



Service Information System

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Special Instruction

SPN 3055 FMI 1 No Start Due to Low Rail Fuel Pressure Troubleshooting for Certain CT660 On Highway Trucks{7000}

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SPN 3055 FMI 1 No Start Due to Low Rail Fuel Pressure Troubleshooting for Certain CT660 On Highway Trucks{7000}

SMCS - 7000

On Highway Truck:

CT660 (S/N: TGA1-UP; TGD1-UP; TJD1-UP; TEJ1-UP; TRK1-UP; TKL1-UP; TEM1-UP; TEP1-UP; TGR1-UP; TGS1-UP; TJS1-UP; TGT1-UP; TGW1-UP; TSW1-UP; TEY1-UP; TSY1-UP; TEZ1-UP; TGZ1-UP)

Introduction

This Special Instruction provides the information to diagnose and troubleshoot low rail fuel pressure on the machines listed above.

Important Safety Information



WARNING

Accidental engine starting can cause injury or death to personnel working on the equipment.

To avoid accidental engine starting, disconnect the battery cable from the negative (-) battery terminal. Completely tape all metal surfaces of the disconnected battery cable end in order to prevent contact with other metal surfaces which could activate the engine electrical system.

Place a Do Not Operate tag at the Start/Stop switch location to inform personnel that the equipment is being worked on.

 **WARNING**

Personal injury or death can result from sudden machine movement.

Sudden movement of the machine can cause injury to persons on or near the machine.

To prevent injury or death, make sure that the area around the machine is clear of personnel and obstructions before operating the machine.

 **WARNING**

Do not attempt to assemble this machine until you read and you understand the assembly instructions.

Improper assembly procedures could result in injury or death.

 **WARNING**

Personal injury can result from hydraulic oil pressure and hot oil.

Hydraulic oil pressure can remain in the hydraulic system after the engine has been stopped. Serious injury can be caused if this pressure is not released before any service is done on the hydraulic system.

Make sure all of the work tools have been lowered to the ground, and the oil is cool before removing any components or lines. Remove the oil filler cap only when the engine is stopped, and the filler cap is cool enough to touch with your bare hand.

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Dealer Service Tool Catalog" for tools and supplies suitable to collect and contain fluids on Cat products.

Dispose of all fluids according to local regulations and mandates.

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

NOTICE

Contact with high pressure fuel may cause personal injury or death. Wait 60 seconds after the engine has stopped to allow fuel pressure to purge before any service or repair is performed on the engine fuel lines.

Note: Cleanliness is an important factor. Before beginning the removal procedure, clean the exterior of the components thoroughly. Cleaning the components will help to prevent dirt from entering the internal mechanism.

Note: Put identification marks on all hoses, on all hose assemblies, on all harness assemblies, and on all tube assemblies for installation purposes. Plug all hose assemblies and all tube assemblies in order to prevent fluid loss, and contaminants from entering the system.

SPN 3055 FMI 1 - Low Fuel Pressure at Start

Table 1

Condition / Description	Setting Criteria	Enable Conditions / Values	Time Required
Fuel Rail Pressure (FRP) below minimum pressure.	Fuel Rail Pressure (FRP) less than 10000 kPa (1450 psi)	Engine Speed > 70 rpm	0.5 seconds
		Ambient Pressure > 83 kPa (12 psi)	
		Ambient Temp > -7.04 °C (19.34 °F)	
		Battery Voltage (before crank) > 11 Volts	

Fault Overview

Fault code sets when the Engine Control Module (ECM) detects FRP does not build within a predetermined time while the engine is cranking.

Malfunction Indicator Lamp (MIL) Reaction

MIL will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 94 FMI 0 (FDP), SPN 157 FMI 3, SPN 157 FMI 4, SPN 157 FMI 20, and SPN 157 FMI 21 (FRP), and SPN 633 FMI 3, SPN 633 FMI 4, and SPN 633 FMI 5 (FPCV).

Drive Cycle to Determine Fault Status

Drive Cycle 2 in Troubleshooting, UENR5715, "2013 HD-OBD Diagnostic Reference Manual".

