ENTIRE PAGE CONFIDENTIAL

BOSCH CP4	CR pump CP4 - Diagnosis report	Report no.	19420
		Date	12/4/2007

Department:	Person responsible:	Telephone:	Use	
Non-responsive content removed			internal	
			external	x

Pump type:	Customer:	Project:	Project/ design sample version
CP4.1XX_298_2x5,25_REC_3,3_1,95_MT4,2	VW	R4 2.0 EU5	D / C2
Item number (Part no.) :	**Date of manufacture:**	**Serial number:**	**Plant - line**
0445B21058	010207	0045	0110 FeP - 1
SAP-No.:	**Samos no.:**	**Customer order no.:**	**Engine/Vehicle number**
DS-164763	578256		AU 481-8-8008
Customer part number	**ER type [customer]:**	**Endurance run conditions:**	**DSBFD no.:**
	Q endurance run		19420
Mileage:	**Received by DS-PC/EDI on:**	**Process no.**	**Confidentiality note**
80000 km	10/22/2007	2007 - CP4 / 0006	Confidential
Complaint:	None. Endurance run end.		

1. Subject

CP4 customer return
Q-ER; CAG 0000 067; AU 481-8-8008

2. Conclusion

The results of the residual soiling test lie within the tolerance of new parts. Only light traces of wear can be seen.

The pump has passed the test.

3. Results of diagnosis (visual findings)

Legend rating stages

OK	x		
non-critical		x	
Critical			x

Finding	OK	non-critical	Critical
3.1 Drive No wear visible	x		
3.2 Drivetrain Only very slight wear visible (Fig. 1 and 2)	x		
3.3 High pressure Only very slight wear visible	x		
3.4 Bearing No striking feature (Fig. 3)	x		
3.5 Shaft seal Minor embedding of the shaft seal	x		
3.6 Bore holes Only very minor cavitation erosion in the tappet bore (Fig. 4)	x		
3.7 Attached components (MU, OV, GP) No striking feature	x		
3.8 Other No striking feature	x		

BOSCH CP4	CR pump CP4 - Diagnosis report	Report no.	19420
		Date	12/4/2007

Department:	Person responsible:	Telephone:	Use	internal	
Non-responsive content removed				external	x

4. Hydraulic function

	n [rpm]	p_rail [bar]	Metering unit [A]	Delivery rate [l/h] New part 2/6/2007	Delivery rate [l/h] after testing 11/5/2007			
ST	200	200	0.4	4.0	3.9	x		
Running limit	1000	1800	0.4	17.5	17.7	x		
KL1-S	3375	500	0.4	67.6	66.7	x		

OK

BOSCH CP4	CR pump CP4 - Diagnosis report	Report no.	19420
		Date	12/4/2007

Department:	Person responsible:	Phone	Use	internal	
[redacted]				external	x

5. Parts storage

   The parts will be stored at RB until 06/2008

6. Attachments

   Figure

Tested:	[redacted]	Telephone:	[redacted]	Date:	14.12.07	Signature:	[redacted]
Department:		Telephone:		Date:	19.12.07	Signature:	
Department:		Telephone:		Date:	07.01.08	Signature:	

EA11003EN-00849[3]

ENTIRE PAGE CONFIDENTIAL

BOSCH	CR pump CP4 - Diagnosis report	Report no.	19420
		date	12/4/2007

Department:	Person responsible:	Telephone:	Use	internal	
Non-responsive content removed				external	x

Fig. 1 010207-0045_cam track_running surface

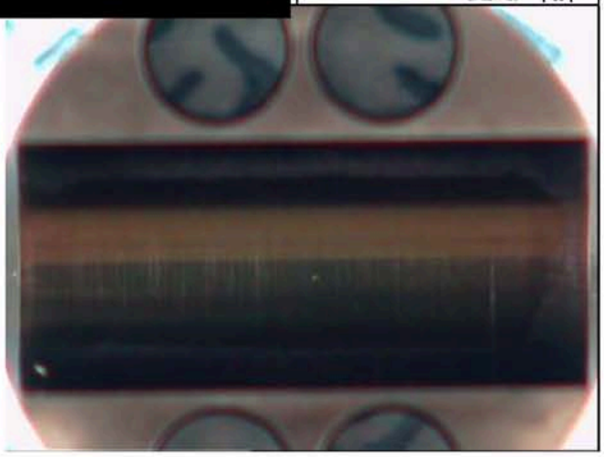


Fig. 2 010207-0045_roller support running surface

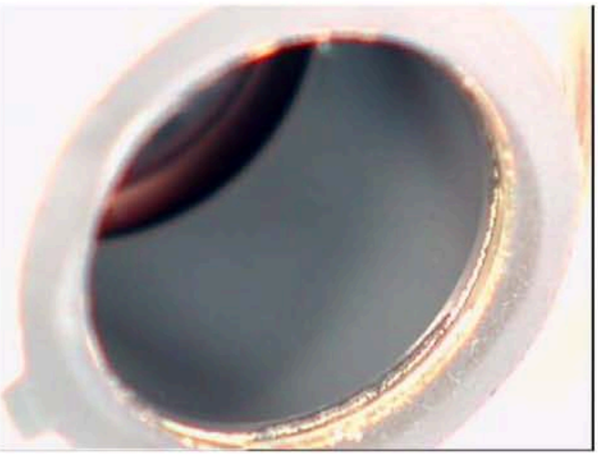


Fig. 3 010207-0045_flange bearing bushing

Fig. 4 010207-0045_housing tappet bore

EA11003EN-01297[0]

ENTIRE PAGE CONFIDENTIAL

From: Non-responsive content removed
To: [redacted]
CC: [redacted]
Date: 9/19/2008 12:50:04 PM
Subject: Teleconference 9/18/2008, Production measures to reduce drivetrain damage

Hello,

Attached are the minutes for today's teleconference on the above topic:

Participants:
Audi: Non-responsive content removed
RB: Non-responsive content removed

1) Metal splashes (roller support)
1.1) Avoidance of metal splashes
- Testing of new system is completed
- 2-day production to be decided (scheduling in progress), fix date, info to Audi in Wk 39 -> Non-responsive content removed
- Proposal: Carry out large-scale test (3 months of production) for VW/Audi, then series release if evaluation is positive

- Discussion of proposal in change meeting on 9/25 -> Non-responsive content removed

1.2) Identification of metal splashes
- 2 quotations (external, internal) submitted
- Large-scale test under series conditions required for evaluation purposes to be sure of avoiding "pseudo scrap" e.g. due to washing residues.

- 2 x visual inspections used at present (after finishing process and after friction coefficient test)
- Objective: 1st step: Implementation of optimized measurement method + assessment by employees, 2nd step: Implementation of assessment using calculation algorithm (longer term)

- From present perspective, implementation of step 1 by Wk 44 achievable for 1st line (FeP)

3) Avoidance of C layer removal
- Completion of transport frame modification scheduled by Wk 42

3.1) Avoidance of C layer removal during pressing-in process of roller support in tappet body (new)
- Flaking C layer particles from roller support during pressing-in process (supporting surface of roller support) are transferred during frictional coefficient test and can lead to preliminary damage in contact with roller/roller support

.

- Possible improvements (optimization of C layer adhesion, avoidance of C coating in area mentioned) under discussion

- Submission of schedule for further procedure Wk 39 -> Non-responsive content removed

4) Avoidance of fusing on roller
- Currently 2 possible solutions are being considered
- 1. Improvement of roller contact through resilient contact plate
- 2. Direct stacking of the rollers ("stack of wood") -> contact through components themselves
- Variant 2 currently prioritized. If this works, implementation by Wk 48 appears to be feasible
- Currently there are 2 x straightedge tests in use Estimation of effectiveness positive, since 2nd test has not yet found any faulty parts.

Failure statistics update (flow chart, etc.) requested by 9/19/2008, and in future each Friday so that presentation the following Monday is possible) -> Non-responsive content removed

Best regards / Mit freundlichen Grüßen

Non-responsive content removed

Robert Bosch GmbH
Non-responsive content removed

Domicile/Sitz: Stuttgart
Court of Registry/Registergericht: Local District Court Stuttgart Commercial Register No. 14000 Chairman of the Supervisory Board: Hermann Scholl;
Management: Franz Fehrenbach, Siegfried Dais;
Bernd Bohr, Rudolf Colm, Gerhard Kümmel, Wolfgang Malchow, Peter Marks; Volk-mar Denner, Uwe Raschke, Peter Tyroller

C3: Avoidance of metal splashes

Status

- Graphite coverings for metal holders in the main power range
  ⇒ 0.2% (1 of 480) metal splashes discovered directly on the adhesive layer, series: 0.2 - 0.4%

  Derived hypothesis: Shielding plate between source and component is the cause of the metal splashes while the C3 source is being conditioned

- Influence of shielding plate while conditioning the source reduced, metallic holders used:
  ⇒ One affected striking feature is currently under examination; result available on 4/10

BOSCH

C3: Avoidance of Metal Splashes

Further work

- Combine the use of graphite coverings + reduce the influence of the shielding plate while conditioning the source
  - Try out process 4/4/2008
  - Coat roller support for testing (480 RS) 4/7/2008
  - Inspection after finishing 4/9/2008
  - Presentation of results 4/11/2008

- Alternative approach for avoiding metal splashes in preparation:
  - Optimized connection of the electrical potential to the components during process 5/9/2008

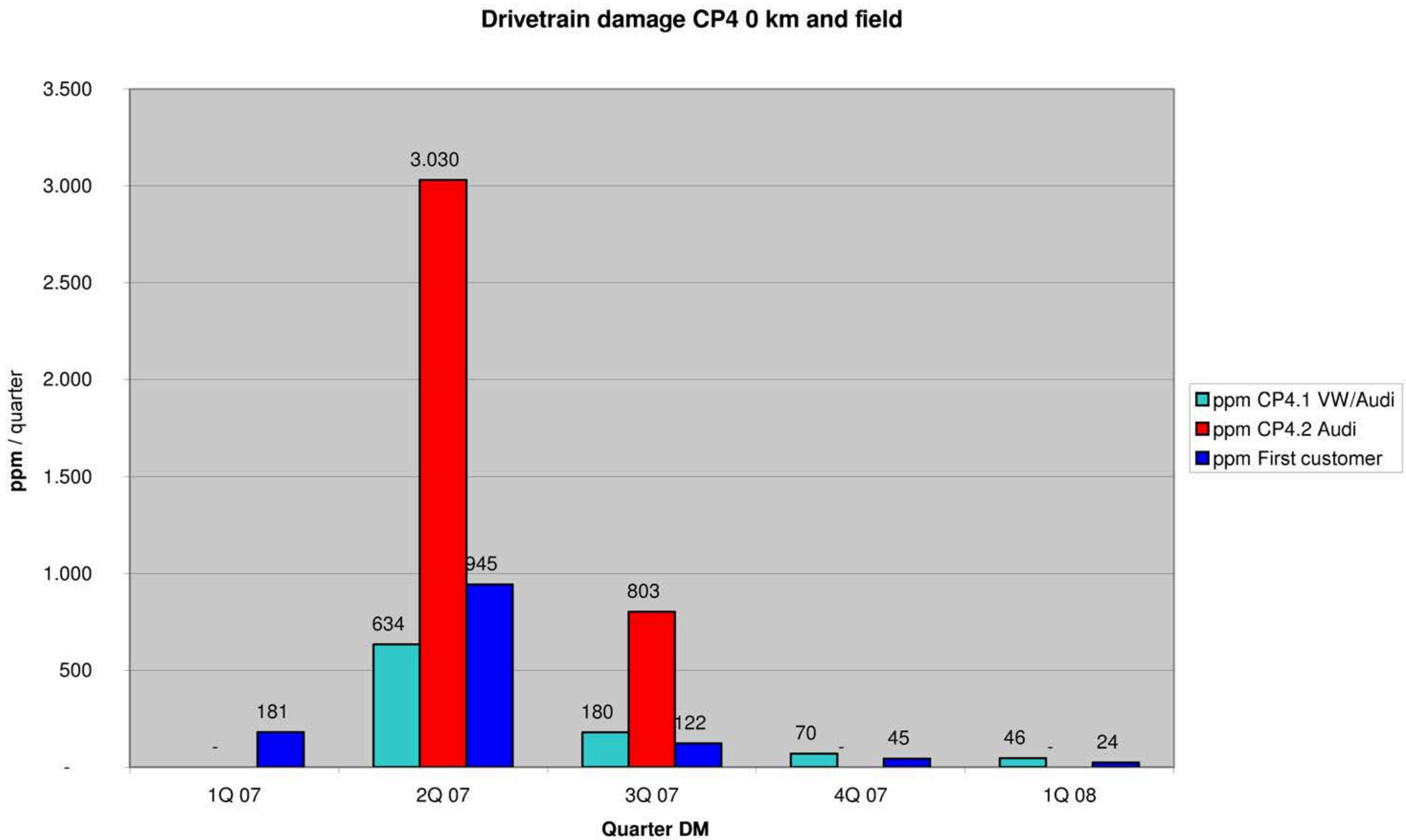
BOSCH

ENTIRE PAGE CONFIDENTIAL

EA11003EN-01375[0]

CP4 Audi drivetrain damage 0 445 010 507/ 03L 130 755

Failure statistics 0 km / Field All customers



BOSCH

Traceability and controlling of not OK pumps

→ Exclusion of pumps with turned tappets / drivetrain damage
- Traceability and control of CP4 pumps carried out by central computer.
- Transponder on the pump is read in each station
  - With not OK processes, the pump is excluded - information to employee via station monitor
  - Pumps with not OK status will be rejected in the following stations

CP4, Tappet anti-turning lock, Status 3/2008

Contents

CP4, Tappet anti-turning lock, Status 3/2008

Motivation

Following occurrence of the initial CP4 drivetrain damage during internal testing or the first start-up of the engine at the customer's, various failure hypotheses were developed.

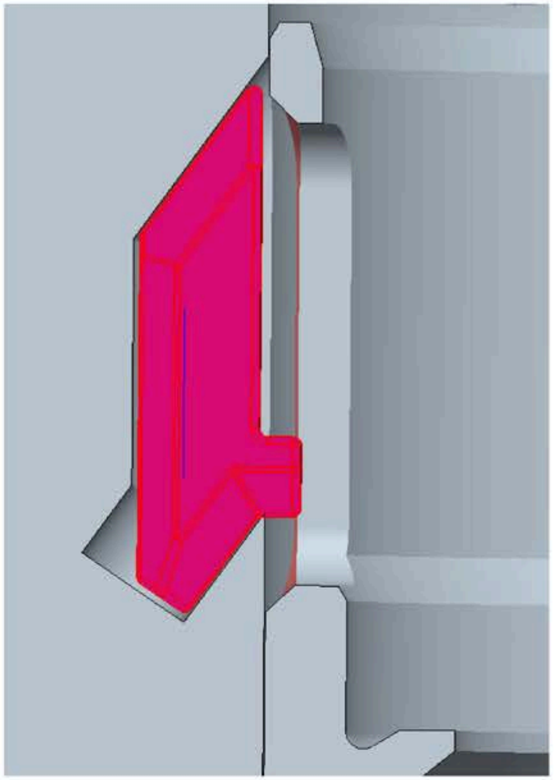
One hypothesis was that turned tappets are the cause for subsequent drive-train damage. To counter this, development on the tappet anti-turning lock was started.

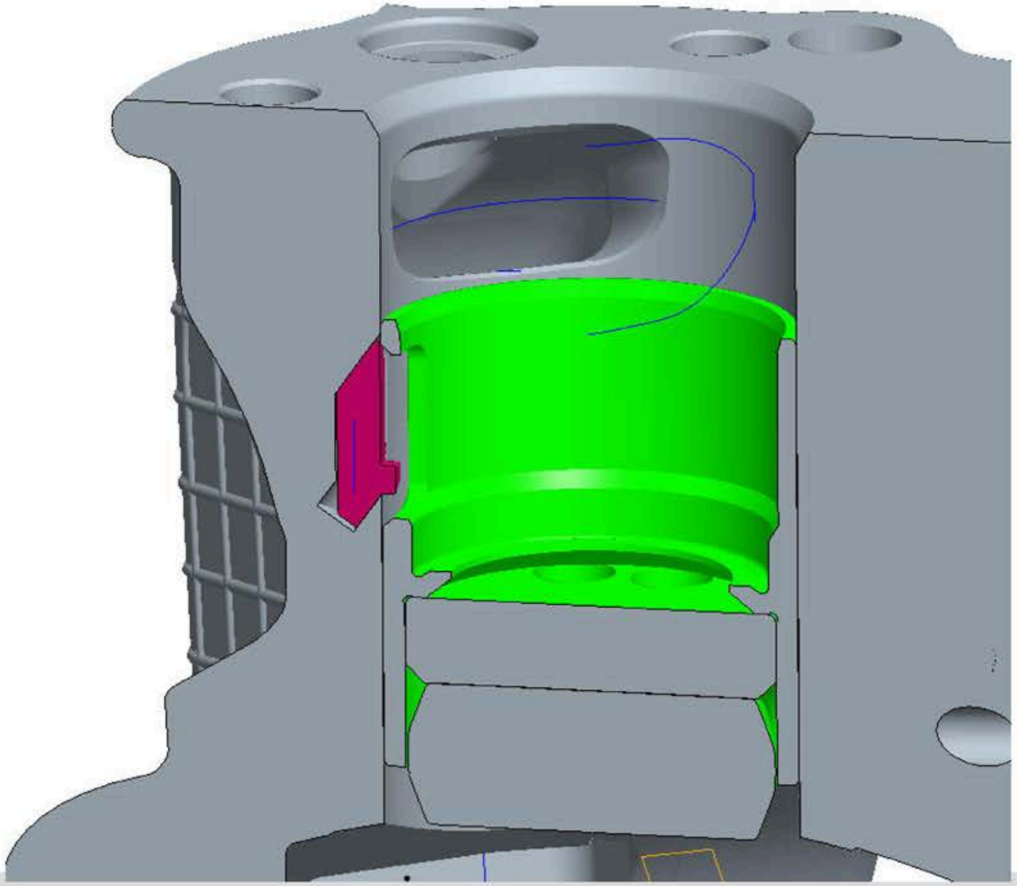
The hypothesis established at that time can no longer be upheld with to-day's information. The cause for the occurring drivetrain damage is either a stiff and/or stuck roller. The subsequent turning of the tappet is therefore a consequence of the stiff / stuck roller. If turning were to be prevented by an anti-turning lock, this would simply delay the failure and not prevent it. Through the introduction of suitable measures in the assembly process (laser scanning of the tappet position), turned installation of the tappet was effectively excluded.

CP4, Tappet anti-turning lock, Status 3/2008

Design

- Preferred solution: Variant with fitted key as insert

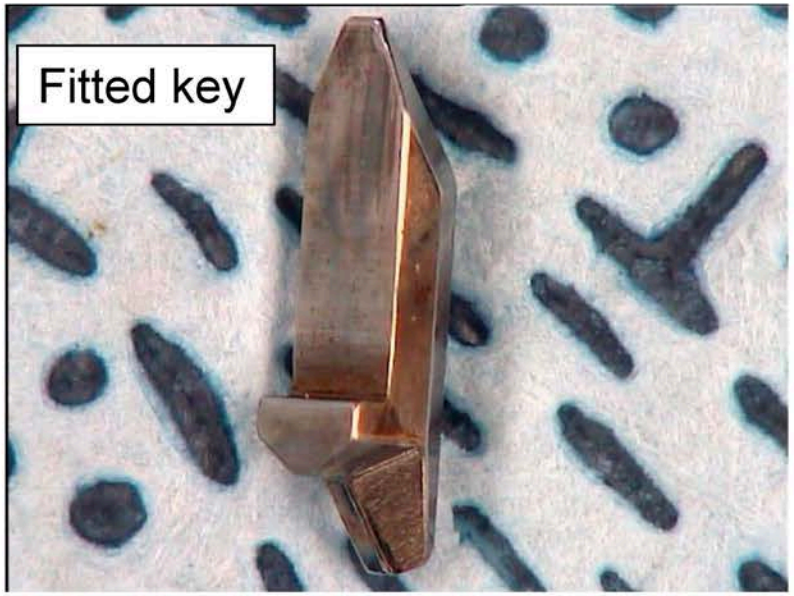


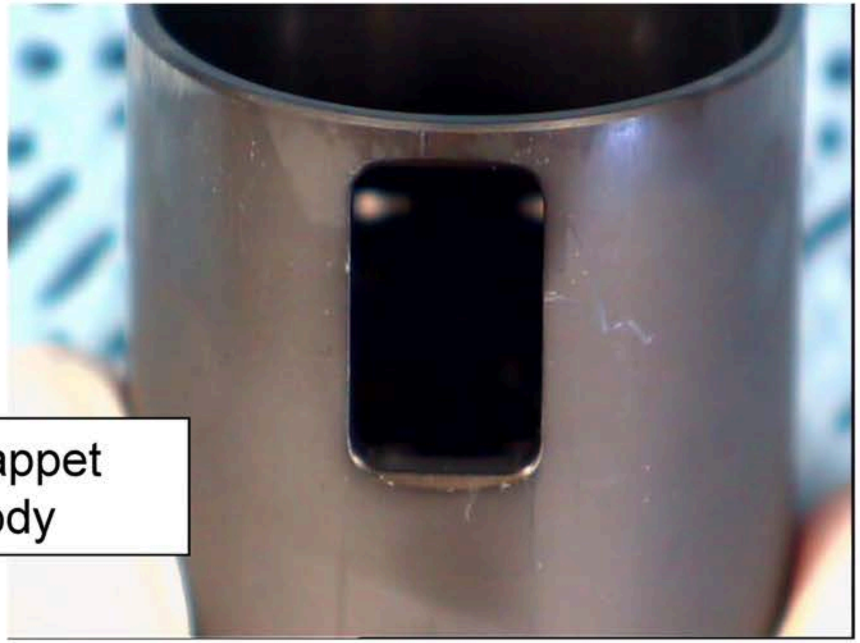


CP4, Tappet anti-turning lock, Status 3/2008

Testing:

- First 2 pumps after approx. 500h ER indicate a good result.
- Parts from near-series production process show tappet breakages (deformation, internal stresses in tappet body)





BOSCH

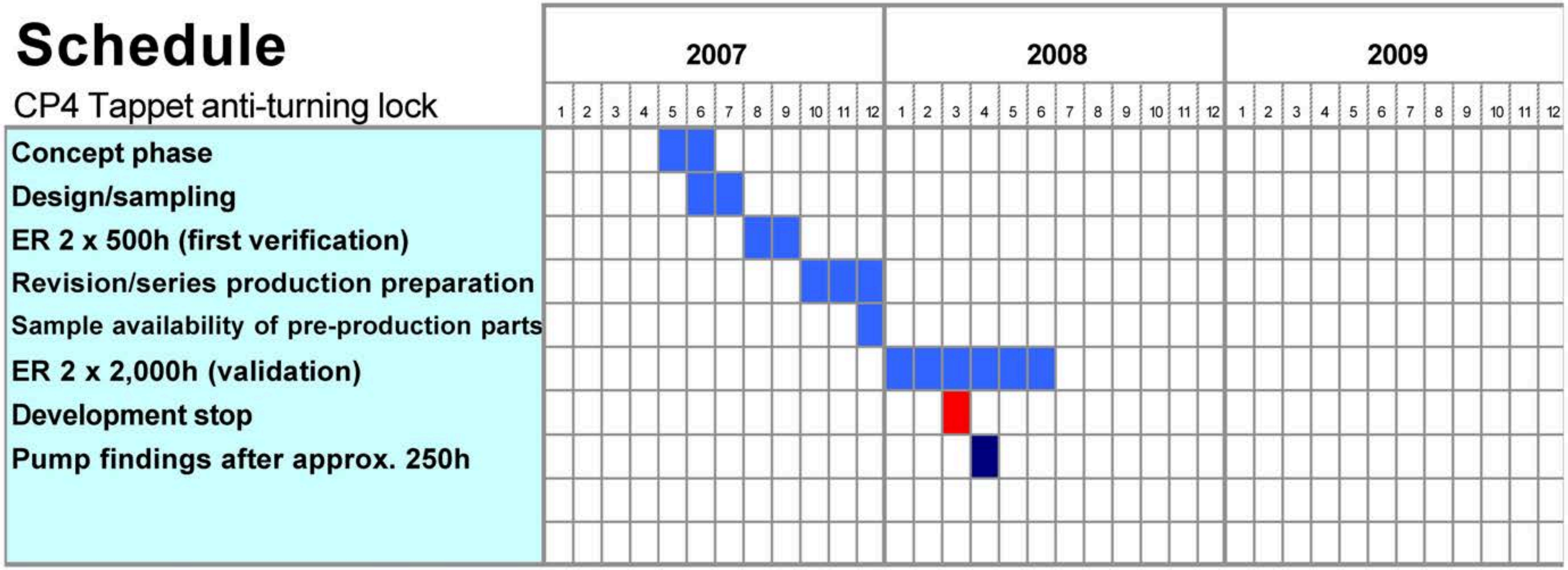
ENTIRE PAGE CONFIDENTIAL

CP4, Tappet anti-turning lock, Status 3/2008

CP4

Schedule

CP4 Tappet anti-turning lock



CP4, Tappet anti-turning lock, Status 3/2008

CP4

Summary of results

- Initial ER results are positive with respect to potential durability of the anti-turning lock described
- Near-series parts produced show weaknesses with regard to durability
- Today's findings on drivetrain damage show that turned tappet is a consequence and not the cause of the drivetrain damage. Stiff rollers are the cause of drivetrain damage. Anti-turning lock is not a corrective measure or does not increase robustness of this.
- Head of development decides to stop development on 3/2008
- Remaining ER pumps are stopped and final findings recorded

Detecting turned tappets, drivetrain damage

→ Detecting turned tappets in the assembly
- 100% laser scan of the alignment of the roller support after installation of the tappet body/roller support/roller assembly immediately before joining and bolting on the cylinder head
- 100% click-clack test after helium leak test before functional inspection - since introduction of the laser query (11/15/2007 L1; 12/21/2007 L2) no further pumps have shown any striking features in the click-clack test

→ Detecting drivetrain damage / turned tappets in the functional inspection
- 100% test
- Detecting by monitoring the temperature difference between the supply and return temperature

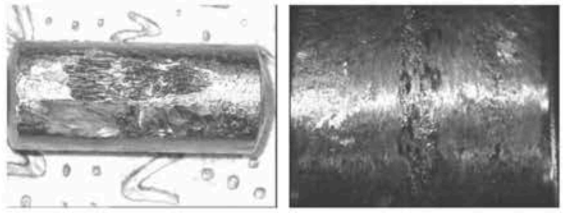
BOSCH

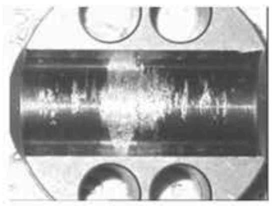
CRP CP4.1 and 4.2 - AUDI
0km complaint FeP

Drivetrain damage

Scope of defect

- 0 km: 3x pump 0445010507/ 03L130755
- Pump DM 1x 3/5/2008
  1x 3/10/2008
  1x 3/11/2008
- Failure DM: 3/14 3/17 3/18/2008
- GR Bosch: 3/25/2008





Photos of the pump DM 3/10/2008; similar failure pattern for all 3 pumps

Description of problem

- Failure on Audi final function test bench (cold test) with noise and rail pressure variances

Cause analysis

- Heavy wear of the cam and roller
- Possible assessment of the damage: Increased friction between roller and roller support leads to slippage between roller and cam. This leads to damage of the cam, roller and roller support and to turning of the tappet.

BOSCH

CRP CP4.1 and 4.2 - AUDI
0km complaint FeP

Measures

- PHA carried out in [redacted] on 7/12/2007
  Result: Commissioning conditions do not comply with specification. Commissioning of the pump was changed
- Optimization of RB test bench sequence
  D: 7/9/2007 completed
- CH assembly with 5° torsion allowance
  D: 7/23/2007 completed
- Dry pressing in of roller support
  D: 7/23/2007 completed
- Introduction of dwell time during assembly of roller support
  D: 8/28/2007 completed
- Extension of high-load testing point
  D: 10/12/2007 completed

BOSCH

CRP CP4.1 and 4.2 - AUDI 0 km
Complaint Feuerbach Plant

Measures

- Improved visual inspection of roller support according to provisional new visual inspection catalog
  D: 12/13/2007 completed
- Friction coefficient test +/- 10° to improve checking of main load range of roller support
  D: 12/13/2008 completed
- Introduction of laser scanning of tappet for the safe positioning of the tappet during assembly
  D: 12/21/2008 completed
- Introduction of final visual inspection catalog
  D: 1/2/2008 completed

Introduction of new inspection program for CP4.1 VW with more stringent test conditions
D: 1/11/2008 completed

- Introduction of visual inspection of roller support using technoscope instead of illuminated magnifier to improve detection of metal splashes
  D: 2/4/2008 completed

BOSCH

CRP CP4.1 and 4.2 - AUDI 0 km
Complaint Feuerbach Plant

Measures

- Introduction of new inspection program for CP4.2 Audi with more stringent test conditions

  D: 2/5/2008 completed
- 100% straightedge test on roller to identify elevations on the roller. Since introduction of the test parts have been found. Parts will be used for large-scale test.
  D: In parts manufacturing since 4/1/2008, in pump as of 4/7/2008
- Tests with 480 parts each to avoid metal splashes in C coating process of roller support
  1. With new electrode cover and optimized conditioning D: 4/11/2008
  2. Optimized electrical potentials for the components during the process D: 5/9/2008

  if large-scale test successful with full batch

BOSCH

Causes and measures

- ➔ Elevations on the roller
  - Impact of elevations on the roller
    - Assessment through large trial
      - Documentation of the failure potential of the elevations on roller fault pattern in the short-term area (functional test) and as medium/long-term failure (0-km/field).
      - Set-up of 50 pumps (if possible) with documented elevations (WLI measurement + EDX analysis).
      - Documentation of tappet assemblies before and after friction coefficient check
      - Installation of tappet assemblies in pumps. Documentation of tappet assemblies after functional test – Evaluation of failures
      - Definition of selected pumps for a short ER

Causes and measures

→ Elevations on the roller

- Identification of elevations on the roller
- Current identification of elevations: The identification of rollers with elevations is very difficult. The visual inspection is very error-prone.
  - Currently no failures in the visual inspection
- Measures to improve identification of elevations
  - Set up a simple device in which the roller is rolled manually against a sharp edge (blade).

BOSCH

Causes and measures

- ➔ Elevations on the roller
  - Schedule to improve identification of elevations
    - Set up simple testing device — D: 04/04
    - Test the device on the current series — D: 04/04
    - Selection of striking rollers from the current series (Prerequisite: The device works and a sufficient number of parts is found) — D: 05/02
    - Documentation + measurement + EDX analysis of striking parts (parallel to 3) — D: 05/09
    - Assemble tappet assemblies, Friction coefficient check and before/after documentation — D: 05/09
    - Installation of tappet assemblies in pumps. Execution of functional test — D: 05/15

BOSCH

Causes and measures

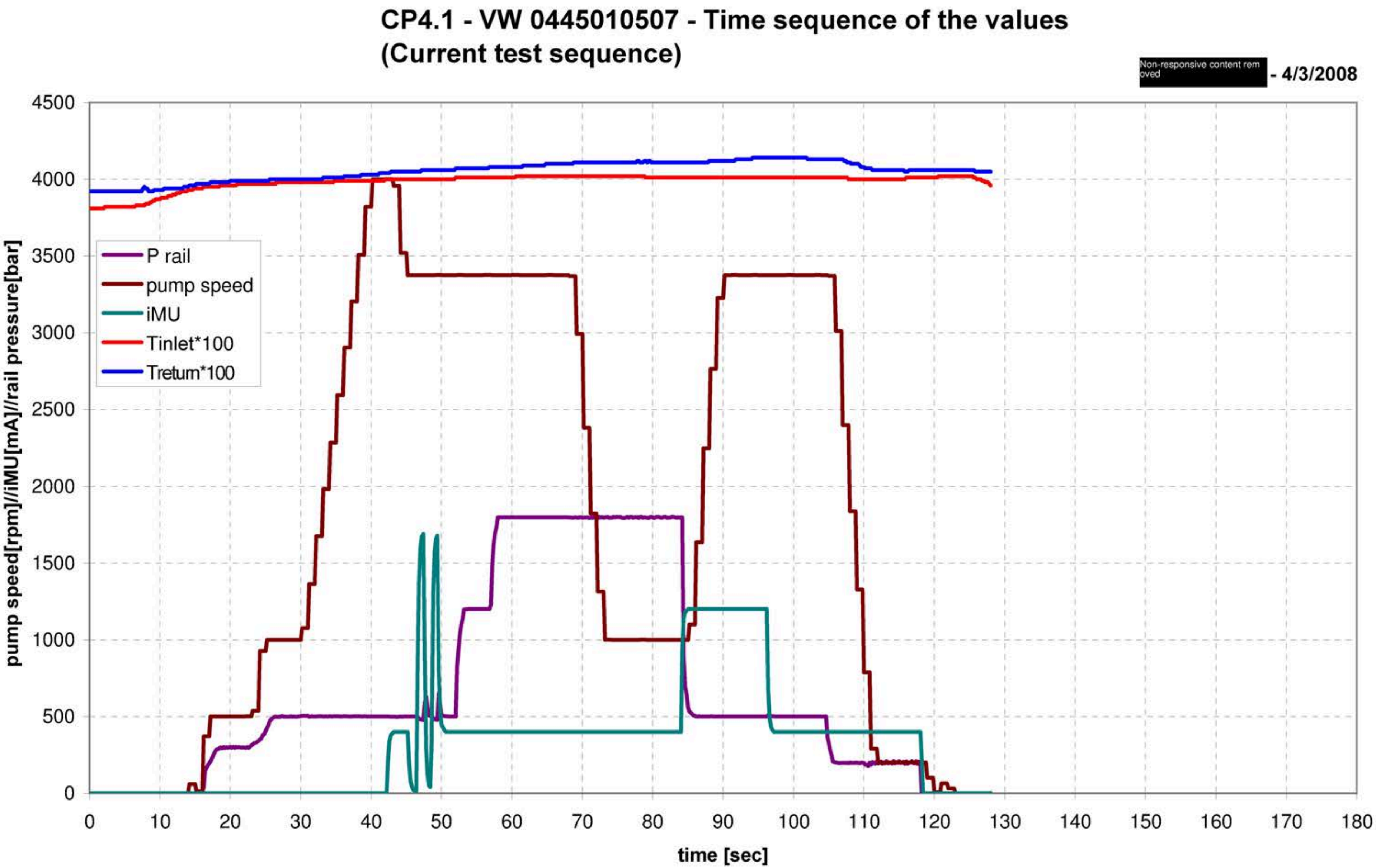
- Elevations on the roller
  - Schedule to improve identification of elevations
    - Assessment of results + decision of ER pumps — D: 5/16
    - End of short ER test (100h) — D: 5/26
    - Complete major trial — D: 5/27

Remark

The above schedule always indicates the end of an activity for all 50 pumps. Many of the activities will run in parallel, which means interim results will be possible. A prerequisite for a successful trial is the functioning detection of elevations and the identification of a sufficient number of elevated rollers

BOSCH

ENTIRE PAGE CONFIDENTIAL



Identification of turned tappet, drivetrain damage

→ Click-clack testing

- Click-clack testing is a manual test to identify turned tappet assemblies at the assembled pump.
- Identification takes place by manually rotating the camshaft. In pumps with a turned tapped an increased variable resistance is noticeable
- Current scope of test
  - 100% after completion – since 5/2007
    - No faulty pump identified up to now
  - 100% before/after assembly, function test - since 7/2007
    - No faulty pump identified since 12/1/2007 Note: Introduction of laser scanning (11/15/2007 L1; 12/21/2007 L2)
- Planned scope of test:
  - Elimination of click-clack testing

BOSCH

EA11003EN-01383[0] **ENTIRE PAGE CONFIDENTIAL**

From: Non-responsive content removed [redacted]
To: [redacted]
CC: [redacted]

Date: 7/19/2007 6:27:25 PM
Subject: Re: Minutes from OEM meeting on CP4.x turned tappet from 7/13/2007 - Item 4 Inspection oil quality CP4

Dear Non-responsive content removed [redacted]
Regarding your question relating to the HFRR value, please consider the following:
- Inspection oil contains anti scuff additives. The effect is specified and must be proven by the supplier in a FBBD (Four Ball Bearing) test.
- HFRR is a standardized test used to determine wear (ball on plate). In other words, it is a measure of the amount of wear. The test runs in the mixed friction area.
- It is possible to measure wear and friction in the HFRR test. However, a correlation of these parameters cannot be proven. This is partly due to the wide dispersion of the HFRR results in the test per se and also to the fact that different wear mechanisms (tribochemical wear/abrasive wear/adhesive wear) are involved here.
- This means that the HFRR value is not a suitable parameter with which to assess friction behavior.
- The HFRR value is relatively high for the inspection oil used in order to ensure a certain running in (abrasion/ smoothing of the surface tips of the parts).
Friction is affected by the following parameters:
- For the hydrodynamic element of friction: f (viscosity of the inspection oil) --> viscosity is specified and is tested (per delivery batch)
- Impurities in the inspection oil:
1. Caused by particles: --> inspection oil is filtered or tested with regard to contamination in the circuit (on a weekly basis).
2. Chemicals in the inspection oil: --> The chemical composition is tested using the FTIR (Fourier Transform Infrared Spectrometry) spectrum (per delivery batch)
- In our opinion therefore, the key parameters that influence the friction properties of the inspection oil are monitored.

Best regards / Mit freundlichen Grüßen / Cordiali saluti

Non-responsive content removed [redacted]

From: Non-responsive content removed
Sent: Thursday, July 19, 2007 12:54 PM
To: Non-responsive content removed
Subject: Re: Minutes from OEM meeting on CP4.x turned tappet from 7/13/2007 - Item 4 Inspection oil quality CP4

As discussed, please reply.

Best regards / Mit freundlichen Grüßen

Non-responsive content removed

From: Non-responsive content removed
Sent: Thursday, July 19, 2007 8:08 AM
To: Non-responsive content removed
Cc:
Subject: ANS: Minutes from OEM meeting on CP4.x turned tappet from 7/13/2007 - Item 4 Inspection oil quality CP4

Hello Non-responsive content removed

Why is the lubrication not being monitored? I thought that was the whole idea?

-----Original message-----
From: Non-responsive content removed
Sent: Wednesday, July 18, 2007 6:26 PM
Non-responsive content removed
Subject: Minutes from OEM meeting on CP4.x turned tappet from 7/13/2007 - Item 4 Inspection oil quality CP4

Hello,
In the meeting on 7/13/2007, a presentation on the monitoring of the inspection oil quality at RB was requested.

1) Inspection oil used: Shell V-Oil 1404 (trade name)

2) The following parameters are monitored: appearance, viscosity, color, density. These are verified by the supplier by means of a certificate.

In the goods receiving inspection at RB, these parameters and the water content and the FTIR spectrum are determined.

Attached are the results of the goods receiving inspection in 2007

<<V1404_AnfrageCP4_VW.pdf>>
Best regards / Mit freundlichen Grüßen

Non-responsive content removed

GERMANY
www.bosch.com

Non-responsive content removed

KT analysis of lateral roller start-up

Hypotheses

1) Dimensional deviation of parallelism of cam to axle A-B (bearings) Oblique position camshaft due to concentricity error between the flange bearing and the housing bearing; axial play

2) Fuel change intervals unfavorable in the failed pumps

3) DT before ER -> pump not filled, therefore fuel deposits with unfavorable a) µ (roller/roller support) have caused consider-able turning of the tappet assembly in the housing
b) µ (tappet/housing) has a negative effect on back-turning

BOSCH

KT analysis of lateral roller start-up

Hypotheses

4a) Micro movement between roller support & TB -> alternating perpendicularity error

4b) Roller runs turned over TDC -> Load due to high pressure in TDC -> Remaining perpendicularity error

5) Missing 5° turning with CH assembly (combined with H4 this is problematic for the drivetrain)

6) Press-in strength of RS too low -> RS loose -> RS turns -> No running in of the C layer

BOSCH

KT analysis of lateral roller start-up

Hypotheses

7) Mutual influencing of tappet twin pistons; Axial movement of the camshaft restricted

8) Elastic resilience camshaft/housing has a alternating effect on the sucking tappet

9) Axial movement influenced by hydraulic axial forces (influence GP)

BOSCH

ENTIRE PAGE CONFIDENTIAL

KT analysis of lateral roller start-up

		Hypotheses										
		1	2	3a	3b	4a	4b	5	6	7	8	9
Facts	1	A1	A4	t	t	A4, A5				✓	✓	
		A2	✓			✓				✓	✓	
	2	✓	✓			✓				✓	✓	
	3	A3	✓			✓				✓	✓	
	4											
	5	✓	A4			A6				✓	✓	
	6	✓	✓							✓	✓	
	7	A4	✓			A6				A7	A7	
	8											
	9											
	10											

A1: Frequent dimensional deviations in the cam form (bathtub); parallelism measured
A2: Only plausible with Sittlinger slide
A3: Axial bearing wear tends to be worse
A4: During operation, single piston behaves different to the twin pistons in terms of angle deviation (series production)
A5: Greater press-in forces for single piston
A6: Press-in forces are not process-secure for a tight fit of the RS (perpendicularity error) -> Plausibility test with measured diameters
A7: Geometrical tolerances have an amplifying effect

BOSCH

Diesel Systems

BOSCH

From	Processor	Tel	Fax

Non-responsive content removed [redacted]

[redacted]
4/11/2008
No. 884107

Log

Recipients
For Info
Host
Participants
Management
Log
Organiz.

Non-responsive content removed [redacted]

Date/location **04/09/2008, 2:30 – 5:30 PM, NeckarsulmSU, B12, middle Conf. Room**

Topic **CP4 technical discussion**

1. Complete overview RB ER test

Bosch presented the latest results from their component endurance runs and the system test. When testing the component using US fuel BDF 570, it is intended at Bosch to allow 2 endurance run pumps to continue up to 2,700 hours. With 2 further pumps, the endurance runs will be repeated on account of the lateral roller start-up.

Non-responsive content removed [redacted]

2. Current status of the gear pump

Bosch has established that only left-rotating pumps with an Eloxal layer on the cover show signs of wear. The cover wear has no influence on the function and the durability.
As a possible measure, Bosch would like to increase the robustness of the gear pump, in the form of a nickel coating on the cover and a reduction in the pressure between the coupling piece and the cover. Bosch is planning further tests to this end. The results will be presented at the next technical meeting.

Non-responsive content removed [redacted]

3. Current status regarding lateral roller start-up

In the component testing at Bosch, 3 pump endurance runs did not pass on account of the lateral roller start-up (rating $\geq$7). In the vehicle test, so far no pump has failed on account of lateral roller start-up. The cause for the failure is an impermissibly high friction between the roller end and the tappet interior surface. This brings about an overload or failure of the C layer on the roller end.

ENTIRE PAGE CONFIDENTIAL

Diesel Systems

BOSCH

From	Processor	Tel	Fax
[redacted]			

[redacted]
4/11/2008
No. 884107

Log
CP4 technical discussion

Bosch has been documenting the press-out forces for 3 weeks now. The tests and the evaluations for the press-in and press-out forces are not yet concluded. The aim is to achieve a clean contact pattern in the roller support and tappet assembly or to optimize the press assembly (increase the press-in forces!).
Audi would like to know in this regard whether the press-in speed has changed in the last 4 - 5 months?
Furthermore, Audi would like to have a graphic evaluation for the press-in forces on the roller support, for the perpendicularity and for the friction coefficient for the series production and an evaluation in view of the “drill test”.
Bosch presented the current status with the KT analysis. 9 hypotheses have been issued within the scope of the KT analysis. The main hypotheses are in the area of the press assembly. Bosch will evaluate / prioritize the hypotheses and present the results at the next technical meeting.
Bosch and Audi have agreed that other W19EU5 pumps from long running vehicles will be assessed in order to obtain further informations regarding the lateral roller start-up. In addition, Audi will verify the choice of fuel in future assessment documentation.

[redacted]

[redacted]

[redacted]

4. Current status of the low-pressure verification

Compared with measurements which were already carried out in August 2007 in the B8 2.7l (EU5 project), considerably greater pressures were measured, which Bosch was unable to explain at first. In the 3rd quarter of 2007, Audi introduced an acoustic measure in the B8 rail, which changed the correlation of PCV, FRL and pump returns. This measure involved inserting a T-piece that combined the return from the PCV and the fuel return line on the hollow screw remote from the return from the CP4. The testing (as well as the LP verification in the B8 2.7l) took place using a T-piece made of metal with an internal diameter of 6 mm. Since WK 34/07 a T-piece made of plastic with an internal diameter of 4 mm has been used in series production.
The circumstances will be discussed again and the further procedure stated at the next technical meeting.

[redacted]

Audi and Bosch have agreed that the topic of start/stop will be presented in a separate meeting by the Bosch System Development department.

[redacted]

ENTIRE PAGE CONFIDENTIAL

CP4 technical discussion Audi 4/9/2008

Hypothesis for GP clutch run-in

Aggravated axial play compensation between shaft dihedron - clutch - gear in conjunction with the warping on the "left" gear supporting surface leads to an axial force on the GP clutch in the direction of the GP cover.

Notes:

- Warping only on the left gear supporting surface (-> therefore no influence in the case of right-runners)
- Warping not found on current new parts, but in the case of used right-runners on the left supporting surface (i.e. must exist in new parts)
- During the ER the warping wears away

Basic tests to confirm the damage theory	**D. 04/09/2008**
Gears will be measured for warping prior to the test	compl. / no warping
Shaft dihedron measured	compl. / OK
• Short PER(7h) with left-runner & without warping	**-> Wear**

BOSCH

CP4 technical discussion Audi 4/9/2008

Estimation

- GP clutch run-in with R.B. testing occurred 100%
  - only on left-rotating pumps
  - only pumps with an Eloxal coating on the cover (not nickel)
- No functional impairment
- No indication of an effect on the durability
- No customer testing, (1 failed pump from W26 showed GP clutch run-in)

Development objective

- Eloxal coating must be present after target running time.

Possibilities to increase robustness

- Cover with nickel coating
- Reduce pressure between the coupling piece and & cover (analog to GP40)

Activities

• Short ER with nickel coated cover (basic test)	4/11/2008
• Short ER with GP 38 cover with 1 mm reduced through bore	4/12/2008
• List differences between the right / left & Assess influences	4/18/2008

BOSCH

Major test - Seizure provocation by metal splashes

Test description:

-> 50 roller supports with metal splashes in various magnitudes were chosen from the total quantity. In doing so it was ensured that the largest splashes and, above all, those in the area of the main load direction, were sought out.

-> The selected metal splashes were subjected to a WLI measurement, documented with photographs and then assembled into assemblies

-> The tappet assemblies were subjected to a friction coefficient testing prior to installation of the pump, the achieved values were documented

-> After the friction coefficient testing, the rollers were documented with photographs.

-> After a successful functional inspection with the standard program, the tappet assemblies were dismantled and the rollers documented again.

BOSCH

Major test - Seizure provocation by metal splashes

-> The tappet assemblies were not dismantled yet

-> **<u>Result</u>:**
Out of the 50 tested pumps, one pump (no. 46) had drivetrain damage. It showed complete roller wear with a final 90° rotation. The point of failure was whilst slowing down from 3375 to 1000 rpm at 1800 bar, as is always the case in series production.

The error-causing metal splashes were approx. 7-8µm high and were located in the main load direction

<u>Summary</u>:

Metal splashes are clearly **<u>a</u>** proven cause for the drivetrain damage in the CP4

BOSCH

Documentation metal splashes short ER

4 tappet assemblies were chosen from the metal splashes major test on 50 parts. These 4 assemblies were to be subjected to a 2x 50h ER.

After 50 h, the ER was interrupted, the roller documented and then the tappet body turned by 180 degrees. Then a further 50 h ER was driven.

Test parts were:	no. 4 = RS 1259
	no. 19 = RS 9633
	no. 35 = RS 4664
	no. 37 = RS 0275
+ extra part	no. 32 = RS 3898

Documentation metal splashes short ER

Summary of short ER metal splashes

Test part	After 50 h *	After 100 h *	Remarks:
No. 4, RS 1259	OK	OK	
No. 19, RS 9633	OK	OK	
No. 35, RS 4664	OK	OK	
No. 37, RS 0275	OK with considerable striking features	Pump not operated any further as parts required for further analysis	Dependency of metal splashes open
Extra part, no. 32, RS 3898	OK	C layer delamination in the area of the metal splashes	Failure at greater running time possible

* Relating to drivetrain damage

BOSCH

Documentation metal splashes short ER

Result of major test metal splashes:

1. Short-term failures (internal/ Okm)

Metal splashes could cause drivetrain damage in the short-term range. However, due to the major test, this could be explained only in the magnitude of 10 ppm. **I.e. there must be further causes for the failure.**

2. Long-term failure (field)

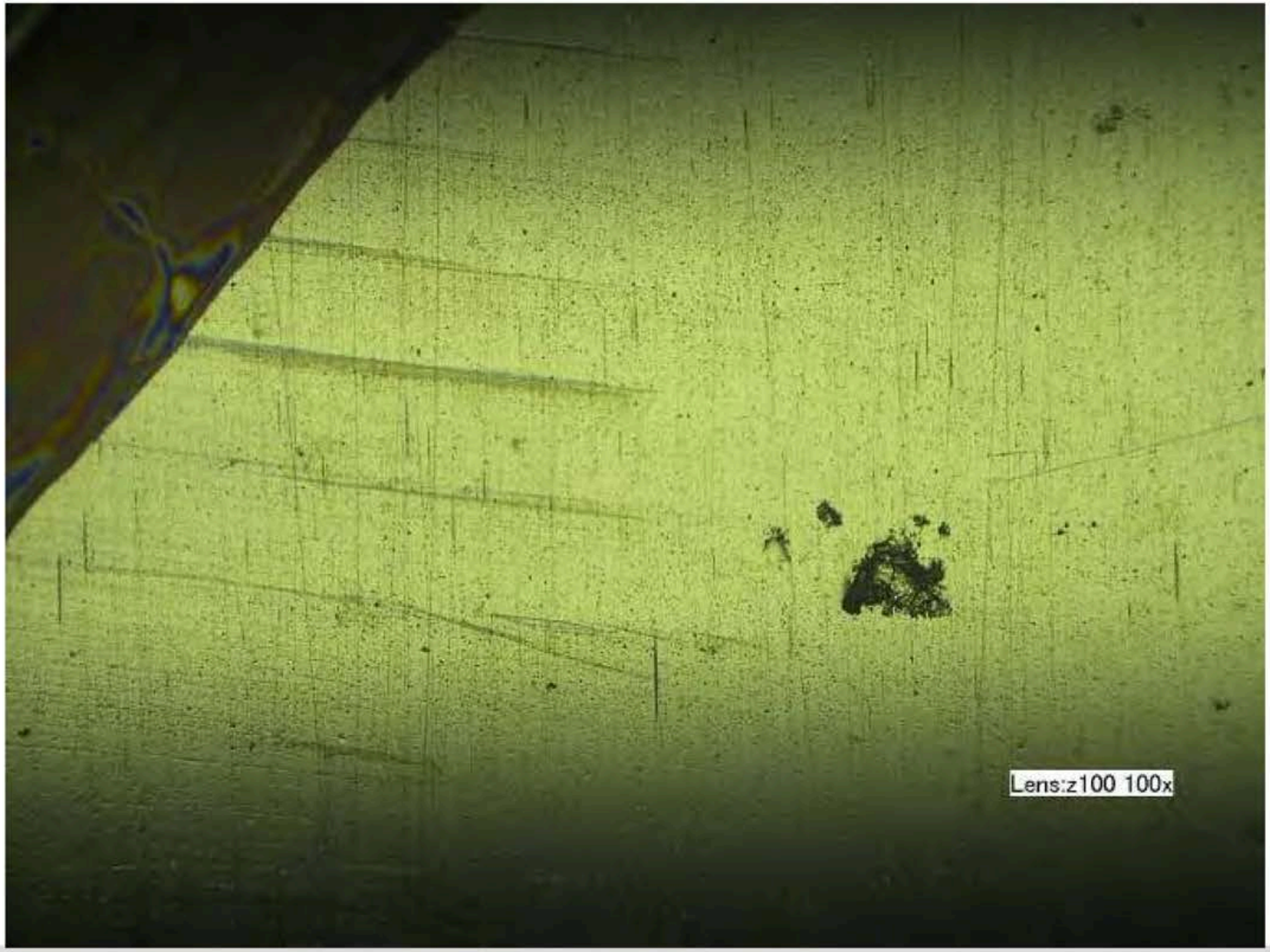
3 of the 5 pumps tested in the ER had no striking features. One pump showed striking features which have not yet been analyzed in full. A connection with the metal splashes is possible, however has not yet been proven. After 50 h an additional pump showed no striking features. After 100 h and dismantling, the C layer of the roller showed a considerable delamination in the RS.

BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

Roller no. 14

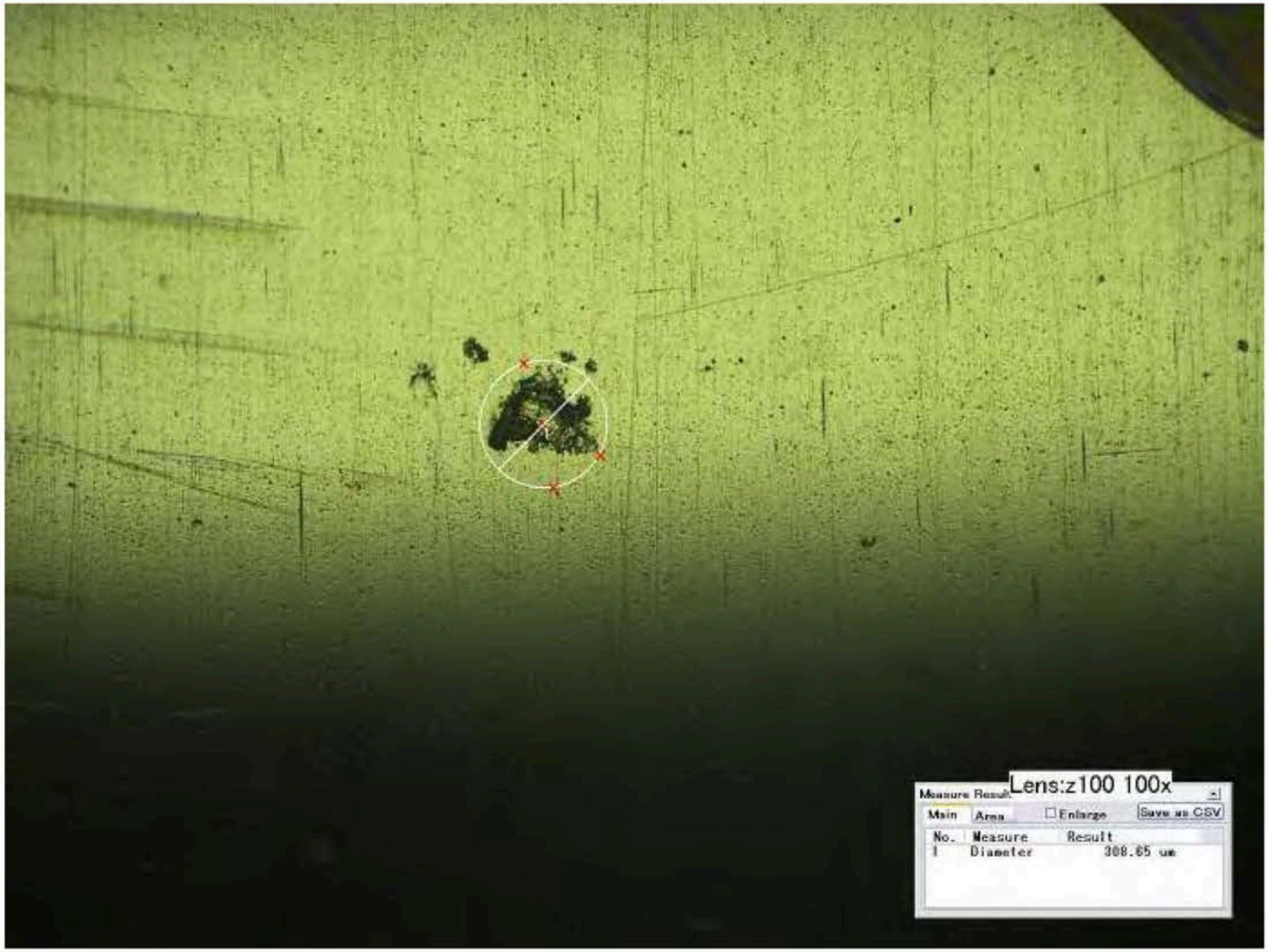


BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

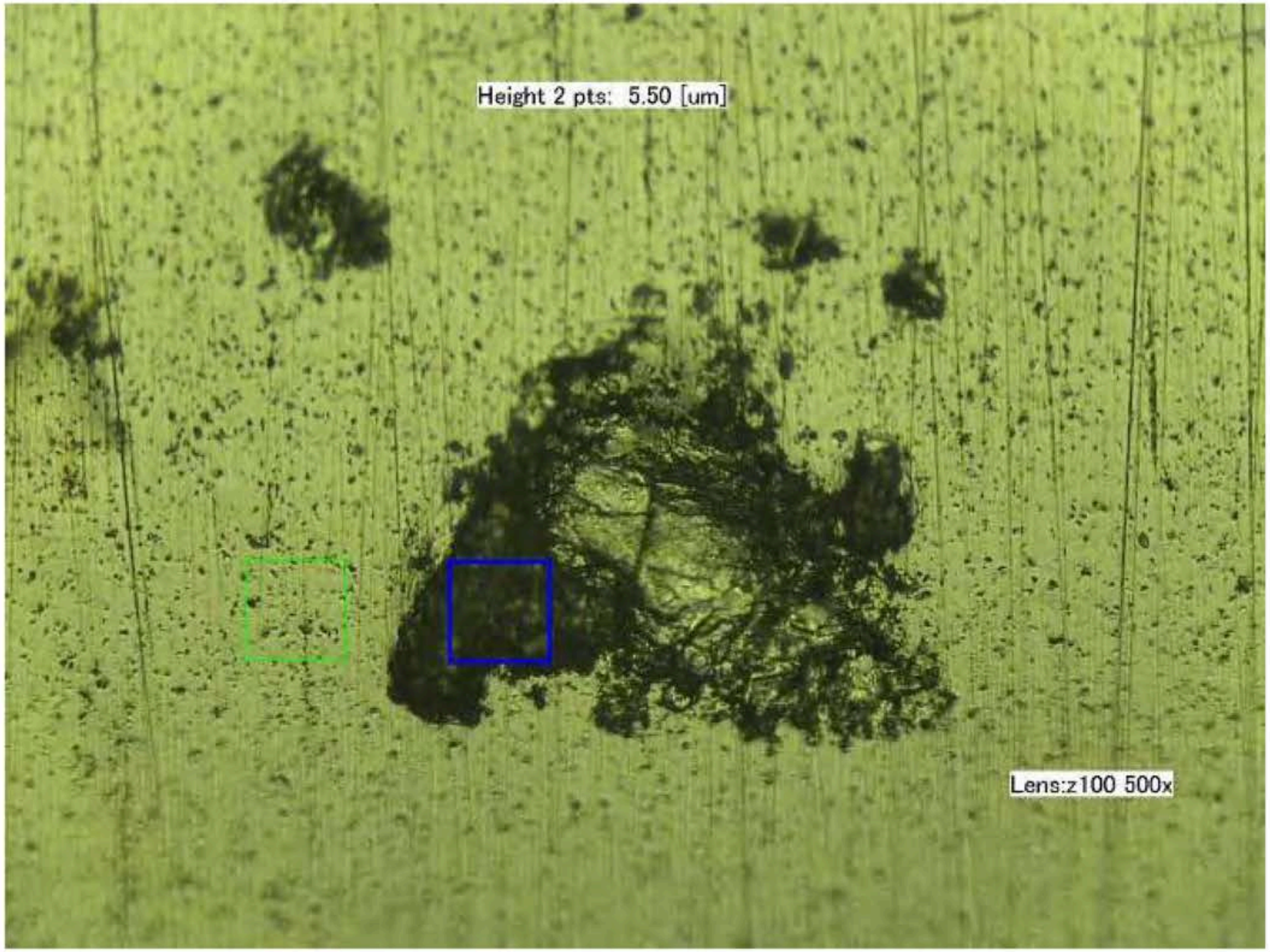
Roller no. 14



BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test Roller no. 14

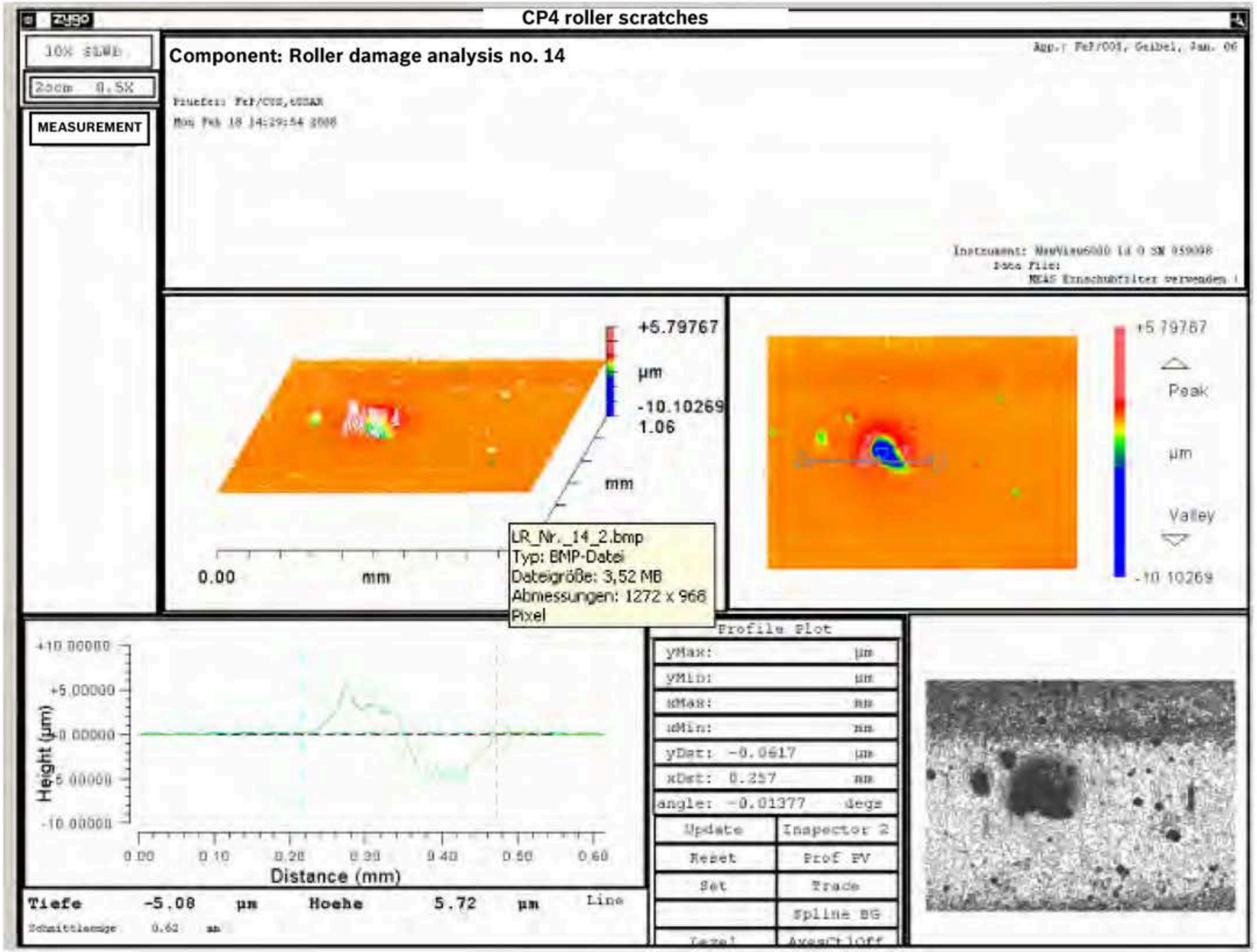


BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

Roller no. 14

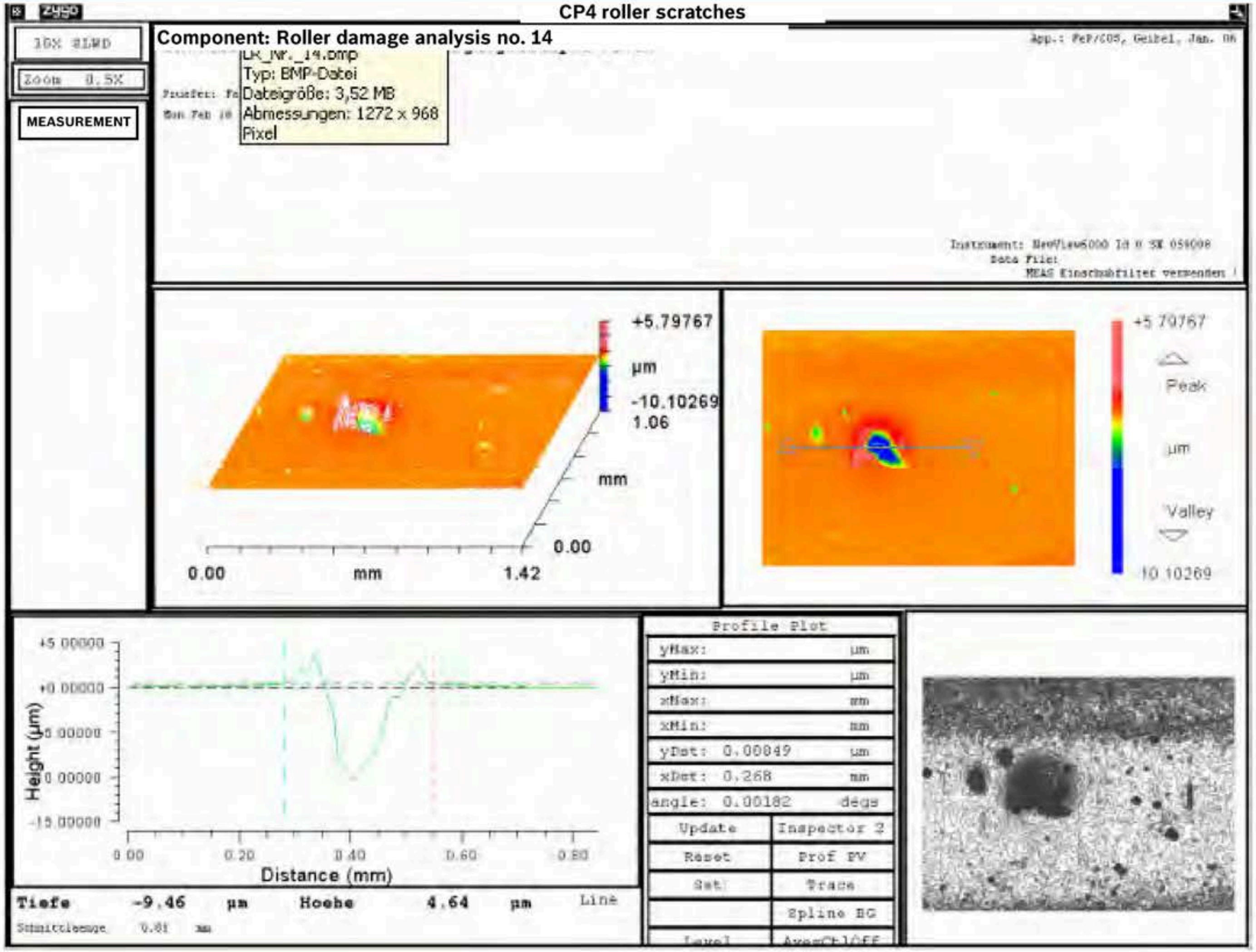


BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

Roller no. 14

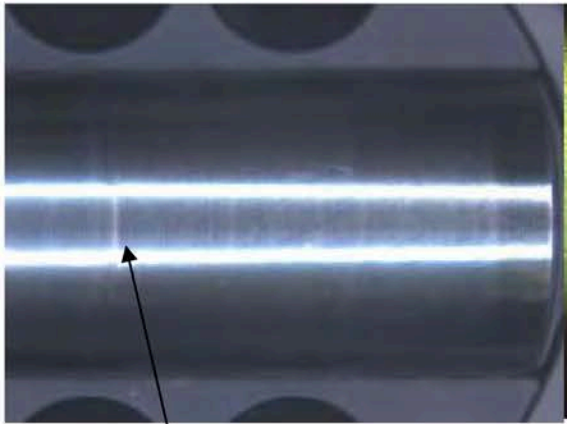


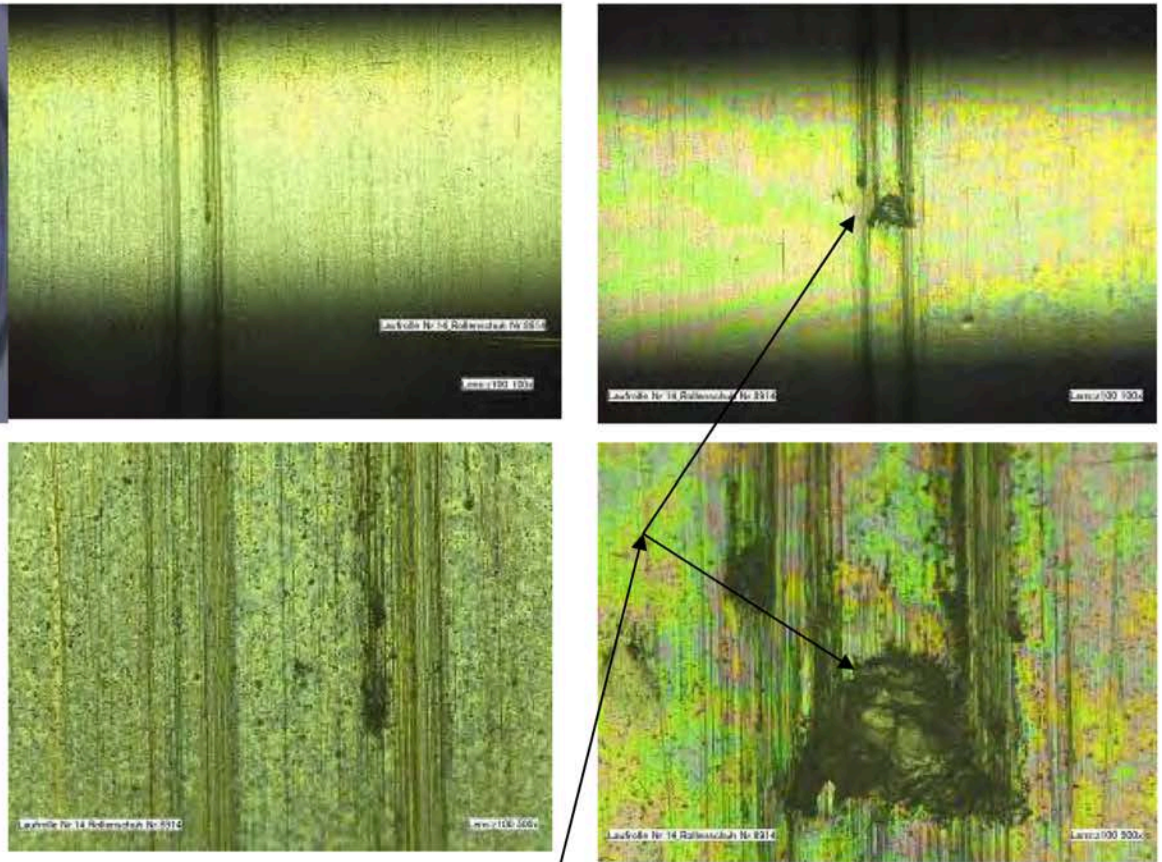
BOSCH

EA11003EN-01393[5]

ENTIRE PAGE CONFIDENTIAL

Roller_test Roller no. 14





Scoring marks

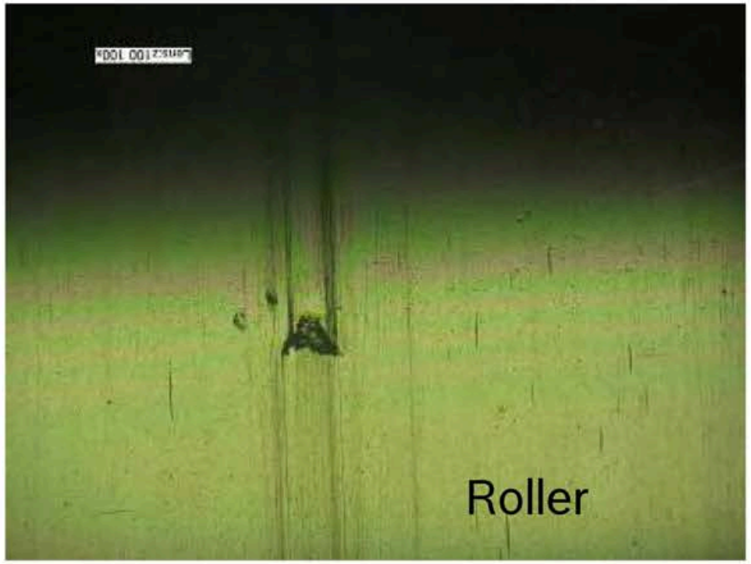
Roller after friction coefficient test

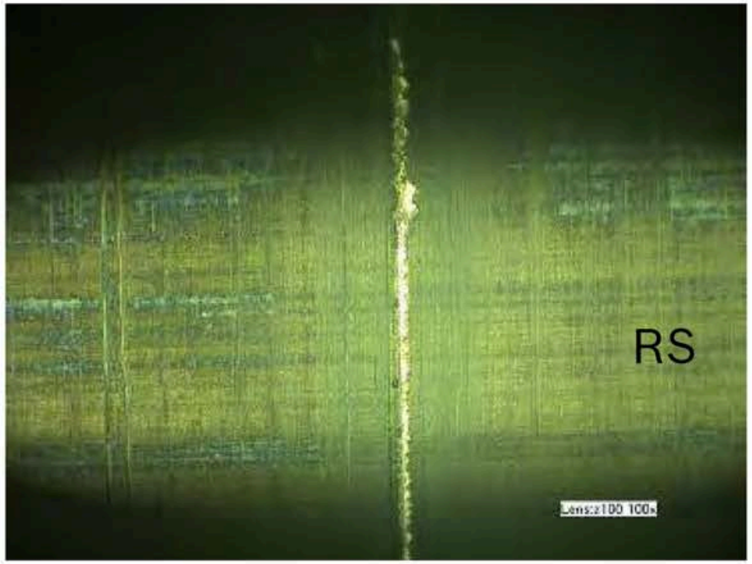
Original position

Roller_test

Roller no. 14

Seizure challenge test:
Roller no . 14 (friction coefficient OK) was installed in a pump and allowed to run with a standard program.



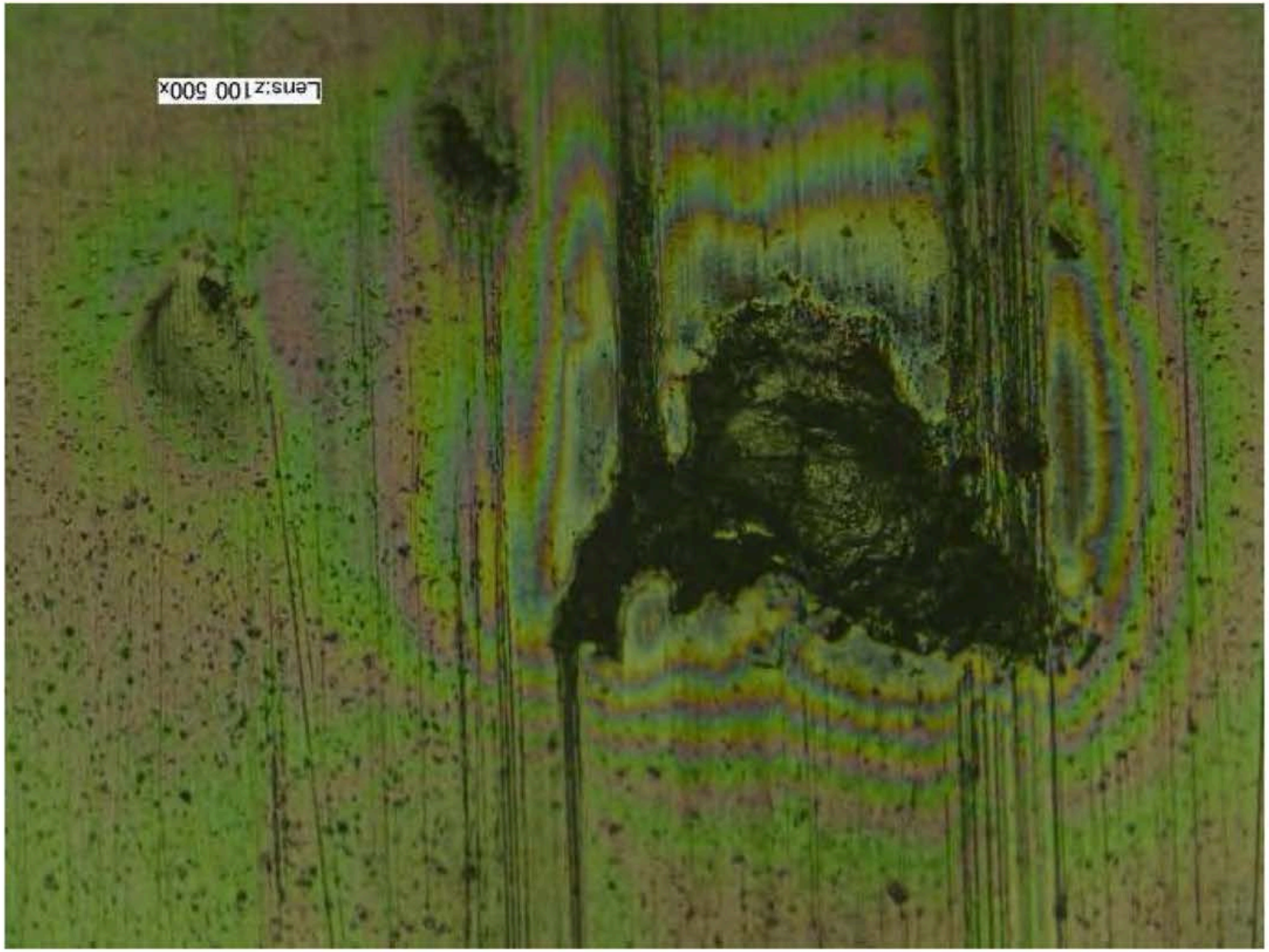


Result: no change to the original status

BOSCH

Roller_test

Roller no. 14



BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

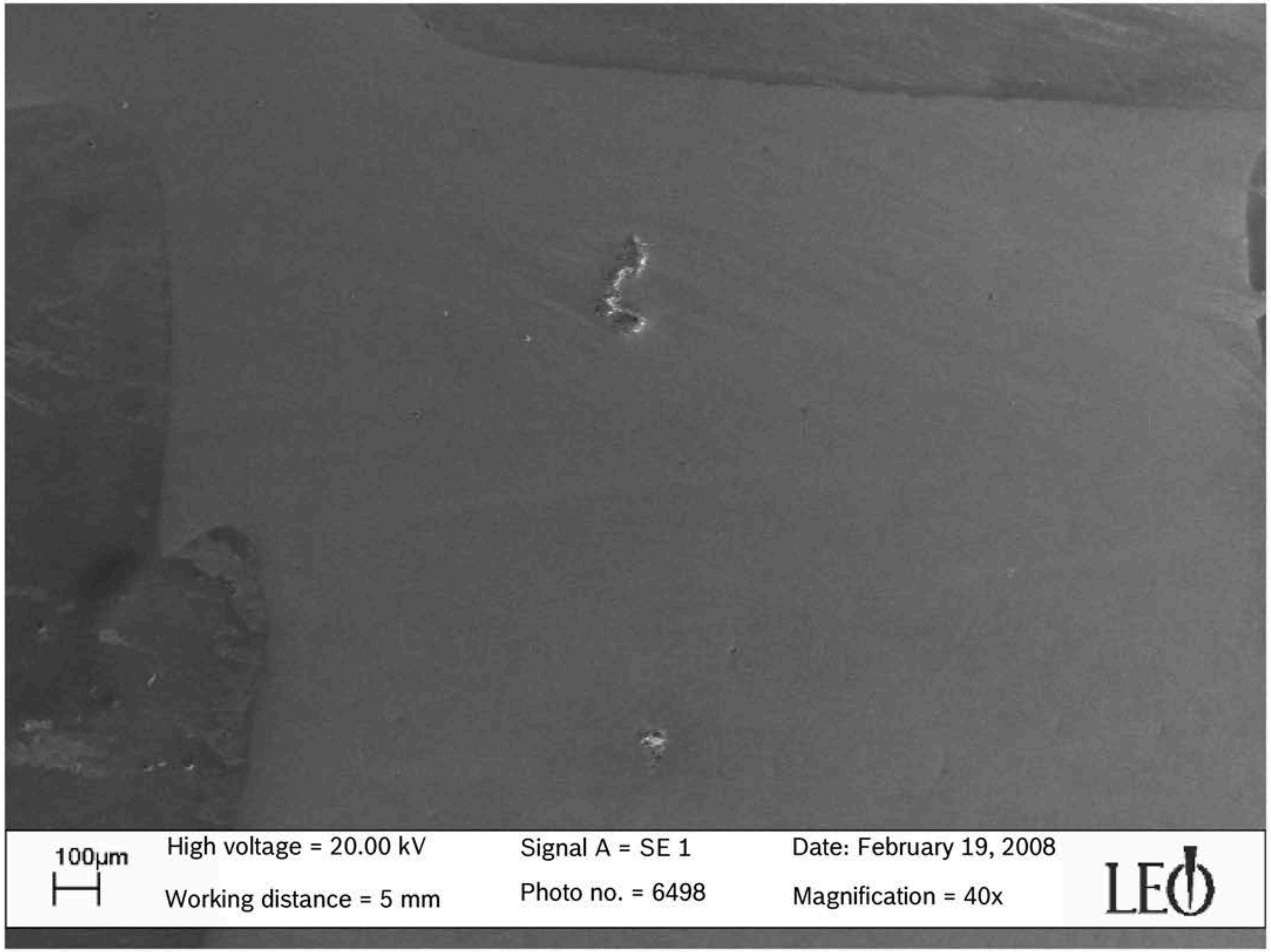
Roller no. 14

Non-responsive content removed

BOSCH

ENTIRE PAGE CONFIDENTIAL

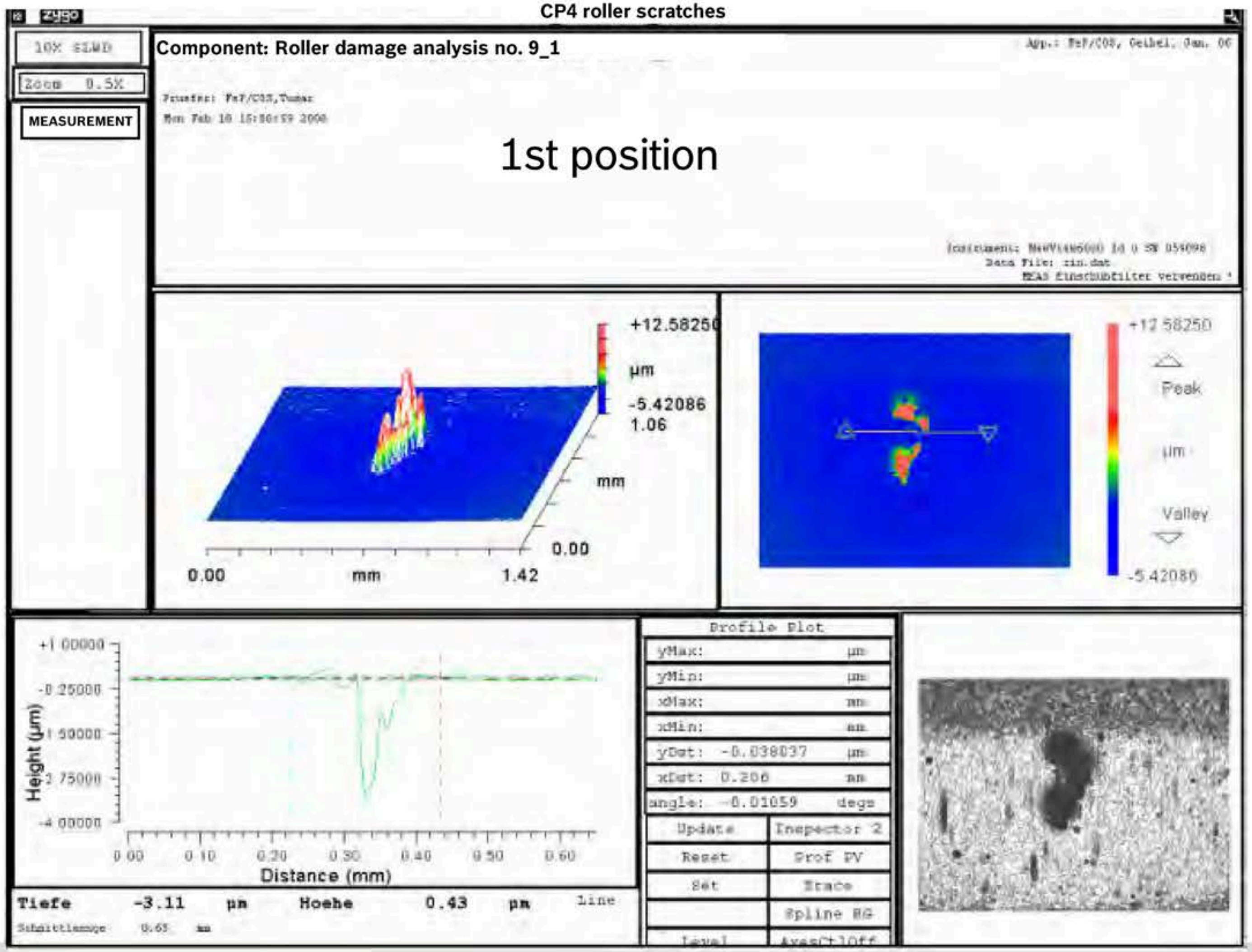
Roller_test — Roller no. 9



ENTIRE PAGE CONFIDENTIAL

Roller_test

Roller no. 9

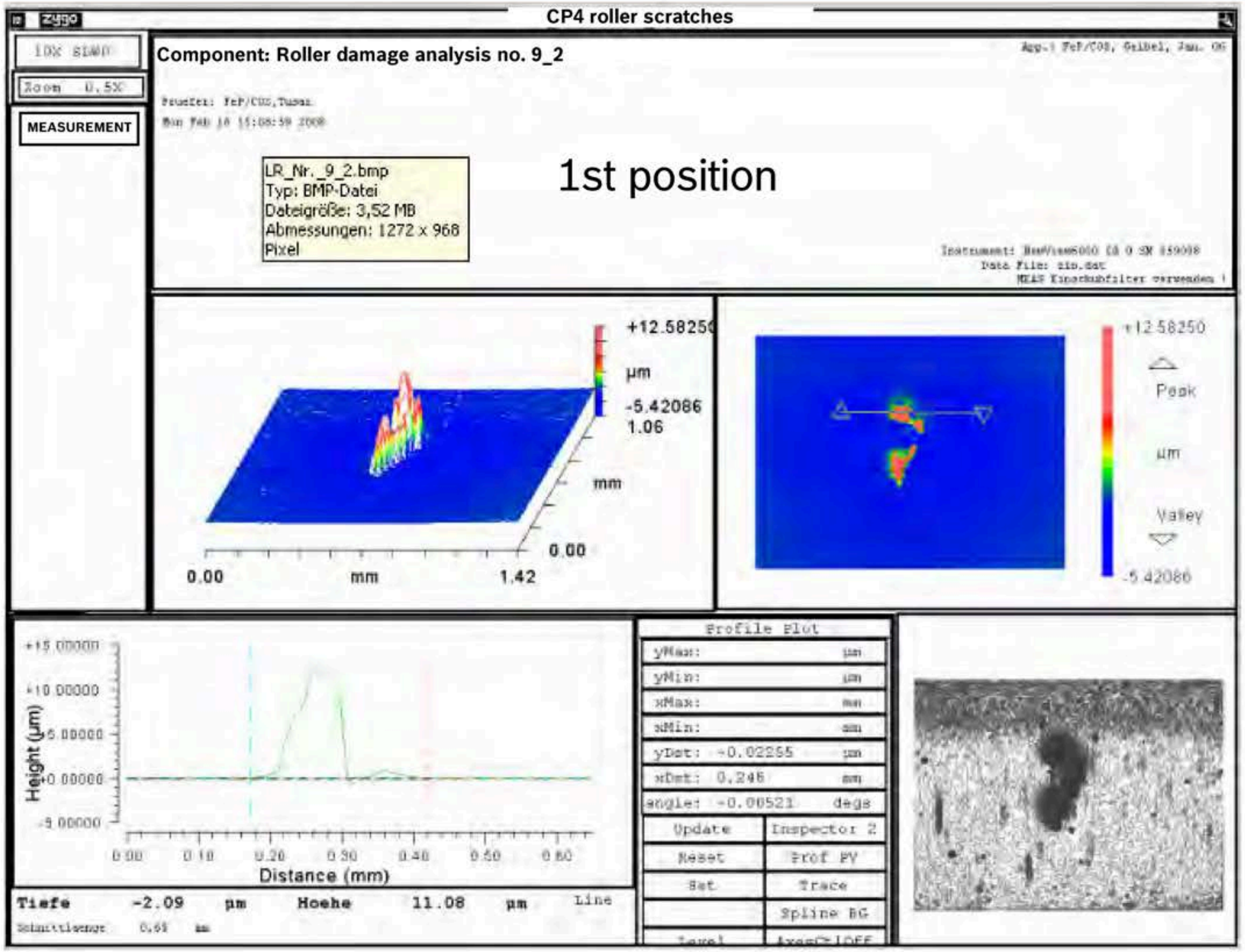


BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

Roller no. 9

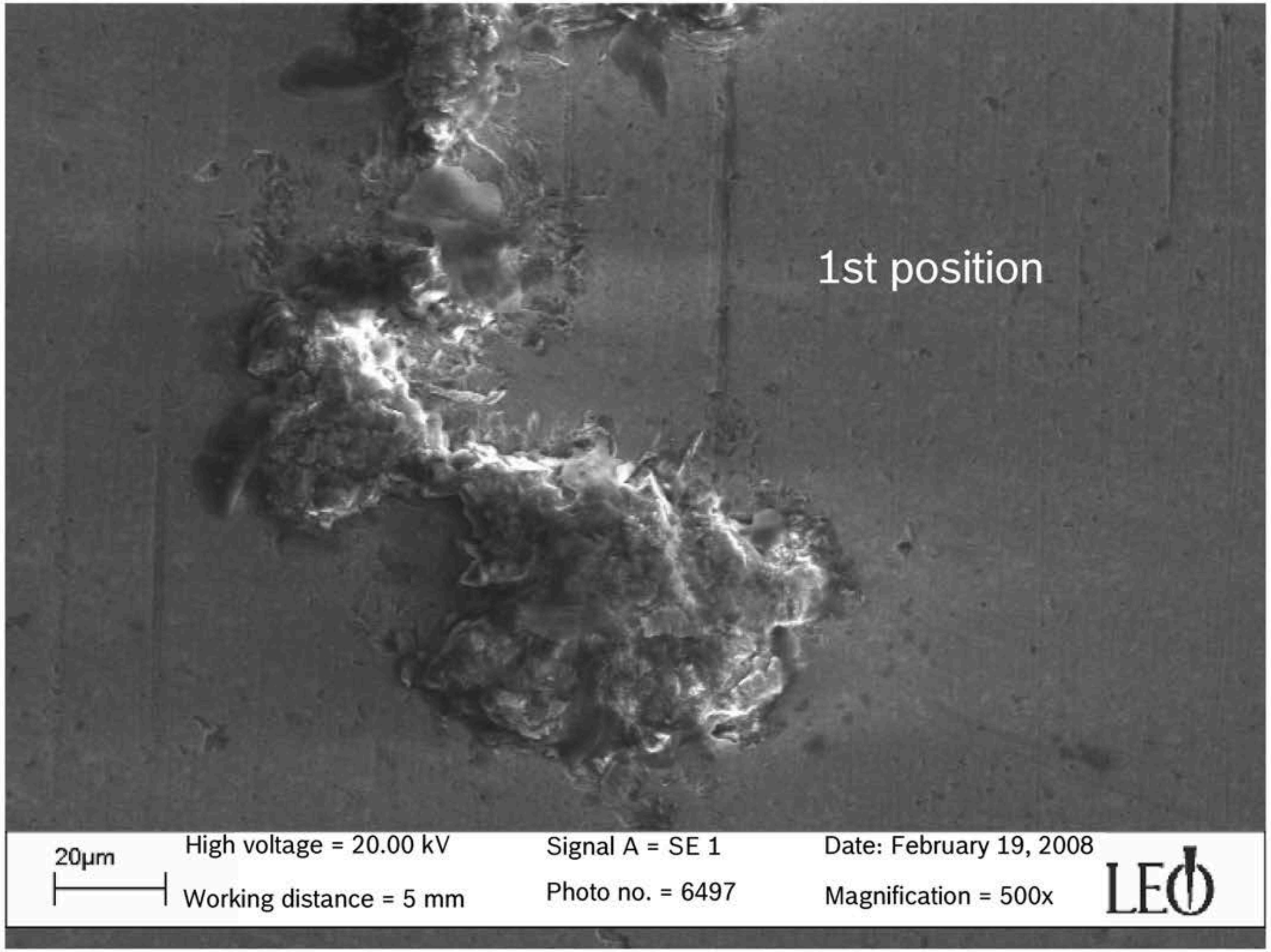


BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

Roller no. 9



Non-responsive content removed

BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

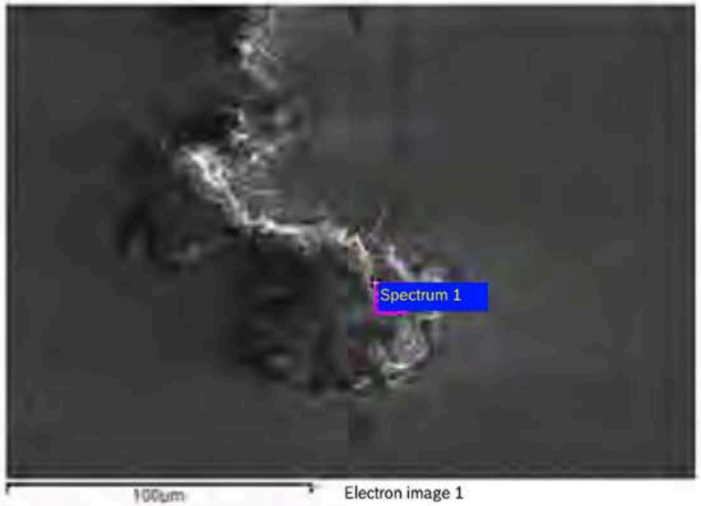
Roller no. 9

Spectrum processing:
Peaks omitted where possible: 0266,1039,2649,321,46 keV

Processing option: All elements analyzed (standardized)
Number of iterations = 4

Standard :
O SiO2 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	dimensions %	atom %
O K	45.57	59.67
Al K	41.61	32.30
Si K	8.70	6.49
Fe K	4.12	1.55
Total	100.00	

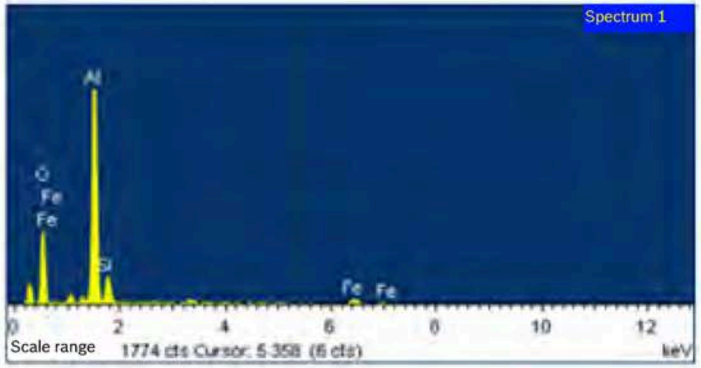


Electron image 1

1st position

Sample comments:
Part no. 9

Comments:

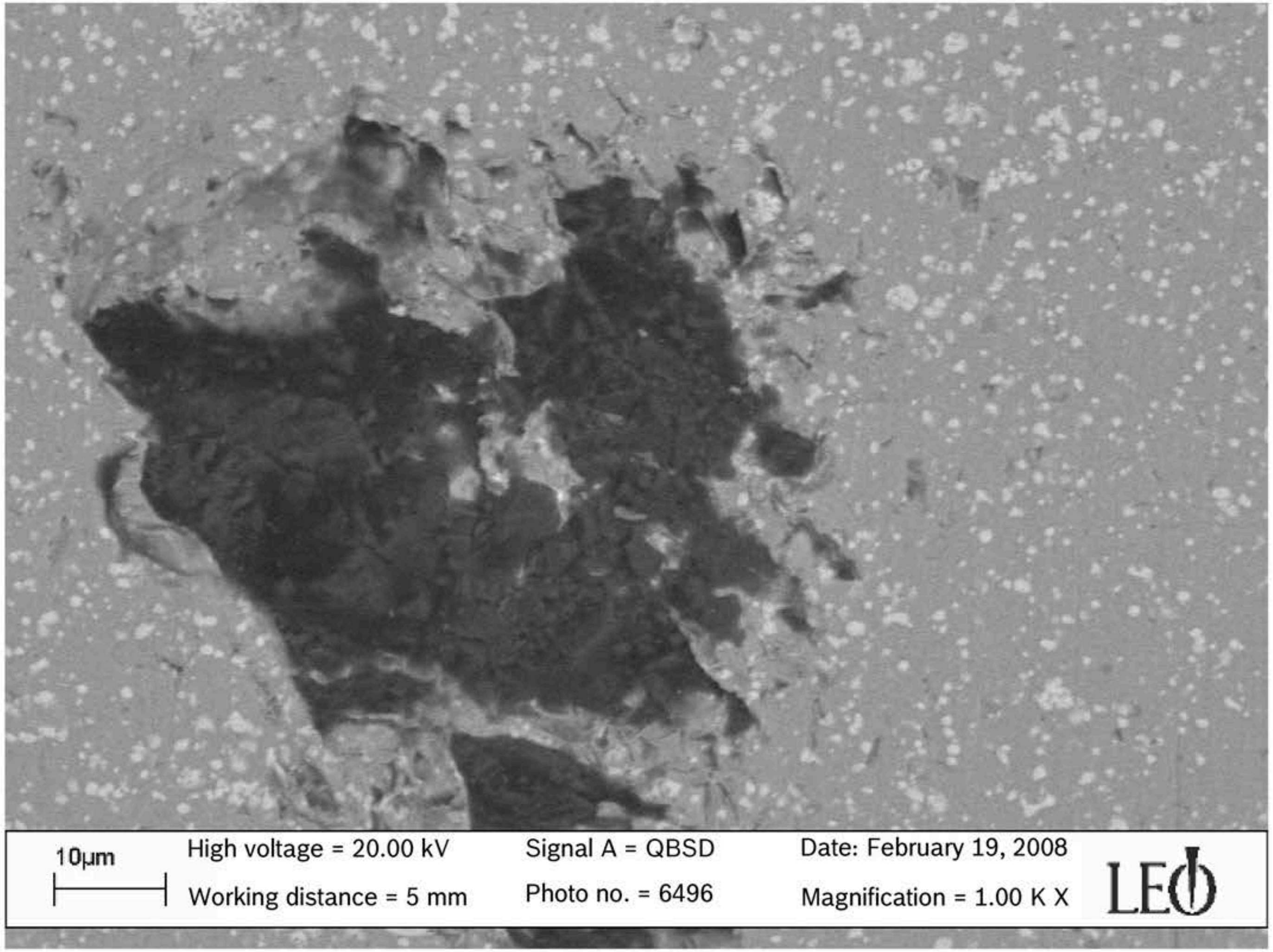


BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

Roller no. 9



BOSCH

Roller_test

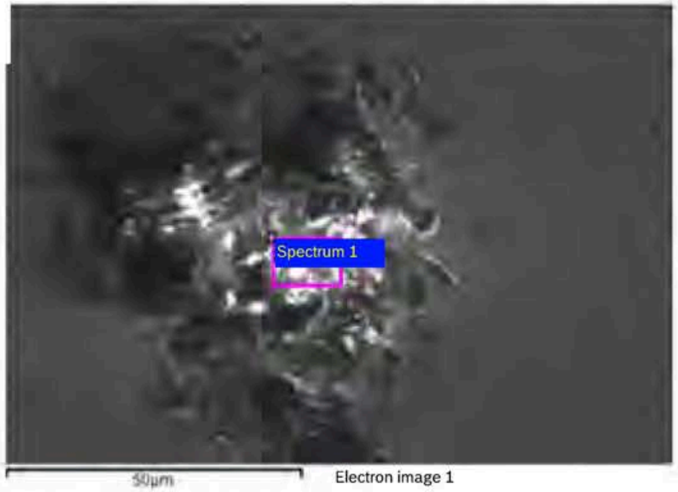
Roller no. 9

Spectrum processing:
Peaks omitted where possible: 0268,1795,2291,4976,5424 keV

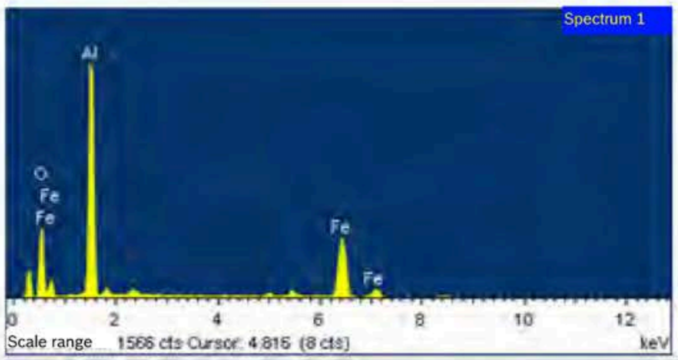
Processing option: All elements analyzed (standardized)
Number of iterations = 4

Standard :
O SiO2 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	dimensions %	atom %
O K	25.81	44.01
Al K	37.78	38.20
Fe K	36.41	17.79
Total	100.00	



2nd position



Sample comments:
Part no. 9

Comments:

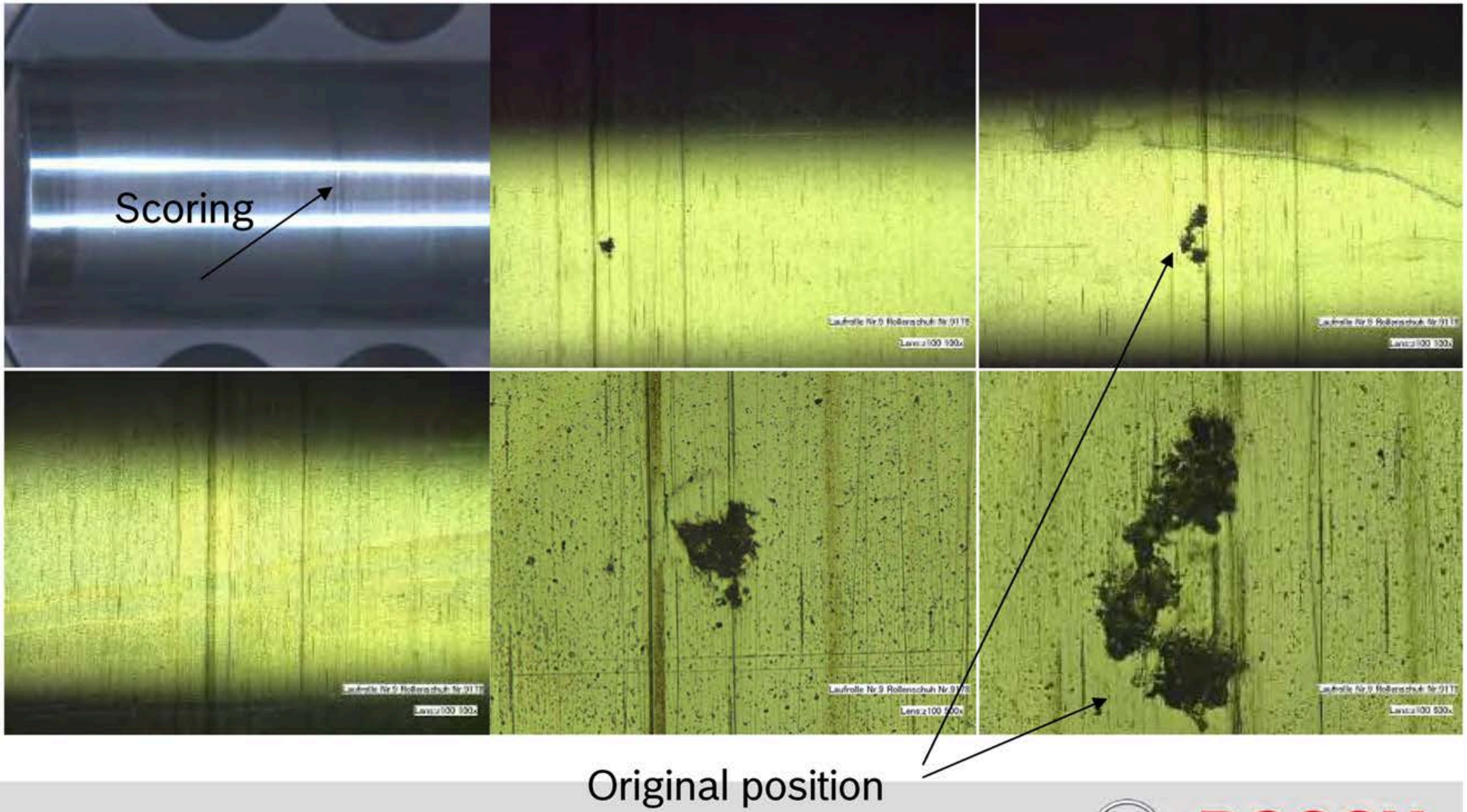
BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

Roller no. 9

Roller after friction coefficient test:

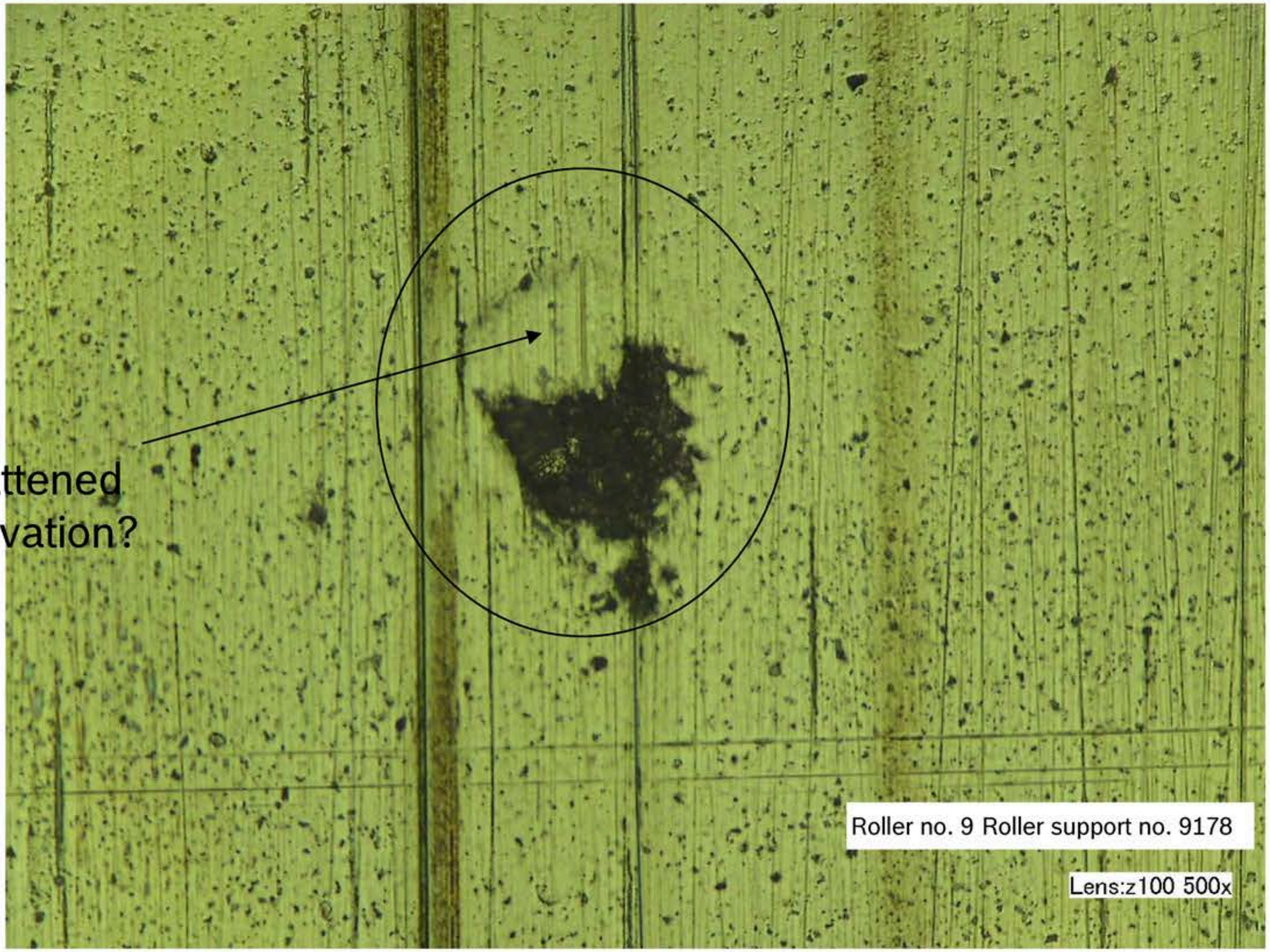


BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

Roller no. 9



Roller_test

Roller no. 9

Seizure challenge test:

Roller no . 9 (friction coefficient not OK) was installed in a pump and allowed to run in a standard program.

