

<b>3.2L Diesel Fuel System Service Tips</b>	
<b>GSB Overview:</b>	This GSB targets the diagnosis, inspection and repair of the 3.2L diesel fuel system.
<b>NOTE:</b> This information is not intended to replace or supersede any warranty, parts and service policy, Workshop Manual (WSM) procedures or technical training or wiring diagram information.	

## ***3.2L Diesel Fuel System Service Tips***

Some vehicles equipped with a 3.2L diesel engine may experience drivability concerns due to fuel system failures. Fuel system failures and/or metal debris are most commonly caused by fuel system contamination.

## 3.2L Diesel Fuel System Service Tips

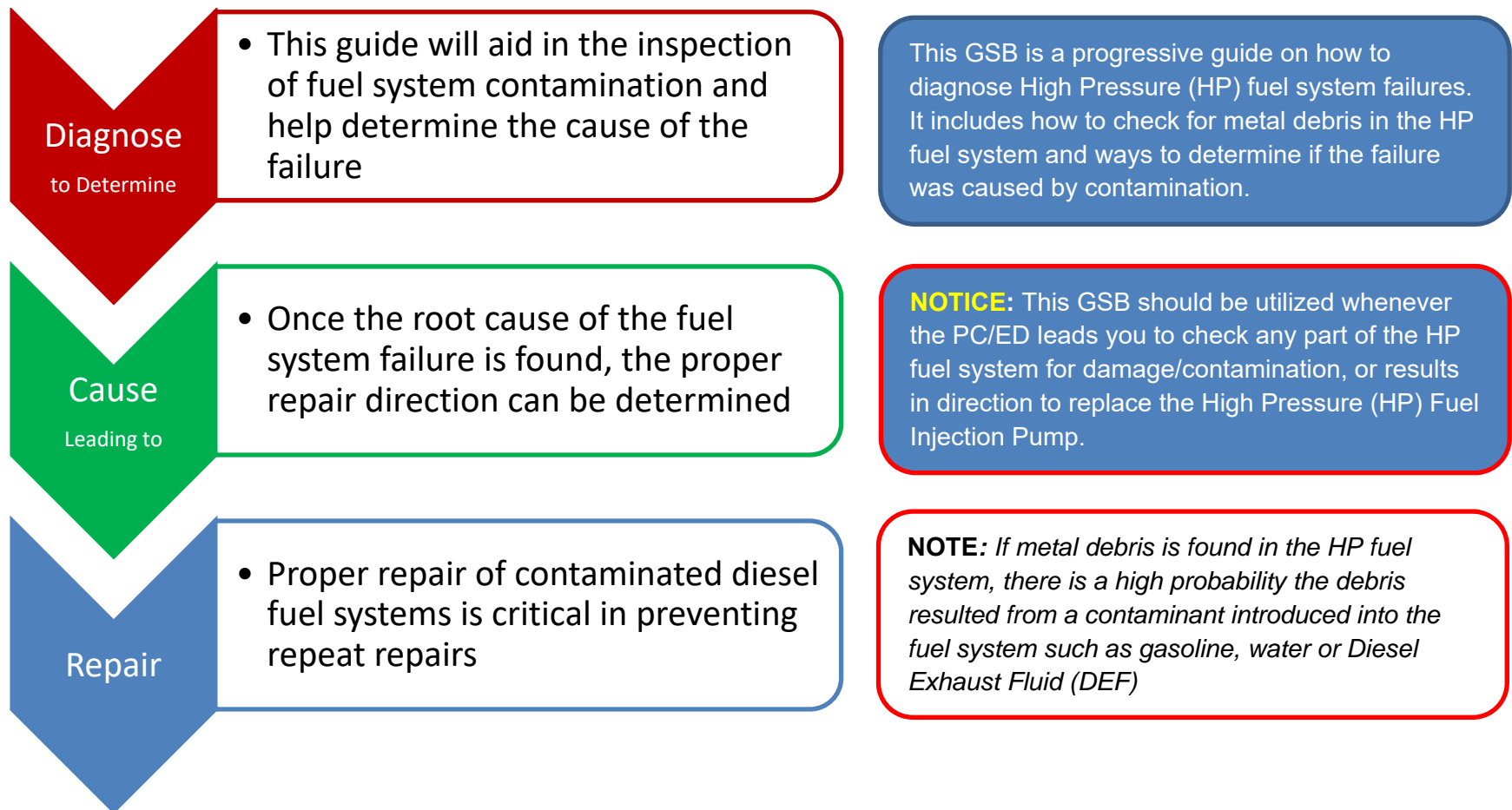
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# Introduction

