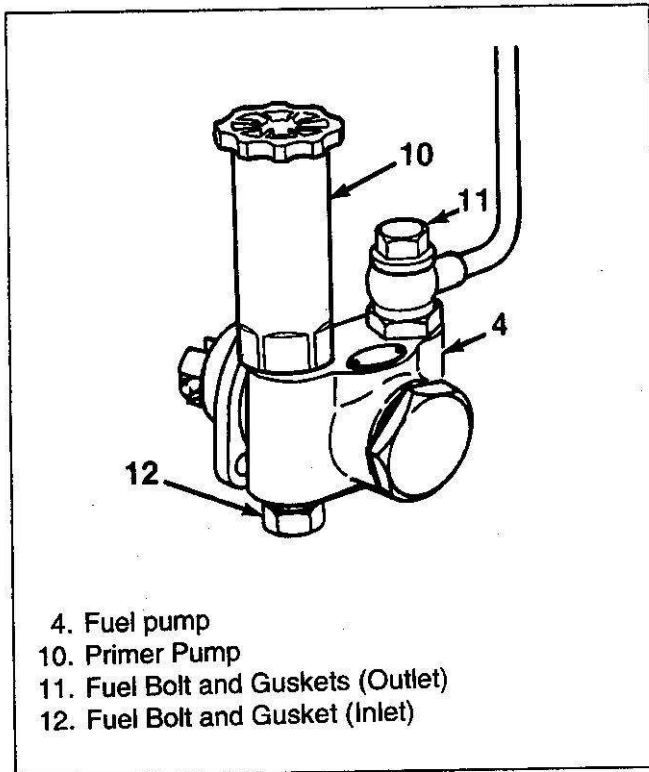


Figure 8. Fuel Pump

FUEL INJECTION NOZZLE

CAUTION: Do not bend injection lines in any shape or form to ease nozzle replacement.

Remove or Disconnect (figures 9 and 10)

- Tilt the cab.
 1. Fuel line fitting at the injection nozzle assembly (1).
 2. Fuel return line nut (16), gasket and fitting.
 3. Injection nozzle assembly (1) from the cylinder head.
 - Cap the fuel lines.
 - Plug the hole in the cylinder head with a clean shop rag.
 4. Nozzle washer (14) and corrugated washer (13).
 5. Check nozzle opening pressure, spray pattern, chatter and oil leakage. Refer to FUEL INJECTION NOZZLE TEST in this service manual.

