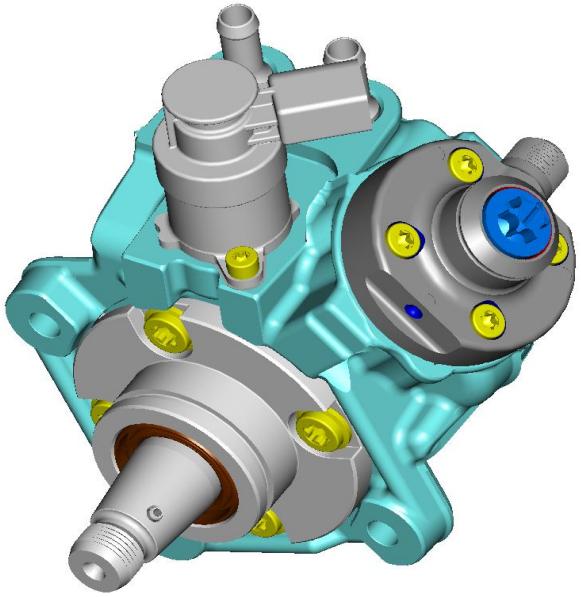
VOLKSWAGEN

AKTIENGESELLSCHAFT



Follow Up Meeting with NHTSA

February 7, 2013

EA11-003 TDI High Pressure Fuel Pump

Agenda

- Lubricity detection
- Update the xchart.xlsx with column containing the RPx pump version
- Review of Warranty Return Analysis spreadsheet
- Statistical analysis of HPFP failure rates (Dec 20th presentation)
- Method for determining fuel related “cause or contributor to HPFP failure”
- VOQ Review
  - Analysis
  - Evaluation
- Q/A

Why doesn't VW use a lubricity detector?

These real-time lubricity or viscosity detectors can inform the engine control unit when to disallow full power that the pump cannot safely deliver during periods of poor fuel quality. [this question is from information found by Duane Stoltzfus]
"Continental AG fuel quality sensor helps adapting cars to different fuel qualities"

- Continental develops the sensor also on behalf of Volkswagen
- Advertisement is a bit over-enthusiastic

- Sensor does not yet exist
- Sensor contains an infrared spectrometer and compares market specific „footprints" of fuel
- „Measuring" lubricity and viscosity, for example, is not yet possible and are not actually measured

Review of the Warranty Return Analysis spreadsheet

- A review of the Warranty Return Analysis spreadsheet (short discussion of each of the fields/columns in the spreadsheet and how they were used in VW analysis)

VIN	Vehicle‘s identification number
Field Report Number	VWGoA Field report corresponding to the incident
Internal #	VWAG internal tracking number
Warranty Claim Number	VWGoA corresponding warranty claim number
8D Report Reference Number	Bosch‘s internal 8D report number
8D Report Date	Date of the 8D report
VW Part Number	Affected VW part number
Part Manufacturing Date	Date the HPFP was buildt
Build	Design level of the HPFP
Vehicle Production Date	Vehicle production date
Warranty Start Date	Date when vehicle was sold
Problem Description, Customer Complaint	Brief customer complaint summary from warranty claim or 8D
Failure Date	Faildate (datestamp from warranty claim)
Mileage	Mileage stated in warranty claim or 8D
Problem Description, Bosch Description	Category used by Bosch to classify 8D report (stated under D2 in 8D)
Category (for analysis)	VWGoA classification for analysis/summarizing 8Ds
Defect Location	As stated in Bosch 8D under D2
Defect Type	As stated in Bosch 8D under D2
Root Cause Analysis	Summarizing findings from Bosch or VW (if no 8D), unifying statements for counting
Preliminary Analysis at VWAG (if available and no 8D present)	Pulled from VW internal part tracking system
VW Assessment (fuel caused or contributed to pump failure)	VW evaluation if fuel influenced failure/8D
Stall while driving (from Xchart)	VW evaluation if stall while driving occurred
Misfuel Combined	Combined misfuel indicator (considering xChart & fuel sample)
Misfuel identified (from xChart)	Misfuel indicator copied from xChart, identifying misfuel in VWGoA data
Misfuel Determined by Fuel Sample	Misfuel detected in fuel sample
Fuel Analysis Recieved & Submission ID	Data copied from fuel sample table
Lubricity, Sulfur, Viscosity, Biodiesel & Flashpoint	Fuel properties copied from fuel sample table for evaluation / connection to 8D

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

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.

