

VOLKSWAGEN

GROUP OF AMERICA

Jeffrey Quandt
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PRODUCT COMPLIANCE DEPARTMENT
248-754-5000 PHONE
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DECEMBER 01, 2010 DATE

Subject: PE10-034 NVS-213hkb: Engine Stall and/or Loss of Motive Power;
TDI Clean Diesel Engine

Dear Mr. Quandt:

Please find attached Volkswagen's response to your letter dated September 14, 2010 requesting information concerning engine stalling and/or loss of motive power, on certain 2009-2010 MY Volkswagen Jetta, 2010 MY Volkswagen Golf and 2010 MY Audi A3 vehicles equipped with the TDI Clean Diesel engine.

Thank you for your consideration in granting our requested extension to December 01, 2010.

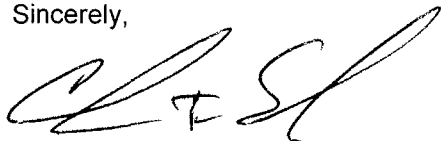
For your convenience, each request is restated verbatim and then followed by our response.

Please note, several documents related to question 8 are included in their original German language format and will be resubmitted upon completion of translation to English.

On a final note, be advised that Robert Bosch GmbH will provide responsive documents under separate cover, in addition to submitting a request for confidentiality.

Please contact me if you have any questions regarding this response.

Sincerely,



Christopher T. Sandvig
General Manager - Compliance/TREAD
Service and Quality

Attachments

VOLKSWAGEN GROUP OF AMERICA, INC.
3800 HAMLIN ROAD
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Request 1

State, by model and model year, the number of subject and peer vehicles VW has manufactured for sale or lease in the United States. Separately, for each subject and peer vehicle manufactured to date by VW, state the following:

- a. Vehicle identification number (VIN);
- b. Make;
- c. Model;
- d. Model Year;
- e. Date of manufacture;
- f. Date warranty coverage commenced; and
- g. The State in the United States where the vehicle was originally sold or leased (or delivered for sale or lease).

Provide the table in Microsoft Access 2000, or a compatible format, entitled "PRODUCTION DATA." See Enclosure 1, Data Collection Disc, for a pre-formatted table which provides further details regarding this submission.

Response 1

In response to your inquiry, Volkswagen has identified the following number of 2009-2010 Model Year (MY) Jetta, 2010 MY Golf and 2010 MY Audi A3 vehicles manufactured and sold to Volkswagen Group of America, Inc. for resale or lease in the United States that were equipped with a TDI Clean Diesel engine:

Subject Vehicles	MY 2009	MY 2010
VW Jetta	37,889	52,757
VW Golf	-	4,446
Audi A3	-	2,180

Please see Microsoft Excel file entitled "PRODUCTION DATA.xlsx" for responses to subparagraphs a) through g), in the folder attached hereto as Exhibit to Request 1.

Source: Business Objects Vehicles Universe

Date Gathered: Through the date of the inquiry

Exhibit to Request 1

PRODUCTION DATA

Data is provided labeled as “PRODUCTION DATA.xlsx” in Microsoft Excel format in the Exhibit to Request 1 folder on the PE10-034 Data Collection Disc

Request 2

State the number of each of the following, received by VW, or of which VW is otherwise aware, which relate to, or may relate to, the alleged defect in the subject and peer vehicles:

- a. Consumer complaints, including those from fleet operators;
- b. Field reports, including dealer field reports;
- c. Reports involving a crash, injury, or fatality, based on claims against the manufacturer involving a death or injury, notices received by the manufacturer alleging or proving that a death or injury was caused by a possible defect in a subject vehicle, property damage claims, consumer complaints, or field reports;
- d. Property damage claims;
- e. Third-party arbitration proceedings where VW is or was a party to the arbitration; and
- f. Lawsuits, both pending and closed, in which VW is or was a defendant or codefendant.

For subparts “a” through “d,” state the total number of each item (e.g., consumer complaints, field reports, etc.) separately. Multiple incidents involving the same vehicle are to be counted separately. Multiple reports of the same incident are also to be counted separately (i.e., a consumer complaint and a field report involving the same incident in which a crash occurred are to be counted as a crash report, a field report and a consumer complaint).

In addition, for items “c” through “f,” provide a summary description of the alleged problem and causal and contributing factors and VW’s assessment of the problem, with a summary of the significant underlying facts and evidence. For items “f” and “g,” identify the parties to the action, as well as the caption, court, docket number, and date on which the complaint or other document initiating the action was filed.

Response 2

a) In response to this inquiry, Volkswagen has identified 46 consumer complaints involving a diesel fuel system component related to the alleged defect in the subject vehicles.

A number of consumer complaints were reviewed that did not contain sufficient information to permit a determination as to whether the incident fell within the definition of “alleged defect” or that the analysis showed the incident to be attributable to a diesel fuel system component. These consumer complaints are nevertheless provided for the Agency’s review.

b) In response to this inquiry, Volkswagen has identified 157 field reports involving a diesel fuel system component related to the alleged defect in the subject vehicles.

A number of field reports were reviewed that did not contain sufficient information to permit a determination as to whether the incident fell within the definition of “alleged defect” or that the analysis showed the incident to be attributable to diesel fuel system related components. These field reports are nevertheless provided for the Agency’s review.

c) In response to this inquiry, Volkswagen has not received any reports involving a crash, injury or fatality, or notices/claims of injury or death alleging or proving that a death or injury was caused by the alleged defect in the subject vehicles. Volkswagen has not received any property damage claims, consumer complaints, or field reports involving or referring to a death or injury related to the alleged defect in the subject vehicles.

d) In response to this inquiry, Volkswagen has not identified any property damage claims.

e) In response to this inquiry, Volkswagen has not identified any third-party arbitration proceedings where VW is or was a party to the arbitration.

f) In response to this inquiry, Volkswagen has identified one closed lawsuit, in which VW is or was a defendant or codefendant. The customer also filed one of the VOQs.

Source: LISTEN, PL, FRED, ATA/VTA

Date Gathered: Through the date of the inquiry

Request 3

Separately, for each item (complaint, report, claim, notice, or matter) within the scope of your response to Request No. 2, state the following information:

- a. VW's file number or other identifier used;
- b. The category of the item, as identified in Request No. 2 (i.e., consumer complaint, field report, etc.);
- c. Vehicle owner or fleet name (and fleet contact person), address, and telephone number;
- d. Vehicle's VIN;
- e. Vehicle's make, model and model year;
- f. Vehicle's mileage at time of incident;
- g. Incident date;
- h. Report or claim date;
- i. Whether a crash is alleged;
- j. Whether property damage is alleged;
- k. Number of alleged injuries, if any; and
- l. Number of alleged fatalities, if any.

Provide this information in Microsoft Access 2000, or a compatible format, entitled "REQUEST NUMBER TWO DATA." See Enclosure 1, Data Collection Disc, for a pre-formatted table which provides further details regarding this submission.

Response 3

Responses to subparagraphs a) through l) are provided in two separate documents entitled, REQUEST NUMBER TWO DATA.xlsx and NON-SPECIFIC REQUEST NUMBER TWO DATA.xlsx, in the folder attached hereto as Exhibit to Request 3. These cases are organized by category then by case number.