A guide to properly diagnose contamination and repair diesel fuel systems



# Overview

## Fuel System Contamination

Fuel contamination on a 3.2L 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:** 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)*
- *Incorrect/Unapproved fuel additives*

**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.*

## 3.2L Diesel Fuel System Service Tips

### Overview

**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.

### Contamination Reference Table

Contaminant	Symptom	Result	Indicator
<b>Water</b>	No start, reduced power, poor drivability	Premature HP pump and injector wear, metal debris, rust/corrosion	Fuel sample, rust/corrosion on HP system components
<b>DEF</b>	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
<b>Gasoline/ Ethanol/ Kerosene/ Incorrect Additives</b>	No start, reduced power, poor drivability, fuel knock	Premature HP pump and injector wear, metal debris	Fuel sample, odor, fuel aeration
<b>Excessive Biodiesel (greater than 20%)</b>	Hard start, reduced power, poor drivability, low fuel pressure in the 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
<b>Lack of Filter Maintenance</b>	No start/hard start, reduced power, poor drivability, low fuel pressure in the Low Pressure (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, 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:**
- Obtain fuel sample from #1 injector tube to inspect for metal debris
- Remove VCV from HPP - Check for contamination and damage
- Inspect fuel inlet and return ports on High Pressure Pump for contamination and damage.

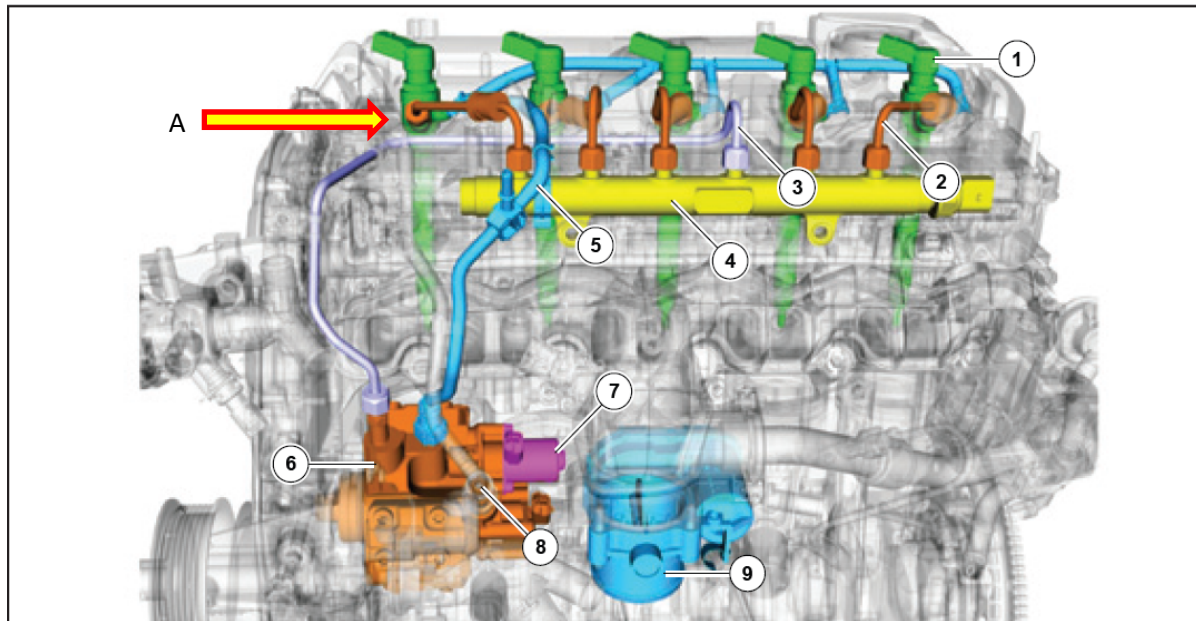


This image shows the presence of metal debris on the Volume Control Valve (VCV) mesh filter screen housing.