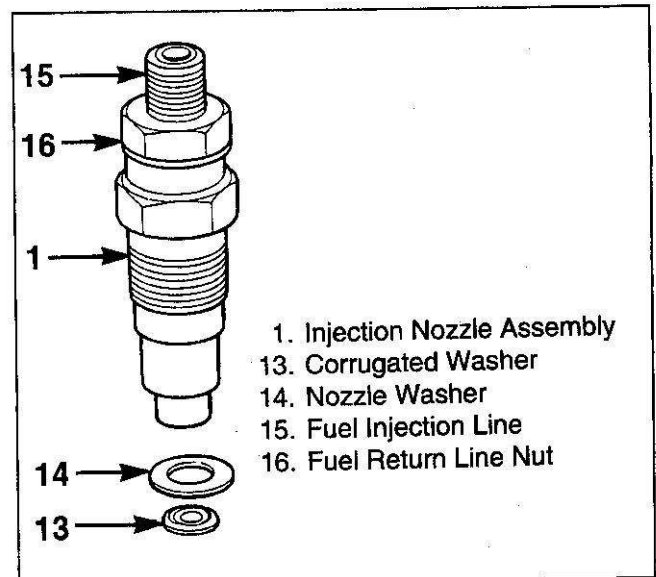
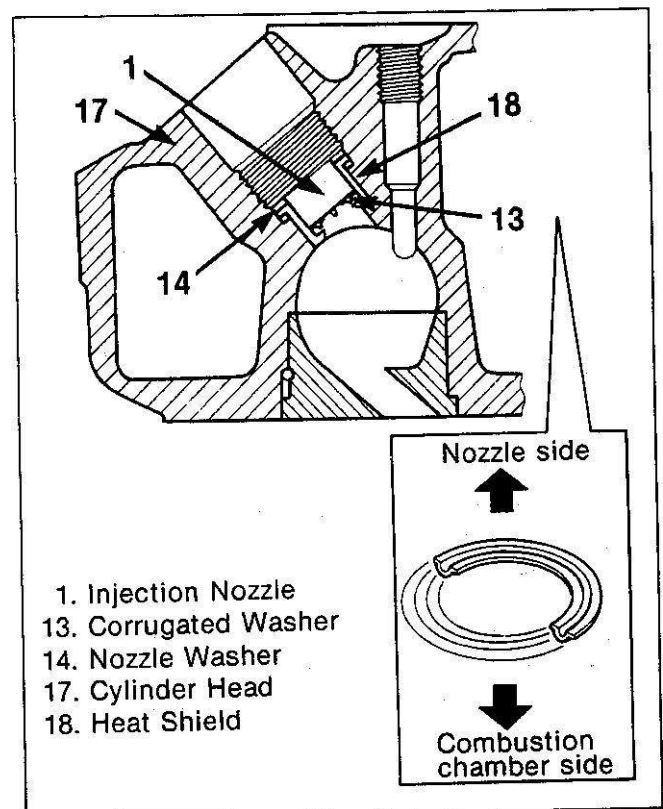
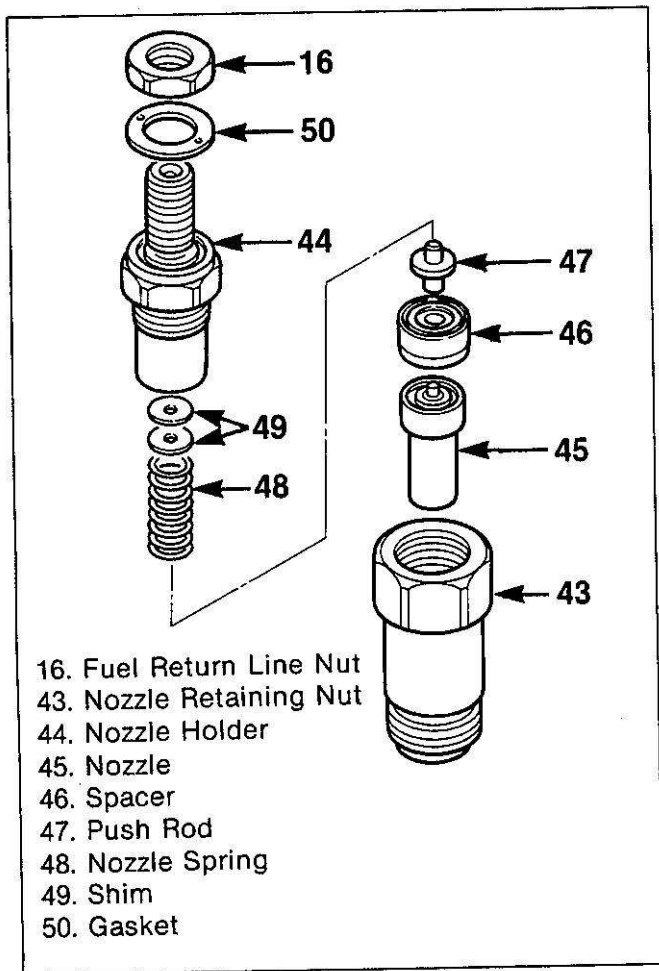


Figure 9. Injection Nozzle Assembly

Disassemble (Figure 11)

1. Clamp the nozzle holder assembly into a vise.
2. Nozzle retaining nut (43).
3. Nozzle (45).
4. Spacer (46).
5. Push rod (47).
6. Nozzle spring (48).
7. Shim (49).
8. Nozzle holder (44).





- 16. Fuel Return Line Nut
- 43. Nozzle Retaining Nut
- 44. Nozzle Holder
- 45. Nozzle
- 46. Spacer
- 47. Push Rod
- 48. Nozzle Spring
- 49. Shim
- 50. Gasket

Figure 11. Injection Nozzle Assembly

Clean (Figures 12, 13, 14 and 15)

Tool Required:

J-39531 Nozzle Cleaning Kit

1. Soak all parts other than the nozzle in a cleaning oil and wipe off all excess residue with a soft cloth or the like. Use the wire brush to clean excessively dirty parts.

CAUTION: Clean the nozzle holder mating surface and both sides of the spacer with a hardwood piece or a soft cloth.

Do not use a metal brush since scars on these surfaces cause oil leakage.

Carefully remove carbon residues sticking to inside of the retaining nut with the appropriate scraper.

Remove carbon residues and dirt on the seat surface, inside surface of the body sliding section, sac cone and spray hole inside of the nozzle body using the cleaning tools (figures 12, 13 and 14).