Source, Date Gathered: See Response 2

Exhibit to Request 3

REQUEST NUMBER TWO DATA

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NON-SPECIFIC REQUEST NUMBER TWO DATA

Data is provided labeled as “REQUEST NUMBER TWO DATA.xlsx” and “NON-SPECIFIC REQUEST NUMBER TWO DATA.xlsx” in Microsoft Excel format in the Exhibit to Request 3 folder on the PE10-034 Data Collection Disc

Request 4

Produce copies of all documents related to each item within the scope of Request No. 2. Organize the documents separately by category (i.e., consumer complaints, field reports, etc.) and describe the method VW used for organizing the documents.

Response 4

In response to this inquiry, Volkswagen is providing copies of documents identified for each item in Response 2. The documents are provided in Adobe Acrobat format, entitled "REQUEST NUMBER FOUR DATA.pdf", in the folder attached hereto as Exhibit to Request 4. The cases are organized by category, then by case number.

Volkswagen is also providing copies of consumer complaints and field reports in which the case does not contain sufficient information for Volkswagen to make a determination as to whether the incident fell within the definition of "alleged defect" or that the incident is attributable to a diesel fuel system related component. The records are provided in Adobe Acrobat format, entitled "NON-SPECIFIC NUMBER FOUR DATA.pdf", in the folder attached hereto as Exhibit to Request 4. The cases are organized by category, then by case number.

Source, Date Gathered: See Response 2

Exhibit to Request 4

REQUEST NUMBER FOUR DATA

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NON-SPECIFIC NUMBER FOUR DATA

Data is provided labeled as “REQUEST NUMBER FOUR DATA.pdf” and “NON-SPECIFIC NUMBER FOUR DATA.pdf” in Adobe Acrobat format in the Exhibit to Request 4 folder on the PE10-034 Data Collection Disc

Request 5

State, by model and model year, a total count for all of the following categories of claims, collectively, that have been paid by VW to date that relate to, or may relate to, the alleged defect in the subject and peer vehicles: warranty claims; extended warranty claims; claims for good will services that were provided; field, zone, or similar adjustments and reimbursements; and warranty claims or repairs made in accordance with a procedure specified in a technical service bulletin or customer satisfaction campaign.

Separately, for each such claim, state the following information:

- a. VW's claim number;
- b. Vehicle owner or fleet name (and fleet contact person) and telephone number;
- c. VIN;
- d. Repair date;
- e. Vehicle mileage at time of repair;
- f. Repairing dealer's or facility's name, telephone number, city and state or ZIP code;
- g. Labor operation number;
- h. Problem code;
- i. Replacement part number(s) and description(s);
- j. Concern stated by customer; and
- k. Comment, if any, by dealer/technician relating to claim and/or repair.

Provide this information in Microsoft Access 2000, or a compatible format, entitled "WARRANTY DATA." See Enclosure 1, Data Collection Disc, for a pre-formatted table which provides further details regarding this submission.

Response 5

In response to this inquiry, Volkswagen has identified 264 warranty claims involving a diesel fuel system component related to the alleged defect in the subject vehicles. Volkswagen notes that 4 of these claims are duplicative of the provided VOQs; 21 are duplicative of consumer complaints and 146 are duplicative of field reports.

Information for these claims is provided in Microsoft Excel format, entitled "WARRANTY DATA.xlsx", in the folder attached hereto as Exhibit to Request 5. The claims are organized by claim number.

Source: Business Objects Warranty Universe

Date Gathered: Through the date of the inquiry

Exhibit to Request 5

WARRANTY DATA

Data is provided labeled as “WARRANTY DATA.xlsx” in Microsoft Excel format in the Exhibit to Request 5 folder on the PE10-034 Data Collection Disc

Request 6

Describe in detail the search criteria used by VW to identify the claims identified in response to Request No. 5, including the labor operations, problem codes, part numbers and any other pertinent parameters used. Provide a list of all labor operations, labor operation descriptions, problem codes, and problem code descriptions applicable to the alleged defect in the subject vehicles. State, by make and model year, the terms of the new vehicle warranty coverage offered by VW on the subject vehicles (i.e., the number of months and mileage for which coverage is provided and the vehicle systems that are covered). Describe any extended warranty coverage option(s) that VW offered for the subject vehicles and state by option, model, and model year, the number of vehicles that are covered under each such extended warranty.

Response 6

In order to respond to this inquiry, the following search criteria were used to search the Warranty Claims data to identify claims in response to Request 5:

- Identify all diesel fuel related system components which retains, transfers, manages and/or directs the flow of diesel fuel in the subject vehicles
- All 2009-2010 MY Volkswagen Jetta, 2010 MY Volkswagen Golf and 2010 MY Audi A3 vehicles equipped with a TDI Clean Diesel engine, manufactured and sold to Volkswagen Group of America, Inc. for resale or lease in the United States

The individual warranty claims were then manually screened to identify those which contained customer concerns related to the alleged defect and which diesel fuel system component(s) were replaced.

The following is a list, by model year and model, of the terms of the New Vehicle Limited, Powertrain Limited and California Emission warranty coverages offered by Volkswagen on the subject vehicles:

Volkswagen	2009	Jetta/Jetta Sportwagen TDI 36 Months / 36,000 miles	Bumper to Bumper
Volkswagen	2010	Jetta/Jetta Sportwagen/Golf TDI 36 Months / 36,000 miles	Bumper to Bumper
Audi	2010	A3 TDI 48 Months / 50,000 miles	Bumper to Bumper
Volkswagen	2009	Jetta/Jetta Sportwagen TDI 60 Months / 60,000 miles	Powertrain Limited Warranty
Volkswagen	2010	Jetta/Jetta Sportwagen/Golf TDI 60 Months / 60,000 miles	Powertrain Limited Warranty
Volkswagen / Audi	2009 - 2010	Jetta / Jetta Sportwagen / Golf / A3 TDI 84 Months / 70,000 miles	California Emissions Warranty

Volkswagen does not offer any other extended warranty covering the subject components on the subject vehicles.

Source: VWGoA

Date Gathered: Through the date of the inquiry

Request 7

Produce copies of all service, warranty, and other documents that relate to, or may relate to, the alleged defect in the subject and peer vehicles, that VW has issued to any dealers, regional or zone offices, field offices, fleet purchasers, or other entities. This includes, but is not limited to, bulletins, advisories, informational documents, training documents, or other documents or communications, with the exception of standard shop manuals. Also include the latest draft copy of any communication that VW is planning to issue within the next 120 days.

Response 7

In response to this inquiry, Volkswagen is providing copies of the requested documents in Adobe Acrobat format, in the folder attached hereto as Exhibit to Request 7.

