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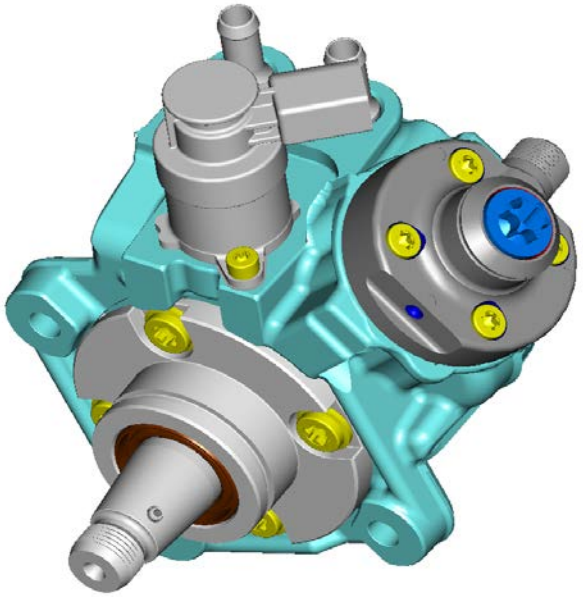


Follow Up Meeting with NHTSA

December 20, 2012

EA11-003 TDI High Pressure Fuel Pump

AGENDA

1. Statistical Analysis – HPFP Failure Rates
2. Failure Modes – Related DTC's
3. Fuel System Filtering/Screening
4. Alleged Defect – DTC's / Warnings / Operating Modes
5. 2013 MY
6. HPFP Failures – 8D Casual Identification
7. VOQ Assessment / Categorization
8. Review Closing Slides – December 12, 2012

Statistical Analysis – HPFP Failure Rates

1) VW statistical analysis of HPFP failure rates (note that this is limited to HPFP failures and should exclude all misfuels or other reports in which the HPFP pump did not fail), including:

   a. RP0, RP1, RP1+ failure rates at common service intervals (6MIS, 12MIS, etc) – identify dates/VIN breakpoints for each by model – *REFERENCE PAGE 4*

   b. Statistical forecasting of failures at 3 YIS, 6 YIS, 10 YIS (e.g., Weibull) – *8D sample size too small after exclusion of NTF / misfuel incidents to accurately calculate Weibull*

   c. Percentage of incidents involving (1) stall while driving, (2) limp mode or other symptoms with no stall, (3) no start, (4) other – *REFERENCE PAGE 4*

Statistical Analysis – HPFP Failure Rates

		CP4.1 & CP4.2		
		RP0	RP1	RP1+
	Population	126821	86431	28027
	Warranty Cases Submitted	3535	1094	43
	8Ds	118	180	3
	"IN" 8Ds	27	5	0
	% factor	22.88%	2.78%	0.00%
	max. undetermined WC	809	30	0
	Sample Failure Rates (C/1000)	6.4	0.4	0.0
	average YIS (a)	3	2	1
	R/1000 per years-in-service	1.96	0.23	0.00
Class. Counts	*Stall While Driving w/No Warning*	0	0	0
	Stall While Driving with Warning	11	1	0
	Limp Mode			0
	No Start	6	1	0
	*Other**	10	3	0
	Unknown	0	0	0
Class. C/1000	*Stall While Driving w/No Warning*	0.0	0.0	0.0
	Stall While Driving with Warning	2.6	0.1	0.0
	Limp Mode	0.0	0.0	0.0
	No Start	1.4	0.1	0.0
	*Other**	2.4	0.2	0.0
	Unknown	0.0	0.0	0.0
C/1000 per YIS	*Stall While Driving w/No Warning*	0.0	0.0	0.0
	Stall While Driving with Warning	0.8	0.0	0.0
	Limp Mode	0.0	0.0	0.0
	No Start	0.4	0.0	0.0
	*Other**	0.7	0.1	0.0
	Unknown	0.0	0.0	0.0

too few CP4.2 analyses to consider separately, field pattern similar

YIS RP0	SOP 5/08, EOP 11/10 --> mid = 8/09
	8/09 to 11/12 = 3 years, 3 months = 3.25 years
YIS RP1	SOP 11/10 EOP 11/11 --> mid = 5/11
	5/11 to 11/12 = 1.5 years
YIS RP1+	11/11 to 11/12 --> mid = 5/12
	5/12 to 11/12 = 0.5 years

	10 vehicles show a DTC (in log or text) that would trigger limp mode (P0087)
	8 from those with warning, 2 others

	3 vehicles show a DTC (in log or text) that would trigger limp mode (P0087)
	all 3 among "others"

Other*	Other warnings/complaints such as rough running, noise, etc.

