General Service Bulletin (GSB):	**6.7L Diesel Fuel System Service Tips**
This GSB targets the diagnosis, inspection and repair of the 6.7L diesel fuel system.	Some 6.7L diesel vehicles may experience drivability concerns due to fuel system failures. Fuel system failures and/or metal debris are most commonly caused by fuel system contamination.

NOTE: This information is not intended to replace or supersede any warranty, parts and service policy, Work Shop Manual (WSM) procedures or technical training or wiring diagram information.

6.7L Diesel Fuel System Service Tips

A Guide to Properly Diagnose Contamination and Repair Diesel Fuel Systems

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Overview

A Guide to properly diagnose contamination and repair diesel fuel systems

Diagnosis
To Determine

- This guide will aid in the **diagnosis** of fuel system contamination and help determine the cause of the failure

Cause
Leading to

- Once the root **cause** of the fuel system failure is found, the proper repair direction can be determined

Repair

- Proper **repair** of contaminated diesel fuel systems is critical in preventing repeat repairs

This GSB is a progressive guide on how to diagnose High Pressure (HP) fuel system failures. It includes how to check for metal debris in the HP fuel system and ways to determine if the failure was caused by contamination.

NOTICE: This GSB should be utilized whenever the PC/ED leads you to check any part of the HP fuel system for damage/contamination, or results in direction to replace the High Pressure (HP) Fuel Injection Pump.

NOTE: *If metal debris is found in the HP fuel system, there is a high probability the debris resulted from a contaminant introduced into the fuel system such as gasoline, water or Diesel Exhaust Fluid (DEF)*

Overview

Fuel System Contamination

Fuel contamination on a 6.7L diesel engine can damage fuel system components including the High Pressure (HP) fuel injection pump and fuel injectors. Engine operation on fuels and additives that do not meet the lubrication, cooling and anti-corrosion properties required by the HP fuel system components may cause symptoms including, but not limited to, the following:

- Crank No Start
- Long Crank/Hard Start
- Runs Rough
- Reduced Power
- Engine Knocking
- Exhaust Smoke
- Fuel Rail Pressure (FRP) slow to build

NOTICE: Failure to follow these procedures may result in fuel system and/or engine damage and may require vehicle warranty cancellation submission.
Repairs required due to the use of improper fluids and fuel are not covered by the New Vehicle Limited Warranty, Extended Service Plan (ESP), or Service Part Warranty (SPW). Refer to Warranty and Policy Manual and Customer Information Guide for details.

NOTE: *The most common sources of fuel contamination are:*

- *Vehicle-mounted auxiliary fuel tanks*
- *Municipal/Fleet storage tanks*
- *Infrequently used fuel sources*
- *Refueling errors (DEF or gasoline introduced into the fuel tank)*

NOTE: ***The best course of action to avoid fuel system concerns is to ensure the vehicle is only fueled from sources with a known quality of diesel fuel verified to be free of water and other contaminants.***

Overview

Contamination Reference Table

NOTE: *Current fuel samples obtained from the vehicle may not be reflective of the vehicle's previous fuel quality and should not be used as the only indicator of fuel quality.*

Contaminant	Symptom	Result	Indicator
Water	No start, reduced power, poor drivability	Premature HP pump and injector wear, metal debris, rust/corrosion	Fuel sample, rust/corrosion on HP system components
DEF	No start, reduced power, poor drivability	Premature HP pump and injector wear, metal debris, rust/corrosion, plugged injector return line	Fuel sample, odor, white crystal residue on dried components
Gasoline/Ethanol/ Kerosene/Incorrect Additives	No start, reduced power, poor drivability, fuel knock	Premature HP pump and injector wear, metal debris	Fuel sample, odor, fuel aeration, DFCM noise
Excessive Biodiesel (greater than 20%)	Hard start, reduced power, poor drivability, low fuel pressure on Low Pressure (LP) and/or HP systems	Premature HP pump and injector wear, metal debris, rust/corrosion, bacterial/fungus growth	Fuel sample, waxing or gelling on primary filter, rust/corrosion on HP components
Lack of Filter Maintenance	No start/Hard start, reduced power, poor drivability, low fuel pressure on LP and/or HP systems	Premature HP pump and injector wear, LP or HP pump noise or failure, metal debris, Rust/corrosion, collapsed filters	Fuel sample, rust/corrosion on HP system components, DFCM noise, collapsed primary fuel filter