Source: VWGoA

Date Gathered: Through the date of the inquiry

Exhibit to Request 7

Data is provided in Adobe Acrobat format in the Exhibit to Request 7 folder on the PE10-034
Data Collection Disc

Request 8

Describe all assessments, analyses, tests, test results, studies, surveys, simulations, investigations, inquiries and/or evaluations (collectively, “actions”) that relate to, or may relate to, the alleged defect in the subject and peer vehicles that have been conducted, are being conducted, are planned, or are being planned by, or for, VW. For each such action, provide the following information:

- a. Action title or identifier;
- b. The actual or planned start date;
- c. The actual or expected end date;
- d. Brief summary of the subject and objective of the action;
- e. Engineering group(s)/supplier(s) responsible for designing and for conducting the action; and
- f. A brief summary of the findings and/or conclusions resulting from the action.

For each action identified, provide copies of all documents related to the action, regardless of whether the documents are in interim, draft, or final form. Organize the documents chronologically by action.

Response 8

Volkswagen has identified 26 reports that relate to, or may relate to, the alleged defect in the subject vehicles.

In addition, Volkswagen is including 34 internal inquires/communications that relate to, or may relate to, the alleged defect in the subject vehicles. Volkswagen is providing copies of all documents for the Agency’s review.

A table outlining each item in a) through f) is provided in an Adobe Acrobat file format, entitled “REQUEST NUMBER EIGHT DATA.pdf”, in the folder attached hereto as Exhibit to Request 8.

Volkswagen provides copies of the requested documents in an Adobe Acrobat file format, in the folder attached hereto as Exhibit to Request 8.

Source: Volkswagen

Date Gathered: Through the date of the inquiry

Exhibit to Request 8

Data is provided in Adobe Acrobat format in the Exhibit to Request 8 folder on the PE10-034
Data Collection Disc

Request 9

Describe all modifications or changes made by, or on behalf of, VW in the design, material composition, manufacture, quality control, supply, or installation of the subject component, from the start of production to date, which relate to, or may relate to, the alleged defect in the subject and peer vehicles. For each such modification or change, provide the following information:

- a. The date or approximate date on which the modification or change was incorporated into vehicle production;
- b. A detailed description of the modification or change;
- c. The reason(s) for the modification or change;
- d. The part number(s) (service and engineering) of the original component;
- e. The part number(s) (service and engineering) of the modified component;
- f. Whether the original unmodified component was withdrawn from production and/or sale, and if so, when;
- g. When the modified component was made available as a service component; and
- h. Whether the modified component can be interchanged with earlier production components.

Also, provide the above information for any modification or change that VW is aware of which may be incorporated into vehicle production within the next 120 days.

Response 9

In response to this inquiry, Volkswagen is providing a table outlining each item in a) through h) in an Adobe Acrobat file, entitled "REQUEST NUMBER NINE DATA.pdf", in the folder attached hereto as Exhibit to Request 9.

Source: VWAG

Date Gathered: Through the date of the inquiry

Exhibit to Request 9

REQUEST NUMBER NINE DATA

Data is provided labeled as “REQUEST NUMBER NINE DATA.pdf” in Adobe Acrobat format in the Exhibit to Request 9 folder on the PE10-034 Data Collection Disc

Request 10

State the number of each of the following that VW has sold that may be used in the subject and peer vehicles by component name, part number (both service and engineering/production), model and model year of the vehicle in which it is used and month/year of sale (including the cut-off date for sales, if applicable):

- a. Subject component; and
- b. Any kits that have been released, or developed, by VW for use in service repairs to the subject component/assembly.

For each component part number, provide the supplier's name, address, and appropriate point of contact (name, title, and telephone number). Also identify by make, model and model year, any other vehicles of which VW is aware that contain the identical component, whether installed in production or in service, and state the applicable dates of production or service usage.

Response 10

In response to this inquiry, Volkswagen is providing a table outlining each item in subparagraph a) in an Adobe Acrobat file, entitled "REQUEST NUMBER TEN DATA_PART SALES.pdf" in the folder attached hereto as Exhibit to Request No. 10.

Volkswagen notes that no kits have been developed or released for use in service repairs to the diesel fuel system, per subparagraph b).

Additionally, in response to this inquiry, Volkswagen is providing supplier identification and point of contact information in an Adobe Acrobat file format, "REQUEST NUMBER TEN DATA_SUPPLIER.pdf", in the folder attached hereto as Exhibit to Request 10.

Source: Volkswagen

Date Gathered: Through the date of the inquiry

Exhibit to Request 10

REQUEST NUMBER TEN DATA_PART SALES

&

REQUEST NUMBER TEN DATA_SUPPLIER

Data is provided in Adobe Acrobat format in the Exhibit to Request 10 folder on the PE10-034
Data Collection Disc

Request 11

Furnish VW's assessment of the alleged defect in the subject vehicle, including:

- a. The causal or contributory factor(s);
- b. The failure mechanism(s);
- c. The failure mode(s);
- d. The risk to motor vehicle safety that it poses;
- e. What warnings, if any, the operator and the other persons both inside and outside the vehicle would have that the alleged defect was occurring or subject component was malfunctioning; and
- f. The reports included with this inquiry.

Response 11

Volkswagen has found no defect related to motor vehicle safety with relation to the TDI Clean Diesel fuel system at issue in this investigation. Rather, after a detailed internal inquiry, which started earlier this year and prior to NHTSA's present preliminary evaluation, Volkswagen has determined that gasoline contaminated diesel fuel is the reason for the subject customer issues. Of about 50 diesel fuel samples taken from complaint vehicles beginning this summer as part of a broad look at the same issues and concerns raised recently by NHTSA, Volkswagen found that nearly 90%, or 43 samples, contained high amounts of gasoline.

Gasoline accidentally introduced into the subject Volkswagen diesel engine explains the type and nature of complaints at issue in this evaluation. The key is understanding that diesel fuel serves not only as the combustion source of the vehicle's engine but also as the lubricant of the high pressure fuel pump (HPFP). As explained in detail below, even a small amount of gasoline in the diesel fuel may disrupt the necessary lubrication required and may cause the HPFP to fail.

Volkswagen has not identified any reports of accidents, crashes and/or injuries possibly related to the alleged defect. Volkswagen received notice of one lawsuit, subsequently withdrawn on September 02, 2010, in which the claimant was found to have consistently used agricultural diesel fuel in his vehicle.

Volkswagen finally notes that the history of the TDI Clean Diesel fuel system includes known manufacturing process issues related to the HPFP during early production which may have led to a limited number of TDI Clean Diesel fuel system failures. The initial manufacturing concerns were resolved during the ramp up to full production of the HPFP.

What is High Pressure Common Rail Diesel Technology?

Diesel fuel systems have evolved dramatically since the early passenger vehicle diesel designs of the 1980's. Greater sophistication of the technology has met the demand for increased fuel economy, reduced emissions, and quieter operation while delivering solid performance.

Common rail diesel engines with high pressure injection technology were developed and introduced to deliver a more environmentally sensitive vehicle with increased performance when compared to former diesel or current gasoline engine concepts.

Even when compared to today's gasoline engines, the diesel engine provides great performance with high fuel efficiency and low emissions. For example, the Volkswagen TDI Clean Diesel engine in the Jetta provides 140HP and a torque of 236 lb-ft with fuel economy of 30/42 mpg¹ - while the currently available gasoline engines offer either 115HP and 125 lb-ft and fuel economy of 23/29 mpg or 170HP and 177 lb-ft and a fuel economy of 23/31 mpg. The diesel engine here provides more than 30% greater fuel economy. Indeed, the 2009 MY Jetta TDI and the 2010 MY Audi A3 TDI respectively were honored as the 2009 / 2010 Green Car of the Year.

