**CONFIDENTIAL**

from Non-responsive content removed

**Weekly report Service Technology WK 13/09** 27.03.09

AUDI AG
85045 Ingolstadt
Germany

Dear Non-responsive content removed

I wish to inform you of the following matter:

**Audi A4, A5, Q7, Q5 V6 TDI EU 5 – cases of high-pressure fuel pump damage after installation**

**Cases of damage:** 8 SF after use of C coating in May 2008
3x Q5, 3x Q7, 1x A5, 1x A4, mileage 100 – 13000 km.
All cases have occurred outside Non-responsive content removed Non-responsive content removed Non-responsive content removed The influence of the fuel quality is currently under consideration.

**Customer complaint:** Check engine lamp lights up, vehicle will not start.

**Workshop observation:** Data storage entry P8700
Fuel pressure regulatory limit undershot The high-pressure system is contaminated with metal splinters.

**Causes:** As a result of increased friction (lack of lubrication) the cam roller and cams of the high-pressure pump start to corrode.

**Measure:** under discussion

Non-responsive content removed

# Summary

- Status:

  Faulty pumps indicate ingress of fuel as a result of smoothed camshafts caused by slippage and wear on the shaft sealing ring
  In some cases, coatings and signs of wear were found on the piston.
  It was agreed that "good" pumps would be replaced. The analysis of the production data offers an initial indication of C coating batches.

- Further action:

  Deployment of the FCT in [redacted] to clarify the market-specific special features. 100% return of all field complaints worldwide Detailed analysis of the systems replaced by FCT, including fuel, will continue. Further analysis of the production data. Analysis of the differences in the systems of different vehicle types. Ishikawa diagram is produced (see slide 2) and will be systematically processed.

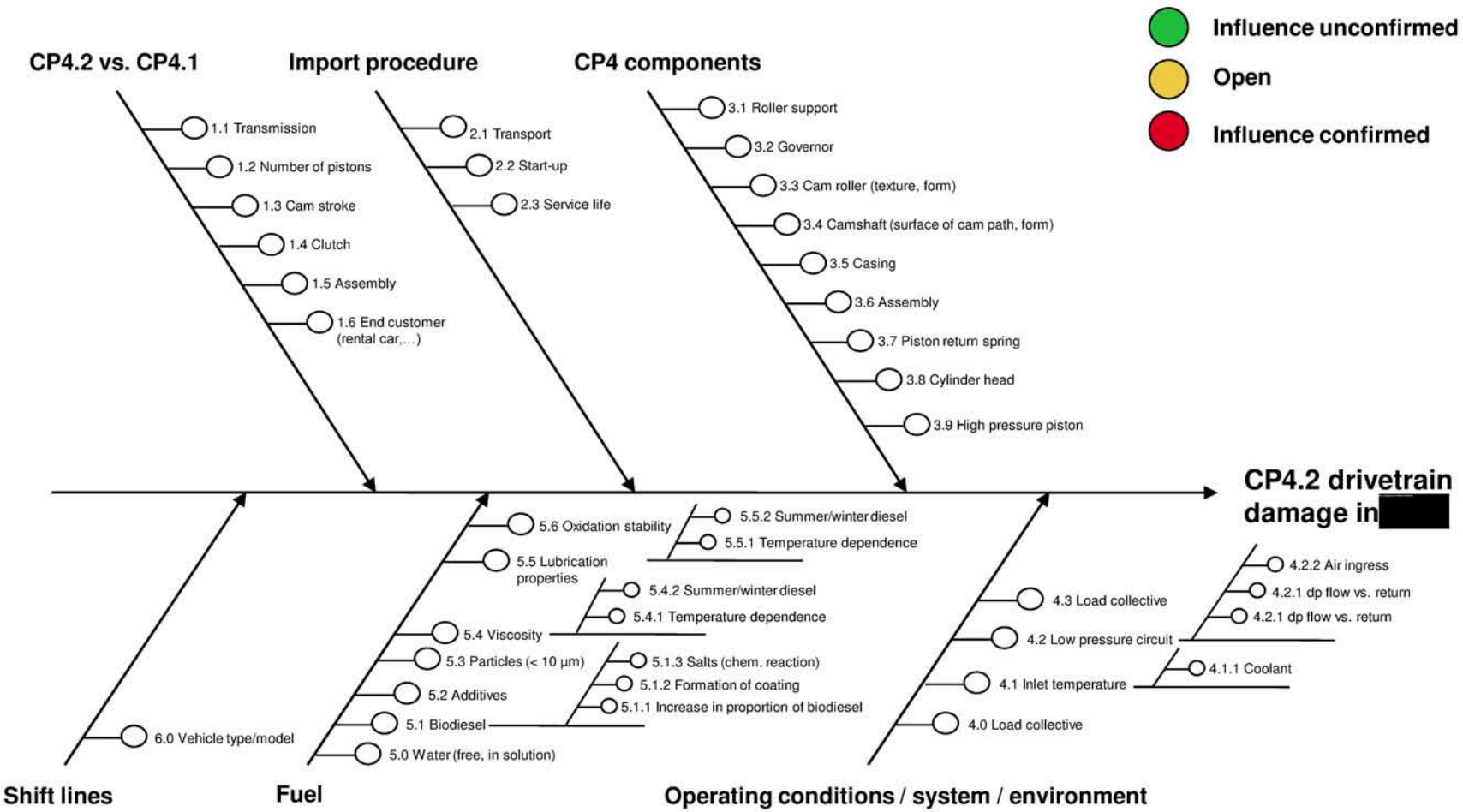
- Special features:

  50% of the vehicles analyzed failed after a short distance after refuelling. In 2 out of 10 cases water was found in the fuel.

# AUDI CP4 Situation in the Field in [redacted]



Status: 11/25/2009



BOSCH

## Operating conditions / Environment / System

**Local FCT team in** [Non-responsive content removed]

Status: 10 vehicles analyzed.
Complete systems from 9 cars sent to Bosch for analysis

Result: 100% drivetrain damage
Nothing unusual in low pressure circuits

Further action: Analysis of other vehicles
Analysis of delivery stores

Special features: (examples) Procedure for venting pumps after repairs was not generally known.
50% of the vehicles analyzed failed after a short distance after





BOSCH

## Components, fuels

### Findings

Status: 29 pumps analyzed, 9 from FCT action. System components and fuels under analysis.

Result: CP4: partial coating,high level of WDR wear and signs of wear on the piston. Splinters in the suction valve Major smoothing of the cam shafts on 3 not fully destroyed pumps.

Further action: Detailed analysis of the components and fuels. Analysis the splinters in the suction valves.

Special features: none

# CP4 components

## Production data analysis

Status: Data preparation of cam roller, roller supoort and cam shaft for 2 pump FD (unusual / not unusual) complete.

Result: All parameters, e.g. roughness, straightness,… no significant differences.
Focus on 2 batches C coating for roller support from the critical period

Further action: Detailed analysis of these 2 batches of roller shoes
Analysis of other production parameters

Special features: C-coating deposits from ATMO after production correlated with unusual features, date 03/2008. Further analysis required

## Operating conditions / Environment / System

## Obtain 40 good pumps

| | |
|---|---|
| Status: | Vehicles identified, importer to contact owners.<br>Importer has new pumps for replacement. |
| Result: | t.b.d. |
| Further action: | First returns not expected before week 50. |
| Special features: | none |