**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. page 15 of this document for a complete list of parts needed for proper repair.

# Diagnosis- Metal Debris

## Testing Location



Number	Component	Number	Component
1	Fuel injector	6	Fuel injection pump
2	Fuel injector supply tube	7	Fuel metering valve
3	Fuel rail supply tube	8	High pressure pump fuel supply line
4	Fuel rail	9	Throttle Body (TB)
5	Fuel injector fuel return line		

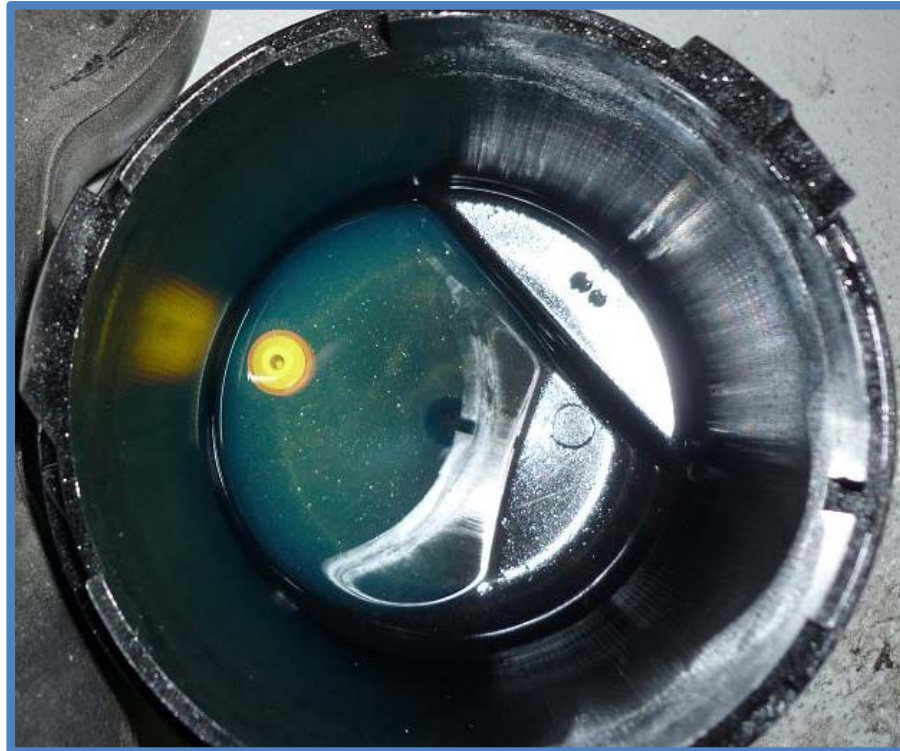
The arrow in the figure labeled "A" is pointing to the #1 injector fuel supply tube. This is the ideal place to collect a fuel sample from when checking for metal debris in the High Pressure Fuel System. To obtain a sample the engine needs to be cranked otherwise no fuel will flow out of this fuel tube. Ensure that the sample is collected in a black plastic aerosol cap or similar container and use a high powered flashlight to inspect the fuel so that the metal debris contrasts against the dark color of the container.