Possible Causes

- Fuel Rail Pressure FRP sensor or circuit fault.
- Low fuel level
- Fuel leaks
- Restricted engine mounted secondary fuel filter
- Aerated fuel delivery
- Restricted fuel supply
- Internal leak in high-pressure fuel system
- Leaking FRP relief valve

- Leaking KUEV valve
- Failed High-pressure fuel pump

Table 2

Low Pressure Fuel System Testing		
Step	Action	Decision
1	Check fuel level. Read fuel level using the vehicle instrument panel gauge and perform a visual inspection of fluid level in the fuel tank.	Yes: Go to Step 2.
		No: Add fuel or repair leaks, and prime engine.
2	Using Personal Computer (PC) with engine diagnostic software, check Diagnostic Trouble Code (DTC) list for SPN 94 FMI 0 (FDP), SPN 157 FMI 3, SPN 157 FMI 4, SPN 157 FMI 20, and SPN 157 FMI 21 (FRP), and SPN 633 FMI 3, SPN 633 FMI 4, and SPN 633 FMI 5 (FPCV). Is PC DTC list free of SPN 94 FMI 0 (FDP), SPN 157 FMI 3, SPN 157 FMI 4, SPN 157 FMI 20, and SPN 157 FMI 21 (FRP), and SPN 633 FMI 3, SPN 633 FMI 4, and SPN 633 FMI 5 (FPCV)?	Yes: Go to Step 3.
		No: Repair SPN 94 FMI 0 (FDP), SPN 157 FMI 3, SPN 157 FMI 4, SPN 157 FMI 20, and SPN 157 FMI 21 (FRP), and SPN 633 FMI 3, SPN 633 FMI 4, and SPN 633 FMI 5 (FPCV). See health report for link to diagnostics.
3	Check that the engine cranks at a minimum of 130 rpm.	Yes: Go to Step 4.
		No: Repair low cranking speed.
4	Verify the engine starts. Crank engine for maximum of 20 seconds. If engine does not start, wait 2 minutes and try again. Does engine start and maintain idle?	Yes: Go to SPN 3055 FMI 15.
		No: Go to Step 5.
5	Check for low Fuel Delivery Pressure (FDP). With Fuel Pressure Gauge 372-5239 connected at inlet to secondary fuel filter, monitor FDP while cranking. Does FDP measure > 207 kPa (30 psi).	Yes: Go to Step 9.
		No: Got to Step 6.
6	Check for low FDP. Perform Fuel Delivery Pressure (FDP) Test. Refer to Level ""Fuel Delivery Pressure (FDP) Test" ". Is FDP > 207 kPa (30 psi) gauge or 138 kPa (20 psi) in engine diagnostic software.	Yes: Repair restriction in fuel supply to Low- Pressure Fuel Pump.
		No: Go to Step 7

7	Check for failed low-pressure fuel pump. Perform Fuel Dead Head Test. Refer to Level ""Fuel Dead Head Test" ". Is pressure 448 kPa (65 psi)?	Yes: Go to Step 8.
		No: Replace High Pressure (HP) fuel pump.
8	Check for a restricted engine fuel filter. Perform High -pressure Pump Inlet Pressure Test. Refer to Level ""High -pressure Pump Inlet Pressure Test" ". Does the fuel pressure gauge read 207 kPa (30 psi)?	Yes: Go to Step 9.
		No: Replace Engine Fuel Filter.
9	Check for aeration in low-pressure fuel system. Perform Fuel Aeration Test. Refer to Level ""Fuel Aeration Test" ". Is fuel system free from aeration?	Yes: Go to Step 10.
		No: Repair aeration in low-pressure fuel system (according to Fuel Aeration Test).
10	Check for restriction in low-pressure fuel system. Perform Fuel Restriction Test. Refer to Level ""Fuel Restriction Test" ". Is fuel system free of restriction?	Yes: Go to Step 11.
		No: Repair restriction in low-pressure fuel system (according to Fuel Restriction Test).

