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.

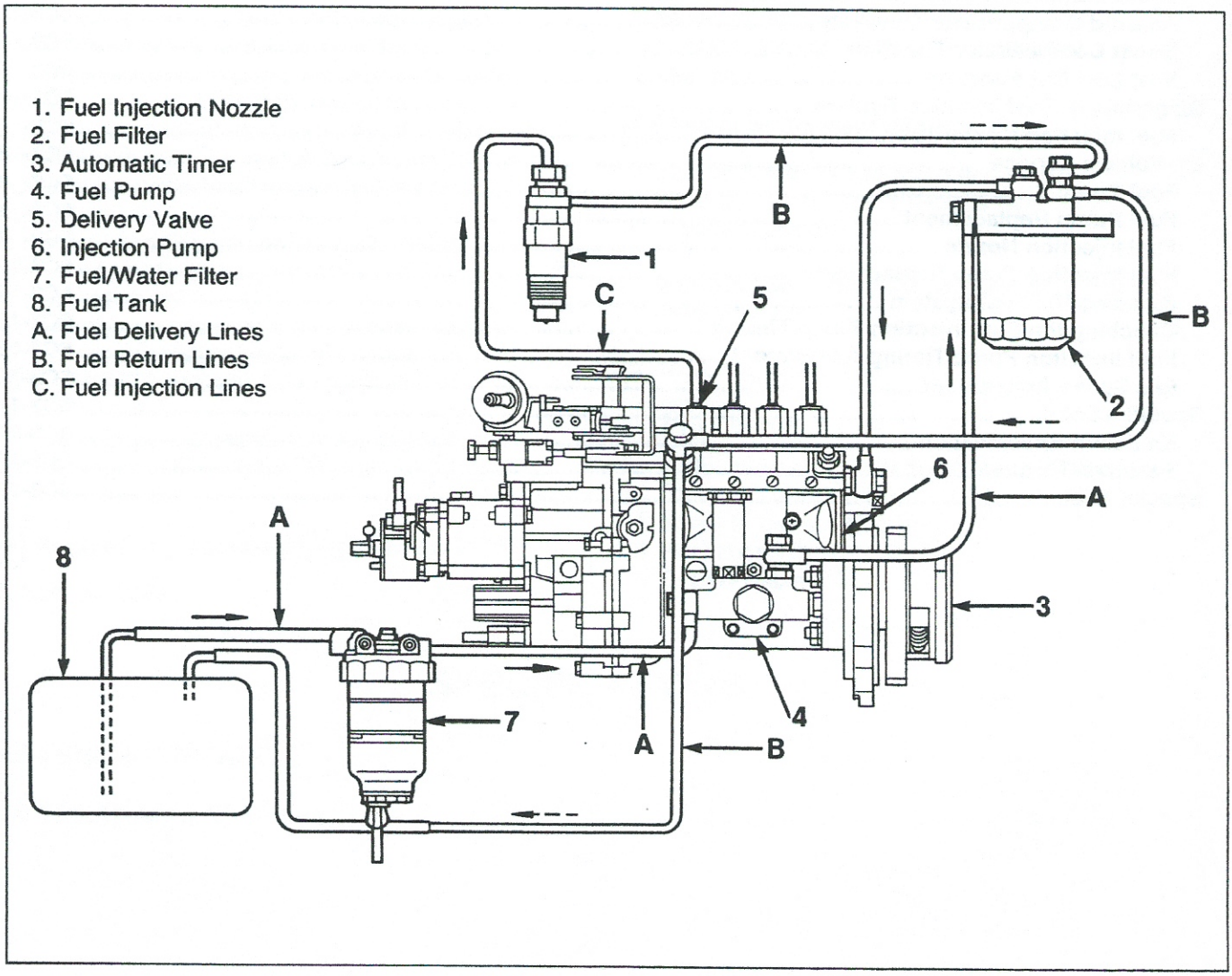
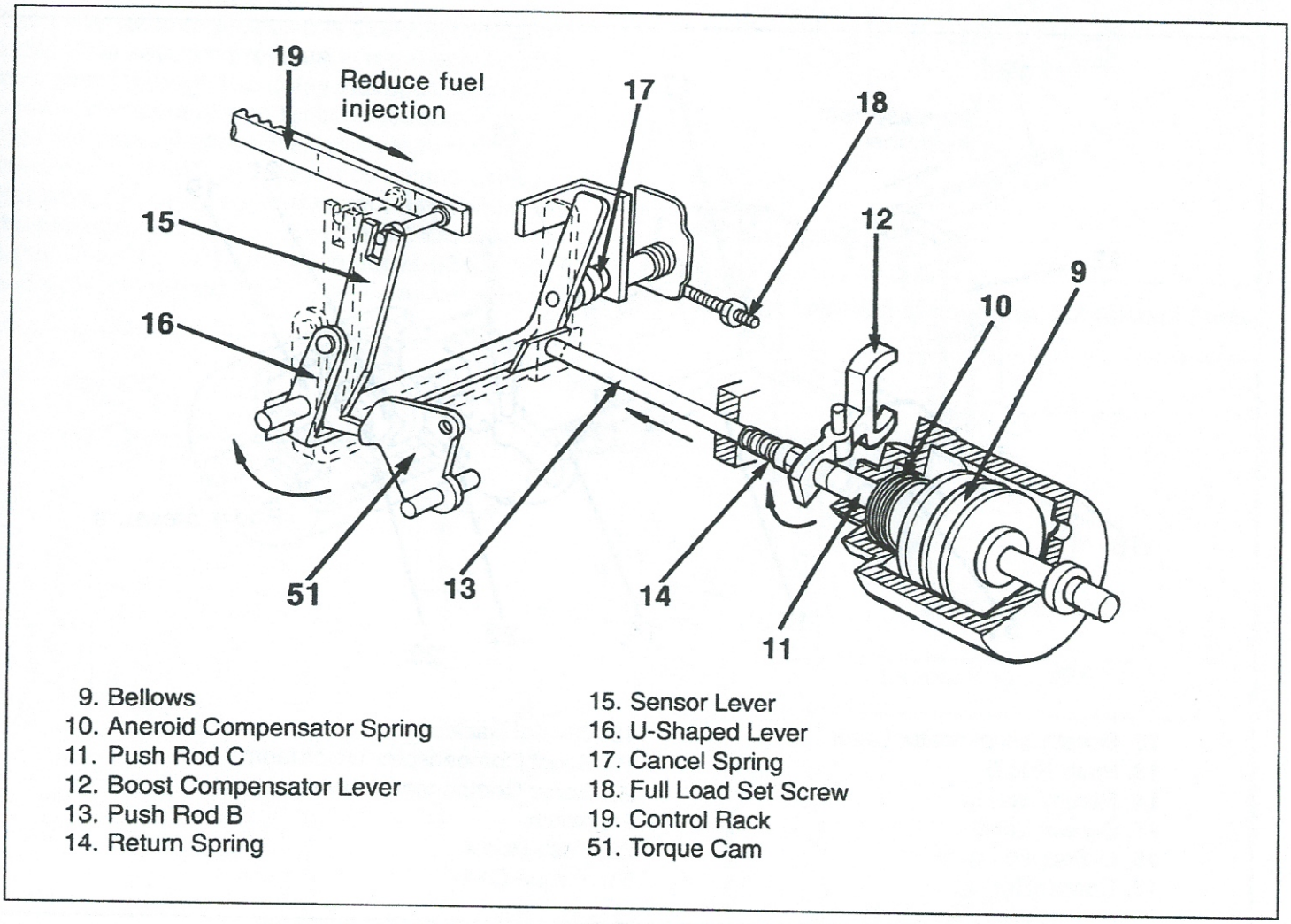