Diagnosis – Metal Debris

Testing for Metal Debris

Symptom

- No start with P0087/P0088 and/or P2291
- Start/Stall
- Runs Rough
- Low or slow to build Fuel Rail Pressure (FRP)
- Erratic FRP and/or LP fuel pressure

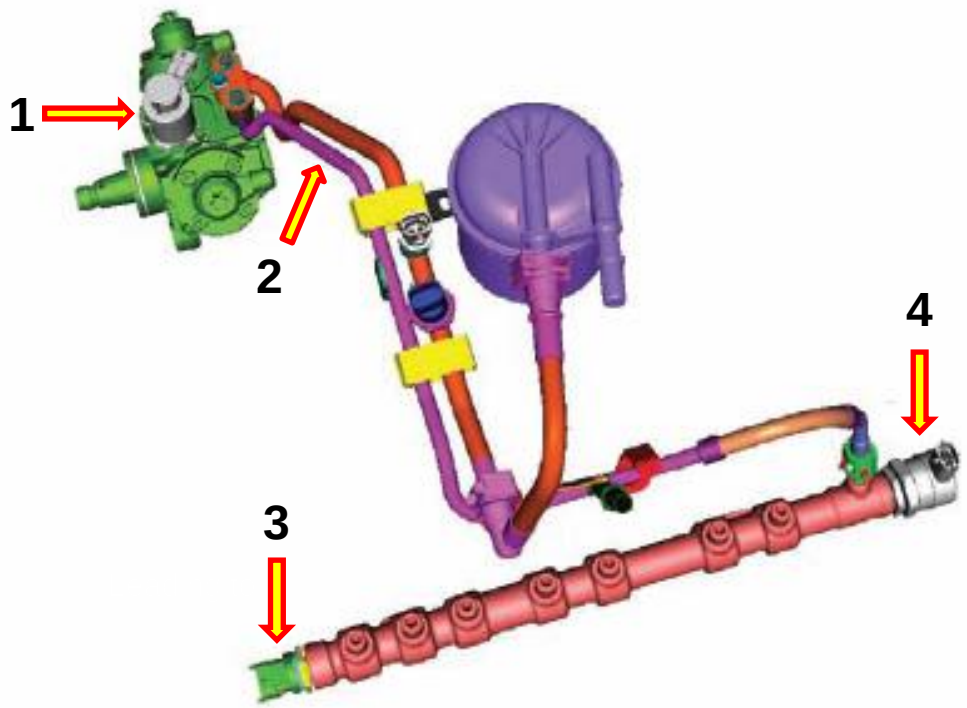
Diagnosis

- **Follow normal PC/ED diagnostics before disassembling the HP fuel system. If the PC/ED leads to inspecting the Volume Control Valve (VCV) or other component for damage, the following checks should be made:**
  - Remove VCV from HPP – Check for metal debris
  - Remove Pressure Control Valve (PCV) from rail – Check for metal debris
  - Obtain fuel sample from HP fuel system (rails or HP lines) – Check for metal debris

NOTICE: If metal debris is found in the HP fuel system, the next step is to check for the presence of contaminated fuel. Fuel contamination is the most common cause of metal debris in the HP fuel system. Metal debris found in the HP fuel system requires that the entire HP fuel system be replaced. See page 19 of this document for a complete list of parts needed for proper repair.

Diagnosis – Metal Debris

Primary Indicators



1 – Volume Control Valve (VCV)
2 – High Pressure fuel supply line (small diameter)
3 – Fuel Rail Pressure (FRP) Sensor
4 – Pressure Control Valve (PCV)

Shown here are the primary locations on the HP fuel system to check for metal debris. Metal debris in the HP fuel system consists of small particles that may be difficult to see in a fuel sample. Closely inspecting these components for the presence of metal particles is the best way of determining if the HP fuel system has metal debris contamination. Pouring a fuel sample through a coffee filter or into a clean black container such as a black spray paint cap or clear glass jar can help aid in finding metal debris due the contrast between the container and the metal.

