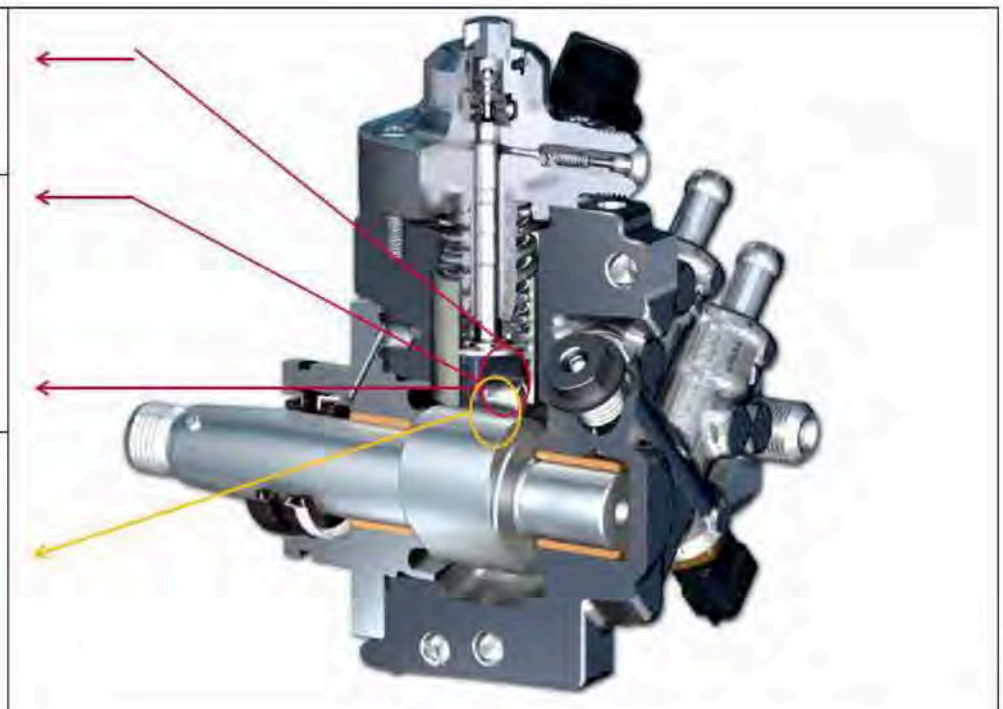
Types of friction in the high-pressure fuel pump

- **Boundary and mixed friction**
  - **Roller/Roller Shoe Group**
  - **Start/stop mode**
- **Mixed friction**
  - **Roller/Roller Shoe Group**
  - **Poor lubricity of fuel**
- **Hydrodynamic friction**
  - (transition from mixed friction to fuel lubrication)
  - - Roller/Roller Shoe Group
- **Elastohydrodynamic friction**
  - (transition from mixed friction to fuel lubrication)
  - - Roller/Camshaft Group



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Assessment of fuel parameters (1/2)

Properties	Subitem	Critical points	Measurement process	Remark
Lubricity	• Wear • Seizures	• Film of lubricant • Viscosity • Boiling point	• HFRR • Mod. HFRR • VKM • SLBOCCLE	• Do not always correlate to cases of damage • Influences of viscosity and volatility not taken into account (IBP > 130°C required) • Corrosion simulated "good lubricity"
Volatility			• Phys. Dis. • Sim. Dis. (modifiable) • Flash point (indicator)	• Influence on lubrication properties • Influences the formation of vapor bubbles (cavitation, cavitation erosion)
Viscosity	•with different T, p	• Temperature • Pressure	• Viscosimeter	• Has a major influence of the thickness of the lubrication film in moving parts (bearing, roller ...)
Density		• Influence observed in spot checks at Bosch but not explained	• Quartz	• Carried but not available immediately as a key

Evaluation of fuel parameters

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Properties	Subitem	Critical points	Measurement process	Remark
Impurity			• Compound • Dimensional distribution • "Glass plate sedimentation" only counts hard particles	• leads to friction on moving parts, seizing and wear and tear • Hard/soft important
Water		• Solved • Unsolved	• Karl-Fischer titration • C+b	• Causes corrosion • Reduces lubricity
Boundary surfaces - tension CP/CFPP – Difference				• For Bosch – injection from VW perspective is irrelevant • As an indicator for WASA
Corrosion			• NACE • NACE mod (saline solution)	• Strengthened by water and FAME degradation products (e.g. acids)
EHN			• Scientific discussion of influence on lubricity/oxidation	
IP				• To report
TAN				• In combination with water (FCF test)
Air/ diesel emulsion			• Bosch house method	• Necessary to develop a process

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Next steps

- Gathering of field analysis data (SGS, Bosch – [redacted] Bosch - [redacted]) End of July
- Analysis of fuels in problem regions September
- Measurement of the existing test fuels End July
- Correlation with damage data End of August
- Selection of fuel parameters September
- Adaptation of test fuels October
  - Option 1: specify existing fuels (current status) more precisely
  - Option 2: additional parameters
- Test conditions
  - Mixtures/ changes
  - Cycles/driving behavior
  - Mixture of benzine, kerosene, aged biodiesel

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Types of friction in measurement processes – HFRR

- **High Frequency Reciprocating Rig (HFRR):**

- **Mapping of elastohydrodynamic friction (roller/camshaft)**
- **Boundary and mixed friction, as well as hydrodynamic friction (roller/roll shoe) ignored**
- **Implementation under constant temperatures (60 ± 2°C)**
- **Constant frequency of the calotte (50 ± 1 Hz = 3000 rpm)**
- **Ambient pressure**
- **Disadvantages: Large spreads (ASTM D 6079: ± 136 µm; EN ISO 12156-1: ± 120 µm)**

➢ **Abrasion problems do not always correlate with the HFRR values.**

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Types of friction in measurement processes – SLBOCLE

- **Scuffing Load Ball on Cylinder Lubricity Evaluator (SLBOCLE):**

- **Mapping of elastohydrodynamic friction (roller/camshaft)**
- **Boundary and mixed friction, as well as hydrodynamic friction (roller/roll shoe) ignored**
- **Implementation under constant temperatures (25 ± 1°C)**
- **Constant rotation of the cylinder (525 ± 1 rpm)**
- **Ambient pressure**
- **Disadvantages: Large spreads (ASTM D 6078: 1500 g)**
  - **“SLBOCLE < 2000 g could lead to massive abrasion”**
  - **“SLBOCLE > 3100 g should prevent massive abrasion”**

➢ **Measurement is not meaningful for possible cases of damage**

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Types of friction in measurement processes – FBBD

- **Four Ball Bearing Device (FBBD):**

- **Mapping of elastohydrodynamic friction (roller/camshaft)**
- **Boundary and mixed friction, as well as hydrodynamic friction (roller/roll shoe) ignored**
- **No standardized method for fuels (modification required)**
- **No consideration of conditions in start-stop mode (boundary and mixed friction)**
- **Implementation under different temperatures (-30 ± 150°C)**
- **Variable rotation of the ball bearings (10 - 5800 rpm)**
- **Ambient pressure**

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Outstanding points - measurement process

- What is the influence of pressure in the HPFP on lubrication or lubricant film and friction
- Measurement methods only reflect conditions between roller and camshaft
- Measurement method does not reflect the critical conditions between the roller and roller shoe.
- To be clarified:
  - Conditions in HPFP
    - Temperature
    - Rotation of the roller in the roller shoe
    - Pressure

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Influence of fuel parameters on friction

- **Viscosity and volatility influence the lubrication film and therefor friction**

– **Volatility:**

- **As the boiling point curve drops, more vapor is formed, leading to poor lubrication.**
- **This results in wear.**

– **Viscosity:**

- **Viscosity has a direct influence on the lubrication film. This declines as viscosity declines.**
- **As a consequence, hydrodynamic lubrication declines. This results in increasing mixed friction and wear.**
- **Mixed friction leads to wear, seizures and the formation of particles.**
- **<u>Influencing factor</u>: Temperature**

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Actions on 5.7.2011

- Sim Dist:
  - 1.) GC – Effort (range) v. phys dist. [redacted]
  - 2.) Reaction of water
  - 3.) Check SGS [redacted])/Survey/Standard/
- Density
  - 1) Bosch has results from Shell/VW – test
  - 2.) No problems known from CTL in [redacted]
  - 3) Inspect pumps from fleets
- Viscosity
  - 1.) FEV: Studies on pressure/temperature – Dependency [redacted], Results Q 3
- Water content
  - 1) Test directly/indirectly (indirect approach better with many samples)
- Air in diesel
  - Demonstrate: from the improvised method to the process
- Cycle
  - Start/stop security

[redacted]

Next steps

- Assessment

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Proposed test program for friction/wear

- **Determination of conditions in the high-pressure fuel pump (temperature, pressure, rotation of the roller,…)**
- **Examination of influential factors for thickness of fuel lubrication films**
  - **Viscosity**
  - **Volatility**
  - **Temperature**
  - **Pressure**
  - **…**
- **Determination of correlation between lubrication film thickness, influential factors and wear**

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Backup

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Proposed test program for friction/wear

- **Scuffing Load Ball on Cylinder Lubricity Evaluator (SLBOCLE):**
  - ASTM standard for distillate (ASTM D6078)
  - Little used in Europe
  - Large tolerance ranges (± 1500 g)
  - Correlation between lubricity and damage symptoms in fuel injection system not perfect

- **Four Ball Bearing Device (FBBD)**
  - Standard test method for oils
  - Not optimized for diesel fuels

- **High Frequency Reciprocating Rig (HFRR):**
  - Currently the standard method
  - Large tolerance ranges (± 136 µm for ASTM D 6079; ± 120 µm for EN ISO 12156-1)
  - Correlation between lubricity and damage symptoms in fuel injection system not perfect

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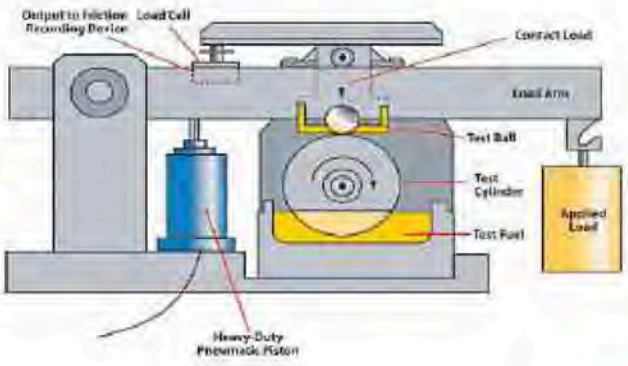
Scuffing Load Ball on Cylinder Lubricity Evaluator (SLBOCLE):

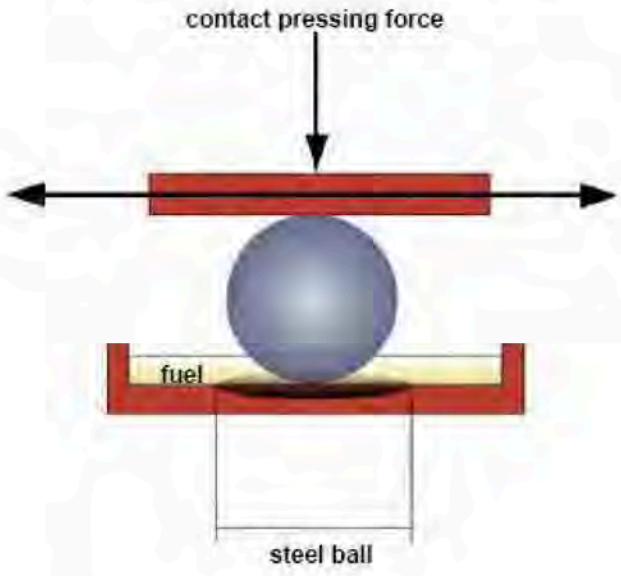


- ASTM standard for distillate
- Little known in [redacted] (only a few laboratories)
- Large spreads (ASTM D 6078: 1500 g)
  - **"SLBOCLE < 2000 g could lead to massive abrasion"**
  - **"SLBOCLE > 3100 g should prevent massive abrasion"**

Because of the enormous spread permitted by the standard, damage symptoms do not always have to correlate to the SLBOCLE!!!

[redacted]

High Frequency Reciprocating Rig (HFRR):



- Standard method for determining lubricity
- Large spread (ASTM D 6079: ± 136 µm; EN ISO 12156-1: ± 120 µm)
- Wear problems do not always correlate with the HFRR values.
- Alternative: always consider the temporal progress of the lubrication film thickness (not a mean value)
  - Better correlations with damage symptoms (VW tests)
  - Early deterioration of the lubrication film and/or thinner lubrication film (≤10%)
    <u>Often massive damage caused</u>
  - Lubricating film (10-20%)
    <u>Wear possible</u>

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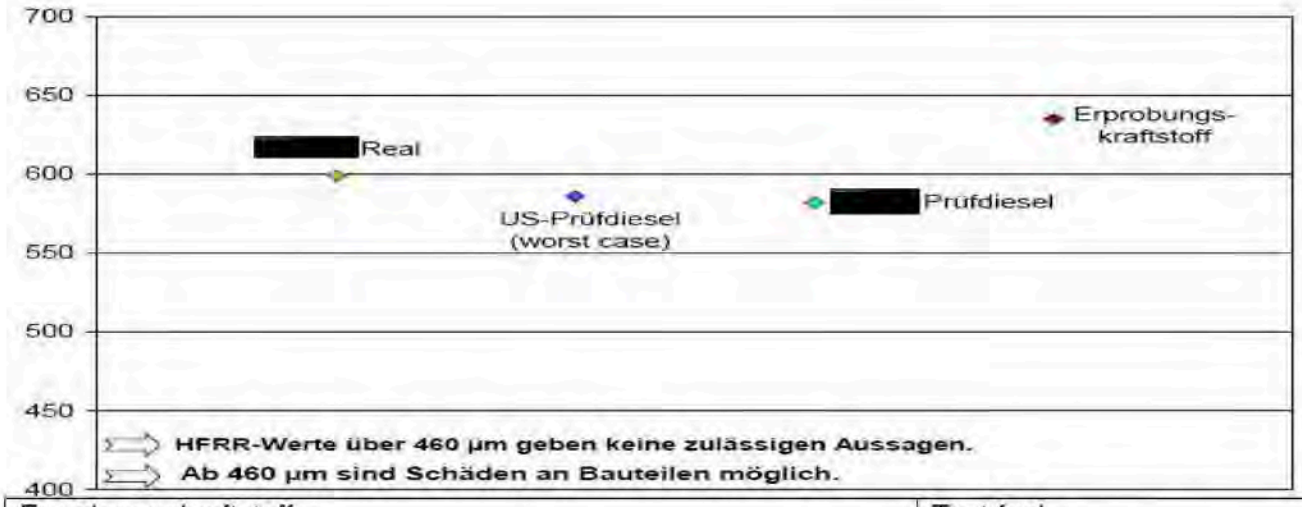
ENTIRE PAGE CONFIDENTIAL

HFRR values of various diesel fuels



Erprobungs-kraftstoff	Test fuel
US-Prüfdiesel (worst case)	Test diesel from US (worst case)
[redacted]-Prüfdiesel	Test diesel from [redacted]
HFRR-Werte über 460 µm geben keine zulässigen Aussagen.	HFRR values over 460 µm are not meaningful
Ab 460 µm sind Schäden an Bauteilen möglich	Damage can be caused to components from 460 µm
HFRR [µm]	HFRR [µm]

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Problems with HFRR measurement

- **The biggest problems were encountered with test diesel from** [redacted]
- **HFRR value lower in comparison with other test fuels.**
- **HFRR value along does not provide reliable information about possible wear problems.**
- **Only a general tendency can be identified (wear is more likely for HFRR greater than 460 µm)**
- **Lubricating film thicknesses can provide support.**
- **Better correlation between observed damage symptoms and lubrication film thickness.**

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Measurement of lubrication film thickness HFRR

- **Measured by means of the drop in potential in a resistance bridge with a voltage of 15 mV and a standard resistance of 10 Ohm**
- **A drop in potential over the test body is a measure of the film resistance compared with the comparative resistance**
  - **A thin/non-existent film of lubricant is associated with a high loss of potential**
    - **Metal-metal contact**
    - **High friction / high abrasion**
  - **A thick film means less metal-metal contact therefore less friction**

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Proposed test program for friction/wear

Indien-Prüfdiesel (HFRR 582 µm)	India test diesel (HFRR 582 µm)
Erprobungskraftstoff (635 µm)	Test fuel (635 µm)
US-Prüfdiesel (worst case) (586 µm)	US test diesel (worst case) (586 µm)
Mexico Real (599 µm)	Mexico Real (599 µm)
Der zeitliche Verlauf der Schmierfilmdicke kann herangezogen werden, um anhand bekannter Probleme (diverse Prüfkraftstoffe) Aussagen treffen zu können, inwieweit Bauteilschäden auftreten können.	The temporal development of the lubricating film can be used to offer information based on existing problems (various test fuels) indicating the extent to which component damage can occur.
Schmierfilme im Bereich zwischen 0-10% führen zu massivem Verschleiß.	Lubricating films in the 0-10% range lead to massive wear.
Schmierfilme im Bereich zwischen 10-20% können zu Problemen führen (nicht zwingend).	Lubricating films between 10-20% can lead to problems (though this not necessarily the case)
Schmierfilm [%]	Lubricating film [%]
Verschleiß, möglich	Wear, possible
Massiver verschleiß, Ausfälle	Massive wear, failures
Messzeit [S]	Measurement period

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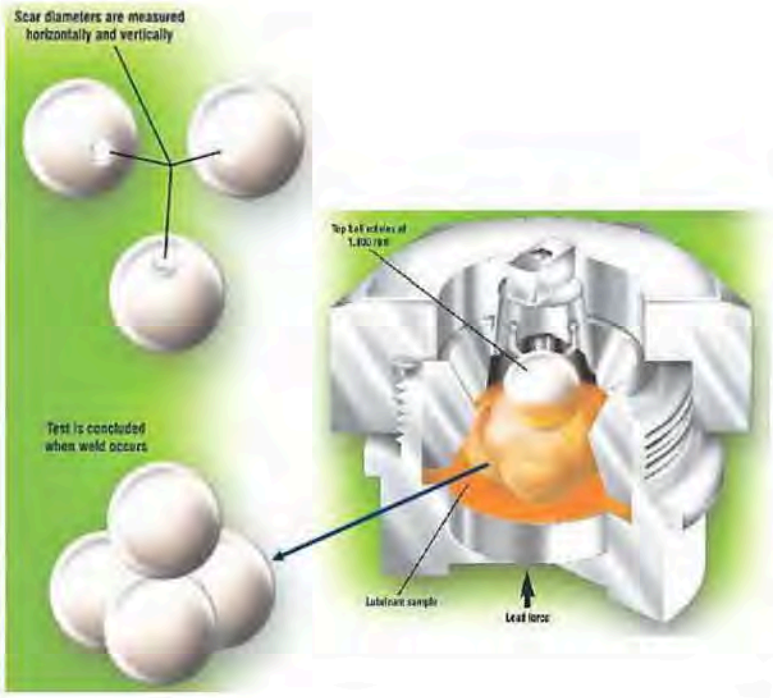
Four Ball Bearing Device (FBBD)



- Standard test method for oils
- Precision data comparable with HFR|R data
- Correlation with damage symptoms unknown (hardly any measurements with diesel)
- Method must first be adapted for diesel fuel:
  - Constant temperature required (to prevent fuel vaporization)
    (not currently in existence in oil method)
  - Load variation leads to vaporization (conditioning required)
  - Humidity has to be set (not the case at present)

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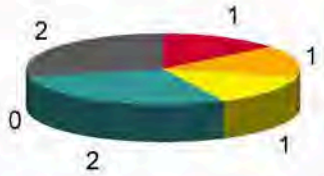
Status report Trouble tickets TD

No. 11 from 01/10/2009

Tracking of serious problems in continuous driving trial at [redacted]

Series measure. . .
RED, not defined yet
YELLOW, in process
GREEN, successful



- 0 - Issue recorded
- 1 - Analysis completed
- 2 - Measure defined
- 3 - Measure in use DE
- 4 - Measure successful
- 5 - Item closed

PT No. / Date	LB	Status	Trouble ticket: *Damaged part (SOP)* / *Description of problem*	*Person responsible* / *Contact person*	Reporting: *Reporting committee* / *Decision*	Tracking: Trial status / approval / *Further tracking*
TE266 9/21/2009	Breakdown	Status 0 Issue recorded	High-pressure fuel pump Q7 3.0l-TDI BIN5 MJ10 (SOP: Wk36/09) The high-pressure fuel pump does not build up pressure. After disassembly of the unit, metal shavings are found in the pump. The pump corresponds to the series status. This is the third failure already in the entire Q7 BIN5 trial.	Non-responsive content removed	Reporting committee: Decision:	Trial status: Approval: Further tracking: Subject at next damage meeting Wk 42/09.

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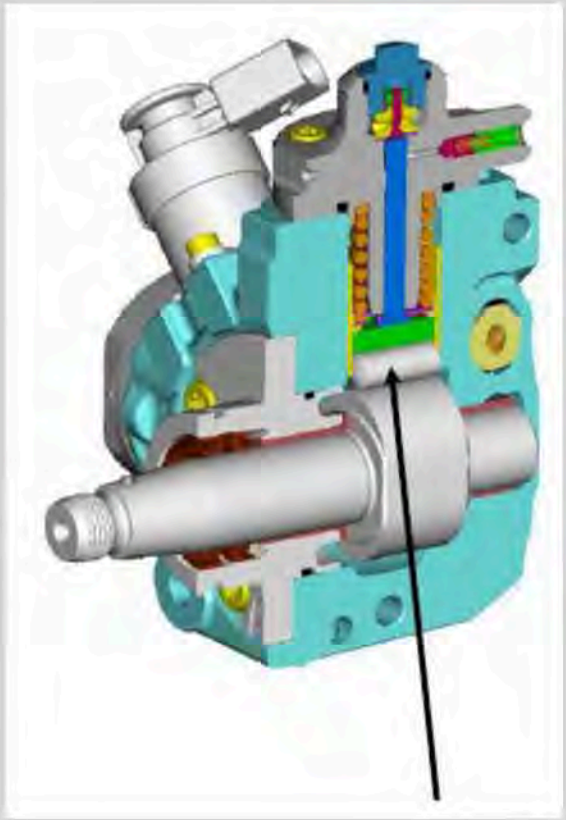
EA11003EN-00021[0]

Audi - Bosch reliability program

CP4 Diesel high-pressure fuel pump in CR injection systems from 1800 bar (EU5)



Left roller tappet

The "sensitive heart" of the pump is the **drivetrain** with:
- Roller
- Roller support
- Twin camshaft

The **roller** with its extremely smooth surface, over the entire lifetime and under all operating conditions must:
- glide smoothly in the C-coated roller support
- roll over a very slippery cam without slippage

If this is not achieved in all situation, the **drivetrain damage** can occur in case of:
- **Sluggishness** of the roller in the roller support due to manufacturing variances (largely eliminated).
- **Critical fuel qualities** in various **markets worldwide**, although the fuel properties that result in damage have not been analytically proven to date:

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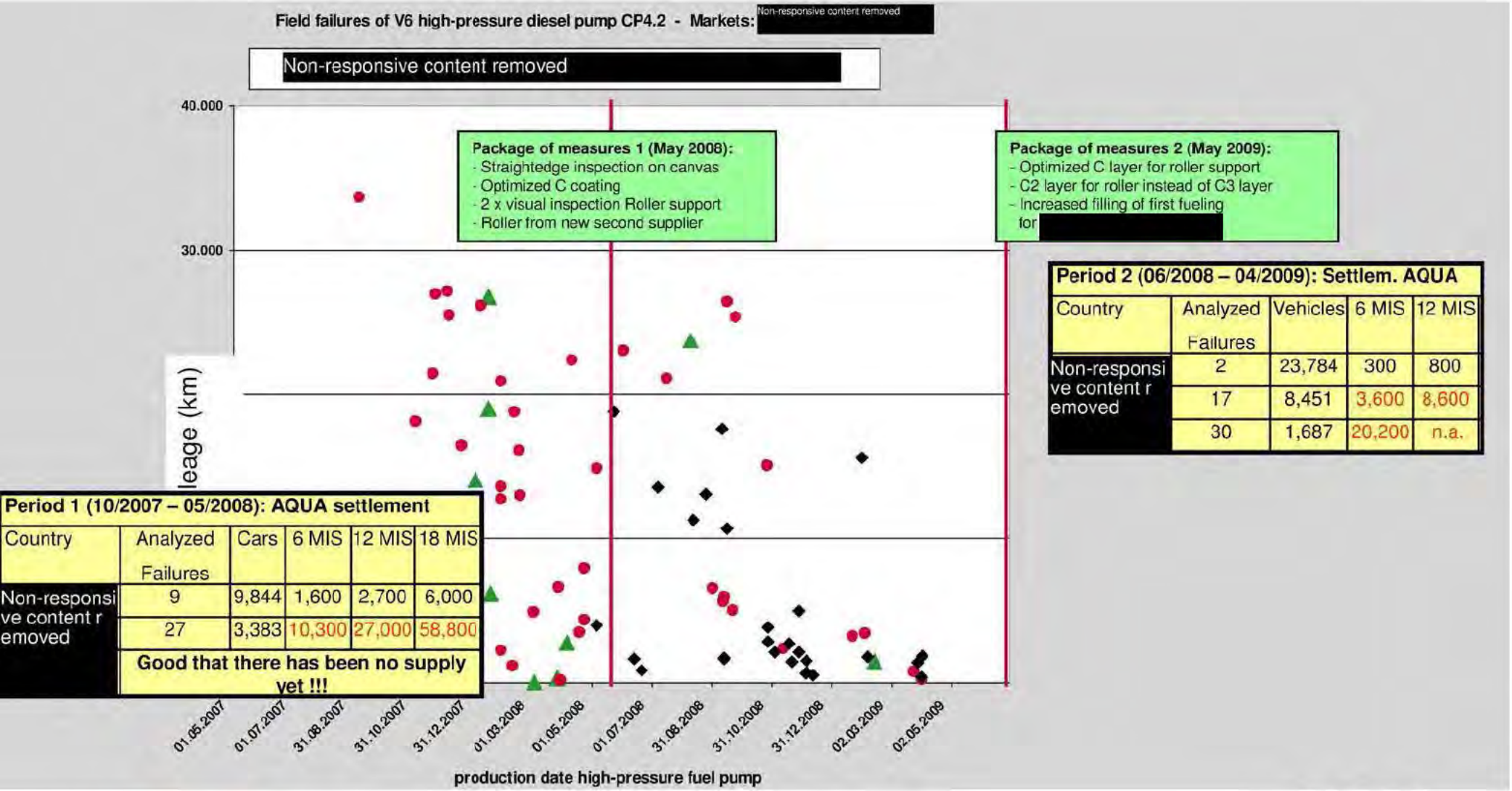
EA11003EN-00021[1]

Audi - Bosch reliability program



Period 1 (10/2007 – 05/2008): AQUA settlement

Country	Analyzed Failures	Cars	6 MIS	12 MIS	18 MIS
Non-responsive content removed	9	9,844	1,600	2,700	6,000
	27	3,383	10,300	27,000	58,800

Good that there has been no supply yet !!!

Period 2 (06/2008 – 04/2009): Settlem. AQUA

Country	Analyzed Failures	Vehicles	6 MIS	12 MIS
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	17	8,451	3,600	8,600
	30	1,687	20,200	n.a.

EA11003EN-00021[2]

Audi - Bosch reliability program

CP4 Diesel high-pressure fuel pump in CR injection systems from 1800 bar (EU5)

Summary:

Global settlements Audi MJ2008 – MJ2010 (Date: 09/09/2009):

V6-TDI: **394 cases** [redacted] 7.0 DC / 1,000 veh. (22 MIS)

R4-TDI: **193 cases** 1.1 DC / 1,000 veh. (24 MIS)

[redacted]

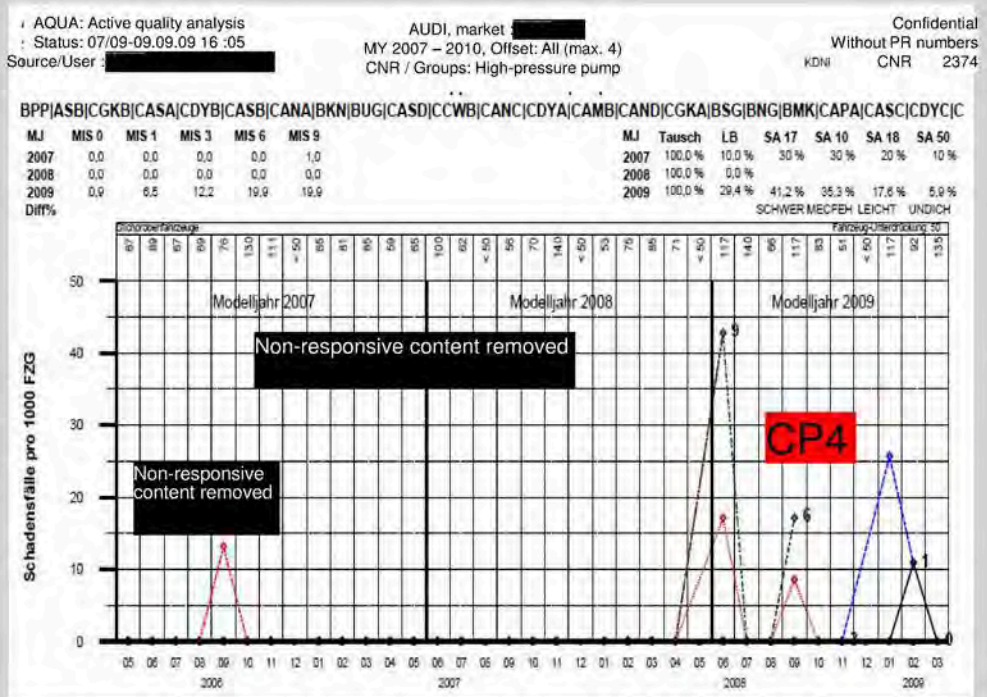
Pump robustness:

In comparison to the predecessor pump types [redacted] and [redacted] with ex-center/polygon drive, the CP4 with roller/cam drive is not sufficiently robust for global fuels.

Recommended decision:

The CP4 should be developed further for a "defined poor fuel" such that all approval checks that are passed today with standard EN590 fuel are also fulfilled with this special fuel.

Start trial program and introduce robustness measures by mid-2010. If not fulfilled, Audi QA demands conversion back to [redacted]



BOSCH

TOP meeting on 9/24/2009

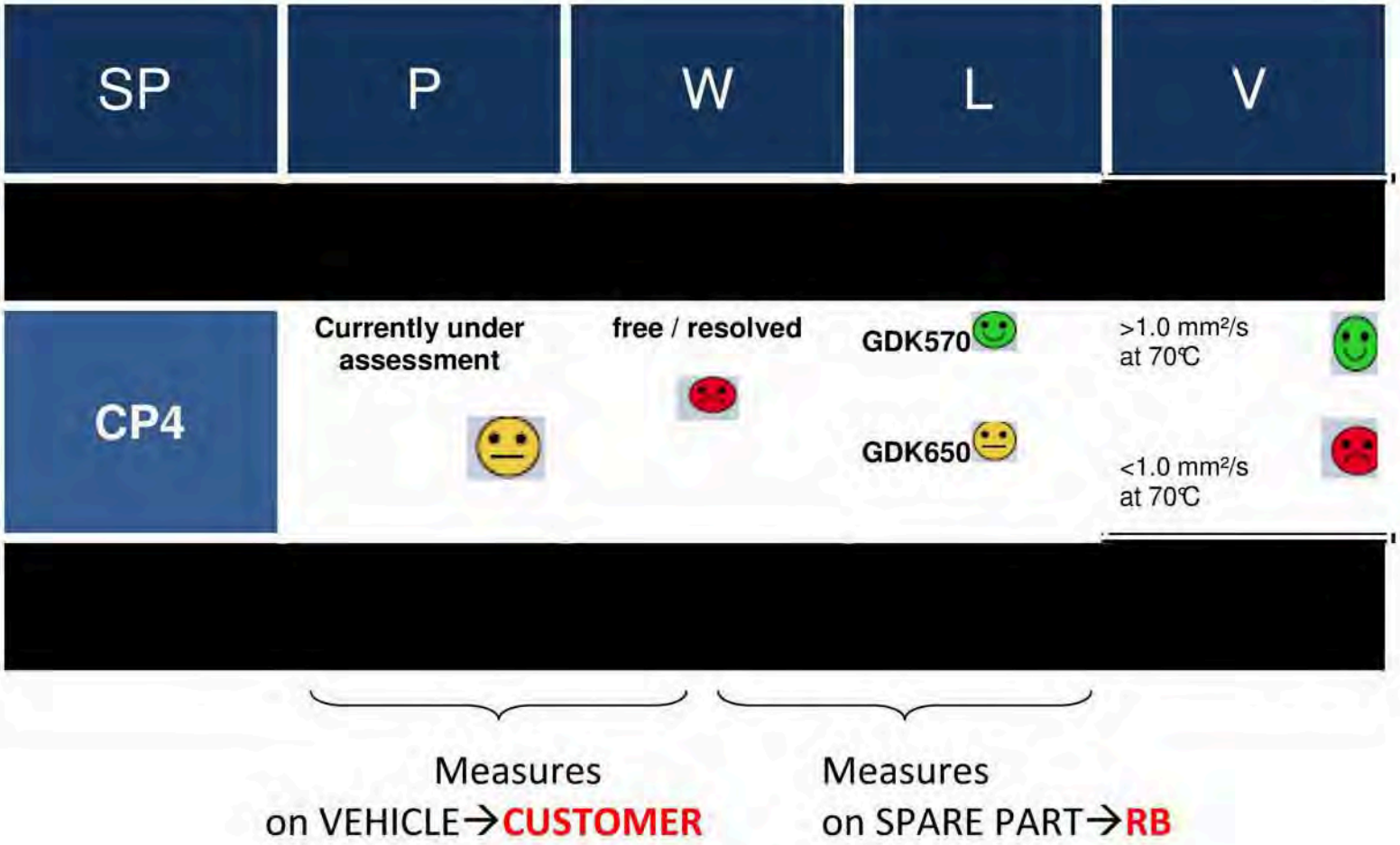
Audi

Robustness of Common Rail System for Rest of the World

Problem	Increasing use of CR system in fuel-critical markets
Cause	Lubricity, viscosity, water, particles in fuel
Measure/	Necessary to use additional measures on hydraulic components and on vehicle (water separator, particle filtering)
Status	Launch SOP July 2010

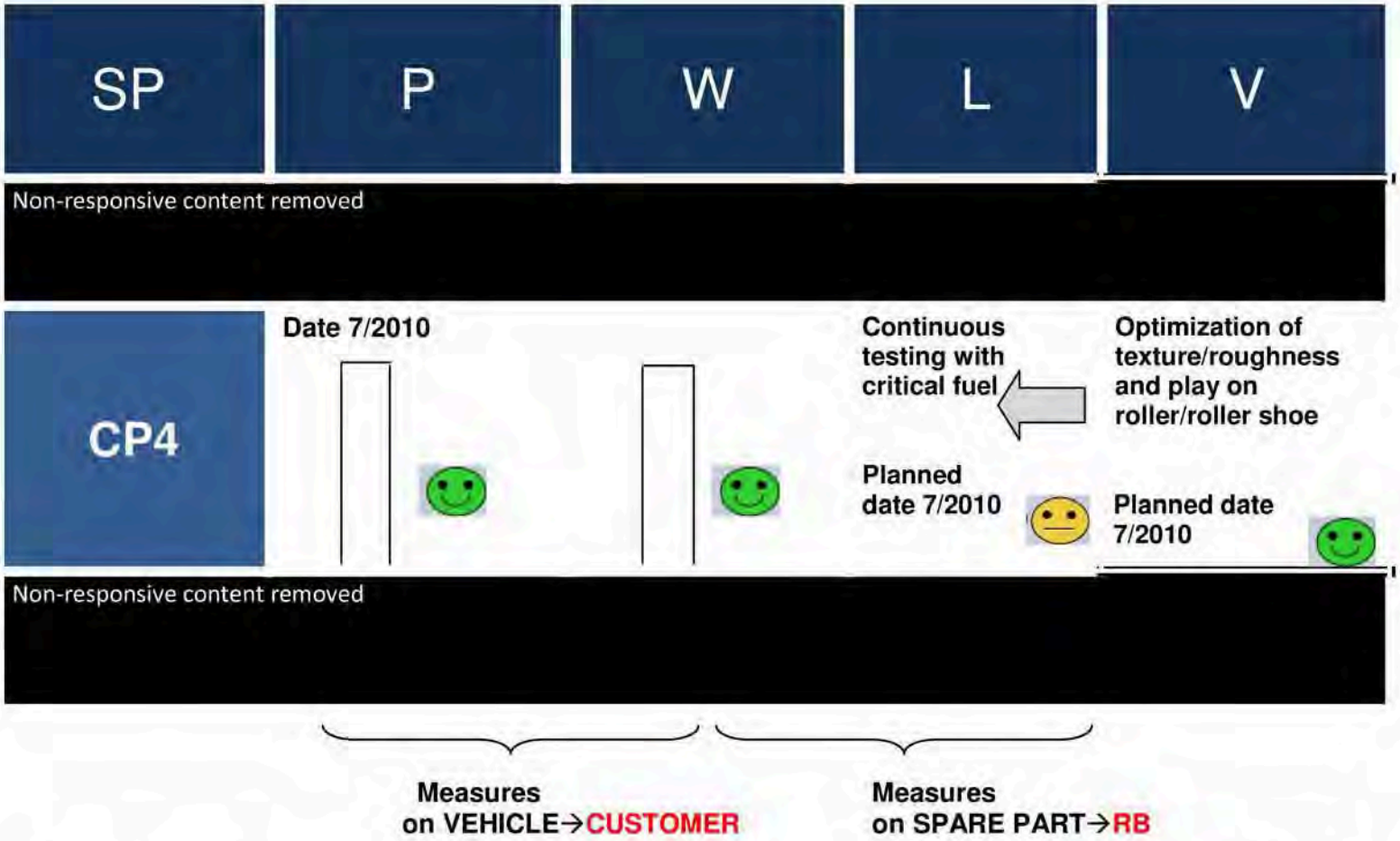
Robustness of Common Rail System for Rest of the World

Status of evaluation of Rest of the World conditions for diesel



Robustness of Common Rail System for Rest of the World

Status of evaluation of Rest of the World conditions for diesel



Workshop for detailed planning of RoW planned for 8.12.09 with VW/ Audi Development

Robustness of Common Rail System for Rest of the World
Measures to increase robustness in fuel-critical markets

• Expert workshop VW/ Audi/ Bosch on fuel-related themes	12/8/2009
Lubricity	
• Further development of wear-optimized C layer (already being tested in medium duty application)	Planned for SOP 07/2010
Viscosity	
• Optimization of texture/ surface of cam roller	done
• Optimization of texture/ surface of C layer in roller shoe	Planned for SOP 07/2010
• Optimization of component tolerances (play) in roller/roller shoe	Planned for SOP 07/2010
Water	
• Introduction of water separator urgently necessary for critical markets	OEM
• Avoidance of fatigue through high quality materials on camshaft/roller (preliminary tests with high quality material pairing ongoing)	04/2010
• Long-term testing will be necessary after the preliminary tests are complete	SOP ?