**AQUA: Active quality analysis**
Status: 10/09-20.11.09 15 :10
Source/user: Non-responsive content removed

**Audi, market:** [redacted]

**MY 2008 – 2010, Offset: all (max. 3)**

**Customer no. / Groups: High-pressure fuel pump**

**Confidential**
Without PR numbers
CUSTOMER NO. 2374

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

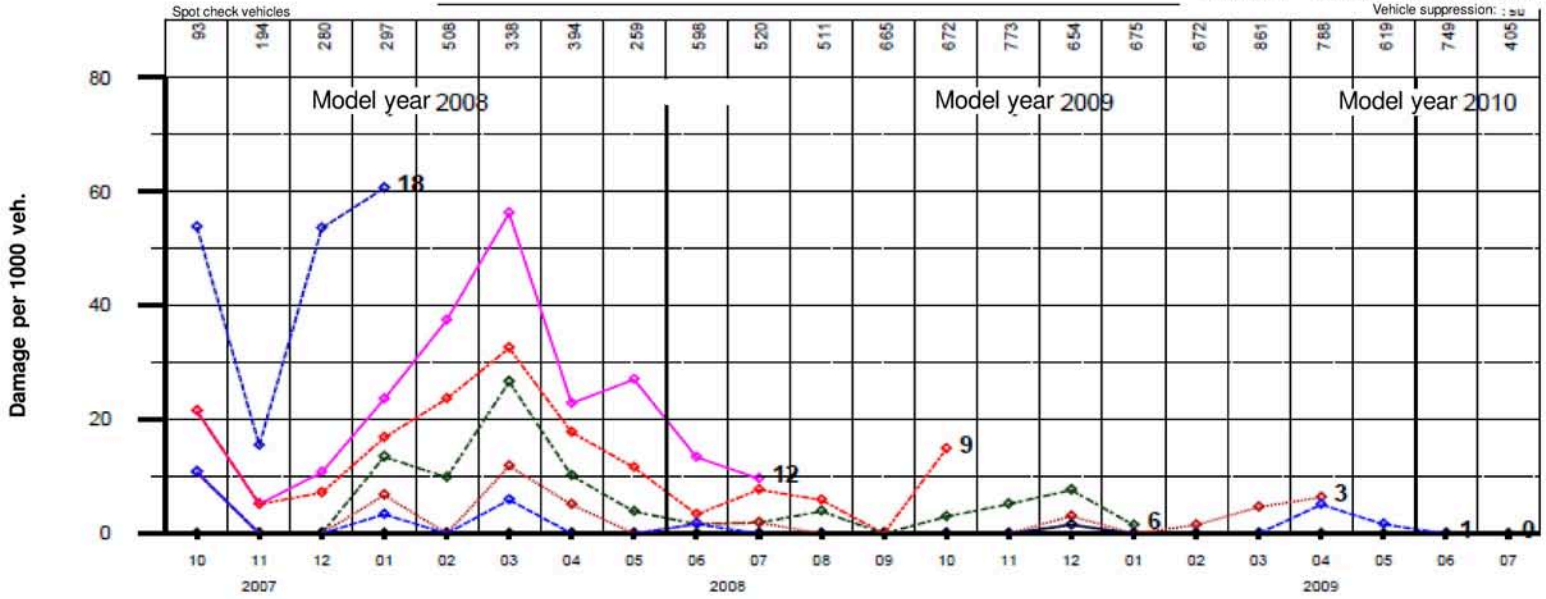
| MY | MIS 0 | MIS 1 | MIS 3 | MIS 6 | MIS 9 | MIS 12 | MIS 18 |
|---|---|---|---|---|---|---|---|
| 2008 | 0,0 | 1,7 | 3,9 | 10,3 | 18,0 | 27,8 | 73,8 |
| 2009 | 0,1 | 0,9 | 1,9 | 4,3 | 8,2 | 13,8 | |
| 2010 | 0,0 | 0,0 | 5,7 | | | | |
| Diff% | -100 | -100 | 194,41 | | | | |

| MY | Replacement | LB | 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

Spot check vehicles

Vehicle suppression: [illegible]




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

CP42 AU all engine codes V5 ITA 08-10

BOSCH

# Summary

- Status of new information since last update on 11/26/09:

  20 fuel samples were examined as part of a fuel survey in [redacted]. The proportion of biodiesel was increased (implementation B7) in 07/2009. There is evidence of old fuel on the market; in 4 samples the oxidation stability was outside of tolerance levels and the TAN (acidity coefficient) is generally higher than usual by a factor of 2. Free water was found in 3 out of 12 fuel samples from faulty pumps and in one case the TAN was also elevated.

  Traces of corrosion, black/ brown coatings and polished camshafts were found, a clear indication of tribochemical wear. A probable failure hypothesis was drawn up (see slide 6).

  The analysis of the production and C coating data indicated nothing unusual.

# Summary

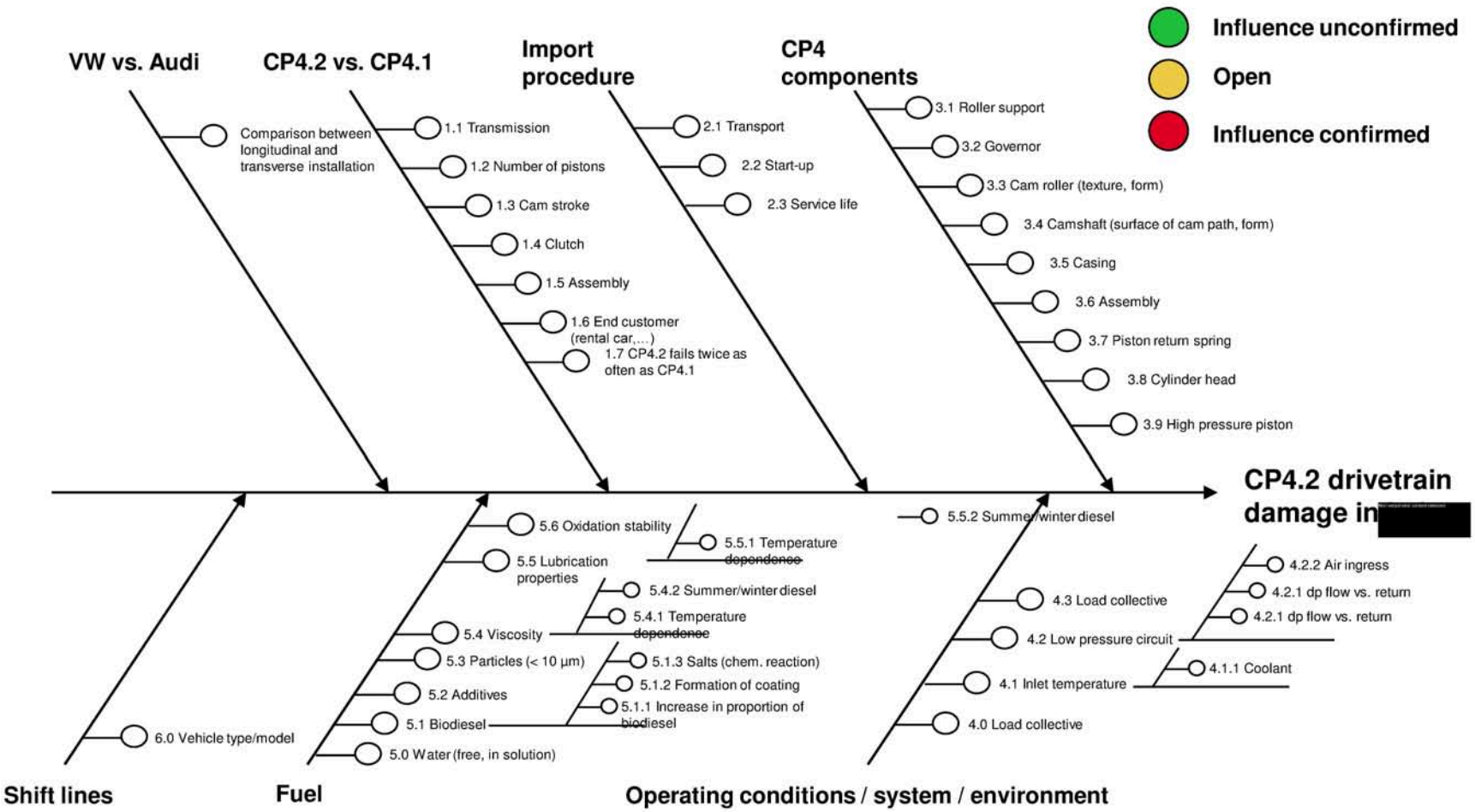
- Further action:

  Detailed analysis of the fuel injection systems replaced by FCT, including fuel and fuel filters, will continue. Further analysis for as yet unspecified influences in production is being carried out on the basis of reference samples.

