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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 drivetrain 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, 2.0l 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: Non-responsive content removed
6. 1:25 - 1:45 PM Statement by Bosch concerning the topic of anti-turning locks
R: Non-responsive content removed
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: Non-responsive content removed
8. 2:00 - 2:10 PM Status of MU O-ring leak, pump verification vehicle
R: Non-responsive content removed
9. 2:10 - 2:15 PM Coordination 2DP date, GP38 Hallein
R: Non-responsive content removed
10. 2:15 - 2:30 PM Audi requirement 250µm, status test
R: Non-responsive content removed
11. 2:30 - 3:00 PM Final meeting
R: all

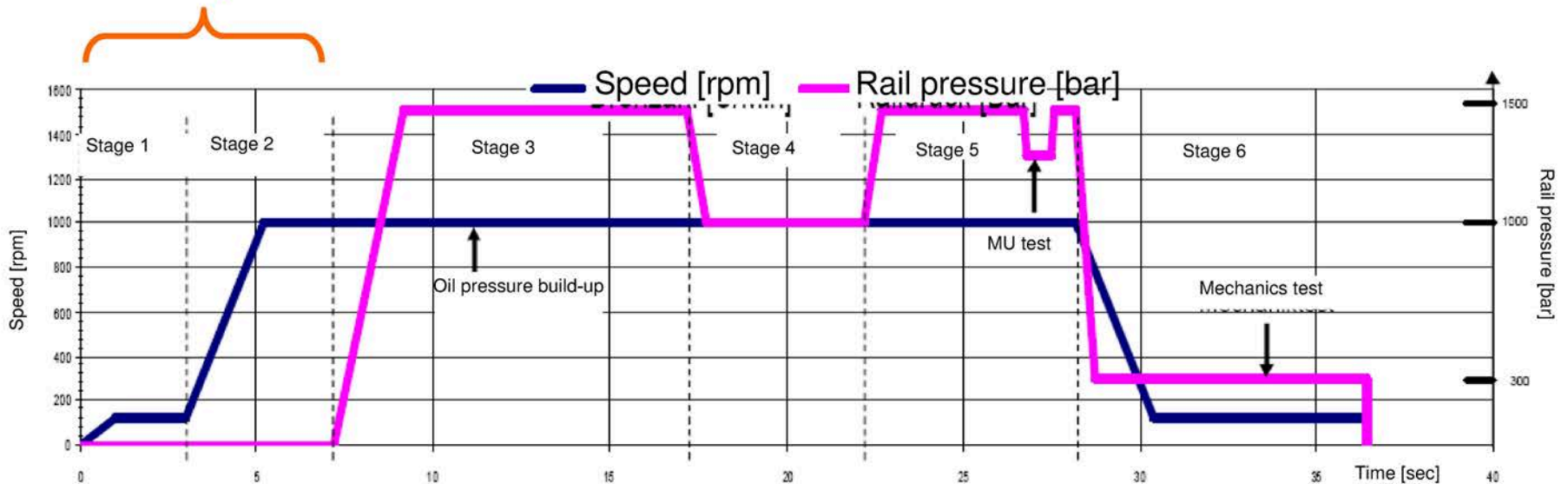
R4 CR TDI

High-pressure fuel pump seized, noisy

Detection of fault in the cold test curves

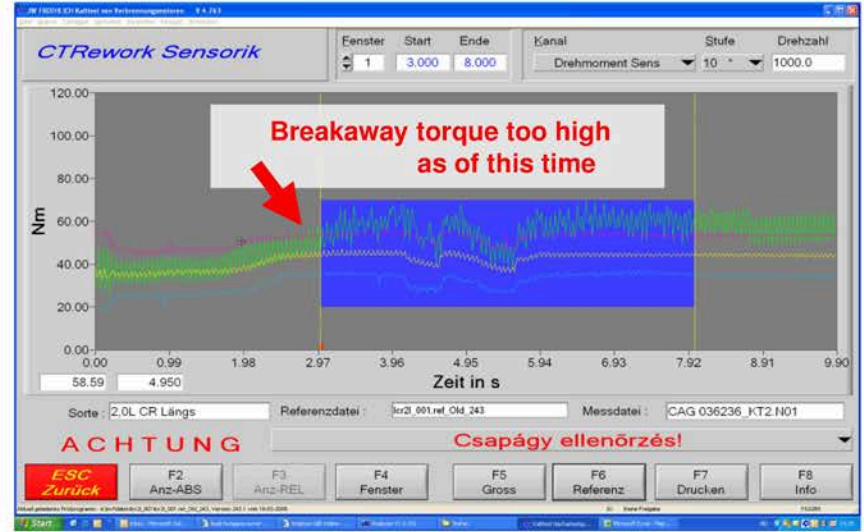
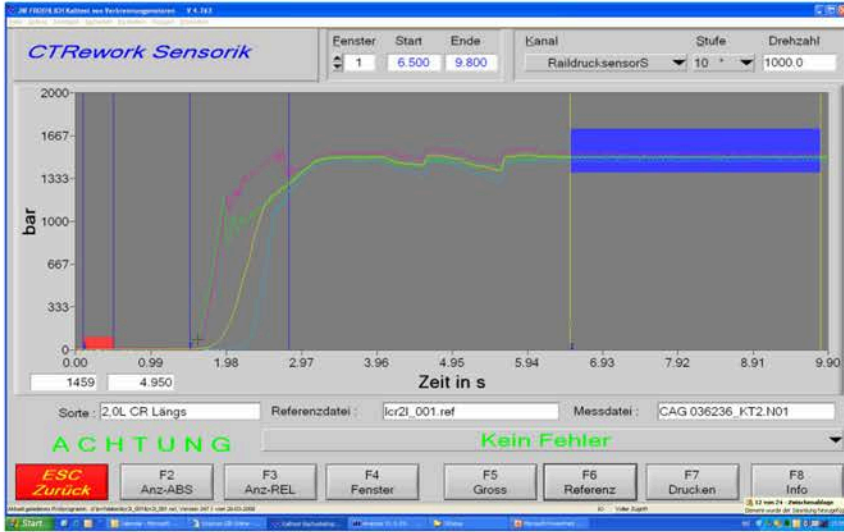
(e.g. on the engine Motor CAG 036236, but it manifests in the same manner in the other two failures)

No striking features

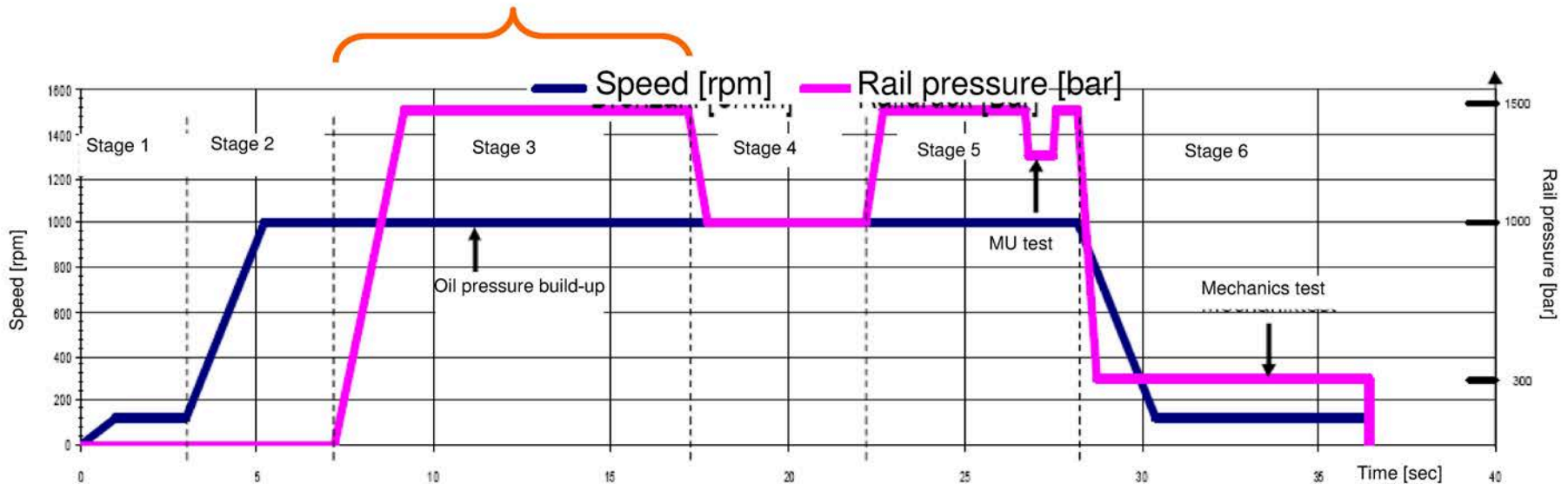


ACTUAL rail pressure

ACTUAL breakaway torque of the engine

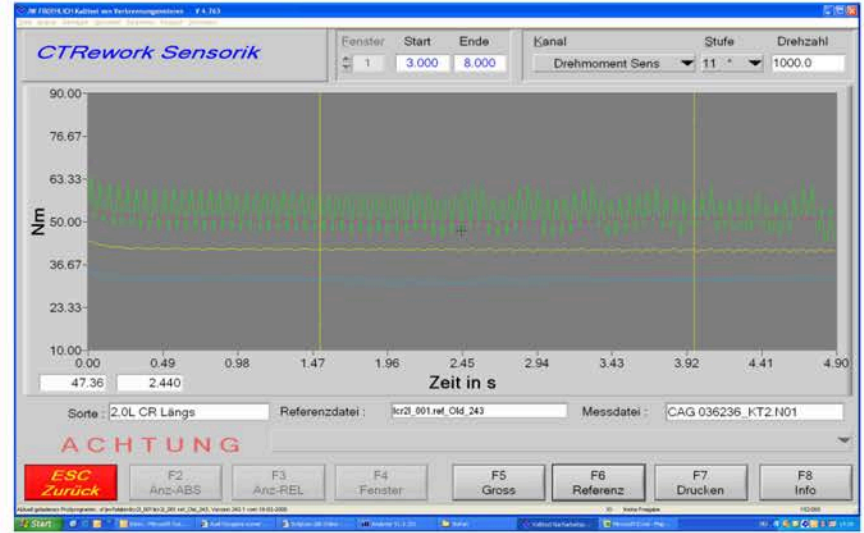
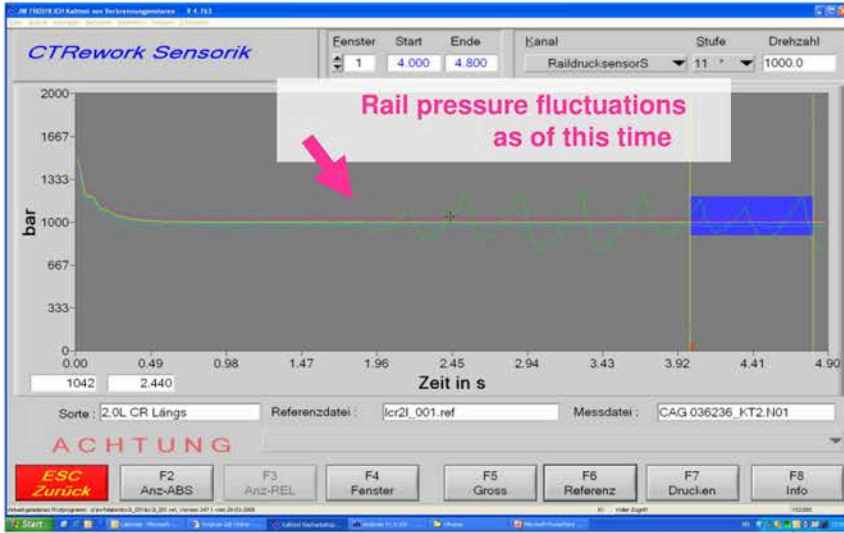


Rail pressure build-up and kept stable, but the torque curve has run up since approx. the second third to a level that is greater than the reference curves

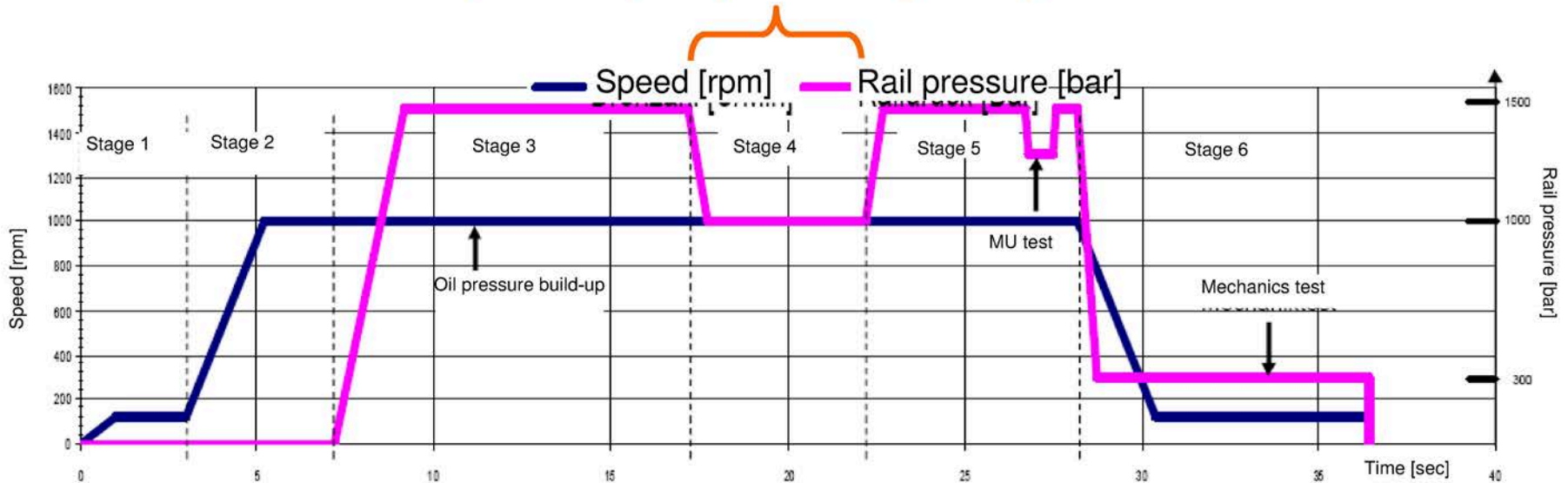


ACTUAL rail pressure

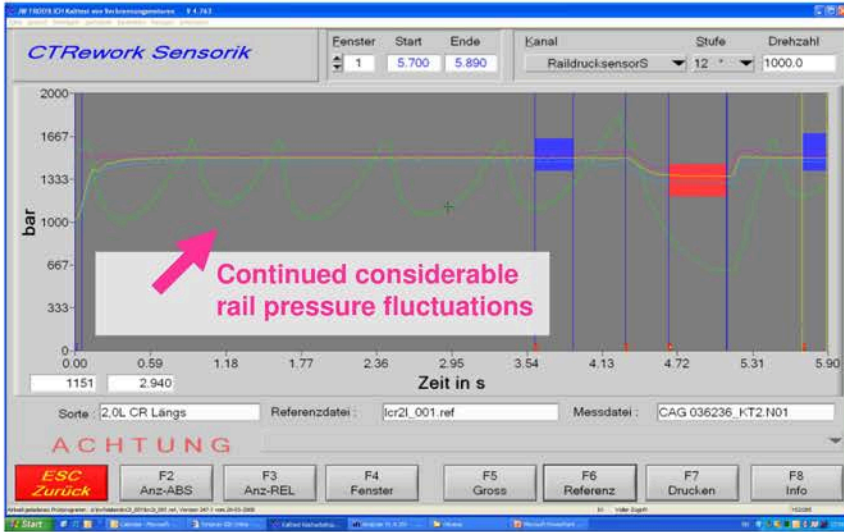
ACTUAL breakaway torque of the engine



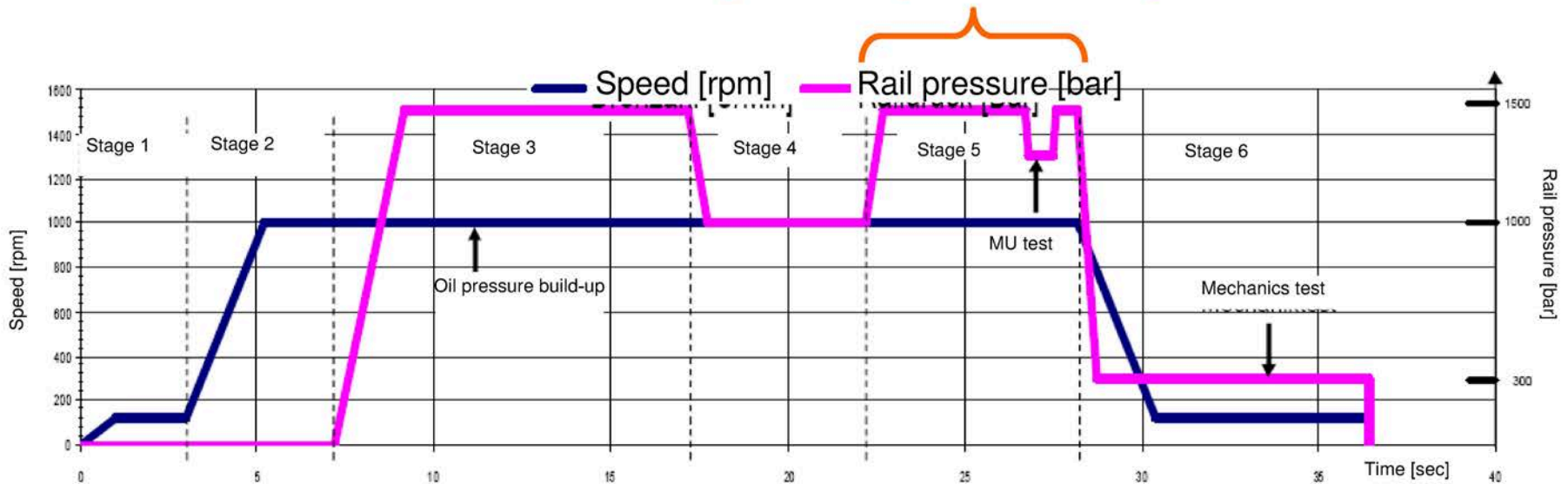
Within a few minutes, considerable rail pressure fluctuations occurred, breakaway torque remaining too high



ACTUAL rail pressure



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



From: Non-responsive content removed**To:****CC:****Date:****Subject: Re: Cold test test run CR engines****Attachments:** [RE_Unterlagen EFT.msg](#)

For your information.