Robustness of Common Rail System for Rest of the World

EA11003EN-00024[4]

Backup

Robustness of Common Rail System for Rest of the World
Diesel Fuel Risk

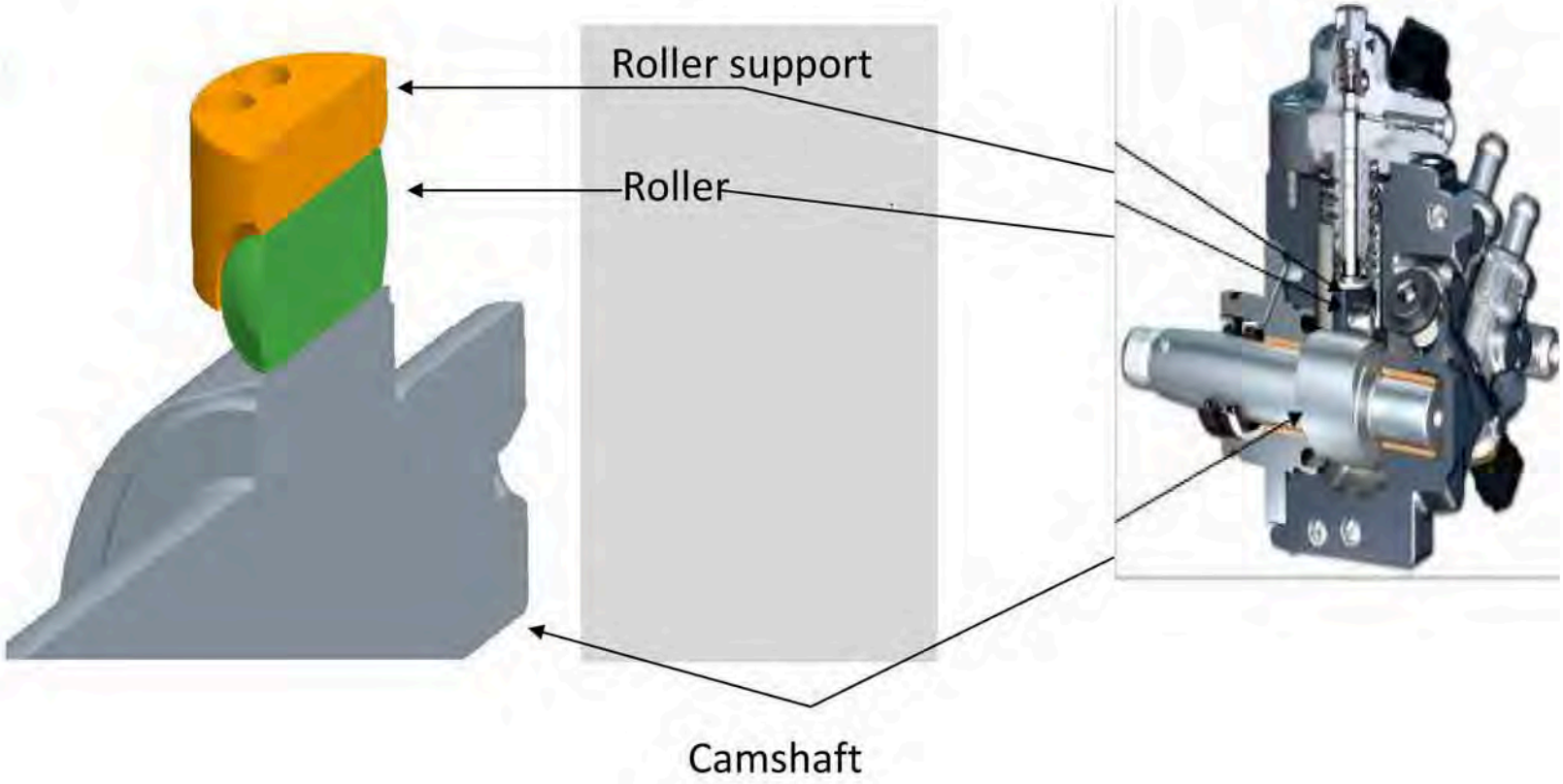
Status/estimate Sept. 2009

Water influences viscosity and lubricity

P: particle • **W**: water • **L**: lubricity • **V**: viscosity • nonspecific market focus •

Robustness of Common Rail System for Rest of the World
Actual context for drivetrain damage CP4

The cause of drivetrain damage is operation with impermissible fuel qualities and/or high of component function sensitivity



Robustness of Common Rail System for Rest of the World
Influence of fuel quality

Low lubricity (kerosene, water,...)

- causes greater wear in the roller/roller shoe combination (up to 200 [1/min]) at start (mixed friction period)

Low viscosity (Sweden diesel, kerosene, water….)

- Leads to thin lubrication film > increased friction/ component contact

  > increased slippage (idle roller)

Water in fuel

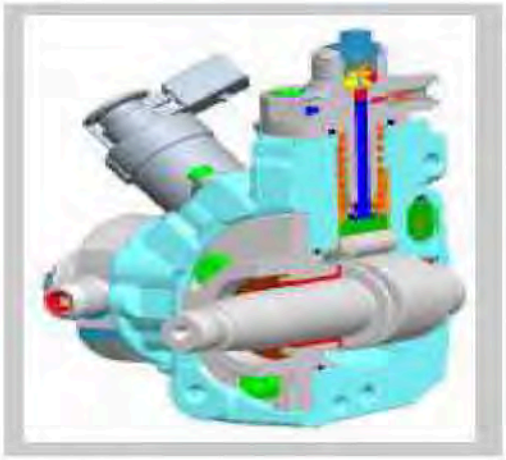
- For influence as emulsion see lubricity & viscosity
- free water (in droplet form) can lead to hydrogen embrittlement/tension crack corrosion, thus causing fatigue in the partner rollers

CP4 field situation worldwide

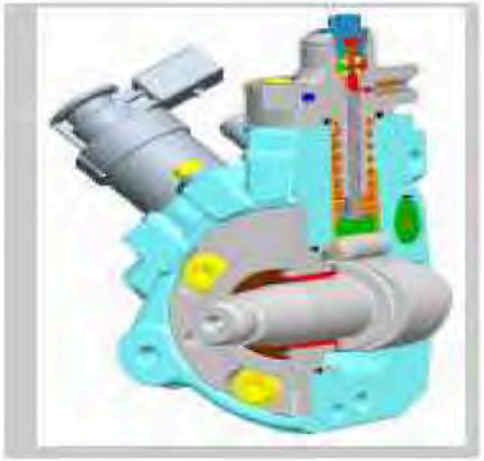
EA11003EN-00025[0]

EA11003EN-00025[1]

CP4 Field situation worldwide
Differences between CP4.1 and CP4.2.



CP4.2
2-piston pump
For use in
6-cylinder engines



CP4.1
1-piston pump
For use in
4-cylinder engines

CP4 Field situtation worldwide

EA110038N-0012012

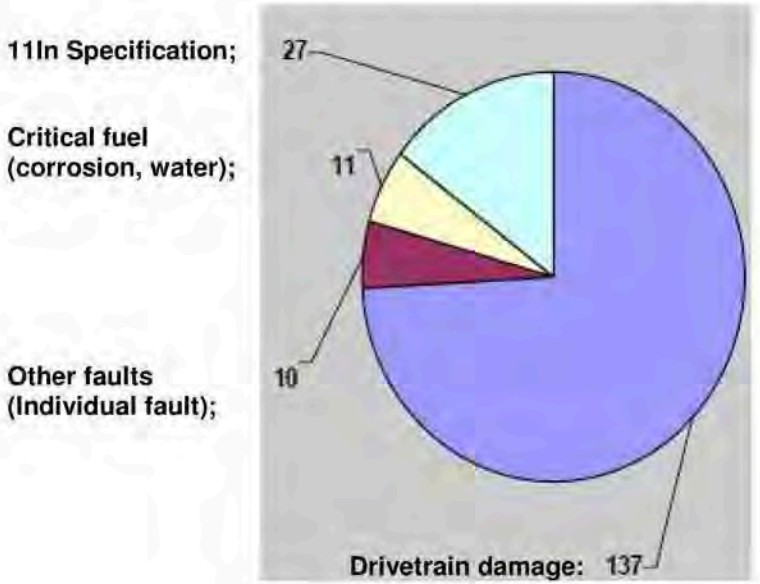
AUDI CP4.2 complaints

Commercial calculations for dealers (delivered quantity: 218,699)

ISO_CTRY	Overall result
Non-responsive content removed	328
	85
	63
	40
	21
	19
	18
	14
	9
	9
	8
	4
	4
	1
Overall result	623

Source Audi-Saga Evaluation period: 08/2007 - 10/2009

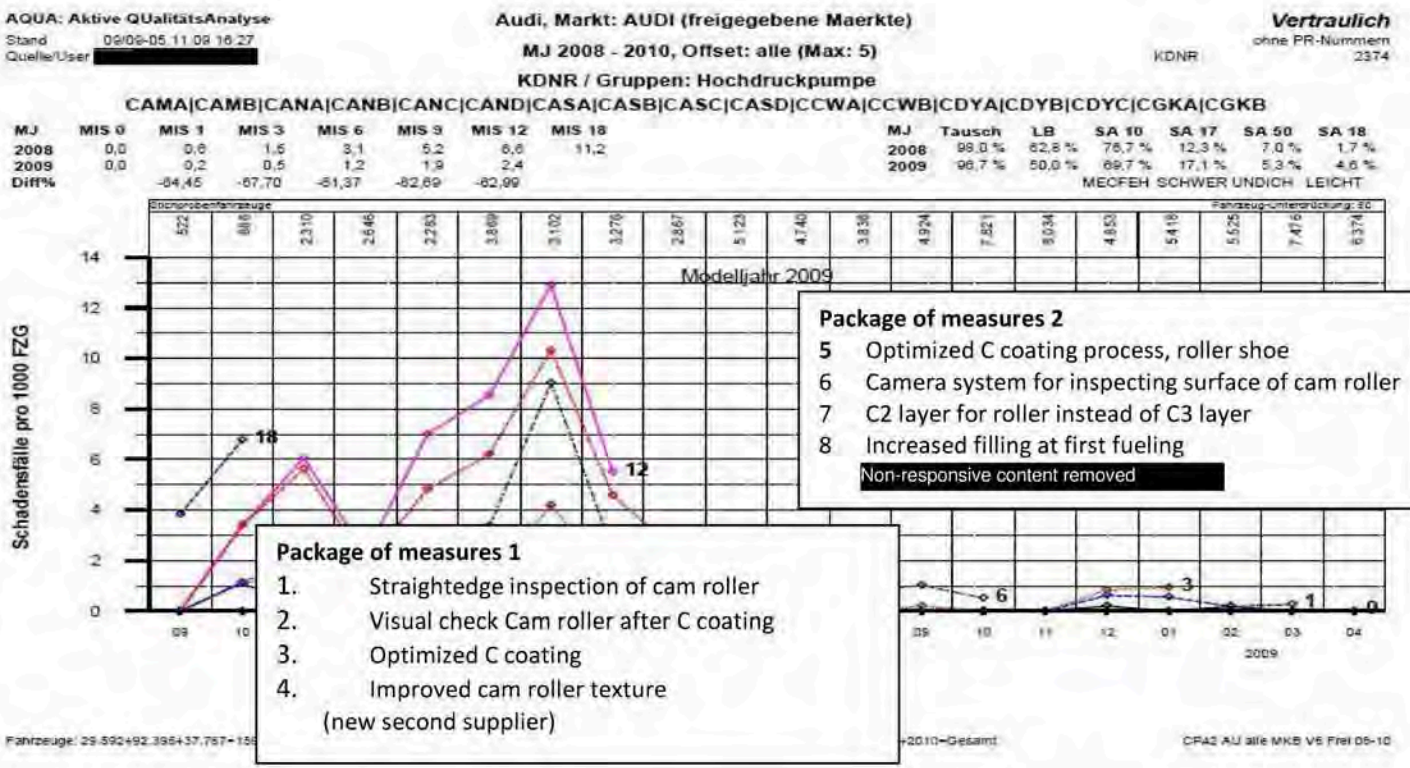
Source Audi-Saga evaluation period: 08/2007 - 10/2009
Findings for the pumps returned to Bosch (185)



Source Bosch IQIS Date: 11/3/2009

CP4 field situation worldwide for AUDI 6-cylinder TDI

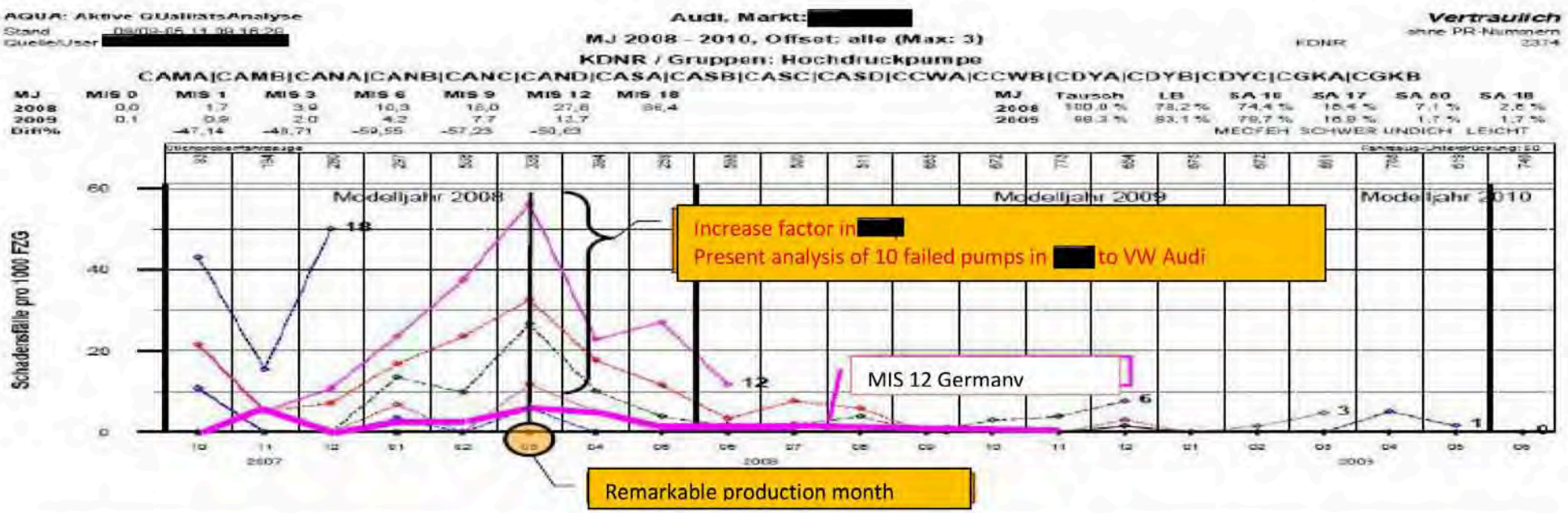
EA111003EN-00025[3]



AQUA: Aktive QUalitätsAnalyse	AQUA: Active quality analysis
Stand	Version
Quelle/User SAGA-Gew / NILP. RC	Source/User SAGA-Gew / NILP. RC
Audi, Markt: AUDI (freigegebene Maerkte)	Audi, market: AUDI (approved markets)
MJ 2008-2010, Offset: alle (Max: 5)	MJ 2008-2010, Offset: all (Max: 5)
KDNR / Gruppen: Hochdruckpumpe	CUST. NO. / Groups High-pressure pump
Vertraulich	Confidential
Ohne PR-Nummern	Without PR numbers
Stichprobenfahrzeuge	Spot check vehicles
MECFEH SCHWER UNDICH LEICHT	MAJOR MECHANICAL FAULT MINOR LEAK
Fahrzeug-Unterdrückung: 50	Vehicle suppression: 50
Scadensfälle pro 1000 FZG	Cases of damage per 1000 veh.
Fahrzeuge: ; Verkauft:; Gesamt	Vehicles: ; sold:; total

CP4 field situation in Italy for AUDI 6-cylinder TDI

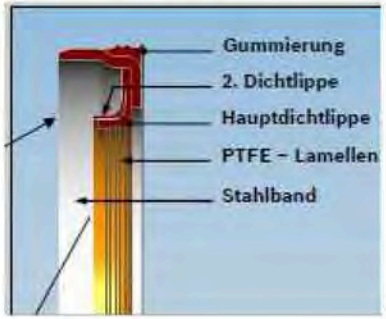
EA11003EN-00025[4]



AQUA: Aktive QUalitätsAnalyse	AQUA: Active quality analysis
Stand	Version
Quelle/User SAGA-Gew / NILP. RC	Source/User SAGA-Gew / NILP. RC
Audi, Markt: ITALIEN	Audi, market: ITALY
MJ 2008-2010, Offset: alle (Max: 3)	MJ 2008-2010, Offset: all (Max: 3)
KDNR / Gruppen: Hochdruckpumpe	CUST. NO. / Groups High-pressure pump
Vertraulich	Confidential
Ohne PR-Nummern	Without PR numbers
Stichprobenfahrzeuge	Spot check vehicles
MECFEH SCHWER UNDICH LEICHT	MAJOR MECHANICAL FAULT MINOR LEAK
Fahrzeug-Unterdrückung: 50	Vehicle suppression: 50
Modelljahr	Model year
Schadensfälle pro 1000 FZG	Cases of damage per 1000 veh.
Fahrzeuge: ; Verkauft:; Gesamt	Vehicles: ; sold:; total

CP4 field situation in [redacted] finding AUDI CP4

Installation of Bruss shaft seal on CP4

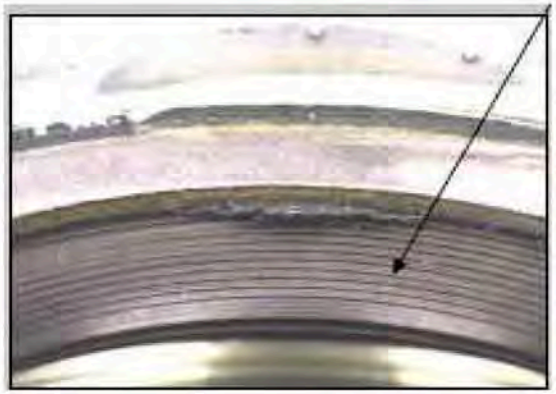


Rubberizing
2nd sealing lip
Main sealing lip
PTFE blades
Steel band

New part

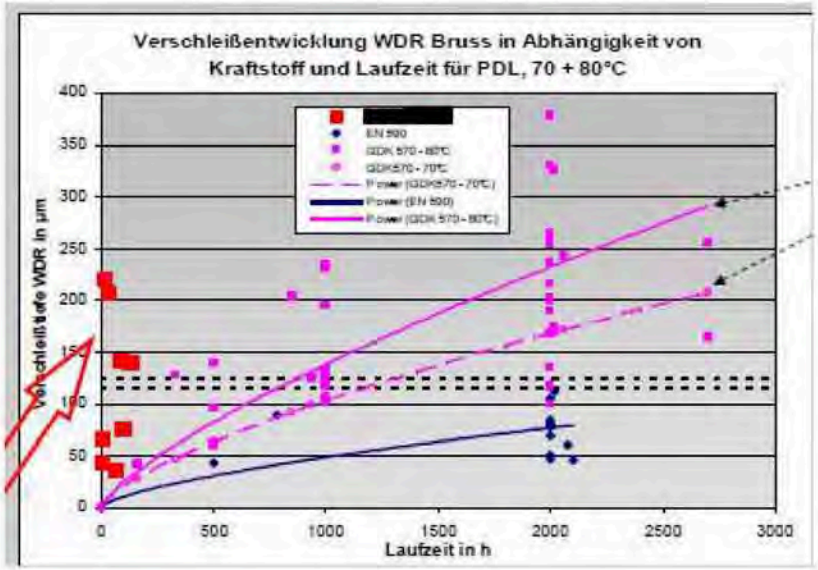
Continuous vehicle testing 118,000 k

Mileage 2,212 km
Failure on 6/15/2009



Dependence of shaft seal wear on fuel and runtime

EN590: Viscosity $_{40°C}$ = 2.5 mm²/s, HFRR$_{60°C}$ = 420 µm
GDK570: Viscosity $_{40°C}$ = 1.9 mm²/s, HFRR$_{60°C}$ = 570 µm



Constraints
-internal continuous test (variable profile)
-runtime = variable
-inlet temperature 80
-inlet temperature 70^0 C

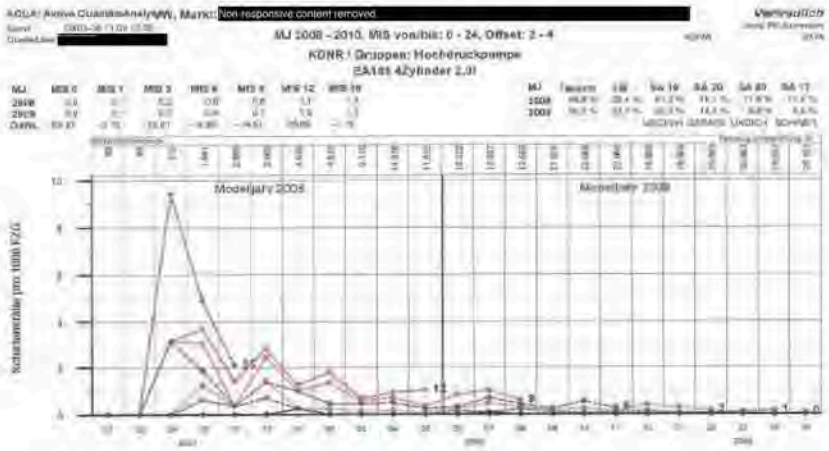
Vehicle: Audi
Inlet temperature 60 °C ?

- **Depth of wear on shaft seal in the case of Audi [redacted] much greater than usual**
- **Clear indicator of poor quality fuel**

Verschleißentwicklung WDR Bruss in Abhängigkeit von Kraftstoff und Laufzeit für PDL, 70 + 80℃	Development of wear on Bruss shaft seal depending on fuel and runtime for PDL, 70 + 80℃
Verschleißtiefe WDR in µm	Depth of wear on shaft seal in µm
Laufzeit in h	Runtime in hours

CP4 field situation in Italy for VW 4-cylinder TDI

EA11003EN-00025[7]



Package of measures 1

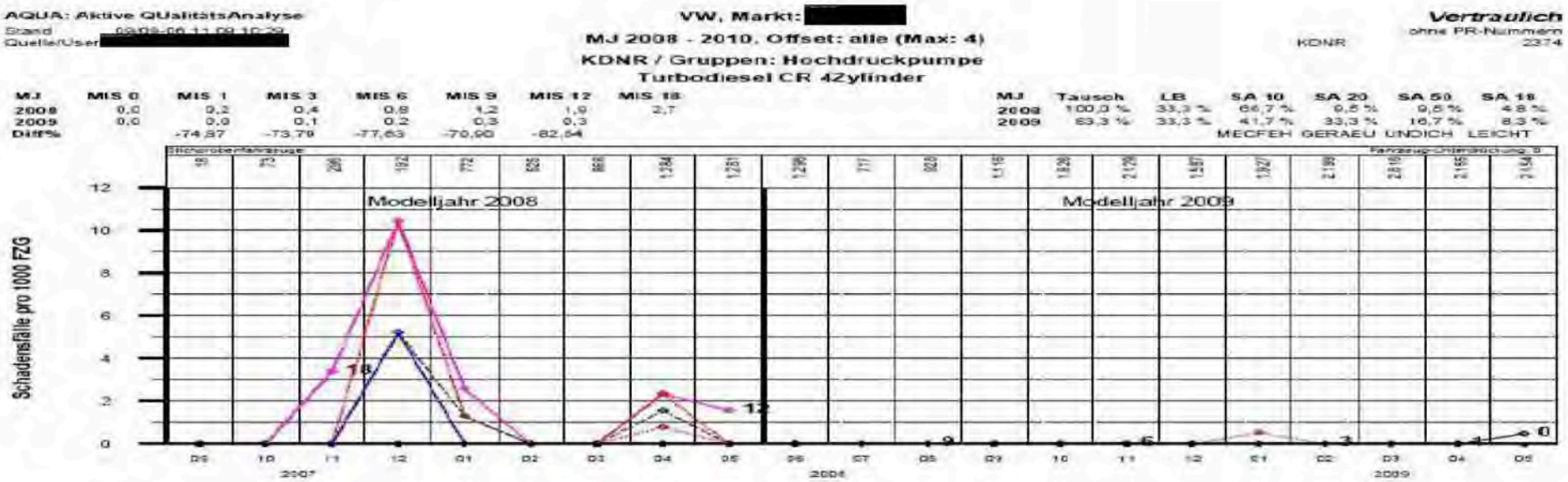
1 Straightedge inspection of cam roller
2 Visual check Cam roller after C coating
3 Optimized C coating
4 Improved cam roller texture
(new second supplier)

Package of measures 2

5. Optimized C coating process, roller shoe
6. Camera system for inspecting surface of cam roller
7. C2 layer for roller instead of C3 layer

AQUA: Aktive QUalitätsAnalyse	AQUA: Active quality analysis
Non-responsive content removed	Non-responsive content removed
Stand	Version
Quelle/User SAGA-Gew / [redacted]	Source/User SAGA-Gew / [redacted]
MJ 2008-2010, MIS von/bis : 0-24, Offset : 2-4	MY 2008-2010, MIS from/to : 0-24, Offset : 2-4
KDNR / Gruppen: Hochdruckpumpe	CUST. NO. / Groups High-pressure pump
Zylinder	Cylinders
Vertraulich	Confidential
Ohne PR-Nummern	Without PR numbers
Stichprobenfahrzeuge	Spot check vehicles
MECFEH SCHWER UNDICH LEICHT	MAJOR MECHANICAL FAULT MINOR LEAK
Fahrzeug-Unterdrückung: 50	Vehicle suppression: 50
Entspricht 3 Fahrzeugen	Corresponds to 3 vehicles
Modelljahr	Model year
Scadensfälle pro 1000 FZG	Cases of damage per 1000 veh.
Fahrzeuge: ; Verkauft:; Gesamt	Vehicles: ; sold:; total

CP4 field situation in Italy for VW 4-cylinder TDI



AQUA: Aktive QUalitätsAnalyse	AQUA: Active quality analysis
Stand	Version
Quelle/User SAGA-Gew / NILP. RC	Source/User SAGA-Gew / NILP. RC
VW, Markt: [redacted]	VW, market: [redacted]
MJ 2008-2010, Offset: alle (Max: 4)	MJ 2008-2010, Offset: all (Max: 4)
KDNR / Gruppen: Hochdruckpumpe	CUST. NO. / Groups High-pressure pump
Turbodiesel CR 4Zylinder	Turbodiesel CR 4-cylinder
Vertraulich	Confidential
Ohne PR-Nummern	Without PR numbers
Stichprobenfahrzeuge	Spot check vehicles
MECFEH SCHWER UNDICH LEICHT	MAJOR MECHANICAL FAULT MINOR LEAK
Fahrzeug-Unterdrückung: 50	Vehicle suppression: 50
Entspricht 2 Fahrzeugen	Corresponds to 2 vehicles
Modelljahr	Model year
Schadensfälle pro 1000 FZG	Cases of damage per 1000 veh.
Fahrzeuge: ; Verkauft:; Gesamt	Vehicles: ; sold:; total

CP4 field situation in [redacted] differences between CP4.1 and CP4.2

Possible ways to interpret likelihood of failure

CP4.2 v CP4.1 in [redacted] out of 30: 1

- 2 : 1 Tappet modules — Factor 2-3
- Pump gear ratio i = 1 : ¾ — Factor 3

Other influential factors:

- Influence of load collective
- Influence of automatic v. manual gears
- Influence of inlet temperature
- Filtering
- SV opening pressure
- ...

CP4 field situation in [redacted] further procedure (main activities)

- Deployment of Bosch field analysis team in [redacted] (importer's headquarters) since 11/09/2009
  Objective:
  Analysis of special market-specific features in [redacted]
  Tasks:
  Analysis of the vehicle prior to repair (together with Audi)
  Analysis of the environment, e.g. fuel quality, etc.
  Analysis of the process on the importer side (from receipt to delivery)
- 100% return of all worldwide Audi field complaints for 3 months 11/9/2009
- Analysis of production documents for pump, engine and vehicle for unusual production data Since 05/11/2009
- Procurement of 20 [redacted] from cars from problem production date in
- Procurement of 20 [redacted] from remaining period in
- Analysis of system differences (application, load collective, low pressure circuit, etc.) A 12/2009, various vehicles

CP4 field situation worldwide backup

EA11003EN-00025[11]

CP4 field situation VW 6-cylinder TDI

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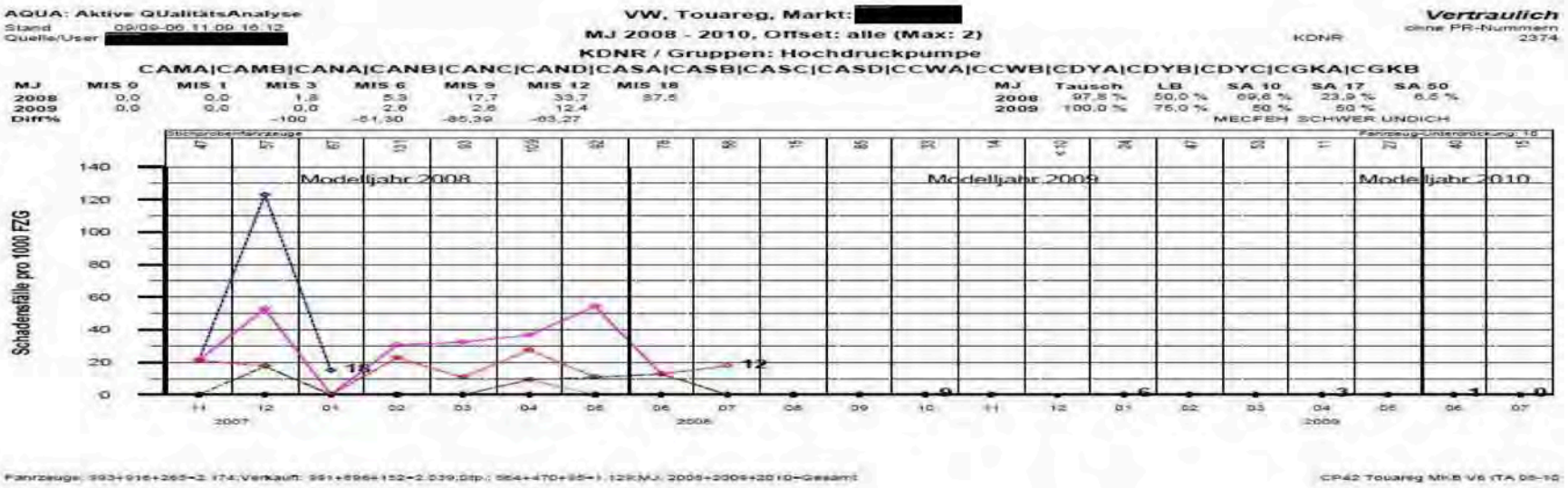


AQUA: Aktive QUalitätsAnalyse	AQUA: Active quality analysis
Stand	Version
Quelle/User SAGA-Gew / NILP. RC	Source/User SAGA-Gew / NILP. RC
VW, Markt: [redacted]	VW, market: [redacted]
MJ 2008-2010, Offset: alle (Max: 4)	MJ 2008-2010, Offset: all (Max: 4)
KDNR / Gruppen: Hochdruckpumpe	CUST. NO. / Groups High-pressure pump
Turbodiesel CR 4Zylinder	Turbodiesel CR 4-cylinder
Vertraulich	Confidential
Ohne PR-Nummern	Without PR numbers
Stichprobenfahrzeuge	Spot check vehicles
MECFEH SCHWER UNDICHT LEICHT	MAJOR MECHANICAL FAULT MINOR LEAK
Fahrzeug-Unterdrückung: 50	Vehicle suppression: 50
Modelljahr	Model year
Schadensfälle pro 1000 FZG	Cases of damage per 1000 veh.
Fahrzeuge: ; Verkauft:; Gesamt	Vehicles: ; sold:; total

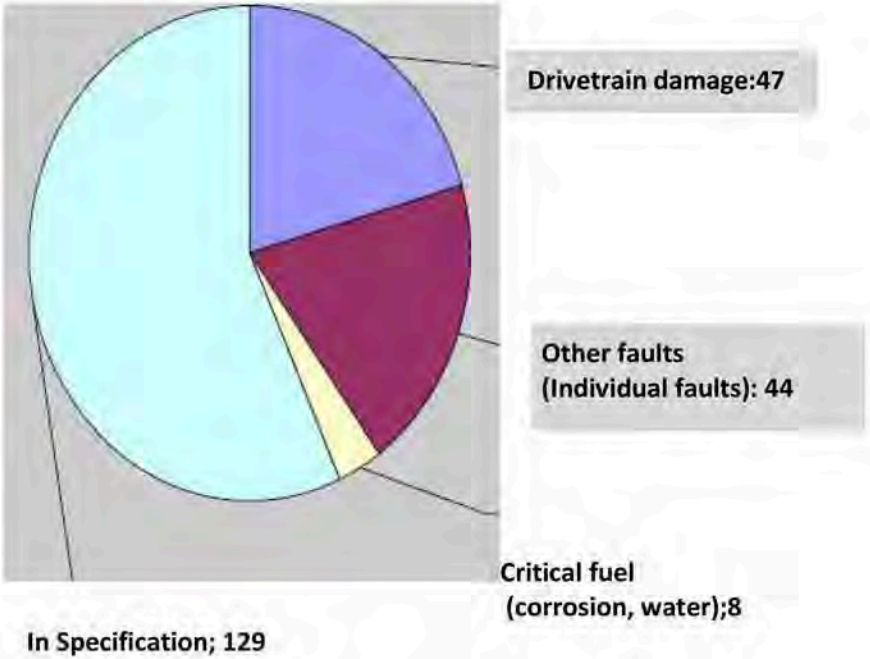
CP4 Field situtation worldwide
AUDI CP4.1 complaints

VW CP4.1 commercial accounting for dealers

VZ COUNTRY		Overall result
Non-responsive content removed		66
		65
		56
		28
		22
		11
		8
		7
		6
		5
		4
		4
		4
		36
Overall result		**322**

Source: VW purchased part list
Evaluation period 06/2006 - 09/2009

Evaluation period 06/2006 - 09/2009 Findings for the pumps returned to Bosch (228)



Source: Bosch IQIS Warranty Database, date 03/11/2009

EA11003EN-00027[0]

From: Non-responsive content removed
To:
CC:
Date: 8/18/2008 3:12:22 PM
Subject: Re: Torque measurements on W19 BIN5, EU6 and W19 EU5

Hello Mr.

We need a **BIN 5 engine** and then an **EU5 engine**.
Of course, this can all take place on separate occasions. In other words, for example BIN 5 at the beginning of the week, then EU5, or vice versa
Both the 5.625 mm and 4.85 mm measurement pumps are ready for use.

What is important is that you have the tension rollers ready:
- W24 min. and max. pre-tension tolerance
- W19 min. and max. pre-tension tolerance

The measurements would be carried out by our expert,

If our suggested date is acceptable, we will make the appropriate reservations (23.+24.09.2008).

Best regards / mit freundlichen Grüßen

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Robert Bosch GmbH
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www.bosch.com

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Domicile: Stuttgart, Court of Registry: Local Court of Stuttgart Commercial Registry no. 14000 Chairman of the Supervisory Board: Chairman of the Supervisory Board: Hermann Scholl; Management: Franz Fehrenbach, Siegfried Dais; Bernd Bohr, Rudolf Colm, Gerhard Kümmel, Wolfgang Malchow, Peter Marks; Volkmar Denner, Uwe Raschke, Peter Tyroller

From: Non-responsive content removed
Sent: Monday, August 18, 2008 3:22 PM
To: Non-responsive content removed
Subject: Re: Torque measurements on W19 BIN5, EU6 and W19 EU5

Hello

Could we perform the measurements on 23.09.2008 in
We would also measure the new PIN position on the BIN5 directly.

No problem from my point of view. What do you need for the measurements? Engine, etc.??

Can you let us know the minimum and maximum permissible belt tension?
From your experience (e.g. with continuous tests) how much does belt tension decrease over time?

We would use this data to carry out replication tests on our pump test bench.

Pre-tension of tension roller:

W19 tension roller 280N +/-15%

W24 tension roller 340N +/-15%

Are there any plans, for example because of a standard tension roller to fit the W19 EU5 with the W19 BIN5 tension roller?

We intend to install the W24 tension roller in the EU5/CO2. However we first need to know from you whether the new phase position + W24 tension roller

has a major influence in terms of thermodynamics (rail pressure pattern, etc.) What is the position with the BIN5/EU6 engine??

Background of measurements
In the case of one failed pump we analyzed unusually small brake flattening (= slippage).
This may have led to inadequate belt tension.

Best regards / mit freundlichen Grüßen

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Audi AG

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Internet: www.audi.com

From: Non-responsive content removed
Sent: Monday, August 18, 2008 2:56 PM
To Non-responsive content removed
Cc
Subject: Torque measurements on W19 BIN5, EU6 and W19 EU5

Hello Mr.

With regard to the W19 EU5 & W19 BIN5/EU6 projects, we still need to verify the torque for min./max. tension of the tension roller.

Could we perform the measurements on 23.09.2008 in
We would also measure the new PIN position on the BIN5 directly.

Can you let us know the minimum and maximum permissible belt tension?
From your experience (e.g. with continuous tests) how much does belt tension decrease over time?
We would use this data to carry out replication tests on our pump test bench.