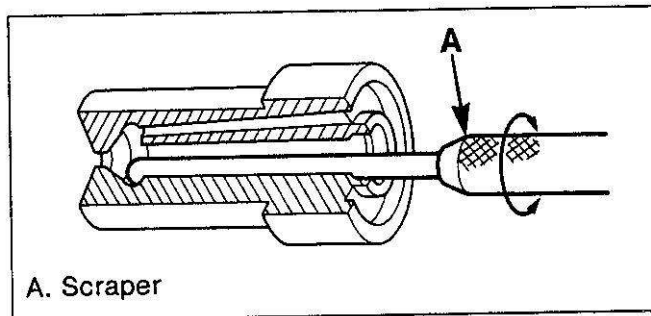


Figure 12. Cleaning of Nozzle Sac Cone

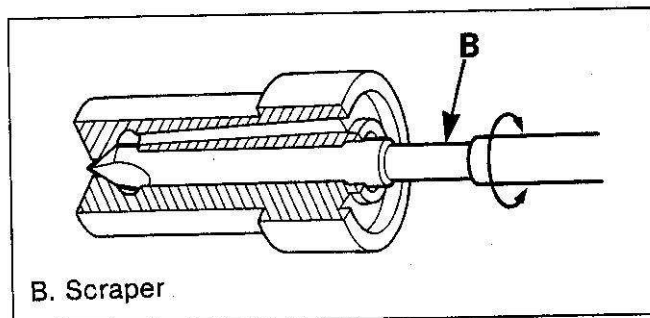


Figure 13. Cleaning of Seat Section

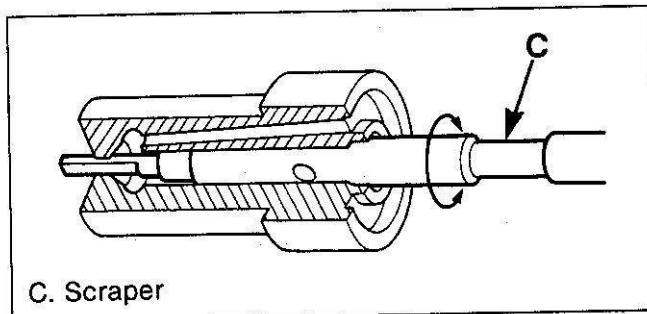


Figure 14. Cleaning of Spray Hole

2. Pull out the needle valve from the nozzle body and clean both of them to clean the nozzle. First, Holding the needle by the stem only clean the shaft section and seat surface of the needle valve using a hardwood dipped in oil or a clean soft cloth (figure 15). If a large amount of carbon residue remains and the nozzle cannot be cleaned well enough, dip the nozzle in carbon cleaner, and repeat the cleaning process.

CAUTION: Never use sand paper, metal scraper, or other abrasive materials to clean the nozzle body and needle valve.

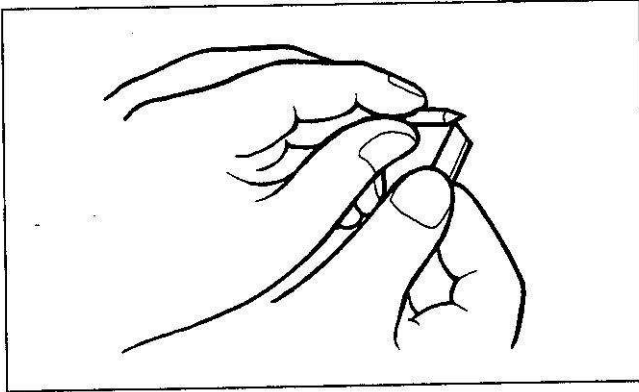


Figure 15. Needle Seat Cleaning with a Wooden Piece

3. Wash all parts in a clean oil and place them on a clean work table. For best results compressed air should be applied to them after the oil cleaning.

CAUTION: After cleaning, all parts must be coated with a light oil to prevent rust.

🔍 Inspect (Figures 11 and 16)

- The following items should be checked on all parts (figure 11):
Abrasion, corrosion, impact marks, scars, breaks, cracks, cavitation erosion, damages caused by foreign material in the fuel, or excessive. Replace any worn, corroded or damaged parts.

Nozzle slide test (Figure 16)

Dip the nozzle and needle in light oil and assemble. Insert the needle all the way into the body. Raise the needle 1/3 (one-third) of the way out and release. The needle must slide all the way back into the body by its own weight. If the needle sticks, reclean and repeat the slide test. Any nozzle that fails must be replaced.