  First results of analysis of system differences in different vehicle types offer no answers, more detailed analysis in train.

# AUDI- CP4 Situation in the Field in [redacted]

Status: 12/2/2009



BOSCH

# Operating conditions / Environment / System

## Local FCT team in [redacted]

| | |
|---|---|
| Status: | Complete fuel injection systems from 16 vehicles including fuel filters and fuel pumps from supply stores have been sent to Bosch for analysis. |
| Result: | 100% drivetrain damage.<br>7/7 analyses of low pressure circuits showed nothing unusual. |
| Further action: | FCT team will stand down until new information requires further action. |
| Special features:<br>(examples) | Free water found in the fuel in 3 vehicles.<br>2 vehicles with deposits in the tank (swirl pot) |

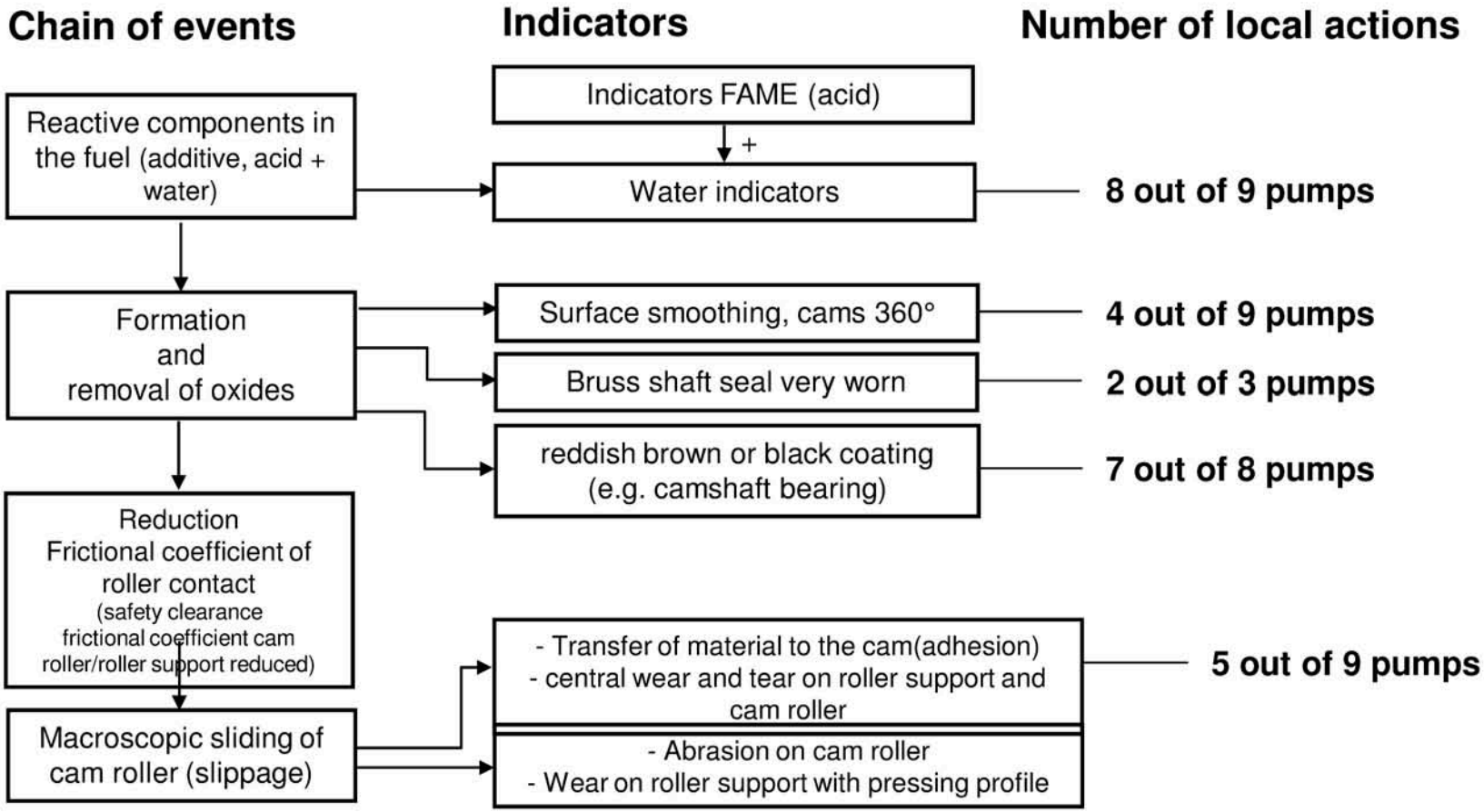
 

# Components, fuels

## Findings

| | |
|---|---|
| Status: | 29 pumps analyzed, 9 from FCT action.<br>Detailed analysis carried out. 7 damage hypotheses developed. |
| Result: | 8/9 signs of corrosion, 8/9 black coating,<br>4 polished camshafts, 9/9 feature 90° turned tappet.<br>Most likely damage hypothesis (see slide 6) is therefore tribochemical wear and tear. |
| Further action: | Further detailed analysis of components and fuels from FCT action. |
| Special features: | Water and acid (twice as high as usual) found probably from spilled biodiesel. |

# Failure hypothesis 4: Fuel additives -> Tribochemicals



# CP4 components

## Production data analysis

Status: Data preparation of cam roller, roller support and cam shaft for 2 pump FD (unusual / not unusual) complete. Detailed analysis of C coating batches carried out.

Result: Nothing unusual in any parameters (see slides 8 and 9).

Further action: Analysis of previously unspecified influenced on the basis of reference samples.

Special features: none

# Roller support roller

| Designation | Data available in ... | Scope of spot check | Comparison Jan/Feb 2008 Oct/Nov 2008 |
|---|---|---|---|
| Ø extent of wear before C layer | SPC | 3 of 480 | Done, no items of note |
| Parallelism after C layer | Paper | 3 of 480 | Done, no items of note |
| Straightness after C layer | Paper | 3 of 480 | Done, no items of note |
| Straightness after C layer | Paper | 3 of 480 | Done, no items of note |
| Straightness after C layer | Paper | 3 of 480 | Done, no items of note |
| Roundness after C layer | Paper | 3 of 480 | Done, no items of note |
| Rmr after C layer | Paper | 3 of 480 | Done, no items of note |
| Rpmax after C layer | SPC | 3 of 480 | Done, no items of note |
| Rvmax after C layer | Paper | 3 of 480 | Done, no items of note |

| Designation | Data available in ... | Scope of spot check | Comparison Jan/Feb 2008 Oct/Nov 2008 |
|---|---|---|---|
| Surface texture | Incoming goods data in SAP, elec. readable | 3 per goods in process Approx. 10,000 | Done, no items of note |
| Rmrmax | Incoming goods data in SAP, elec. readable | 3 per goods in process Approx. 10,000 | Done, no items of note |
| Parallelism | Incoming goods data in SAP, elec. readable | 3 per goods in process Approx. 10,000 | Done, no items of note |
| Roundness | Incoming goods data in SAP, elec. readable | 3 per goods in process Approx. 10,000 | Done, no items of note |
| Ø | Incoming goods data in SAP, elec. readable | 3 per goods in process Approx. 10,000 | Done, no items of note |

# Camshaft

| Designation | Data available in ... | Scope of spot check | Comparison Jan/Feb 2008 Oct/Nov 2008 |
|---|---|---|---|
| Parallelism | Paper | 1 of 96 | Done No items of note |
| Parallelism | SPC | 1 of 96 | Done No items of note |
| Straightness | SPC | 1 of 96 | Done No items of note |
| Deviation in form | Paper | 1 of 96 | No values available from period 1 |
| Deviation in form | Paper | 1 of 96 | No values available from period 1 |
| Surface texture | Paper | 1 of 96 | Done No items of note |
| Surface texture | SPC | 1 of 96 | Done No items of note |
| Surface texture | Paper | 1 of 96 | Done No items of note |