Figure 1. Fuel Injection System

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.



9. Bellows
10. Aneroid Compensator Spring
11. Push Rod C
12. Boost Compensator Lever
13. Push Rod B
14. Return Spring
15. Sensor Lever
16. U-Shaped Lever
17. Cancel Spring
18. Full Load Set Screw
19. Control Rack
51. Torque Cam

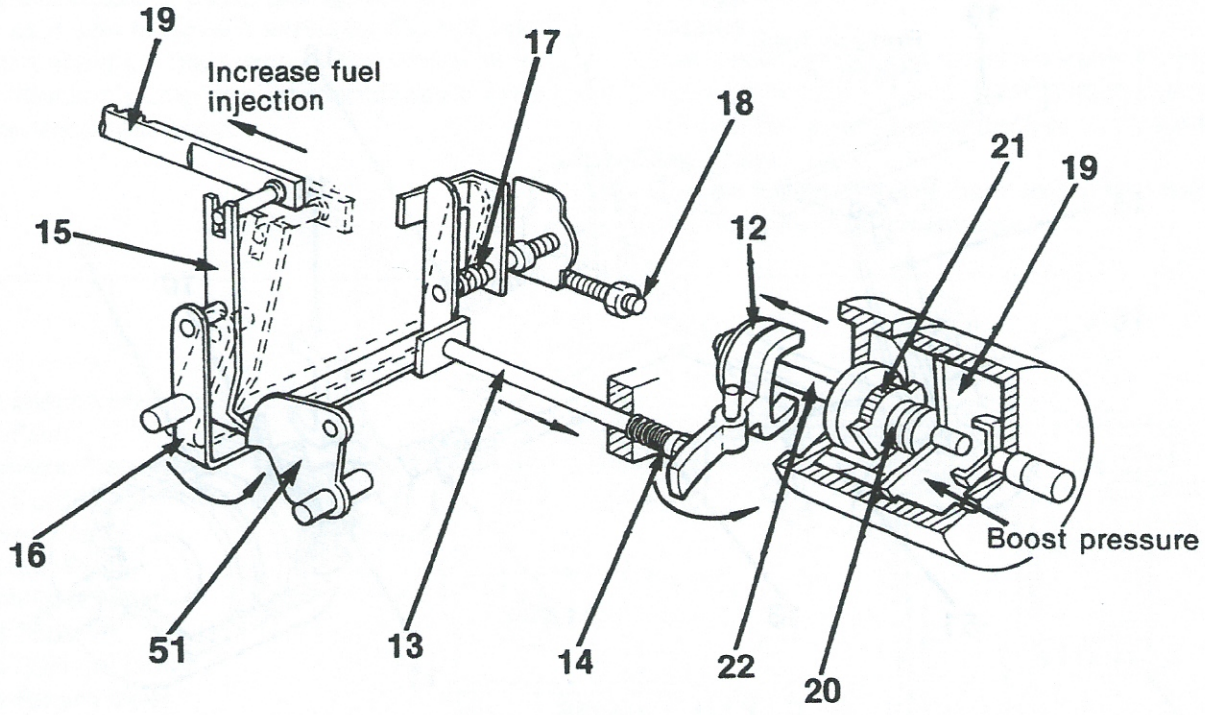
Figure 2. Link Motion when Aneroid Compensator is Functioning

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 (19) to move away from the governor to increase fuel injection.



12. Boost Compensator Lever
13. Push Rod B
14. Return Spring
15. Sensor Lever
16. U-Shaped Lever
17. Cancel Spring
18. Control Rack
19. Boost Compensator Diaphragm
20. Boost Compensator Spring
21. Notch
22. Push Rod A
51. Torque Cam

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 overheat by sensing the engine coolant temperature (ECT) with the aneroid compensator.

This system consists of a thermo switch, (sences 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.