Are there any plans, for example because of a standard tension roller to fit the W19 EU5 with the W19 BIN5 tension roller?

EA11003EN-00027[2]

Background of measurements
In the case of one failed pump we analyzed unusually small brake flattening (= slippage).
This may have led to inadequate belt tension.

<<EHC_0346_[redacted] Audi, Drehmomentmessungen, 18-08-2008.pdf>>

Thank you.

Best regards / mit freundlichen Grüßen

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GERMANY
www.bosch.com

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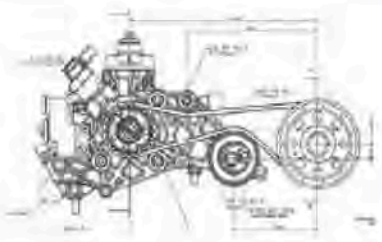
Variations in speed, comparison
Vehicle test bench

Vehicle measurement, engine speed variation: Q7 W19 EU5:

- Engine: W19 EU5
- Pump: CP4.2_644_REC_2x4,85_3,3_1,35, instrumentation
- Readings:
  - Pump speed, OT pump
  - Engine speed, rail pressure, injector current cylinder 1
  - INCA readings

- Measurement program:
  - Full load acceleration in CPC mode
  - Load: 100 %, p_Rail max. = 1800 bar
  - Phasing of the pump from series installation (0°) t ooth-by-tooth to
    - 6 teeth (- 5 teethe corresponds to installation position EU6)
    + 2 teeth
  - Measurement program with EU6M and EU5P tension roller



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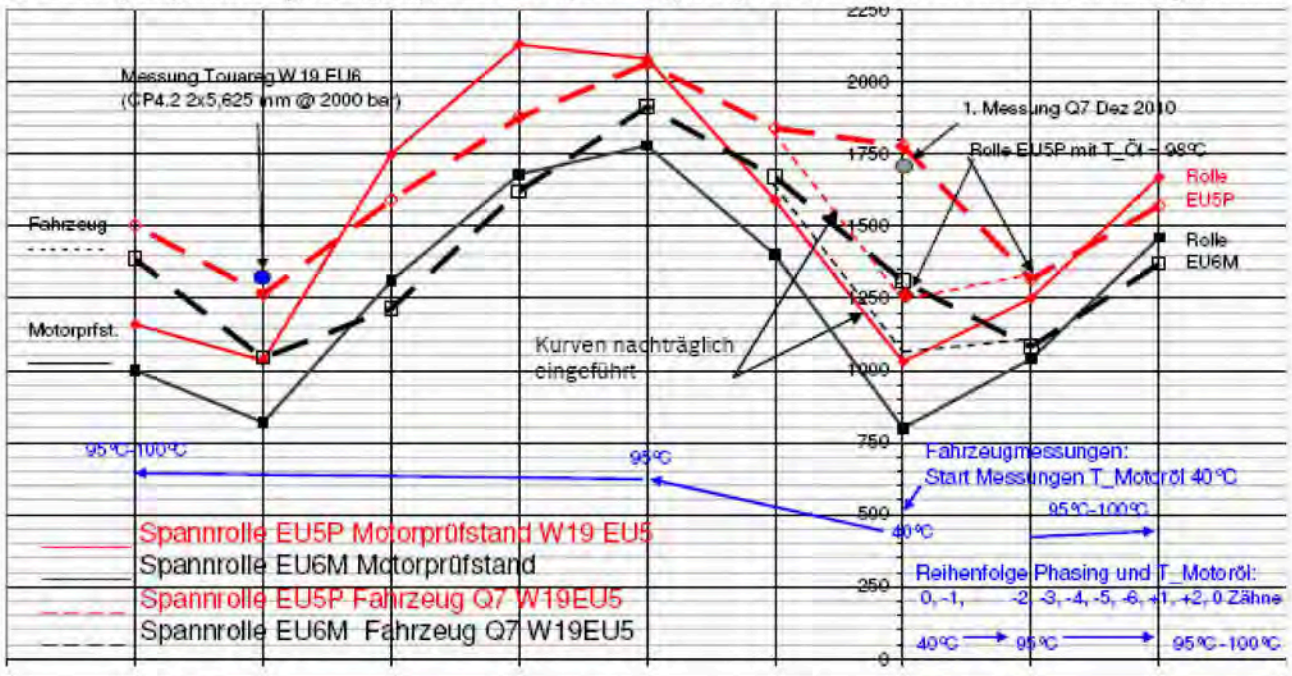
Variations in speed, comparison Vehicle test bench

Variation in pump speed peak - peak = f (phasing position),
@ 2440 rpm (@ 3250 rpm engine), W19 EU5 (full load), engine test bench and vehicle in comparison



Messung Touareg W 19 EU6 (CP4.2 2x5, 625 mm @ 2000 bar	Measurement for Touareg W 19 EU6 (CP4.2 2x5, 625 mm @ 2000 bar
1.Messung Q7 Dez 2010	1st measurement Q7 Dec 2010
Rolle EU5P mit T-OI=98° C	EU5P roller with T oil =98° C
Rolle EU5P	EU5P roller
Fahrzeug	Vehicle
Motorprfst.	Engine testing center
Kurven nachträglich eingeführt	Curves introduced at a later point
Fahrzeugmessungen:	Vehicle measurements

Start Messungen T_Motoröl 40° C	Start measurements T_engine oil 40° C
Spannrolle EU5P Motorprüfstand W 19 EU5	Tension roller EU5P engine test bench W 19 EU5
Spannrolle EU6M Motorprüfstand	Tension roller EU6M engine test bench
Spannrolle EU5P Fahrzeug Q7 W19EU5	Tension roller EU5P vehicle Q7 W19EU5
Spannrolle EU6M Fahrzeug Q7 W19EU5	Tension roller EU6M vehicle Q7 W19EU5
Reihenfolge Phasing und T_Motoröl:	Sequence, phasing and T engine oil:
Zähne	Teeth
Phasingposition [Zähne]	Phasing position [teeth]
Drehzahlschwankung Pumpe p-p[rpm]	Speed variation, pump p-p[rpm]

Summary:

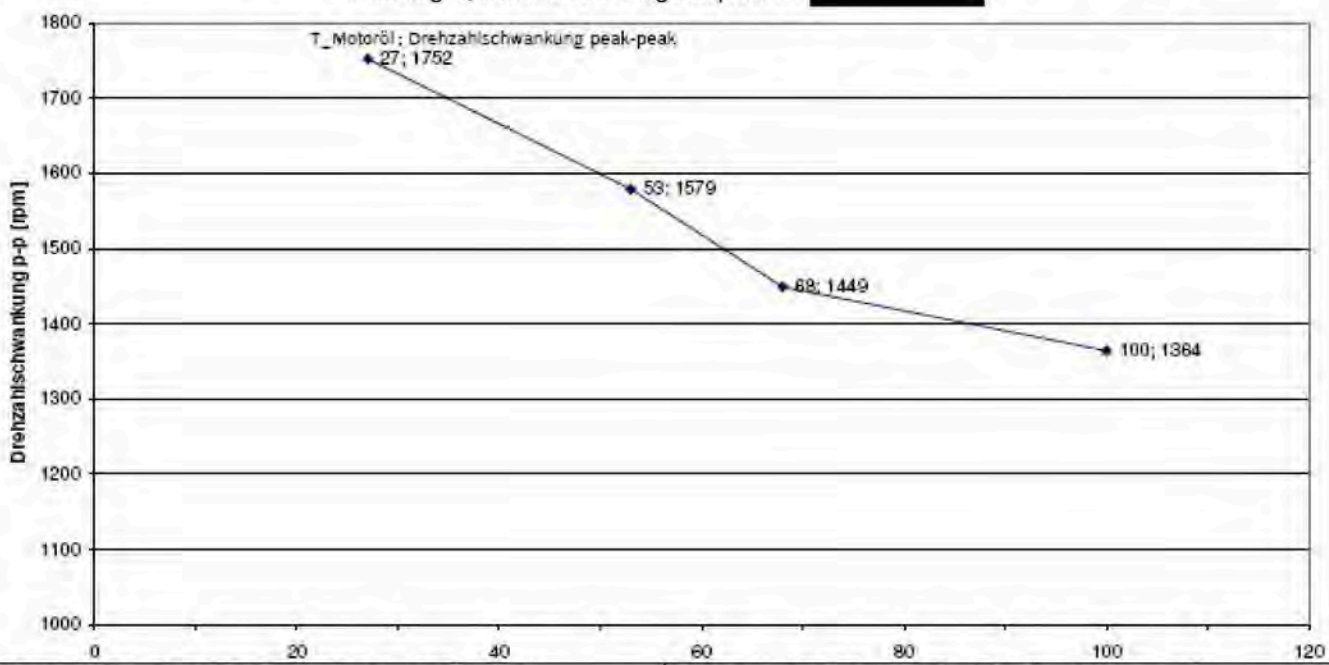
- EU 6 tension roller in the relevant phasing positions with less speed variation on the pump

Variations in speed, comparison
Vehicle test bench

CP4 speed variation on vehicle = f (engine oil temperature)

Measurement of Q7 full load acceleration, @ 3250 rpm engine (2440 rpm pump) / 1800 bar

Phasing 0; roller EU5P original part Q7[redacted]



T_Motoröl ; Drehzahlschwankung peak-peak	T_engine oil ; speed variation peak-peak
Motoröltemperatur [℃]	Engine oil temperature [℃]
Drehzahlschwankung p-p [rpm]	Speed variation p-p [rpm]

Summary:

- Speed variation on the pump largely depends on engine roller temperature

Variations in speed, comparison Vehicle test bench

Necessary interpretation of measurements
Caution: There is a temperature overlap in the diagram because not all measurement points can take place with a constant oil temperature
That is why a series of oil temperature measurements were carried out, Appendix 2
The first obvious influence over phasing between the engine and vehicle in position 0 is in reality the temperature influence between 40 and 95℃

Oscillations in engine test bench for vehicle at 500-600 rpm confirmed at position 0
Oscillations at W19 EU5 with EU6 tension roller are confirmed as being reduced by 300 rpm (belt tension is increased)
Oscillations are very dependent on the engine oil temperature, Delta +70℃ yield -400 rpm (probably due to the influence of hydraulic chain tensioners)
Maximum oscillations at phasing 2 numbers. approx. 2100 rpm is measured with hot engine; oscillation is greater in cold state

CP4 rating catalog for visual findings

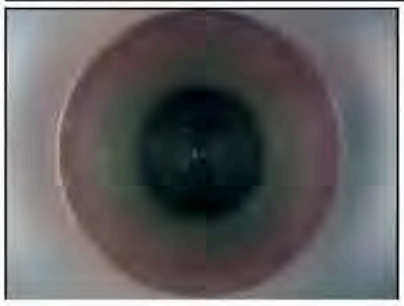
High-pressure piston (coated) – Sonne

- Functions
  - Transfer of hydraulic forces to roller shoe
- Wear caused by
  - movement of piston
- Types of wear
  - Smoothing
  - Particles
  - Cavitation erosion
- Remark

BOSCH

CP4 rating catalog for visual findings

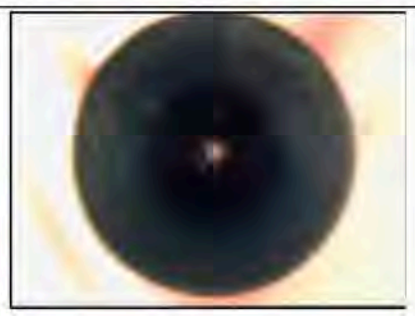
High-pressure piston (coated) – Sonne – Status Green

Rating	Photos	Description
2	 	→ As new → Only slightly used → Smoothing

BOSCH

CP4 rating catalog for visual findings

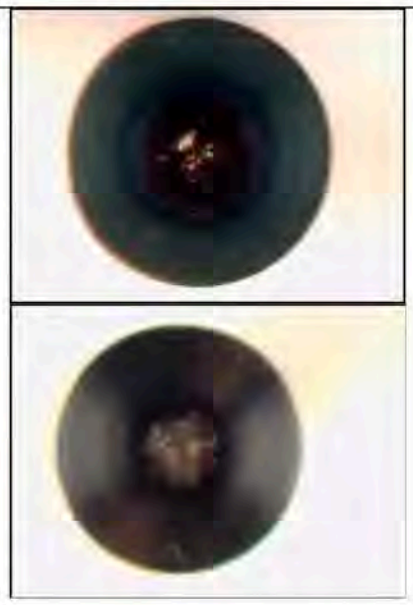
High-pressure piston (coated) – Sonne – Status Yellow

Rating	Photos	Description
4		→ C-coating slightly worn in the middle

BOSCH

CP4 rating catalog for visual findings

High-pressure piston (coated) – Sonne – Status Yellow

Rating	Photos	Description
6		→ several particle impacts → C-coating slightly worn in the middle

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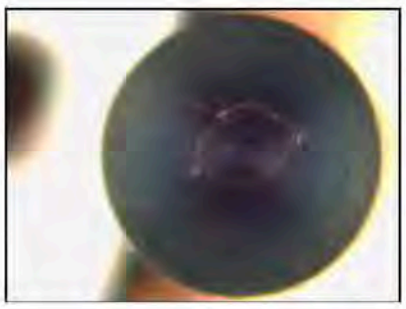
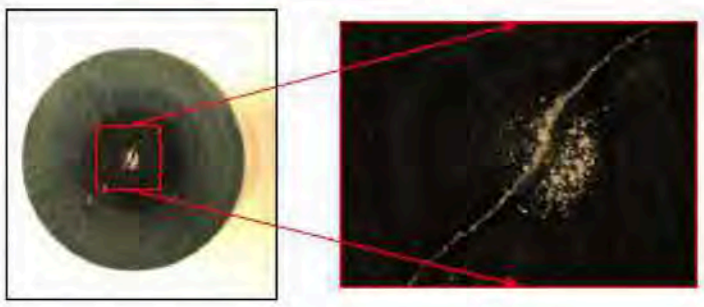
CP4 rating catalog for visual findings

High-pressure piston (coated) – Sonne – Status Red

Rating	Photos	Description
7	 	→ Crack on piston foot

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CP4 rating catalog for visual findings

High-pressure piston (coated) – Sonne – Status Red

Rating	Photos	Description
7		→ Massive particle impact → Massive wear → Clear signs of seizing → C coating worn away on entire contact area Breakage

BOSCH

CP4 rating catalog for visual findings

High-pressure piston (uncoated) – Sonne

- ➔ Functions
  - Generate high pressure
- ➔ Wear caused by
  - particles
  - Poorly lubricating medium
- ➔ Types of wear
  - Stiff pistons
  - Seized pistons
  - Scoring by particles
- ➔ Remark

BOSCH

CP4 rating catalog for visual findings

High-pressure piston (uncoated) – Sonne – Status Green

Rating	Photos	Description
Green 2		➔ As new ➔ Hardly used ➔ Smoothing ➔ Slight signs of cavitation
		
		

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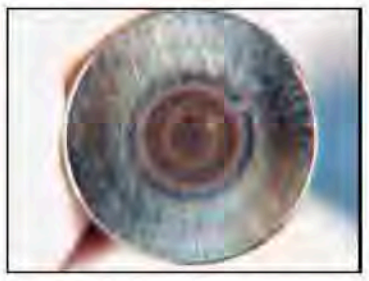
CP4 rating catalog for visual findings

High-pressure piston (uncoated) – Sonne – Status Yellow

Rating	Photos	Description
Yellow 4		➔ Slightly impacted particles ➔ Signs of cavitation erosion points within the contact area

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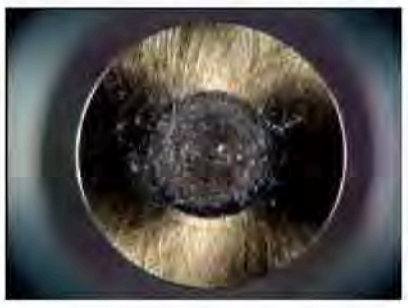
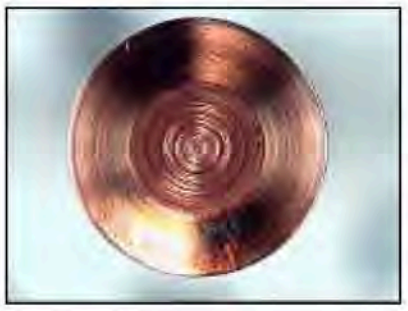
CP4 rating catalog for visual findings

High-pressure piston (uncoated) – Sonne – Status Yellow

Rating	Photos	Description
Yellow 6	 	➔ Impacted particles ➔ Signs of seizures ➔ Signs of scoring ➔ Smoothing almost to the edge of the piston

CP4 rating catalog for visual findings

High-pressure piston (uncoated) – Sonne – Status Red

Rating	Photos	Description
Rot 7		➔ Particles extremely impacted ➔ Massive wear as far as the edge of the piston

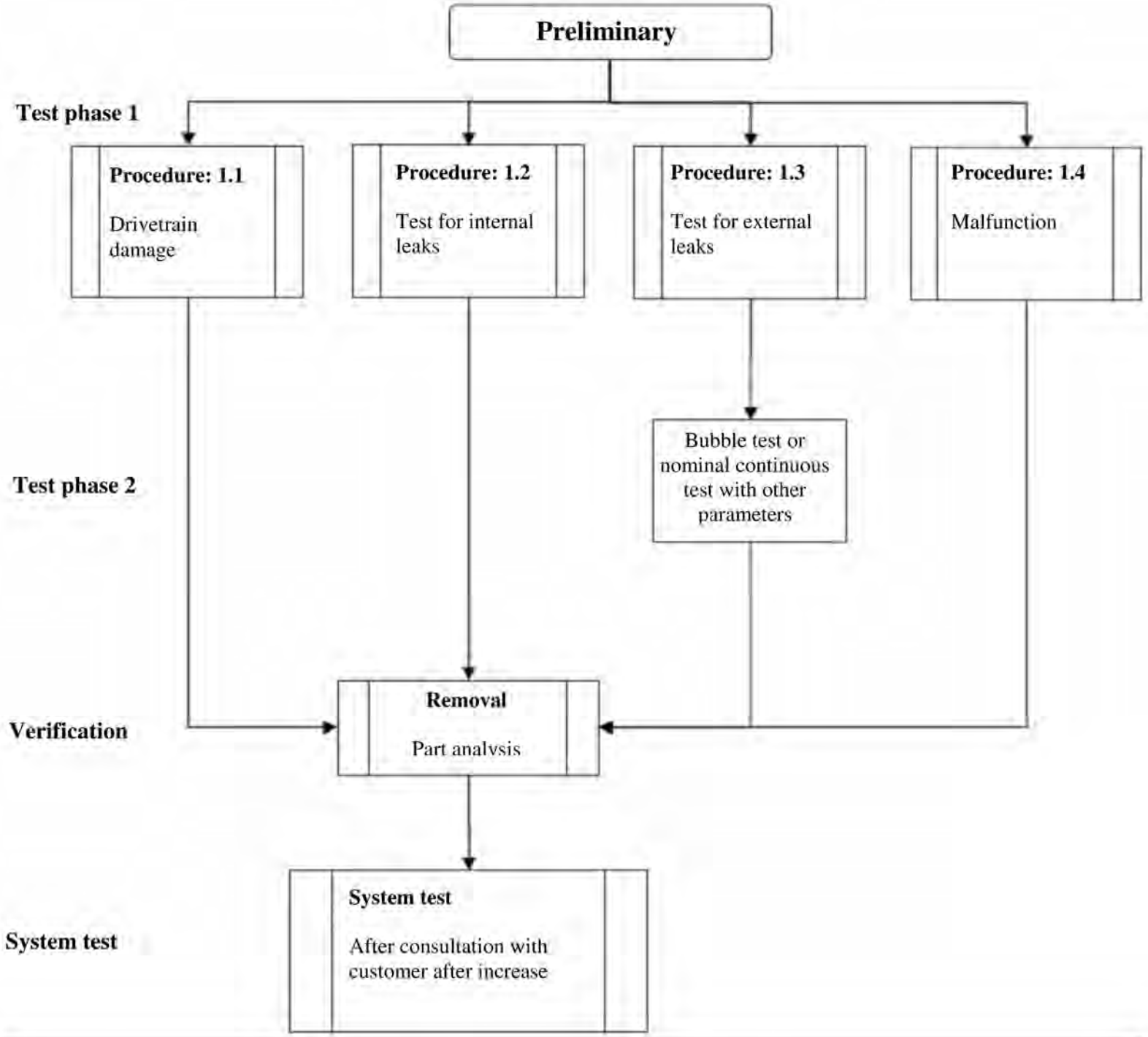
BOSCH

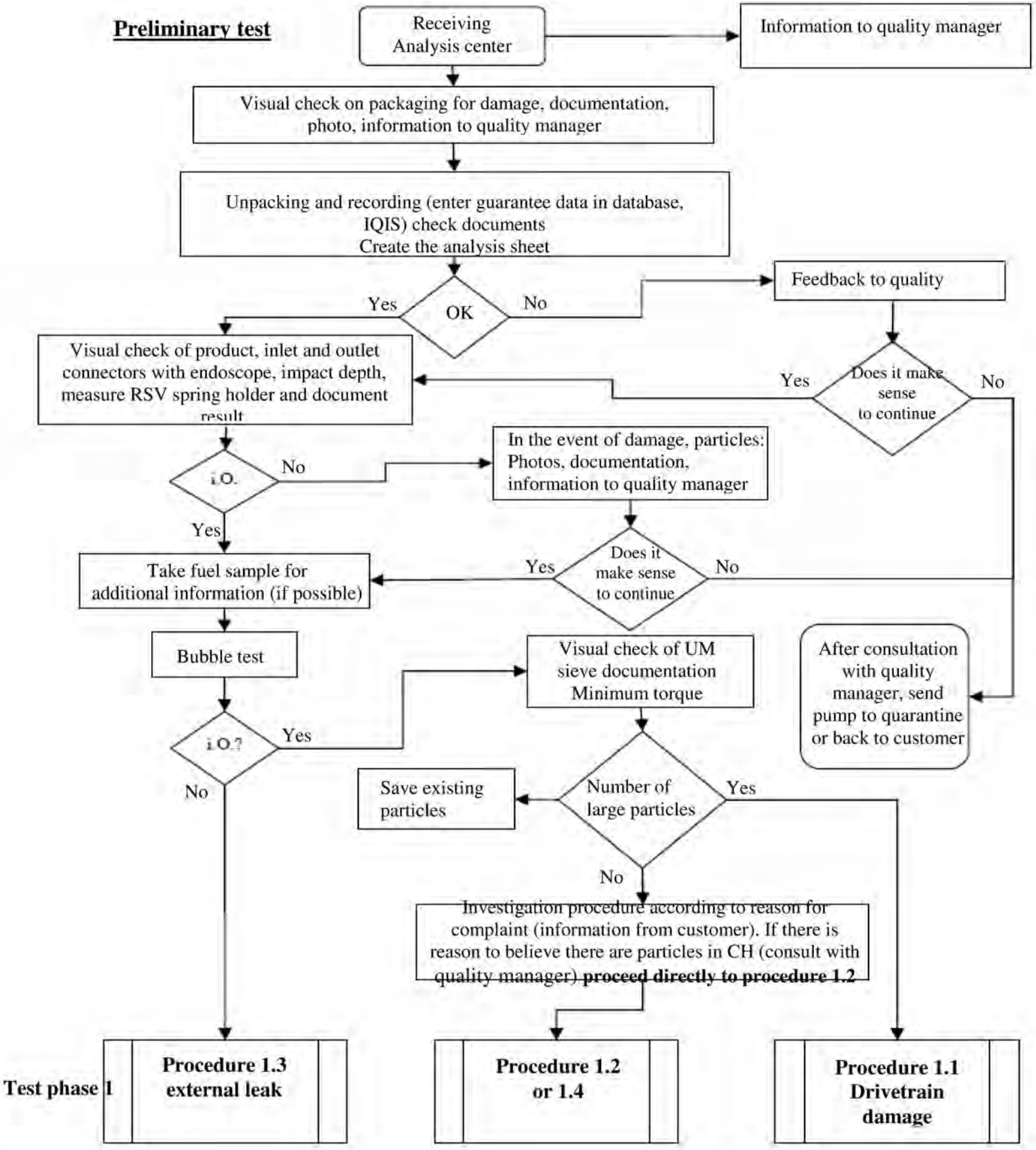
CP4 rating catalog for visual findings

High-pressure piston (uncoated) – Sonne – Status Red

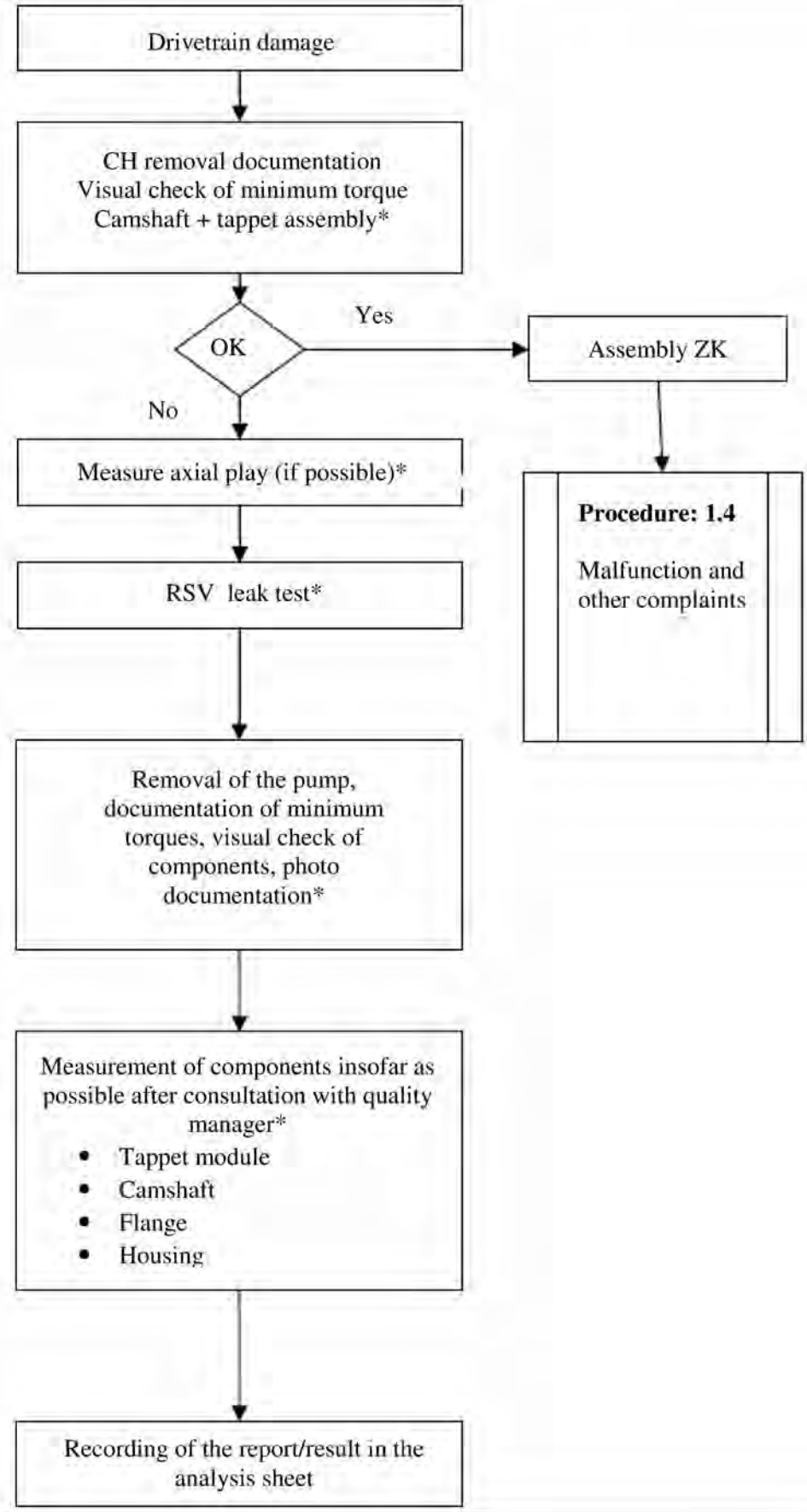
Rating	Photos	Description
Red 9		➔ Breakage

Overview of test phases

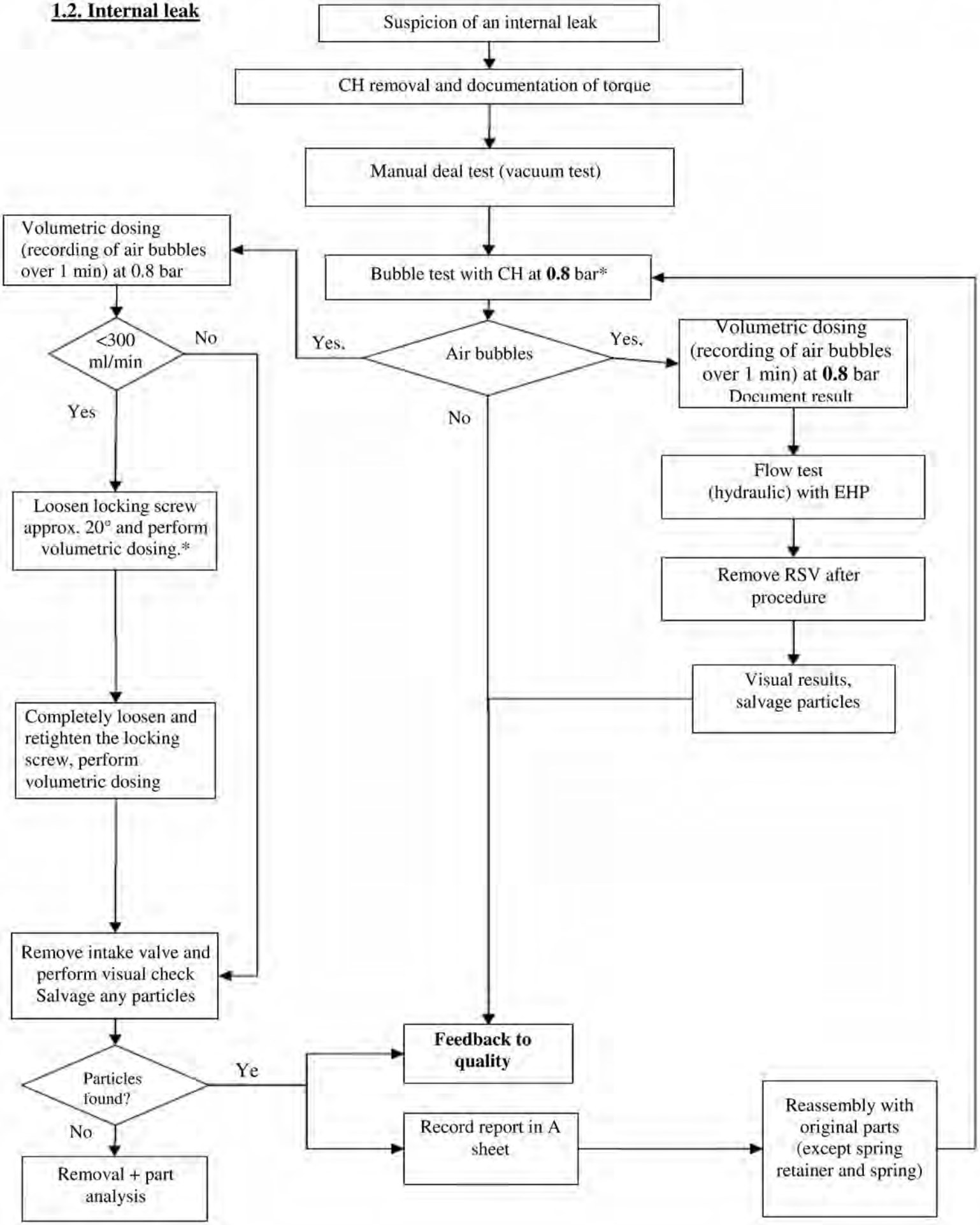




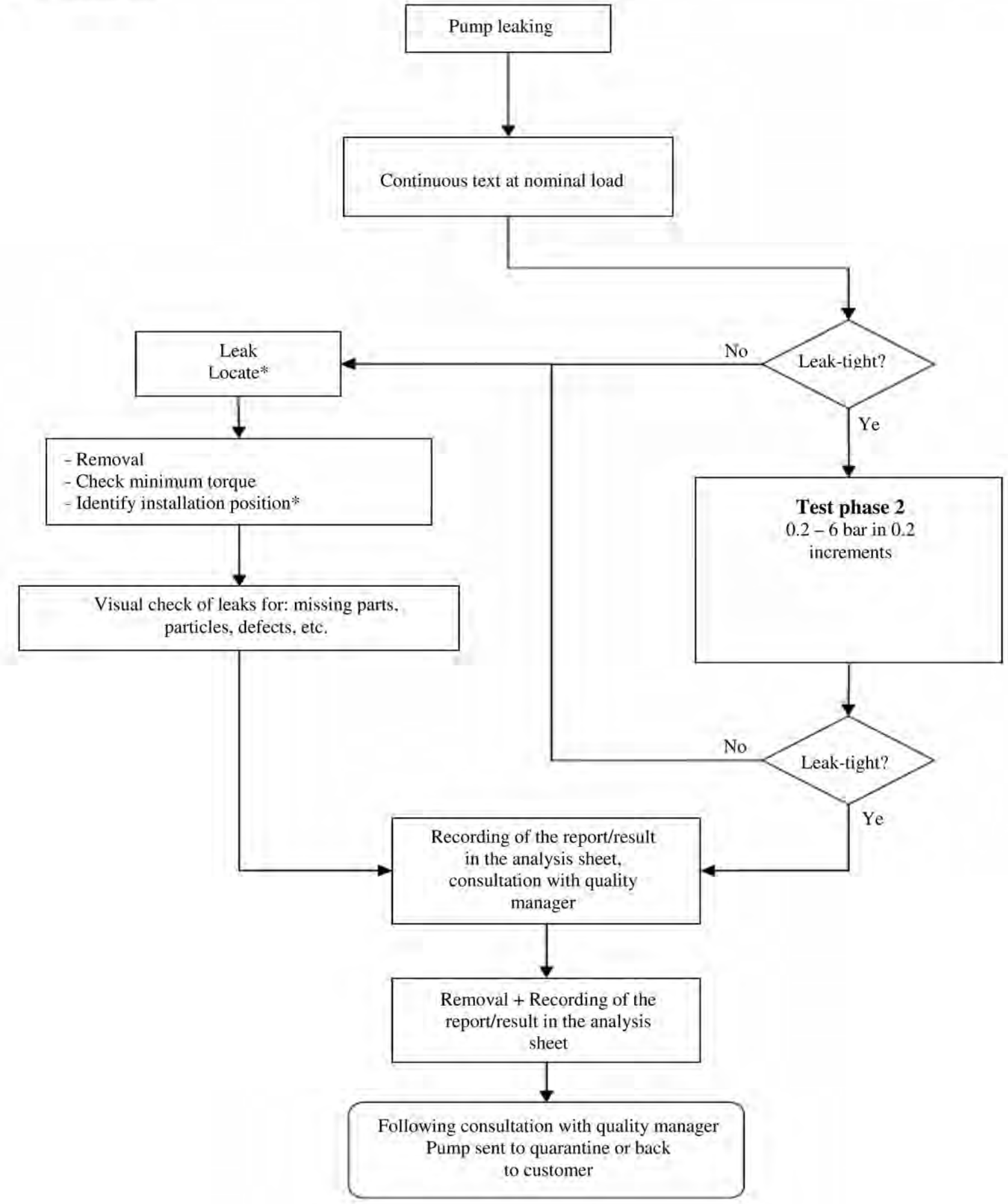
1.1. Drivetrain damage



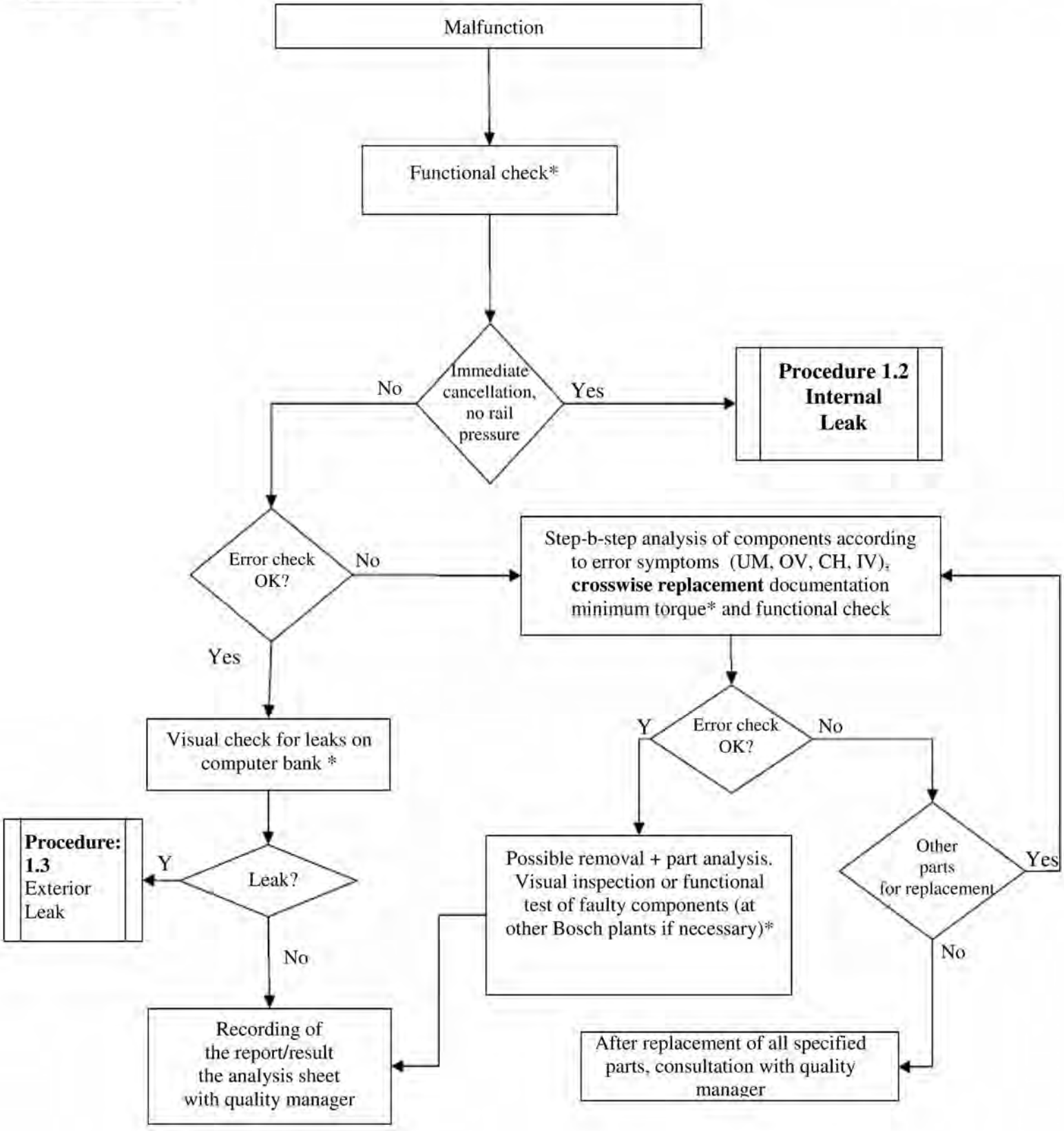
1.2. Internal leak



1.2.External leak



1.4. Malfunction



*Recording of the report/result in the analysis sheet

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EA1v093EN-00037[1]