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

Qualitätssicherung

Review of the statistical analysis of HPFP failure rates

NHTSA required analysis of 8Ds after excluding NTF and fuel related / misfuel failures
VWGoA provides an updated table with additional column stating „in/out“ and reason

Approach:

Deposits in 8D-analysis show prior use of improper fuel (majority rust/corrosion/water related deposits) – not necessarily caused with the current fuel in the vehicle. Current fuel may be according to spec (as sample shows), but fuel issue occured in vehicle history.

- „Root cause determination“ column used for evaluation
- „Deposit“- 8D were considered as fuel related and were excluded from evaluation as required.
- Vehicles with identified misfuel in data (w/o fuel sample) were also excluded.
- Vehicle with „due to unsuitable fuel“ were excluded
- Vehicle with other fuel related issue were excluded (water, algae, dirt)

- Column has been added to identify IN/OUT records (incl. reason for OUT) for NHTSA review (warranty return analysis – 20130207.xlsx)

Review of the statistical analysis of HPFP failure rates

Misfuel / unsuitable fuel / deposits etc. stated in 8D analysis, root cause column

Determination was not only based on sample and data sources, but also on the statements and findings of the 8D.

All field rtns

Misfuel identified in xChart (acknowledged misfuel?)	Misfuel identified in fuel sample	VW Assessment (fuel caused or contributed to pump failure) Yes	No	No determ possible	NTF	Total
Yes	Yes	8			39	47
	Biodiesel	1			1	2
	No	14			47	61
	Total	23			87	110
Yes?	No	1				1
No	No	103	1	27	55	186
	Biodiesel	3				3
	No ULSD	1				1
	Total	107	1	27	55	190
Total		131	1	27	142	301

No evidence of misfuel? = 117 % w/HPFP failure = 53%

Field rtns with fuel sample

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Yes	Yes	8			39	47
	Biodiesel	1			1	2
	No	2			1	3
	Total	11			41	52
No	No	39			19	58
	Biodiesel	3				3
	No ULSD	1				1
	Total	43			19	62
Total		54			60	114

No evidence of misfuel? = 41 % w/HPFP failure = 47%

Review of the statistical analysis of HPFP failure rates

E.g. deposits or corrosion detected in HPFP in about half of 8Ds. HPFP damage may have been caused earlier.
→ VW Assessment of 8D is based on report findings/statements

Use of improper fuel may have happened in vehicle history, not in current tank filling

All field rtns

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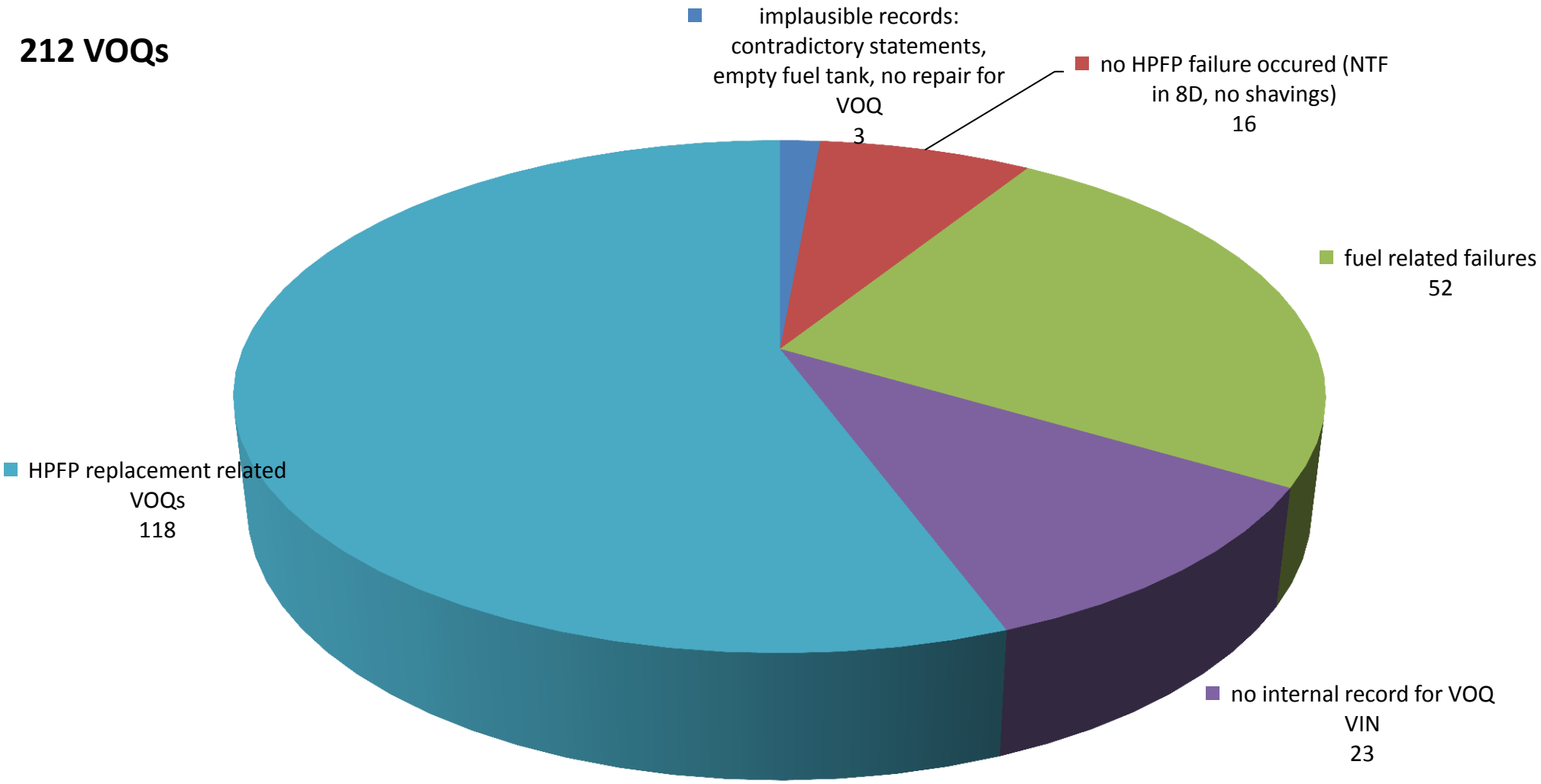
VOQ Review / Evaluation – General statements