Failure Modes – Related DTCs

2) Using pump diagram and 8D reports/pictures, review following failure modes and mechanisms for each and all expected DTCs

   a. No start condition – including review of the two related 8D reports – *Both incidents were caused by use of improper fuel (deposits detected during analysis - 4VW0994, 4VW1026) and diagnostic logs were not available for each VIN – REFERENCE PAGE 6 (metallic flakes)*

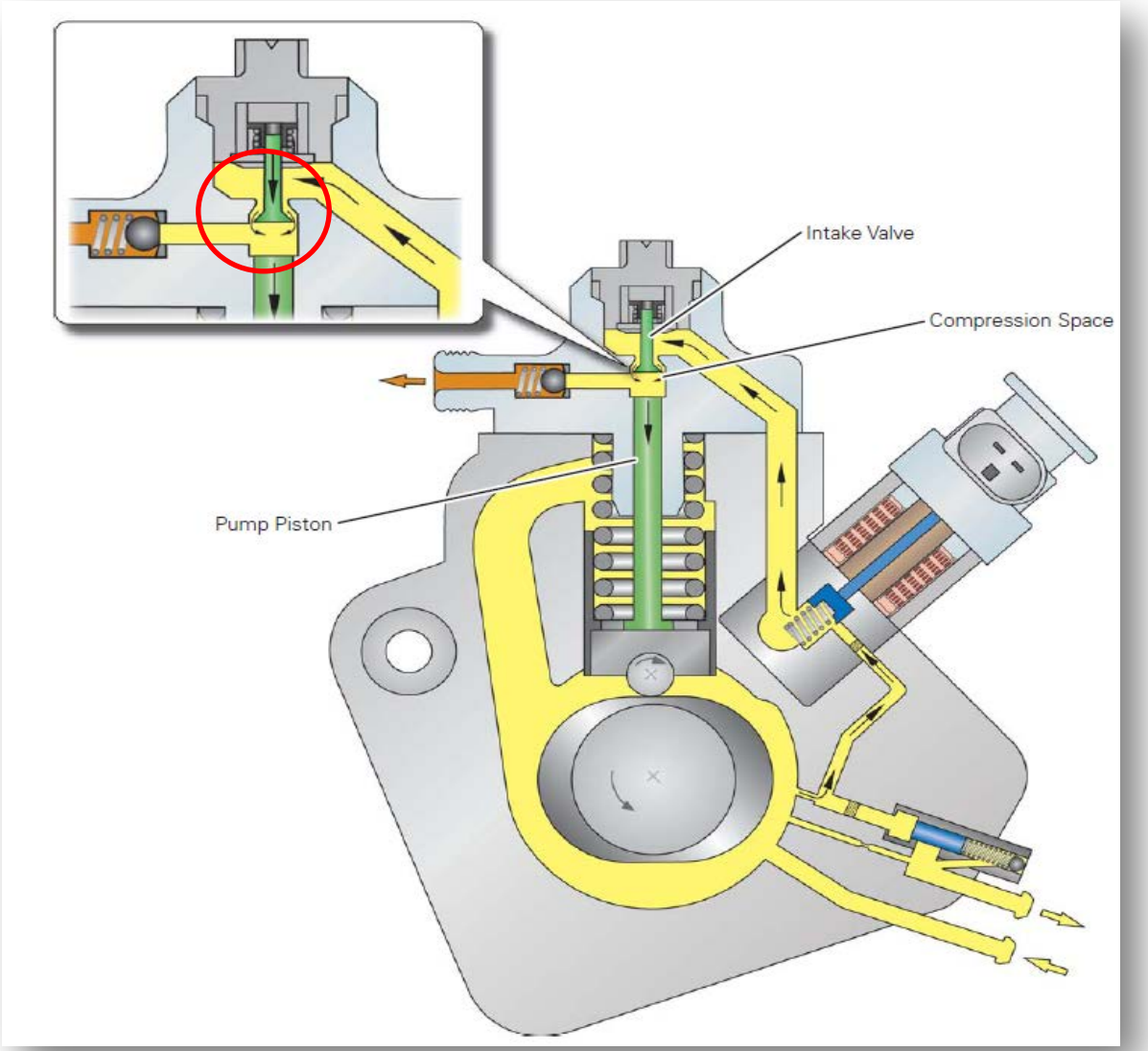
Failure Modes – Related DTCs

Metallic flakes may lodge at the seat of the suction valve when fuel velocity is zero (when engine is turned off).

As no pressure build up is possible under this condition (as the valve remains open) there is a no-start condition with the engine.

Metallic flakes remain in position between valve face and valve seat, due to return spring pressure on the valve.

No longer possible with RP1 HPFP due to additional strainer at suction valve.



Failure Modes – Related DTC's