Best wishes, Non-responsive content removed

Non-responsive content removed

From: Non-responsive content removed**Sent:** Tuesday, April 08, 2008 4:30 PM**To:** Non-responsive content removed**Cc:**

Non-responsive content removed

Subject: ANS: Cold test test run CR engines

Hello

I can explain this after the meeting today with Non-responsive content removed allow me to choose a clearer format, because it would appear that a number of people do not quite want to explain it in this manner:

The cold test test benches in [REDACTED] are the oldest, because they have already been used for pump/nozzle unit engines: here the CR had to fit in with the specified time slot.

Non-responsive content removed have received a lot of new KFT test benches.

The cycle times in the engine plants and lines differ; i.e. the engine designer and fitter must conduct his specified tests (often more than 50) within a prescribed period of time.

Sometimes engine or test bench sensory equipment will be used for the tests (engines are not all the same)

A pre-filling in all the group plants had to be introduced exclusively for the (over-)sensitive pump CP4 (costs > 1 million); in [REDACTED] an extra independent pre-filling station.

It is exclusively due to this pre-filling time that [REDACTED] had to procure an additional KFT test bench (costs 1 million), because [REDACTED] can only conduct the pre-filling in KFT.

==> You can of course understand that, as a result, all companies involved like VW, Audi, first OEM user, and Fröhlich are annoyed by the continuously postponed and drawn-out demands from Bosch:

All run-in requirements of RB have been (in some cases at a later time) 100% implemented in the test program

[REDACTED] has ensured that everything is being implemented correctly.

We have the recordings and documentation of rail pressure and speed (only not in the **recently** requested sampling rate and in combination, but in individual measurement windows) - **See attachment**

LP fuel supply and return pressure are monitored as MIN / MAX and switched off if necessary.

Flows for the MU and PCV are specified by final stage (similar also to engine ECU)

So what does Bosch now request?

A complete test run without interruptions should be conducted using external measuring equipment **with greater sampling rate on 5 engines** (approx. the 6 specified parameters) for each cold test and hot test bench (in total approx. 20).

It is only for the cold test that different parameters are to be recorded with lower (available) sampling rate in the respective test steps and then durably saved with the test results.

The costs of around 30,000 € per plant are not being adopted by VW and Audi, because the requirement was lodged by RB!!!

How is this possible?

Bosch accepts the costs of > 90,000 € (this would be the easiest as Fröhlich is prepared) or Bosch will carry out the measurements and [REDACTED] will offer support with test-bench-side connections)

but: big problem e.g. in [REDACTED] we are working 20 shifts and it is only during the Wednesday early shift from 6:00 AM - 1:00 PM that we can servicing or measurements can be carried out.

The costs of approx. 30,000 € per site can only be maintained if [REDACTED] can measure all test benches at one location one behind the other.

Cost per test bench approx. 1 day is being calculated by [REDACTED]

So what does Bosch think to that?

With best wishes

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AUDI AG

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[http:// www.audi.com](http://www.audi.com)

Sitz/Domicile: Ingolstadt

Registergericht/Court of Registry: Local District Court Ingolstadt

HRB Nr./Commercial Register No.: 1

Vorsitzender des Aufsichtsrats/Chairman of the Supervisory Board: Martin Winterkorn

Vorstand/Board of Management: Rupert Stadler (Vorsitzender/Chairman), Ulf Berkenhagen, Michael Dick, Frank Dreves, Peter Schwarzenbauer, Axel Strotbek, Werner Widuckel

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From: Non-responsive content removed

Sent: Tuesday, April 08, 2008 3:26 PM

To: Non-responsive content removed

Cc:

Non-responsive content removed

Subject: ANS: Cold test test run CR engines

Hello Non-responsive content removed

Could you please explain for our 3rd internal zero-fault meeting on Thursday 04/10/2008 why with VW and Audi there are two different **set-final** functional test runs for the **cold test commissioning** of the R4, 2.0l engine?

The question: Should/can the time be maintained with **1000 speed and rail pressure ZERO** ???

We will have to clarify this on Thursday.

Mit freundlichem Grüßen /Best Regards

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Robert Bosch GmbH

Non-responsive content removed

www.bosch.com

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Robert Bosch GmbH, Head-office: Stuttgart, Court of Registry: Local District Court Stuttgart, Commercial Register No. 14000;

Chairman of the Supervisory Board: Hermann Scholl;

Management: Franz Fehrenbach, Siegfried Dais, Bernd Bohr, Wolfgang Chur, Rudolf Colm, Gerhard Kümmel, Wolfgang Malchow, Peter Marks, Volkmar Denner, Peter Tyroller

From: Non-responsive content removed
Sent: Friday, March 28, 2008 11:49 AM
To: Non-responsive content removed
Cc: Non-responsive content removed
Subject: Re: Cold test test run CR engines
Importance: High

Non-responsive content removed

If the values are to be logged, then you could of course supply the logs for these distributors for the 3 failed HPP!

If the week after next Bosch is coming to you, please obtain clarification concerning:

ACTUAL run: Will the data required by Bosch have been logged? I can't really imagine it has been. Why then was Non-responsive content removed with Bosch and VW with Non-responsive content removed ? (probable topic: Line plots instead of individual values in order to record pressure and speed peaks etc.)

SET run:

Question (comes from Non-responsive content removed and also to BOSCH: Should/can the time be maintained **with speed 1000 and rail pressure ZERO** ??? Compare here please both SET curves; they seem to be different (one 9 seconds - one 2 seconds). Which applies? Or have I misread it?

<<Cold test test run CR engines>> <<Prüflauf_V5 1.xls>> <P160>Yours sincerely,

Mit freundlichen Grü??en

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AUDI AG

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<http://www.audi.com>

Sitz/Domicile: Ingolstadt
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From: Non-responsive content removed
Sent: Thursday, March 27, 2008 9:50 AM
To: Non-responsive content removed
Cc: removed
Subject: RE: Cold test test run CR engines

Hello

The actual values (measured values) will be saved from each engine and can be traced for several years. These values comply with the set values in the diagram.

With best wishes

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CC:

From: Non-responsive content removed
Sent: Wednesday, March 26, 2008 5:03 PM
To: Non-responsive content removed
Cc: Non-responsive content removed

Non-responsive content removed

Subject: ANS: Cold test test run CR engines

Hello Non-responsive content removed

Thank you for the information.

Here is the set run.

The objective is to record the actual values over a long period of time (perhaps only for a short periods, if space is a problem). **As our competitor, BMW, also practices using Fröhlich testing technology.**

<< File: EFT R4 CR-TDI.pdf >>

With kind regards

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AUDIAG

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From: Non-responsive content removed
Sent: Wednesday, March 26, 2008 11:10 AM
To: Non-responsive content removed
Cc: Non-responsive content removed
Subject: Cold test test run CR engines

Hello gentlemen,

In the attachment I am sending you the current cold test test run for the 2l CR engines.

The diagram shows the rail pressure and the speed for the individual steps, the step times, ramp times, tested features and measurement channels per stage etc. are shown in the table.

< File: EFT R4 CR-TDI.pdf >>

With best wishes

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Compliance with Bosch TCD Requirements for high-pressure fuel pump

November 10, 2010

Compliance with Bosch CP4 TCD

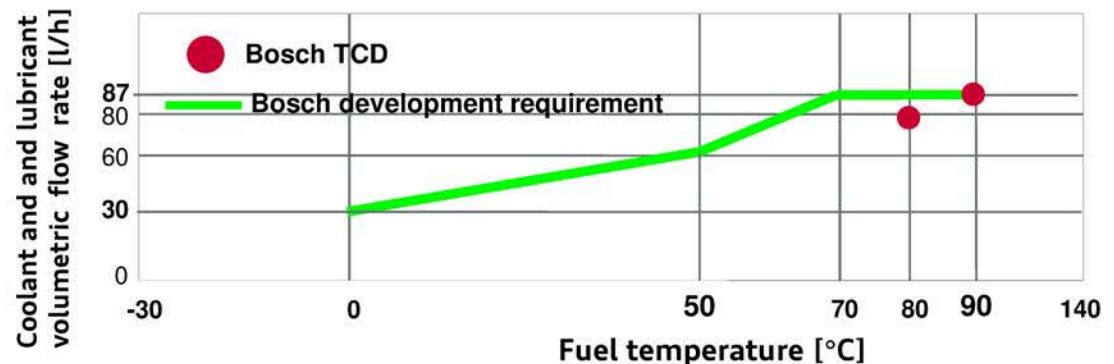
Cooling and lubricating volumes for high-pressure fuel pump

"2bar" tank system (all V-Diesel vehicle starts from 2008)

- ▶ Tank EFP (2bar) and inline EFP (6bar) connected in series
 - ▶ No on-demand delivery; EFPs always on full delivery
- ▶ **Bosch TCD requirement** for return volume (cooling and lubricating volume)
 - ▶ $\geq 80\text{l/h}$ at 80°C fuel temp. in HPP supply; $\geq 87\text{l/h}$ at 90°C
- **The TCD is complied with in operation under all conditions; this also applies to the damaged vehicles (checked on 10 vehicles with drivetrain damage)**

"6bar" tank system (all V-Diesel vehicle starts from 2010, e.g., Touareg NF)

- ▶ Only tank EFP (6bar), on-demand delivery tank EFP
- ▶ **Bosch development requirement** for return volume (cooling and lubricating volume) for use of a controlled EFP

→ **The TCD is complied with under all conditions**

Compliance with Bosch CP4 TCD

Fuel temperature in high-pressure fuel pump supply

Bosch TCD requirement:

- ▶ Maximum fuel temperature in high-pressure fuel pump supply
 - ▶ In operation to 70°C permanent
 - to 80°C 100h of service life
 - to 90°C 100h of service life (max. 1h continuous)
- ▶ Ambient temperature of high-pressure fuel pump with engine at operating warmth
 - ▶ To 120°C operation allowed
 - ▶ To 140°C residual heat from standing engine
 - ▶ >140°C not allowed

The TCD is complied with in operation under all boundary conditions

In the residual heat phase, temperatures of up to 120°C are reached in the fuel inlet.

Measures to increase robustness of high-pressure fuel pump

Optimized cooling and lubricating volume during engine start

Problem:

Bosch CP4 has proven to be particularly sensitive during engine start due to the roller-roller support concept:

- Mixed friction between roller and roller support with poor quality fuel results in a delay in starting the roller (braking flats)
- This can result in failure of the HPP as a consequence.

To avoid the problems of the CP4 principle, additional measures beyond the TCD specifications will be checked and implemented as necessary.

Measure:

- ▶ Optimization of cooling and lubrication of high-pressure fuel pump when starting the engine.
 - ▶ Control of the EFP with terminal 15
 - ▶ EFP control in afterrun with hot fuel temperatures for cooling the CP4
 - ▶ EFP control through door contact (additionally for 6 bar tank system)

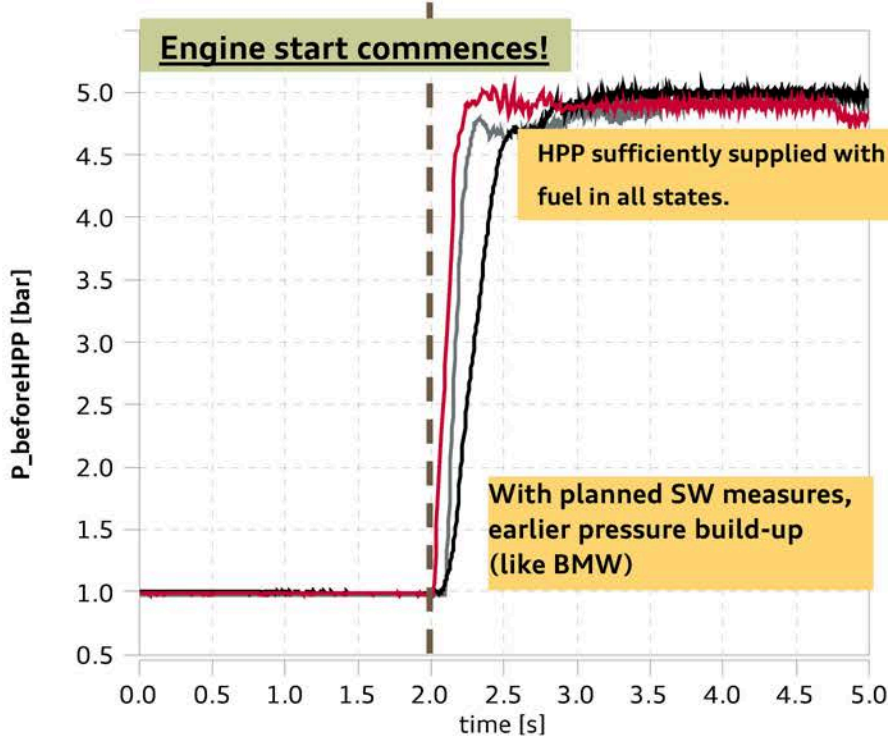
Dates:

- ▶ SW specification 2 bar tank system by the end of WK 45
Objective: To attain field action in Non-responsive content removed (beginning of 2011)
- ▶ SW specification 6 bar tank system by the end of WK 47

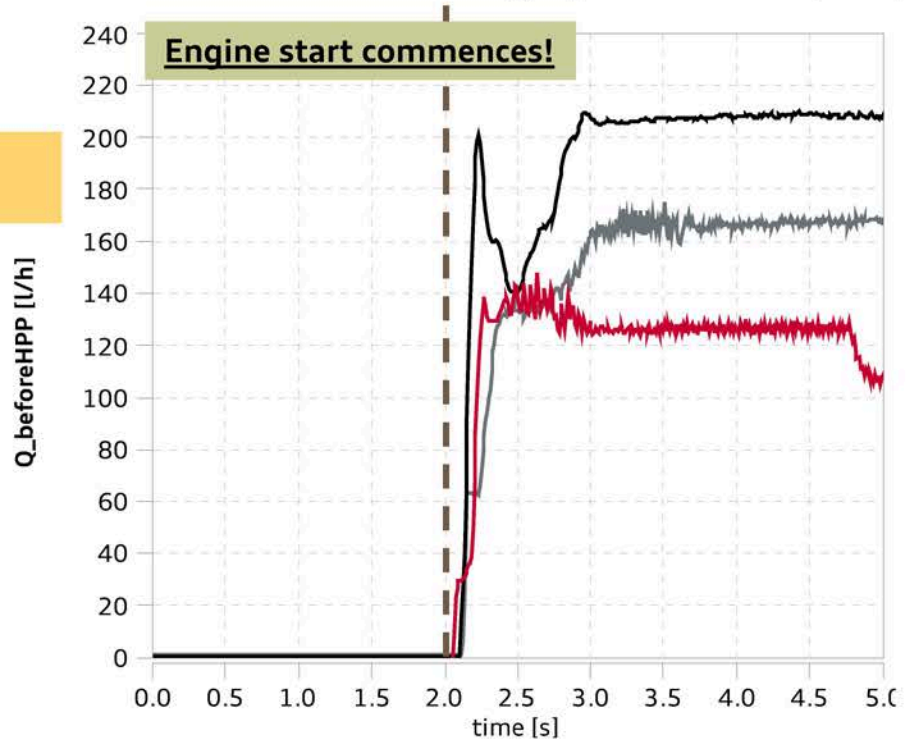
Pressure/volume flow at start

Q7	2bar tank system (current series)
Touareg NF	6bar tank system (current series)
BMW 330d	