Metal debris can be 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*

#### **Metal Debris in Low Pressure Fuel Filters**

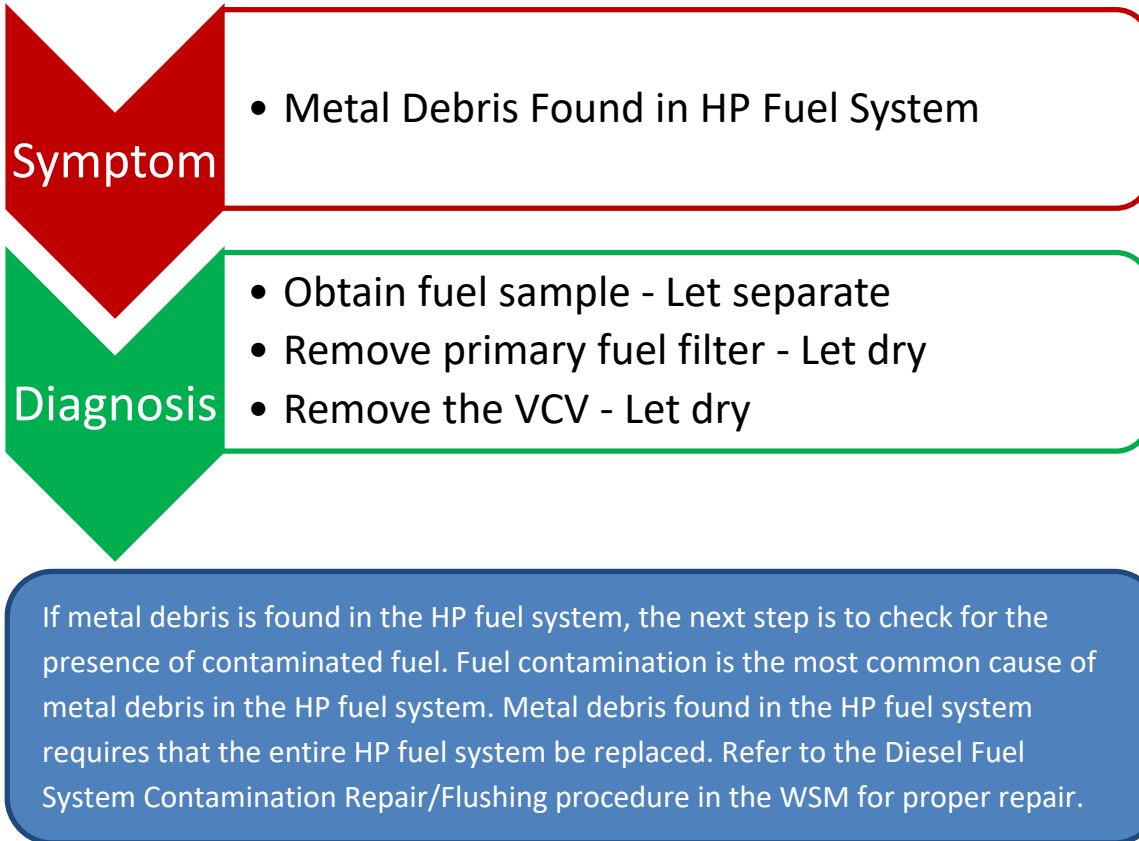
Shiny particles visible in the fuel filter bowl are the result of normal break in, wear and fuel source (filling station, refinery and storage). The presence of these particles does not signify any form of failure and does not warrant repair. Follow the published maintenance schedule for fuel filter service.