Metal debris is formed when the HP Pump wears due to a lack of lubricity. Contaminates such as DEF, water, gasoline or ethanol introduced into the fuel system will cause the HP Pump to prematurely wear resulting in this failure mode. It is crucial to check for contaminated fuel if metal debris is found in the HP fuel system.

Diagnosis – Metal Debris

Shown here are examples of metal debris found in the HP fuel system. **1)** PCV **2)** FRP Sensor **3)** VCV **4)** HP Pump with VCV removed). Metal debris found in the HP fuel system requires that the entire HP fuel system be replaced and indicates the overall fuel system should be highly scrutinized for the presence of fuel contamination.

NOTE: ***ANY*** *Metal debris found in the HP fuel system requires that the entire HP fuel system be replaced. See page 19 of this document for a complete list of parts needed for proper repair.*

Diagnosis – Fuel System Contamination

Testing for Contaminants

Symptom

- **Metal Debris found in HP fuel system**

Diagnosis

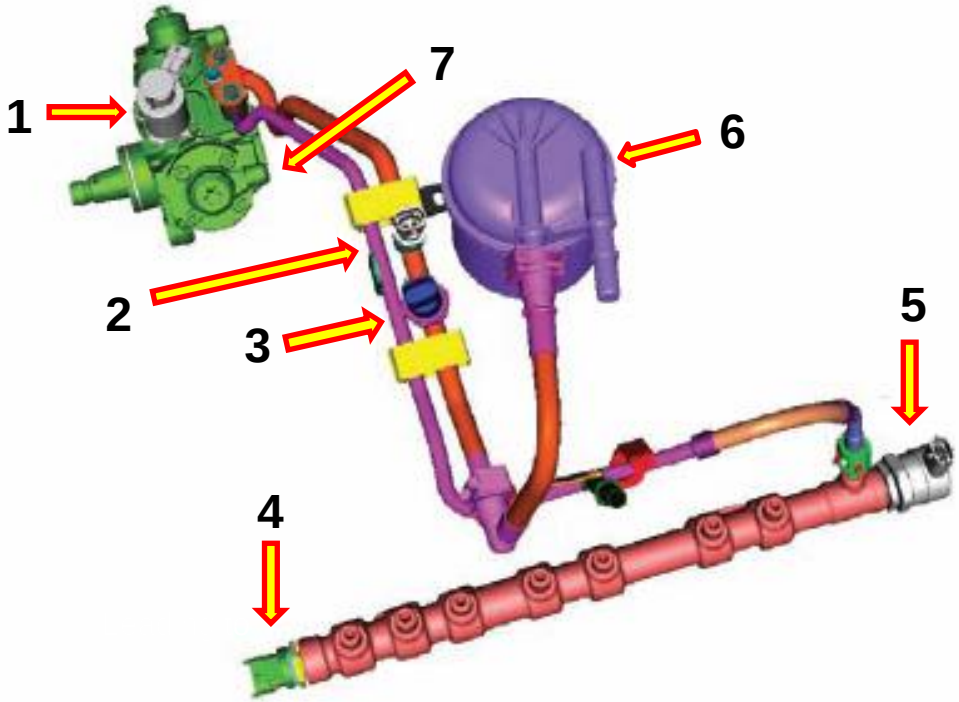
- Obtain fuel sample – Let separate
- Remove primary fuel filter – Let dry
- Remove the VCV, PCV, FRP sensor – Let dry

If metal debris is found in the HP fuel system, the next step is to check for the presence of contaminated fuel. Fuel contamination is the most common cause of metal debris in the HP fuel system. Metal debris found in the HP fuel system requires that the entire HP fuel system be replaced. See page 19 of this document for a complete list of parts needed for proper repair.

Fuel Quality Verification

1. Using an appropriate container, obtain a fuel sample from the Diesel Fuel Conditioning Module (DFCM) water drain. Refer to section 4 (Diagnostic Subroutines) of the PC/ED for additional information.
2. Allow fuel sample to sit for 15 minutes.
3. Visually inspect fuel sample to determine the type of contamination. See pages 11-15 for examples of contamination.
4. Remove the Primary filter element from the DFCM and allow the filter and DFCM cover to dry for 2 hours.
5. Visually inspect the filter and cover for evidence of DEF crystals.
6. If no DEF crystals are found, proceed to further inspect the HP fuel system for rust and/or corrosion.