Common Rail & High Pressure Fuel Pump Technology

Volkswagens' TDI Clean Diesel system operates under an extremely high fuel injection pressure (up to 1,800 bar / 26,107 psi) to ensure optimal power and clean combustion.

Piezo-style injectors enable several fuel injections during one combustion cycle, producing a smooth running engine with precise emissions control. The substantial injection pressure is one of the key factors to achieve the solid performance of the TDI Clean Diesel engine. The HPFP is the primary fuel system component which boosts the diesel fuel to the high pressures required, prior to delivery to the "common rail," a pressure storage tank, that in turn distributes the diesel fuel to each of the 4 fuel injectors (Reference - Image 1). The "common rail" is equipped with both a pressure sensor and a regulation valve to adapt the fuel injection pressure to the actual value required for optimum efficiency and performance, dependent on engine load and speed.

¹ City/Highway Estimates – 2010 Model Year Source: www.fueleconomy.gov

Image 1 displays the schematic of Volkswagen’s TDI Clean Diesel “common rail” system. (Please note that “fuel” always refers to diesel fuel unless otherwise stated.)

In addition, Volkswagen submits to NHTSA as part of this response, copies of the Self Study Programs (Reference - Included in Response to Request # 7) for the Agency’s reference, providing greater detail about the properties and operation of the TDI Clean Diesel “common rail” system engines.

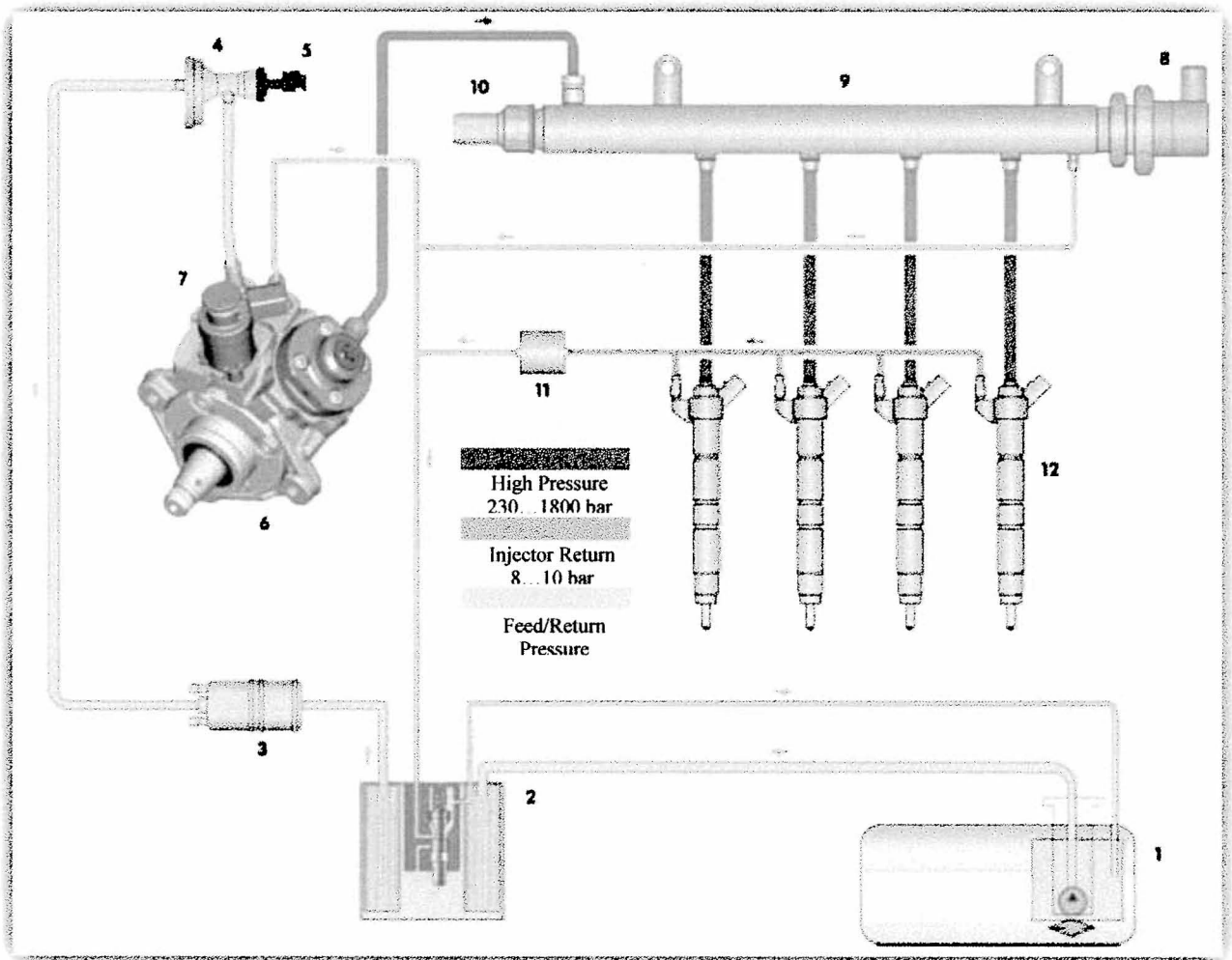


Image 1 – Fuel System Schematic

The principal components of the TDI Clean Diesel fuel system are (Reference – Image 1):

- 1) Fuel delivery unit (in-tank fuel pump)
- 2) Fuel filter with pre-warming valve
- 3) In-line fuel pump (or auxiliary pump)
- 4) Strainer (included in the fuel metering unit, #7 below)
- 5) Fuel temperature sensor
- 6) High pressure fuel pump (HPFP)
- 7) Fuel metering unit
- 8) Pressure regulation valve
- 9) Common rail
- 10) Pressure sensor
- 11) Pressure retention valve
- 12) Injectors

The in-tank fuel pump¹ delivers the diesel fuel from the fuel tank to the fuel filter², located within the engine compartment. A secondary “in-line” fuel pump³ provides additional pressure to the feed line. The fuel passes a fuel temperature sensor⁵ and enters the HPFP⁶ through a strainer⁴. The HPFP increases the fuel pressure up to 1,800 bar / 26,107 psi and feeds the fuel to the “common rail.”⁹ The actual pressure inside the common rail is controlled by a pressure sensor¹⁰ and a regulation valve⁸, depending on engine operating load and fuel demand requirements. The engine control unit operates the fuel injectors¹² and provides for multiple injections (when necessary) during one combustion cycle. Excess fuel is returned via return lines to the fuel filter. The pressure retention valve¹¹ in the return line provides a reference pressure for each injector during operation and prevents the injectors from running dry (fuel being drained from the line) when the engine is off. Inside the fuel filter², a temperature valve determines whether fuel is redirected to either the HPFP or to the fuel tank, dependent on operating and ambient temperatures.