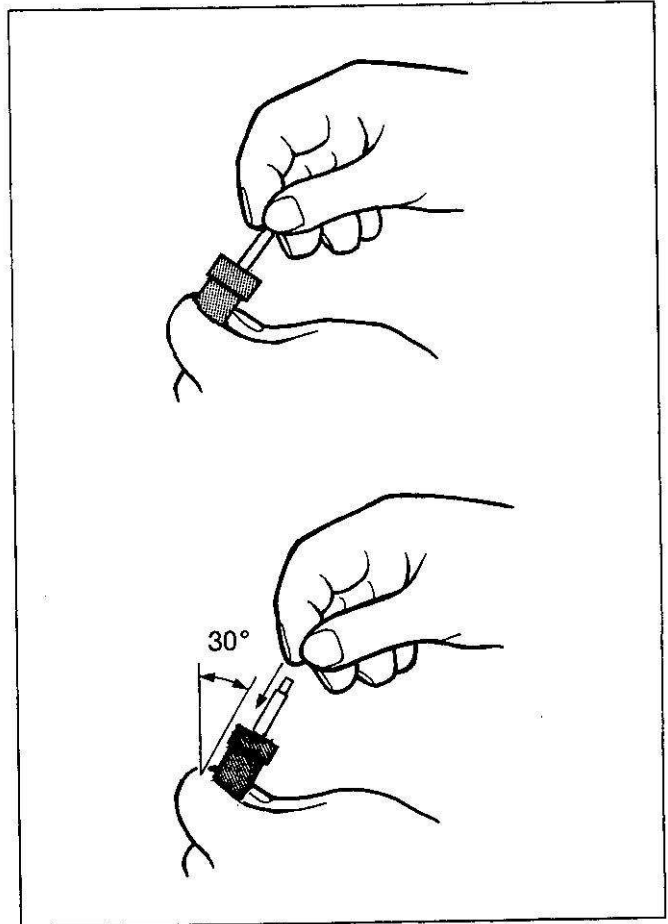


Figure 16. Nozzle Slide test

⊠ Assemble (Figure 11)

CAUTION: New nozzle must be cleaned in a solvent to remove protective coating. The nozzle body and needle must always be replaced as an assembly.

Tool Required:

J-39543 Nozzle guide

1. Clamp the nozzle holder to a vise.
2. Shim (49).
3. Nozzle spring (48).
4. Push rod (47).
5. Spacer (46).
6. Nozzle (45).
7. Nozzle retaining nut (43).
8. Insert the nozzle guide to center the nozzle in the retaining nut.

🔩 Tighten

- Retaining nut to 88 N·m (65 lb-ft).

9. Check nozzle opening pressure, spray pattern, chatter and oil leakage. Refer to FUEL INJECTION TEST in this service manual.

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Nozzle Opening Pressure Adjustment

1. Check nozzle opening pressure.
 - The gage should read 13 700 to 14 500 kPa (2 000 to 2 100 psi).
 2. If the nozzle opening pressure does not meet specification, disassemble the nozzle and holder assembly and replace the shim with a new one.
 - Use a thicker shim, if the pressure is lower than the specification.
 - Use a thinner shim, if the pressure is higher than the specification.
- The shim is available in the following thickness.

0.50 mm 0.0197 in	0.78 mm 0.0307 in
0.54 mm 0.0213 in	0.82 mm 0.0323 in
0.58 mm 0.0228 in	0.86 mm 0.0339 in
0.62 mm 0.0244 in	0.90 mm 0.0354 in
0.66 mm 0.0260 in	0.94 mm 0.0370 in
0.70 mm 0.0276 in	0.98 mm 0.0386 in
0.74 mm 0.0291 in	1.00 mm 0.0394 in

Install or Connect (Figures 9 and 10)

1. New corrugated washer (13) with blue color painted side turned to the nozzle.
2. New nozzle washer (14).
3. Injection nozzle assembly (1).

Tighten

- Injection nozzle assembly to 64 N·m (47 lb·ft).

4. Gasket, fuel return line and nut (16).

Tighten

- Fuel return line nut to 35 N·m (26 lb·ft).

5. Fuel line (15).

Tighten

- Fuel line sleeve nut (15) to 30 N·m (22 lb·ft).