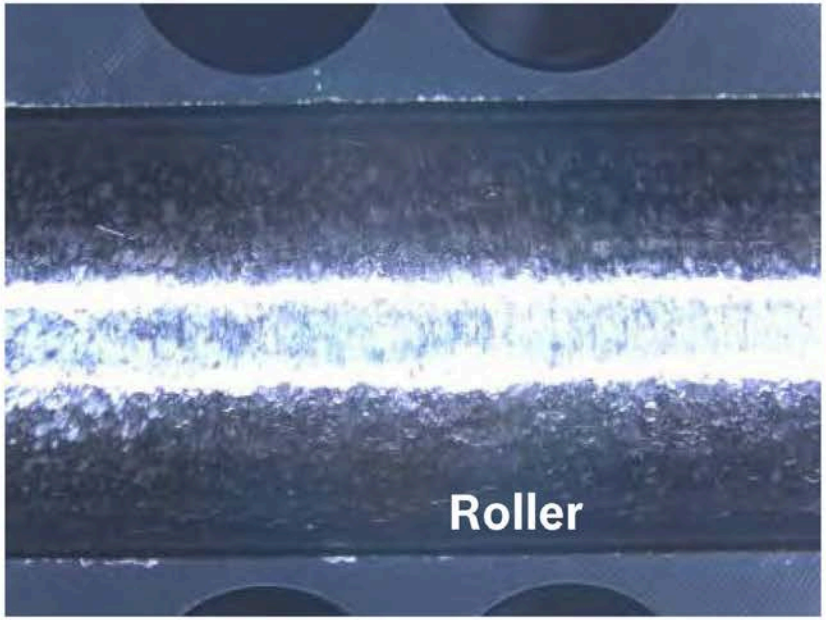
Result: Failure of the pump in TP9 at 3,375 rpm and 1800 bar, complete roller wear

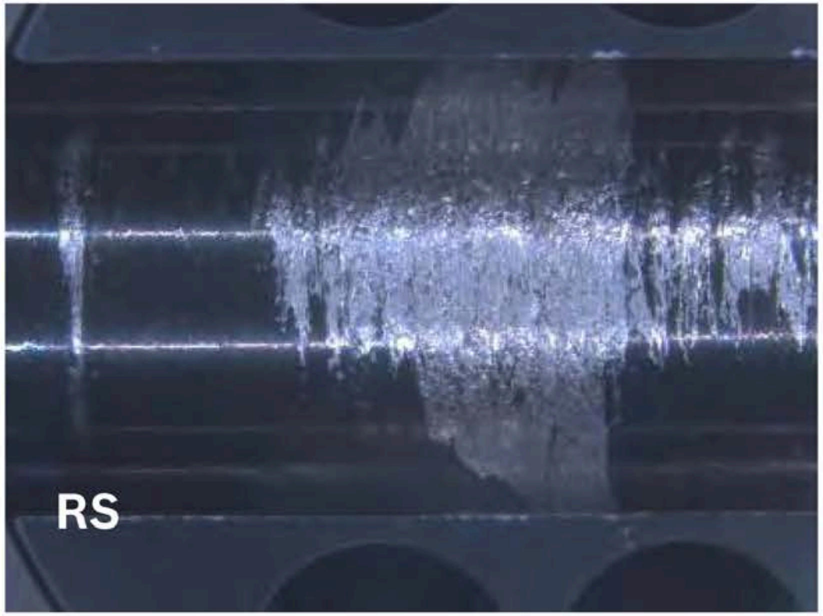
BOSCH

ENTIRE PAGE CONFIDENTIAL

Roller_test

Roller no. 9



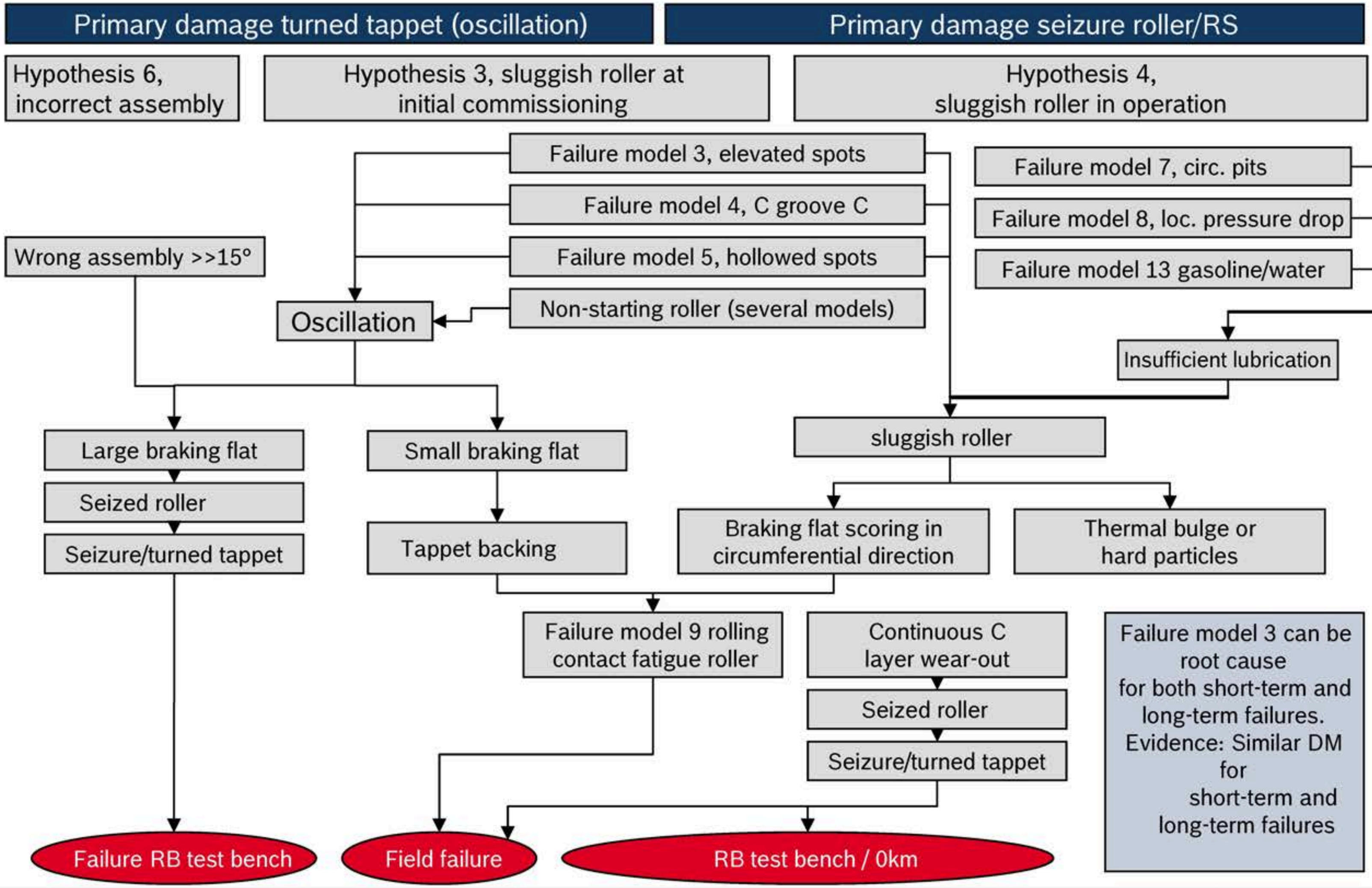


Circumferential roller wear, no 90° turning evident

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status drivetrain damage SC 3/19/2008



C3: Avoiding metal splashes

Status

→ Graphite covers on metal brackets in the main power area

⇒ 0.2% (1 of 480) metal splashes discovered directly on the adhesive layer, standard: 0.2 – 0.4%

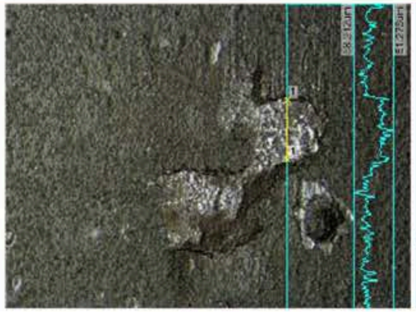
Hypothesis derived: Shielding plate between the source and the component is the cause for metal splashes during the conditioning of the C3 source

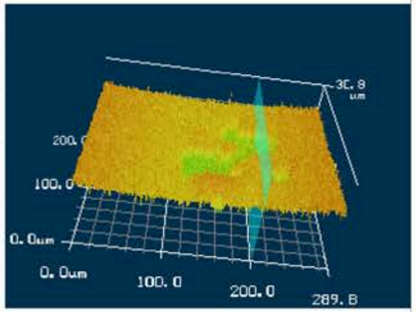
→ Influence of the shielding plate reduced during conditioning, metal bracket used

⇒ A striking feature

BOSCH

C3: Avoiding metal splashes





Status

Reduced influence of the shielding plate: Status of the analysis of the striking features:

→ SEM analysis - NMI:
both the topography as well as the EDX analysis (element analysis) suggest that the striking feature is not metal splashes

→ FIB section follows

Result:

→ Probable relevant mechanisms for metal splash generation and successful avoidance measure found

BOSCH

C3: Avoiding metal splashes

Proposed further work

Statistical verification of the result: One process with 2880 roller supports

→ Additional verifications already carried out in the run-up (model wear)

→ Recommendation for a positive test: Immediate conversion to optimized process

 ENTIRE PAGE CONFIDENTIAL

Non-responsive content removed

Sent: Monday, April 07, 2008 1:44 PM
Subject: Agenda for 3. Audi CP4 zero-fault meeting on 04/10/2008 with a focus on drivetrain damage

Agenda for 3. Audi CP4 zero-fault meeting on 04/10/2008 with a focus on drive-train damage

PN: Audi: Non-responsive content removed
VW:
Bosch:

1. 08:00 - 08:15 AM CP4-Q situation 0km/field Audi/VW, Non-responsive content removed
R: [redacted]
CP4-Q-situation 0km/field Audi/VW, Non-responsive content removed
R: [redacted]

2. 08:15 - 11:00 AM Status of drivetrain damage, OPL fr. telco from 03/05/2008,

2.1 08:15 - 08:25 AM Failure hypotheses for drivetrain damage (if required)
[redacted]

2.2 08:25 - 09:00 AM Major test on metal splashes io the roller support (RS)
R: [redacted]

2.3 9:00 - 9:20 AM Avoid metal splashes on the roller support (RS)
R: [redacted]

2.4 09:20 - 09:45 AM Avoid elevations on roller
R: [redacted]

2.5 09:45 - 09:55 AM Presentation of Bosch CP4.1 and CP4.2 functional test sequence old/new with indication of internal drivetrain failures old/new
R: Non-responsive content removed

2.6 09:55 - 10:05 AM Recording actual sequence of the cold and hot test benches Audi Györ, VW Chemnitz, and Salzgitter Skoda
R: Non-responsive content removed

2.7 10:05 - 10:30 AM Appraisal of 3 CP4.1 from R4, 2.01 engine Audi Györ
R: [redacted]
Appraisal of 1 CP4.1 from VW Jetta (US07), verification vehicle
R: [redacted]

2.8 10:30 - 10:40 AM Question from [redacted] regarding set cold test run in Györ:
Can/should the time be retained with speed 1000 and rail pressure ZERO???
Please compare the two target curves; in my opinion, they are different (one is 9 sec, one is 2 sec). Which applies?
R: [redacted]

2.9 10:40 - 10:45 AM Audi/VW cold test process differences - why
R: Non-responsive content removed

2.10 10:45 - 10:55 AM Checking the production, assembly and testing data of failed CP4.1 for striking features
R: [redacted]

2.11 10:55 - 11:00 AM How can a turned tappet be reliably detected at RB? Description click-clack test (production tour)

R: Non-responsive content removed

3. 11:00 AM - 12:30 PM Production inspection
3.1 Handling of CP4 reworking, not OK Function test (DNA table)
R: [redacted]
3.2 Acceptance of module 4
R: [redacted]

4. 12:30 - 1:15 PM Lunch (canteen)

5. 1:15 - 1:25 PM Comparison of the relative properties Bosch test oil with diesel
R: [redacted]

6. 1:25 - 1:45 PM Statement by Bosch concerning the topic of anti-turning locks
R: [redacted]

7. 1:45 - 2:00 PM Inspection 4. module, Feuerbach plant
1.1 Change notification - Module 4. Parts production
1.2 Verification sheet FeP/QMM3
R: [redacted]

8. 2:00 - 2:10 PM Status of MU O-ring leak, pump verification vehicle
R: [redacted]

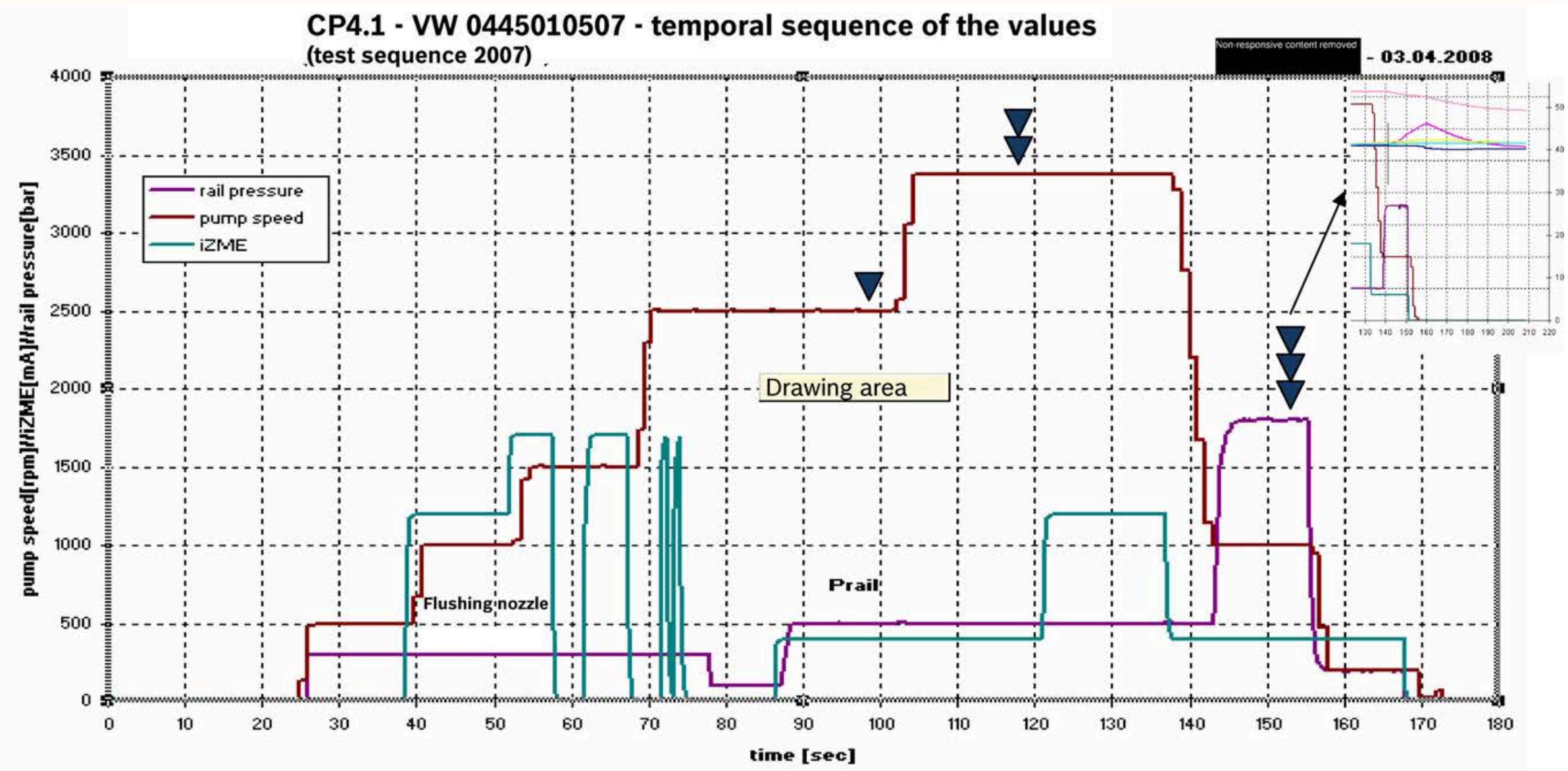
9. 2:10 - 2:15 PM Coordination 2DP date, GP38 Hallein
R: [redacted]

10. 2:15 - 2:30 PM Audi requirement 250µm, status test
R: [redacted]

11. 2:30 - 3:00 PM Final meeting
R: all

ENTIRE PAGE CONFIDENTIAL

VW_Drivetrain damage_Failure overview

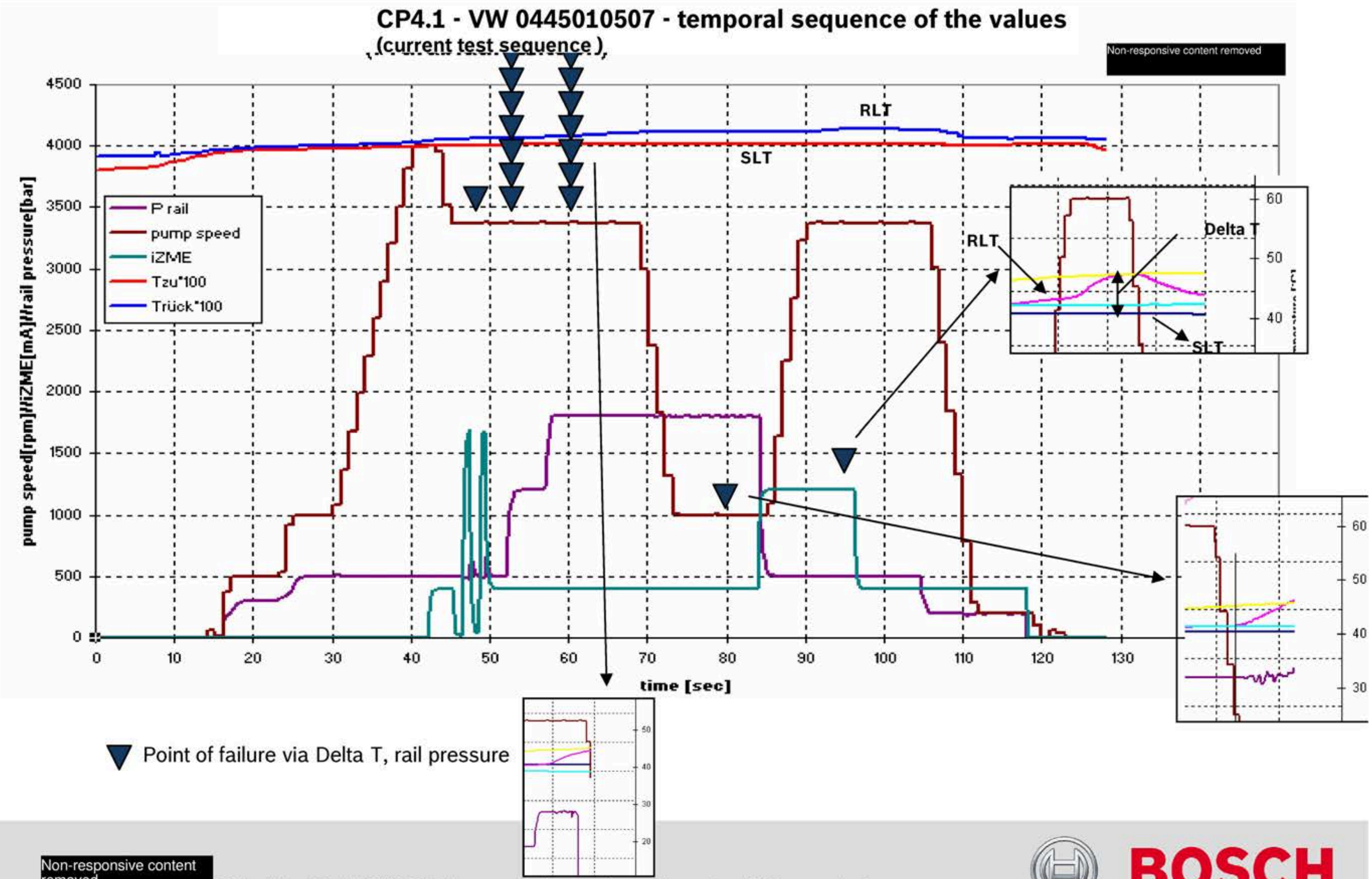


▼ Point of failure via rail pressure, Delta T, etc.

BOSCH

ENTIRE PAGE CONFIDENTIAL

VW_Drivetrain damage_Failure overview



BOSCH

CP4, Tappet anti-turning lock, Status 3/2008

Contents

- Motivation
- Design
- Testing
- Schedule
- Summary of results

CP4, Tappet anti-turning lock, Status 3/2008

Motivation

Following occurrence of the initial CP4 drivetrain damage during internal testing or the first start-up of the engine at the customer's, various failure hypotheses were developed.

One hypothesis was that turned tappets are the cause for subsequent drive-train damage. To counter this, development on the tappet anti-turning lock was started.

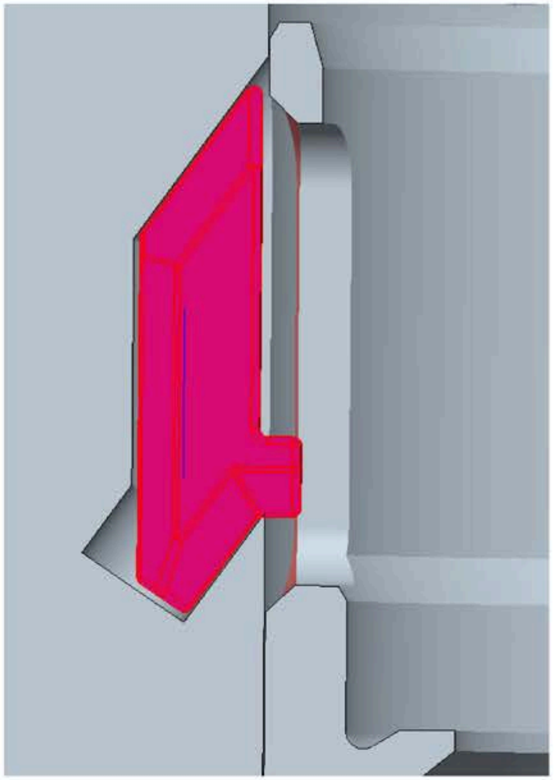
The hypothesis established at that time can no longer be upheld with to-day's information. The cause for the occurring drivetrain damage is either a stiff and/or stuck roller. The subsequent turning of the tappet is therefore a consequence of the stiff / stuck roller. If turning were to be prevented by an anti-turning lock, this would simply delay the failure and not prevent it. Through the introduction of suitable measures in the assembly process (laser scanning of the tappet position), turned installation of the tappet was effectively excluded.

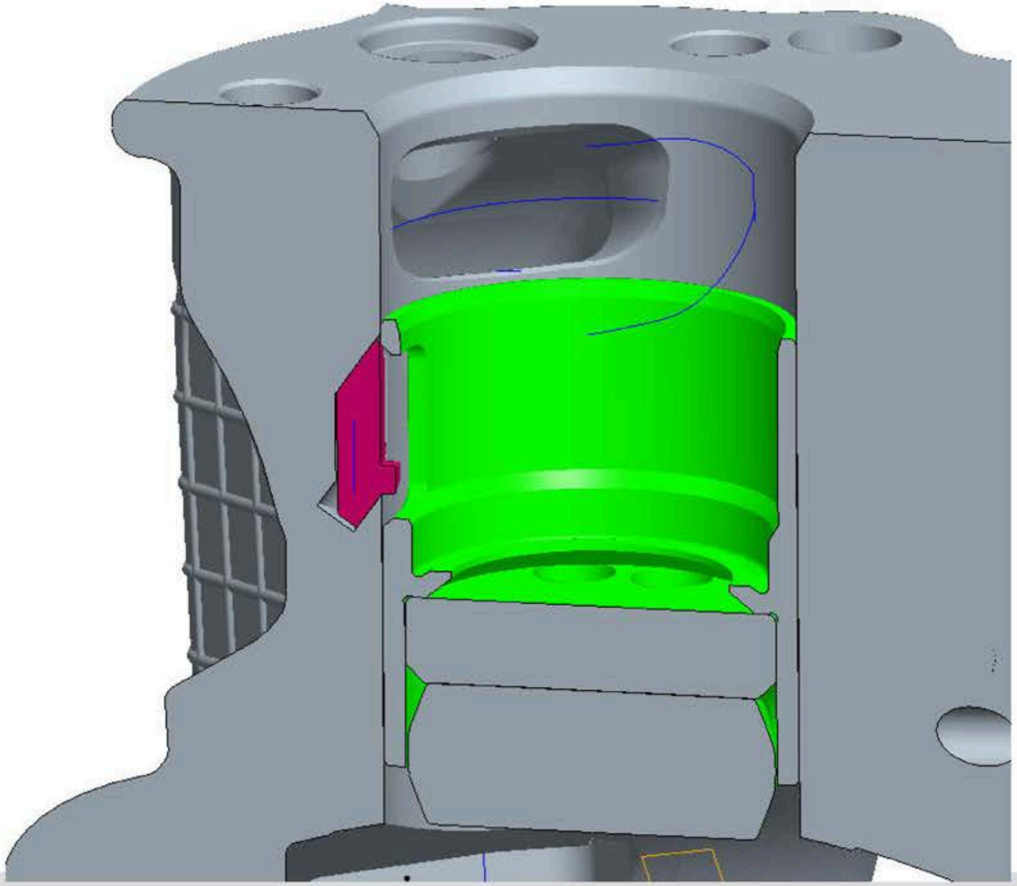
BOSCH

CP4, Tappet anti-turning lock, Status 3/2008

Design

- Preferred solution: Variant with fitted key as insert



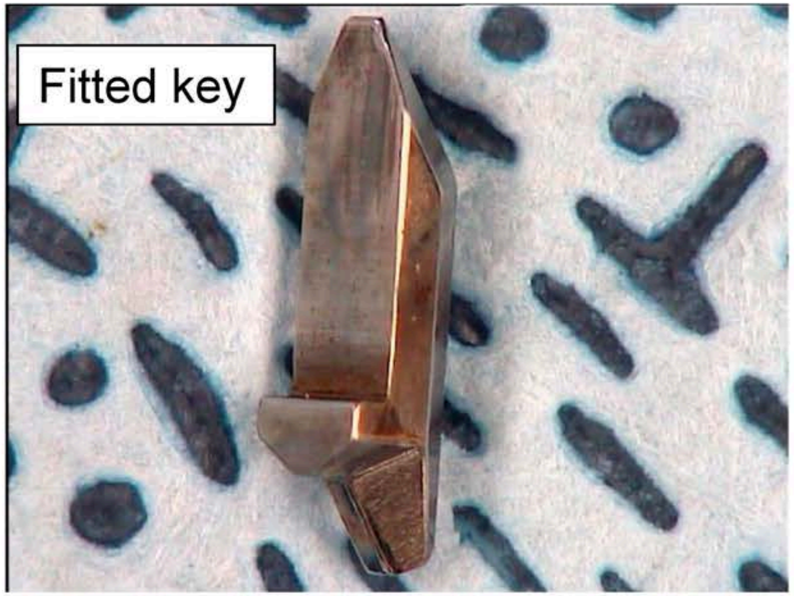


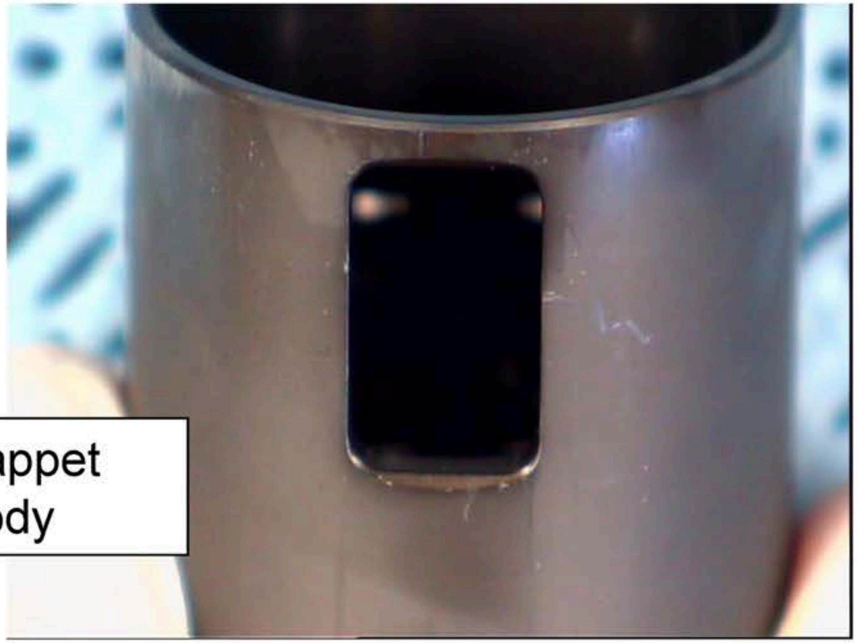
BOSCH

CP4, Tappet anti-turning lock, Status 3/2008

Testing:

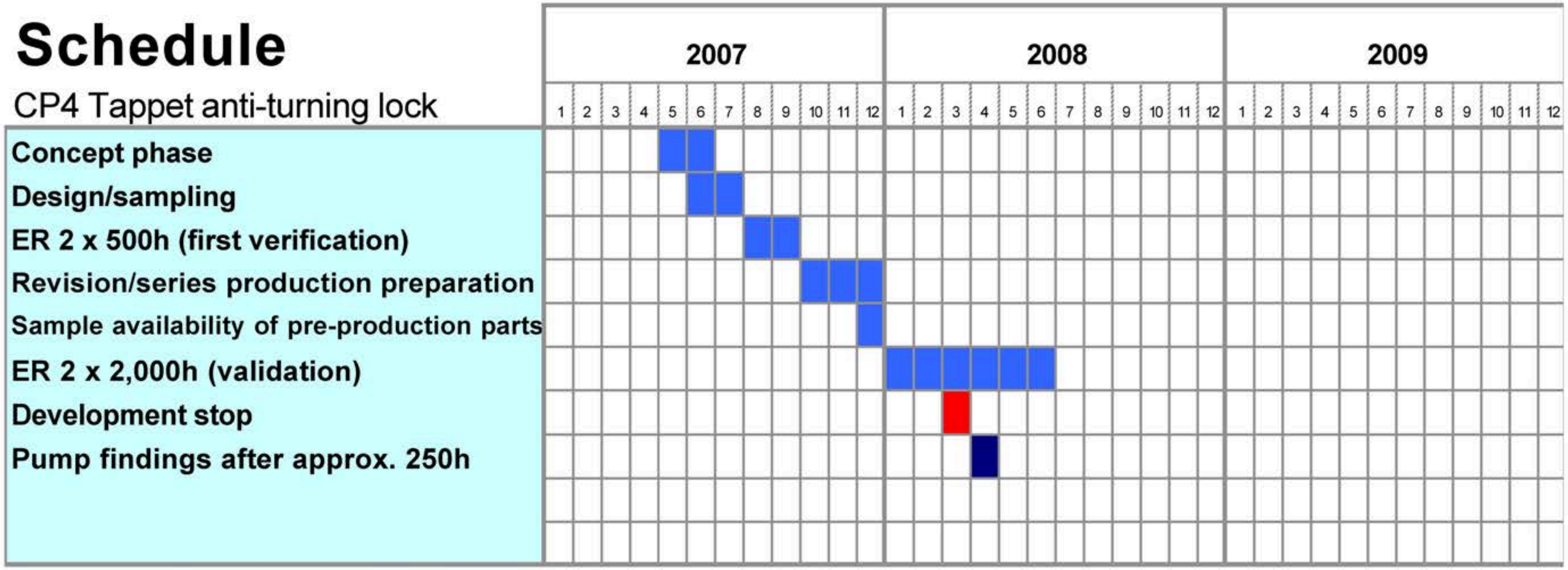
- First 2 pumps after approx. 500h ER indicate a good result.
- Parts from near-series production process show tappet breakages (deformation, internal stresses in tappet body)





CP4, Tappet anti-turning lock, Status 3/2008

CP4



CP4, Tappet anti-turning lock, Status 3/2008

Summary of results

- Initial ER results are positive with respect to potential durability of the anti-turning lock described
- Near-series parts produced show weaknesses with regard to durability
- Today's findings on drivetrain damage show that turned tappet is a consequence and not the cause of the drivetrain damage. Stiff rollers are the cause of drivetrain damage. Anti-turning lock is not a corrective measure or does not increase robustness of this.
- Head of development decides to stop development on 3/2008
- Remaining ER pumps are stopped and final findings recorded

BOSCH

Straightedge test on roller

Objective of test:

Identify rollers with various types of elevations (fusing, pushed-in particles, etc.).

BOSCH

Straightedge test on roller

Procedure:

1. Remove roller from frame and place in front of blade of test equipment.
2. With one finger, press the roller against the blade slightly and cautiously turn the roller 2-3 revolutions with one finger.
3. If slight scratching is noticed, the roller can be rotated more often; if the roller can then be turned without scratching, it is OK.
4. If the roller snags noticeably or juts out while turning, the roller should be removed immediately.
5. Failed rollers should be placed by part no. and documented in the list.

Straightedge test on roller

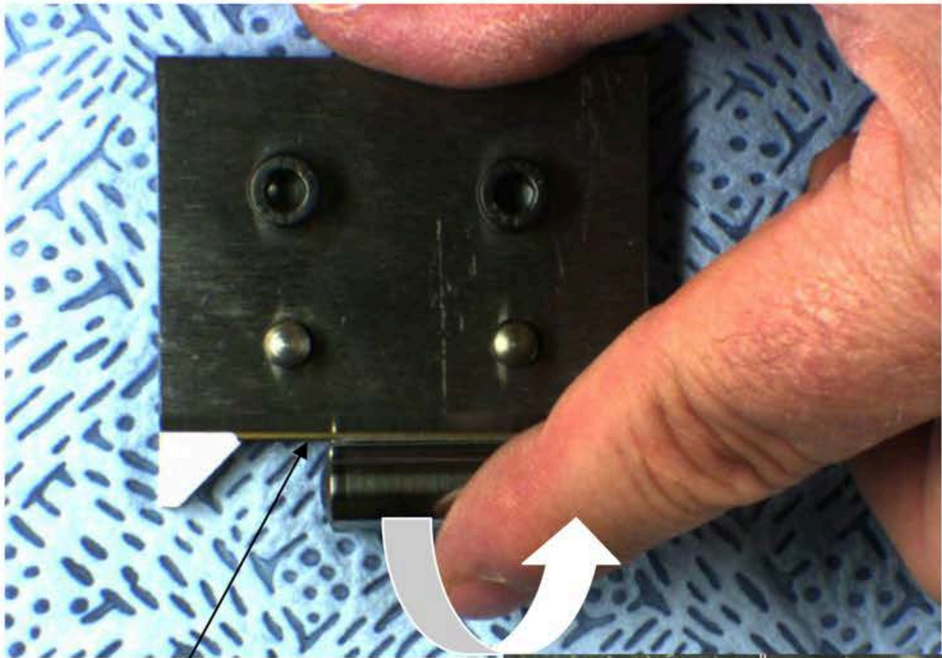
Remarks:

→ Make sure the blade is sharp; turn or swap out the blade every 4 frames. If necessary, the blade can also be replaced earlier. Only the 2 opposite blade sides can be used.

→ Wipe the blade regularly with a lint-free cloth, **be careful! The blade is very sharp.**

→ Use the entire width of the blade for turning when possible, so the blade is worn evenly

Straightedge test on roller



Inserted
sharp blade

Straightedge test on roller

Roller is turned manually with a finger **against** an inserted sharp blade.

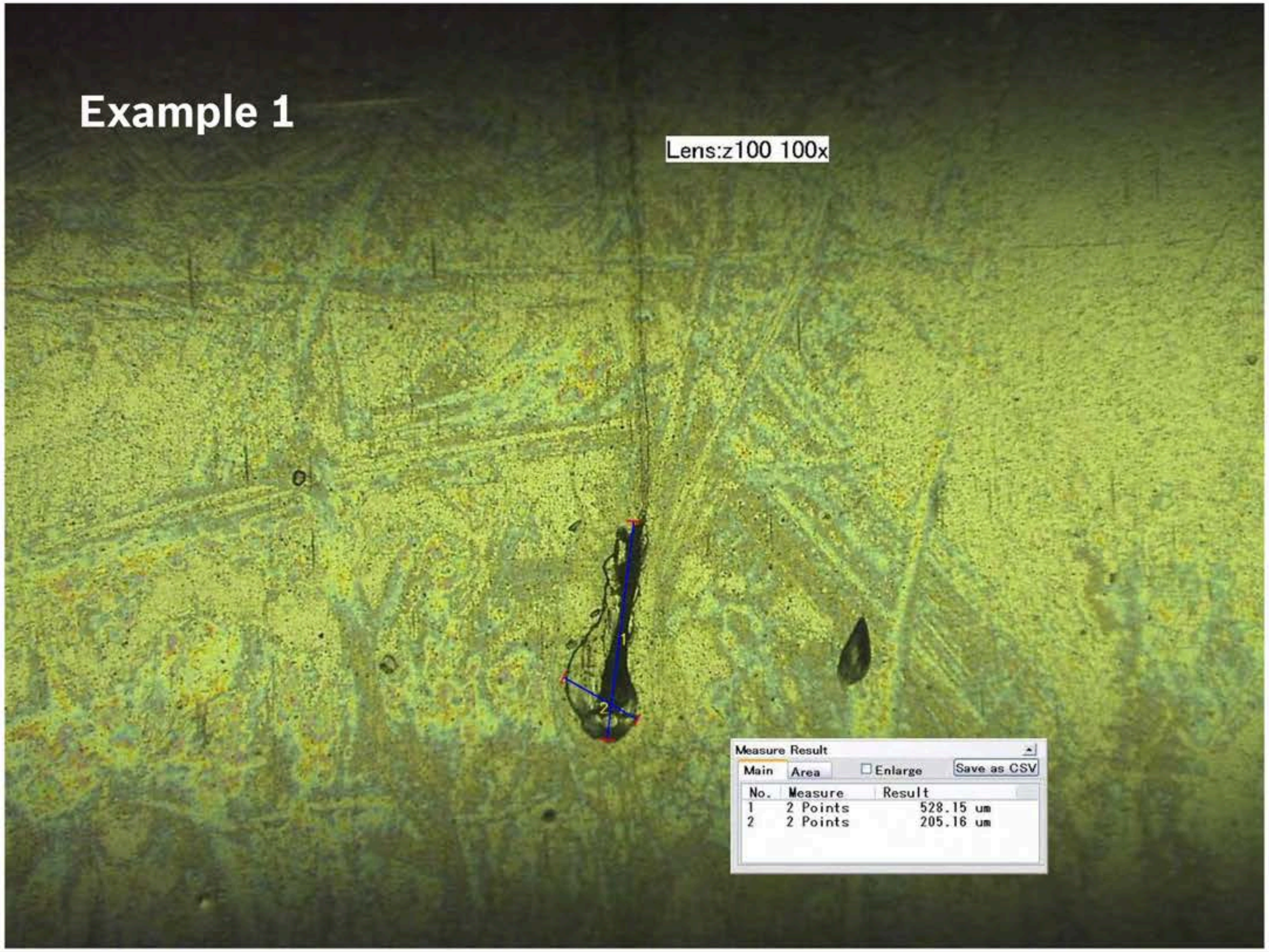
→ Approx. 2-3 revolutions

→ Elevations are detected through scratching or lifting of the roller

BOSCH

ENTIRE PAGE CONFIDENTIAL

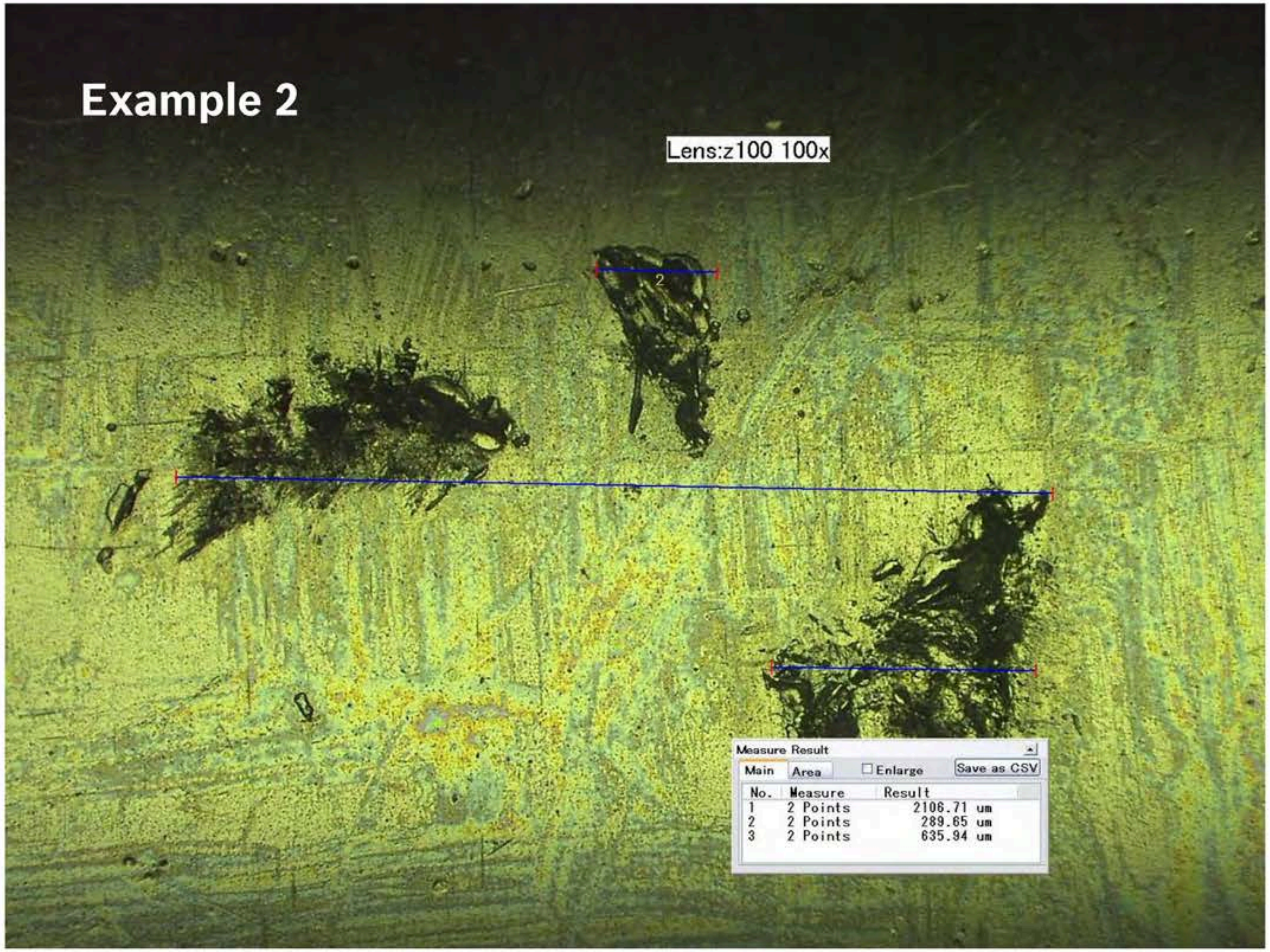
Straightedge test on roller



BOSCH

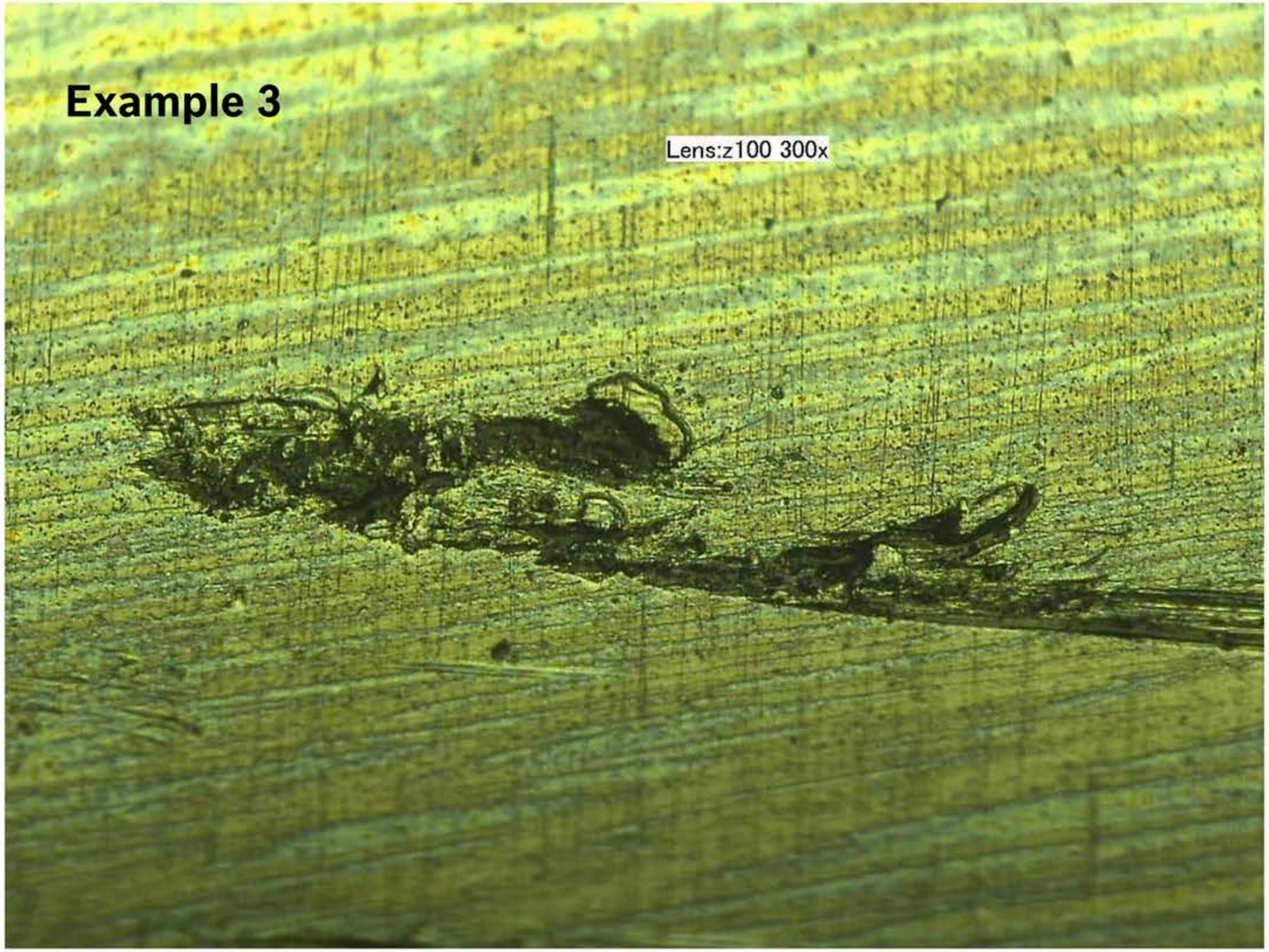
ENTIRE PAGE CONFIDENTIAL

Straightedge test on roller



BOSCH

Straightedge test on roller



BOSCH

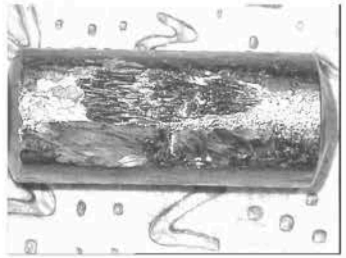
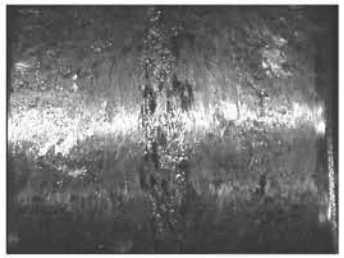
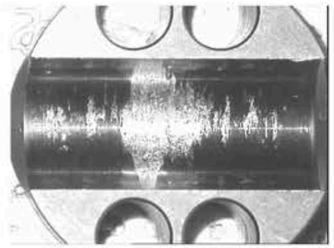
ENTIRE PAGE CONFIDENTIAL

CP4.1 (R4) and CP4.2 (V6-V8-V12) VW / AUDI
Status of drivetrain damage

0km complaint

Scope of defect (current failures - March)

- 0km: 3 x pumps 0445010507/ 03L130755
- Pump DM 1x 03/05/2008
  1x 03/10/2008
  1x 03/11/2008
- Failure DM: 14.3., 17.03. 3/18/2008
- GR Bosch: 3/25/2008

Images of pump - DM 03/10/2008; failure patterns of all 3 pumps are similar

Description of problem

- Failure on Audi final function test rig (cold test) with noise and rail pressure fluctuations

Cause analysis

- Considerable wear on the cam and the roller
- Possible damage profile: Increased friction between roller and roller support leads to slippage between roller and cam. This leads to damage of the cam, roller and roller support and to turning of the tappet.

BOSCH

CRP CP4.1 and 4.2 - AUDI
0km complaints - FeP

Total measures since SOP:

- Analysis of the assembly and handling processes carried out in Dresden on 07/12/2007. Result: Commissioning conditions not according to specification. Commissioning of the vehicles has been changed immediately
- Optimization of test bench process of Bosch by raising the start-up speed from 200 rpm to 500 rpm
  D: 7/9/2007 compl.
- Cylinder head assembly with 5° torsion allowance
  D: 07/23/2007 compl.
- Dry pressing in of roller support
  D: 07/23/2007 compl.
- Introduction of dwell time during mounting of tappet assembly
  D: 8/28/2007 compl.
- Extension of high-load testing point
  D: 10/12/2007 compl.

Non-responsive content removed

BOSCH

CRP CP4.1 and 4.2 - AUDI
0km complaints - FeP

Measures

- Improved visual inspection of the roller support according to new visual inspection catalog D: 12/13/2007 compl.
- Friction coefficient test +/- 10° for an improved checking of the main load area of the roller support
  D: 12/13/2008 compl.
- Introduce tappet position query by means of laser to ensure the tappet is fitted in the correct place during assembly
  12/21/2008 compl.
- Introduction of a new test program for CP4.1 VW with intensified test conditions i.e.
  - Start-up with steeper speed ramp in order to cause drivetrain damage internally and not at the customer
  - Critical load points (1,800 bar) moved from end of test process to start of test process, so that drivetrain damage can be better detected.
  - Elimination of the flushing nozzle, thus detection of not OK rail pressures even during flushing of the pump and omission of the critical switching procedure from flushing to measuring.
  - Flush operation of 300 bar and 2,500 rpm to 1,800 bar and 3,375 rpm - revolutions intensified

  D: 1/11/2008 compl.

BOSCH

CRP CP4.1 and 4.2 - AUDI
0km complaints - FeP

Measures

- Introduction of visual inspection of the roller support using a technoscope instead of a magnifying glass for a better detection of the metal splashes
  D: 2/4/2008 compl.

- Introduction of a new test program for CP4.2 Audi with intensified testing conditions analog to VW for CP4.1, T: 2/5/2008 compl.

- 100% straightedge test on the roller to detect elevations on the roller. Parts have been found since the introduction of the test. Parts will be used for major test.
  D: since 04/01/2008 in parts production, as of 04/07/2008 in the pump

- Measures currently in testing C coating:

  Roller support (RS):

  1. Reduction of the influence of the shielding plate, test with 480 RS batch; first result positive, FIB section still open; if FIB section positive - step 2.
  2. Reduction of the influence of the shielding plate, test with 2,800 RS batch; is result positive then Audi will authorize the changeover of the C coating process;
     planned date of introduction: 4/18/2008

BOSCH

CRP CP4.1 and 4.2 - AUDI
0km complaints - FeP

Measures

Measures currently in testing C coating:

Roller:

Optimized holder concept for roller to avoid fusing

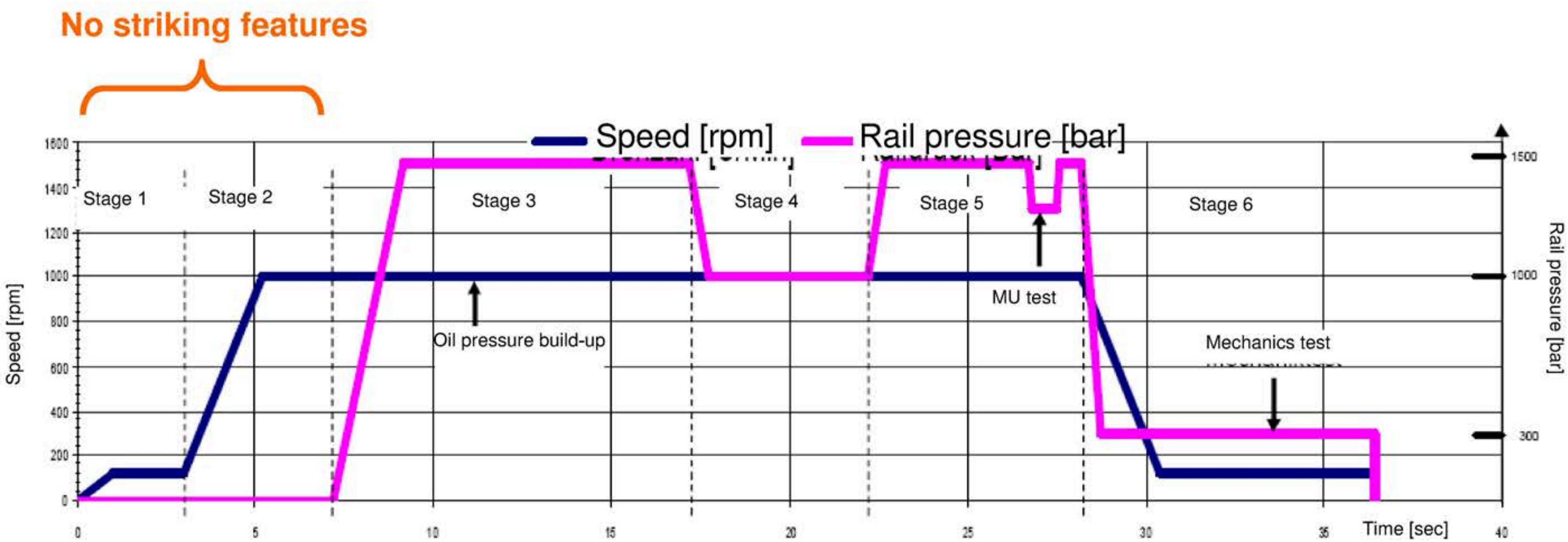
D: currently being clarified as the change to the holder is quite intensive

ENTIRE PAGE CONFIDENTIAL

R4 CR TDI
High-pressure fuel pump seized, noisy

Detection of fault in the cold test curves

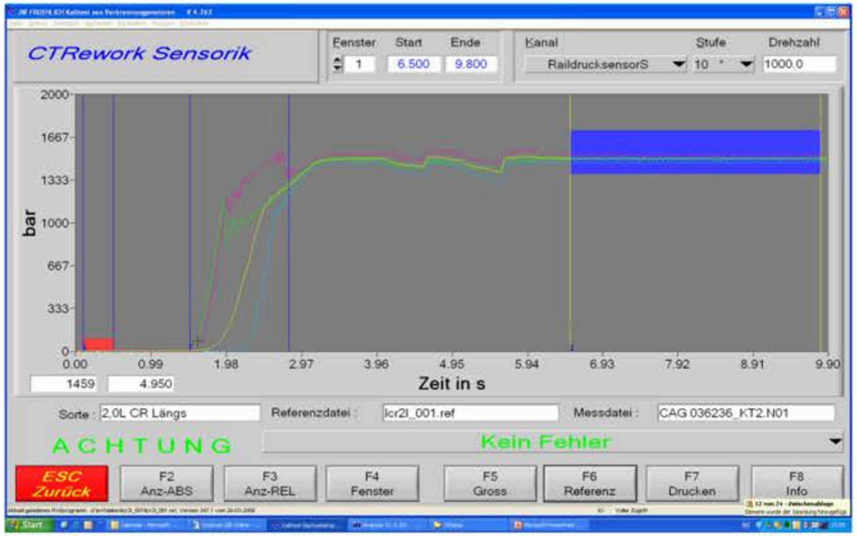
(e.g. on the engine Motor CAG 036236, but it manifests in the same manner in the other two failures)



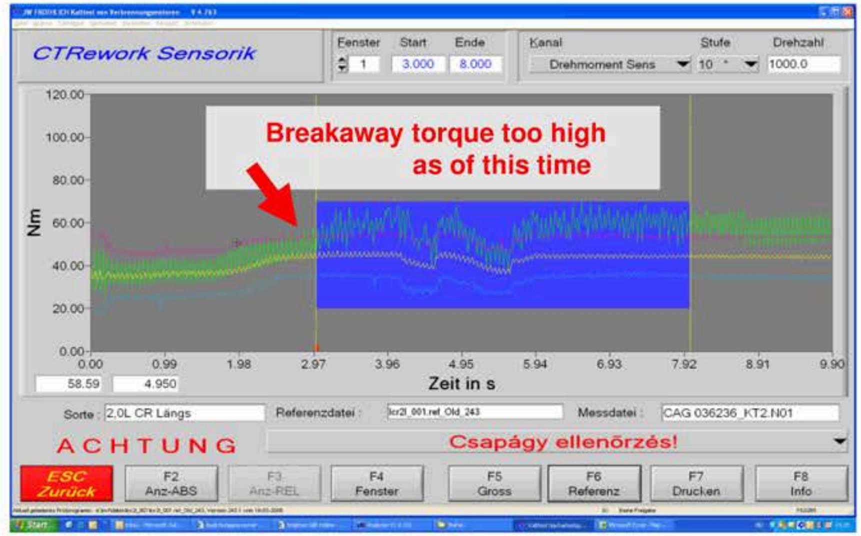
EA11003EN-01402[1]

ENTIRE PAGE CONFIDENTIAL

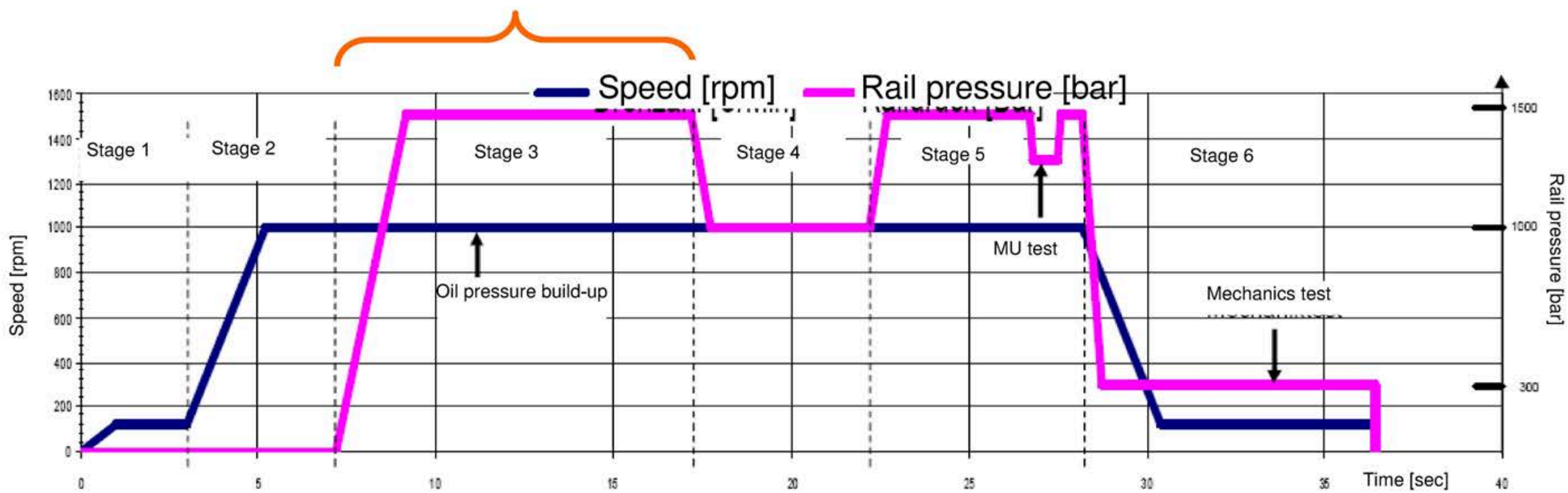
ACTUAL rail pressure



ACTUAL breakaway torque of the engine



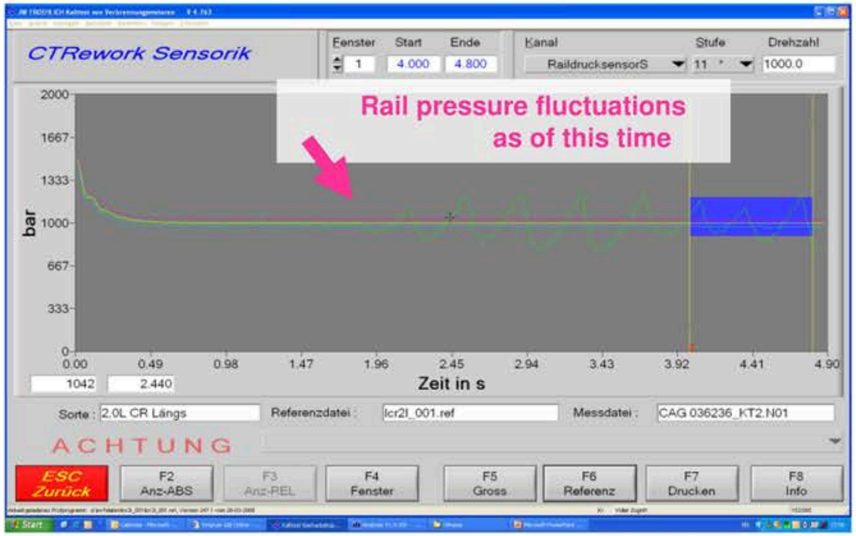
Rail pressure buid-up and kept stable, but the torque curve has run up since approx. the second third to a level that is greater than the reference curves



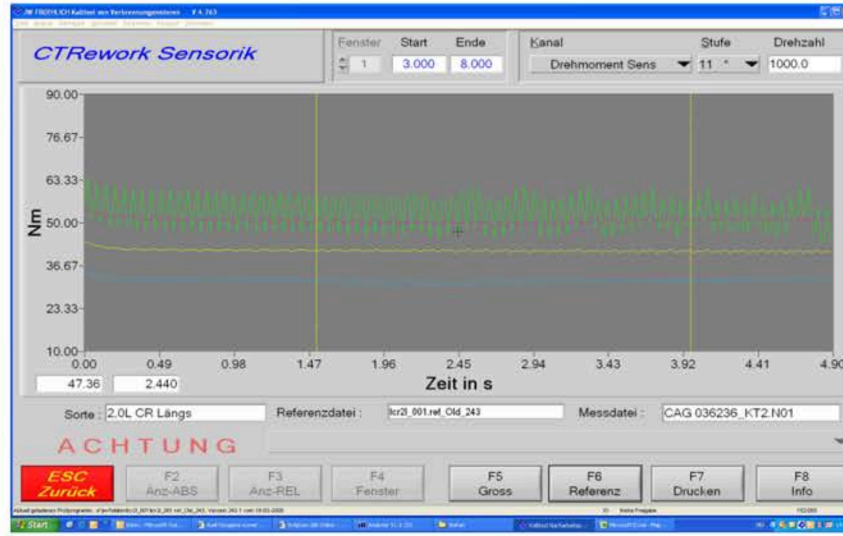
EA11003EN-01402[2]

ENTIRE PAGE CONFIDENTIAL

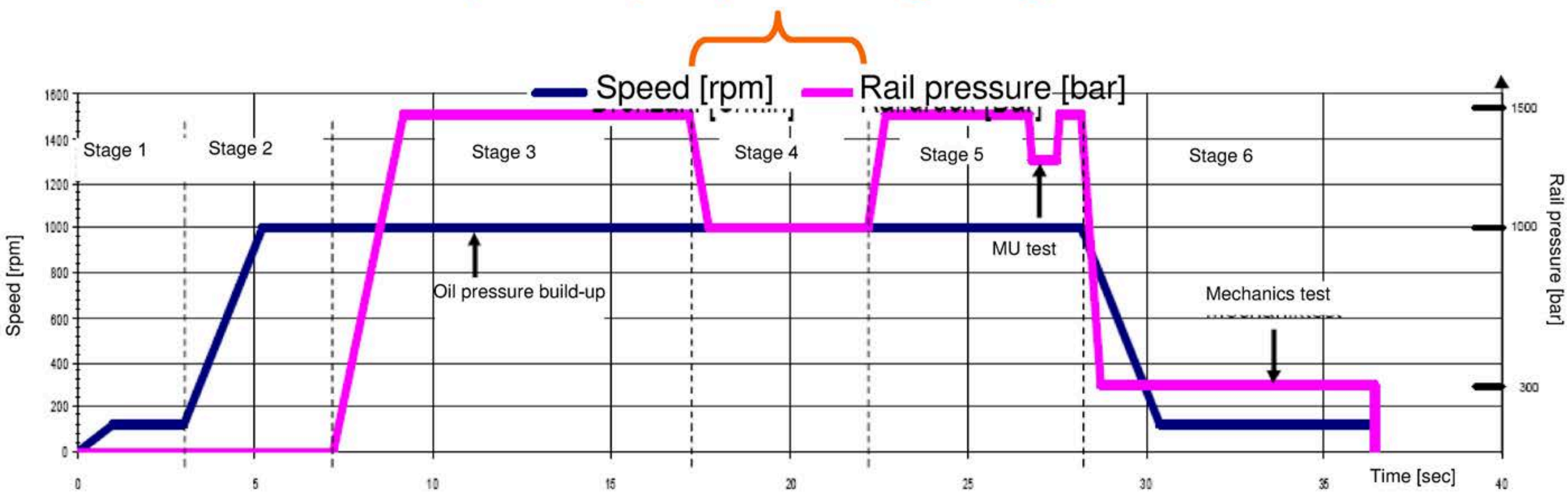
ACTUAL rail pressure



ACTUAL breakaway torque of the engine



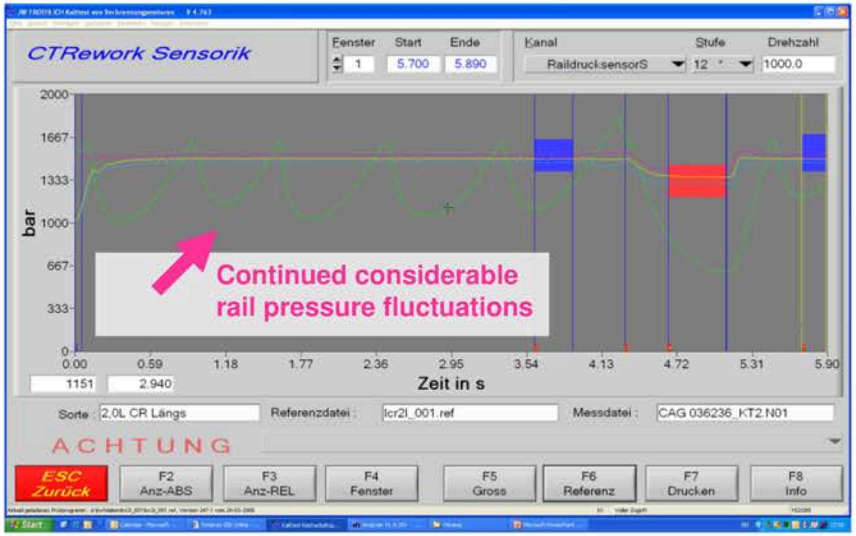
Within a few minutes, considerable rail pressure fluctuations occurred, breakaway torque remaining too high



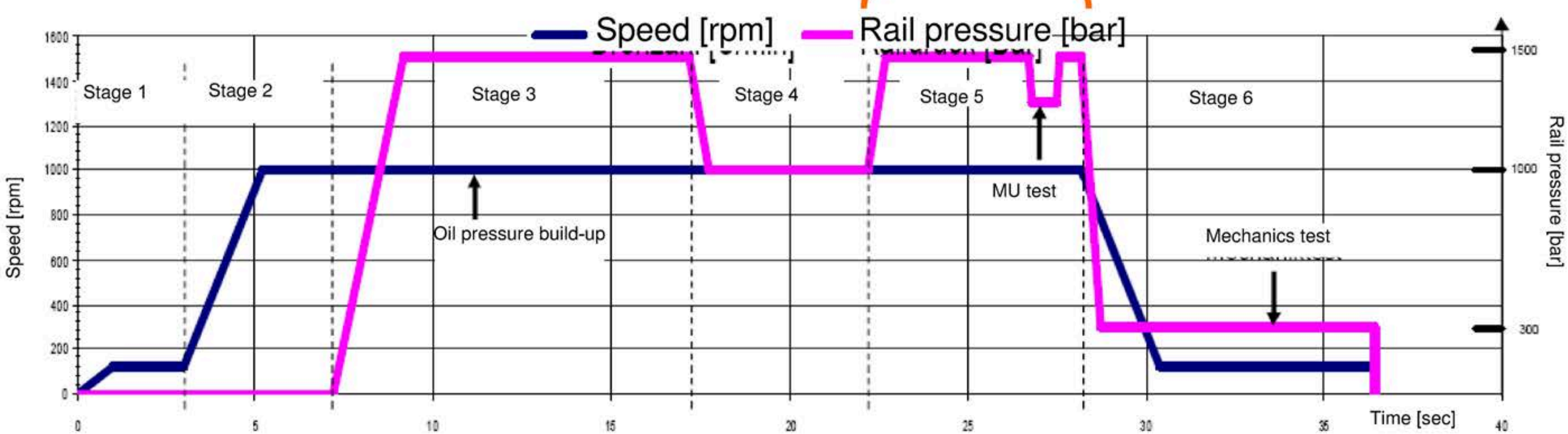
EA11003EN-01402[3]

ENTIRE PAGE CONFIDENTIAL

ACTUAL rail pressure



Rail pressure in the further phases of the testing were always unstable, engine not OK



Subject: Commissioning CP4 in the engine plant
Cold test

1) Test sequence VW R4, CP4.1

- The target test sequence for [redacted] presented by Audi at the end of March 2008 is basically in line with Bosch requirements
- The startup phase, 1,000 rpm without rail pressure, is to be reduced to the minimum possible time and is currently OK at < 10 seconds.

2) Further test bench procedure, recommendation from Audi/Bosch, 4/10/2008:

- joint measurement of at least one test bench "actual test process" by Bosch/Audi/Fröhlich (Wednesday, early shift), Audi/Fröhlich to provide the interface, Bosch the measurement technology (each party to be responsible for their own costs) Target date 04.2008
- Development/Test Bench Technology in [redacted] will attend during measurement, so that it will be able to carry out these measurements itself on the other test benches
- VW Test Technology in Non-responsive content removed were to take part in the meeting

3) Exchange of information relating to CP4 requirements

- A local meeting will be held in [redacted] after the measurement results are available, involving Bosch Development, the plant and QM, target date 05.2008

4) Permanent saving of test bench test parameters

- Check to establish that the present offering in relation to documentation from Fröhlich meets requirements, R: Bosch, date 04.2008
- Costs are to be clarified between Fröhlich and Audi

5) Hot test

- If the schedule allows, the hot test is also to be measured on the Wednesday afternoon, following the same procedure as for the cold test as described above

ENTIRE PAGE CONFIDENTIAL

Deadline	Agenda: Topics	Agenda: Details	Responsible
1/31/2008	**CP4 Q meeting/zero error meeting VW/Audi in Feuerbach**		
1/31/2008	presentation of current Q situation 0km/field Audi VW		Non-responsive content removed [redacted]
1/31/2008	Defective O-ring on MU	Summary of Audi complaints (including pump from [redacted] storage check)	
1/31/2008		Action plan	
1/31/2008		Current point cloud for MU testing point	
1/31/2008	CP4 drivetrain damage	Summary of complaints total/VW/Audi and diagnosis results	
1/31/2008		Measures	
1/31/2008		- C coating	
1/31/2008		- assembly, manufacture, test processes	
1/31/2008	Field failure Q7 CP4.2 crack in cylinder head		
1/31/2008	Intake/high-pressure valve leakage due to particles	Overview of complaints VW/Audi and diagnosis results	
1/31/2008		Measures	
1/31/2008		Overall situation of CP4 cleanliness:	
1/31/2008		- cleanliness concept FeP	
1/31/2008		- action plan incl. prospects for CP4 cleanliness	
1/31/2008		- Status of reworking of [redacted] pumps	
1/31/2008	Production tour - CP4		
1/31/2008	Complaints from leak test Chemnitz	Results of findings for the returns	
1/31/2008		Further action	
1/31/2008	Status of Jihlava release		
1/31/2008	Planning 1. PHA in Salzgitter and vehicle plants, 2. SOP tour Non-responsive content removed [redacted]		
1/31/2008	Miscellaneous		
1/31/2008	Coordination of drafts for presentations of changes to customers.		
1/31/2008			
Non-responsive content removed [redacted]			
2/27/2008	**CP4 Q meeting VW Salzgitter**		
2/27/2008	Discussion of OPL		
2/27/2008	- Status of 0km complaints		
2/27/2008	- Status of field complaints		
2/27/2008	- Status of PHA (if applicable, manufacture inspection - body assembly	PHA OPL is distributed. Addition VW deadlines measures is in progress	
2/27/2008	- Status of internal failures	Not dealt with	
2/27/2008	- Status of other lines	Was presented in advance in separate round	
2/27/2008	- Miscella-		
Non-responsive content removed [redacted]			
3/26/2008	**CP4 Q meeting telcon netmeeting Braunschweig (Brunswick)**		
3/26/2008	**9:30 AM - 11:00 AM CP4 topics**		
3/26/2008	Status of OPL from WaP (MU manufacture)		
3/26/2008	PHA: Status of OPL, next steps		
3/26/2008	Status of complaints "Particles in intake valve " (measures, current cases, other open points)		
3/26/2008	Drivetrain damage to US pump (status of investigations, current situation, implementation of measures)		
Non-responsive content removed [redacted]			

EA11003EN-01404[1]

ENTIRE PAGE CONFIDENTIAL

OPL 2. Audi CP4 zero-fault meeting on 3/11/2008 with a focus on cleanliness									Changes important
Ser. no.	**Q meeting deadline**	**Discussion with**	**Topic**	**Component**	**Detail/construction element**	**OPL point / measure**	**Responsible**	**Date**	**Status**
218	3/11/2008	Audi	Component	CP4	CP4 release	Draw up change notification for release of CP4.1 and CP4.1, [redacted] plant and to Audi	Non-responsive content removed [redacted]	3/14/2008	t.b.d.
219	3/11/2008	Audi	Verification	CP4	Release of module 4. Sampling scope, number of parts	1. Complete sampling of CP4.1 with VW 2. In each case carry out cover sheet sampling for ... 755 AB and ...755 AG. 2. 3-5 CP4.1 or CP4.2 go to Győr for installation test and brake; 3. Clarification of feasibility QZ-ER for CP4.2 from module 4. , feedback to Mr Nilp		1. Clarification 2. 3/20/2008 3. Clarification 4. Clarification	t.b.d.
220	3/11/2008	Audi	Verification	CP4	Release of GP38 - production Bosch Hallein Planning 2DP GP38	Clarification of orders for CP4.2 with GP38 to establish a 2DP date, Hallein plant with participation of Audi; Feedback possible 2DP deadlines to distributors		3/21/2008	t.b.d.
222	11.03.2008	Audi	Cleanliness	CP4	Pneumatic air flushing of cylinder head	Audi wants presentation of trials with specification of place of introduction (map), particle type and size and identified effectiveness.		4/10/2008	t.b.d.
223	3/11/2008	Audi	Cleanliness	CP4	Pneumatic air flushing of cylinder head	The particle collection container for the respective modules/stations must be emptied and evaluated at set intervals (number of flushed heads). The number of particles, the particle size and materials must be documented.		4/10/2008	t.b.d.
224	3/11/2008	Audi	Cleanliness	CP4	Pneumatic air flushing of cylinder head	Audi question - can a damage to the intake valve on account of a pneumatic flushing be excluded?		4/10/2008	t.b.d.
225	3/11/2008	Audi	Component	CP4	Bruss oil seal	Update of the individual tracking slide with regard to the measures with the supplier, CP4.1 on shaft seal leaking		3/26/2008	t.b.d.
226	3/11/2008	Audi	Cleanliness	CP4	Establishing cleanliness progress EZ-CP4 high-pressure side	1. Carry out and evaluate a particle material analysis on the CP4 product high-pressure side on 25 CP4 2. Add ppm valuations to point cloud		4/10/2008	t.b.d.
227	3/11/2008	Audi	Cleanliness	CP4	MU action	1. Analysis of particles found during the visual inspection in the MU at [redacted] plant. 2. Correlation of the particles to processes [redacted] 3. Definition of corrective action at [redacted] plant		Immediate	t.b.d.
228	3/11/2008	Audi	Cleanliness	CP4	Clean as-sembly line Material con-tainers	Creation of work instructions for the cleaning of material containers on CP4 assem-bly line.		4/10/2008	t.b.d.
229	3/11/2008	Audi	Cleanliness	CP4	Cleanliness workshop Housing/ Flange	Sending of matrix from cleanliness workshop to Audi, recording of implementation status		4/10/2008	t.b.d.
230	3/11/2008	Audi	Cleanliness	CP4	Cleanliness workshop Bore hole coverage	Clarification as to whether the bore hole coverage adhesive can be removed again without leaving any residue		4/10/2008	t.b.d.
231	3/11/2008	Audi	Cleanliness	CP4	Risk assessment for CH CU failures	VW requests risk assessment of number of possible further failures due to particles in the intake valve.		3/14/2008	t.b.d.
232	3/11/2008	Audi	Cleanliness	CP4	Cleanliness workshop on ECM for housing/ Flange	Audi wants a check to ascertain whether housing and flange couldn't also be deburred by means of ECM.		4/10/2008	t.b.d.
233	3/11/2008	Audi	Cleanliness	CP4	Cleanliness workshop on MU4 O-ring	Audi requests that cleanliness tests also be carried out on O-ring deliveries along-side series production		immediately	t.b.d.
234	3/11/2008	Audi	Cleanliness	CP4	Cleanliness workshop MU4-pot	Check as to whether brush process or other measures can be introduced to MU4 housing to reduce possible particles. Clarification with supplier.		03/21/2008	t.b.d.
235	3/11/2008	Audi	Cleanliness	CP4	100% Visual inspection of MU4	Introduction of a 100% visual inspection, scope analog to Feuerbach in the Waiblingen p		immediately	t.b.d.
236	3/11/2008	Audi	Cleanliness	CP4	Visual inspection of MU strainer	Visual inspection of a large number of MU strainers relating to plastic chips, present results in Feuerbach, if applicable introduce measures at suppliers		03/21/2008	t.b.d.
237	3/11/2008	Audi	Cleanliness	CP4	Audi request 250µm CP4-EZ	Activation of 250µm particle limit for timeframe WK12/2008 with execution of B-test test when limit value is exceeded. Info on results at next pump technical meeting on 03/26/2008 in NSU. Then a mutual decision regarding further steps.		WK 12/2008	t.b.d.
238	3/11/2008	Audi	test	CP4	Leak test [redacted] geometry calotte	Audi demands the preparation and presentation of the suppliers calotte roundness data measured since 02/18/2008		3/26/2008	t.b.d.
239	3/11/2008	Audi	Component	CP4	Assembly CP38 CP4.2	Audi requires that an interim report be drawn up as soon as possible regarding status of point 2 and point 4 of the OPL		3/21/2008	t.b.d.

ENTIRE PAGE CONFIDENTIAL

OPL 3. Audi CP4 zero-fault meeting Status 04/10/2008									Changes / important
Ser. no.:	Q meeting deadline	meeting with	Topic	component	Detail/construction element	OPL point / measure	Responsible	Deadline	Status
[redacted] Non-responsive content removed									
2	4/10/2008	Audi	Component	CP4.1	Pressure retaining test	Coordination with VW Development and VW [redacted] concerning further actions - pressure retaining test	[redacted] Non-responsive content removed		t.b.d.
3	4/10/2008	Audi	Component	CP4	Analysis process	Forward CP4.x analysis procedures to Audi [redacted]			t.b.d.
4	4/10/2008	Audi	Drivetrain damage	CP4	Click-clack test	Audi approves with the elimination of the click-clack test. Approval of VW still to be obtained			t.b.d.
5	4/10/2008	Audi	Component	CP4	Weekly status report with a focus on faults	Audi requests a weekly status report concerning the CP4 main fault areas for non-starters due to particles in the intake valve, drivetrain damage. MU O-ring		with imme-diate effect	t.b.d.
6	4/10/2008	Audi	Drivetrain damage	CP4	Roller	Roller is conical on the outer ends and therefore has areas that are not load-bear-ing Audi question: Can the non-loaded area of the roller be saved; advantage: lighter roller;			t.b.d.
7	4/10/2008	Audi	Drivetrain damage	CP4	Roller support	Audi applies for an extension to the belt finishing so that metal splashes can be reliably removed; awaiting statement from Bosch			t.b.d.
8	4/10/2008	Audi	Drivetrain damage	CP4	Functional inspection	Audi wants presentation of status of the special testing point for the CP4.2 including presenta-tion of the failure statistics of this testing point during the pump technical meeting			t.b.d.
9	4/10/2008	Audi	Component	CP4	Production inspection Module 4	Bubble test product; draw up production and test instructions as to the max. bubble formation in the bubble test on the Bruss shaft seal that is permissible.			t.b.d.
10	4/10/2008	Audi	Drivetrain damage	CP4	Production inspection laser position query	Presentation / evaluation of the laser position query assembly module - module 1 and module 2			t.b.d.
11	4/10/2008	Audi	Component	CP4	Alignment position of the camshaft	Audi would like a different camshaft alignment position for the CP4.2. Coordination during technical meeting in Neckarsulm			t.b.d.
12	4/10/2008	Audi	Drivetrain damage	CP4	Documentation	Documentation of the internal drivetrain damages - [redacted] plant Number of failures / WK			t.b.d.
13	4/10/2008	Audi	Drivetrain damage	CP4	Test bench errors	Audi wants the presentation of the possible influences / causes for test bench errors; representation of test oil flow, pipework and pipework materials, filter arrangement, what happens to the chips from drivetrain damage; PCV replacement when and how often?			t.b.d.
14	4/10/2008	Audi	Drivetrain damage	CP4.1	Failures in the cold test [redacted]	Send the engine assembly data of the three failed engines with CP4.1, [redacted] plant			t.b.d.
15	4/10/2008	Audi	Drivetrain damage	CP4.1	Failures in the cold test - Györ	Bosch draws up final report for the findings for the three 0km cold test failures in [redacted]			t.b.d.
16	4/10/2008	Audi	Component	CP4.2	Module 4	Coordination of Bosch - Audi concerning necessary number of CP4.2 for installation test in [redacted]			t.b.d.
17	4/10/2008	Audi	Component	CP38	Relocation of housing production	Without the involvement of Audi, the housing production of the GP38 at [redacted] plant was relocated to another plant; Audi would like to see a presentation of the relocation scope and a risk assessment at the next pump technical meeting in Neckarsulm			t.b.d.
18	4/10/2008	Audi	Component	CP38	2-days' production	Clarification of set-up date for 2DP - Hallein plant - Bosch - Audi			t.b.d.
19	4/10/2008	Audi	Drivetrain damage	CP4	C coating on the roller	Introduction of an optimized holder concept for roller in order to avoid fusing			t.b.d.
20	4/10/2008	Audi	Drivetrain damage	CP4	C coating roller support to avoid metal splashes	Reduction of the influence of the shielding plate, test with 2,800 RS full batch; if result positive then Audi will authorize the changeover of the C coating process;		4/18/2008	t.b.d.
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									
61									
62									
63									
64									
65									
66									
67									
68									
69									
70									
71									
72									
73									
74									
75									
76									
77									
78									
79									
80									
81									
82									
83									
84									
85									
86									
87									
88									
89									
90									
91									
92									
93									
94									
95									
96									
97									
98									
99									
100									
101									
102									
103									
104									
105									
106									
107									
108									
109									
110									
111									
112									
113									
114									
115									
116									
117									
118									
119									
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135									
136									
137									
138									
139									
140									
141									
142									
143									
144									
145									
146									
147									
148									
149									
150									
151									
152									
153									
154									
155									
156									
157									
158									
159									
160									
161									
162									
163									
164									
165									
166									
167									
168									
169									
170									
171									
172									
173									
174									
175									
176									
177									
178									
179									
180									
181									
182									
183									
184									
185									
186									
187									
188									
189									
190									
191									
192									
193									
194									
195									
196									
197									
198									
199									
200									
201									
202									
203									
204									
205									
206									
207									
208									
209									
210									
211									
212									
213									
214									
215									
216									
217									
218									
219									
220									
221									
222									
223									

EA11003EN-01404[3]

ENTIRE PAGE CONFIDENTIAL

ENTIRE PAGE CONFIDENTIAL

Non-responsive content removed

[redacted]

EA11003EN-01405[0]

ENTIRE PAGE CONFIDENTIAL

Paynter Chart 0km and field failures CP4.1 for Non-responsive content removed

Non-responsive content removed

Non-responsive content removed

Production period		Jan 08	Feb 08	Mar 08	Apr 08	May 08	Jun 08	Jul 08	Aug 08	Sept 08	Oct 08	Nov 08	Dec 08	Jan 09	No of units 08/01-09/01	PPM
Supply Qty (..507) Non-responsive content removed		0	13,168	17,648	0	0	0	0	0	0	0	0	0	0	30,816	
Drivetrain damage / turned tappet	0km														0	0
	Field														0	0
Particles IV	0km		1												1	32
	Field														0	0
Particles NRV	0km														0	0
	Field														0	0
MU O-ring damaged	0km														0	0
	Field														0	0
Leaky shaft seal	0km														0	0
	Field														0	0
[redacted] pressure retaining test not OK, RB OK according to spec.	0km														0	0
	Field														0	0
OK according to specification	0km			2											2	65
	Field														0	0
	0km														0	0
	Field														0	0
Customer error (shaft seal folded)	0km														0	0
	Field														0	0
t.b.d.	0km														0	0
	Field														0	0
Total of complaints	0km	0	1	2	0	0	0	0	0	0	0	0	0	0	3	
	Field	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total ppm-quota	ppm 0km	0	76	113	0	0	0	0	0	0	0	0	0	0		97
	ppm Field	0	0	0	0	0	0	0	0	0	0	0	0	0		0
Total number of acknowledged complaints	0km	0	1	0	0	0	0	0	0	0	0	0	0	0	1	
	Field	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
acknowledged ppm-quota	ppm 0km	0	76	0	0	0	0	0	0	0	0	0	0	0		32
	ppm Field	0	0	0	0	0	0	0	0	0	0	0	0	0		0

acknowledged complaints

Non-responsive content removed

EA11003EN-01405[1]

ENTIRE PAGE CONFIDENTIAL

Paynter Chart 0km and field failures CP4.1 for Non-responsive content removed

Non-responsive content removed

Non-responsive content removed

Production period		Jan 08	Feb 08	Mar 08	Apr 08	May 08	Jun 08	Jul 08	Aug 08	Sept 08	Oct 08	Nov 08	Dec 08	Jan 09	No of units 08/01-09/01	PPM
Supply Qty (..507) (to [redacted]		0	0	1,536	0	0	0	0	0	0	0	0	0	0	1,536	
Supply Qty to [redacted]		0	13,168	19,184	0	0	0	0	0	0	0	0	0	0	32,352	
Drivetrain damage / turned tappet	0km														0	0
	Field														0	0
Particles IV	0km														0	0
	Field														0	0
Particles NRV	0km														0	0
	Field														0	0
MU O-ring damaged	0km														0	0
	Field														0	0
MU RAS missing	0km														0	0
	Field														0	0
Crack on cylinder head	0km														0	0
	Field														0	0
OK according to specification	0km														0	0
	Field														0	0
Customer error (shaft seal folded)	0km														0	0
	Field														0	0
t.b.d.	0km														0	0
	Field														0	0
Total of complaints	0km	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Field	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total ppm-quota	ppm 0km	0	0	0	0	0	0	0	0	0	0	0	0	0		0
	ppm Field	0	0	0	0	0	0	0	0	0	0	0	0	0		0
Total number of acknowledged complaints	0km	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Field	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
acknowledged ppm-quota	ppm 0km	0	0	0	0	0	0	0	0	0	0	0	0	0		0
	ppm Field	0	0	0	0	0	0	0	0	0	0	0	0	0		0

acknowledged complaints

Non-responsive content removed

EA11003EN-01405[2]

ENTIRE PAGE CONFIDENTIAL

Non-responsive content removed

Non-responsive content removed

Paynter Chart 0km and field failures CP4.1 for all plants

Non-responsive content removed

Production period		Jan 08	Feb 08	Mar 08	Apr 08	May 08	Jun 08	Jul 08	Aug 08	Sept 08	Oct 08	Nov 08	Dec 08	Jan 09	No of units 08/01-09/01	PPM
Supply Qty to Non-responsive content removed		0	13,168	19,184	0	0	0	0	0	0	0	0	0	0	32,352	
Drivetrain damage / turned tappet	0km														0	0
	Field														0	0
Particles IV	0km		1												1	31
	Field														0	0
Particles NRV	0km														0	0
	Field														0	0
MU O-ring damaged	0km														0	0
	Field														0	0
Leaky shaft seal	0km														0	0
	Field														0	0
Crack on cylinder head	0km														0	0
	Field														0	0
[redacted] pressure retaining test not OK, RB OK according to spec.	0km														0	0
	Field														0	0
OK according to specification	0km			2											2	62
	Field														0	0
Customer error (shaft seal folded)	0km														0	0
	Field														0	0
t.b.d.	0km														0	0
	Field														0	0
Total of complaints	0km	0	1	2	0	0	0	0	0	0	0	0	0	0	3	
	Field	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total ppm-quota	ppm 0km	-	76	104	0	0	0	0	0	0	0	0	0	0		93
	ppm Field	-	0	0	0	0	0	0	0	0	0	0	0	0		0
Total number of acknowledged complaints	0km	0	1	0	0	0	0	0	0	0	0	0	0	0	1	
	Field	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
acknowledged ppm-quota	ppm 0km	-	76	0	0	0	0	0	0	0	0	0	0	0		31
	ppm Field	-	0	0	0	0	0	0	0	0	0	0	0	0		0

acknowledged complaints

Non-responsive content removed

EA11003EN-01407[0]

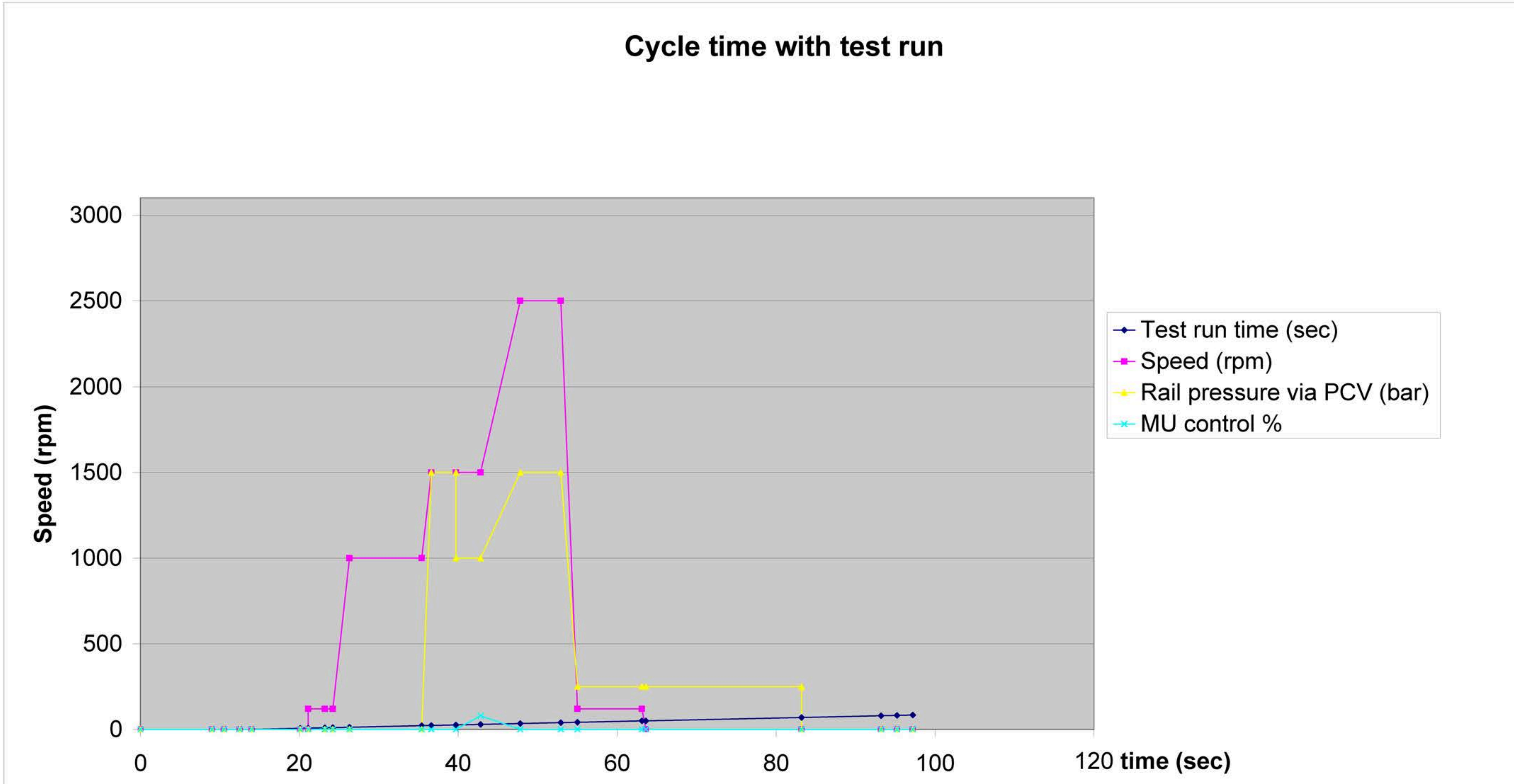
ENTIRE PAGE CONFIDENTIAL

Provisional test program for CR engine with Bosch HPP

Stage no.

	R0	9	0 R	1.5	0R	11	12R	12	13R	13	21R	21	15R	15	16R	16
Designation	Pallet change		Pallet lift		Provide drive carriages with MKP		E-contacting		Glow plugs Sensor test Regulating flaps Throttle valves glow plug test		Injector connection test		Breakaway Breakaway torque		Mechanics test (Control time check) (Additional function)	
Stage time / ramp time (sec)	0	9	1.5	0	2	0	1.5	0	0	6.1	0	1	0	2.1	0	1
Cycle time (sec)	0	9	10.5	10.5	12.5	12.5	14	14	14	20.1	20.1	21.1	21.1	23.2	23.2	24.2
Test run time (sec)	0	0	0	0	0	0	0	0	0	6.1	6.1	7.1	7.1	9.2	9.2	10.2
Speed (rpm)	0	0	0	0	0	0	0	0	0	0	0	0	120	120	120	120
Rail pressure via PCV (bar)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU control %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	22R	22	23R	23	24R	24	25R	25	31R	31	32R	32	33R	33	41R	41	32R	32	41R	41
Designation	Oil pressure build-up		Rail pressure build-up		MU test		Turbocharger Mechanical vibration		Mechanics test		Blow out		Rail pressure drop test (additional integrated)		residue		E contacting and drive carriage back		Lower pallet	
Stage time / ramp time (sec)	2.1	9.1	1.2	3.1	0	3.1	5	5.1	2.1	8.1	0	0	0.5	19.6	0	10	0	2	0	2
Cycle time (sec)	26.3	35.4	36.6	39.7	39.7	42.8	47.8	52.9	55	63.1	63.1	63.1	63.6	83.2	83.2	93.2	93.2	95.2	95.2	97.2
Test run time (sec)	12.3	21.4	22.6	25.7	25.7	28.8	33.8	38.9	41	49.1	49.1	49.1	49.6	69.2	69.2	79.2	79.2	81.2	81.2	83.2
Speed (rpm)	1,000	1,000	1,500	1,500	1,500	1,500	2,500	2,500	120	120	120	120	0	0	0	0	0	0	0	0
Rail pressure via PCV (bar)	0	0	1,500	1,500	1,000	1,000	1,500	1,500	250	250	250	250	250	250	0	0	0	0	0	0
MU control %	0	0	0	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Non-responsive content removed Date:
4/3/2006
Pressure: 4/14/2008, 3:03 PM

Non-responsive content removed

Cleanliness CP4

Increase in permissible residual dirt values

- ➔ Audi is insisting on an increase in the residual dirt values permitted for CP4
  - No particles > 250 µm permitted
  - CP4 residual dirt values coordinated with the injector requirements
- ➔ Background:
  - Pump failures due to particles with a size in the region of 300 µm
    Failure mechanism: Intake valve and non return valve malfunction in the cylinder head caused by particles
  - Current plant limit for the product:
    - High pressure: 4 particles permitted in the category 200-400µm
    - Low pressure 8 particles permitted in the category 200-400µm
- ➔ Current particle situation
  - The cleanliness values for the product comply with the current plant limits.
  - Particle category 200-400 µm:
    - High pressure* Mean value = 0.68 particles (25 measurements CP4.1 VW)
    - Low pressure Mean value = 1.68 particles (25 measurements CP4.1 VW)

High pressure: Measurement of the particles flushed by the high pressure – Hydraulic flow: Flow into housing ´ MU – inlet hole between the housing and the CH – inlet hole between the CH and the IV space - HP

BOSCH

Cleanliness CP4

Possible actions when limit value exceeded

➔ Repeated function test/flushing – previous investigations did not show any improvement in the residual dirt values for products flushed twice

➔ Disassembly of products – great risk of damage and occurrence of particles

➔ **No known effective procedure for flushing finished products**

BOSCH

Cleanliness CP4

Strategy and objectives

➔ Cleanliness must be ensured at part and assembly level.
- Housing/flange workshop
- Cylinder head
  - Pneumatic flushing (current test stage)
  - ECM deburring

➔ Previously, particle-based failures were solely due to particles in the IV and NRV areas of the cylinder head.

➔ Consequently, more stringent cleanliness requirements are necessary, especially in relation to the fuel-carrying areas from the MU to the non-return valve.

➔ The main objective of such intensive activities to improve cleanliness is to prevent the occurrence of small particles in the aforementioned areas.

➔ Particle extraction from components also includes the complete outer contour. A separate evaluation is not possible for the relevant fuel-carrying areas.

➔ The objective is, as far as possible, particle-free production of the aforementioned area (MU - NRV) in order to prevent the occurrence of pump failures. Monitoring through the use of particle measurements with an upper limit is not possible at present.

Cleanliness CP4

Simulation with a higher upper limit for residual dirt

- ➔ Over a production period of 2 weeks, the upper limit of “no particles > 200 µm” was reliably simulated in high pressure.
- ➔ Result
  - The upper limit of “no particles > 200 µm” was exceeded three times.
  - The B samples taken subsequently (2 pumps in each case) were within the increased specification.
  - No noticeable development of the “internal particle-based failures”.
  - All in all, continuation of the positive trend in the development of residual dirt values
- ➔ Summary
  - Compliance with the upper limit of “no particles > 200 µm” cannot be ensured at present.
  - At present, the residual dirt results for particles > 200 µm does not suggest a deviation in the processes.
  - There is no recognizable correlation between the individual residual dirt results and pump failures.

BOSCH

Cleanliness CP4

Further action

➔ Continuation of cleanliness work with the following objectives:
- No external and internal particle-based failures
- Further improvement of the residual dirt level, ensured compliance with the upper limit of "no particles > 200 µm" in high pressure
- Focus
  - Housing
  - Flange
  - Cylinder head
  - MU

➔ Test program involving 25 pumps to determine the origin of the particles in each particle category (similar to the investigation conducted in 2006) – question: What particle sources exist following implementation of the improvements? D: M05/2008

➔ Decision on how to proceed when particles > 200 µm occur in the high-pressure area
- Amend the action plan – Problem: No effective procedure for finished products when the limit value is exceeded.
- Analysis of all particles > 200 µm – Problem: Handling of small particles

BOSCH

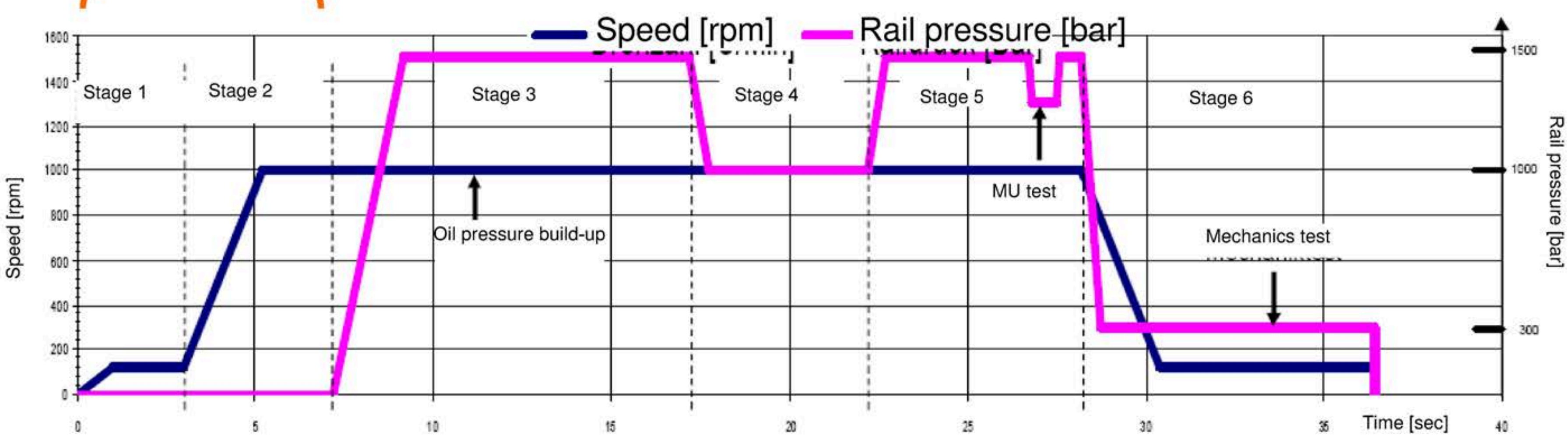
ENTIRE PAGE CONFIDENTIAL

R4 CR TDI
High-pressure fuel pump seized, noisy

Detection of fault in the cold test curves

(e.g. on the engine Motor CAG 036236, but it manifests in the same manner in the other two failures)

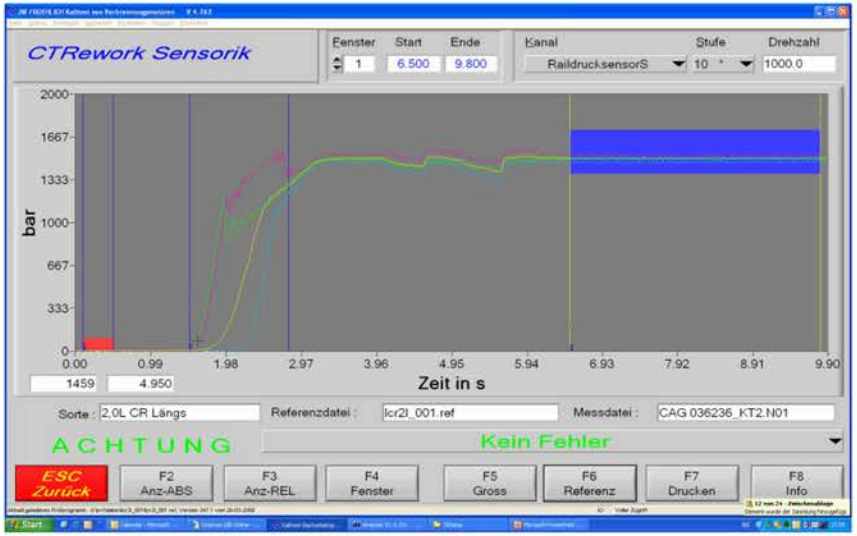
No striking features



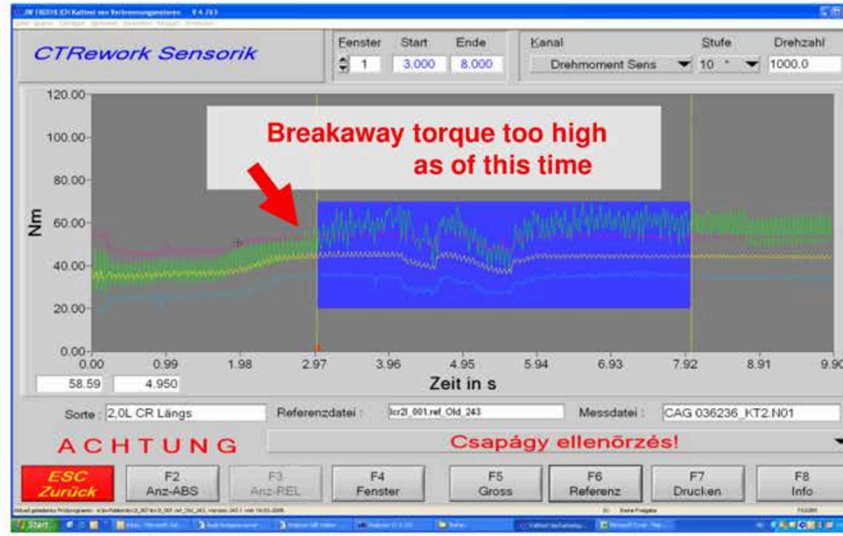
EA11003EN-01411[1]

ENTIRE PAGE CONFIDENTIAL

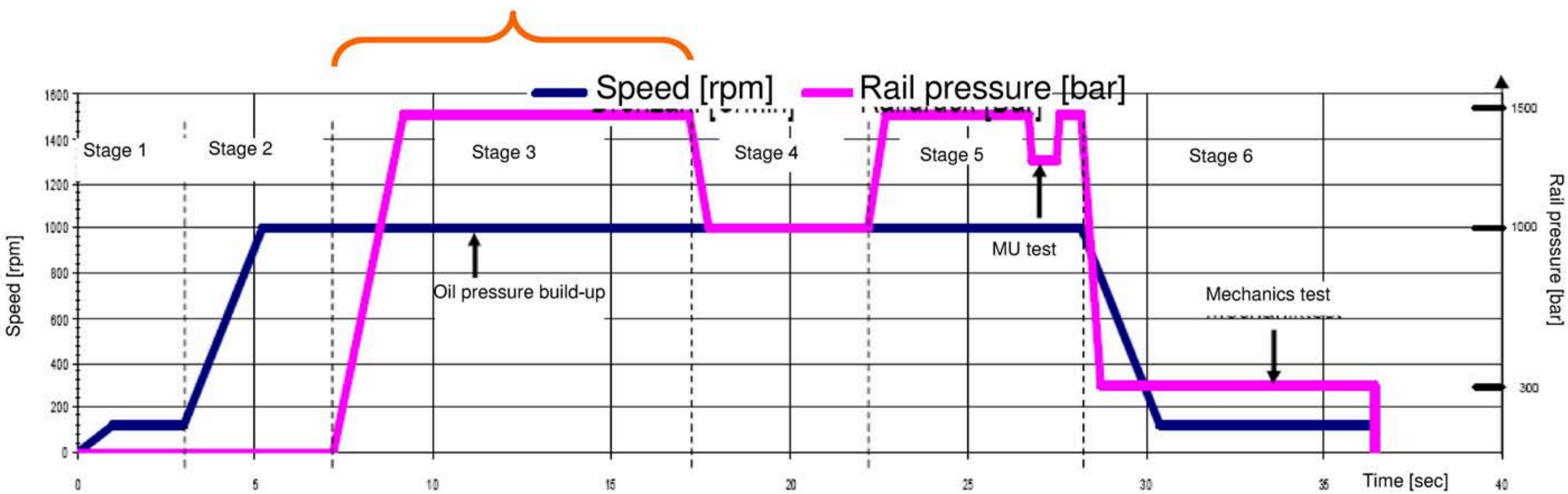
ACTUAL rail pressure



ACTUAL breakaway torque of the engine



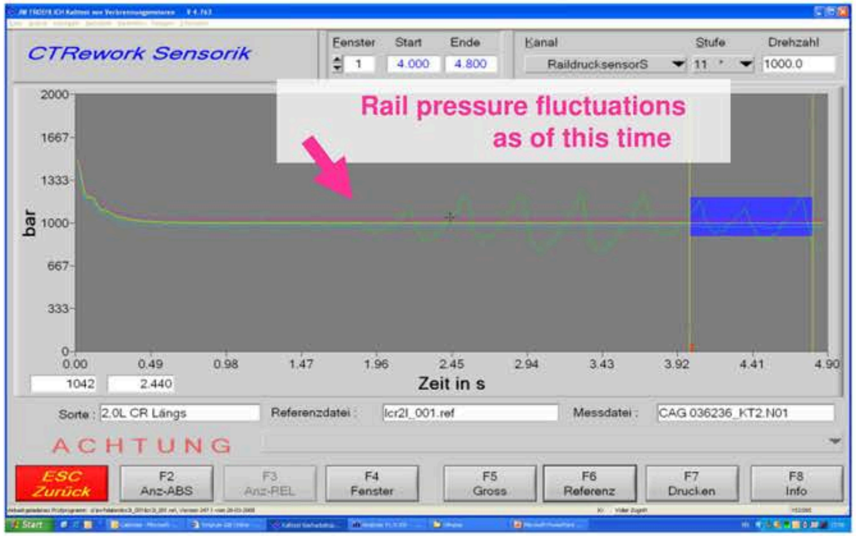
Rail pressure buid-up and kept stable, but the torque curve has run up since approx. the second third to a level that is greater than the reference curves



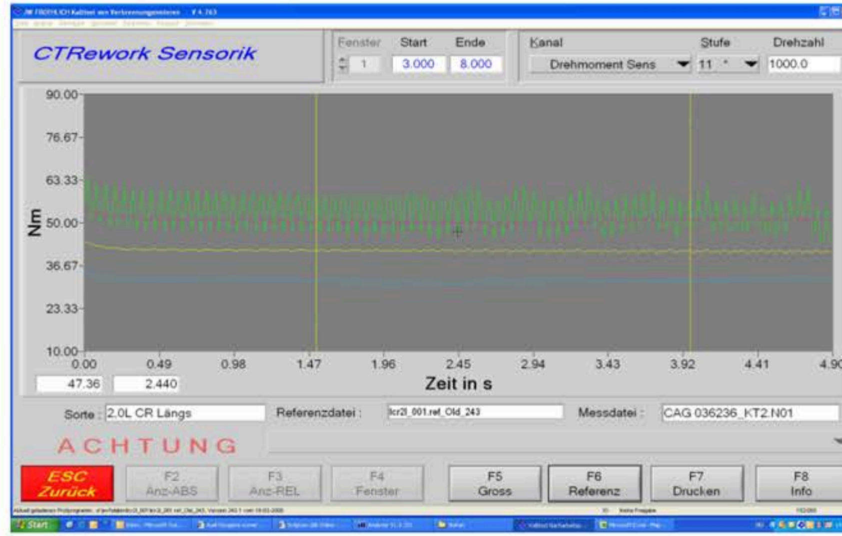
EA11003EN-01411[2]

ENTIRE PAGE CONFIDENTIAL

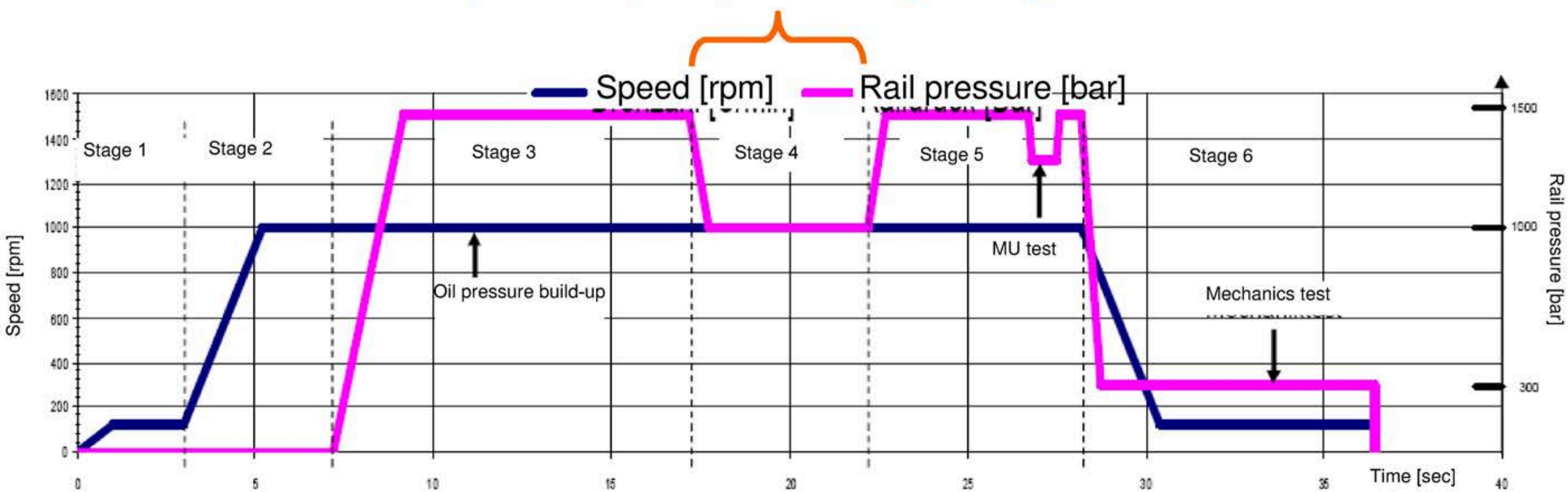
ACTUAL rail pressure



ACTUAL breakaway torque of the engine

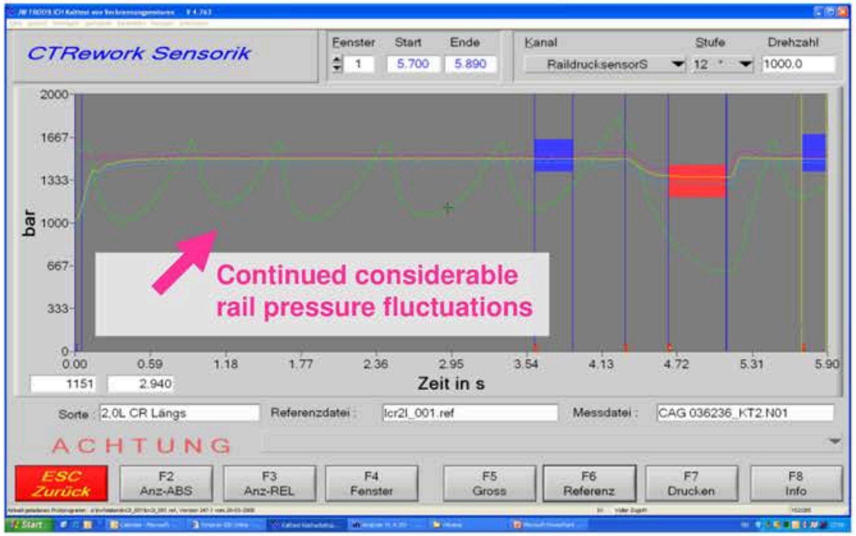


Within a few minutes, considerable rail pressure fluctuations occurred, breakaway torque remaining too high

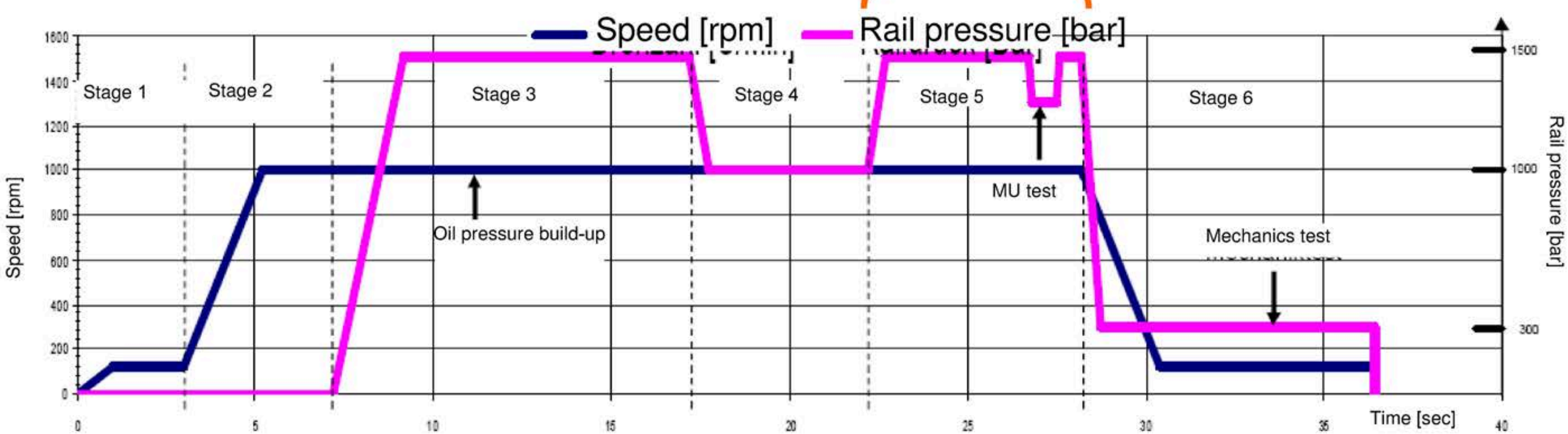


ENTIRE PAGE CONFIDENTIAL

ACTUAL rail pressure



Rail pressure in the further phases of the testing were always unstable, engine not OK



 ENTIRE PAGE CONFIDENTIAL

From: [redacted]
To: [redacted]
CC: [redacted]

Date: 7/19/2007 6:27:25 PM
Subject: Re: Minutes from OEM meeting on CP4.x turned tappet from 7/13/2007 - Item 4 Inspection oil quality CP4

Dear [redacted]
Regarding your question relating to the HFRR value, please consider the following:
- Inspection oil contains anti scuff additives. The effect is specified and must be proven by the supplier in a FBBD (Four Ball Bearing) test.
- HFRR is a standardized test used to determine wear (ball on plate). In other words, it is a measure of the amount of wear. The test runs in the mixed friction area.
- It is possible to measure wear and friction in the HFRR test. However, a correlation of these parameters cannot be proven. This is partly due to the wide dispersion of the HFRR results in the test per se and also to the fact that different wear mechanisms (tribochemical wear/abrasive wear/adhesive wear) are involved here.
- This means that the HFRR value is not a suitable parameter with which to assess friction behavior.
- The HFRR value is relatively high for the inspection oil used in order to ensure a certain running in (abrasion/ smoothing of the surface tips of the parts).