Diagnosis – Fuel System Contamination



1 – Volume Control Valve (VCV)
2 – Fuel Rail Temperature (FRT) Sensor
3 – Fuel Pressure Switch
4 – Fuel Rail Pressure (FRP) Sensor
5 – Pressure Control Valve (PCV)
6 – Secondary Fuel Filter
7 – HP Pump Overflow Valve

Primary Indicators

Shown here are the primary locations on the HP fuel system to check for fuel contamination. Fuel that has been contaminated should show evidence of the contamination at these points.

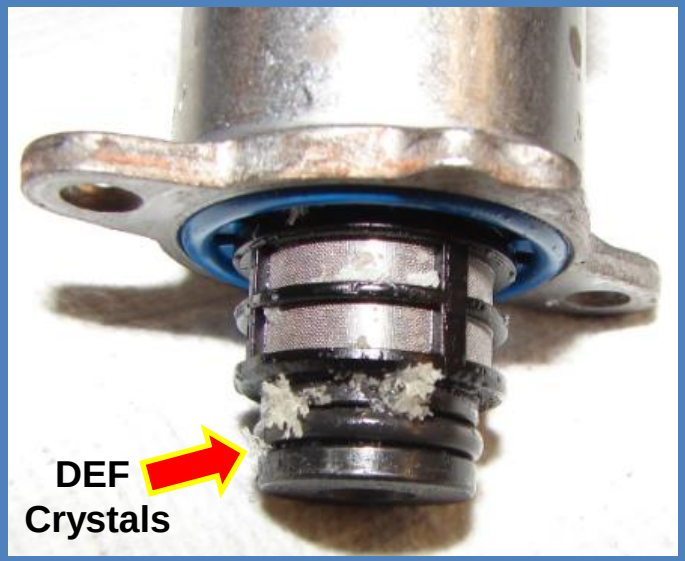
NOTE: *Further removal of fuel system components may be required to determine the type of contamination and extent of system damage*

NOTICE: If the fuel tank has been contaminated with DEF, gasoline or any other non-diesel fluid and the ignition was turned to run or the engine started, perform procedure A located on page 18.

If the fuel tank has been contaminated with DEF, gasoline or any other non-diesel fluid and the ignition was NOT turned on and the engine NOT started, perform procedure B located on page 20.

Diagnosis – Fuel System Contamination

Diesel Exhaust Fluid (DEF)



Volume Control Valve (VCV)

Fuel Sample

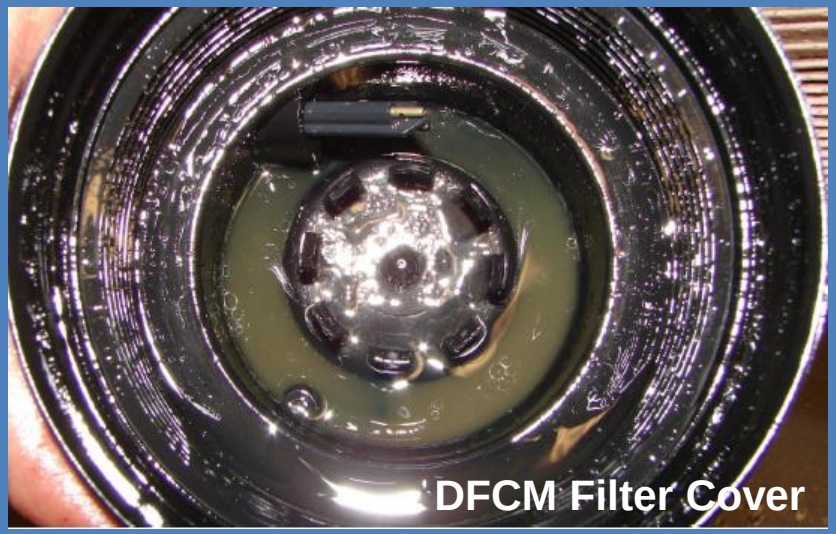
Primary Fuel Filter

The above photos are of components contaminated with DEF and allowed to dry for 2 hours. Primary indication of DEF contamination can be found by obtaining a fuel sample as well as removing the primary fuel filter and VCV and allowing them to dry for 2 hours. If white crystals form on any fuel system component, the system has been contaminated with DEF. The fuel sample above shows how DEF and fuel separate in a fuel sample (DEF is the darker cloudy substance).