# Tappet module

| Designation | Data available in ... | Scope of spot check | Comparison Jan/Feb 2008 Oct/Nov 2008 |
|---|---|---|---|
| Frictional coefficient | Central computer | 100% | Done No items of note |
| 90° angle | Central computer | 100% | Done No items of note |

# C coating

| Designation | Data available in ... | Scope of spot check | Review period Nov. 2007 - March 2008 |
|---|---|---|---|
| Coating thickness | Excel | 3 of 2880 | Done No items of note |
| Adhesion | Excel | 3 of 2880 | Done No items of note |

# AUDI CP4 Situation in the Field in [redacted]



## Operating conditions / Environment / System

## Obtain 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 week 50. |
| Special features: | none |

**AQUA: Active quality analysis**
Status: 10/09-20.11.09 15 :10
Source/user: [redacted]

**Audi, market:** [redacted]

**MY 2008 – 2010, Offset: all (max. 3)**

**Customer no. / Groups: High-pressure fuel pump**

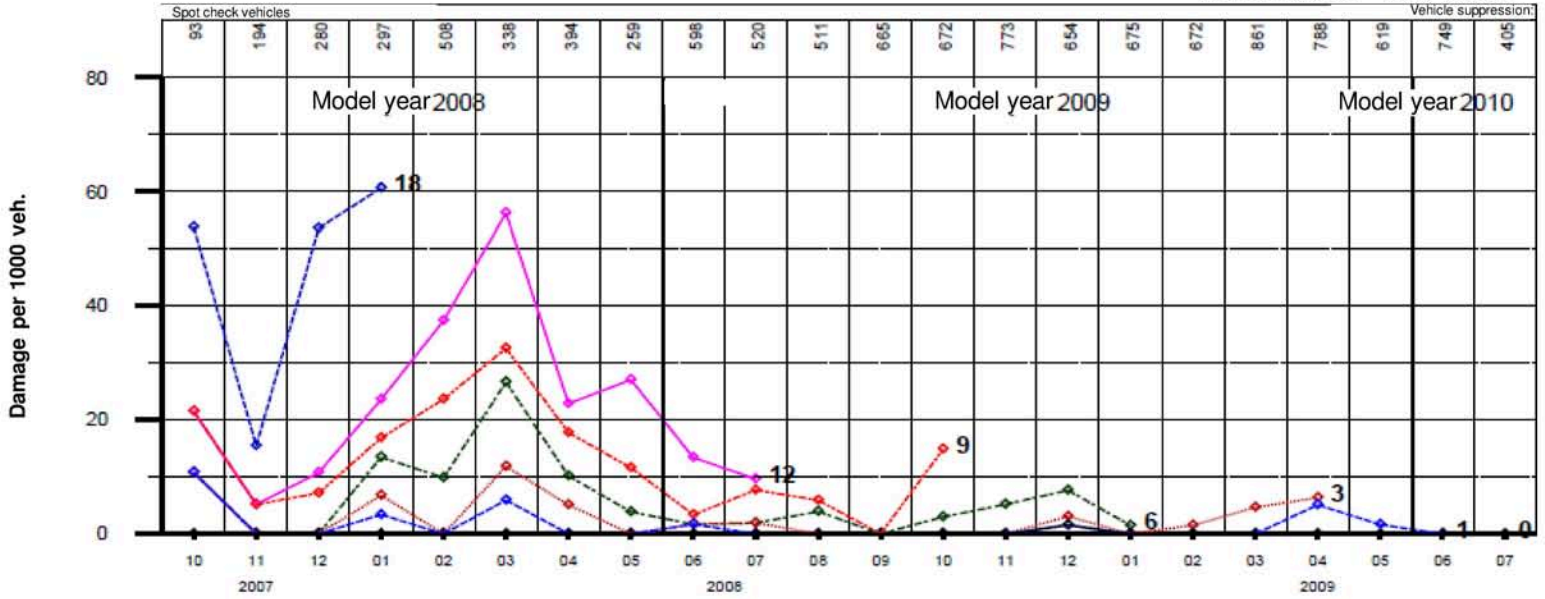
**CAMA|CAMB|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CCWA|CCWB|CDYA|CDYB|CDYC|CGKA|CGKB**

**Confidential**
Without PR numbers
CUSTOMER NO. 2374

| 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 | Replacement | LB | 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;Stp.: 2.335+7.730+2.800=12.865;MY:2008+2009+2010 =Total

CP42 AU all engine codes V5 [redacted] 08-10

# Summary

- Status of new information since last update on 11/26/09:

  20 fuel samples were examined as part of a fuel survey in Northern [redacted]. The proportion of biodiesel was increased (implementation B7) in 07/2009. There is evidence of old fuel on the market; in 4 samples the oxidation stability was outside of tolerance levels and the TAN (acidity coefficient) is generally higher than usual by a factor of 2. Free water was found in 3 out of 12 fuel samples from faulty pumps and in one case the TAN was also elevated.

  Traces of corrosion, black/ brown coatings and polished camshafts were found, a clear indication of tribochemical wear. A probable failure hypothesis was drawn up (see slide 6).

  The analysis of the production and C coating data indicated nothing unusual.

# Summary

- Further action:

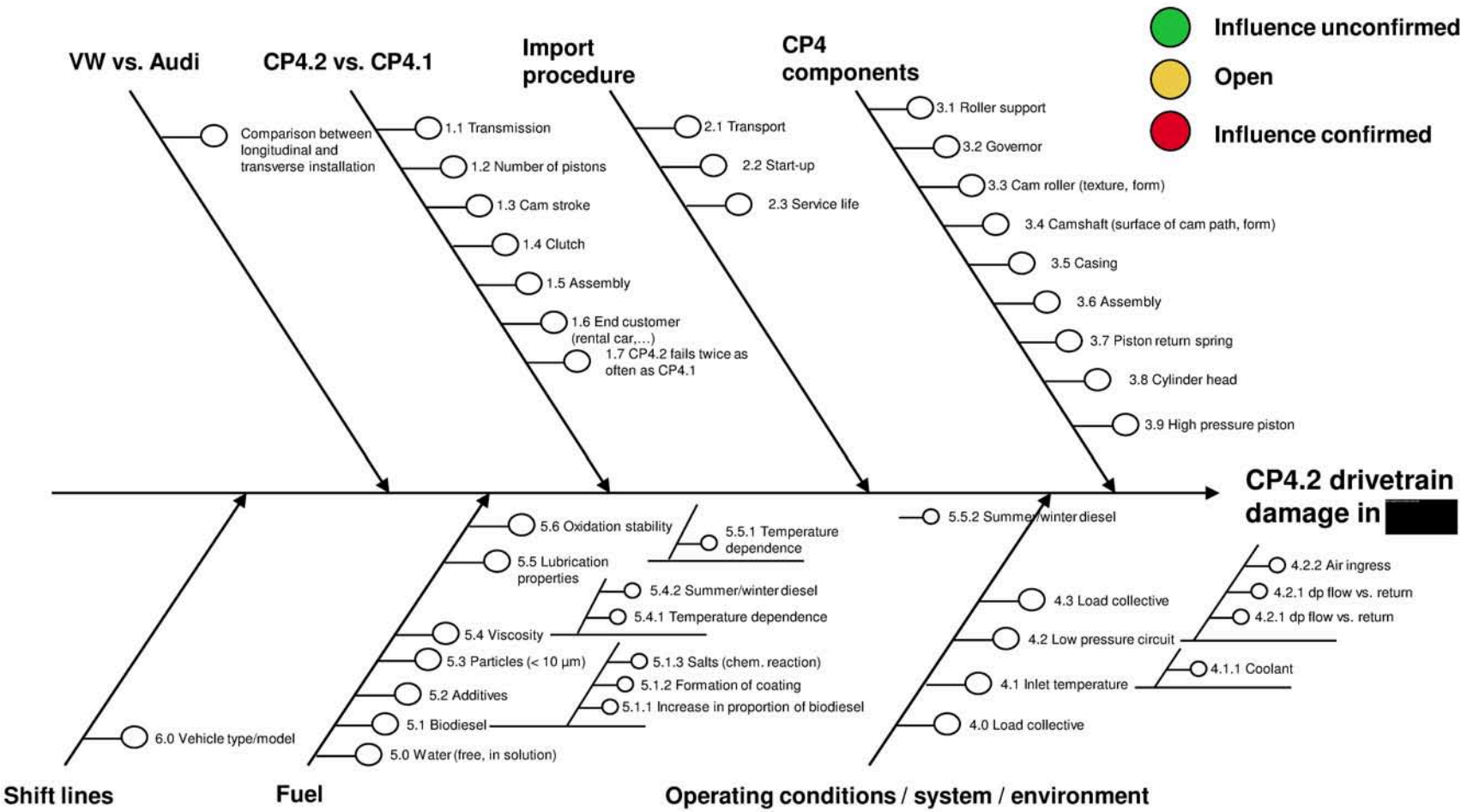
  Detailed analysis of the fuel injection systems replaced by FCT, including fuel and fuel filters, will continue. Further analysis for as yet unspecified influences in production is being carried out on the basis of reference samples.