How Does the High Pressure Fuel Pump Work?

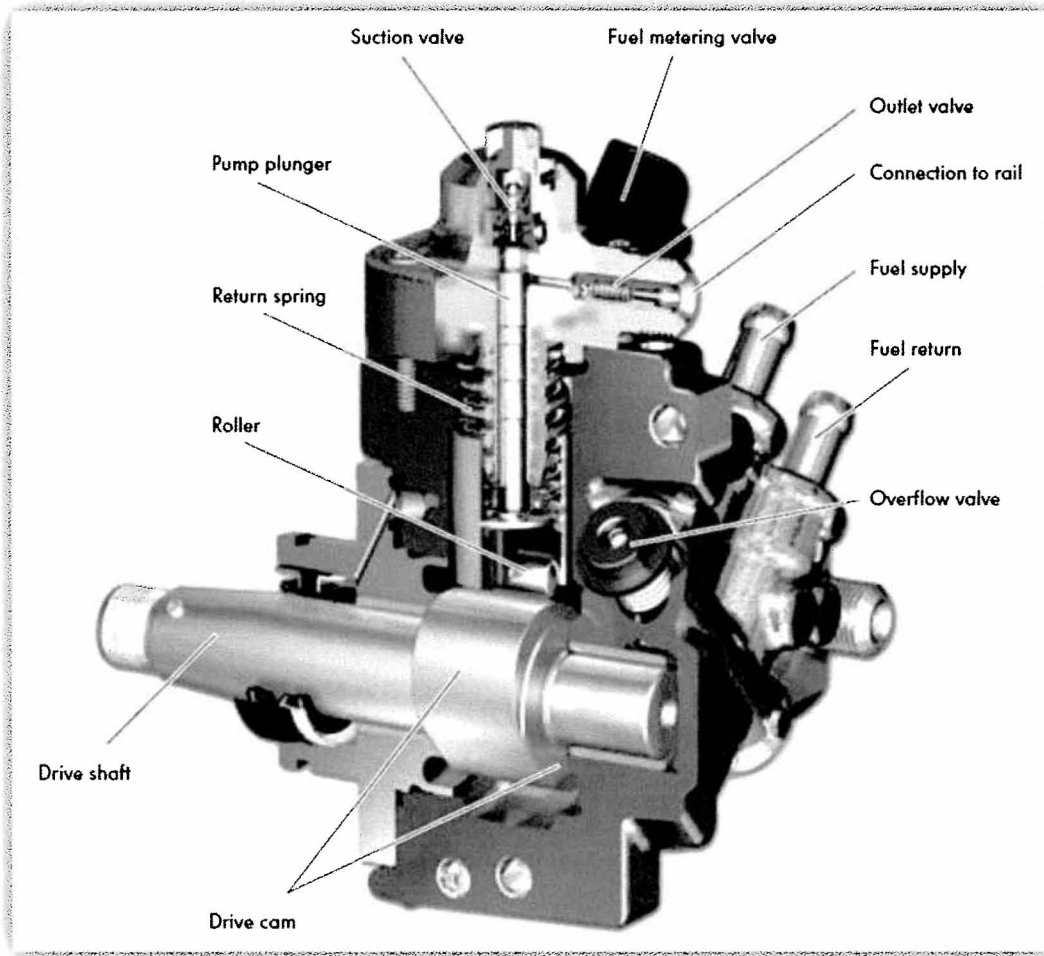


Image 2 – High Pressure Fuel Pump – Cut-away Model

Image 2 shows a cut-away model of the HPFP and displays the internal components. The basic design of the HPFP is a radial piston pump.

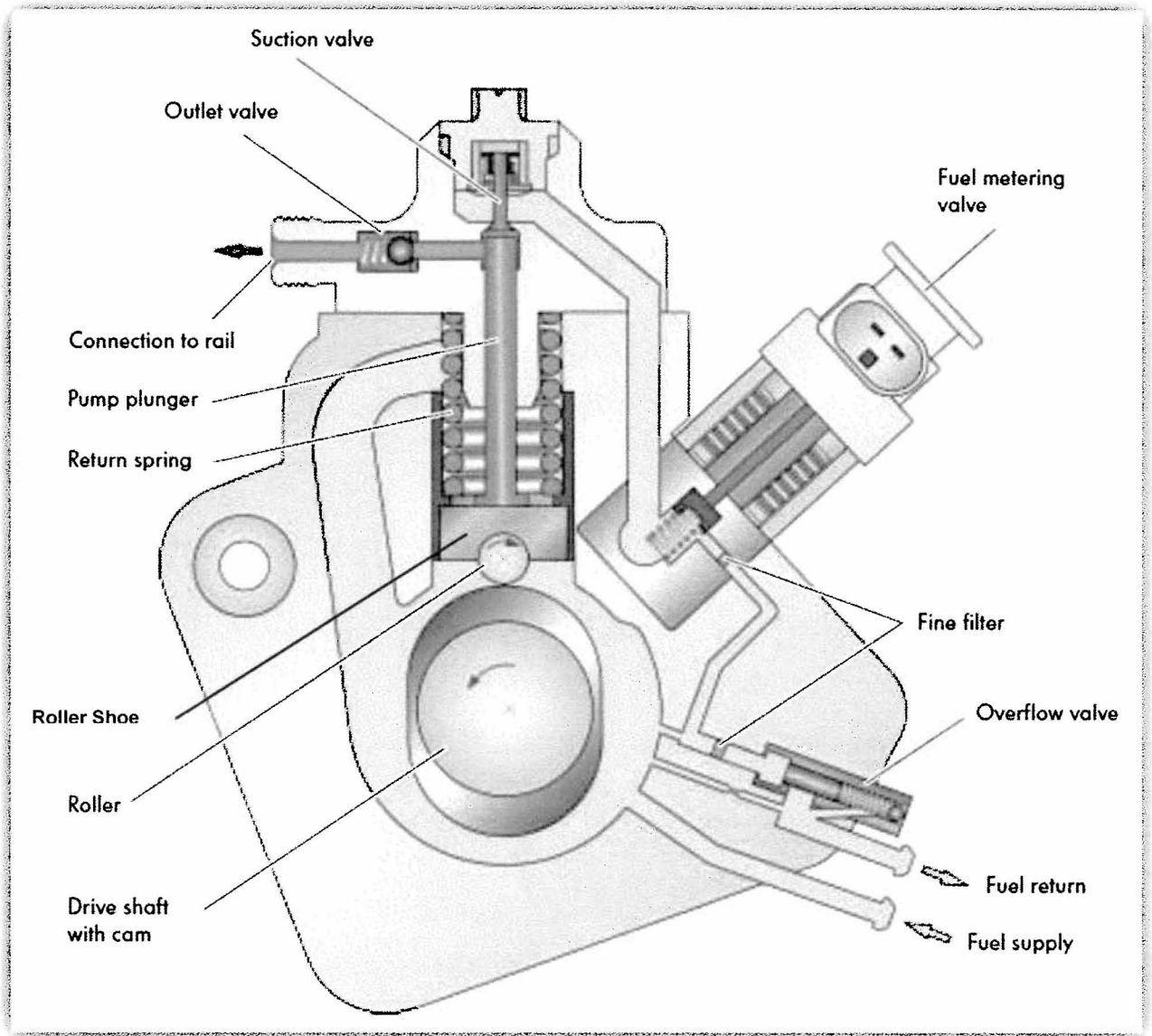


Image 3 – High Pressure Fuel Pump - Schematic

Image 3 displays the operation of the HPFP.