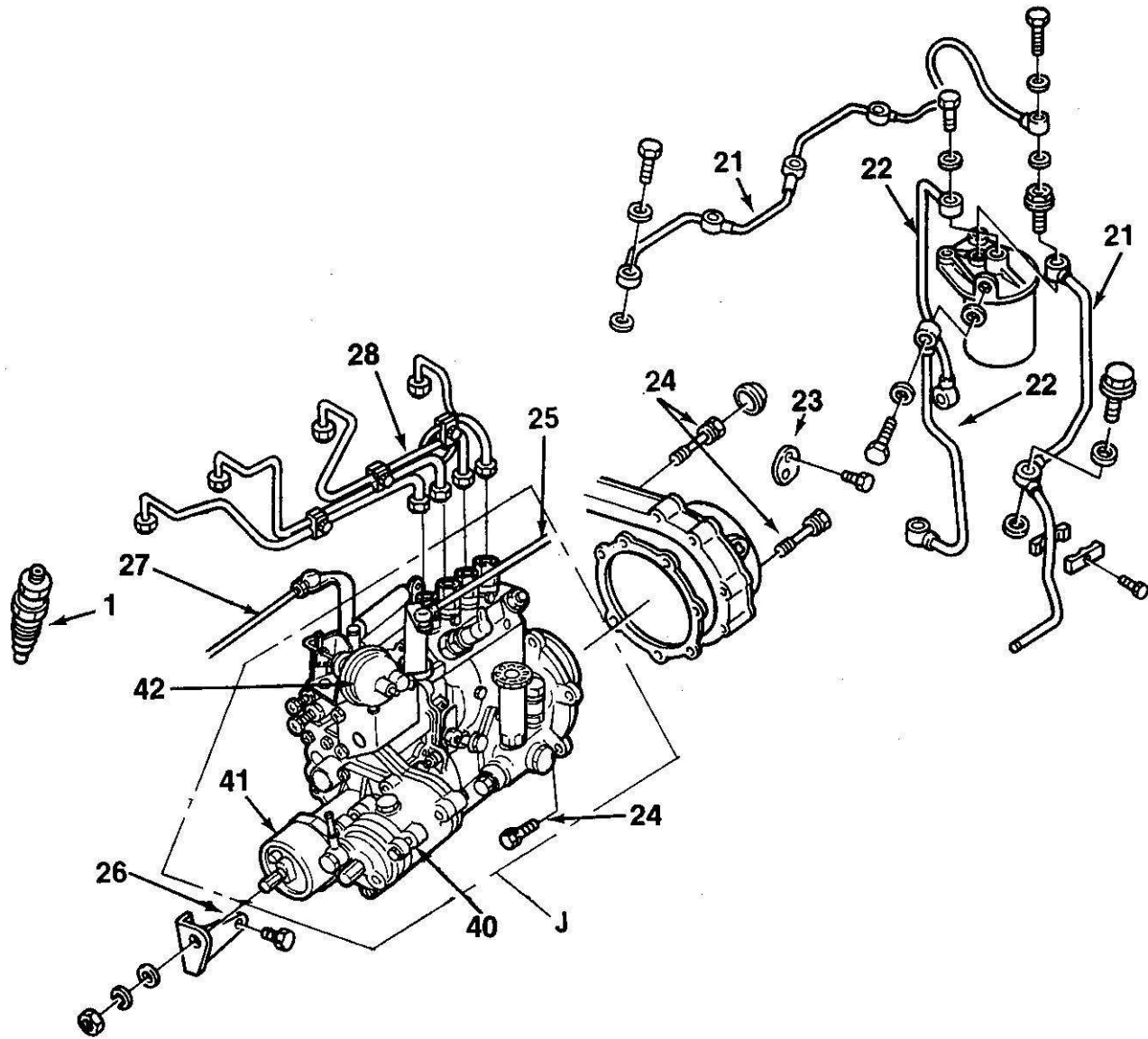
6. Bleed the fuel system.

NOTICE: After the Cleaning Procedure is completed, be sure to perform the Opening Pressure Test, the Spray Pattern Test, the Leakage Test and Chatter Test. Refer to appropriate section in to the Service Manual for details on these tests.

FUEL INJECTION PUMP REPLACEMENT

Remove or Disconnect (Figures 17 and 18)

- Tilt the cab.
 1. Battery positive cable.
 2. Engine stop cable (25).
 3. fuel injection lines (28).
 4. Injector return line (21).
 5. Intake manifold.
 6. Accelerator cable (27).
 7. Fuel lines between the secondary fuel filter and the pump (22).
 8. Hole cover from timer housing (23).
 - For ease in reinstalling the injection pump, align the timing mark on the automatic timer with the pointer on the timer housing (figure 17).
 9. Injection pump mounting bolts (24).
10. Injection pump.



- 1. Fuel Injection Nozzle
- 21. Fuel Return Line
- 22. Fuel Delivery Line
- 23. Hole Cover
- 24. Mounting Bolt
- 25. Engine Stop Cable
- 26. Mounting Bracket
- 27. Accelerator Cable
- 28. Fuel Injection Lines
- 40. Boost Compensator
- 41. Aneroid Compensator
- 42. Fast Idle Actuator
- J. Fuel Injection Pump Assembly