  First results of analysis of system differences in different vehicle types offer no answers, more detailed analysis in train.

# AUDI- CP4 Situation in the Field in [redacted]

Status: 12/2/2009



# Operating conditions / Environment / System

## Local FCT team in [redacted]

Status: Complete fuel injection systems from 16 vehicles including fuel filters and fuel pumps from supply stores have been sent to Bosch for analysis.

Result: 100% drivetrain damage.
7/7 analyses of low pressure circuits showed nothing unusual.

Further action: FCT team will stand down until new information requires further action.

Special features: (examples) Free water found in the fuel in 3 vehicles.
2 vehicles with deposits in the tank (swirl pot)

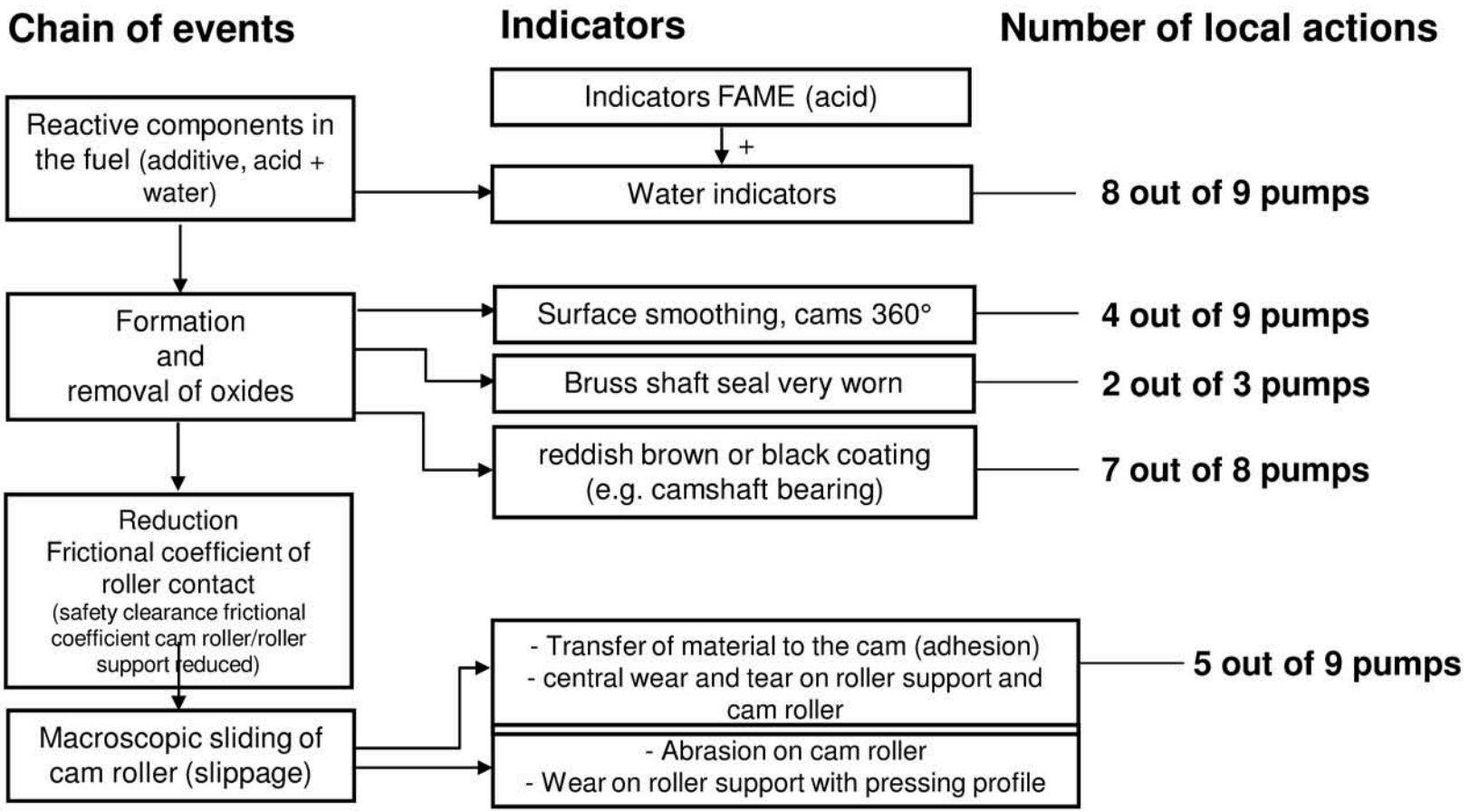
 

# Components, fuels

## Findings

| | |
|---|---|
| Status: | 29 pumps analyzed, 9 from FCT action.<br>Detailed analysis carried out. 7 damage hypotheses developed. |
| Result: | 8/9 signs of corrosion, 8/9 black coating,<br>4 polished camshafts, 9/9 feature 90° turned tappet.<br>Most likely damage hypothesis (see slide 6) is therefore tribochemical wear and tear. |
| Further action: | Further detailed analysis of components and fuels from FCT action. |
| Special features: | Water and acid (twice as high as usual) found probably from spilled biodiesel. |

# Failure hypothesis 4: Fuel additives -> Tribochemicals



# CP4 components

## Production data analysis

Status: Data preparation of cam roller, roller support and cam shaft for 2 pump FD (unusual / not unusual) complete. Detailed analysis of C coating batches carried out.

Result: Nothing unusual in any parameters (see slides 8 and 9).

Further action: Analysis of previously unspecified influenced on the basis of reference samples.

Special features: none

# Roller support roller

| Designation | Data available in ... | Scope of spot check | Comparison Jan/Feb 2008 Oct/Nov 2008 |
|---|---|---|---|
| Ø extent of wear before C layer | SPC | 3 of 480 | Done, no items of note |
| Parallelism after C layer | Paper | 3 of 480 | Done, no items of note |
| Straightness after C layer | Paper | 3 of 480 | Done, no items of note |
| Straightness after C layer | Paper | 3 of 480 | Done, no items of note |
| Straightness after C layer | Paper | 3 of 480 | Done, no items of note |
| Roundness after C layer | Paper | 3 of 480 | Done, no items of note |
| Rmr after C layer | Paper | 3 of 480 | Done, no items of note |
| Rpmax after C layer | SPC | 3 of 480 | Done, no items of note |
| Rvmax after C layer | Paper | 3 of 480 | Done, no items of note |

| Designation | Data available in ... | Scope of spot check | Comparison Jan/Feb 2008 Oct/Nov 2008 |
|---|---|---|---|
| Surface texture | Incoming goods data in SAP, elec. readable | 3 per goods in process Approx. 10,000 | Done, no items of note |
| Rmrmax | Incoming goods data in SAP, elec. readable | 3 per goods in process Approx. 10,000 | Done, no items of note |
| Parallelism | Incoming goods data in SAP, elec. readable | 3 per goods in process Approx. 10,000 | Done, no items of note |
| Roundness | Incoming goods data in SAP, elec. readable | 3 per goods in process Approx. 10,000 | Done, no items of note |
| Ø | Incoming goods data in SAP, elec. readable | 3 per goods in process Approx. 10,000 | Done, no items of note |