Pressure before high-pressure fuel pump



Volume flow before high-pressure fuel pump



Measures to increase robustness of high-pressure fuel pump

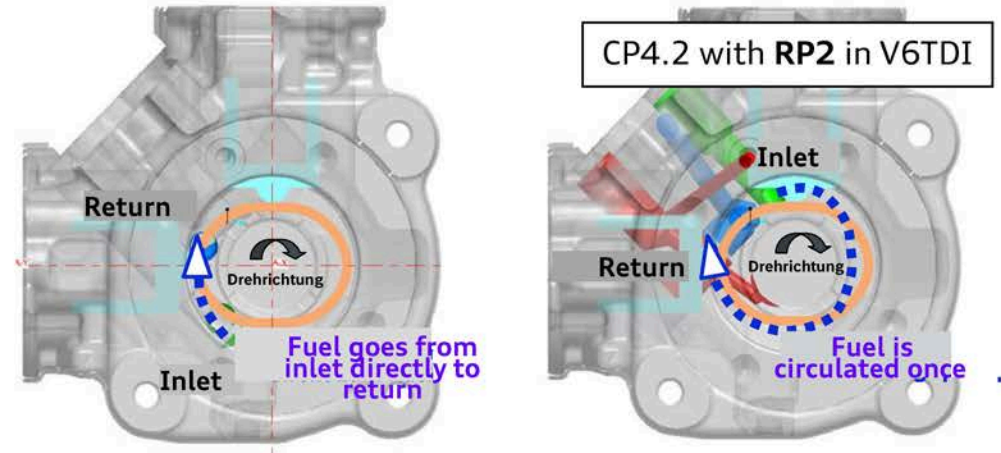
Anti-wear package 2 (RP2)

Task

- ▶ Reduction of local temperature in right roller support
(Bosch planning error with right rotation of high-pressure fuel pump)

Measures

- ▶ Optimize arrangement of inlet and return position
(exchange inlet / outlet connections)



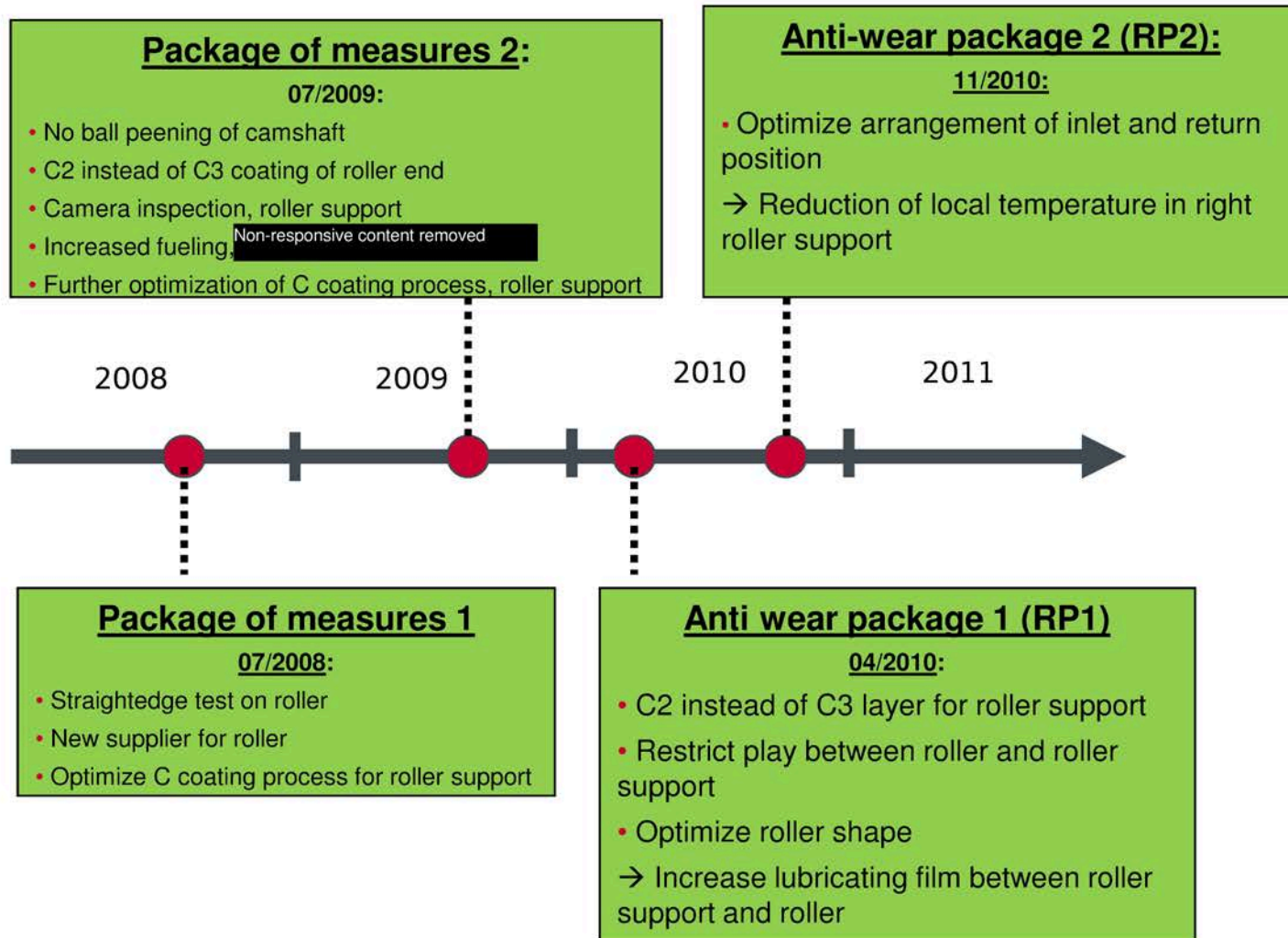
Result

- ▶ Reduction of temp. in lubrication gap by ~25°C (from 136°C to 111°C @ 80l/h @ 70°C supply)
- ▶ Now same temp. level as CP4.1 (single piston pump) and competition
- ▶ Avoid mixed friction between roller and roller support (especially during hot start)
- ▶ Avoids fuel decomposition → Much less deposit formation on the roller support, thus avoiding braking flatsg due to stuck roller

Dates

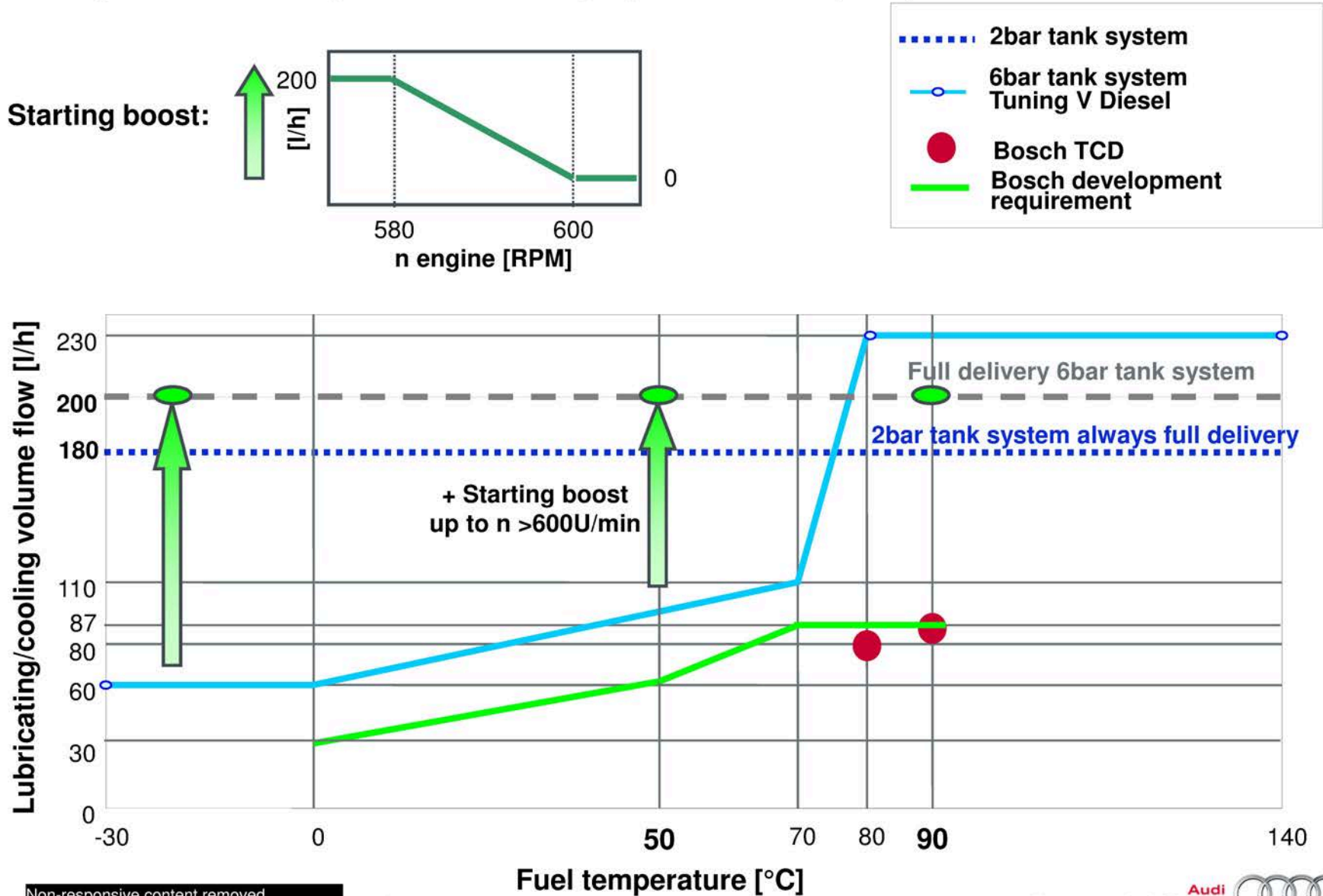
- ▶ Used for all V6 TDI from Wk45/10

Backup

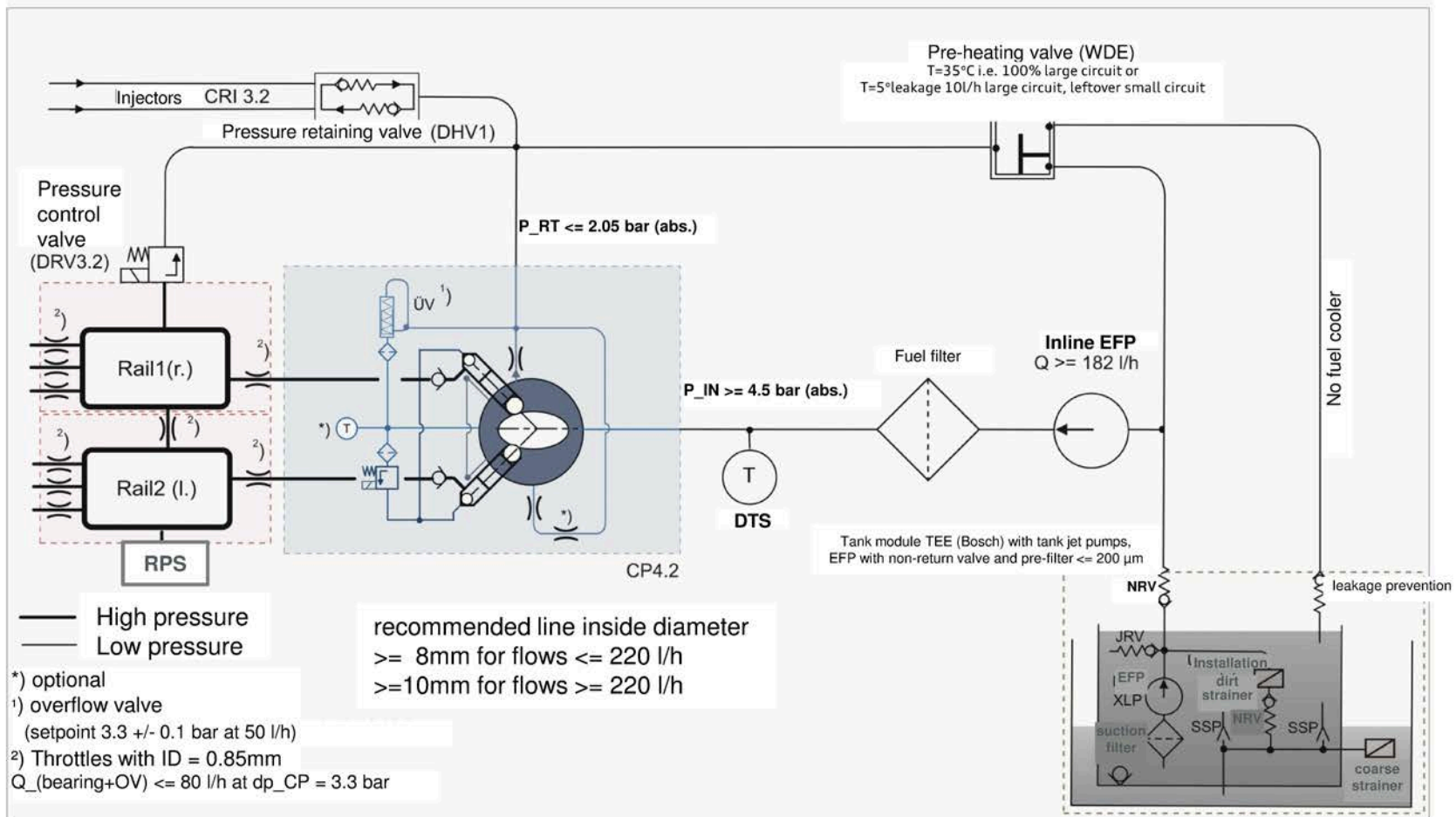
Defined measures for CP4.2

Compliance with Bosch CP4 TCD

Cooling and lubricating volumes for high-pressure fuel pump



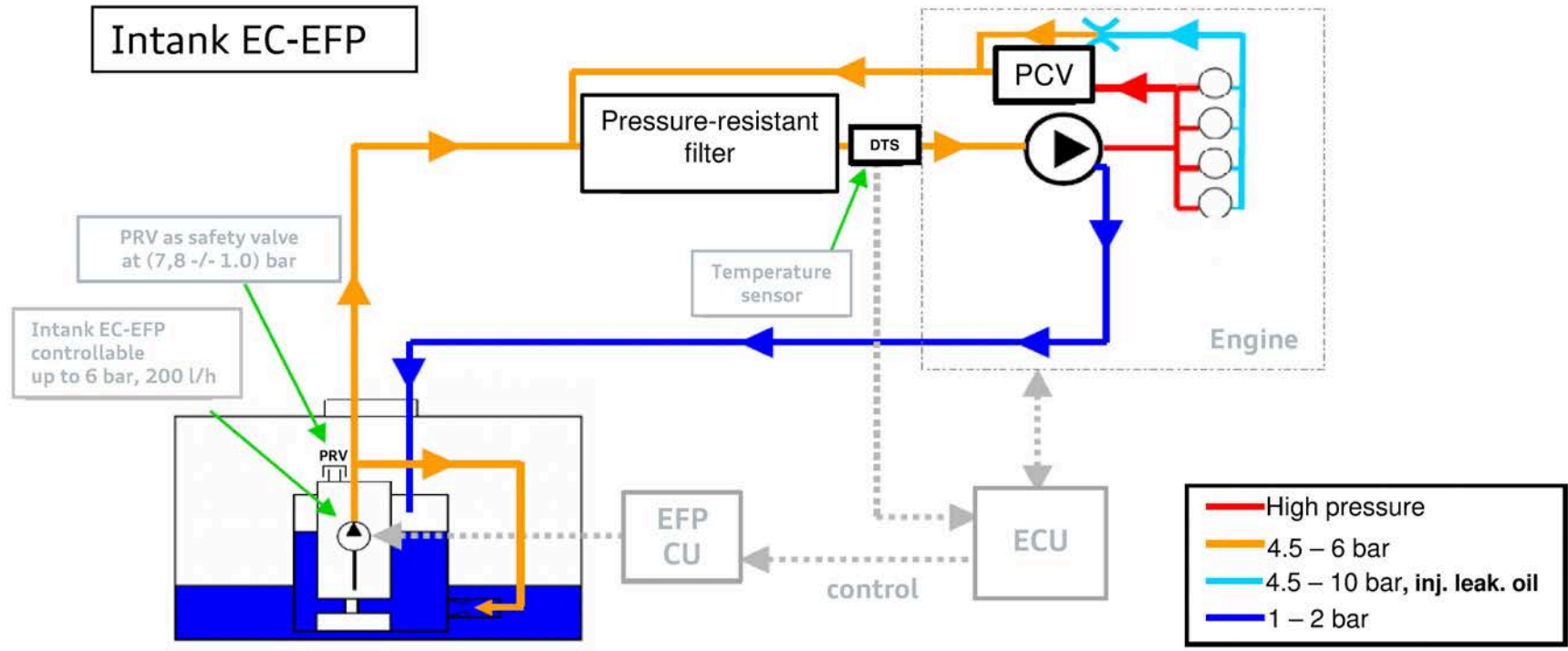
"2bar" - low-pressure system - V6 TDI EU5 in B8 and Q5