2) Using pump diagram and 8D reports/pictures, review following failure modes and mechanisms for each and all expected DTCs

b. Limp mode operation – with sample 8D reports showing drivetrain condition for limp with no stall

(1) Include discussion of how this could be influenced by different pump failure modes (e.g., straight roller & turned roller)

"Limp home mode" engagement by the engine is confirmed by the setting of DTC P0087; DTC P0087 also activates the Glow Plug Light and will also activate the MIL if the condition is present for 2 ignition key cycles. – REFERENCE PAGE 8

A turned roller condition was identified in four 8D reports, all from within the first 90 days of production (calendar year 2008). All four incidents occurred with less than 9,500 miles. The wear rate differential between a turned roller and a straight roller, has not been defined. (4VW0121, 4VW0149, 4VW0150, 4VW0151)

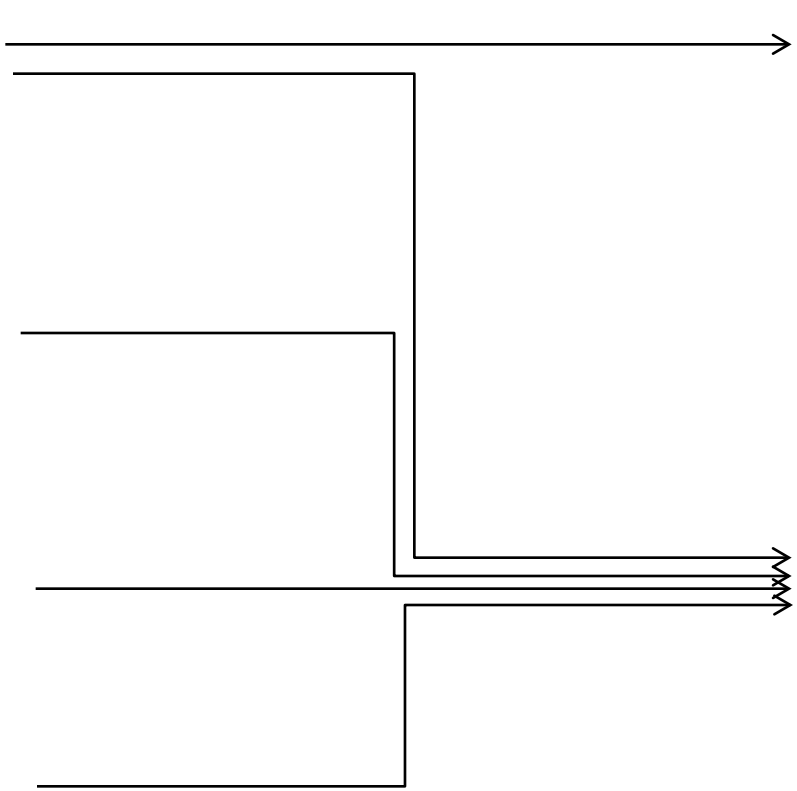
Failure Modes – Related DTCs

P0087/88
Rail pressure control
(e.g. pressure commanded by the ECU cannot be reached)