NOTE: *DEF contamination is non-warrantable.*

Diagnosis – Fuel System Contamination

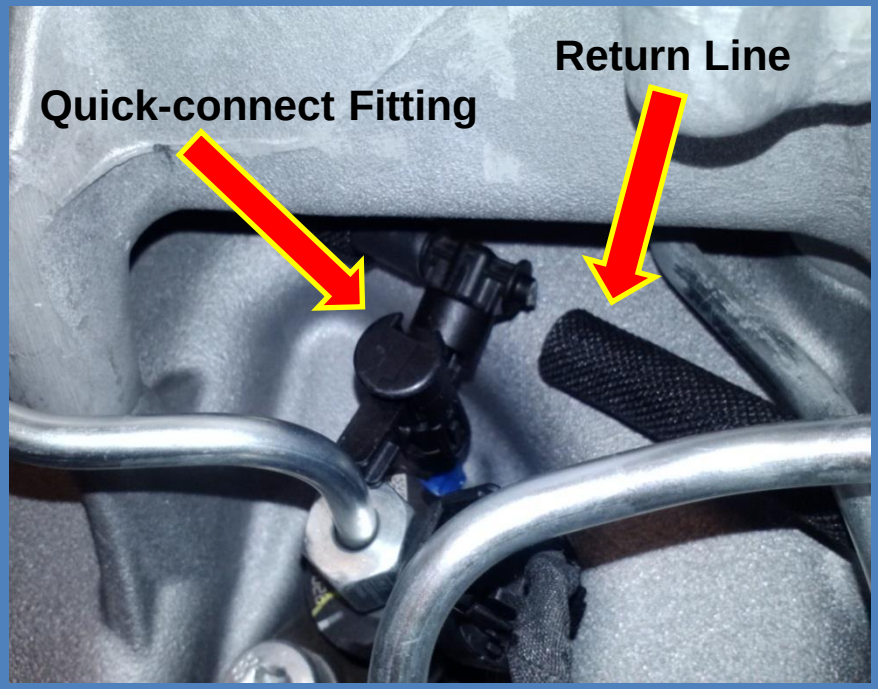
Diesel Exhaust Fluid (DEF)



Further indicators of DEF contamination are the DFCM housing and engine-mounted fuel filter. DEF contamination may be present in Low Pressure (LP) fuel lines and other HP system components as well. DEF crystals form as the DEF and fuel evaporate and is evident by the white crystals that form.

Diagnosis – Fuel System Contamination

Diesel Exhaust Fluid (DEF)



Another indication that the fuel system may be contaminated with DEF is if a fuel injector return line breaks loose from the quick connect fitting. If DEF enters the fuel injector return lines it can crystallize and cause increased line pressure resulting in the line disconnecting from the quick connect fitting and potentially breaking the barb.

If a fuel injector return line is found disconnected/loose/damaged, check the fuel system for possible DEF contamination before proceeding with repairs.

Diagnosis – Fuel System Contamination

Water Contamination

Volume Control Valve (VCV)

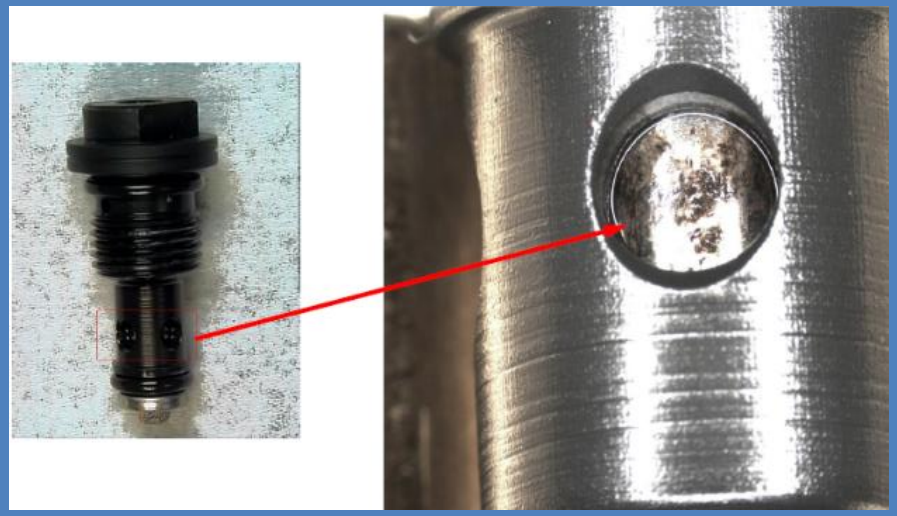
Pressure Control Valve (PCV)