Status: 2/18/2008 DS/ECC 8820148d_Wo_000** Audi

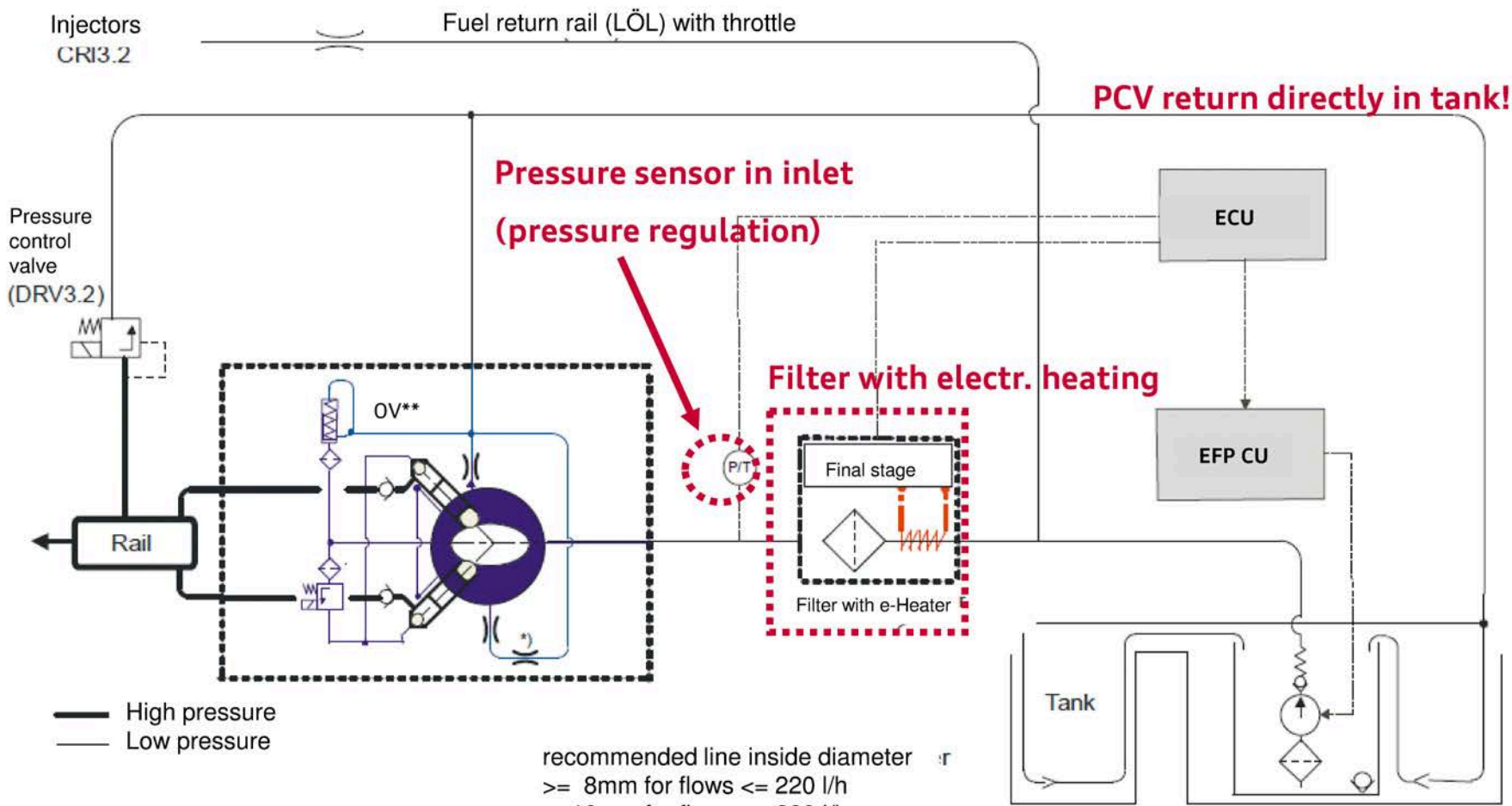
Current "6bar" tank system

Low-pressure fuel system with controlled intank EC EFP with 6bar PCV



Competition tank system with p_{inlet} -controlled EFP (BMW)

red → Differences between BMW and Audi "6bar"

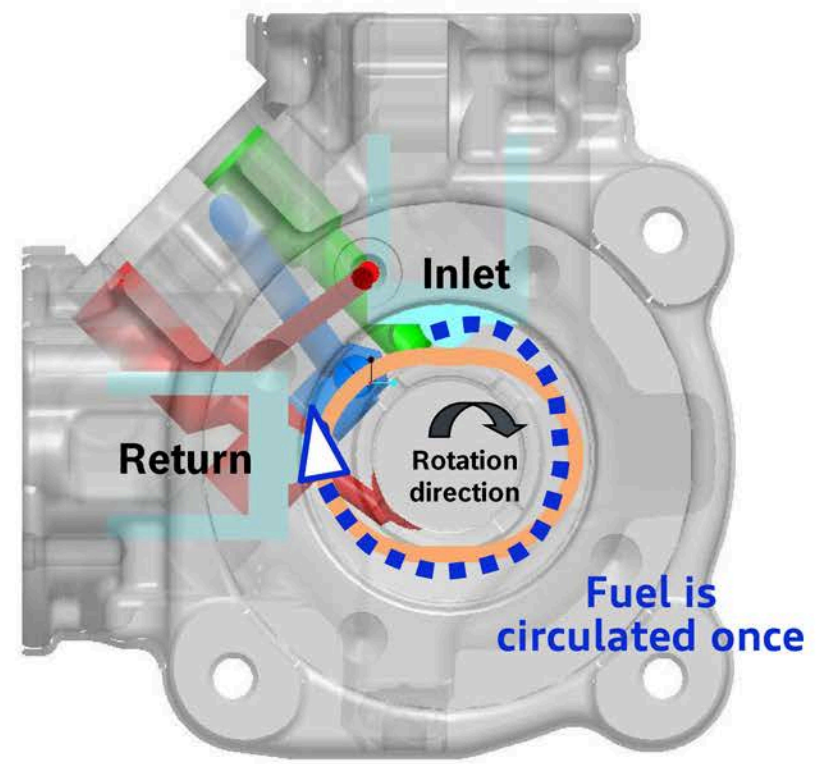
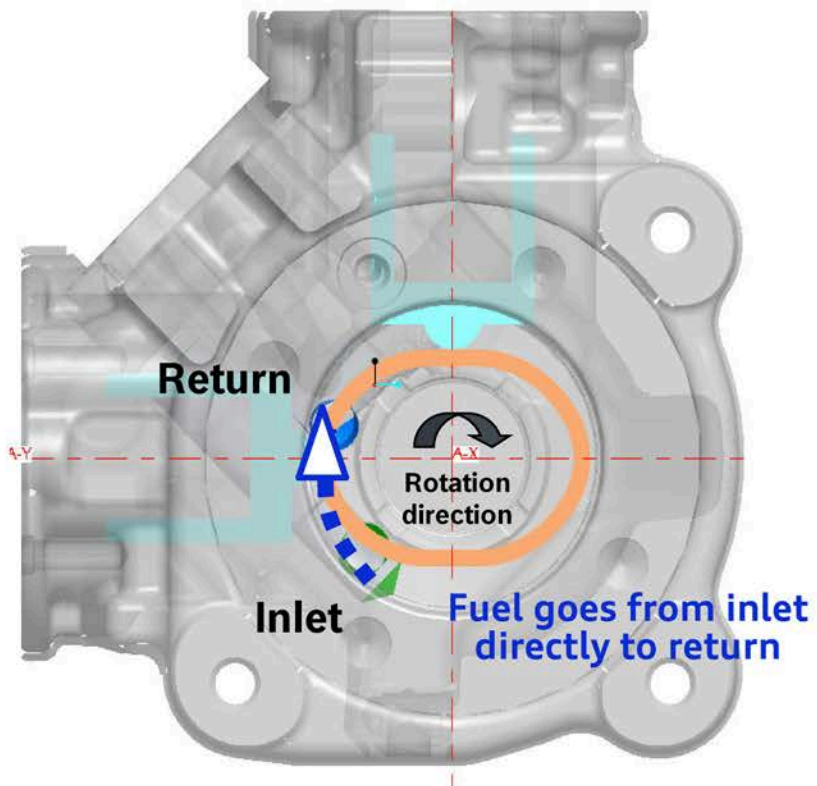


Measures to increase robustness of high-pressure fuel pump

Anti-wear package 2 (RP2)

CP4.2 / V6 TDI

CP4.2 with **RP2** in V6 TDI (exchange inlet - return)









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, parti- cle filtering)
Status	Launch SOP July 2010

ENTIRE PAGE CONFIDENTIAL

EA11003EN-01825[1]

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
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CP4	Currently under assessment 	free / resolved 	BDF570  BDF650 	>1,0 mm ² /s at 70°C  <1.0 mm ² /s at 70°C 
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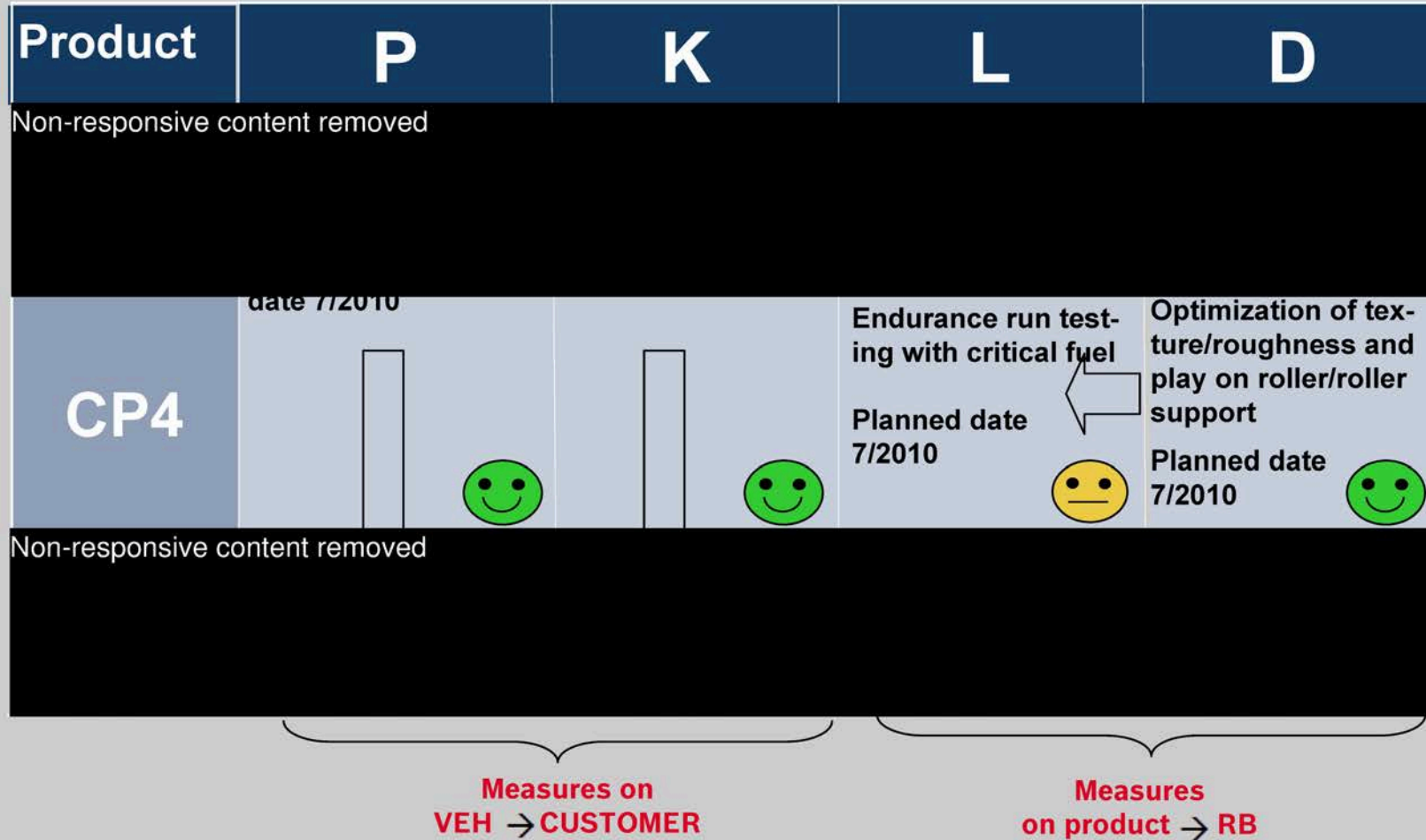
Measures on
VEH → CUSTOMER

Measures on
product → RB

ENTIRE PAGE CONFIDENTIAL

EA11003EN-01825[2]

Robustness of Common Rail System for Rest of the World
Status of evaluation of Rest of the World conditions for diesel



Workshop for detailed planning of RoW planned for 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

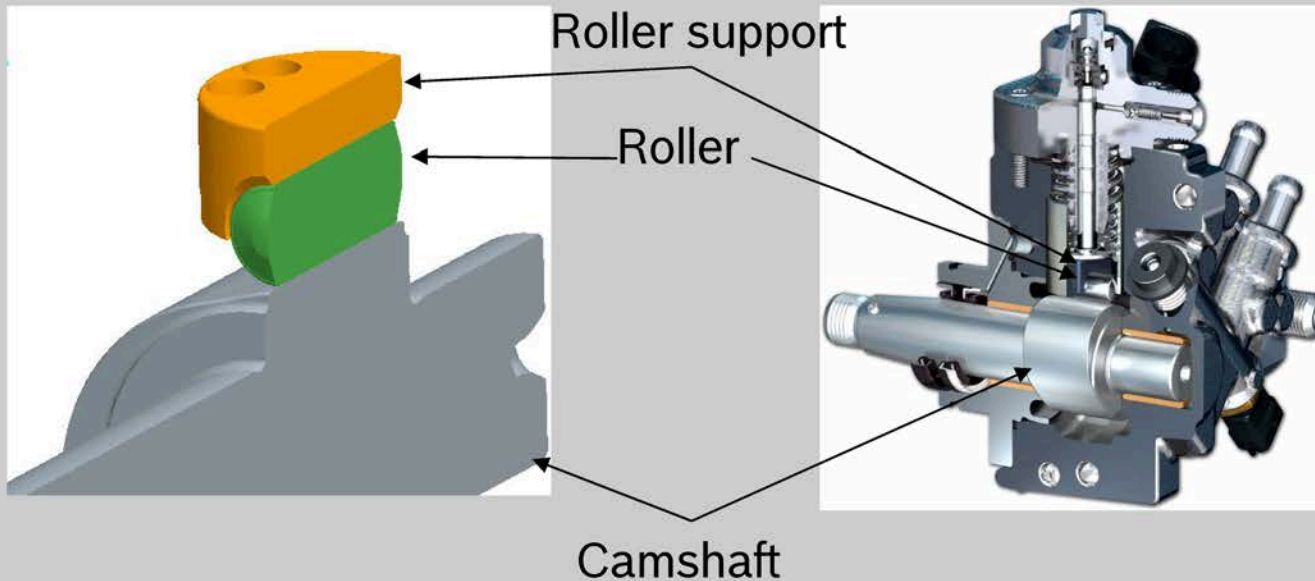
- Introduction of water separator urgently necessary for critical markets OEM
- Avoidance of fatigue through higher quality materials on camshaft/roller (preliminary tests with higher quality material pairing ongoing) 04/2010
- Long-term testing will be necessary after the preliminary tests are complete SOP ?

Robustness of Common Rail System for Rest of the World Backup



Robustness of Common Rail System for Rest of the World 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,...)

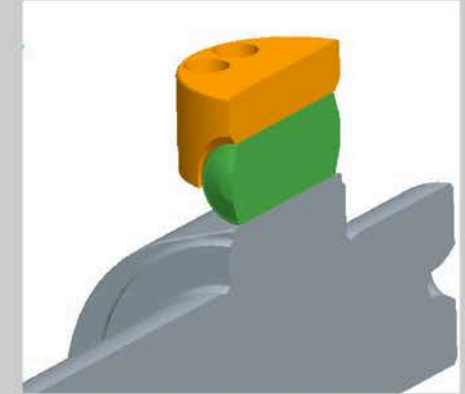
- causes greater wear in the roller/roller support assembly (up to 200 [rpm]) at start (mixed friction area)

Low viscosity Non-responsive content removed diesel, kerosene, water....)