Table 3

High Pressure Fuel System Testing		
Step	Action	Decision
11	Check for fuel return. Perform Fuel Rail Pressure (FRP) Return Flow Test part 1. Disconnect fuel drain tube assembly at rear of cylinder head. Connect High Pressure Return Line Tester 373-4728 -1 to cylinder head and route other end to diesel fuel container. Crank engine for 20 seconds while monitoring fuel return from High Pressure Return Line Tester 373-4728-1. Is the line free of return fuel from cylinder head and rail?	Yes: Go to Step 12.
		No: Go to Step 14.
12	Check for a failed fuel pressure relief valve. Perform Fuel Rail Pressure (FRP) Return Flow Test part 2. Restore all fuel line connections. Disconnect fuel rail return line at fuel rail. Connect High Pressure Return Line Tester 373-4728-1 to fuel rail return port and route other end to diesel fuel container. Crank engine and monitor fuel return from High Pressure Return Line Tester 373-4728-1. Is the line free of return fuel from fuel rail?	Yes: Go to Step 13.
		No: Replace fuel rail.
13		Yes: Replace High Pressure (HP) fuel

	Check for a failed KUEV Valve. Complete the HP Pump Return Flow Test. Refer to Level ""HP Pump Return Flow Test" ". Is fuel line free of fuel from the high-pressure pump return port?	pump then go to step 15. No: Replace KUEV valve.
14	Check for an internal leak in the high-pressure fuel system. Perform Fuel Rail Pressure (FRP) Leak Isolation Test. Refer to Level ""Fuel Rail Pressure (FRP) Leak Isolation Test" ". Is engine free of leaking injector?	Yes: Retest for SPN 3055 FMI 1 and if it remains notify supervisor. No: Replace the last capped injector and all HP lines removed during this test.
15	Run HP Pump Fuel Return Pressure Test. Refer to ""HP Pump Fuel Return Pressure Test" ". Is Pressure 90 kPa (13 psi)?	Yes: Retest for SPN 3055 FMI 1. No: Repair restriction in fuel return line between high - pressure fuel pump and fuel tank.

Note: After performing all diagnostic steps, if SPN 3055 FMI 1 remains, verify that each step was completed correctly and the proper decision was made. Notify supervisor for further action.

Table 4

Quantity	Part Description	Part Number	Step	SRT Description
1	High-pressure fuel rail	376-2724	12	High-pressure fuel rail, Replace
1	High-pressure fuel pump kit	421-3155	13	High Pressure Fuel Pump & Drive Gear, Replace
1	KUEV	435-4822	13	KUEV, Replace

5 HARD START AND NO START DIAGNOSTICS

Fuel Delivery Pressure (FDP) Test

Purpose

Verify that there is sufficient fuel pressure in low-pressure fuel system to start engine.

Tools

- Personal Computer (PC) with engine diagnostic software
- NexIQ Usb-Link
- 372-5842 – Clean Fuel Source Tool
- 373-4730 – Air Cap, Fuel Cap, and Plug Kit

Procedure

Note: To prevent damage to engine, plug component connections immediately after each fuel line is removed using clean fuel system caps.

Note: Ensure that fuel lines are clear of heavy debris before breaking fuel line connections.

1. With the engine OFF, disconnect fuel supply line at low-pressure fuel pump inlet.
2. Use Air Cap, Fuel Cap, and Plug Kit 373-4730 to cap disconnected fuel supply line.



Illustration 1

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Clean Fuel Source Tool connected to low-pressure fuel pump inlet

3. Connect Clean Fuel Source Tool 372-5842 to low-pressure fuel pump inlet.
4. Crank engine to remove air from fuel lines.
5. Turn ignition switch to ON, engine OFF.
6. Connect PC to vehicle's Diagnostic Connector.

7. Start engine diagnostic software.
8. Select Hard Start - No Start session.

T	Name	Value	Units
	Engine Speed	164.50	RPM
	Fuel Delivery Pressure	130	psi
	Fuel Pressure Control Valve	50.05	%
	Fuel Rail Pressure	14,572.89	psi
	Fuel Rail Pressure Desired	14,572.89	psi
	Switched Battery	11.00	V
	TCI Turbine Outlet Pressure	14.79	psi

V00135

Illustration 2

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Hard Start - No Start session signals

9. Crank engine for 20 seconds while monitoring Fuel Delivery Pressure (FDP) signal. Record results on Diagnostics Form.

Note: Engine diagnostic software displays Fuel Delivery Pressure (FDP) signal 103 kPa (15 psi) below actual gauge pressure.

- If FDP is below specification, go to Fuel Dead Head Test.
- If FDP builds above specification, go to Fuel Aeration Test.