P0191
Adaptation of pressure control valve
(e.g. comparison of commanded to actual value)

P020A…D
Combustion Position Control
(e.g. ignition timing)

P0263/266/269/272
Adaptation of minimum injection



Glow Plug Light Flashing

1st ignition cycle
&
Limp Home with reduced injection pressure

MIL Illumination

2nd ignition cycle,
no limp mode

Additional DTCs detected in Diagnostic Logs:
(P030x – misfire, P0090 metering unit fault, P13Dx implausible cylinder pressure, P100x implausible cylinder torque, P026x deviation in injection amount)

Failure Modes – Related DTC's

2) Using pump diagram and 8D reports/pictures, review following failure modes and mechanisms for each and all expected DTCs

b. Limp mode operation – with sample 8D reports showing drivetrain condition for limp with no stall

(2) Include discussion of effects of pump drive train debris on injection system

Metallic flakes will contaminate fuel lines, fuel rail, fuel injectors, fuel tank and fuel filter. Multiple fuel system components are replaced due to "consequential" damage from the metallic flakes. If the fuel system is not properly flushed, the replaced fuel system components could be re-contaminated.

Majority of the fuel circulated through the HPFP is needed for cooling and lubrication of the HPFP. Only very small amounts needed for actual injection are compressed and fed to the rail/injectors.

There are 7 of 301 8D reports that identify DTC P026 (implausible injection amount) for a single injector, indicating a possible restriction. However, this was not analyzed at the time of occurrence, as fuel injectors are replaced as a "consequential" components when metallic flakes are present. (4VW1196, 4VW1070, 4VW1082, 4VW1114, 4VW1206, 4VW1131, 4VW1135)*

Failure Modes – Related DTC's

2) Using pump diagram and 8D reports/pictures, review following failure modes and mechanisms for each and all expected DTCs

c. VW assessment / explanation of incidents alleging stall with no warning (ODI to provide VOQ numbers as examples) – review of 8D reports for sampling of these incidents (ODI can provide VOQ/VIN numbers for this if necessary) – *Volkswagen is still assessing each of the 213 unique VINS which ODI provided on Monday, December 17, 2012*

d. VW assessment / explanation of incidents with no DTC's – *In each incident where a vehicle log file is present, relevant DTC's are provided. Volkswagen will provide an updated 8D table identifying the associated DTC's with each 8D / VIN.*

Where a log file is not present, Volkswagen must rely on available records to render an assessment; these assessments (for # of 8D's / VINs??) is still in progress as of December 20, 2012

Fuel System Filtering/Screening

3) Using system/pump diagrams, review all filtering/screening in fuel system and internal to pump