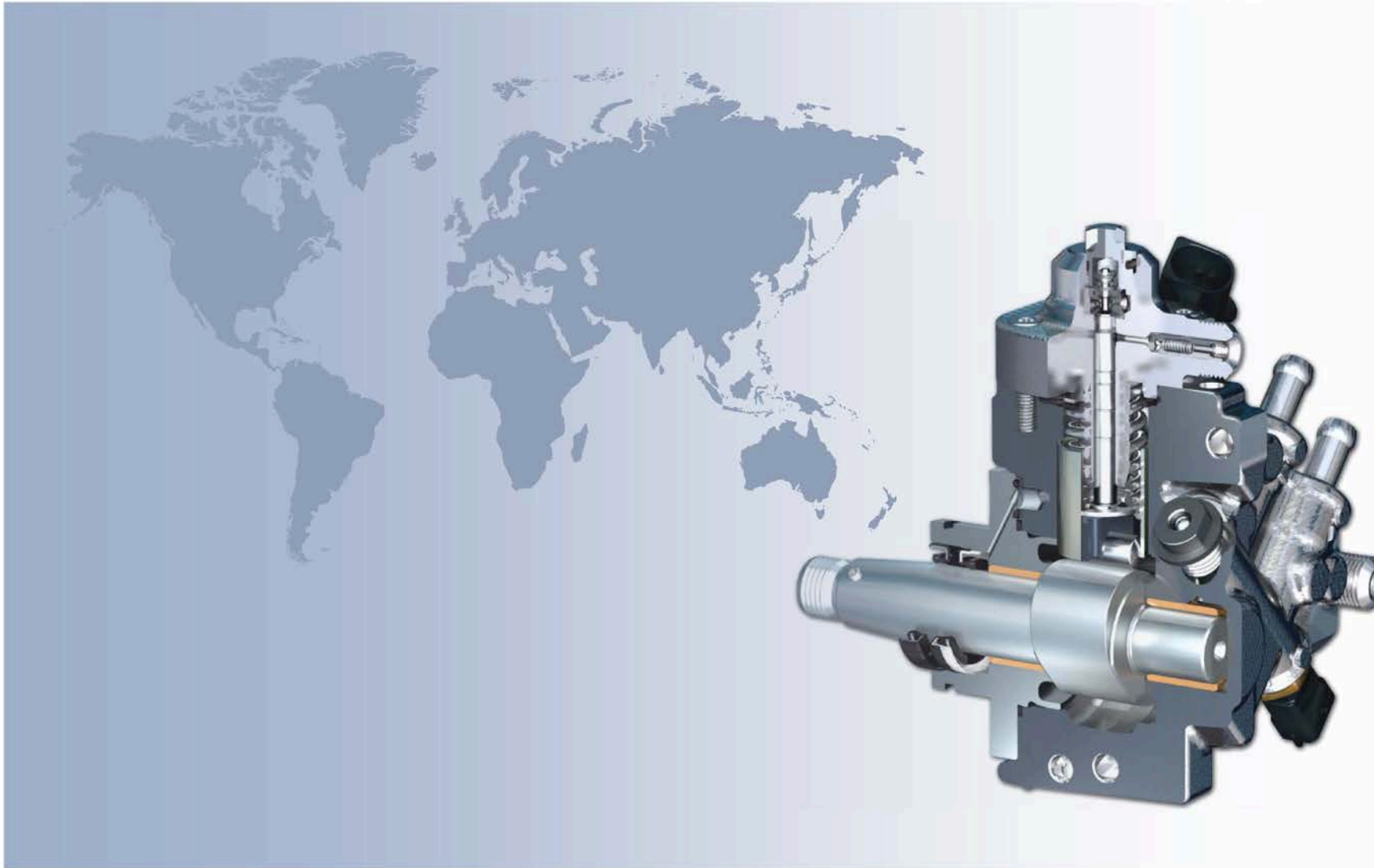
- leads to thin lubrication film -> increased friction/ component contact
-> increased slippage (idle roller)

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

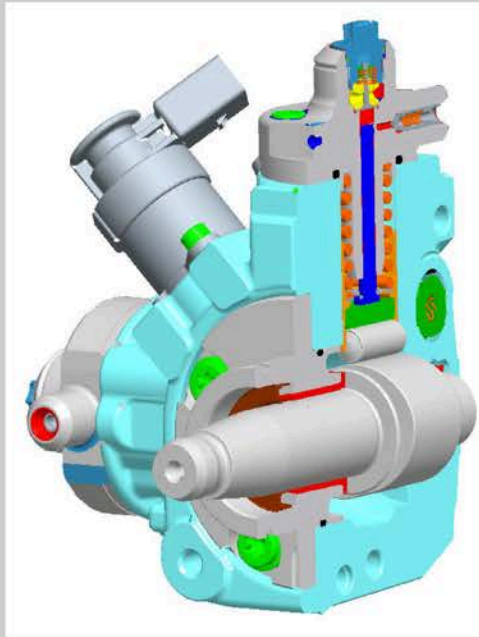


CP4 field situation worldwide



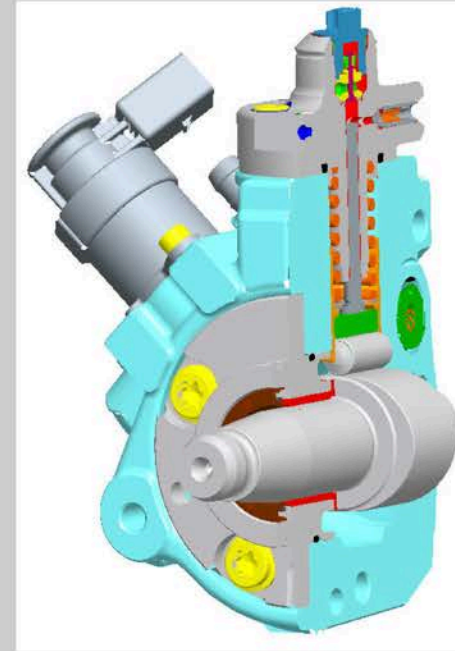
CP4 field situation worldwide

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

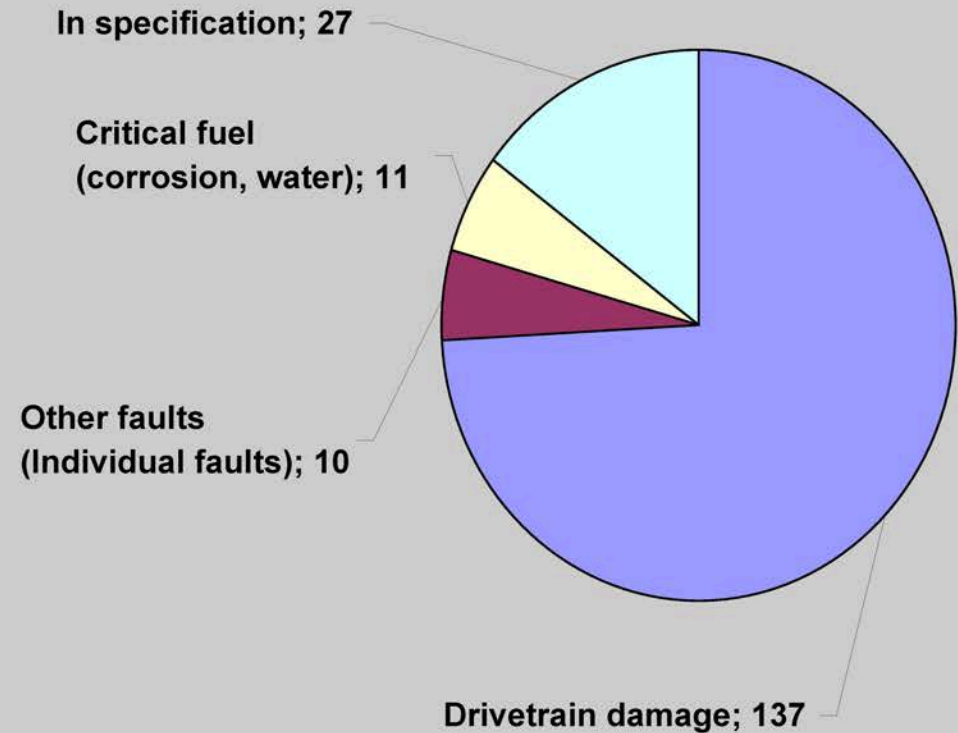
CP4 field situation worldwide AUDI CP4.2 complaints

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

ISO_CTRY	Overall result
Non-responsive content removed	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 returned to Bosch (185)



Source Bosch IQIS Date: 11/3/2009

EA11003EN-01826[3]

CP4 field situation worldwide AUDI VW 6-cylinder TDI

AQUA, Active quality analysis
Status 09/09-11.05.09 04:27 PM
Source/user Non-responsive content removed

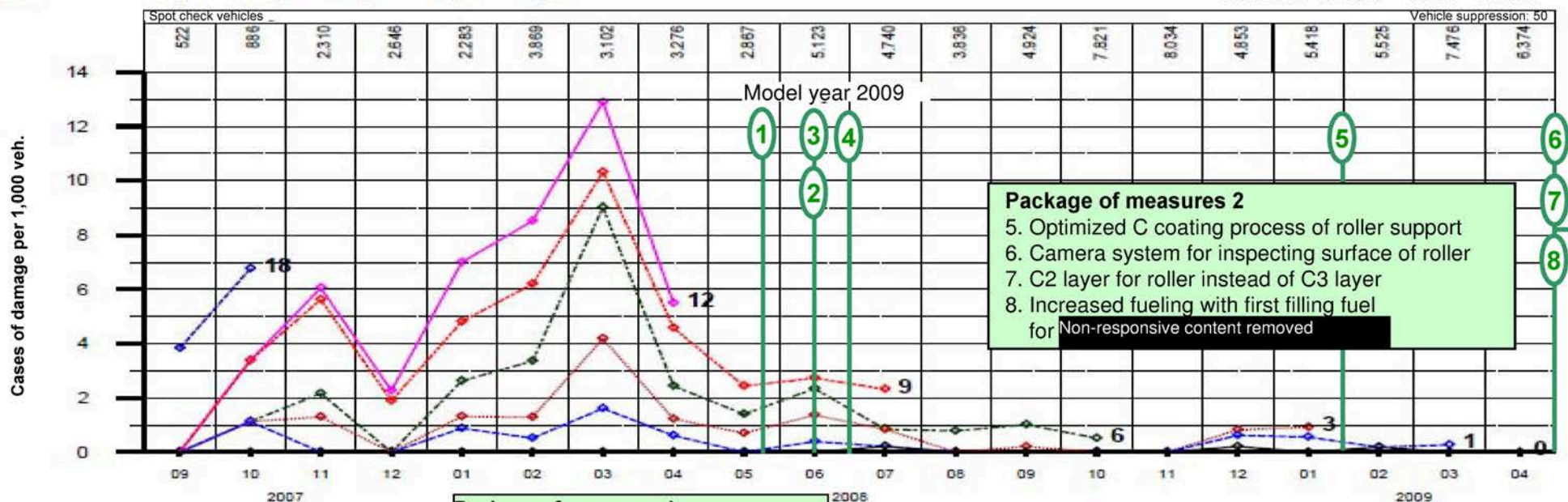
Audi, market: AUDI (approved markets)
MY 2008 - 2010, Offset: all (Max: 5)
CNR / Groups High-pressure pump

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



Vehicle: 29.592+92.395+37.767=159.754; Sold: 29.424+89

11.914; MY:2008+2009+2010=Total

CP42 AU alle MKB V6 Freil 08-10



Quality Conference 11/19/2009



I1003EN-01826[4]

CP4 field situation

AUDI VW 6-cylinder TDI

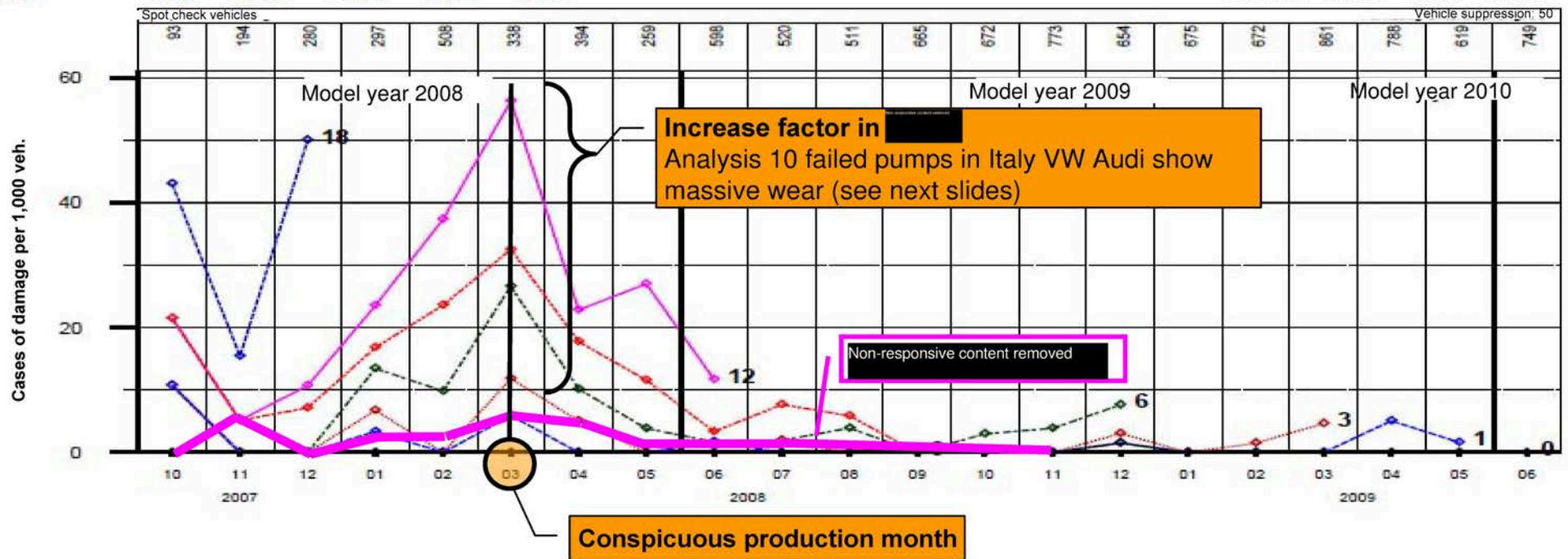
Non-responsive content removed

AQUA, Active quality analysis
 Status 09/09-11.05.09 4:29 PM
 Source/user Non-responsive content removed

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

Confidential
 Without PR numbers
 CNR 2374

.MY	CAMA CAMB CANA CANB CANC CAND CASA CASB CASC CASD CCWA CCWB CDYA CDYB CDYC CGKA CGKB								MY	Exchange	BD	SA 10	SA 17	SA 50	SA 18
	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	2008	100,0 %	78,2 %	74,4 %	15,4 %	7,1 %	2,6 %	
2009	0,1	0,9	2,0	4,2	7,7	13,7		2009	98,3 %	83,1 %	79,7 %	18,9 %	1,7 %	1,7 %	
Diff%		-47,14	-48,71	-59,55	-57,23	-50,83						MEC ERR	MAJOR	LEAK	MINOR

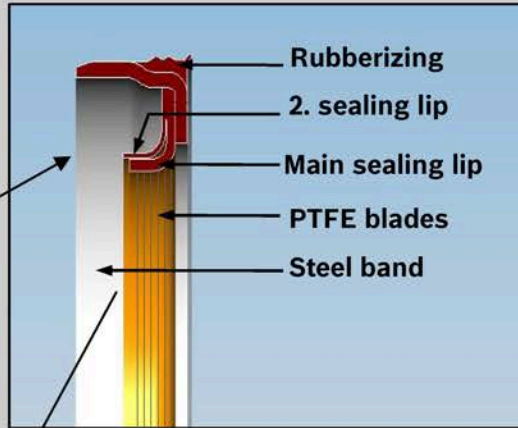
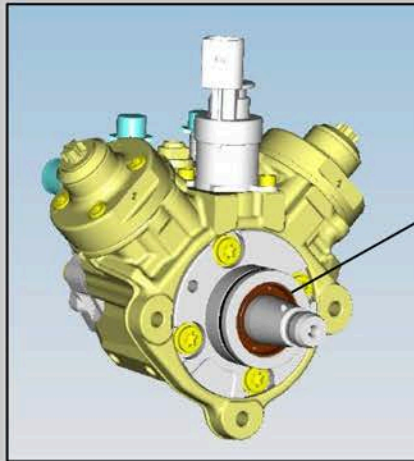


Vehicle: 3.389+12.041+4.481-19.911; Sold: 3.385+11.240+2.900-17.525; UP: 2.335+7.730+2.115-12.180 MY: 2008+2009+2010-(Total)