The pump is driven by a dual lobe camshaft. The camshaft is in constant contact with a roller, which is retained in position by a spring loaded roller shoe. The roller shoe provides the contact point between the roller and pump plunger. One revolution of the camshaft provides two actuations of the pump plunger.

Well-lubricated operation of this shoe/roller/cam contact is vital to the pump's mechanism and, as discussed later, an area directly impacted by gasoline contamination in the diesel fuel supply.

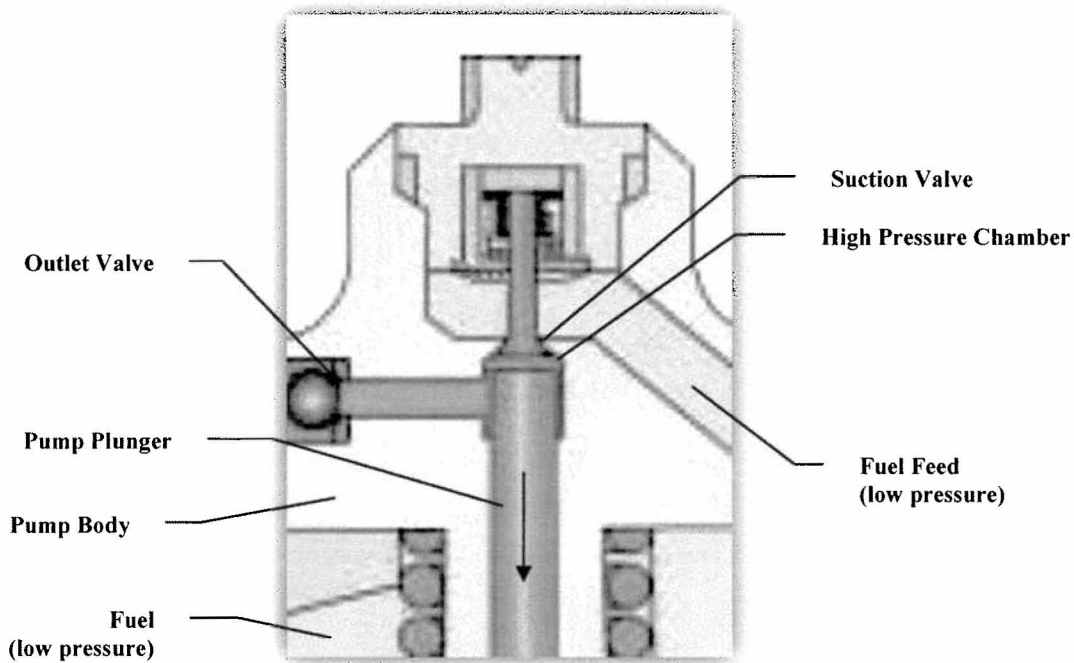


Image 4 – High Pressure Fuel Pump – High Pressure Chamber Detail

Image 4 displays the high pressure chamber of the HPFP in detail. As the plunger moves down (in the direction of the arrow), the suction valve opens and draws fuel into the high pressure chamber. As the camshaft lobe drives the plunger up, the suction valve closes, raising the pressure of the fuel within the high pressure chamber. The outlet valve then opens, feeding the high pressure fuel to the “common rail.”

Due to the extreme operating pressure in the high pressure chamber and the pressure gradient to the low pressure area at the pump’s drive, a certain amount of fuel passes between the pump plunger and the pump body. As such, it is not technologically feasible to insert a gasket that would withstand that pressure level and gradient. A separate oil lubrication and cooling circuit in the HPFP is, therefore, not possible as the diesel fuel and oil would mix. The engineering solution has been to design one fluid circuit in which the diesel fuel serves as not only the fuel for the engine but also as the lubricant and cooling agent for the HPFP. Accordingly, the surfaces and loads inside the HPFP are designed to the lubricating properties of Ultra Low Sulfur Diesel (ULSD) Fuel No. 2 meeting the ASTM D-975 standard.

Thus, the use of the correct specification diesel fuel is a vital factor for the operation of the HPFP, as the diesel fuel provides the lubricant – just as the use of the correct engine oil is vital for the proper lubrication of an engine.

Diesel Fuel Requirements as Provided in the Owner's Manual

As the diesel fuel quality is so important, the Owner's Manual clearly provides that the commonly available ULSD Fuel No. 2, meeting the ASTM D-975 standard, is the correct fuel that must be used for Volkswagen and Audi vehicles equipped with the TDI Clean Diesel engines² (Reference – Attachment in Response to Request # 11 - Volkswagen / Audi Owner's Manual). The Owner's Manual informs the customer that the engine was specifically designed to operate only on ULSD fuel and warns never to use regular gasoline or heating oil, or products such as "starting assist fluids" or "fuel-line antifreeze" (offered for gasoline engines).

The customer is also reminded to use only ULSD fuel through a "Diesel" label on the fuel filler door, the fuel tank cap, and a sticker located near the headlight switch in the passenger compartment (Reference – Attachment in Response to Request # 11 – Diesel Requirement Info).

The Owner's Manual clearly states when operating the engine on fuels other than the specified ULSD fuel, the properties of those fuels can cause serious damage to the diesel fuel injection system and engine, which may cause expensive repairs and may adversely affect the New Vehicle Limited Warranty.

While the subject HPFP was successfully tested even with certain diesel fuels outside of the ASTM D-975 specification, gasoline contamination of the diesel fuel cannot be tolerated in the fuel system. Customers are therefore clearly instructed never to use any gasoline.

Failure Mechanism / Failure Mode

Gasoline contamination destroys the lubricity of the diesel fuel required by the HPFP and will lead to damage and failure of the component. As discussed above, active parts of the HPFP such as the camshaft lobe, roller and roller shoe require lubrication by the diesel fuel. The roller spins on the camshaft lobe and slides in the roller shoe building up a hydrodynamic lubrication film that separates the components' surfaces. Without the proper lubrication of these surfaces, the components will grind and wear. With increasing wear, the roller will no longer slide in the roller shoe and instead stick or bind. The roller will then also no longer spin on the camshaft lobe and similarly start to slide and bind. The resulting failure is excessive wear and flat spots on the roller and camshaft lobe surfaces. Part analyses indicate a sticking roller may also turn the roller shoe out of position in relation to the camshaft lobe, leading to further acceleration of roller wear. With progression of the wear, metallic particles can be shaved off and the return lines will circulate those particles throughout the fuel system. Such HPFP failures require a complete replacement of the fuel system because this metallic debris could spread to the pumps, filters, injectors, and fuel tank.