Vehicle failures in the field only

Model	Engine	Market	Failures	Total	Delivery volume Vehicles SOP - June 08	Delivery volume Vehicles SOP - July - Sept. 08	Delivery volume Vehicles SOP - Sept. 08	First vehicle delivery to market	Failure quota per million to June 08	Failure quota per million to September 08	Factor above average in worldwide comparison	Factor above average in comparison, [redacted]
Audi Q7 3.0l	**3.0l**	**worldwide**		**48**	**19.344**	4.537	**23.881**	Dez. 07	**2,5**	**2,0**	---	
		Non-responsive content removed [redacted]	0		5.685	1.199	6.884	Dez. 07	0,0	0,0		
			8		187	71	258	Dez. 07	42,8	31,0	17	#DIV/0!
			16		317	4	321	Dez. 07	50,5	49,8	20	#DIV/0!
			3		477	24	501	Dez. 07	6,3	6,0	3	#DIV/0!
			10		1.954	583	2.537	Dez. 07	5,1	3,9	2	#DIV/0!
			4		76	???	76	Jan. 08	52,6	52,6	21	#DIV/0!
			2		2.612	925	3.537	Dez. 07	0,8	0,6		
			2		???	???	???	???	#WERT!	#WERT!		
			1		???	???	???	???	#WERT!	#WERT!		
			1		69	7	76	Dez. 07	14,5	13,2		
			1		1.712	368	2.080	Dez. 07	0,6	0,5		
Audi A4/A5 2.0l	**2.0l**	**worldwide**		**12**	**87.660**	52.870	**140.530**	Okt. 07	**0,1**	**0,1**		
		Non-responsive content removed [redacted]	6		24.813	15.545	40.358	Okt. 07	0,2	0,1		
			2		10.324	3.884	14.208	Nov. 07	0,2	0,1		
			2		1.225	494	1.719	Dez. 07	1,6	1,2		
			0		8.733	7.393	16.126	Dez. 07	0,0	0,0		
			1		1.724	1.070	2.794	Dez. 07	0,6	0,4	4	2
			1		1.225	634	1.859	Nov. 07	0,8	0,5	6	3
Audi A4/A5 2.7l	**2.7l**	**worldwide**		**42**	**18.516**	6.040	**24.556**	Sep. 07	**2,3**	**1,7**		
		Non-responsive content removed [redacted]	7		5.899	2.389	8.288	Sep. 07	1,2	0,8		
			13		243	148	391	Dez. 07	53,5	33,2	24	45
			10		161	3	164	Nov. 07	62,1	61,0	27	52
			9		1.985	622	2.607	Sep. 07	4,5	3,5	2	4
			2		1.777	318	2.095	Sep. 07	1,1	1,0		
			1		2.329	850	3.179	Sep. 07	0,4	0,3		
Audi A4/A5 3.0l	**3.0l**	**worldwide**		**2**	**40**	2.238	**2.278**	Sep. 08	50,0	**0,9**		
		Non-responsive content removed [redacted]	0		40	970	**1.010**	Sep. 08		0,0		
			0		0	334	**334**	Sep. 08		0,0		
			1									
			1		0	26	**26**	Sep. 08		38,5		
VW Phaeton 3.0l	**3.0l**			**3**	**2.807**		**2.807**		**1,1**	**1,1**		
			1				0		#DIV/0!	#DIV/0!		
			2				0		#DIV/0!	#DIV/0!		
VW Touareg 3.0l	**3.0l**			**35**	**13.266**		**13.266**		0,0	0,0		
			1		4.780		4.780		0,2	0,2		
			7		141		141		49,6	49,6	#DIV/0!	237
			11		1.112		1.112		9,9	9,9	#DIV/0!	47
			5		789		789		6,3	6,3	#DIV/0!	30
			5				0		#DIV/0!	#DIV/0!		
			5		2.437		2.437		2,1	2,1	#DIV/0!	10
			1				0		#DIV/0!	#DIV/0!		
VW Passat 2.0l	**2.0l VW all**		---	**8**			**0**		#WERT!	#WERT!		
			1				0		#DIV/0!	#DIV/0!		
			1				0		#DIV/0!	#DIV/0!		
VW Tiguan 2.0l	**2.0l**		---		**18.752**		**18.752**					
			1				0		#DIV/0!	#DIV/0!		
			3				0		#DIV/0!	#DIV/0!		
VW Jetta 2.0l	**2.0l**	USA	2		1.994		1.994		1,0	1,0		
Field total			**150**									

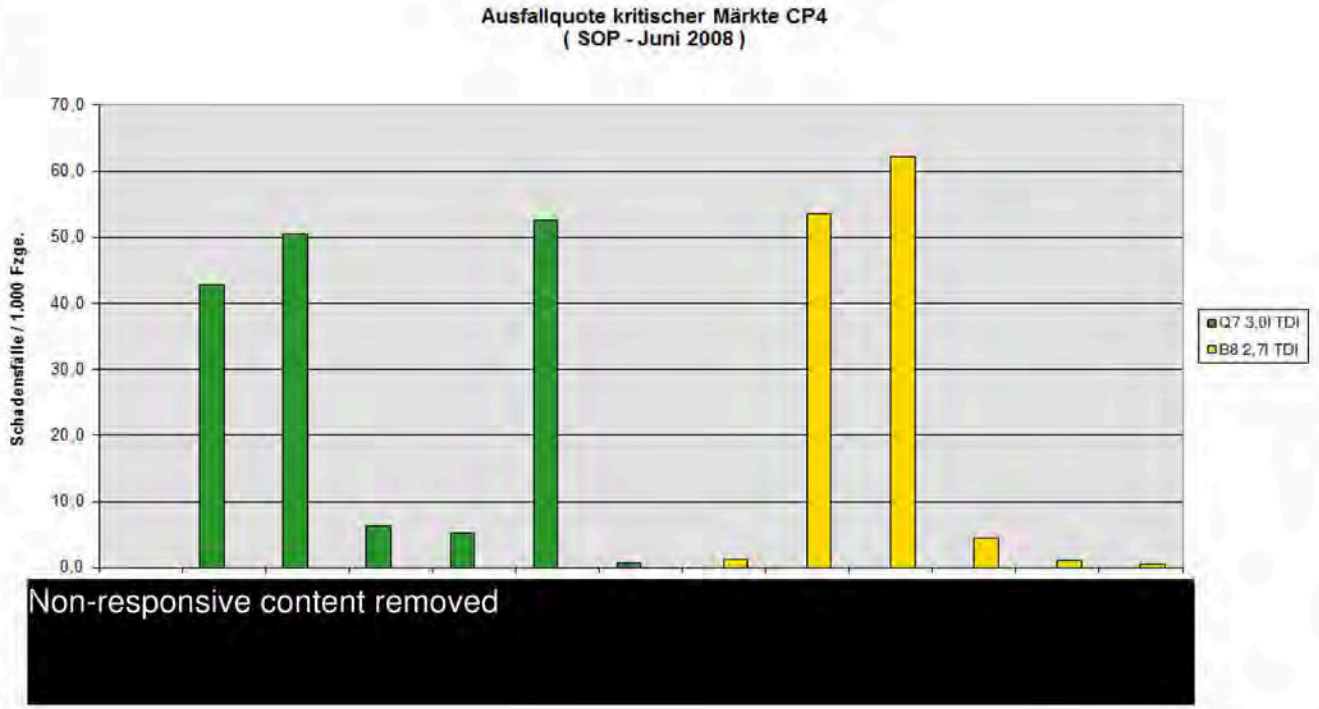
	Qty.	Deliveries	Failure rate (per mill.)
Non-responsive content removed [redacted]	33	3610	9,1
	33	2993	11,0
	3	501	6,0
	31	22716	1,4
	17	61320	0,3

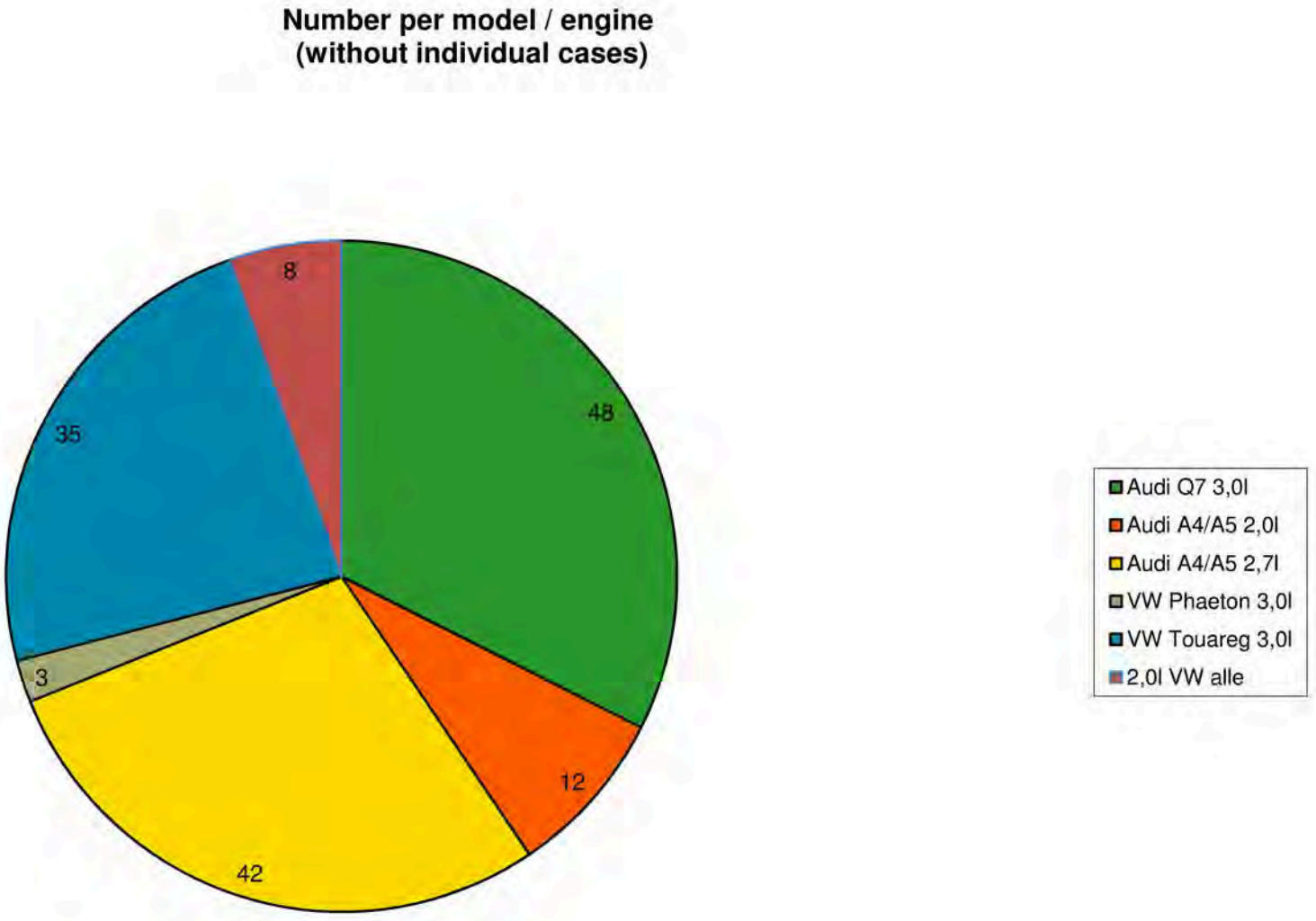
EA11003EN-00037[2]

Diagram text
Failure rate in critical markets CP4
(SOP June 2008)
Cases of damage / 1,000 vehicles

[redacted]

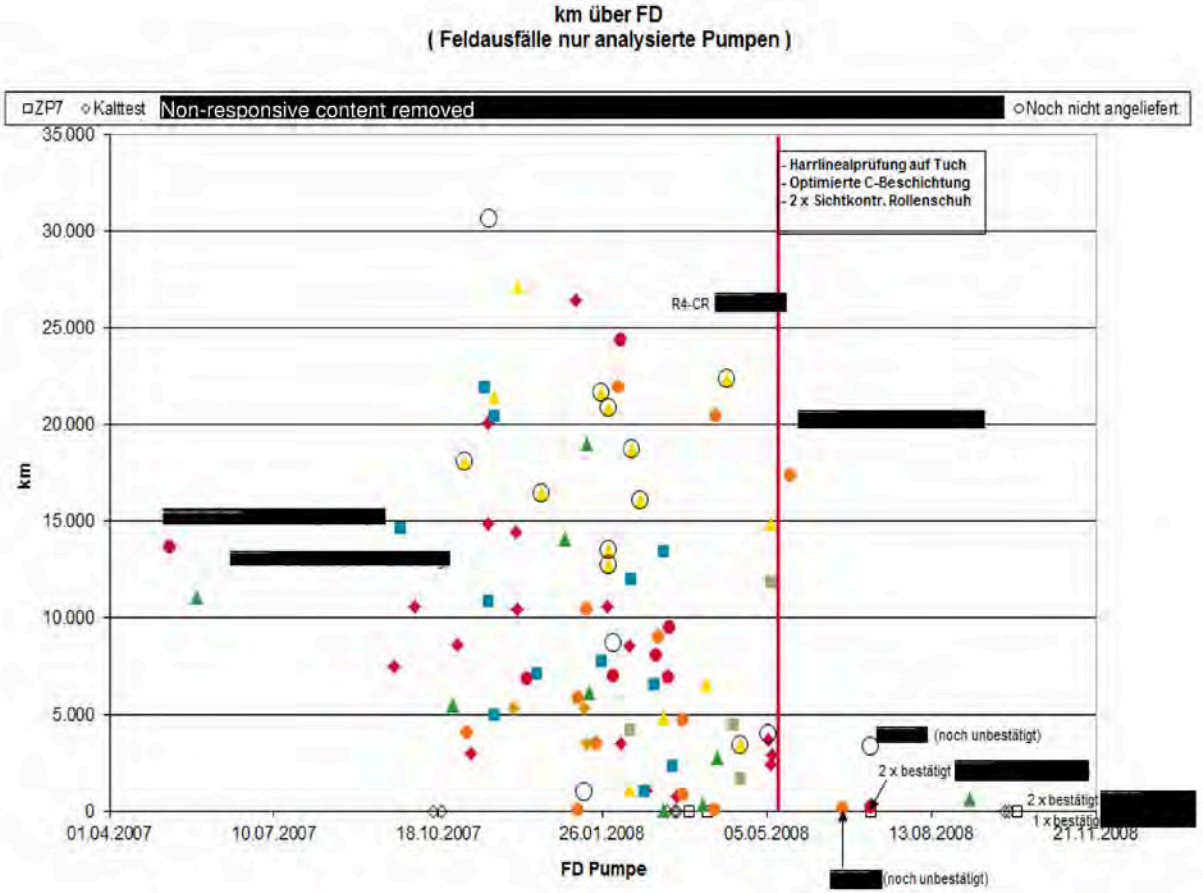
Type / Market





EA11003EN-00037[4]

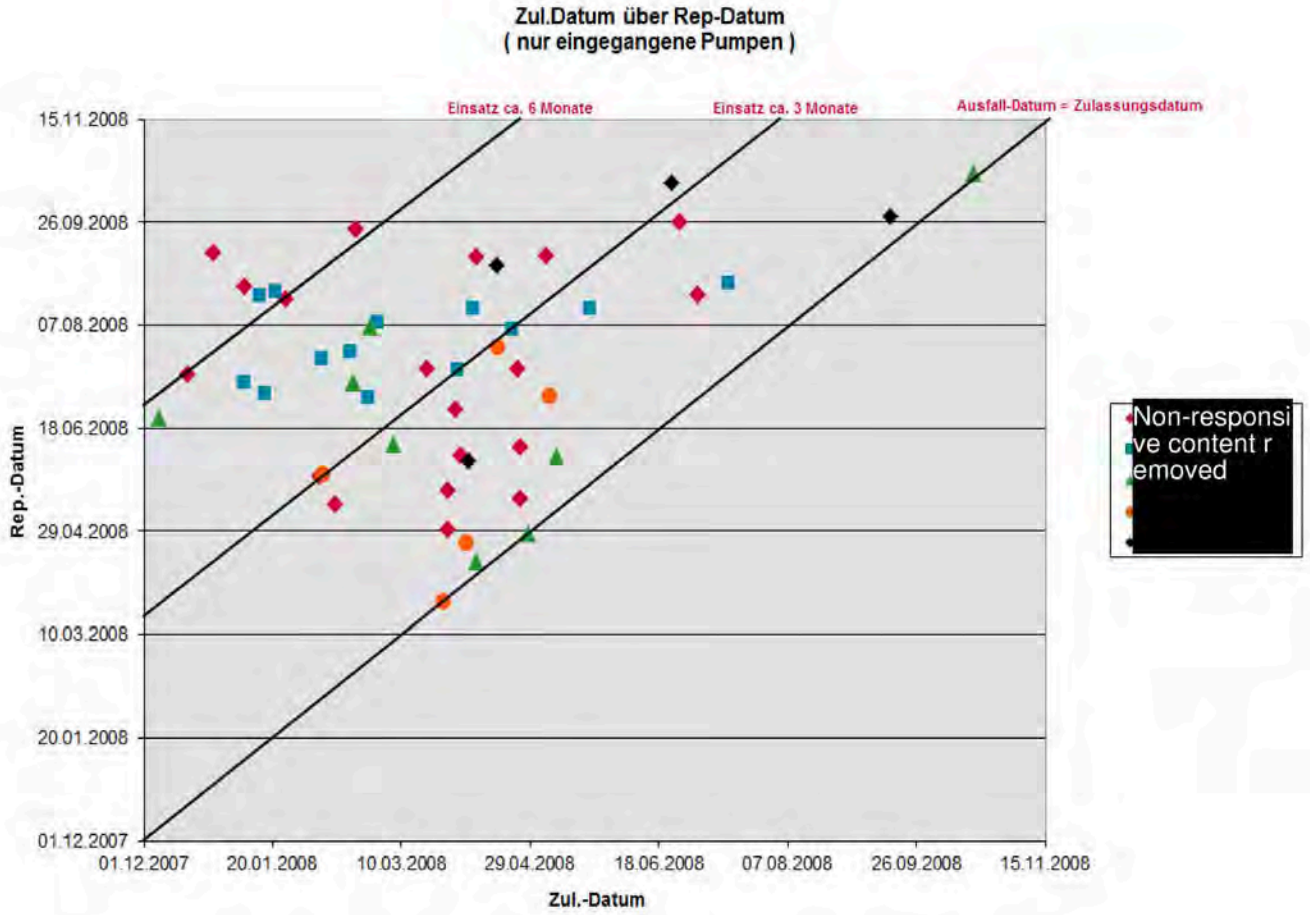
Diagram text
km over DoM
(field failures, analyzed pumps only)
Cold test
[redacted]
Not yet delivered
Straightedge inspection on canvas
Optimized C layer
2 x visual check Roller support
[redacted]



EA11003EN-00037[5]

Diagram text
Reg. date over rep. date (received pumps only)

Installed approx. 6 months
Installed approx. 3 months
Failure date - registration date
Rep. date
[redacted]
Reg. date



EA11003EN-00037[6]

Diagram text
Failure and repair date
Failure date
Repair date
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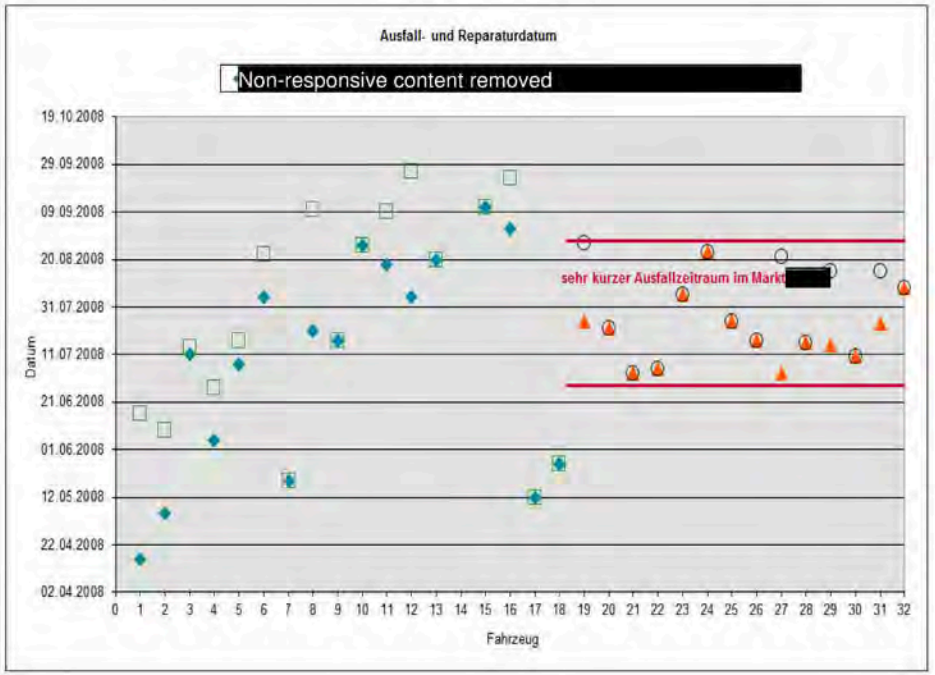
Very short failure period in Ireland market
Date
Vehicle



EA11003EN-00039[0]

From: Non-responsive content removed
To:
CC:
Date: 9/26/2008 1:35:41 PM
Subject: Re: Fuel requirement for V6 TDI in C6PA (2.7 L and 3.0 L TDI)

Hello Mr [redacted]

If anything changes in the IBN procedure, it must be handled via the CS order tool.
The approval of GQ is always required for this!

Best wishes,

>With best regards
>
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>
>Non-responsive content removed
>Sent: Friday, September 26, 2008 1:25 PM
>Non-responsive content removed
>Subject: Re: Fuel requirement for V6 TDI in C6PA (2.7 L and 3.0 L TDI)
>Importance: High

EA11003EN-00039[1]

>
Dear All,
>
>Another e-mail on the same topic as this morning. This time the fear is that the process specifications may have been abandoned because of come processes (CIP...)
>
>According to Mr. [redacted], the required 240 seconds are achieved in [redacted] when controlling the EKP. Can we now also ensure that things stay that way?
>
Please let me have your brief feedback.
>
>With best regards
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>
>From: Non-responsive content removed
>Sent: Friday, September 26, 2008 1:04 PM
>To: Non-responsive content removed
>Subject: Re: Fuel requirement for V6 TDI in C6PA (2.7 L and 3.0 L TDI)
>Importance: High
>
>Dear [redacted]
>
>As discussed, see below.
>
>Best wishes,
>
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EA11003EN-00039[2]

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>85045 Ingolstadt
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>
>_____
From: Non-responsive content removed
>Sent: Friday, September 26, 2008 10:18 AM
>To: Non-responsive content removed
>Subject: Re: Fuel requirement for V6 TDI in C6PA (2.7 L and 3.0 L TDI)
>Importance: High
>
>_____
>From: Non-responsive content removed
>Sent: Friday, September 26, 2008 10:14 AM
Non-responsive content removed
>Subject: Re: Fuel requirement for V6 TDI in C6PA (2.7 L and 3.0 L TDI)
>Importance: High
>
>Dear Mr Non-responsive content removed
>
>Please get involved here.
>Please make sure that the processes set down in the tests are always followed.
>It has already happened in various plants that this pre-installed fueling has been abandoned due to CIP or a model year change.
>Initial regulation V6-TDI now exists as a 'normal pdf document', but will shortly be defined as a PDM (Mr. [redacted].
>If PDM is the wrong document in which to ensure process compliance, please offer another suggestion.
>
> < File: Bandende-Einlaufspezifikation_V6TDI_20080529.pdf >>< File: Diesel Hochdruckpumpe C6PA.pdf >>
>
>This relates to all common rail concepts with high-pressure fuel pump CP4 (from EU5 onwards, not interim); i.e. at present all 2.0 l CR + V6 CR (without D3 V6 EU4; D3 + Q7 V8 EU4); shortly also V8-TDI EU5 and V12-TDI.
>This is to be assured in all car plants Non-responsive content removed
>Please forward to the relevant locations.
>Thanks!
>

EA11003EN-00039[3]

>Dear [redacted]
>Please see to process regulation V8 and V12 TDI and 2.0 l CR from VW.
>
>
>
>With best regards
>
[redacted]
>
>AUDI AG
[redacted]
>85045 Ingolstadt
[redacted]
>
>
>
>From: [redacted]
>Sent: Friday, September 26, 2008 9:21 AM
[redacted]
>Subject: Fuel requirement for V6 TDI in C6PA (2.7 L and 3.0 L TDI)
>
Good morning all,
>
>During my visit yesterday to C6 production in [redacted] I found that although the fuel pre-filling function is activated in the engine controller again, the required pre-filling time of 240 seconds was not assured.
>Despite my instructions (Thursday18.09.) that no vehicles were to be started without sufficient pre-filling, vehicles have still been started the fuel systems of which were only pre-filled for 120 seconds.
>
As an immediate measure to ensure the required pre-filling of fuel, two additional ignition changes could be integrated in the production process. This enables the required pre-filling period to be achieved for all vehicles built (starting from Thursday 25 Sept.2008 at 16.45 hours with vehicle ID 40 1 2354, chassis no. WAU ZZZ 4F29N [redacted] This measure is to continue until Thurs. 02.10 By this point the fuel pre-filling should be integrated at the transition line by rejigging the test program. see the attached correspondence)
>
The fuel pre-filling implemented in the C6 has fallen victim to CIP measures, which is why the required amount of fuel (240 seconds pre-filling time) has not been observed in the C6PA.
Unfortunately the people responsible for fuel pre-filling knew nothing of these "CIP optimizations" and the associated reduction in the pre-filling times. Accordingly we need to ensure that future CIP processes are not allowed to have a negative impact on fuel pre-filling.
>One option is to add clear comments to the program parts, and program steps in the test process required for pre-filing in order to avoid any changes to this due to uncertainty.
>

EA11003EN-00039[4]

>Dear Mr Non-responsive content removed
>Please organise things so that the program parts are clearly commented.
>
>
>
>With best regards
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>Vorstand/Board of Management: Rupert Stadler (Vorsitzender/Chairman), Ulf Berkenhagen, Michael Dick, Frank Dreves, Peter Schwarzenbauer, Axel Strotbek, Werner Widuckel>

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>
>
>_____
From: Non-responsive content removed
>Sent: Thursday, September 25, 2008 6:29 PM
Non-responsive content removed

>Subject: Fuel requirement for V6 TDI in C6PA (2.7 L and 3.0 L TDI)
>
>
>Dear Sir/Madam,
>
>In order to avoid damaging the new V6 TDI high-pressure pump in the C6PA, the >fuel pump in the vehicle's fuel tank must have run for at least 4 minutes (240 seconds) before the vehicle is started> >(TE requirement, see appendix below).
>
>At present we are not achieving this 4 mins during the various ECOS tests.

EA11003EN-00039[5]

>
>Production is to help us immediately by arranging for one worker to switch the ignition on and off again after at least 60 seconds pre-transport time
(Switching on the ignition after the wet calibration of the tank causes the pump to run automatically for 60 seconds) Switching off the ignition stops the pump immediately.)
>
>1. Door fitting platform: The worker (door installation) switches the ignition on after the door is installed > and the next worker (B pillar and gear N setting) switches the ignition off again. --> 1min fuel pre-transport
> Agreed with Mr [redacted] and [redacted]
>
>2. Transfer line: The worker (functional checking) switches the ignition on again after testing functions and the next worker switches the ignition off again after at least 60 seconds. --> 1min fuel pre-transport
> Agreed with [redacted]
>
>These two measures should continue until the test program on the transfer line is changed. The target for this is Thursday 02 Oct. 11.00 hours.
>
>We already have approx. 60 seconds of fuel pre-transport in the "Tank wet calibration" and 60 seconds during "Functional testing" on the transfer line
>
We aim to meet the requirement of the TE of 4 minutes by making further changes to the test program.
>The target for actively implementing the new test program in production is Thursday 02 Oct. 11.00 hours.
> Agreed with Mr [redacted] and verified by Mr [redacted]
>
>Assurance of the pre-transport time of 4 mins starting Thurs 25.Sep.2008 at16.45 hours with vehicle:
>Code no. 40 1 2354
>Chassis no. WAU ZZZ 4F29N [redacted]
>Timing 68
>
>Thanks again for your swift support..
>
>Attachments:
>
> < File: Bandende-Einlaufspezifikation_V6TDI_20080529.pdf >>
> < File: Diesel Hochdruckpumpe C6PA.pdf >>
>
>
>Best regards

[redacted]

>
>[redacted]
>
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[redacted]

EA11003EN-00039[6]

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>

[redacted]

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>

>

EA11003EN-00040[0]

From: Non-responsive content removed
To:
CC:
Date: 9/30/2008 6:41:41 AM
Subject: Re: Fuel requirement for V6 TDI in C6PA (2.7 L and 3.0 L TDI)

Hi all,

The following is a supplement to the list of vehicles at risk:

In the case of the following vehicles (in addition to the listed vehicles) although it was possible to reactivate the long adjustment in the engine controller for fuel pre-filling, the pre-filling times were 120 seconds rather than 240 seconds as required.
Starting from the following vehicle, a 240 second period for fuel pre-filling was assured.

Thursday 25 Sept. 2008 at 16.45 hours with vehicle:
Code no. 40 1 2354
Chassis no. WAU ZZZ 4F29N[redacted]

This should also be taken into account

With best wishes

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EA11003EN-00040[1]

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[redacted]

>
>From: Non-responsive content removed
>Sent: Tuesday, September 30, 2008 7:07 AM
Non-responsive content removed
>Subject: Re: Fuel requirement for V6 TDI in C6PA (2.7 L and 3.0 L TDI)
>
Dear [redacted] colleagues,
>
The issue pf CP4 drivetrain damage is sufficiently well known.
>The analyses at Bosch currently indicate that after pump FD on 5.5.08 there is no more confirmed drivetrain damage.
>
As a very large number of C6PA pumps were not correctly pre-filled (see appendix), these pumps are at particular risk of failure according to experience in [redacted]
>
>< Message: Re: C6PA initial start without sufficient initial fuel fill. >>
>In the event of failures, please check the OK chassis numbers listed below, to see whether the relevant vehicles belong in this range. If so, they must then be evaluated differently in order to avoid drawing the wrong conclusions.
>
>With best regards
>
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>

[redacted]

EA1 1003EN-00140[2]

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>

>

>_____

>From: Non-responsive content removed

>Sent: Thursday, September 25, 2008 6:29 PM

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>Subject: Fuel requirement for V6 TDI in C6PA (2.7 L and 3.0 L TDI)

>

>

>Dear Sir/Madam,

>

>In order to avoid damaging the new V6 TDI high-pressure pump in the C6PA, the >fuel pump in the vehicle's fuel tank must have run for at least 4 minutes (240 seconds) before the vehicle is started> >(TE requirement, see appendix below).

>

>At present we are not achieving this 4 mins during the various ECOS tests.

>

>Production is to help us immediately by arranging for one worker to switch the ignition on and off again after at least 60 seconds pre-transport time
(Switching on the ignition after the wet calibration of the tank causes the pump to run automatically for 60 seconds) Switching off the ignition stops the pump immediately.)

>

>1. Door fitting platform: The worker (door installation) switches the ignition on after the door is installed > and the next worker (B pillar and gear N setting) switches the ignition off again. > 1 minute pre-transport of fuel agreed with Mr Non-responsive content removed

>

>2. Transfer line: The worker (functional checking) switches the ignition on again after testing functions and the next worker switches the ignition off again after > at least 60 seconds. --> 1min fuel pre-transport
> Agreed with Mr [redacted]

>

>These two measures should continue until the test program on the transfer line is changed. The target for this is Thursday 02 Oct. 11.00 hours.

>

>We already have approx. 60 seconds of fuel pre-transport in the "Tank wet calibration" and 60 seconds during "Functional testing" on the transfer line

>

We aim to meet the requirement of the TE of 4 minutes by making further changes to the test program.
>The target for actively implementing the new test program in production is Thursday 02 Oct. 11.00 hours.
> Agreed with Mr [redacted] and verified by Mr [redacted]

>

>Assurance of the pre-transport time of 4 mins starting Thurs 25.Sep.2008 at16.45 hours with vehicle:
>Code no. 40 1 2354
>Chassis no. WAU ZZZ 4F29N[redacted]
>Timing 68

EA11003EN-00040[3]

>
>Thanks again for your swift support..
>
>Attachments:
>
> < File: Bandende-Einlaufspezifikation_V6TDI_20080529.pdf >>
> < File: Diesel Hochdruckpumpe C6PA.pdf >>
>
>
>Best regards

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>
>Audi AG Plant Neckarsulm

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EA11003EN-00042[1]

Vehicle failures in the field only

Model	Engine	Market	Failures	Delivery volume Vehicles SOP - June 08	Failure quota per mill.	Factor above average in worldwide comparison	Factor above average in comparison Germany	Remark
Audi Q7	3.0l	worldwide	39	19.344	2,0	—		
		[redacted]	0	5.685	0,0			
			7	187	37,4	19	#DIV/0!	
			14	317	44,2	22	#DIV/0!	
			3	477	6,3	3	#DIV/0!	
			2	?				1 veh. 2 failures
			5	?				
			3	76	39,5	20	#DIV/0!	
			2	2.612	0,8			
			1	?				
			1	?				
			1	?				
Audi A4/A5	2.0l	worldwide	7	87.660	0,1			
		[redacted]	5	24.813	0,2			
			1	1.724	0,6	7	3	
			1	1.225	0,8	10	4	
	2.7l	worldwide	36	18.516	1,9			
		[redacted]	6	5.899	1,0			
			12	243	49,4	25	49	
			10	161	62,1	32	61	
			7	1.985	3,5			
			1	?				
	3.0l		0	?				
			1					
VW Phaeton	3.0l		1	2.807	0,4			Late damage, poor ventilation in 06/07?
VW Touareg	3.0l	Free markets	25	13.266	1,9			
		[redacted]	1	4.780	0,2			
			6	141	42,6	23	203	Suspicion of proportion of biodiesel in [redacted]
			7	1.112	6,3	3	30	
			5	2.437	2,1	1	10	
			5	789	6,3	3	30	
			1	?				
VW Tiguan	2.0l		1	18.752	0,1			
AudiA4/A5	unknown		1					
	unknown		1					
	unknown		1					
Field total			113					

	Qty.	Deliveries	Failure rate (per mill.)
Sweden	28	2295	12,2
Ireland	30	478	62,8
Romania	3	477	6,3
Italy	20		
Germany	15	62736	0,2

Increase in initial fill of diesel in Non-responsive content removed markets

Extreme field failures with CP4 high-pressure fuel pump in Non-responsive content removed

Cause/analysis

Production slippage at Bosch (microgeometry) leads to stiff roller and to a failure of the pump drivetrain in conjunction with special fuel properties in certain markets (still unidentified despite laboratory analyses).

Failure quota, [redacted] partial factor 50 and [redacted] partial factor 60 via inland (see below)

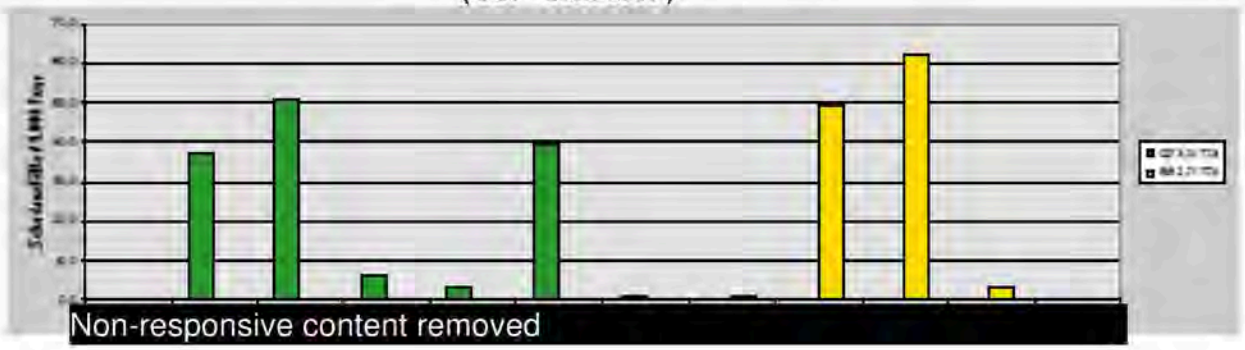
Situation:

In the two ports in [redacted], the logistics provider Scandia Transport, acting on the request of the dealer, adds 10 liters of diesel from non-public fuel stations in addition to the standard 8 liters.

Failed vehicles were filled to approx. 80% there (quota for all V6-TDIs approx. 60%)

The failure situation is still unclear in [redacted] (suspected kerosene? / rep. all approx. July 2008?).