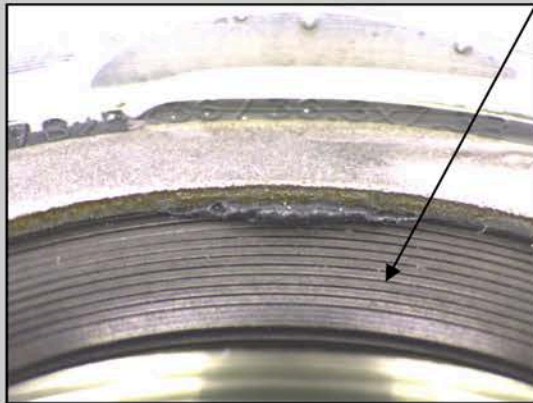
CP42 AU alle MKB V6 08-10

CP4 field situation Non-responsive content removed Finding AUDI CP4

Installation of Bruss shaft seal on CP4



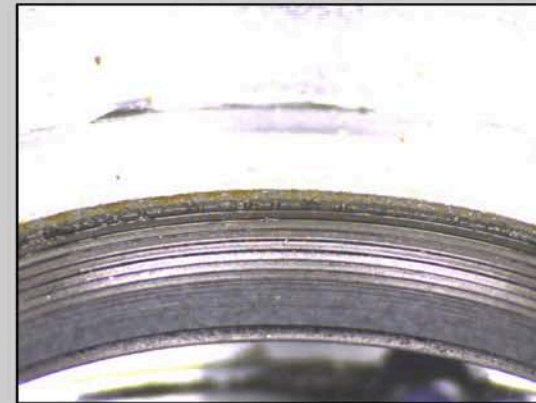
New part



Vehicle endurance run
118,000 km



Mileage 2,212 km
Failure on 6/15/2009 in Non-responsive content removed

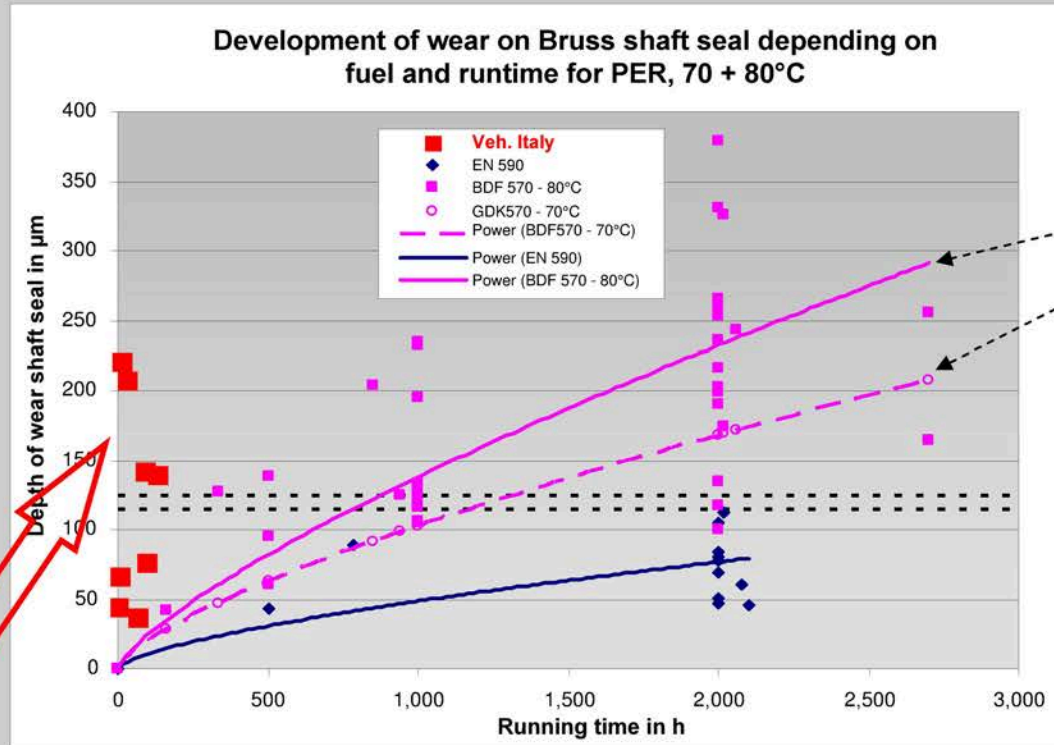


CP4 field situation Non-responsive content removed Finding AUDI CP4

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 Non-responsive content removed much greater than usual
- Clear indicator of poor quality fuel

CP4 field situation worldwide VW 4-cylinder TDI

VW, market: **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

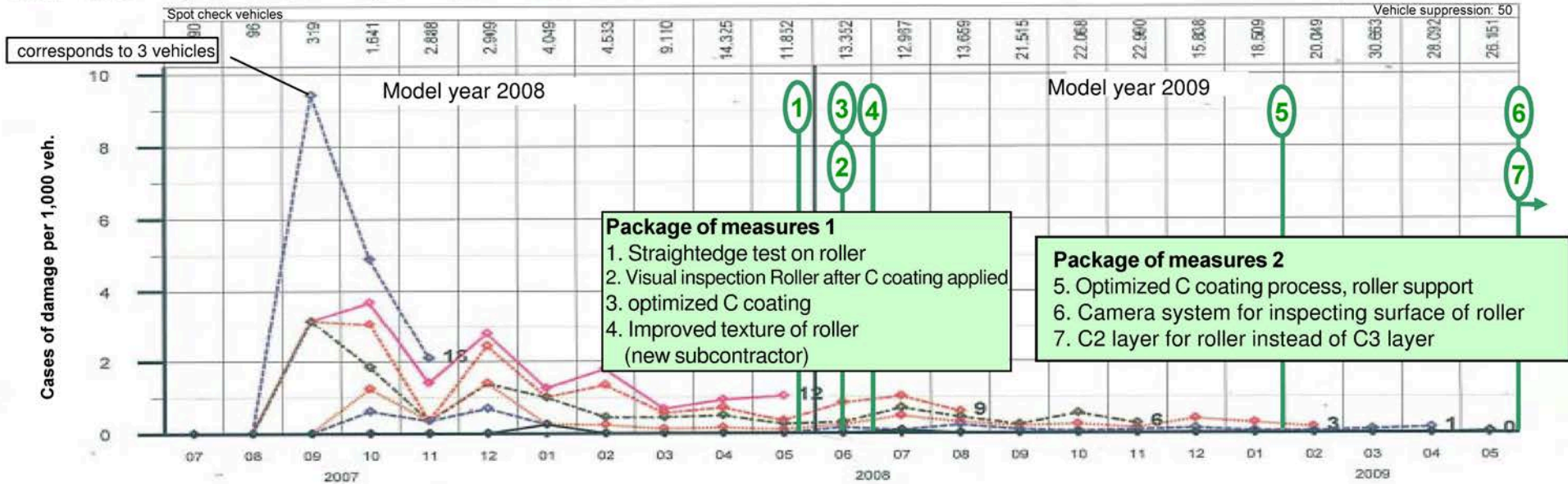
Confidential
Without PR numbers
2374

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

CNR

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+386.679+117.081=555.436; UP: 48.739+244.925+100.898=394.562 MY: 2008+2009+2010=Total

Non-responsive content removed

CP4 field situation VW 4-cylinder TDI

Non-responsive content removed

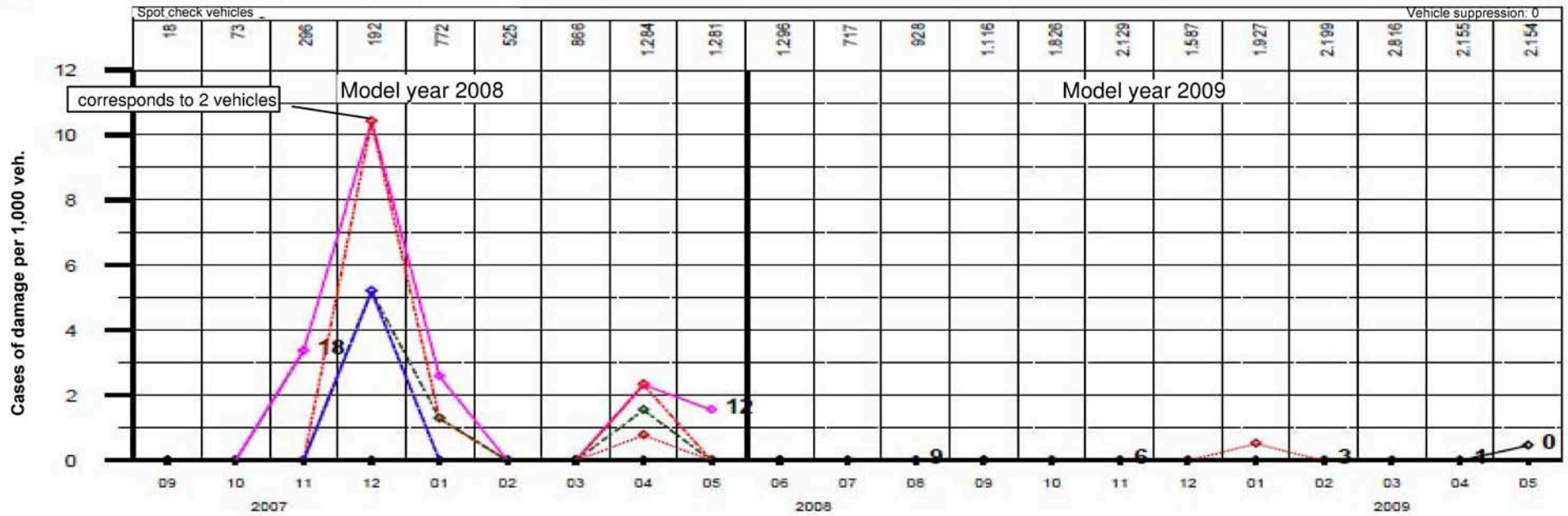
AQUA, Active quality analysis
Status 09/09-11.06.09 10:29 AM
Source/user Non-responsive content removed

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: 8.647+41.846+23.061-73.754; Sold: 8.619+40.026+13.915-62.762; UP: 5.146+20.478+11.802-37.426; MY 2008+2009+2010-(Total

CP41 VW R4-CR [redacted] 08-10

CP4 field situation Non-responsive content removed

Differences between CP4.1 and CP4.2.

Possible ways to interpret failure probability CP4.2 to CP4.1 in Non-responsive content removed out of 30 : 1

- 2 : 1 Tappet modules factor 2-3
- Pump gear ratio $i = 1 : \frac{3}{4}$ 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 Non-responsive content removed Further procedure (main activities)

- Deployment of Bosch field analysis team in Non-responsive content removed (importer's domicile) since 9/11/2009
Objective:
Analysis of special market-specific features in Non-responsive content removed
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 Non-responsive content removed "good pumps" from cars from conspicuous production date in progress
- Procurement of 20 Non-responsive content removed "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]

CP4 field situation VW 6-cylinder TDI

Non-responsive content removed

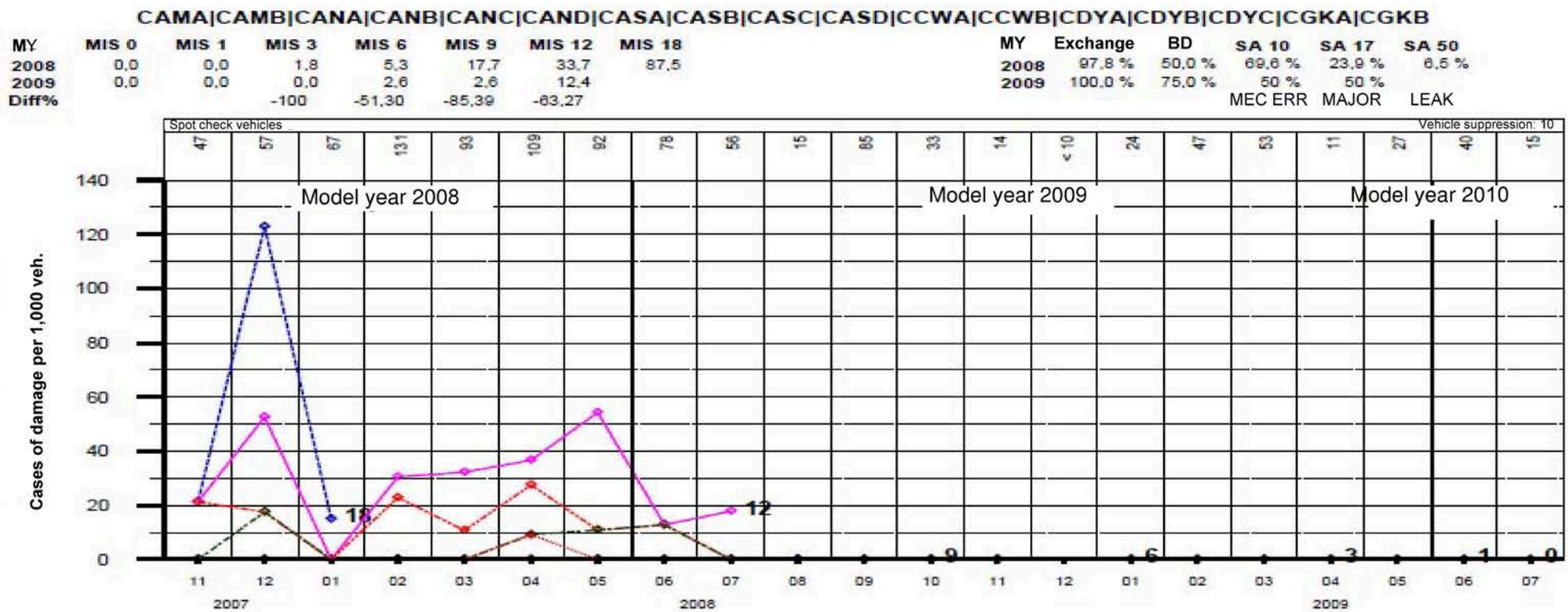
AQUA, Active quality analysis

Status 09/09-11.06.09 4:12 PM

Source/user Non-responsive content removed

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

Confidential
Without PR numbers
CNR 2374



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 08-10

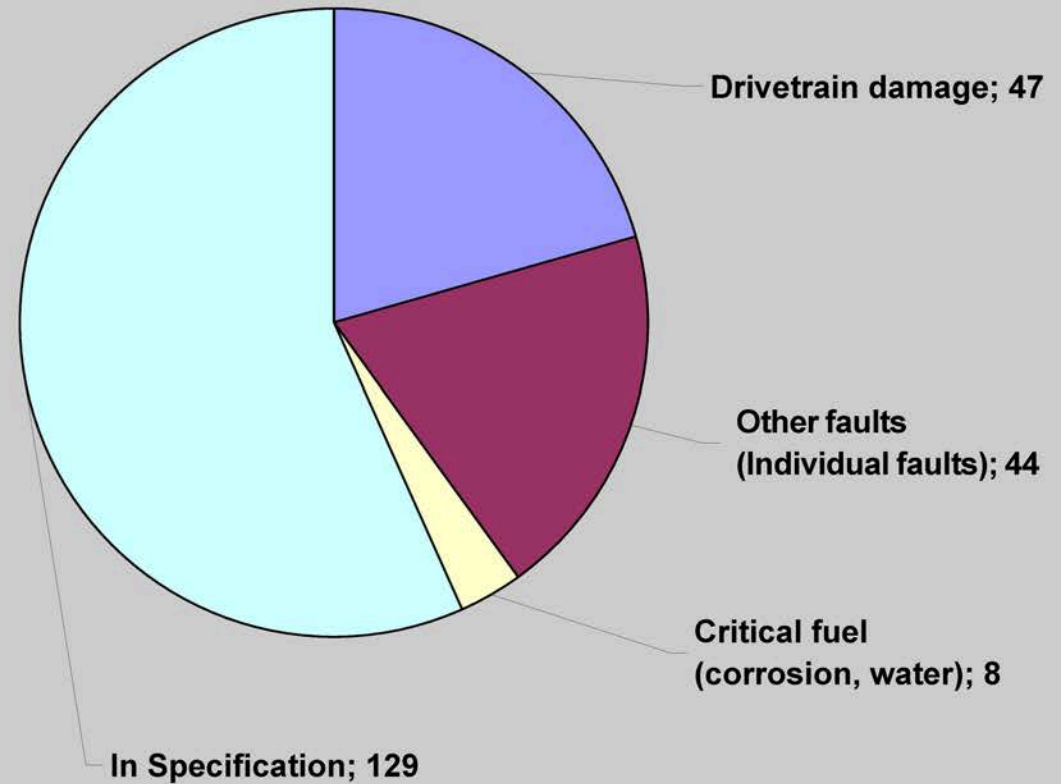
CP4 field situation worldwide VW CP4.1 complaints

VW CP4.1 commercial accounting for dealers

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

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

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



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

From: Non-responsive content removed
To: [REDACTED]
CC: [REDACTED]
Date: 12/17/2009, 11:59:00 AM
Subject: Re: Status report CP4 failures AUDI dated 12/16/2009
Attachments: [AUDI CP4 Wochenbericht 10 12 2009_V3.ppt](#)
[CP4.2 AU alle MKB V6 ohne A6 MJ08-10 \[REDACTED\].pdf](#)
[Abrechnungen alle CP4.2 V6-TDI 15.12.09.xls](#)

Sorry, but I can't accept this status report any longer!

Page 1, last sentence:

Further detailed analysis... => new approaches must be named here.

The specification of (filtered) R profiles (without waviness) in the definition of surfaces is an indication that the latest findings have not been rated according to present know-how.

The surfaces are to be measured with P and W profiles. The **waviness** is of potentially critical importance here.

The measurement of roundness without Fourier analysis is no longer current either.

The comprehensive adhesion of the C layer must be (destructively) tested at excess temperature at the end of the analyses.

Page 2, paragraph 2:

The parameters that increase robustness have not been named/changed (only particularly good parts were sorted out)!

Test planning is already available; the results are supposed to be available by late Jan. 2010; we've announced this up to the board of management; we cannot "soften it up".

Page 3, peculiarities:

Free water at 200 ppm is not a peculiarity according to TCD permissible water - it is normal!

As long as the deposits are in the swirl pot (that is, before the filter), it's not a problem; we have strainers and filters for this in the tank and in front of the HPP as well.

Page 4, FCT result:

16 fuel samples were OK according to EN590 and the pump failed anyway; only 2 samples were not OK.

The algae has not been chemically proven yet (only conveyed orally; please avoid suppositions); our lab will need to be activated.

As already stated, free water is allowed.

The idea that algae produce noticeable acid components is not proven yet (provide proof).

Page 5, Brass shaft seal:

16 of 17 shaft seals have heavy wear with EN590 fuel ; Bosch finally has to accept that 16 of 18 samples

were in accordance with EN590!!!

Page 10, chart:

Old version; I distributed a new one on Tuesday (see **Attachment 2**); **13% failures** in the peak!!!

No pages:

There was no "rapid" conversion from B0 to B7 in [REDACTED]; according to Bosch, in 2008 [REDACTED] already had 3-5% biodiesel content.

Non-responsive content removed

Best regards

From: Non-responsive content removed

Non-responsive content removed

Sent: Thursday, December 17, 2009, 9:57 AM

Non-responsive content removed

Subject: Re: Status report CP4 failures AUDI dated 12/16/2009

Importance: High

Please check

Yours sincerely,

Non-responsive content removed

From: Non-responsive content removed

Sent: Wednesday, December 16, 2009, 7:23 PM

Non-responsive content removed

Subject: Re: Status report CP4 failures AUDI dated 12/16/2009

Importance: High

Good morning

Non-responsive content removed

Attached please find the status report on CP4 failures dated 12/16/2009.