Figure 17. Fuel Injection Pump and Related Parts

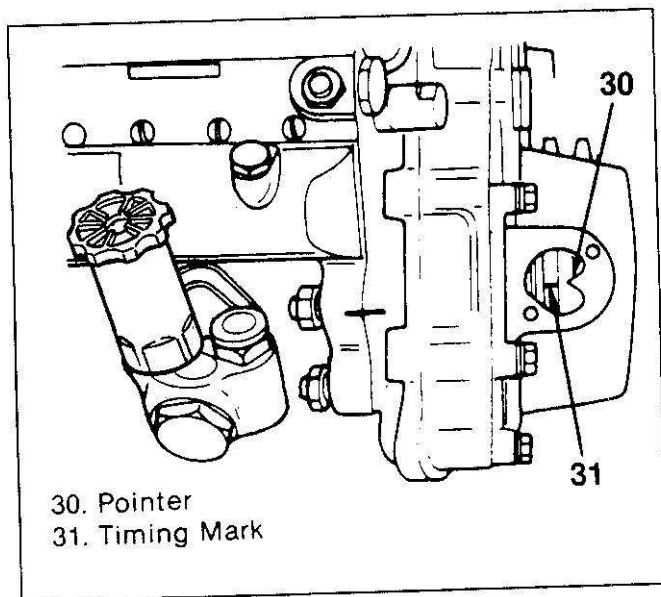


Figure 18. Timing Marks and Pointer

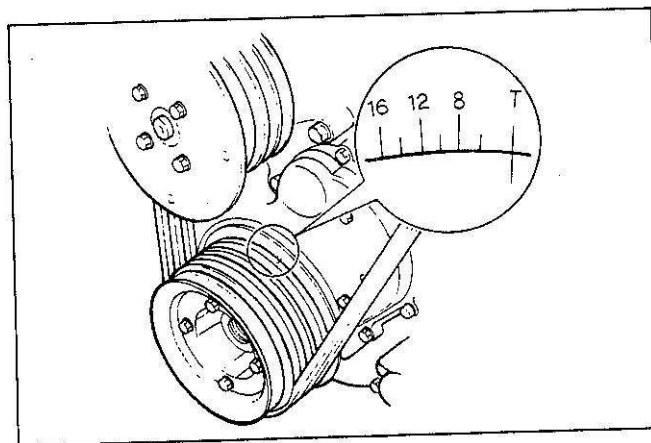


Figure 19. TDC Mark and Crank Pulley Mark

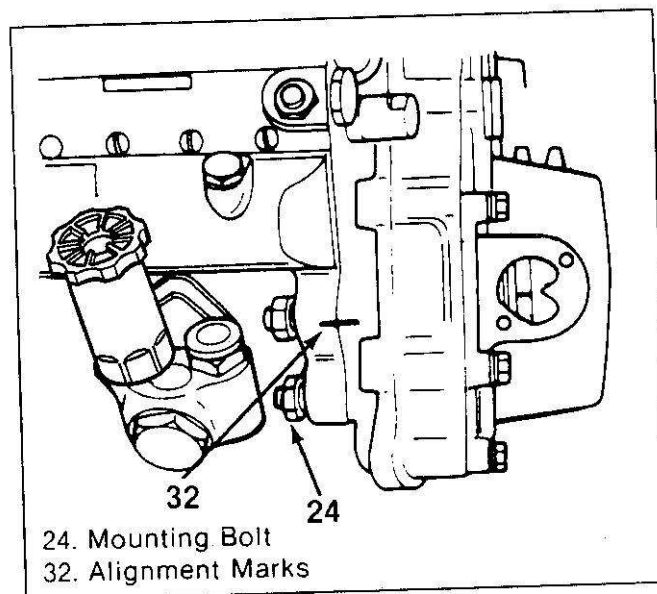


Figure 20. Alignment Marks

Install or Connect (Figures 17, 18, 19 and 20)

- Before installing the fuel injection pump, add 1/2 liter (one pint) of engine oil in through the engine oil feed hole.
- Turn the crank to align the timing mark on the crank pulley with the TDC mark (figure 19).
 1. Injection pump to the engine.
 - Install the injection pump so that the timing mark on the timer aligns with the pointer on the timer housing (figure 18).
 - Also align the marks on the injection pump and the timing gear housing (figure 20).
 2. Injection pump mounting bolts (24).
 3. Fuel delivery lines between the filter and the pump (22).
 4. Accelerator cable (27).
 5. Intake manifold.
 6. Fuel return lines (21).
 7. fuel injection lines (28).
 8. Engine stop cable (25).
 9. Hole cover on timing gear housing (23).
 10. Battery positive cable.
 11. Check the injection pump to engine timing as described under "Checking the Injection Pump Timing" in this section and time if necessary.
 12. Bleed the fuel system of air.

BLEEDING THE FUEL SYSTEM

Anytime the fuel system is opened to the atmosphere, outside air can enter. Air bubbles, trapped in the fuel system, will cause the engine to run poorly. After any service that requires opening the fuel system has been performed, all trapped air must be removed by bleeding the system (figure 21).

1. Tilt the cab.
2. Loosen jam nut and bleed screw on the injection pump.
3. Pump the primer pump until fuel flow is free of air bubbles.
4. Tighten the bleed screw and jam nut.
5. Lower the cab.