Fuel Dead Head Test

Purpose

Isolate fuel pump to determine if it is able to build proper pressure.

Tools

- Compucheck fitting
- 372-5842 – Clean Fuel Source Tool
- 372-5239 – Fuel Pressure Gauge
- 373-4727 – Fuel Inlet Restriction / Aeration Tool
- 373-4734 – Fuel Block Off Tool

Procedure

1. Retain connection between Clean Fuel Source Tool 372-5842 and low-pressure fuel pump inlet from previous test.
2. Disconnect fuel line from low-pressure fuel pump outlet.



Illustration 3

g03664511

Fuel Inlet Restriction / Aeration Tool 373-4727 connected to low-pressure fuel pump outlet

3. Connect Fuel Inlet Restriction / Aeration Tool 373-4727 to low-pressure fuel pump outlet.
4. Use compuccheck fitting to connect Fuel Pressure Gauge to Fuel Inlet Restriction / Aeration Tool 373-4727.
5. Connect Fuel Block Off Tool to Fuel Restriction / Aeration Tool 373-4727.
6. Crank engine to remove air from fuel lines.
7. Crank engine until fuel pressure stabilizes or up to a maximum of 20 seconds.
8. Record gauge pressure on Diagnostics Form.
 - If pressure is within specification, inspect secondary fuel filter, stand pipe, and housing for defects or damage. If no defect or damage is found, go to Fuel Rail Pressure (FRP) Return Flow Test.
 - If pressure is below specification, replace fuel pump following procedures in the Engine Service Manual. To prevent damage to a newly installed fuel pump and to verify that high back

pressure did not cause fuel pump to fail, perform High Pressure Pump Fuel Return Pressure Test any time fuel pump is replaced.

Note: Before installing a new fuel pump, ensure that new fuel pump is the correct replacement part.

High Pressure Pump Inlet Pressure Test

Purpose

Verify that high-pressure fuel pump is receiving fuel.

Tools

- 372-5239 – Fuel Pressure Gauge
- 373-4727 – Fuel Inlet Restriction / Aeration Tool
- 373-4734 – Fuel Block Off Tool
- 373-4735 – Fuel Line Coupler

Procedure

1. Disconnect fuel supply to AFT fuel doser module.
2. Use Fuel Line Coupler 373-4735 to connect Fuel Inlet Restriction / Aeration Tool 373-4727 to AFT fuel doser module fuel supply line.

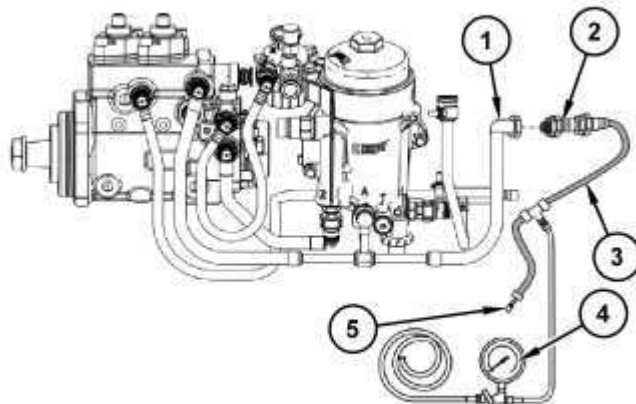


Illustration 4

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Fuel Pressure Gauge connected to AFT fuel doser module fuel supply line

- (1) AFT fuel doser module Fuel Supply Line
- (2) Fuel Line Coupler 373-4735
- (3) Fuel Inlet Restriction / Aeration Tool 373-4727
- (4) Fuel Pressure Gauge 372-5239
- (5) Fuel Block Off Tool 373-4734

3. Connect Fuel Block Off Tool 373-4734 to Fuel Inlet Restriction / Aeration Tool 373-4727.
4. Connect Fuel Pressure Gauge 372-5239 to Fuel Inlet Restriction / Aeration Tool 373-4727.
5. Crank engine while monitoring Fuel Pressure Gauge 372-5239. Record results on Diagnostics Form.
 - If gauge pressure is within specification, go to High-pressure Fuel Return Flow Test.
 - If gauge pressure is below specification, replace secondary fuel filter and go to High-pressure Fuel Return Flow Test.