# Diagnosis– Fuel System Contamination

## Testing for Contaminants



### Fuel Quality Verification

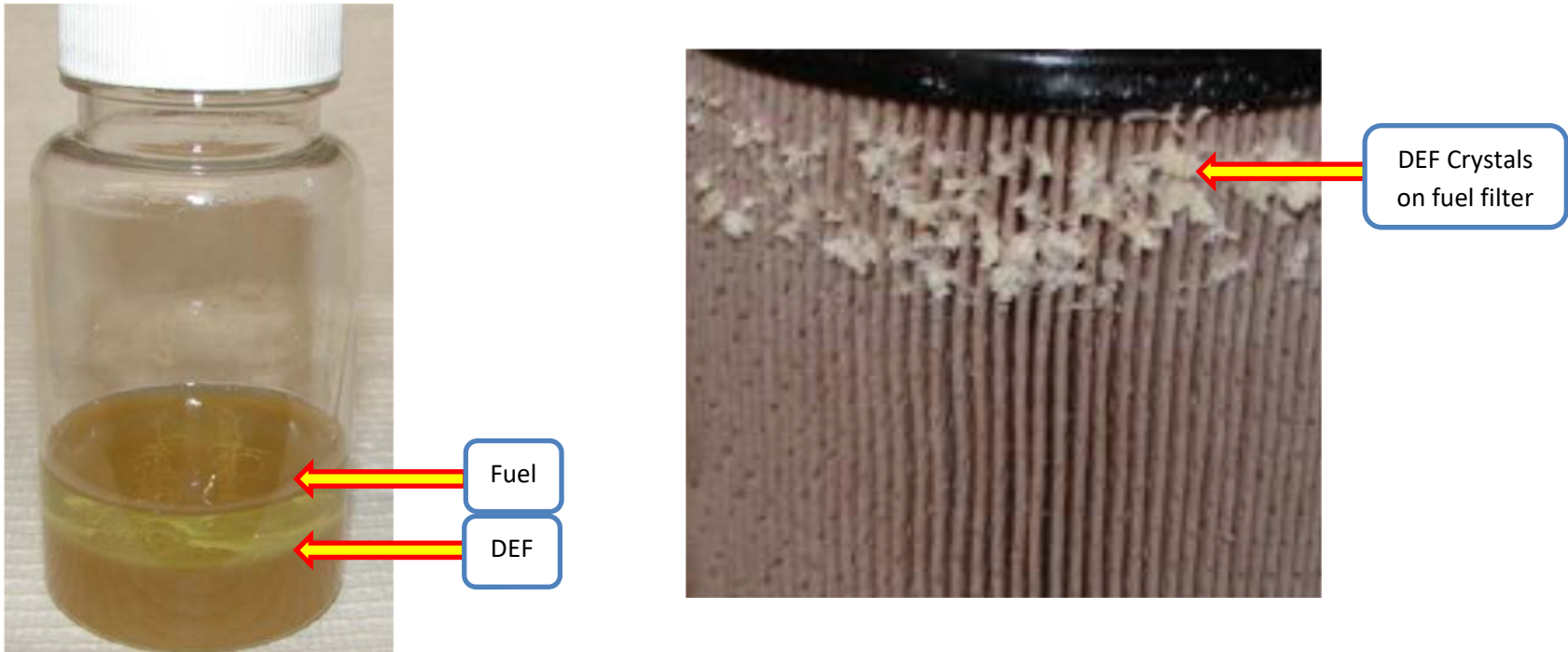
To verify the Fuel Quality, perform the Sufficient Clean Fuel test as outlined in the PC/ED > Section 4: Diagnostic Subroutines. During this test, it may be necessary to allow the fuel sample to sit for 15 minutes to allow the contaminants to separate from the fuel.

See page 9 for examples of DEF contamination in the fuel sample and on the fuel filter.

# Diagnosis – Fuel System Contamination

## Primary Indicators

### Diesel Exhaust Fluid (DEF)



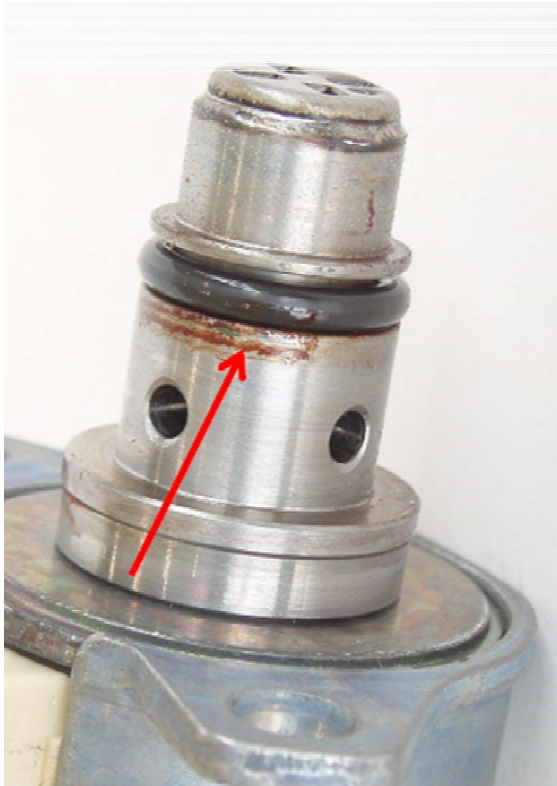
The above photos show DEF contamination. The fuel sample and the fuel filter were allowed to sit for 2 hours. The fuel sample shows how the Diesel Fuel and the DEF separate. Once separated, the DEF will be a darker, cloudy substance. The Fuel Filter shows DEF crystals forming. If white crystals form on any fuel system component, the system has been contaminated with DEF.