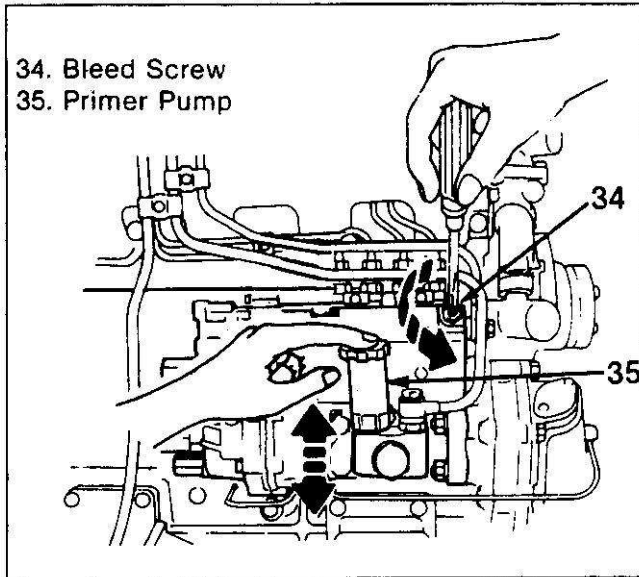


Figure 21. Bleeding the Fuel System

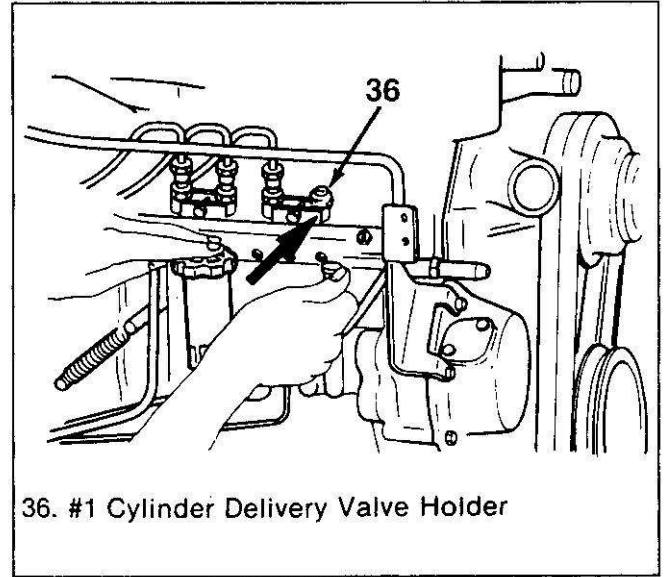


Figure 22. Timing the Injection Pump

CHECKING THE FUEL INJECTION PUMP TIMING

1. Tilt the cab.
2. Disconnect the positive battery cable.
3. Check that the marks on the automatic timer and the pump housing are properly aligned (figure 18).
4. Check that the timer mounting bolts are tight (figure 20).
5. Disconnect the fuel line from the #1 cylinder fuel injection line (figure 22).
6. Remove the delivery valve holder, spring and the delivery valve (figure 23).
7. Install the delivery valve holder back into the injection pump and tighten to 40 N·m (30 lb·ft).
8. Rotate the crankshaft until fuel appears at the open top of the delivery valve holder.
9. Observe the timing mark on the crank pulley (figure 19). Refer to "Specifications" for the correct timing figures.
10. If timing is correct, install the delivery valve and spring and tighten the delivery valve holder to 40 N·m (30 lb·ft). If timing is not correct, proceed as follows:

FUEL INJECTION PUMP TIMING ADJUSTMENT

1. Turn the crank until the timing mark on the crank pulley is aligned with the correct number of degrees from the "Specifications" at the end of this section.
2. Remove the fuel line between the fuel feed pump and the fuel filter for access to the automatic timer mounting nuts. Do not bend the fuel line.
3. Loosen the four timer mounting nuts (figure 20).
4. Replace the fuel line.
5. Disconnect the fuel line from the #1 cylinder fuel injection (figure 21).
6. Remove the delivery valve holder, spring and the delivery valve (figure 22).
7. Install the delivery valve holder back into the injection pump and tighten to 40 N·m (30 lb·ft).
8. Pump the fuel primer pump till fuel flows from the open top of the delivery valve holder. Continue to pump the primer pump and at the same time turn the injection pump housing in the opposite direction to crankshaft rotation (figure 22).
9. Turn the pump housing until the fuel flow from the delivery valve holder stops. Then pump the primer pump a little more to be sure that the fuel flow has completely stopped.
10. Remove the fuel line for access to the timer mounting nuts.
11. Tighten the timer mounting nuts.
12. Re-install the fuel line.
13. Check the timing as described earlier under "Checking the Fuel Injection Pump Timing"
14. Install the delivery valve and spring back into

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- the injection pump and tighten to 40 N·m (30 lb·ft).
15. Install the fuel line to #1 cylinder fuel injection.
 16. Connect the positive battery cable.