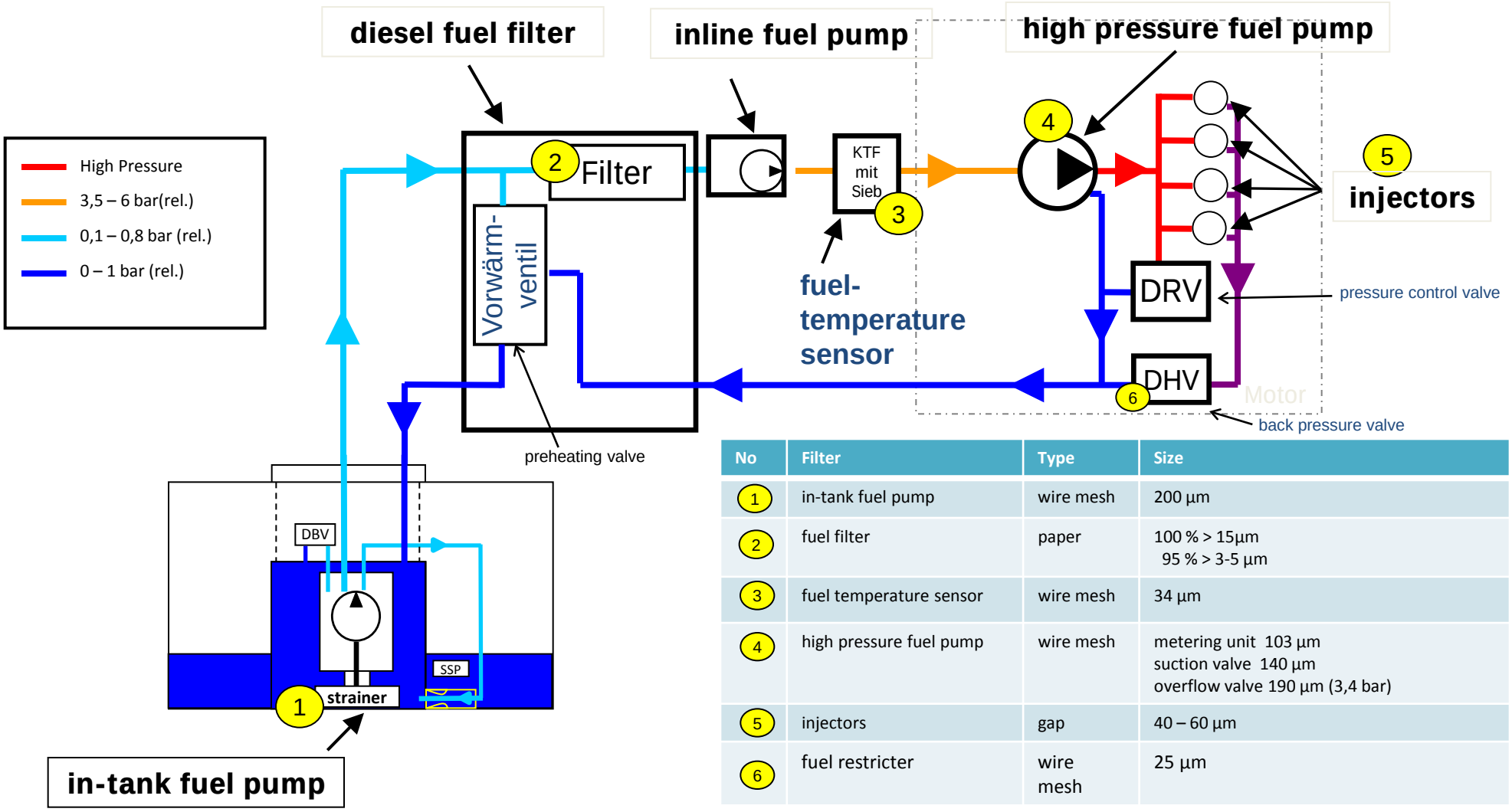
a. Mesh/screen sizes for each – *REFERENCE PAGE 12*

b. Locations in fuel system– *REFERENCE PAGE 12*

c. What components are affected by metal debris? – *All fuel system components will be contaminated and require replacement. Volkswagen has not identified other fuel system related component failures (in-tank pump, in-line pump, fuel injector, etc) as these are replaced as "consequential"" to the repair. "Consequential" items are not analyzed, as they are required replacement items.*

d. Can metal debris block injectors? If so, what is the sequence of events leading to engine shutdown and timing of notifications to the driver? This seems to be a more natural path of metal shavings downstream of the pump, why is it not the primary mode to cause lack of propulsion? – *REFERENCE item 2b2. Not detected as issue in diagnostic logs and fuel injectors were not analyzed separately for metallic flakes when HPFP was replaced.*

Fuel System Filtering/Screening – CP4.1 shown



No	Filter	Type	Size
1	in-tank fuel pump	wire mesh	200 µm
2	fuel filter	paper	100 % > 15µm 95 % > 3-5 µm
3	fuel temperature sensor	wire mesh	34 µm
4	high pressure fuel pump	wire mesh	metering unit 103 µm suction valve 140 µm overflow valve 190 µm (3,4 bar)
5	injectors	gap	40 – 60 µm
6	fuel restricter	wire mesh	25 µm