Friction is affected by the following parameters:
- For the hydrodynamic element of friction: f (viscosity of the inspection oil) --> viscosity is specified and is tested (per delivery batch)
- Impurities in the inspection oil:

1. Caused by particles: --> inspection oil is filtered or tested with regard to contamination in the circuit (on a weekly basis).
2. Chemicals in the inspection oil: --> The chemical composition is tested using the FTIR (Fourier Transform Infrared Spectrometry) spectrum (per delivery batch)

- In our opinion therefore, the key parameters that influence the friction properties of the inspection oil are monitored.

Best regards / Mit freundlichen Grüßen / Cordiali saluti

[redacted]

From: Non-responsive content removed
Sent: Thursday, July 19, 2007 12:54 PM
To: Non-responsive content removed
Subject: Re: Minutes from OEM meeting on CP4.x turned tappet from 7/13/2007 - Item 4 Inspection oil quality CP4

As discussed, please reply.

Best regards / Mit freundlichen Grüßen

Non-responsive content removed

From: Non-responsive content removed
Sent: Thursday, July 19, 2007 8:08 AM
To: Non-responsive content removed
Cc: [redacted]
Subject: ANS: Minutes from OEM meeting on CP4.x turned tappet from 7/13/2007 - Item 4 Inspection oil quality CP4

Hello [redacted]

Why is the lubrication not being monitored? I thought that was the whole idea?

-----Original message-----
From: Non-responsive content removed
Sent: Wednesday, July 18, 2007 6:26 PM
Non-responsive content removed
Subject: Minutes from OEM meeting on CP4.x turned tappet from 7/13/2007 - Item 4 Inspection oil quality CP4

Hello,
In the meeting on 7/13/2007, a presentation on the monitoring of the inspection oil quality at RB was requested.

1) Inspection oil used: Shell V-Oil 1404 (trade name)

2) The following parameters are monitored: appearance, viscosity, color, density. These are verified by the supplier by means of a certificate.

In the goods receiving inspection at RB, these parameters and the water content and the FTIR spectrum are determined.

Attached are the results of the goods receiving inspection in 2007

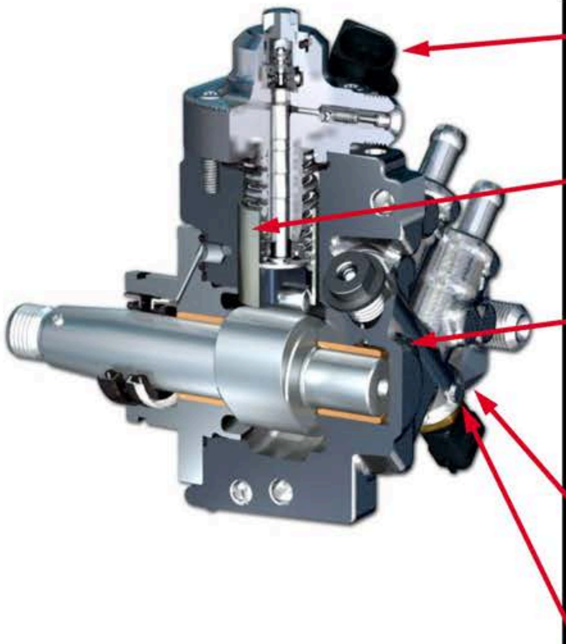
<<V1404_AnfrageCP4_VW.pdf>>
Best regards / Mit freundlichen Grüßen

Non-responsive content removed
[redacted]

ENTIRE PAGE CONFIDENTIAL

List of Design Differences of W36 to Production Pumps

W36: List of Design Differences of W36 to Current Production Pumps



Metering unit	new (axial exit direction of metering unit [electrical] connector)
Tappet	optimized tappet assembly, C2.1 on end of roller
Housing	new housing (metering unit rotated, through holes, engine-side radial shaft seal ring)
Cylinder head left	new cylinder head, due to changed exit direction (on side);
Nameplate	new assembly setup (TSS position on left)

BOSCH

Replication operation with non-OK rollers

Topic

Confirmation of failure hypothesis for "export countries"
"Drivetrain damage due to combination of stiff cam roller (in this instance, fusing on the cam roller) in combination with country-specific peculiarities(in this instance, fuel)" **through a replication test**

Implementation (0445010**613** instead of 0445010**611** due to C-coated piston to prevent piston seizure) CP4.2 W19 BIN5 with melt on the cam rollers (waste from straightedge test; subsequent frictional value test OK) set up and operated with poorly lubricating fuel GDK650 (HFRR 650 µm).

Result
Drivetrain damage after 35 hours of operation

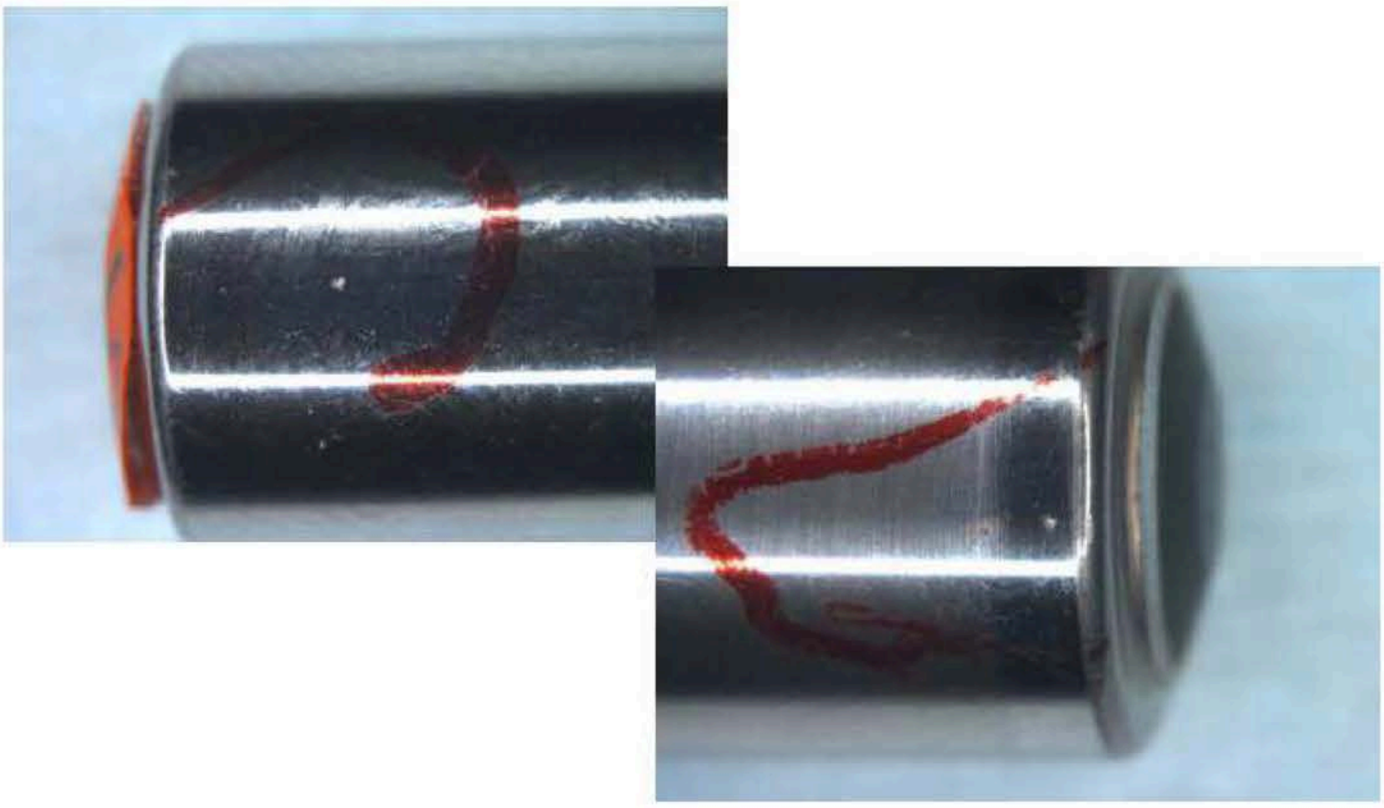
Note
The **drivetrain** task force carried out several similar tests with EN590, although only one case of drivetrain damage occurred.

Conclusion
Result confirms the **failure hypothesis**. Pumps manufactured prior to the introduction of the straight-edge test (7.04.2008) can--in combination with poor lubricity--experience failures.

BOSCH

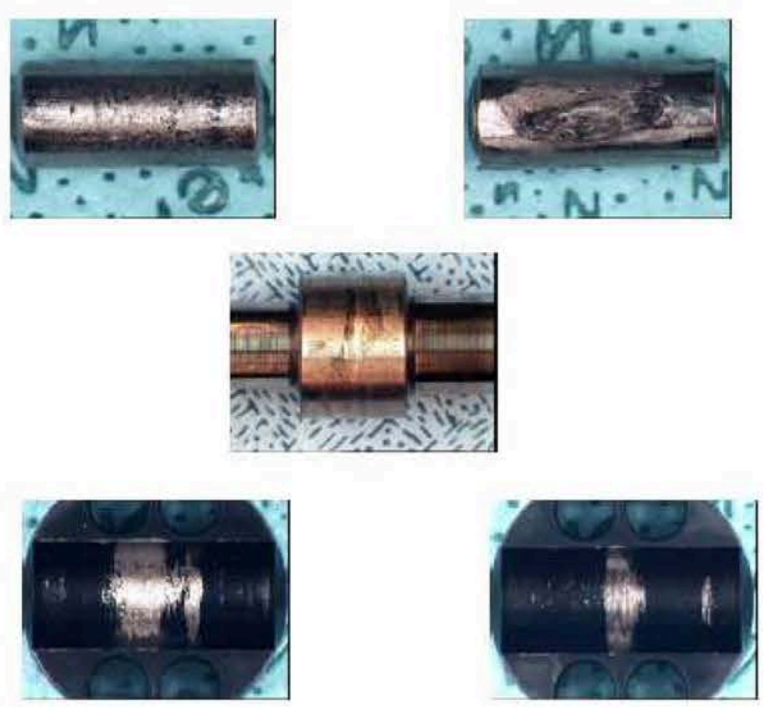
Provocative operation with non-OK rollers

Photos of roller before continuous test



Provocative operation with non-OK rollers

Photos after continuous test



BOSCH

Task Force Summary

→ Status of new information since last update on 1/20/2010 (changes in blue):

Task force work concentrates on the following key areas:

1. Analysis of field parts/fuel samples, good pumps, filtering, reserve samples from production.
2. Analysis of the differences between CP4.1 and CP4.2 in the case of critical fuels.
3. Reappear test of the differences between CP4.1 and CP4.2 and confirmation of the damage mechanisms.
4. Introduction of anti-wear package 1 (C2 coating, reduced play on roller/roller support, 100% avoidance of fusing and metal splashes)
   Implementation decision by RB/AUDI after positive completion of validation
   Start of week 9/2010
5. Definition of anti-wear package 2 (RoW action) after completion of points 1 and 2.
   This needs to be checked and validated with boundary fuel (already defined with AUDI).

1. Summary of analysis

➔ Other analyses in the fuel samples from local factions in [redacted] support the results from the fuel survey in [redacted] and the analyses from the problematic pumps. The mineral oil industry in [redacted] confirms in principle the poor fuel results (water, aged biofuel).

The analyses in relation to pumps, fuel samples and particles/ residues from local actions are complete. In some cases oxidation stability (aging) was outside the standard; in addition, particles of plastic and traces of algae were found in some tanks and pumps. One of the special features in [redacted] is the us of the Tunap 183 additive to clean the fuel injection system in service. According to the manufacturers, Tunap 183 is supposed to improve lubrication (HFRR value). Evaluation of the information by the Bosch and Audi laboratories. Verification of influence through tests run by Bosch.
Tests conclusion in week 8/2010 .

BOSCH

1. Summary of analysis

➔ Return of the requested 40 good pumps from [redacted] and 20 good pumps from [redacted]
First returns announced from [redacted] (5 pumps) and [redacted] (4 pumps). 4 pumps received from [redacted] on 1/25/2010. Pumps from [redacted] still outstanding.
1 in 4 pumps has signs of previous damage to the roller/ camshaft at TDC, same results as with 1 pump from returns from local team action.
Similar damage was found on an as yet still working V12-TDI pump from [redacted] (sister pump of drivetrain damage after 1,600 km), where the roller was at a significant slope on the cam and there were signs of corrosion on the roller.
These signs of damage indicate sluggish rollers in conjunction with poor quality fuel.
Further detailed analysis required, completion by 2/3/2010.

1. Summary of analysis

Information gathered to date supports the failure mechanisms presented in the last reports.

1. Tribochemical wear
2. Deposit / coatings from algae and oxidation products and therefore significant deterioration in friction coefficient.
3. Corrosion on the surface of cams and roller

Analysis of reference samples:

The analysis of the reference samples from the conspicuous production period (up to May 2008) indicates nothing unusual in relation to drawing-related features. Other detailed analyses (roller surface texture, ripple in roller support, roundness with Fourier analysis, local adhesion of coating with temperature analysis) are complete.

Analyses to date confirm the production status at the time, with spatter of metal on the roller support; also the surfaces of the C coatings indicate abnormalities that are still under investigation. Will be concluded on a further 25 parts by 2/3/2010.

BOSCH

2. Summary of differences between CP4.1 and CP4.2

- The MIS12 (MY08) failure quota of the CP4.2 is up to 10 times higher in [redacted] than the CP4.1.
- The MIS 12 (MY08) of CP4.2 is approximately 10 times higher [redacted] than in [redacted]
- The MIS 12 (MY08) of CP4.2 is approximately 2 times higher [redacted] than in MY09.

Conclusions:

- In addition to the influence of the fuel quality, there must also be design and application-specific differences between CP4.1 and CP4.2.
- Concentration of further work on an analysis of the differences between CP4.1 and CP4.2 (see slide 6 and 7).

2. Summary of differences between CP4.1 and CP4.2

Further action:

Implement examinations of

- ➔ the flow and pressure conditions in the tappet chamber of both pump types.
  Initial investigations of flow conditions indicate now differences.
- ➔ the influence of the low pressure circuit.
  The plan is to reproduce the entire low pressure circuit of 4-/6-cyl. engines on the test bench in order to test individual influences, such as water ingress from the tank to the pump. D. 2/24/2010
- ➔ the tappet position when stopping (position of roller with cam at TDC).
  Initial analysis showed that the tappet position in 6-cylinder engines in approx. 10% of cases can be just before or at TDC after the motor stops. When the engine is restarted, the roller must start from the instable position at TDC. This could cause the tappet to turn.
  In the case of 4-cylinder engines this critical position does not exist, however this is to be confirmed again by VW/AUDI by means of measurement data on the vehicle. T. 2/3/2010

3. Reappear test for differences between CP4.1 and CP4.2

Further action:

Validation with EN590 shows a turned tappet on the cam shaft of less than one degree.

Further investigations are required on the test bench in relation to the startup of the roller at TDC with critical fuel (Arctic Diesel). D. 2/3/2010

Measurements need to be carried out using kerosene on the complete engine at AUDI in [redacted] in week 5/2010.

4. Summary of anti-wear package 1

➔ Further action:

Measures to increase robustness (roller surface texture, roller support and play) are defined and their effectiveness will be verified with the same test parameters. A test schedule has been drawn up, partial results will be available by the end of week 8/2010. The latest information shows that the roughness of the roller support is the decisive parameter in increasing robustness. According to a simulation, narrowing tolerance R_V from 1.3 to 0.8 µm increases the safety factor of the friction coefficient by approx. 50%.

Investigations into the creation of roughness in the roller support shows that roughness is primarily determined by the C3 coating and not the processing.

4. Summary of anti-wear package 1

Roughness measurements on roller supports with C2 coating show a clear improvement in roughness.

Changes in process technology from C3 sputter coating to C2 plasma coating on the roller support and roller enables quality to be improved by avoiding 100% of fusing and metal splashes.

That is why it is necessary to switch to C2 coating.

The basic test with EN590 and BDF 570 for C2 coating is complete.

The "rest of the world" trials are still outstanding.

Further action:

→ In case of positive validation of the anti-wear package by the end of WK 8/2010 with limit samples and critical fuels (Kerosene, Arctic Diesel, WCF, FCF), a series introduction was decided for V6-TDI EU5 + BIN5 series and W36 pumps.

Production readiness is assured from WK 9/2010 onwards.

This will confirm the schedule requirements from Audi from the last task force.

4. Summary of anti-wear package 1

→ A further objective is to enable the anti-wear package on a provisional basis in customer service worldwide.

After the anti-wear package is installed in series, the first 400 pumps will be provided for customer service.

Task Force Summary

→ Status of new insights since last update on 2/3/2010
(changes in blue):

Task force work concentrates on the following key areas:

1. Analysis of field parts/fuel samples, good pumps, filtering, reserve samples from production.
2. Analysis of the differences between CP4.1 and CP4.2 with critical fuels.
3. Reappear test of the differences between CP4.1 and CP4.2 and confirmation of the damage mechanisms.
4. Introduction of anti-wear package 1 (C2 coating, reduced play between roller/roller support, 100% avoidance of fusing and metal spatters), decision for implementation through RB/AUDI after positive conclusion of validation early WK9/2010.
5. Definition of anti-wear package 2 (RoW action) after completion of points 1 and 2. This needs to be checked and validated with boundary fuel (already defined with AUDI).

BOSCH

ENTIRE PAGE CONFIDENTIAL

1. Summary of analysis

→ **Analysis of field pumps and fuel samples from [redacted]**

→ FAME deposits	11 of 54 pumps
→ Corrosion indicators, evidence of water	45 of 54 pumps
→ Free water in fuel sample	4 of 24 samples
→ Cellulose residue, algae, glycerin	9 of 24 pumps
→ Heavy wear of shaft seal	17 of 17 pumps
→ OK pumps with preliminary damage [redacted]	6 of 13 pumps

BOSCH

1. Summary of analysis

→ Return of the requested 40 good pumps from [redacted] and 20 good pumps from [redacted]

First returns received from [redacted] (6 pumps) and [redacted] (13 pumps).

6 of 13 pumps have preliminary damage and show braking flats with transfer of material to roller and camshaft.

Damage symptoms indicate a seized roller during pump startup with poor fuel.

The cause of the roller standstill is the clogging in the roller support through deposits of reaction products from the aged biofuel.

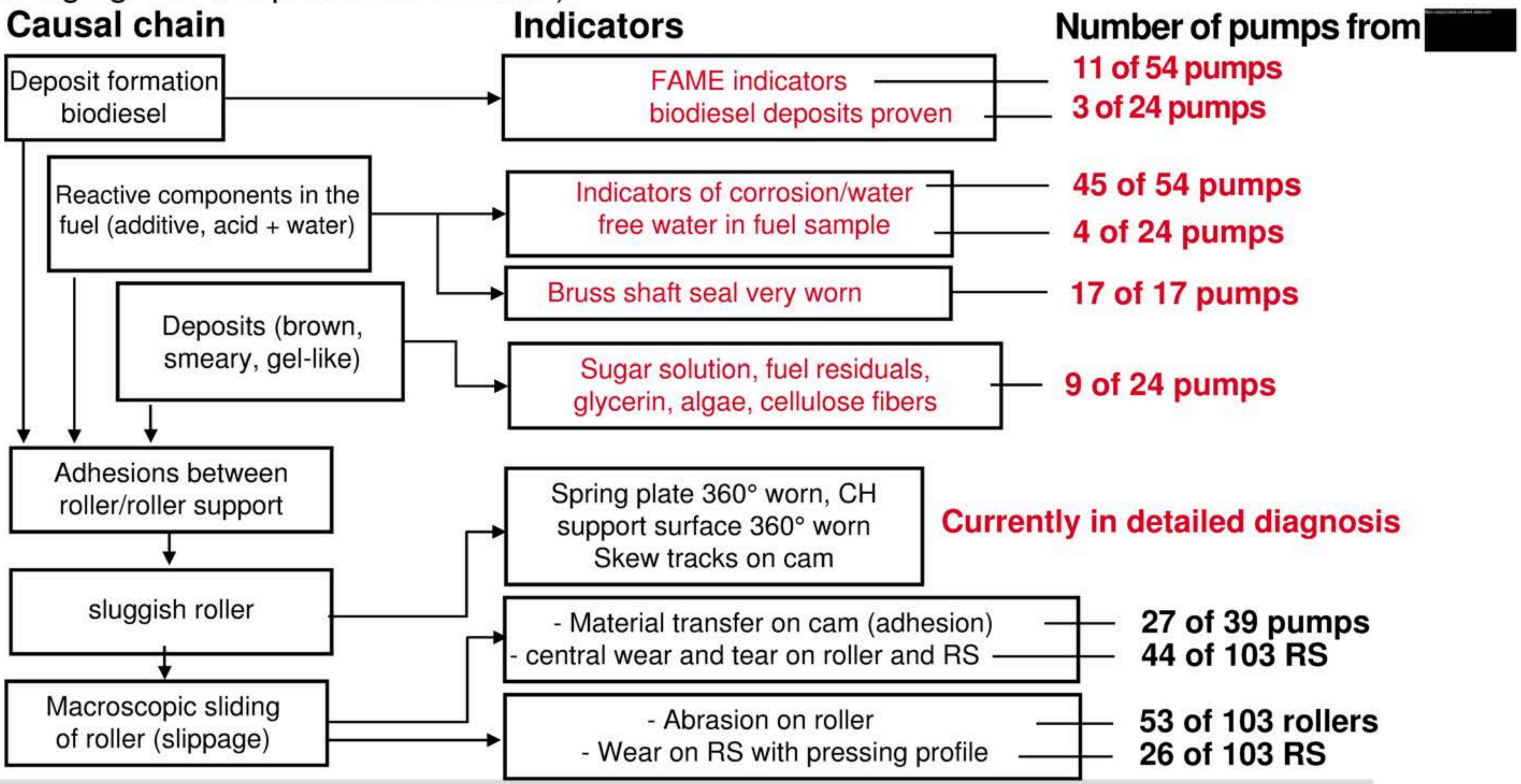
Reappear tests with poor fuel confirm the seized roller and similar damage symptoms.

ENTIRE PAGE CONFIDENTIAL

AUDI-CP4 Situation in the field in [redacted] 2/10/2010

1. Summary of analysis

(fuel aging with the presence of water)



BOSCH

ENTIRE PAGE CONFIDENTIAL

AUDI-CP4 Situation in the field in [redacted] 2/10/2010

2. Summary of differences between CP4.1 and CP4.2

→ The MIS12 (MY08) failure quota of the CP4.2 is up to 10 times higher in [redacted] than the CP4.1.

→ The MIS 12 (MY08) of CP4.2 is approximately 10 times higher in [redacted] than in [redacted]

→ The MIS 12 (MY08) of CP4.2 is approximately 2 times higher in [redacted] than in MY09.

Conclusions:

→ In addition to the influence of the fuel quality, there must also be design and application-specific differences between CP4.1 and CP4.2.

A stationary roller with potential to transfer material on the camshaft can only be generated under load (pressure) and with low-quality fuel.

Based on the new hypothesis of the stationary roller during the start-up with low-quality fuel, the additional tests focus on the differences in the pressure build-up/pressure changes between CP4.1 and CP4.2. To this end, further measurements are performed at the engine. Additional measurements will be carried out on the engine for this purpose. Date coordination with VW underway.

BOSCH

4. Summary of anti-wear package 1

→ Further action:

Measures to increase robustness (roller surface texture, roller support and play) are defined and their effectiveness will be verified with the same test parameters. A test schedule has been drawn up, partial results will be available by the end of week 8/2010. The latest information shows that the roughness of the roller support is the decisive parameter in increasing robustness.

According to a simulation, narrowing tolerance R_V from 1.3 to 0.8 µm increases the safety factor of the frictional coefficient by approx. 50%.

Investigations into the creation of roughness in the roller support shows that roughness is primarily determined by the C3 coating and not the processing.

ENTIRE PAGE CONFIDENTIAL

4. Summary of anti-wear package 1

Roughness measurements on roller supports with C2 coating show a clear improvement in roughness.
Changes in process technology from C3 sputter coating to C2 plasma coating on the roller support and roller enables quality to be improved by avoiding 100% of melts and metal spatter. That is why it is necessary to switch to C2 coating.
The basic test with EN590 and BDF 570 for C2 coating is complete. The “rest of the world” trials are still outstanding.

Friction coefficient investigations (Stribeck curves) with C2 coating and close play between the roller and roller support indicate a positive shift toward lower frictional coefficients with poor quality fuels (Arctic diesel, kerosene), (see slides 8 and 9).

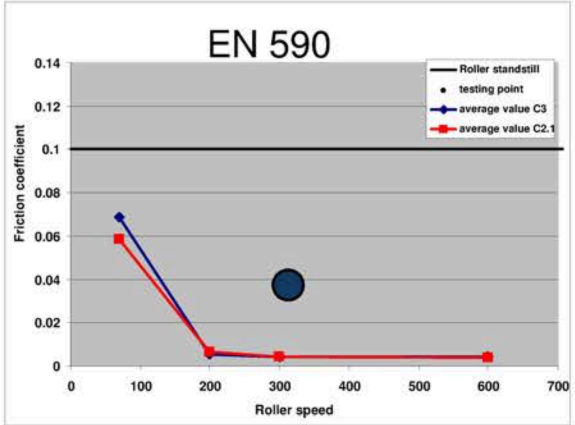
→ Better frictional coefficients improve the start-up behavior of the roller in the roller support.

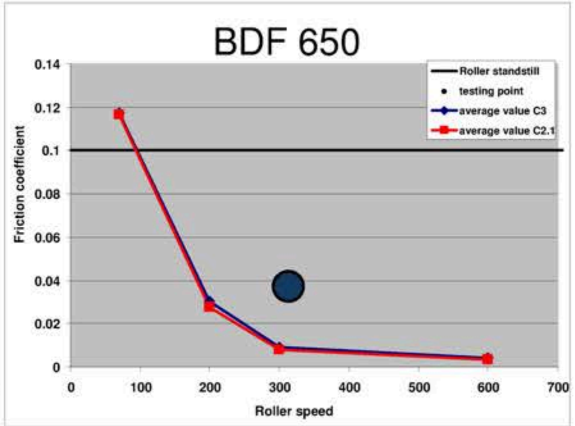
ENTIRE PAGE CONFIDENTIAL

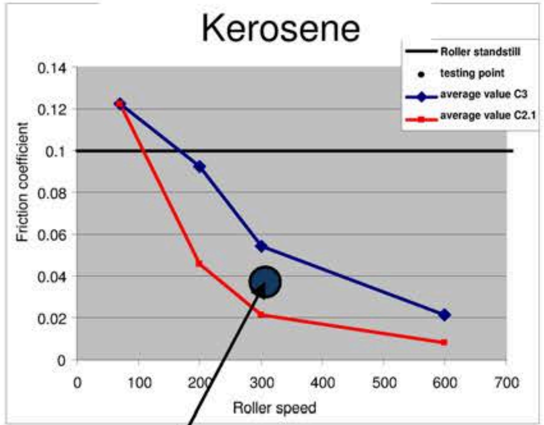
AUDI-CP4 Situation in the field in [redacted] 2/10/2010

4. Summary of anti-wear package 1

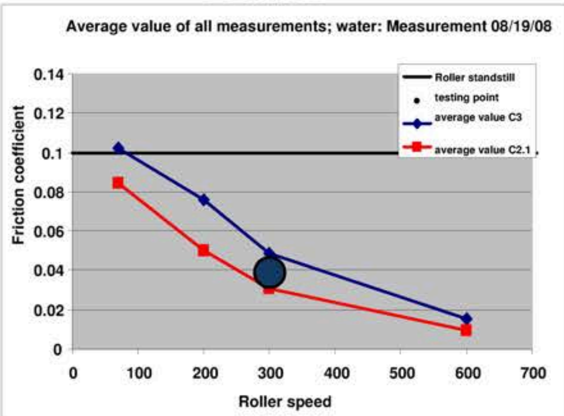
Comparison of layer system* C3-C2.1 on friction coefficient test bench for



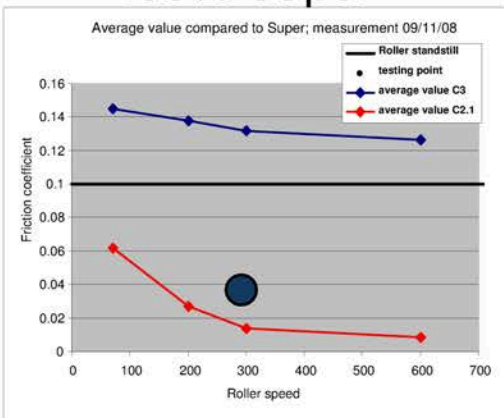




Water



100% Super



Assessment criterion: friction coefficient

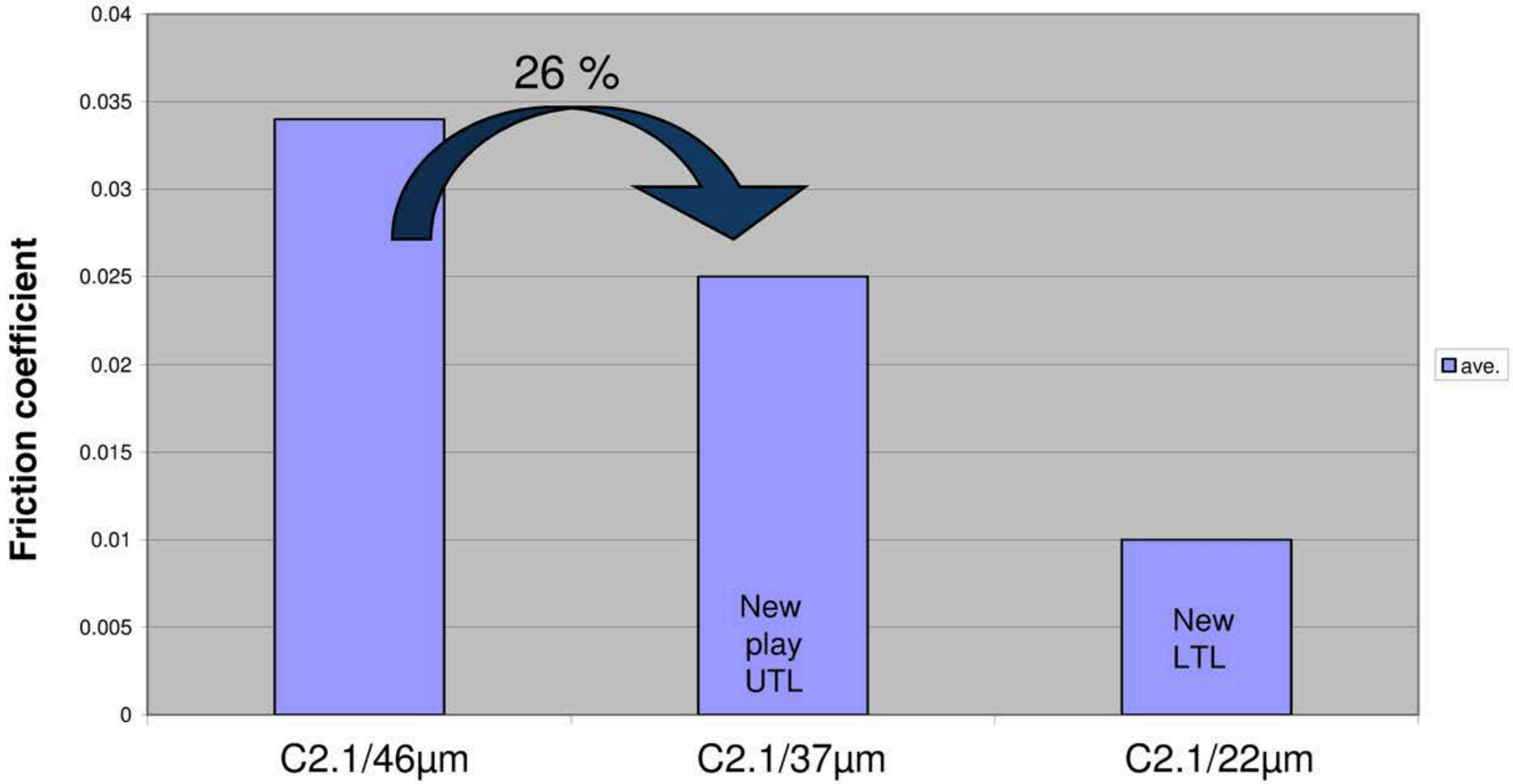
***average comparable play**

BOSCH

ENTIRE PAGE CONFIDENTIAL

4. Summary of anti-wear package 1

Examination with viscosity 1.4mm²/s @40°C (Arctic Diesel)
Testing point 300rpm



4. Summary of anti-wear package 1

Further action:

→ Because the anti-wear package was positively validated by the end of week 8/2010 with limit samples and critical fuels (kerosene, Arctic Diesel, WCF, FCF) series introduction approved for all CP4.2 pumps from Audi / VW (V6, V8, V12 TDI).
Production readiness is assured from week 9/2010 onwards.
This will confirm the schedule requirements from Audi from the last task force.

→ A further objective is to enable the anti-wear package on a provisional basis in customer service worldwide.After the anti-wear package is installed in series, the first 400 pumps will be provided for customer service.

→ An additional low-lubricity package (LLPx) is required for RoW (rest of world). LLPx is a combination of anti-wear package 1 plus a C coated pump piston plus measures for the improved start-up of the roller when starting the engine with poorly lubricating fuel.

AUDI-CP4 Situation in the field in Non-responsive content removed 2/10/2010

4. Summary of anti-wear package 1

Effectiveness of robustness system:

Fuel quality	Problem	Series	RP1	LLPx*	Water separator
EN590/BDF520		+**	++**	++	
BDF650	Lubricity	(+)**	+**	+	
Kerosene	Viscosity	-	(+)	+	
Old biofuel	Adhesion, Lubrication	-	(-)	+*	
Water > 200ppm	Lubrication Visco, Corrosion	-	-	-	+

* LLPx: Depending on investigations of the differences between CP4.2 zu CP4.1 and the results of the FCF and WCF tests with RP1 measures, determination in the next 8 weeks

** with C coated piston (USA)

BOSCH

ENTIRE PAGE CONFIDENTIAL

AUDI-CP4 Situation in the field in Non-responsive content removed 2/10/2010

AQUA: Active quality analysis
Status 12/09-01/16/10 8:43 AM
Source/user Non-responsive content removed

Audi, *, market: [redacted] **CP4.2**

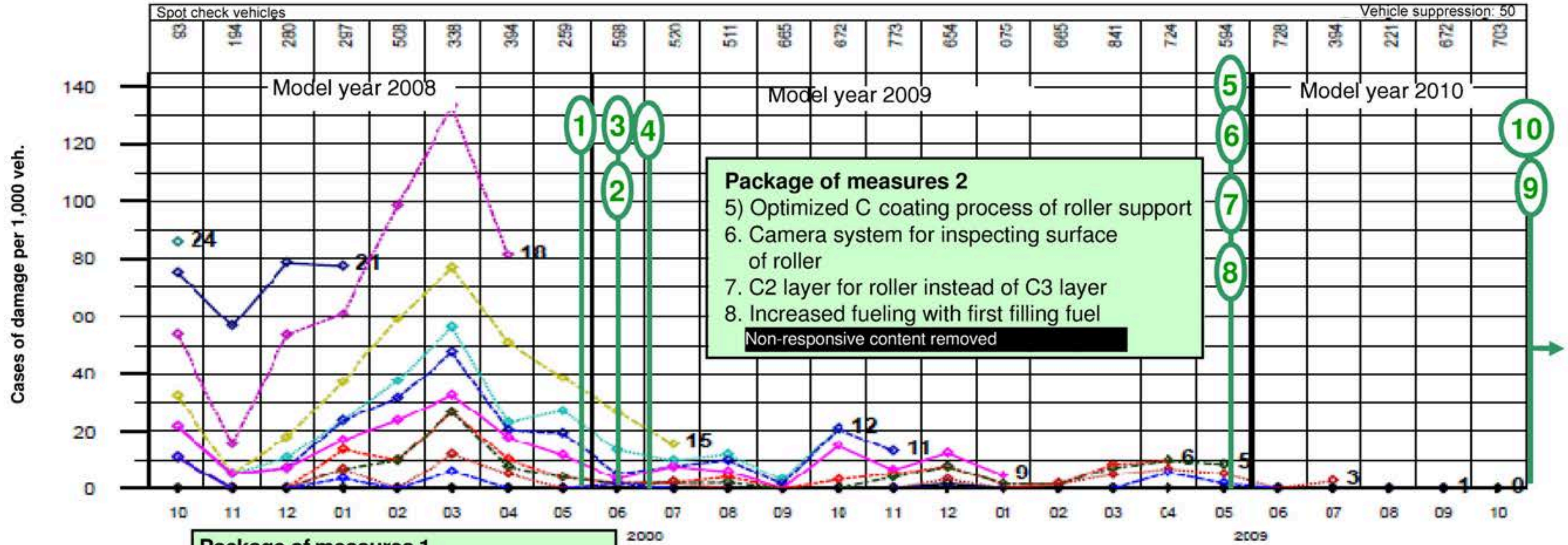
MY 2008 - 2010, Offset: all (Max: 2)
CNR / Groups High-pressure pump

Confidential
Without PR numbers
CNR 2374

CAMA|CAMB|CAMD|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CATA|CATB|CCLA|CCMA|CCWA|CCWB|CDYA|CDYB|CDYC|CGK

MY	MIS 0	MIS 1	MIS 3	MIS 5	MIS 6	MIS 9	MIS 11	MIS 12	MIS 15	MIS 18	MIS 21	MIS 24
2008	0.0	1,7	3,9	9,0	10,3	18,0	23,6	27,8	44,5	78,5	103,2	119,7
2009	0.1	0,9	1,9	3,8	4,4	7,8	11,7	14,3	23,0			
2010	0.0	0.0	2.1	3.1	3.1							
Diff%	-100	-100	8,53	-16,22	-29,13							

MY	Exchange	BD	SA 10	SA 17
2008	100,0 %	81,3 %	75,6 %	14,2 %
2009	97,2 %	86,0 %	79,4 %	13,1 %
2010	100.0 %	100.0 %	50.0 %	50.0 %
			MEC ERR	MAJOR



Package of measures 2
5) Optimized C coating process of roller support
6. Camera system for inspecting surface of roller
7. C2 layer for roller instead of C3 layer
8. Increased fueling with first filling fuel
Non-responsive content removed

Vehicle: 3.389+12.041+6... ...35+7.730+3.776=13.341; MY: 2008+2009+2010=...

Package of measures 1
1. Straightedge test on roller
2. Visual inspection of roller after C coating
3. optimized C coating
4. Improved texture of roller (new subcontractor)

Package of measures 3
9. HC washing roller support (Jan 2010)
10. Introduction of anti-wear package 1, SOP Bosch (March 2010)

Diesel Systems

BOSCH

CP4 complaints - Collective completion QTS / IQIS messages

Background

→ Completion of approx. 600 [redacted] pumps by AUDI in late 2010

→ Reference report on distribution of error pattern through completed measures

- Completion statistics with failure country [redacted] complaint period 01/2008 - 12/2010 (IQIS) by pump DM and fault name or fault pattern
- In accordance with mail from [redacted] from 01/11/2010

Overview: Number by fault name, pump family, [redacted] 01/2008 - 12/2010

Fault name	CP4.1	CP4.2	Total result
External intervention	1	3	4
OK according to spec.	16	70	86
Non-starter	5		5
Poor quality fuel	15	39	54
Drivetrain damage	62	176	238
Drivetrain damage / fuel not OK	68	211	279
CH cracked	1		1
MU defective	1		1
Overall result	169	499	668

BOSCH

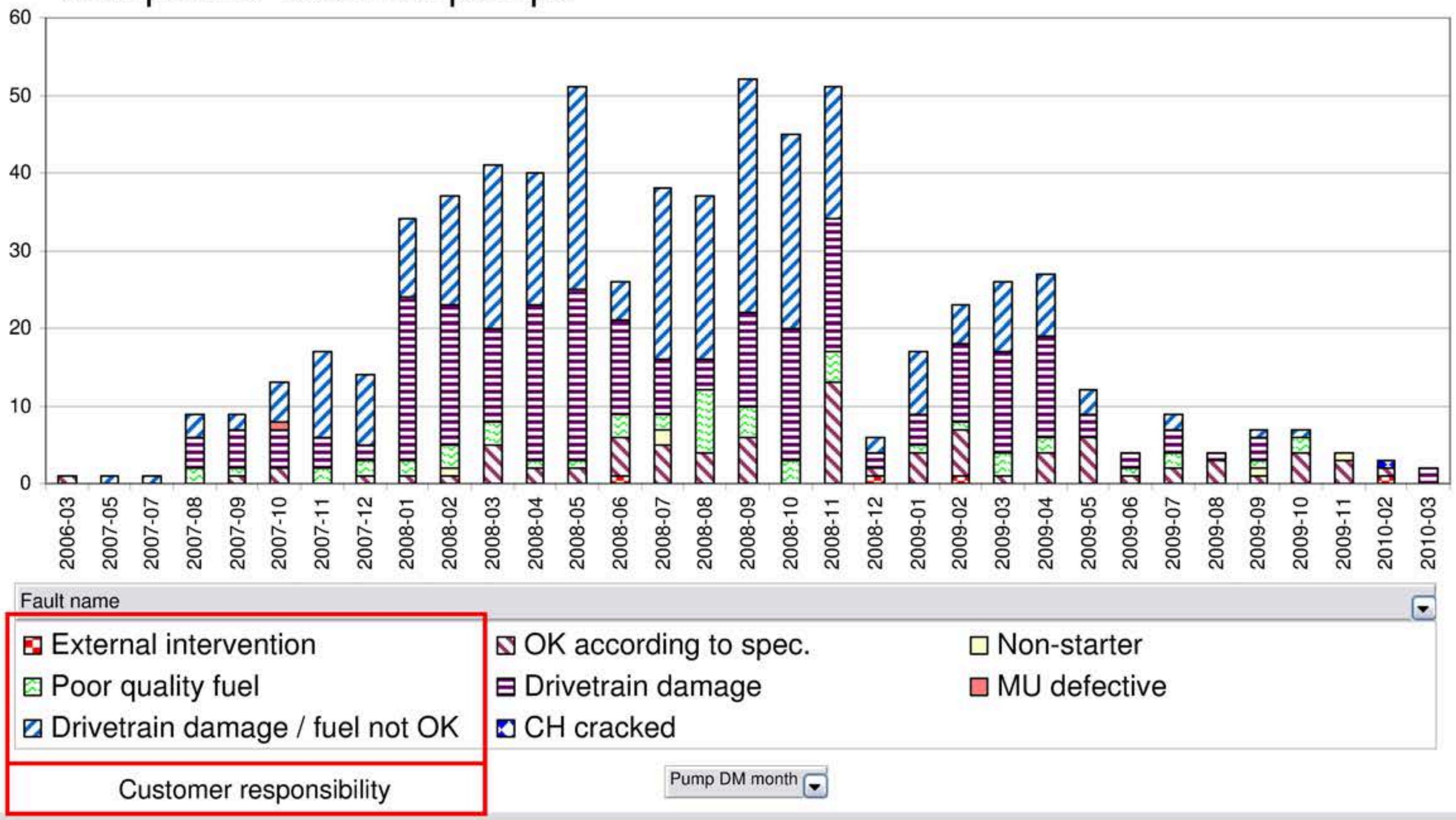
ENTIRE PAGE CONFIDENTIAL

CP4 complaints - Collective completion QTS / IQIS messages

Distribution of error symptoms through completed messages

Failure country: [redacted] complaint period (IQIS): 1/1/2008 - 12/31/2010

Complaint / returned pumps



Diesel Systems

BOSCH

CP4 drivetrain damage - Collective completion QTS / IQIS messages

Distribution of error symptoms through completed messages

Total complaints	Fault name								
Pump DM mo	External intervention	OK according to spec.	Non-starter	Poor quality fuel	Drivetrain damage	Drivetrain damage / poor fuel	CH cracked	MU defective	Overall result
2006-03		1							1
2007-05						1			1
2007-07						1			1
2007-08				2	4	3			9
2007-09		1		1	5	2			9
2007-10		2			5	5		1	13
2007-11				2	4	11			17
2007-12		1		2	2	9			14
2008-01		1		2	21	10			34
2008-02		1	1	3	18	14			37
2008-03		5		3	12	21			41
2008-04		2		1	20	17			40
2008-05		2		1	22	26			51
2008-06	1	5		3	12	5			26
2008-07		5	2	2	7	22			38
2008-08		4		8	4	21			37
2008-09		6		4	12	30			52
2008-10				3	17	25			45
2008-11		13		4	17	17			51
2008-12	1	1			2	2			6
2009-01		4		1	4	8			17
2009-02	1	6		1	10	5			23
2009-03		1		3	13	9			26
2009-04		4		2	13	8			27
2009-05		6			3	3			12
2009-06		1		1	2				4
2009-07		2		2	3	2			9
2009-08		3			1				4
2009-09		1	1	1	3	1			7
2009-10		4		2		1			7
2009-11		3	1						4
2010-02	1	1					1		3
2010-03					2				2
Overall result	4	86	5	54	238	279	1	1	668

Failure country: [redacted] complaint period (IQIS): 01/01/08 - 12/31/10, complaint / returned pumps

ENTIRE PAGE CONFIDENTIAL

CP4 drivetrain damage - Collective completion
QTS / IQIS messages

Distribution of error symptoms through completed messages

	CP4.1								CP4.1 result	CP4.2					CP4.2 result	Total result
Pump DM month	External intervention	OK according to spec.	Non-starter	Poor fuel	Drivetrain damage	Drivetrain damage/ not OK	CH cracked	MU defective		External intervention	OK according to spec.	Poor fuel	Drivetrain damage	Drivetrain damage / not OK		
2006-03											1				1	1
2007-05														1	1	1
2007-07														1	1	1
2007-08												2	4	3	9	9
2007-09		1							1			1	5	2	8	9
2007-10								1	1		2		5	5	12	13
2007-11				1		2			3			1	4	9	14	17
2007-12					2	3			5		1	2		6	9	14
2008-01					5	1			6		1	2	16	9	28	34
2008-02		1	1	2	8	3			15			1	10	11	22	37
2008-03		1		1	5	7			14		4	2	7	14	27	41
2008-04		2			12	3			17			1	8	14	23	40
2008-05					12	10			22		2	1	10	16	29	51
2008-06				1	4	3			8	1	5	2	8	2	18	26
2008-07			2			7			9		5	2	7	15	29	38
2008-08				4	2	6			12		4	4	2	15	25	37
2008-09		3		2	2	6			13		3	2	10	24	39	52
2008-10				1	3	4			8			2	14	21	37	45
2008-11		1			3	4			8		12	4	14	13	43	51
2008-12										1	1		2	2	6	6
2009-01		2		1	1	3			7		2		3	5	10	17
2009-02		1				2			3	1	5	1	10	3	20	23
2009-03						2			2		1	3	13	7	24	26
2009-04				1	1				2		4	1	12	8	25	27
2009-05		3				1			4		3		3	2	8	12
2009-06											1	1	2		4	4
2009-07											2	2	3	2	9	9
2009-08					1				1		3				3	4
2009-09			1		1	1			3		1	1	2		4	7
2009-10				1					1		4	1		1	6	7
2009-11			1						1		3				3	4
2010-02	1	1					1		3							3
2010-03													2		2	2
erall result	1	16	5	15	62	68	1	1	169	3	70	39	176	211	499	668

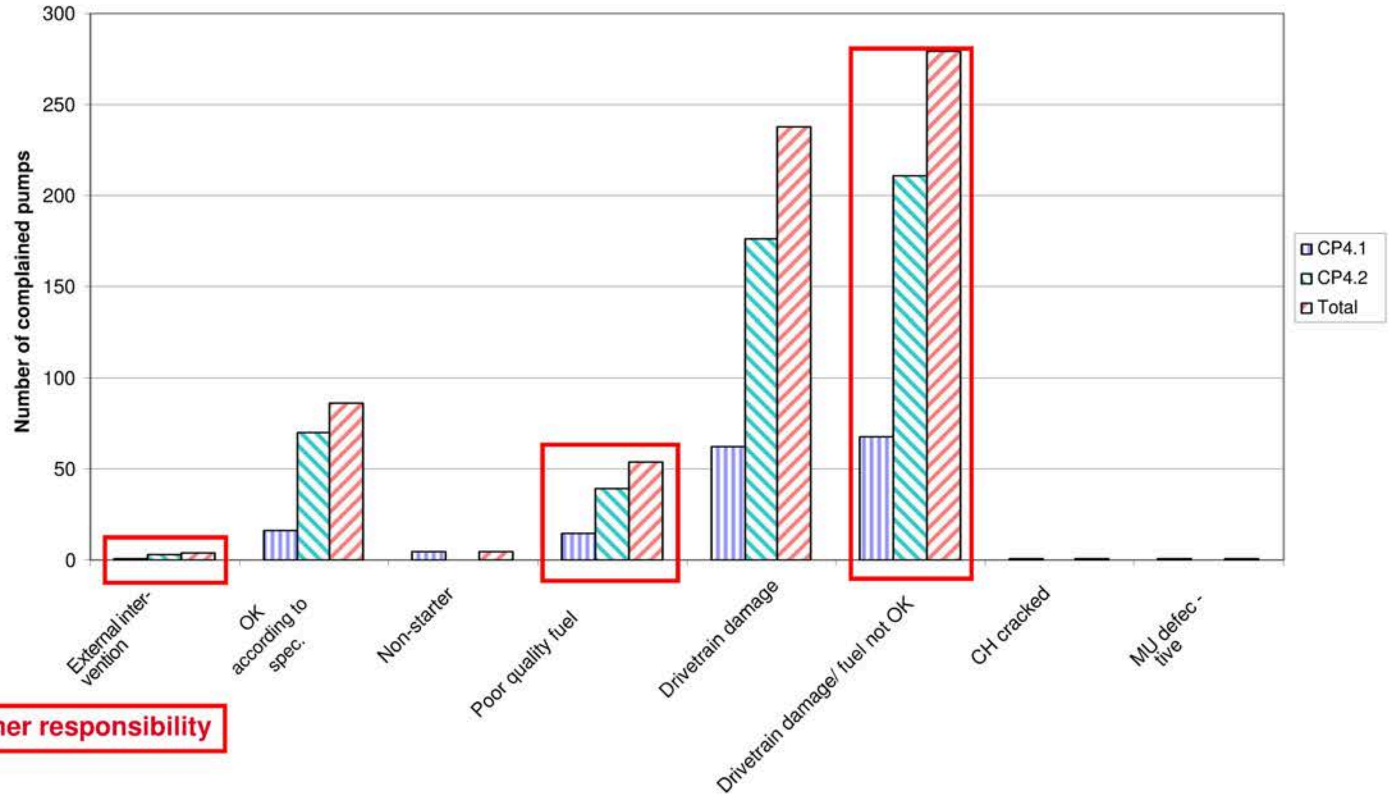
Failure country: [redacted]; complaint period (IQIS): 01/01/08 - 12/31/10, complained / returned pumps, single/twin pistons

ENTIRE PAGE CONFIDENTIAL

CP4 drivetrain damage - Collective completion QTS / IQIS messages

Distribution of error symptoms through completed Messages

Failure country: [redacted] complaint period (IQIS): 1/1/2008 - 12/31/2010
Complained / returned pumps



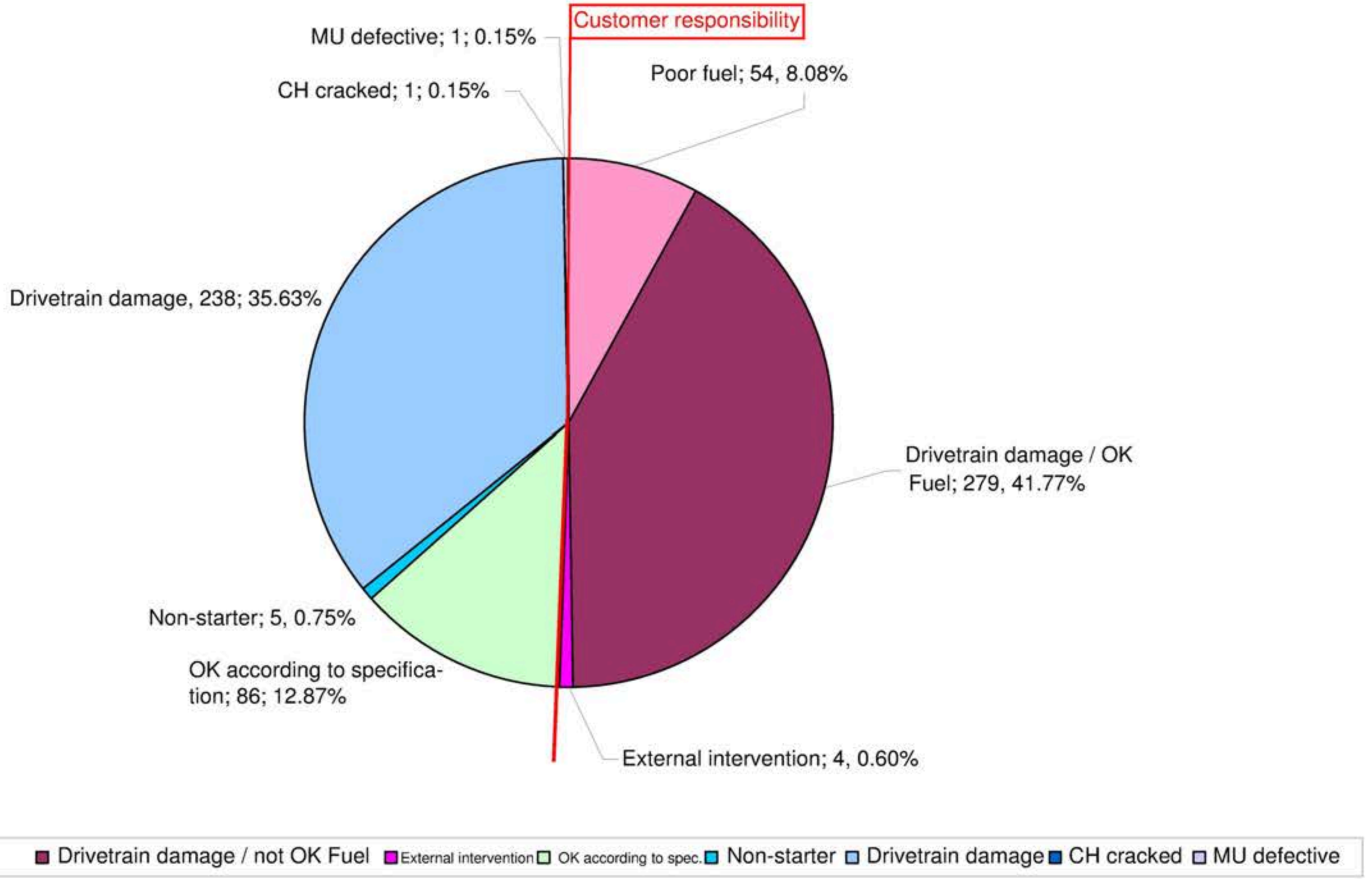
Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

CP4 drivetrain damage - Collective completion QTS / IQIS messages

Share of CP4 error symptoms [redacted] of returned pumps - completed messages 01/01/2008 - 12/31/2010



Failure country [redacted] complaint period (IQIS): 01/01/08 - 12/31/10, complained / returned pumps

Diesel Systems

BOSCH

CP4 drivetrain damage - Collective completion QTS / IQIS messages

Notes on individual error symptoms

RB responsibility:	**Summary:***
→ Drivetrain damage	Measures see slide 8.
→ Non-starter	Measures see slides 9-14
→ MU defective (o-ring damaged)	Measure: new process for ensuring lubrication of o-ring before MU assembly starting 11/22/07
→ CH cracked	Measures: high-resolution ultrasound examination (Circular disc reflector = 0.7 instead of 1.5 previously) from 03/17/08; lining of fusing plant from 12/01/07

OK according to specification

→ Will be tracked further as part of rail pressure fluctuation (error memory P0087 and P0088)

Customer responsibility:

→ Poor fuel - during fuel analysis, water/RME content above the EN590 requirements or deposit formation was determined

* Details are documented in the respective 8D reports

ENTIRE PAGE CONFIDENTIAL

CP4 drivetrain damage - Collective completion
QTS / IQIS messages

Measures to avoid drivetrain damage

No.	Measures to reduce drivetrain damage	Introduction FeP		Introduction JhP	
		Today's date	WK	Date	WK
1	No reuse of tappet after OK press-in process	5/10/2007	WK19/07	1/31/2008	WK04/08
2	Click-clack test prior to delivery	5/10/2007	WK19/07	1/31/2008	WK04/08
3	Click-clack test	5/14/2007	WK0/07	1/31/2008	WK04/08
4	Delta T and Delta Tmax test on test bench	5/23/2007	WK21/07	1/31/2008	WK04/08
5	Click-clack test at end of assembly line	5/29/2007	WK22/07	1/31/2008	WK04/08
6	New switching process between flushing and inspection	5/30/2007	WK22/07	1/31/2008	WK04/08
7	Simultaneous noise measurement	6/18/2007	WK25/07	1/31/2008	WK04/08
8	Retest on friction coefficient test bench dropped	6/20/2007	WK25/07	12/1/2007	WK48/07
9	Optimization of test rig sequence (>500 rpm)	7/9/2007	WK28/07	1/31/2008	WK04/08
10	Cylinder head assembly with 5° torsion allowance	7/23/2007	WK30/07	12/1/2007	WK48/07
11	Dry pressing in of roller support	7/23/2007	WK30/07	2/6/2008	WK05/08
12	Uncoated spring plate (Customer C)	7/23/2007	WK30/07	1/31/2008	WK04/08
13	Introducing dwell time during roller tappet assembly	8/28/2007	WK35/07	2/6/2008	WK05/08
14	Extension of high-load testing point	10/1/2007	WK40/07	1/31/2008	WK04/08
15	Testing point V7.2 (Customer C)	11/16/2007	WK46/07	1/31/2008	WK04/08
16	Improved visual inspection of roller support	12/13/2007	WK50/07	1/31/2008	WK04/08
17	Friction coefficient test + / -10°	12/13/2007	WK50/07	2/7/2008	WK05/08
18	Tappet position query during assembly	12/21/2007	WK51/07	2/7/2008	WK05/08
19	New visual inspection catalog for roller support	1/2/2008	WK01/08	1/20/2008	WK02/08
20	Test program V7.2 (VW), visual inspection catalog for roller support	1/11/2008	WK02/08	1/31/2008	WK04/08
21	Test program V7.2 (Audi)	2/1/2008	WK05/08	1/31/2008	WK04/08
22	Switching of roller for models ... 507/...508	3/17/2008	WK12/08	1/31/2008	WK04/08
23	Straightedge testing, visual inspection catalog for roller support	4/7/2008	(WK5/08)	4/7/2008	WK14/08
24	Cleaning cloth with straightedge testing	5/1/2008	WK8/08	5/1/2008	WK7/08
25	Visual inspection of the roller after C coating	5/1/2008	WK8/08	5/1/2008	WK7/08
26	Optimization of the C coating (roller support)	5/1/2008	WK8/08	5/1/2008	WK7/08
27	Switching of roller for models ... 611/...613 to second source supplier	5/15/2008	WK0/08	11/3/2008	WK4/08
28	New washing and transport frames for the roller	10/29/2008	WK4/08	10/29/2008	WK4/08
29	Modified RS holding tool when pressing in the tappet body	11/24/2008	WK48/08	5/6/2009	WK19/09
30	Carbon covers / holders in system N for roller support	12/12/2008	WK50/08	12/12/2008	WK50/08
31	Carbon covers / holders in system O for roller support	3/16/2009	WK12/09	3/16/2009	WK12/09
32	Camera system to detect metal spatters on roller support System installed / testing		WK19/09	Roller support will be supplied from FeP	
	Series introduction from mid 06/2009 soonest	Number of parts	WK25/09	RS will be supplied from FeP	
33	Introduction of C2.1 layer instead of C3 layer on roller end (VW/Audi)	23.05.2009	WK22/09	23.05.2009	WK22/09
34	Optimized substrate holder to prevent fusing on roller, at the earliest	Activity broken off because not expedient ~~WK32/09~~		Activity broken off because not expedient ~~WK32/09~~	
35	HC washing of roller supports instead of aqueous washing	12/2/2009	WK49/09	12/2/2009	WK49/09
36	Introduction of anti-wear package RP1 in FeP and JhP (twin pistons)	3/9/2010	WK10/10	3/9/2010	WK10/10
37	Introduction of anti-wear package RP2 in FeP and JhP (twin pistons)	10/26/2010	WK 43/10	11/18/2010	WK45/10

Cause of error / measures will be developed in weekly task force with AUDI

Status: WK03/2011

Diesel Systems

BOSCH

Cleanliness status CP4 as of 10/13/2010

FeP: Cleanliness measures — Pre-assembly

CH pre-assembly **R:** Non-responsive content removed

No.	Measure for reducing the residual dirt	Introduction FeP	
		Date	WK
4	Improvement of the LS bolting process: - Height monitoring, manual pre-fixing of screws at the assembly station 1 since 4/3/06 - Rearrangement of all the manual workplaces	5/26/2009	22
6*	Strainer in front of the intake valve	Pilot customer from 01/18/2010, additional customers in planning	
7	Changeover of the LS delivery from bulk goods to workpieces in blister	11/5/2009	45
8	St.220/230: Adhesive rollers for hand gloves introduced on all modules.	2/19/2010	7
9	St.220: Change the design of the HP screw thread	1/29/2010	4
10	St.230: Determine contact points for handling of parts (Manufacturing methods and processes)	1/22/2010	3
11	Encapsulation (supply LS and IV, module removal), module 1 and 6 completed	3/19/2010	11
12	Check the checker Parts not painted but covered with yellow shrink-fit hose	4/30/2010	17
12*	St.230: Support on the measuring device. Optimization of the CH alignment.	6/28/2010	26
13*	St.210: Change supports to Vulkollan material	7/17/2010	28
14*	St.220: Changeover to rotary plate with Vulkollan for handing over the workpiece	6/26/2010	30
15	St.220: Encapsulation (complete with doors)	9/10/2010	36
16	St.210: Encapsulated space / rack for reintroduction of parts with procedural errors in the production flow (on all modules)	10/1/2010	39
	St. 201 = Station to press in non-return valve (NRV)		
	St. 220 = Station to screw in locking screw (LS)		
	St. 230 = Station to match cylinder head and piston		
	Abbreviations: IV = Intake valve, NRV = Non-return valve		

Legend: implemented | Implementation as planned | Date of implementation exceeded | Implementation not expedient; effectiveness being checked

ENTIRE PAGE CONFIDENTIAL

Cleanliness status CP4 as of 10/13/2010

FeP: Cleanliness measures Assembly

Assembly Non-responsive content removed

No.	Measure for reducing the residual dirt	Introduction FeP	
		Today's date	WK
14	Introduction of radius on the MU magnetic core for avoiding shavings on the housing in the CP4 assembly station, screw on MU 130 - Test (3000 pc.) with radius on the magnetic core positively concluded - Test with early delivery (300 parts) on 07.07.09 - Implement	11/2/2009	45
15	Optimize cleaning to avoid soiling tappet body holders on WPC (Manufacturing methods and processes adjusted)	12/1/2009	49
16	Dyeing the transponder on the next delivery	1/29/2010	4
17	Work without gloves on module 2, test stopped due to risk of accident	1/29/2010	4
18	Introduction of new clamping device for WPC housing on module 6	2/5/2010	5
19	Optimization of the grab containers (O-rings) with larger radii (chip nests) on all modules (pc. 60/110/120)	2/5/2010	10
20	Tape roller for gloves and glove supports on all modules for cylinder head assembly stations 1 & 2 (st110 & st120)	4/16/2010	15
21	Change handling at station 10 Press in low-pressure connections and station 50 Pre-assemble flange to avoid intervention in the housing interior.	4/16/2010	15
22	Mount holding clips for goods accompanying documents on the corresponding stations (on all modules)	4/16/2010	15
23	Sensitization and instruction of all employees of all CP4 modules with cleanliness film Non-starters	4/30/2010	17
24*	St.80: Regular check and exchange of Murtfeld supports	7/1/2010	26
25*	Makrolon cover on the transport belt st.110 to st.130 (on all modules)	7/5/2010	27
26*	Change handling at st.50 to avoid intervention in the flange (adhesive films)	7/17/2010	28
27*	During the assembly of the cylinder head (st. 110/120), the frames will be replaced by blisters on all modules	7/31/2010	30
26	St. 10: New involute clamping device like module 6 (on all modules)	9/3/2010	35
28*	Pilot project on module 6: Add suction for o-ring insertion into housing during assembly of cylinder head st. 110/120, decision on introduction of other modules; R: FeP/MOE	10/2/2010	39

Legend: implemented | Implementation as planned | Date of implementation exceeded | Implementation not expedient; effectiveness being checked

Diesel Systems

BOSCH

Cleanliness status CP4 as of 12/16/2010

FeP: Cleanliness measures Housing production

Housing **R:** Non-responsive content removed

No.	Measure for reducing the residual dirt	Introduction FeP	
		Date	WK
22	Optimization deburring of the transition (no suggestions)	9/20/2009	38
23	Optimize deburring separating area with fan nozzle	9/21/2009	39
24	Optimization of the deburring of the separating area by mounting the fan nozzle in a titled manner	9/21/2009	39
25	Standardization of the visual inspection equipment	9/25/2009	39
26	Extension of the approach path of the HP lance in the bow-shaped channel (35 mm instead of 50 mm)	9/30/2009	40
27	Optimization of the processing sequence	9/30/2009	40
28	Rinsing the internal area of the pump from inside to outside	9/30/2009	40
29	Intr oduction of ball cutter for improving the situation of burr; cylinder head inlet to MU	10/21/2009	43
30	Regular cleaning of the gripper in the chain. Extension of the inspection and maintenance plans	15,012,010	2
31	OP40 Optimization of the tool sequence (for avoiding the entry of dirt in the cleaning system)	2/28/2010	8
32	Production test with blasted housing blanks	4/30/2010	17
33	Increasing the nozzle diameter of the rotating HP lance	5/21/2010	19
34	Avoidance of particle in collar bushing (beneath stop disk)	5/21/2010	20
35	Avoidance of particles in housing interior: Optimization of seal & flush, fixing of additional pipes for more flow to the inner chamber flushing system	5/21/2010	20
36	Optimization of rotating HP lance	6/21/2010	24
37*	Avoidance of particles in the housing interior, test of HP lance on module 8	8/6/2010	31
38	Increase nozzle diameter of **rotating HP lance; trial completed, implemented on one module; other modules by** WK45	11/11/2010	45

Legend:	implemented	Implementation as planned	Date of implementation exceeded	Implementation not expedient; effectiveness being checked

Cleanliness status CP4 as of 10/13/2010

FeP: Cleanliness measures CH production

CH production **R:** Non-responsive content removed

No.	Measure for reducing the residual dirt	Introduction FeP	
		Date	WK
1*	Visual check after the HC cleaning: Temporary more strict visual check targeted at particles for collecting findings. No particles found since the date of introduction (statement applies to FeP)	2/16/2009	7
2	Ban on reuse of covering bags on finished cylinder heads (after visual inspection)	2/23/2010	8
3	Visual check: Equip cover transport belt with maintenance lid	2/23/2010	8
4	Eliminate compressed air connection at visual inspection station; connection of compressed-air pistol no longer possible	3/12/2010	10
5	Determine or re-define MAE cleaning intervals (revise cleaning catalog)	4/30/2010	17
6	Washing system: Magnetic separator in the filter	5/3/2010	18
7	Adjust cleaning intervals of the transport wagons	6/30/2010	26

Legend:

implemented	Implementation as planned	Date of implementation exceeded	Implementation not expedient; effectiveness being checked

BOSCH

Cleanliness status CP4 as of 10/13/2010

FeP: Cleanliness measures Intake valve & flange

Intake valve Non-responsive content removed

No.	Measure for reducing the residual dirt	Introduction FeP	
		Date	WK
1	Manual suction of the IV before introduction of visual check	4/9/2010	14
2	Do not reintroduce oil carried-off from the automatic station into the process, but dispose it off separately	4/29/2010	17
3	Protective coverings constantly between assembly and supermarket	8/13/2010	32
4	Integrate automatic suction facility in the automatic machine	9/10/2010	36

Flange R: Non-responsive content removed

No.	Measure for reducing the residual dirt	Introduction FeP	
		Today's date	WK
1	Deburring the tapering 19 inch milling border	2/15/2008	7
2	Rinsing the cleaning chamber after every cleaning cycle (3 cleaning stages)	2/15/2008	7
3	Introduce the rinsing tool in OP40	10/20/2009	43
4	Optimizing the brushes of the screw contact surface	12/2/2009	49

Legend: implemented | Implementation as planned | Date of implementation exceeded | Implementation not expedient; effectiveness being checked

BOSCH

ENTIRE PAGE CONFIDENTIAL

Cleanliness status CP4 as of 10/13/2010

FeP: Cleanliness measures Locking screw

LS supplier **R:** Non-responsive content removed

No.	Measure for reducing the residual dirt	Introduction FeP	
		Date	WK
1	Sensitization of the supplier about the effects of faulty LS threads; short-term introduction of 2x sorting, currently more than 1x under higher resolution	1/29/2009	5
2	Further optimization of the spilling process after thread rolling and filling of the blasting system on the supplier's site	5/25/2009	23
	Additional LS brushing after thread rolling	6/8/2009	24
3	100% automatic camera check of LS thread in the (no proposals) - Camera inspection installed, query of geometric dimensions of LS introduced	8/1/2009	30
4	Optimization of image recognition of the LS thread flanks according to limit sample catalog (see pt. 7)	See item 7	
5	Change test guideline / LS limit sample catalog Draft of new test guideline: 10/09/09 / Creation of special release for test guideline with restrictions	10/14/2009	42
6	Changeover of the LS delivery from bulk goods to workpieces in blister (Presentation sample blister: 10/19 / Sample from series tool: 10/21/09 / Changeover from 10/30)	11/5/2009	45
7	Introduction LS washing before the visual check and packing	4/1/2010	13

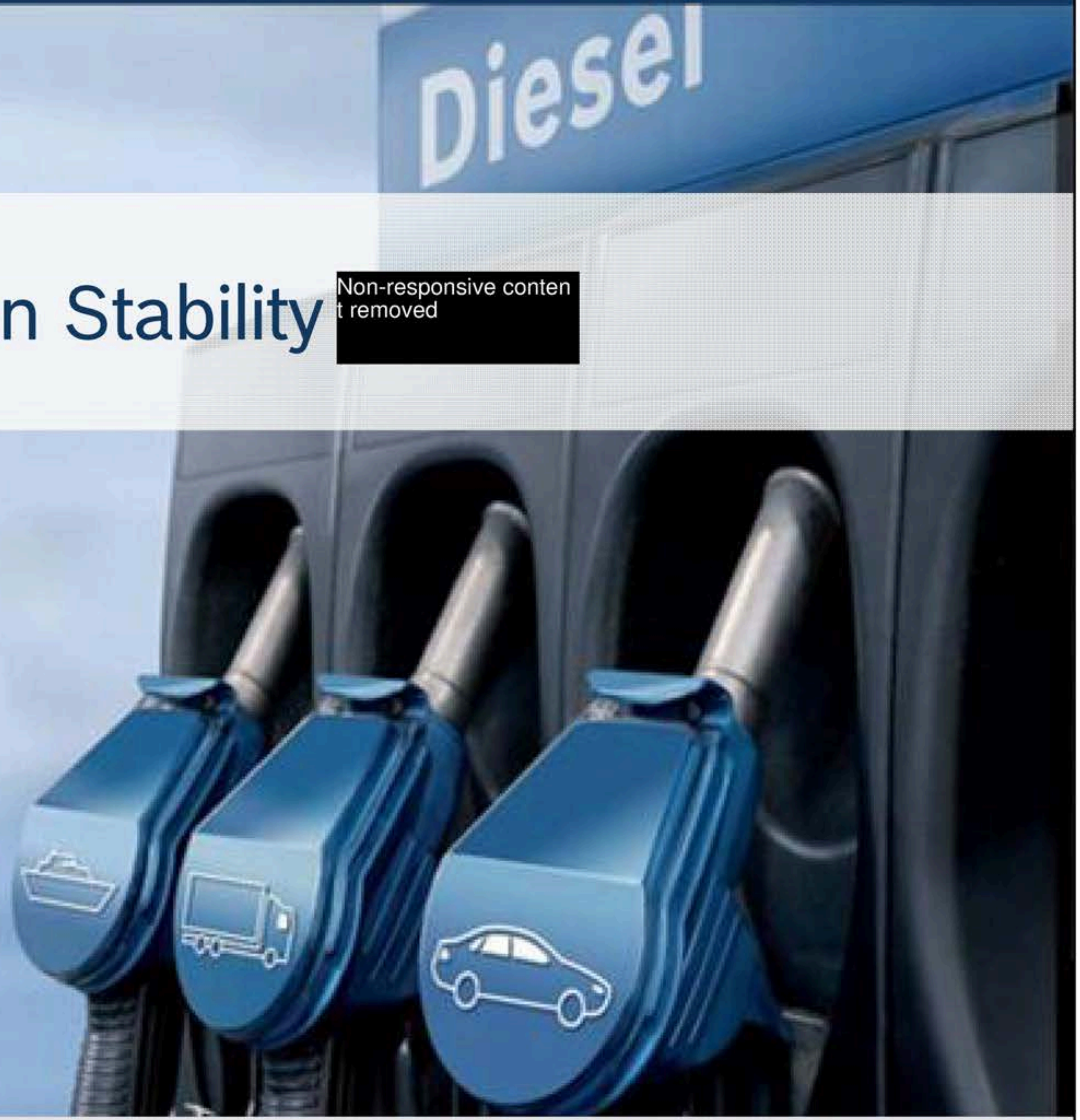
Legend:

implemented	Implementation as planned	Date of implementation exceeded	Implementation not expedient; effectiveness being checked

BOSCH

Diesel Fuel Oxidation Stability

Non-responsive content removed

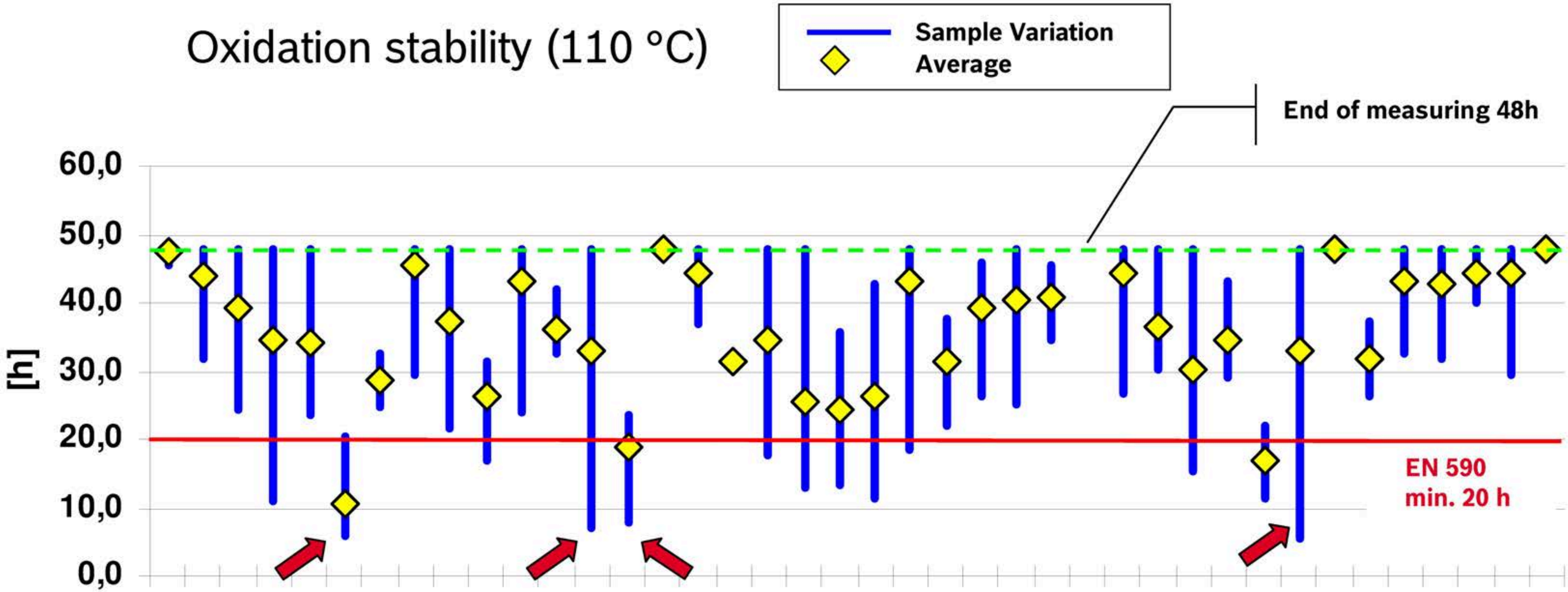


Situation May 2011

- with introduction of biodiesel admixture oxidation stability [redacted] diesel fuel
  - dropped significantly
  - exhibits larger number of samples not fulfilling EN590 specification
- worst case quality
  - similar to not developed diesel markets like [redacted]
  - significantly worse than in established diesel markets like [redacted] or [redacted]
- improvements seen between 2009 and 2010, but **quality worsened again in 2011!**

- **establishment of EN590 spec fuel quality absolutely necessary to avoid problems at end customer**

ENTIRE PAGE CONFIDENTIAL
EA11003EN-01818[2]

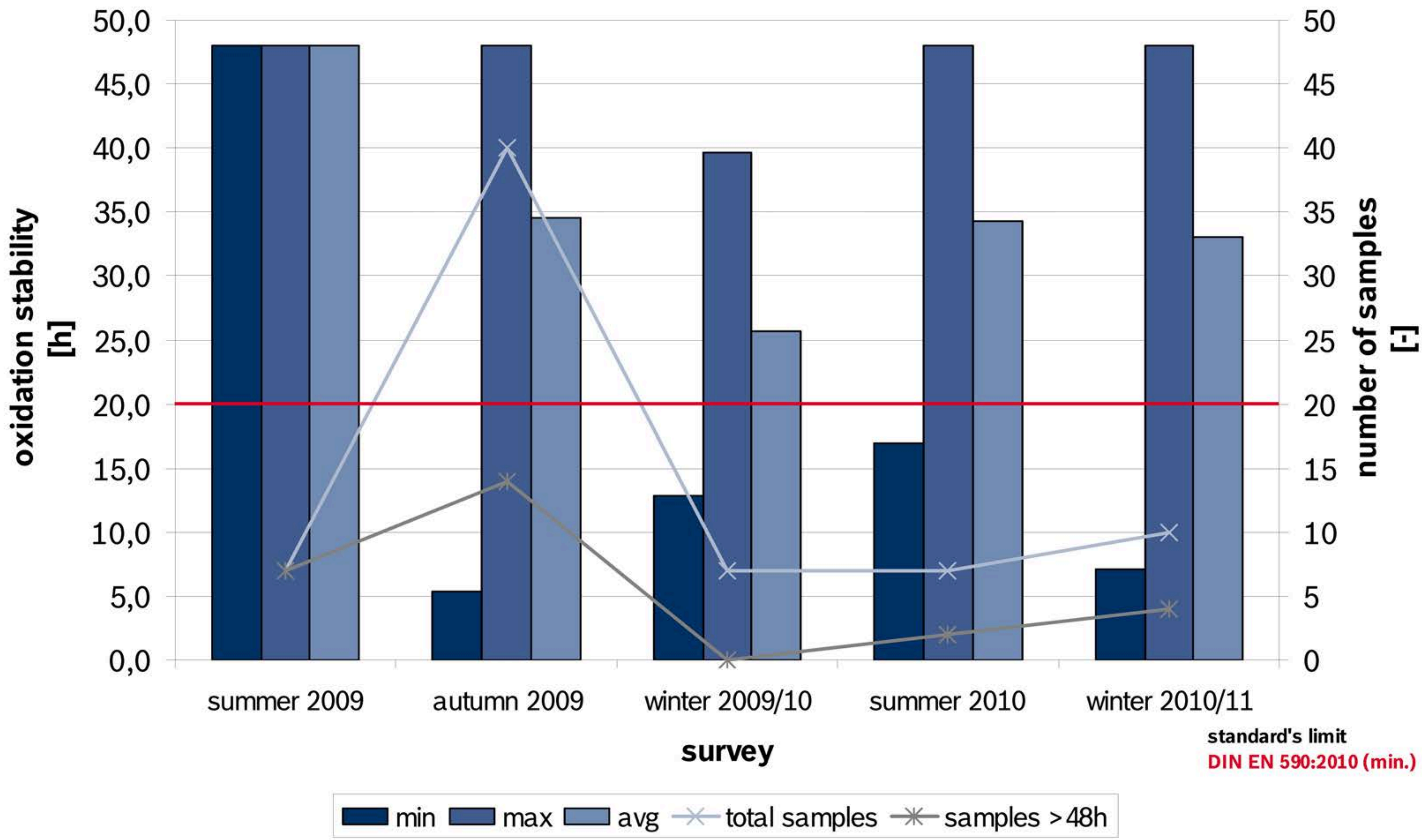


[redacted]

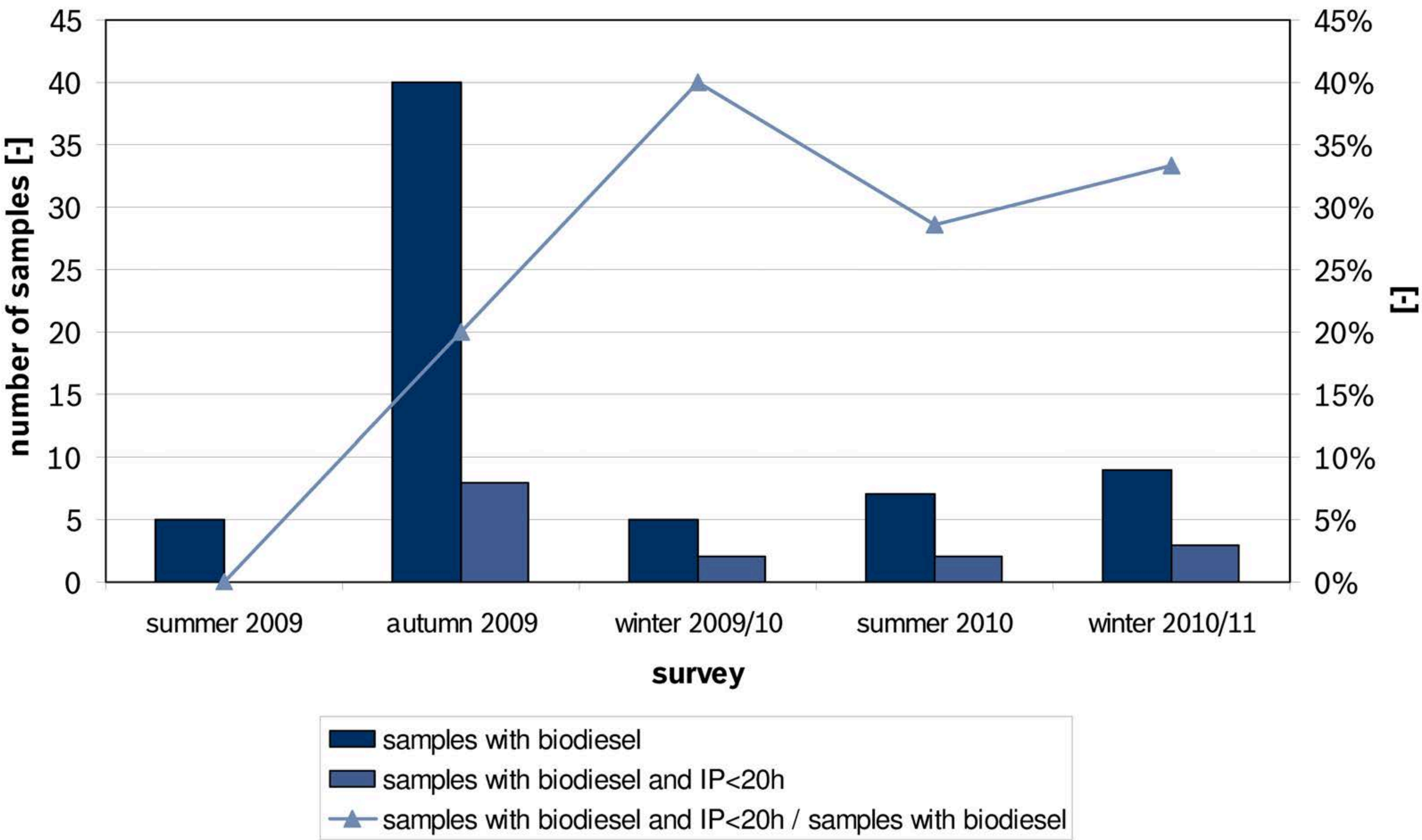
[redacted]

[redacted]

Oxidation Stability (Rancimat) [redacted]



Oxidation Stability (Rancimat) [redacted]



Remarks

- in total 71 [redacted] SGS samples from summer 2009 to winter 2010/2011 are available
- samples above 48 hours of oxidation stability are included in minimum, maximum and average calculation with the value 48
- all samples from summer 2009 (without biodiesel!) are above 48 hours of oxidation stability
- source:
  - SGS_summer09,
  - SGS_[redacted],
  - SGS_[redacted],
  - SGS_[redacted],
  - SGS_winter1011

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

ENTIRE PAGE CONFIDENTIAL

Robustness of Common Rail System for Rest of the World

Status of evaluation of Rest of the World conditions for diesel

Product	P	K	L	D
Non-responsive content removed [redacted]				
CP4	Currently under assessment	free / resolved	BDF570 BDF650	>1,0 mm²/s at 70°C <1.0 mm²/s at 70°C
Non-responsive content removed [redacted]				

Measures on VEH → **CUSTOMER**

Measures on product → **RB**

Robustness of Common Rail System for Rest of the World

Status of evaluation of Rest of the World conditions for diesel

Product	P	K	L	D
Non-responsive content removed [redacted]				
CP4			Endurance run testing with critical fuel Planned date 7/2010	Optimization of texture/roughness and play on roller/roller support Planned date 7/2010
Non-responsive content removed [redacted]				

Measures on VEH → CUSTOMER

Measures on product → RB

Workshop for detailed planning of RoW planned for 12/8/09 with VW/ Audi Development

Robustness of Common Rail System for Rest of the World

Measures to increase robustness in fuel-critical markets

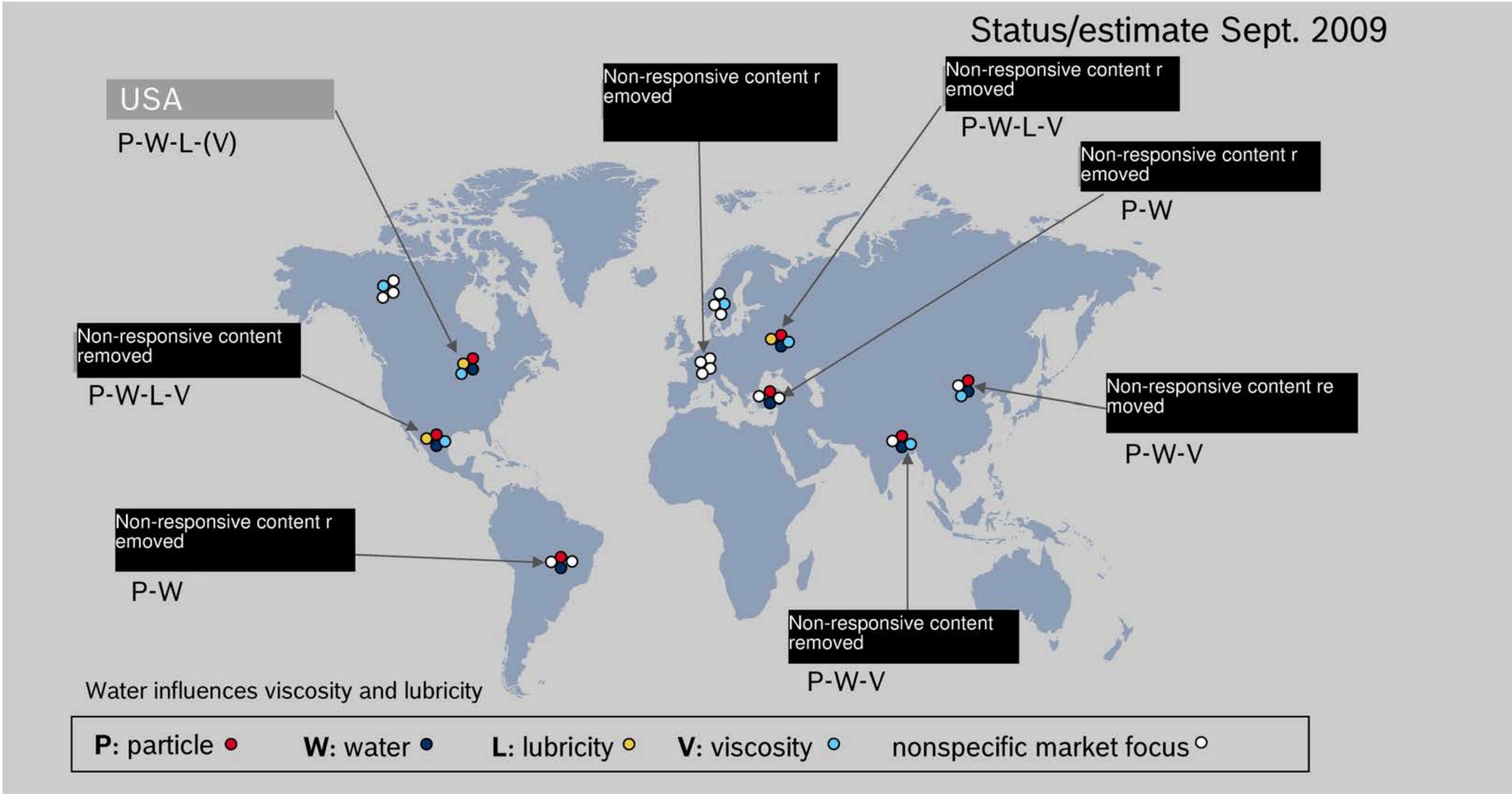
• Expert workshop VW/ Audi/ Bosch on fuel-related themes	12/8/2009
Lubricity	
• Further development of wear-optimized C layer (already being tested in medium duty application)	planned for SOP 07/2010
Viscosity	
• Optimize texture/surface of roller	done
• Optimize texture/surface of C layer in roller support	planned for SOP 07/2010
• Optimize component tolerances (play) roller-roller support	planned for SOP 07/2010
Water	
• Introduction of water separator urgently necessary for critical markets	OEM
• Avoidance of fatigue through higher quality materials on camshaft/roller (preliminary tests with higher 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

Backup

Robustness of Common Rail System for Rest of the World

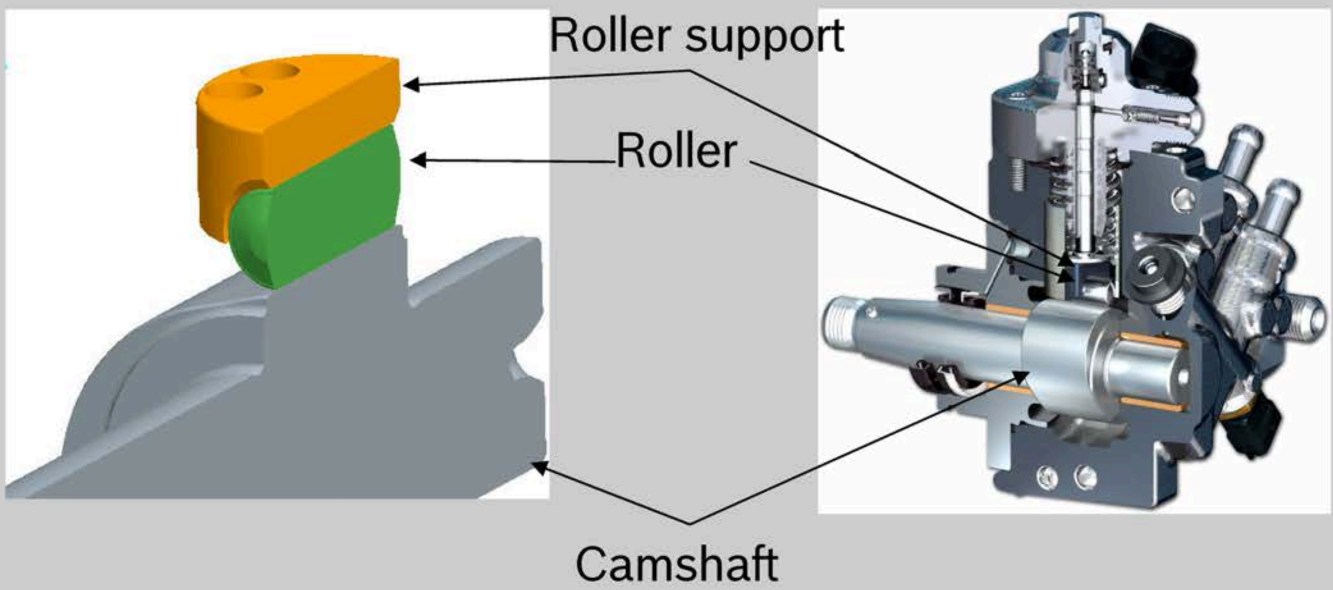
Diesel Fuel Risk



Robustness of Common Rail System for Rest of the World

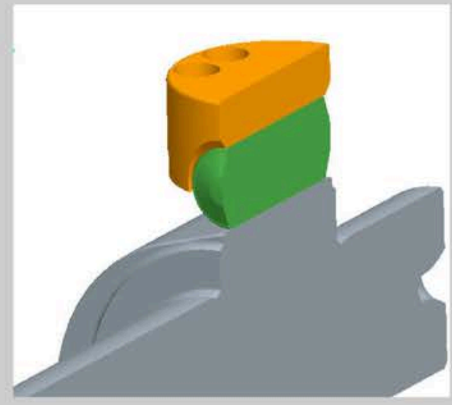
Interactions of CP4 drivetrain damages

The cause of drivetrain damage is operation with impermissible fuel qualities and/or high 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 support assembly

  (up to 200 [rpm]) at start (mixed friction area)

Low viscosity [redacted] diesel, kerosene, water....)

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

  -> increased slippage (idle roller)

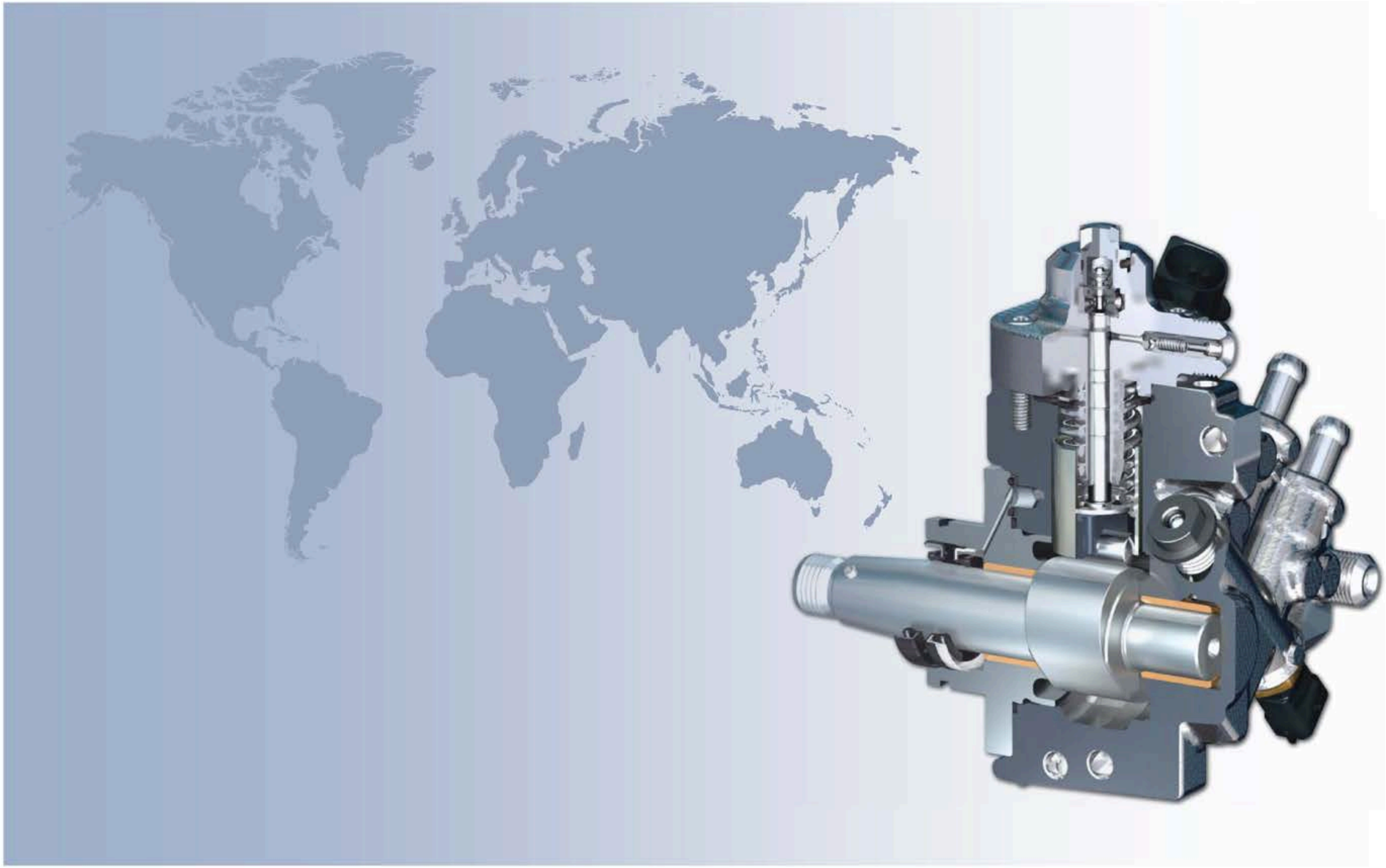
Water in fuel

- Influence as emulsion, see lubricity & viscosity
- Free water (in droplet form) can result in hydrogen embrittlement / stress corrosion and thus to fatigue of the partner roller

ENTIRE PAGE CONFIDENTIAL

11003EN-01826[0]

CP4 field situation worldwide



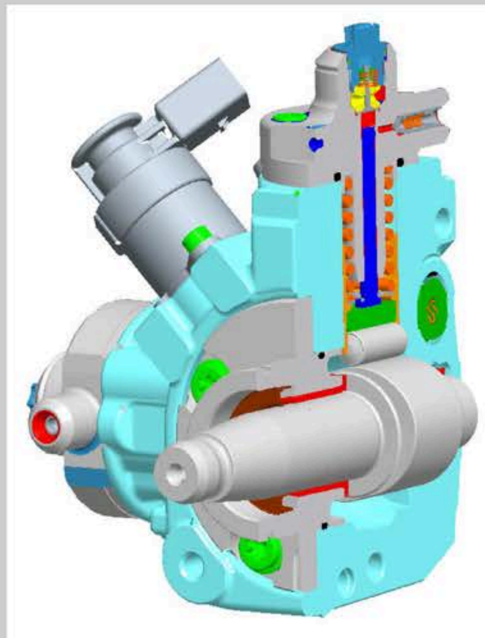
BOSCH
Technik fürs Leben

Quality Conference 11/19/2009

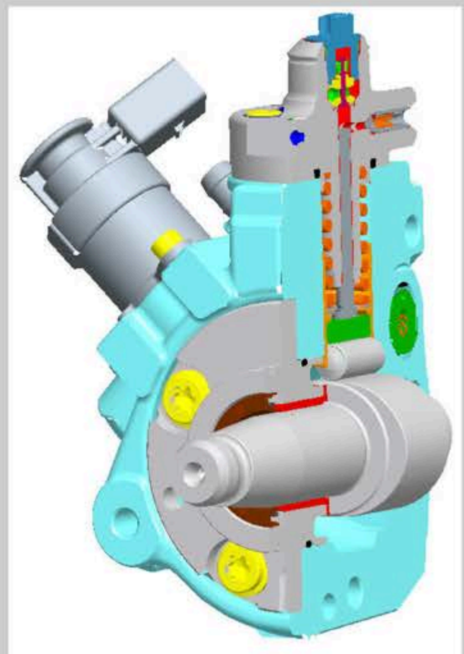
VOLKSWAGEN
AKTIENGESELLSCHAFT

CP4 field situation worldwide

Differences between CP4.1 and CP4.2



CP4.2
Twin pistons pump
for use in
6-cylinder engines



CP4.1
Single piston
pump for use in
4-cylinder engines

CP4 field situation worldwide

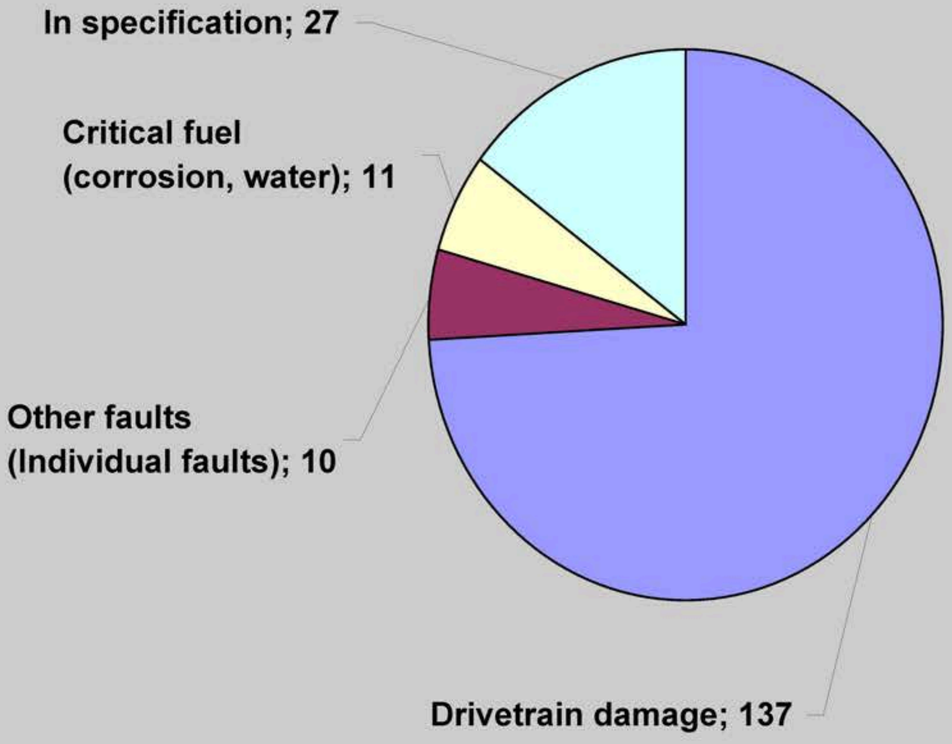
AUDI CP4.2 complaints

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

ISO_CTRY	Overall result
Non-responsive content removed [redacted]	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

Results of findings for the pumps re-turned to Bosch (185)



Source Bosch IQIS Date: 11/3/2009

ENTIRE PAGE CONFIDENTIAL

CP4 field situation worldwide

AUDI VW 6-cylinder TDI

AQUA, Active quality analysis
Status 09/09-11.05.09 04:27 PM
Source/user [redacted]

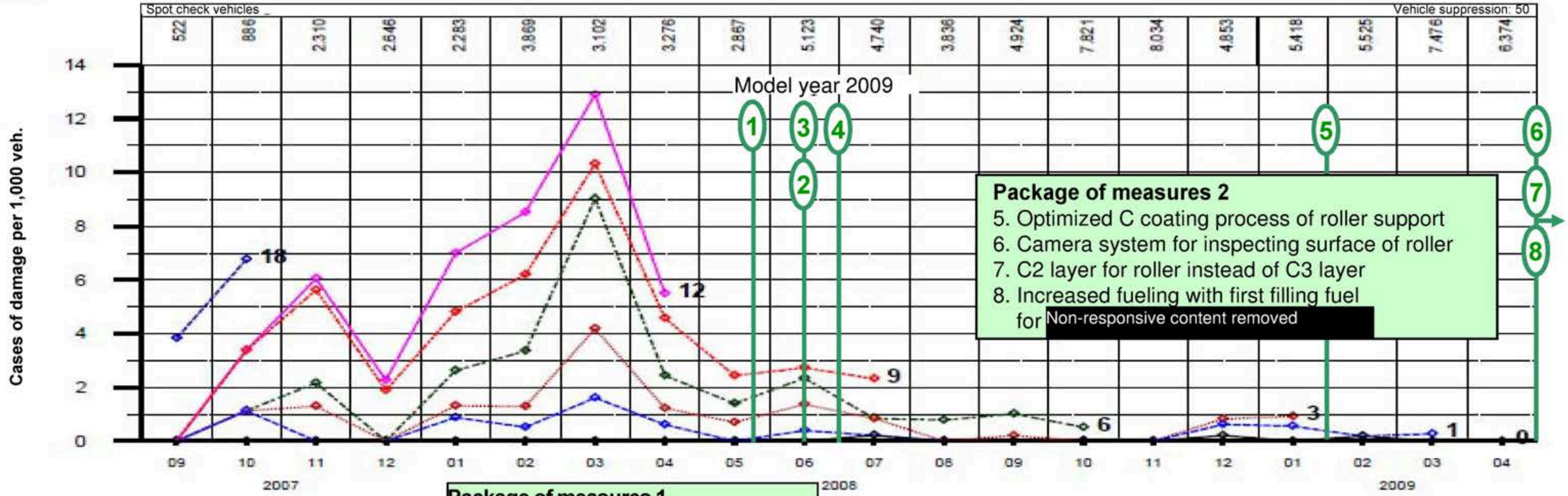
Audi, market: AUDI (approved markets)
MY 2008 - 2010, Offset: all (Max: 5)
CNR / Groups High-pressure pump

Confidential
Without PR numbers
CNR 2374

CAMA|CAMB|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CCWA|CCWB|CDYA|CDYB|CDYC|CGKA|CGKB

MY	MIS 0	MIS 1	MIS 3	MIS 6	MIS 9	MIS 12	MIS 18
2008	0,0	0,6	1,5	3,1	5,2	6,6	11,2
2009	0,0	0,2	0,5	1,2	1,9	2,4	
Diff%		-64,45	-67,70	-61,37	-62,69	-62,99	

MY	Exchange	BD	SA 10	SA 17	SA 50	SA 18
2008	98,0 %	62,8 %	76,7 %	12,3 %	7,0 %	1,7 %
2009	96,7 %	50,0 %	69,7 %	17,1 %	5,3 %	4,6 %
			MEC ERR	MAJOR	LEAK	MINOR



Package of measures 2
5. Optimized C coating process of roller support
6. Camera system for inspecting surface of roller
7. C2 layer for roller instead of C3 layer
8. Increased fueling with first filling fuel for [redacted]

Package of measures 1
1. Straightedge test on roller
2. Visual inspection of roller after C coating
3. optimized C coating
4. Improved texture of roller (new subcontractor)

Vehicle: 29.592+92.395+37.767=159.754; Sold: 29.424+89 ... 111.914; MY:2008+2009+2010=Total

CP42 AU alle MKB V6 Frei 08-10

ENTIRE PAGE CONFIDENTIAL

I1003EN-01826[4]

CP4 field situation [redacted]

AUDI VW 6-cylinder TDI

AQUA, Active quality analysis
Status 09/09-11.05.09 4:29 PM
Source/user [redacted]

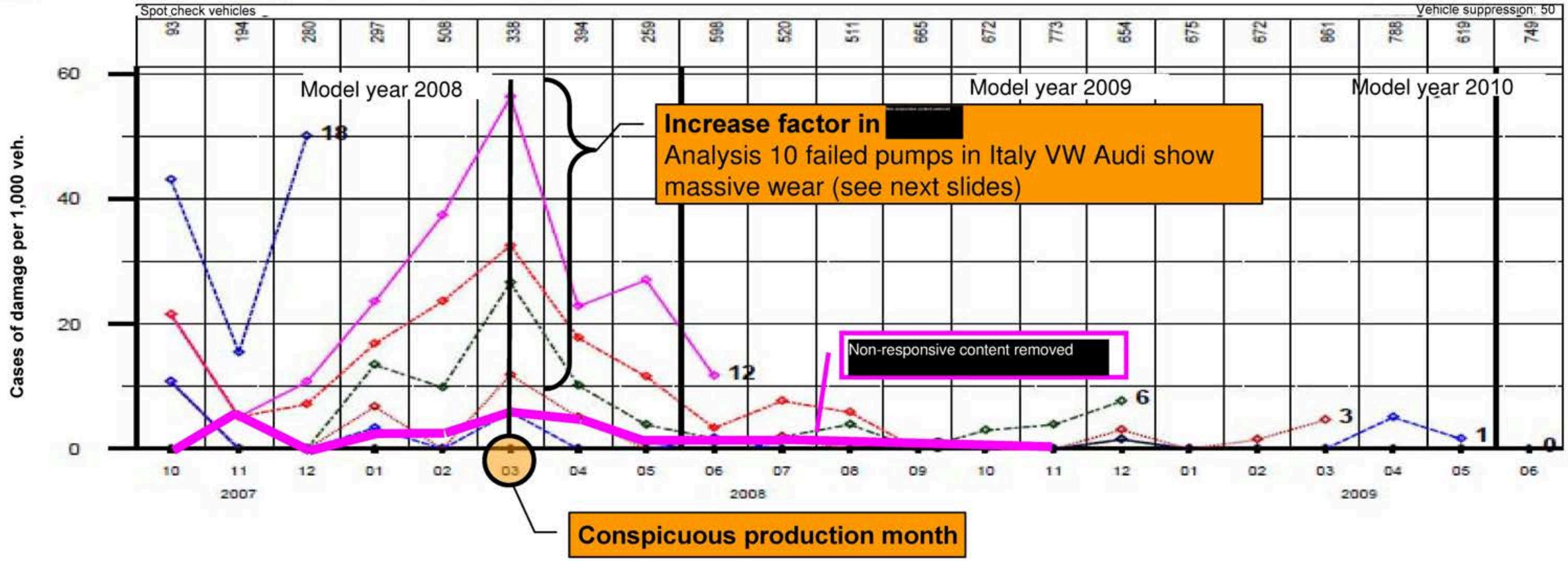
Audi, market: [redacted]
MY 2008 - 2010, Offset: all (Max: 3)
CNR / Groups High-pressure pump

Confidential
Without PR numbers
CNR 2374

CAMA|CAMB|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CCWA|CCWB|CDYA|CDYB|CDYC|CGKA|CGKB

MY	MIS 0	MIS 1	MIS 3	MIS 6	MIS 9	MIS 12	MIS 18
2008	0,0	1,7	3,9	10,3	18,0	27,8	66,4
2009	0,1	0,9	2,0	4,2	7,7	13,7	
Diff%		-47,14	-48,71	-59,55	-57,23	-50,63	

MY	Exchange	BD	SA 10	SA 17	SA 50	SA 18
2008	100,0 %	78,2 %	74,4 %	15,4 %	7,1 %	2,6 %
2009	98,3 %	83,1 %	79,7 %	16,9 %	1,7 %	1,7 %
			MEC ERR	MAJOR	LEAK	MINOR



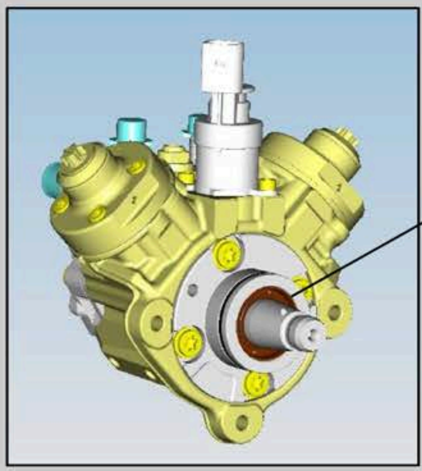
Vehicle: 3.389+12.041+4.481=19.911; Sold:: 3.385+11.240+2.900=17.525; UP:: 2.335+7.730+2.115=12.180 MY: 2008+2009+2010=(Total

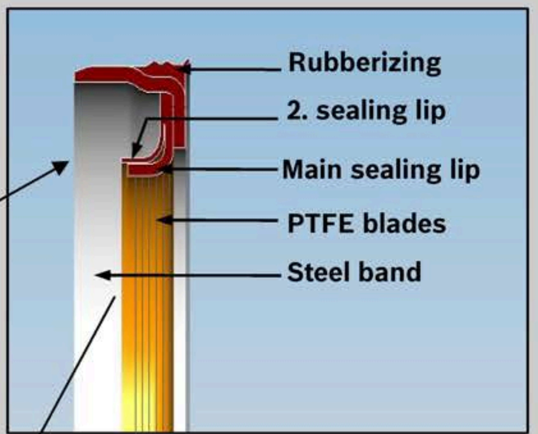
CP42 AU alle MKB V6 [redacted] 08-10

CP4 field situation [redacted]

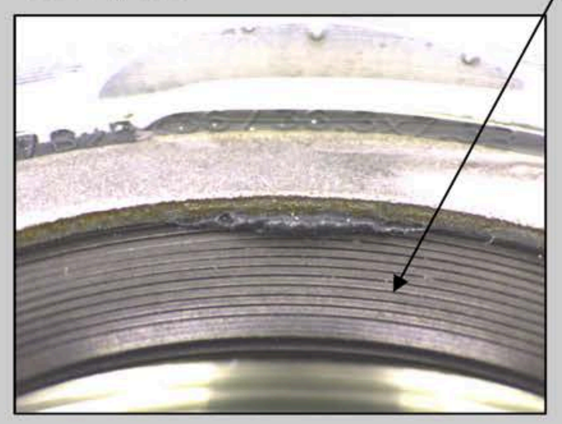
Finding AUDI CP4

Installation of Bruss shaft seal on CP4





New part



Vehicle endurance run
118,000 km

Mileage 2,212 km
Failure on 6/15/2009 in [redacted]

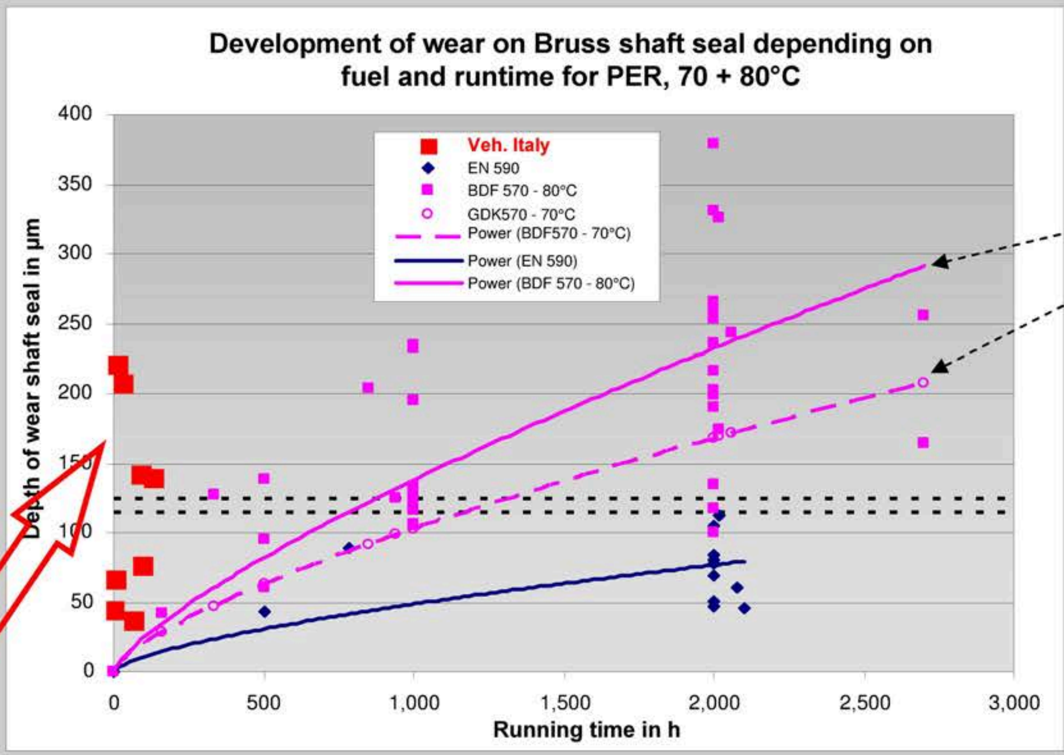
EA11003EN-01826[6]

CP4 field situation [redacted]

Finding AUDI CP4

Dependence of shaft seal wear on fuel and runtime

EN590: Viscosity$_{40°C}$ = 2.5 mm²/s, HFRR$_{60°C}$ = 420 µm
BDF570: Viscosity$_{40°C}$ = 1.9 mm²/s, HFRR$_{60°C}$ = 570 µm



Constraints

- Internal endurance run (variable profile)
- Runtime = variable
- Supply temp. 80
- Supply temp. 70 °C

Vehicle AUDI

Supply temp. 60 °C ?