# Diagnosis – Fuel System Contamination

## Primary Indicators

### Fuel Metering Valve/Volume Control Valve (VCV)

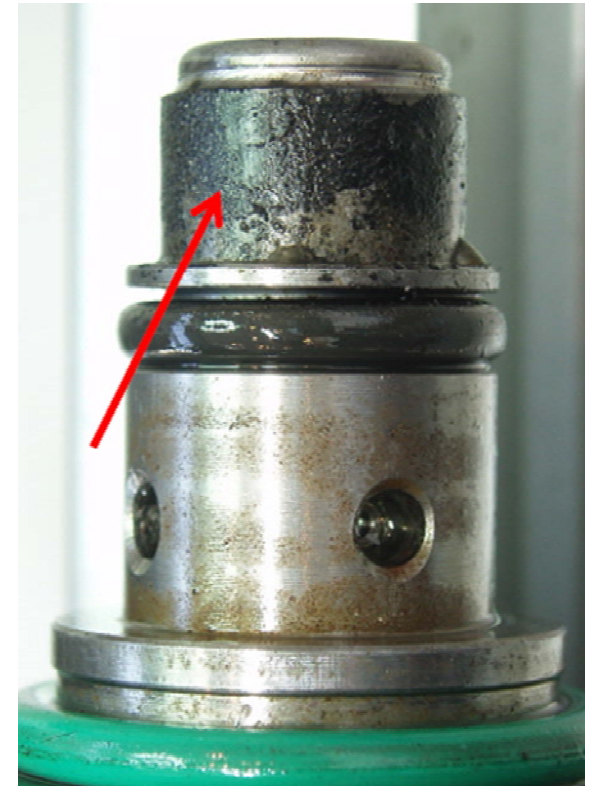
Degraded Diesel Fuel



Light Rust/Pitting



Degraded Diesel Fuel/Contamination



# Diagnosis – Fuel System Contamination

## Primary Indicators

### High Pressure Fuel Pump Port Corrosion



The discoloration of the metal fuel ports are indications of water or other contaminants causing rust or corrosion. To the left is the brass fuel return port from the fuel rail, and on the right is the high pressure feed line to the fuel rail. Inspect the brass port on the HP fuel pump carefully, as etching of the brass (shown below) is also an indication of a fuel quality concern.