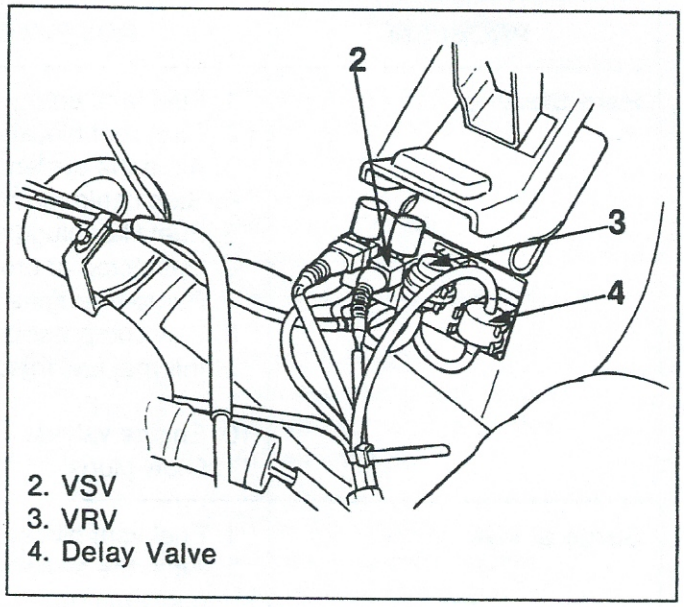


Figure 4. Location of Fuel Low Cut System Parts

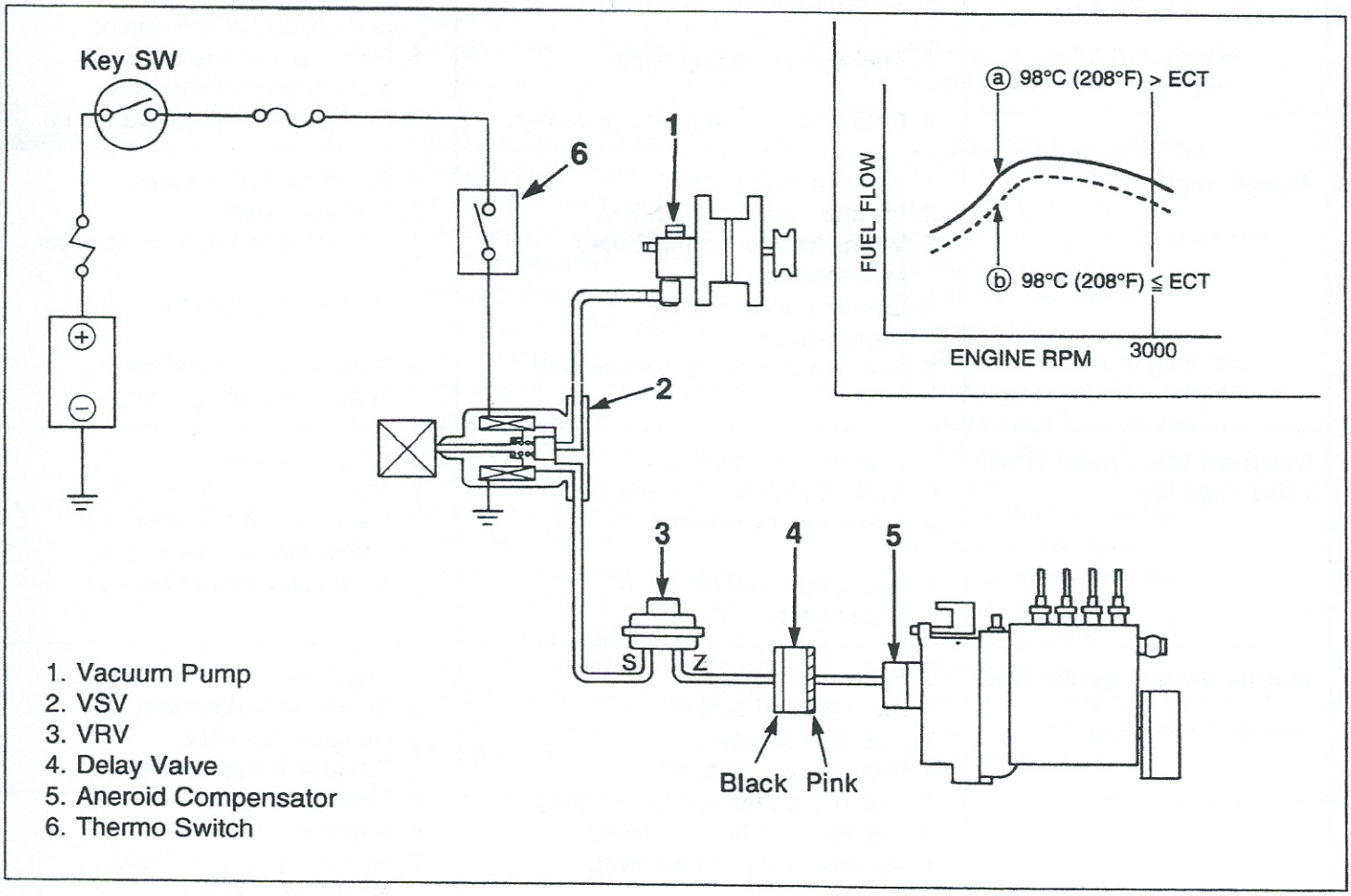


Figure 5. Diagram of Fuel Low Cut System

DIAGNOSIS OF FUEL INJECTION SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hard Starting	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.	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	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.	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	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.	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	1. Low idle not adjusted. 2. No-load high idle not adjusted. 3. Governor not working properly. 4. Accelerator linkage out of adjustment.	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	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.	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.