Fuel Aeration Test

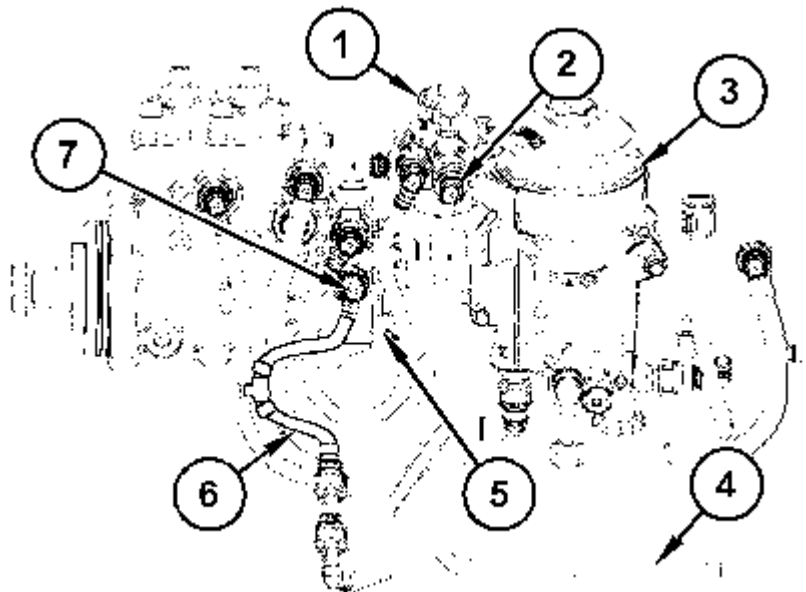


Illustration 5

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Fuel aeration test diagram

- (1) Strainer / primer pump

- (2) Aeration test point 2
- (3) Secondary fuel filter
- (4) Fuel supply from primary fuel filter
- (5) Low-pressure fuel pump
- (6) Fuel Inlet Restriction / Aeration Tool 373-4727
- (7) Aeration test point 1

Purpose

Check for fuel aeration.

Tools

- 372-5842 – Clean Fuel Source Tool
- 373-4727 – Fuel Inlet Restriction / Aeration Tool
- 373-4734 – Fuel Block Off Tool
- 373-4735 – Fuel Line Coupler

Procedure

Follow the below aeration test procedures.

Aeration Test Point 1

1. Remove Clean Fuel Source Tool 372-5842 from low-pressure fuel pump inlet.
2. Use Fuel Line Coupler 373-4735 to connect Fuel Inlet Restriction / Aeration Tool 373-4727 between fuel supply line to secondary fuel filter and low-pressure fuel pump outlet.
3. Prime fuel system by pumping primer pump.
4. Crank engine while visually monitoring for fuel aeration (air bubbles passing through the clean line). Record results on Diagnostics Form.
 - If fuel is not aerated, go to Fuel Restriction Test.
 - If fuel is aerated, go to Aeration Test Point 2.

Aeration Test Point 2

1. Connect Clean Fuel Source Tool 372-5842 to primer pump inlet.

2. Prime fuel system by pumping primer pump
3. Crank engine while visually monitoring for fuel aeration (air bubbles passing through the clean line). Record results on Diagnostics Form.
 - If fuel is not aerated, repair open in fuel supply line between fuel primer pump and fuel tank.
 - If fuel is aerated, repair open in low-pressure fuel pump supply line or fuel primer pump.

Fuel Restriction Test

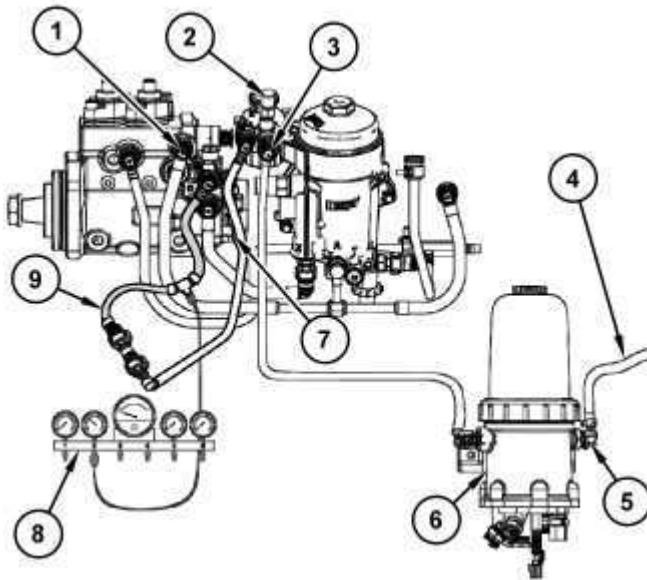


Illustration 6

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Fuel restriction test diagram