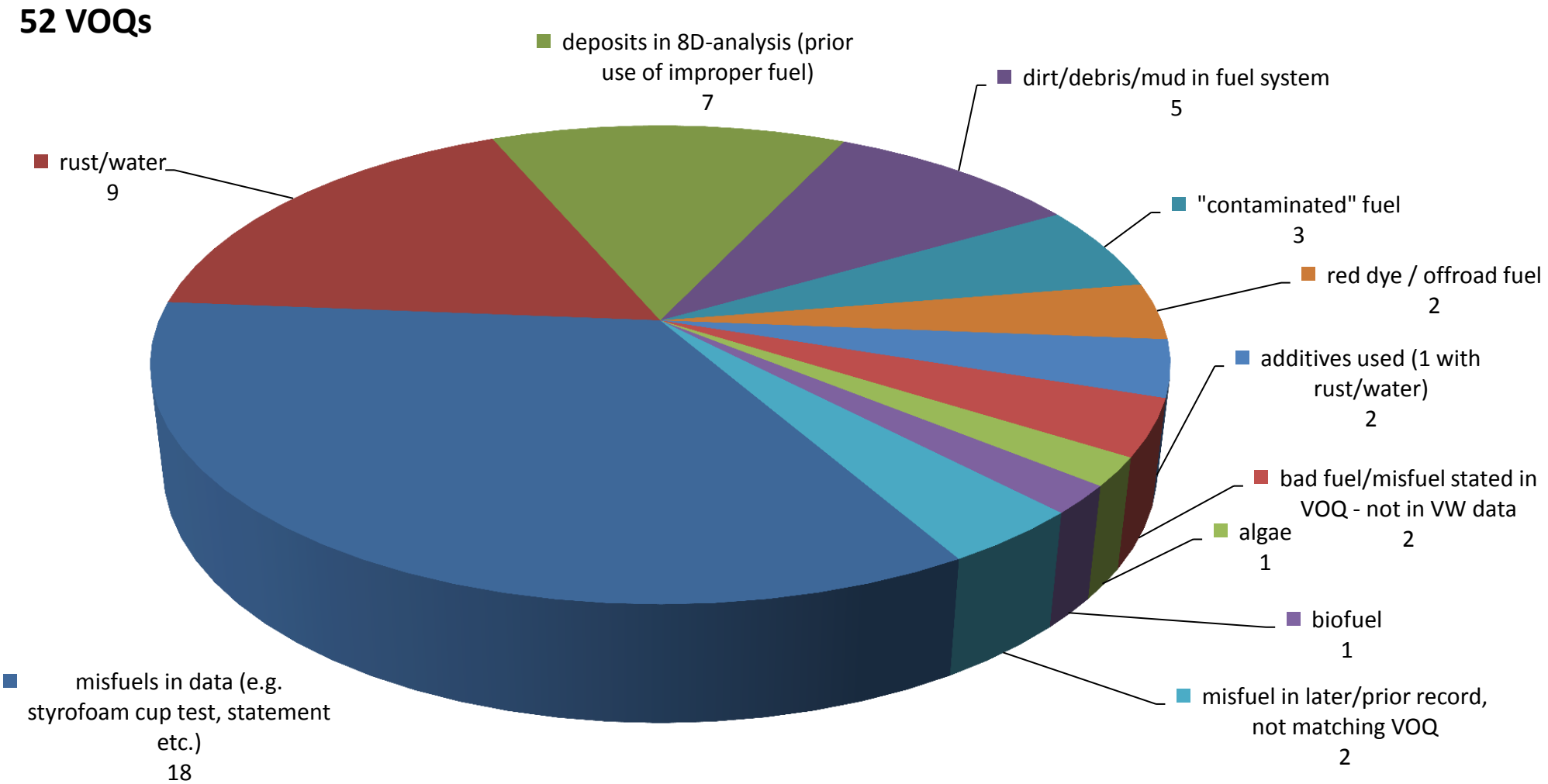
- NHTSA provided 213 VOQs for evaluation
- 1 VOQ (10451977) was excluded from evaluation as the cause was a fractured fuel line (subject to recall 11V-490)
- The following slides are based on review of the 212 remaining VOQs