The above photos are of components contaminated with water resulting in rust/corrosion. Primary indication of water contamination can be found by obtaining a fuel sample as well as removing the VCV and/or PCV and checking for rust and/or corrosion.

NOTE: *Current fuel samples obtained from the vehicle may not be reflective of the vehicle's previous fuel quality levels and should not be used as the 'sole' indicator of fuel quality.*

Diagnosis – Fuel System Contamination

Water Contamination



HP Pump Overflow Valve

Another indicator of water contamination is the HP pump overflow valve located on the driver side of the pump at the rear. When water is introduced into the HP fuel system, rust/corrosion can form on the ports of the overflow valve as shown in the above photos.

NOTE: ***Water, Biodiesel, Gasoline and/or other fuel system contamination is non-warrantable.***

Repair – Fuel System

Repair of the HP fuel system

Diagnosis

- Metal Debris found in HP fuel system
- Contamination found in HP fuel system

Repair

- **Follow the proper Flush and repair procedure based on the type of contamination found**

Repair Direction

If the fuel tank has been contaminated with DEF, gasoline, or any other non-diesel fluid and the ignition was turned to run or the engine started, perform procedure A located on page 18.

If the fuel tank has been contaminated with DEF, gasoline, or any other non-diesel fluid and the ignition was NOT turned on and the engine NOT started, perform procedure B located on page 20.

NOTICE: When **ANY** metal debris and/or fuel system contamination is found in the HP fuel system, it is extremely important to properly flush and replace all of the required components or repeat fuel system failure may occur.

Repair – Flushing Procedure

Flushing contamination from the fuel system

NOTE: *This procedure should be followed **BEFORE** replacing any HP fuel system components*

1. Remove the front (inlet) Fuel Cooler Line that feeds fuel to the cooler from the engine. Do Not flush contaminated fuel through the fuel cooler.
2. Place the open end of the hose into a suitable container.
3. Use Scan Tool Active Commands or cycle the ignition key to RUN to activate the low pressure fuel pump to flush the lines.
4. Allow the fuel pump to run for 3 min or until approximately 3 gallons of fuel has been flushed through the system.

This procedure is for flushing the Low Pressure fuel system lines from the fuel tank, through both fuel filters and the HP Pump to remove all contaminates before installing new fuel system components.

NOTE: *Leave original fuel filters, HP injection pump, fuel lines, fuel rails and injectors in place until the flushing procedure is completed to prevent contamination of replacement components.*

Repair – Procedure A

Fuel Contaminated, Key turned to run or engine started

1. Drain fuel tank completely by removing the tank and cleaning to prevent the possibility of reintroducing contamination. (Dispose of contaminated fuel in accordance with local laws and regulations.)

2. Fill fuel tank with fresh, clean, good quality diesel fuel.

3. Using an appropriate container, drain DFCM of any residual liquids.

4. Perform Fuel System Flush Procedure on page 17.

5. Replace both fuel filters (primary and secondary).

6. Replace ALL High Pressure fuel system components;

- High Pressure Fuel Pump
- Engine-mounted high pressure fuel lines
- Both high pressure fuel rails
- Eight fuel injectors
- Fuel injector return hose assembly
- Fuel delivery pressure switch (located on the engine low pressure line near the secondary fuel filter)

This Procedure is to be used when metal debris and/or fuel system contamination is present

NOTE: *Leave original fuel filters, HP injection pump, fuel lines, fuel rails and injectors in place until the flushing procedure is completed to prevent contamination of replacement components.*

NOTE: *The DFCM must be inspected during filter replacement to verify no low pressure fuel system damage. If metal debris or DEF contamination is present, the DFCM must be replaced.*

NOTE: *All remaining steel low pressure fuel lines can be reused if no physical damage is present.*

Repair – Required Parts

Below is a list of fuel system components that are **REQUIRED** to be replaced when **ANY** metal debris and/or fuel contamination is found in the HP fuel system. These parts should be replaced only **AFTER** the fuel system has been properly flushed per the flushing procedure.