Strainers and filters inside the HPFP prevent a certain amount of these particles from reaching the suction valve (Reference - Image 4), but if the strainer is overloaded, particles may block the suction valve and keep it open, preventing the generation of high pressure in the pressure

² Diesel fuel surveys conducted twice a year by the Alliance of Automobile Manufacturers, show that samples taken during the survey periods generally meet the ASTM D-975 standard.

chamber. As a consequence, the engine could stall when the rail is no longer fed with fuel, the pressure collapses and fuel is no longer supplied to the injectors.

External laboratory test results identify that ULSD fuel with a 1% gasoline contamination will already reduce the diesel fuel's flashpoint outside the ASTM D-975 specification and will degrade the effectiveness of the diesel fuel lubricity to a range that can cause serious damage (Reference – Attachment in Response to Request # 11 – Flashpoint Analysis). Accordingly, warnings and clear instructions are included in the Owner's Manual.

In addition, certain fault codes are associated with the fault condition of gasoline contaminated diesel fuel:

- P0087 fuel system rail pressure too low
- P0191 fuel rail pressure sensor circuit – range performance

Damage caused by wear, even when excessive, typically develops over time. It is noted that current HPFP failures potentially could have been the result of a previous gasoline contamination of the diesel fuel at some time prior to the failure, as indicated by diesel fuel samples taken at time of failure finding diesel fuel that is within specification. However, Volkswagen notes in the majority of cases in which a sample was taken at the time of the failure there was found to be gasoline contamination of the diesel fuel.

Warnings / Notification to the Customer / VOQs

The driver will be alerted about the failure of the HPFP through the illumination of the MIL and/or glow plug lamp, rough idle, rough running engine and reduced engine performance. As the HPFP is damaged by a wear condition, sudden engine failure and/or shutdown is unlikely. If these warning signs are ignored, the metallic particles may ultimately block the HPFP suction valve, causing the vehicle to stall. Depending on the amount of gasoline contaminating the diesel fuel, the failure of the HPFP can happen within one fuel tank filling which equals up to approximately 500 miles.

Volkswagen notes that the VOQs provided with the inquiry indicated that customers acknowledged warning light illumination and reduced engine power prior to the failure of the HPFP.

Analysis of the Data and Reports Provided with the Inquiry

To identify the fuel system components that possibly cause stalling and/or loss of power, the warranty claims provide detailed information about the replaced parts in service of the fuel system.

Volkswagen identified 467 incidents where stalling or loss of power was alleged including: 264 warranty claims; 46 consumer complaints; and 157 field reports.

Analysis of the 264 warranty claims show the HPFP to be the primary cause of the customer's concern in 154 cases. Other significant TDI Clean Diesel fuel components involved the following numbers of warranty claims: 32 incidents were related to an injector; 22 incidents were related to the pressure retention valve; 20 incidents were related to the fuel filter element; 14 incidents were related to the common rail pressure sensor and/or pressure regulation valve; 12 incidents were related to the in-tank fuel pump; and 4 incidents were related to the secondary in-line fuel pump. The remaining 6 incidents, spread among 5 different components, appear to be unique events and are set aside from the analysis, but are nevertheless included in the warranty file for the Agency's review.

The history of the TDI Clean Diesel fuel system includes identified manufacturing process issues related to the HPFP during early production which may have led to a limited number of fuel system failures. The initial manufacturing concerns were resolved during the ramp up to full production. The incident rate shows a maximum peak at 15 R/1000 for the HPFP in the first month of US vehicle production. However, the overall rate of HPFP failure is about 1.6 R/1000.

Taking all claims into consideration for the whole population, a rate of 2.7 R/1000 can be calculated if no actual cause is considered.

Volkswagen has further identified 125 incidents of acknowledged mis-fueling and those records are provided for the agency's review (Reference – Attachment in Response to Request # 11 - MIS-FUEL REQUEST NUMBER ELEVEN DATA.xlsx).

Findings

High pressure fuel pump (HPFP)

In March 2010, Volkswagen initiated an analysis regarding complaints related to HPFPs. The initial data indicated early failure of HPFPs in vehicles within the first 0 to 3 months in service. The stated concerns were related to "no-start" or "reduced performance" conditions. As part of Volkswagen's standard quality control process, 27 pumps were sent to the supplier's lab for analysis (Reference – Please refer to separate submission of "8D" laboratory reports provided by Bosch under request for confidentiality). The results were as follows:

- 8 pumps proved to be fully functional and without damage
- 5 failures were due to fuel quality issues (corrosion by water, resinified residue from over-aged biodiesel)
- 14 were suspected to be caused by manufacturing faults at early production (coating faults / metallic spillings in coating)

A similar HPFP was used in Europe prior to the release for US production. The HPFP for use in the US improved on this earlier design to address manufacturing process issues and account for US-specific fuel quality and standards. The changes incorporated in the development process of the US HPFP are referenced in some documents provided as part of this response as "countermeasure" or "improved parts." Nevertheless, not all manufacturing issues were entirely resolved prior to the start of production for the US and some early concerns had to be addressed

during ramped up production. These improvements included some additional measures implemented during early MY2009 production (Reference – Bosch report BSA000001085-001 provided separately by Bosch under request for confidentiality).

In March 2009, the manufacturing process for the carbon coating on the roller ends was changed. The former electrical coating process caused a blemish on the running surface where the electrical current was induced. By changing to a plasma coating process, the blemishing was eliminated, which in consequence enhanced the properties of the tribological system by reducing the roughness of the contact surface. The HPFPs resulting from this improvement would have been available to final vehicle assembly approximately in June 2009, at the beginning of 2010 MY production (Reference – Attachment in Response to Request # 8 – Action 8-23 and Bosch report BSA000001085-001 provided separately by Bosch under request for confidentiality).

Aside from these improvements to the HPFP addressing the manufacturing issues, fuel contamination remained the major cause of HPFP and related fuel system failures. Accordingly, a Technical Service Bulletin was issued in May 2010, instructing workshops to inspect the diesel fuel and to take appropriate steps with any warranty service in the event contamination was the cause (Reference – Attachments in Response to Request # 7 – VW TB V011011 2023624 and Audi TB A011008 2023360-1; Attachment in Response to Request # 8 - Action 8-61; Action 8-62; Action 8-66; Action 8-71).

Another robustness/durability improvement was just introduced into HPFP production in week 45, 2010 as part of the continuous quality optimization process. Play was reduced and surface finish was further optimized to improve the hydraulic lubrication film in the roller/shoe/cam contact to tolerate short time fuel deviations, such as out of specification or low quality ULSD fuel. It is important to note, however, that the HPFP was designed to the properties of ULSD, according to ASTM D-975, and thus cannot operate with gasoline contaminated diesel fuel - at issue here.

As analysis of failed parts continued to support the concern with fuel contamination, Volkswagen decided to purchase specific testing equipment in August 2010 for precise and timely identification of fuel contamination for the workshops without the need for a time consuming analysis in a testing laboratory.

Attachment (Reference – Attachment in Response to Request # 8 – Action 8-79) provides a table with the results of those analyses. The table shows the content of gasoline, biodiesel and water (in parts per million (ppm)) for 3 repeated measurements per sample.