Alleged Defect – DTCs / Warnings / Operating Modes

4) Review all DTCs, warning lights and operating modes associated with alleged defect

a. Counts or approx. % of incidents with DTCs – *Volkswagen has identified 17 (53%) incidents in which a diagnostic log is available, and the HPFP failure analysis result was not NTF or attributed to a misfuel. In each log DTCs are present.*

b. Number of key cycles that codes are stored - *Volkswagen continues to research Item 4b via Engineering as of December 20, 2012 and awaits final confirmation.*

Initial evaluation: Codes remain in stored until erased with a scan tool (or similar). GPL indicator will turn off after an ignition key cycle, when fault condition is no longer present. The DTC will then be set from "static" to "sporadic", but remain stored. If an error condition was present for two ignition cycles, MIL will illuminate. MIL will not be turned off, even if fault condition is no longer present (OBD requirements) until vehicle is serviced.

DTC table containing related DTCs as found in the Diagnostic Logs is provided as backup information.

2013 MY

5) Review MY 2013 problem experience (HPFP failures – complaints, field reports & warranty), including

a. Start of sales and number sold to date

b. Incident counts in comparison to similar exposure time for prior MY's

		VIO	Claims	C/1000
2013	A3	1479	2	1.352
	Jetta	9445	4	0.424
	Golf	1919	1	0.521
	Audi Q7	1065	0	0.000
	Touareg	910	0	0.000
	Grand Total	14818	7	0.472

2013 MY

5) Review MY 2013 problem experience (HPFP failures – complaints, field reports & warranty), including

b. Incident counts in comparison to similar exposure time (July – November) for prior MY's

		VIO	Claims	C/1000
2013	A3	1479	2	1,352
	Jetta	9445	4	0,424
	Golf	1919	1	0,521
	Audi Q7	1065	0	0,000
	Touareg	910	0	0,000
	Grand Total	24951	8	0,321

		VIO	Claims	C/1000
2012	A3	1342	6	4,471
	Jetta	11212	11	0,981
	Golf	2101	8	3,808
	Audi Q7	1264	1	0,791
	Touareg	1264	1	0,791
	Grand Total	21045	36	1,711
2011	A3	1525	2	1,311
	Jetta	3843	2	0,520
	Golf	1398	2	1,431
	Audi Q7	1481	0	0,000
	Touareg	297	0	0,000
	Grand Total	8544	6	0,702
2010	A3	192	0	0,000
	Jetta	10054	5	0,497
	Golf	336	1	2,976
	Audi Q7	702	0	0,000
	Touareg	232	0	0,000
	Grand Total	11516	6	0,521
2009	A3	0	0	--
	Jetta	9923	6	0,605
	Golf	0	0	--
	Audi Q7	0	0	--
	Touareg	1	0	0,000
	Grand Total	9924	6	0,605

2013 MY

5) Review MY 2013 problem experience (HPFP failures – complaints, field reports & warranty), including

c. Any investigation/details regarding incident causes and effects on vehicle operation

	SWD		Misfuel			Classification of claims (each claim may have multiple complaints)				
Vehicle Carline	Yes	No	Yes	Contaminated Fuel	Unknown	GPL	MIL	Limp	No Start	Unknown
Golf	0	1	0	0	1	0	1	1	0	0
Jetta	0	4	0	1	3	2	1	1	0	1
A3	0	2	1	0	1	2	1	0	1	0
Total	0	7	1	1	5	4	3	2	1	1

These claims indicate **HPFP replacements**, not actual failures.
Diagnostic logs show proper operation (3 VINs) when HPFP was tested per Guided Fault Finding or available photographs provide (1 VIN), that no metal flakes were present.

Volkswagen expects a substantial NTF rate for these replacements.

HPFP Failures – 8D Casual Identification

Number of HPFP failures in which 8D was able to positively identify the cause, such as:

a. Assembly process

b. Deposits
   i. Rust
   ii. Biodiesel deposits

c. Low viscosity fuel sample

8D table provided as attachment to the presentation.

VOQ Assessment / Categorization

Numbers of all HPFP failures resulting in:

a. Stall while driving with no warning

b. Stall while driving with warning - include discussion of type and amount of warning (time interval)

c. Limp mode

d. No start

e. Other?