NOTE: ***The HP Fuel System Kit*** **(9B246)** *should be used in place of ordering individual parts when repairing the fuel system due to metal debris and/or fuel contamination. The kit includes the list of parts below (unless noted) that will require replacement.*

- **Fuel Filters –** 9N184 **not included with 9B246 kit*
- **High Pressure Fuel Pump -** 9A543
- **Engine Mounted High Pressure Fuel Lines –** 9E964
- **Both RH and LH High Pressure Fuel Rails –** (2) 9D280
- **All Eight Fuel Injectors –** (8) 9H529
- **Low Pressure Fuel Injector Return Hose Assembly –** 9A564
- **HPP Fuel Supply Lines (includes LP fuel switch) –** 9J280

NOTE: Fuel system parts are different between model years. Be sure that you order the correct parts for the model year vehicle you are servicing.

NOTICE: HP Fuel system components cannot be flushed and re-used once they have been contaminated with any type of contaminant. If all required fuel system components are not replaced, repeat fuel system failure may occur and would be considered an improper repair and non-warrantable.

Repair – Procedure B

Fuel Contaminated, Key **NOT** turned to run and engine **NOT** started

1. Drain fuel tank completely by removing the tank and cleaning to prevent the possibility of reintroducing contamination. (Dispose of contaminated fuel in accordance with local laws and regulations.)

2. Fill fuel tank with fresh, clean, good quality diesel fuel.

3. Using an appropriate container, drain DFCM of any residual liquids.

4. Replace both fuel filters (primary and secondary).

5. Perform Fuel System Flush Procedure on page 17.

This procedure is to be used when fuel system contamination has been introduced ONLY to the fuel tank. If the key has been turned to the "RUN" position allowing the DFCM to prime, this procedure does not apply and Procedure A should be followed.

NOTE: *The DFCM must be inspected during filter replacement to verify no low pressure fuel system damage. If DEF contamination is present, this procedure does not apply and Procedure A should be followed.*

Frequently Asked Questions

Q. What can cause rust or corrosion in a fuel system?

A. Poor quality or contaminated fuel

Q. What is poor quality or contaminated fuel?

A. Diesel Fuel or Biodiesel Fuel not meeting the specifications listed in the 6.7L Owner Manual Diesel Supplement. Some examples of fuel contamination are:

- Water content exceeding specification
- DEF (Diesel Exhaust Fluid)
- Fuel with High TAN (Total Acid Number) – Acidic Fuel
- Aged/Oxidized Fuel
- Organic Growth (Bacteria, Fungus)
- Unapproved fuel additives

Q. How does water affect the high pressure fuel system?

A. Modern High Pressure Common Rail (HPCR) Fuel Systems have very tight tolerances required to develop high system pressures (up to 30,000 psi). Fuel is used to lubricate the fuel pump. Water in the fuel can reduce the lubrication of the pump causing wear, and can cause the highly machined surfaces of the pump to rust or corrode. Water is also a catalyst for acid formation and acts as a host for organic growth, which can damage the fuel system.

Frequently Asked Questions

Q. What do the Water In Fuel (WIF) indicators (lights) or Message Center messages mean?

A. This means that the 6.7L Diesel Fuel Conditioning Module (DFCM) should be drained as soon as safely possible. The WIF light or message appears when enough water has been detected in the reservoir. Water in excess of the DFCM reservoir capacity will be passed through to the fuel system resulting in damage to the system. Refer to the 6.7L Owner Manual Diesel Supplement for DFCM capacities.

Q. How often should the 6.7L Diesel Fuel Conditioning Module (DFCM) be drained?

A. Monthly at minimum or when the WIF light turns on or message appears (whichever occurs first). Refer to the 6.7L Owner Manual Diesel Supplement for DFCM draining intervals/procedures.