Failure rate in critical markets CP4
(SOP - June 2008)



Increase in initial fill of diesel in Non-responsive content removed markets

Extreme field failures with CP4 high-pressure fuel pump in Non-responsive content removed

Measure / remedy:

In order to exclude the influence of poor quality initial fuel in these markets, a maximum fill of 16 liters of diesel should be provided in the car plant for a limited period and the topping up of diesel vehicles at the port in [redacted] should be avoided.
In terms of running in and protection from wear, the first fill of diesel fuel in the plant offers much better quality than standard fuel according to EN 59

Affected vehicles:

According to EBRA, approx. 16,000 A3, A4, A5, A6 ,TT,Q7 vehicles are delivered in [redacted] in 2008.
The diesel proportion of the EU5 engine is approx. 50% (depending on the model approx. 30 - 70%). In other words and estimated 8,000 vehicles
are delivered to [redacted] each year with HPFP CP4 = EU5 TDI (X1D).
The relevant annual CP4 diesel vehicle volume in Ireland (X2E) is approx. 3,000 vehicles [redacted] approx. 400 vehicles (X8F).

Recommended decision:

The Engines steering group notes the situation described and requests the relevant departments at Audi to implement the remedial measures (see above) for the Non-responsive content removed markets for 1 year to begin with.

Investigation report no. 11/0390

[redacted]

Audi

Department	Customer	Phone	Date
[redacted]	[redacted]	[redacted]	**1/17/2011**

Vehicle	Subject	Part number
	DK from plant...:SCK and CKD	

QTS number	Mileage / time	Cardowns	A faults	B faults	C Faults
		☐	☐	☐	☐

Field	Shop floor incident	Number of problem parts	Supplier	Material
☐	☐			

Process/ examination (details provided by the client)

→ Checking of the fuel quality

Result of checks:

- The quality of CKD and SKD production varies greatly; in many cases the fuel in SKD production is not OK
- The values for the CKD fuel is generally OK, but could be better in some points, such as lubricity (HFRR).
- The following parameters are noticeable in SKD production:
  - Very poor lubricity from 539 µm.
  - Very low viscosity at 40℃ of just 1.769 mm/s2. (n orm: min. 2.0)
  - Extremely high phosphorous content of 2520 ppm.
  - The boiling curve can be used to determine the composition of the fuel. The fuel contains approx. 10% low-boiling components (start of boiling 138 ℃) most probably to influence cold performance. However it is possible to discount contamination with petrol because the flash point is sufficiently high at 60 ℃.
- The fuel produced in SKD production is a diesel fuel that has been intentionally mixed with kerosene to improve cold performance.

- Individual results are contained in the Appendix.
- ICP scan with details of element traces in fuel will be sent later.

Findings of the inspection: PETROLAB 03/2011 No.1 (CKD production) + No. 2 (SKD production)
General note: Please note that at least 2.5 liters of fuel are required for a full analysis. If the amount is insufficient, the scope of analysis must be adjusted/reduced.

Test costs			Image access no.

Persons responsible	Phone	noted	Date of completion
[redacted]	[redacted]		**3/14/2010**

EA11003EN-00050[0]

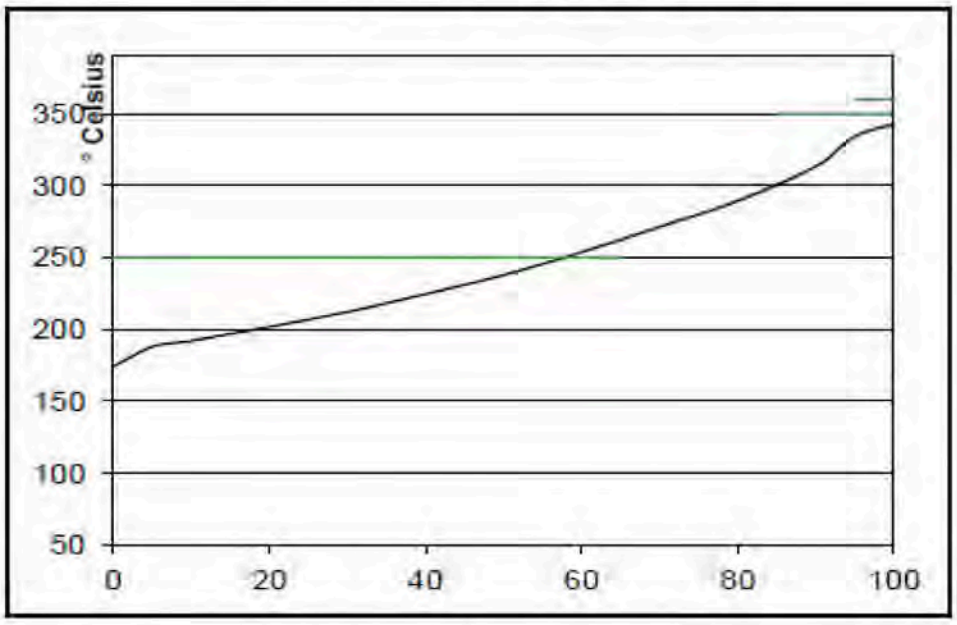
Sample name:	03/11 No.1
Sample for examination job:	390
PetroLab - certificate no:	PRO14953
Description / keyword	CKD - production, [redacted]

Analysis results

Color		c+b, -
Density	*kg/m³*	824.0
Distillation process		
Start of distillation	*°C*	174.2
5 % v/v rec./evap	*°C*	187.9 / 186.9
10 % v/v rec./evap	*°C*	192.2 / 191.5
20 % v/v rec./evap	*°C*	201.8 / 200.6
30 % v/v rec./evap	*°C*	212.2 / 211.2
40 % v/v rec./evap	*°C*	224.6 / 223.8
50 % v/v rec./evap	*°C*	253.8 / 236.9
60 % v/v rec./evap	*°C*	253.7 / 252.4
70 % v/v rec./evap	*°C*	271.3 / 269.6
80 % v/v rec./evap	*°C*	289.4 / 287.7
90 % v/v rec./evap	*°C*	313.3 / 310.7
95 % v/v rec./evap	*°C*	334.0 / 329.4
End of distillation	*°C*	342.8
Residue	*% v/v*	1.3
Loss	*% v/v*	0.9
vaporized@ 250 °C	*% v/v*	58.5
vaporized@ 350 °C	*% v/v*	-
vaporized@ 370 °C	*% v/v*	-
Cetane number		-
Cetane index		-
Oxidation stability	*g/m³*	<0.1
Oxidation stability	*Hours*	-
Carbon residue		
Distillate residue	*% m/m*	-
based on original	*% m/m*	-
Ash content / oxide ash	*% m/m*	-
Filterability (CFPP)	*°C*	-
Cloudpoint (CP)	*°C*	-
Pour point	*°C*	-
Flash point (PenskyMartens)	*°C*	57.6
Lubricity (HFRR)	*[µm]*	344
Viscosity (40 °C)	*mm²/s*	2.011
Phosphorous content	*mg/kg*	19
Total Acid Number (TAN)	*mgKOH/g*	<0.03
PIONA - Analysis		
Paraffins	*% v/v*	-
Aromatic compounds	*% v/v*	-
Naphthene	*% v/v*	-
Olefins	*% v/v*	-
Biodiesel content (FAME)	*% v/v*	<0.1
Aromatic compound content		
Monoaromatic compounds	*% m/m*	-
Diaromatic compounds	*% m/m*	-
Tri+ - aromatic compounds	*% m/m*	-
Polyaromatic compounds (PCA)	*% m/m*	-
Total aromatic compounds	*% m/m*	-
PCAs according to DIN EN 590	*% m/m*	####
Water content	*mg/kg*	25
Calorific value		
Ho	*MJ/kg*	-
Hu	*MJ/kg*	-
Copper corrosion		-
Silver corrosion		-
Total impurities	*mg/l*	10
Number of particles	*Volume/l*	

Fatty acid distribution			
Low fatty acids - <C12	*% m/m*	-	< C12
Lauric acid - C12/0	*% m/m*	-	C12/0
Myristic acid - C14/0	*% m/m*	-	C14/0
Palmitic acid - C16/0	*% m/m*	-	C16/0
Palmitoleic acid - C16/1	*% m/m*	-	C16/1
Stearic acid	*% m/m*	-	C18/0
Oleic acid - C18/1	*% m/m*	-	C18/1
Linoleic acid - C18/2	*% m/m*	-	C18/2
Linoleic acid - C18/3	*% m/m*	-	C18/3
Arachidic acid - C20/0	*% m/m*	-	C20/0
Gadoleic acid - C20/1	*% m/m*	-	C20/1
Higher fatty acids ->C20	*% m/m*	-	> C20
Iodine value (calculated from distribution)	*g_iodine/lOOg*		#####

Distillation process according to DIN EN 590



The curve is extrapolated from 13 measurements

C/H/O ratio

C	*% m/m*	-
H	*% m/m*	-
O	*% m/m*	-

Molecular weight		
Mean	*g/mol*	-

Microbiological contamination

Bacteria	*Cfu/l*	-
Yeasts/ fungi	*Cfu/l*	-
Colonies	*Cfu/l*	-

Oil in DK	*% m/m*	-

ICP screening		
Aluminium	*mg/kg*	-
Barium	*mg/kg*	-
Lead	*mg/kg*	-
Boron	*mg/kg*	-
Calcium	*mg/kg*	-
Chrome	*mg/kg*	-
Iron	*mg/kg*	-
Potassium	*mg/kg*	-
Copper	*mg/kg*	-
Magnesium	*mg/kg*	-
Manganese	*mg/kg*	-
Molybdenum	*mg/kg*	-
Sodium	*mg/kg*	-
Nickel	*mg/kg*	-
Phosphorus	*mg/kg*	-
Silver	*mg/kg*	-
Silicone	*mg/kg*	-
Titanium	*mg/kg*	-
Vanadium	*mg/kg*	-
Zink	*mg/kg*	-
Tin	*mg/kg*	-

Other measurements / comments

NACE class:E

Non-responsive content removed

EA11003EN-00051[0]

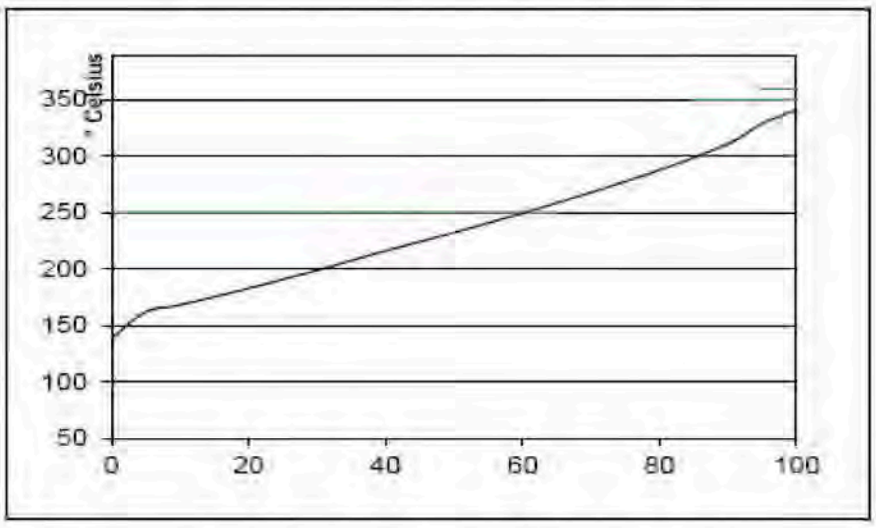
Sample name:	**03/11 No.2**
Sample for examination job:	390
PetroLab - certificate no:	PRO15004
Description / keyword	SKD - production, [redacted]

Analysis results

Color		c+b, -
Density	*kg/m³*	817.8
Distillation process		
Start of distillation	*°C*	138.1
5 % v/v rec./evap	*°C*	162.0 / 161.1
10 % v/v rec./evap	*°C*	168.1 / 167.2
20 % v/v rec./evap	*°C*	182.8 / 182.3
30 % v/v rec./evap	*°C*	198.9 / 198.3
40 % v/v rec./evap	*°C*	216,1 / 215,7
50 % v/v rec./evap	*°C*	232.3 / 231.5
60 % v/v rec./evap	*°C*	249.5 / 248.3
70 % v/v rec./evap	*°C*	267.9 / 267.0
80 % v/v rec./evap	*°C*	287.8 / 286.8
90 % v/v rec./evap	*°C*	311.0 / 309.9
95 % v/v rec./evap	*°C*	328.9 / 326.8
End of distillation	*°C*	341.5
Residue	*% v/v*	1.5
Loss	*% v/v*	0.5
vaporized@ 250 ℃	*% v/v*	60.6
vaporized@ 350 ℃	*% v/v*	-
vaporized@ 370 ℃	*% v/v*	-
Cetane number		-
Cetane index		-
Oxidation stability	*g/m³*	<0.10
Oxidation stability	*Hours*	-
Carbon residue		
Distillate residue	*% m/m*	-
based on original	*% m/m*	-
Ash content / oxide ash	*% m/m*	-
Filterability (CFPP)	*°C*	-
Cloudpoint (CP)	*°C*	-
Pour point	*°C*	-
Flash point (PenskyMartens)	*°C*	60.1
Lubricity (HFRR)	*[µm]*	539
Viscosity (40 °C)	*mm²/s*	1.769
Phosphorous content	*mg/kg*	2520
Total Acid Number (TAN)	*mgKOH/g*	<0.03
PIONA - Analysis		
Paraffins	*% v/v*	-
Aromatic compounds	*% v/v*	-
Naphthene	*% v/v*	-
Olefins	*% v/v*	-
Biodiesel content (FAME)	*% v/v*	<0.1
Aromatic compound content		
Monoaromatic compounds	*% m/m*	-
Diaromatic compounds	*% m/m*	-
Tri+ - aromatic compounds	*% m/m*	-
Polyaromatic compounds (PCA)	*% m/m*	-
Total aromatic compounds	*% m/m*	-
PCAs according to DIN EN 590	*% m/m*	####
Water content	*mg/kg*	57
Calorific value		
Ho	*MJ/kg*	-
Hu	*MJ/kg*	-
Copper corrosion		-
Silver corrosion		-
Total impurities	*mg/l*	7
Number of particles	*Volume/l*	

Fatty acid distribution		
Low fatty acids - <C12	*% m/m*	- < C12
Lauric acid - C12/0	*% m/m*	- C12/0
Myristic acid - C14/0	*% m/m*	- C14/0
Palmitic acid - C16/0	*% m/m*	- C16/0
Palmitoleic acid - C16/1	*% m/m*	- C16/1
Stearic acid	*% m/m*	- C18/0
Oleic acid - C18/1	*% m/m*	- C18/1
Linoleic acid - C18/2	*% m/m*	- C18/2
Linoleic acid - C18/3	*% m/m*	- C18/3
Arachidic acid - C20/0	*% m/m*	- C20/0
Gadoleic acid - C20/1	*% m/m*	- C20/1
Higher fatty acids ->C20	*% m/m*	- > C20
Iodine value (calculated from distribution)	*g_iodine/lOOg*	#####

Distillation process according to DIN EN 590



The curve is extrapolated from 13 measurements

C/H/O ratio		
C	*% m/m*	-
H	*% m/m*	-
O	*% m/m*	-

Molecular weight		
Mean	*g/mol*	-

Microbiological contamination		
Bacteria	*Cfu/l*	-
Yeasts/ fungi	*Cfu/l*	-
Colonies	*Cfu/l*	-
Oil in DK	*% m/m*	-

ICP screening		
Aluminum	*mg/kg*	-
Barium	*mg/kg*	-
Lead	*mg/kg*	-
Boron	*mg/kg*	-
Calcium	*mg/kg*	-
Chrome	*mg/kg*	-
Iron	*mg/kg*	-
Potassium	*mg/kg*	-
Copper	*mg/kg*	-
Magnesium	*mg/kg*	-
Manganese	*mg/kg*	-
Molybdenum	*mg/kg*	-
Sodium	*mg/kg*	-
Nickel	*mg/kg*	-
Phosphorus	*mg/kg*	-
Silver	*mg/kg*	-
Silicone	*mg/kg*	-
Titanium	*mg/kg*	-
Vanadium	*mg/kg*	-
Zink	*mg/kg*	-
Tin	*mg/kg*	-

Other measurements / comments

NACE class:B+

Non-responsive content removed

Audi
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Investigation report no. 11/0390

[redacted]

Audi

Department	Customer	Phone	Date
[redacted]	[redacted]	[redacted]	1/17/2011

Vehicle	Subject	Part number
	DK from plant...:SCK and CKD	

QTS number	Mileage / time	Cardowns	A faults	B faults	C Faults
		☐	☐	☐	☐

Field	Shop floor incident	Number of problem parts	Supplier	Material
☐	☐			

Process/ examination (details provided by the client)

→ Checking of the fuel quality

Result of checks:

- The quality of CKD and SKD production varies greatly; in many cases the fuel in SKD production is not OK
- The values for the CKD fuel is generally OK, but could be better in some points, such as lubricity (HFRR).
- The following parameters are noticeable in SKD production:
  - Very poor lubricity from 539 µm.
  - Very low viscosity at 40°C of just 1.769 mm/s2. (n orm: min. 2.0)
  - Extremely high phosphorous content of 2520 ppm.
  - The boiling curve can be used to determine the composition of the fuel. The fuel contains approx. 10% low-boiling components (start of boiling 138 °C) most probably to influence cold performance. However it is possible to discount contamination with petrol because the flash point is sufficiently high at 60 °C.
- The fuel produced in SKD production is a diesel fuel that has been intentionally mixed with kerosene to improve cold performance.
- The ICP scan shows that none of the fuels are contaminated with foreign bodies.
- The silicone content (if any) is under the notifiable limit of 0.5 mg/kg (= < 0.5 ppm).

- Individual results are contained in the Appendix.

Findings of the inspection: PETROLAB 03/2011 No.1 (CKD production) + No. 2 (SKD production)
General note: Please note that at least 2.5 liters of fuel are required for a full analysis. If the amount is insufficient, the scope of analysis must be adjusted/reduced.

Test costs	Image access no.

Persons responsible	Phone	noted	Date of completion
[redacted]	[redacted]		**3/14/2010**

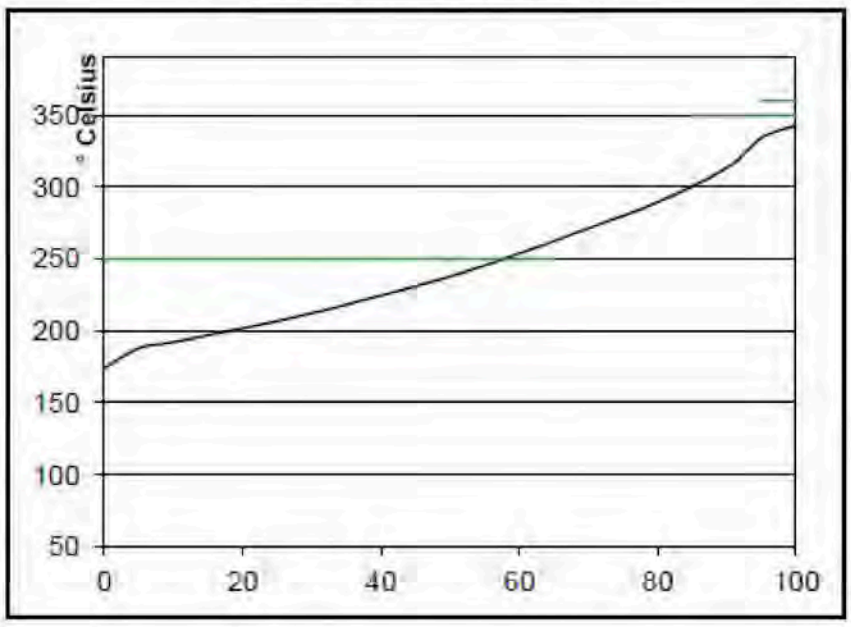
Sample name:	**03/11 No.1**
Sample for examination job:	390
PetroLab - certificate no:	PRO14953
Description / keyword	CKD - production, [redacted]

Analysis results

Color		c+b, -
Density	*kg/m³*	824.0
Distillation process		
Start of distillation	*°C*	174.2
5 % v/v rec./evap	*°C*	187.9 / 186.9
10 % v/v rec./evap	*°C*	192.2 / 191.5
20 % v/v rec./evap	*°C*	201.8 / 200.6
30 % v/v rec./evap	*°C*	212.2 / 211.2
40 % v/v rec./evap	*°C*	224.6 / 223.8
50 % v/v rec./evap	*°C*	253.8 / 236.9
60 % v/v rec./evap	*°C*	253.7 / 252.4
70 % v/v rec./evap	*°C*	271.3 / 269.6
80 % v/v rec./evap	*°C*	289.4 / 287.7
90 % v/v rec./evap	*°C*	313.3 / 310.7
95 % v/v rec./evap	*°C*	334.0 / 329.4
End of distillation	*°C*	342.8
Residue	*% v/v*	1.3
Loss	*% v/v*	0.9
vaporized@ 250 ℃	*% v/v*	58.5
vaporized@ 350 ℃	*% v/v*	-
vaporized@ 370 ℃	*% v/v*	-
Cetane number		-
Cetane index		-
Oxidation stability	*g/m³*	<0.1
Oxidation stability	*Hours*	-
Carbon residue		
Distillate residue	*% m/m*	-
based on original	*% m/m*	-
Ash content / oxide ash	*% m/m*	-
Filterability (CFPP)	*°C*	-
Cloudpoint (CP)	*°C*	-
Pour point	*°C*	-
Flash point (PenskyMartens)	*°C*	57.6
Lubricity (HFRR)	*[µm]*	344
Viscosity (40 °C)	*mm²/s*	2.011
Phosphorous content	*mg/kg*	19
Total Acid Number (TAN)	*mgKOH/g*	<0.03
PIONA - Analysis		
Paraffins	*% v/v*	-
Aromatic compounds	*% v/v*	-
Naphthene	*% v/v*	-
Olefins	*% v/v*	-
Biodiesel content (FAME)	*% v/v*	<0.1
Aromatic compound content		
Monoaromatic compounds	*% m/m*	-
Diaromatic compounds	*% m/m*	-
Tri+ - aromatic compounds	*% m/m*	-
Polyaromatic compounds (PCA)	*% m/m*	-
Total aromatic compounds	*% m/m*	-
PCAs according to DIN EN 590	*% m/m*	-
	% m/m	####
Water content	*mg/kg*	25
Calorific value		
Ho	*MJ/kg*	-
Hu	*MJ/kg*	-
Copper corrosion		-
Silver corrosion		-
Total impurities	*mg/l*	10
Number of particles	*Volume/l*	

Fatty acid distribution		
Low fatty acids - <C12	*% m/m*	- < C12
Lauric acid - C12/0	*% m/m*	- C12/0
Myristic acid - C14/0	*% m/m*	- C14/0
Palmitic acid - C16/0	*% m/m*	- C16/0
Palmitoleic acid - C16/1	*% m/m*	- C16/1
Stearic acid	*% m/m*	- C18/0
Oleic acid - C18/1	*% m/m*	- C18/1
Linoleic acid - C18/2	*% m/m*	- C18/2
Linoleic acid - C18/3	*% m/m*	- C18/3
Arachidic acid - C20/0	*% m/m*	- C20/0
Gadoleic acid - C20/1	*% m/m*	- C20/1
Higher fatty acids ->C20	*% m/m*	- > C20
Iodine value (calculated from distribution)	*g_iodine/lOOg*	#####

Distillation process according to DIN



The curve is extrapolated from 13 measurements

C/H/O ratio

C	*% m/m*	-
H	*% m/m*	-
O	*% m/m*	-

Molecular weight		
Mean	*g/mol*	-

Microbiological contamination

Bacteria	*Cfu/l*	-
Yeasts/ fungi	*Cfu/l*	-
Colonies	*Cfu/l*	-

Oil in DK	*% m/m*	-

ICP screening		
Aluminum	*mg/kg*	n. sp.
Barium	*mg/kg*	n. sp.
Lead	*mg/kg*	n. sp.
Boron	*mg/kg*	n. sp.
Calcium	*mg/kg*	n. sp.
Chrome	*mg/kg*	n. sp.
Iron	*mg/kg*	n. sp.
Potassium	*mg/kg*	n. sp.
Copper	*mg/kg*	n. sp.
Magnesium	*mg/kg*	n. sp.
Manganese	*mg/kg*	n. sp.
Molybdenum	*mg/kg*	n. sp.
Sodium	*mg/kg*	n. sp.
Nickel	*mg/kg*	n. sp.
Phosphorus	*mg/kg*	n. sp.
Silver	*mg/kg*	n. sp.
Silicone	*mg/kg*	< 0.5
Titanium	*mg/kg*	n. sp.
Vanadium	*mg/kg*	n. sp.
Zink	*mg/kg*	n. sp.
Tin	*mg/kg*	n. sp.

Other measurements / comments

NACE class:E

Non-responsive content removed

Audi
Vorsprung durch Technik

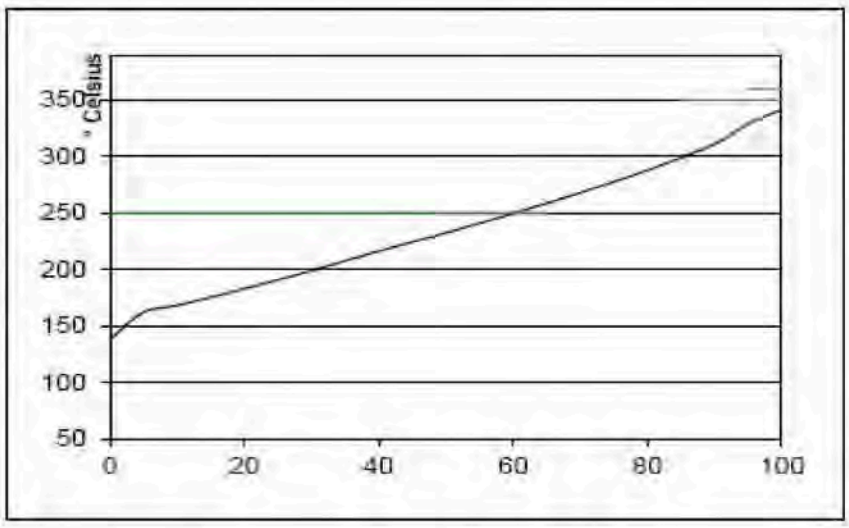
Sample name:	**03/11 No.2**
Sample for examination job:	390
PetroLab - certificate no:	PRO15004
Description / keyword	SKD - production, [redacted]

Analysis results

Color		c+b, -
Density	*kg/m³*	817.8
Distillation process		
Start of distillation	*°C*	138.1
5 % v/v rec./evap	*°C*	162.0 / 161.1
10 % v/v rec./evap	*°C*	168.1 / 167.2
20 % v/v rec./evap	*°C*	182.8 / 182.3
30 % v/v rec./evap	*°C*	198.9 / 198.3
40 % v/v rec./evap	*°C*	216.1 / 215.7
50 % v/v rec./evap	*°C*	232.3 / 231.5
60 % v/v rec./evap	*°C*	249.5 / 248.3
70 % v/v rec./evap	*°C*	267.9 / 267.0
80 % v/v rec./evap	*°C*	287.8 / 286.8
90 % v/v rec./evap	*°C*	311.0 / 309.9
95 % v/v rec./evap	*°C*	328.9 / 326.8
End of distillation	*°C*	341.5
Residue	*% v/v*	1.5
Loss	*% v/v*	0.5
vaporized@ 250 ℃	*% v/v*	60.6
vaporized@ 350 ℃	*% v/v*	-
vaporized@ 370 ℃	*% v/v*	-
Cetane number		-
Cetane index		-
Oxidation stability	*g/m³*	<0.10
Oxidation stability	*Hours*	-
Carbon residue		
Distillate residue	*% m/m*	-
based on original	*% m/m*	-
Ash content / oxide ash	*% m/m*	-
Filterability (CFPP)	*°C*	-
Cloudpoint (CP)	*°C*	-
Pour point	*°C*	-
Flash point (PenskyMartens)	*°C*	60.1
Lubricity (HFRR)	*[µm]*	539
Viscosity (40 °C)	*mm²/s*	1.769
Phosphorous content	*mg/kg*	2520
Total Acid Number (TAN)	*mgKOH/g*	<0.03
PIONA - Analysis		
Paraffins	*% v/v*	-
Aromatic compounds	*% v/v*	-
Naphthene	*% v/v*	-
Olefins	*% v/v*	-
Biodiesel content (FAME)	*% v/v*	<0.1
Aromatic compound content		
Monoaromatic compounds	*% m/m*	-
Diaromatic compounds	*% m/m*	-
Tri+ - aromatic compounds	*% m/m*	-
Polyaromatic compounds (PCA)	*% m/m*	-
Total aromatic compounds	*% m/m*	-
PCAs according to DIN EN 590	*% m/m*	####
Water content	*mg/kg*	57
Calorific value		
Ho	*MJ/kg*	-
Hu	*MJ/kg*	-
Copper corrosion		-
Silver corrosion		-
Total impurities	*mg/l*	7
Number of particles	*Volume/l*	

Fatty acid distribution		
Low fatty acids - <C12	*% m/m*	- < C12
Lauric acid - C12/0	*% m/m*	- C12/0
Myristic acid - C14/0	*% m/m*	- C14/0
Palmitic acid - C16/0	*% m/m*	- C16/0
Palmitoleic acid - C16/1	*% m/m*	- C16/1
Stearic acid	*% m/m*	- C18/0
Oleic acid - C18/1	*% m/m*	- C18/1
Linoleic acid - C18/2	*% m/m*	- C18/2
Linoleic acid - C18/3	*% m/m*	- C18/3
Arachidic acid - C20/0	*% m/m*	- C20/0
Gadoleic acid - C20/1	*% m/m*	- C20/1
Higher fatty acids ->C20	*% m/m*	- > C20
Iodine value (calculated from distribution)	*g_iodine/lOOg*	#####

Distillation process according to DIN EN 590



The curve is extrapolated from 13 measurements

C/H/O ratio

C	*% m/m*	-
H	*% m/m*	-
O	*% m/m*	-

Molecular weight

Mean	*g/mol*	-

Microbiological contamination

Bacteria	*Cfu/l*	-
Yeasts/ fungi	*Cfu/l*	-
Colonies	*Cfu/l*	-

Oil in DK	*% m/m*	-

ICP screening

Aluminum	*mg/kg*	n. sp.
Barium	*mg/kg*	n. sp.
Lead	*mg/kg*	n. sp.
Boron	*mg/kg*	n. sp.
Calcium	*mg/kg*	n. sp.
Chrome	*mg/kg*	n. sp.
Iron	*mg/kg*	n. sp.
Potassium	*mg/kg*	n. sp.
Copper	*mg/kg*	n. sp.
Magnesium	*mg/kg*	n. sp.
Manganese	*mg/kg*	n. sp.
Molybdenum	*mg/kg*	n. sp.
Sodium	*mg/kg*	n. sp.
Nickel	*mg/kg*	n. sp.
Phosphorus	*mg/kg*	n. sp.
Silver	*mg/kg*	n. sp.
Silicone	*mg/kg*	< 0.5
Titanium	*mg/kg*	n. sp.
Vanadium	*mg/kg*	n. sp.
Zink	*mg/kg*	n. sp.
Tin	*mg/kg*	n. sp.

Other measurements / comments

NACE class:B+

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EA11003EN-00057[0]

Audi
Vorsprung durch Technik

Non-responsive content removed **Managers'** Non-responsive content removed **12.04.2011**

08.04.2011, Non-responsive content removed / Non-responsive content removed

[redacted] Managers' Meeting in [redacted] 12.04.2011

Fuel quality in the VW Group Car Plants with Audi Production (R4 and V-TDI)

- Fuel quality according to TL788X and EN590 met in all locations in 2009 [redacted] changeover in engine production in 2010 to TL788X)
- The reports for 2010 are in preparation in the VW laboratory and include Martorell (will be provided later by Dr. [redacted]
- Despite requests, we have no results for [redacted] (escalation via I/GQ-2)
- VW [redacted] (SKD production): Changeover at the end of April 2011 to OK CKD fuel from [redacted] agreed
- [redacted] 2010 (2 samples)

→ Not OK according to TL788X and EN590 (but OK according to [redacted] standard)

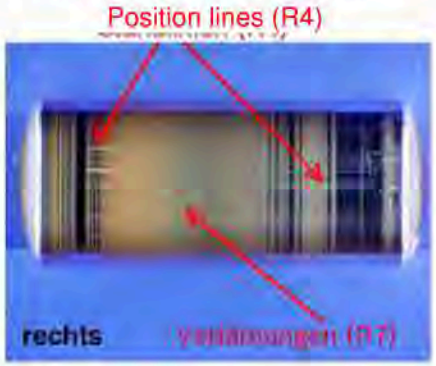
→ FAW-VW not prepared to to change to "EU-5" fuel from a [redacted] refinery.
Reason: - fundamental robustness problem with Audi engines
- No other decisive diesel projects for [redacted] after discontinuance of C6

→ New attempt: Replacement of remaining fuel in [redacted] because of possible "over-aging" before installation of C6 V6 2.7l TDI with robust CP1H HPFP via QA manager for Audi brand at FAW-VW

[redacted] Managers' Meeting **in Györ 12.04.2011**

But: Fuel quality is not everything!

Despite compliance with EN590 / TL788X, some brown deposits were detected on the cam roller and/or camshaft of high-pressure fuel pump CP4.2 in locations [redacted] ("end of the line pumps") !



Evaluation by BOSCH:

Rating 7 (red light = serious fault) indicates poor quality fuel or operation outside of TKU

Objection [redacted]:

- Running-in processes in the plants checked several times with Bosch and found to be OK
- Fuel quality confirmed as OK
- Brown deposits also occur in approx. 80% of continuous tests on current engines and vehicles (older continuously tested parts will be examined at a later point)

Cause / effect of "brown deposits" not understood by Bosch or Audi !

Will be dealt with further as part of CP 4.2 Task Force

VOLKSWAGEN

Instructions for the first fill/venting of the low-pressure fuel system for VOLKSWAGEN vehicles with 4-cylinder Common – Rail TDI engines and BOSCH CP4.1 high-pressure fuel pumps CP4.1 without mechanical pre-conveyor pump

Production process instructions

In the production process for vehicles with Common-Rail TDI engines in conjunction with a CP4.1 high-pressure fuel pump from BOSCH, it is essential to fill the low-pressure fuel system for the first time BEFORE first starting the engine at the end of the production line.

Such an initial filling process is currently in the process of being implemented. Otherwise, it is to be expected that the high-pressure fuel injection system will fail while the vehicle is still in the plant or before it reaches the customer.

Technical explanation:
The Common Rail High-Pressure Fuel Pump (CR HPFP) operates tribologically in the drivetrain space on the basis of the lubricity of the diesel fuel.. If this HPFP is operated without lubrication, irreversible damage to the HDP is to be expected. For this reason, the two electric fuel pumps (EFP) in the vehicle, one in the tank and one on the right in the front of the vehicle, must be run for at least 60 seconds before the engine is started.
An initial filling process can then be triggered with a VAS device or DIADRA notebook. These EFPs then transport the lubricating fuel through the lines and fill the HPFP. The HPFP has an overflow valve that returns excess fuel to the tank, even when the engine is not running. Thus, running the EFP for longer than the minimum requirement of 60 seconds will not harm the system as a whole.
It takes about 60 seconds to vent the whole low pressure fuel system in the vehicle and to fill it with fuel. The HPFP will be adequately lubricated immediately after the engine is started.
This significantly reduces the engine start from 45 seconds to a maximum of 4 seconds or less.

Instructions for customer service organizations (all brands)

It is also necessary to vent the fuel system after the HPFP and all components upstream of the HPFP in the low pressure fuel system have been replaced (e.g. fuel filter, fuel lines)
It is necessary to activate the EFPs for at least 60 seconds when replacing components upstream of the HPFP.
When replacing the HPFP itself, the EFPs should be activated for approx. 180 seconds (repeat the function as appropriate)

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Volkswagen AG

Non-responsive content removed

EA11003EN-00061[0]

From: Non-responsive content removed
To:
CC:
Date: 8/18/2011 11:20:00 AM
Subject: Re: KPM 5425822

Hello Mr. Non-responsive content removed

Mr Non-responsive content removed

With regard to run-in check / assembly in [redacted] I would add:
* that only longitudinally mounted engines with powertrain damage fail
* That one major different in the engine components is a stainless steel line from ...
* That there was a move of production location by the subcontractor of this supplier which could have led to the particles
* That it has never been proven that the particles were the cause of the damage and that particles were not found in spot checks.

Best regards

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From: Non-responsive content removed
Sent: Thursday, August 18, 2011 11:48 AM
To: Non-responsive content removed
Subject: RE: KPM 5425822

Hello Mr [redacted]! Do you know Mr Non-responsive content removed? In response to his request I prepared the letter below on the subject of HDP TS.
Are you in agreement or do you have a better formulation?
Regards
[redacted]

Dear Mr. [redacted]

we have no access to KPM at present, I hope that we will be able to enter the latest data by Monday latest.

In relation to HPFP drivetrain damage,one could know that we have witnessed this since the start of 2008, both in the field and 0 km vehicles with a declining tendency
In relation to the current 0 km drivetrain damage, Bosch rejects all failures with the argument that the parts have been 100% checked for function.
Although the same pump is delivered to VW plants in large numbers and no complains are known there, it was assumed that there were deviations in the highly detailed startup and ventilation process either in [redacted] in the Audi can plant.
This is why we organized joint process tests together with Bosch and Non-responsive content removed in [redacted] at the beginning of June with OK result, on 21.07. in [redacted] with the following result:
- in three observed vehicles the engine's first runtime was 10 sec (Bosch recommendation > 20 sec) for full ventilation

- one vehicle rolled off the line simply with a sticker on the windscreen; starting the engine would have also caused damage in this case and failure to fuel would not have been traceable
- one vehicle was accidentally started on the assembly line, start time not known - one vehicle was unintentionally started by connecting the wiring system power in the luggage compartment for 20 seconds

Because it is the vacation period, we will probably only be able to decide how to proceed with this information next week.

On Bosch or AHM side

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From: Non-responsive content removed
Sent: Wednesday, August 17, 2011 6:51 PM
To: Non-responsive content removed
Subject: KPM 5425822

Dear sirs,

In the context of cardown tracking, you are named as the responsible persons for this KPM point. Please check whether this has resulted in a new status or or update the system accordingly as I assume that Mr. Non-responsive content removed will want to take an up-to-date version with him to the VoSi meeting in week 34.