# Camshaft

| Designation | Data available in ... | Scope of spot check | Comparison Jan/Feb 2008 Oct/Nov 2008 |
|---|---|---|---|
| Parallelism | Paper | 1 of 96 | Done No items of note |
| Parallelism | SPC | 1 of 96 | Done No items of note |
| Straightness | SPC | 1 of 96 | Done No items of note |
| Deviation in form | Paper | 1 of 96 | No values available from period 1 |
| Deviation in form | Paper | 1 of 96 | No values available from period 1 |
| Surface texture | Paper | 1 of 96 | Done No items of note |
| Surface texture | SPC | 1 of 96 | Done No items of note |
| Surface texture | Paper | 1 of 96 | Done No items of note |

# Tappet module

| Designation | Data available in ... | Scope of spot check | Comparison Jan/Feb 2008 Oct/Nov 2008 |
|---|---|---|---|
| Frictional coefficient | Central computer | 100% | Done No items of note |
| 90° angle | Central computer | 100% | Done No items of note |

# C coating

| Designation | Data available in ... | Scope of spot check | Review period Nov. 2007 - March 2008 |
|---|---|---|---|
| Coating thickness | Excel | 3 of 2880 | Done No items of note |
| Adhesion | Excel | 3 of 2880 | Done No items of note |

## Operating conditions / Environment / System

## Obtain 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 week 50. |
| Special features: | none |

**AQUA: Active quality analysis**
Status: 10/09-20.11.09 15 :10
[redacted]

**Audi, market: [redacted]**
**MY 2008 – 2010, Offset: all (max. 3)**
**Customer no. / Groups: High-pressure fuel pump**

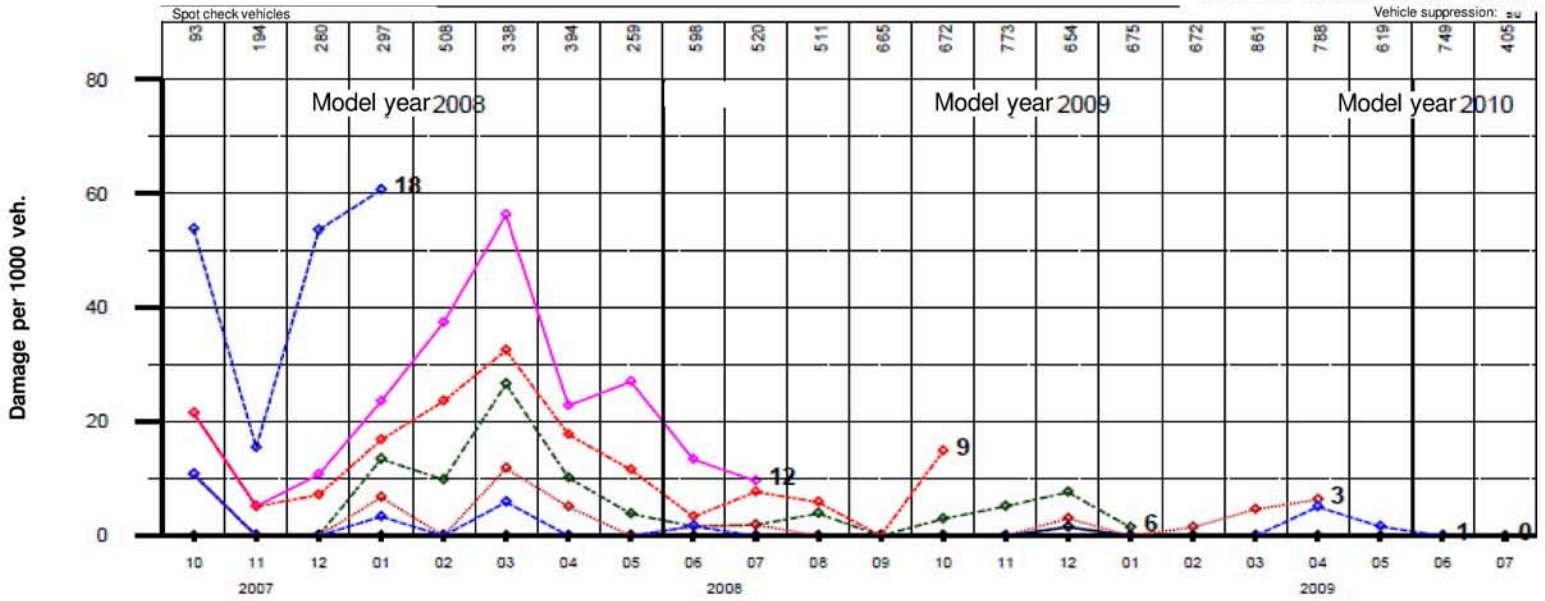
**Confidential**
Without PR numbers
CUSTOMER NO. 2374

**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 | Replacement | LB | 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;Stp.: 2.335+7.730+2.800=12.865;MY:2008+2009+2010

CP42 AU all engine codes V5 ITA 08-10

# Summary

- Status of new information since last update on 12/2/09:

  20 fuel samples were examined as part of a fuel survey in Non-responsive content removed. The proportion of biodiesel was increased (implementation B7) in 07/2009. There is evidence of old fuel on the market; in 4 samples the oxidation stability was outside of tolerance levels and the TAN (acidity coefficient) is generally higher than usual by a factor of 2-3. Additional information from the analysis of the fuels and linings brought along by the FCT team Algae found in the first sample, which can form acid as metabolic by-product

  Signs of corrosion, black/brown coatings and polished camshafts. The new information also points to tribochemical wear on other faulty mechanisms (no. 2 + 3)

  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

# Summary

- Further action:

  Continuation of the detailed analysis of fuel injection systems replaced by FCT, including fuel and fuel filter Further analysis for influences as yet unspecified in the drawing in production is being carried out on the basis of reference samples. For this, 50 reference samples will be analyzed in detail (production data and visual inspection)

  Different problems between longitudinal and transverse installations and between Audi and VW involving the same pump are to be analyzed, in particular in relation to system differences (how does water reach the pump?)

  Evaluations will take the form of an Ishikawa diagram.

# AUDI Q7 4 Situation in the Field in [redacted]

## Operating conditions / Environment / System

### Local FCT team in [redacted]

| | |
|---|---|
| Status: | 18 vehicles examined at local level 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.<br>2/4 cases of drivetrain damage from damaged parts stores systems<br>7/7 analyses of low pressure circuits showed nothing unusual. |
| Special features: | Free water found in the fuel in 3 vehicles.<br>4 vehicles with deposits in the tank (swirl pot)<br>- 1x reddish, sticky coatings,<br>- 1x white flocculation,<br>- 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:
Oxidation stability was found to be outside the tolerance in 2 fuel samples.
In the first analysis of the coatings, algae were found in the fuel.
Other coatings 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