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

ENTIRE PAGE CONFIDENTIAL

CP4 field situation worldwide

VW 4-cylinder TDI

VW, market: Non-responsive content removed

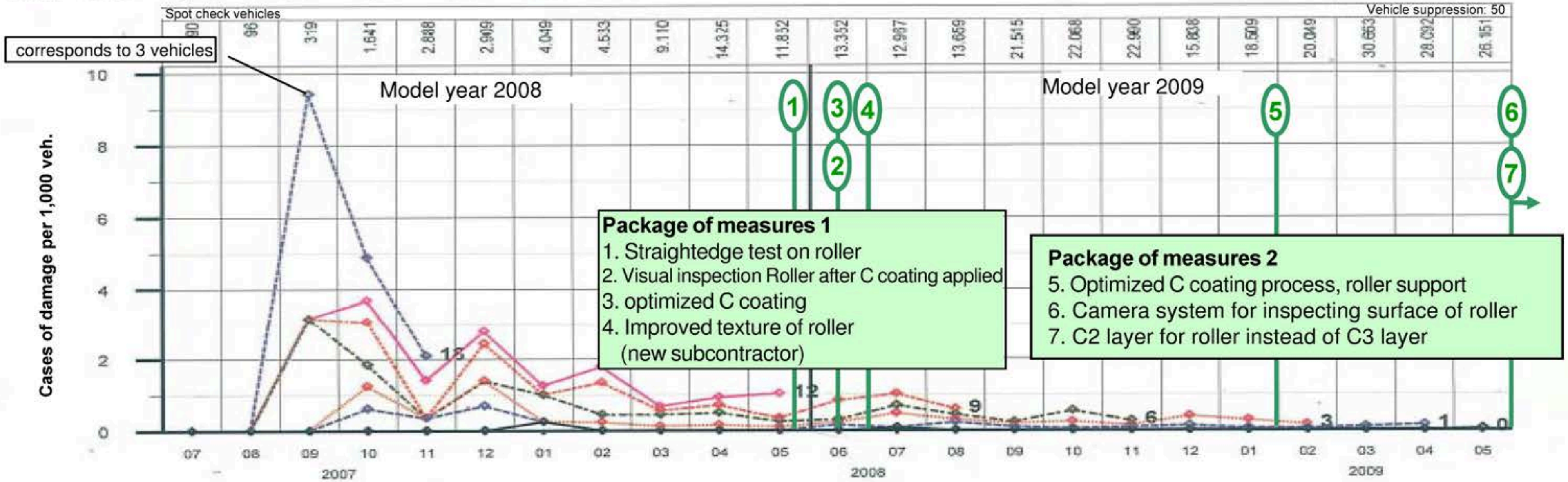
AQUA, Active quality analysis
Status 09/09-11.09.09 12:06 PM
Source/user Non-responsive content removed

MY 2008 - 2010, MIS from/to : 0 - 24, Offset: 2 - 4
CNR / Groups High-pressure pump
EA 189 4-cylinder 2,0l

Confidential
Without PR numbers
CNR 2374

MY	MIS 0	MIS 1	MIS 3	MIS 6	MIS 9	MIS 12	MIS 18
2008	0,0	0,1	0,2	0,6	0,8	1,1	1,9
2009	0,0	0,1	0,3	0,4	0,7	1,9	1,9
Diff%	-59,87	-0,12	10,01	-19,59	-14,51	65,86	-1,19

MY	Exchange	BD	SA 10	SA 20	SA 50	SA 17
2008	96,8 %	20,4 %	61,3 %	15,1 %	11,8 %	10,8 %
2009	90,2 %	23,3 %	60,7 %	19,0 %	9,8 %	8,6 %
			MEC ERR	NOISE	LEAK	MAJOR



Vehicle: 72.372+384.834+167.997=625.203; Sold: 71.676+366.679+117.081=555.436; UP: 48.739+244.925+100.898=394.562 MY: 2008+2009+2010=Total

Non-responsive content removed

EA11003EN-01826[8]

ENTIRE PAGE CONFIDENTIAL

CP4 field situation [redacted]

VW 4-cylinder TDI

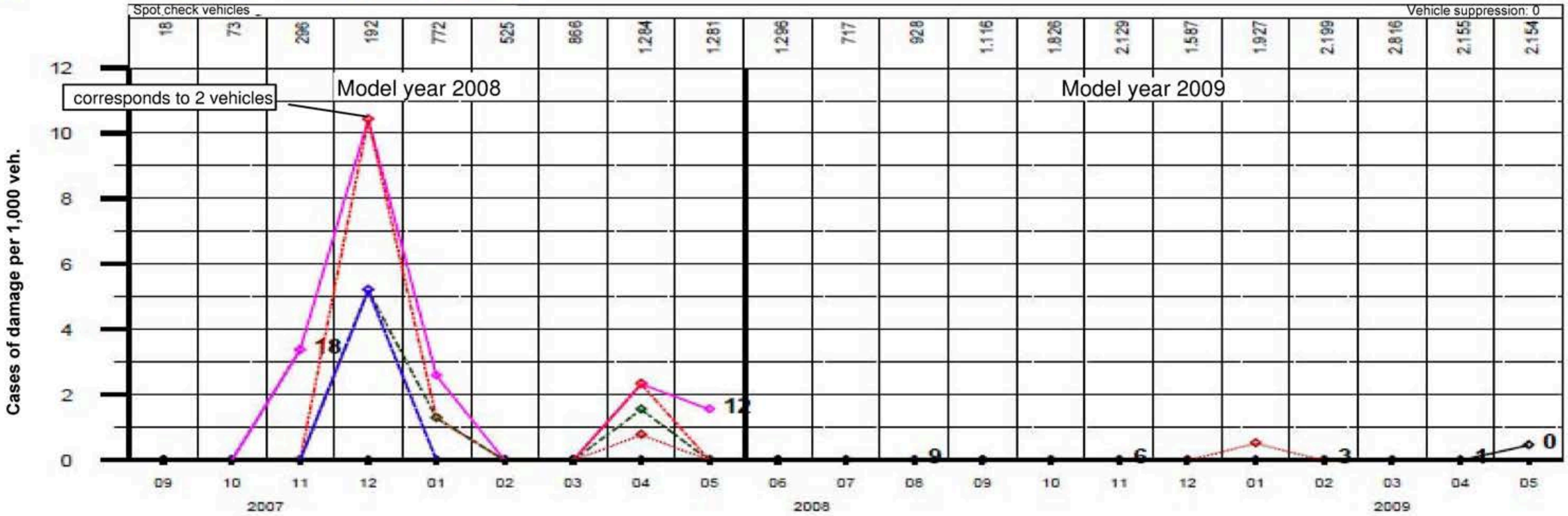
AQUA, Active quality analysis
Status 09/09-11.06.09 10:29 AM
Source/user [redacted]

VW, market: [redacted]
MY 2008 - 2010, Offset: all (Max: 4)
CNR / Groups High-pressure pump
Turbodiesel CR 4-cylinder

Confidential
Without PR numbers
CNR 2374

MY	MIS 0	MIS 1	MIS 3	MIS 6	MIS 9	MIS 12	MIS 18
2008	0,0	0,2	0,4	0,8	1,2	1,9	2,7
2009	0,0	0,0	0,1	0,2	0,3	0,3	
Diff%		-74,87	-73,79	-77,63	-70,90	-82,54	

MY	Exchange	BD	SA 10	SA 20	SA 50	SA 18
2008	100,0 %	33,3 %	66,7 %	9,5 %	9,5 %	4,8 %
2009	83,3 %	33,3 %	41,7 %	33,3 %	16,7 %	8,3 %
			MEC ERR	NOISE	LEAK	MINOR



Vehicle: 8.847+41.846+23.061=73.754; Sold: 8.819+40.028+13.915=62.762; UP: 5.146+20.478+11.802=37.426; MY2008+2009+2010=Total

CP41 VW R4-CR [redacted] 08-10

BOSCH
Technik fürs Leben

Quality Conference 11/19/2009

VOLKSWAGEN
AKTIENGESELLSCHAFT

CP4 field situation [redacted]

Differences between CP4.1 and CP4.2.

Possible ways to interpret failure probability
CP4.2 to 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 supply temperature
- Filtering
- IV opening pressure
- ...

CP4 field situation [redacted]

Further procedure (main activities)

- Deployment of Bosch field analysis team in [redacted] (importer's domicile) — since 9/11/2009

  Objective:

  Analysis of special market-specific features in [redacted]

  Tasks:

  Analysis of the vehicle prior to repair (together with 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 conspicuous veh. production data — since 11/05/2009

- Procurement of 20 [redacted] good pumps" from cars from conspicuous production date — in progress

- Procurement of 20 [redacted] good pumps" from remaining period — in progress

- Analysis of system differences (application, load collective, low pressure circuit, etc.) from various vehicles — A.12/2009

CP4 field situation worldwide

Backup

EA11003EN-01826[12]

ENTIRE PAGE CONFIDENTIAL

CP4 field situation [redacted]

VW 6-cylinder TDI

AQUA, Active quality analysis
Status 09/09-11.06.09 4:12 PM
Source/user [redacted]

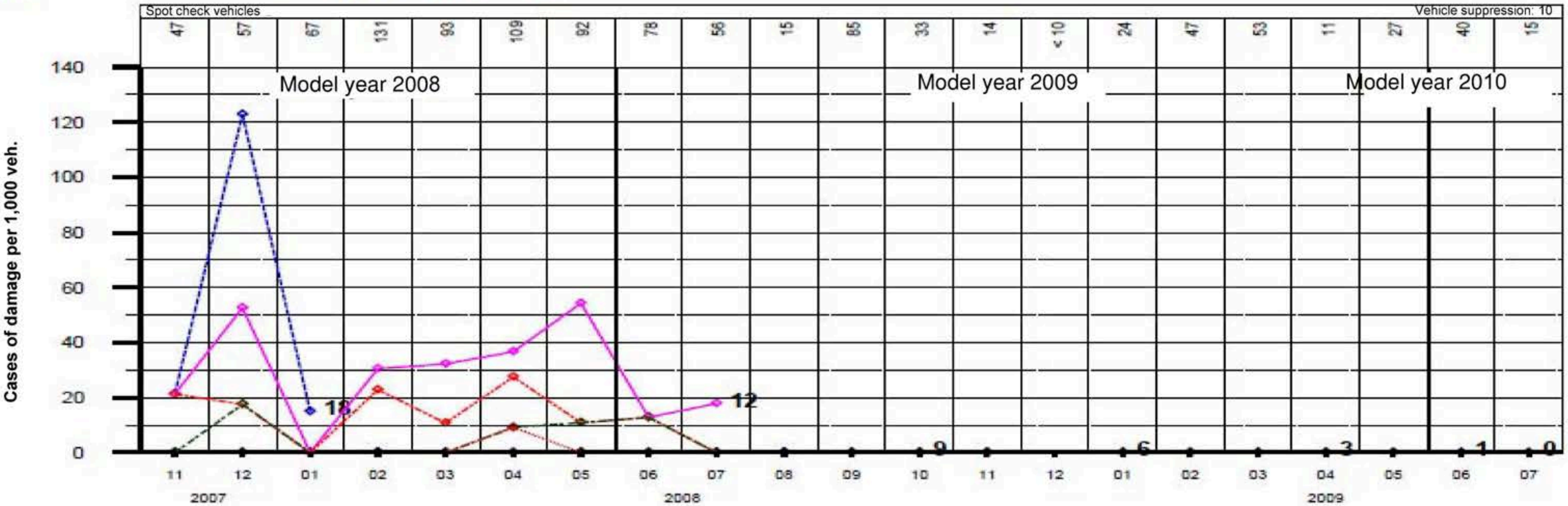
VW, Touareg, market: [redacted]
MY 2008 - 2010, Offset: all (Max: 2)
CNR / Groups High-pressure pump

Confidential
Without PR numbers
CNR 2374

CAMA|CAMB|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CCWA|CCWB|CDYA|CDYB|CDYC|CGKA|CGKB

MY	MIS 0	MIS 1	MIS 3	MIS 6	MIS 9	MIS 12	MIS 18
2008	0,0	0,0	1,8	5,3	17,7	33,7	87,5
2009	0,0	0,0	0,0	2,6	2,6	12,4	
Diff%			-100	-51,30	-85,39	-63,27	

MY	Exchange	BD	SA 10	SA 17	SA 50
2008	97,8 %	50,0 %	69,6 %	23,9 %	6,5 %
2009	100,0 %	75,0 %	50 %	50 %	
			MEC ERR	MAJOR	LEAK



Vehicle:: 993+916+265=2.174; Sold:: 991+896+152=2.039; UP: 564+470+95=1.129; MY:2008+2009+2010=Total

CP42 Touareg MKB V6 [redacted] 08-10

BOSCH
Technik fürs Leben

Quality Conference 11/19/2009

VOLKSWAGEN
AKTIENGESELLSCHAFT

CP4 field situation worldwide

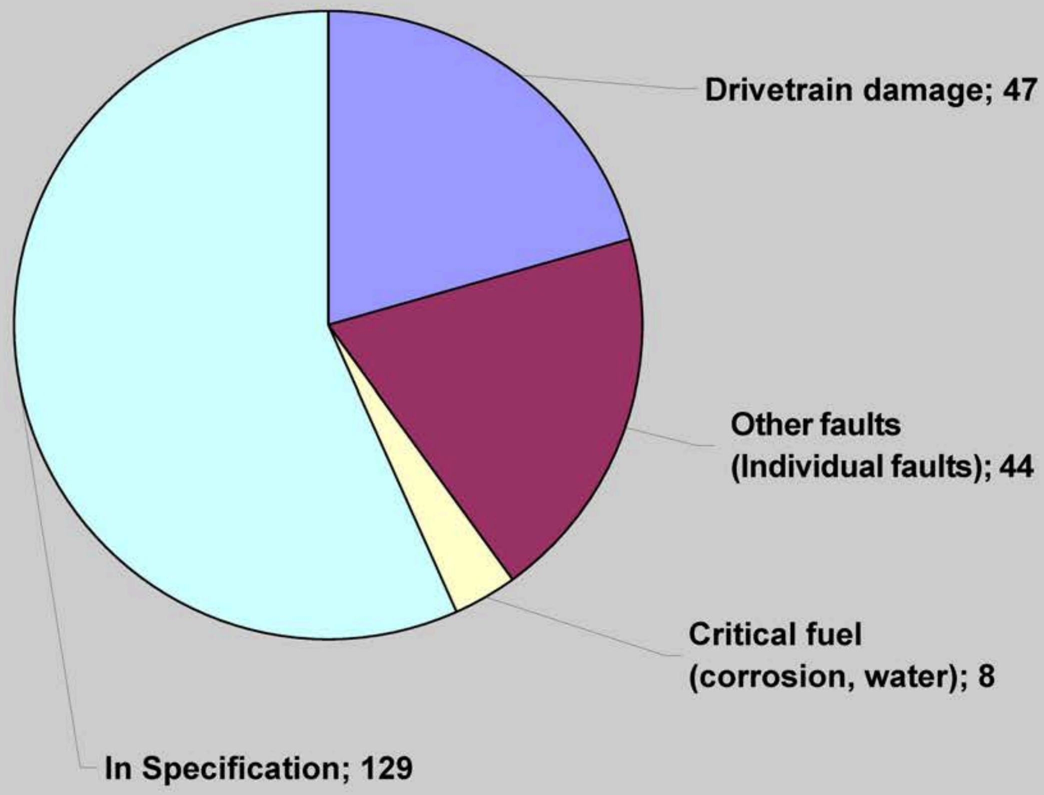
VW CP4.1 complaints

VW CP4.1 commercial accounting for dealers

DC COUNTRY	Overall result
Non-responsive content removed [redacted]	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

Results of findings for the pumps returned to Bosch (228)



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

Summary

➔ Status of new information since last update on 12/10/09:

Other analyses in the fuel samples from on-site actions in [redacted] support the results from the fuel survey in Non-responsive content removed and the analyses from the problematic pumps. Further detailed analysis of the fuel samples and fuel filters will be complete by 1/22/10.

Information gathered to date supports the failure mechanisms presented in the last report.

1. Tribochemical wear
2. Deposit / coatings from algae and oxidation products and therefore a significant deterioration in frictional coefficient.
3. Corrosion on the surface of cams and roller

The analysis of the reference samples from the problematic production period indicates nothing unusual in relation to drawing-related features. Other detailed analyses) will be completed by 01/13/10.

Summary

- **Further action:**

  For the purpose of practically confirming the damage hypotheses, reappear tests will be carried out on the hydraulic test bench with limit sample parts and fuels from 1/14/10 onwards. A test schedule has been drawn up.

  Measures to increase) are defined and their effectiveness will be verified with the same test parameters. Detailed plans will be drawn up dependent on the reappear tests.

  Return of the requested 40 good pumps from [redacted] and 20 good pumps [redacted] is agreed to WK 03/2010.

  Mechanism whereby the tappet is turned, roller lifted from the camshaft depending on the engine vibrations on the pump drive, is to be examined on the engine with AUDI. Technical meeting for this purpose 01/12/2010

Operating conditions / Environment / System

Local FCT team in [redacted]

Status: 18 vehicles examined on-site and 4 systems received from damaged parts stores. Complete fuel injection systems including fuel filters and fuel samples have been sent to Bosch for analysis.

Result: 12/12 cases of drivetrain damage from local actions.
2/4 cases of drivetrain damage from damaged parts stores systems.
7/7 analyses of low pressure circuits showed nothing unusual.

Special features: In 3 vehicles, free water found in fuel.
4 vehicles with deposits in the tank (swirl pot)
- 1x reddish, sticky coatings,
- 1x white flocculation,
- 2x dark/ black particles

Fuels
Findings

Status: 20 fuel samples analyzed from [redacted]
10 fuel samples analyzed from [redacted]

Result: Survey:
Oxidation stability was found to be outside the tolerance in 4 fuel samples and the TAN (acid coefficient) is generally 2-3 times higher than usual, probably due to spilled biodiesel.

FCT:
In 2 fuel samples oxidation stability was outside the tolerance.
In the first analysis of the coatings, algae were found in the fuel.
Other deposits from other pumps are under analysis and probably also contain algae. Fuels containing microorganisms always contain free water. This is also consistent with the slight acidification of another fuel sample from the same damage scenario. Algae develop acids as metabolized material.

Summary of analysis results

Result of analysis of [redacted] pumps

17 out of 17 Bruss shaft seals stronger worn than with EN590
45 out of 54 pumps have signs of corrosion
11 out of 54 pumps have brown fuel deposits

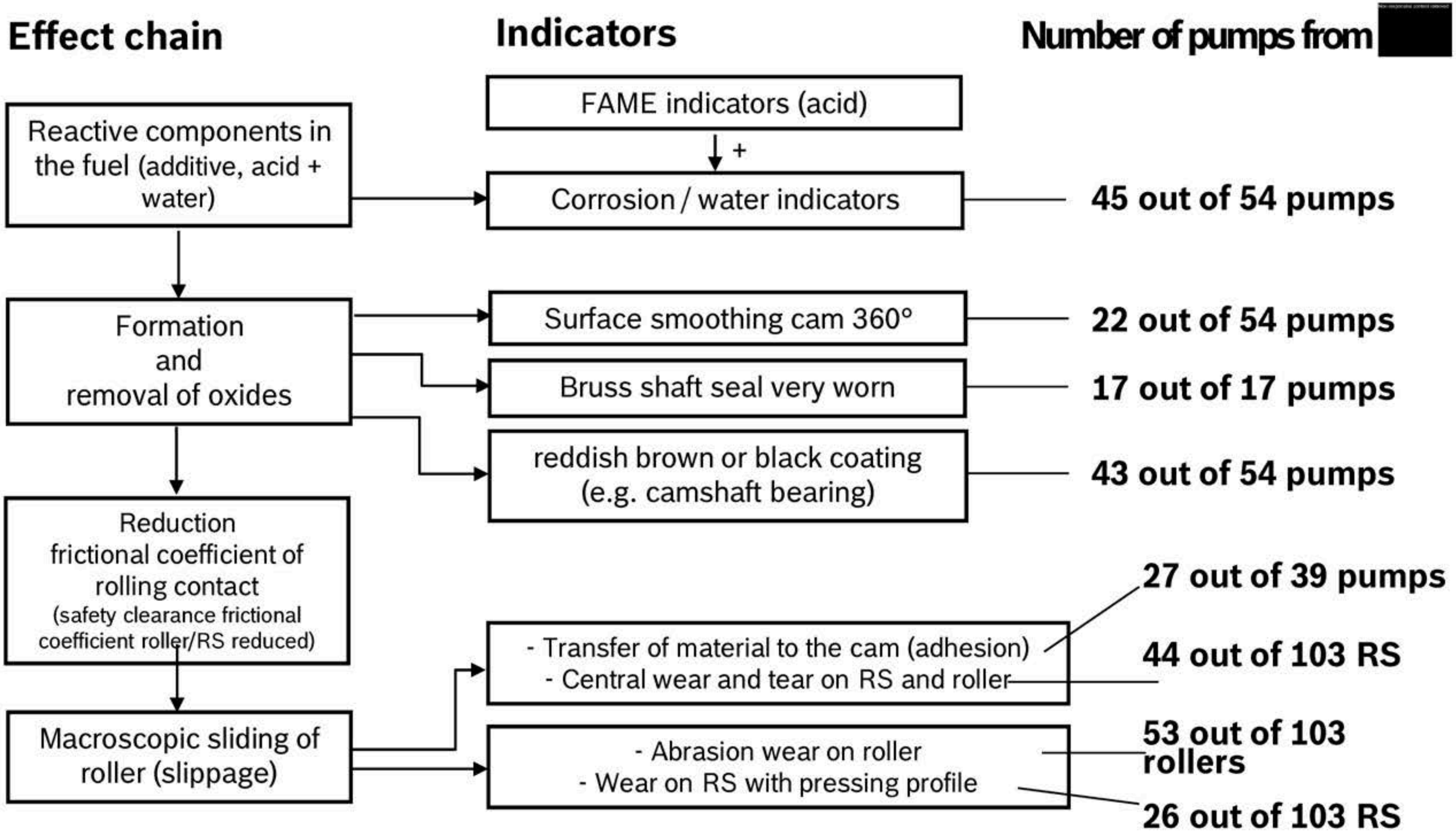
45 out of 52 drivetrain failures have turned tappet bodies
22 out of 54 pumps have surface smoothing on the cam
9 out of 52 drivetrain failures have fatigue damage on the cam
3 out of 54 pumps have pitting on the cam

44 out of 103 roller supports are worn in the middle
29 out of 103 roller supports are completely worn
26 out of 103 roller supports are worn in the shape of the press profile

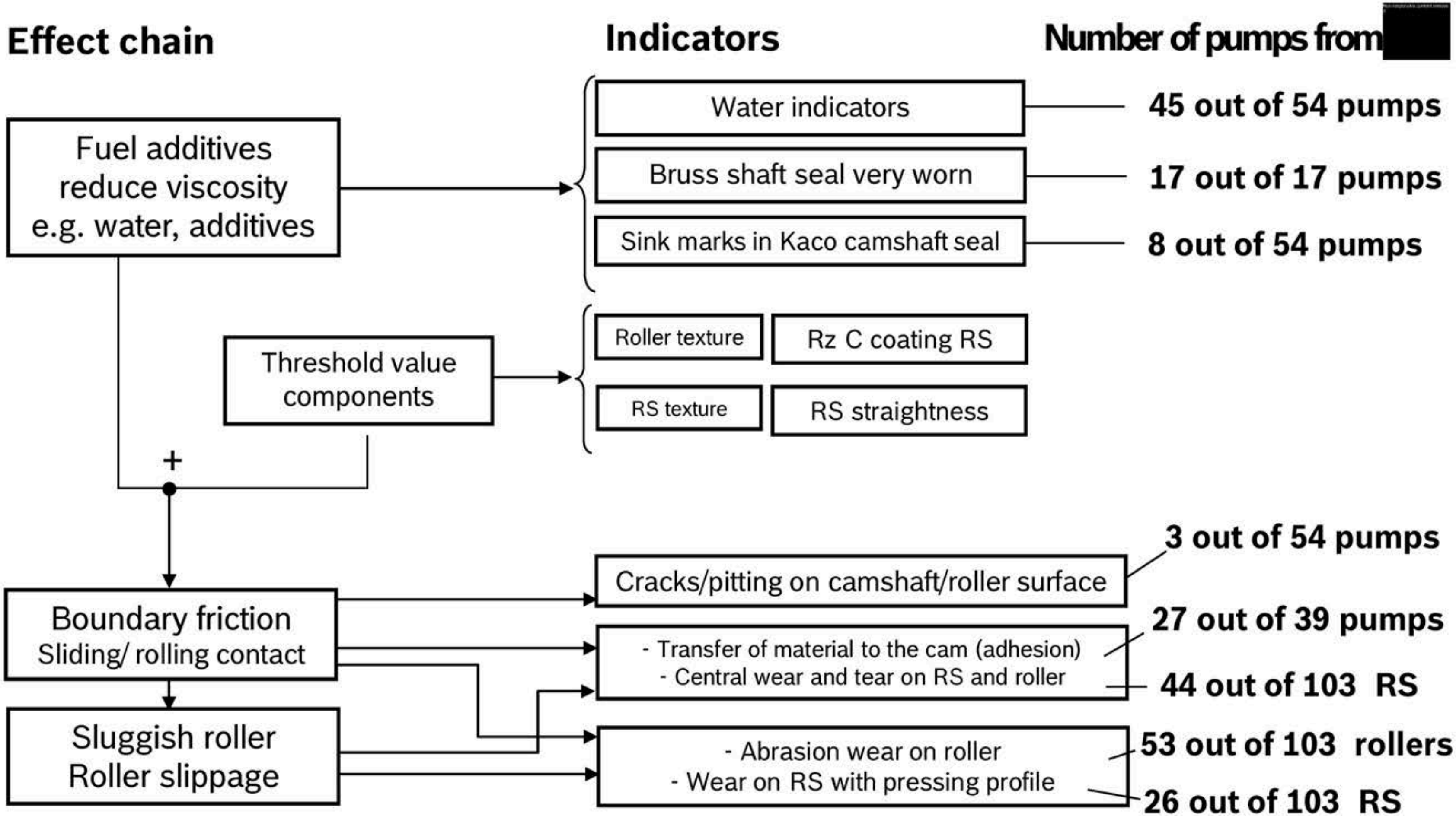
1 x fuel sample tank: Algae
1 x wash mark with striations

Validation CP4: Analysis system for drivetrain damage in Non-responsive content removed

Failure hypothesis 4: Fuel additives -> Tribochemicals



Failure hypothesis 6: Fuel viscosity -> Boundary friction



Failure hypothesis 3: Biodiesel -> adhesions

Effect chain	Indicators	Number of pumps from [redacted]
Rise in proportion of biodiesel in [redacted]		
↓		
Formation of deposits →	brown deposits (FAME indicators)	11 out of 54 pumps
↓		
Adhesions between roller/RS		
↓		
Sluggish roller		
↓		
Macroscopic sliding of roller (slippage) →	- Transfer of material to the cam (adhesion) - Central wear and tear on RS and roller	27 out of 39 pumps 44 out of 103 RS
Macroscopic sliding of roller (slippage) →	- Abrasion wear on roller - Wear on RS with pressing profile	53 out of 103 rollers 26 out of 103 RS

Operating conditions / Environment / System

Procure 40 good pumps

Status:	Vehicles identified, importer to contact owners. Importer has new pumps for replacement.
Result:	t.b.d.
Further action:	First returns not expected before WK 03/2010.
Special features:	none

AUDI - CP4 field situation in [redacted]

ENTIRE PAGE CONFIDENTIAL

Status: 12/01/2009

AQUA: Active quality analysis
Status: 10/09-20.11.09 09 :14
Source/user: [redacted]

Audi, market: [redacted]

MY 2008 – 2010, Offset: all (max. 2)

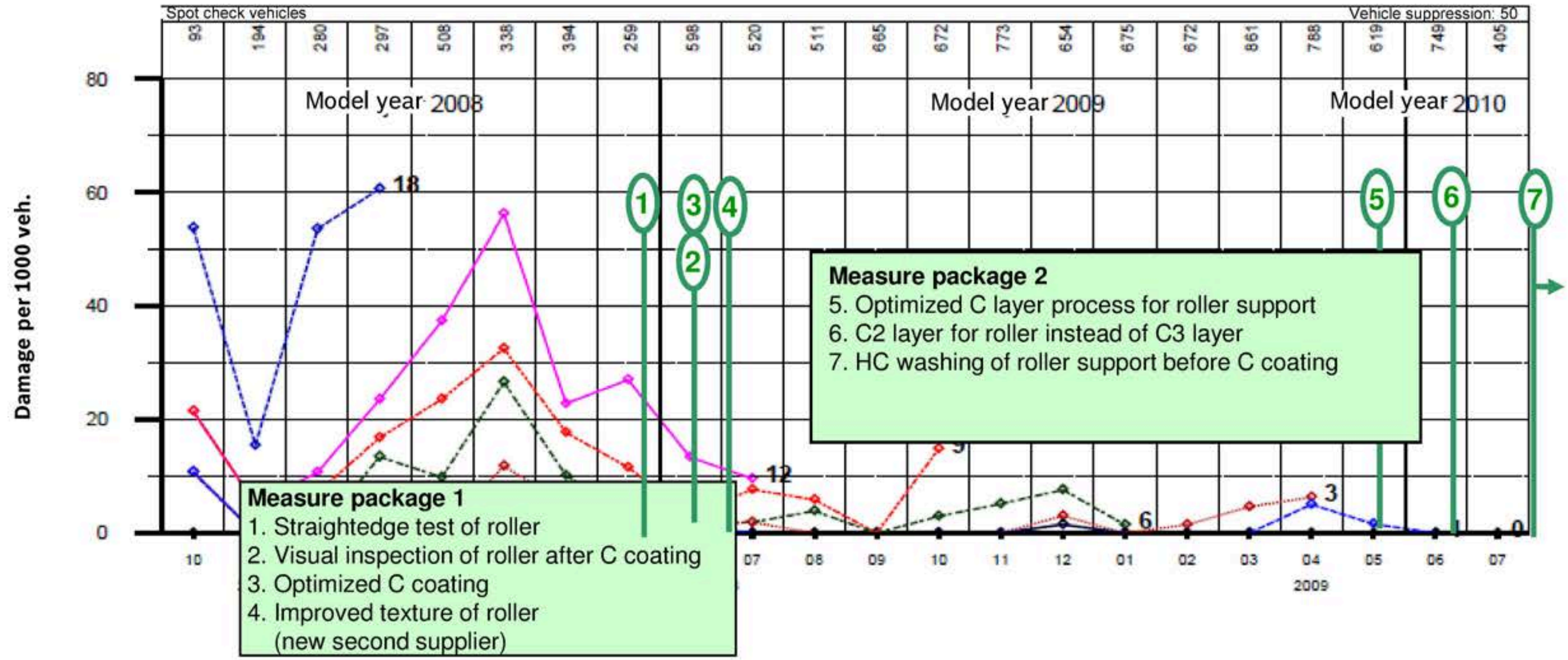
CNR / Groups: High-pressure fuel pump

Confidential
without PR numbers
CNR 2374

CAMA|CAMB|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CCWA|CCWB|CDYA|CDYB|CDYC|CGKA|CGKB

MY	MIS 0	MIS 1	MIS 3	MIS 6	MIS 9	MIS 12	MIS 18
2008	0,0	1,7	3,9	10,3	18,0	27,8	73,8
2009	0,1	0,9	1,9	4,3	8,2	13,8	
2010	0,0	0,0	5,7				
Diff%	-100	-100	194,41				

MY	Exchange	BD	SA 10	SA 17	SA 50	SA 18
2008	100,0 %	79,7 %	74,9 %	15,0 %	7,5 %	2,1 %
2009	96,0 %	85,3 %	81,3 %	14,7 %	2,7 %	1,3 %
2010	100,0 %	100,0 %	50 %	50 %		
			MEC ERR	MAJOR	LEAK	MINOR



Vehicles: 3.389+12.041+5.434=20.864; Sold: 3.386+11.357+3.740=18.483; UP: 2.335+7.730+2.800=12.865;MY:2008+2009+2010= Total

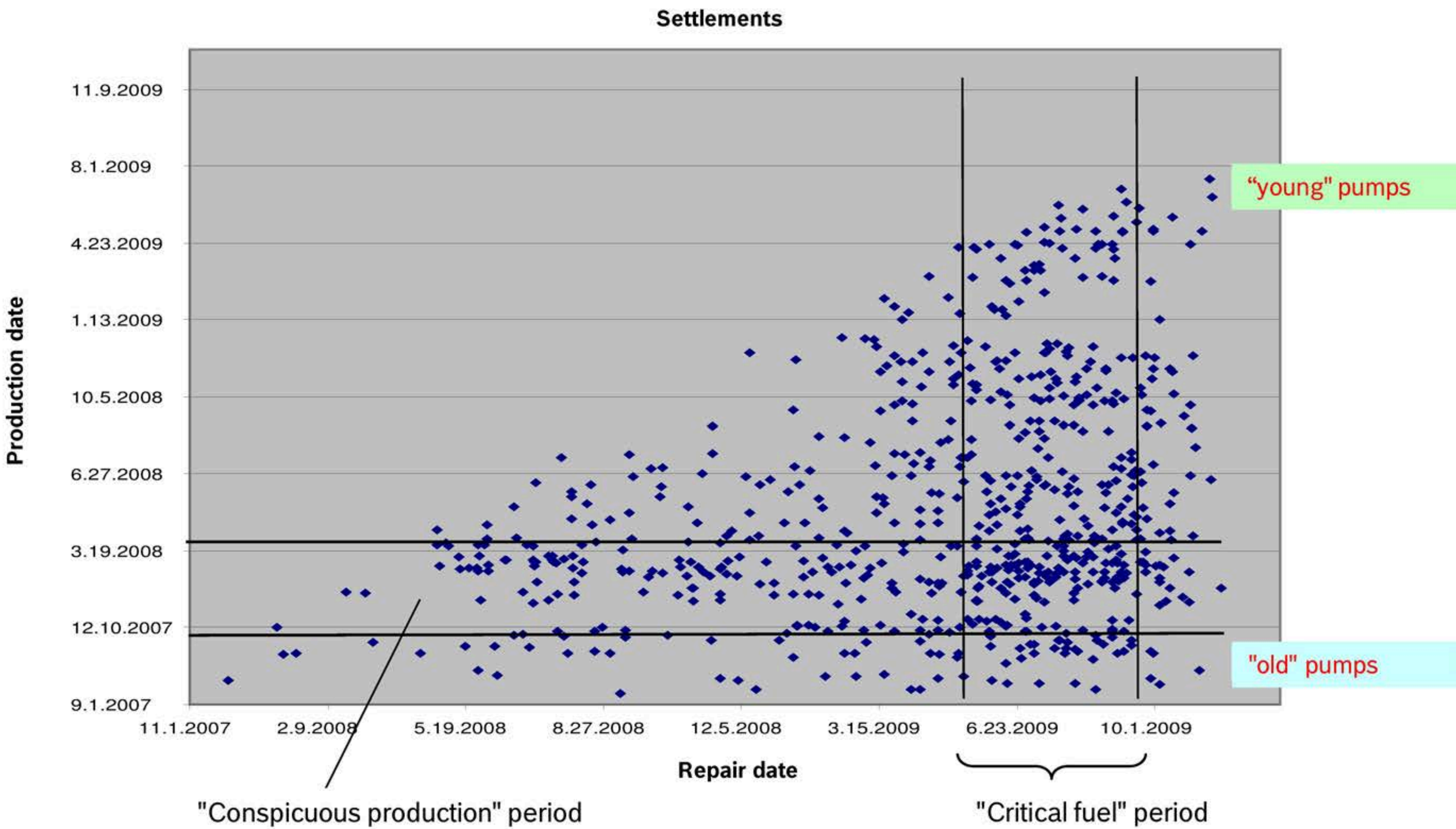
CP42 AU all MKB V6[redacted]08-10

Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

AUDI - CP4 field situation in [redacted] Status: 12/16/2009

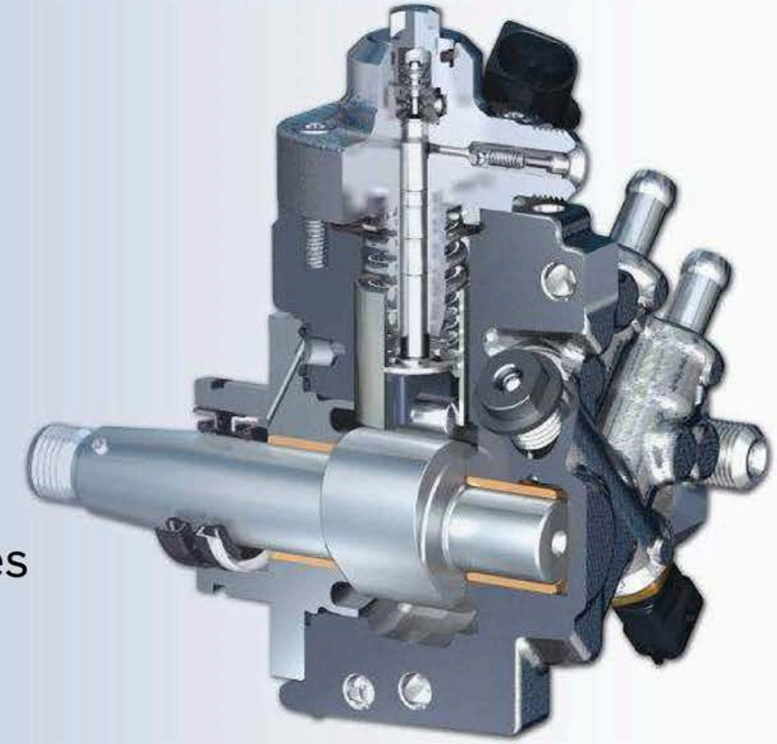


ENTIRE PAGE CONFIDENTIAL

Audi meeting on 02/12/2010

Non-responsive content removed [redacted]

1. Ishikawa of influencing factors
2. Analysis of failed pumps / fuels
3. Component sensitivity
4. Good pumps
5. Hypothesis
6. Anti-wear package 1
7. Proof of robustness: Stribeck curves
8. Assessment of measures

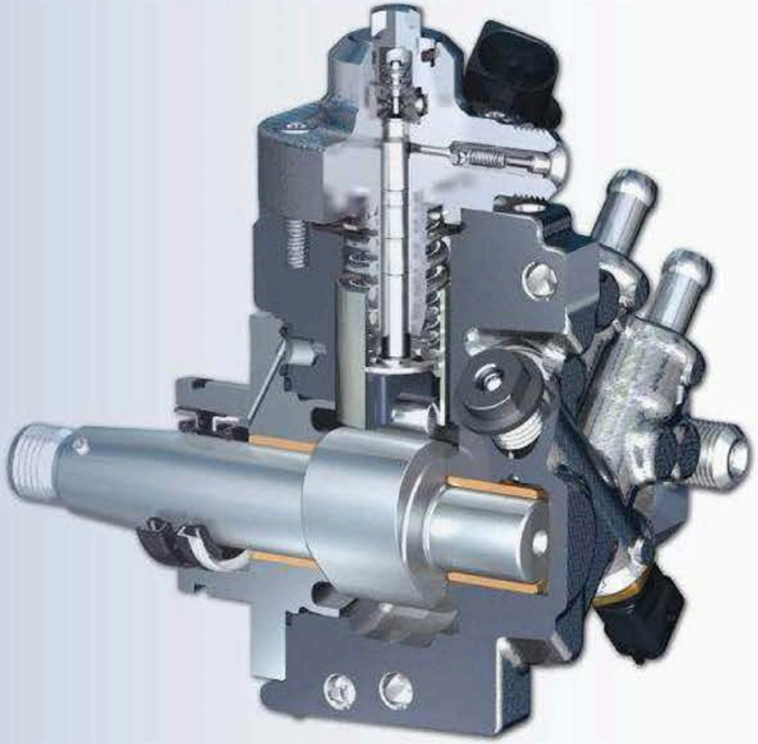


BOSCH

1) Ishikawa of influencing factors

Non-responsive content removed

[redacted]

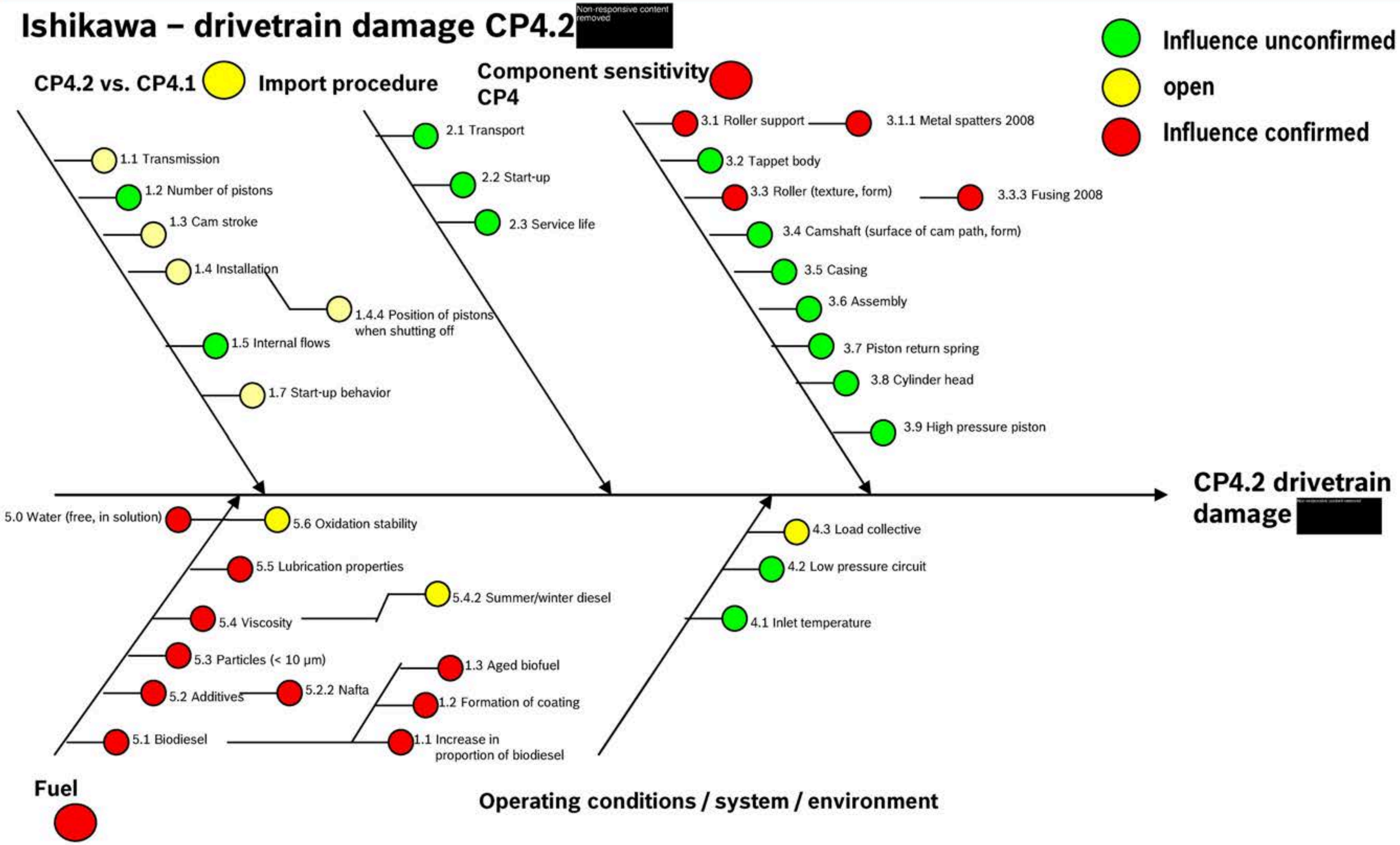


BOSCH

ENTIRE PAGE CONFIDENTIAL

Audi meeting on 02/12/2010

Ishikawa – drivetrain damage CP4.2 Non-responsive content removed



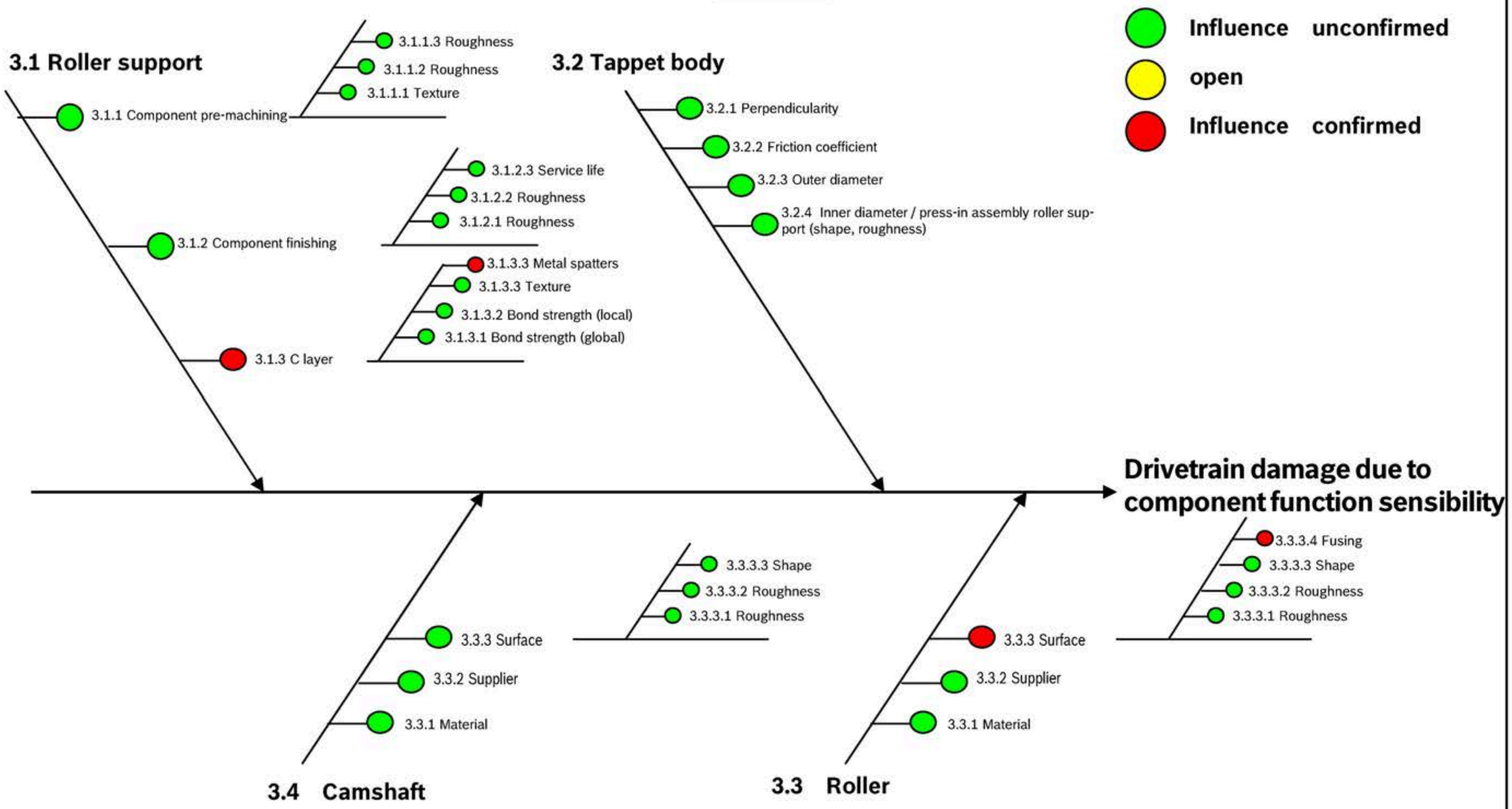
BOSCH

ENTIRE PAGE CONFIDENTIAL

Audi meeting

Audi meeting on 02/12/2010

Ishikawa – drivetrain damage CP4.2 Non-responsive content removed



Audi meeting on 02/12/2010

Summary of areas of action from Ishikawa:

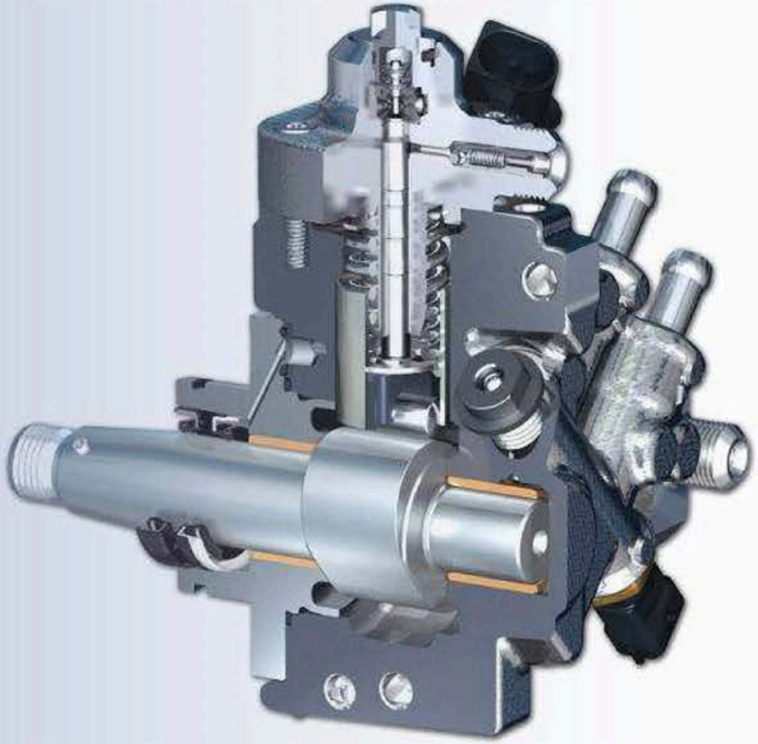
1. Fuel influence
2. Component sensitivity: Metal spatters / fusing
3. Differences between CP4.2 – CP4.1 in application and design

BOSCH

ENTIRE PAGE CONFIDENTIAL

2) Analysis of failed pumps / fuels

Non-responsive content removed



BOSCH

Audi meeting on 02/12/2010

Determination of causes for failure focus [redacted]

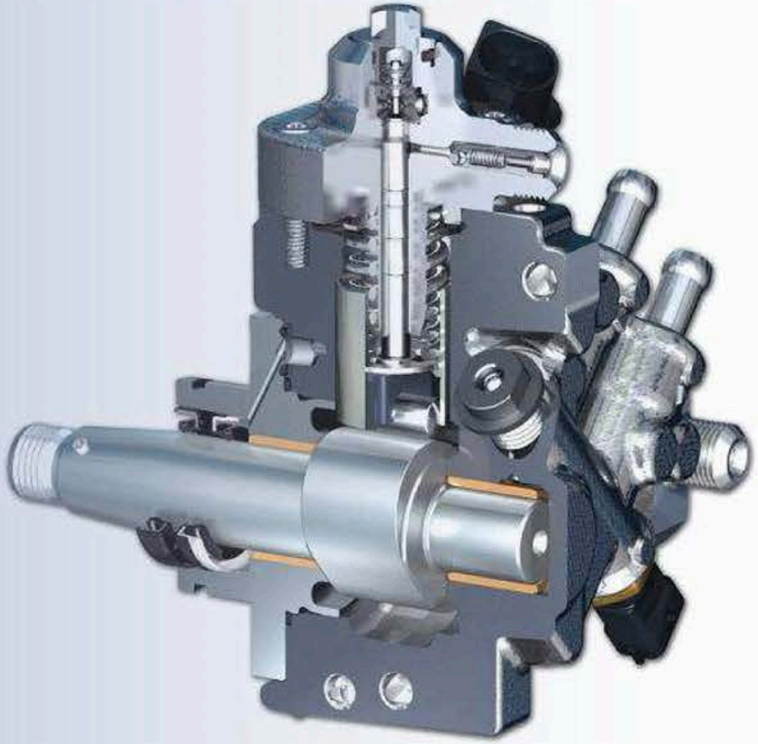
Analysis of field pumps and fuel samples from [redacted]

➢ FAME deposits	11 of 54 pumps
➢ Corrosion indicators, evidence of water	45 of 54 pumps
➢ Free water in fuel sample	4 of 24 samples
➢ Cellulose residue, algae, glycerin	9 of 24 pumps
➢ Heavy wear of shaft seal	17 of 17 pumps
➢ Good pumps with preliminary damage - [redacted]	6 of 13 pumps

ENTIRE PAGE CONFIDENTIAL

3) Component sensitivity

[redacted]

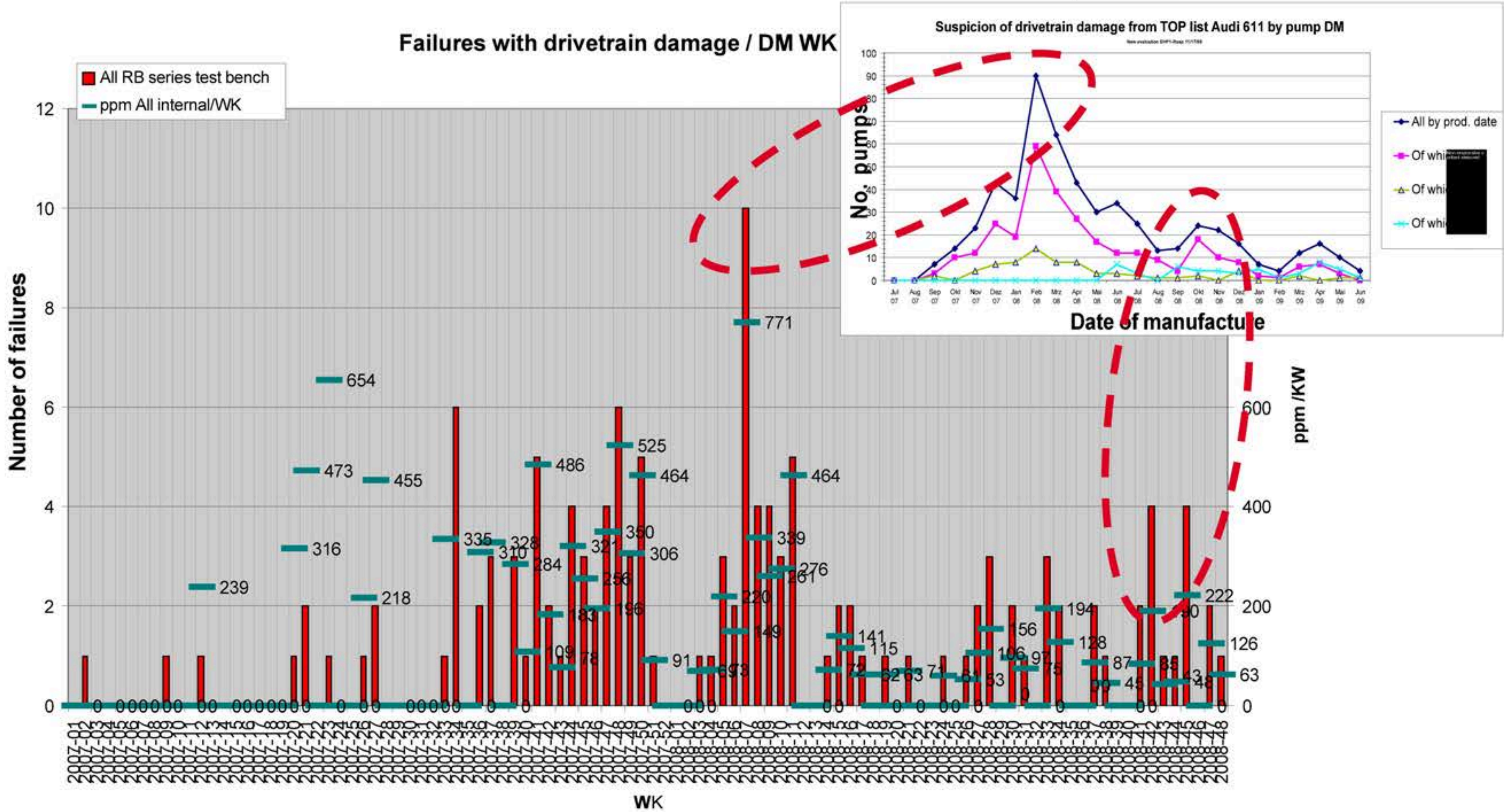


BOSCH

ENTIRE PAGE CONFIDENTIAL

Audi meeting on 02/12/2010

Overview of failures, internal test bench & Field Non-responsive content removed (failure peaks)



-> Increased internal test bench failures correlate with increased field failures

Diesel Systems

BOSCH

Component sensitivity

1. **Metal spatters in roller support C3 coating**

   Metal spatters significantly reduced through optimization of plants

   5/2008 Sensitivity to small metal spatters with EN590/ BDF570 verified from 5/2008.

2. **Roller with fusing**

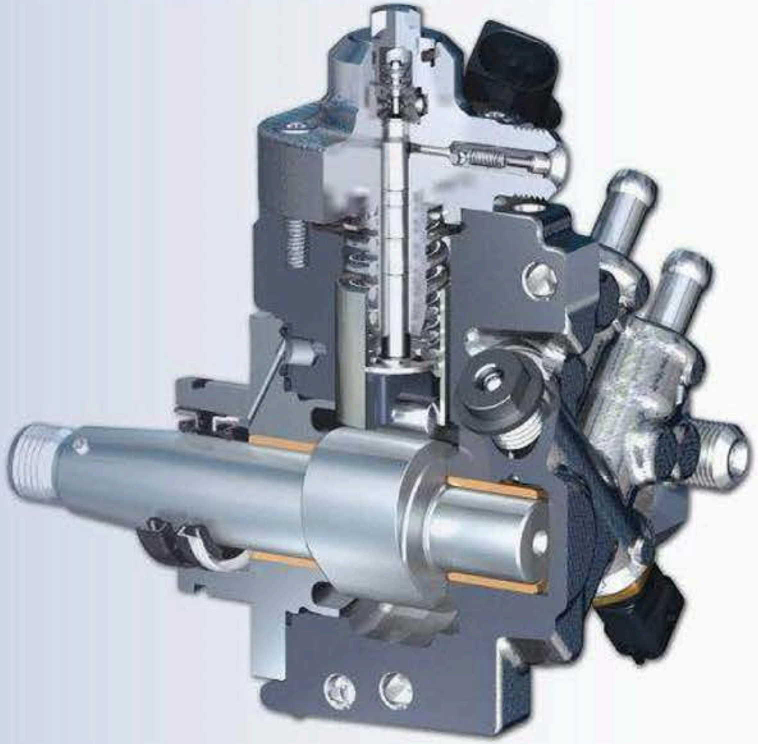
   To select rollers with fusing, the straightedge test was introduced in 5/2008.

   The conversion of the roller edge end to C2 in 5/2009 eliminated the fusing.

ENTIRE PAGE CONFIDENTIAL

4) Good pumps

[redacted]



BOSCH

Audi meeting on 02/12/2010

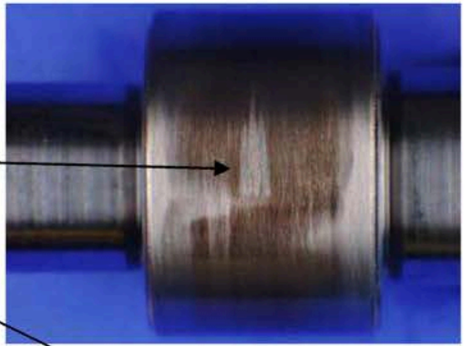
TF AUDI [redacted] Good pump (2009-CP4_0685)

5,125 km (no failure)

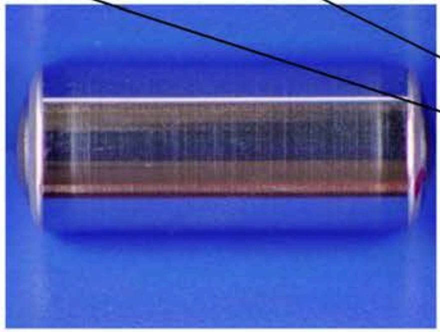
Summary analysis results

→ Transfer of material from roller to cam

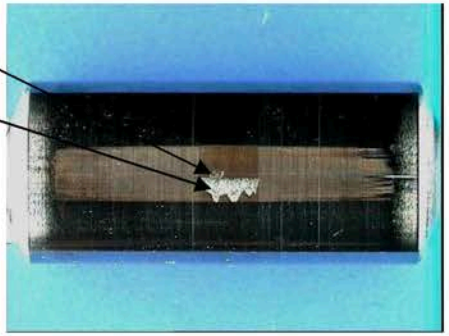
→ Braking flat from non-starter



Interpretation:
Roll does not start when engine is started (sluggish)



Left roller



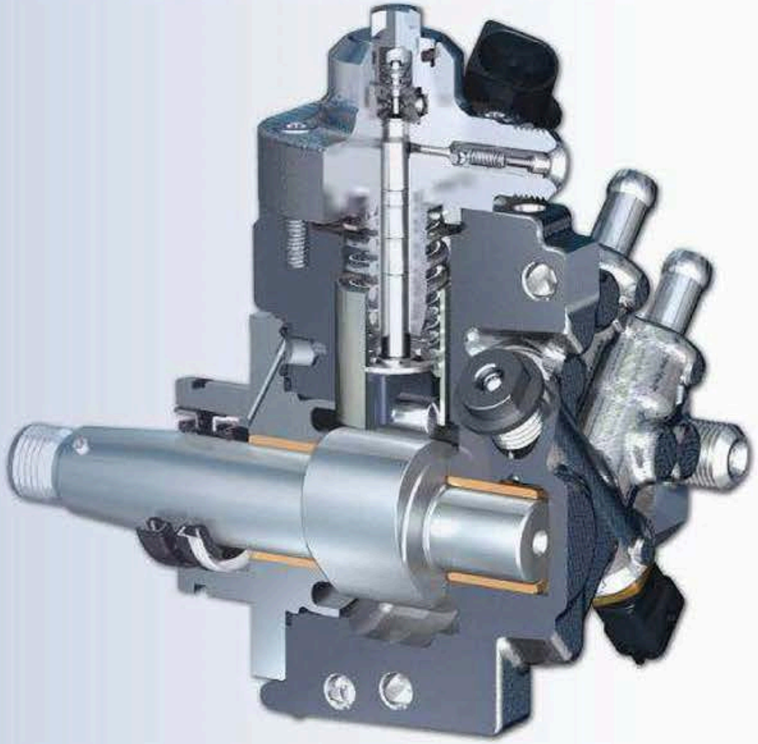
Right roller

6 of 13 OK pumps from [redacted] have the same symptoms.
Preliminary damage does not necessarily result in failure (failure primarily due to continued driving with poor fuel).
Experience from initial reappear tests.

BOSCH

5) Hypotheses

[redacted]

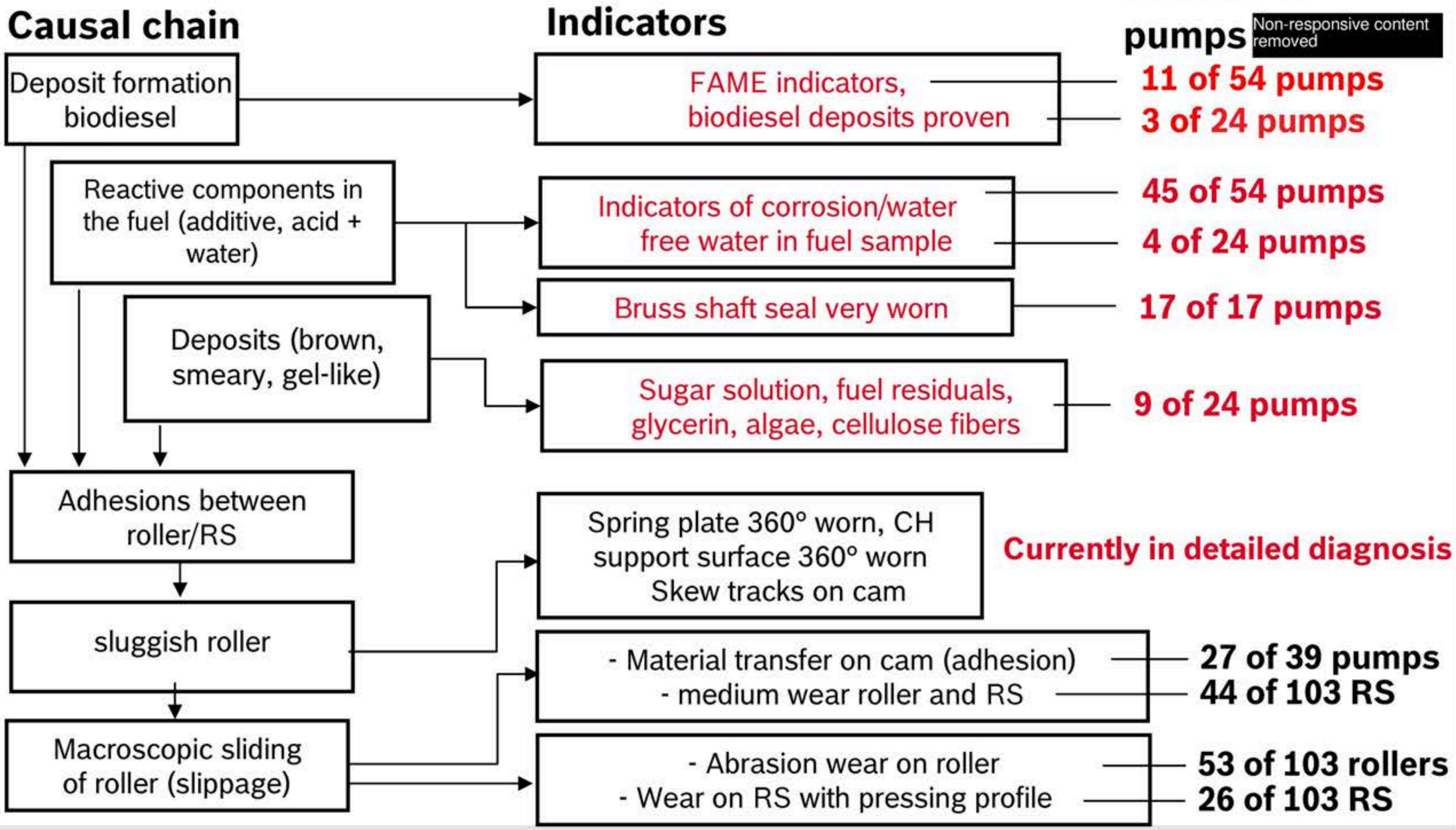


BOSCH

ENTIRE PAGE CONFIDENTIAL

Audi meeting on 02/12/2010

Potential damage based on hypotheses 3 and 4
(aged fuel with presence of water)



BOSCH

Audi meeting on 02/12/2010

Differences between CP4.2 and CP4.1

Hypotheses: Based on poor start-up of the pump (analysis of good pumps), the following hypotheses for the differences can be examined:

1. Different start/pressure build up speed between 4-cylinder and 6-cylinder engine -> start-up worse with poor-quality fuels
2. Different position of roller on cam when shutting down engine. Mounting situation of pump on 4/6-cylinder engine
3. Belt tension during pump start-up (pre-tension)
4. Different flow patterns in pump interior (no influence)

Further work:

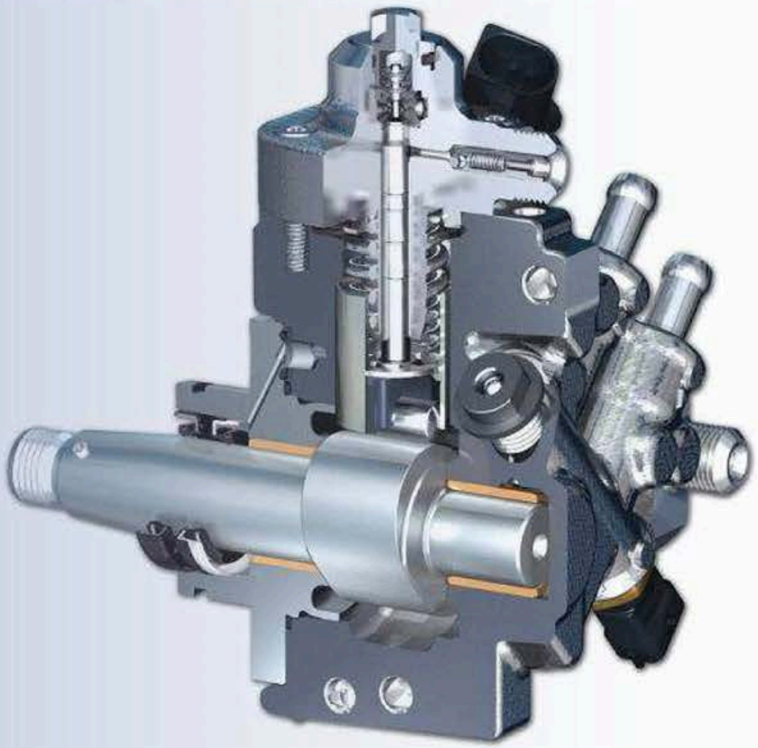
High-speed camera & start-up examinations with poor quality fuel 2/26/2010

Damage case with stopped (seized) roller can be reproduced with reappear test and Arctic Diesel.

ENTIRE PAGE CONFIDENTIAL

6) Anti-wear package 1

Non-responsive content removed [redacted]



BOSCH

Audi meeting on 02/12/2010

Anti-wear package 1 (task; features)

Assignment

Increase robustness of drivetrain by increasing the height of the lubricating film between roller support bore and roller.

Features of anti-wear package 1

1) Reduction of roller support roughness in combination with change to C2 layer on roller support.

2) Reduction of roller play by shifting average tolerance and tolerance range of roller support bore.

Results from simulation: Increase in robustness of ~ 50%*

(*compared to today's borderline tolerances)

Further work: Verification & RP1

by WK8

Diesel Systems

BOSCH

Audi meeting on 02/12/2010

Introduction of anti-wear package 1 in current series

Status

Basic test of C2.1 layer incl. release for 3 customers with EN590 & ASTM975 (US fuel) available. No engine start/stop test for ASTM975. Verification with poorly lubricating fuel (kerosene, Arctic, aged biodiesel, ...) started.

Open items

Verification of reduced play

- Risk assessment with DRBFMpositive — done
- Borderline part provision — done
- Functional & endurance runs — see schedule

BOSCH

Audi meeting on 02/12/2010

Verification of RP1 in overload tests

WK5

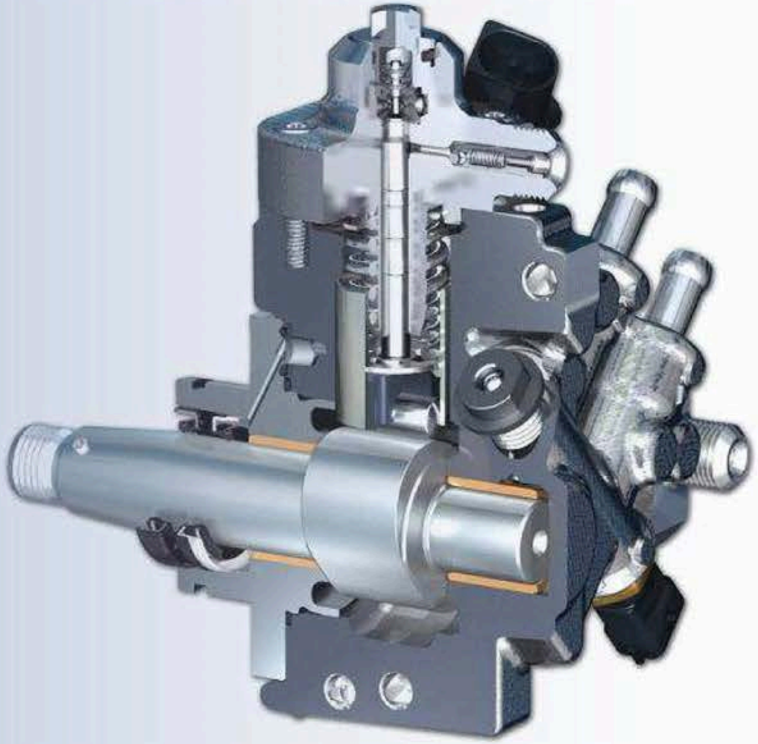
Level	Target number		Status	End date
Tappet "good" after visual inspection of C3 RS	2	150h		WK5
Tappet "bad" after visual inspection of C3 RS	2	150h	100% 100%	WK5
Best of series C2.1 with RP1 (24µm)	2	150		WK6
	20			WK
	36	400h		WK
	12	1,000h		WK
	24	2,000h		Done WK
	12	400 h		Done WK

Will be revised & submitted later

BOSCH

7) Robustness increase based on Stribeck curves

[redacted]



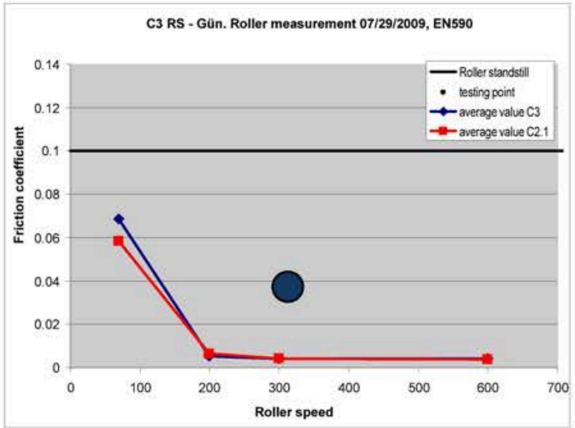
BOSCH

ENTIRE PAGE CONFIDENTIAL

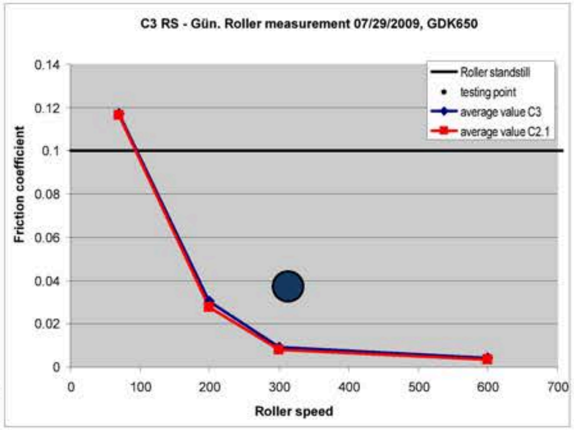
Audi meeting on 02/12/2010

Comparison of layer system* C3-C2.1 on friction coefficient test bench at

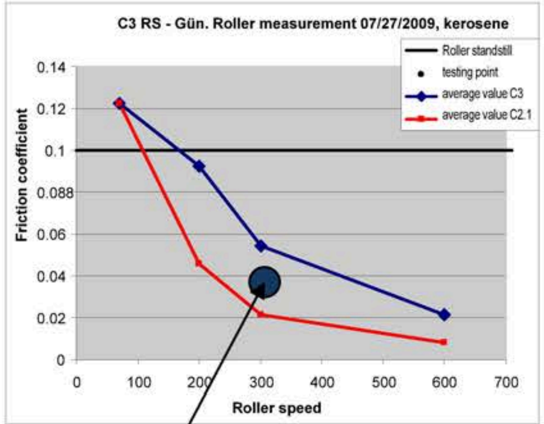
EN 590



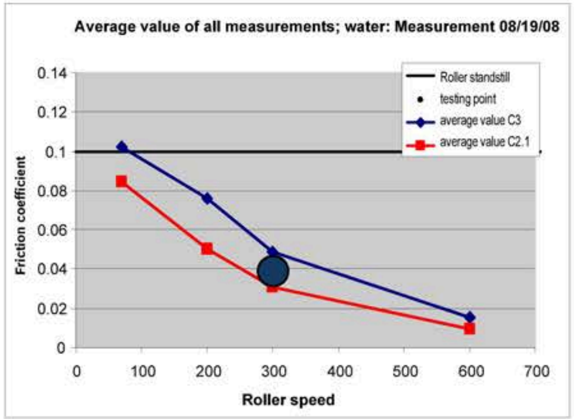
BDF 650



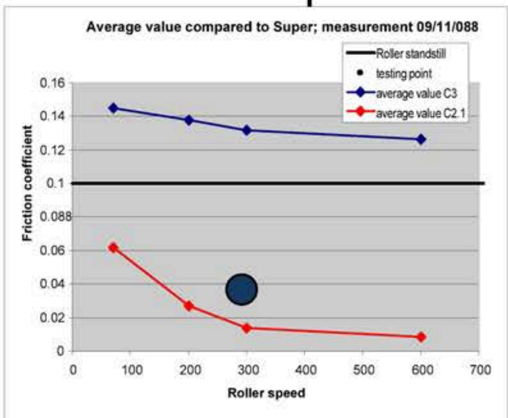
Kerosene



Water



100% Super



Assessment criterion:
friction coefficient

***average comparable play**

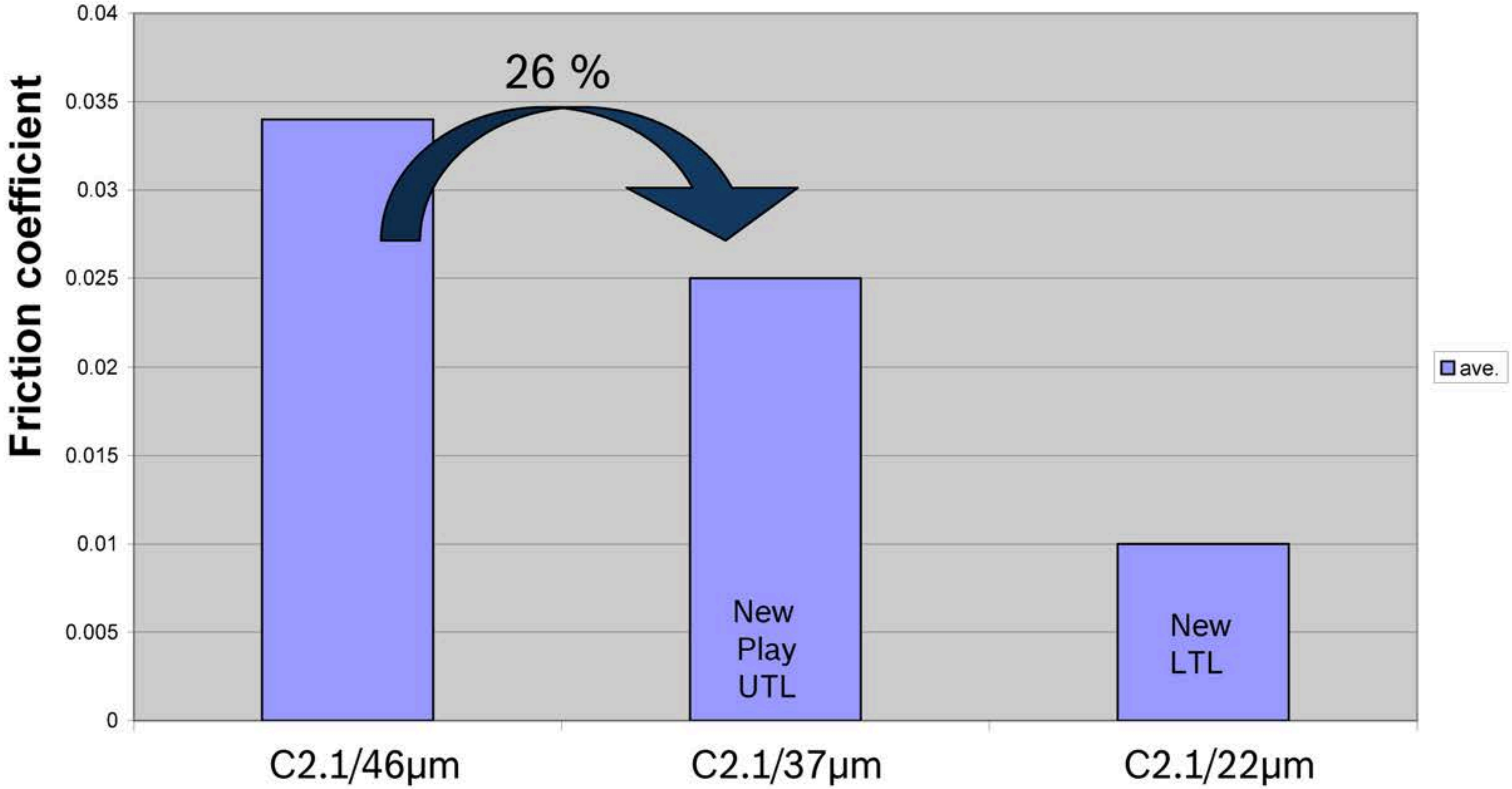
BOSCH

ENTIRE PAGE CONFIDENTIAL

Audi meeting on 02/12/2010

Examination with viscosity 1.4mm²/s @40°C (Arctic Diesel)

Testing point 300rpm

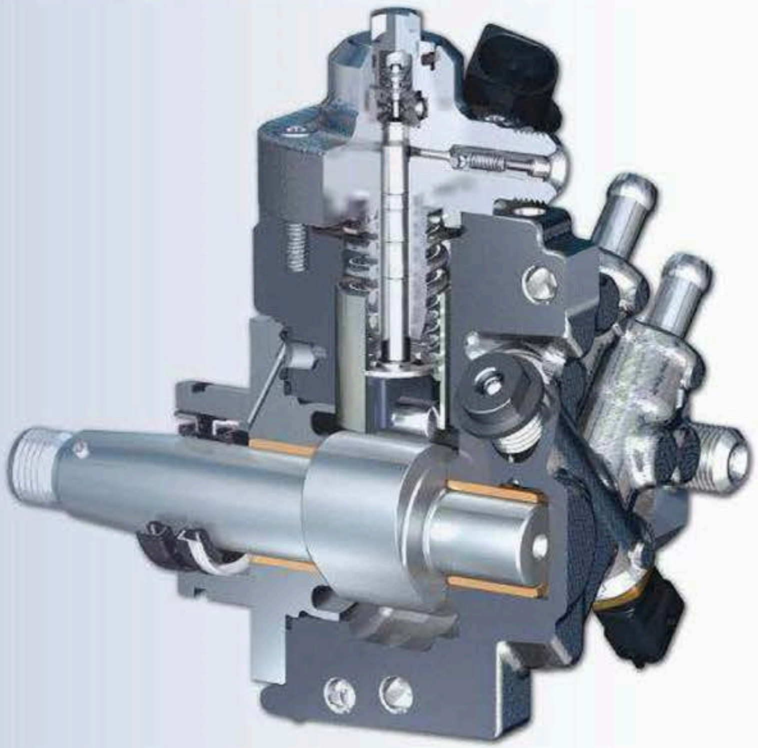


BOSCH

ENTIRE PAGE CONFIDENTIAL

8) Assessment of measures

Non-responsive content removed



Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

Audi meeting on 02/12/2010

Effectiveness of robustness system:

Fuel quality	Problem	Series production	RP1	LLPx*	Water separator
EN590 / BDF520		+**	++**	++	
BDF650	Lubricity	(+)**	+**	+	
Kerosene	Viscosity	-	(+)	+	
Aged fuel	Gumming Lubricity	-	(-)	+*	
Water > 200ppm	Viscosity Lubricity Corrosion	-	-	-	+

*LLPx: Dependent on examination of differences between Cp4.2 and CP4.1, as well as results of FCF and WCF test with RP1. Definition of measures in the next 8 weeks.

** with C coated piston (USA)

BOSCH

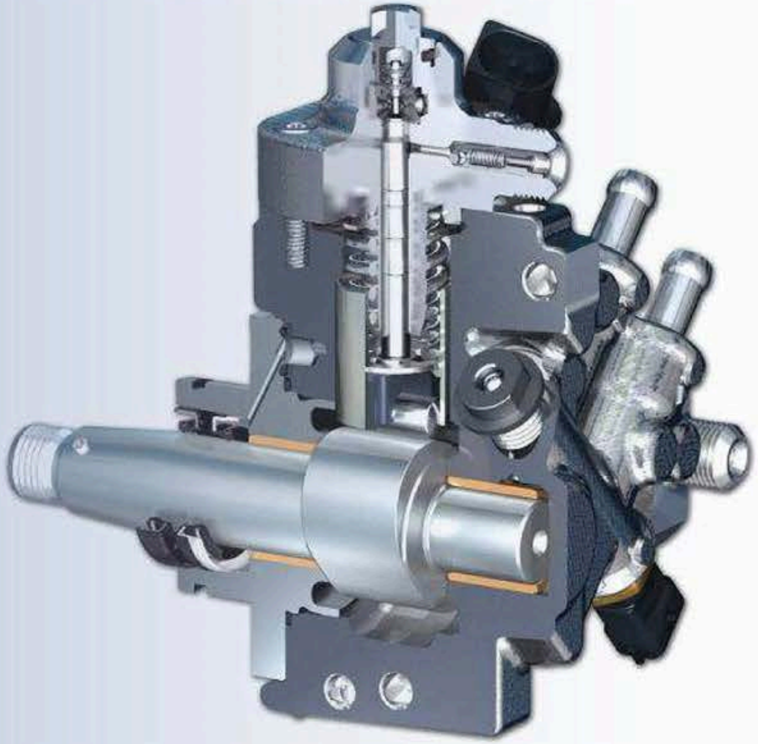
Summary: Task Force CP4 Drivetrain

[redacted]

1. Audi field data
2. Field data / Ishikawa of influencing factors
3. Analysis of failed pumps / fuels in [redacted]
4. Component sensitivity
5. Good pumps [redacted]
6. Hypotheses [redacted]
7. Comparison CP4.2 and CP4.1
8. Possible measures (anti-wear package 2)
9. Anti-wear package 1 to improve durability with poor viscosity / lubricity
   9.1 Proof of robustness based on Stribeck curves
   9.2 Endurance runs with C2 / C3

1) Field data Audi

[redacted]



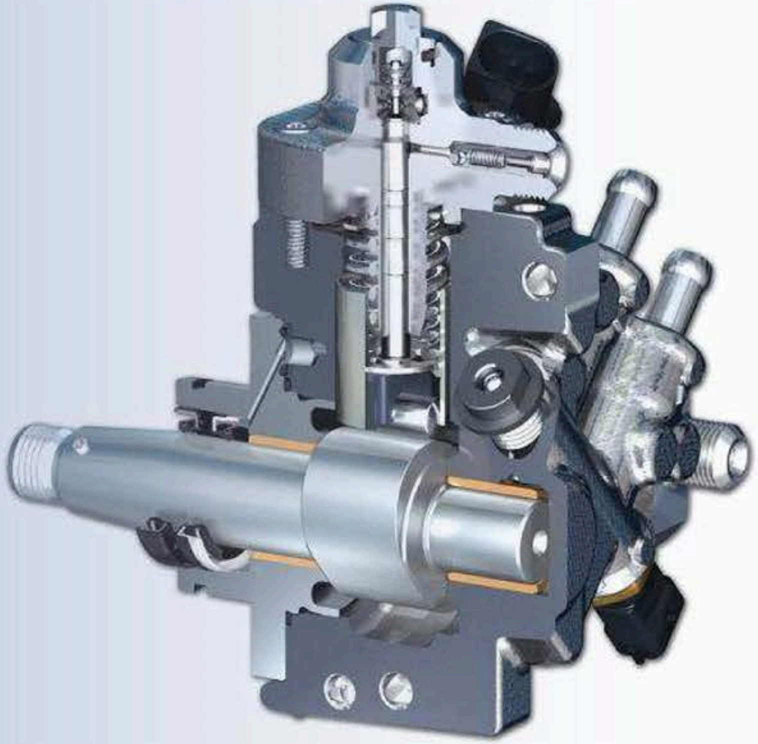
Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

2) Field data & Ishikawa of influencing factors

Non-responsive content removed



BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

AUDI - CP4 field situation in [redacted]

Status: 2/3/2010

AQUA, active **q**uality analysis
status 12/09-01/16/10 08:43
Source/User [redacted]

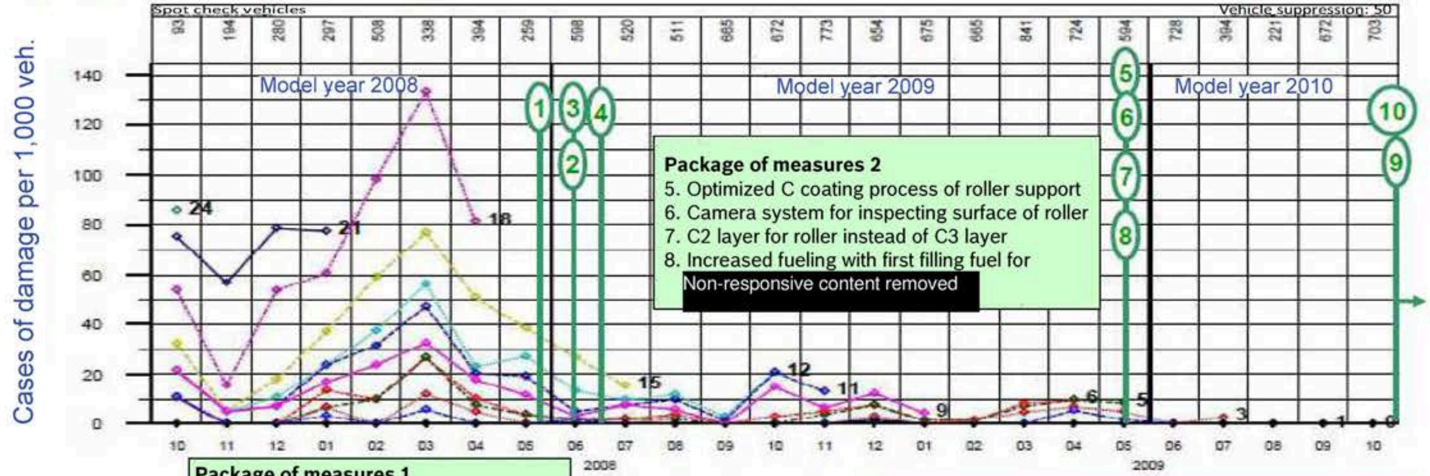
Audi, *, market: [redacted]
MY 2008 - 2010, Offset: all (Max: 2)
CNR / Groups High-pressure pump

Confidential
Without PR numbers
CNR 2374

CAMA|CAMB|CAMD|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CATA|CATB|CCLA|CCMA|CCWA|CCWB|CDYA|CDYB|CDYC|CGK

MY	MIS 0	MIS 1	MIS 3	MIS 5	MIS 6	MIS 9	MIS 11	MIS 12	MIS 15	MIS 18	MIS 21	MIS 24
2008	0,0	1,7	3,9	9,0	10,3	18,0	23,6	27,8	44,5	78,5	103,2	119,7
2009	0,1	0,9	1,9	3,8	4,4	7,8	11,7	14,3	23,0			
2010	0,0	0,0	2,1	3,1	3,1							
Diff%	-100	-100	8,53	-16,22	-29,13							

MY	Exchange	BD	SA 10	SA 17
2008	100,0 %	81,3 %	75,6 %	14,2 %
2009	97,2 %	80,0 %	79,4 %	13,1 %
2010	100,0 %	100,0 %	50,0 %	50,0 %
			MEC ERR	MAJOR



Package of measures 1
1. Straightedge test on roller
2. Visual inspection of roller after C coating
3. Optimized C coating
4. Improved texture of roller
(new subcontractor)

Vehicle: 3.389+12.041+6 ... 35+7.730+3.776=13.841;MY2008+2009+2010=

Package of measures 3
9. HC washing roller support (Jan 2010)
10. Introduction of anti-wear package 1. SOP (March 2010)

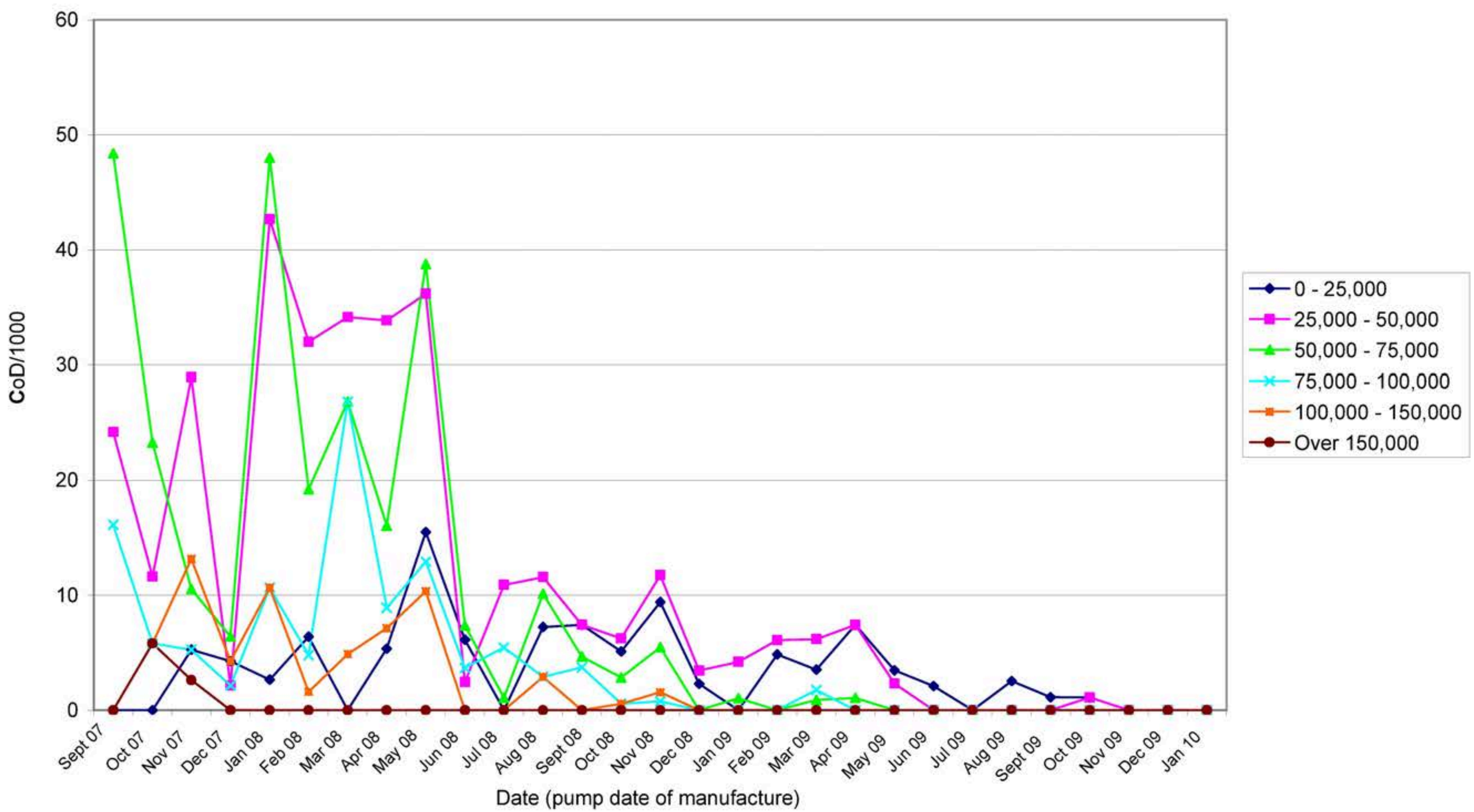
BOSCH

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Mileage contour lines, CP4.2 Non-responsive content removed



Diesel Systems

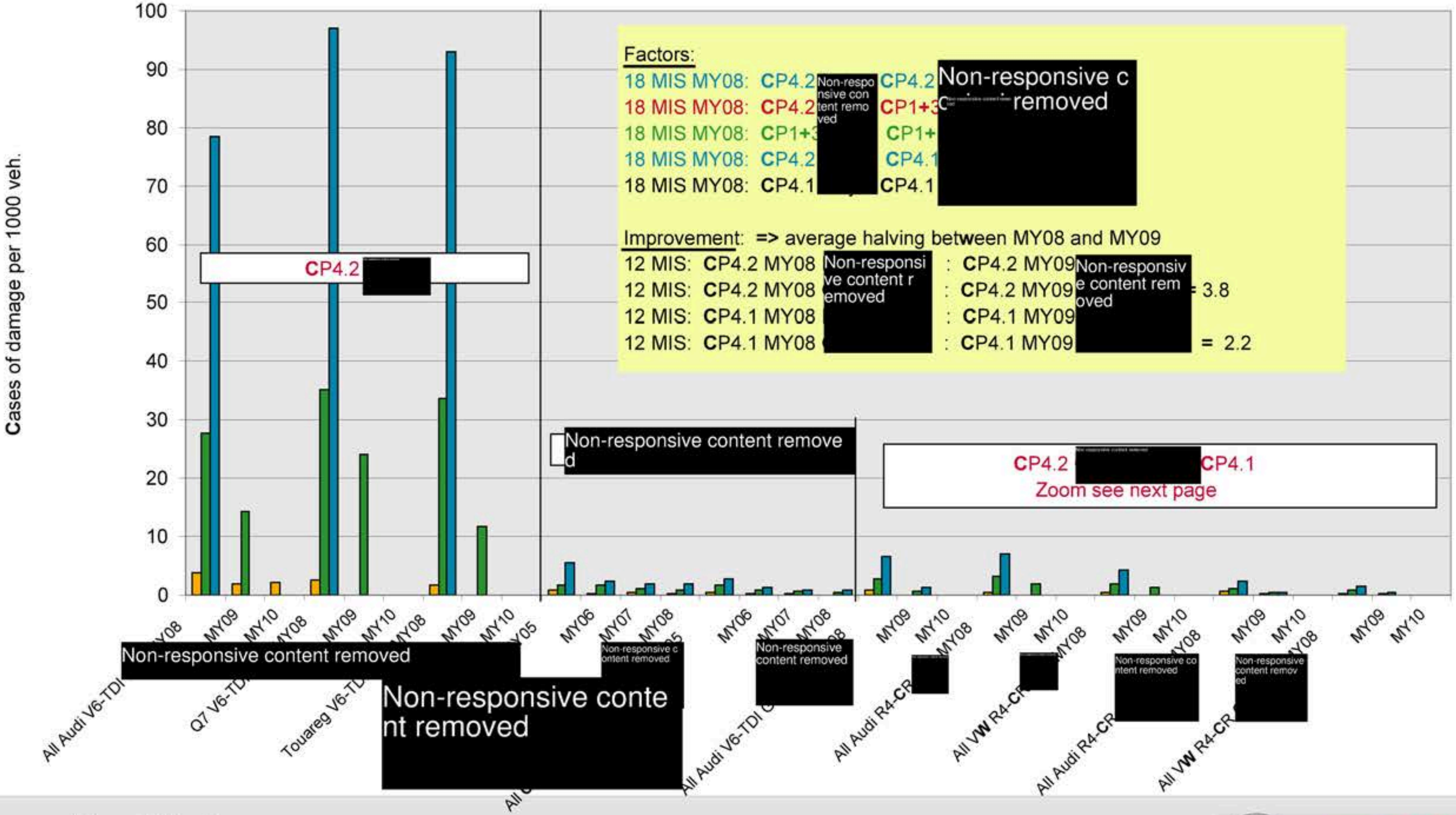
BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Drivetrain damage high pressure diesel fuel pump CP4.2

Comparison of damage quotas Audi VW / [redacted] / V6 TDI to R4 CR / CP4 to CP1+3



Diesel Systems

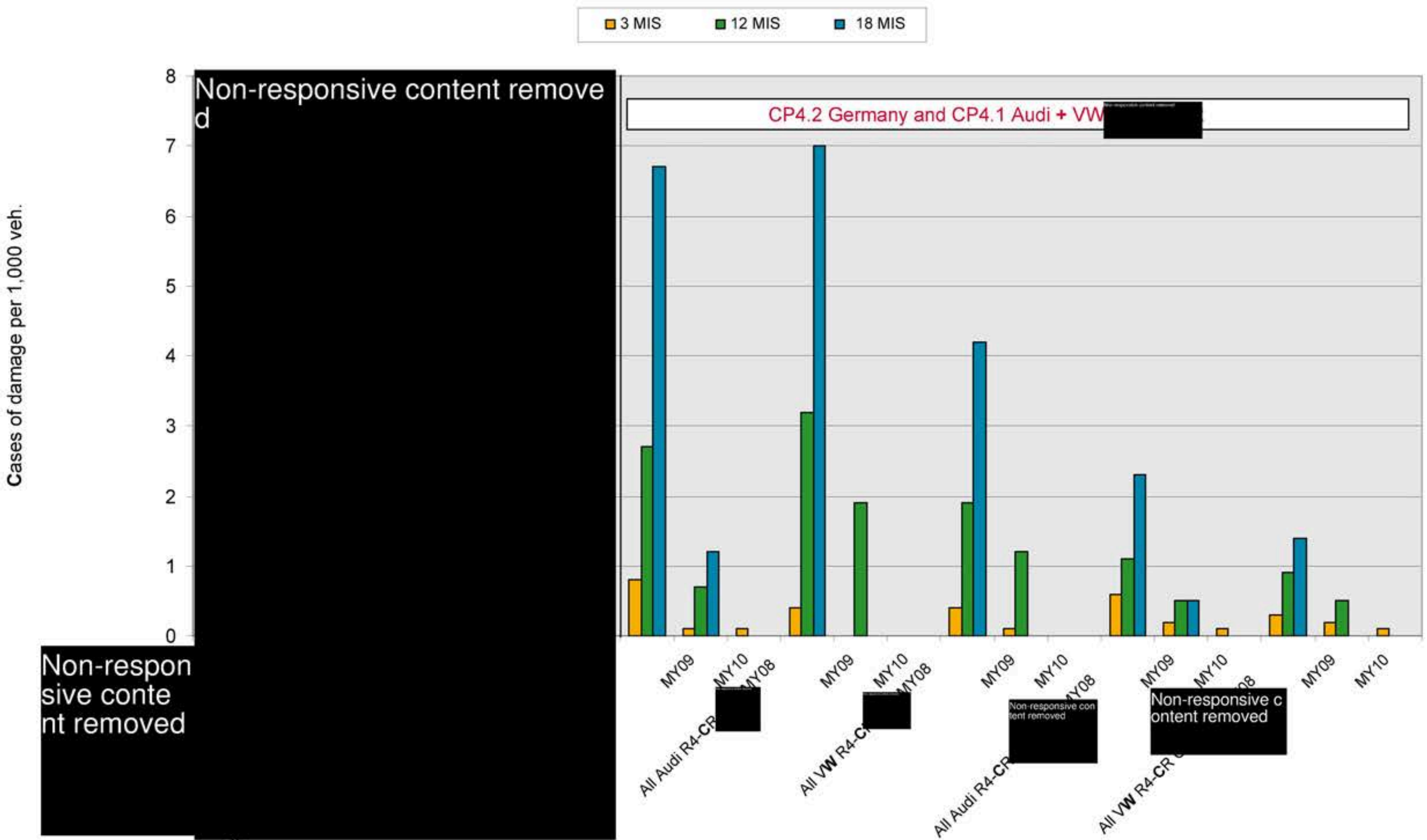
BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Drivetrain damage high pressure diesel fuel pump CP4.2

Comparison of damage quotas Audi VW /[redacted] V6 TDI to R4 CR (without V6[redacted]



Diesel Systems

Failure data Audi CP4.2 (basis: mid-February)

Distribution by country (basis: mid-February)

Total	[redacted]				Other
1125	594	103	59	56	313

Distribution by model year - all (base: mid-February)

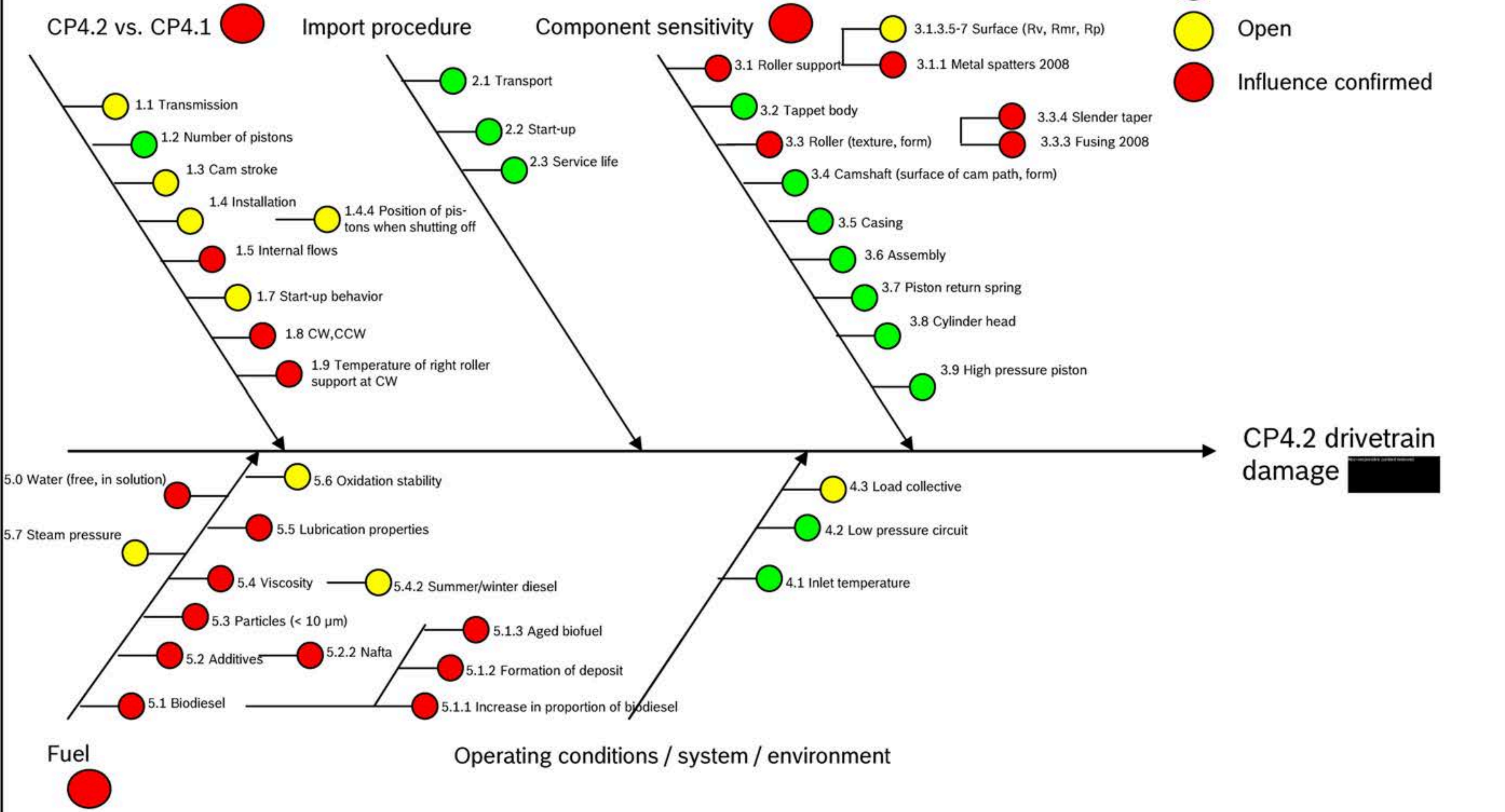
Total	2008	2009	2010
1179	687	458	34

6 MIS line by model years in [redacted]

2008	2009	2010	
10.5	4.8	2.8	x/1000 vehicles

Status Task Force CP4

Ishikawa – Drivetrain damage CP4.2 [redacted]

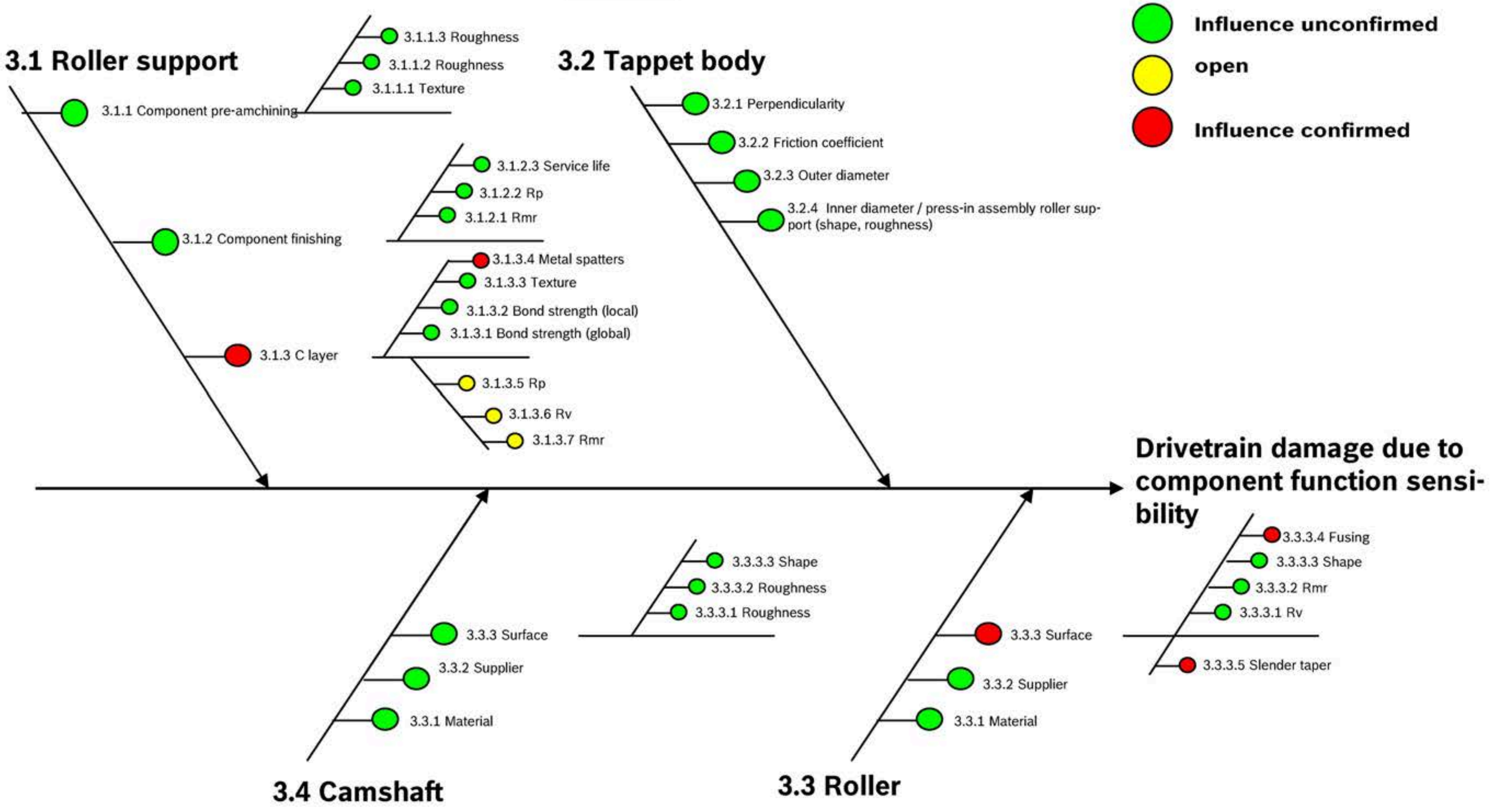


ENTIRE PAGE CONFIDENTIAL

Audi meeting

Status Task Force CP4

Ishikawa – drivetrain damage CP4.2[redacted]



Diesel Systems

BOSCH

Status Task Force CP4

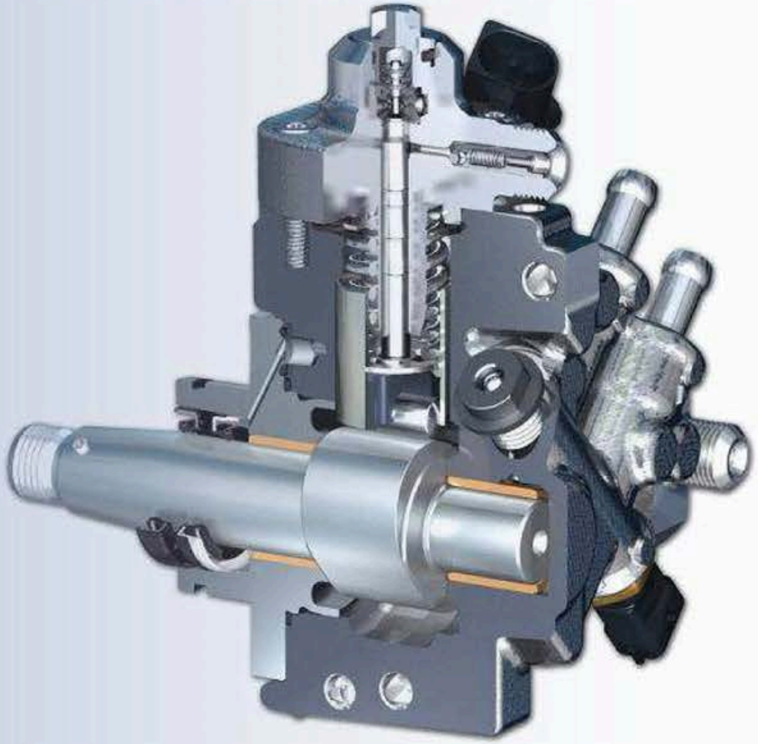
Summary of areas of action from Ishikawa:

1. Fuel influence
2. Component sensitivity (metal spatters / fusing)
3. Differences between CP4.2 – CP4.1 in application and design

ENTIRE PAGE CONFIDENTIAL

3) Analysis of failed pumps / fuels

Non-responsive content removed



BOSCH

Status Task Force CP4

Analysis of field pumps and fuel samples from [redacted]

FAME deposits	11 of 54 pumps
Corrosion indicators, evidence of water	45 of 54 pumps
Free water in fuel sample	4 of 24 samples
Cellulose residue, algae, glycerin	9 of 24 pumps
Heavy wear of shaft seal	17 of 17 pumps
Good pumps with preliminary damage [redacted]	6 of 13 pumps

BOSCH

Determination of causes for failure focus [redacted]

Influence of fuel on [redacted] market:

Comprehensive switch from B0 to B7 from July 2009

Hypothesis:

- B7 fuel already stored in advance for changeover from July 2009, as a result, acidic, aged B7 fuel in circulation
- Latent free water in fuel tank and LP system possible

-> Combination of aged biofuel with free water results in deposits
Deposits in the roller assembly prevent the roller from starting.
Primary damage: Braking flats on roller and camshaft in start case

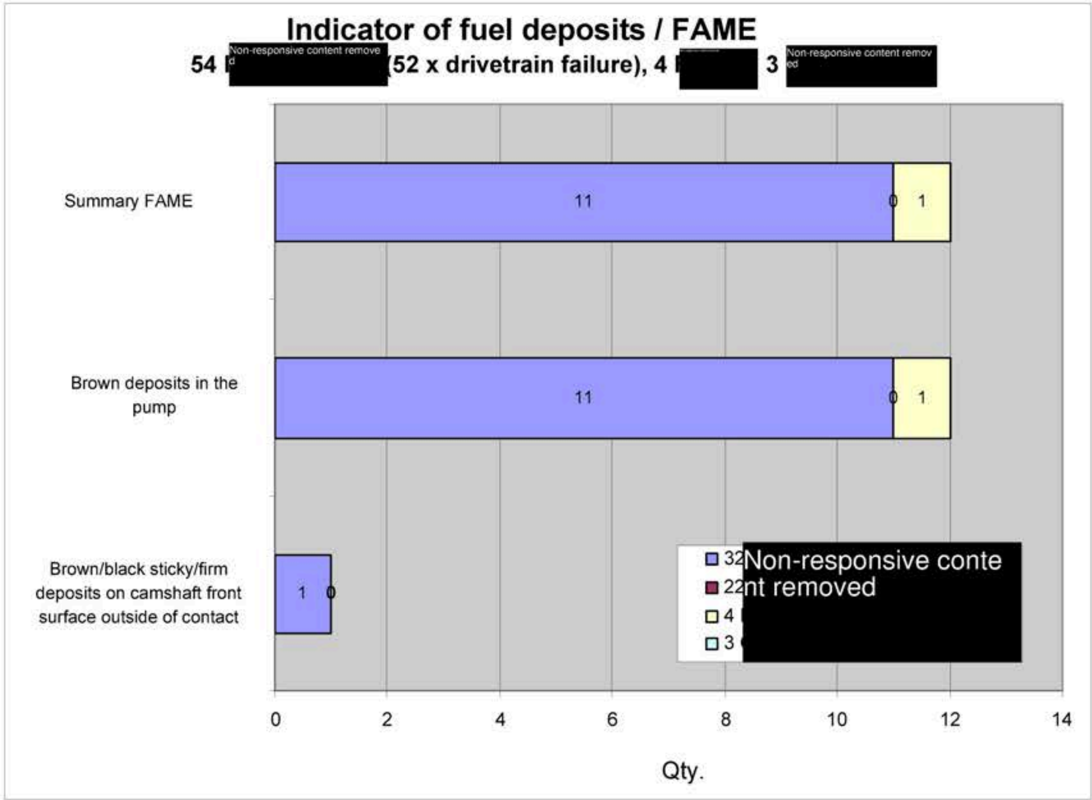
-> Sloshing water results in sluggish, blocked roller.
Primary damage: Braking flats on roller and camshaft
(tank emptying trip vehicle test, customer B)

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Result from diagnosis for fuel aging indicators



[redacted]
32 pumps

[redacted] **on-site action**
22 pumps, 20 x drive-train failure

[redacted]
4 pumps

[redacted]
3 pumps

4 x reference De OK,
2 x Audi
2 x VW

=> 11 out of 54 pumps have brown fuel deposits =>
On-site action: 0 out of 22 pumps

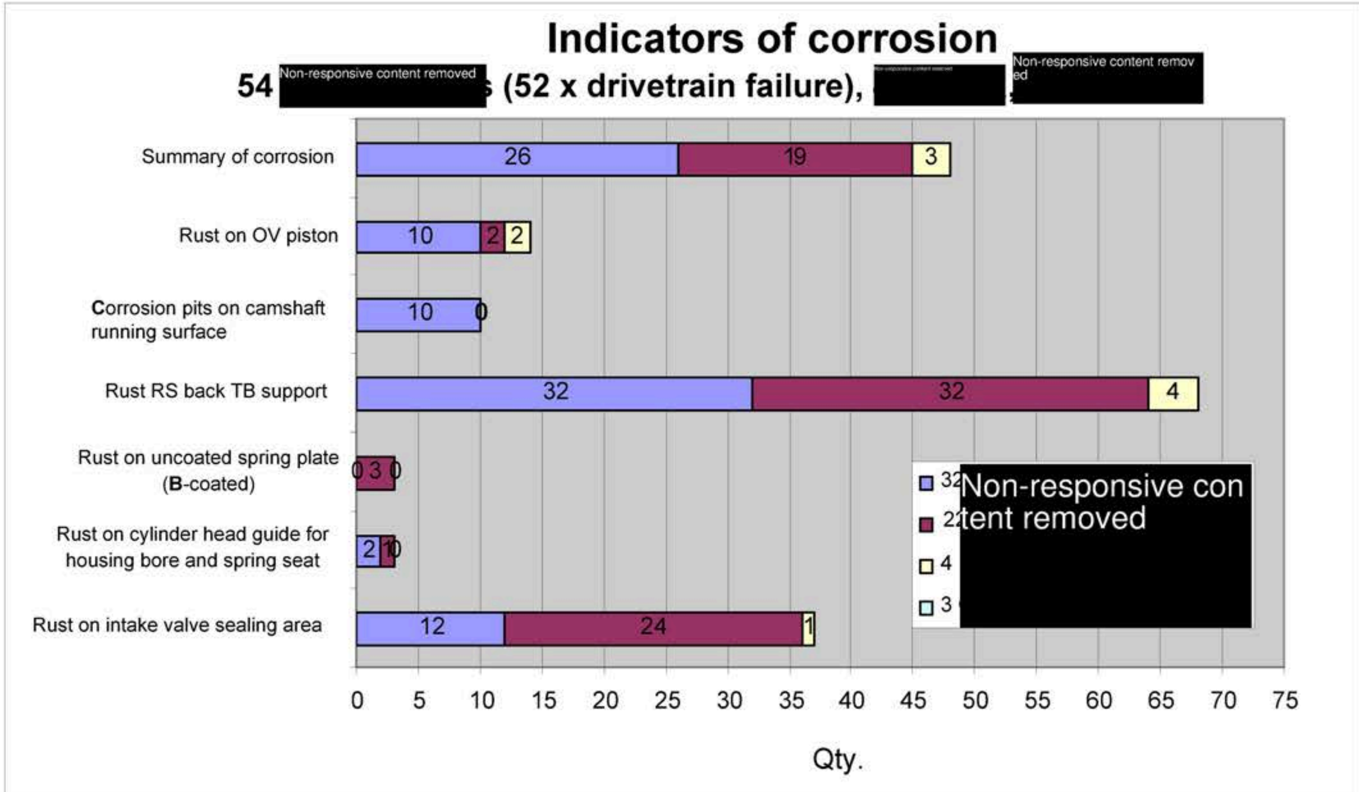
Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Result from diagnosis for corrosion indicators



[redacted]
32 pumps

[redacted]n-site action
22 pumps, 20 x drive-train failure

[redacted]
4 pumps

[redacted]
3 pumps

4 x reference De OK,
2 x Audi
2 x VW

=> on-site action 19 of 22 pumps with signs of corrosion

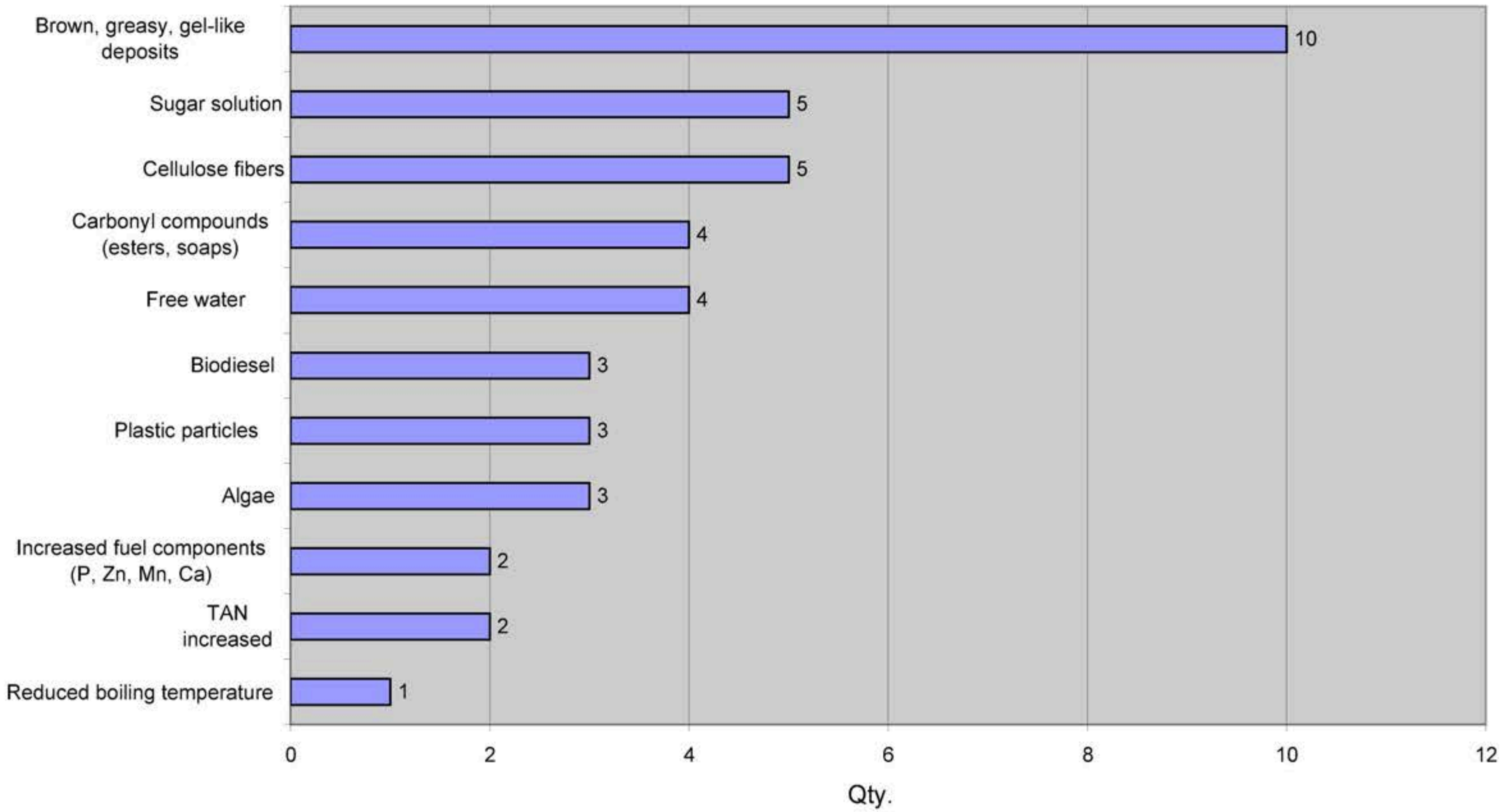
BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Result of fuel analyses

Results of fuel analyses and deposits from 24 vehicles [redacted] Audi).