Case assessment for VOQs provided by NHTSA

212 VOQs



Details for Fuel Related VOQs – 52 VOQs



VOQ Review - Summary

212 VOQs

- 118 records about HPFP failures/replacements, corresponding to VWGoA records, 20 of those without warranty claim
- 52 fuel issue related VOQs – typically not disclosed in the VOQ
- 23 VOQ without a corresponding VWGoA record (no customer contact, no warranty claim)
- 16 records without HPFP failure, cause for vehicle issue unknown/not HPFP caused

- Volkswagen submits that VOQ sample is not representative of the HPFP universe
  - Customers do not include possibility of refueling mistake when registering their VOQ
  - Customer description of incident may not be supported by manufacturers record
  - Comments tend to disassociate warning indicators from alleged HPFP failure
    - Verbatims may be influenced by blog / internet comments
  - Many complaints allude to cost of repair/replacement of parts
  - A review of the VOQs indicate that none of these vehicles were involved in property damage, accidents, or injuries

Volkswagen concludes that 8D analysis provides a more reliable, „representative“ failure mode distribution/clarification

VOQ Review / Evaluation – Stall without warning?

VWAG test drives (misfuel – 3 minutes / drivetrain damage – 30/45 minutes) vs. Customer statements of sudden failure without warning

- For 122 of 212 VOQs a corresponding Diagnostic Log was detected.

- The DTC P0087 (rail pressure deviation) is stored, when fuel pressure in the rail does not follow the command value. This DTC considered as the essential DTC: P0087 activates the flashing glow plug warning and triggers the limp home mode, in the instance when it is stored.

- Multiple P0087 recordings are possible, as diagnosis is performed for each rail pressure control path (Metering unit, Pressure Reg Valve, Cylinder Pressure Control?)

- In all incidents, where data is available, DTCs (P0087 and additional) are set.

- DTCs do not provide information about rough running, sluggish and hesitating engine operating. There may be additional warning to the customer (as stated in some VOQs) that precede any recorded system reaction.