- (1) Fuel restriction test point 1
- (2) Strainer / primer pump
- (3) Fuel restriction test point 2
- (4) Fuel supply from tank
- (5) Fuel restriction test point 3
- (6) Primary fuel filter
- (7) Low-pressure fuel pump
- (8) Vacuum gauge
- (9) Fuel Inlet Restriction / Aeration Tool 373-4727

Purpose

Check for fuel supply restriction.

Tools

- Computer check fitting
- Vacuum gauge
- 372-5842 – Clean Fuel Source Tool
- 373-4727 – Fuel Inlet Restriction / Aeration Tool
- 373-4735 – Fuel Line Coupler

Procedure

Follow the below restriction test procedures.

Restriction Test Point 1

1. Use Fuel Line Coupler 373-4735 to connect Fuel Inlet Restriction / Aeration Tool 373-4727 between low-pressure fuel pump supply line and low-pressure fuel pump inlet.
2. Connect vacuum gauge to Fuel Inlet Restriction / Aeration Tool 373-4727.
3. Prime fuel system by pumping primer pump.
4. Crank engine while monitoring vacuum gauge. Record results on Diagnostics Form.
 - If restriction is within specification, verify Fuel Delivery Pressure (FDP) sensor reading with gauge.
 - If restriction is above specification, go to Restriction Test Point 2

Restriction Test Point 2

1. Connect Clean Fuel Source Tool 372-5842 to primer pump inlet.
2. Prime fuel system by pumping primer pump.
3. Crank engine while monitoring vacuum gauge. Record results on Diagnostics Form.
 - If restriction is within specification, go to Restriction Test Point 3.
 - If restriction is above specification, repair or replace fuel strainer and primer pump assembly, and check fuel lines.

Restriction Test Point 3

1. Connect Clean Fuel Source Tool 372-5842 to primary fuel filter inlet.
2. Prime fuel system by pumping primer pump.
3. Crank engine while monitoring vacuum gauge. Record results on Diagnostics Form.
 - If restriction is within specification, repair restriction between primary fuel filter and fuel tank.
 - If restriction is above specification, replace primary fuel filter, clean fuel strainer, and check fuel lines.

HP Pump Return Flow Test

Purpose

Verify that fuel is flowing from high-pressure return.

Tools

- Diesel fuel container
- 373-4728-1 - High Pressure Return Line Tester

Procedure

1. Connect High Pressure Return Line Tester 373-4728-1 to high-pressure fuel pump return port.
2. Route the other end of High Pressure Return Line Tester 373-4728-1 into a diesel fuel container.
3. Crank engine for 20 seconds while monitoring fuel return from High Pressure Return Line Tester 373-4728-1.
 - If fuel is flowing from High Pressure Return Line Tester 373-4728-1, replace piston overflow valve.
 - If fuel does not flow from High Pressure Return Line Tester 373-4728-1, replace fuel pump. Refer to the Engine Service Manual for replacement procedure and perform High Pressure Pump Fuel Return Pressure Test to verify high back pressure did not cause fuel pump failure.

Fuel Rail Pressure (FRP) Leak Isolation

Purpose

Isolate pressure loss in high-pressure fuel system.

Tools

- Diesel fuel container
- 373-4728-1 – High Pressure Rail Return Line Tester
- 372-5215 – High Pressure Rail Plugs

Procedure

Note: Perform this procedure only if engine does NOT START because of low or nonexistent Fuel Rail Pressure (FRP).