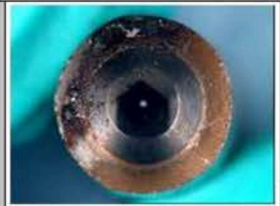


BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Indicators of fuel aging

Biodiesel	Component	Description/characteristics	Overview image
A1	Roller	Brown/sticky to black/firm deposits on the roller end (outside the C layer)	
A2	Camshaft	Brown/sticky to black/firm deposits on the untouched front surfaces of the camshaft	
A3	Intake valve	Brown/sticky to black/firm deposits on the shaft of the intake valve piston (outside the guide surfaces)	
A4	Roller support	Brown/sticky to black/firm deposits on the back of the roller support (outside the contact surfaces)	

Description/characteristics	Overview image
Brown/sticky to black/firm deposits on the unprocessed surfaces	
Brown/sticky to black/firm deposits on the adjustment ring of the MU	
Brown/sticky to black/firm deposits on the mesh of the OV strainer OV strainer pressed in	

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Indicators for corrosion (validated by WCF)

Corrosion	Component	Description/characteristics	Overview image	Detailed picture	Analysis picture
K5	Cylinder head	Rust in wear area due to tappet spring			
K6	Cylinder head	Rust on centering collar of cylinder head to housing			
K7	Tappet body	Rust deposits on bearing surface to spring plate			
K8	Spring plate	Rust in wear area on the bearing surface to tappet body or tappet spring			

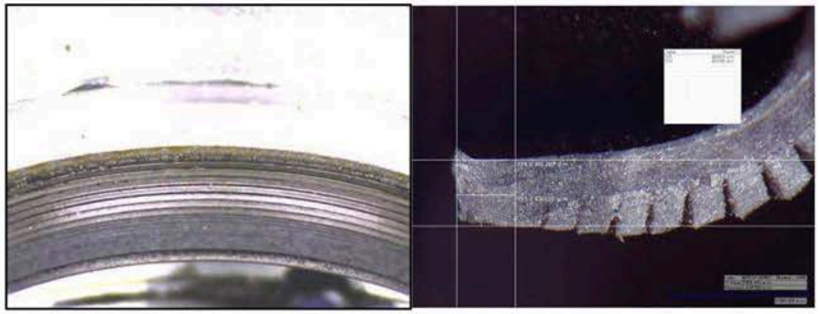
Diesel Systems

BOSCH

Examples for wear of Bruss shaft seal

- -> Project W19 EU6/BIN5
- -> Report 2009-CP4_0122 ER end
- -> SN 0 445 010 613
- -> Pump DM 01/22/2008 No. 0893
- -> Vehicle AU716 80219 engine 059.G VN6 121
- -> Mileage **201,335 km**

Wear depth approx. 74 µm



- -> QC no. 230002542476 (4A203)
- -> SN 0 445 010 611
- -> Pump DM 10/30/2008 No. 0702 R2
- -> Mileage **2,212 km**
- -> Failure on 6/15/2009 in [redacted]

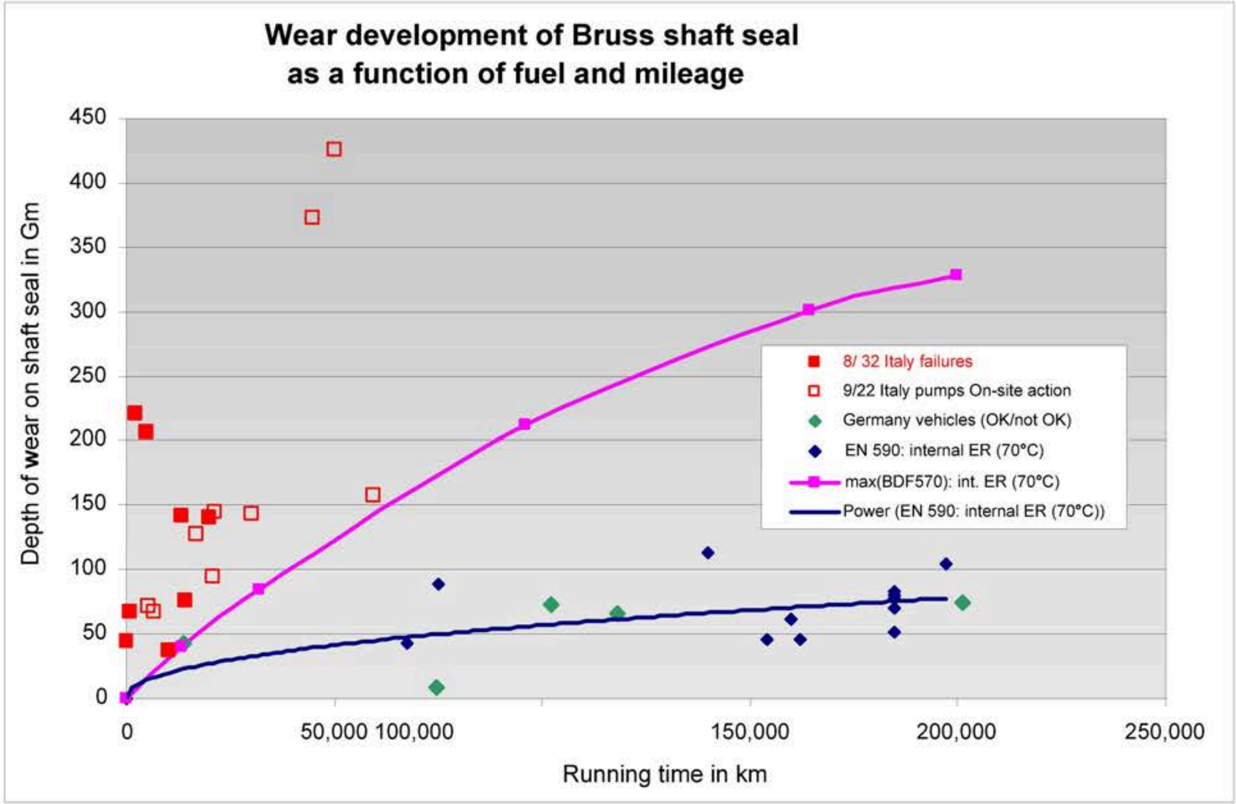
Wear depth approx. 221 µm

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Result of shaft seal wear measurement, [redacted]



=> Bruss shaft seal [redacted] (17x) worn more than with EN590 (= fuel influence)
=> No functional leakage of described shaft seal
=> No dependency on manufacturing or failure date

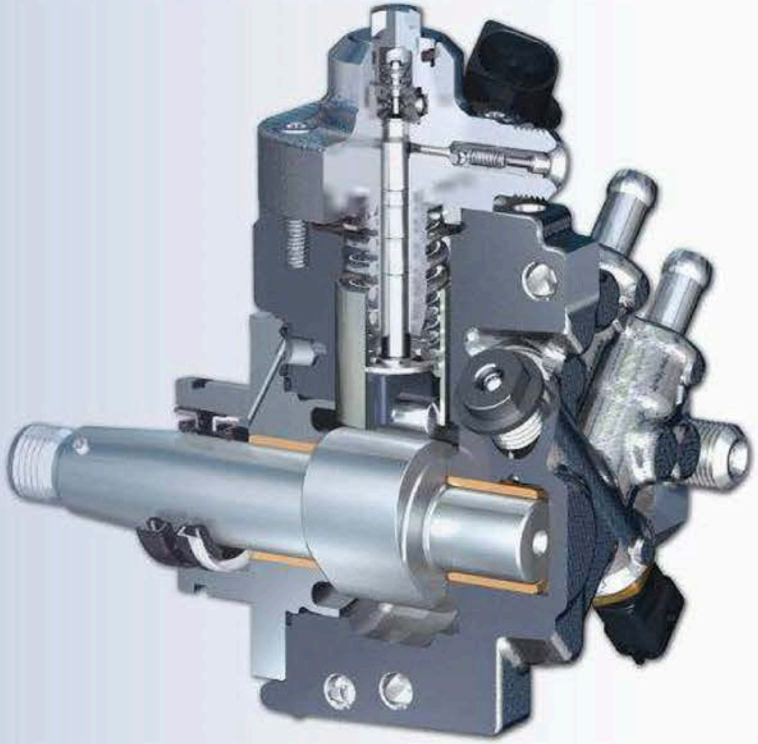
Analysis results of failure pumps / fuel investigations

1. Non-standard biofuels (aged)
2. Cellulose, sugar, acids, algae
3. Water (rust)
4. Field failures in Italy with turned tappet as aftereffect (field failures in Germany with abrasion wear as aftereffect)
5. The roller support is primarily worn in the middle

BOSCH

4) Component sensitivity

[redacted]

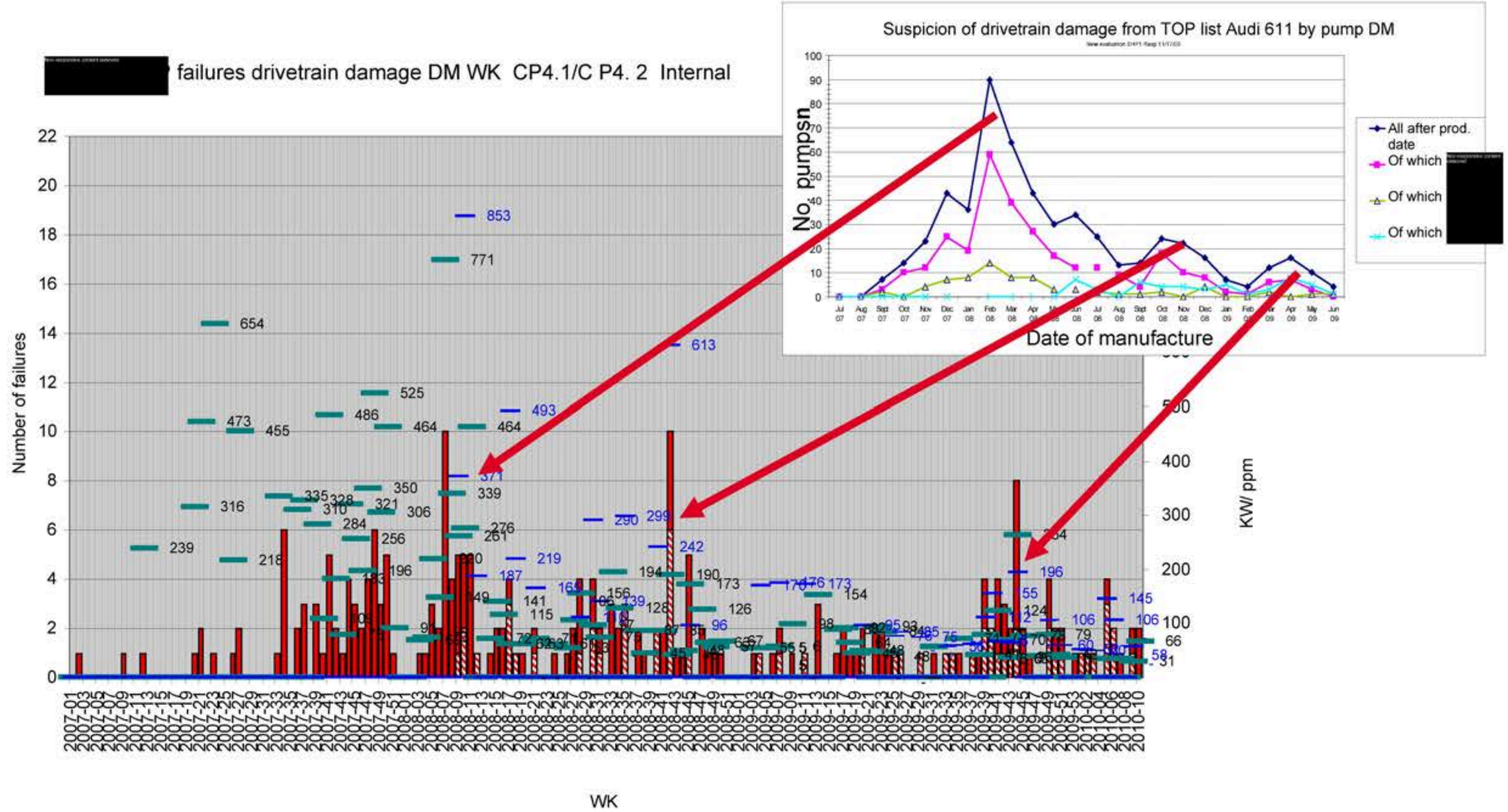


BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Overview of failures, internal test bench & Field [redacted] (failure peaks)



-> Increased internal test bench failures correlate with increased field failures

BOSCH

Status Task Force CP4

Component sensitivity

1. **Metal spatters in C3 coated roller support**

   Metal spatters 5/2008 highly reduced through optimization of plants.

   Sensitivity to small metal spatters with EN590/ BDF570 verified from 5/2008.

   Note: C2 does not have any metal spatters.

2. **Roller with fusing**

   To select rollers with fusing, the straightedge test was introduced in 5/2008.

   The conversion of the roller end coating to C2 in 5/2009 eliminated the fusing.

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

1. Test of component sensitivity

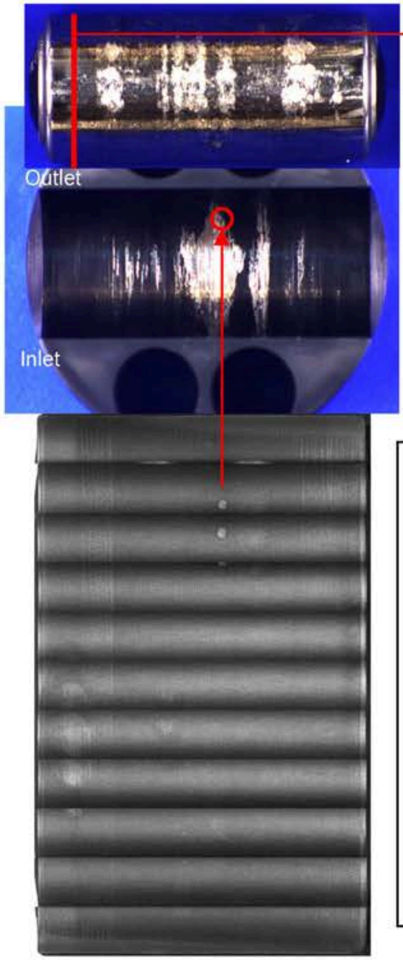
-> "Mixed friction" variant
-> 1x CP4.2, lift 5.25 mm (part no. ...617, VVT 2010-CP4_0065, ER 17319)
-> Arctic Diesel Class 4, 90° inlet temperature
-> 2,300 bar, 600 rpm (overload program)
-> Target: 15h run-in program (4,000rpm@2kbar) + 150h overload
-> C3 series RS, but with large metal spatters, i.e. scrap under current visual inspection
->Roller with fusing
->Failure after approx. 13 min. in run-in program with Arctic Diesel

BOSCH

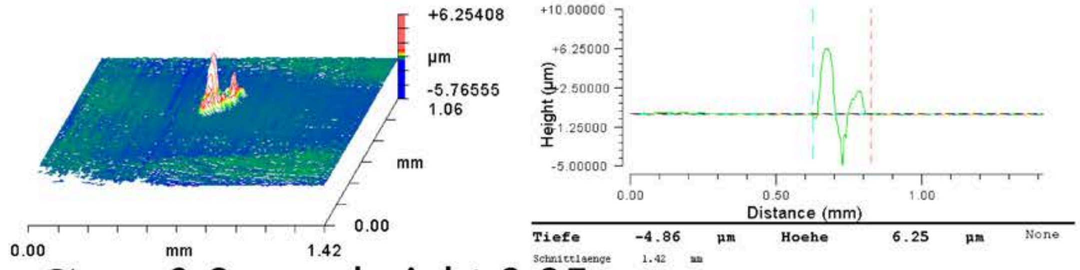
ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Tappet left RS 2949; roller 15

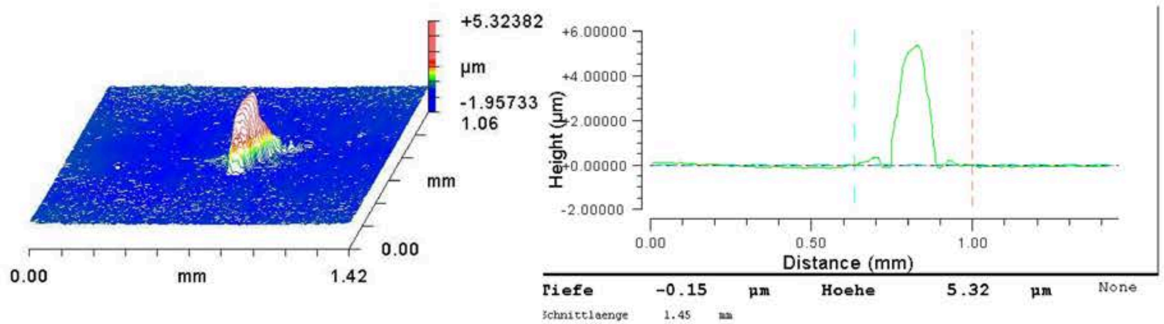


Location of fusing in roller end taper



∅□ ~ 0.2mm ; height 6.25µm

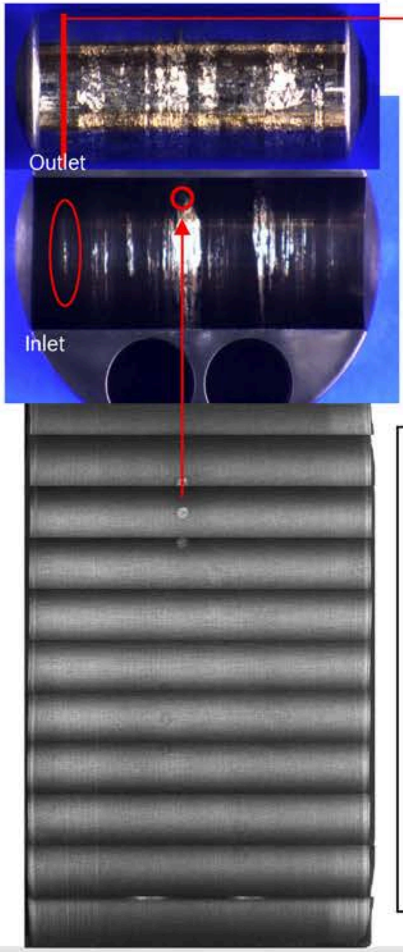
Metal chips in the roller support



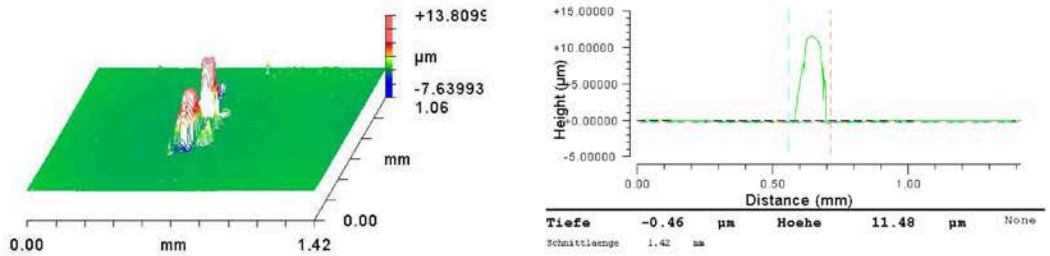
∅□ ~ 0.2mm ; height 5.32µm

BOSCH

Tappet right RS 5794; roller 07

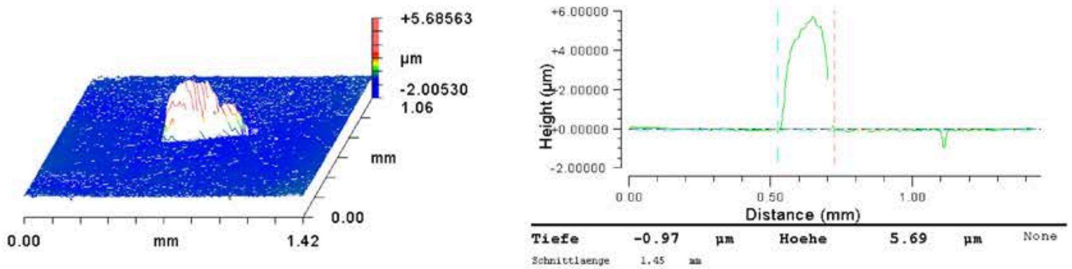


Location of fusing in roller end taper



Ø□ ~ 0.3mm ; height 11.48µm

Metal chips in the roller support



Ø□ ~ 0.2mm ; height 5.69µm

Status Task Force CP4

2. Test of component sensitivity

-> "Staged test" variant

-> 1x CP4.2, lift 5.25 mm (part no. ...617, VVT 2010-CP4_0066, ER 17320)

-> Run-in + two steps (target program):

- Run-in: 15h, 3000 rpm, 1300 bar, EN590, 40°
- Step 1: CER, 200h, 3000 rpm, 1300 bar, EN590, 40°
- Step 2: CER, 150h, 600 rpm, 2300 bar, Arctic Diesel Cl. 4, 90°

-> C3 series RS, but with small metal spatter, i.e. scrap under visual inspection

-> Roller with fusing

-> Run-in + step 1 - EN 590 200h positive

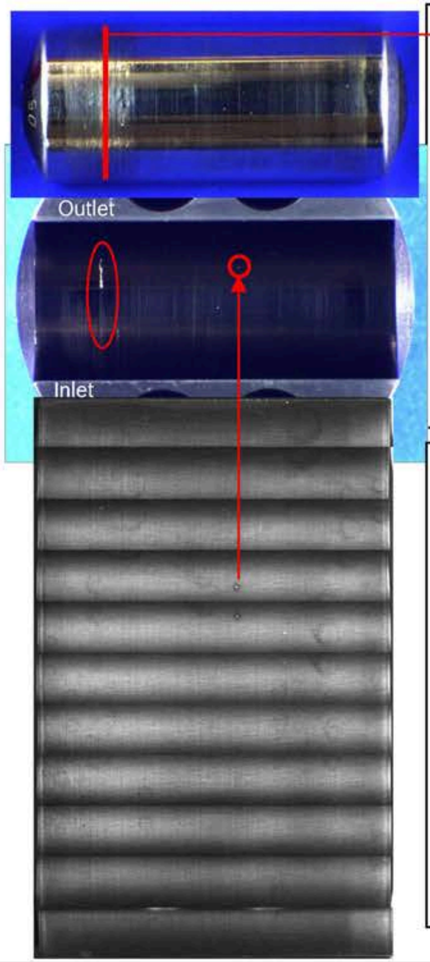
-> Failure after approx. 2h in step 2 after change from EN590 to Arctic Diesel

BOSCH

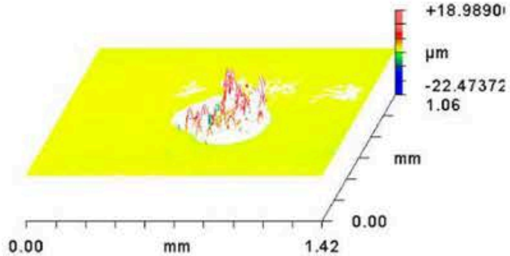
ENTIRE PAGE CONFIDENTIAL

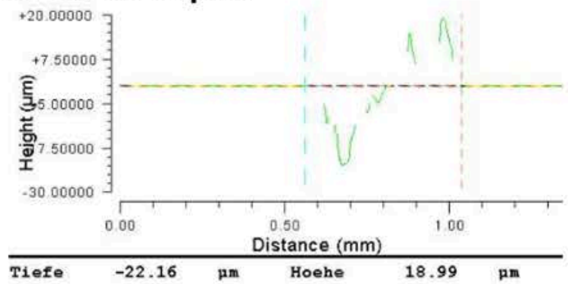
Status Task Force CP4

Tappet left RS 3566; roller 05



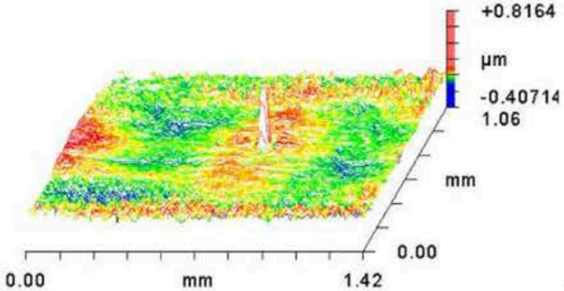
Location of fusing in roller end taper

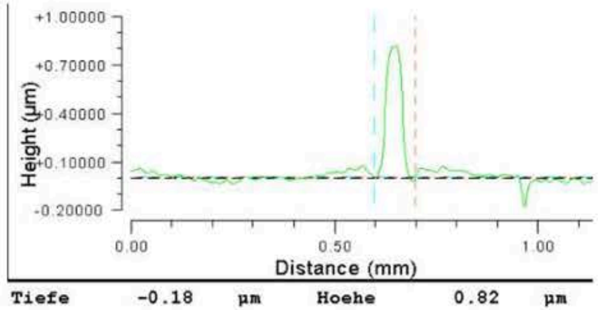




Ø ~ 0.5mm ; height 18.99µm

Metal chips in the roller support





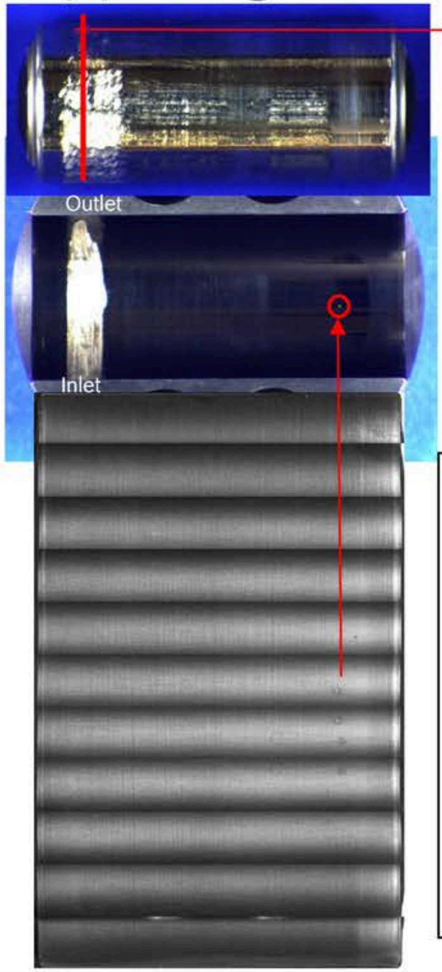
Ø ~ 0.1mm ; height 0.82µm

BOSCH

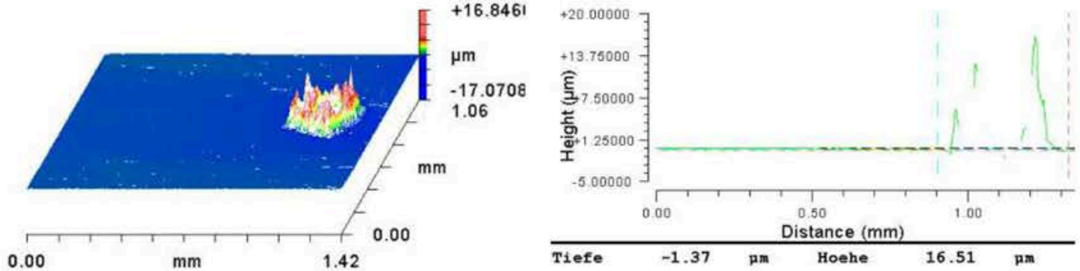
ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Tappet right RS 3874; roller 11

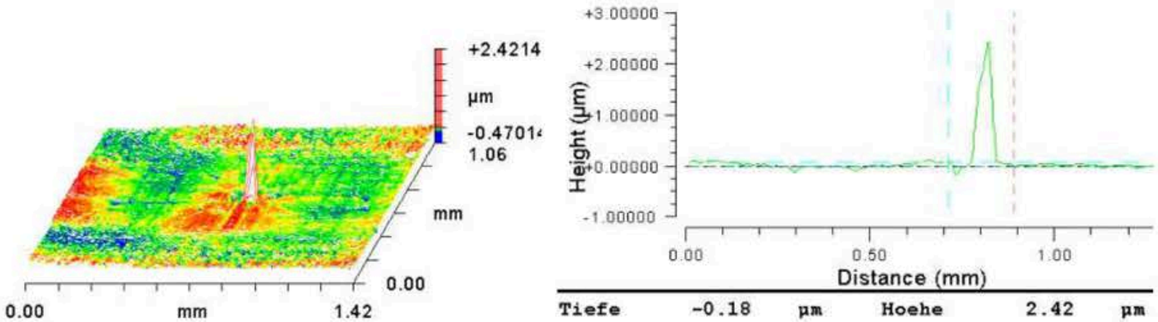


Location of fusing in roller end taper



Ø ~ 0.3mm ; height 16.51µm

Metal chips in the roller support



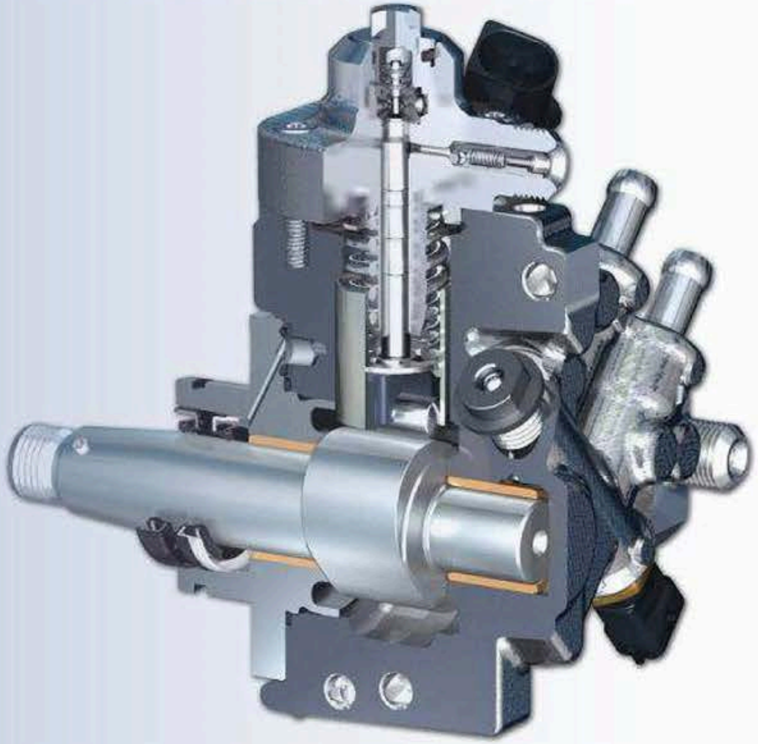
Ø ~ 0.2mm ; height 2.42µm

BOSCH

ENTIRE PAGE CONFIDENTIAL

5) Good pumps from [redacted]

[redacted]



Diesel Systems

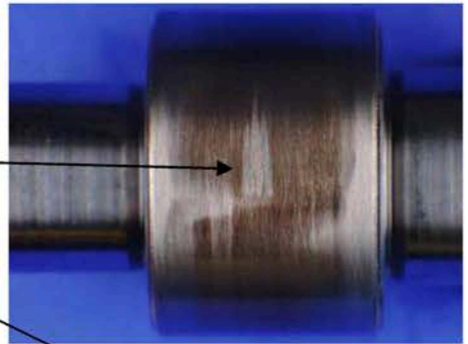
TF AUDI [redacted] Good pump (2009-CP4_0685)

5,125 km (no failure)

Summary analysis results

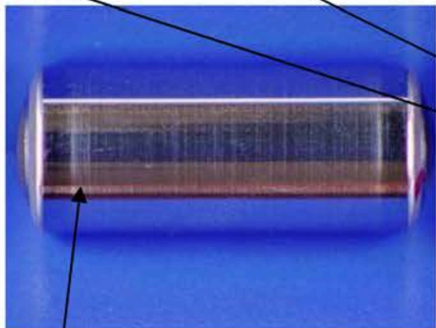
-> Transfer of material from roller to cam

-> Braking flat from non-starter

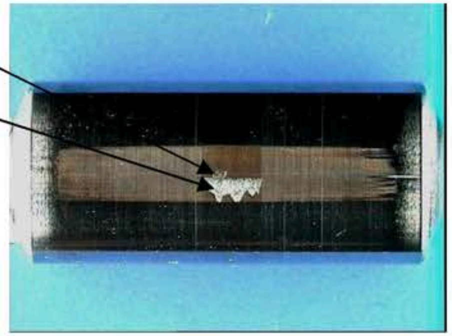


Interpretation:

Sluggish roller @ engine start



Left roller



Right roller

Edge wear

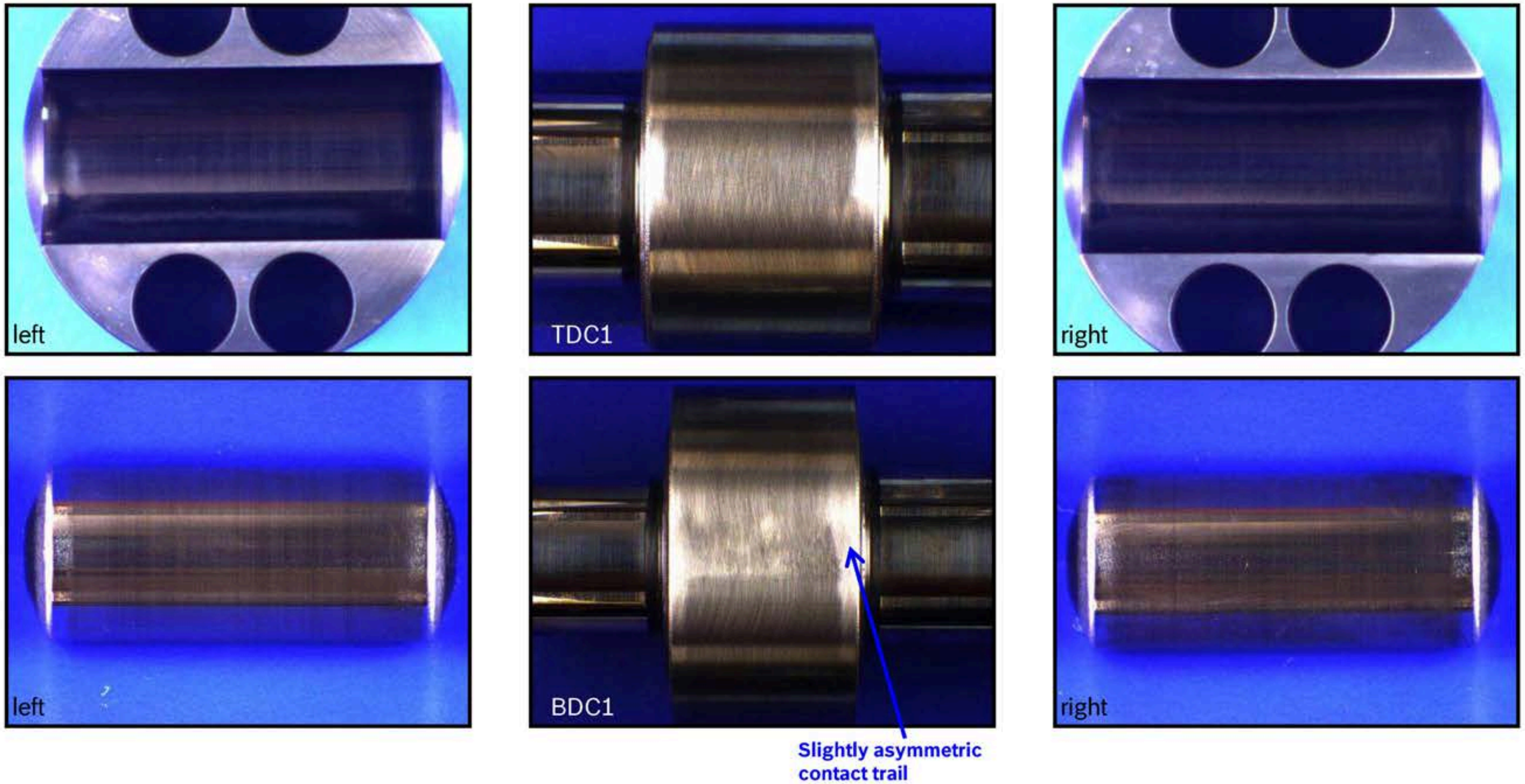
6 of 13 good pumps from [redacted] have the same symptoms.
Preliminary damage does not necessarily result in failure (failure primarily due to con-tinued driving with poor fuel).
Experience from initial reappear tests.

BOSCH

ENTIRE PAGE CONFIDENTIAL

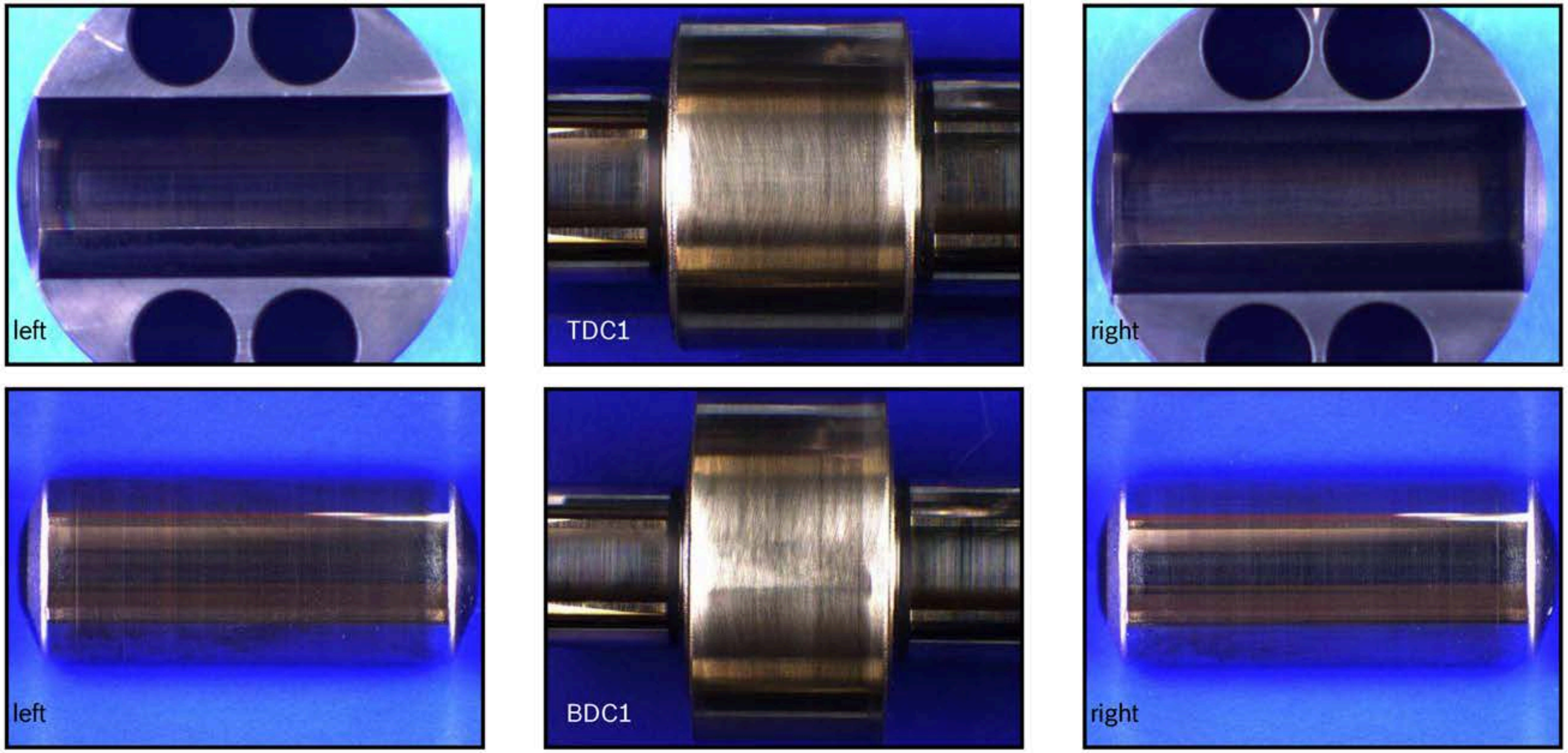
Status Task Force CP4

2010-CP4_0045 "Good pump" field [redacted] with 39,701km (vehicle 4L69D 007303) 0445 010 611; DM: 6/18/2008; Ch. index 0010



Status Task Force CP4

2010-CP4_0046 “Good pump” field [redacted] with 22,751km (vehicle 4L99D 006730) 0445 010 611; DM: 06/16/2008; Ch. index 0010

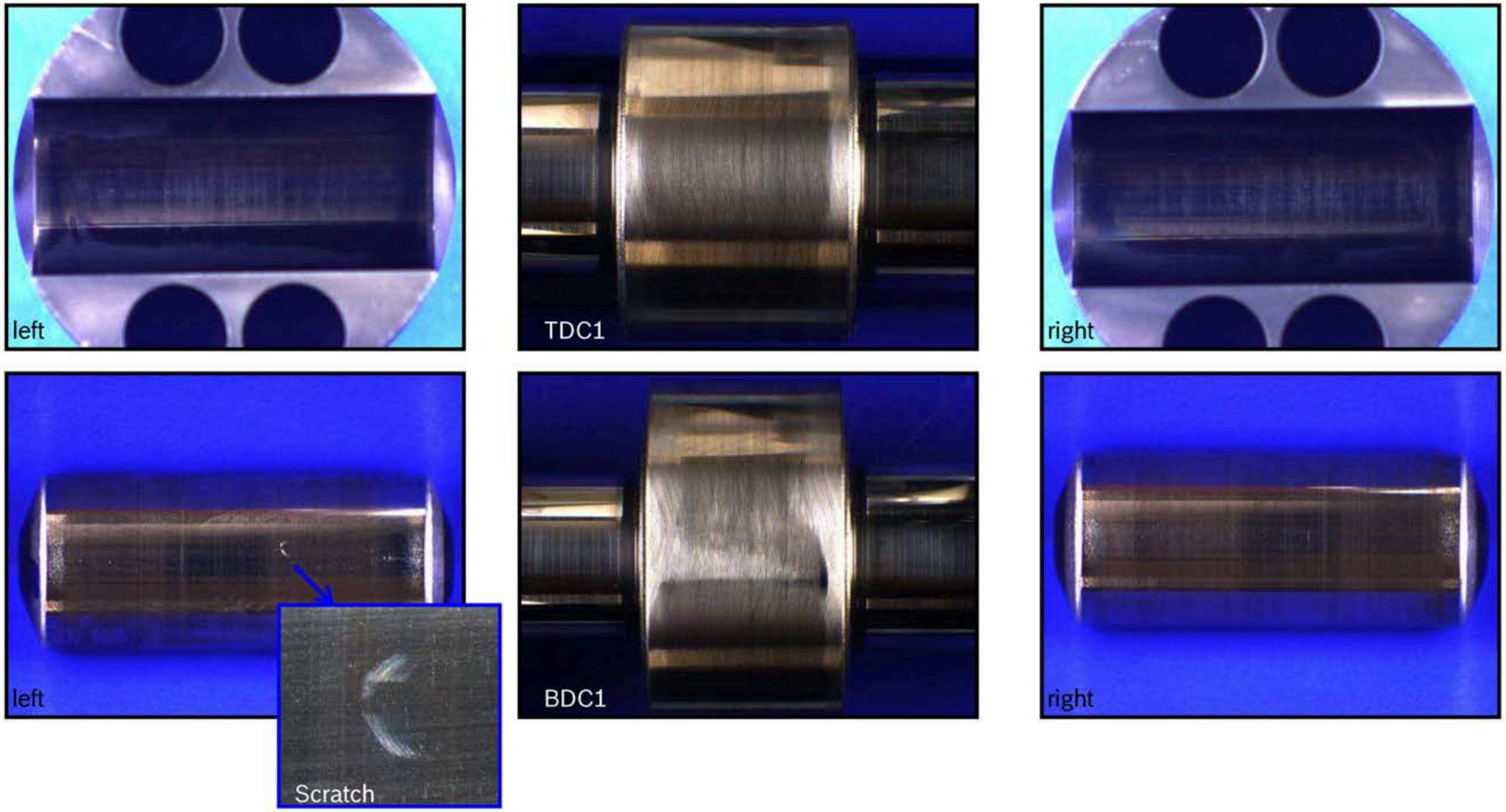


Diesel Systems

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

2010-CP4_0047 "Good pump" field Non-responsive content removed with 29,537km (vehicle 4L19D 016121) 0445 010 611; DM: 8/4/2008; Ch. index 0010

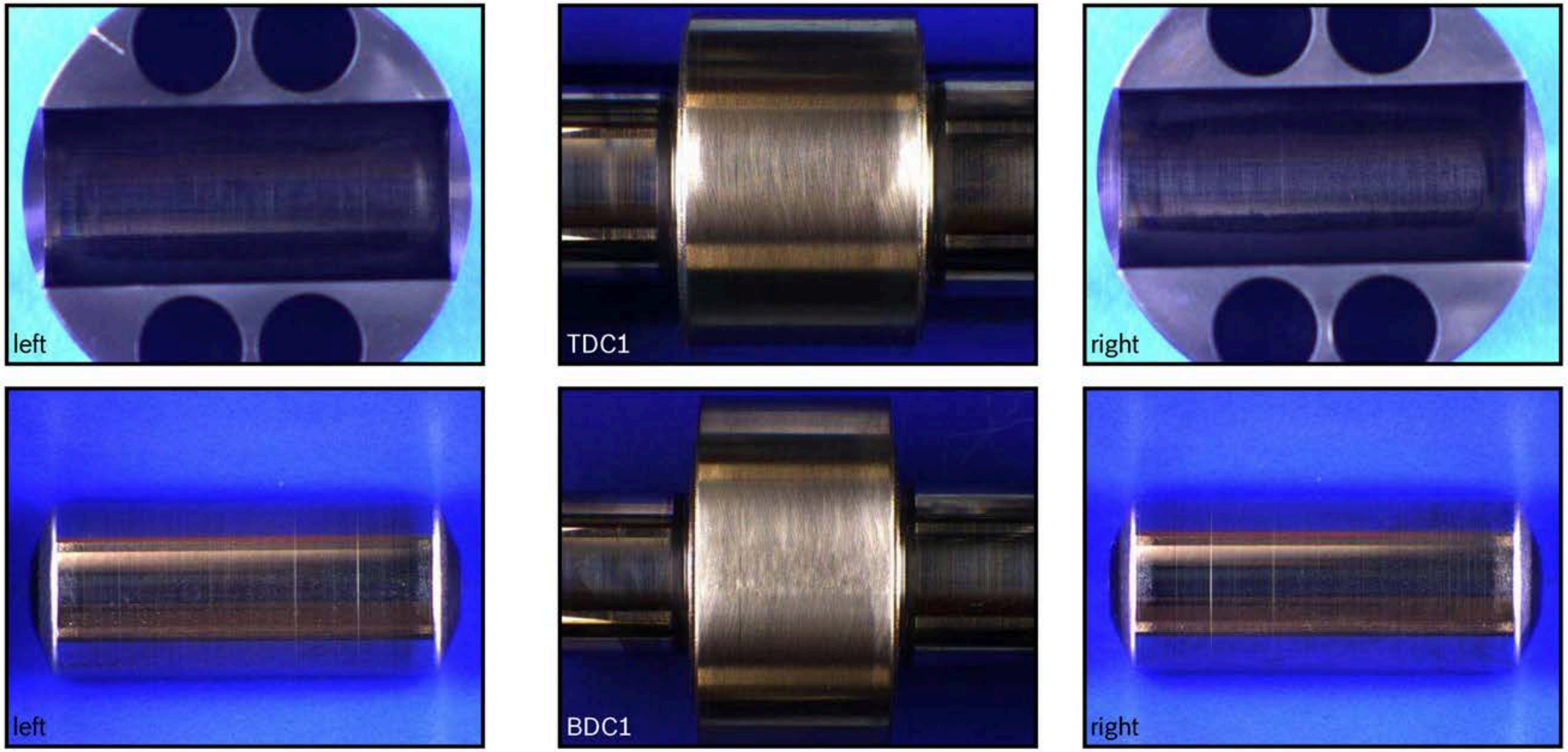


BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

2010-CP4_0048 "Good pump" field [redacted] with 60037km (vehicle 4L89D 006380) 0445 010 611; DM: 6/12/2008; Ch. index 0010

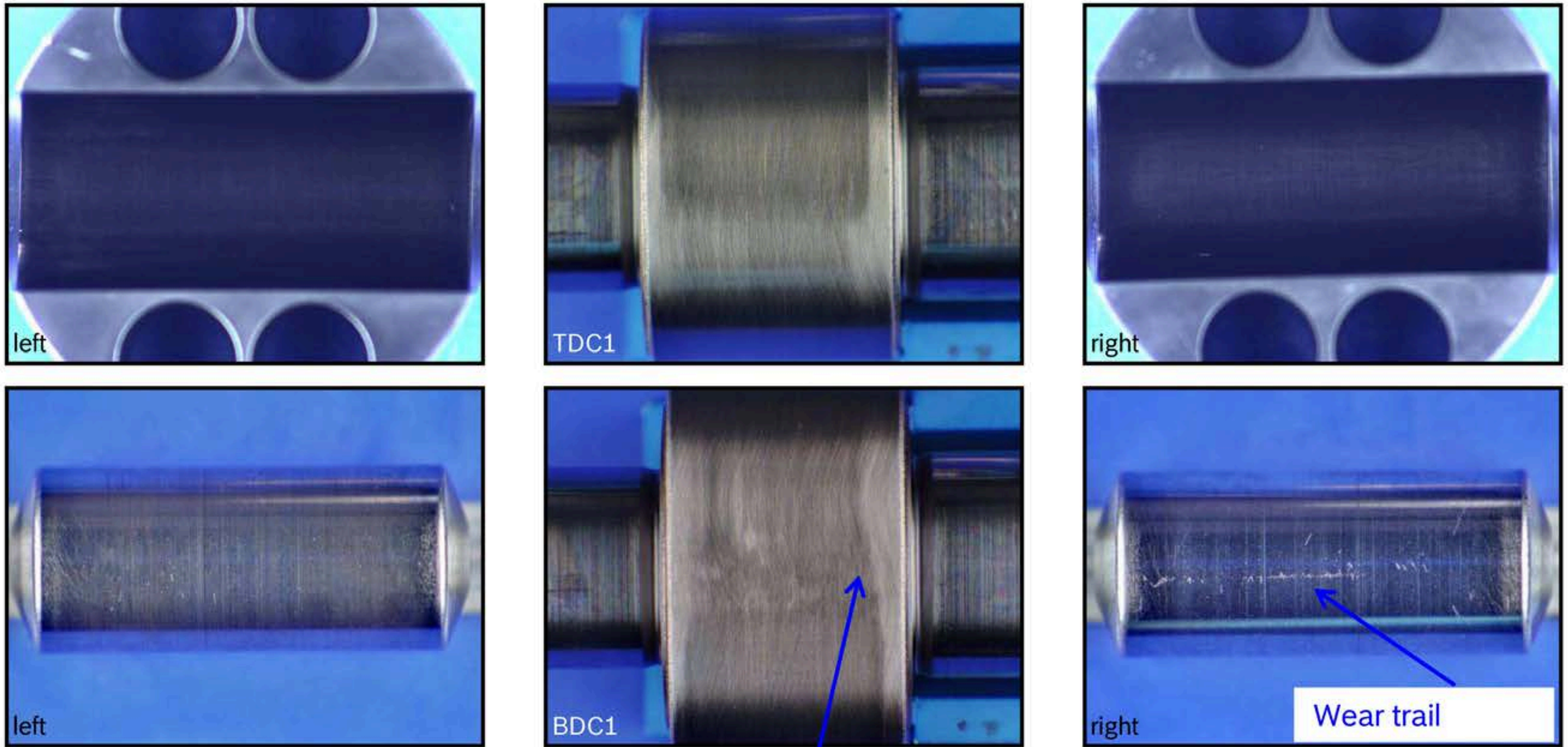


BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

2010-CP4_0062 "Good pump" field [redacted] with 39,967km (vehicle 4L49D 009440) 0445 010 611; DM: 6/28/2008; Ch. index 0010



BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Field failure Audi W26 after 1596 km in Non-responsive content removed

1) Failure pump: **2010-CP4_0013** (QMM 4A236) on bench 1
   0445010619 LW; line 01; DM 090624; ser. no. 1403;
   Ch. index 0003 (-> Roller end C2.1)

   ->Drivetrain damage

   - Complete camshaft, roller, RS wear
   - no final 90° turn
   - Corrosion on intake valve plate left

2) Sibling pump on bench 2: 2010-CP4_0014 (QMM 4A237)
   0445010619 LW; line 01; DoM 090505; seq. no. 0677;
   Ch. index 0002 (-> Roller edge C3)

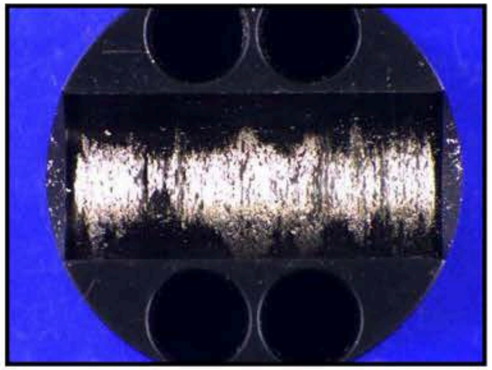
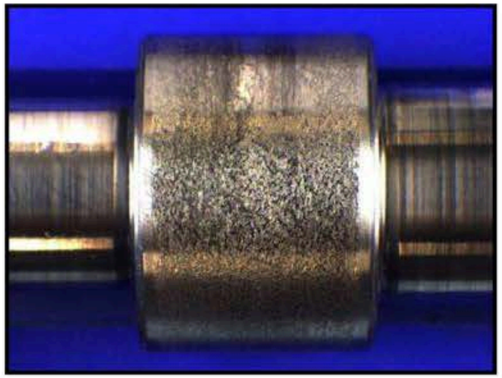
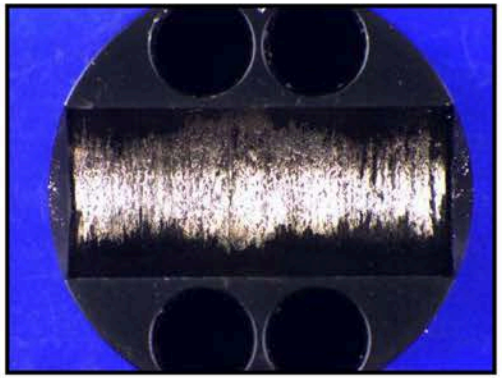
   -> No drivetrain damage, but preliminary damage

   - Braking flat on the roller
   - tracks indicating a turned tappet assembly
   - Corrosion on roller

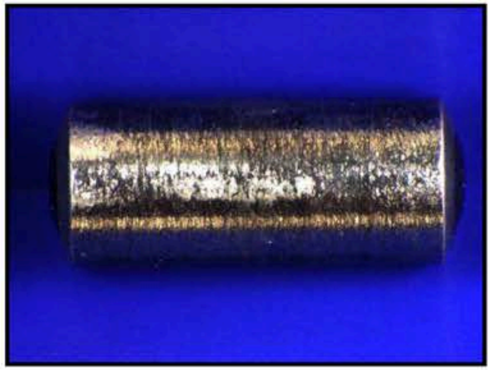
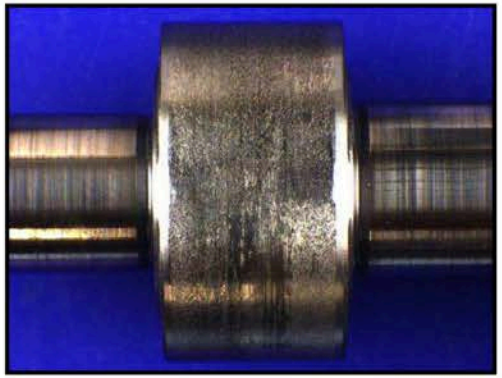
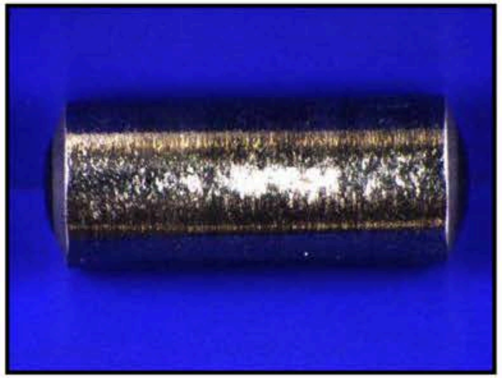
ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Field failed pump **W26** (bench 1) from [redacted] 2010-CP4_0013 (QMM 4A236)

Complete abrasive wear

BOSCH

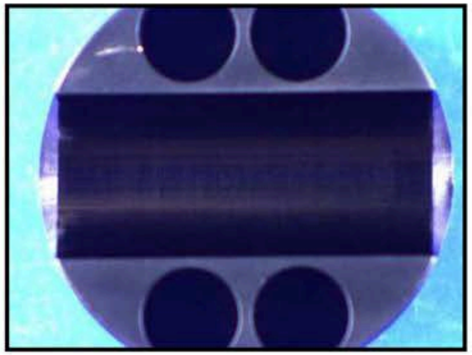
ENTIRE PAGE CONFIDENTIAL

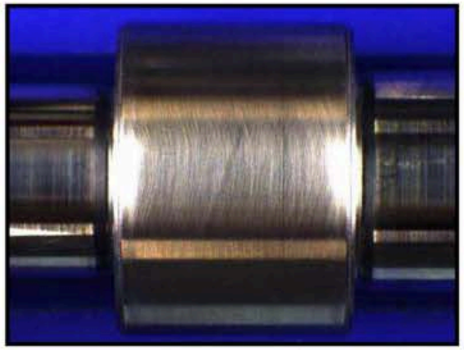
Status Task Force CP4

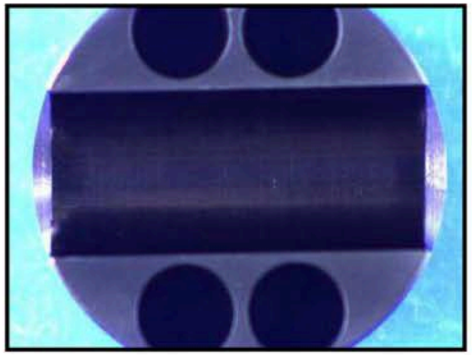
Sibling pump **W26** (bench 2) from Non-responsive content removed 2010-CP4_0014 (QMM 4A237)

Left tappet assembly

Right tappet assembly

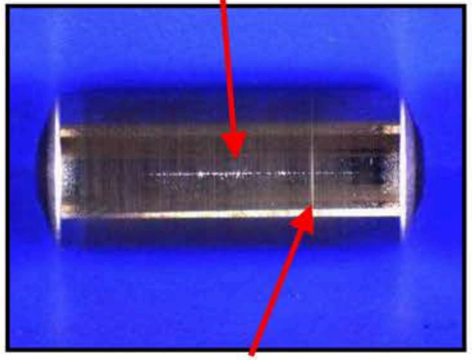


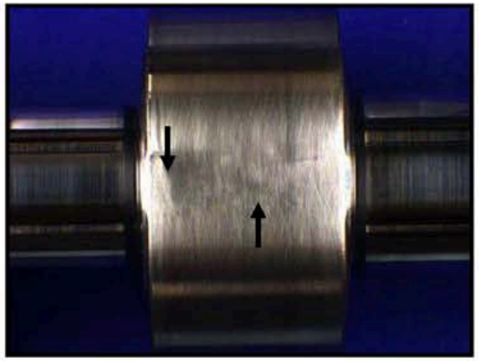


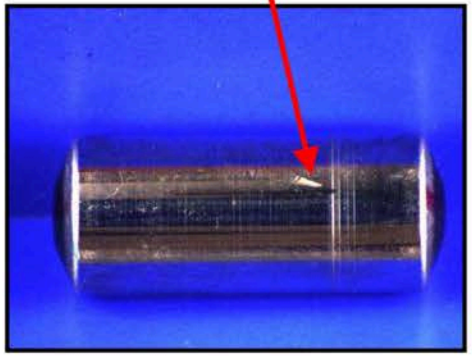


Braking flat

Abrasive wear







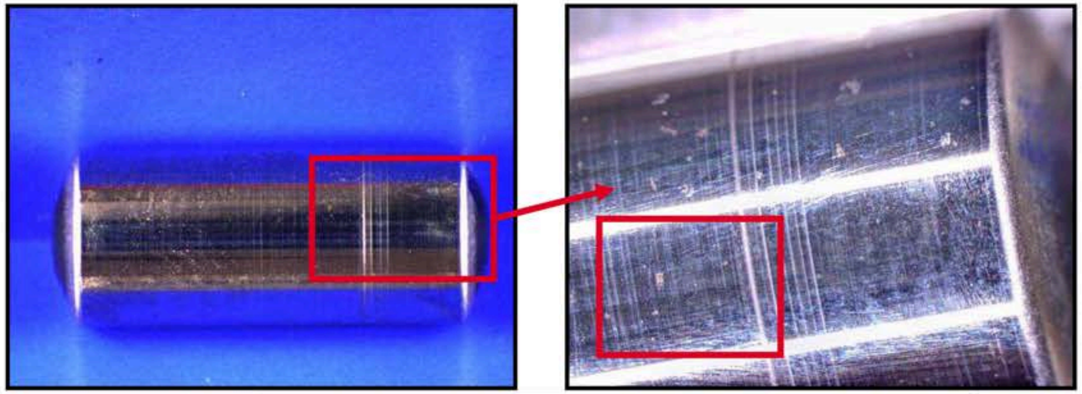
Particle wear

BOSCH

ENTIRE PAGE CONFIDENTIAL

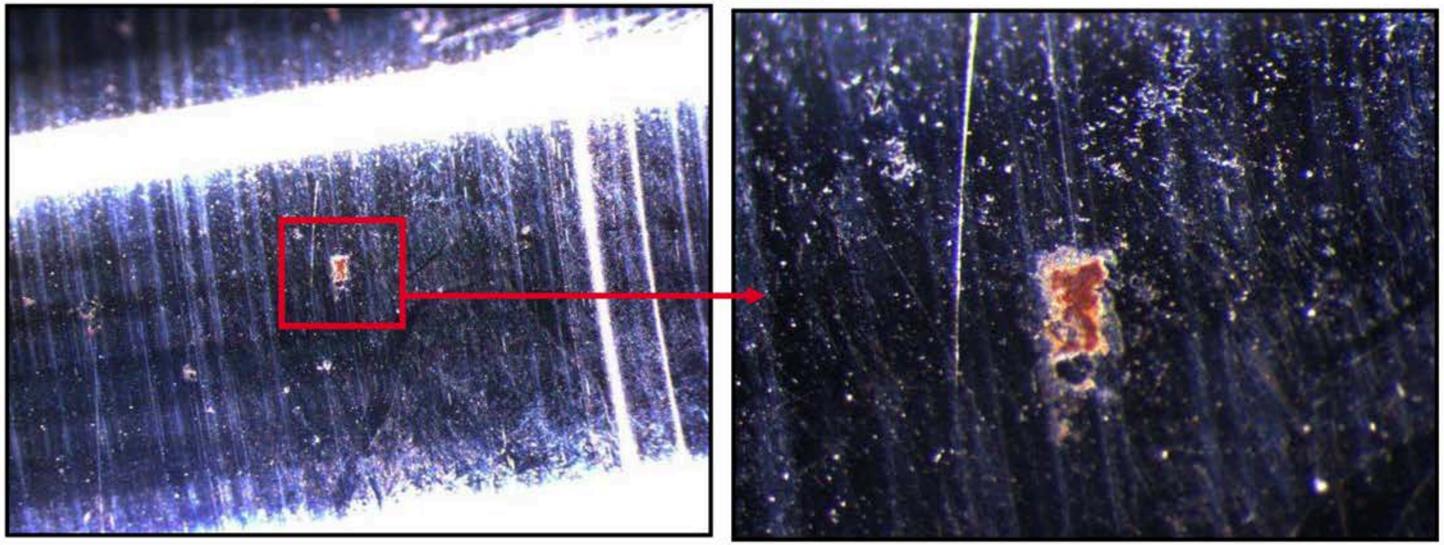
Status Task Force CP4

Sibling pump **W26** (bench 2) from [redacted] 2010-CP4_0014 (QMM 4A237)



Right roller

Corrosion in numerous places



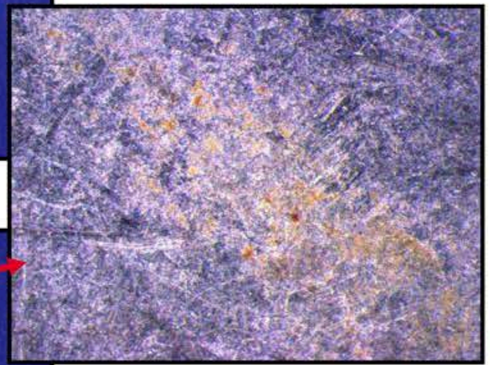
BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

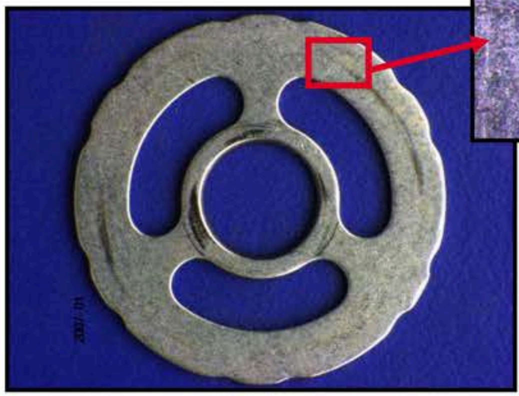
Sibling pump **W26** (bench 2) **from** Non-responsive content removed 2010-CP4_0014 (QMM 4A237)

Spring set



Brownish fuel deposits

Piston set



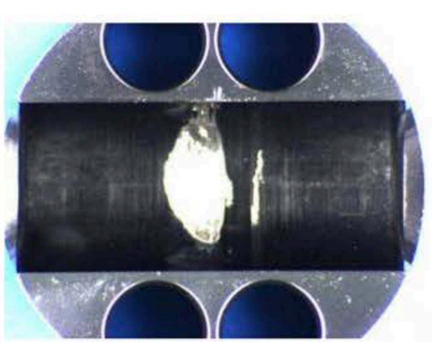
left

right

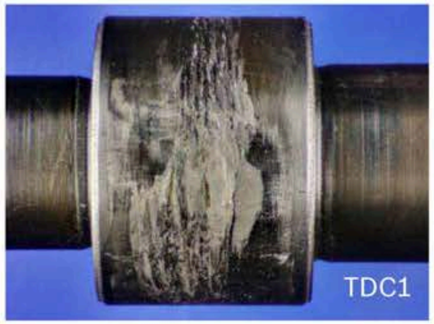
ENTIRE PAGE CONFIDENTIAL

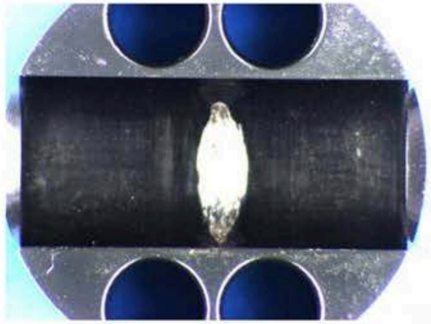
Status Task Force CP4

2010-CP4_0051 field failed pump **W26** [redacted] 22,270 km (vehicle) 0445 010 619; DM: 10/13/2008



left





right

left

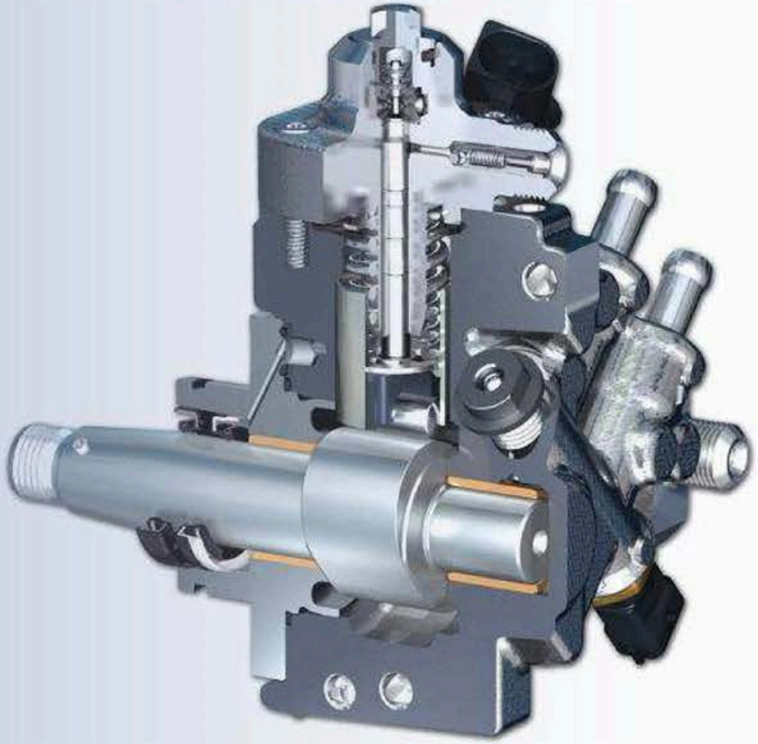
right

BOSCH

ENTIRE PAGE CONFIDENTIAL

6) Hypotheses for [redacted]

[redacted]



Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Possible sequence of damage (fuel aging with the presence of water)

Chemical interrelationships: see next page

Causal chain

Deposit formation biodiesel

Reactive components in the fuel (additive, acid + water)

Hard / gel-like deposits

Deposits between roller/ RS -> roller seizing up

Roller standstill

Macroscopic sliding of roller (slippage)

Indicators

FAME indicators, biodiesel deposits proven

Indicators of corrosion/**water** free water in fuel sample

Bruss shaft seal very worn

Sugar solution, fuel residuals, glycerin, algae, cellulose fibers

Spring plate 360° worn, CH support surface 360° worn Skew tracks on cam

- Material transfer on cam (adhesion) - medium wear roller and RS

- Abrasion on roller
- Wear on RS with pressing profile

Number of pumps from [redacted]

11 of 54 pumps
3 of 24 pumps

45 of 54 pumps
4 of 24 pumps

17 of 17 pumps

9 of 24 pumps

27 of 39 pumps
44 of 103 roller supports

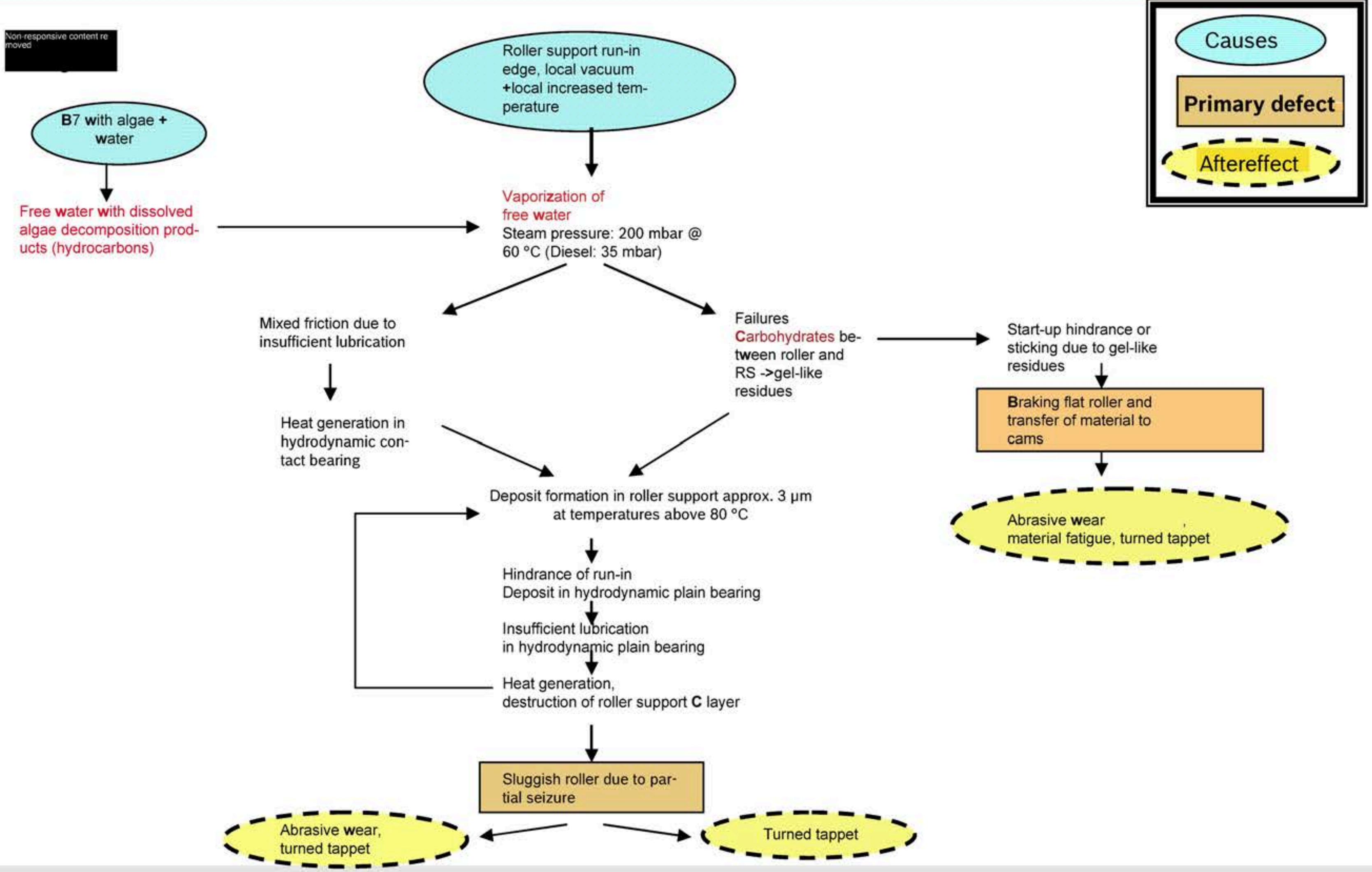
53 of 103 rollers 26 of 103 roller supports

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Non-responsive content removed



Diesel Systems

BOSCH

Differences between CP4.2 and CP4.1

Deposits in roller support arise at increased temperatures.

Causes:

- Through additives at temperatures approx. 140°C
- Through hydrocarbons (algae residues) dissolved in water approx. 80-100°C

Increased temperatures in roller support result from mixed friction.

Causes:

- Fuel influence (viscosity / lubricity / steam pressure)
- Insufficient lubrication (steam pressure increased in presence of kerosene, gasoline, water)

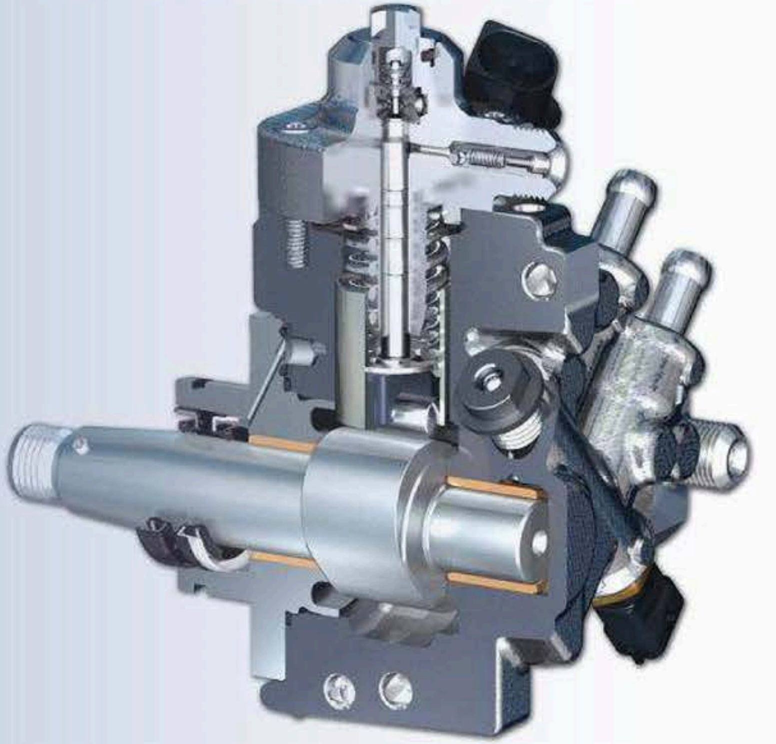
Why is temperature in roller support higher with CP4.2 than with CP4.1?
Why is temperature in roller support higher with ccw than with cw?
Differences must be sought in design & application.

BOSCH

ENTIRE PAGE CONFIDENTIAL

7) Comparison CP4.2 vs. CP4.1

[redacted]



BOSCH

Status Task Force CP4

For the CP4.2, the following picture is derived from good pumps with preliminary damage

	[redacted]	[redacted]	
W19	4 of 6 right 1 of 6 both sides 1 of 6 left	1 of 2 right	CW
W26		1 of 2 left	CCW

-> The right roller support is primarily affected

-> Disadvantage of the CP4.2 on the right roller support due to "shadowing" of the cam movement

-> This shadowing is not present in the CP4.1 due to handles

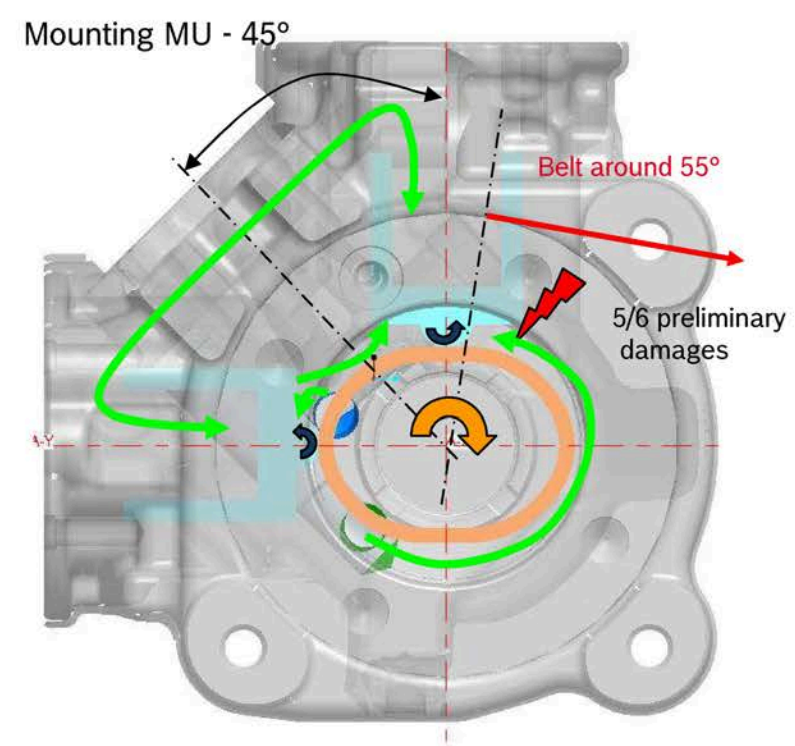
BOSCH

Comparison of geometry CP4.2 to CP4.1

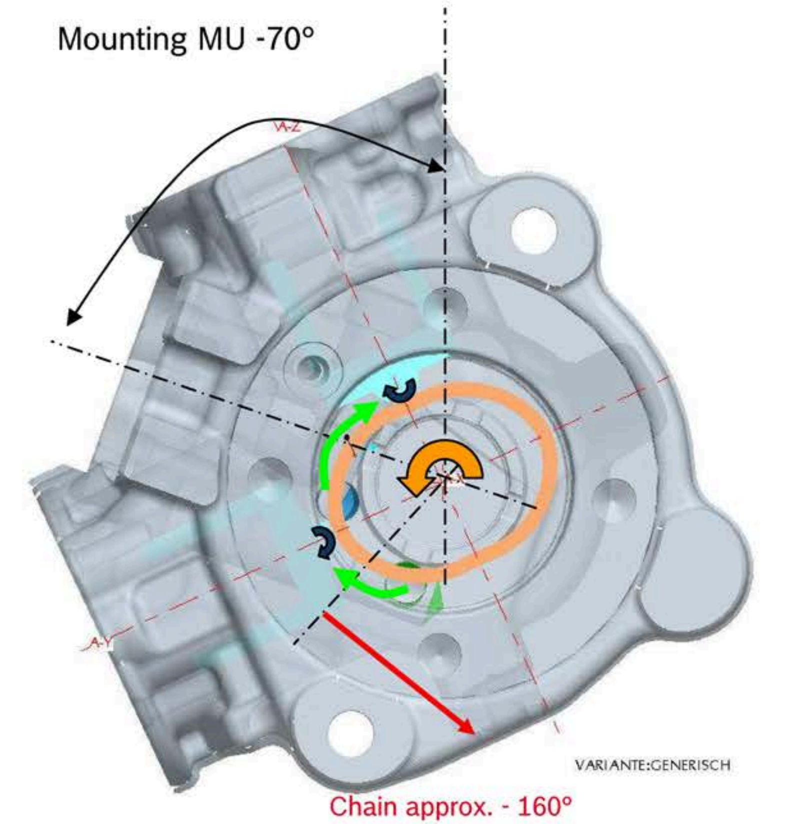
1. Design comparison (inlet/return position)
2. High-speed film (steam pressure)
3. Steam pressure curves
4. Application comparison (inlet/return pressure)

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4



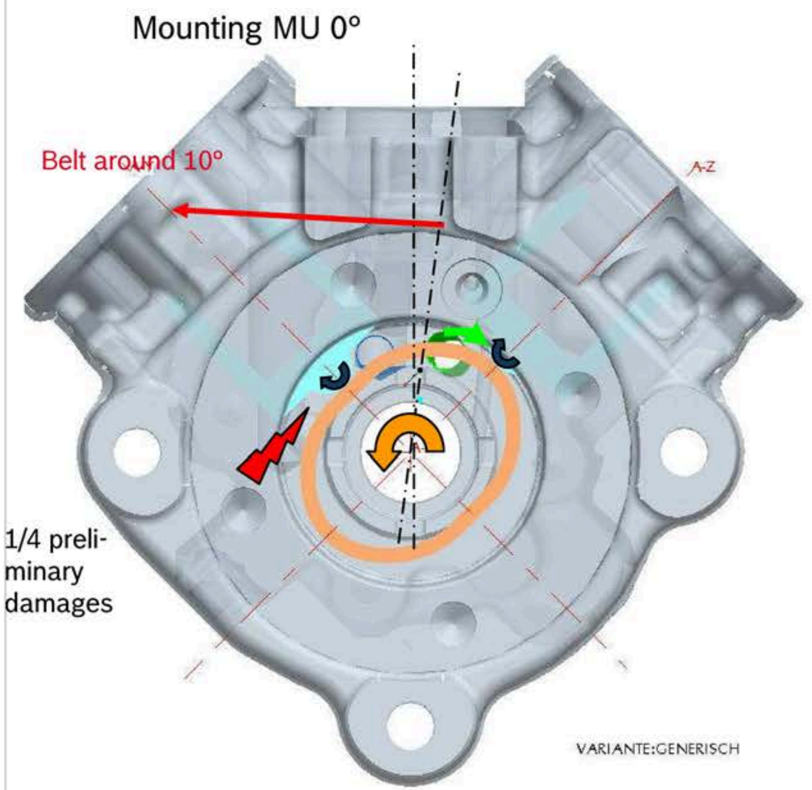
CP4.2 EFP cw Audi 0 445 010 611 (W19)

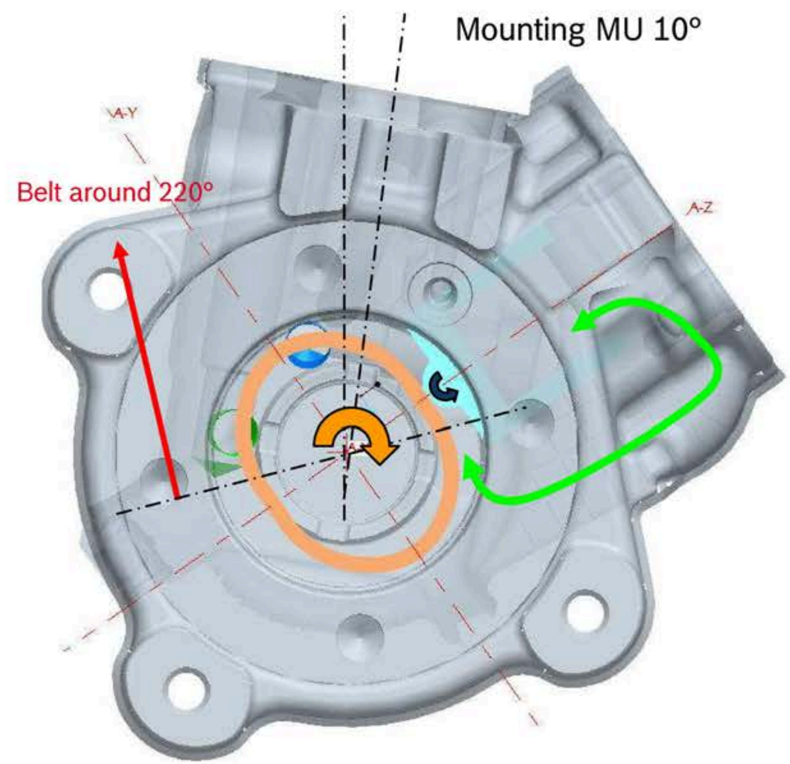


CP4.2 EFP ccw BMW 0 445 010 6xx

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

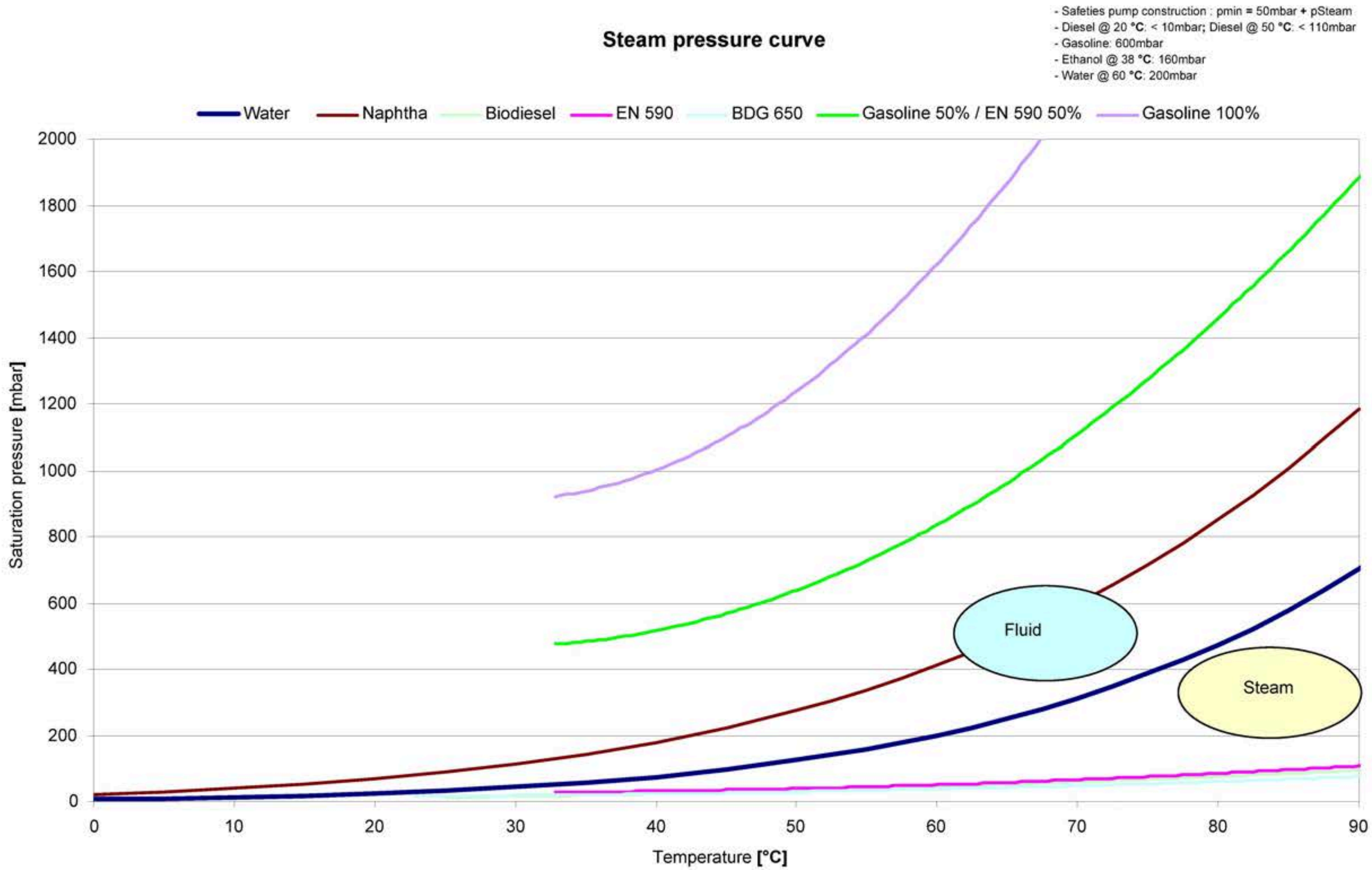




CP4.2 GP ccw Audi W26/W24	CP4.1 EFP cw VW / Audi

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4



Diesel Systems

BOSCH

Status Task Force CP4

3. Application comparison

Comparison of **inlet/return** pressure and **differential pressure** via the pump

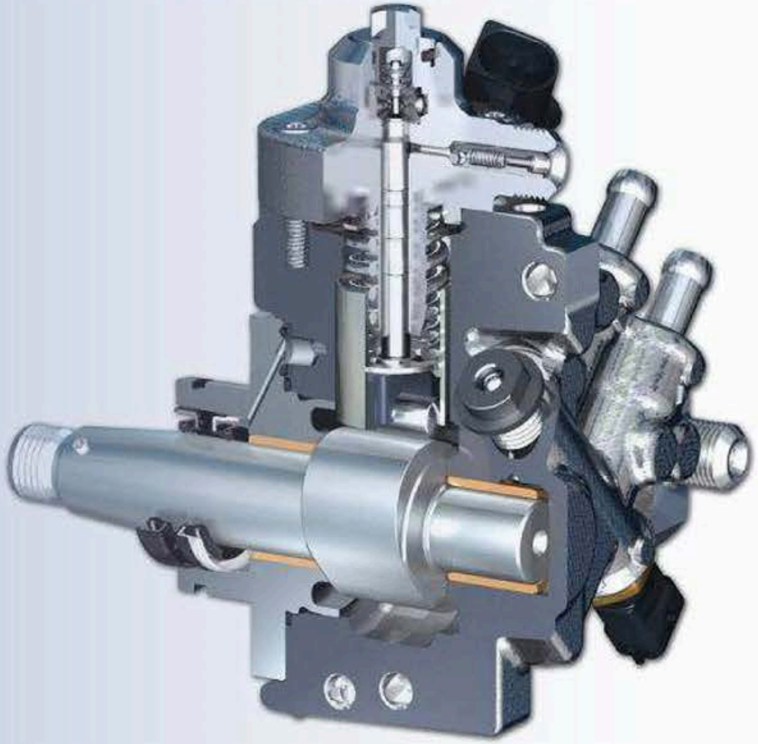
1) W19 vs. W26 (mech. supply pump)
2) W19 vs. W24
3) W19 vs. R4 with CP4.1 in B8 (with inline EFP)
3) W19 vs. W19 with 6 bar low-pressure circuit (non-restricted pump return)
4) W19 vs. BMW N57 (inlet pressure-regulated)

BOSCH

ENTIRE PAGE CONFIDENTIAL

8) Possible measures: Anti-wear package 2

Non-responsive content removed



BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Anti-wear package 2 (RP2)

Objective

Improve start-up behavior of roller, improve robustness with regard to fuel components with lower boiling points (high steam pressure/ absolute)

Characteristics in examination and assessment

- Roller support with reduced wrap angle
- Position-optimized inlet bore (CP4.2 cw vs. CP4.2 GP)
- Increase of pump interior pressure > 5 bar (overflow valve/governor)
- Cylindrical roller

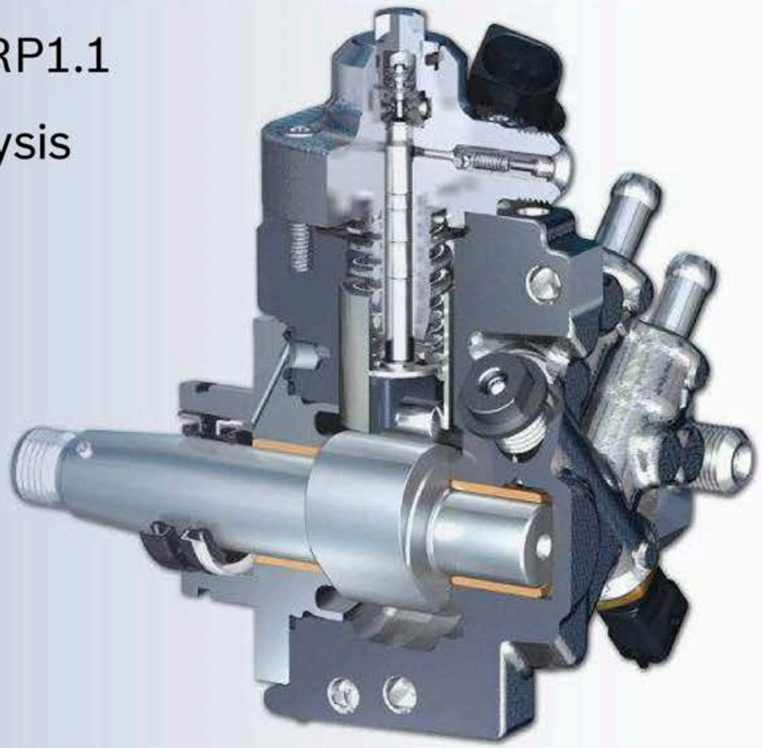
BOSCH

ENTIRE PAGE CONFIDENTIAL

9) Anti-wear package 1

[redacted]

1) Objectives & characteristics of RP1.1
2) Endurance run overview & analysis



Status Task Force CP4

1) Objectives & characteristics of anti-wear package 1.1

Objective

Increasing robustness of drivetrain through increase of lubricating film height between roller support bore and roller.