The table shows the results for 49 vehicles' samples as follows:

- In 4 cases the customer stated or admitted to have used gasoline instead of diesel
- In 2 instances gasoline was used by mistake at a dealership sales department or during pre-delivery inspection
- In 43 cases, a sample was taken and analyzed from the fuel tank of the affected vehicle
 - Only 6 samples showed no or negligible amounts of gasoline in the sample, while one showed approximately 2.5% water in the fuel
 - The remaining 37 samples clearly showed average contamination of 8.5% gasoline in the diesel fuel³

In summary, nearly 90% of the vehicles evidenced gasoline contaminated diesel fuel to be the cause of the failure.

Applying that 90% to the overall rate of 2.7 R/1000, the rate then drops to about 0.27 R/1000 that may have been caused by manufacturing issues or a HPFP that had been damaged through a previous fueling with gasoline contaminated diesel fuel.

Reports

Volkswagen provides in this response a number of reports from the supplier's laboratory relating to the analysis of allegedly faulty HPFPs. While the supplier accepted responsibility for a number of those claims, the recent results discussed here showing significant gasoline contamination in the diesel fuel may shed new light on the cases associated with carbon coating or metallic spilling from the production process. It is important also to note that the supplier reports contain indications of rust/corrosion by water (Reference – Please refer to separate submission of “8D” laboratory reports provided by Bosch under request for confidentiality – Action 8-24; Action 8-26) and resinified residue from over-aged biodiesel (Reference – Please refer to separate submission of Bosch reports provided under request for confidentiality – Action 8-29; Action 8-30), both indications of other fuel contamination in 5 out of 27 supplier analyses. In other cases (8 out of 27 parts analyzed), the pumps were found to be in good operating order (Reference – Please refer to separate submission of “8D” laboratory reports provided by Bosch under request for confidentiality – Action 8-25; Action 8-32; Action 8-33).

Vaporization of Gasoline

Apart from the impact gasoline contamination has on the lubricity of the diesel fuel, vaporization of gasoline in the fuel system would also explain certain issues observed in the subject engines. The high temperatures in the fuel system, 80-90°C (176-194°F) can vaporize gasoline, but not diesel fuel, and create gas bubbles in areas with low fuel pressure. Such gas bubbles could affect the operation of the metering unit of the HPFP, which monitors and controls fuel supply in relation to engine load, speed and rail pressure. This could lead to inconsistencies in the fuel supply and trigger fault codes.

³ If gasoline is detected in the sample, a displayed “water” content could be ethanol contained in the gasoline because water and ethanol share the same infrared band. In cases of non-gasoline contaminated diesel, the measurement would actually be water content.

The fault codes possibly associated with the gas bubble condition are:

- P0087 - fuel system rail pressure too low
- P0191 - fuel rail pressure sensor circuit – range performance
- P0201/202/203/204 - injector cylinder 1/2/3/4 electrical fault/interrupted
- P0263 - deviation of fuel amount
- P020A/B/C/D - injection time cylinder 1/2/3/4 out of tolerance

Volkswagen suspects that, when the vehicle was brought into the workshop, the technician attempted to identify the concern based on these fault codes and replaced parts assumed to be the cause. The vast majority of the replaced parts, however, were later found to be fully functional when analyzed.

Injectors

32 injectors have been analyzed after an alleged failure. 30 were determined to be fault free, while 2 showed o-ring/gasket particles blocking the return line (Reference – Attachment in Response to Request # 8 – Action 8-08). The 30 injectors found to be without fault could have been associated with unnecessary replacements because of trouble codes stored in the engine control unit. The 2 injectors showing gasket particles were from early in the production of the subject vehicles. The issue was immediately detected and remedied by process changes at the supplier (Reference – Attachment in Response to Request # 8 – Action 8-08 and Action 8-16 provided by Bosch under request for confidentiality). Gasket particles caused by improper manufacturing by the supplier would be present from the outset of service and lead to an early failure without any future risk to motor vehicle safety.

Fuel Pressure Sensor (at Rail)

11 sensors have been analyzed after an alleged failure, all of which have been determined to be fault free (Reference – Attachment in Response to Request # 8 – Action 8-19). Again, the sensors appear to have been replaced unnecessarily because of trouble codes stored in the engine control unit.

Pressure Regulation Valve (at Rail)

7 valves were analyzed after an alleged failure. 6 of the valves were determined to be fault free (and likely to have been replaced because of fault codes), while 1 was found to be functional but with debris in the attached filter. In the instance of debris in the filter, undetermined fuel contamination was suspected as cause (Reference – Attachment in Response to Request # 8 – Action 8-18).

Pressure Retention Valve (Injector Return Line)

Some cases of pressure retention valve replacements have been reported, however, no analyses have been identified by Volkswagen.

Fuel Filter Replacements

Volkswagen identified 20 replacements of the fuel filter element only, at an average of 12,000 miles. Volkswagen submits that such “clogged” filters are an additional indication of bad or contaminated fuel, for example containing biodiesel content far above the ASTM D-975 specification, with the risk of aging and hygroscopic properties.

Lawsuit identified under Request 2

The dealership reported that the pump in the fuel tank of the customer’s vehicle failed in early January 2010. The workshop detected red-dyed agricultural or off road diesel in the fuel tank which was confirmed by the customer. Additionally, sediments, rust and moisture were found in a fuel sample taken by the dealership. The fuel filter also showed rust and silt. Volkswagen repaired the vehicle under goodwill (as the fuel contamination placed the matter outside the New Vehicle Limited Warranty), but refused to extend goodwill service when the customer presented the vehicle again several weeks later with the same problem. The customer started a lawsuit in early 2010 but ultimately the action was dropped. This customer also filed a VOQ with NHTSA in July 2010. Documents related to this lawsuit are included in the Response to Request 4.

Conclusion

Volkswagen has not identified any unreasonable risk to motor vehicle safety related to the alleged defect in the subject vehicles.

Based on laboratory results of a variety of replaced TDI Clean Diesel fuel system parts, Volkswagen determined the underlying cause of customer concerns related to engine stalling and/or loss of motive power in TDI Clean Diesel equipped vehicles, to gasoline contaminated diesel fuel. Of about 50 diesel fuel samples taken from complaint vehicles beginning this summer as part of a broad look at the issues and concerns raised here by NHTSA, Volkswagen found that nearly 90%, or 43 samples, contained substantial amounts of gasoline. Gasoline accidentally introduced into the subject Volkswagen diesel engine explains the type and nature of complaints at issue in this evaluation. The gasoline degrades the lubrication required from the diesel fuel by the HPFP.

Volkswagen has found no defect related to motor vehicle safety with relation to the fuel system at issue in this investigation. Volkswagen developed and designed the engine, the injection system and especially the HPFP to the ASTM D-975 standard for diesel fuel. As explained above, the common rail diesel fuel technology, including the HPFP, cannot tolerate gasoline contamination as found in the subject complaint vehicles. The vast majority of failures evaluated by Volkswagen were caused by outside influence and gasoline contaminated diesel fuel and not related to a manufacturing or design defect of the subject components or vehicles.

Exhibit to Request 11

Data is provided in Adobe Acrobat format in the Exhibit to Request 10 folder on the PE10-034
Data Collection Disc