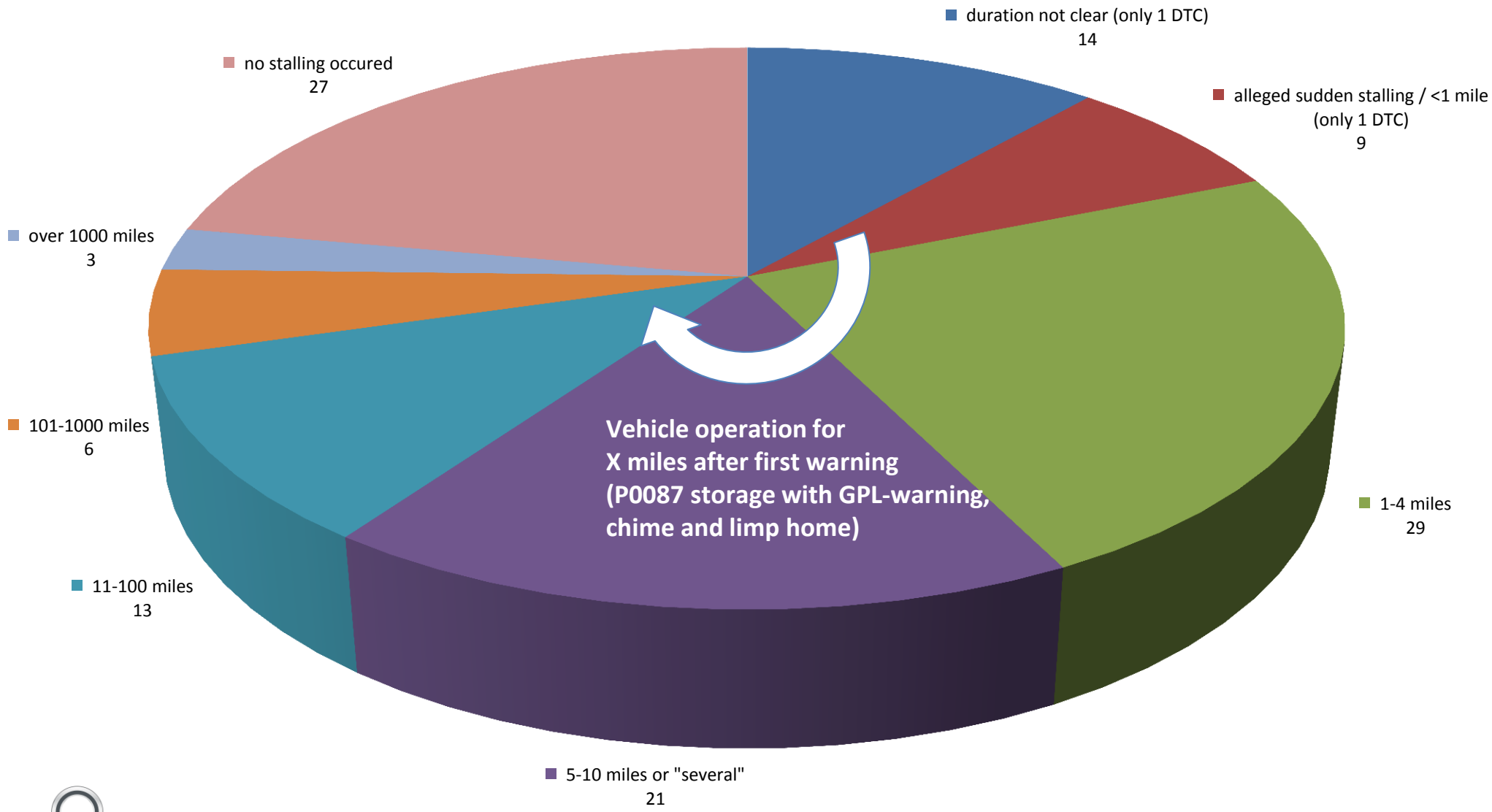
VOQ Review / Evaluation – Stall without warning?

Evaluation of the DiagLogs:

- Several recordings of P0087 or other DTCs after P0087 was stored, indicate continued operation after warning and limp home occured.
- Recording of codes over several miles indicated, that no sudden stalling without warning occured. However, as for example ignition cycles are not recorded, this is no absolute proof.
- Warning duration is primarily estimated from log, secondary from customer verbatim and other data.

- Single recording of one P0087 DTC may result from only one control mode being affected and does not allow the direct conclusion of a sudden stalling.
- For example VOQ 10475371 shows only one P0087 DTC and customer expressively states „no stalling“.
- Volkwagen‘s understanding here is, that a customer complaint of „sudden“ can neither be proved nor disproved when only one DTC was recorded.
- Here the customer verbatim is the only source of information.

DTC recording duration (122 VOQs)



VOQ Review / Evaluation – Stall without warning?

Summary

- HPFP drivetrain is mechanical – no direct surveillance is possible
- Detection of „trouble“ is only possible by measurement of secondary values: mainly the pressure generated in the rail.
- All vehicles (where data is available) show storage of DTCs. HPFP does not „fail“ without the engine control system recognizing the fault and activating warning/limp home.
- Over 90% of the vehicles show continued operation after P0087 storage (with flashing glow plug light, chime and limp home mode) which Volkswagen interprets as „no sudden stalling“
- In single incidents the time between warning and stalling may be short. Single reports state 10-20 seconds or „sudden“.

Thank You!

Additional questions?