Features of anti-wear package 1.1

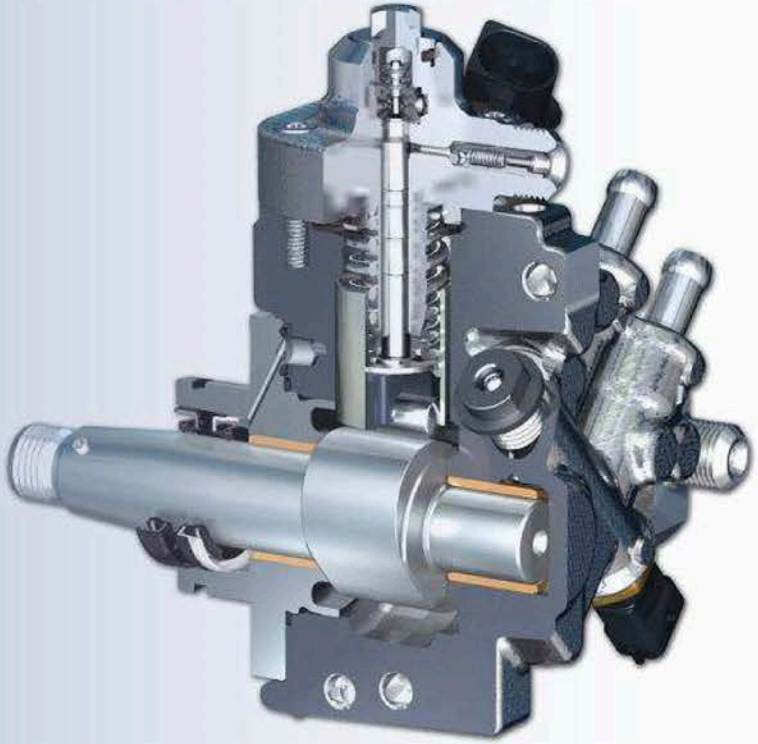
1) Reduction of roller support roughness in combination with change to C2 layer on roller support.
2) Reduction of roller play through smaller roller support bore
3) Reduced roller surface through opt. finishing process
4) Optimized definition of fine geometry (edge taper) of roller

BOSCH

ENTIRE PAGE CONFIDENTIAL

9.1) Robustness increase based on Stribeck curves

[redacted]



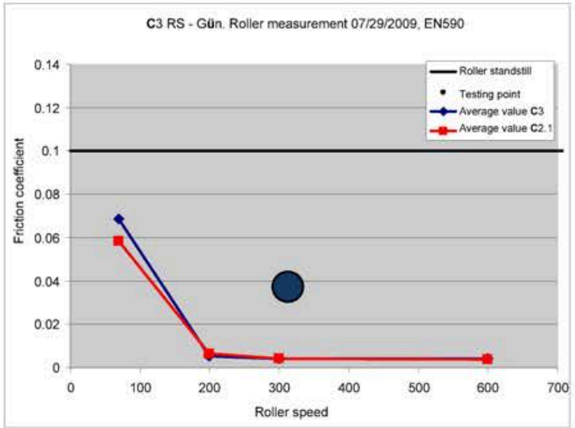
BOSCH

ENTIRE PAGE CONFIDENTIAL

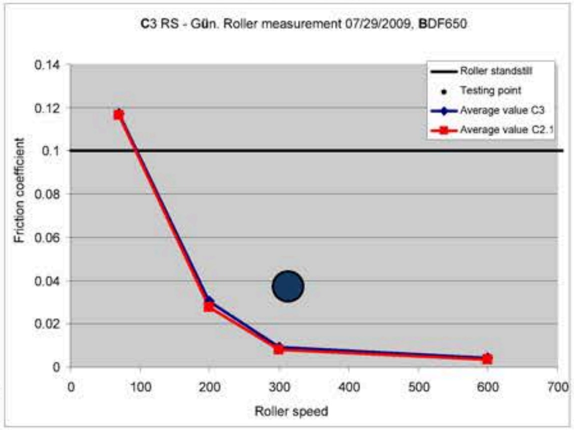
Status Task Force CP4

Comparison of layer system* C3-C2.1 on friction coefficient test bench with

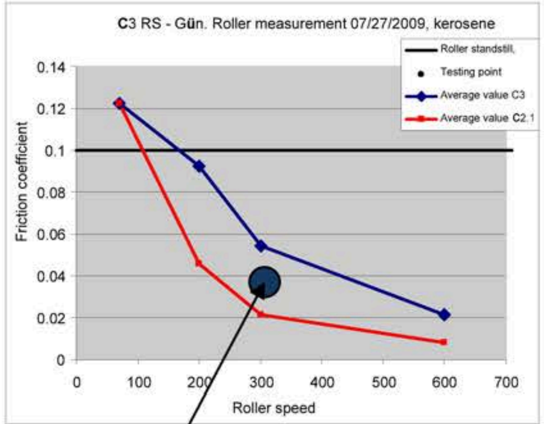
EN 590



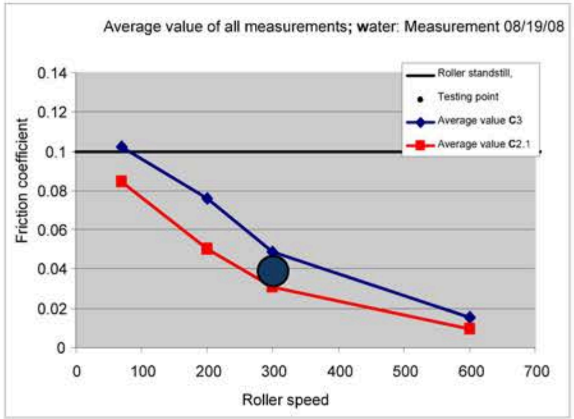
BDF 650



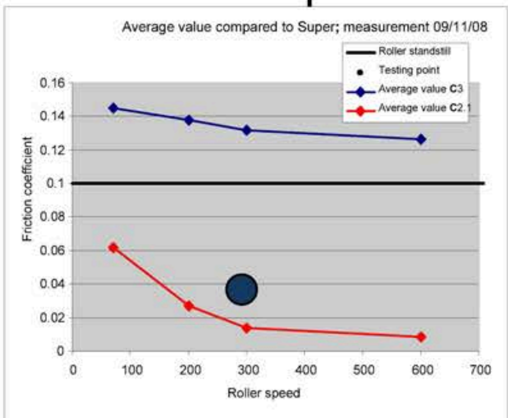
Kerosene



Water



100% Super



Assessment criterion:
friction coefficient

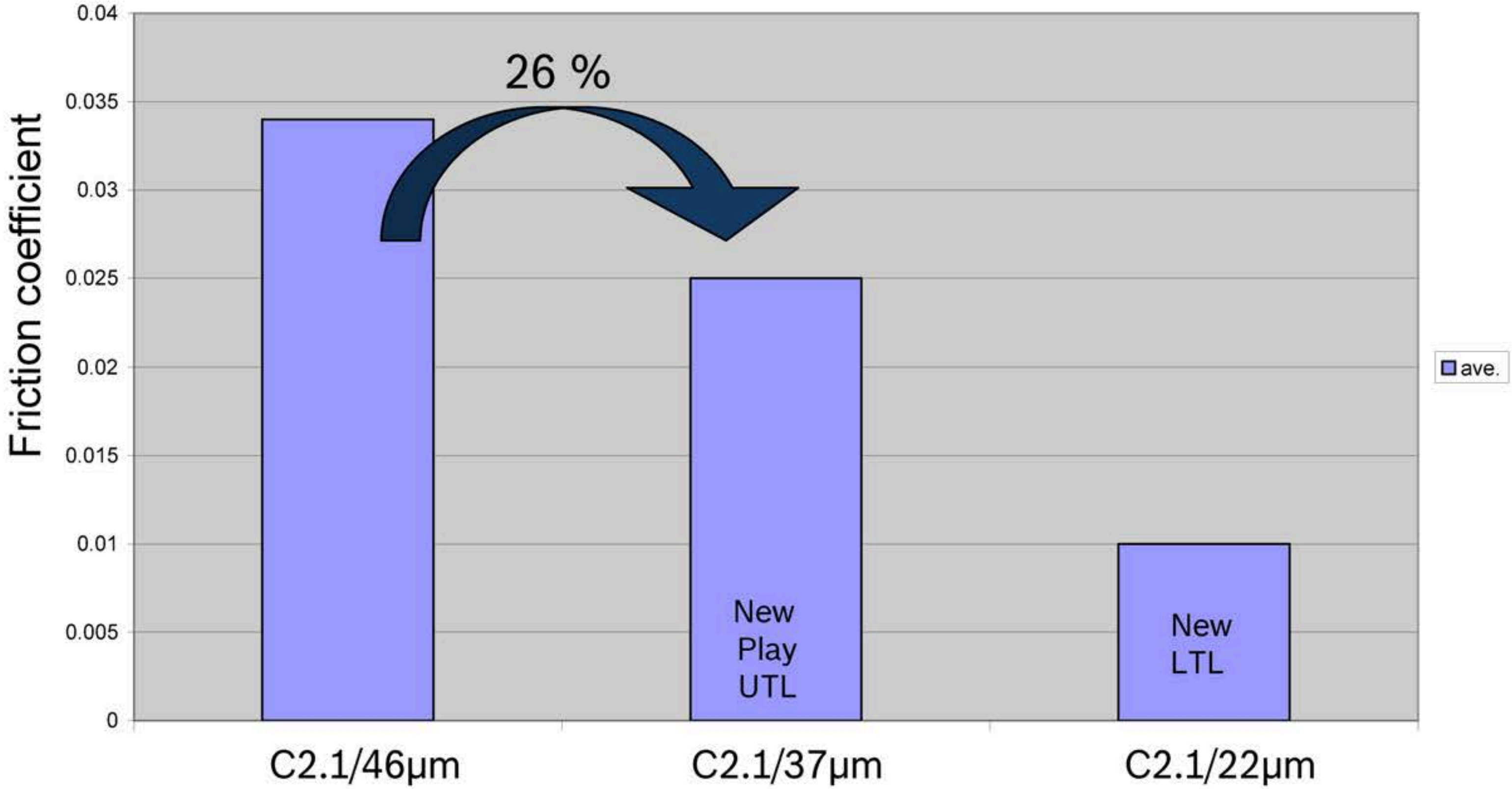
***average comparable play**

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Examination with viscosity 1.4mm²/s @40°C (Arctic Diesel)

Testing point 300rpm



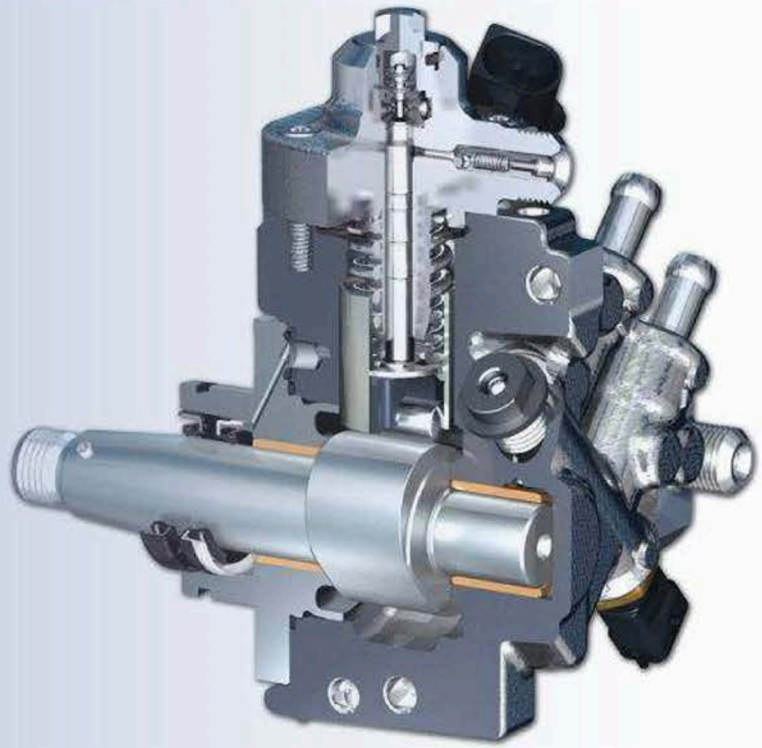
Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

9.2) Robustness increase based on endurance runs

[redacted]



BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Test parts and test conditions

C3 RS (tappet good and bad), Non-responsive content removed

- Tappet "good": Roller support without texture, roughness/play medium (2010-CP4_0727)
- Tappet "bad": Roller support without texture, roughness/play medium (2010-CP4_0728)

C2.1 RS (best parts), Non-responsive content removed

- Tappet "best": Low play approx. 24 µm, Rmr 0.1, depth>90%, Rv<0.2 (2010-CP4_0029)
- Tappet "best": Low play approx. 24 µm, Rmr 0.1, depth>90%, Rv<0.2 (2010-CP4_0030)

C2.1 RS (best parts), Non-responsive content removed

- Tappet "best": Low play approx. 18 µm, Rmr 0.1, depth>90%, Rv<0.2 (2010-CP4_0053)
- Tappet "best": Low play approx. 18 µm, Rmr 0.1, depth>90%, Rv<0.2 (2010-CP4_0054)

Overload test drivetrain CP4 Non-responsive content removed

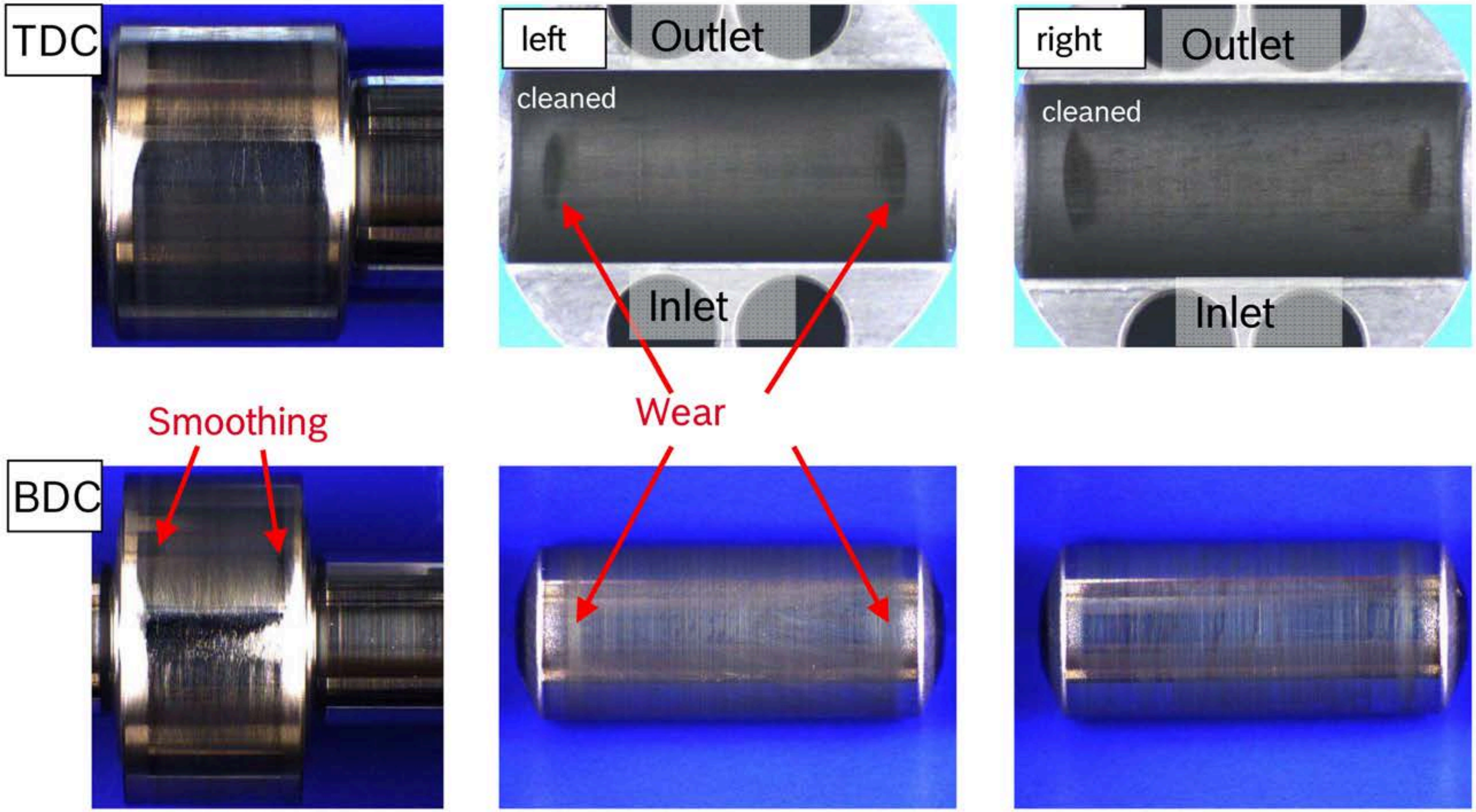
-> Basic pump 0445010617

-> Variant 1: Mixed friction at low RPMs

- Run-in program (15 h, 4,000 rpm, 2,000 bar, 40°C, Arctic Diesel Cl. 4.
- Endurance run program (150 h, 600 rpm, 2,300 bar, 90°C, Arctic Diesel Cl. 4.

BOSCH

Pictures RS L C3 good 35 µm (2010-CP4_0727)

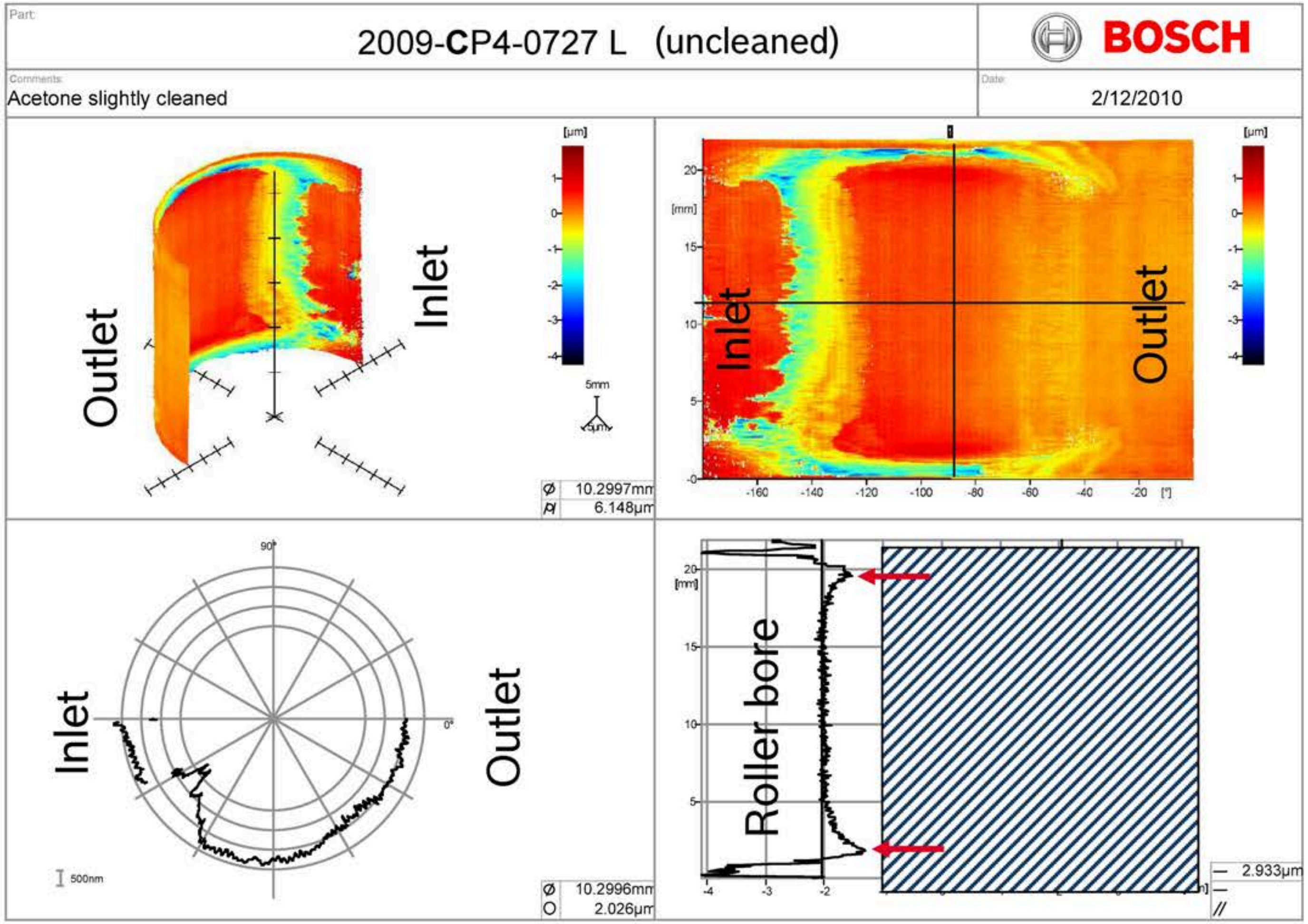


BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

WP measurement RS L C3 good 35 µm (2009-CP4_0727)



Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Part:

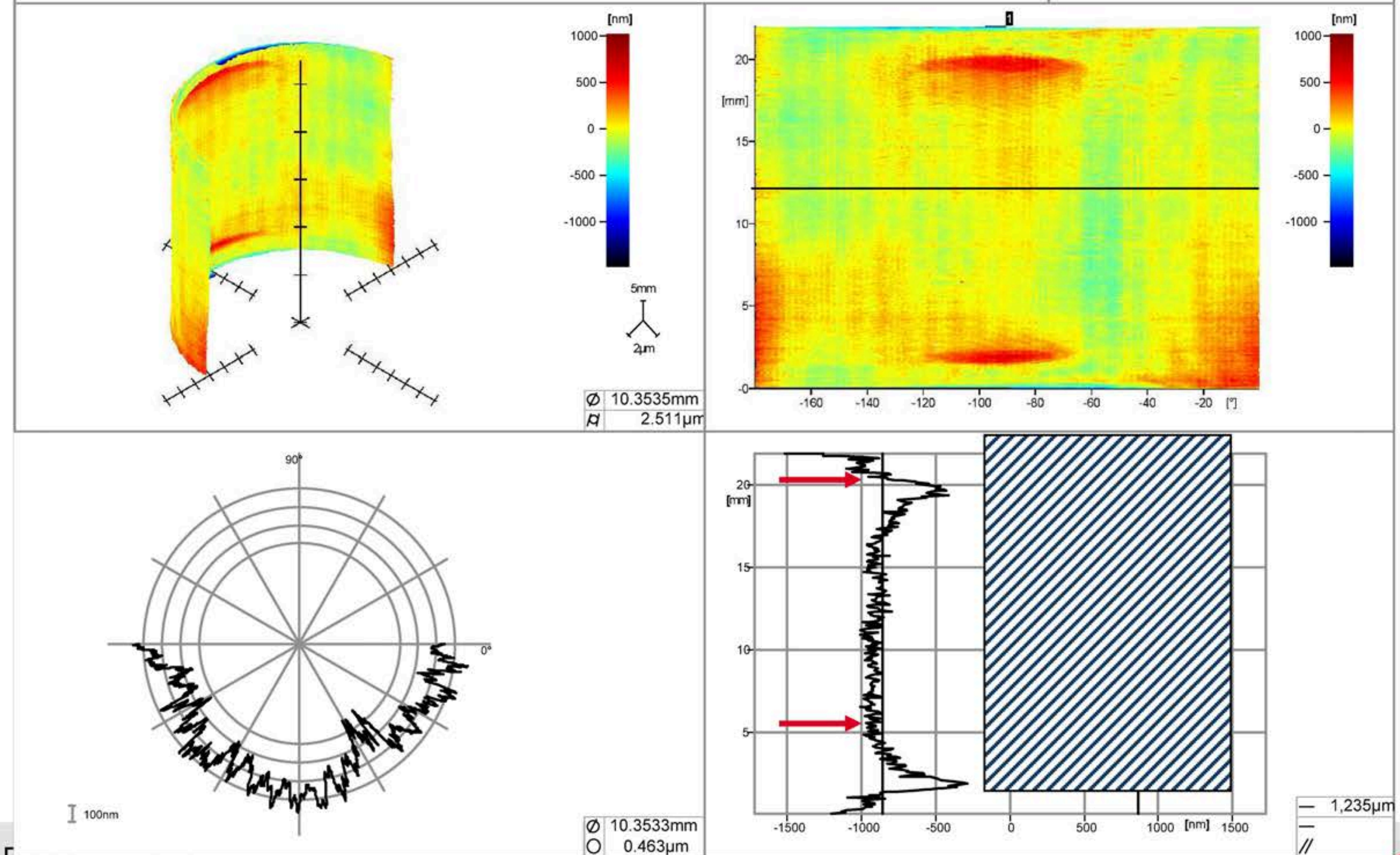
2009-CP4-0727 L cleaned

BOSCH

Comments:

Date:

2/18/2010

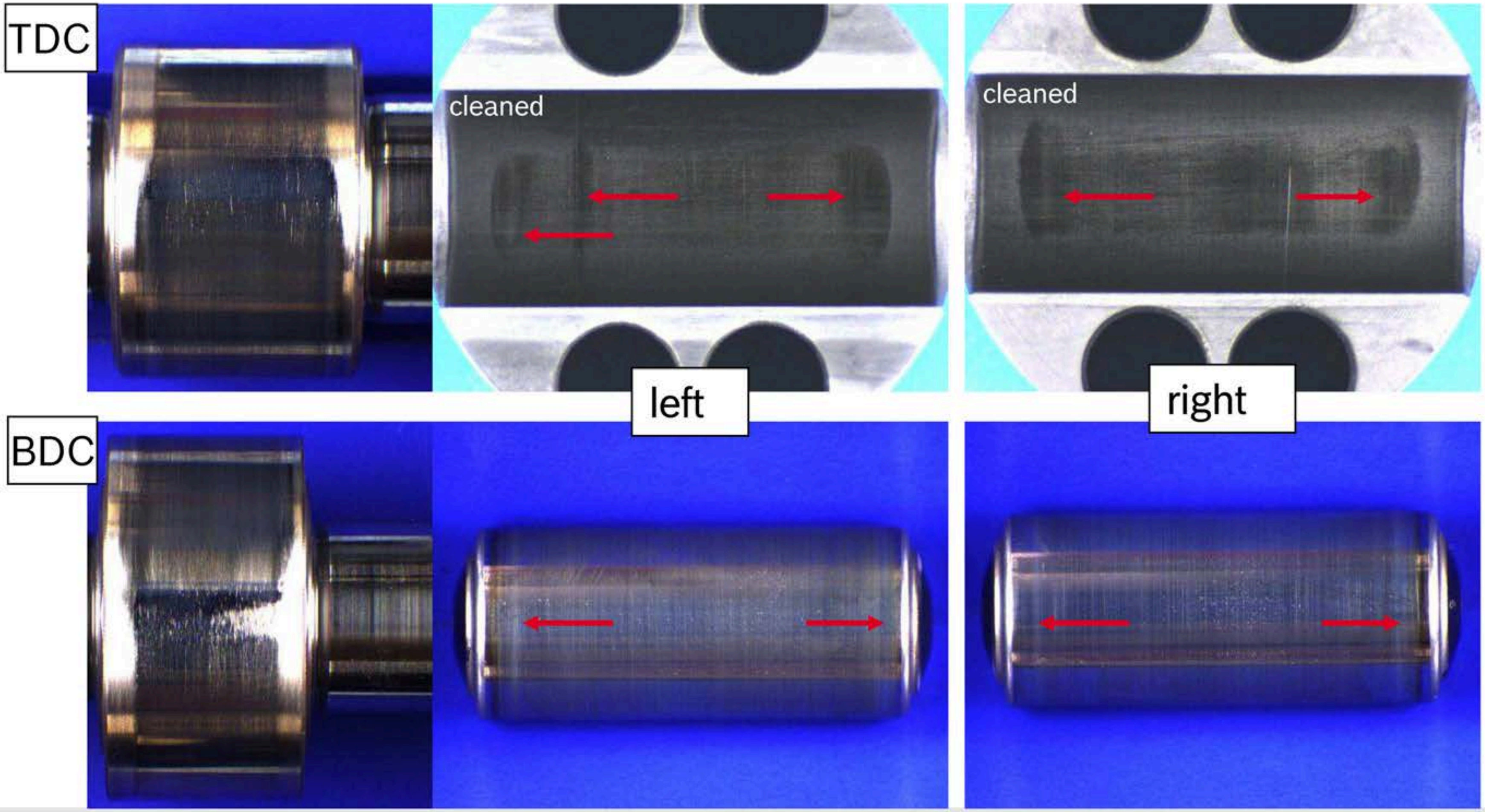


BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Pictures RS L C3 bad 35 µm (2010-CP4_0728)

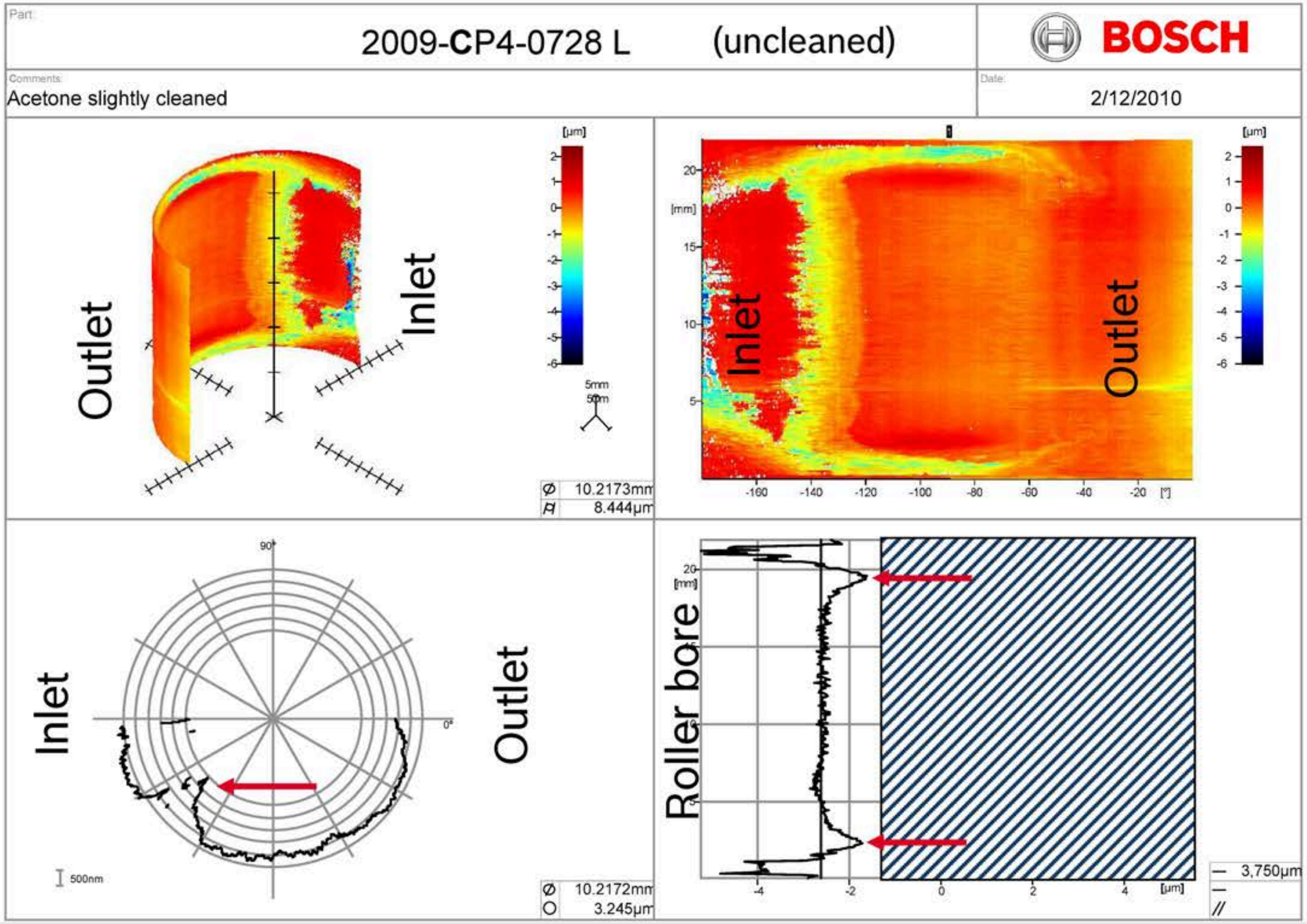


BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

WP measurement RS L C3 bad 35 µm (2009-CP4_0728)



Diesel Systems

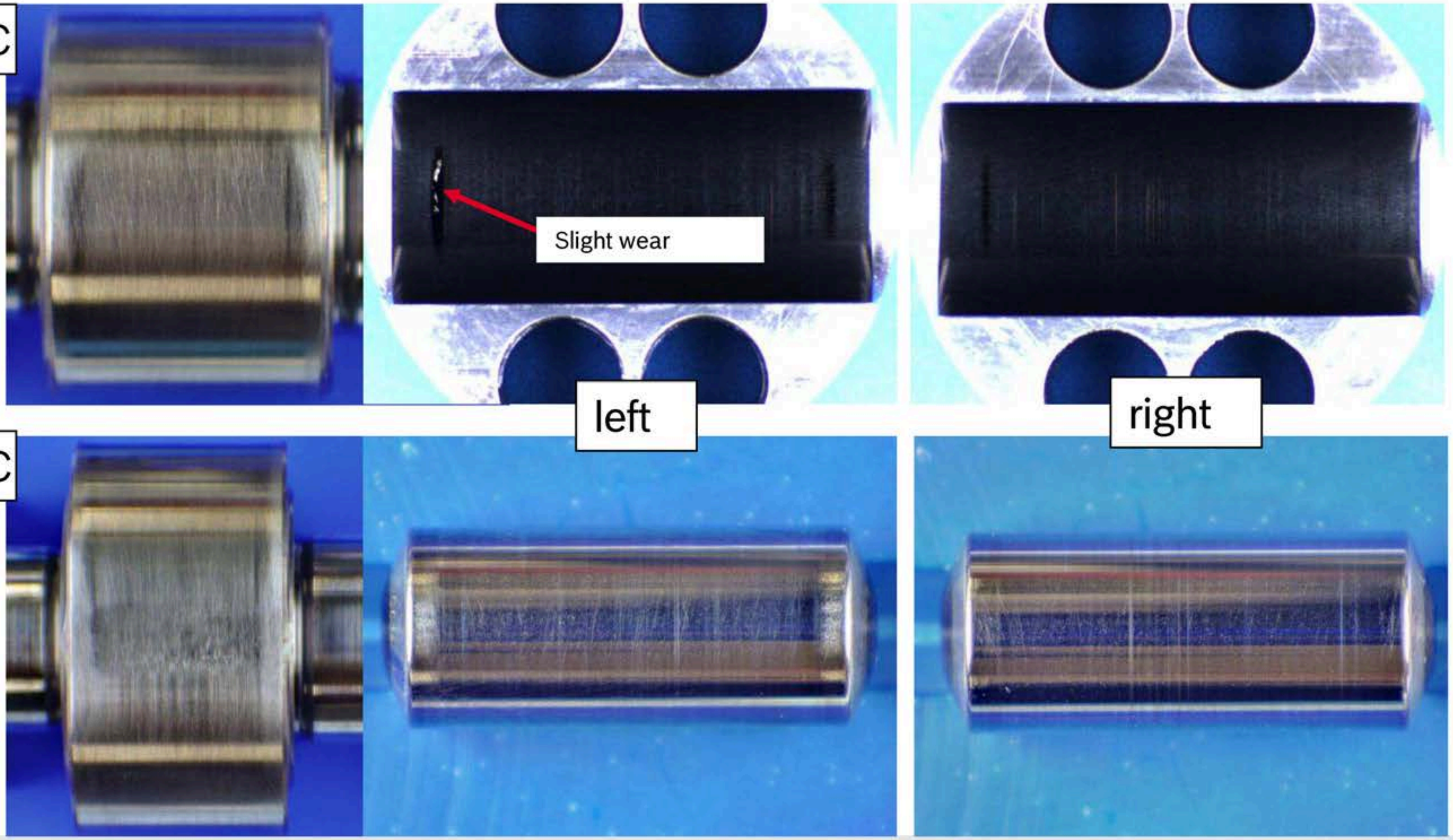
BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Pictures C2.1 good 18 µm (2010-CP4_0053)

TDC



BDC

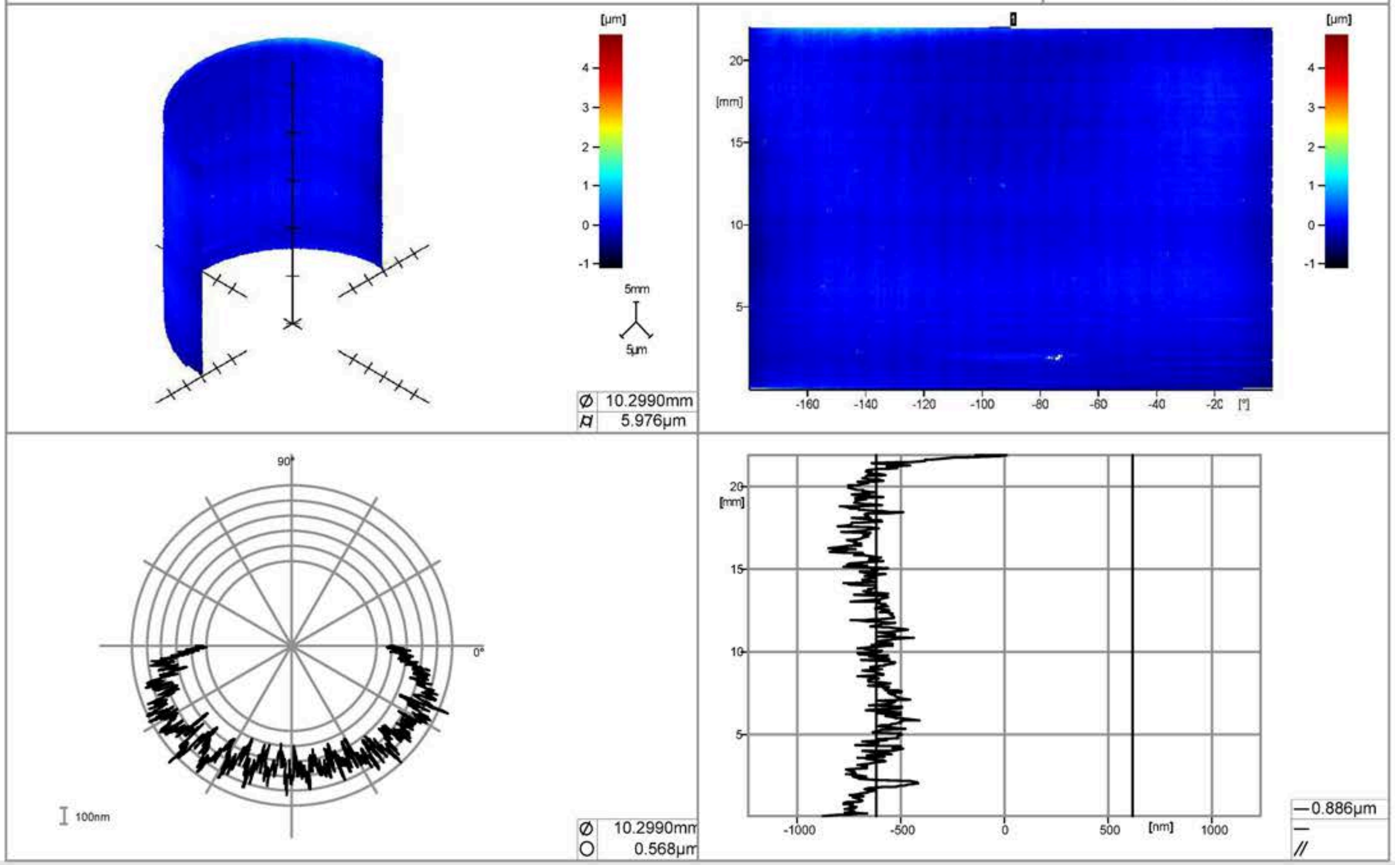
BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

WP measurement RS L C2.1 best 18 µm (2010-CP4_0053)

Part: 2010-CP4-0053 L cleaned	BOSCH
Comments:	Date: 2/23/2010



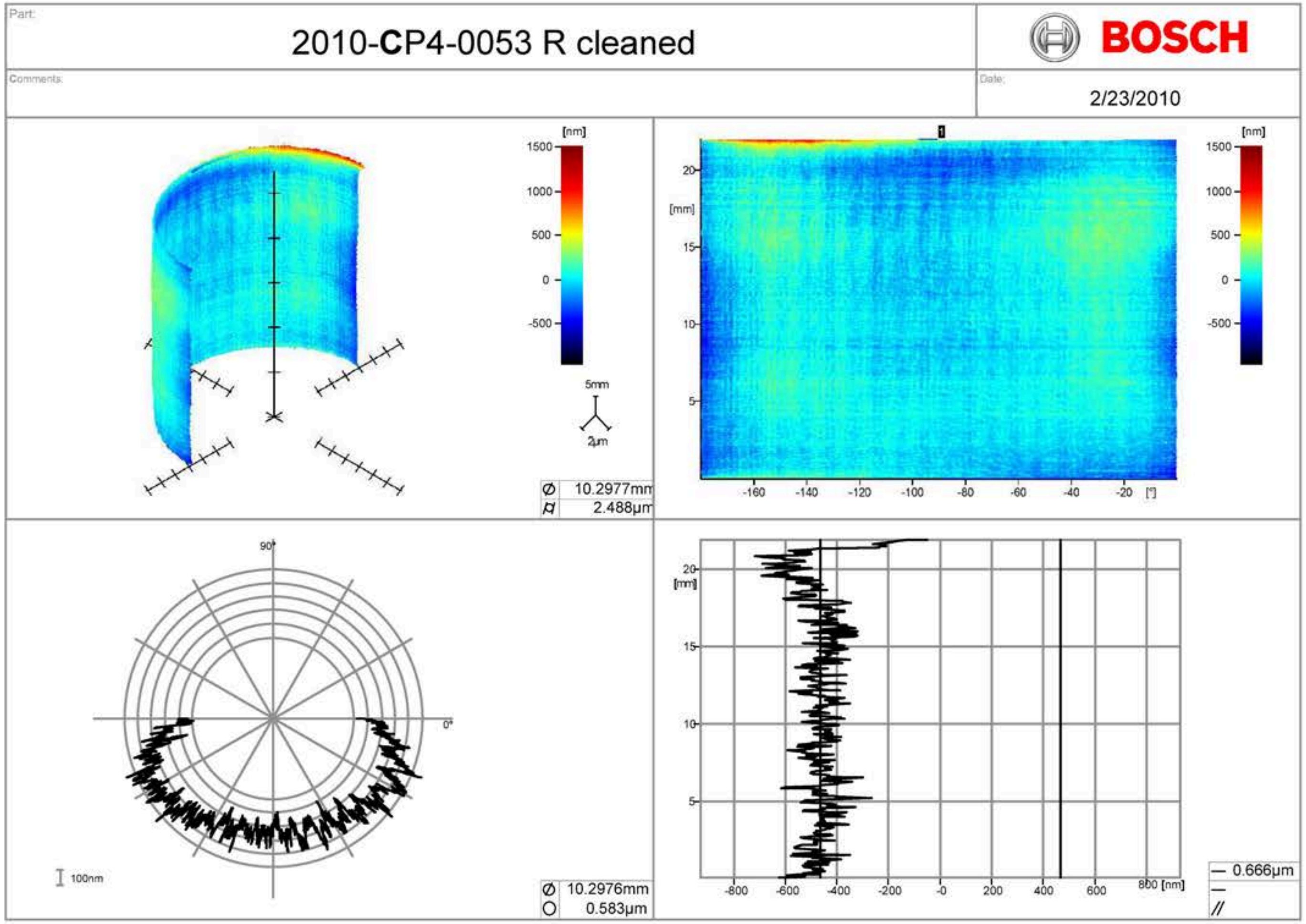
Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

WP measurement RS L C2.1 best 18 µm (2010-CP4_0053)



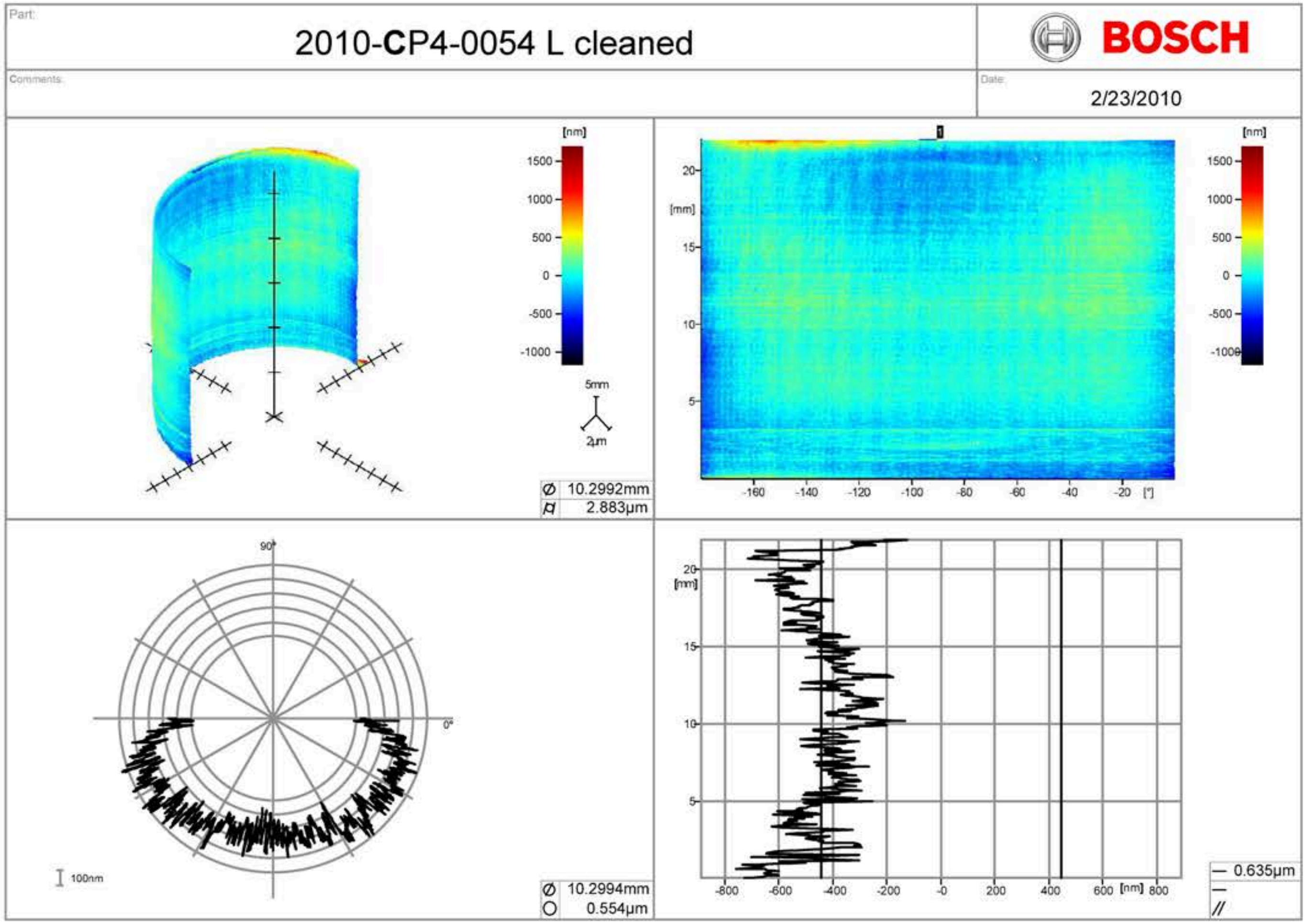
Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

WP measurement RS L C2.1 best 18 µm (2010-CP4_0054)



Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

Overload test conditions

-> ”Mixed friction” variant

-> 2x CP4.1, lift 5.25 mm (part no. ...508, VW R4 BIN5)

-> Arctic Diesel Class 4

-> 90° inlet temperature

-> 2,300 bar

-> 600 rpm

-> 150 h

-> One pump each with good and bad parts tappet assembly (C3 layer), that is, bad parts are scrap from visual inspection (series manufacturing)

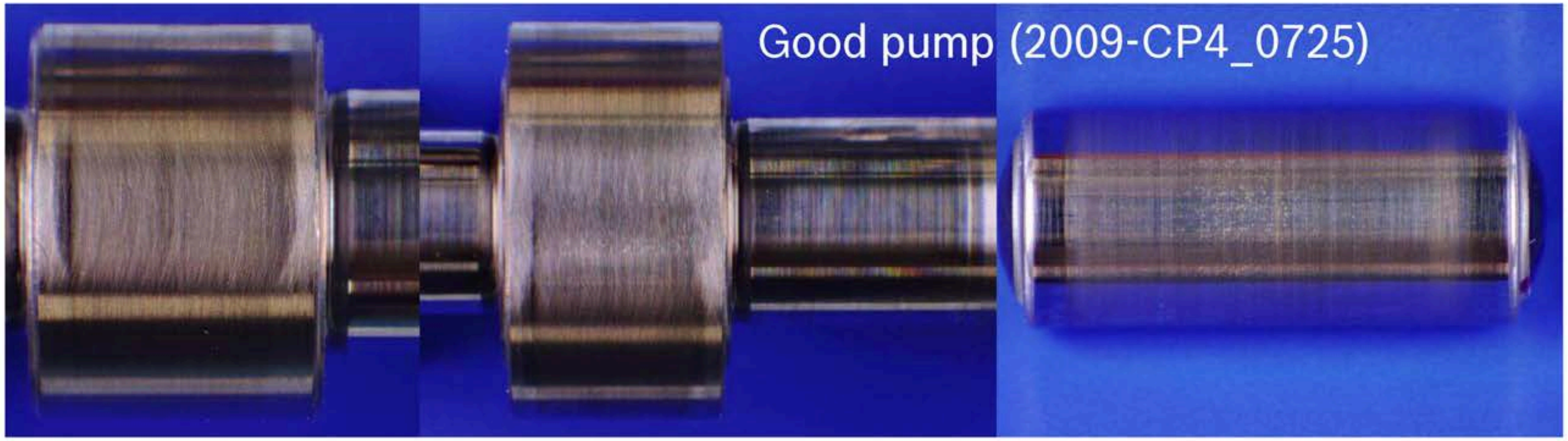
- VVT 2009-CP4_0725 (good), Non-responsive content removed
- VVT 2009-CP4_0726 (bad), Non-responsive content removed

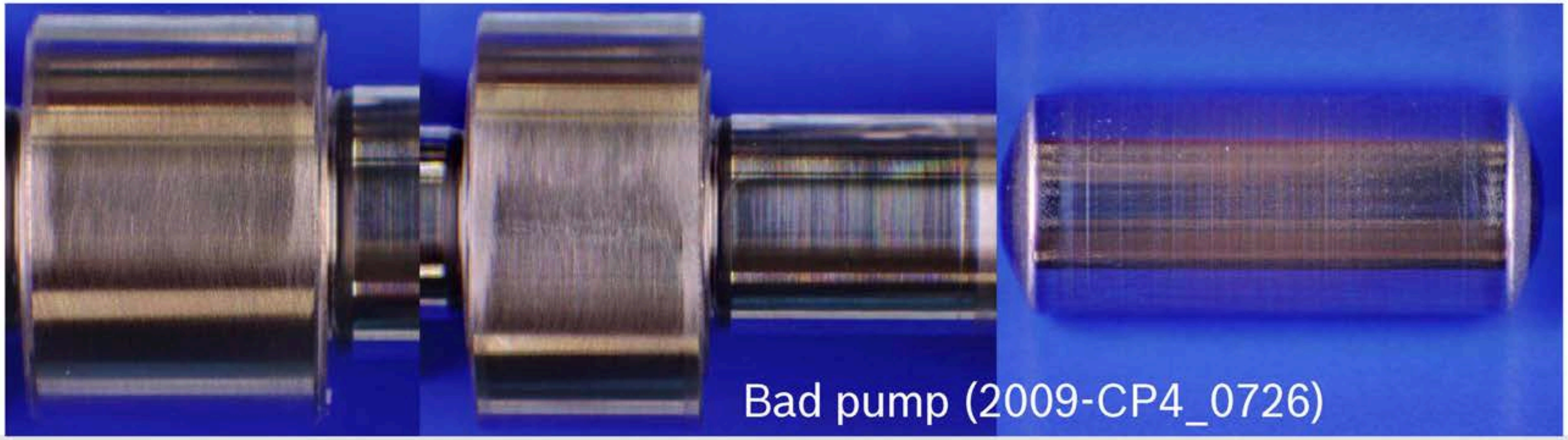
BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Diagnosis pictures camshaft, roller



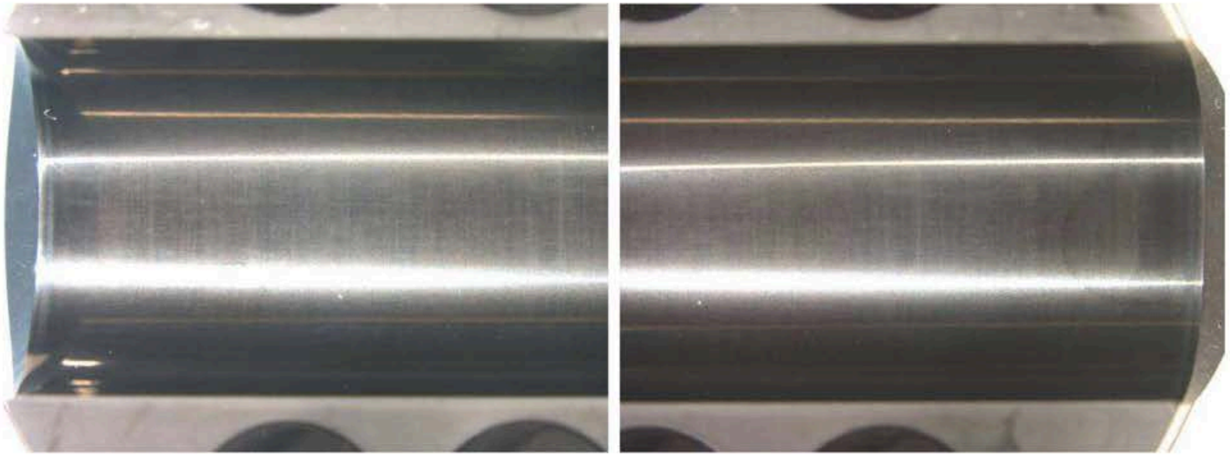


BOSCH

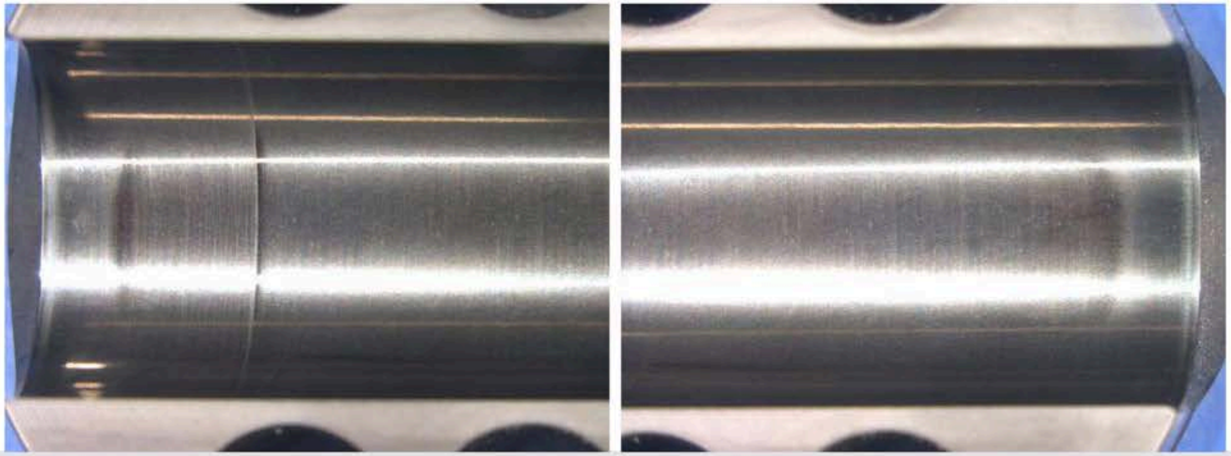
ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Diagnosis pictures roller support



Good pump (2009-CP4_0725)



Significant smoothing

Bad pump (2009-CP4_0726)

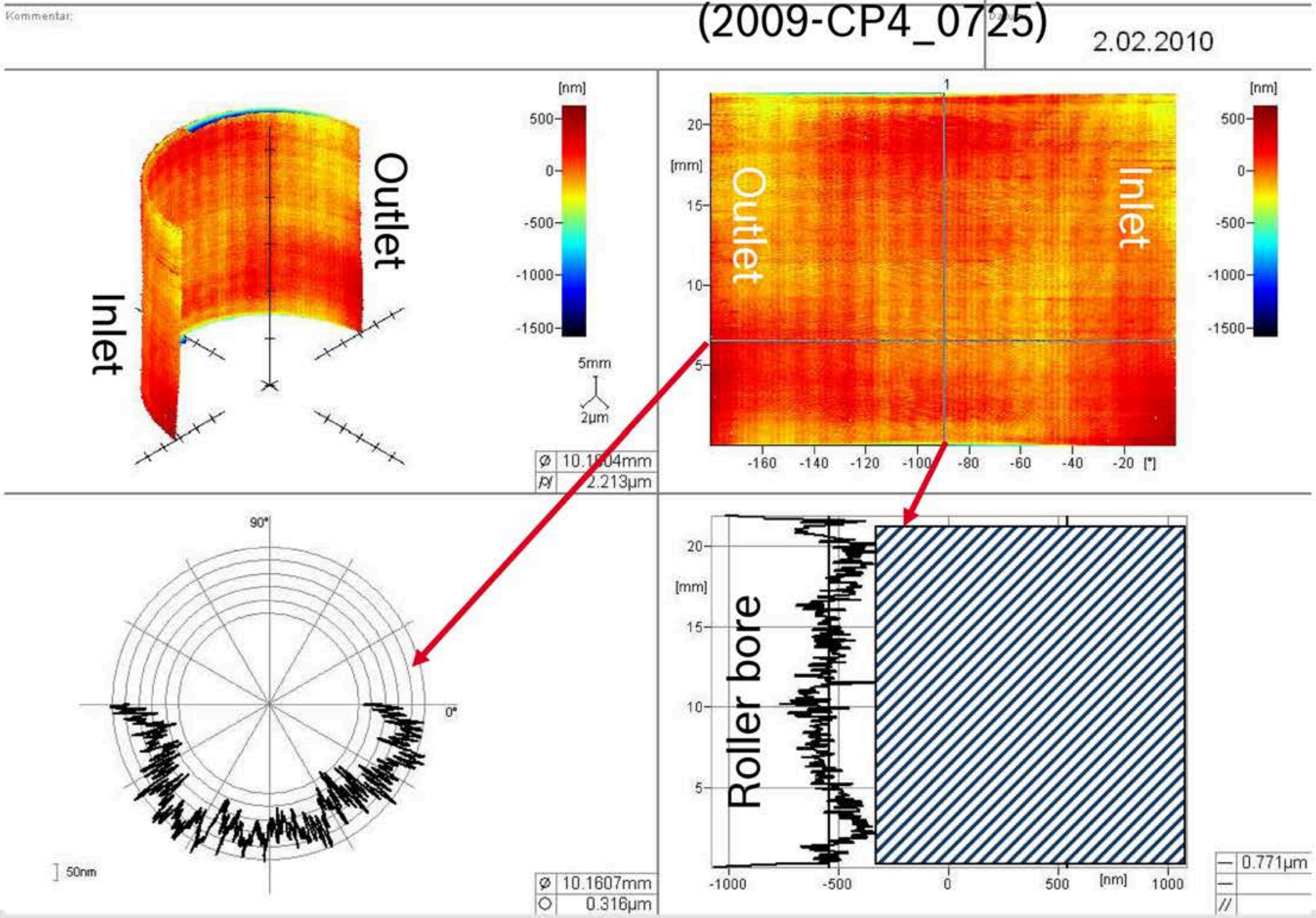
BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

RS 6007-4984 Good pump (2009-CP4_0725)

2.02.2010



Diesel Systems

ENTIRE PAGE CONFIDENTIAL

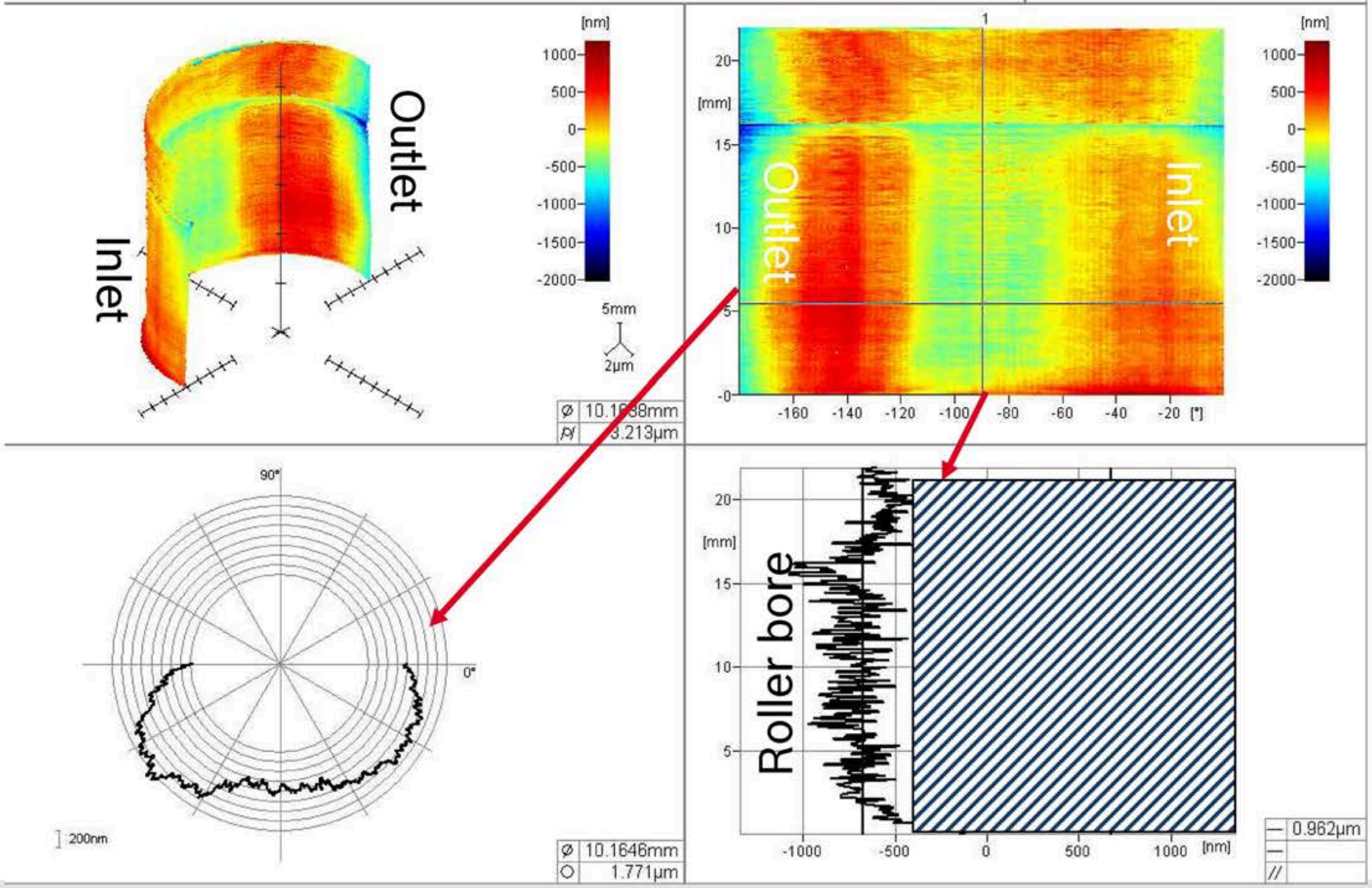
Status Task Force CP4

6007-0316 Bad pump (2009-CP4_0726)

BOSCH

Kommentar:

Datum: 2.02.2010



Diesel Systems

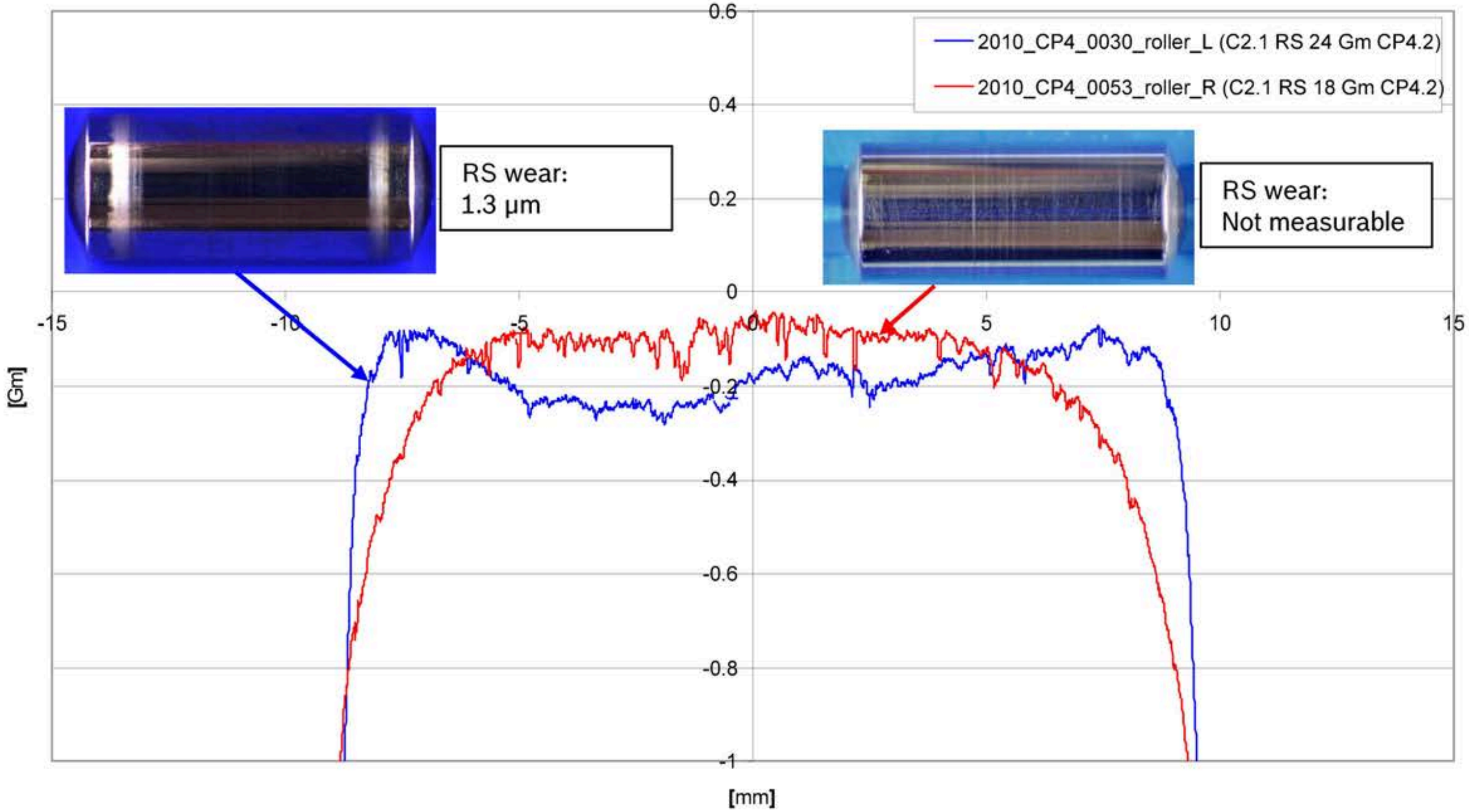
BOSCH

ENTIRE PAGE CONFIDENTIAL

Status Task Force CP4

Roller contour plots

Contour plots of roller with (C2.1 RS 24/18 Gm CP4.2)



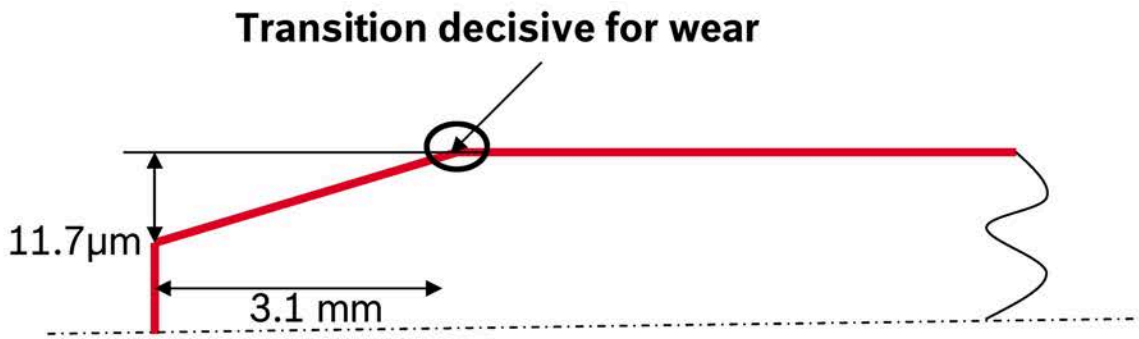
BOSCH

Status Task Force CP4

Correlation smoothing at edge

-> Subsequent measurement of parts showed that smoothing at the edge of the roller support were created during operations under QALT conditions due to the shape of the slender taper on the roller

-> Flat transition of the slender taper results in maintenance of the lubrication gap at the edge of the roller even with extremely small lubrication gaps (reduced mixed friction).



Status Task Force CP4

Backup

BOSCH

Status Task Force CP4

Proof of robustness

End of Life QALT endurance runs @ 600rpm, 2,300bar, 90°C Arctic Diesel) with

A1) C1) 1 x roller support C3 (max.)* and roller with "edge" (convex)

1 2

A1) C2) 1 x roller support C3 (max.)* and roller without "edge" (convex)

S1) S2) 1 x RP1 roller support (max.)* and roller without "edge" (convex) (=RP1.1)

3 4

B2) D2) 1 x RP1 roller support (min.)* and roller without "edge" (concave) (=RP1.1)

E) 2 x RP1 roller support (min.)* and roller without "edge" but concave 150h) prio B

Kerosene

F) 2 x RP1 roller support (max.)* and roller without "edge" (=RP1.1) WK14

(min. / max.)*: Measurement of 100 series roller supports, table-based presentation of data, selection of borderline roller supports from this table

BOSCH

Status Task Force CP4

Test overview of anti-wear package 1 (basis: EHP_342 from 03/16/2010)

Description	TP no.	Fuel target	RT	Actual RT	Status	End date
Tappet "good" (RS C3.0 & roller OK according to visual inspection characteristics)	2009-CP4_0725	Arctic diesel	150	150		WK4
Tappet "bad" (RS C3.0 & roller OK according to visual inspection characteristics)	2009-CP4_0726	Arctic diesel	150	150		WK4
Tappet "good" (RS C3.0 & roller OK according to visual inspection characteristics)	2009-CP4_0727	Arctic diesel	150	150		WK6
Tappet "bad" (RS 3.0 & roller OK according to visual inspection characteristics)	2009-CP4_0728	Arctic diesel	150	150		WK6
Tappet with RP "best" of series" (with measured surface)	2010-CP4_0029	Arctic diesel	150	150		WK7
Tappet with RP "best" of series" (with measured surface)	2010-CP4_0030	Arctic diesel	150	150		WK8
Tappet with RP "worst of series" (with measured surface)	2010-CP4-0031	Arctic diesel	150	150		WK7
Tappet with RP "worst of series" (with measured surface)	2010-CP4-0032	Arctic diesel	150	150		WK8
Tappet with RP "worst of series" (with measured surface)	2010-CP4-0034	Kerosene	150	15 min		WK6
Tappet with RP "best of series" (with measured surface)	2010-CP4-0033	Kerosene	150	4		WK7
Reappear Test (metal spatters & fusing)	2010-CP4-0065	Arctic diesel	150	13min		WK8
Reappear step test (metal spatters & fusing)	2010-CP4-0066	Arctic diesel	350	202		WK9
Tappet with RP "best" (with measured surface)	2010-CP4-0053	Arctic diesel	150	150		WK9
Tappet with RP "best" (with measured surface)	2009-CP4-0054	Arctic diesel	150	150		WK9
Tappet with RP "worst" (with measured surface)	2009-CP4-0073	Arctic diesel	150	150		WK10
Tappet with RP "worst" (with measured surface)	2009-CP4-0074	Arctic diesel	150	150		WK10

Endurance run completed & diagnosed positively

Endurance run ended with striking features

Endurance run failed

Diesel Systems

BOSCH

Status Task Force CP4

Test overview of anti-wear package 1.1 (basis: EHP_342 from 03/16/2010)

Description	TP no.	Fuel	target R	Actual	Status	End daten
Tappet witlmax. RP1.1 (roller convex, without edge)	2009-CP4-0188	Arctic diesel	EOL	150	15	WK14
Tappet witlmax. RP1.1 (roller convex, without edge)	2009-CP4-0189	Arctic diesel	EOL	150	15	WK14
Tappet witlmin. RP1.1 (roller convex, without edge)	2009-CP4-0073	Arctic diesel	EOL	150	15	WK14
Tappet witlmin. RP1.1 (roller convex, without edge)	2009-CP4-0074	Arctic diesel	EOL	150	15	WK14
Tappet witmax. C3.0 (roller concave, with edge)	2010-CP4_0xx	Arctic diesel	EOL	150	0	WK14
Tappet witlmax. C3.0 (roller concave, with edge)	2010-CP4_0xx	Arctic diesel	EOL	150	0	WK14
Tappet witmax. C3.0 (roller convex, without edge)	2010-CP4_0xx	Arctic diesel	EOL	150	0	WK14
Tappet witlmax. C3.0 (roller convex, without edge)	2010-CP4_0xx	Arctic diesel	EOL	150	0	WK14

Endurance run completed & diagnosed positively

Endurance run ended with striking features

Endurance run failed

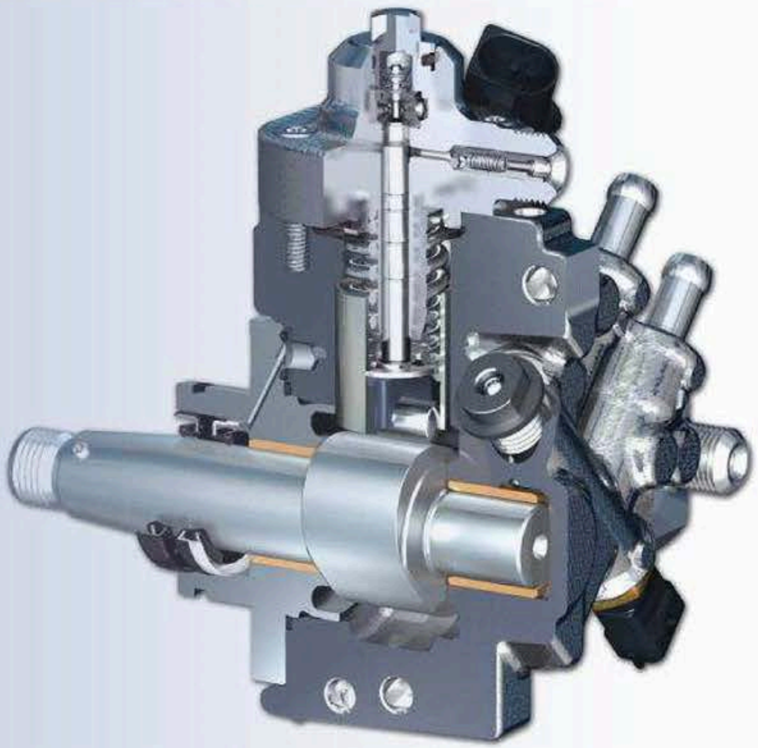
BOSCH

ENTIRE PAGE CONFIDENTIAL

Overview of CP4 robustness

Non-responsive content removed

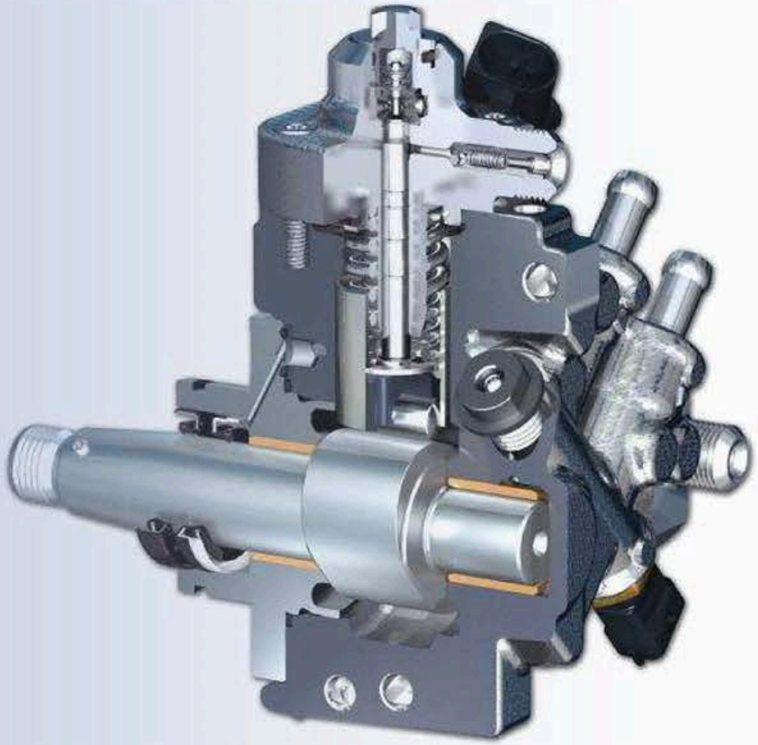
1) **Anti-wear package 1 (RP1)**
2) **Anti-wear package 2 (RP2)**
3) **Failure statistics CP4** Non-responsive content removed



BOSCH

1) Anti-wear package 1 (RP1)

Non-responsive content removed



CP4 robustness

Anti-wear package 1

Assignment

Increase lubricating film between roller support and roller for fuels with lower viscosity (reduction of mixed friction fraction & temperatures)

Measures (derived from simulation results)

- Reduction in roughness in the roller support due to changeover to C2 coating
- Prevention of metal splashes (for process-related reasons there are no metal splashes with C2)
- Reduction of play between roller and roller support (smaller roller support bore)
- Reducing the roughness of the roller
- Optimization of edge taper on the roller (slender taper)

Execution

Testing RP1 vs. series in QHALT (600 rpm; 2,300bar; Arctic diesel; 90°C)

Result

RP1 increases lubricating film by 2 x (derived from findings)

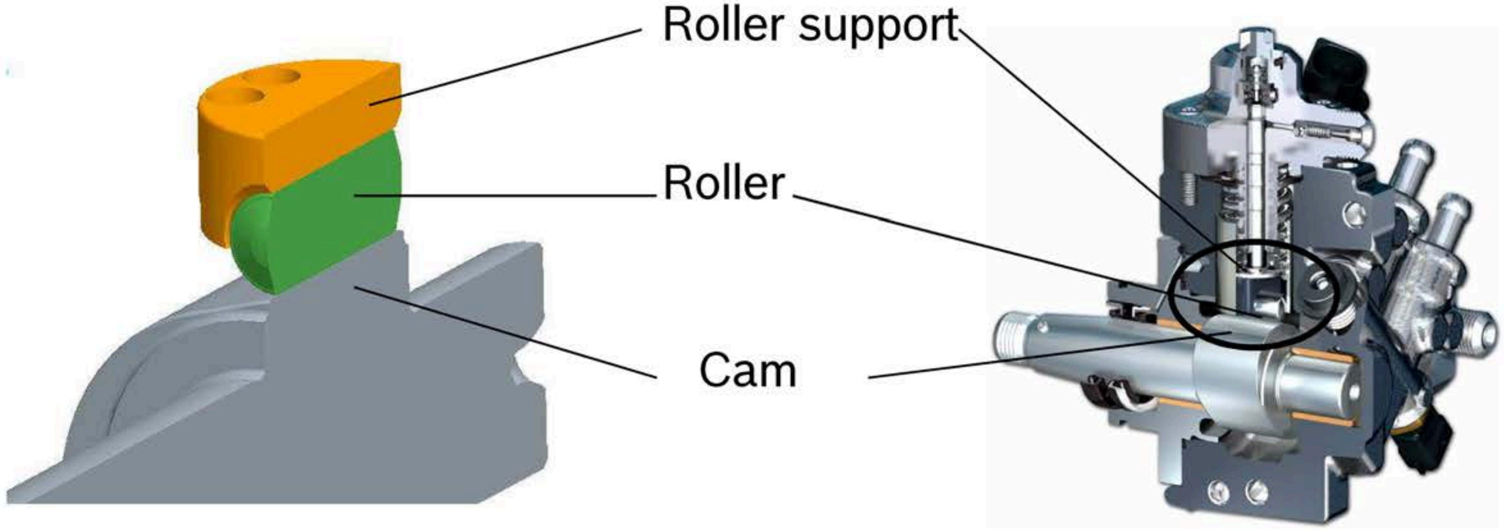
RP1 in series for all CP4.2 at Audi since WK12

BOSCH

ENTIRE PAGE CONFIDENTIAL

CP4 robustness

Anti-wear package 1

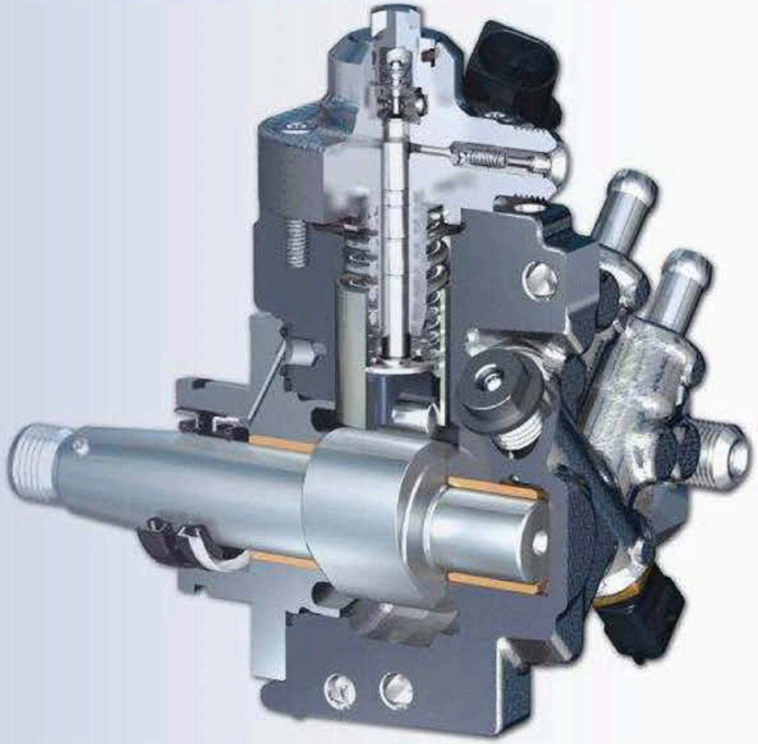


BOSCH

ENTIRE PAGE CONFIDENTIAL

Anti-wear package 2 (RP2)

[redacted]



BOSCH

CP4 robustness

Anti-wear package 2

Assignment

Reduction of local temperatures of the right (critical) roller tappet with target level CP4.1 for clockwise CP4.2 (Audi V6, not Audi V8)

Measures

- Optimized arrangement of supply & return position (result: Swapping of supply / return connections

Execution

Temperature measurements on roller support	done
Testing RP2 in QHALT (600 rpm; 2,300bar; Arctic diesel; 90°C)	WK24

Result

Function measurements show by the optimized supply/return adjustment that temperatures as in CP4.1 can be achieved (temperature reduction of > 15°C in lubrication gap).

Further work

Confirm effectiveness in QHALT endurance run WK24

Pumps for testing delivered to Audi. Introduction in series possible from WK 28.

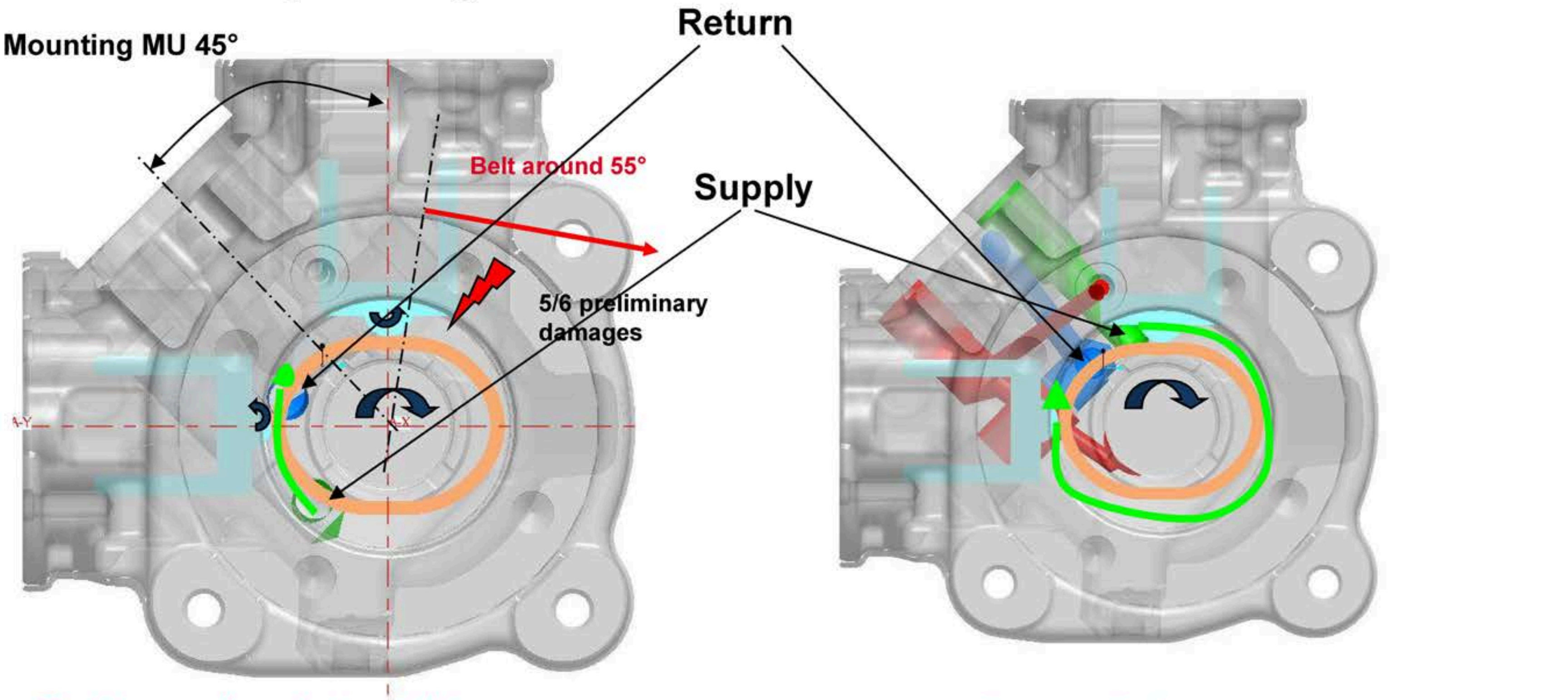
BOSCH

EA11003EN-01838[6]

ENTIRE PAGE CONFIDENTIAL

CP4 robustness

Anti-wear package 2



Fuel goes directly to outlet

CP4.2-EFP cw Audi W19

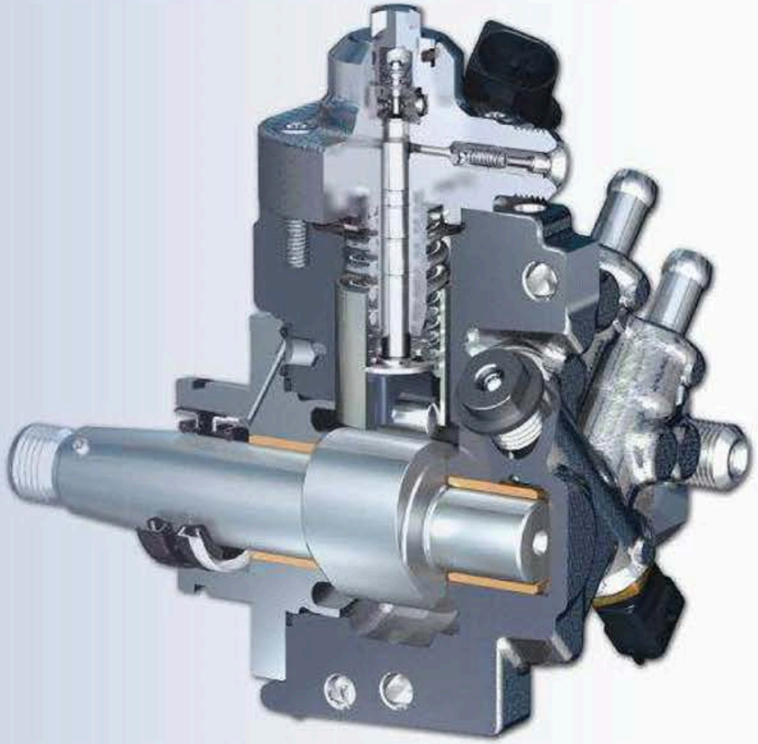
Fuel is recycled once

CP4.2 EFP cw **AWP2** for Audi W19

ENTIRE PAGE CONFIDENTIAL

3) Failure statistics

Non-responsive content removed [redacted]



BOSCH

CP4 robustness

Failure statistics [redacted]

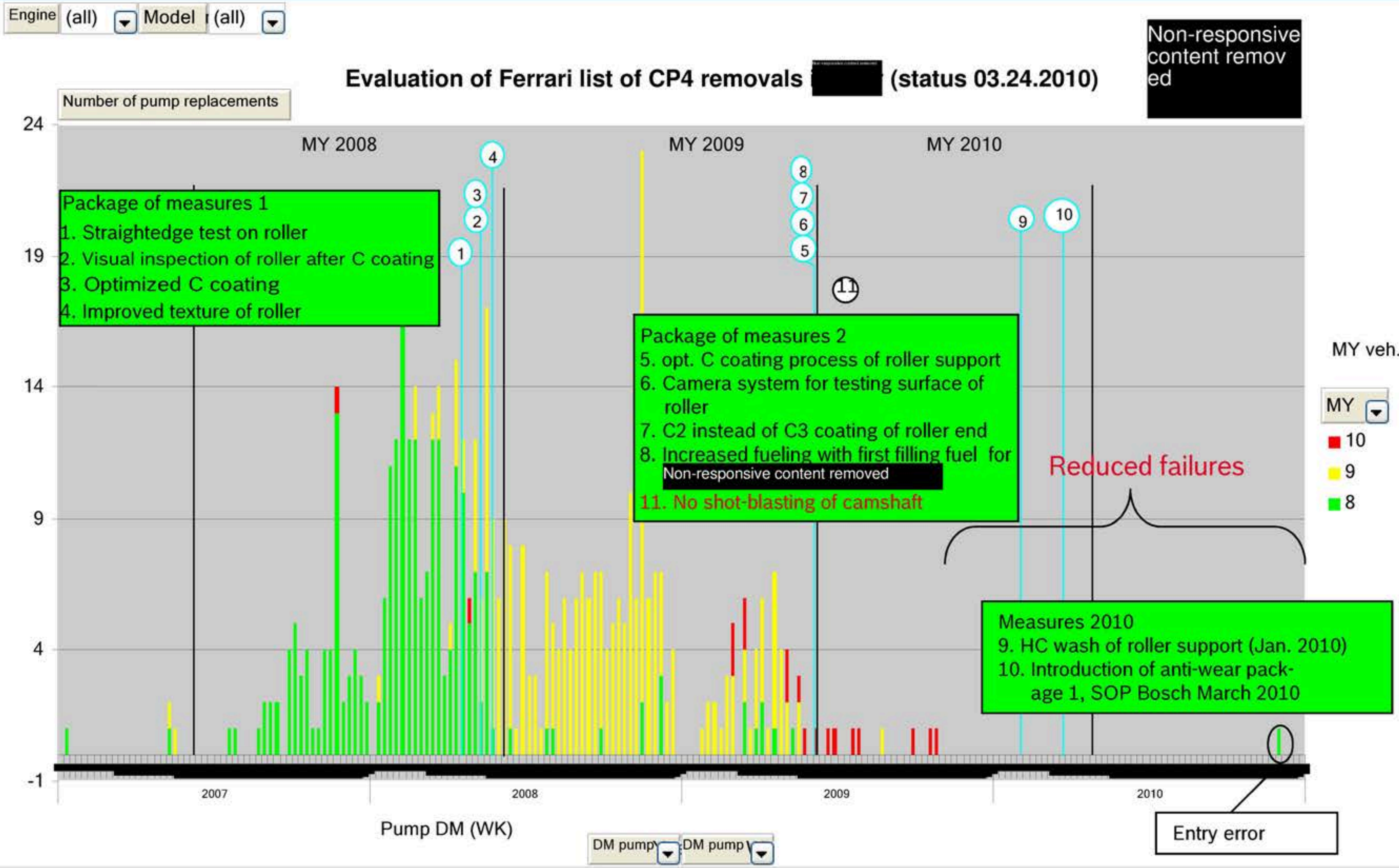
Italy (see page 10, 11, 12)

- Decline in complaints CP4.2 with pumps DM after Jun 2009 (page 10)
- Absolute increase in complaints CP4.2 & CP4.1 in [redacted] from 03/2010 (page 11, 12)
  - Presentation of relative values (CP4.2 / CP4.1 / total / vehicle model) agreed up on with Audi
  - Joint analysis “Influence of vehicle model as part of task force
  - CP4.1 complaints likely not 100% drivetrain damage, but rather
    - Non-starters due to shavings in intake valve
    - Pump exchange due to noise complaint

BOSCH

ENTIRE PAGE CONFIDENTIAL

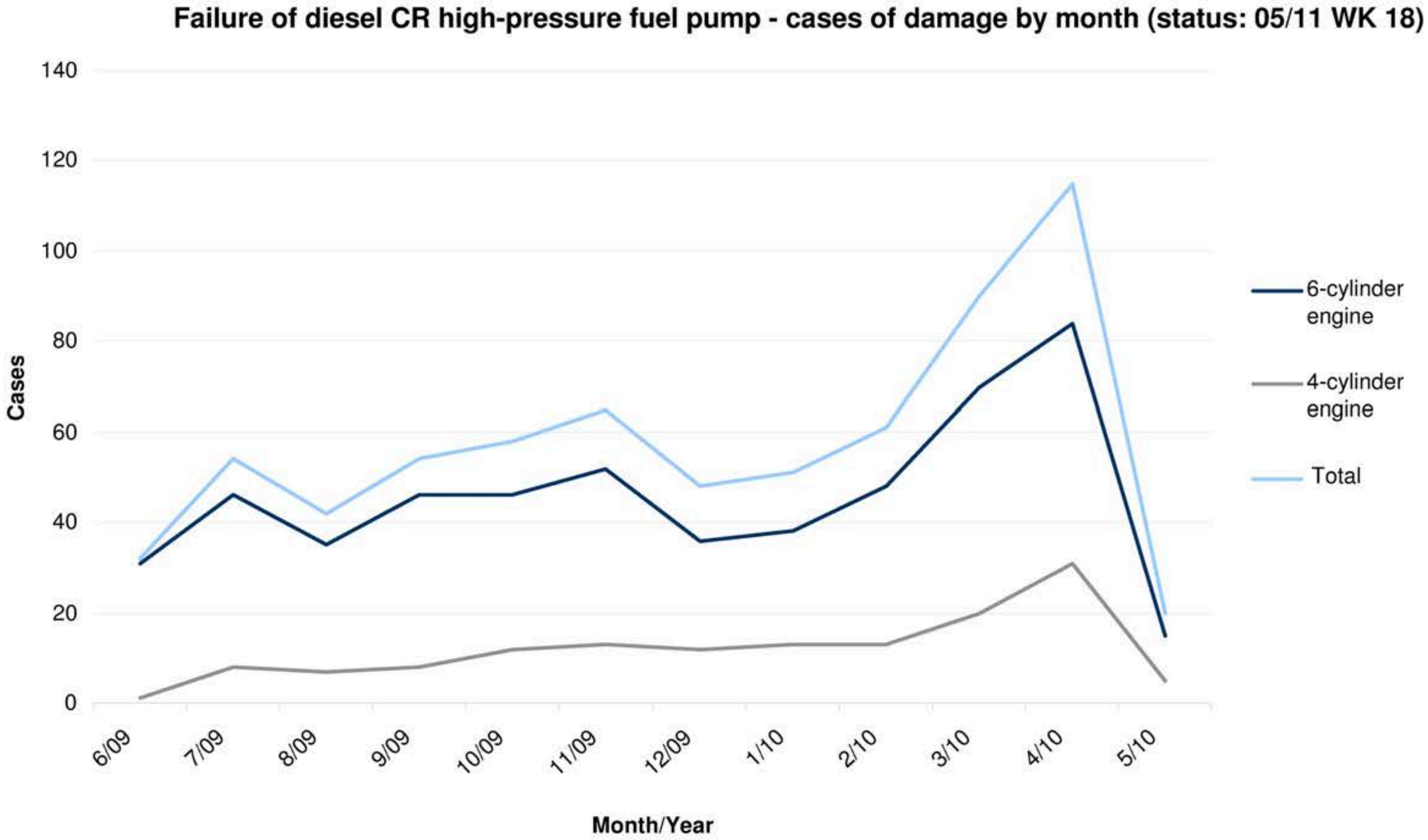
CP4 robustness



BOSCH

CP4 robustness

Failure statistics [redacted] (total of all vehicles)

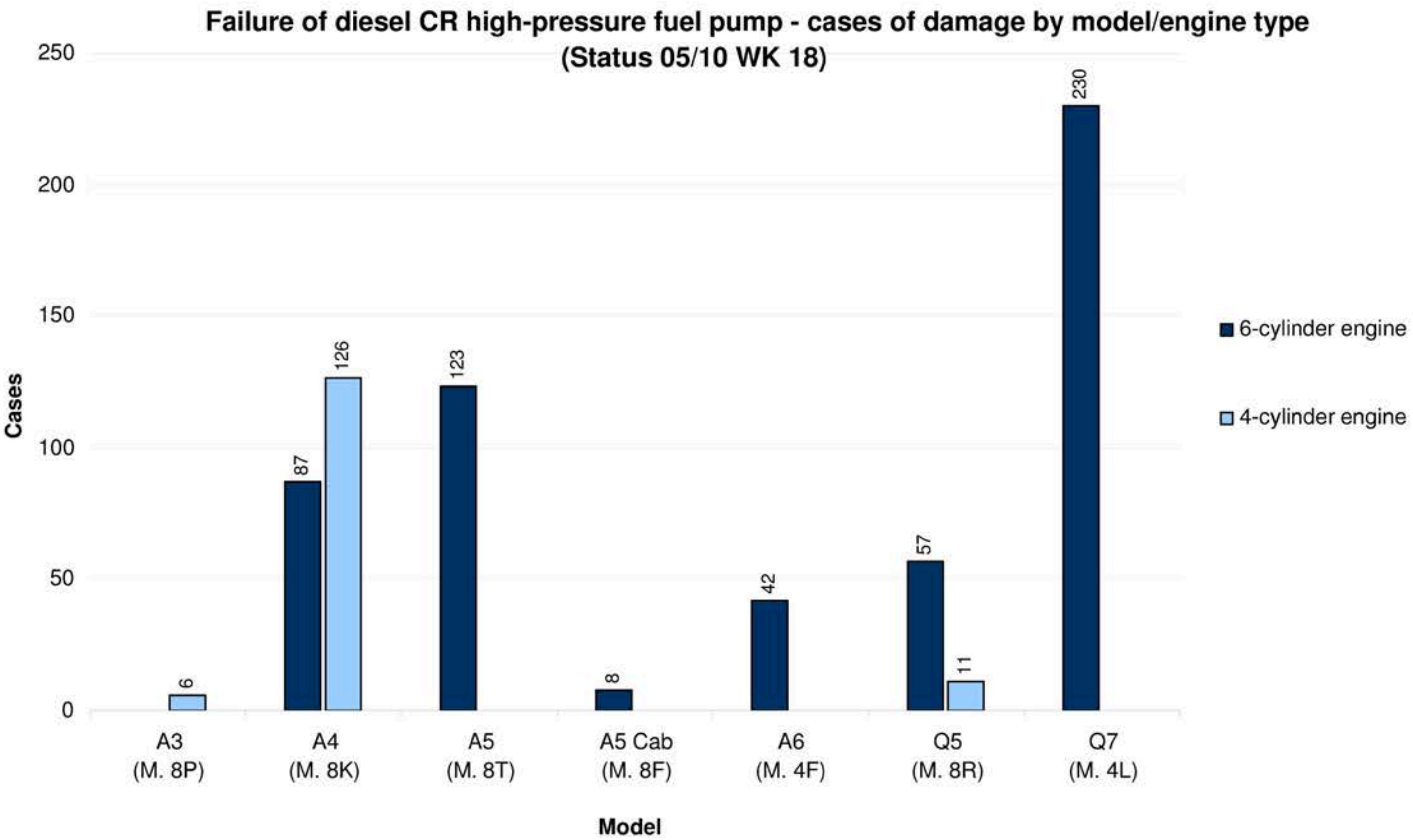


BOSCH

ENTIRE PAGE CONFIDENTIAL

CP4 robustness

Failure statistics Non-responsive content removed (vehicles)



BOSCH

Status of on-site meeting in [redacted] (WK30/10)

Previous results and further action

→ Of the 4 vehicles inspected in [redacted] and 2 in [redacted] (Arctic Diesel), there were no violations of the specified return volume (80 l/h) under the examined measurement conditions.

→ Additional vehicles will be measured to identify the further impact of fuel conditions on the injection system, including low-pressure circuit, in [redacted]

→ We have agreed to examine the application of the BEM.

→ Measurements of B8 vehicles and 4-cylinder (CP4.1) are planned, among others, for WK31. If possible, an A3 with transverse-mounted engine is also to be measured.

Further action #2

→ A TEE with tank EFP was removed from one of the vehicles, to check whether the necessary output has changed compared to the new status.

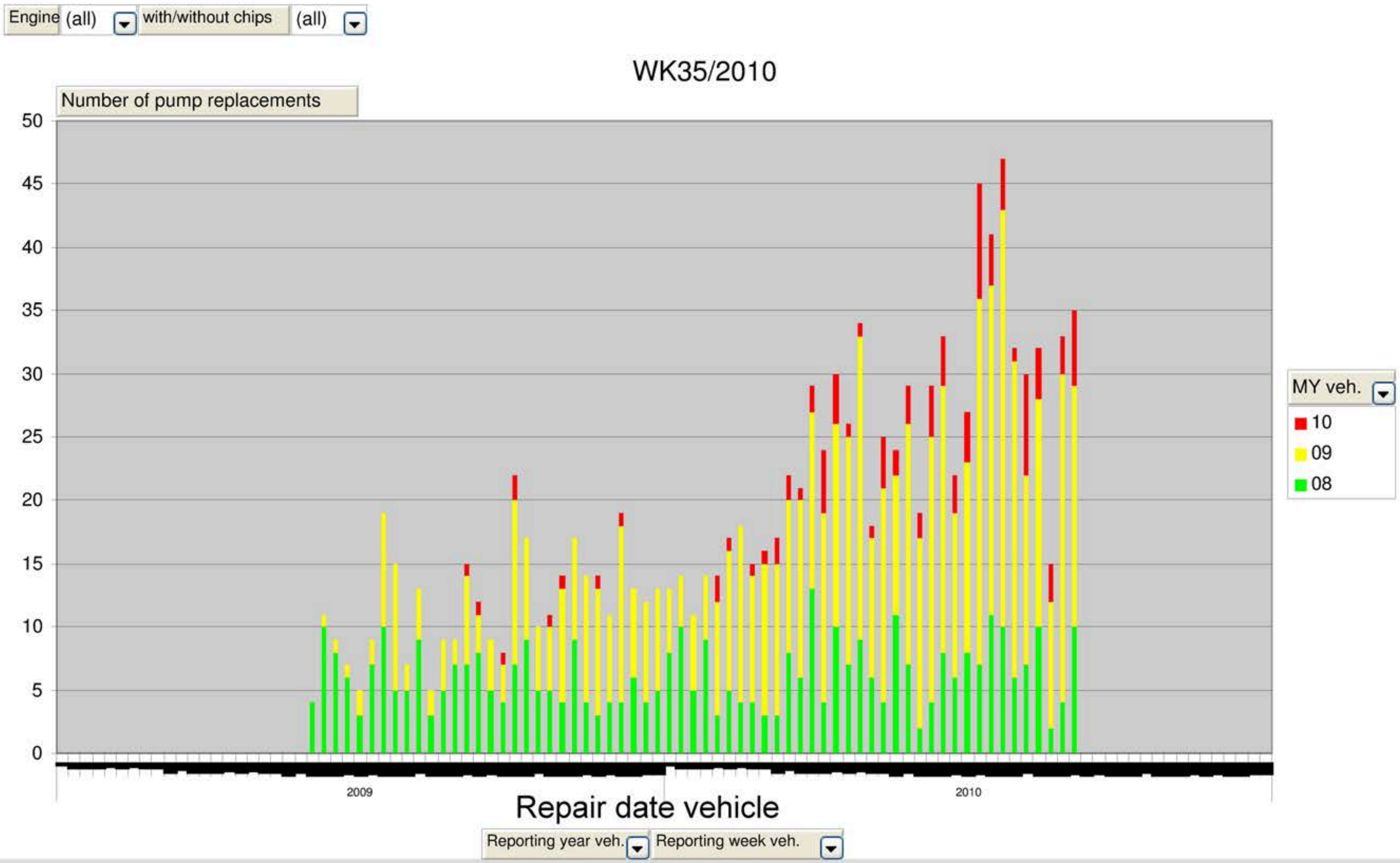
→ For further measurements, a transparent hose will be used to check whether air bubbles can be observed in the return of the CP4.

→ Audi will provide Bosch with an affected vehicle for more comprehensive measurements, to assess the influencing factors (viscosity, temperature, battery voltage, tank level).