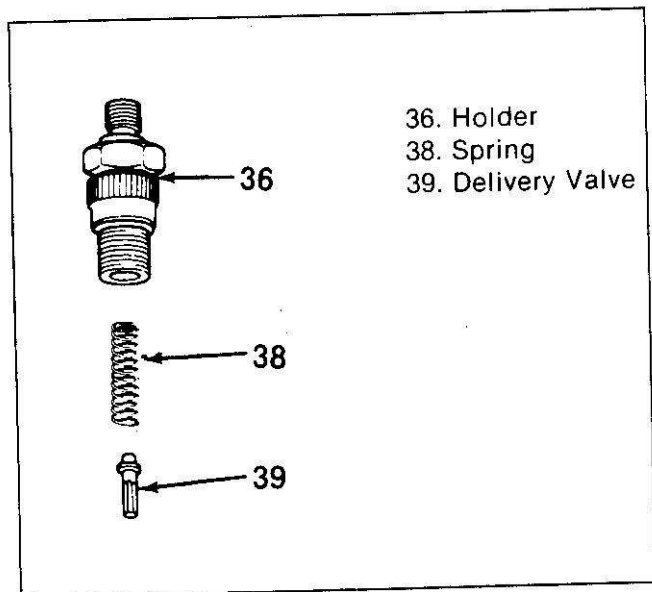


Figure 23. Delivery Valve Components

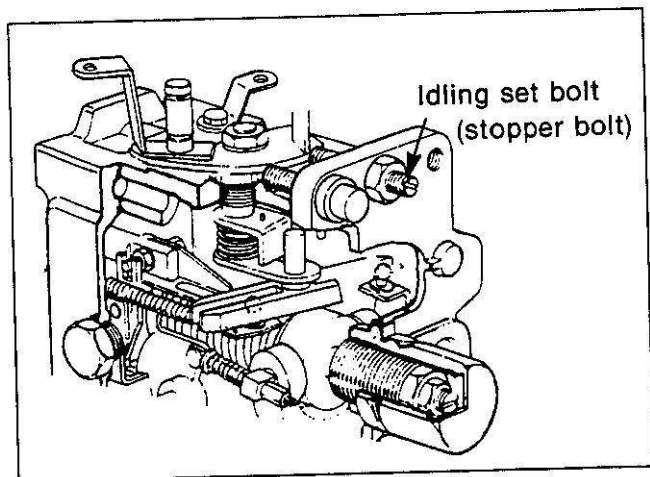


Figure 24. Idling Speed Adjustment

IDLE SPEED ADJUSTMENT

1. Bring the engine to operating temperature.
2. Make sure that the control lever is in contact with the stopper bolt at idle.
3. Adjust the idle speed to specification.

Manual Transmission:

650 ± 30 RPM

Automatic Transmission:

650 ± 30 RPM (in "D" position)

WARNING:

- WHEN SELECTOR LEVER IS SHIFTED TO "D" POSITION, APPLY PARKING BRAKE AND BLOCK BOTH FRONT AND REAR WHEELS WITH CHOCKS.
- WHEN RACING ENGINE ON AUTOMATIC TRANSMISSION EQUIPPED MODELS, MAKE SURE THAT SHIFT LEVER IS IN "N" POSITION AND DEPRESS BRAKE PEDAL TO PREVENT FORWARD SURGE OF VEHICLE.
- AFTER THE ADJUSTMENT HAS BEEN MADE, SHIFT THE LEVER TO THE "N" POSITION AND REMOVE WHEEL CHOCKS.

Adjust

- Loosen the jam nut and turn the stopper bolt.
 - Turn the stopper bolt clockwise to increase engine speed.
 - Turn the stopper bolt counterclockwise to decrease engine speed.
- Tighten the jam nut.

SPECIFICATIONS

EMISSION SPECIFICATIONS

Engine Idle Speed.....	Manual Transmission 650 ± 30 RPM Automatic Transmission 650 ± 30 RPM (in "D" position)
Injection Timing.....	BTDC 8°
Injection Nozzle Opening Pressure	
Production.....	13 700–14 500 kPa (2 000–2 100 psi)
Service Limit.....	13 240 kPa (1 920 psi)

FASTENER TORQUES

Injection Nozzle Retaining Nut.....	88 N·m (65 lb·ft)
Injection Nozzle Assembly to Cylinder Head.....	64 N·m (47 lb·ft)
Fuel Return Line Nut.....	35 N·m (26 lb·ft)
Fuel Line Sleeve Nut.....	30 N·m (22 lb·ft)

SPECIAL TOOLS

J-28829	Nozzle Tester
J-39531	Nozzle Cleaning Kit
J-39543	Nozzle Guide