Thanks in advance, best wishes

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Non-responsive content removed

AUDI AG

Non-responsive content removed

EA11003EN-00061[2]

Non-responsive content removed

[redacted]

CP4.1 VW R4 2.0L 42.Project Meeting 10.17.07

Agenda

- → Turned tappet status
- → Noise
- → Test status
- → Status of customer returns

CP4.1 Turned tappet Status 10.02.2007

Measures package: (Implemented since 07.23.2007)

→ **Improving detectability in friction coefficient test, preliminary work step without assembly oil -> dry pressing of roller support**

→ **Investigating the cause of stiff rollers in the friction coefficient test**

→ **Flushing and testing program RB:**
Avoidance of speeds < 500 rpm.

→ **Component and assembly changes:**

a. **Omission of anti-friction paint coating of spring washer** (increased bonding between spring / spring plate / tappet body; **not Audi / VW)**
b. **Clearance for assembly winding angle of tappet spring**(reduced winding stress)

→ **Customer test program**

Steeply ascending speed ramps 0 -> 500 rpm

BOSCH

CP4.1 Turned tappet Status 10.02.2007

Observation of roller supports with stiff rollers

- Abnormal roller supports show coating defects, micro-particles of metal in the C coating
- Cause of the micro-particles found, corrective action on 9.10. implemented in the coating process
- Impact on turned tappet / drivetrain damage pending
- continuous running with faulty C coatings started, result calender week 42

BOSCH

CP4.1 Turned tappet Status 10.02.2007

Failure hypothesis 2

Failure hypothesis: Turned tappet > 15° even while installing the tappet assembly

Findings

- Tappet assembly mounted at a winding angle of 45° causes drivetrain damage in RB test
- Falling of the tappet body from the positioning device in connection with the turned camshaft
- Pulling out the positioned tappet body possible
- 9 pumps with turned tappet bodies were discovered in the click clack test
- .....
- Free fall of tappet body allows turned tappet
- ....

- Analysis
- Simulation
- Functional test
- Component analysis

Conclusion

Hypothesis is confirmed by a test

Further work

- Immediate measure: Dwell time introduced in the tappet body assembly from 8.28.
- Change to the assembly process to ensure durable alignment of the tappet body

CP4.1 Turned tappet Status 10.02.2007

Future measures against turned tappet

1. Optimization of the assembly process to ensure durable alignment of the tappet assembly
   → Workshop conducted with adoption of measures
   → Temporary introduction of laser sensor in the assembly line T: t.b.d.

2. Further optimization of friction coefficient test with the goal of testing friction in an extended range T: A 07.11

3. Increase in the C coating quality, avoidance of metallic micro-particles, Measures in the coating process have been implemented since 9.10.

4. Development of turned tappet protection
   Preliminary test terminated (2 x 500 h Sl, 1 x 300 h interior vibration test)
   Design optimization is in progress
   Test completion planned until T: 05.31.08

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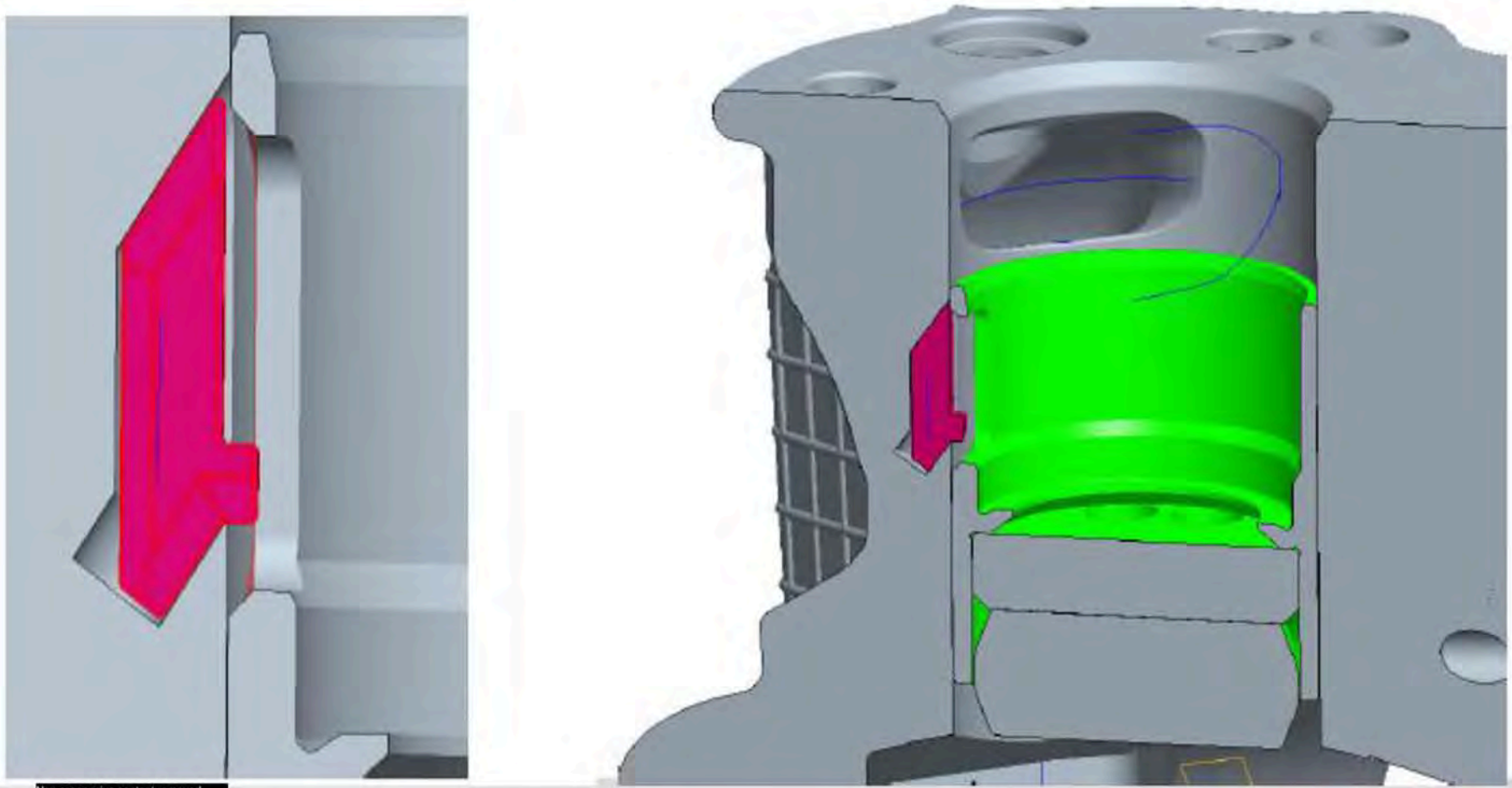
CP4, turned tappet protection status 09.17.07

Preferred solution: Version with a feather key as insert part



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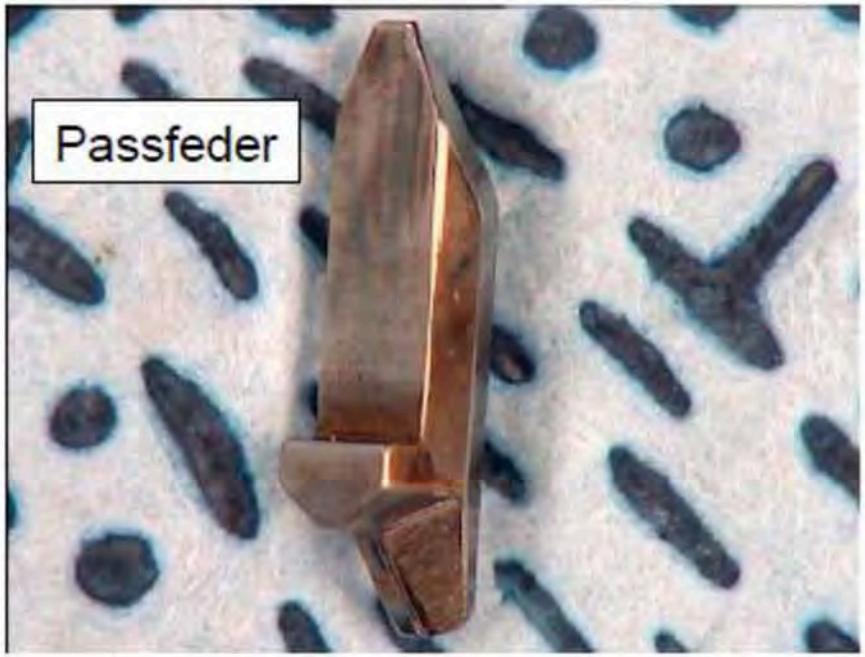
CP4, turned tappet protection status 09.17.07

- Test status:
  - 2 pumps opened after about 500 h endurance run
  - Visual findings does not show any critical anomalies. Solution has the potential for start of production.



Feather key

Tappet body

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CP4, turned tappet protection status 09.17.07

Planned design improvement measures:

- Increasing overlap length of top feather key
- Ventilation of feather key back through hydraulic connection
- Edge rounding of the feather key back
- Auxiliary joint hole on the feather key

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Noise

Pump noise at CP4.1 and CP4.2

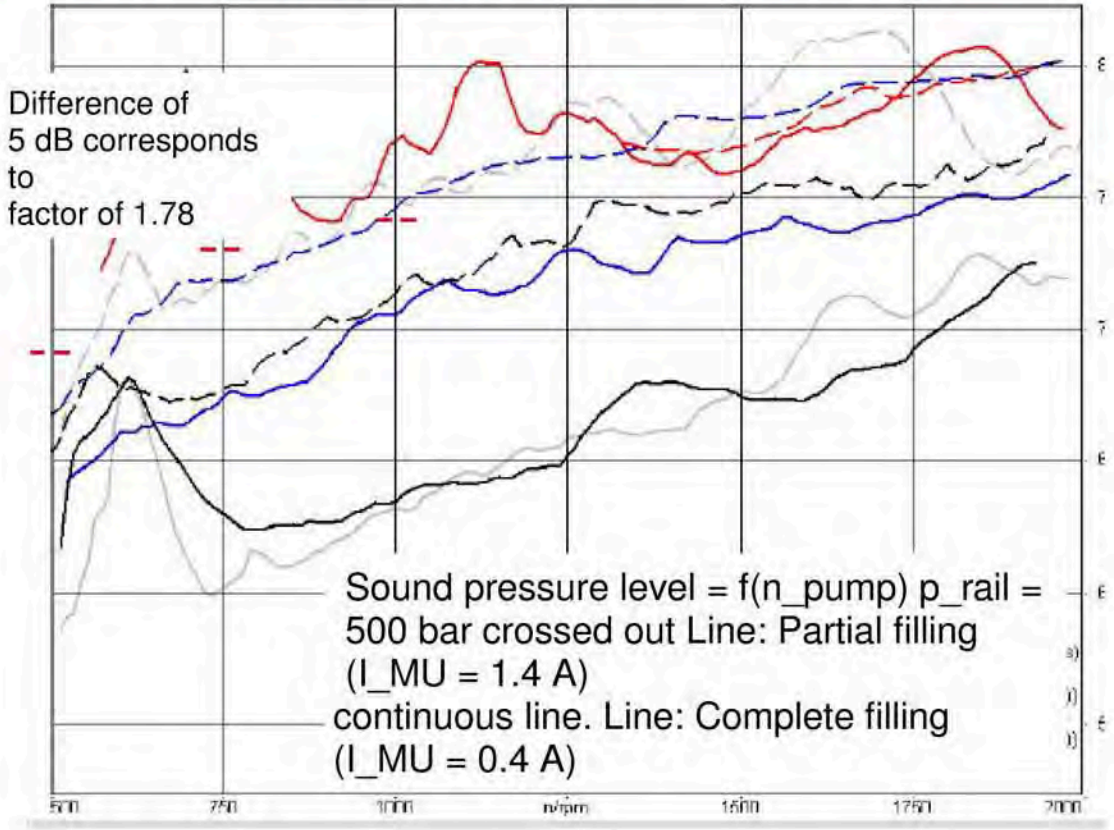
→ **Mechanism:**

- High speeds
- High impact speed of the high-pressure piston on the liquid ("water hammer" effect)
- As a result, the intake valve is closed very dynamically
- Impact of valve disk on valve seat leads to broad range of excitation and sound radiation, the higher the engine speed and the lower the filling ratio.

→ Example: Compared to CP3.2+ in partial filling, sound pressure level CP4.2 is approximately the same at same speed

CP4 pump noise

Speed dependency of pump noise CP1H, CP3.2+, CP4



[Average values of four microphone signals (distance between microphone and pump 40 cm)

- CP1H
- CP3.2+
- CP4.2
- CP4.1

CP4.1 (partial filling): only data from 500, 750, 1000 and 1300 up to 2,000 rpm available

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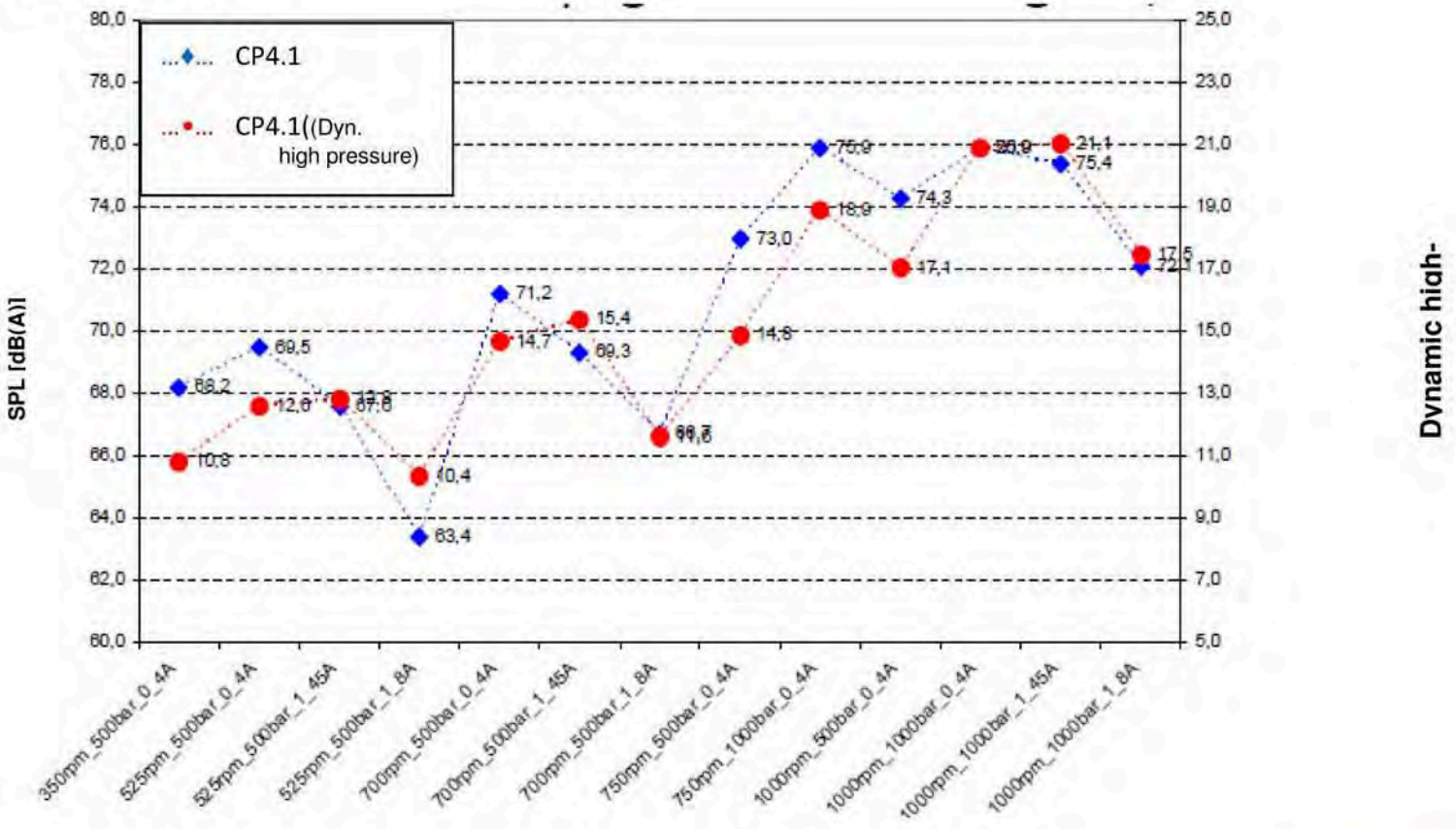
CP4 pump noise

Correlation of sound pressure level - high-pressure signal (CP4.1)



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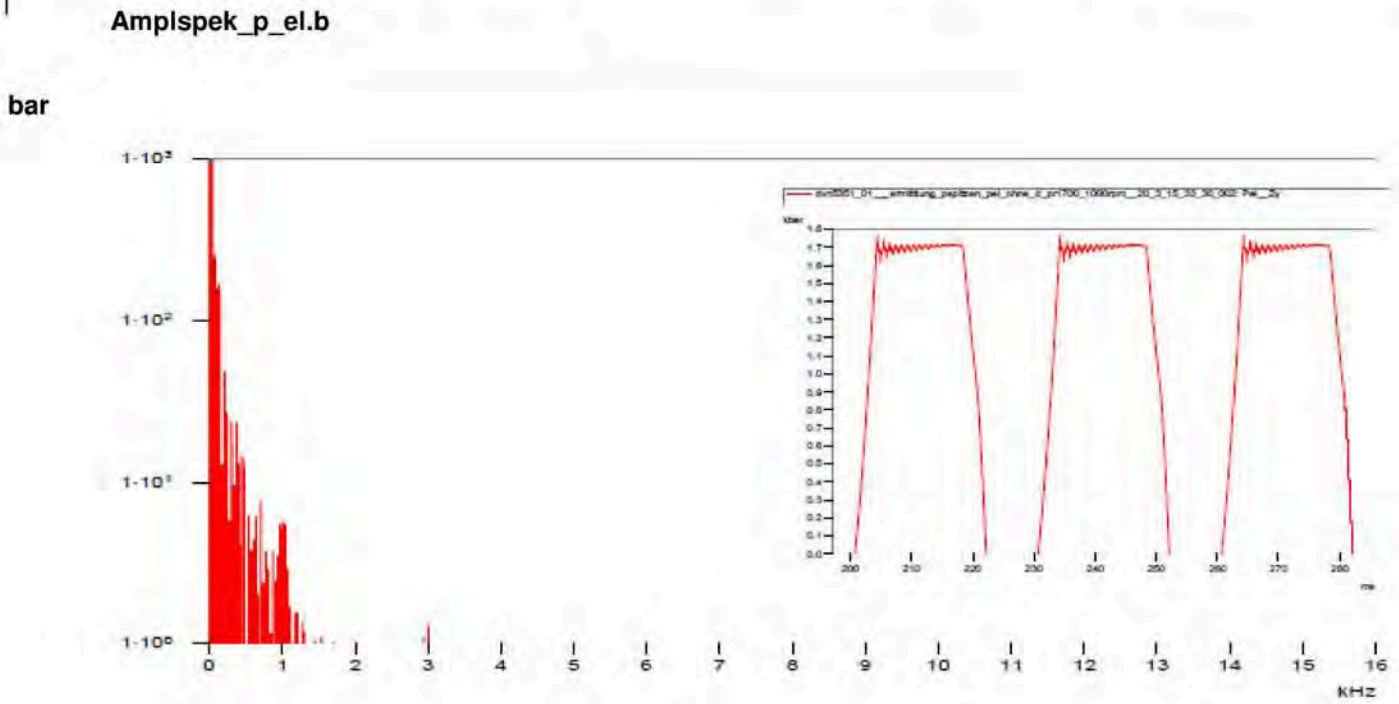
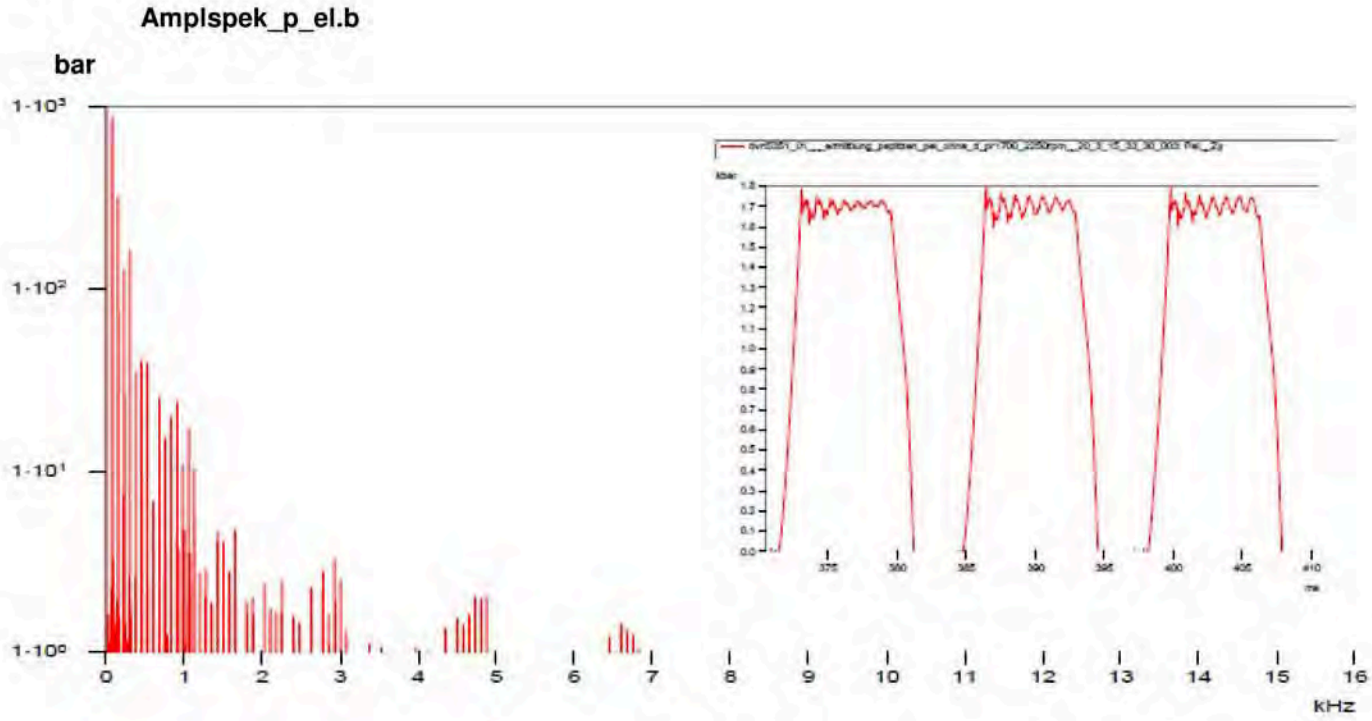
Amplitude spectrum p_el, 1,000 rpm, metering unit open



CP4 pump noise

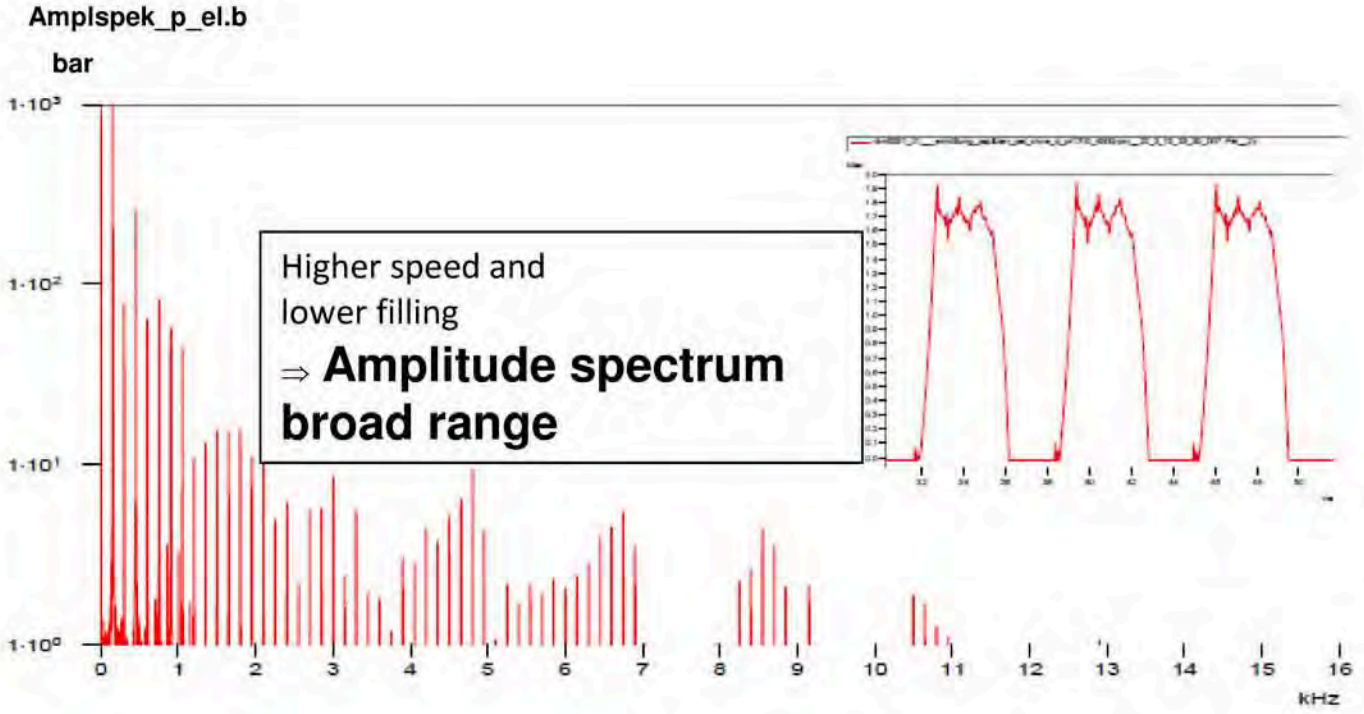
Amplitude spectrum p_el, 2,250 rpm, metering unit open



BOSCH

CP4 pump noise

Amplitude spectrum p_el, 4,500 rpm, metering unit open

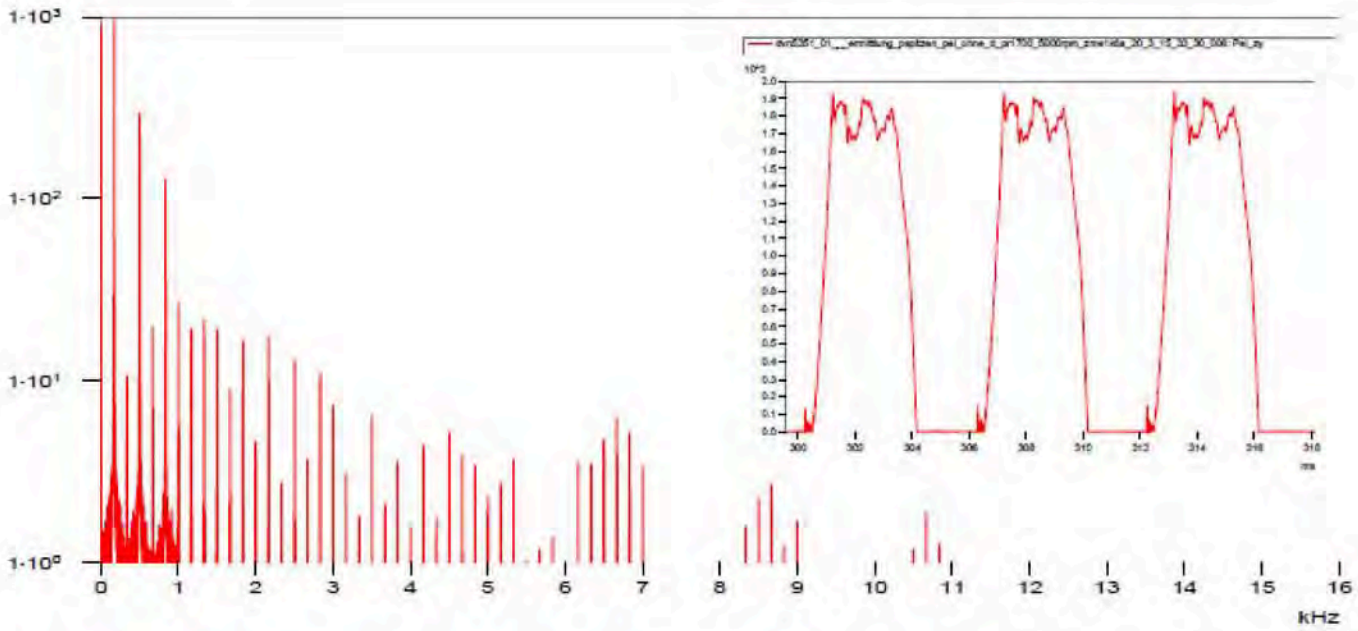


BOSCH

CP4 pump noise

Amplitude spectrum p_el, 5,000 rpm, metering unit open

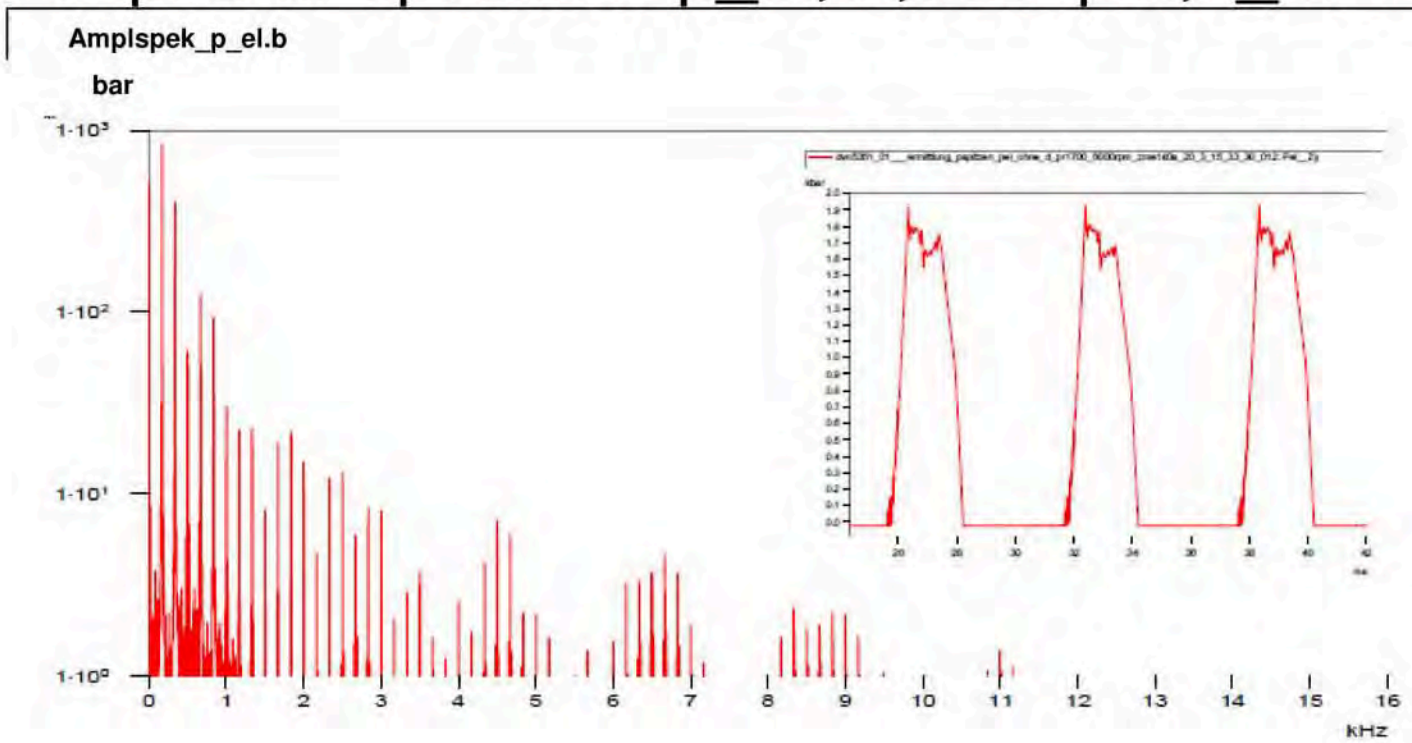
Amplspek_p_el.b



BOSCH

CP4 pump noise

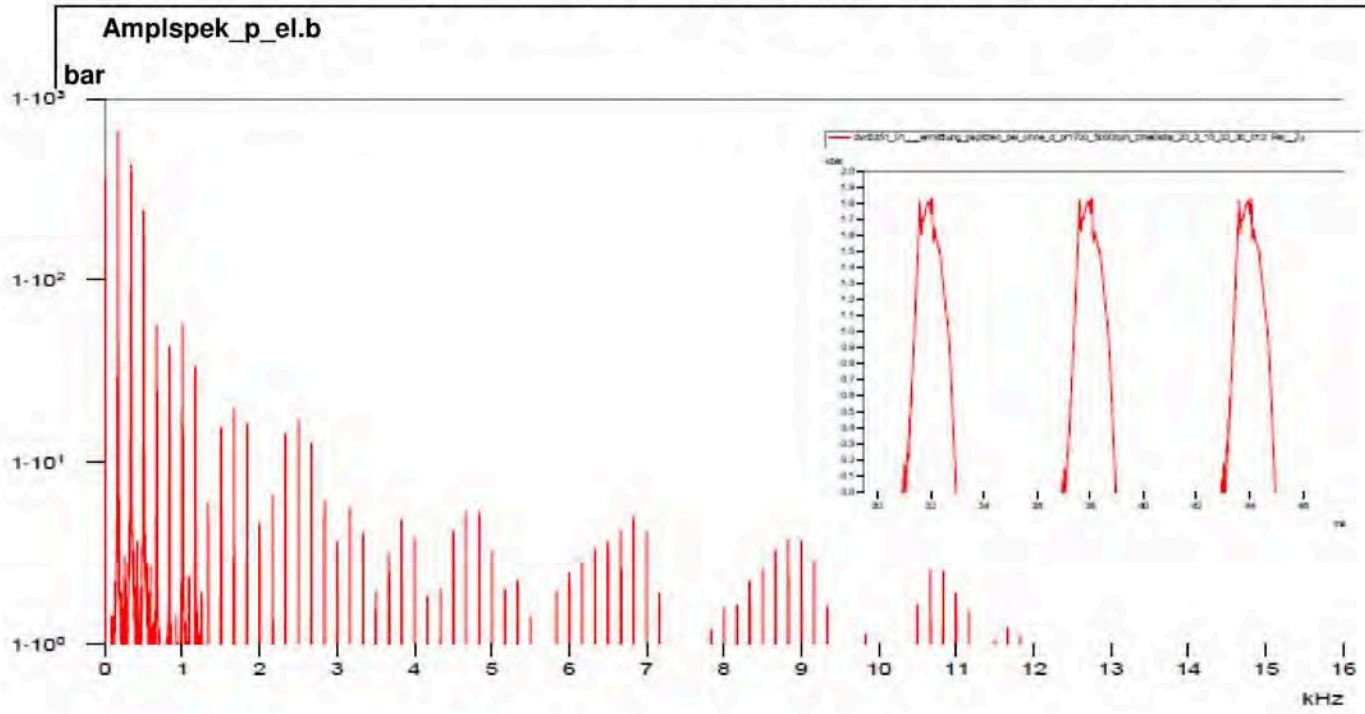
Amplitude spectrum p_el, 5,000 rpm, I_MU=1A



BOSCH

CP4 pump noise

Amplitude spectrum p_el, 5,000 rpm, I_MU=0.8A



BOSCH

CP4 pump noise

Pump noise at CP4.1 (4-cylinder HPP (1 piston)) and CP4.2 (4-cylinder HPP (2 piston))

→ **Approaches for noise reduction:**

- Reduce pump speed
- Reduce proportions with partial filling
- (Airborne) sound radiation reduced by insulation
- Close intake valve before water hammer effect sets in

CP4.1 VW R4 2.0L 42. Project meeting 10.17.07

Testing status

Vibration of pump housing

➔ **Measurement of housing surface with a laser scanning vibrometer**

- Vibration_housing_1000rpm
- Vibration_housing_700rpm

➔ **Result:**

- No distinct characteristic shape of the pump housing in the frequency range from 0 to 5 kHz recognizable
- Housing oscillates in phase with the test set-up (see reference measurement range for clamping plate)
- Additional reinforcement of the housing ineffective

Test status

Internal testing R4 2.0L

BIN5

➔ Total running time of 9,500 h reached
- 4xPDL_2000h completed (3x passed, 1x diagnosis pending)
- 3xKDL completed (2x passed, 1x repeat)

➔ Functional testing of all endurance run end pumps after endurance run is OK

➔ Cold seal-tightness OK

➔ Pumps seal-tight to the outside

➔ 4x system endurance run (current running time 1,602 h)

EU5

➔ 2x system DL EU5 completed with 2,204 h

EU5+BIN5: Vibrational acceleration at the metering unit connector, out of specification

➔ Retesting critical component CP4.1 planned before the end of 11.2007

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CP4.1 VW R4 2.0L 42. Project meeting 10.17.07

Bearing melting after 500 h constant endurance run

➔ can be reproduced only at a return flow rate = 0 l/h

➔ Hypothesis: Bearing damage probably during start-up

➔ Analysis results:

1. Installation and functional test on the CP4 serial line are normal
2. Initial measurement is normal
3. 500 hours constant continuous running at RB (4,500 rpm / 1,850 bar / GDK570 / 70 °C) ended without any anomaly
4. Final measurement (running time 500 hours) without any abnormality or significant deviation from the initial measurement
5. Cold leak test at -40 °C without complaint
6. Visual findings: Flange bearing fused

Further steps

➔ additional investigation: Step test with reduction of return flow rate by 10 l/h per day result ~~WK42.07~~
(Rescheduled due to testing bench problems WK46.07

BOSCH

CP4.1 testing status

EU5

➔ Basic validation		
Testing scope of CP4.1 with CP3 Bruss WDR reached		
pending: Diagnosis of customer returns		11.07
➔ Reliability validation		
Testing scope of CP4.1 with CP3 Bruss WDR reached		
pending: 2x 100 tkm with cold pack	expected	01.08
Diagnosis of returns		02.08

BIN5

➔ Basic validation:		
Testing scope of CP4.1 with CP3 Bruss WDR reached		
pending: Diagnosis of customer returns		11.07
➔ Reliability validation		
Expected end of running time		03.08
Diagnosis of returns		04.08

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BOSCH

CP4.1 VW R4 2.0L 42. Project meeting 10.17.07

VW testing EU5 (basic VW information as of 09.18.07)