# *Diagnosis – Fuel System Contamination*

## Primary Indicators

### High Pressure Fuel Pump Port Corrosion

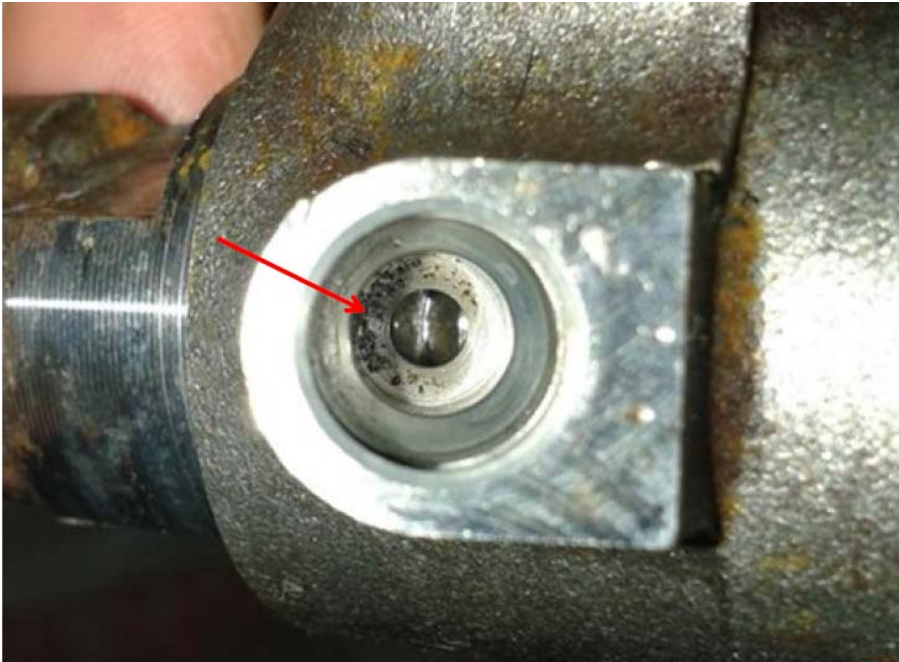


These images show more examples of etching, discoloration, and corrosion on the high pressure fuel pump ports that occur when there are fuel contamination/quality concerns.

# *Diagnosis – Fuel System Contamination*

## Primary Indicators

### Fuel Injector Ports



On the left is an injector fuel return port and on the right is the injector fuel inlet port. In both images there is rust/corrosion present. These are indications of fuel contamination or fuel quality concerns.

# Repair – Fuel System

## Repair of the HP Fuel System

### Diagnosis

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

### Repair

- Follow the proper flush and repair procedure that is found in the WSM 310-00C > General Procedures > Diesel Fuel System Contamination Repair/Flushing

### 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 the procedure outlined in the WSM 310-00C > General Procedures > Diesel Fuel System Contamination Repair/Flushing.

If the fuel tank has been contaminated with DEF, gasoline, or any other non-diesel fluid and the ignition was NOT turned on, the fuel tank should be cleaned/flushed and filled with clean diesel fuel.

**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 – Fuel System

## 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 High Pressure Fuel system. These parts should be replaced only **AFTER** the fuel system has been properly flushed per the flushing procedure from the WSM 310-00C > General Procedures > Diesel Fuel System Contamination Repair/Flushing

- Fuel Injection Pump
- Fuel Rail Supply Tube
- Fuel Injector Supply Tubes
- Fuel Injector Fuel Return Line
- Fuel Rail
- Fuel Injectors

**NOTE:** Fuel system parts may be different between model years, and part numbers can be updated. Be sure that you order the correct parts for the model year and vehicle that 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.



### *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 vehicle Owner's Manual. Some examples of fuel contamination are:

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

### *Frequently Asked Questions*

**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.

**Q. What does the Water in Fuel (WIF) indicator (light) or Message Center message mean?**

**A.** This means that the 3.2L Fuel Conditioning Module (FCM) 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 FCM reservoir capacity will be passed through to the fuel system resulting in damage to the system. Refer to the vehicle Owner's Manual for FCM capacities.

**Q. How often should the 3.2L Fuel Conditioning Module (FCM) be drained?**

**A.** Monthly at a minimum, during oil changes or when the WIF light message appears (whichever occurs first). Refer to the vehicle Owner's Manual for FCM draining intervals/procedures.

### *Frequently Asked Questions*

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

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

**Q. What happens if I accidentally 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 the WSM 310-00C > General Procedures > Diesel Fuel System Contamination Repair/Flushing.

### *Frequently Asked Questions*

**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

**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.

### *Frequently Asked Questions*

**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 the specifications listed in the vehicle Owner's Manual 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 WIF related DTCs present or WIF light/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 system. Fuel filters not meeting OEM specifications may not properly separate the water resulting in undetected water entering the fuel system. An unplugged WIF sensor or damaged circuit can result in undetected water in the FCM reservoir.

**Q. What are the effects of not changing fuel filters at 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. Restricted filters can reduce flow to the HP pump which starve the HP pump of the cooling and lubrication provided by the diesel fuel that it needs for long life.