## Components

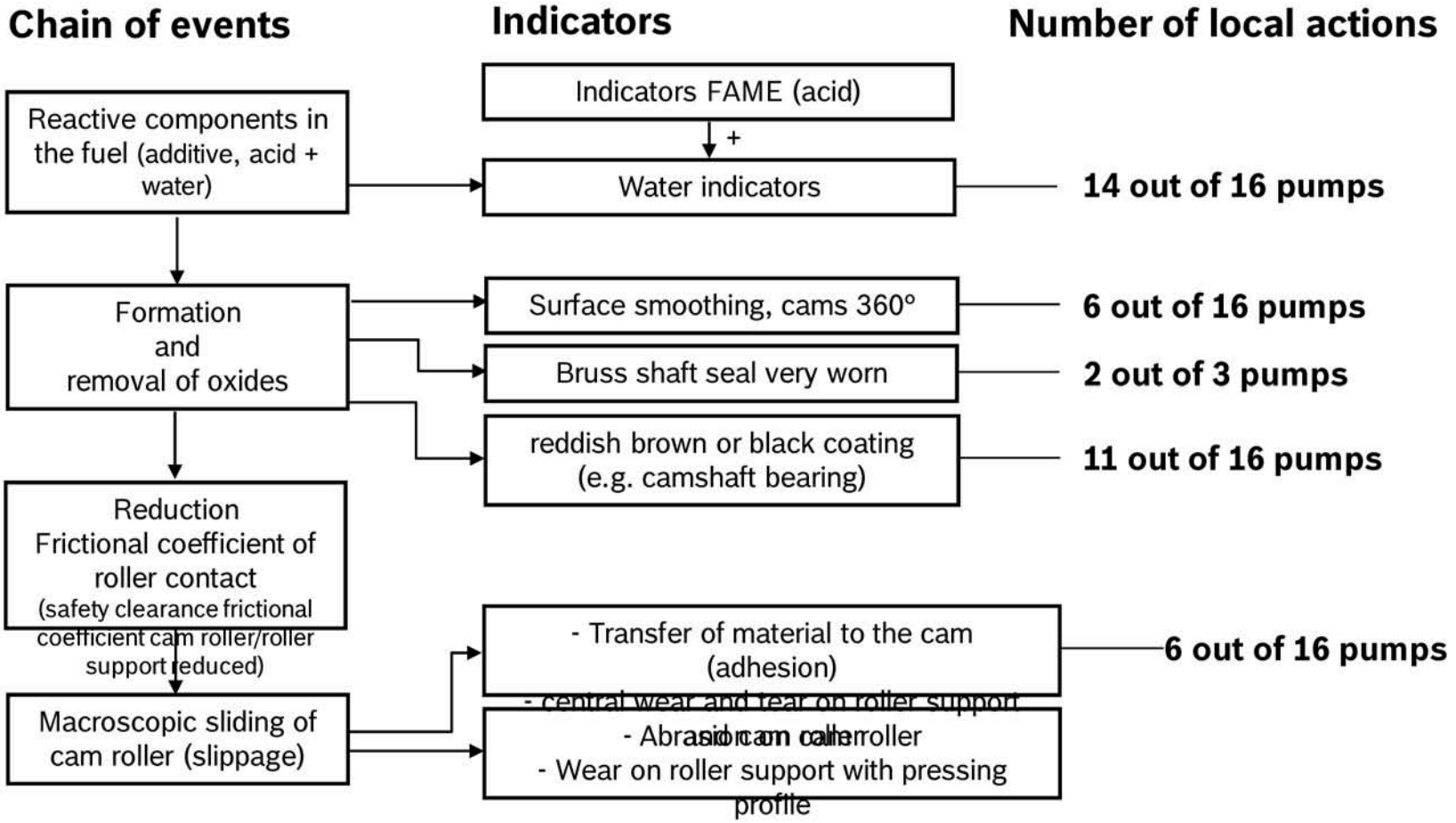
### Findings

Status: 16 pumps analyzed.
Various damage hypotheses developed.

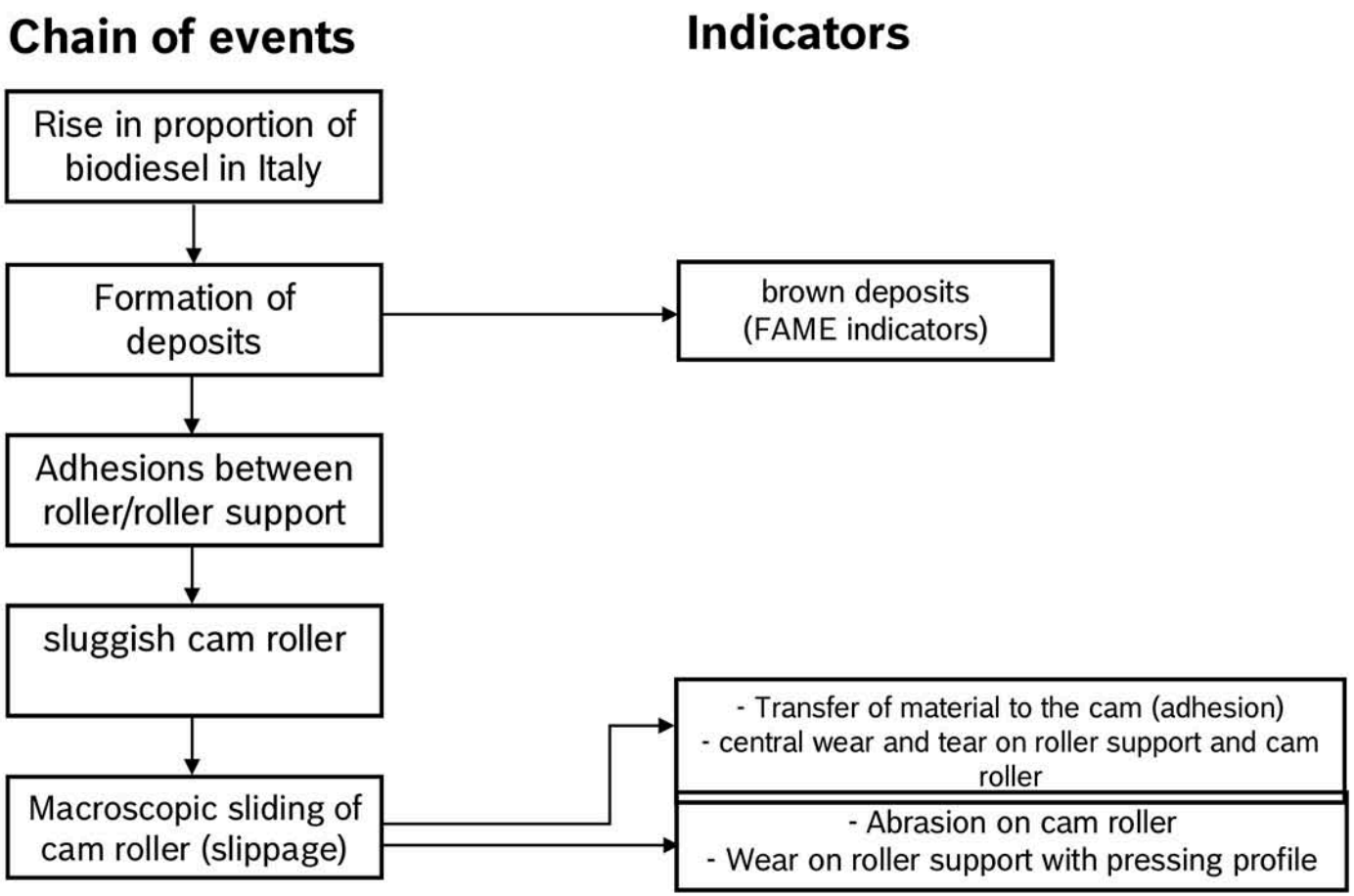
Result: The analysis of the pumps produced the following picture
- 14/16 signs of corrosion
- 11/16 black coating on cams and bearings (under analysis)
- 6 camshafts smoothed (polished)
- 16/16 feature two tappets turned by 90°
- 2/3 Bruss shaft seals very worn

Most probable damage hypothesis is therefore tribochemical wear and jammed roller due to residue (such as soaps) -> anti-algal products.