Volkswagen is still assessing each of the 213 unique VINS which ODI provided on Monday, December 17, 2012

VOQ Assessment / Categorization

Identify 3.a and 3.b incidents which are involved in field return analysis and/or fuel sampling analysis

a. ODI can provide these incidents from VOQ analysis

b. Pull all available records for these incidents to assess cause(s) and progression of effects on vehicle performance:

   i. Driver narrative of incident

   ii. Evidence from dealer diagnosis (e.g., DTC's)

   iii. 8D findings

   iv. Fuel sampling results

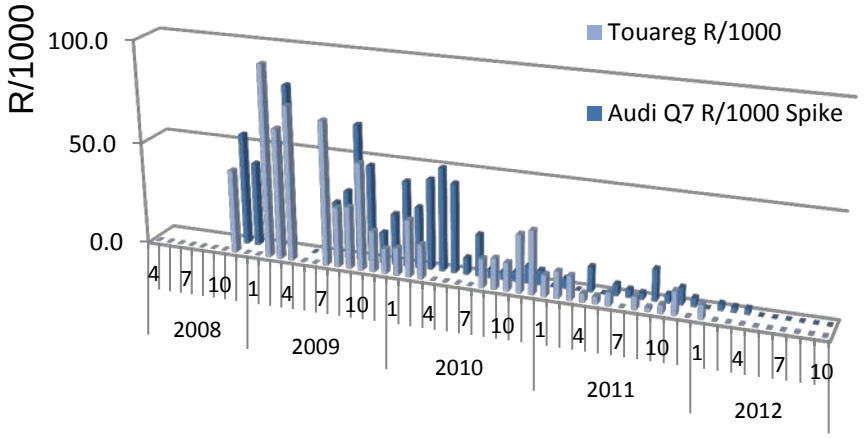
   v. Other

Volkswagen is still assessing each of the 213 unique VINS which ODI provided on Monday, December 17, 2012

Review Closing Slides – December 12, 2012

Q7 vs. Touareg

Does the misfuel protection not work?



Volkswagen considers several reasons as the cause for Q7 being „over represented“

- AdBlue filler neck close to fuel filler neck (this was the reason to implement the misfuel restrictor in the Q7) ;
  AdBlue commonly being refilled with bottles (misfuel restrictor allows 6L/min „emergency fueling“)
  → several Q7 AdBlue incidents found
  (Touareg has AdBlue filler neck in the trunk…)
- Small population: Few HPFP replacements have huge effect on rates, statistical evaluation is rather weak
- Expensive premium vehicle: Dealers may be more willing to replace HPFPs to keep customers happy, although it would not be necessary
- Use of adapters to override misfuel inhibitor (sold by dealers and at every fuel station)
  → some misfuels detected in data / fuel samples
- Misfuel by roadside assistance occurred when refueling with spare can

EPA acknowledges misfueling and the role of labels and information in 2011

- EPA, when requiring greater ethanol content in gasoline, primarily addressed the misfueling problem in July 2011 with a "**Proposed Misfueling Mitigation Measures Program**." See EPA, "Regulation To Mitigate the Misfueling of Vehicles and Engines With Gasoline Containing Greater Than Ten Volume Percent Ethanol and Modifications to the Reformulated and Conventional Gasoline Programs," 76 F.R. 44406 (July 25, 2011) (Final Rule).

- In an earlier Final Rule dealing with highway diesel fuel sulfur control requirements, dated January 18, 2001, EPA sought to minimize the possibility of misfueling by adopting "**labeling requirements that apply both to retail stations and vehicle manufacturers**." Given adoption of its 2001 program, EPA believed that "intentional misfueling will not be a serious problem." And, "because vehicle owners will likely void the manufacturer's warranty if they misfuel with 500 ppm sulfur fuel, they will have additional incentive not to misfuel." See EPA, "Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements; Final Rule," 66 FR at 5070-5071 (Jan. 18, 2001).