1. Retain High Pressure Return Line Tester 373-4728-1 connection to cylinder head from previous test.

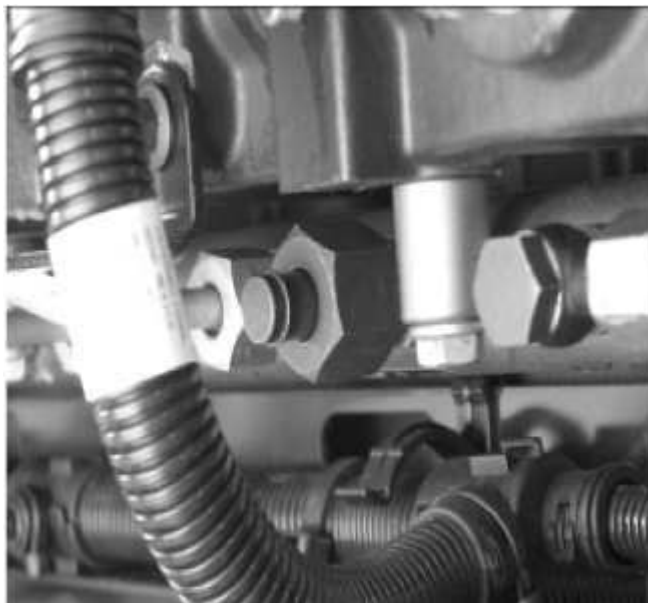


Illustration 7

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High Pressure Rail Plug installed on injector six

2. Disconnect number six injector fuel line and cap off rail with High Pressure Rail Plug 372-5215.
3. Crank engine while monitoring fuel leaking out of High Pressure Return Line Tester 373-4728-1.
 - If fuel is leaking out of High Pressure Return Line Tester 373-4728-1, leave High Pressure Rail Plug 372-5215 connected. Continue capping off one injector supply port at a time until fuel rail

builds starting pressure. Once starting pressure is met, replace the removed injector tubes with new parts. Verify that engine will start.

- If fuel is not leaking out of High Pressure Return Line Tester 373-4728-1 and fuel rail builds starting pressure, replace number six injector tube and fuel pipe.

HP Pump Fuel Return Pressure Test

Purpose

Verify that return flow is within specifications.

Tools

- Compucheck fitting
- 372-5239 – Fuel Pressure Gauge
- 373-4727 – Fuel Inlet Restriction / Aeration Tool
- 373-4735 – Fuel Line Coupler

Procedure

Note: Prior to performing this test, ensure that new fuel pump is the correct replacement part.

1. Restore fuel system to normal operating condition.
2. Disconnect high-pressure fuel pump return line.

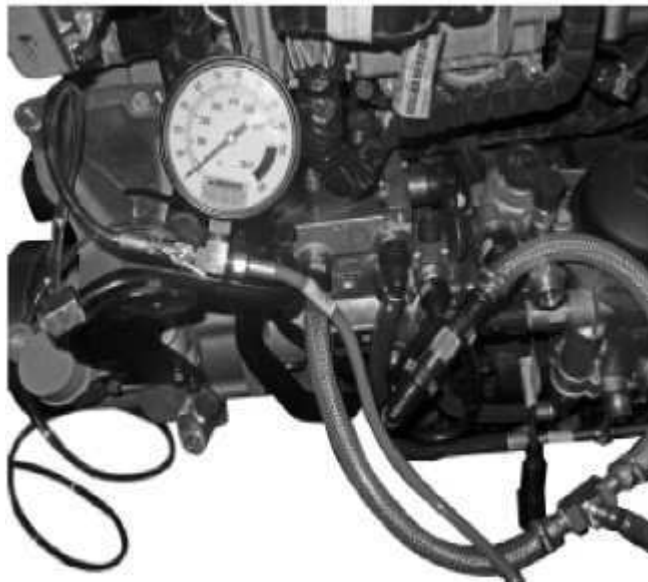


Illustration 8

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High-pressure fuel pump return line connected to Fuel Pressure Gauge 372-5239

3. Use Fuel Line Coupler 373-4735 to connect high-pressure fuel pump return line to Fuel Inlet Restriction / Aeration Tool 373-4727.
4. Use compuchek fitting to connect Fuel Inlet Restriction / Aeration Tool 373-4727 to Fuel Pressure Gauge 372-5239.
5. Start engine and run high idle while monitoring Fuel Pressure Gauge 372-5239.
 - If pressure is above specification, inspect fuel return line between high-pressure fuel pump and fuel tank for restriction.
 - If pressure is below specification, no further action is required.

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