Basic validation (2x75 tkm, 1x 100 tkm, 2x Σ 100 tkm) ➔ with Bruss CP3 design		**Running time met**
• 102,372 km • 98,230 km • 95,000 km • 77,264 km • 64,864 km		met in conjunction with **BIN5 project**
Reliability validation (4x75 tkm, 2x 100 tkm, 4xΣ 200 tkm)		**Running time met**
➔ with Kaco • 12 vehiclesε100,000 km ➔ with Bruss CP3 design		
• 59,920 km • 57,894 km • 41,653 km • 41,148 km • 34,764 km	101,023 km (BIN5) 111,626 km (BIN5) 94,119 km (BIN5) 81,821 km (BIN5) 77,909 km (BIN5)	met in conjunction with BIN5 project

BOSCH

CP4.1 VW R4 2.0L 42. Project meeting 10.17.07

VW testing BIN5 (basic VW information as of 09.18.07)

B1) Basic validation (2x75 tkm, 1x 100 tkm, 2x © 100 tkm) **Running time met**

➔ with Bruss CP3 design

• 101,023 km	71,167 km	18,229 km
• 111,626 km	50,194 km	
• 94,119 km	45,260 km	
• 81,821 km	22,249 km	
• 77,909 km	20,839 km	

B2) Basic validation (2x75 tkm, 1x 100 tkm, 2x © 100 tkm)

➔ with cold pack (serial state)

• 40,423 km	12,156 km
• 37,839 km	5,066 km
• 35,853 km	4,337 km
• 30,986 km	3,997 km
• 20,597 km	

Z) Reliability validation (8x75 tkm, 4x 100 tkm, 8x © 200 tkm)

➔ Z1) with Kaco

- 5 vehicles ε 100,000 km

➔ Z2) is part of reliability validation 2x 100 tkm with cold pack

- Expected end of running time (B1 + B2 + Z2)
- Completion of diagnosis

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CP4.1 VW R4 2.0L 42. Project meeting 10.17.07

Testing of cold pack (Bruss oil seal, metering unit O-rings)

	Target	As-is	Running time status: 9/26/2007	Deadline
Internal full load test	4x 500 h	4x 500 h	100 %	05.07
Internal program test	12x 2000 h	12x	92 %	10.07
Internal overload test	2	2	100 %	05.07
VW engine testing full load + program			Σ US: 5,306 h	08.07
VW vehicle testing		12x	ΣUS: 700,513 km (max 111,626 km)	08.07
Internal test	4x 2000 h	4x	81 %	11.07
Endurance run system	4x 2000 h	4x	1602 H	12.07
VW basic testing of engine full load*	1x 800 h	1x	US: h	11.07
VW basic testing of engine program*	1x 800 h	1x (4x)	503 h (ΣUS 894 h)	10.07
VW vehicle testing*	2x 100 tkm	2x (10x)	78,262 km (©US: 192,409 km)	11.07

CP3 design
CP4 design + metering unit cold pack

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Status of customer returns

Status of customer returns 10.16.2007

- ➔ 74 pumps received or announced since 07/2006
- ➔ Receipt 07/2006 to 05/2007: © 17 pumps (slide 2)
  - Diagnoses completed.
  - 5x drivetrain failures, 2 anti-friction paint of faulty spring plates, 1x loose protective cap
  - 9x no critical wear points. Continuous running passed
- ➔ Receipt 05/2007: © 17 pumps (slide 3)
  - 15 diagnoses completed. 2 pending D: Calendar week 43
  - 15x no critical wear points. Continuous running passed
- ➔ Receipt 07/2007: © 15 pumps
- ➔ Announced pumps in 09/2007 and 10/2007: © 24 pumps (slide 4 to 6)
  - Diagnosis pending. Pumps were prioritized according to running time and test type
  - Priority A up to calendar week 51/2007 (11 pumps)
  - Priority B up to 03/2008 (16 pumps)
  - Priority C up to 04/2008 (12 pumps)
- ➔ Receipt 10.12.2007: Complaint with one pump (slide 7)
  - Drivetrain damage. Water in fuel. D: Calendar week 47/2007

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CP4.1 VW R4 2.0L 42. Project meeting 10.17.07

Status of customer returns received between 07/2006 and 05/2007

Customer returns no.	PNR	DoM Specification on type plate	Serial no.	Fuel (according to project definition)	ASMUS / SAMOS	Endurance run type	Mileage	Unit of mileage [h or km]	complained (Yes / No)	recognized (Yes / No)	Testing conditions	Faults and breaking points	Date of receipt EDI [MM.DD.YY]	Completion date EDI1 [MM.DD.YY]	PRIORITY (A / B / C / warehouse)
95	0445B21058_02	685	130	EN590	127009.067 9828.001	Engine test	0	h	Yes	No	quasi 0 km failure, leaking shortly after start of engine test, possibly back pressure at Audi too high	:No defect verifiable	7/17/2006	8/8/2006	
118	0445B21058_06	8/15/2006	0018	EN590	731099.054 4295.001	Engine test	0	h	Yes	No	Engine 03LB/17495	:A: Roller: stationary roller	10/11/2006	1/19/2007	
135	0445B21058_06	8/15/2006	0017	EN590	731099.054 4290.001	Endurance run-engine	0	h	Yes	No	Endurance run engine start-up	:A: Roller: stationary roller	10/11/2006	1/19/2007	
136	0445B21058_06	685	4007	EN590	-	Endurance run-engine	470	h	Yes	Yes	Engine 03LD/16702, 470 h thereof 395 h PZD	S: Tappet spring plate: Anti-friction paint peeled off			
137	0445B21058_06	686	4875	EN590	-	Endurance run-engine	321	h	Yes	Yes	Engine 03LB/16794, 321 h thereof 246 h PZD	S: Tappet spring plate: Anti-friction paint peeled off			
141	0445B21058_06	690	4255	EN590	731099.054 5714.001	Engine test	0.5	h	Yes	No	Start-up of power test bench	:A: Roller: stationary roller	10/20/2006	1/19/2007	
142	0445B21058_06	690	4067	EN590	-	Engine test	0.03	h	Yes	No	Start-up of power test bench	:A: Roller: stationary roller			
143	0445B21058_06	689	4824	EN590	731099.054 5714.002	Engine test	5	h	No		Start-up of power test bench	:No defect verifiable	10/19/2006	1/11/2007	
144	0445B21058_06	689	4827	EN590	731099.054 5714.003	Engine test	5	h	No		Start-up of power test bench	:No defect verifiable	10/19/2006	1/11/2007	
171	0445B21058_02	685	4869	EN590	0552811	Engine test	9.4	h	Yes	No	Hydraulic testing station: Stationary points and AD ramps in standard tests at 40 °C.	:No defect verifiable	12/15/2006	2/13/2007	
177	0445B21060_10	690	4656	US	0550562	Endurance run-engine	15	h	Yes	No	Hot test	S: loose protective cap	1/8/2007	4/17/2007	
204	0445B21057_07	11/24/2006	dummy # 1	EN590	0554243	Engine test			Yes	No	Corrosion test, salt spray test	:No defect verifiable	2/20/2007	4/19/2007	
222	0445B21058_07	11/24/2006	dummy # 2	EN590	0555146	Engine test			Yes	No	Corrosion test, salt spray test	:No defect verifiable	2/28/2007	4/19/2007	
255	0445B21058_06	689	4896	EN590	0558495	Endurance run-engine	910	h	No		ÖVL + PZD + ÖVL	:No defect verifiable	03.27.07	09.12.07	
256	0445B21058_06	689	4922	EN590	0558493	Endurance run-engine	767	h	No		IFL	:No defect verifiable	3/27/2007	9/12/2007	
257	0445B21058_07	690	4989	EN590	0558490	Endurance run-engine	428	h	No		EWL (Ehra Exchange Rate of Heavy Vehicles)	:No defect verifiable	3/27/2007	9/10/2007	

(*) A = failure
S = weak point

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CP4.1 VW R4 2.0L 42. Project meeting 10.17.07

Status of customer returns received between 07/2006 and 05/2007

Customer returns no.	PNR	DoM Specification on type plate	Serial no.	Fuel (according to project definition)	ASMUS / SAMOS	Endurance run type	Mileage	Unit of mileage [h or km]	complained (Yes / No)	recognized (Yes / No)	Testing conditions	Faults and breaking points	Date of receipt EDI [MM.DD.YY]	Completion date EDI1 [MM.DD.YY]
266	0445B21058_06	8/15/2006	0019	EN590	731223.056 0380.001	Endurance run-engine	38549	km	Yes	Yes	EWP (Ehra variable track for passenger cars) on test bench (gear) customer PNR: 03L 130755	A: Roller support: C coating wear	4/26/2007	6/29/2007
286	0445B21058_07	690	4356	EN590	0560384	Endurance run-engine	442	h	No		ÖVL-Endurance run1-ÖVL, on engine 03LB/17787	:No defect verifiable	5/7/2007	8/10/2007
287	0445B21060_10	690	4661	US	0560387	Endurance run-engine	453	h	No		ÖVL-DL1; on 03LD/17482	:No defect verifiable	5/7/2007	7/11/2007
288	0455b21058_07	690	4726	EN590	0560391	Endurance run vehicle	47200	km	No		GDV-EWP; on 03LA/17764	:No defect verifiable	5/7/2007	9/19/2007
289	0455b21058_06	689	4159	EN590	05690396	Endurance run-engine	508	h	No		ÖVL-Endurance run1; on 03LB/17482	:No defect verifiable	5/7/2007	In circulation 10/11/2007
290	0445B21058_02	685	00044	EN590	0560399	Engine test	605	h	No		KRT	:No defect verifiable	5/7/2007	6/6/2007
291	0445b21058_07	691	4886	En590	0560408	Endurance run-engine	645	h	No		ÖVL PZD (80% full load)	:No defect verifiable	5/7/2007	8/10/2007
292	0445b21058_07	691	4001	En590	0560410	Endurance run-engine	648	h	No		ÖVL-Endurance run2 ÖVL	:No defect verifiable	5/7/2007	7/11/2007
293	0445B21058_02	686	00115	EN590	0560414	Endurance run vehicle	69580	km	No		GDV-EWP 03LA/16538	:No defect verifiable	5/7/2007	9/19/2007
294	0445B21058_07	690	4519	EN590	0560417	Endurance run vehicle	78000	km	No		GDV-EWP 03LA/17338	:No defect verifiable	5/7/2007	9/19/2007
295	0445B21058_05	8/15/2006	0010	EN590	0560413	Engine test	685	h	No		TTHS with US fuel on 03LD/16933	:No defect verifiable	5/7/2007	9/19/2007
296	0445B21060_05	689	4945	US	0560407	Engine test	615	h	No		KRT; on 03LD/17269	:No defect verifiable	5/7/2007	8/13/2007
297	0445B21058_01	684	4551	EN590	0560420	Engine test	200	h	No		ATL tuning	:No defect verifiable	5/7/2007	7/11/2007
299	0445B21058_02	685	0131	EN590	731223.056 0379.001	Endurance run-engine	300	h	No		Endurance run1 (full load endurance run)	:No defect verifiable	5/7/2007	8/10/2007
303	0445B21058_05	150806	0009	US	0565041	Endurance run-engine	890	h	No		ÖVL+PZD ; on 03LD/17259	:No defect verifiable	5/15/2007	8/10/2007
304	0445B21060_02	689	4997	EN590	0565037	Endurance run-engine	860	h	No		ÖVL + PZD; companies with US fuel, no AWP on 03LD/17468	:No defect verifiable	5/15/2007	In circulation 10/16/2007
305	0445B21060_02	685	4811	US	0565038	Endurance run-engine	174	h	No		ÖVL+PZD ; 03LD/16702	:pump was supplied with squashed return connector	5/15/2007	8/10/2007
306	0445B21058_07	690	4502	US	0565040	Endurance run-engine	843	h	No		ÖVL+IFL ; 03LB/17782	:No defect verifiable	5/15/2007	8/10/2007

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CP4.1 VW R4 2.0L 42. Project meeting 10.17.07

Status of customer returns received between 07/2006 and 05/2007

Customer returns no.	PNR	DoM Specification on type plate	Serial no.	Fuel (according to project definition)	ASMUS / SAMOS	Endurance run type	Mileage	Unit of mileage [h or km]	complained (Yes / No)	recognized (Yes / No)	Testing conditions	Faults and breaking points	Date of receipt EDI [MM.DD.YY]	Completion date EDI1 [MM.DD.YY]	PRIORITY (A / B / C / warehouse)
360	0445B21060_10	690	4422	US	0568938	Endurance run-engine	995	h	No		ÖVL+NDVL; 03LD/17486		7/18/2007	Wk48	A
362	0445B21058_02	686	4011	EN590	0568935	Endurance run-engine	60000	km	No		EWP; 03LA16512; ran with Audi Injectors		7/18/2007	Wk48	A
363	0445B21058_07	690	4381	EN590	0568934	Engine test	54476	km	No		Function; 03LA/17776		7/18/2007	Calendar week 49	A
370	0445B21058	201206	0060	EN590	0568688	Endurance run-engine	974	h	No		ÖVL+PZD+ÖVL ; 3LAP 270 101 ; Bruss oil seal		7/18/2007	Calendar week 49	A
439	0445b21058	?	0045	EN590	?		80000	km	No		Q-DL; CAG 0000 067; AU 481-8-8008			Calendar week 49	A
442	0445B21058	?	0073	EN590	?		98221	km	No		GDV-EWP; 3LAP270056			Calendar week 49	A
457	0445B21058_05	?	4926	EN590	?		100000	km	No		EWP; 03LA/17115			Calendar week 50	A
458	0445B21058	?	0034	EN590	?		78049	km	No		?????; AU 481-8-1110			Calendar week 50	A
460	0445B21060_05	?	4909	US??	?		100000	km	No		Endurance run corrosion; 03LD/17266			Calendar week 50	A
461	0445B21058_06	?	4888	EN590	?		120000	km	No		Q-verification; 03LA/17301			Calendar week 51	A
464	0445B21060_10	?	4653	US??	?		118388	km	No		GDV-EWP; 03LD/17477			Calendar week 51	A

Red input: unclear
Priority A: Comprehensive diagnosis
Priority B: Shorter program (only functional test, image documentation and visual findings)
Priority C: Minimal program (functional test, image documentation, short findings without visual findings)

CP4.1 VW R4 2.0L 42. Project meeting 10.17.07

Status of customer returns received between 07/2006 and 05/2007

Customer returns no.	PNR	DoM Specification on type plate	Serial no.	Fuel (according to project definition)	ASMUS / SAMOS	Endurance run type	Mileage	Unit of mileage [h or km]	complained (Yes / No)	recognized (Yes / No)	Testing conditions	Faults and breaking points	Date of receipt EDI [MM.DD.YY]	Completion date EDI1 [MM.DD.YY]	PRIORITY (A / B / C / warehouse)
359	0445B21058	201206	0087	EN590	0568693	Endurance run-engine	750	h	No		PZD; 3LAP 270 093		7/18/2007	2/1/2008	B
361	0445B21060_05	689	4053	EN590	0568937	Engine test	1058	h	No		EGR application 03LD/17254		7/18/2007	2/1/2008	B
364	0445B21058	071206	0018	EN590	0568933	Endurance run vehicle	42898	km	No		EWP-GDV; CAG 0000047		7/18/2007	2/1/2008	B
367	0445B21060_06	689	4140	US	0568695	Endurance run vehicle	39700	km	No		WL1; 03LD/17087		7/18/2007	2/1/2008	B
368	0445B21060_06	689	4236	EN590	0568694	Endurance run-engine	26036	km	No		EWP; 03LD/17470		7/18/2007	2/1/2008	B
371	0445B21058_06	150806	0020	EN590	0568687	Endurance run-engine	800	h	No		ÖVL+PZD+ÖVL; 03LB/17345		7/18/2007	2/1/2008	B
372	0445B21058_07	690	4705	EN590	0568692	Endurance run-engine	600	h	No		IFL; 03LA/17772		7/18/2007	2/1/2008	B
373	0445b21060_06	689	4146	US	0568940	Endurance run vehicle	24001	km	No		WL1; 03LD/16927		7/18/2007	2/1/2008	B
441	0445B21060	?	0184	US??	?		863	h	No		70h ÖVL+793h PZD; CBE 0000 059			2/1/2008	B
444	0445B21058	?	0035	EN590	?		52008	km	No		GDV; CBA 0000 303			3/1/2008	B
447	0445B21058	?	4747	EN590	?		2056	h	No		Function; 03LD/16369			3/1/2008	B
448	0445B21058	?	0125	EN590	?		1064	h	No		70 h ÖVL + 493 h PZD + 501 h Reso (?)			3/1/2008	B
455	0445B21058	?	0061	EN590	?		755	h	No		?????; 3LAP270102			3/1/2008	B
456	0445B21058	?	0133	EN590	?		223	h	No		ÖVL+DL1; engine no.???			3/1/2008	B
462	0445B21058_02	?	4742	EN590	?		70440	km	No		?????			3/1/2008	B
465	0445B21058_01	?	4555	EN590	?		495	h	No		ÖVL+DL1; engine no.???			3/1/2008	B

Red input: unclear
Priority A: Comprehensive diagnosis
Priority B: Shorter program (only functional test, image documentation and visual findings)
Priority C: Minimal program (functional test, image documentation, short findings without visual findings)

CP4.1 VW R4 2.0L 42. Project meeting 10.17.07

Status of customer returns received between 07/2006 and 05/2007

Customer returns no.	PNR	DoM (Specification on type plate)	Serial no.	Fuel (according to project definition)	ASMUS / SAMOS	Endurance run type	Mileage	Unit of mileage [h or km]	complained (Yes / No)	recognized (Yes / No)	Testing conditions	Faults and breaking points	Date of receipt EDI [MM.DD.YY]	Completion date EDI1 [MM.DD.YY]	PRIORITY (A / B / C / warehouse)
365	0445B21058	071206	0011	EN590	0568932	Engine test	826	h	No		Function; CAG 0000050		7/18/2007	3/1/2008	C
366	0445B21060_05	689	4886	EN590	0568698	Engine test	1092	h	No		Function; 03LD/17085		7/18/2007	3/1/2008	C
369	0445B21058_01	683	4396	EN590	0568684	Engine test	1690	h	No		Cold EGR + POI3; 03LD/16353		7/18/2007	3/1/2008	C
438	0445B21058_06	?	0016	EN590	?		32000	km	No		Function			3/1/2008	C
440	0445B21058_06	?	4890	EN590	?		19940	km	No		?????; 03LA/17098 VW 462-7-0224			3/1/2008	C
443	0445B21058	?	0082	EN590	?		420	h	No		Reso run (?) 0000 081 CAG			4/1/2008	C
449	0445B21058	?	0080	EN590	?		209	h	No		Reso run (?) 0000 082 CAG			4/1/2008	C
451	0445B21058	?	0055	EN590	?		163	h	No		Reso run (?) 0000 075 CAG			4/1/2008	C
452	0445B21058	?	0015	EN590	?		299	h	No		?????; 3LAP270110			4/1/2008	C
453	0445B21060	?	0224	US??	?		321	h	No		ÖVL+TTHS; CBE 0000 077			4/1/2008	C
454	0445B21058	?	0028	EN590	?		340	h	No		ÖVL+PZD; 3LAP270109			4/1/2008	C
459	0445B21058	?	0029	EN590	?		424	h	No		FCT; 3LAP270095			4/1/2008	C

Red input: unclear
Priority A: Comprehensive diagnosis
Priority B: Shorter program (only functional test, image documentation and visual findings)
Priority C: Minimal program (functional test, image documentation, short findings without visual findings)

BOSCH

Pump complaint

- → Pump no.: 081206 0049
- → TT no.: 0045 B21 058
- → DS-PC/EDI receipt: 10/12/2007
- → VW complaint: Chips in the high-pressure pump
- → Testing conditions are not known yet

- → First results
  - Drivetrain damage with a 90° turned roller
  - Corrosion on running surface
  - Free water in the pump!

EA11003EN-00111[0]

From: Non-responsive content removed
To:
CC:

Date: February 16, 2009, 16:54:30
Subject: CP4 prefilling / first start on the line in [redacted]
Attachments: Vorbefüllung Erststart [redacted].msg

Hi all,

Here are the minutes; see To... for participants

The assembly lines for B8 (Audi A4, A5, etc.) and C6 (Audi A6) were assessed.

In accordance with the distributed production layout (see attachment), the following prefilling times have been met and measured in [redacted] unfortunately, storage of the actual start times is not possible due to a lack of measurement equipment on the line section, in contrast to [redacted] see attachment for the measured start times.

EA11003EN-00111[1]

The following items will be clarified:
* How long does it take from the "EFP_ON" event until fuel arrives at the CP4; measured on the actual V6-TDI closed fuel system => Non-responsive content removed
* Bosch requires 60 sec. prefilling from the "Fuel to CP4_Input" event (addendum: according to Mr. Non-responsive content removed new requirement) => Non-responsive content removed
* Derived from this, the minimum required prefilling time should be calculated for each vehicle type (caution: a certain buffer must be included) => Non-responsive content removed Non-responsive content removed
* from around the end of CW03/09, the start times for R4-C4 were roughly halved in Non-responsive content removed average value approx. 6-7 sec. (previously 12-14 sec.) => see next item!
* for CP4.1 for R4-CR, Bosch initiated a reduction of the opening pressure of the HD non-return valve in the 4th quarter 08, which enables the vehicle EFP to open the intake and non-return valves safely independently of the actual tolerance position => Non-responsive content removed will clarify when that began and pumps were delivered to Audi [redacted]; then Non-responsive content removed will please determine the delivery time / engine numbers of the engines for IN (A3 and A4), Non-responsive content removed
* Someone will check whether the quantity balance of the W36 allows a reduction of the opening pressure of the high-pressure non-return valve (the W37 surely does not) => Non-responsive content removed
* All the participants believe that the processes in [redacted] are not the cause for the current drivetrain damage in [redacted]; all possible influences should be researched for subsequent clarification => Non-responsive content removed will request the relevant data and parameters from a list of occurred breakdowns from the appropriate instances (tank content, subsequent work, entries in the vehicle inspection card, first start time, opening pressure of input valve and non-return valve, subsequent work and special features of [redacted] manufacturing).
* [redacted] development will create an updated prefilling and run-in regulation for all engines at Audi from the R4-CR to the V12-TDI, which will subsequently be declared as a binding PDM sheet for the vehicle plants => Non-responsive content removed
* Since February 2, 2009, 02.02.09 the V6-TDI engines in [redacted] are blown off with 4 bar overpressure for 7 sec. via inlet and simultaneously exhausted on the return hose with -0.5 bar 15 sec. (exhaust >> blow); starting February 5, 2009, the pressure control valve on the rail is closed => Non-responsive content removed will find out how the air is filtered; Non-responsive content removed is asked to confirm the permissibility of this measure.

P.S.: The next line inspection date will be CW 10 in [redacted] (Wednesday or Friday morning).

>With best wishes
>

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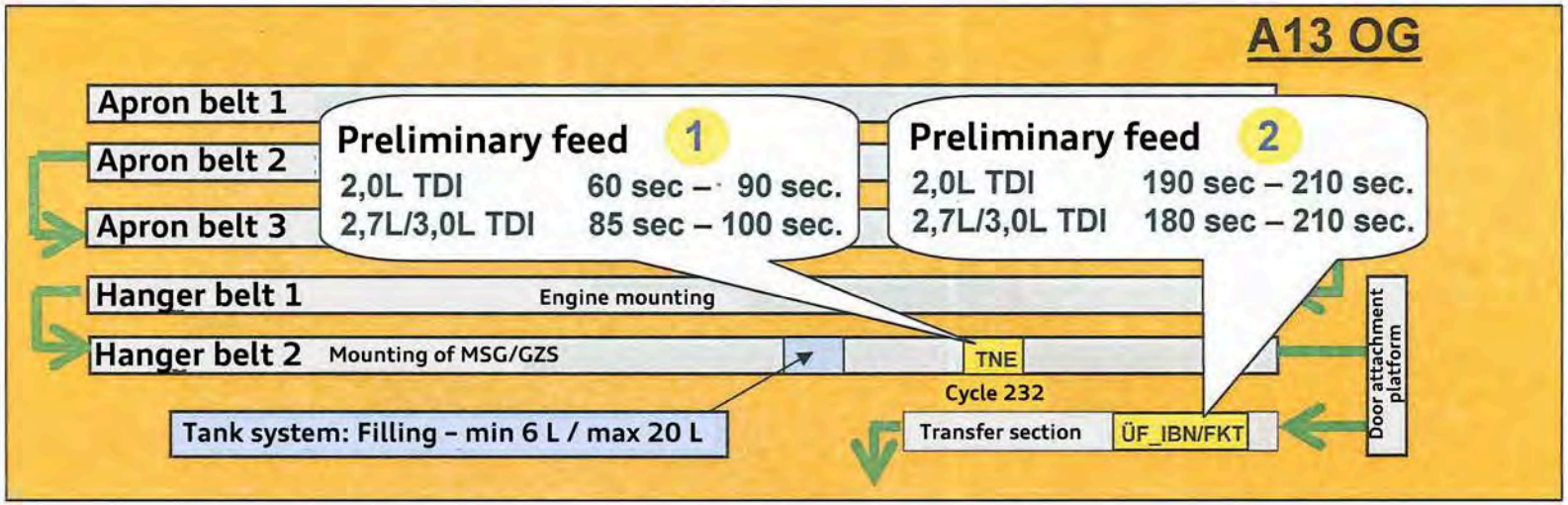
AUDI AG

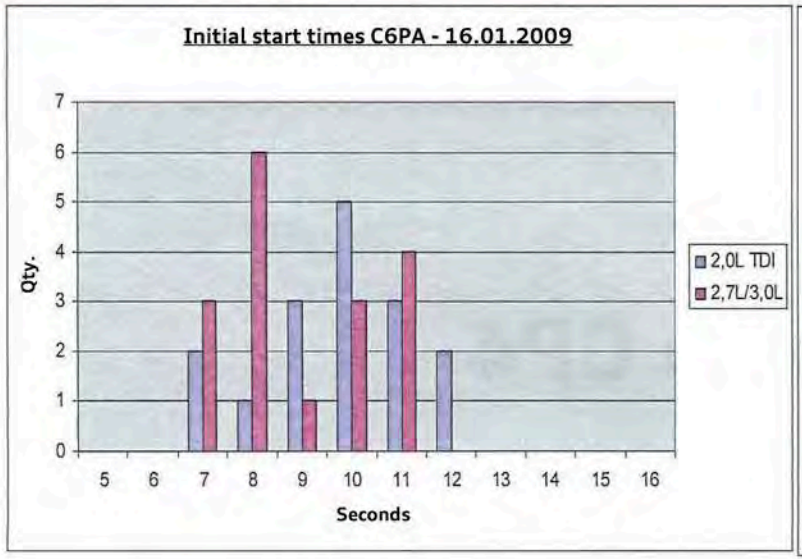
Non-responsive content removed

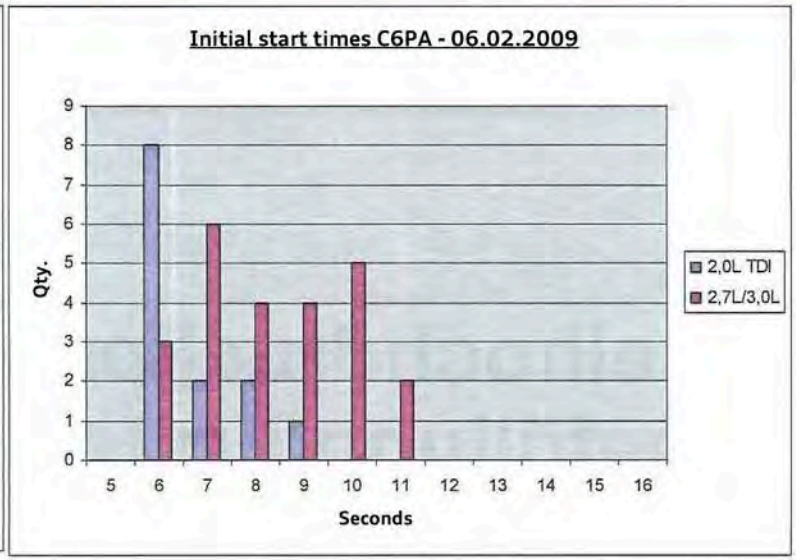
High-pressure diesel pump CP4
Preliminary filling/Initial start

High-pressure diesel pump CP4 Preliminary filling/Initial start

Production line: C6PA





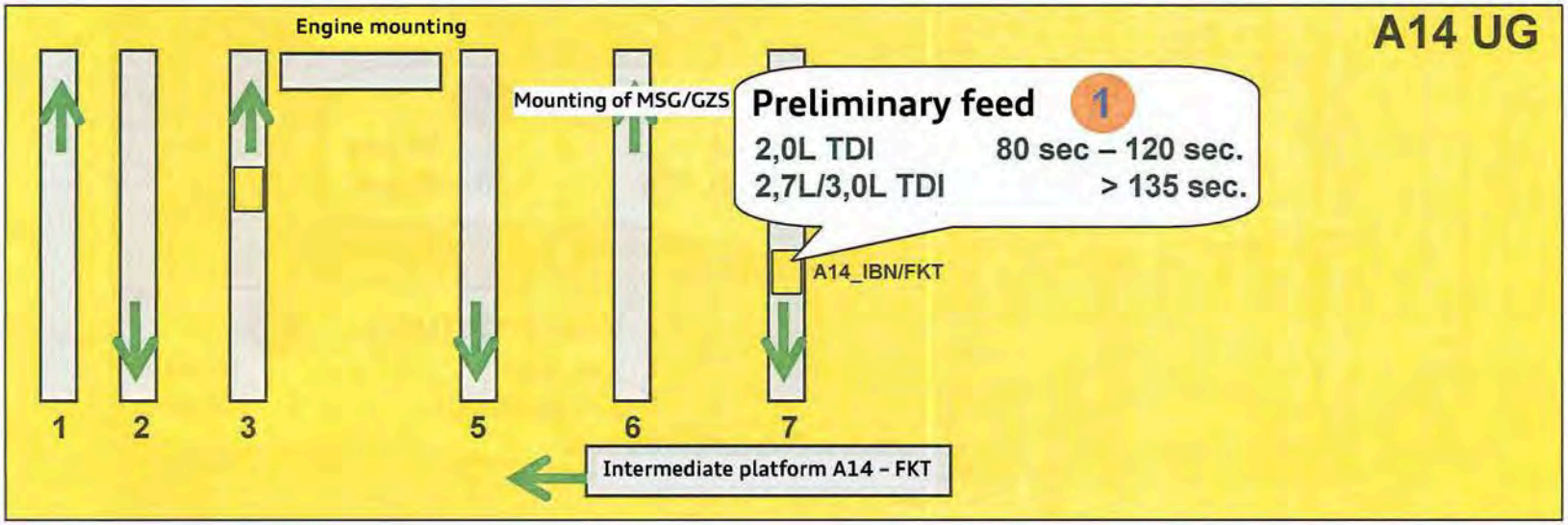


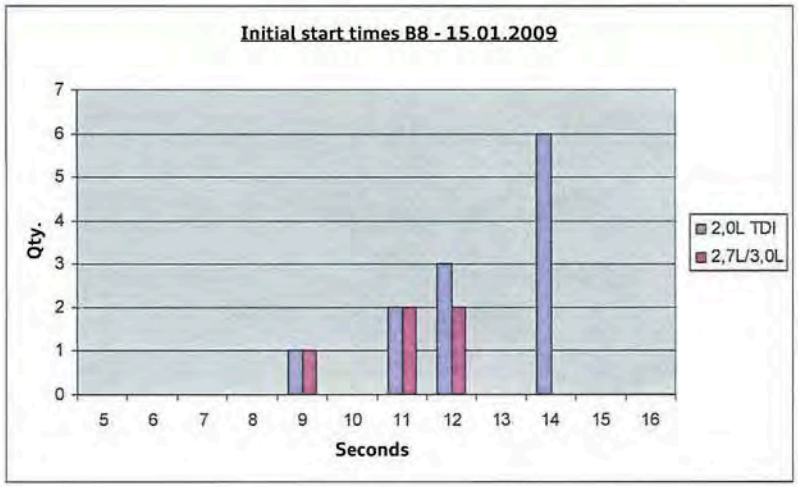
Non-responsive content removed high-pressure diesel pump CP4 preliminary filling/initial start, February 5, 2009

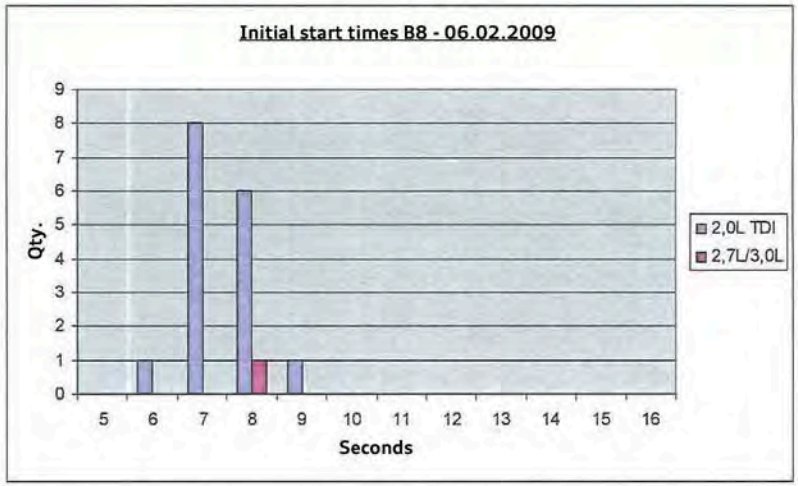
Note: Drawings not to scale

High-pressure diesel pump CP4 Preliminary filling/Initial start

Production line B8 – up to WK 22/09



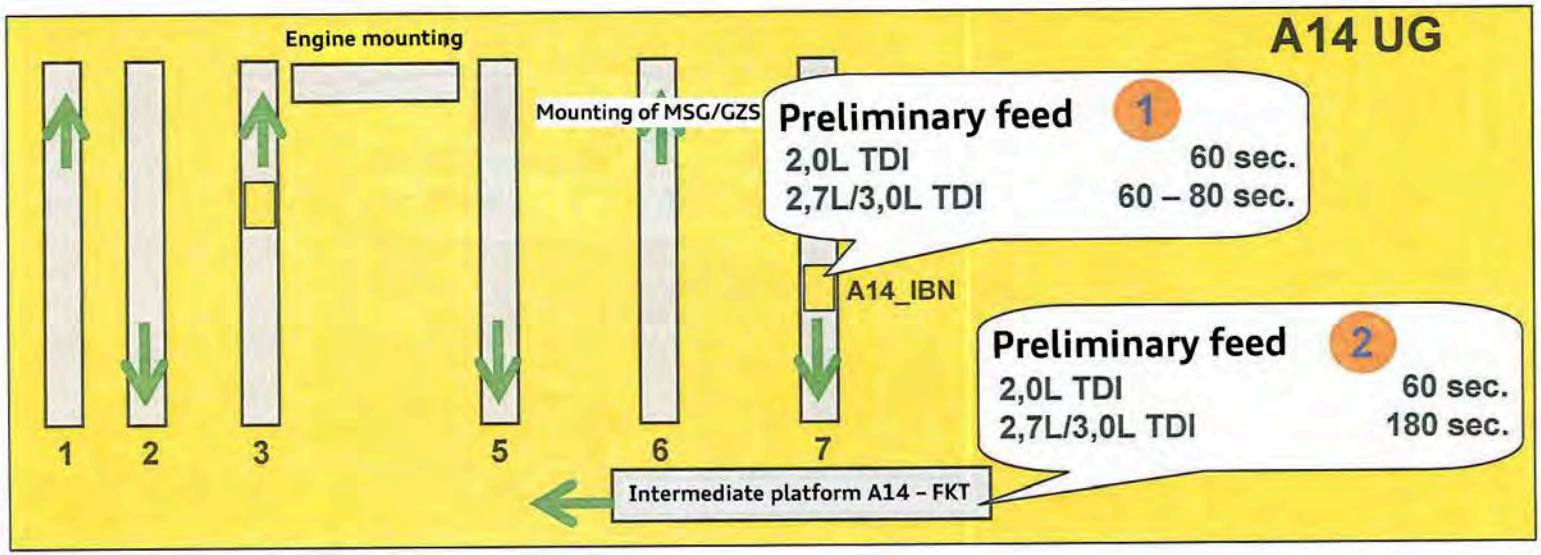




Note: Drawings not to scale

High-pressure diesel pump CP4 Preliminary filling/Initial start

Production line B8 – from WK 22/09



Note: Drawings not to scale

Investigation report. No. 10 / 0667

Non-responsive content removed

Audi

Department	Client	Phone	Date
[redacted]	[redacted]	[redacted]	**3/5/2010**
Vehicle	Subject 2x DK - Mucter	Part number	

QTS number	Mileage / time	Breakdowns	A faults	B faults	C Faults
		☐	☐	☐	☐

Field	Shop floor incident	Number of problem parts	Supplier	Material
☐	☐			

Process/ examination (details provided by the client)

Checking the cooling capability of both cold fuel samples

Investigation results:

→ **Both fuels are significantly different in relation to their cooling capability.**
→ **The described starting problems are probably due to insufficient cooling capability of the fuel used**

- The "Berg" sample corresponds to a cooling capability (CFPP: cold filter plugging point) of about -31 °C of Class 1 for Arctic or harsh climat
- The "Denver" sample corresponds to a cooling capability (cold filter plugging point) of about-160 °C of Class 1 for temperate climate, this is comparable to a transitional quality "Autumn" (Summer, 0 °C -> Winter - 20 °C) in Germany
- The so-called cloud points of the samples also fall within the cold classes described.
- Cetane number could not be determined due to the small sample size. The calculated cetane index is always slightly below the cetane number and conforms to European standard EN 590 for both fuels; in this case, the "Berg" sample should be regarded as having a better quality. (The CI is calculated empirically, the real values are actually very good, but cannot determine any cetane number enhancer)
- Both samples are free of biodiesel (FAME) and virtually sulfur-free.
- Very low lubricity or flash point of the *"Denver"* sample does not comply with the standard (acc. EN 590). (Max. 460 µm or min. 55 °C)
  Very low lubricity of the diesel can lead to problems with the high-pressure fuel pumps of the modern common rail systems.
- The boiling point distributions of both samples comply with the standard, what is abnormal is the lower boiling point of the "Denver" sample. (Low-boiling components -.> Lowering the flash point)
- For individual results, see appendices.