Joint Approach

In response to the misfueling situation, Volkswagen respectfully proposes regulation:

- diesel fuel quality up to the fuel nozzle at the fuel station similar to the existing regulations for gasoline
- nozzle diameters and gas stations requiring defined different diameters for gas nozzles and for diesel nozzles
- clear and standardized labels for the different fuels and their respective pumps at fuel stations

Incorporating the aforementioned actions will assist manufacturers to meet the federally mandated fuel economy and emissions regulations. This will also supplement the actions taken by Volkswagen and other OEMs to prevent misfueling incidents.

Summary

- Volkswagen has not identified a defect within the TDI Clean Diesel vehicle‘s high pressure fuel pump.

- HPFPs have been designed, tested and approved – including substantial design margins against fuel which is out of specification.

- Volkswagen has not received any reports involving a crash, injury or fatality.

→ Misfueling with gasoline was detected as the predominant reason for the issues seen in the field.

Volkswagen submits that there is no unreasonable risk to motor vehicle safety regarding the alleged High Pressure Fuel Pump failures.

Summary

<u>Nevertheless, Volkswagen will assist its customers in avoiding misfuel incidents</u>

- Volkswagen has initiated a customer information campaign, creating awareness to the importance of proper diesel fuel and possible consequences if wrong fuel is used
- Volkswagen has developed a series misfuel protection device and implemented this into production in MY2013
- Volkswagen has developed a service misfuel protection device for Jetta, Golf and Audi A3 and will initiate another service action with customer mailing to have our dealerships install these inhibitors in customer's vehicles

Thank you for your attention …

Questions / Discussion?

BACKUP

Pcode	Description	Description - ENG
P0087	Kraftstoff Rail- / Systemdruck zu niedrig	Rail Pressure
P0088	Kraftstoff Rail- / Systemdruck zu hoch	Rail Pressure
P0090	Ventil für Kraftstoffdosierung elektrischer Fehler	Metering Unit (N290)
P0183	Geber für Kraftstofftemp.-G81 Unterbrechung/Kurzschluss nach Plus	Rail Sensors
P0191	Geber für Kraftstoffdruck unplausibles Signal	Rail Sensors
P0193	Geber für Kraftstoffdruck Kurzschluss nach Plus	Rail Sensors
P020A	Einspritzzeitpunkt Zylinder 1 ausserhalb der Toleranz	Injection Timing
P020B	Einspritzzeitpunkt Zylinder 2 ausserhalb der Toleranz	Injection Timing
P020C	Einspritzzeitpunkt Zylinder 3 ausserhalb der Toleranz	Injection Timing
P020D	Einspritzzeitpunkt Zylinder 4 ausserhalb der Toleranz	Injection Timing
P0263	Abweichung Einspritzmenge Zyl.1	Injection Amount
P0266	Abweichung Einspritzmenge Zyl.2	Injection Amount
P0269	Abweichung Einspritzmenge Zyl.3	Injection Amount
P0272	Abweichung Einspritzmenge Zyl.4	Injection Amount
P0300	Verbrennungsaussetzer erkannt	Misfire
P0301	Zyl.1 Verbrennungsaussetzer erkannt	Misfire
P0302	Zyl.2 Verbrennungsaussetzer erkannt	Misfire
P0303	Zyl.3 Verbrennungsaussetzer erkannt	Misfire
P0304	Zyl.4 Verbrennungsaussetzer erkannt	Misfire
P1004	Momentendifferenz Zyl.1 Grenzwert überschritten	Torque difference
P1005	Momentendifferenz Zyl.2 Grenzwert überschritten	Torque difference
P1006	Momentendifferenz Zyl.3 Grenzwert überschritten	Torque difference
P1007	Momentendifferenz Zyl.4 Grenzwert überschritten	Torque difference
P13D0	Geber für Innendruck Zylinder 1 unplausibles Signal	cylinder pressure
P13D3	Geber für Innendruck Zylinder 2 unplausibles Signal	cylinder pressure
P13D6	Geber für Innendruck Zylinder 3 unplausibles Signal	cylinder pressure
P13D9	Geber für Innendruck Zylinder 4 unplausibles Signal	cylinder pressure
P13DC	Geber für Innendruck Zylinder 5 unplausibles Signal	cylinder pressure
P13E3	Geber für Innendruck Zylinder 4 Fehlfunktion	cylinder pressure