We agreed with Audi to hold the next TF meeting on 01/13/2010 and distribute the next status report on 01/14/2010.

Please review and approve it.

Best regards

Non-responsive content removed

Domicile: Stuttgart, Court of Registry: Local District Court

Stuttgart, Commercial Register No. 14000;

Chairman of the Supervisory Board: Hermann Scholl;

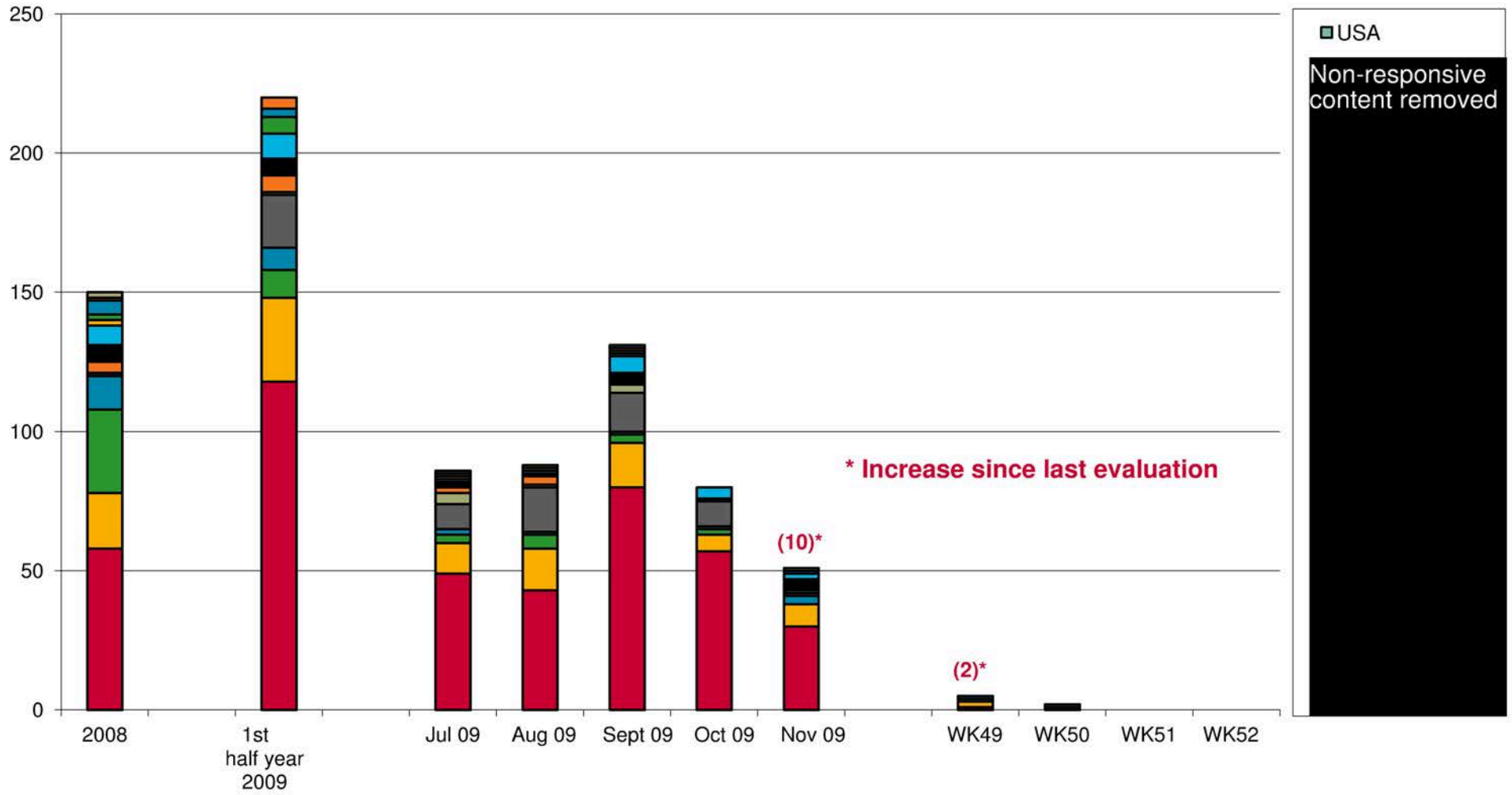
Management: Franz Fehrenbach, Siegfried Dais;

Bernd Bohr, Rudolf Colm, Volkmar Denner, Gerhard Kümmel,

Wolfgang Malchow, Peter Marks,

Peter Tyroller; Uwe Raschke

Figures for the high-pressure fuel pump CP4.2 V6-TDI Audi
(after **setting date** in AQUA)



ENTIRE PAGE CONFIDENTIAL

Bills for high-pressure fuel pumps CP4.2 Audi V6-TDI (after setting date in AQUA)

Country	2008	1st half year 2009	Jul 09	Aug 09	Sept 09	Oct 09	Nov 09		WK49	WK50	WK51	WK52	Total
Non-responsive content removed	58	118	49	43	80	57	30		1				436
	20	30	11	15	16	6	8		2				108
	1	19	9	16	14	9	1		0	1			70
	30	10	3	5	3	2	0		0				53
	7	9	1	1	6	4	2		1				31
	12	8	2	1	1	1	3		1				29
	6	6	2	1	4	1	4		0				24
	4	6	2	3	0	0	0		0				15
	5	3	1	0	1	0	1		0	1			12
	2	6	1	0	1	0	0		0				10
	0	1	4	1	3	0	1		0				10
	1	4	0	0	1	0	0		0				6
	2	0	1	1	0	0	0		0				4
	2	0	0	1	0	0	0		0				3
USA	0	0	0	0	1	0	1		0				2
Total	150	220	86	88	131	80	51		5	2			813

* Increase since last evaluation dated 12/15/09

10

2

2

Audi

Vorsprung durch Technik



Drivetrain damage high pressure diesel fuel pump CP4.2

Drivetrain damage high pressure diesel fuel pump CP4.**Summary of activities CP4.2**

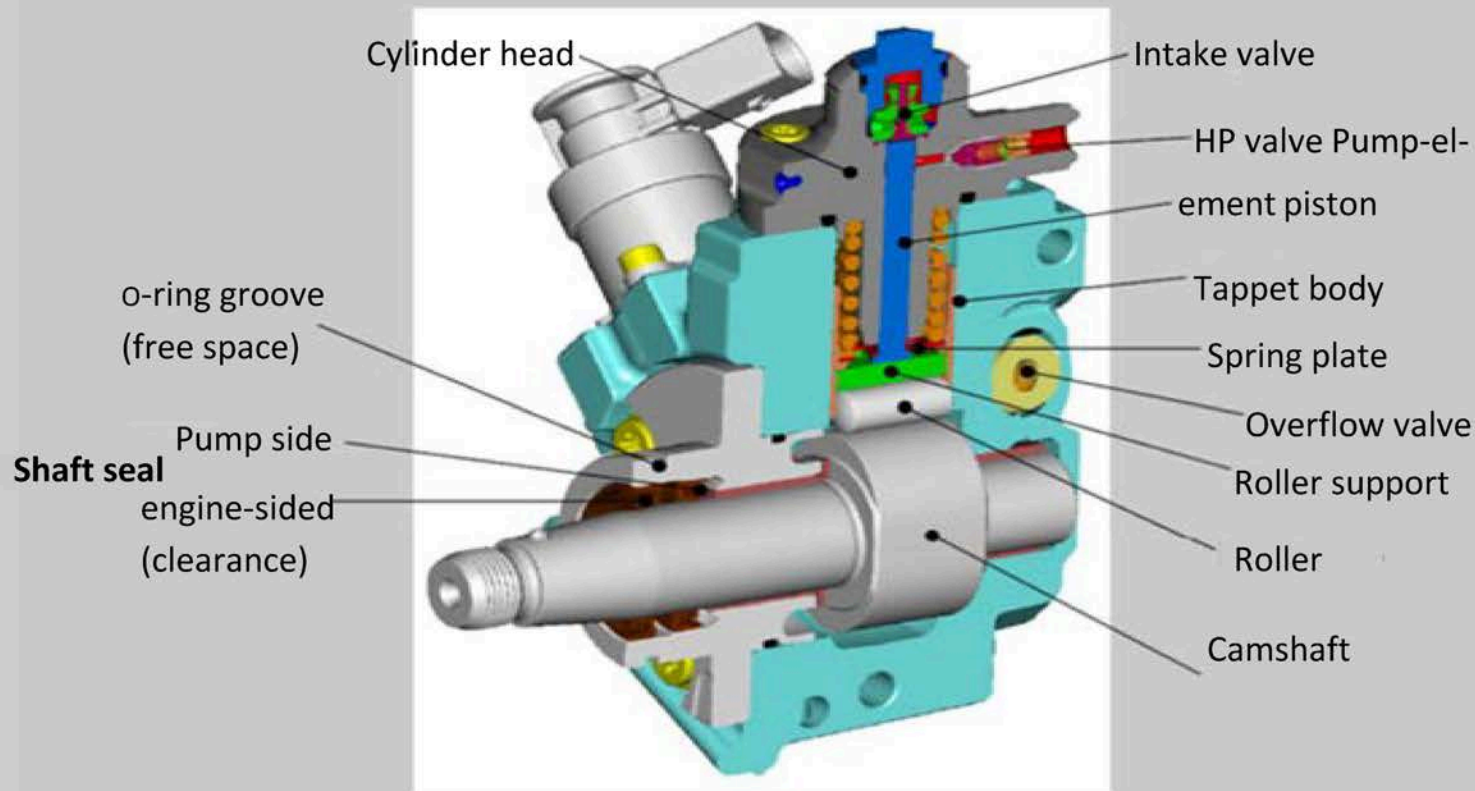
- ▶ Current CoD: worldwide 724 settlements, of which 403 in [redacted] (about 80% drivetrain damage)
- ▶ Findings by Task force [redacted]
 - Striking features of fuel (FAME acid) due to switchover from 0 to 7% biodiesel in mid-2009 in [redacted]
 - Damage pattern [redacted] different from [redacted] + Rdw (smoothened cam, shaft seal worn, etc.)
 - Individual C coated batches show high failure rates
- ▶ New failure hypotheses for [redacted] market by Bosch

Smoothening of the camshaft and change to the behavior of the coefficient of friction due to fuel-related oxidation processes and slip of the roller (tribochemical wear)
- ▶ Further measures:
 - Continuation of the detailed fuel and damage pump analysis
 - Review of all failure hypotheses / Ishikawa diagram
 - Test for reproduction of damage mechanism on test rig
 - Conducting the workshop "Fuels and vehicle operations worldwide" with VW Group and Bosch
 - Comparison of production parameters CP4.2 (quality records) without any evidence of damaging deviations so far € Further analysis of previously unspecified parameters (especially C coating)
 - Current status with respect to implementation of anti-wear package (planned Launch SOP July 2010) pump parts currently in production and survey
Initial test results with critical fuel by end of January 2010

Diesel high-pressure pump CP4



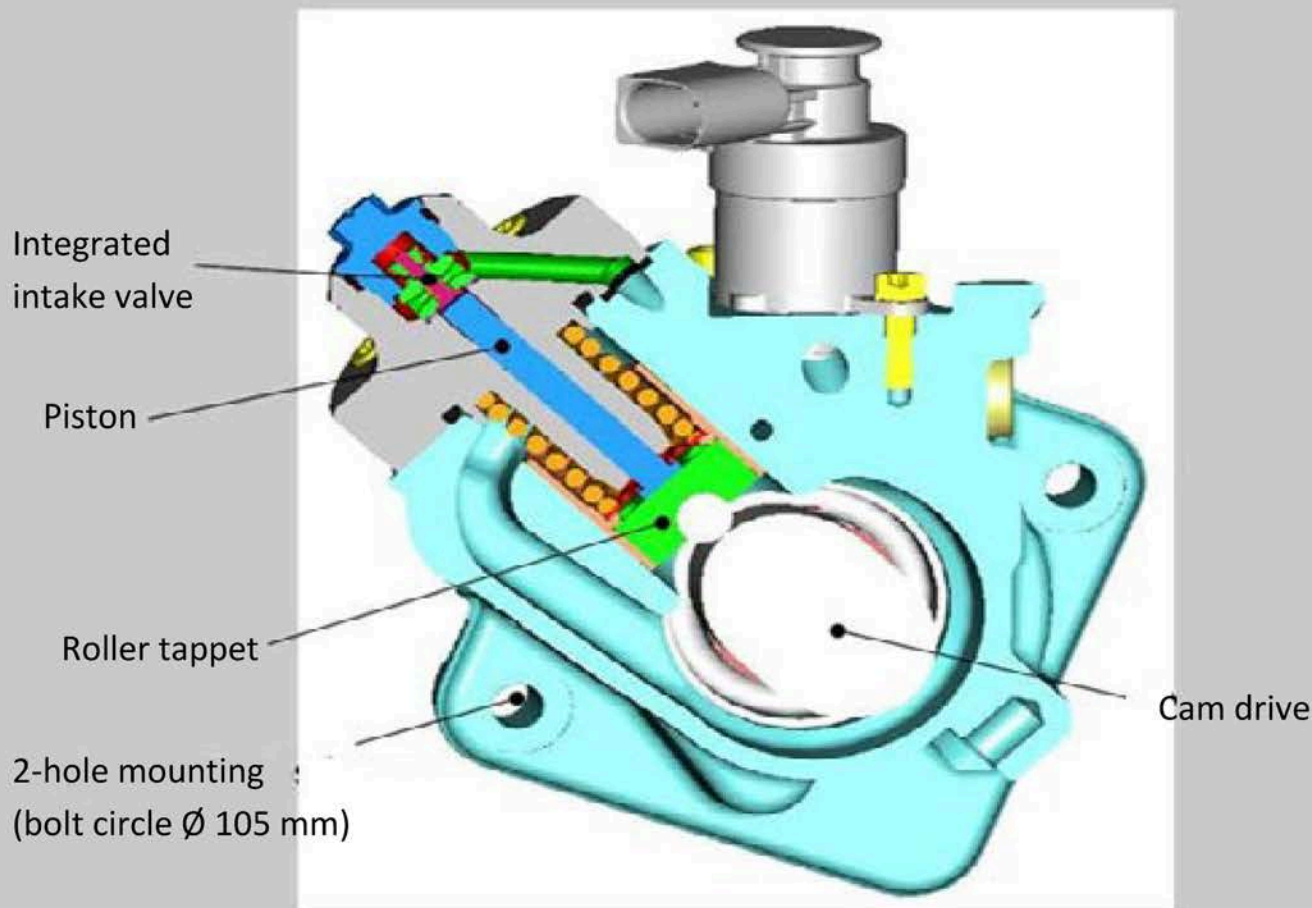
Technical information CP4.1



Diesel high-pressure pump CP4



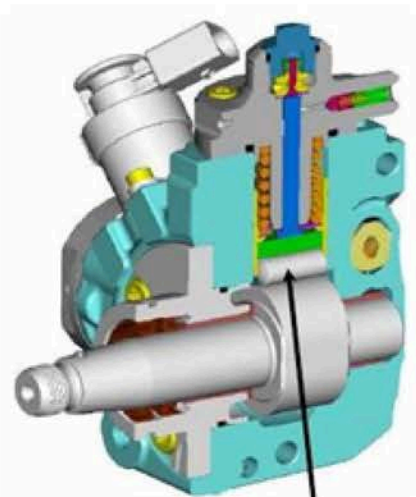
Technical information CP4.1



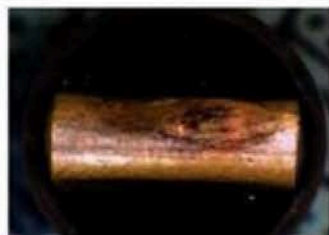
Drivetrain damage high pressure diesel fuel pump CP4



High-pressure fuel pump CP4.2



Right roller tappet



Left roller tappet



Drivetrain damage high pressure diesel fuel pump CP4

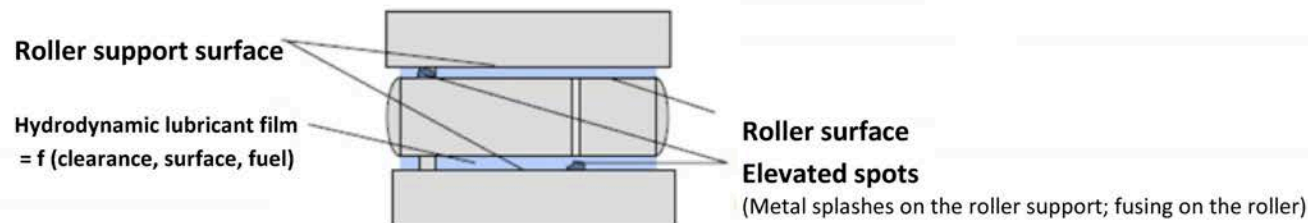


Status CP4 drivetrain damage @ VW & Audi

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 is increasing
- If coefficient of friction between roller and roller support > coefficient of friction between roller and cam -> braking flats
- Abrasive 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



Drivetrain damage high pressure diesel fuel pump CP4

**Causes / Analyses:**

Production slip by Bosch (microgeometry deviations) leads to stiff roller and especially to failures of the pump drivetrain when combined with fuel characteristics of certain markets.