Q. Will the DFCM separate other contaminants in the fuel besides water?

A. The DFCM separates water from the fuel. Water droplets in the fuel are grouped and removed by the various filter components and collected in the DFCM reservoir. The DFCM is not designed to separate organic growth, oxidized fuel, acidic fuel, or other chemicals. Fuel additives that emulsify water reduce the effectiveness of the DFCM to separate water and must not be used.

Frequently Asked Questions

Q. What happens if I accidently put DEF in the fuel tank?

A. DO NOT turn the ignition key to RUN or start the vehicle. Turning the key to RUN will send the DEF into the high pressure fuel system and damage the system. Disconnect the batteries if the key needs to be turned on to unlock the steering column for vehicle towing due to fuel system DEF contamination. DEF is an aqueous solution of 32.5% high quality urea and 67.5% de-ionized water. DEF contamination may cause the WIF light to turn on, but damage will already be done due to either the amount of DEF or the un-separated non-aqueous (non-water) parts of the DEF entering the fuel system. Refer to procedures A or B in the 6.7L Diesel Fuel Contamination Diagnosis and Service Procedure Job Aid for proper repair procedures depending on if the engine has been started or not.

Q. What are some sources of poor quality or contaminated fuel?

A. Sources of poor quality or contaminated fuel may include:

- Fuel stations with fuel outside of ASTM specifications or contaminated fuel (improperly formulated, Biodiesel percentage too high or improperly produced Biodiesel, aged fuel, etc.)
- Auxiliary fuel tanks or above ground storage tanks (improper venting, aged fuel, temperature extremes)
- In ground tanks (flooding, leaking tanks, etc.)
- Non-recommended fuel additives (alcohol based, water emulsifiers, etc.)
- Incorrectly adding DEF to the fuel tank

Frequently Asked Questions

Q. What are the effects of Oxidized, Acidic or Organic Growth in fuel (Diesel & Biodiesel)?

A. Fuel contaminated with Organic Growth such as Bacteria or Fungus may cause similar effects on fuel systems (rust or corrosion) as excessive water content. The effects can be accelerated as the fuel ages and/or the TAN (acidity or oxidation) increases, which may be more severe on fuel system components than water. These contaminants may also coat the Water in Fuel (WIF) Sensor pins and prevent the detection of water.

Q. What are the potential effects of Biodiesel concentration above specifications?

A. Biodiesel concentrations above the specified amounts may cause fuel filter restrictions, which may result in a lack of power and or damage to fuel system components. Biodiesel not meeting 6.7L Owner Manual Diesel Supplement specifications can cause bacterial/fungus growth, increased water content, chemical attack of fuel system, and premature fuel filter plugging/fuel starvation due to cold temperature fuel gelling.

Q. What are the effects of non-recommended fuel additives?

A. Alcohol based additives or other chemicals that cause water to disperse/emulsify will cause damage to the fuel system. Chemicals that disperse/emulsify the water in the fuel will not allow the filters to properly separate the water and pass it through to the fuel system. Alcohol based additives also decrease the lubricity of the fuel, which can damage the high pressure fuel system.

Frequently Asked Questions

Q. Why do fuel system components show signs of contamination (e.g., rusted or corroded high pressure fuel system components) with no Water in Fuel related DTCs present or Water in Fuel light or message present?

A. Water is not the only contaminant that can cause fuel system damage. Bacteria, fungus, oxidized or aged fuel, and other chemicals/additives will not be separated from the fuel resulting in fuel system damage if passed through to the fuel system. Dispersed/emulsified water due to unapproved additives may not be separated from the fuel resulting in fuel system damage if passed through to the fuel system. Fuel filters not meeting OEM specifications may not properly separate the water resulting in undetected water entering the fuel system. An unplugged Water in Fuel Sensor or damaged circuit can result in undetected water in the HFCM or DFCM reservoir.

Q. What are the effects of not changing fuel filters per the recommended maintenance intervals or when directed by the vehicle message center?

A. Degradation in filter performance and water separation performance, which can result in damage to the fuel system. Fuel filters not meeting OEM specifications may not properly separate the water resulting in undetected water entering the fuel system.