BOSCH

ENTIRE PAGE CONFIDENTIAL

Evaluation of CP4 removals Non-responsive content removed
Status: WK35/2010 R4 and V6 engine



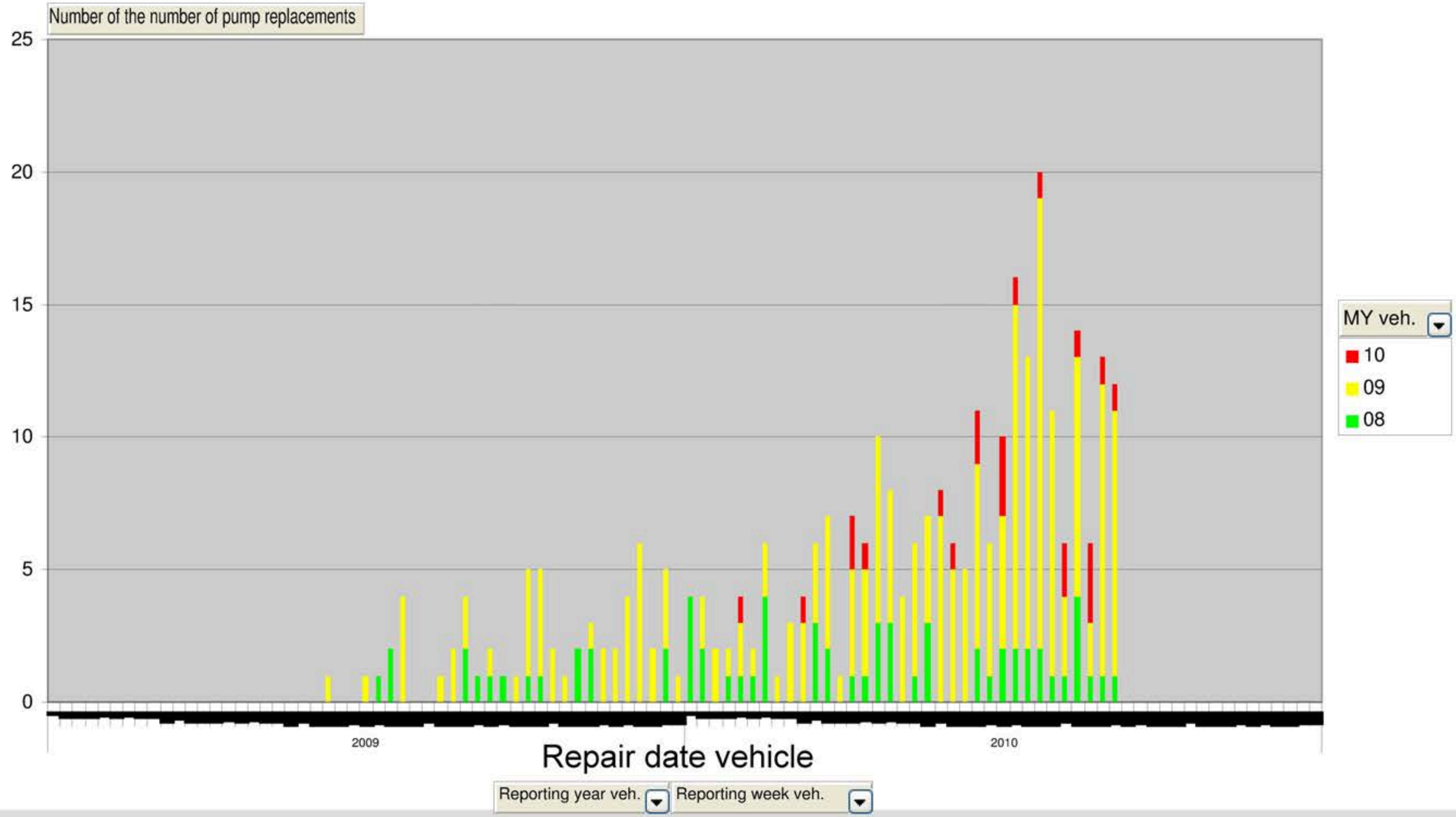
BOSCH

ENTIRE PAGE CONFIDENTIAL

Evaluation of CP4 removals Non-responsive content removed
Status: WK35/2010 R4 engine

Engine R4 with/without chips (all)

WK35/2010

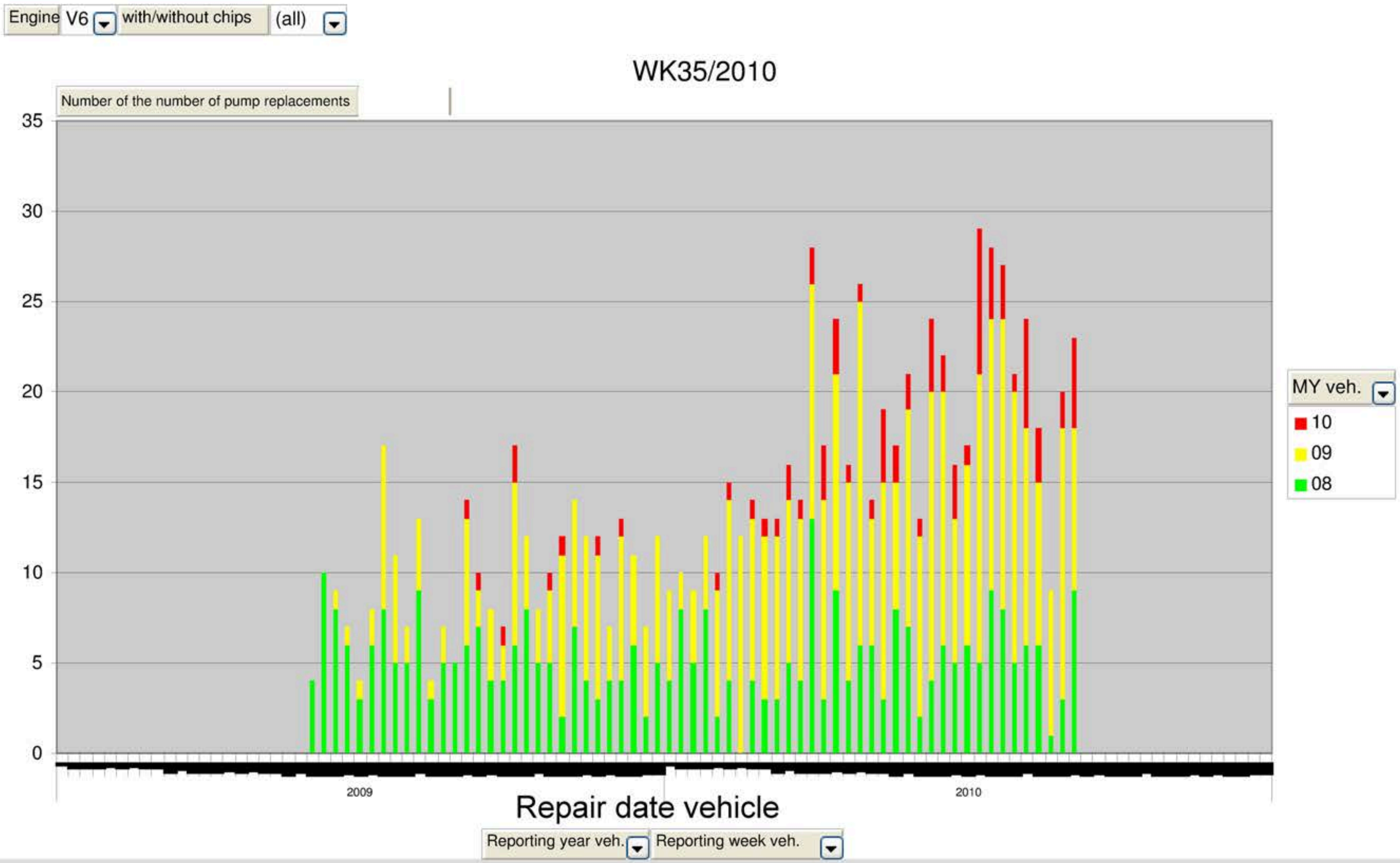


BOSCH

EA11003EN-01848[2]

ENTIRE PAGE CONFIDENTIAL

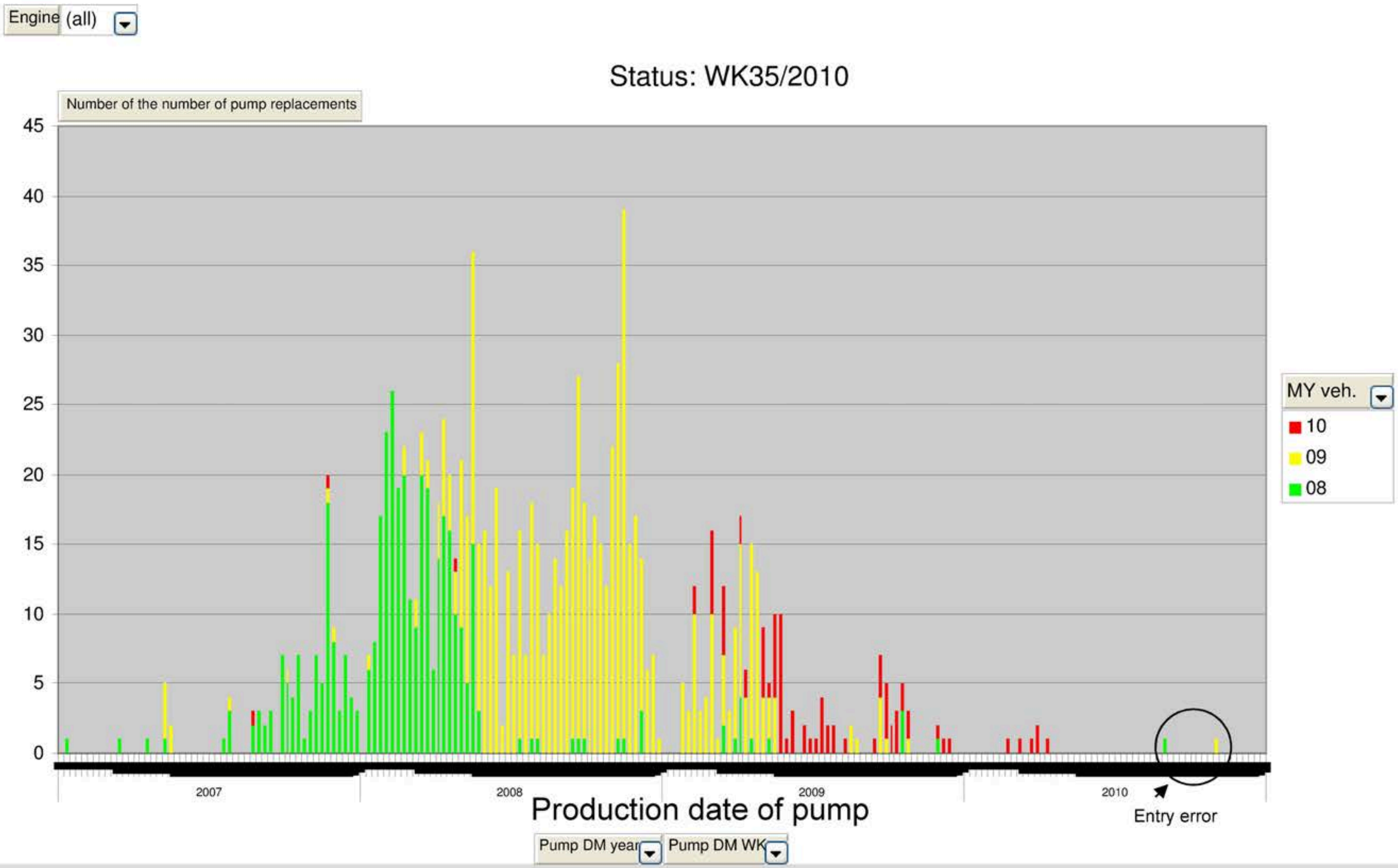
Evaluation of CP4 removals Non-responsive content removed
Status: WK35/2010 V6 engine



BOSCH

ENTIRE PAGE CONFIDENTIAL

Evaluation of CP4 removals Non-responsive content removed [redacted]
Status: WK35/2010 R4 and V6 engine

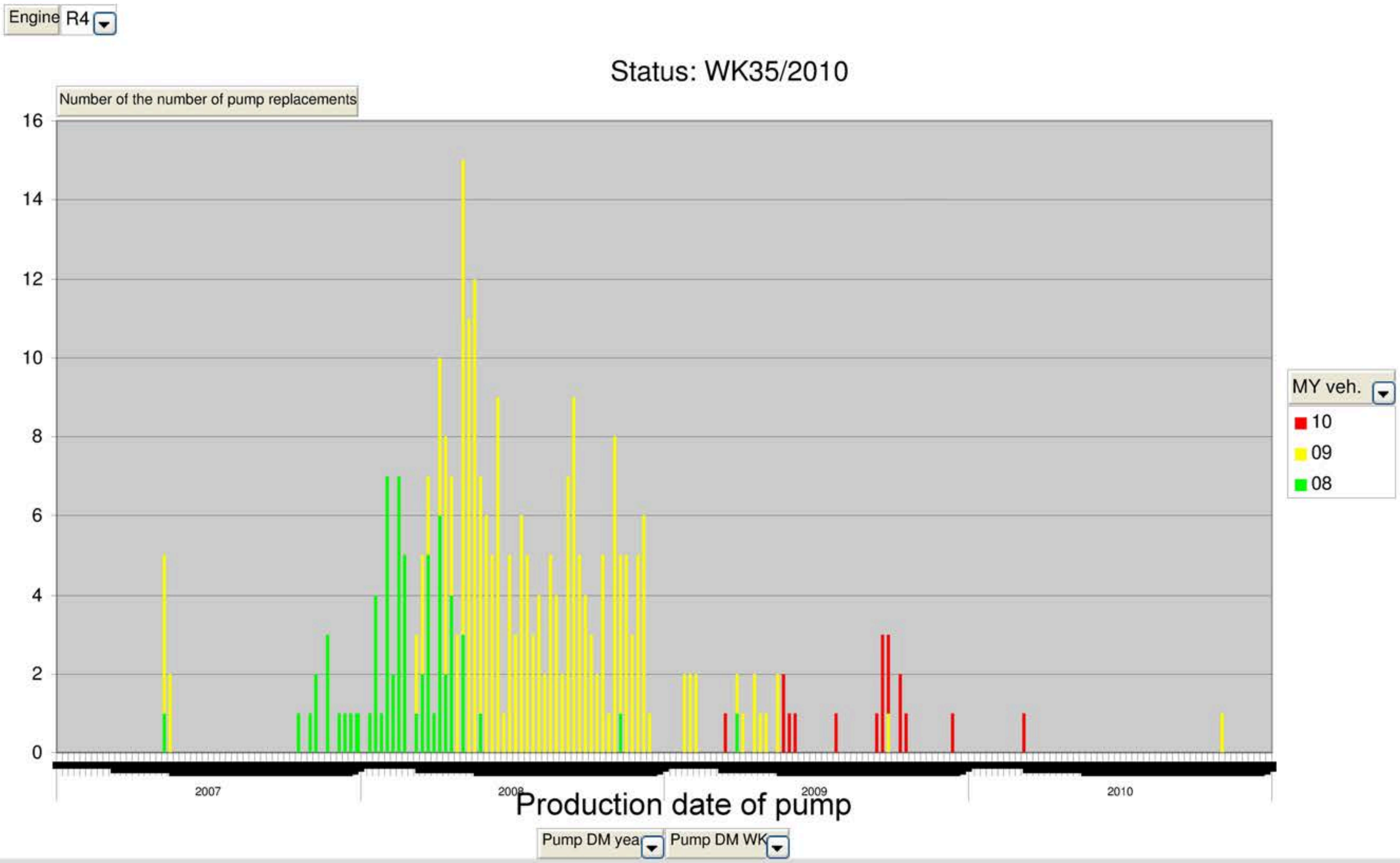


BOSCH

ENTIRE PAGE CONFIDENTIAL

Evaluation of CP4 removals Non-responsive content removed

Status: WK35/2010 R4 engine

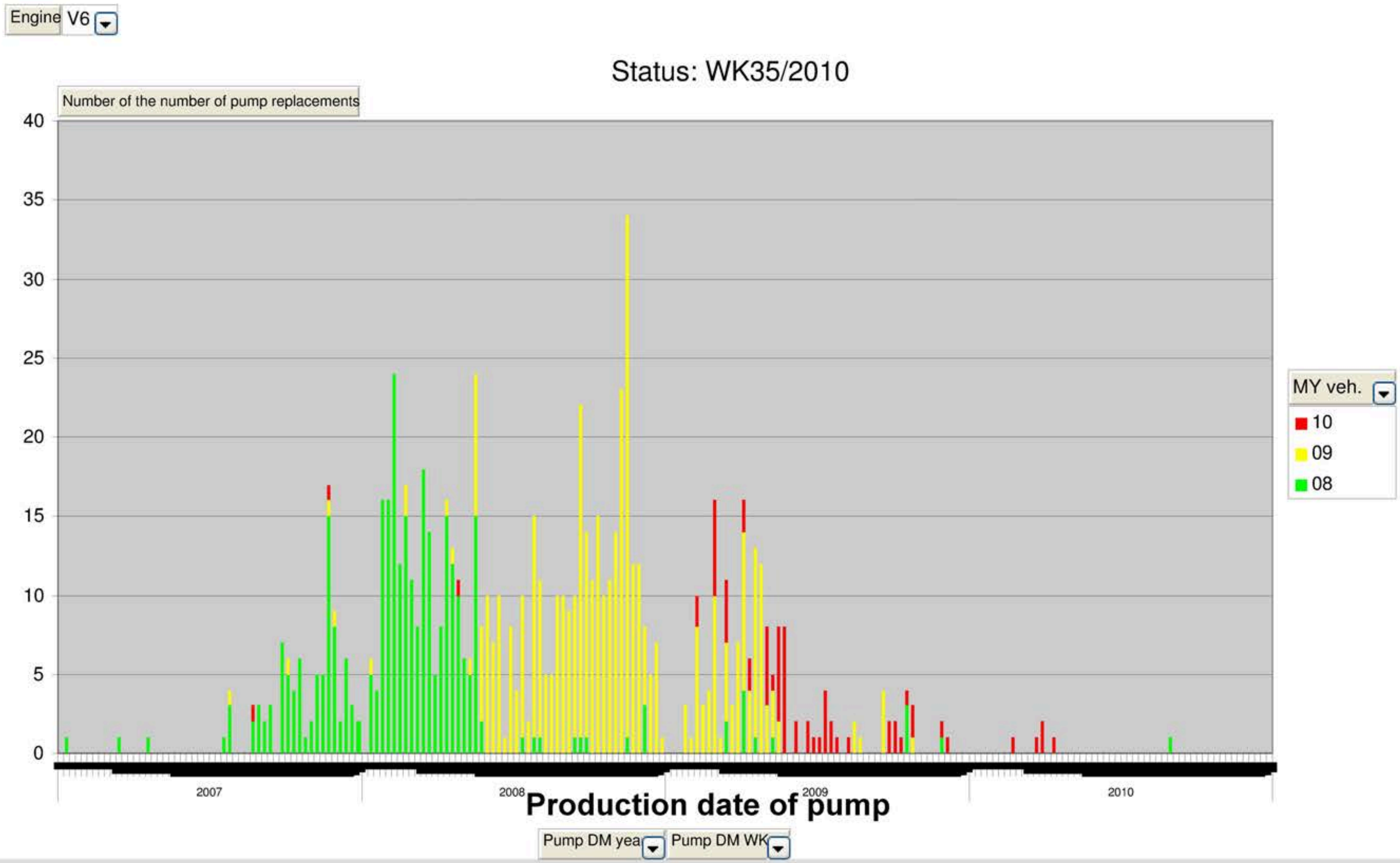


BOSCH

ENTIRE PAGE CONFIDENTIAL

Evaluation of CP4 removals Non-responsive content removed

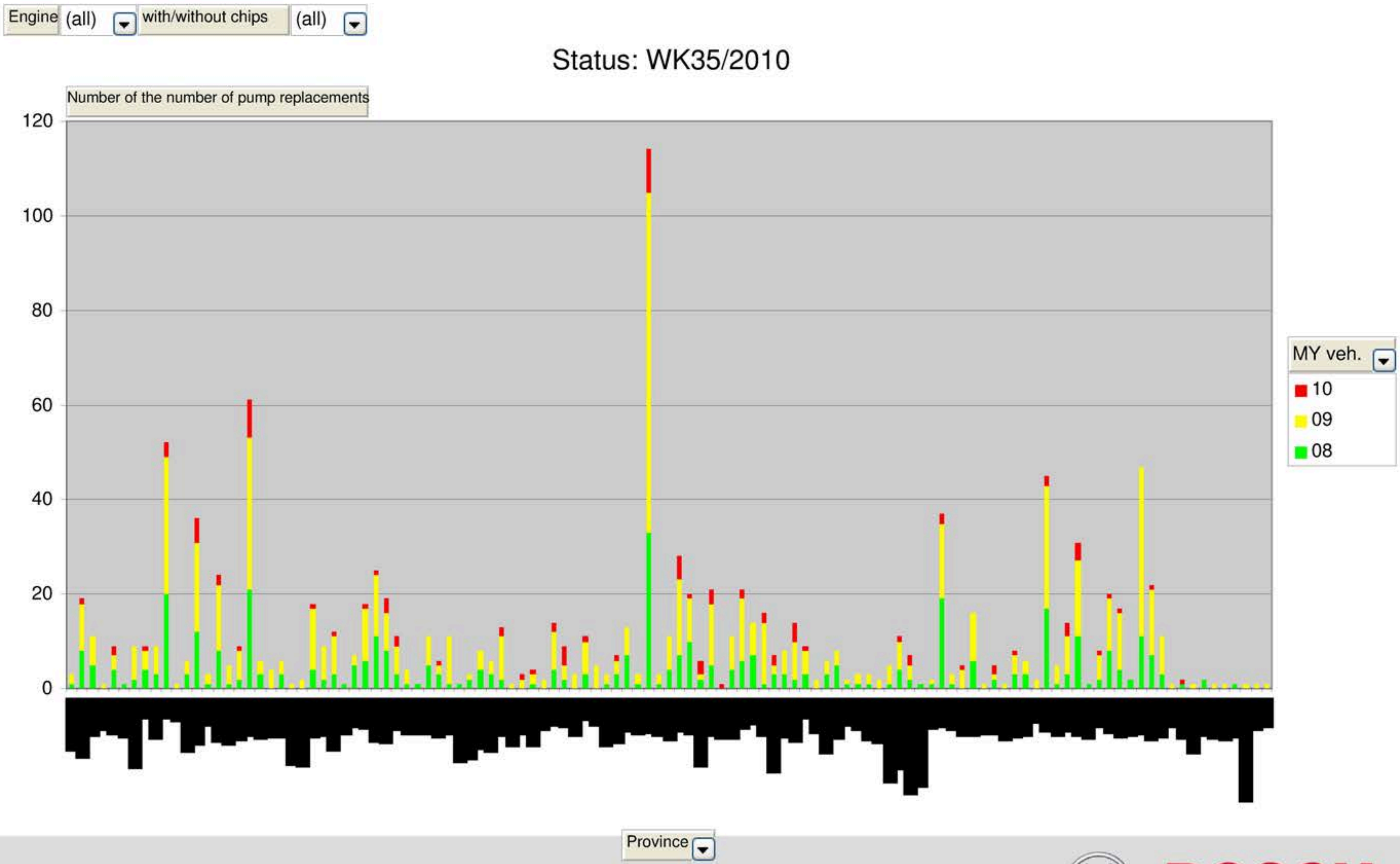
Status: WK35/2010 V6 engine



BOSCH

ENTIRE PAGE CONFIDENTIAL

Evaluation of CP4 removals Non-responsive content removed
Status: WK35/2010 R4 and V6 engine



[redacted]

BOSCH

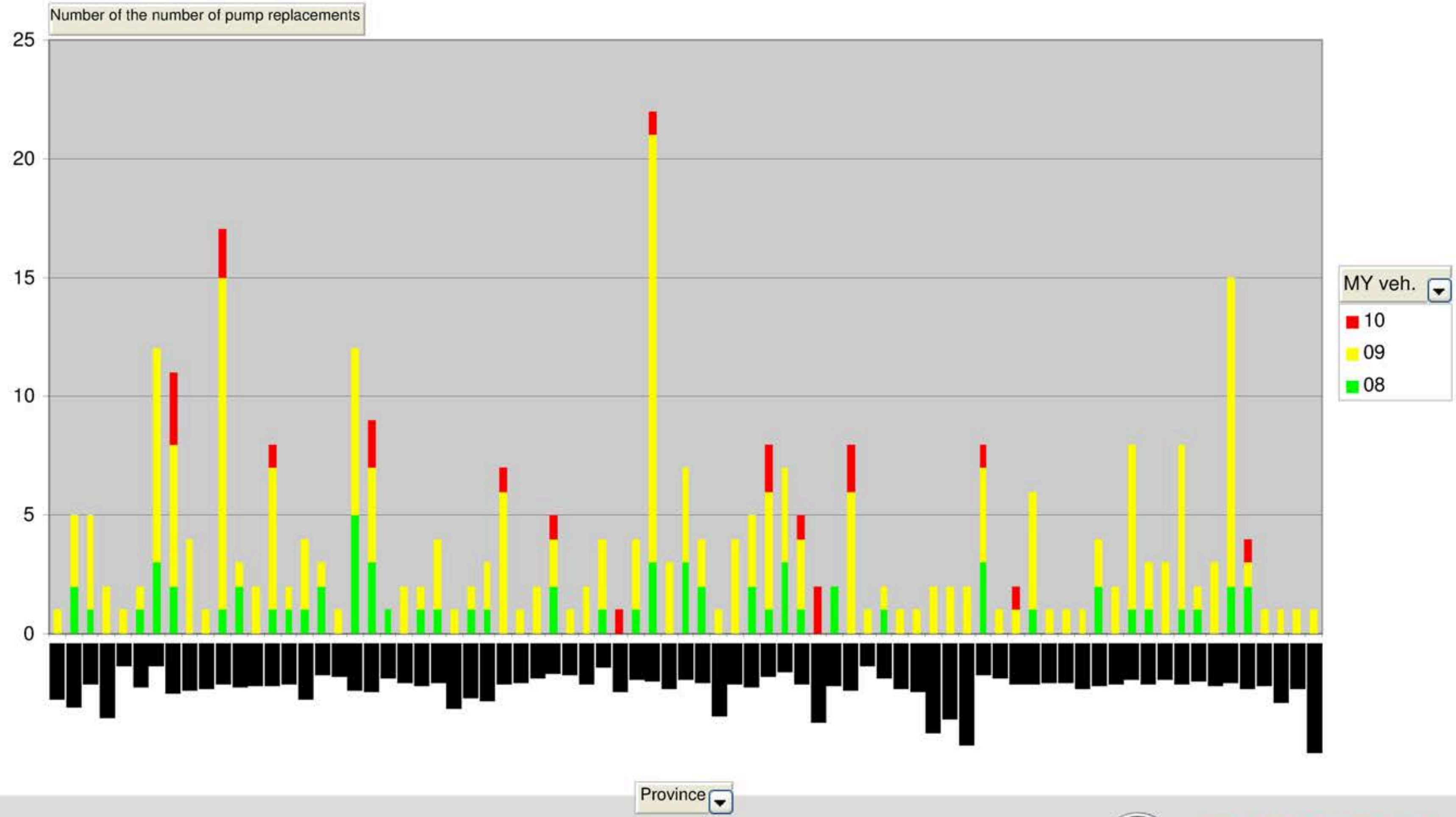
EA11003EN-01848[7]

ENTIRE PAGE CONFIDENTIAL

Evaluation of CP4 removals Non-responsive content removed
Status: WK35/2010 R4 engine

Engine R4 | with/without chips (all)

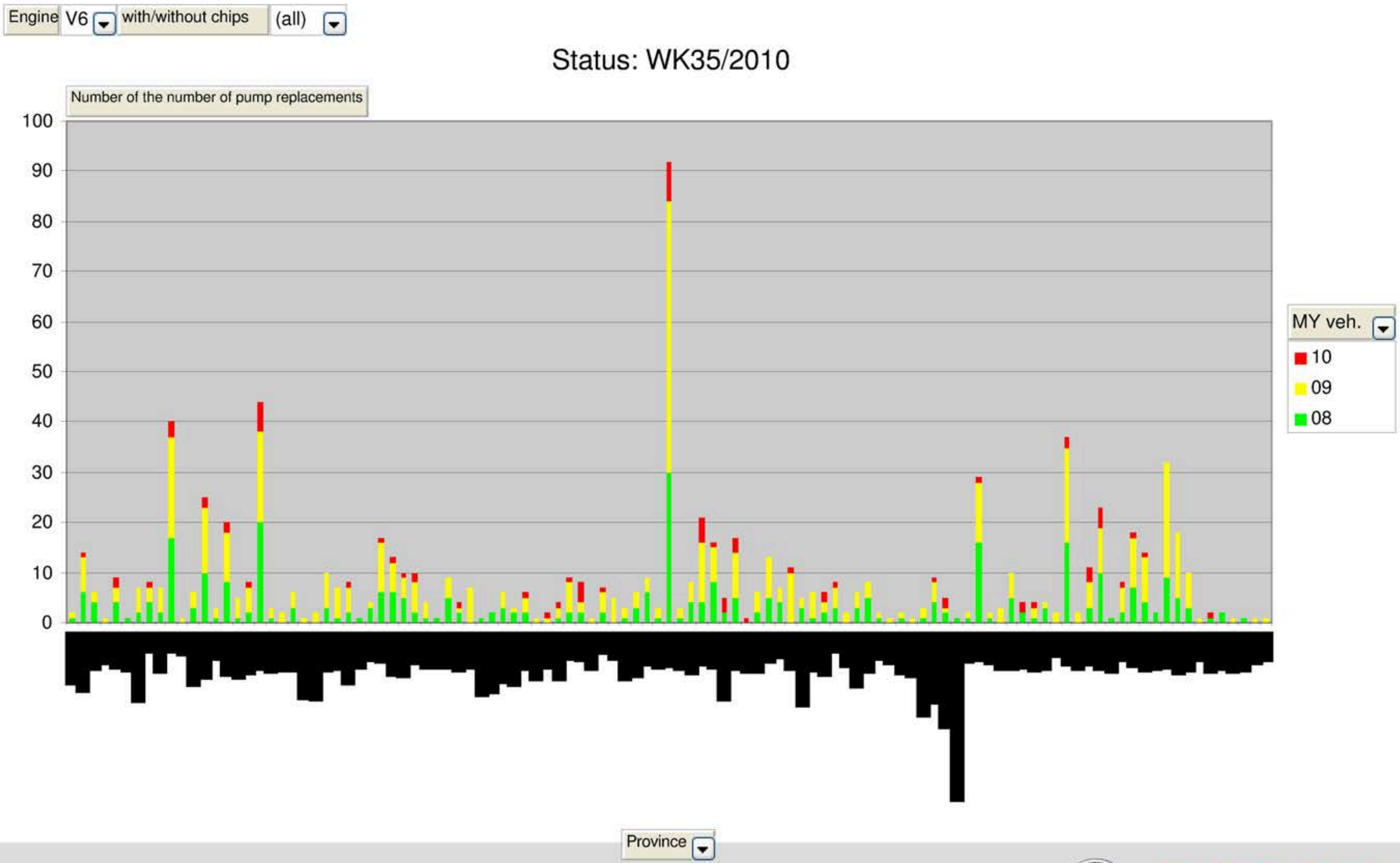
Status: WK35/2010



BOSCH

ENTIRE PAGE CONFIDENTIAL

Evaluation of CP4 removals Non-responsive content removed
Status: WK35/2010 V6 engine



BOSCH

ENTIRE PAGE CONFIDENTIAL

From: Non-responsive content removed [redacted]
To: [redacted]
CC: [redacted]

Date: 03.18.2008 1:59:01 PM
Subject: Preliminary analysis result: Failed pump on-field VW US07
Attachments: Alle_Triebwerk_gesamt_Stand_080317.pdf

Dear Non-responsive content removed [redacted]

The drivetrain damage is confirmed by us.
The camshaft shows a deep groove in the middle.
It can be seen on the camshaft pendulum motions as well as the final 90° turn of the roller tappet. The roller shows several braking flats.
In the area of tappet hole of the housing, deposits to be analyzed later were found. The metering unit including O-ring is subjected to a detailed analysis in Waiblingen.
The roller support assembly is also subjected to a detailed analysis. The analysis results will be submitted to you - ASAP.

Please notify us the result of your fuel analysis.

The attached slide shows the status of the "drivetrain damage" issue based on the date of manufacture of the pumps.

<<Alle_Triebwerk_gesamt_Stand_080317.pdf>>

Mit freundlichen Grüßen / Best regards

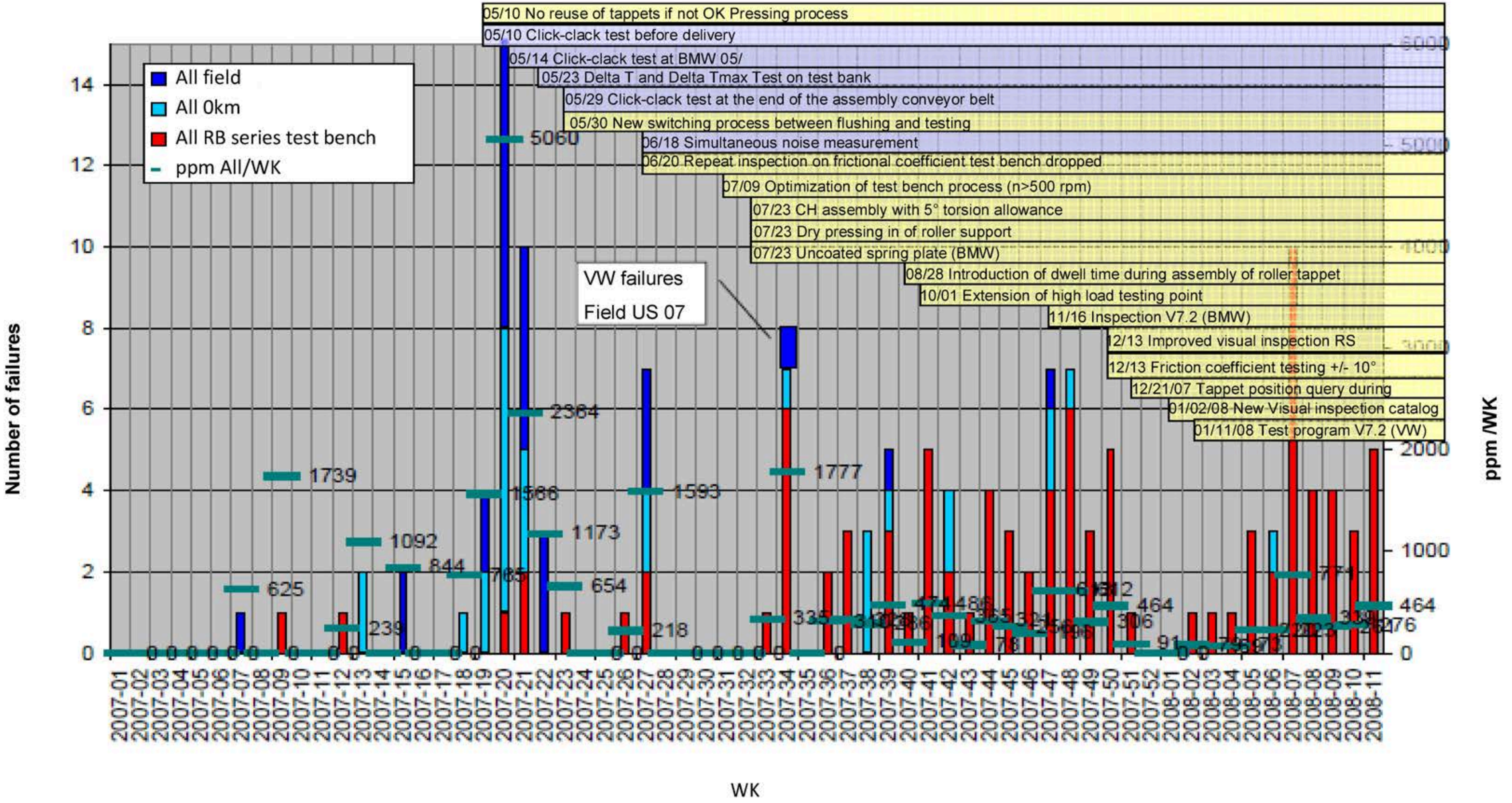
Non-responsive content removed [redacted]

Robert Bosch GmbH
Non-responsive content removed [redacted]

ENTIRE PAGE CONFIDENTIAL

ENTIRE PAGE CONFIDENTIAL

Failures due to drivetrain damages FD-WK

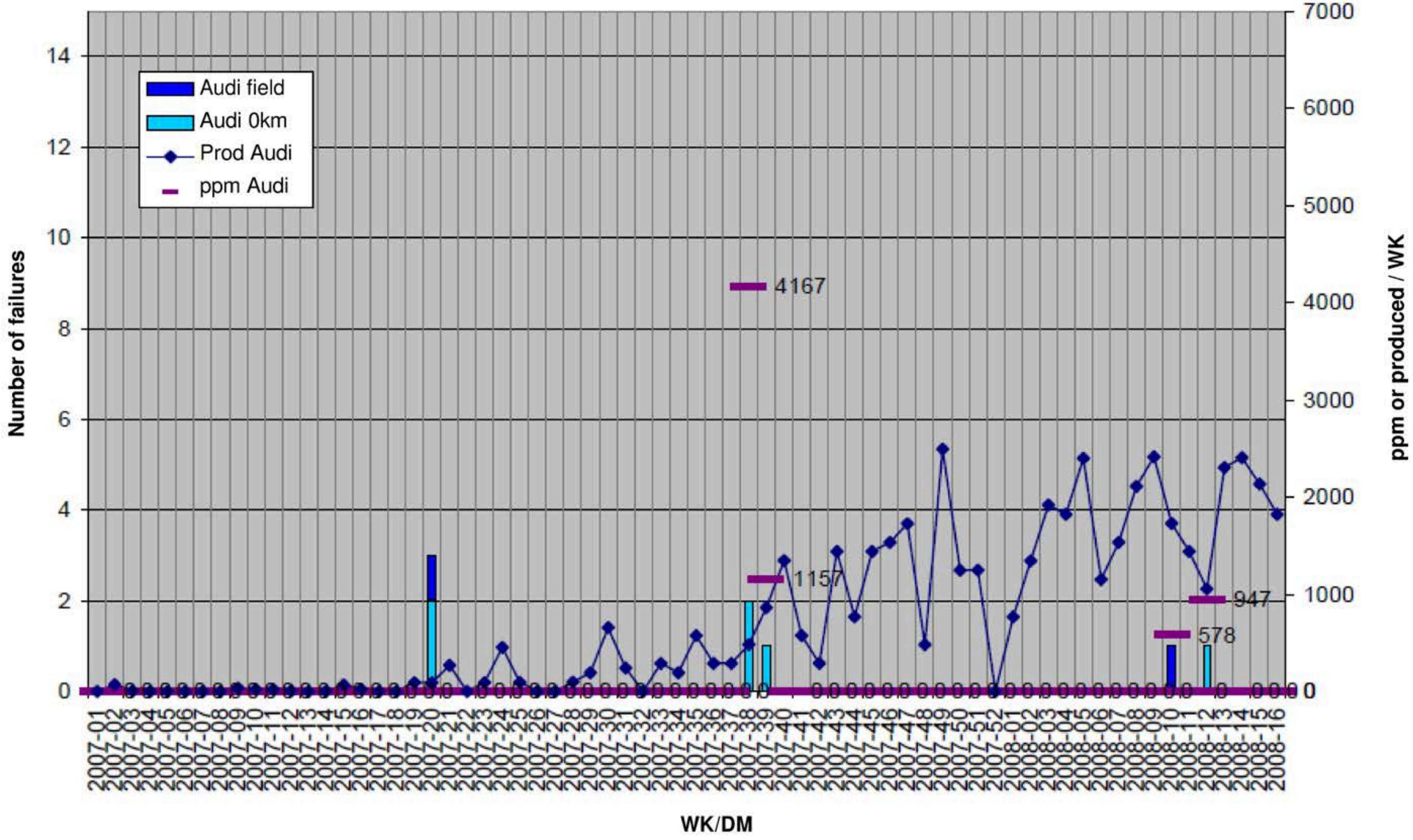


Non-responsive content removed

Status as on: 3/17/2008

ENTIRE PAGE CONFIDENTIAL

Failures drivetrain damage
-611/-613 (Audi) / DM-KW

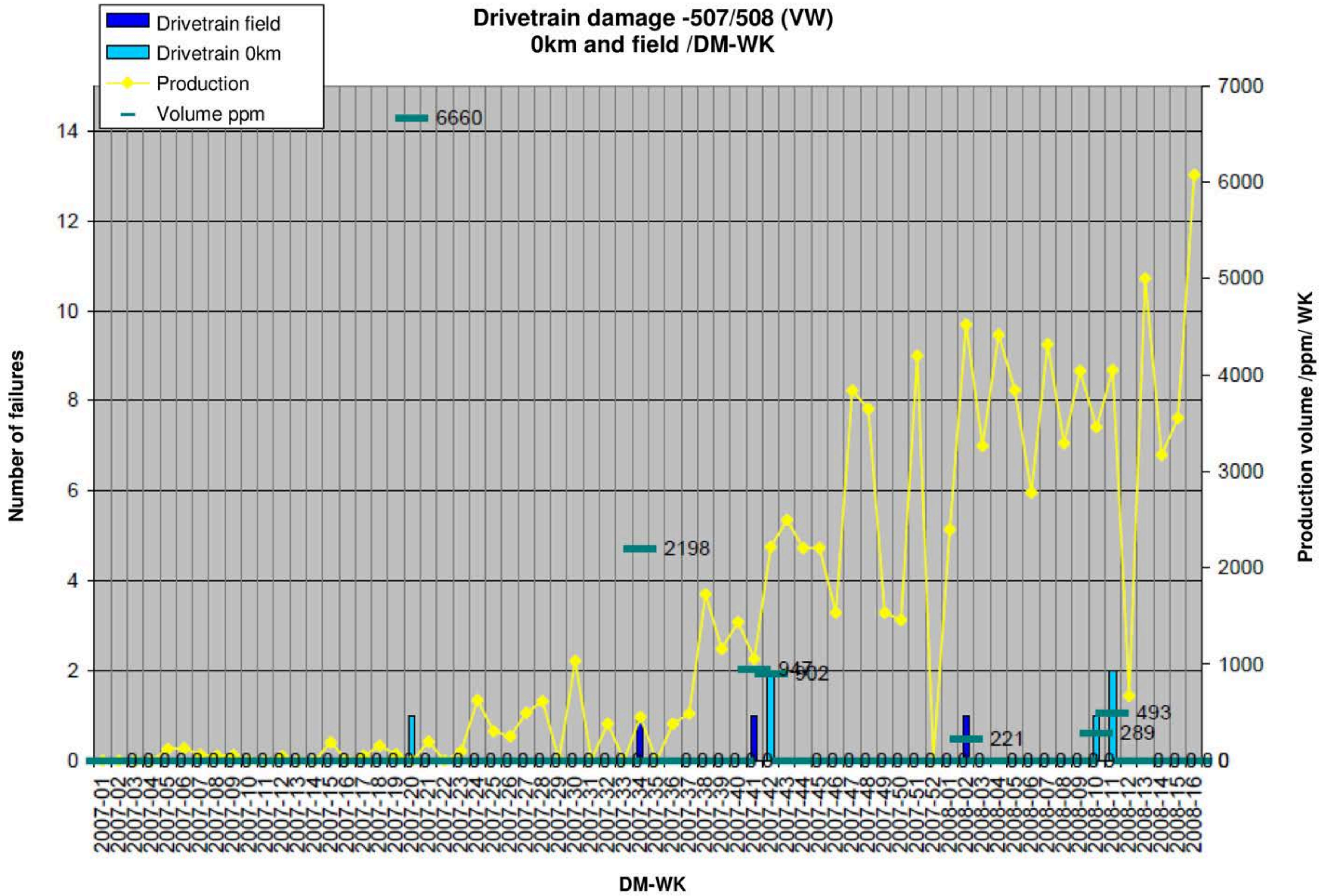


Non-responsive content removed

Status: 4/21/2008

EA11003EN-02029[0]

ENTIRE PAGE CONFIDENTIAL



Non-responsive content removed

Status: 4/21/2008

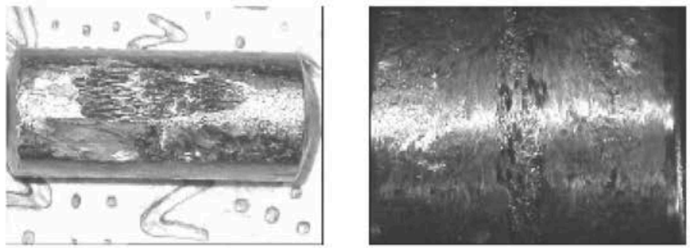
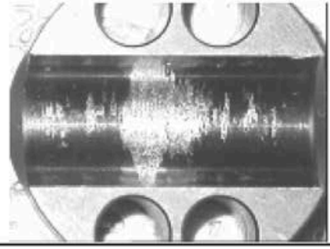
0km complaints

Scope of defect
(current failures March / April)

0km 3x pump 0445010507 / 03L130755 (a)

1x pump 0445010611 / 059130755AB (b)

- Pumps DM a) 1x 03.05.2008 | b) 1x 03.19.2008
  1x 03.10.2008
  1x 03.11.2008
- Failure date: a) 03.14., 03.17., 03.18.2008
  b) 04.06.08
- GR Bosch: 03.25.08 (a), 04.14.08 (b)

Pictures of pump DM 03.10.2008, failure patterns of all pumps are similar

Description of problem

- Failure on Audi final function test rig
  (Cold test) with noise and rail pressure fluctuations or no fuel pressure

BOSCH

On-field complaints

Error scope (current failures April)

- Field: 1x pump 0445010507 / 03L130755
  1x pump 0445010611 / 059130755AB
- DM and mileage
  - 1x 01.11.2008; 25 km (Non-responsive content removed [redacted] A4 2,0l)
  - 1 x 03.03.2008; 6 km (Non-responsive content removed [redacted], VOT-operating mode, A4 2,7l)
- Failure date: 03.26.2008, 04.08.08
- GR Bosch: 04.14.2008, 04.17.2008

Description of problem

- Engine does not start up
- Engine stopped while driving

Cause analysis

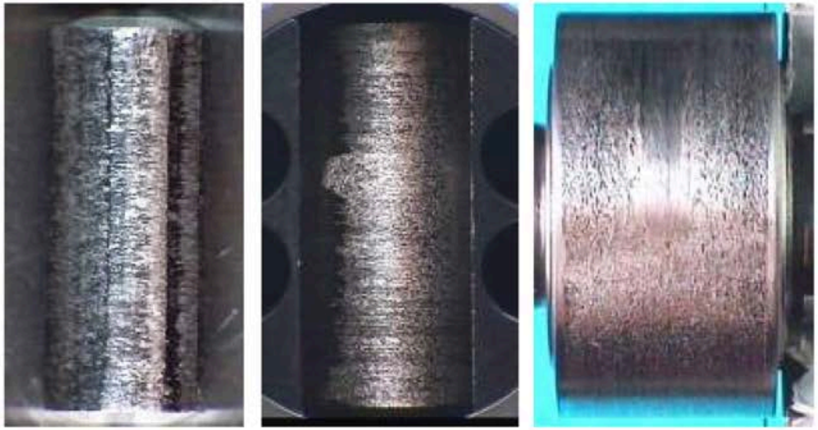
- Excessive wear of the cam and the roller
- Possible damage profile: Increased friction between the roller and roller support leads to slip between the roller and cam. This causes damage to the cam, roller and roller support and turned tappet.

BOSCH

CP4.x - AUDI customer complaints/ Drivetrain damage Feuerbach plant

Error scope (previous failures)

- 0km: 5x Pump 0445010611/ 059130755AB
- DM 2x 05.14.2007
  2x 09.20.2007
  1x 09.28.2007
- WE 07.06.07/ 10.26.07/ 11.07.07/ 11.14.07



Description of problem

- Vehicle stop switch
- Injectors contaminated with particles

Cause analysis

- Excessive wear on the entire lateral surface of all rollers and camshafts
- Diameter of the rollers is greatly reduced, so that they cannot be held by the roller support any longer

BOSCH

EA11003EN-02030[3]

Overall measures since SOP:

- Analysis of assembly and handling processes performed in Dresden on 07.12.2007. Result: Commissioning conditions not according to specification. Commissioning of the vehicles were changed immediately

- Optimization of Bosch test bench sequence by raising the starting speed from 200 rpm to 500 rpm.

D: 07.09.07 completed

- Cylinder head assembly with 5° torsion allowance

D: 07.23.07 completed

- Dry pressing in of roller support

D: 07.23.07 completed

- Introduction of dwell time in assembly of tappet assembly

D: 08.28.2007 completed

- Extension of high-load testing point

D: 10.12.2007 completed

BOSCH

Measures

- Improved visual check of roller support for new visual check catalog
  D: 12.13.2007 completed

- Friction coefficient test +/- 10° for better testing of the main load area of the roller support
  D: 12.13.2008 completed

- Introduction of tappet position query using laser for secure alignment of the tappet during assembly
  12.21.2008 completed

- Introduction of a new test program for CP4.1 VW with tighter testing conditions, namely
  - Starting with a steeper speed ramp to cause drivetrain damage internally and not at the customer
  - Critical load points (1,800 bar) are placed from the end of the test sequence to the start of the test sequence, so that drivetrain damage can be detected better.
  - Elimination of the flushing nozzle, thus detection of not OK rail pressures even during flushing of the pump and omission of the critical switching procedure from flushing to measurement.
  - Flushing operation has been made more intense from a state of 300 bar and 2,500 rpm to 1,800 bar and 3,375 rpm

  D: 01.11.2008 completed

BOSCH

Measures

- Introduction of visual check of roller support with techno scope instead of magnifier for better detection of metal spatter
  D: 02.04.2008 completed
- Introduction of a new test program for Audi CP4.2 with stricter testing conditions similar to VW CP4.1, D: 02.05.2008 completed
- 100% straightedge testing of roller to detect elevations of the roller; since the introduction of the test, parts are found. Parts are used for large-scale test.
  D: since 04.01.2008 in parts production, from 04.07.2008 in pump
- Measures currently in testing C coating:

Roller support (RS):

1. Reduction in the valances impact, trial with 480 RS batch; first result positive; Result: FIB cut did not show any metal spatter, then step 2.

BOSCH

Measures

Measures currently in testing C coating:

Roller support (RS)

2. Reduction in the valances impact, trial with 2880 RS batch;

   If the result is positive, Audi agrees to the switchover of the C coating process;

   Result: The result of the whole batch with 2880 pieces showed only a metal spatter, so clear improvement over the trial batch, hence the C coating series process for the RS is changed;
   Launch date of roller support tentatively on: 04.23.2008;
   Launch date product CP4.1 / CP4.2: after 04.30.2008

Measures currently in testing C-coating:

Roller:

Optimized holder model for roller to prevent fusing

D: Time schedule 04.23.2008

[redacted]

Audi - CP4 drive train damage

US Test with CP4.2 for V6 BIN5

- 3 failures in quality assurance (2 x Q7, 1x Touareg)
- **Analysis:** Probably stiff roller; cause is no longer detectable
- Preventive replacement measure (in Germany): 1 of 6 pumps show abnormality at roller
  Action: Tests for damage reproduction WK32; RB

BOSCH

[redacted]

ENTIRE PAGE CONFIDENTIAL

Audi - CP4 drive train damage

Testing, quality assurance, on-field CP4.1 & CP4.2 ([redacted] list, pages 5 and 6)

55 Audi & VW worldwide failures (50 field, 4 quality assurance, 1 testing, delivery quantity Audi 125,520)

- 22 complaints in [redacted] (VW & Audi) — Delivery quantity Audi 2,154 / VW unknown
  - 15 CP4.2 (12xAudi, 3xVW) — Delivery quantity Audi 430 / VW unknown
  - 1 CP4.1 Audi — Delivery quantity 1724
  - 6 CP4.x Audi — Delivery quantity unknown

3 [redacted] pumps submitted: 3 x drivetrain damage, detailed analysis — WK32; RB

- 9 complaints in [redacted] (VW & Audi) — Delivery quantity 478 (only Audi)
  - 9 CP4.2 (5 x Audi, 4 x VW) — Delivery quantity 478 / VW unknown
  - 0 CP4.1

2 [redacted] pumps submitted: 1 x suspected cam fatigue (overload); detailed analysis WK32, RB

Action: Organize VW delivery quantities — WK32; RB

[redacted]

ENTIRE PAGE CONFIDENTIAL

Audi - CP4 drive train damage

Hypotheses & Activities

1) Water in fuel

Analysis: No corrosion observed on pump components

Action: Basic test with splash water — WK 32, RB

analysis of fuel filters & fuels for moisture content — Audi/ RB

2) [redacted] -> Fuel characteristics (steroyl glucosides)

Unlikely, because [redacted] does not use biodiesel

Fuel analysis (SGS Survey) from winter 2006/2007 and 2007 [redacted] and [redacted] do not show any indication of similarities / abnormalities with regard to the fuel properties in these countries

Procurement (steroyl glucosides) for basic tests — a.s.a.p.; RB

3) Air in the fuel (false air in the system)

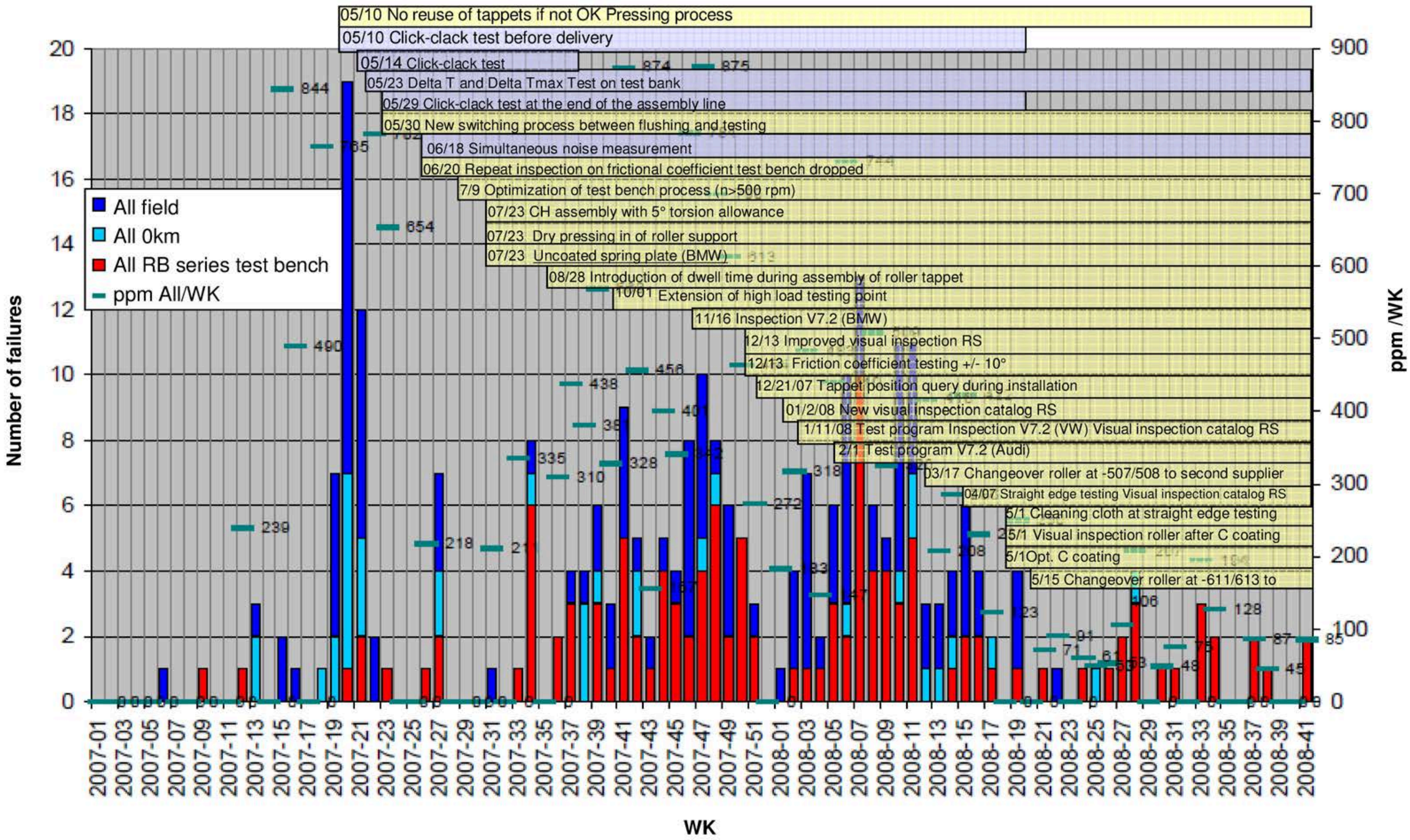
Basic test with a high proportion of air — WK32; RB

4) CT analysis of vehicle system (4 vs. 6 cylinder, application, load pattern), WK 32; RB
(comparison of CP4.2 with CP4.1 operating conditions, fitting, drive)

5) Analysis of fuels in and around [redacted] — a.s.a.p.; RB

BOSCH

Failures due to drivetrain damage DM WK

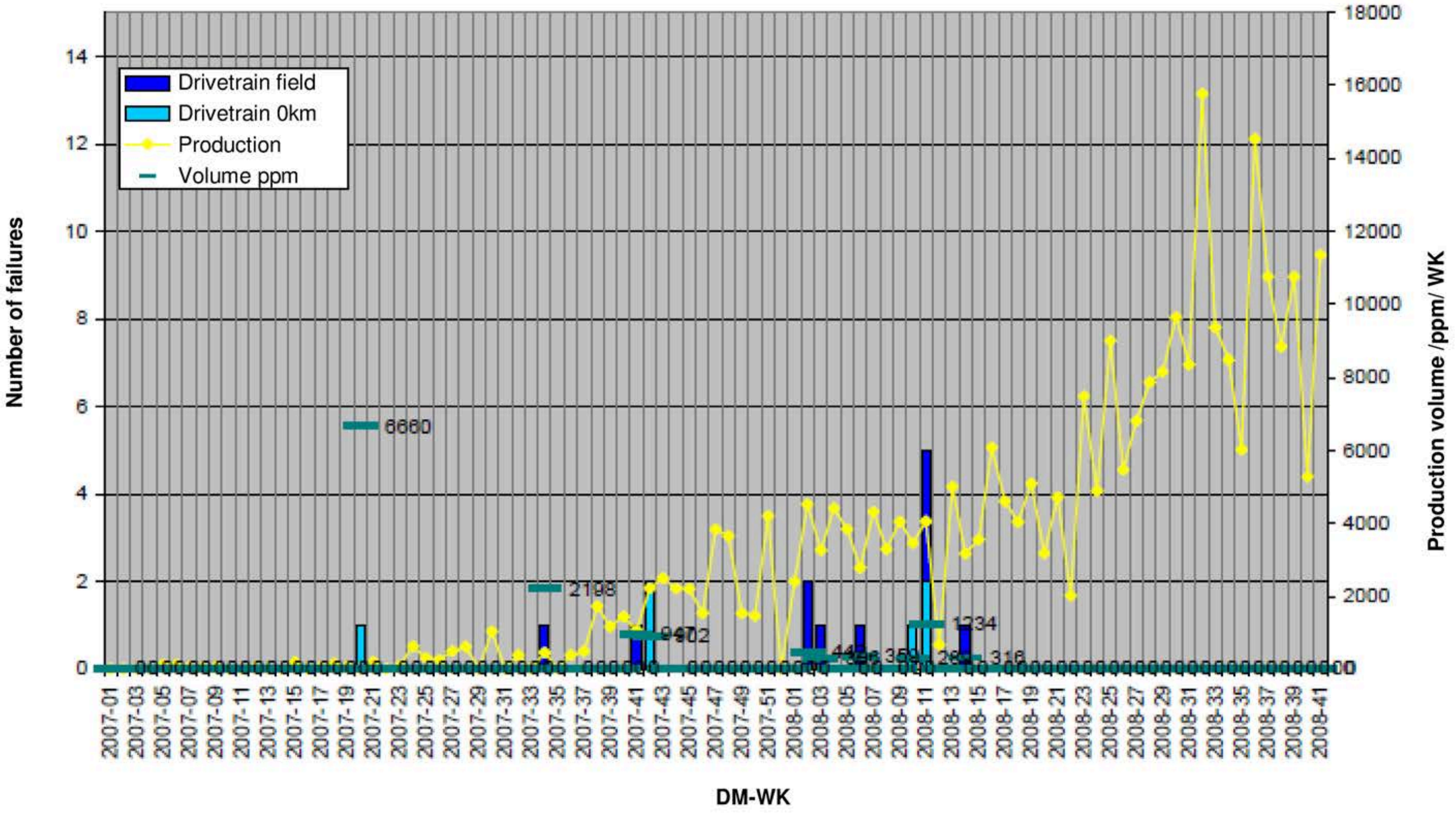


Status: 10/15/2008

Non-responsive content removed

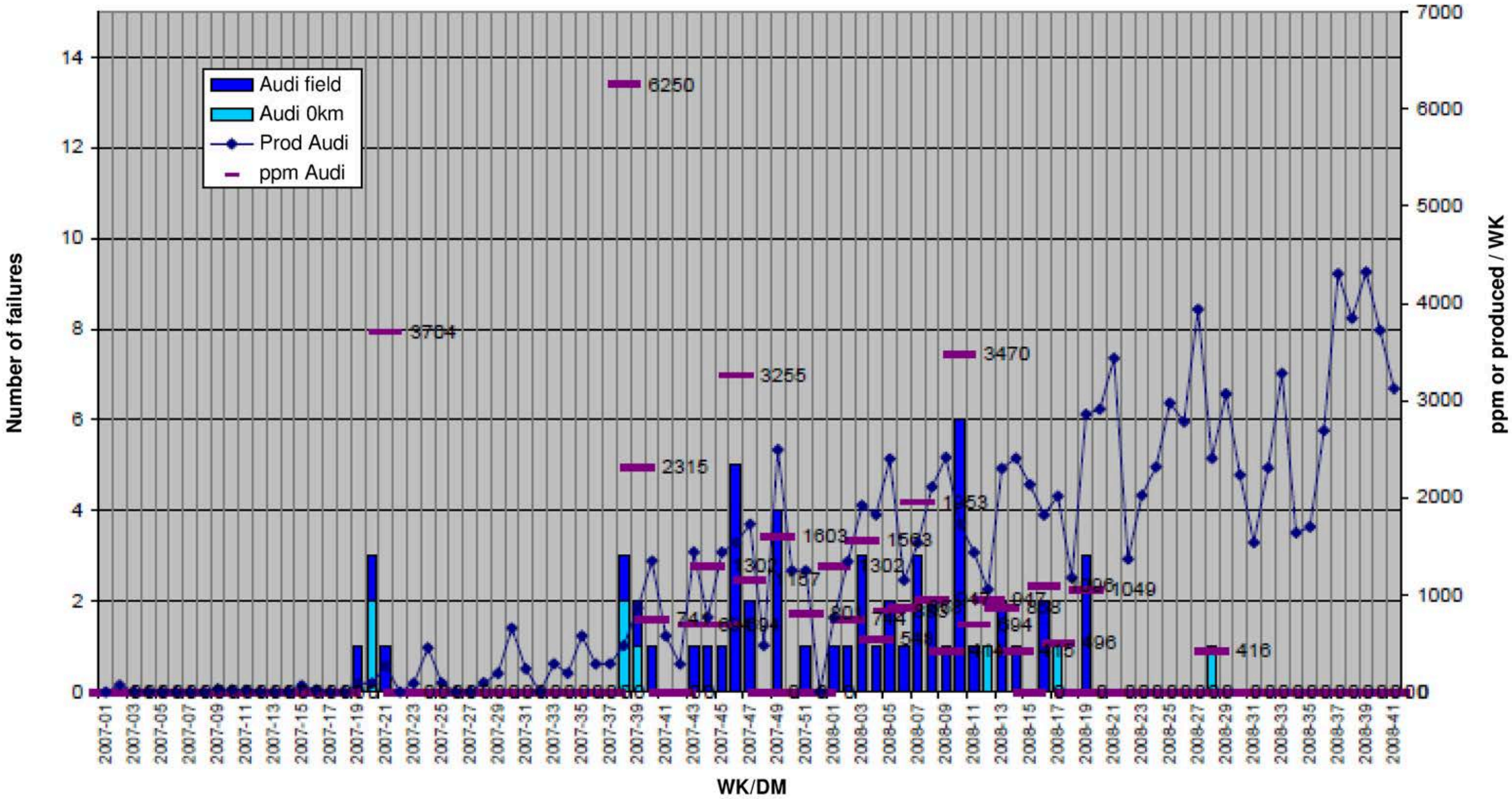
ENTIRE PAGE CONFIDENTIAL

Drivetrain damage VW/Audi CP4.1(-507/508)
0km and field /DM-WK



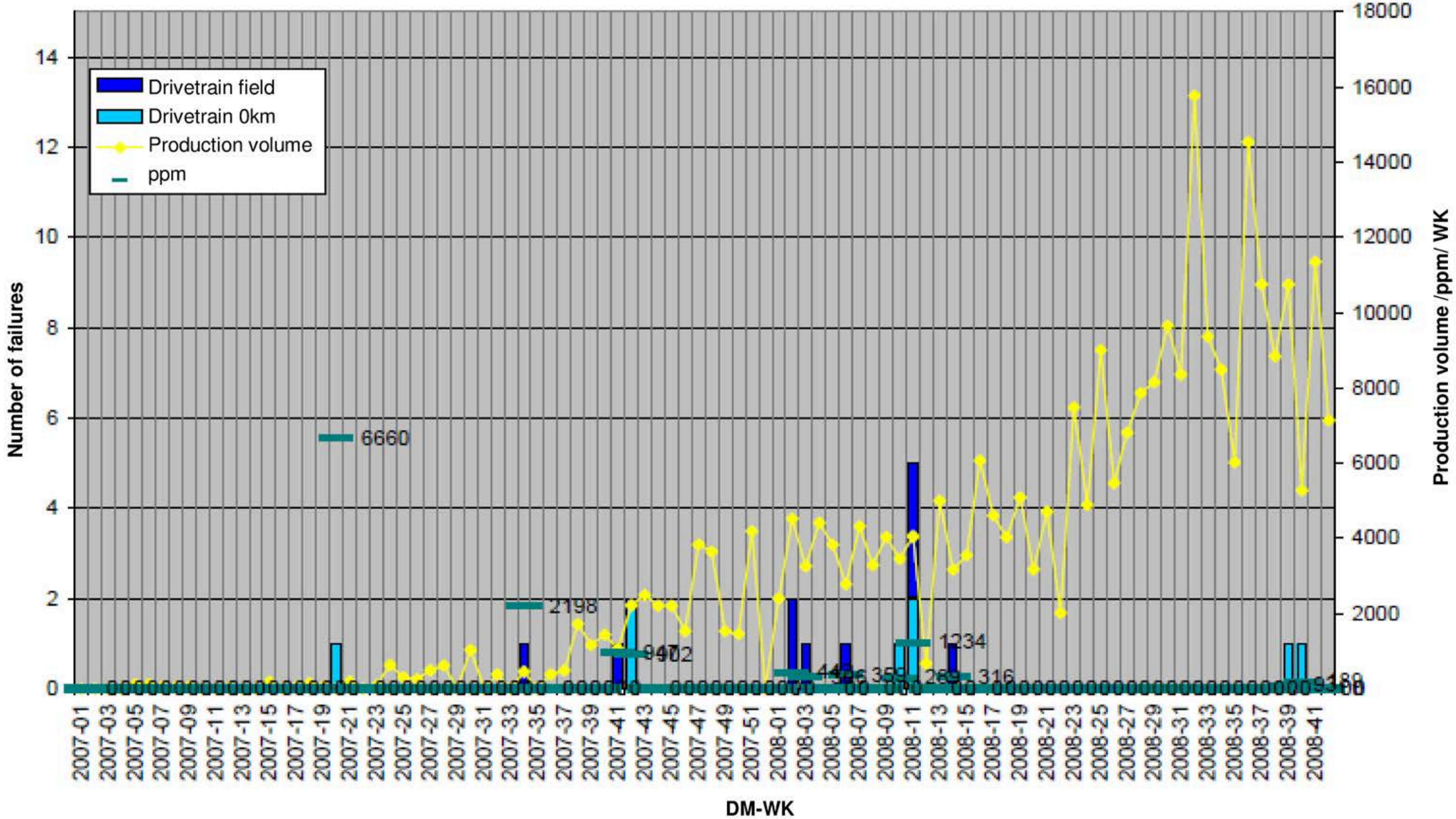
Non-responsive content removed

Drivetrain damage VW/Audi CP4.2 (-611/613)
0km and field /DM-WK



ENTIRE PAGE CONFIDENTIAL

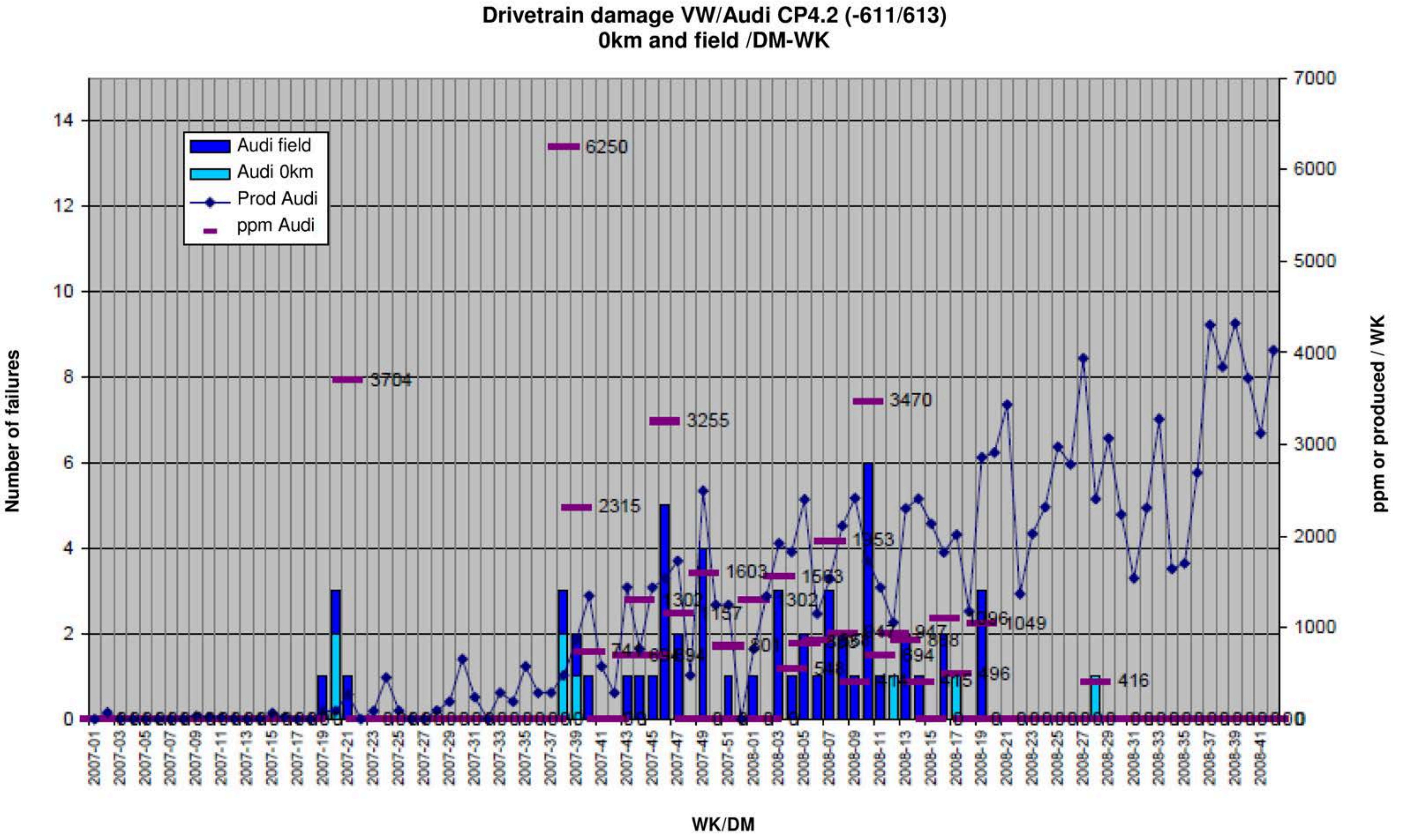
Drivetrain damage VW/Audi CP4.1(-507/508)
0km and field /DM-WK



[redacted]

Status: 10/20/2008

ENTIRE PAGE CONFIDENTIAL



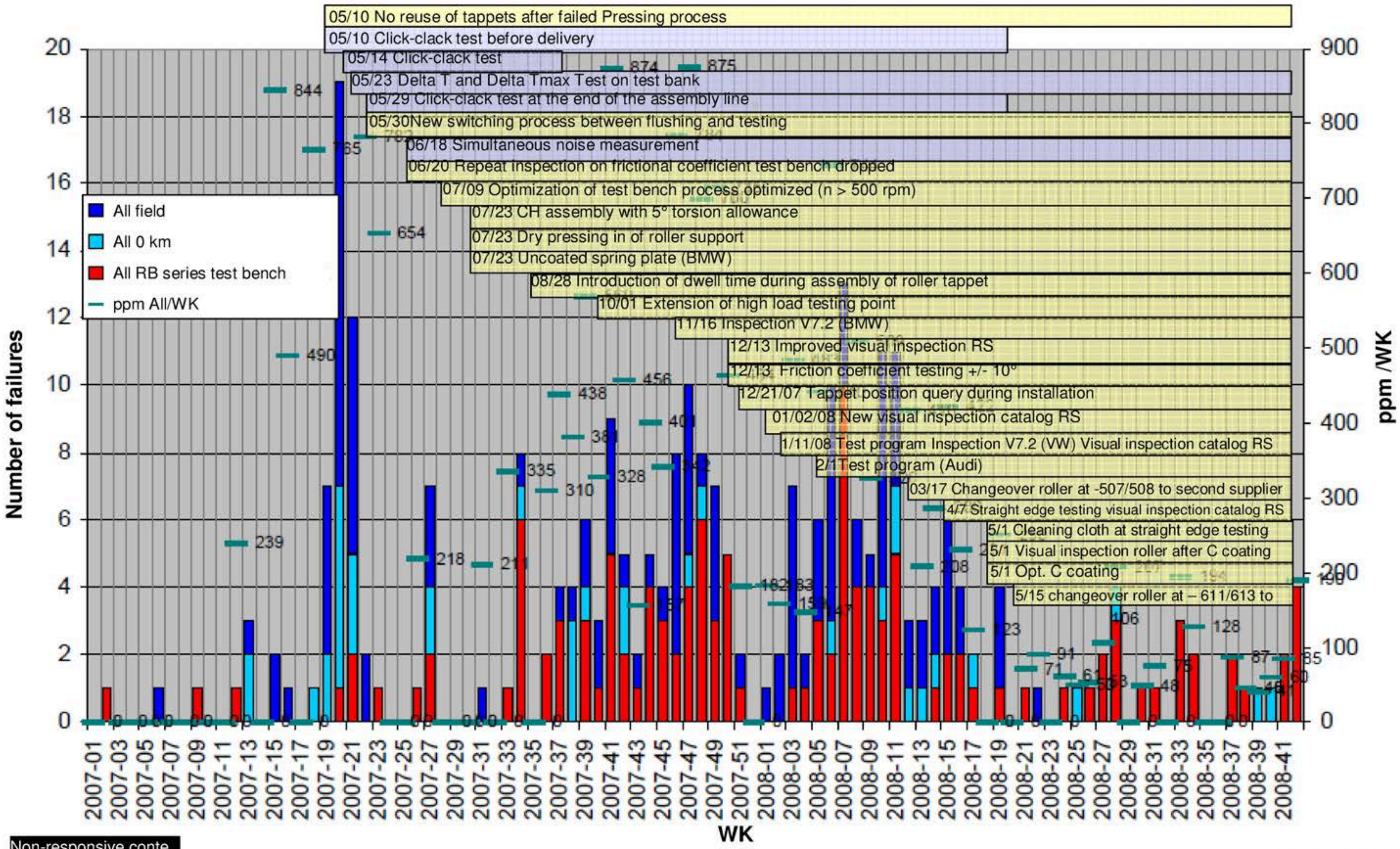
[redacted]

Status: 10/20/2008

EA11003EN-02046[0]

ENTIRE PAGE CONFIDENTIAL

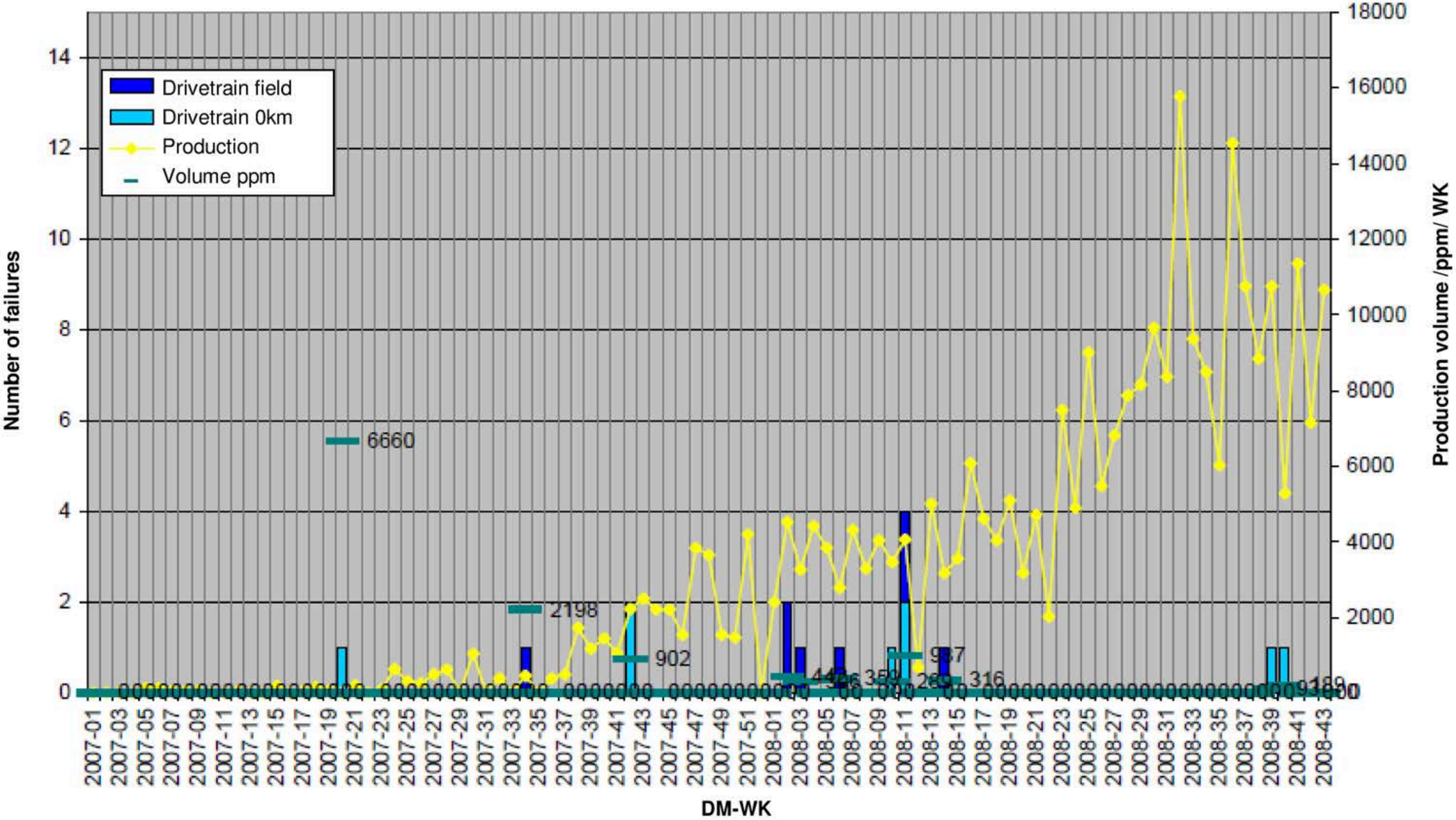
Failures due to drivetrain damage DM-WK



Non-responsive conte nt removed

Status: 10/20/2008

Drivetrain damage VW/Audi CP4.1 (-507/-508 or 03L 130 755 / 03L 130 755 A)
0km and field /DM-WK

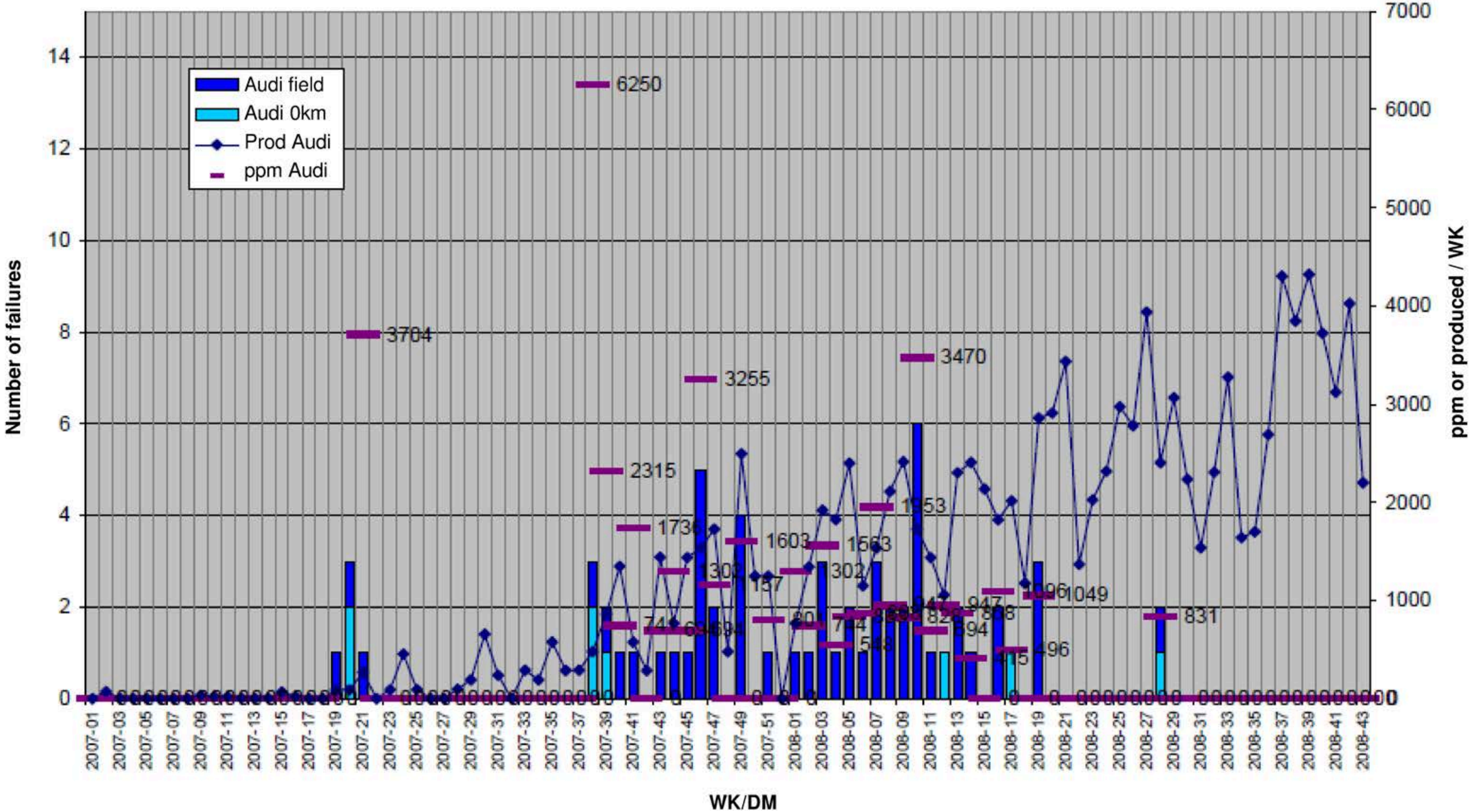


[redacted]

Status: 10/30/2008

ENTIRE PAGE CONFIDENTIAL

Drivetrain damage VW/Audi CP4.2 (-611/613 or 03L 130 755 AB / AG)
0km and field /DM-WK



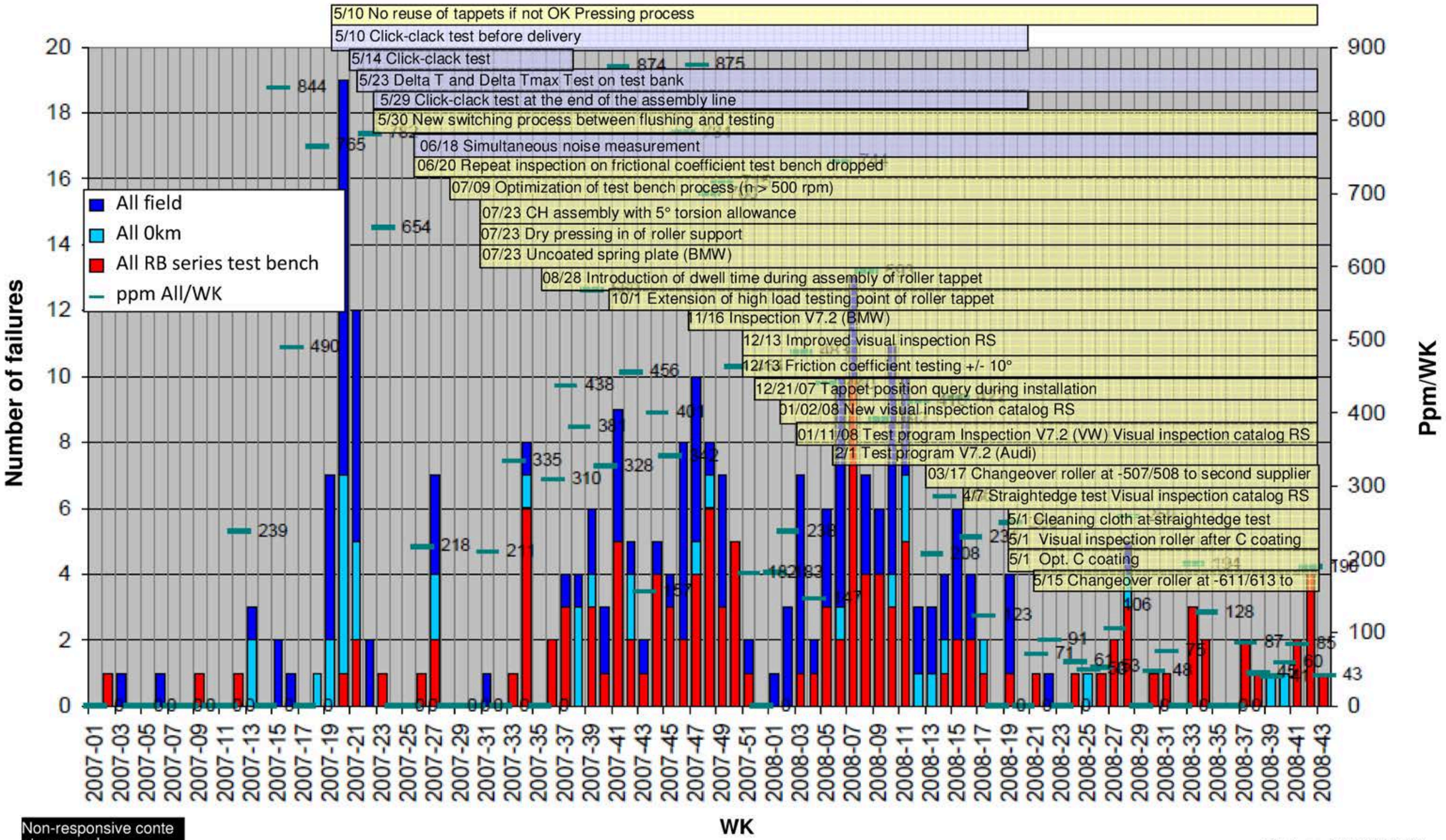
[redacted]

Status: 10/30/2008

EA11003EN-02050[0]

ENTIRE PAGE CONFIDENTIAL

Failures due to drivetrain damage DM-WK



Non-responsive conte nt removed

Status: 10/30/2008

EA11003EN-02052[0]

ENTIRE PAGE CONFIDENTIAL

Drivetrain damage in CP4 high-pressure fuel pump

Keyword - Failure location	Country of failure	Vehicle No.	Part No. Audi/VW	RB no.	QTS-/ AV3 no.	IQIS no.	QMM3 Pump in FeP	Task force no.:	Failure location: Field	test Q-AL	Vehicle work	Hot test	Cold test	Veh.: VW	Skoda	Veh. plant: AU	A3	IN A4	NSU A4	IN A5	NSU A6	Puebla	Emden	WOB	DD	Brat.	Engine: R4 2.0l	V6 2.7l	V6 3.0l	V6 3.0l BIN5	Pump factory: FeP	JhP	ML pump: ML1	ML2	ML3	ML4	DM pump	DM vehicle	allowed date	Failure-/ Assumption date	Rep. date	km status	Roller Nogushi Güntert	Right roller only 2 pistons	Comment / complaint	Additional information: TS cat. (R/L)	Fuel sample	max. coefficient of friction new left tappet (or CP4.1)	max. coefficient of friction new right tappet	average coefficient of friction tappet with fuel sample	kinematic viscosity Audi	Diagnosis results/ comment
[redacted]			03L 130 755	507	AV3 1180937	BSA000001209-001	4VW09						[redacted]														[redacted]				FeP		01-0055				10/20/2007					0	Nog.	n.a.	[redacted]	1	-	0.0047				[redacted]
			03L130 755	507	AV3 1180937	BSA000001210-001	4VW10																								FeP		01-0595				10/15/2007					0	Nog.	n.a.		2	-	0.0016				
			03L 130 755	507	2943784	WIA000001838-001	4VW80	210																							FeP		01-0260				3/5/2008					0	Nog.	n.a.		1	-	0.0098				
			03L 130 755	507	2949867	WIA000001840-001	4VW81	211																							FeP		01-0540				3/11/2008					0	Nog.	n.a.		1	-	0.0142				
			03L 130 755	507	2949867	WIA000001840-002	4VW82	212																							FeP			02-0272			3/10/2008					0	Nog.	n.a.		1	-	0.0079				
			03L 130 755 A	508	?	IGH000000105-001	4VW02	49				X																			FeP		010456				5/15/2007					0	Nog.	n.a.		1	-	No values				
		Engine CAR003060	059 130 755 AB	611	2801936	WIA000001637-001	4VW09	149				X																		X		FeP		01-0901				9/28/2007					0	Nog.	Nog.		1	-	0.0047				
		Engine CAS022611	059 130 755 AB	611	2969671	WIA000001879-001	4A13	234			X					X										X			X		FeP		01-0078				3/19/2008					0	Nog.	Nog.		1	-	No values				

EA11003EN-02052[1]

ENTIRE PAGE CONFIDENTIAL

Parts not available in-house:

[redacted]

			Filter + fuel Filter																										
7LZ9D004674	059 130 755 AB	611	VW Touareg		X	X									X			X						[illegible]	10/[illegible]/2008		[illegible]	214	
7LZ8D054404	059 130 755 AB	611	VW Touareg		X	X									X			X						1/25/2008	2/6/2008		8/11/2008	24,000	
7LZ8D054806	059 130 755 AB	611	VW Touareg		X	X									X			X						1/28/2008	3/5/2008		11/25/2008	15,188	
7LZ9D008690	059 130 755 AB	611	VW Touareg		X	X									X			X						6/24/2008	8/30/2008		1/12/2009	5,578	
4LX8D052548	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X	[redacted]					2/25/2008	3/27/2008		4/29/2008	2,720	
8T08A045409	059 130 755 AB	611	A5 2.7L TDI	requested	X		X			X							X			01-0429			7/7/2008	5/19/2008	5/30/2008	8/20/2008	9/1/2008	3,324	
4L08D046354	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X											
4L18D044077	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X											
4L18D058416	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X											
4L28D043245	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X											
4L38D053931	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X											
4L48D058099	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X						3/28/2008	4/10/2008		7/3/2008	4,000	
4L58D051002	059 130 755 AB	611	Q7 3.0L TDI	7/30/2008	X		X								X			X			02-0310		2/2/2008	2/15/2008	3/5/2008		9/8/2008	8,706	
4L78D041653	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X											
4L78D043225	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X						12/21/2007	1/25/2008		7/17/2008	13,000	
4L78D067511	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X											
4LX8D059760	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X											
7LZ8D059328	059 130 755 AB	611	VW Touareg		X	X									X			X							5/9/2008	6/4/2008		4,590	
8T28A015568	059 130 755 AB	611	A5 2.7L TDI	1. failure	X		X			X							X							10/5/2007	1/4/2008		7/7/2008	14,000	
8T28A015568	059 130 755 AB	611	A5 2.7L TDI	2. Failure reported 07.22	X		X			X							X							10/5/2007	1/4/2008			16,471	
8T28A031785	059 130 755 AB	611	A5 2.7L TDI		X		X			X							X												
8T58A026337	059 130 755 AB	611	A5 2.7L TDI		X		X			X							X												
8TX8A034465	059 130 755 AB	611	A5 2.7L TDI		X		X			X							X												
4L38D046235	059 130 755 AB	611	Q7 3.0L TDI	Part + fuel requested	X		X								X			X		01-0174			12/20/2007	1/22/2008	3/6/2008	10/20/2008	10/22/2008	16,405	
4L48D064842	059 130 755 AB	611	Q7 3.0L TDI	Part + fuel requested	X		X								X			X			02-1053		4/11/2008	4/25/2008	6/20/2008	11/3/2008	11/4/2008	22,294	
4L68D050943	059 130 755 AB	611	Q7 3.0L TDI	Part requested	X		X								X			X			02-0203		1/30/2008	2/14/2008	3/6/2008	9/29/2008	10/1/2008	13,500	
4L98D054100	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X			02-0784		2/13/2008	3/3/2008	3/28/2008	7/23/2008	7/30/2008	18,691	
7LZ8D038732	059 130 755 AB	611	VW Touareg		X	X									X			X							12/11/2007		7/29/2008	20,737	
7LZ8D048789	059 130 755 AB	611	VW Touareg		X	X									X			X						39433	12/28/2007		11/5/2008	3,592	
7LZ8D055972	059 130 755 AB	611	VW Touareg		X	X									X			X						39479	2/29/2008		10/10/2008	53,000	
7LZ8D065032	059 130 755 AB	611	VW Touareg		X	X									X			X							3/25/2008		8/6/2008	4,065	
7LZ8D076518	059 130 755 AB	611	VW Touareg		X	X									X			X						5/6/2008	7/1/2008		11/11/2008	27,000	
7LZ9D007402	059 130 755 AB	611	VW Touareg		X	X									X			X						6/18/2008	7/2/2008		11/27/2008	21,000	
8K58A002031	059 130 755 AB	611	A4 2.7L TDI		X		X	X									X							11/15/2007	12/21/2007		7/4/2008	13,662	
8T28A022021	059 130 755 AB	611	A5 2.7L TDI		X		X			X							X								4/29/2008			12,800	
8T48A028709	059 130 755 AB	611	A5 2.7L TDI		X		X			X							X							1/25/2008	2/15/2008		2/22/2008	1,223	
8T48A038351	059 130 755 AB	611	A5 2.7L TDI		X		X			X							X							3/27/2008	6/25/2008		7/2/2008	129	
8T68A028422	059 130 755 AB	611	A5 2.7L TDI		X		X			X							X								1/31/2008			6,062	
8T88A035565	059 130 755 AB	611	A5 2.7L TDI	Part + fuel requested	X		X			X							X				02-0066		2/18/2008	3/7/2008	5/23/2008	10/21/2008	10/27/2008	16,053	
8TX8A032232	059 130 755 AB	611	A5 2.7L TDI	Part + fuel requested	X		X			X							X			01-0709			1/25/2008	2/15/2008	2/29/2008	10/27/2008	10/30/2008	21,608	
3DZ88001212	059 130 755 AB	611	Phaeton		X	X								X				X						8/22/2007	9/4/2007		10/21/2008	44,139	
4L39D022387	059 130 755 AB	611	Q7 3.0L TDI	Part + fuel + filter requested	X		X								X			X				04-0388	9/12/2008	10/3/2008	10/30/2008	12/2/2008	12/2/2008	1,672	Yes
7LZ8D073669	059 130 755 AB	611	VW Touareg		X	X									X			X						4/22/2008	6/26/2008		12/20/2008	5,485	
7LZ8D074070	059 130 755 AB	611	VW Touareg		X	X									X			X						4/23/2008	7/6/2008		12/13/2008	15,162	
7LZ8D074787	059 130 755 AB	611	VW Touareg		X	X									X			X						4/25/2008	8/7/2008		10/19/2008	7,769	
7LZ8D074787	059 130 755 AB	611	VW Touareg		X	X									X			X						4/25/2008	8/7/2008		10/19/2008	7,769	
7LZ8D074910	059 130 755 AB	611	VW Touareg		X	X									X			X						4/26/2008	6/30/2008		11/6/2008	8,401	
7LZ8D076284	059 130 755 AB	611	VW Touareg		X	X									X			X						5/5/2008	7/31/2008		10/28/2008	5,373	
7LZ8D076284	059 130 755 AB	611	VW Touareg		X	X									X			X						5/5/2008	7/31/2008		12/3/2008	6,703	
7LZ8D076286	059 130 755 AB	611	VW Touareg		X	X									X			X						5/5/2008	9/8/2008		12/7/2008	7,996	
7LZ8D076286	059 130 755 AB	611	VW Touareg		X	X									X			X						5/5/2008	9/8/2008		12/25/2008	8,007	
7LZ8D076612	059 130 755 AB	611	VW Touareg		X	X									X			X						5/6/2008	8/15/2008		12/20/2008	5,037	
7LZ8D077002	059 130 755 AB	611	VW Touareg		X	X									X			X	[redacted]						6/20/2008			13,657	
7LZ8D077032	059 130 755 AB	611	VW Touareg		X	X									X			X						5/7/2008	7/21/2008		11/20/2008	18,019	
7LZ8D077470	059 130 755 AB	611	VW Touareg		X	X									X			X						5/12/2008	6/16/2008		12/18/2008	10,244	
7LZ8D079271	059 130 755 AB	611	VW Touareg		X	X									X			X							7/16/2008			2,105	
7LZ8D079271	059 130 755 AB	611	VW Touareg		X	X									X			X							7/16/2008			2,018	
7LZ9D001269	059 130 755 AB	611	VW Touareg		X	X									X			X							7/29/2008			2,518	
7LZ9D001269	059 130 755 AB	611	VW Touareg		X	X									X			X						5/22/2008	7/29/2008		8/13/2008	2,518	
7LZ9D001482	059 130 755 AB	611	VW Touareg		X	X									X			X							7/10/2008			3,614	
7LZ9D004856	059 130 755 AB	611	VW Touareg		X	X									X			X						6/9/2008	8/29/2008		11/27/2008	5,750	
7LZ9D007700	059 130 755 AB	611	VW Touareg		X	X									X			X						6/19/2008	12/16/2008		12/18/2008	278	
7LZ9D010088	059 130 755 AB	611	VW Touareg		X	X									X			X						7/1/2008	12/8/2008		12/19/2008	864	
7LZ9D011443	059 130 755 AB	611	VW Touareg		X	X									X			X						7/9/2008	10/27/2008		12/12/2008	5,939	
7LZ9D016980	059 130 755 AB	611	VW Touareg		X	X									X			X						8/15/2008	???		11/9/2008	68	
4L48D050620	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X							2/13/2008		5/20/2008	454	
4LX8D059368	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X							5/13/2008		5/19/2008	130	
7LZ8D039939	059 130 755 AB	611	VW Touareg		X	X									X			X							12/20/2007		11/25/2008	46,353	
7LZ8D042792	059 130 755 AB	611	VW Touareg		X	X									X			X							12/20/2007			15,592	
7LZ8D043956	059 130 755 AB	611	VW Touareg		X	X									X			X							1/4/2008			12,422	
7LZ8D050335	059 130 755 AB	611	VW Touareg		X	X									X			X						1/8/2008	2/6/2008		10/22/2008	29,006	
7LZ8D052473	059 130 755 AB	611	VW Touareg		X	X									X			X							2/14/2008		9/9/2008	18,598	
7LZ8D055231	059 130 755 AB	611	VW Touareg		X	X									X			X						1/30/2008	5/29/2008		12/29/2008	20,395	
7LZ8D056727	059 130 755 AB	611	VW Touareg		X	X									X			X						2/5/2008	3/14/2008		8/27/2008	9,317	
7LZ8D068514	059 130 755 AB	611	VW Touareg		X	X									X			X						3/28/2008	5/5/2008		7/10/2008	9,438	
7LZ8D072828	059 130 755 AB	611	VW Touareg		X	X									X			X							5/16/2008			3,386	
8K48N026913	059 130 755 AB	611	A4 2.7L TDI		X		X		X								X								5/7/2008		6/10/2008	850	
8K88N011315	059 130 755 AB	611	A4 2.7L TDI		X		X		X								X							2/29/2008	4/2/2008		6/5/2008	1,687	
8K88N011508	059 130 755 AB	611	A4 2.7L TDI		X		X		X								X							2/28/2008	3/28/2008		4/30/2008	2,000	
8T08A032210	059 130 755 AB	611	A5 2.7L TDI		X		X			X							X								3/18/2008		4/15/2008	434	
8T58A036673	059 130 755 AB	611	A5 2.7L TDI		X		X			X							X								4/9/2008		6/2/2008	1,462	
7LZ8D044527	059 130 755 AB	611	VW Touareg		X	X									X			X						11/29/2007	1/14/2008		9/19/2008	37,168	
4L38D059096	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X		01-0855			3/10/2008		4/25/2008	11/24/2008	11/28/2008	14,398	
7LZ8D048962	059 130 755 AB	611	VW Touareg		X	X									X			X						12/18/2007	1/15/2008		11/27/2008	50,000	
7LZ8D074238	059 130 755 AB	611	VW Touareg		X	X									X			X							5/15/2008	10/31/2008	11/10/2008	12,537	
7LZ8D075285	059 130 755 AB	611	VW Touareg		X	X									X			X						4/29/2008	5/23/2008		12/2/2008	19,030	
7LZ8D076742	059 130 755 AB	611	VW Touareg		X	X									X			X						5/6/2008	6/4/2008		10/20/2008	9,210	
7LZ8D061105	059 130 755 AB	611	VW Touareg		X	X									X			X						2/22/2008	3/28/2008		12/15/2008	7,000	
3DZ88000892	059 130 755 AB	611	Phaeton	Part + fuel + filter requested	X	X							X					X							12/28/2007			3,090	
3DZ88002927	059 130 755 AB	611	Phaeton	Part + fuel + filter requested	X	X							X					X							2/27/2008			4,141	
4L98D048085	059 130 755 AB	611	Q7 3.0L TDI		X		X								X			X		01-1108			1/15/2008	39478	4/30/2008		6/7/2008	1,000	
7LZ8D042129	059 130 755 AB	611	VW Touareg	Part + fuel + filter requested	X	X									X			X							1/31/2008			4,536	
7LZ8D056223	059 130 755 AB	611	VW Touareg	Part + fuel + filter requested	X	X									X			X							5/6/2008			1,090	
7LZ8D063719	059 130 755 AB	611	VW Touareg	Part + fuel + filter requested	X	X									X			X							6/16/2008			9,841	
7LZ8D064426	059 130 755 AB	611	VW Touareg	Part + fuel + filter requested	X	X									X			X							5/16/2008			11,110	
7LZ8D065387	059 130 755 AB	611	VW Touareg	Part + fuel + filter requested	X	X									X			X							5/29/2008			5,400	
3VWCL71K79M001277	03L 130 755 A	508	Jetta 103 kW		X	X					X				[redacted]								5/17/2008	8/22/2008		10/6/2008	5,538	
3VWCL71K79M001	0131L 130 755 A	508	Jetta 103 kW		X	X					X													5/20/2008	9/13/2008		12/26/2008	10,414	
3VWCL71K79M001	0131L 130 755 A	508	Jetta 103 kW		X	X					X													5/20/2008	9/13/2008		12/26/2008	20,492	
3VWTL71K89M277	0131L 130 755 A	508	VARIANT 2.0		X	X																			9/13/2008	10/12/2008		12/9/2008	4,262	
3VWRL71K59M018	0538L 130 755 A	508	Jetta 103 kW		X	X					X													7/29/2008	8/20/2008		10/15/2008	4,392	
5NZ9W008799	03L 130 755	507	Tiguan 103kW		X	X							X												6/3/2008	8/28/2008		9/22/2008	1,000	
3CZ8E208532	03L 130 755	507	Passat 103kW		X	X						X													4/3/2008	4/16/2008		10/14/2008	27,372	
3CZ9E015656	03L 130 755	507	Passat 103kW		X	X						X													6/26/2008	7/17/2008		8/7/2008	26	
3CZ9E018733	03L 130 755	507	Passat 103kW		X	X						X													6/23/2008	7/24/2008		11/7/2008	4,800	
3CZ9E039304	03L 130 755	507	Passat 103kW		X	X						X													9/5/2008	9/22/2008		9/22/2008	53	
5NZ8W003486	03L 130 755	507	Tiguan 103kW		X	X							X												10/20/2007	11/21/2007		12/12/2008	22,028	
5NZ9W029174	03L 130 755	507	Tiguan 103kW		X	X							X												8/2/2008	8/25/2008		12/29/2008	8,097	
5NZ9W040394	03L 130 755	507	Tiguan 103kW		X	X							X												9/6/2008	10/5/2008		10/14/2008	1,106	
5NZ9W051206	03L 130 755	507	Tiguan 103kW		X	X							X												10/16/2008	10/31/2008		12/17/2008	1,720	
1KZ9W435332	03L 130 755	507	Golf		X	X																			11/25/2008	12/19/2008		12/30/2008	0	
5NZ8W001238	03L 130 755	507	Tiguan 103kW		X	X							X												9/25/2007	11/7/2007		12/17/2008	15,000	
5NZ8W007944	03L 130 755	507	Tiguan 103kW		X	X							X												11/18/2007	12/24/2007		12/3/2008	66,000	
5NZ8W052297	03L 130 755	507	Tiguan 103kW		X	X							X												5/10/2008	5/29/2008		10/13/2008	16,000	
3CZ9E029915	03L 130 755	507	Passat 103kW		X	X																			7/16/2008	9/30/2008		8/11/2008	6	
3CZ9P026939	03L 130 755	507	Passat 103kW		X	X																			8/29/2008	11/25/2008		9/30/2008	8	
3CZ9E089677	03L 130 755	507	Passat 103kW		X	X																			12/4/2008	12/19/2008		12/22/2008	150	
5NZ8W031510	03L 130 755	507	Tiguan 103kW		X	X							X												2/20/2008	3/31/2008		9/1/2008	5,353	
5NZ8W031537	03L 130 755	507	Tiguan 103kW		X	X							X												2/20/2008	3/12/2008		10/16/2008	26,583	
8K18A017285	03L 130 755	507	A4 2,0 L TDI		X		X	X																						
8K78A022720	03L 130 755	507	A4 2,0 L TDI		X		X	X																						
3CZ9P009102	03L 130 755	507	Passat 103kW		X	X																			6/16/2008	8/27/2008		11/11/2008	4,000	
8K98A036067	03L 130 755	507	A4 2,0 L TDI	Part requested WK22	X		X	X																	4/1/2008	4/25/2008	5/6/2008	5/15/2008	329	
5NZ9W508006	03L 130 755	507	Tiguan 103kW		X	X							X												8/2/2008	8/28/2008		9/2/2008	120	
3CZ9E019781	03L 130 755	507	Passat 103kW		X	X						X													6/25/2008	9/4/2008		10/22/2008	4,834	
5NZ8W024309	03L 130 755	507	Tiguan 103kW	Part requested for SZ 09.19.08	X	X																			1/29/2008	3/31/2008		8/12/2008	20,797	
5NZ8W024309	03L 130 755	507	Tiguan 103kW	Part requested for SZ	X	X																			1/29/2008	3/31/2008		8/21/2008	20,850	
3CZ9E023479	03L 130 755	507	Passat 103kW		X	X						X													8/13/2008	9/19/2008		9/24/2008	1,000	
3CZ9P014582	03L 130 755	507	Passat 103kW		X	X																			7/2/2008	12/23/2008		12/23/2008	0	
5NZ8W005778	03L 130 755	507	Tiguan 103kW		X	X							X												11/6/2007	12/21/2007		10/30/2008	21,000	
5NZ8W031232	03L 130 755	507	Tiguan 103kW		X	X							X												2/21/2008	3/12/2008		12/10/2008	12,000	
5NZ8W036950	03L 130 755	507	Tiguan 103kW		X	X							X												3/12/2008	5/27/2008		12/18/2008	21,956	

[redacted]

[redacted]

ENTIRE PAGE CONFIDENTIAL

ENTIRE PAGE CONFIDENTIAL

EA11003EN-02052[4]

ENTIRE PAGE CONFIDENTIAL

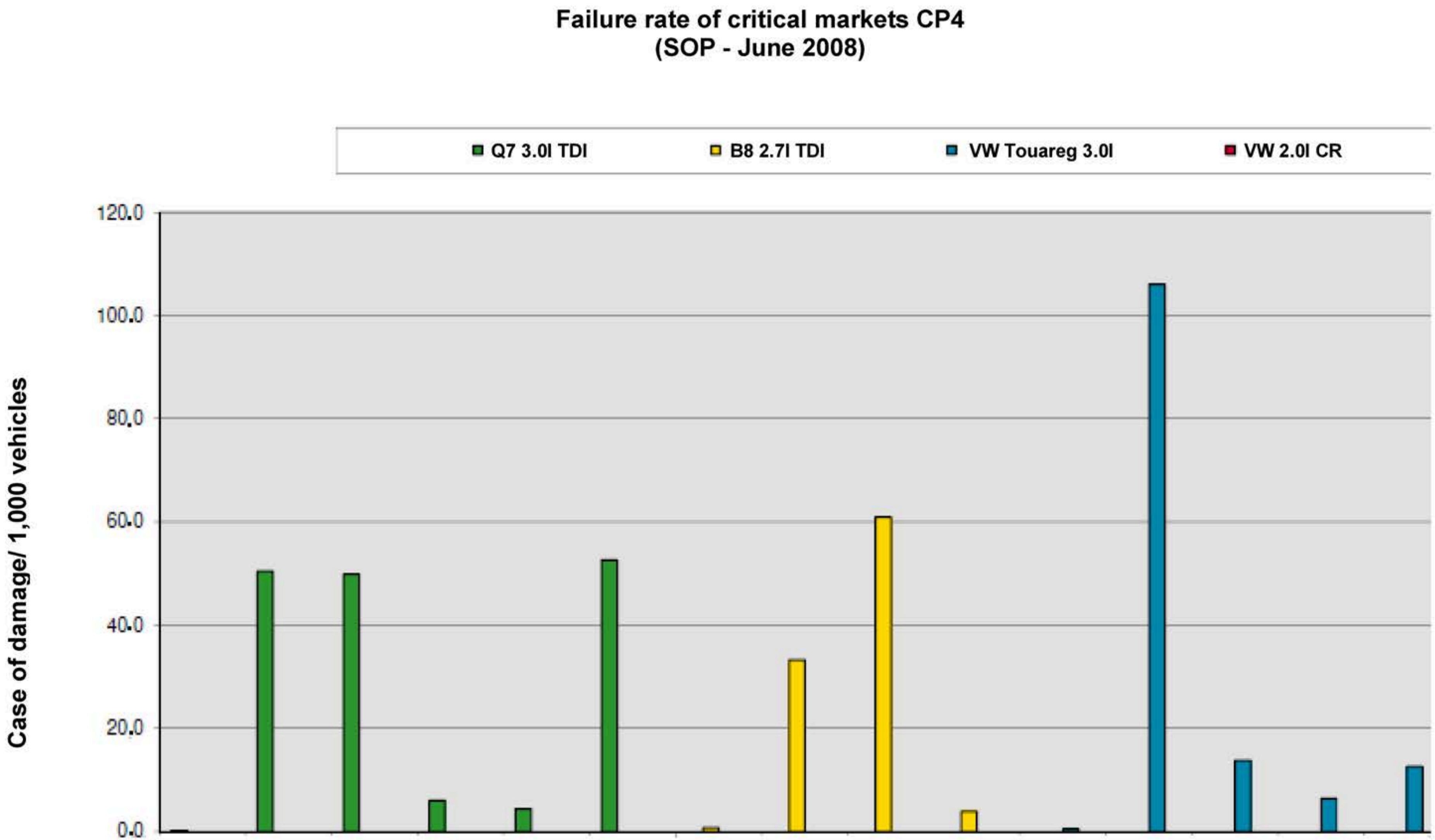
Only vehicle failures in the field

Model	Engine	Market	Failures	Total	Delivery amount of vehicles SOP - June 08	Delivery amount of vehicles July - Sept. 08	Delivery amount of vehicles SOP - Sept. 08	First vehicle delivery in the market	Failure rate in parts per thousand until June 08	Failure rate in parts per thousand until September 08	Factor above average in worldwide comparison	Non-responsive content removed
Audi Q7 3.0l	3.0l	Non-responsive content removed [redacted]		57	19,344	4,537	23,881	Dec 07	2.9	2.4	---	
			1		5,685	1,199	6,884	Dec 07	0.2	0.1		
			13		187	71	258	Dec 07	69.5	50.4	21	347
			16		317	4	321	Dec 07	50.5	49.8	21	343
			3		477	24	501	Dec 07	6.3	6.0	3	41
			11		1,954	583	2,537	Dec 07	5.6	4.3	2	30
			4		76	???	76	Jan 08	52.6	52.6	22	362
			2		2,612	925	3,537	Dec 07	0.8	0.6		
			2		No own national code							
			1		No own national code							
			1							#DIV/0!		
			1							#DIV/0!		
			1		69	7	76	Dec 07	14.5	13.2		
			1		1,712	368	2,080	Dec 07	0.6	0.5		
Audi A3/A4/A5 2.0l	2.0l			14	87,660	52,870	140,530	Oct. 07	0.2	0.1		
			7		24,813	15,545	40,358	Oct. 07	0.3	0.2		
			1		10,324	3,884	14,208	Nov 07	0.1	0.1		
			2		1,225	494	1,719	Dec 07	1.6	1.2		
			1		8,733	7,393	16,126	Dec 07	0.1	0.1		
			2		1,724	1,070	2,794	Dec 07	1.2	0.7	7	4
			1		1,225	634	1,859	Nov 07	0.8	0.5	5	3
Audi A4/A5 2.7l	2.7l			43	18,516	6,040	24,556	Sept. 07	2.3	1.8		
			6		5,899	2,389	8,288	Sept. 07	1.0	0.7		
			13		243	148	391	Dec 07	53.5	33.2	19	46
			10		161	3	164	Nov 07	62.1	61.0	35	84
			10		1,985	622	2,607	Sept. 07	5.0	3.8	2	5
			2		1,777	318	2,095	Sept. 07	1.1	1.0		
			1							#DIV/0!		
			1		2,329	850	3,179	Sept. 07	0.4	0.3		
Audi A4/A5 3.0l	3.0l			2	40	2,238	2,278	Sept. 08	50.0	0.9		
			0		40	970	1,010	Sept. 08		0.0		
			0		0	334	334	Sept. 08		0.0		
			1							#DIV/0!		
			1		0	26	26	Sept. 08		38.5		
VW Phaeton 3.0l	3.0l			4	3,347	431	3,778	Oct. 06	1.2	1.1		
			1		2,624	376	3,000	Oct. 06	0.4	0.3		
			1							#DIV/0!		
			2		Not in QUASI-FI					#DIV/0!		
VW Touareg 3.0l	3.0l			75	10,825	2,688	13,513	March 07	6.9	5.6		
			3		4,591	1,657	6,248	March 07	0.7	0.5		
			14		120	12	132	Nov 07	116.7	106.1	19	221
			17		1,009	227	1,236	Nov 07	16.8	13.8	2	29
			5		789	in QUASI-FI total	789	in QUASI-FI total	6.3	6.3	1	13
			23		1,562	278	1,840	Apr 08	14.7	12.5	2	26
			4		433	72	505	Nov 07	9.2	7.9	1	16
			5		Not in QUASI-FI							
			1		Not in QUASI-FI							
			1							#DIV/0!		
			1							#DIV/0!		
			1		Not in QUASI-FI							
VW Passat 2.0l	2.0l		---	12	42,039	25,039	67,078	July 07	0.3	0.2		
			4		18,505	12,621	31,126	Jul 07	0.2	0.1		
			3		6,250	3,995	10,245	Feb. 08	0.5	0.3		
			1		407	47	454	Feb. 08	2.5	2.2		
			2		5,111	1,636	6,747	Feb. 08	0.4	0.3		
			2		4,813	2,221	7,034	Feb. 08	0.4	0.3		
VW Tiguan 2.0l	2.0l		---	19	44,962	15,971	60,933	Feb. 07	0.4	0.3		
			5		17,928	7,002	24,930	Feb. 07	0.3	0.2		
			2		4,163	1,479	5,642	Oct. 07	0.5	0.4		
			1		2,073	856	2,929	Sept. 07		0.3		
			2							#DIV/0!		
			1							#DIV/0!		
			1							#DIV/0!		
1 x Golf			4		6,299	2,166	8,465	Sept. 07		0.5		
			3		579	294	873	Sept. 07	5.2	3.4	11	17
Jetta USA 2.0l	2.0l	Jetta USA 2.0l	8		1,379	4,779	6,158	Oct. 07	5.8	1.3	4	6
Skoda Superb 2	2.0l 125 kW	[redacted]	1									
Total field			234									

Names, departments displaced by ABCD

	Qty.	Deliveries	Failure (parts per thousand)
Non-responsive content removed	46	4474	10.3
	33	2993	11.0
	41	29874	1.4
	26	2294	11.3
	27	41759	0.6

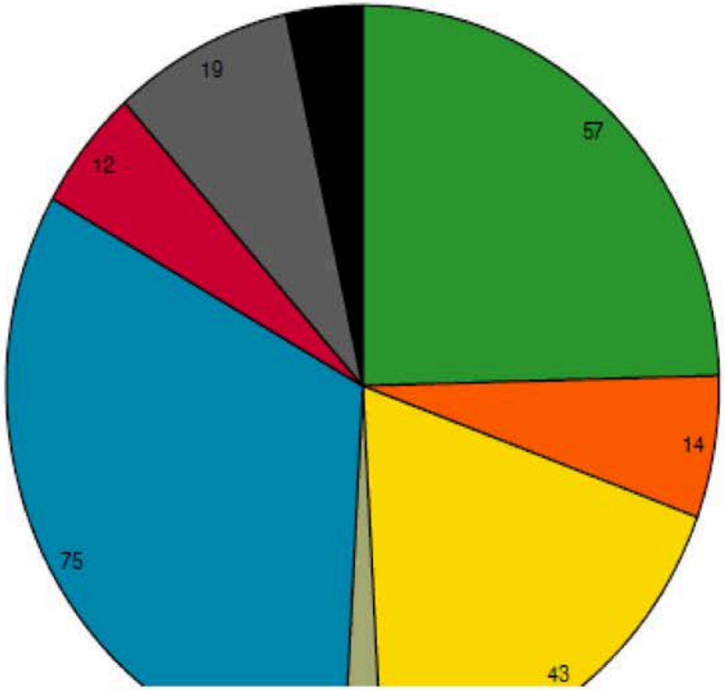
ENTIRE PAGE CONFIDENTIAL



Non-responsive content removed

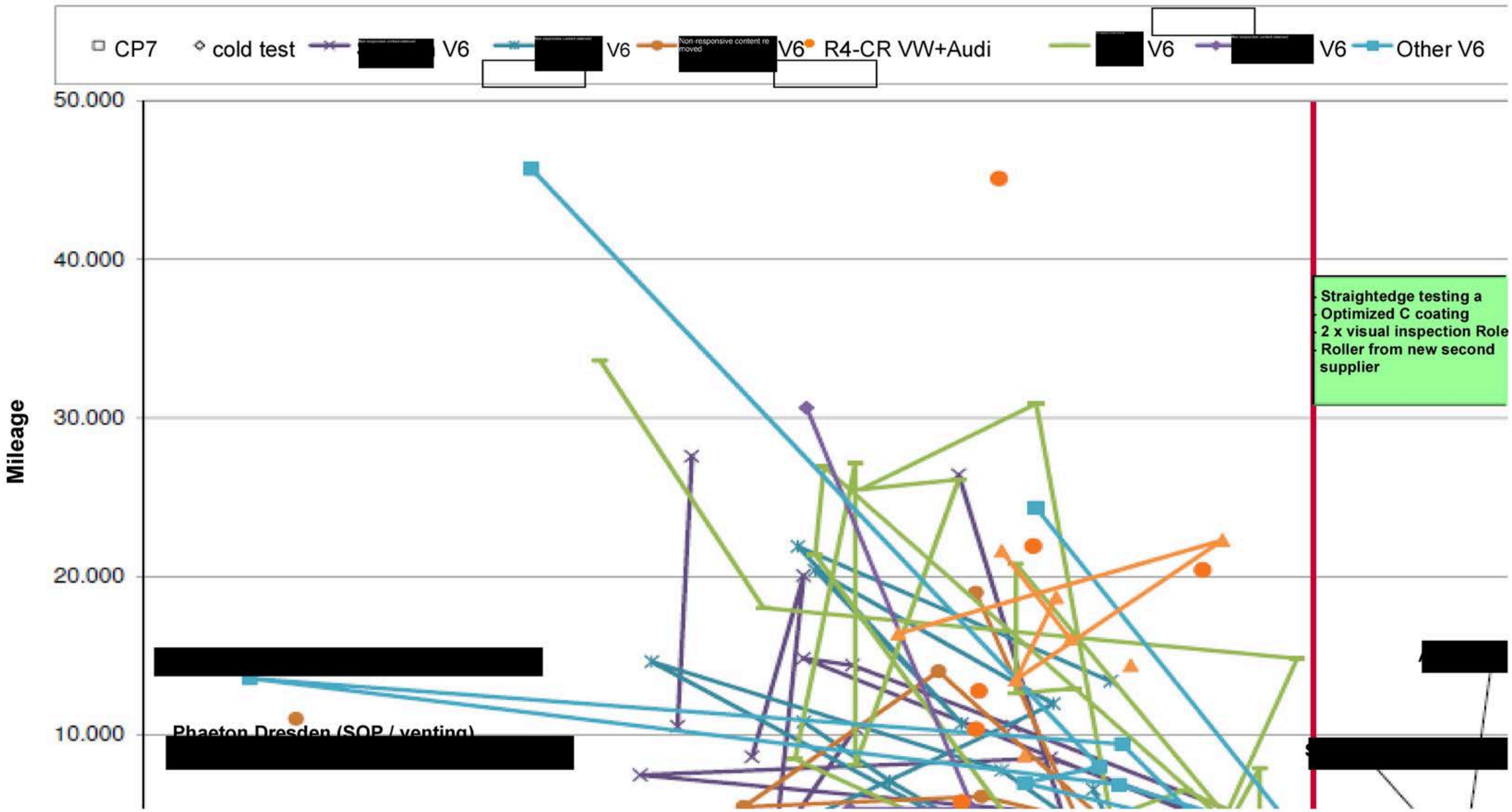
ENTIRE PAGE CONFIDENTIAL

Number per model / engine
(without individual cases)