Findings of the investigation: PETROLAB 19/10 No. 1 (Berg-Diesel) + 2 (Denver-Diesel)
Please note that at least 2.5 liters of fuel are required for a full analysis. If the amount is insufficient, the scope of analysis must be adjusted/reduced!

Test costs			Image access no.
Persons responsible	Phone	noted	Date of completion
[redacted]	[redacted]		**3/14/2010**

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EA11003EN-00143[0]

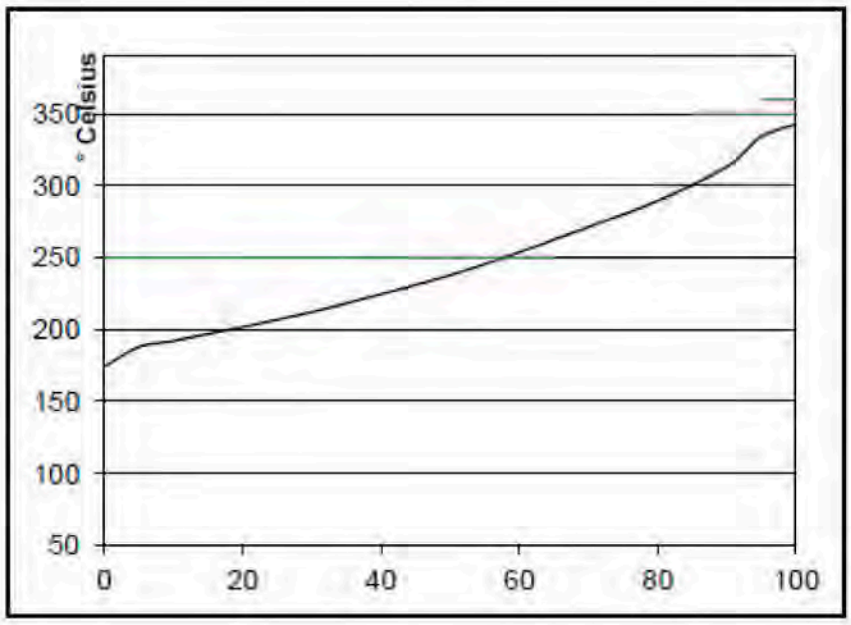
Sample name: **19/10 no.1**
Sample for examination job: 667
PetroLab - certificate no: 98.332
Description / keyword Fuel: **Diesel** – Winter performance – Berg-Diesel – AU353 08048

Analysis results

Color	Slightly yellowish	
Density	*kg/m³*	836.8
Distillation process		
Start of distillation	*°C*	180.6
5 % v/v rec./evap	*°C*	200.7 / -
10 % v/v rec./evap	*°C*	208.7 / -
20 % v/v rec./evap	*°C*	222.3 / -
30 % v/v rec./evap	*°C*	235.3 / -
40 % v/v rec./evap	*°C*	248.3 / -
50 % v/v rec./evap	*°C*	260.7 / -
60 % v/v rec./evap	*°C*	272.8 / -
70 % v/v rec./evap	*°C*	285.6 / -
80 % v/v rec./evap	*°C*	300.1 / -
90 % v/v rec./evap	*°C*	318.5 / -
95 % v/v rec./evap	*°C*	333.0 / -
End of distillation	*°C*	345.0
Residue	*% v/v*	1.0
Loss	*% v/v*	0.9
vaporized@ 250 ℃	*% v/v*	41.3
vaporized@ 350 ℃	*% v/v*	99.9
vaporized@ 370 ℃	*% v/v*	99.9
Cetane number		-
Cetane index		50.2
Oxidation stability	*g/m³*	-
Oxidation stability	*Hours*	-
Carbon residue		
Distillate residue	*% m/m*	-
based on original	*% m/m*	-
Ash content / oxide ash	*% m/m*	-
Filterability (CFPP)	*°C*	-31
Cloudpoint (CP)	*°C*	-17
Pour point	*°C*	-
Flash point (PenskyMartens)	*°C*	60
Lubricity (HFRR)	*µm*	389
Viscosity (40 °C)	*mm²/s*	2.6
Phosphorous content	*mg/kg*	5.7
Total Acid Number (TAN)	*mgKOH/g*	-
PIONA - Analysis		
Paraffins	*% v/v*	-
Aromatic compounds	*% v/v*	-
Naphthene	*% v/v*	-
Olefins	*% v/v*	-
Biodiesel content (FAME)	*% v/v*	<0.1
Aromatic compound content		
Monoaromatic compounds	*% m/m*	22.20
Diaromatic compounds	*% m/m*	1.40
Tri+ - aromatic compounds	*% m/m*	0.10
Polyaromatic compounds (PCA)	*% m/m*	1.50
Total aromatic compounds	*% m/m*	23.70
PCAs according to DIN EN 590	*% m/m*	1.50
Water content	*mg/kg*	30
Calorific value		
Ho	*MJ/kg*	-
Hu	*MJ/kg*	-
Copper corrosion		-
Silver corrosion		-
Total impurities	*mg/kg*	-
Number of particles	*Volume/l*	

Fatty acid distribution		
Low fatty acids - <C12	*% m/m*	-
Lauric acid - C12/0	*% m/m*	-
Myristic acid - C14/0	*% m/m*	-
Palmitic acid - C16/0	*% m/m*	-
Palmitoleic acid - C16/1	*% m/m*	-
Stearic acid	*% m/m*	-
Oleic acid - C18/1	*% m/m*	-
Linoleic acid - C18/2	*% m/m*	-
Linoleic acid - C18/3	*% m/m*	-
Arachidic acid - C20/0	*% m/m*	-
Gadoleic acid - C20/1	*% m/m*	-
Higher fatty acids ->C20	*% m/m*	-
Iodine value (calculated from distribution)	*g_iodine/lOOg*	#####

Distillation process according to DIN EN 590



The curve is extrapolated from 13 measurements

Particle distribution

Difference	*Volume/ml*	-
4 – 5 mm	*Volume/ml*	-
5 – 6 mm	*Volume/ml*	-
6 – 7 mm	*Volume/ml*	-
7 – 8 mm	*Volume/ml*	-
8 - 9 mm	*Volume/ml*	-
9 - 10 mm	*Volume/ml*	-
10 – 11 mm	*Volume/ml*	-
11 – 12 mm	*Volume/ml*	-
12 - 13 mm	*Volume/ml*	-
13 – 14 mm	*Volume/ml*	-
14 – 15 mm	*Volume/ml*	-
15 – 16 mm	*Volume/ml*	-
16 – 25 mm	*Volume/ml*	-
25 – 38 mm	*Volume/ml*	-
38 – 58 mm	*Volume/ml*	-
> 58 mm	*Volume/ml*	-

Cumulative

> 4 mm	*Volume/ml*	-
> 5 mm	*Volume/ml*	-
> 6 mm	*Volume/ml*	-
> 7 mm	*Volume/ml*	-
> 8 mm	*Volume/ml*	-
> 9 mm	*Volume/ml*	-
> 10 mm	*Volume/ml*	-
> 11 mm	*Volume/ml*	-
> 12 mm	*Volume/ml*	-
> 13 mm	*Volume/ml*	-
> 14 mm	*Volume/ml*	-
> 15 mm	*Volume/ml*	-
> 16 mm	*Volume/ml*	-
> 25 mm	*Volume/ml*	-
> 38 mm	*Volume/ml*	-
> 58 mm	*Volume/ml*	-

Total for all particles

ISO Code	> 4 mm	-
	> 6 mm	-
	> 14 mm	-

C/H/O ratio

C	*% m/m*	-
H	*% m/m*	-
O	*% m/m*	-

Molecular weight

Mean	*g/mol*	-

Microbiological contamination

Bacteria	*Cfu/l*	-
Yeasts/ fungi	*Cfu/l*	-
Colonies	*Cfu/l*	-
Oil in DK	*% m/m*	-

ICP screening

Aluminum	*mg/kg*	-
Barium	*mg/kg*	-
Lead	*mg/kg*	-
Boron	*mg/kg*	-
Calcium	*mg/kg*	-
Chrome	*mg/kg*	-
Iron	*mg/kg*	-
Potassium	*mg/kg*	-
Copper	*mg/kg*	-
Magnesium	*mg/kg*	-
Manganese	*mg/kg*	-
Molybdenum	*mg/kg*	-
Sodium	*mg/kg*	-
Nickel	*mg/kg*	-
Phosphorus	*mg/kg*	-
Silver	*mg/kg*	-
Silicone	*mg/kg*	-
Titanium	*mg/kg*	-
Vanadium	*mg/kg*	-
Zink	*mg/kg*	-
Tin	*mg/kg*	-

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14.04.2010

EA11003EN-00144[0]

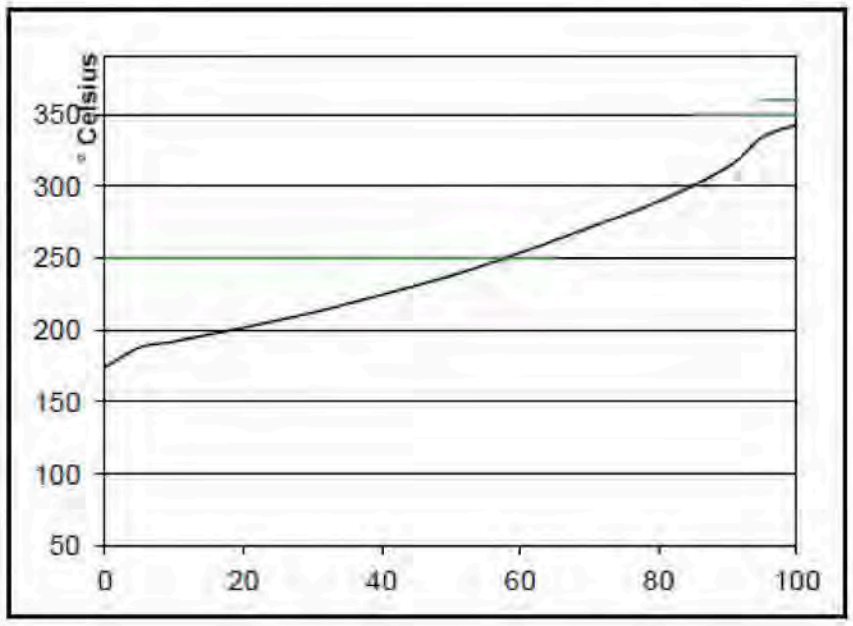
Sample name:	19/10 no.2
Sample for examination job:	667
PetroLab - certificate no:	98.332
Description / keyword	Fuel: Diesel - winter performance – Denver diesel AU353 08051

Analysis results

Color		yellowish green
Density	*kg/m³*	847,3
Distillation process		
Start of distillation	°C	174.2
5 % v/v rec./evap	°C	198.3 /-
10 % v/v rec./evap	°C	207.5 /-
20 % v/v rec./evap	°C	222.5 /-
30 % v/v rec./evap	°C	236.6 /-
40 % v/v rec./evap	°C	250.5 /-
50 % v/v rec./evap	°C	264.1 /-
60 % v/v rec./evap	°C	277.5 /-
70 % v/v rec./evap	°C	291.6 /-
80 % v/v rec./evap	°C	306.9 /-
90 % v/v rec./evap	°C	325.5 /-
95 % v/v rec./evap	°C	338.7 /-
End of distillation	°C	357.0
Residue	% v/v	0.0
Loss	% v/v	0.1
vaporized@ 250 °C	% v/v	39.7
vaporized@ 350 °C	% v/v	97.6
vaporized@ 370 °C	% v/v	99.9
Cetane number		-
Cetane index		46.8
Oxidation stability	*g/m³*	<0.10
Oxidation stability	*Hours*	-
Carbon residue		
Distillate residue	% m/m	-
based on original	% m/m	-
Ash content / oxide ash	% m/m	
Filterability (CFPP)	°C	-16
Cloudpoint (CP)	°C	-13
Pour point	°C	-
Flash point (PenskyMartens)	°C	50
Lubricity (HFRR)	*[µm]*	530
Viscosity (40 °C)	*mm²/s*	2.72
Phosphorous content	*mg/kg*	6.9
Total Acid Number (TAN)	*mgKOH/g*	-
PIONA - Analysis		
Paraffins	% v/v	-
Aromatic compounds	% v/v	-
Naphthene	% v/v	-
Olefins	% v/v	-
Biodiesel content (FAME)	% v/v	<0.1
Aromatic compound content		
Monoaromatic compounds	% m/m	27.80
Diaromatic compounds	% m/m	2.60
Tri+ - aromatic compounds	% m/m	0.40
Polyaromatic compounds (PCA)	% m/m	3.00
Total aromatic compounds	% m/m	30.80
PCAs according to DIN EN 590	% m/m	3.00
Water content	*mg/kg*	20
Calorific value		
Ho	MJ/kg	-
Hu	MJ/kg	-
Copper corrosion		-
Silver corrosion		-
Total impurities	*mg/l*	-
Number of particles	*Volume/l*	

Fatty acid distribution		
Low fatty acids - <C12	% m/m	-
Lauric acid - C12/0	% m/m	-
Myristic acid - C14/0	% m/m	-
Palmitic acid - C16/0	% m/m	-
Palmitoleic acid - C16/1	% m/m	-
Stearic acid	% m/m	-
Oleic acid - C18/1	% m/m	-
Linoleic acid - C18/2	% m/m	-
Linoleic acid - C18/3	% m/m	-
Arachidic acid - C20/0	% m/m	-
Gadoleic acid - C20/1	% m/m	-
Higher fatty acids ->C20	% m/m	-
Iodine value (calculated from distribution)	g_iodine/lOOg	#####

Distillation process according to DIN EN 590



The curve is extrapolated from 13 measurements

Particle distribution

Difference		
4-5 mm	*Volume/ml*	-
5-6 mm	*Volume/ml*	-
6-7 mm	*Volume/ml*	-
7-8 mm	*Volume/ml*	-
8-9 mm	*Volume/ml*	-
9-10 mm	*Volume/ml*	-
10-11 mm	*Volume/ml*	-
11-12 mm	*Volume/ml*	-
12-13 mm	*Volume/ml*	-
13-14 mm	*Volume/ml*	-
14-15 mm	*Volume/ml*	-
15-16 mm	*Volume/ml*	-
16-25 mm	*Volume/ml*	-
25-38 mm	*Volume/ml*	-
38-58 mm	*Volume/ml*	-
>58 mm	*Volume/ml*	-
Cumulative		
>4 mm	*Volume/ml*	-
>5 mm	*Volume/ml*	-
>6 mm	*Volume/ml*	-
>7 mm	*Volume/ml*	-
>8 mm	*Volume/ml*	-
>9 mm	*Volume/ml*	-
>10 mm	*Volume/ml*	-
>11 mm	*Volume/ml*	-
>12 mm	*Volume/ml*	-
>13 mm	*Volume/ml*	-
>14 mm	*Volume/ml*	-
>15 mm	*Volume/ml*	-
>16 mm	*Volume/ml*	-
>25 mm	*Volume/ml*	-
>38 mm	*Volume/ml*	-
>58 mm	*Volume/ml*	-

Total for all particles

Iso Code	>4 mm	-
	>6 mm	-
	>14 mm	-

C/H/O ratio		
C	% m/m	-
H	% m/m	-
O	% m/m	-

Molecular weight		
Mean	g/mol	-

Microbiological contamination

Bacteria	*Cfu/l*	-
Yeasts/ fungi	*Cfu/l*	-
Colonies	*Cfu/l*	-

Oil in DK	% m/m	-

ICP - Screening		
Aluminium	mg/kg	-
Barium	mg/kg	-
Lead	mg/kg	-
Boron	mg/kg	-
Calcium	mg/kg	-
Chrome	mg/kg	-
Iron	mg/kg	-
Potassium	mg/kg	-
Copper	mg/kg	-
Magnesium	mg/kg	-
Manganese	mg/kg	-
Molybdenum	mg/kg	-
Sodium	mg/kg	-
Nickel	mg/kg	-
Phosphorus	mg/kg	-
Silver	mg/kg	-
Silicone	mg/kg	-
Titanium	mg/kg	-
Vanadium	mg/kg	-
Zink	mg/kg	-
Tin	mg/kg	-

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14.4.2010

EA11003EN-00145[0]

From: Non-responsive content removed
To:
CC:

Date: 6/14/2010 3:08:00 PM
Subject: Re: Pricing for robustness packages, overflow valve

Dear Ms. [redacted]

These are the questions that were asked at TOP Management and that we have already discussed in the past with our Development and with Bosch.

Let me summarize the situation from my point of view. This should also be the guiding line for the next TOP meeting between Bosch and Audi on 12 July and the preliminary meeting with Mr. [redacted] on 8 July.

[redacted] please let me know if you see things differently.

Overall it must be said that from today's perspective, with the introduction of various packages of measures from SOP to July 2009, we have reached a quality level in the markets that is much better than MY2008, for example; the improvement quota is still quite uncertain because the mileage figures have not been as high since then

On the other hand, RP1 was first used in WK12/2010; it is very risky to evaluate this in the field already; the fact is that there have been 7 repeat failures to date in [redacted] where this pump was installed as a replacement part; the reasons for this are (still) unknown (prior damage when venting the CP4 during installation by the repair shop?? or very poor quality fuel??? or even the pump with RP1???)

We have tried to determine the effectiveness of the RP1 by means of pump RAFF continuous tests.

Unfortunately this was not possible over longer mileages, but rather by means of visual properties in the roller shoe, etc. (deposits; abrasion patterns, etc.)

Our Development Department foresees greater potential for improvements to RP1 than I do; however these are subjective evaluations.

The aim of RP2 is to achieve the same temperature level in the V6 TDI pump as in the R4 CR pump.

This means that RP2 enables the same level to be achieved as R4-CR, but not better; and R4-CR is known also to fail; however much less often, in some cases by a factor of 10.

Again the effectiveness of RP2 can only be proven by means of short-term temperature measurements on the test bench; in other words, the same temperature level has been reached on the test bench. However, topics are already being gathered for an RP3 because more and more information is coming to light and some improvements can only be achieved in the long term.

When I look at the pricing used by Bosch, I get the feeling that Bosch is using these packages to make money.

We definitely need to bring this up at the next TOP meetings between Audi and Bosch on 12 July.

The latest measurements by Bosch in our EFP/tank system indicate the possibility that under certain specific conditions the flushing/lubricating volume of the CP4 might not be sufficient; however these are simply initial measurements that need to be expanded upon.

The warranty costs are not yet determined within the entire scope; according to my experience it can often take Audi and Bosch years to reach an agreement.

At present the Italian failures are recognized by Bosch in the EDP system in isolation, while the failures in [redacted] are not recognized because these fuels do not meet the EN590 fuel standard according to Bosch. I don't know if this is accounting position is implemented consistently in all export markets.

Export markets are normally calculated according to domestic factors, but this would lead to extreme anomalies because Non-responsive content removed has far fewer drivetrain failures.

In addition, CS has specific measures in mind for [redacted] and other countries.

Overall this has been a total fiasco with CP4 quality and the subsequent costs.

Best regards

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EA11003EN-00145[2]

From: Non-responsive content removed
Sent: Monday, June 14, 2010 2:11 PM
To: Non-responsive content removed
Subject: Re: Pricing for robustness packages, overflow valve

Hello Mr. [redacted]

Thank you for forwarding this.

How effective are the measures and what about Bosch's acceptance of its guarantee responsibilities?

How sure are we that no more action will be needed after Rob. 2?

Best wishes
[redacted]

From: Non-responsive content removed
Sent: Monday, June 14, 2010 1:32 PM
To: Non-responsive content removed
Subject: Re: Pricing for robustness packages, overflow valve

Best regards

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From: Non-responsive content removed
Sent: Sunday, June 13, 2010 9:47 PM
Non-responsive content removed
Subject: Re: Pricing for robustness packages, overflow valve

EA11003EN-00145[3]

Hi all,

Here are the prices for the CP4 robustness packages

RP0 is the C coating for the pump plunger

RP1 entails the optimizations to the roller shoe and cam roller integrated in WK 12.

In the list RP2 simply stands for the modified pump casing.

The "robust flange" which means a cost reduction for Bosch, is not mentioned in the list.

Prices still need to be negotiated. (probably WK 25)

With best wishes

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Head of Thermodynamics and Application, Diesel Engines

AUDI AG
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www.audi.com

Sitz/Domicile: Ingolstadt
Registergericht/Court of Registry: Amtsgericht Ingolstadt
HRB Nr./Commercial Register No.: 1
Vorsitzender des Aufsichtsrats/Chairman of the Supervisory Board: Martin Winterkorn
Vorstand/Board of Management: Rupert Stadler (Vorsitzender/Chairman), Ulf Berkenhagen, Michael
Dick, Frank Dreves, Peter Schwarzenbauer, Axel Strotbek, Werner Widuckel

EA11003EN-00145[4]

From Non-responsive content removed

Sent: Friday, June 11, 2010 9:25 PM

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Subject: Pricing for robustness packages, overflow valve

Dear Mr Non-responsive content removed

As promised and confirmed in todays Team 1 meeting, attached please find the prices for the robustness packages and the overflow valve. There has been an increase to 0.54 EUR/plunger in comparison with the first indicator for RP1, amounting to EUR 0.20 EUR/plunger.

The reasons for this are as follows:

Inclusion of improved cam roller in RP1

Substrate holder for C2.1 layer

The other cost blocks are a 100% process measurement and an increase in waste which were reevaluated on the basis of the final RP1.

Please don't hesitate to ask if you have any further queries.

Best regards / mit freundlichen Grüßen

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Robert Bosch GmbH

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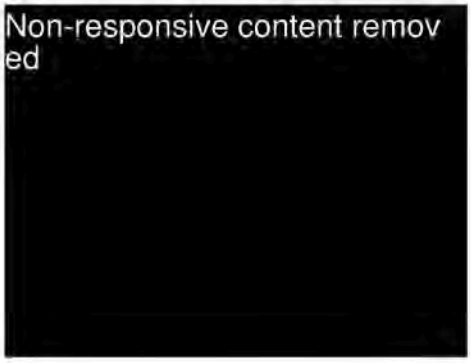
EA11003EN-00145[5]

GERMANY

www.bosch.com



Domicile: Stuttgart, Court of Registry: Amtsgericht Stuttgart, HRB 14000;

Chairman of the Supervisory Board: Hermann Scholl; Management: Franz Fehrenbach, Siegfried Dais;

Bernd Bohr, Rudolf Colm, Volkmar Denner, Gerhard Kümmel, Wolfgang Malchow, Peter Marks,

Peter Tyroller; Uwe Raschke

EA11003EN-00147[0]

From: Non-responsive content removed
To:
CC:

Date: 9/15/2010, 7:02:35 AM
Subject: Re: Caddy GP - 1.6 CR fuel pump - AWP measure

Good morning colleagues,

In principle, [redacted]s correct in that the sulfur does not pose any problems, at least for the pump.
In particular, sulfur damages the exhaust gas treatment and certain parts of the drivetrain.
The problem with the pump is, firstly, poor lubricity, which results in wear and tear (higher HFRR), and free water, which leads to corrosion.

In particular, [redacted] list will have to be supplemented with the following markets (regardless of whether or not they are already listed in the LTÜ):

* [redacted] (poor lubricity)
* [redacted] (poor lubricity)
* [redacted] (poor lubricity)
* [redacted] (poor lubricity)
* [redacted] (poor lubricity)
* [redacted] (free water)
* Non-responsive content removed (free water)
* Non-responsive content removed (free water)
* [redacted] (free water)
* Non-responsive content removed (free water)
* Non-responsive content removed free water)
* [redacted] (free water)

We urgently need an appointment on this topic, in which the persons responsible for the pump components specifically can contribute their technically advice.
My words of warning alone do not improve anything at this point; they merely indicate the existing problems.

With best wishes

Non-responsive content removed
Volkswagen AG
Non-responsive content removed
www.volkswagen.com

>

EA11003EN-00147[1]

>Von: Non-responsive content removed
>Sent: Tuesday, September 14, 2010, 7:22 PM
>To: Non-responsive content removed
>Cc:
>Subject: Re: Caddy GP - 1.6 CR fuel pump - AWP measure
>
>Hello
>
>I've scanned the list. Sulfur is not the problem with the HPP. In my opinion, due to the poor HFRR values, I would not approve either the pump with integrated presupply pump (0.5 bar system) nor ITP (6 bar system) for the following countries:
>
>Countries with HFRR > 528
>
>
>
>
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>
>
>The other countries should be covered by the regular "AWP" pump (03L130 755 G / P) (with a water separator, if necessary).
>
> Non-responsive content removed has the last word as the person responsible for the system, however, and is more involved, but he has left the office for the day. He can normally be reached in the early mornings.
>
>Best wishes,
Non-responsive content removed
>
>
>_____
>Von: Non-responsive content removed
>Sent: Tuesday, September 14, 2010, 6:27 PM
>To: Non-responsive content removed
>Cc:
>Subject: Re: Caddy GP - 1.6 CR fuel pump - AWP measure
>Importance: High
>
>
>Hello Non-responsive content removed
>With the aid of country list no. 27, which you provided, I have set up the following table:
>
> < File: 1,6l CR ohne AWP - Auswirkung auf LTÜ.xls >>
>This file contains all the countries in which the LTÜ Caddy GP has the condition "AWP required".
>The colors indicate a reference to the sulfur content problem:
>- Green indicates the countries that, according to your list, no longer require an AWP and lie beneath the critical sulfur limit of 2000, and can therefore be approved.

EA11003EN-00147[2]

>- Yellow indicates countries that exceed the sulfur content limit of 2000 and are therefore already blocked in the LTÜ (which means they are not currently critical for the project)
>- Red indicates the countries that require an AWP, but which are not currently blocked due to sulfur content – these countries need action.
>
>Can you please review the list and tell me whether some of the countries that are marked in red or yellow don't need an AWP after all and therefore don't have to be blocked?
>Because the LTÜ is supposed to be frozen tomorrow (Wednesday), it would be ideal if you could at least provide a statement as to the red countries at short notice.
>
>It would also be important to know whether the AWP1 package would be sufficient in the red countries, or whether they will have to be converted to the 6-bar system.
>
>Many thanks for your support.
>
>Best regards,
>

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>
>
>Postal address:
>Volkswagen AG
Non-responsive content removed
38436 Wolfsburg
>

Non-responsive content removed

>http://www.volkswagen.de
>
>VOLKSWAGEN AG
>Sitz/Domicile: Wolfsburg
>Court of Registry/Registergericht: Amtsgericht Braunschweig
>HRB Nr./. Commercial Register No.: 100484
>Chairman of the Supervisory Board/Vorsitzender des Aufsichtsrats: Ferdinand Piëch
>Vorstand/Board of Management: Martin Winterkorn (Vorsitzender/Chairman), Francisco J. Garcia Sanz, Jochem Heizmann, Horst Neumann, Hans Dieter Pötsch
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>Wichtiger Hinweis: Die vorgenannten Angaben werden jeder E-Mail automatisch hinzugefügt und lassen keine Rückschlüsse auf den Rechtscharakter der E-Mail zu.>
>
>

EA11003EN-00147[3]

>
>
>_____
>Von: Non-responsive content removed
>Sent: Tuesday, September 14, 2010, 5:06 PM
>To: Non-responsive content removed
>Cc:
>Subject: Re: Caddy GP - 1.6 CR fuel pump - AWP measure
>
>
>Now what? >Block? Can we still do that at this point?
>In my opinion, we need to meet and discuss this, using [redacted] as an example.
>_____
>From: Non-responsive content removed
>Sent: Tuesday, September 14, 2010, 4:49 PM
>To: Non-responsive content removed
>Cc:
>Subject: Re: Caddy GP - 1.6 CR fuel pump - AWP measure
>
>Hello,
>In all countries that do not have EN 590, they always have at least an AWP
>0.5 bar system: 03L130 755 G / P stainless steel spring, support piston 100 Cr6 / strainer in inlet starting CW22/11
>6 bar system 03L 130 755 H / Q ditto
>
>In countries with extremely poor lubricity, analogous to Non-responsive content removed
>
>6 bar system 03L 130 755 T/ AD harder intake valves / strainer in inlet starting CW 22/11
>
>Note: The 0.5 bar pump 755 S was only a start-up solution for Pune, do not plan it any longer
>
>Free water results in corrosion to various components, especially if there is no additivation (NACE D..E) and to breakage of the normal support piston spring. We have long desired a functioning water separator, like every pump supplier requests of us.
>
>
>Regards,
>
>
>_____
>From: Non-responsive content removed
>Sent: Tuesday, September 14, 2010, 4:35 PM
>To: Non-responsive content removed
>Cc:
>Subject: Re: Caddy GP - 1.6 CR fuel pump - AWP measure
>
>
>Hi all,
>
>Please provide a statement as to the extent to which free water can result in the 1.6 system described below.
>
>Background:
>The 1.6 system was approved based on the AWP for [redacted] because water sometimes occurs there. The lubricity is not a problem there. But there is no AWP for RdW.

EA11003EN-00147[4]

>
>How should we handle this and which consequences can occasionally occurring water have?
>
>Thanks and best regards,
>
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>_____
>From: Non-responsive content removed
>Sent: Tuesday, September 14, 2010, 4:21 PM
>To: Non-responsive content removed
>Cc:
>Subject: Re: Caddy GP - 1.6 CR fuel pump - AWP measure
>
>Hello Non-responsive content removed
>
>The EU3 project for the Caddy GP currently has the 0.5 bar fuel system compatible with DIN EN590.
>
>Regards
>
Non-responsive content removed
>
>VOLKSWAGEN AG
>Sitz/Domicile: Wolfsburg
>Court of Registry/Registergericht: Amtsgericht Braunschweig
>HRB Nr./. Commercial Register No.: 100484
>Chairman of the Supervisory Board/Vorsitzender des Aufsichtsrats: Ferdinand Piëch
>Vorstand/Board of Management: Martin Winterkorn (Vorsitzender/Chairman), Francisco J. Garcia Sanz, Jochem Heizmann, Horst Neumann, Hans Dieter Pötsch
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>
>
>
>_____
>From: Non-responsive content removed
>Sent: Tuesday, September 14, 2010, 3:47 PM
>To: Non-responsive content removed
>Cc:
>Subject: Caddy GP - 1.6 CR fuel pump - AWP measure
>
>Hello Non-responsive content removed
>Can you tell me which version of the fuel supply with which measures is used in the 1.6l CR in the Caddy GP?

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>According to [redacted] there are different versions for the 1.6l, and he needs more detailed information to make a statement as to whether the 1.6l CR EU3 can be used in [redacted]
>
>Best regards,
>
[redacted]
>
>
>Postal address:
>Volkswagen AG
[redacted]
38436 Wolfsburg
>
[redacted]
>http://www.volkswagen.de
>
>VOLKSWAGEN AG
>Sitz/Domicile: Wolfsburg
>Court of Registry/Registergericht: Amtsgericht Braunschweig
>HRB Nr./. Commercial Register No.: 100484
>Chairman of the Supervisory Board/Vorsitzender des Aufsichtsrats: Ferdinand Piëch
>Vorstand/Board of Management: Martin Winterkorn (Vorsitzender/Chairman), Francisco J. Garcia Sanz, Jochem Heizmann, Horst Neumann, Hans Dieter Pötsch
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[redacted]
>

Internal message

To:
c.c.:

Non-responsive content removed	From: Org. Unit/PO Box Phone Fax E-mail
23.11.2010	Date
	1 Number of pages

National releases for diesel engines - robustness of fuel lubricated injection components for global markets

At present the exhaust standards are used for the national release and control of the diesel vehicles. A summary of several type test countries in a sales region does not consider the very mixed fuel qualities and the future quality development within a test country. In particular, the desulfurization of the diesel fuels required for DPF use results in a considerable reduction in lubricity. Validation results of current, fuel lubricated fuel injection system components point to the parameters used in SGS fuel surveys as references for national releases at Volkswagen; in many type test countries there are critical trends in relation to robustness reserves, particularly in high-pressure fuel pumps.

Some of the unspecific seasonal additions of kerosene, etc. to increase winter performance are seen as problematic as they can cause a drastic deterioration in lubricity, depending on the mixing ratio.

In the case of a release without prior validation of the fuel injection components under typical market conditions, higher failure rates and warranty costs are to be expected , which cannot be passed on subsequently to the supplier without validation.

Under certain conditions in relation to the fuel qualities, system manufacturers usually require additional robustness measures, improved fuel filtering and water separation; these must be provided in the projects in good time. A simple transfer of injection system releases over several vehicle projects is not permissible without prior testing because of the influence of different collective loads in conjunction with critical fuel qualities.

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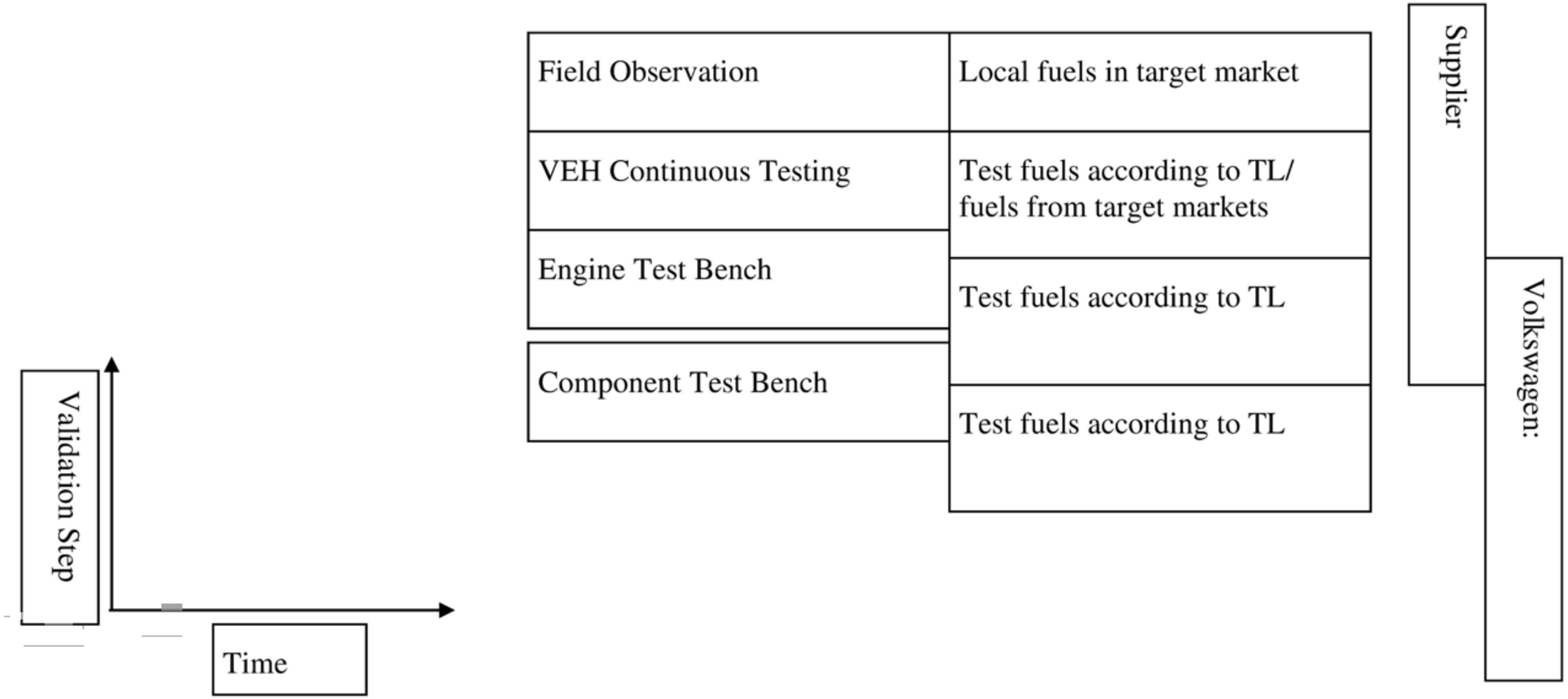
Release Requirements



Start 1 year prior to VW SOP For key projects and key markets

ENTIRE PAGE CONFIDENTIAL

EA11003EN-00151[0]

Main menu

Dieselfuelmarket examination

Country / Generic ID green = standard diesel yellow = special release premium diesel red = no release possible (no data)	Country (with generic ID)	Type test country VW old (valid to	Type test country	Fuel type	Spec. (if visible at the gas station)	Basis for decision (report)	Comments	**Height information** Drivable height (m)	High application / passes (m)	**Emissions legislation** Required vehicle – exhaust standard (source: EAMA - 01 10 10)	Next vehicle exhaust level (year)	**Fuel notices** Part number of fuel notice	Coverage of the languages of the fuel notice	Content of fuel notice	Appearance of fuel notice	**Exhaust treatment** Use of oxicate for filling EU3 (EU4 for lightweight vehicles)	PMS for EU4 CR	Installation of DPF	Water separator	**Fuel injection system (validation in consultation with EADE presumed)** First fuel filling after TL 788 X	Conti (1.6 L TDI) orange = Risk Purple = Increased risk	Bosch (2.0 L TDI) orange = Risk Purple = Increased	**Service** Maximum releasable service intervals for car diesel enghes Recommended by EAD	Maximum releasable service intervals for commercial vehicle diesel Recommended by EAD	Required engine oil (service)	Required engine oils (first filling)	**Sulfur content [mg/kg]** OK Standard (EN 590) max 10 mg / kg Min	Max	**Cetane number [number]** standardized (EN 590) min 51 (S, W); min 47 (A) Min	Max	**Lubricity WSD (60°C) [µm]** OK Inline with standardsmax 460 µm Min	Max	**Density (15°C) [kg/m³]** I.O. In line with standards (EN 590) max 845 kg/m³ Min	Max	**Viscosity 40°C (mm²/s)** EN 590 min. 2,00 mm²/s max. 4,50 mm²/s Min.	Max.
[redacted]		637	887	Local standard diesel		W 08/09 SGS Special testing	DPF vehicles can only be used after prior consultation with EAD in fleets in urban areas such as [redacted] with Eurodiesel	Roki-Pass - 2995	Height application > 2500 m required	EU 4	EU 5 (2014)	1K0.010.455.E	[redacted]	Diesel, not for biodiesel	[redacted]	Yes	Yes	No	Yes	First fuel filling	AWP 2	AWP	5.000 km or 1 year (+ caddy)	5.000 km or 1 Year	VW 50501 (VW 50601)	TL 52 167	26	1970	45,6	54,5	254	703	810,3	842,6	1,40	3,27

[redacted]