Lack of robustness of CP4 with respect to fuel qualities occurring worldwide.

Measures implemented:

- Straightedge testing on eyeglass cloth WK 19 / 2008
- Roller of new second source supplier WK20 / 2008
- Optimized C coating on roller support (error-related about 80% effectiveness) WK 23 / 2008 – **Q observation**
(1) June 2008
- Further optimization. (carbon holder for 2 systems) C coating of roller support (>> 95%), WK16 / 2009
- C2 instead of C3 coating on roller end (reducing fusing) WK21 / 2009 – **Q observation**
Date of manufacture of HP pump from Bosch on type plate: 06.01.2009 (2) June 2009
- Camera system (prototype) for optimum screen display of surface
flaws in the roller support, introduced for partial quantity WK26 / 2009

Further procedure:

- Stricter testing point in final testing CP4.2 at Bosch for the selection of "borderline not OK drivetrains" due to failure / 1st partial large-scale test 1,000 units in Audi Q7 without internal failure in 04.+05.2009, 2nd partial test 10,000 pieces planned 3rd/4th Quarter 2009 (problem: there are currently no series capacity for trial at Bosch)
Optimized press-fit tappet / roller support (geometry + strength) 4th quarter 2009
- Testing of further development of the camera system for objective evaluation 2010?
- Further development of rollers fine geometry of surface 2010?
- Further development of C coating of roller support 2010?

High-pressure diesel pump CP4, Q7 market failures

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AQUA: Active quality analysis

Status as on 05/09-06.18.09 4.28 PM
 Source / User SAGA_Gew / [redacted]

Audi, Audi Q7, Market: [redacted]
 MY 2008 - 2010, offset: all (max: 3)
 CNR / groups: High-pressure fuel pump
 CASA|CASB

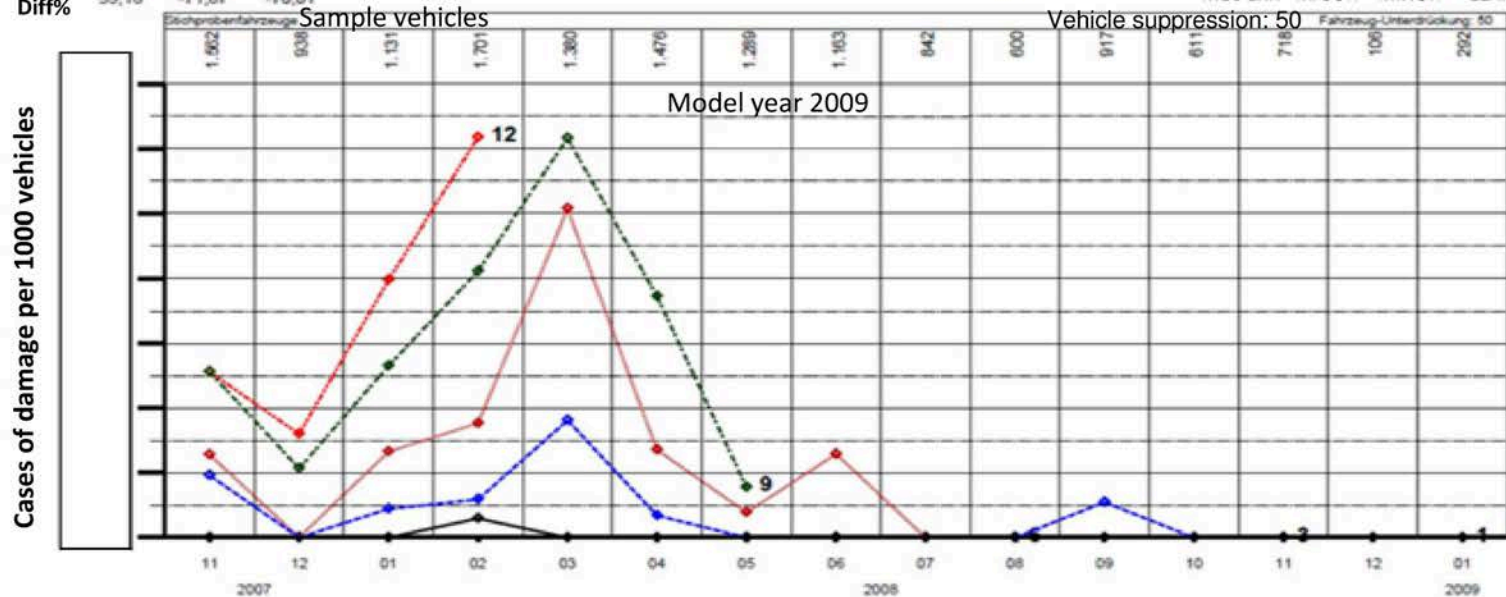
Confidential

Without PR-Number
 CNR 2374

MY	MIS 1	MIS 3	MIS 6	MIS 9	MIS 12
2008	0,1	1,3	3,5	6,4	8,6
2009	0,2	0,4	1,0		
Diff%	59,16	-71,87	-70,01		

MY	Replacement	BD	SA10	SA17	SA20	SA50
2008	97,8 %	61,1 %	68,9 %	14,4 %	3,3 %	11,1 %
2009	90,9 %	45,5 %	45,5 %	45,5 %	9,1 %	

MEC ERR MAJOR MINOR LEAK



CP4 Q7 3.01 TDI EU5

Note: Overall market in [redacted] Q7: Sharp decline in failures due to measures at Bosch. There is continued lack of robustness with certain fuels worldwide.

High-pressure diesel pump CP4, Q7 market failures

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AQUA: active quality analysis

Status as on 05/09-06, 18.09 5.53 PM
Source / User SAGA_Gew / [redacted]

Audi, *, Market: [redacted]

MY 2008 2010, Offset: all (Max: 3)

CNR / groups: High-pressure fuel pump

CGKB|CAMB|CCWA|CGKA|CAMA|CCWB

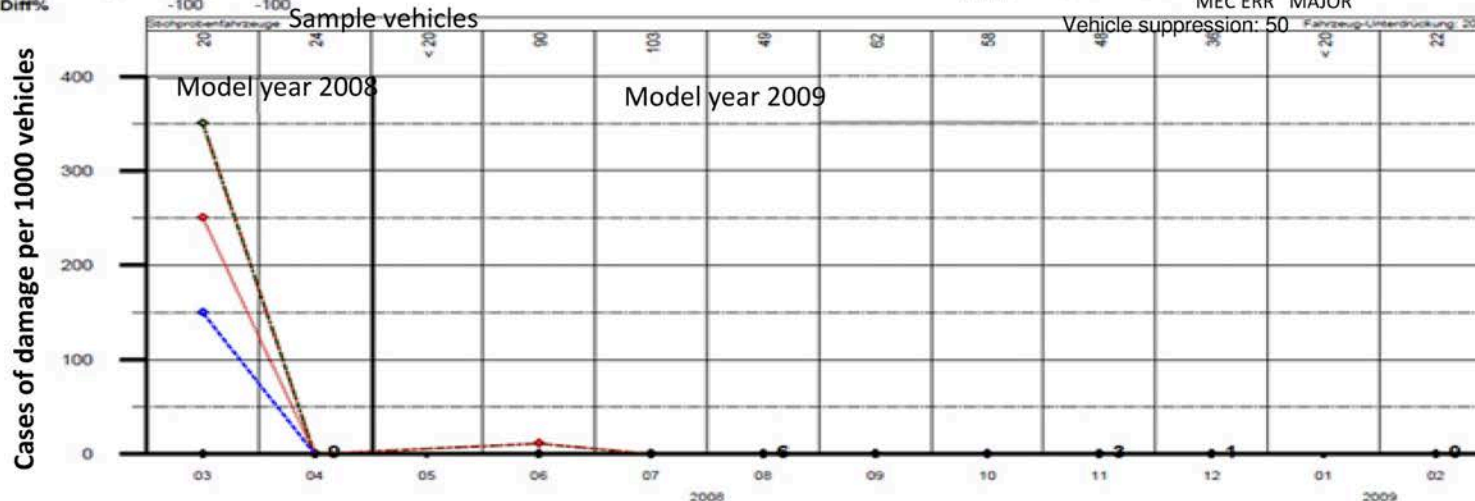
Confidential

Without PR numbers

CNR 2374

MY	MIS 0	MIS 1	MIS 3	MIS 6	MIS 9
2008	0,0	39,6	79,2	108,9	118,8
2009	0,0	0,0	0,0		
Diff%		-100	-100		

MY	Renlacement	RD	SA10	SA17
2008	83,3 %	58,3 %	100 %	
2009	100,0 %	100,0 %	50 %	50 %



[redacted]

CP4 A4, A5, Q5, Q7 V6-TD

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Note: MY 2008 - after 9 months approx. 10%

MY 2009 - after 9 months 0%

Market [redacted] Extremely sharp decline in failures due to elimination of the critical fuel (Winter diesel in the summer = low viscosity); market currently without any problems.

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Increased first fill volume diesel fuel for [redacted] market, October 15, 2008

High-pressure diesel pump CP4, Q7 market failures

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AQUA: active quality analysis

Status as on 05/09-06.18.09 4.41 PM
 Source / User SAGA_Gew / RC

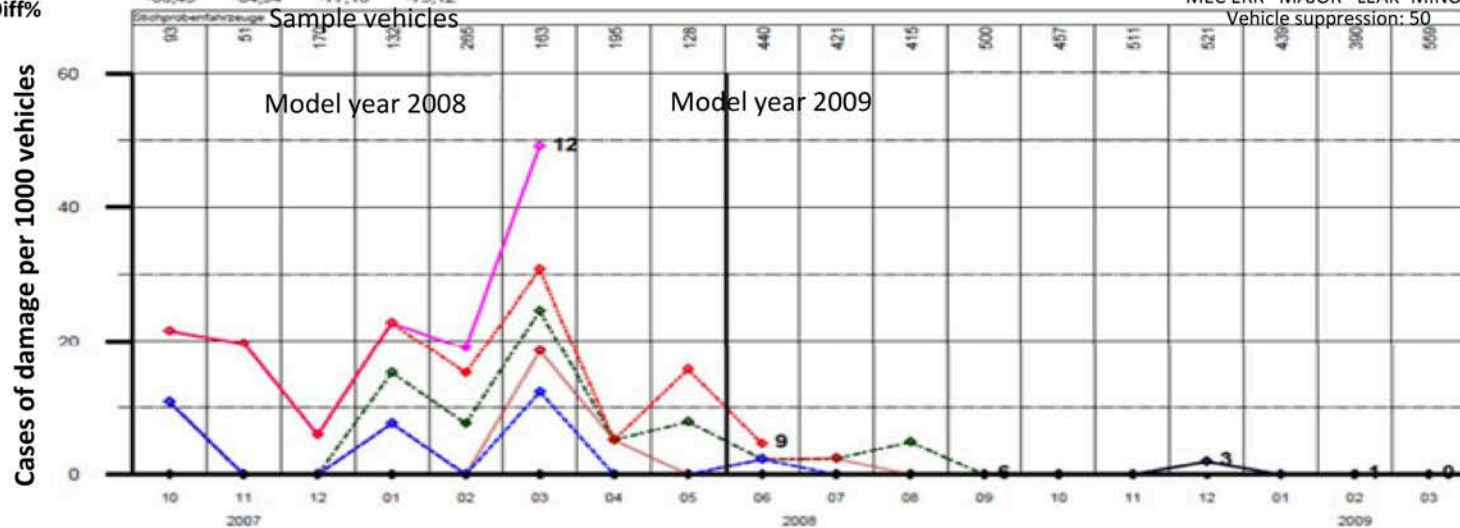
Audi, *, Market: [redacted]

MY 2008 2010, Offset: all (Max: 2)
 CNR / groups: High-pressure fuel pump
 CGKB|CAMB|CCWA|CGKA|CAMA|CCWB

Confidential

Without PR numbers
 CNR 2374

MY	MIS 0	MIS 1	MIS 3	MIS 6	MIS 9	MIS 12	MY Replacement BD	SA10	SA17	SA50	SA18	
2008	0.0	3.3	5.0	9.2	15.9	19.9	2008	100.0 %	56.3 %	68.8 %	18.8 %	12.5 %
2009	0.2	0.5	0.8	2.1	4.0		2009	100.0 %	50.0 %	60 %	20 %	10 %
Diff%		-86.43	-84.94	-77.18	-75.12							



[Redacted]

CP4 A4, A5, Q5, Q7 V6-TDI [redacted]

Note:

MY 2008 – after 12 months 2.0 % failure; after 9 months 1.6%
 MY 2009 - after 9 months 0.4%

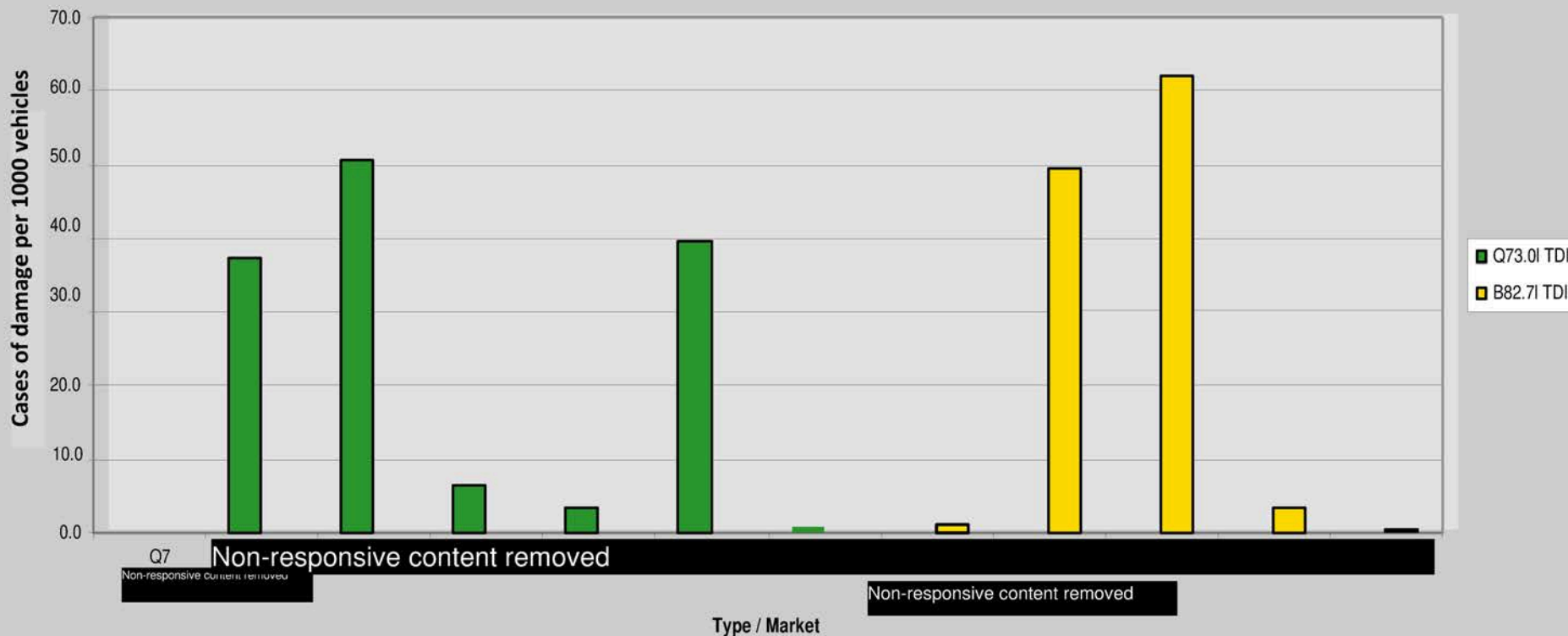
Market Italy: Currently, the most critical Volume market (suspicion of water, partly proven in individual cases)

Drivetrain damage high pressure diesel fuel pump CP4



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





Settlements for high-pressure fuel pump CP4.2 V6-TDI Audi

ENTIRE PAGE CONFIDENTIAL

Settlements for high-pressure fuel pump CP4.2 V6-TDI Audi

(by **setting date** in AQUA)

Country	2008	1 st half year 2009	Jul 09	Aug 09	Sep 09	Oct 09	Nov 09	WK49	WK50	WK51	WK52	Total
Non-responsive content removed	58	118	49	43	80	59	33	1	1			442
	20	30	11	15	16	7	10	2	1			112
	1	19	9	16	14	9	1	1	2			72
	30	10	3	5	3	2	0					53
	7	9	1	1	6	4	3	1				32
	12	8	2	1	1	1	3	1				29
	6	6	2	1	4	2	4					25
	4	6	2	3	0	0	0					15
	5	3	1	0	1	0	1		1			12
	2	6	1	0	1	0	0					10
	0	1	4	1	3	0	1					10
	1	4	0	0	1	0	0					6
	2	0	1	1	0	0	0					4
	2	0	0	1	0	0	0					3
USA	0	0	0	0	1	0	1	1				3
Total	150	220	86	88	131	84	57	7	5			828

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Settlements for high-pressure fuel pump CP4.2, December 18, 2009

Settlements for high-pressure fuel pump CP4.2 V6-TDI Audi

Settlements for high-pressure fuel pump CP4.2 V6-TDI Audi
(by setting date in AQUA)