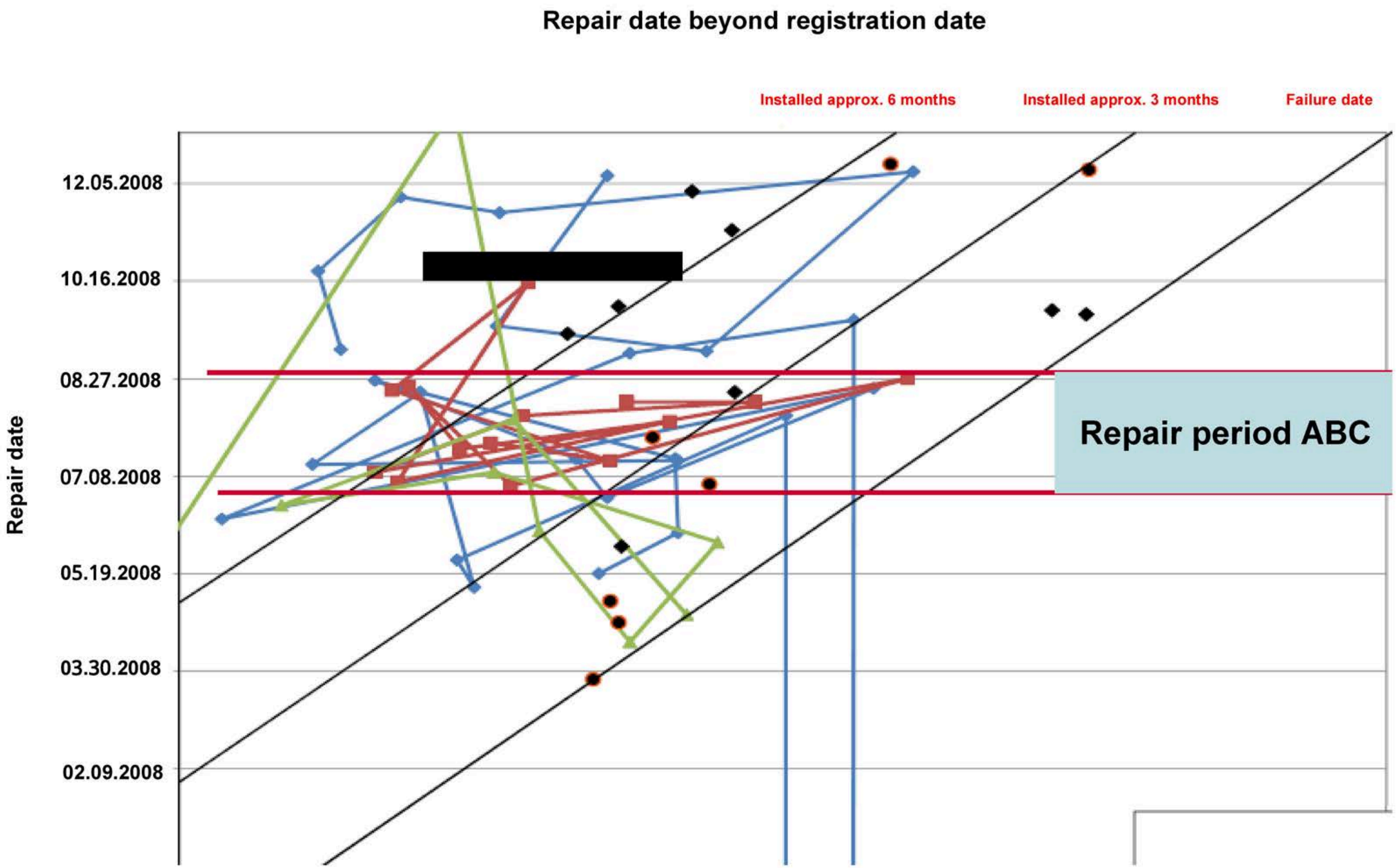


ENTIRE PAGE CONFIDENTIAL

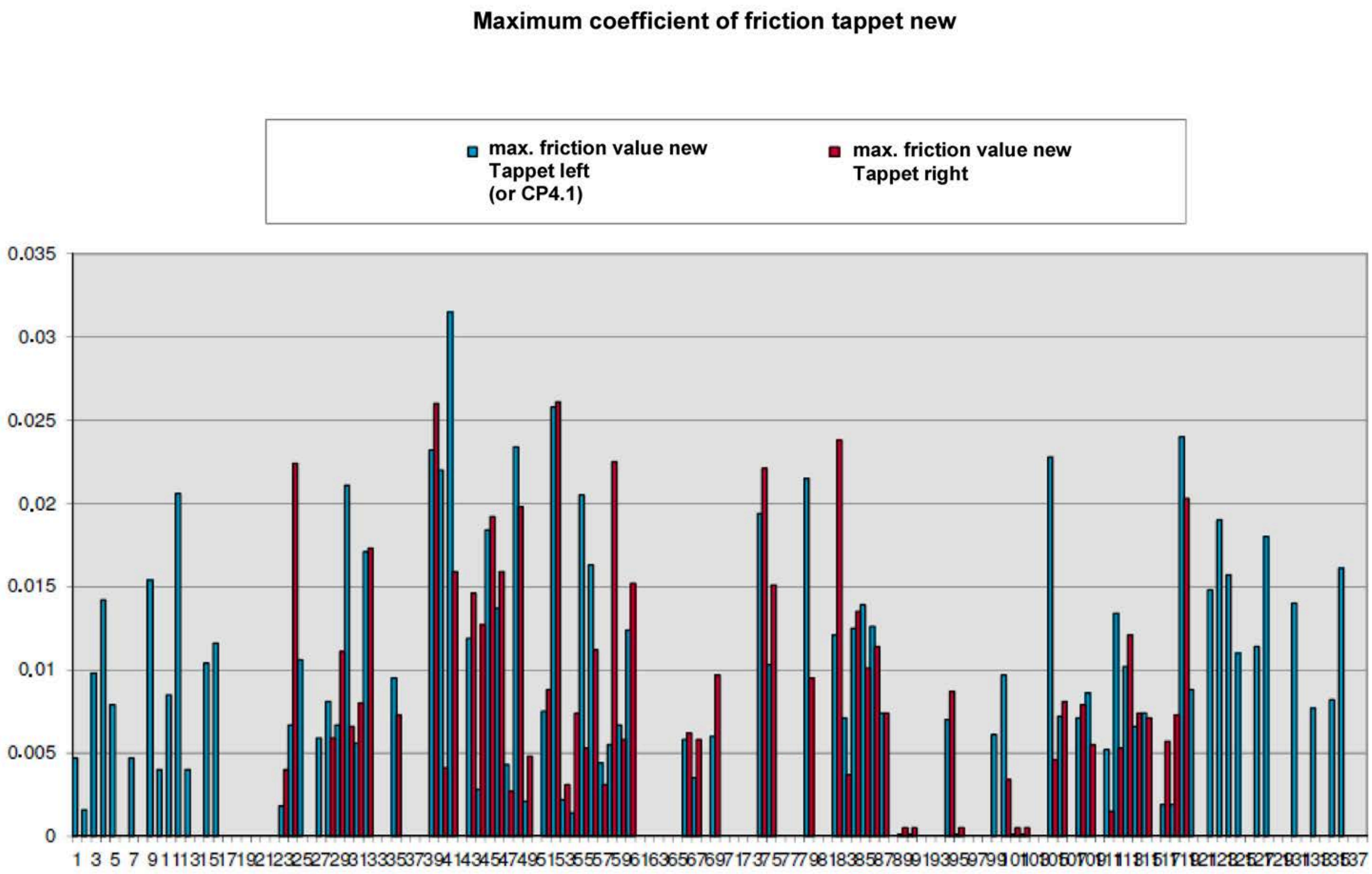
Effectiveness of actions



ENTIRE PAGE CONFIDENTIAL



ENTIRE PAGE CONFIDENTIAL



Status of drivetrain damage

Status CP4 drivetrain damage @ VW & Audi

Worldwide on-field failures (based on [redacted] list dated 02.04.2009)

Observation period from each vehicle SOP up to June 2008

[redacted]

→ 41 x CP4.2 / delivery quantity 550 -> 74,545 ppm

→ 5 x CP4.1 / delivery quantity 2,303 -> 2,171 ppm

[redacted]

→ 31 x CP4.2 / delivery quantity 1,267 -> 24,467 ppm

→ 2 x CP4.1 / delivery quantity 1,225 -> 1,632 ppm

[redacted]

→ 11 x CP4.2 / delivery quantity 18,839 -> 584 ppm

→ 16 x CP4.1 / delivery quantity 61,246 -> 261 ppm

→ **After DM WK 20/2008 no field failures in the aforementioned markets.**

BOSCH

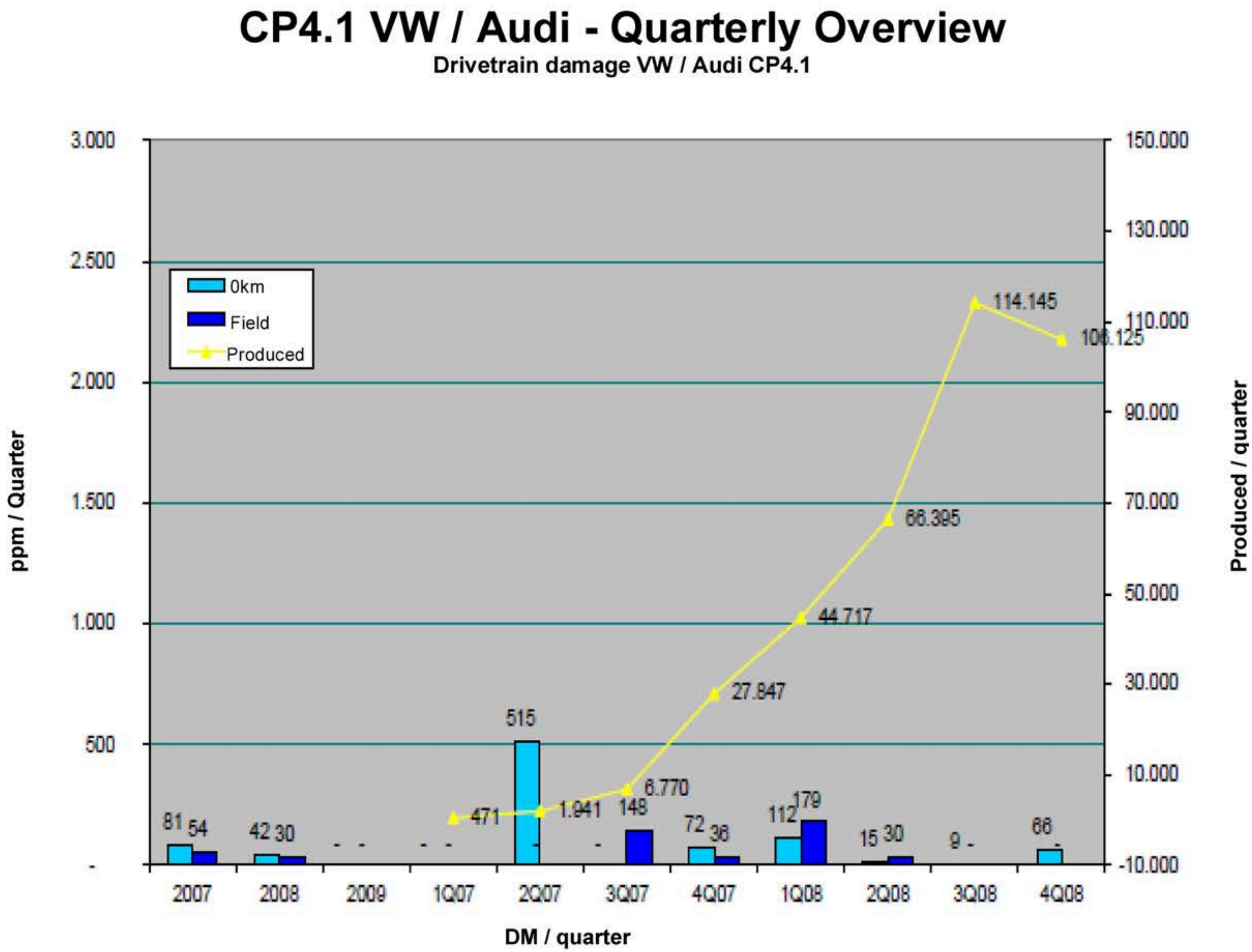
Field failures worldwide (excluding testing and ER)

VW vehicles total:	**120/27** reported / thereof diagnosed and confirmed	
➔ 4-cylinder [redacted] (CP4.1):	34/5	(Tiguan, Passat)
➔ 4-cylinder US07 (CP4.1):	8/3	(Jetta)
➔ 6-cylinder (CP4.2):	78/19	(Touareg, Phaeton)
Audi vehicles total:	**121/73** reported / thereof diagnosed and confirmed	
➔ 4-cylinder [redacted] (CP4.1):	16/8	(B8)
➔ 6-cylinder (CP4.2):	105/65	(B8, Q7)

Status: WK 06.09

BOSCH

Q-situation CP4 - VW / AU status: 02.09.2009



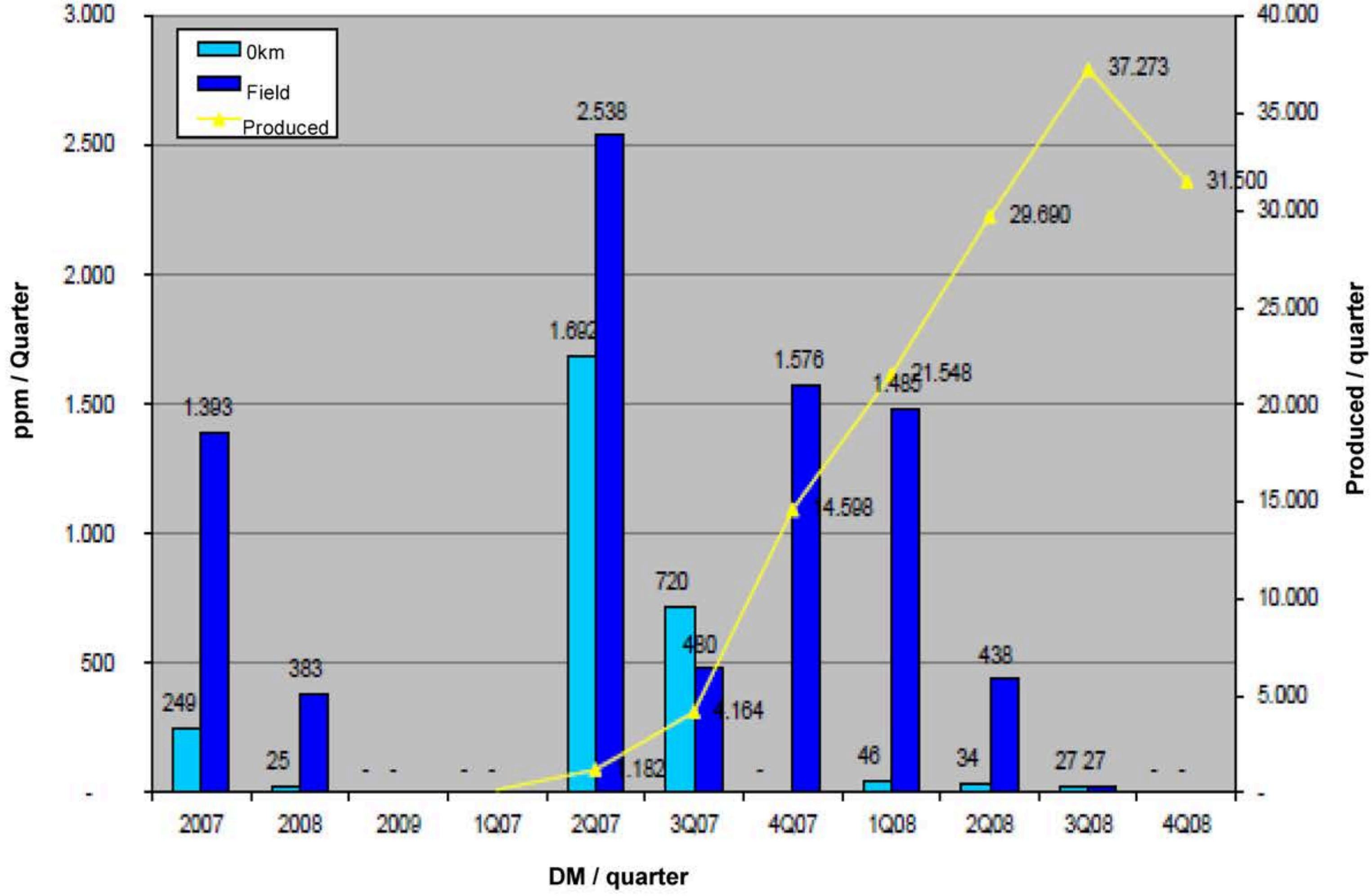
Including BA 40 = Field goods
BA 70 = outside the RB warranty for testing

Appendix 9 to [redacted] SVW 982 154 - 8. Steering Committee Diesel Systems

BOSCH

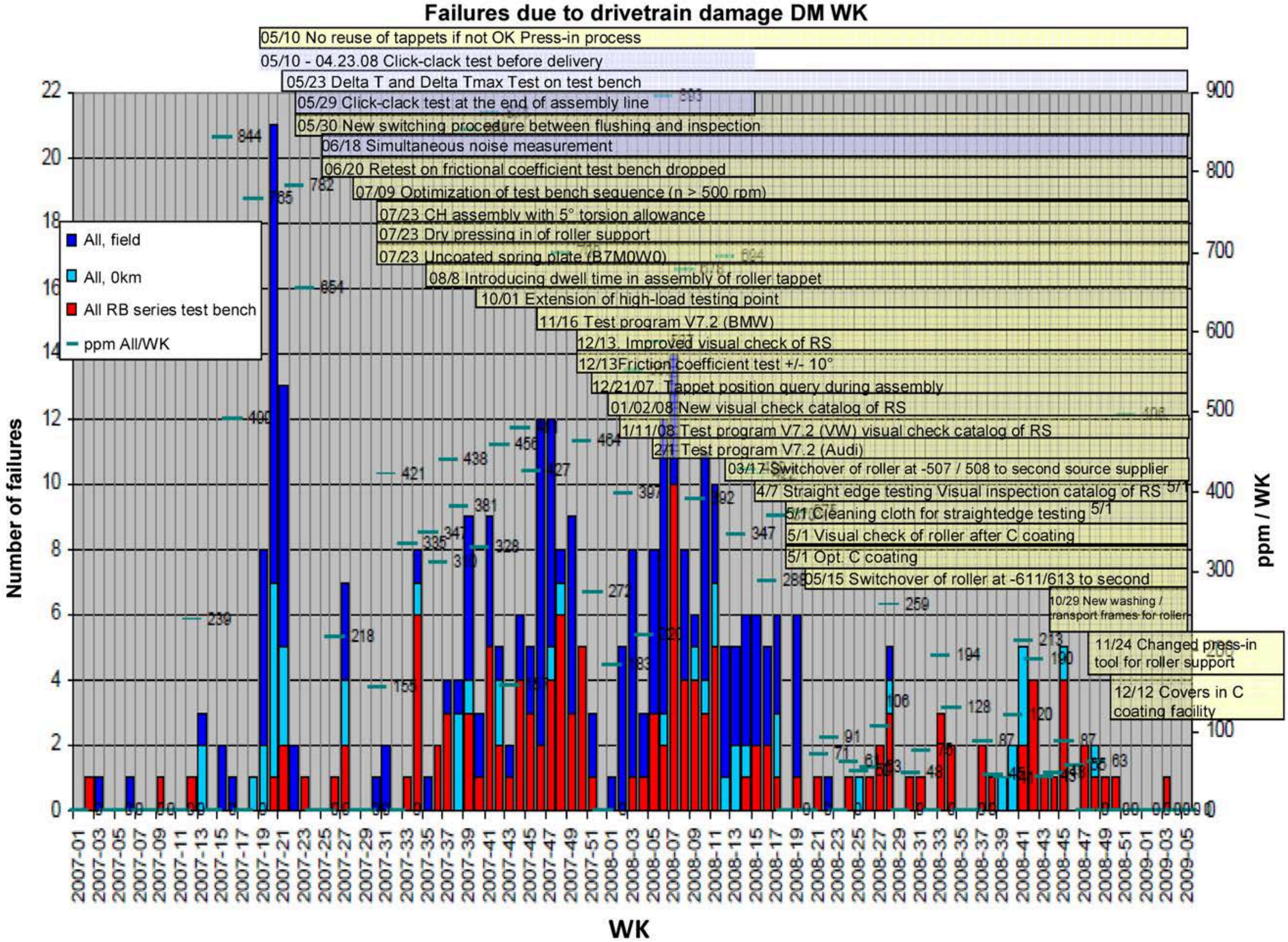
CP4.2 VW / Audi - Quarterly Overview

Drivetrain damage Audi / VW - CP4.2



Including BA 40 = Field goods
BA 70 = outside the RB warranty for testing

Overview of drivetrain damage



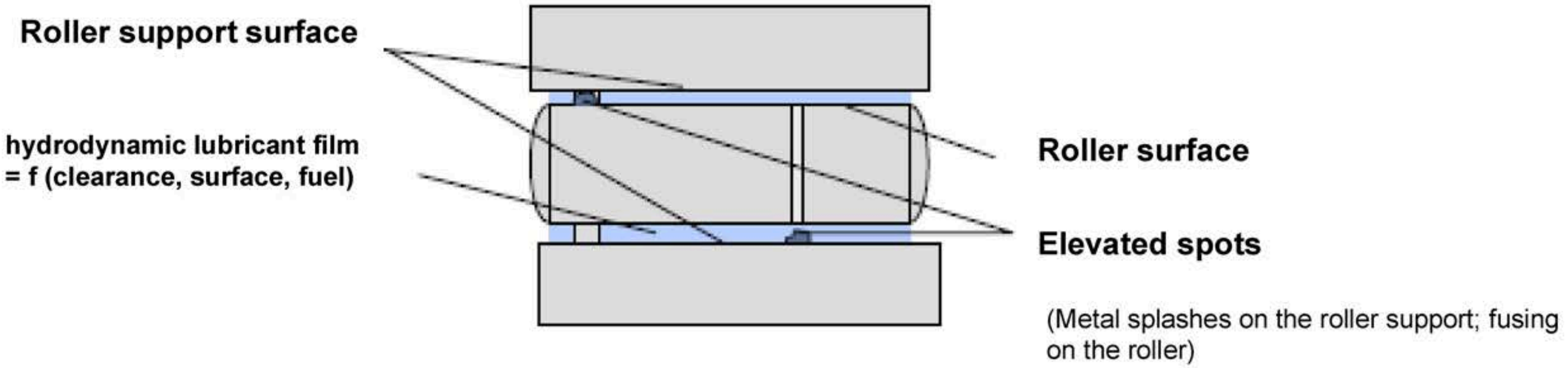
Appendix 9 to [redacted] - 8. Steering Committee
Diesel Systems

BOSCH

CP4 Drivetrain damage: Damage mechanism

- Unacceptably high mixed friction between roller and roller support cause "local" contacts during operation
- The C coating is disrupted (wear and erosion of the C coating), the coefficient of friction between roller and roller support increases
- Stiff roller -> Wear -> Particle formation -> Drivetrain damage

Intensification factors: Fuel with low viscosity; elevated spots on roller (e.g. fusing) and in the roller support (e.g. metal splashes); surface of roller/roller support



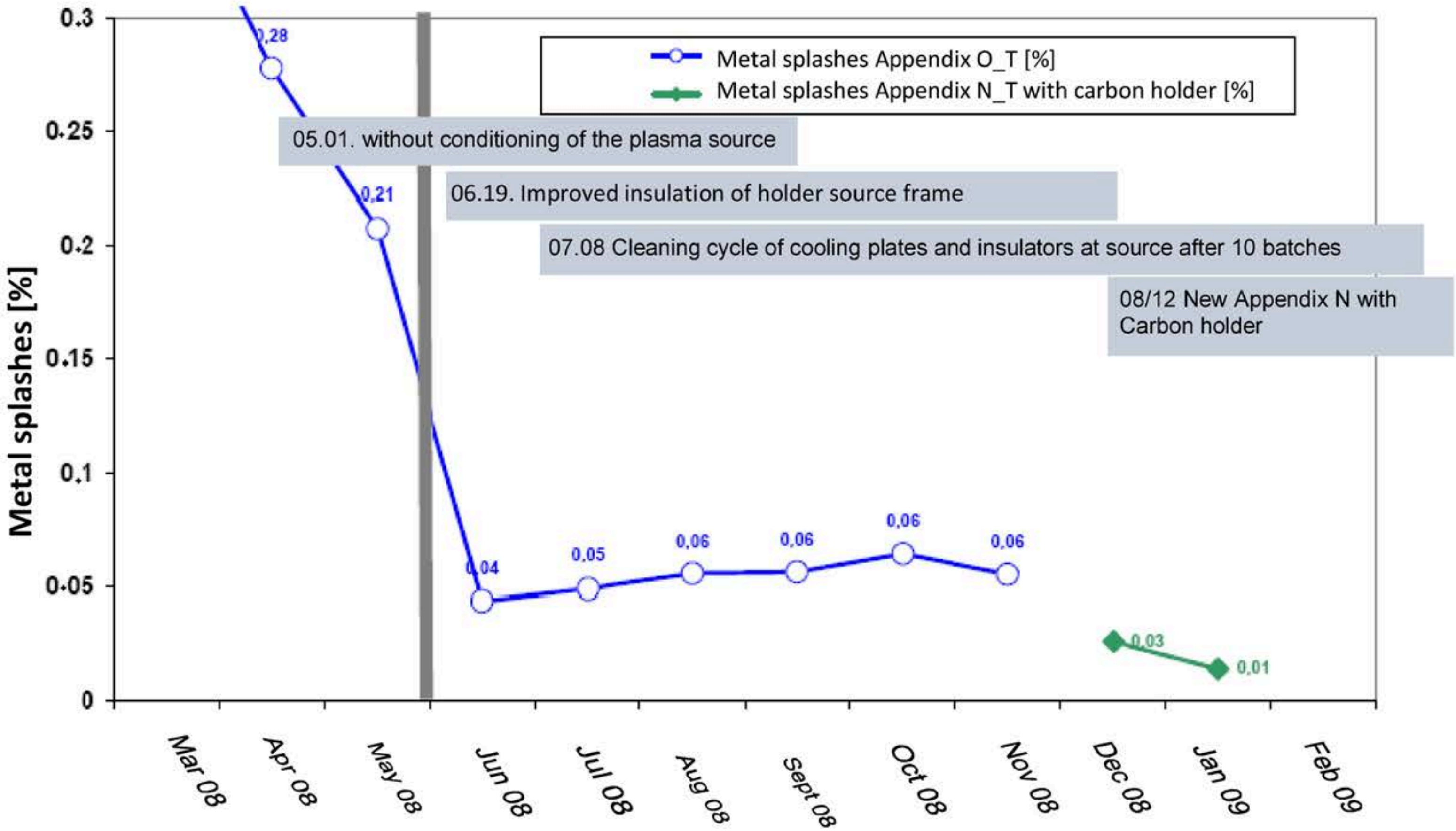
Explanation of terms: **"Metal splashes"**

	Affected component: **Roller support** **Remark:** Metal splashes are frequently rough-finished and then become visible. Depending on the size and height, a visible shadow is also created by the finishing process
	Cause: During the C3 coating process of the RS, ambient material is entrained and deposits on the component. There are different shapes, sizes and degrees of metal splashes. Depending on the time of occurrence, the metal splashes are finally coated with C3

BOSCH

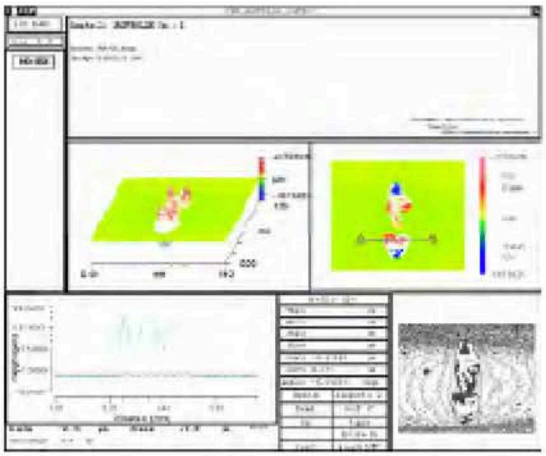
Development of metal splashes on roller support

Monthly trend 2008 + 2009
Metal splashes in CP4 - roller support after band finishing

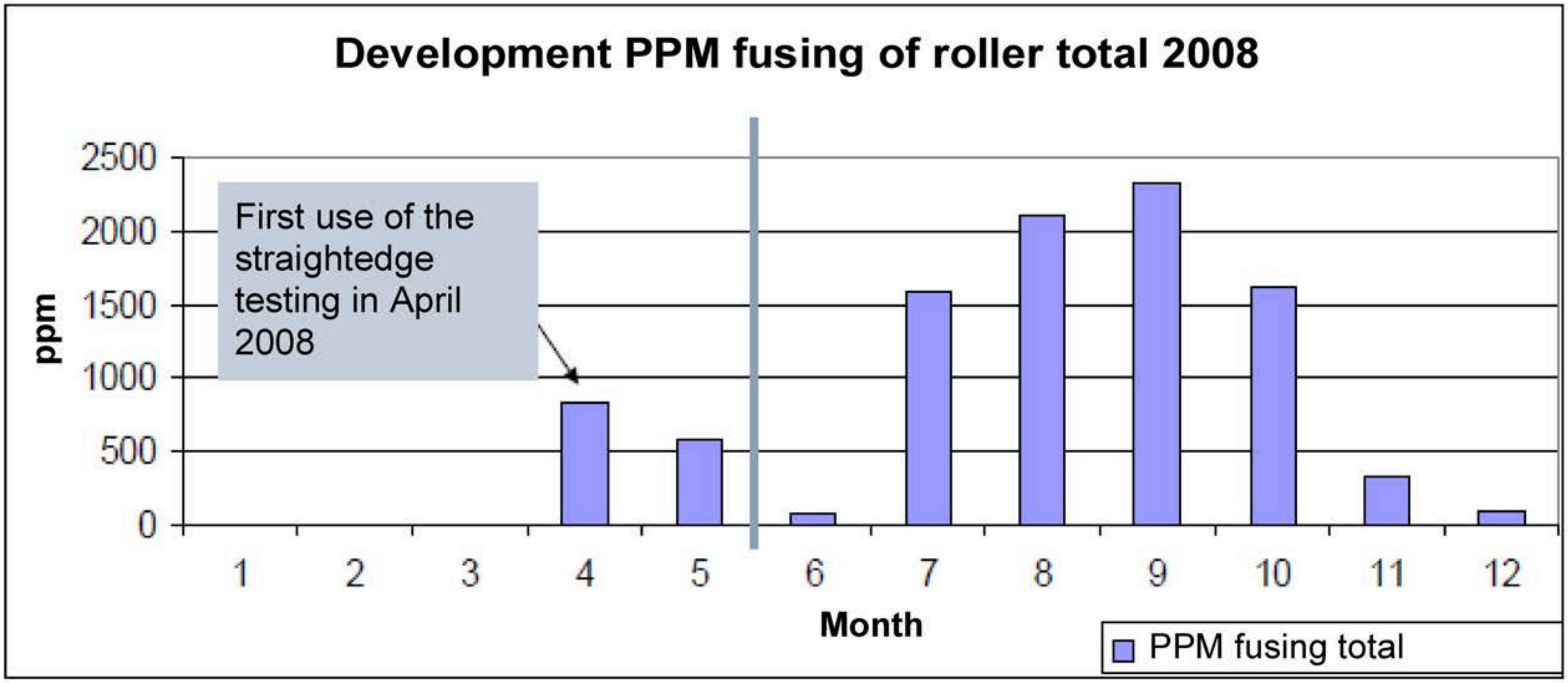


BOSCH

Explanation of terms: **"Fusing"**

	Affected component: **Roller**
	**Suspected cause:** Fusing occur during the C3 coating process of the roller end due to insufficient contacting between the rollers in the holder. Partly excessive current flows and leads to material melts of the roller having depressions and elevations. Occurrence is strongly scattered

Development of the fusing



Friction coefficient examinations

Assignment

Calculation of the coefficients of friction between roller / roller supports with "boundary" roller surfaces (supplier 1 & 2) in combination with different fuels

Results

- → **Little influence of the roller surface on the coefficient of friction with EN590** recognizable
- → **Boundary coefficient of friction with "boundary" roller surfaces of a supplier 1**, but below limit (0.035@300 revolutions of roller, 600 N)
- → **Coefficient of friction not OK** for **"boundary" roller surfaces (supplier 1) @ Sweden diesel & GDK570**
- → **Coefficient of friction OK for "boundary" roller surfaces (supplier 2) @ Sweden diesel & GDK570**

Assessment

Rollers from supplier 1 show greater sensitivity to coefficient of friction during measurement with low viscosity fuels. Measure: Optimization of quality Roller surface supplier 1 at supplier 2 level.

BOSCH

Task Force drivetrain - additional measures

1. Reduce surface texture of roller from supplier 1
   Introduction of supplier 2: CP4.1 WK12/08(Fe); WK04/08(JhP)
   CP4.2 WK20/08(Fe); WK44/08(JhP)

2. Performing challenge trials with poorly lubricating fuel and boundary parts

3. Retesting of the camshaft with respect to drivetrain damage, e.g. particle transfer -> performing challenge trials

4. Joint verification of the start-up conditions in the engine plants / vehicle plants (-> Audi).

5. Evaluating and analyzing the results of roller camera documentation after friction coefficient test

Status CP4 drivetrain damage @ VW & Audi

Summary

- ➔ Significant reduction in drivetrain damage since WK20 2008 (in particular field),
- ➔ Since then only RB internal failures and 0km (CP7)
  (Causes of these failures are being analyzed)
- ➔ Measures for fault detection and avoidance in the plant show impact
  (especially straightedge testing & optimized visual inspection catalog of roller support)
- ➔ Additional measures (see previous slide) is under implementation
- ➔ Fuel impact (viscosity) on coefficient of friction is proven

BOSCH

Open measures

- Line scan camera system to scan the RS bore — WK 19
- Camera documentation of roller after friction coefficient test is under — progress
- New concept of roller holders for C coating (critical) — D: open

BOSCH

Review Bosch FCT cases for VW/Audi 2.0L TDI up to January 2009

BOSCH

Summary

		Audi	VW	
Total known	(IQIS+FCT)	45 cases	36 cases	(9*)
Reported to FCT		30 cases	21 cases	(6*)
Analyzed on-site		8 cases	5 cases	(3*)

Distribution of the major errors focuses of the cases reported to FCT:

	Audi	VW
Hydraulic faults	13 cases	13 cases
Electrical faults	11 cases	4 cases
Engine mechanics	4 cases	3 cases
Cause of fault unknown	2 cases	1 case

*Status up to VW review 06.19.2008

ENTIRE PAGE CONFIDENTIAL

VW field failures Non-responsive content removed [redacted] from 6.19.08 to 01.19.09

(from Bosch warranty system)

CP4.1

GE	Customer complaint	QC no.	Cust. Ref. No. 1	Part no.	DM	CS	Failure D.	Mileage [km]	VIN	Error text	OSA
B	Leaking; liquid loss of diesel	230002229012	VA 98866	0445010507	4/7/2008	5/14/2008	8/11/2008	3901	3C8E234655	Shaft seal flange leaking	without
B	Fuel loss	230002294951	VA 98950	0445010507	3/14/2008	4/16/2008	10/14/2008	27372	3CZ8E208532	Shaft seal flange leaking	without
B	Rail pressure too low	230002284765	VA 98914	0445010507	1/16/2008	3/17/2008	9/19/2008	10380	5NZ8W026463	Pump drivetrain damage	without
B	Leaking, loss of fuel	230002234230	VA 98873	0445010507	10/18/2007	1/2/2008	2/22/2008	30	5N8W011353	Leaking at the shaft seal	without
C	Engine stopped while driving	230002165195	VA 98799	0445010507	1/22/2008	4/1/2008	5/5/2008	3452	5NZ8W036616	Not OK Fuel	1664
S	Vehicle will not start	230002254823	VA 98884	0445010507	10/29/2007	1/16/2008	8/1/2008	20816	5N8W014390	OK according to specification	without
S	Engine does not start. Fuel rail /	230002254821	VA 98885	0445010507	7/6/2008	8/3/2008	8/4/2008	106	5N9W010496	OK according to specification	without
S	Engine jerks when accelerating.	230002293065	VA 98945	0445010507	8/21/2007	11/9/2007	9/24/2008	12815	5N8W002189	OK according to specification	without
S	Stiff, engine does not start.	230002259785	VA 98890	0445010507	9/17/2007	11/9/2007	5/21/2008	9051	5N8W003445	OK according to specification	without
O	Engine does not start	230002347357	VA 98983	0445010507	2/13/2008	5/23/2008	10/21/2008	15884	3C8E230001		without
O	Engine does not start up	230002348978	VA 98982	0445010507	10/8/2007	9/25/2008	9/25/2008	6532	5N8W006469		without
O	Function not OK	230002348979	VA 98982	0445010507	11/29/2007	2/7/2008	11/11/2008	40837	5N8W017664		without
O	Function not OK	230002348980	VA 98982	0445010507	10/2/2007	11/30/2007	10/6/2008	22362	5N8W005842		without
O	High pressure fuel pump (HPP) is leaking	230002348981	VA 98982	0445010507	1/24/2008	3/29/2008	12/1/2008	16350	3CZ8E190050		without

CRI3.2

GE	Customer complaint	QC no.	Cust. Ref. No. 1	Part no.	DM	CS	Failure D.	Mileage [km]	VIN	Error text	OSA
C	leaking	230002206366	VA 98840	0445116030	5/16/2008	8/1/2008	8/4/2008	333	3C9E512520	Foreign objects from the outside	1710
C	Engine does not start;	230002216696	VA 98856	0445116030	2/15/2008	6/11/2008	7/9/2008	3348	3CZ8E242833	Foreign objects from the outside	1728
S	Electrical fault	230002211193	VA 98852	0445116030	3/26/2008	5/6/2008	7/29/2008	14092	3C8E231884	OK according to specification	without
O	Loss of fuel at the return line port	230002346982	VA 98984	0445116030	5/10/2008	6/28/2008	10/31/2008	4749	5NZ9W008027	RL O-ring damaged	without

EDC17 No complaints

BOSCH

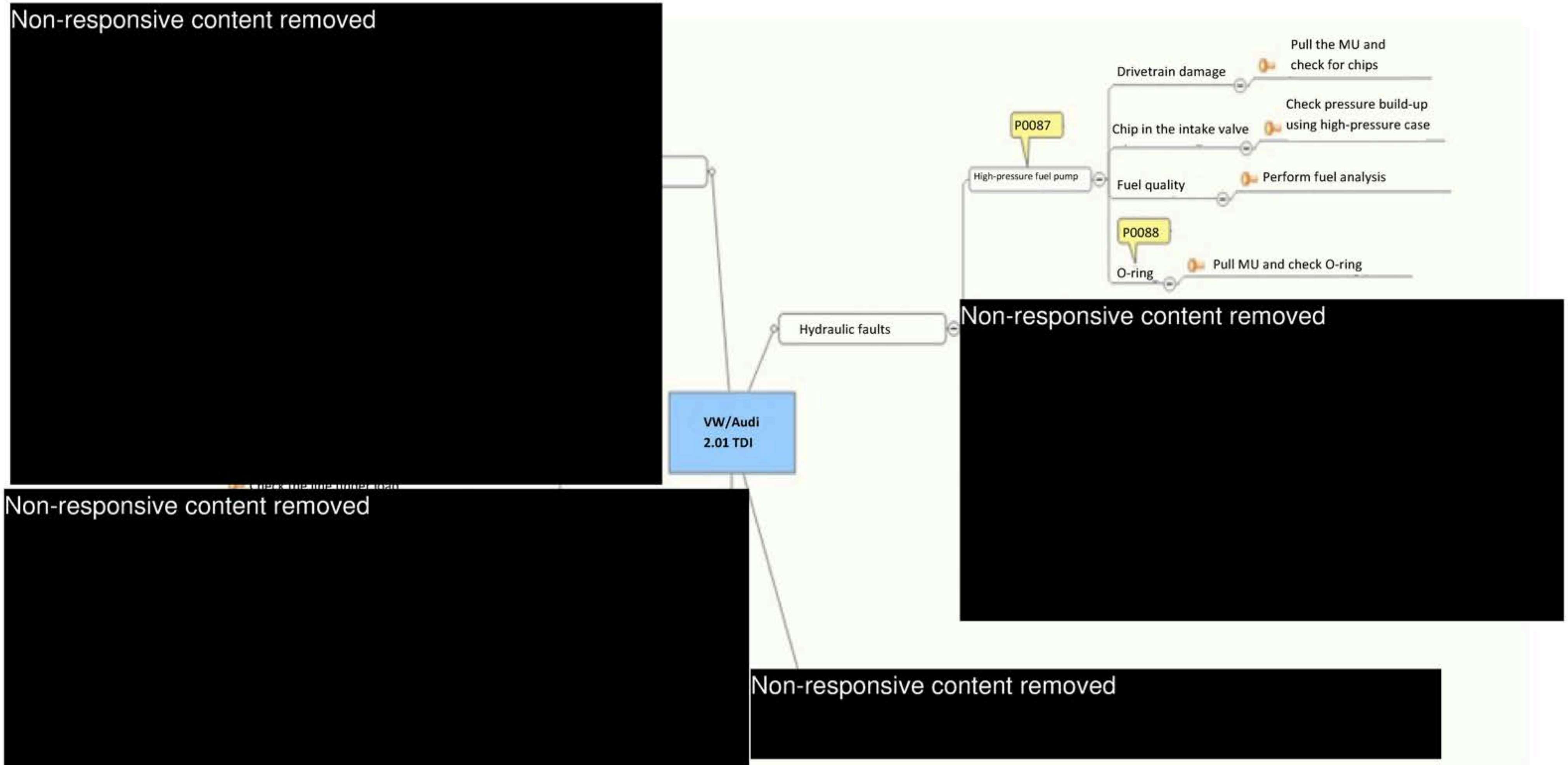
AUDI field failures of submarket Non-responsive content removed until 01.19.09

(from Bosch warranty system)

Group	GE	Customer complaint	QC no.	QTS no.	Part no.	DM	CS	Failure D.	Mileage [km]	VIN	Error text	OSA
CP4.1	B	Rail pressure not OK	230001917421	2864439	0445010507	9/17/2007	12/11/2007	1/4/2008	350	8K48A003378	intake valve leaking	1533
	B	Veh. will not start.	230002070696	2974476	0445010507	1/11/2008	3/26/2008	3/26/2008	25	8K48N006273	Pump drivetrain damage	1623
	B	Engine will not start.	230002158348	3051740	0445010507	3/15/2008	4/4/2008	4/24/2008	814	8K58A037278	Pump drivetrain damage	without
	B	Electrical faults	230002177333	3070039	0445010507	3/15/2008	5/6/2008	7/4/2008	4682	8K68A039265	Pump drivetrain damage	without
	B	Preheat light is lit up, vehicle stopped	230002125197	3016558	0445010507	3/12/2008	4/17/2008	5/5/2008	1584	8K18A035821	tappet spring is broken	1635
	B	Mechanical fault	230001930606	2875958	0445010507	10/5/2007	12/6/2007	12/13/2007	365	8K08A002485	MU O-ring sheared off	1535
	B	leaking	230001992667	2943041	0445010507	11/18/2007	1/15/2008	3/12/2008	6793	8K69A000578	MU O-ring sheared off	1620
	C	Engine has stopped and does not restart	230002225640	3118777	0445010507	2/29/2008	4/16/2008	7/28/2008	20422	8K88N022279	Not OK Fuel	1738
	S	Breakdown will not start.	230002139769	3031672	0445010507	11/5/2007	2/8/2008	5/27/2008	4057	8KX8N002048	OK - Original not submitted	1647
	O	**Generator control lights up sporadically**	**230002283240**	**3179166**	**0445010507**	**4/30/2008**	**6/23/2008**	**10/8/2008**	**17355**	**8K19A033066**		**without**
	GE	Customer complaint	QC no.	QTS no.	Part no.	DM	CS	Failure D.	Mileage [km]	VIN	Error text	OSA
CRI3.2	B	Engine stopped while driving	230002250477	3146228	0445116030	7/4/2008	8/15/2008	9/9/2008	2202	8K49A068667	Particles in the return pipe	1725
	B	Engine stopped while driving	230002297332	3205241	0445116030	4/23/2008	10/16/2008	10/18/2008	1500	8K39A019637	Particles in the return pipe	without
	C	Connecting rod broken	230001941819	2906283	0445116030	1/3/2008	1/23/2008	1/23/2008	28	8K28A002522	Engine failure, injector damaged	1555
	C	Veh. will not start.	230002043566	2961515	0445116030	1/10/2008	3/26/2008	3/26/2008	25	8K48N006273	Foreign objects from the outside	1623
	C	Veh. will not start.	230002043567	2961515	0445116030	1/10/2008	3/26/2008	3/26/2008	25	8K48N006273	Foreign objects from the outside	1623
	C	Veh. will not start.	230002070697	2961515	0445116030	1/10/2008	3/26/2008	3/26/2008	25	8K48N006273	Foreign objects from the outside	1623
	C	Veh. will not start.	230002070698	2961515	0445116030	1/10/2008	3/26/2008	3/26/2008	25	8K48N006273	Foreign objects from the outside	1623
	C	Spray pattern not OK 1 hole clogged	230002216497	3088144	0445116030	3/19/2008	5/6/2008	7/1/2008	4739	8K69A006042	Particles in the nozzle spray hole	without
	S	Engine irregular when idling	230002156418	3046621	0445116030	12/1/2007	1/28/2008	4/1/2008	8552	8K58N004256	OK according to specification	without
	S	Engine stopped while driving	230002250476	3146228	0445116030	7/4/2008	8/15/2008	9/9/2008	2202	8K49A068667	OK according to specification	1725
	S	Engine stopped while driving	230002250482	3146228	0445116030	7/4/2008	8/15/2008	9/9/2008	2202	8K49A068667	OK according to specification	1725
	S	Engine stopped while driving	230002250483	3146228	0445116030	7/4/2008	8/15/2008	9/9/2008	2202	8K49A068667	OK according to specification	1725
	O	Vehicle smells of diesel.	230002349569	3240975	0445116030	7/21/2008	5/30/2008	12/22/2008	48969	8K79A012688		without
	GE	Customer complaint	QC no.	QTS no.	Part no.	DM	CS	Failure D.	Mileage [km]	VIN	Error text	OSA
EDC17	B	Engine hums and stops	230001981754	2935479	0281014235	11/22/2007	1/30/2008	2/19/2008	6	8K58A008962	Short-circuit capacitor	1604
	B	Engine has stopped while driving	230002151338	3034801	0281014235	11/23/2007	2/8/2008	5/22/2008	15196	8K48A010962	Foreign object in Q1 adhesive	without
	B	Engine stopped while driving.	230002135455	3023186	0281014235	3/4/2008	3/15/2008	4/28/2008	251	8K88A031667	Short-circuit capacitor	1653
	B	Vehicle during the freeway driving	230002229377	3120076	0281014592	6/3/2008	7/29/2008	8/26/2008	616	8K99A067546	DC-DC converter is burning down	1712
	C	Engine does not start up	230002230861	3126268	0281014235	4/26/2008	7/8/2008	8/20/2008	8570	8K29A017264	Mechanically damaged	without
	S	Preheat light is lit up and engine has	230002177332	3067281	0281014235	12/2/2007	1/17/2008	6/6/2008	27028	8K88A011077	OK according to specification	without
	S	Exhaust control is lit up	230002197321	3078324	0281014235	4/3/2008	5/21/2008	6/27/2008	6011	8K69A007708	OK according to specification	without
	S	Vehicle has no power.	230002242395	3133937	0281014235	11/19/2007	1/10/2008	9/2/2008	45729	8K98A008592	OK according to specification	without
	S	Engine no longer starts	230002300707	0	0281014592	8/13/2008	9/10/2008	10/30/2008	1440	8K19N021959	CU OK (cable harness pin)	1788
	O	Electrical faults	230002342492	3237051	0281014235	3/7/2008	4/1/2008	10/27/2008	17392	8KX8033453		without
	O	Starter turns only when the ignition stops	230002347436	3240693	0281014235	4/29/2008	6/16/2008	11/28/2008	9871	8K69A021088		without

BOSCH

VW / AUDI error overview



P Code List

P0087, 0088 Fuel rail / system pressure; too **low** – too **high**

P0192, P0193 fuel pressure sensor G247, short-circuit to **positive** - to **ground**

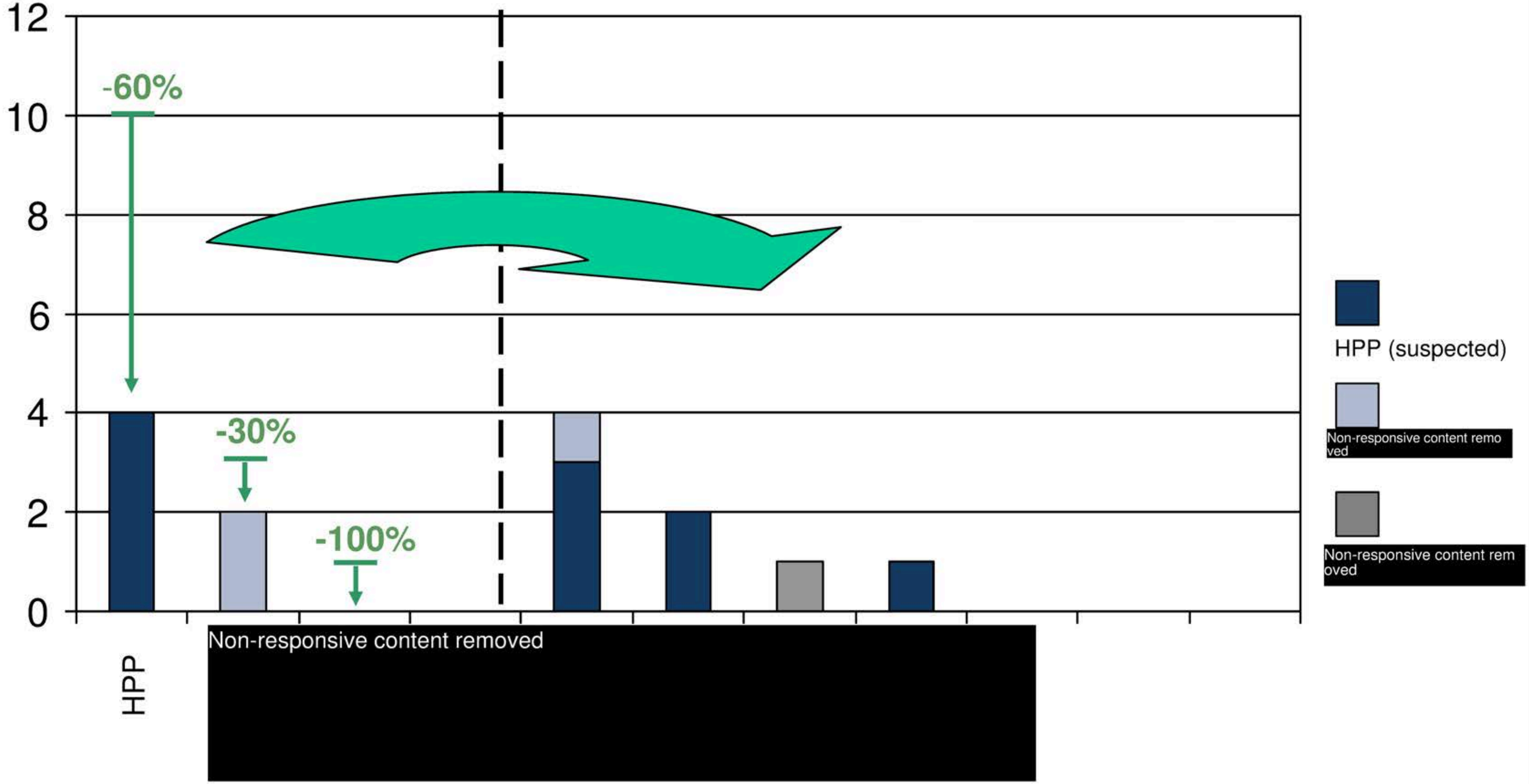
P2149, supply to injector valve(s) B interruption,

P020x, injection valve cylinder x, electric fault in the circuit

P0299 boost-pressure control, fallen below control limit

P0302 cylinder. 2 misfiring detected

VW - causes determined by FCT

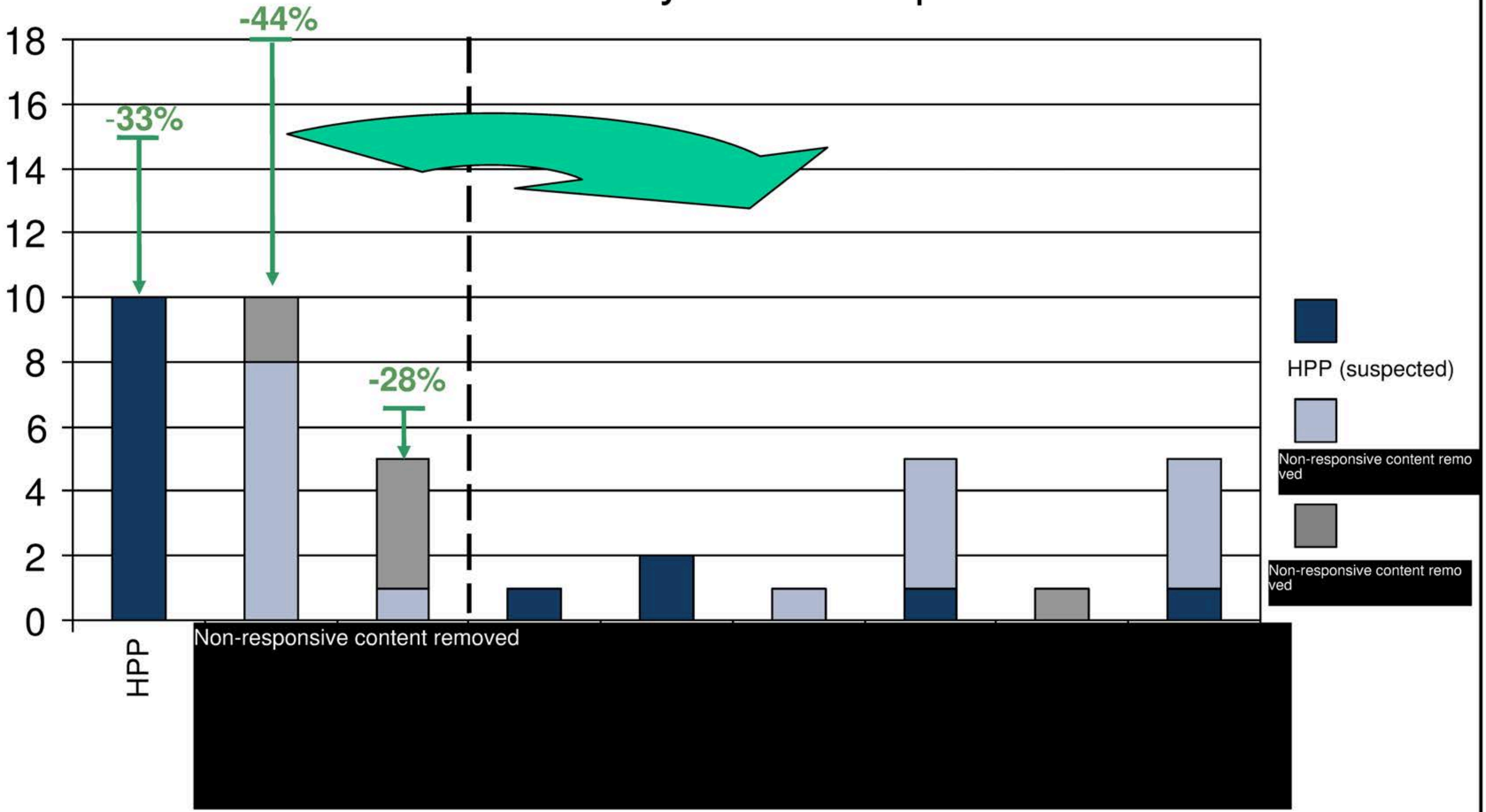


BOSCH

ENTIRE PAGE CONFIDENTIAL

Field Competence Team Review VW/AUDI 2.0L TDI

AUDI - causes determined by Field Competence Team



Diesel Systems

BOSCH

Conclusions

- Very good cooperation between VW and AUDI.
  - → Open communication with TSC, I / GS and dealers.
  - → A Common on-site processing of cases.
- Fast response time from WS report up to on-site operation.
- The agreed procedures have proven in the previous project period.
- What is striking is the S-error rate, i.e. cases where the replaced component corresponds to the specification (slides 3 and 4). However, the cooperation between service, partner operations and Bosch-FCT did significantly reduce the potential S-error.
- The intensive cooperation led to important findings and conclusions for VW / AUDI and RB, especially for the guided troubleshooting.

Identified measures VW / Audi

No	Measure	implement
1	Introduction of low-pressure test *	✓
2	Use of injector return line volumetric measurements with PRV adapter *	
3	Use of high-pressure cases *	
4	Pragmatic solutions for localizing faults in drivetrain damage (pull MU)	✓
5	Suggestions for improving the GFF by Field Competence Team	✓
6	Inclusion of electric faults in the GFF and mechanical faults in the repair manual. Guidelines for a uniform system	
7	Combination of rail pressure P-code and fault path for component demarcation *	
8	Adapt selection of displayed ambient conditions to P code *	
9	Illustrate rail pressure data uniformly in the tester (*target = hPa and actual = kPa*).	

* Backup slides

BOSCH

Outlook: New Projects

Non-responsive content removed

[redacted]

Proposals for future cooperation:

- extension of mandatory reporting of specific components
- Exchange of information on changes in the GFF

BOSCH

From	Person responsible	Telephone	Fax

Non-responsive content removed [redacted]

Feuerbach
06.08.2009
No. 2009_19

Minutes

Recipient: Participant

FYI: Non-responsive content removed [redacted]

Invited by

Participants

Line

Minutes

Organiz.

Date / location **4.2.2009, 12:30 - 2:30 PM**

Topic **Review of field start-up support by the Bosch Field Competence Team (FCT)**

1. Overview of Mission Field Competence Team
   see Appendix

2. Discussion of the FCT operations and results
   In the VW field failures, 4 cases with replaced high-pressure fuel pump CP4.1 and 1 case for the injector CRI3.2 have been noticed, wherein the informed and no malfunction has been confirmed in the analysis of the in the Bosch analysis center. Justification by VW: The on-field complaints are not covered by the VW
   obligation to report. The VW partner workshop can therefore independently component replacement. An extension of the mandatory reporting current vehicle models is not intended.
   Note VW: The VW partner company will not be re-debited for the replaced when the guided troubleshooting (GFF) has recommended the component replacement, but a detailed investigation of the component at Bosch does not confirm any errors.

BOSCH

From	Person responsible	Telephone	Fax	Feuerbach
Non-responsive content removed				6/8/2009 No. 2009_19

Minutes

Review of on-field support by the Bosch Field Competence Team (FCT)

Comment Audi: With eight on-site operations, less FCT support was unexpectedly required by Audi. However, on-site analysis was no longer required during detection of chips in the fuel system after the first cases. The processing time between failure date / FCT use at VW/Audi partner company and completion of the component analysis in the Bosch analysis center is high. An evaluation of the processing time will be created to find the cause.

R: Non-responsive content removed
D: WK26/09

3. Possible improvement measures (see Attachment slide # 9)
   - Pcode assignment to fault diagnosis paths of engine control unit: Identical Pcodes are partly used for different fault diagnosis paths (example P0087, rail pressure too low). By distinguishing the different fault paths, it could be distinguished better between the different root causes in Service. ⇨ Under review by persons in charge of the application.

     R: Non-responsive content removed
     Non-responsive content removed
     D: WK26/09
   - Improvements in guided troubleshooting (GFF)
     The GFF will be optimized cyclically in a GFF team (personnel from Audi and VW) and supplemented.
     Check whether employees from VW commercial vehicles can participate in the GFF team.
     Bosch FCT can give information on possible improvements based on specific cases of support. For further support, a request should be submitted by Sales to the responsible Development Department [redacted] Non-responsive content removed.

     R: Non-responsive content removed guided troubleshooting team
     R: Non-responsive content removed, Non-responsive content removed
     D: WK26/09
   - The feasibility of the suggestions for improvement of the which have not been implemented previously is to be assessed jointly by VW and Audi.
   - Establishment of a central VW office, from where information on Field Competence Team operations come in a pooled manner and via which feedback is made.
   - Check how the knowhow transfer of experience from the FCT operations to the residents of the VW / Audi engine plants is possible. In particular, the knowhow transfer of the residents among themselves should also be ensured, for example in job rotation.
   - Bosch FCT offers support even for preproduction and verification vehicles. VW / Audi test feasibility.
   - The FCT at DS supports primary cases in the German market. In other markets, there is the possibility to receive support

Non-responsive content removed

BOSCH

From	Person responsible	Telephone	Fax
Non-responsive content removed			

Feuerbach
6/8/2009
No. 2009_19

Minutes

Review of on-field support by the Bosch Field Competence Team (FCT)

from the regional companies (e.g. for SCR in the US market) in case of on-field problems. There is already an exchange of information between the FCT and the regional companies.

4. Further cooperation
VW, Audi and Bosch assess the start-up support from FCT as being very positive. Possible structural improvements are cited under 3. Therefore, further collaboration in future projects is desired. For the following projects / market launches, support by FCT is planned:
   - Start-up of the R4 2.0 l engine Gen2 (CRI3.2 and sleeve) in commercial vehicles (e.g. T5) from about WK31/2009. At VW on-field support is not provided by the TSC, but by the VW Commercial Vehicles Service Center (NSC). Bosch asks VW to pass on the experience gathered in the previous R4 start-ups by the TSC to the NSC team.
   - Startup of SCR system on the German market. (Support in the North American market is provided by the regional company).
   - Start-up of CRI2.5 in the R4 unit after about WK43/2009

R: Non-responsive content removed
R:
D: WK26/09

Non-responsive content removed

ENTIRE PAGE CONFIDENTIAL

CP4 robustness

Agenda

BOSCH

ENTIRE PAGE CONFIDENTIAL

CP4 robustness

Main characteristics of CP4 for car applications

Rail pressure	2000bar
Piston diameter / stroke	6.5mm / 6.75mm*
*New piston stroke stages: (6 / 6.5 / 7)mm	
Fuels	without AWP: EN590
	with AWP: US fuels with
service life of	300,000 km
Fuel inlet temperature of	70°C

BOSCH

CP4 robustness

Development of main characteristics of CP4 for MD & OHW

Rail pressure MD / OHW	**2,500 bar** / 2,000 bar
piston diameter / stroke	6.5mm / **7.5**mm
Fuels	with AWP: US fuels
with service life MD / OHW	**750,000 km** / 10,000 h
and fuel inlet temperature of	**80°C**

Development focus: Robustness increase of drivetrain (P. 7,8)

BOSCH

Robustness CP 4

Approval for the following fuels

without AWP: EN590

with AWP: ASTM 975-05 (US fuels with HFRR 520µm)

Approval verified by testing

@ R.B. with EN590 / GDK570

1) Lubricity 460µm / 570µm
2) Viscosity 2.5mm2/s / 1.9mm2/s

Random trials with GDK650, kerosene, gasoline, water, particles.

@ Customer: Verification in target market with country-specific fuel

ENTIRE PAGE CONFIDENTIAL

Robustness CP 4

Approval for Rest of World (RoW) fuels

What do "RoW" fuels refer to?

1) Low lubricity
2) Low viscosity
3) High particle contamination, high water content, low proportion of additives

For 1 & 2) robustness measures, see pages 7, 8

For 3) particle and water limits (similar to EN590 / ASTM 975-05) should be ensured by filter or water separator.

BOSCH

Robustness CP 4

Comparison of pump drive concepts for RoW use

Drive concept	lubricity	Viscosity
Eccentric drive (CP3, CP1H, competitors)	--	+
Roller cam drive (CP4)	+	O

Roller cam drive has the greater potential @ RoW applications

BOSCH

Robustness CP 4

Increase robustness of drivetrain (anti-wear package)

1) Compared to fuels with poor lubricity

(= robustness increase compared to mixed friction)

1a) Improved roller support surface

In CP22 / 2 for W37 implemented through use of advanced C3 coating.

1b) Optimized tappet assembly

Pressing & friction-optimized tappet implemented for W36 & W37; series implementation possible upon customer approval.

1c) C coated high-pressure piston

In series production for W19 Bin5; implementation in series possible upon customer request.

1a) and 1b) are verified in the platform CP4 MD, OHW & CP4 car 22 / x.

BOSCH

CP4 robustness

Increase robustness of drivetrain (anti-wear package)

2) Compared to low-viscosity fuels

(= robustness increase of lubricating film (hydrodynamics) -> reduction in mixed friction content)

Lubricating film thickness_roller_RS = f (fuel, contamination, surfaces, component tolerances)

2a) Optimized roller (surface coefficients)

Parts of potential implemented by commissioning supplier 2 quality.

2b) Optimized roller support surface

In CP22 / 2 for W37 implemented through use of advanced C3 coating.

2c) Optimized component tolerances (clearances)

Is considered as part of CP4 platform development.

2a) and 2b) are verified in the platform CP4 MD, OHW & CP4 car 22 / x.

BOSCH

CP4 - strainer at intake valve

Status

1. Preferred solution: Single piece plastic strainer

→ Premise: Uniform 100% switchover of the external contour of the IV plates from "cylindrical" to "stepped" for all customers (including customers who do not get a strainer and CP4.2)

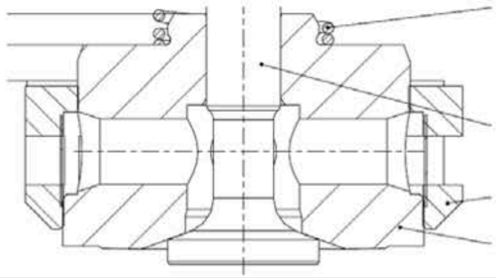
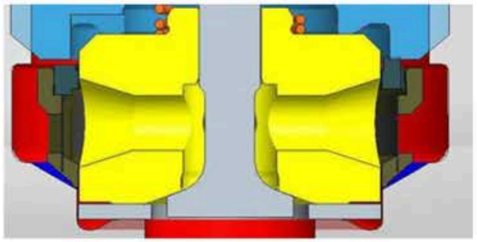
2. Postponed: 2-piece plastic strainer

→ No change to the IV plate

→ Risks: Pressing (scraping of chips during assembly)

ENTIRE PAGE CONFIDENTIAL

CP4 - strainer at intake valve

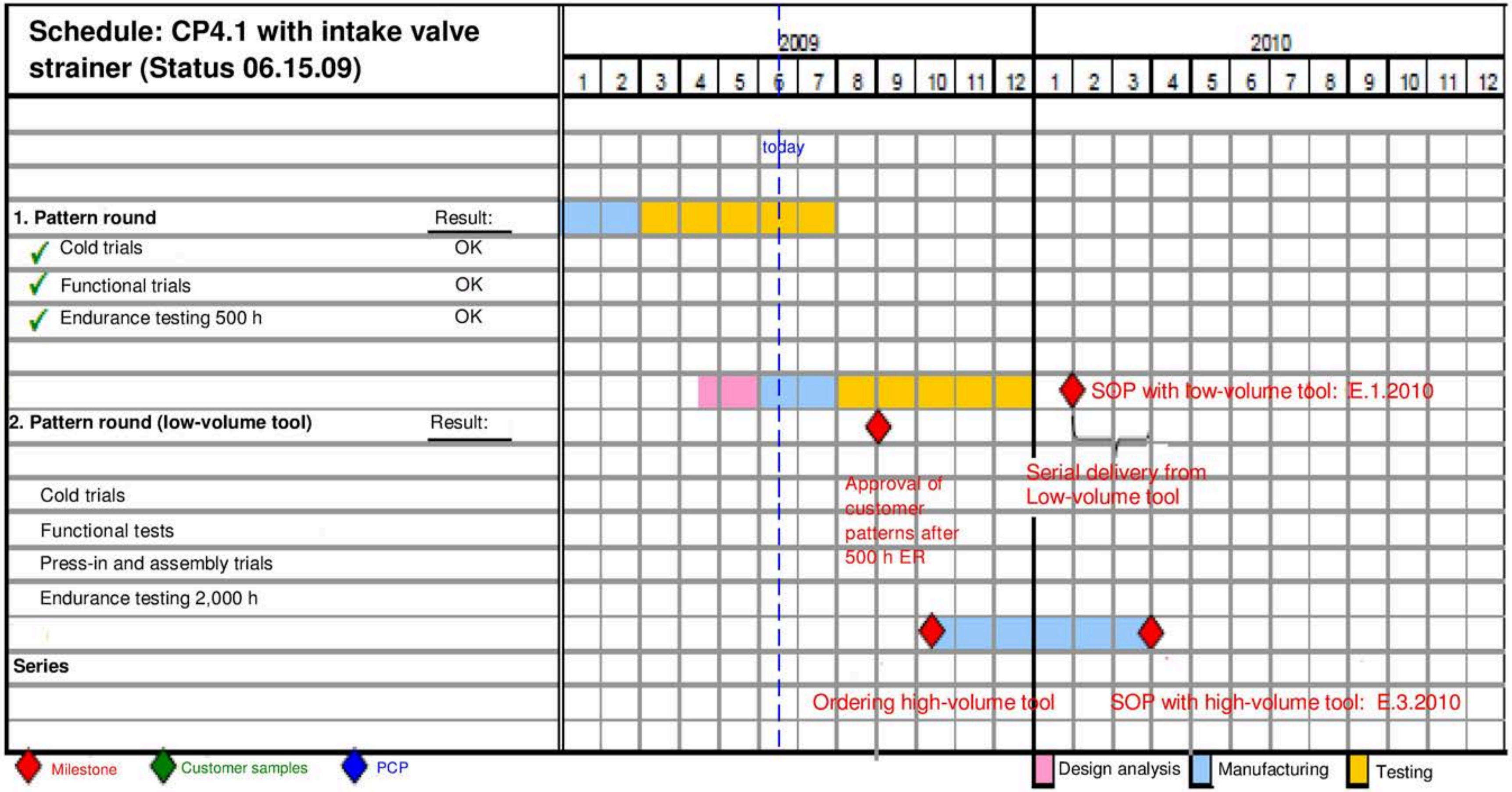
	1. Single piece plastic	2. Double piece plastic
Version		
Trial	- Basic trial of mesh size 100 µm OK. - Firm seat after ER / DT open - Cold trials and durability open - Press-in procedure	- Basic trial of mesh size 100 µm OK. - Firm seat after ER / DT open - Cold trials and durability open - Press-in procedure
Remark	Preferred solution since 05.18.2009	Preferred solution up to 05.18.2009

BOSCH

ENTIRE PAGE CONFIDENTIAL

CP4 - strainer at intake valve

Schedule



BOSCH

BOSCH

Diesel systems

From	Persons responsible	Phone	Fax
Non-responsive content removed			

Feuerbach
October 23, 2009
No. 990158

Protocol

Recipient Non-responsive content removed
Currently

Invited
Audi partici

Line
Protocol
Organis.

Date/location **October 21,2009 2:00 PM - Audi N** Non-responsive content removed
Non-responsive content removed

Topic **Technical meeting r.e. high-pressure fuel pump CP**
Special topic - robustness CP4/water separation

1. Use of CRS in trest of world (RoW)

On account of returns from various markets, Audi is unsure about the use of the CP4 worldwide. Audi's Quality Assurance is not prepared to approve further use of the CP4 if the failure situation does not improve.

The technical discussion r.e. the CP4 at this agreed date.

Further meetings Audi/Bosch with top level on October 27, 2009 in Non-responsive content removed and together with VW on December 08, 2009 in Non-responsive content removed

2. Slides robustness of the CP4

See attachment

Malfunctions as a result of poor lubricity / viscosity / water were detected by Bosch on the CP4 and the CP3/CP1H - irrespective of the drive concept.

Bosch considers the drive concept of the CP4 to be superior to that of the CP1H - CP3 drive concepts.

There is always a dependence on fuels which could present a risk, depending on the country and time of year.

Customer sample can be ordered with anti-wear package from February 2010 (see slide 24). *Note: The price of the anti-wear package option is established based on the ERs in 2010.*

A vehicle validation (see slide 25) is necessary for the approval in the target markets/target clusters and it would be practical for this to be carried out

BOSCH

Diesel systems

Fram	Persons responsible	Phone	Fax
Non-responsive content removed			

Feuerbach
October 23, 2009
no. 990158

Protocol
Technical discussion r.e. high-pressure fuel pump CP
robustness of the CP4/water separation

using borderline parts, as average pumps cannot be used due to the wide safety reserve.

3. Water separator (talk by Audi N/EA912 M Non-responsive content removed

In the laboratory test, the fuel filters with water separators currently being used by Audi comply with the Bosch TCD.
In the vehicle (random sample), manually introduced water is partially dissolved again in the fuel flow. A remedy would be e.g. a "water trap", i.e. deflector for the separated water and separation from the fuel flow.

Tests were carried out with UIP, CP1H with GP & CP3.3 with GP. Bosch believes that the results cannot be transferred to CP4 with EFP, as the filter is run through much more often.

The current standard for the measurement of the degree of water separation is currently being revised, the new ISO16332 (new draft prov. E.2009) will take into consideration innovations with regard to the proportion of biodiesel, desulphurised fuel etc.. Bosch will draw upon this ISO for the fuel properties in the forthcoming TCD.
Audi has requested a representation of the changes - new/old TCD

Non-responsive content removed

Audi will clarify the further procedure internally.

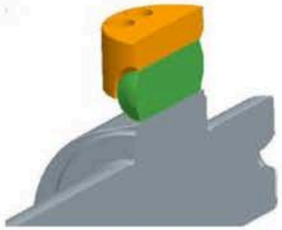
4. Rail pressure deviation after cold start with B10

Audi has repeatedly established that with a cold start of a Q5 technology demonstration vehicle with fuel B10, the flow volume of the CP with a cold start reduces on the CFPP of the fuel and rail pressure deviation is detected.
The hypothesis is the clogging of the MU filter with the paraffin flakes in the pipe volume after the fuel filter up to the CP.
The current Audi requirements on the cold start have not been achieved in this test.
Audi will draw up an internal fuel road map with the possible procedures.
Bosch was asked to prepare a topic for the next TM (within the scope of CRI TM or CP TM or special meeting)

Non-responsive content removed

Non-responsive content removed

CP4 robustness



Influence of fuel quality

Low lubricity (kerosene, water,...)

- Leads to increased wear in the roller / roller support combination in the start case (mixed friction area)

Less viscosity (kerosene, [redacted] diesel, water,…)

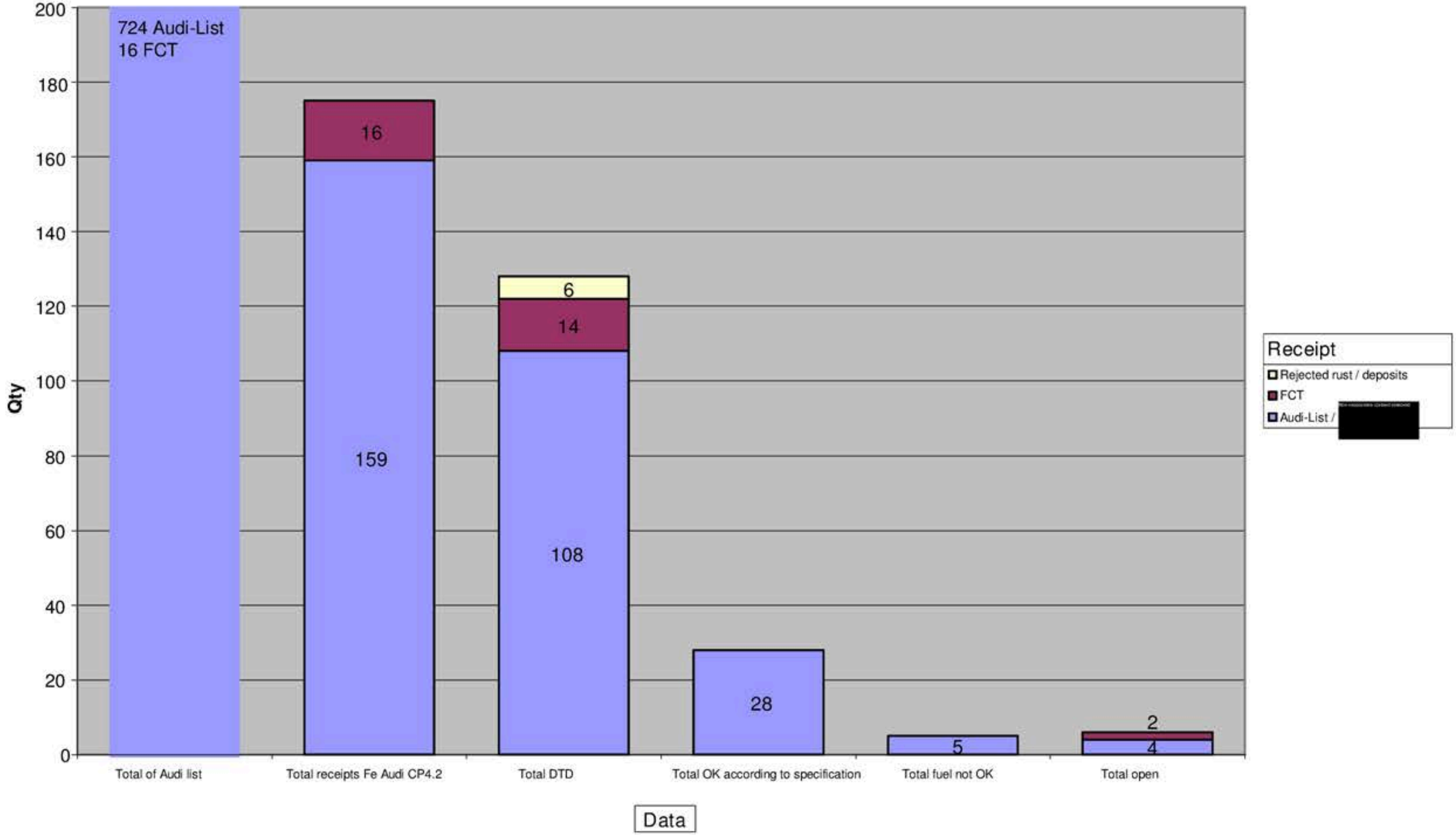
- Leads to low lubrication film thickness -> increased friction due to component contact

  -> Increase in slip (idle status of roller)

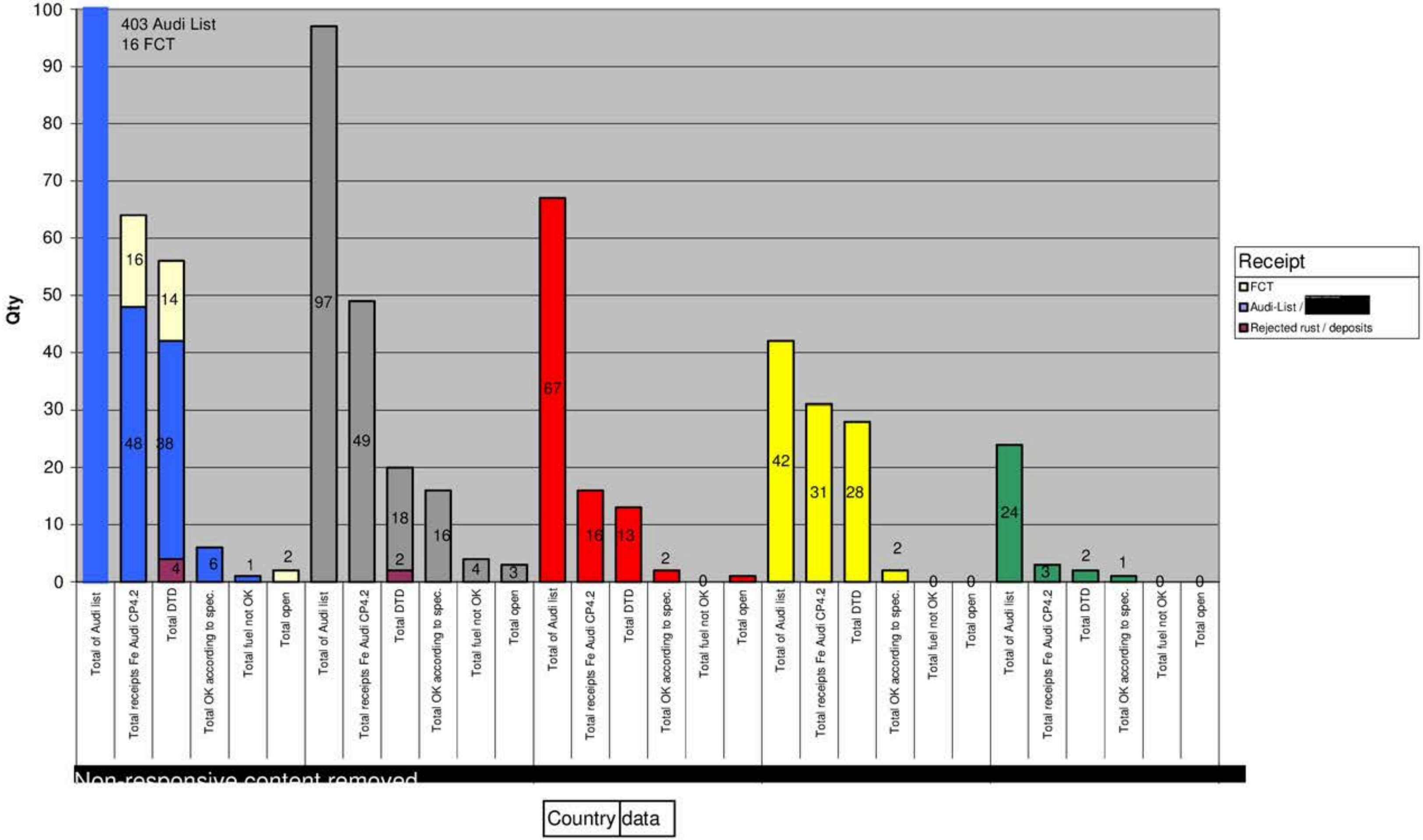
Water in fuel

- Influence as an emulsion, see lubricity and viscosity
- Free water can lead to hydrogen wear / corrosion fatigue and thereby damage the parts in rolling contact

TOP5 countries - All



TOP5 countries



BOSCH

Summary

➔ Status of new information since last update on 12/10/09:

Other analyses in the fuel samples from on-site actions in [redacted] support the results from the fuel survey in Northern Italy and the analyses from the problematic pumps. Further detailed analysis of the fuel samples and fuel filters will be complete by 1/22/10.

Information gathered to date supports the failure mechanisms presented in the last report.

1. Tribochemical wear
2. Deposit / coatings from algae and oxidation products and therefore a significant deterioration in frictional coefficient.
3. Corrosion on the surface of cams and roller

The analysis of the reference samples from the problematic production period indicates nothing unusual in relation to drawing-related features. Other detailed analyses (roller surface texture, ripple in roller support, roundness with Fourier analysis, local adhesion of coating with temperature analysis) will be completed by 01/20/10.

Summary

➔ **Further action:**

For the purpose of practically confirming the damage hypotheses, reappear tests will be carried out on the hydraulic test bench with boundary sample parts and fuels from 1/14/10 onwards. A test schedule has been drawn up.

Measures to increase robustness (roller surface texture, roller support and play) are defined and their effectiveness will be verified with the same test parameters. A test schedule has been drawn up, partial results will be available by the end of week 01/2010

Return of the requested 40 good pumps from [redacted] and 20 good pumps [redacted] is agreed to WK 03/2010.

Mechanism whereby the tappet is turned, roller lifted from the camshaft depending on the engine vibrations on the pump drive, is to be examined on the engine with AUDI. Technical meeting for this purpose 01/12/2010

Operating conditions / Environment / System

Local FCT team in Non-responsive content removed

Status:	18 vehicles examined on-site and 4 systems received from damaged parts stores. Complete fuel injection systems including fuel filters and fuel pumps have been sent to Bosch for analysis.
Result:	12/12 cases of drivetrain damage from local actions. 2/4 cases of drivetrain damage from damaged parts stores systems. 7/7 analyses of low pressure circuits showed nothing unusual.
Special features:	In 3 vehicles, free water (>> 200 ppm) found in fuel. 4 vehicles with deposits in the tank (swirl pot) - 1x reddish, sticky coatings, - 1x white flocculation, - 2x dark/ black particles

BOSCH

Fuels
Findings

Status: 20 fuel samples analyzed from survey.
10 fuel samples analyzed from FCT.

Result: Survey:
Oxidation stability was found to be outside the tolerance in 4 fuel samples and the TAN (acid coefficient) is generally 2-3 times higher than usual, probably due to spilled biodiesel.
FCT:
No striking features identified in 8 fuel samples,
in 2 fuel samples oxidation stability was outside the tolerance.
In the first analysis of the coatings, algae were found in the fuel.
Other deposits from other pumps are under analysis and probably also contain algae. Fuels containing microorganisms always contain free water. This is also consistent with the slight acidification of another fuel sample from the same damage scenario. Algae develop acids as metabolized material.

BOSCH

Summary of analysis results

Result of analysis of [redacted] pumps

17 out of 17 Bruss shaft seals more worn than known from trial
45 out of 54 pumps have signs of corrosion
11 out of 54 pumps have brown fuel deposits

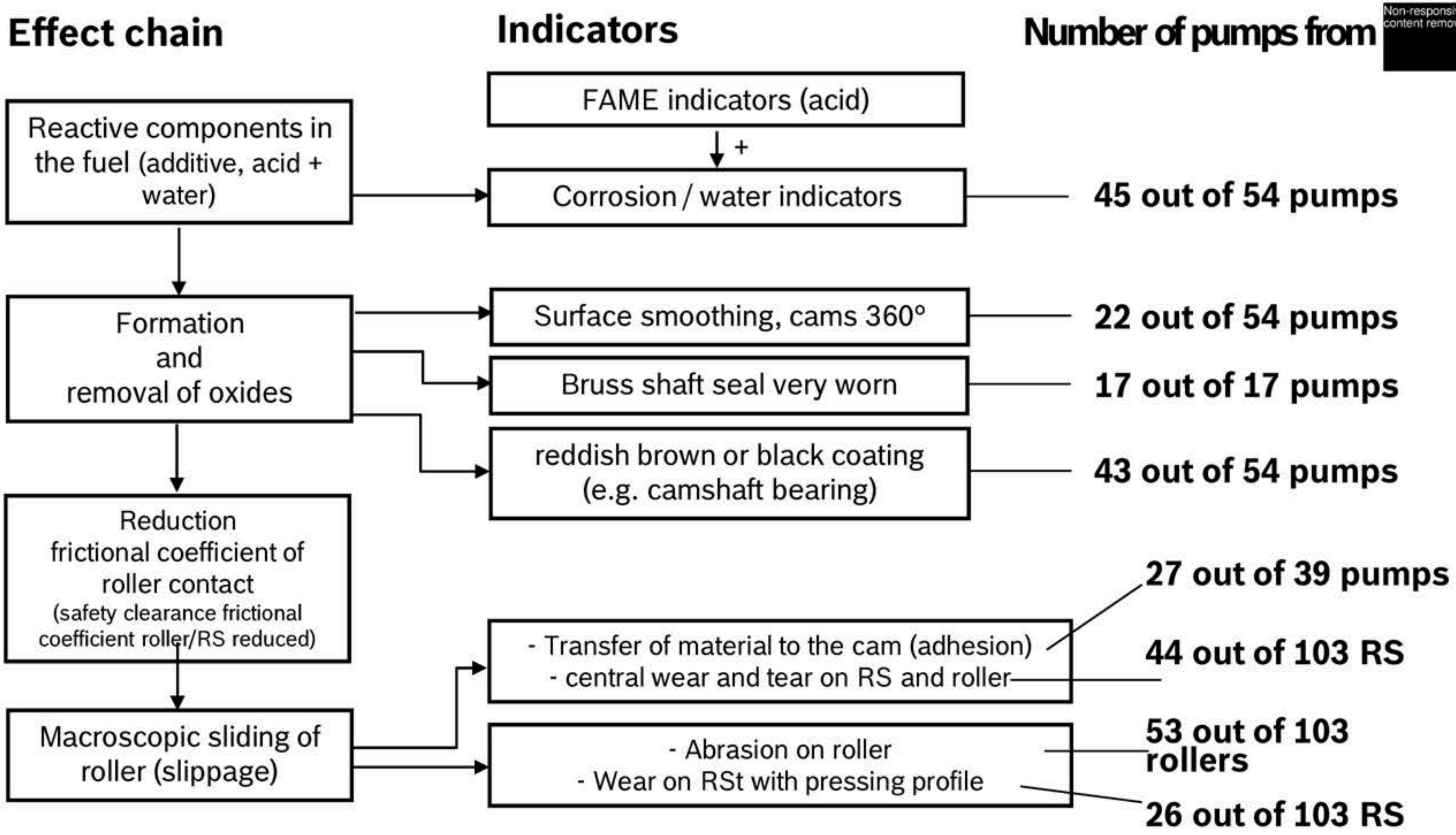
45 out of 52 drivetrain failures have turned tappet bodies
22 out of 54 pumps have surface smoothing on the cam
9 out of 52 drivetrain failures have fatigue damage on the cam
3 out of 54 pumps have pitting on the cam

44 out of 103 roller supports are worn in the middle
29 out of 103 roller supports are completely worn
26 out of 103 roller supports are worn in the shape of the press profile

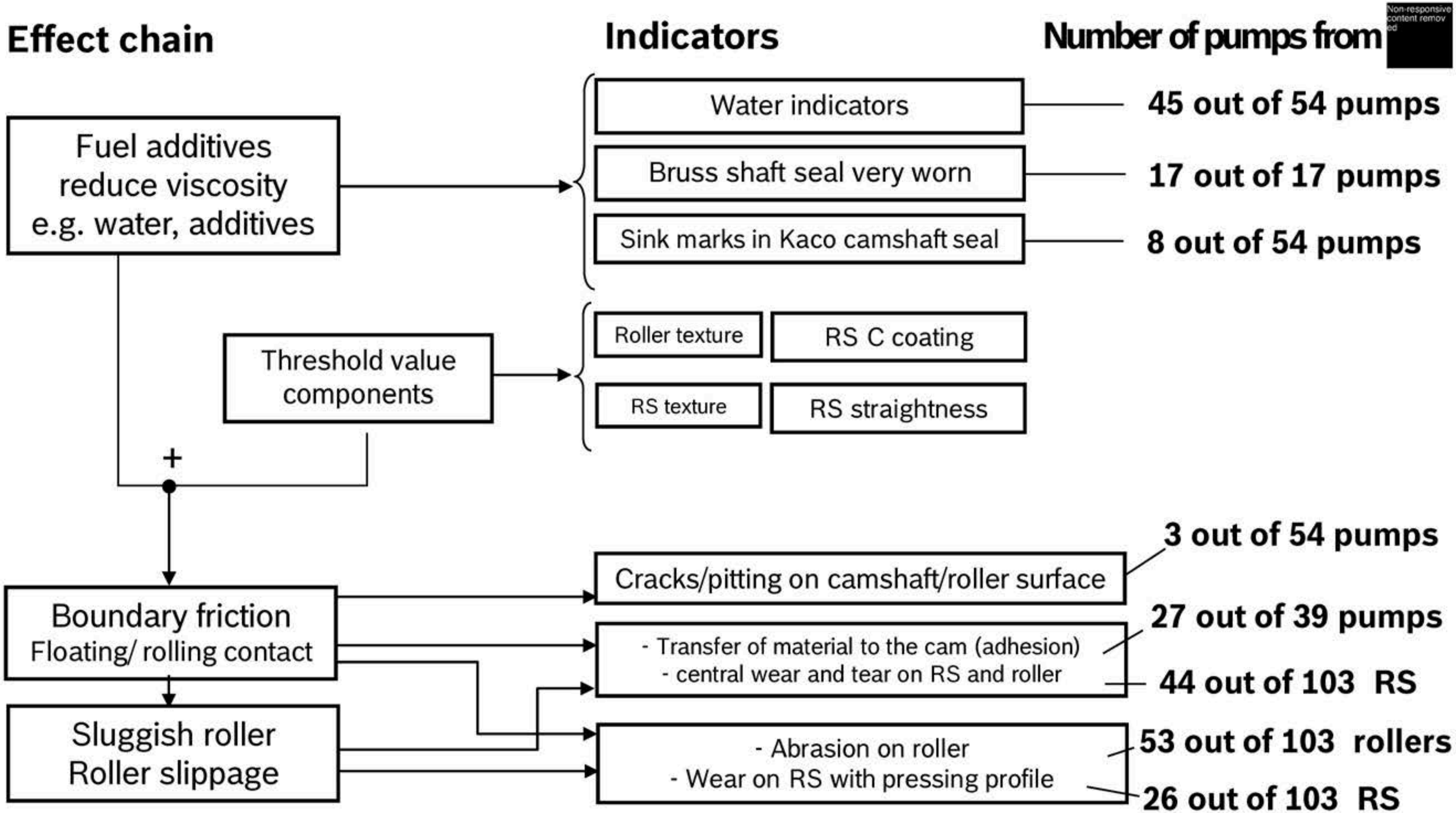
1 x fuel sample tank: Algae
1 x wash mark with striations

Validation CP4: Analysis system for drivetrain damage in Italy

Failure hypothesis 4: Fuel additives -> Tribochemicals



Failure hypothesis 6: Fuel viscosity -> Boundary friction



Failure hypothesis 3: Biodiesel -> adhesions

Effect chain	Indicators	Number of pumps from Non-responsive content removed
Rise in proportion of biodiesel in Italy ↓		
Formation of deposits →	brown deposits (FAME indicators)	11 out of 54 pumps
↓ Adhesions between roller/RS		
↓ Sluggish roller		
↓ Macroscopic sliding of roller (slippage) →	- Transfer of material to the cam (adhesion) - central wear and tear on RS and roller	27 out of 39 pumps 44 out of 103 RS
Macroscopic sliding of roller (slippage) →	- Abrasion on roller - Wear on RS with pressing profile	53 out of 103 rollers 26 out of 103 RS

ENTIRE PAGE CONFIDENTIAL

AUDI CP4 Situation in the Field in [redacted]

Status: 12/16/2009

Operating conditions / Environment / System

Procure 40 good pumps

<u>Status:</u>	Vehicles identified, importer to contact owners. Importer has new pumps for replacement.
<u>Result:</u>	t.b.d.
<u>Further action:</u>	First returns not expected before WK 03/2010.
<u>Special features:</u>	none

BOSCH

AUDI CP4 Situation in the Field in [redacted] ENTIRE PAGE CONFIDENTIAL Status: 12/16/2009

AQUA: Active quality analysis
Status: 10/09-20.11.09 09 :14
Source/user: SAGA-Gew[redacted]

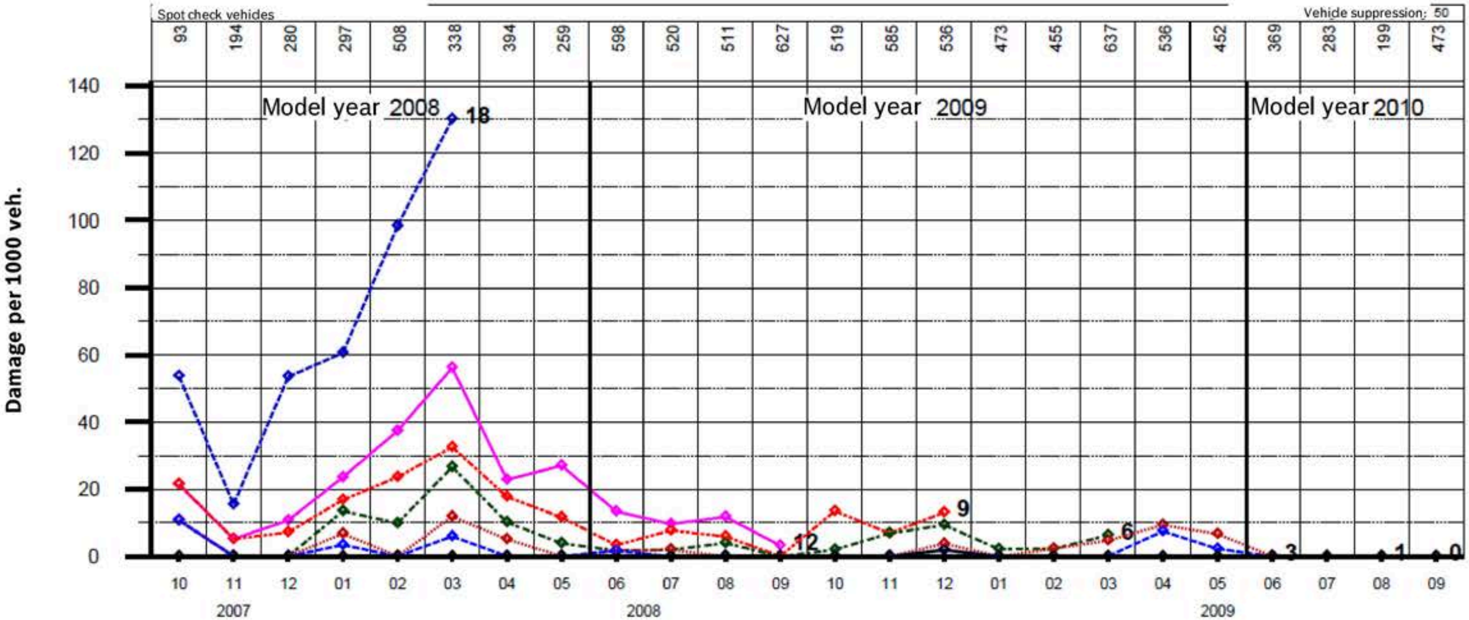
Audi, market:[redacted]
MY 2008 – 2010, Offset: all (max. 2)
CNR / Groups: High-pressure fuel pump

Confidential
without PR numbers
CNR 2374

CAMA|CAMB|CASA|CASB|CASC|CASD|CCWA|CCWB|CGKA|CGKB

MY	MIS 0	MIS 1	MIS 3	MIS 6	MIS 9	MIS 12	MIS 18
2008	0,0	1,7	3,9	10,3	18,0	27,8	77,3
2009	0,2	1,1	2,2	4,4	7,5	13,7	
2010	0,0	0,0	4,9				
Diff%	-100	-100	121,12				

MY	Replacement	BD	SA 17	SA 10	SA 50	SA 18
2008	100,0 %	81,1 %	14,6 %	75 %	7,1 %	2,4 %
2009	96,3 %	86,3 %	13,8 %	80 %	3,8 %	1,3 %
2010	100,0 %	100,0 %	66,7 %	33,3 %		
			MAJOR	MEC ERR	LEAK	MINOR



Vehicles: : 3.389+9.366+4.312=17.067; Sold: 3.386+9.211+2.973=15.570;UP : 2.335+6.347+2.249=10.931 MY:2008+2009+2010 =Total

CP4 A4,A5,Q5,Q7 V6[redacted]

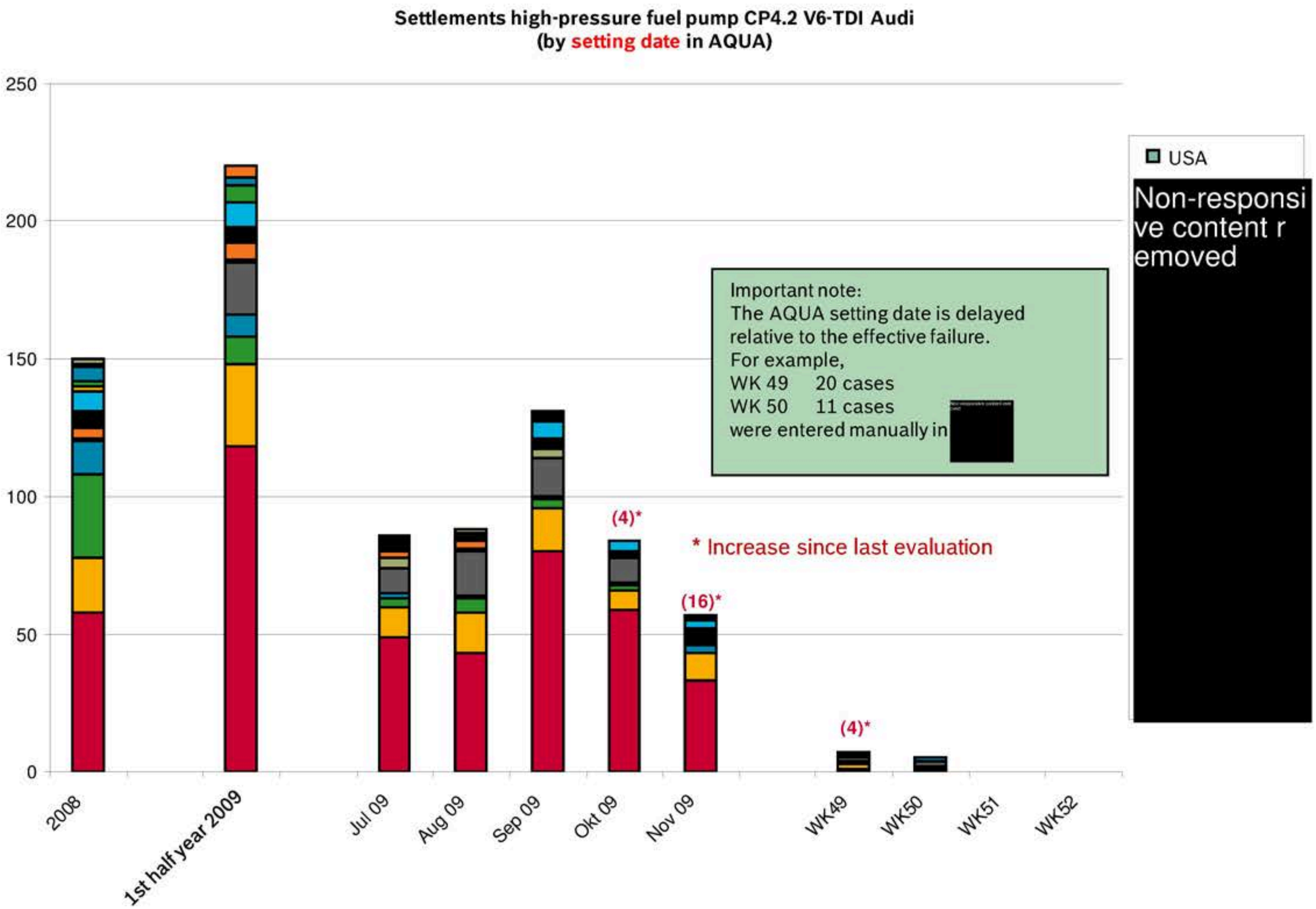
Diesel Systems

BOSCH

AUDI CP4 Situation in the Field in [redacted]

ENTIRE PAGE CONFIDENTIAL

Status: 11/16/2009



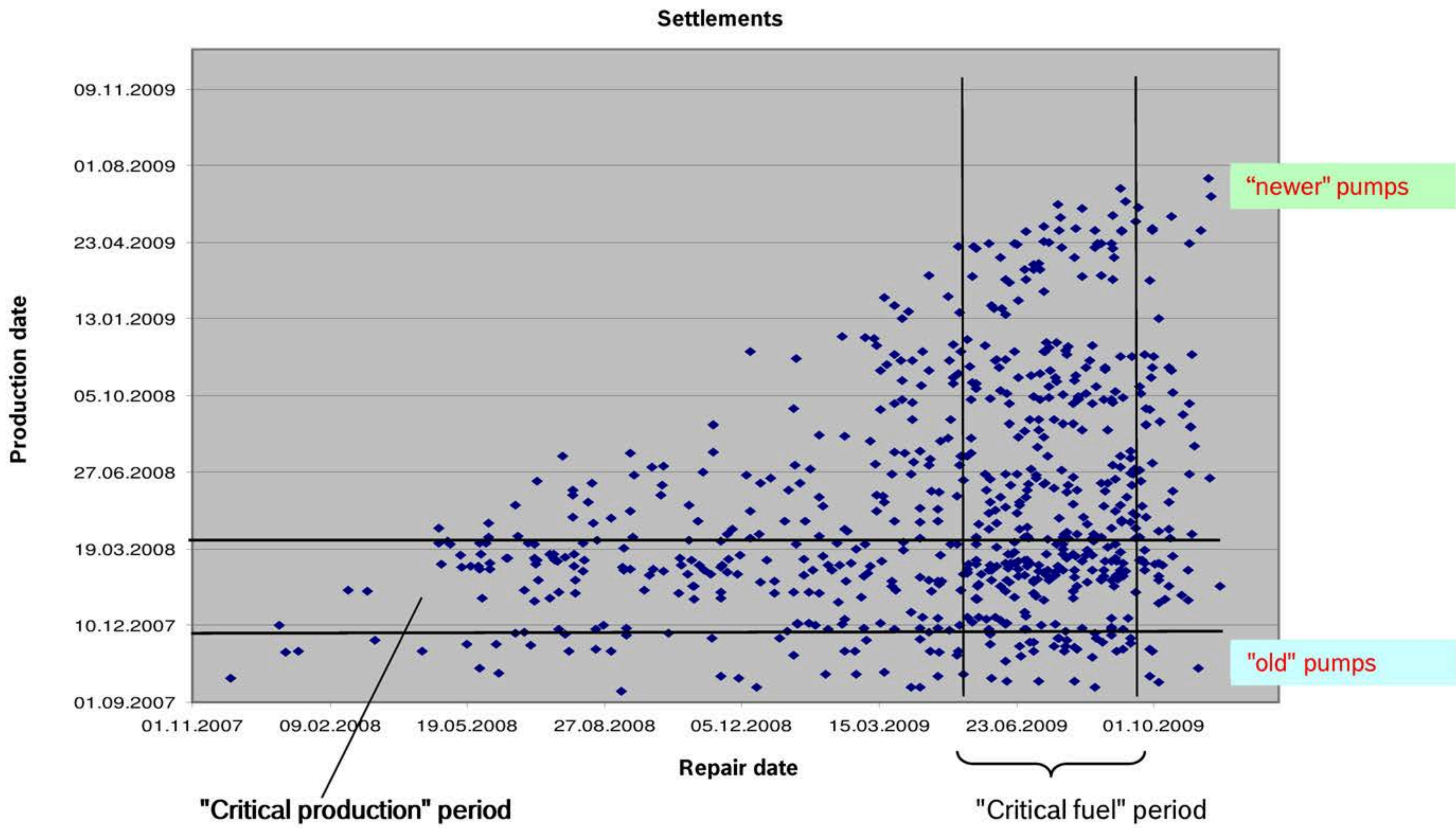
Diesel Systems

BOSCH

ENTIRE PAGE CONFIDENTIAL

AUDI CP4 Situation in the Field in Non-responsive content removed [redacted]

Status: 12/16/2009



BOSCH

Task force summary

- Status of new information since last update on 1/20/2010
  (changes in blue):

  Task force work concentrates on the following key areas:

1. Analysis of field parts/fuel samples, good pumps, filtering, reserve samples from production.
2. Analysis of the differences between CP4.1 and CP4.2 in the case of critical fuels.
3. Reappear test of the differences between CP4.1 and CP4.2 and confirmation of the damage mechanisms.
4. Introduction of anti-wear package 1 (C2 coating, reduced play on roller/roller support, 100% avoidance of fusing and metal spatter)
   Implementation decision by RB/AUDI after positive completion of validation
   Start of WK 9/2010
5. Definition of anti-wear package 2 (RoW use) after completion of points 1 and 2.
   This needs to be checked and validated with boundary fuel (already defined with AUDI).

1. Summary of analysis

- Other analyses in the fuel samples from on-site actions in [redacted] support the results from the fuel survey in Northern [redacted] and the analyses from the problematic pumps. The mineral oil industry in [redacted] confirms in principle the poor fuel results (water, aged biofuel)

  The analyses in relation to pumps, fuel samples and particles / residues from local actions are complete. In some cases oxidation stability (aging) was outside the standard; in addition, particles of plastic and traces of algae were found in some tanks and pumps. One of the special features in [redacted] is the use of the Tunap 183 additive to clean the fuel injection system in service. According to the manufacturers, Tunap 183 is supposed to improve lubrication (HFRR value). Evaluation of the information by the Bosch and Audi laboratories. Verification of influence through tests run by Bosch.
  Tests concluded in week 8/2010

1. Summary of analysis

➔ Return of the requested 40 good pumps from [redacted] and 20 good pumps from [redacted]

First returns announced from [redacted] (5 pumps) and [redacted] (4 pumps). 4 pumps received from Italy on 1/25/2010. Pumps from [redacted] still outstanding.

1 out of 4 pumps has signs of previous damage to the roller/ camshaft in TDC, same results as with 1 pump from returns from on-site action.

Similar damage was found on an as yet still working V12-TDI pump from [redacted] (sister pump of drivetrain damage after 1,600 km), where the roller was at a significant slope on the cam and there were signs of corrosion on the roller.

These signs of damage indicate sluggish rollers in conjunction with poor quality fuel.

Further detailed analysis required, completion by 2/3/2010.

1. Summary of analysis

Information gathered to date supports the failure mechanisms presented in the last report.

1. Tribochemical wear
2. Deposit / coatings from algae and oxidation products and therefore a significant deterioration in frictional coefficient.
3. Corrosion on the surface of cams and roller

Analysis of reference samples:

The analysis of the reference samples from the problematic production period (up to May 2008) indicates nothing unusual in relation to drawing-related features.

Other detailed analyses (roller surface texture, ripple in roller support, roundness with Fourier analysis, local adhesion of coating with temperature analysis) are complete.

Analyses to date confirm the production status at the time, with splashes of metal on the roller support; also the surfaces of the C coatings indicate abnormalities that are still under investigation. Will be concluded on a further 25 parts by 2/3/2010.

2. Summary of differences between CP4.1 and CP4.2

- The MIS12 (MY08) failure quota of the CP4.2 is up to 10 times higher in [redacted] than the CP4.1.
- The MIS 12 (MY08) of CP4.2 is approximately 10 times higher in [redacted] than in [redacted]
- The MIS 12 (MY08) of CP4.2 is approximately 2 times higher in [redacted] than in MY09.

Conclusions:

- In addition to the influence of the fuel quality, there must also be design and application-specific differences between CP4.1 and CP4.2.
- Concentration of further work on an analysis of the differences between CP4.1 and CP4.2 (see slide 6 and 7).

2. Summary of differences between CP4.1 and CP4.2

Further action:

Implement examinations

- ➔ The flow and pressure conditions in the tappet chamber of both pump types.
  Initial investigations of flow conditions indicate now differences.
- ➔ Influence of the low pressure circuit.
  The plan is to reproduce the entire low pressure circuit of 4/6-cyl. engines on the test bench in order to test individual influences, such as water ingress from the tank to the pump. D. 2/24/2010
- ➔ the tappet position when stopping (position of roller with cam TDC)
  Initial analysis showed that the tappet position in 6-cylinder engines in approx. 10% of cases can be just before or at TDC after the motor stops. When the engine is restarted the roller must start from the instable position at TDC This could cause the tappet to turn.
  In the case of 4-cylinder engines this critical position does not exist, however this is to be confirmed again by VW/AUDI by means of measurement data on the vehicle. D. 2/3/2010

3. Reappear test for differences between CP4.1 and CP4.2

Further action:

Validation with EN590 shows a turned tappet on the camshaft of less than one degree. Further investigations are required on the test bench in relation to the startup of the roller at TDC with critical fuel (Arctic diesel). D. 2/3/2010
Measurements need to be carried out using kerosene on the complete engine at AUDI in [redacted] in WK 5/2010.

BOSCH

4. Summary of anti-wear package 1.

→ Further action:

Measures to increase robustness (cam roller surface texture, roller support and play) are defined and their effectiveness will be verified with the same test parameters. A test schedule has been drawn up, partial results will be available by the end of WK 8/2010. The latest information shows that the roughness of the roller support is the decisive parameter in increasing robustness.
According to a simulation, narrowing tolerance R_V from 1.3 to 0.8 µm increases the safety factor of the frictional coefficient by approx. 50%.

Investigations into the creation of roughness in the roller support shows that roughness is primarily determined by the C3 coating and not the processing.

4. Summary of anti-wear package 1.

Roughness measurements on roller supports with C2 coating show a clear improvement in roughness.

Changes in process technology from C3 sputter coating to C2 plasma coating on the roller support and roller enables quality to be improved by avoiding 100% of fusings and metal spatter.

That is why it is necessary to switch to C2 coating.

The basic test with EN590 and GDK 570 for C2 coating is complete.

The "rest of the world" trials are still outstanding.

Further action:

→ In case of positive validation of the anti-wear package with boundary samples and critical fuels (Kerosene, A rctic Diesel, WCF, FCF) by the end of WK 8/2010 , a series introduction was decided for pumps V6-TDI EU5 + BIN5 series and W36. Production readiness is assured from week 9/2010 onwards. This will confirm the schedule requirements from Audi from the last task force.

4. Summary of anti-wear package 1.

➔ A further objective is to enable the anti-wear package on a provisional basis in customer service worldwide.
After the anti-wear package is installed in series, the first 400 pumps will be provided for customer service.