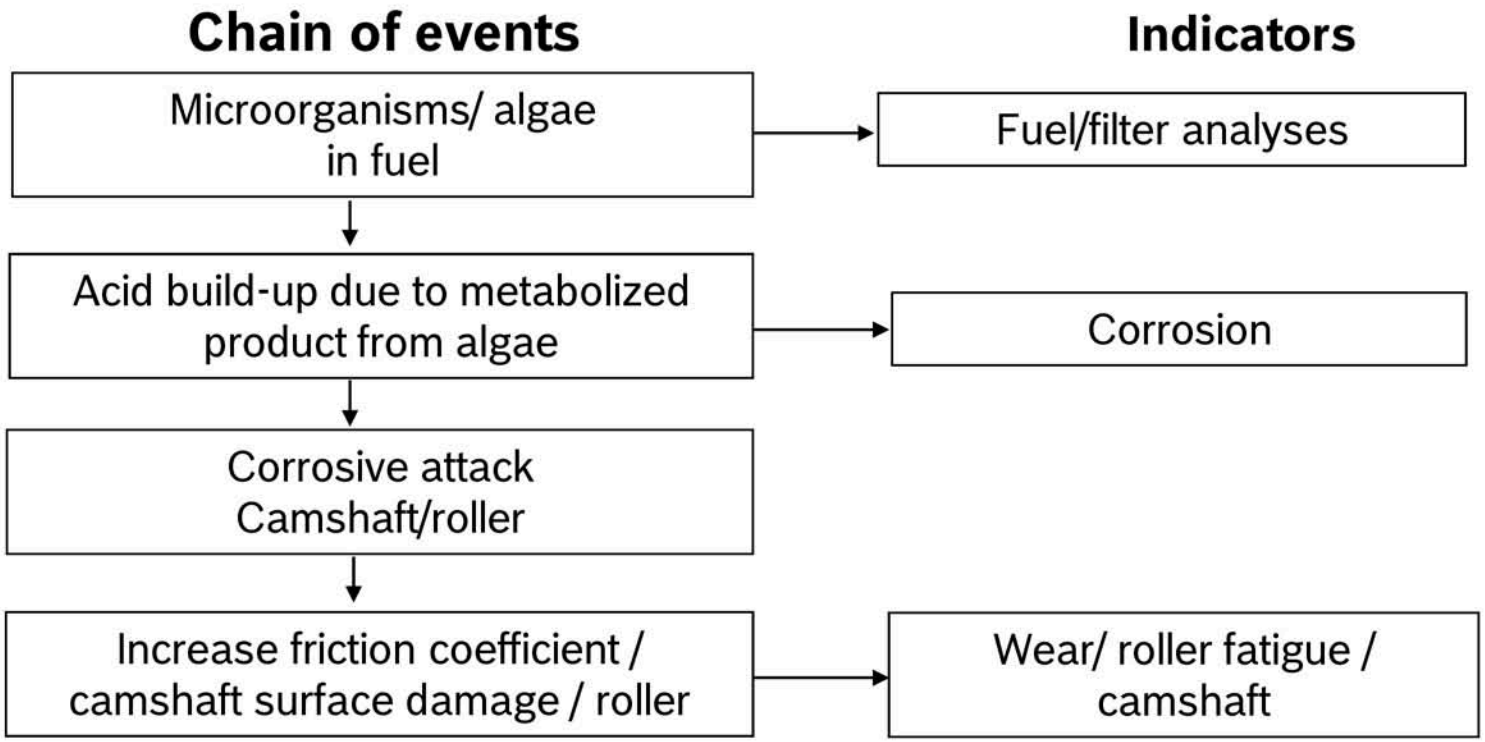
# Failure hypothesis: Fuel additives -> Tribochemicals



# Failure hypothesis 3: Biodiesel -> adhesions



## Failure hypothesis: Algae* -> Corrosion




*In cases of microbiological growth in fuels, there must always be a free water phase. The microorganisms live in water and feed from the 'organic' material in the boundary layer between the water and fuel.

## Operating conditions / Environment / System

## Obtain 40 good pumps

| | |
|---|---|
| Status: | Vehicles identified, importer to contact owners.<br>Importer has new pumps for replacement. |
| Result: | t.b.d. |
| Further action: | First returns not expected before week 50. |
| Special features: | none |

# AUDI CP4 Situation in the Field in [redacted]

Status: 12/2/2009

**AQUA: Active quality analysis**
Status: 10/09-20.11.09 15 :10
Source/user: Non-responsive content removed

**Audi, market:** [redacted]

**MY 2008 – 2010, Offset: all (max. 3)**

**Customer no. / Groups: High-pressure fuel pump**

**Confidential**
Without PR numbers
CUSTOMER NO. 2374

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

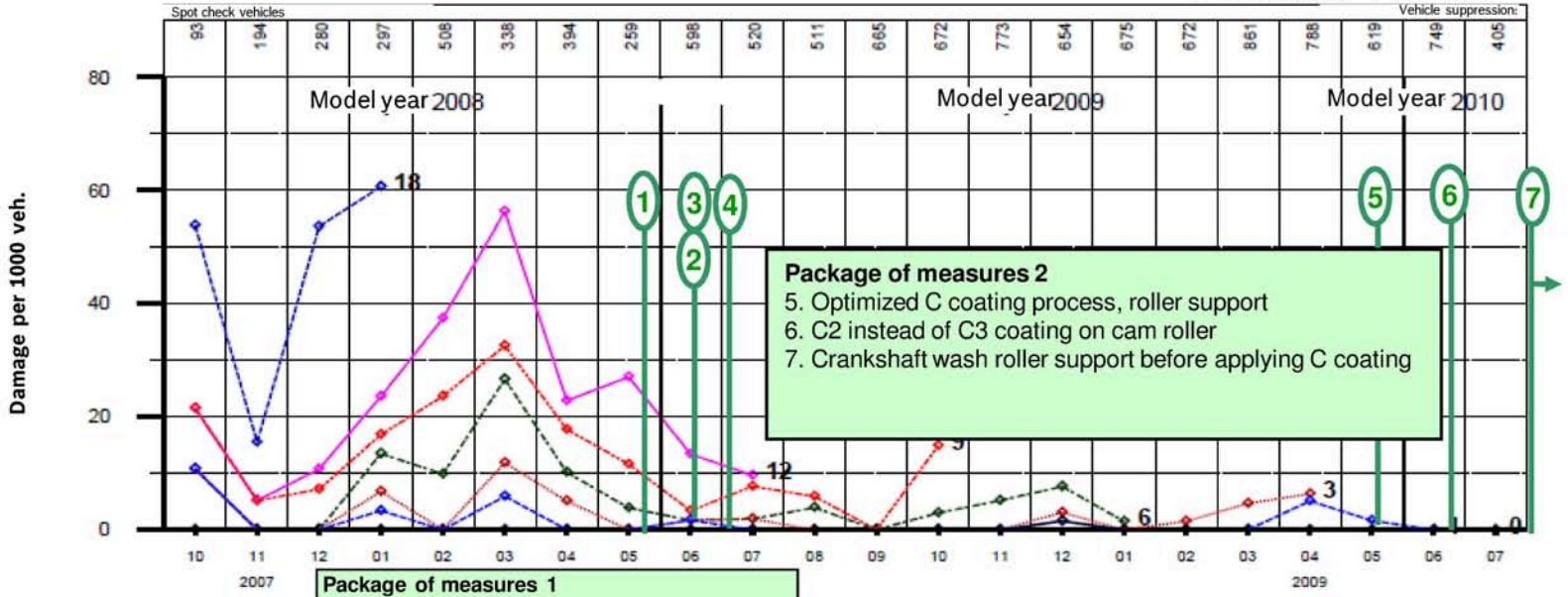
| MY | MIS 0 | MIS 1 | MIS 3 | MIS 6 | MIS 9 | MIS 12 | MIS 18 |
|---|---|---|---|---|---|---|---|
| 2008 | 0,0 | 1,7 | 3,9 | 10,3 | 18,0 | 27,8 | 73,8 |
| 2009 | 0,1 | 0,9 | 1,9 | 4,3 | 8,2 | 13,8 | |
| 2010 | 0,0 | 0,0 | 5,7 | | | | |
| Diff% | -100 | -100 | 194,41 | | | | |

| MY | Replacement | LB | 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

Spot check vehicles

Vehicle suppression:




Vehicles: 3.389+12.041+5.434=20.864

MY: 2008+2009+2010

CP42 AU all engine codes V[redacted] 08-10

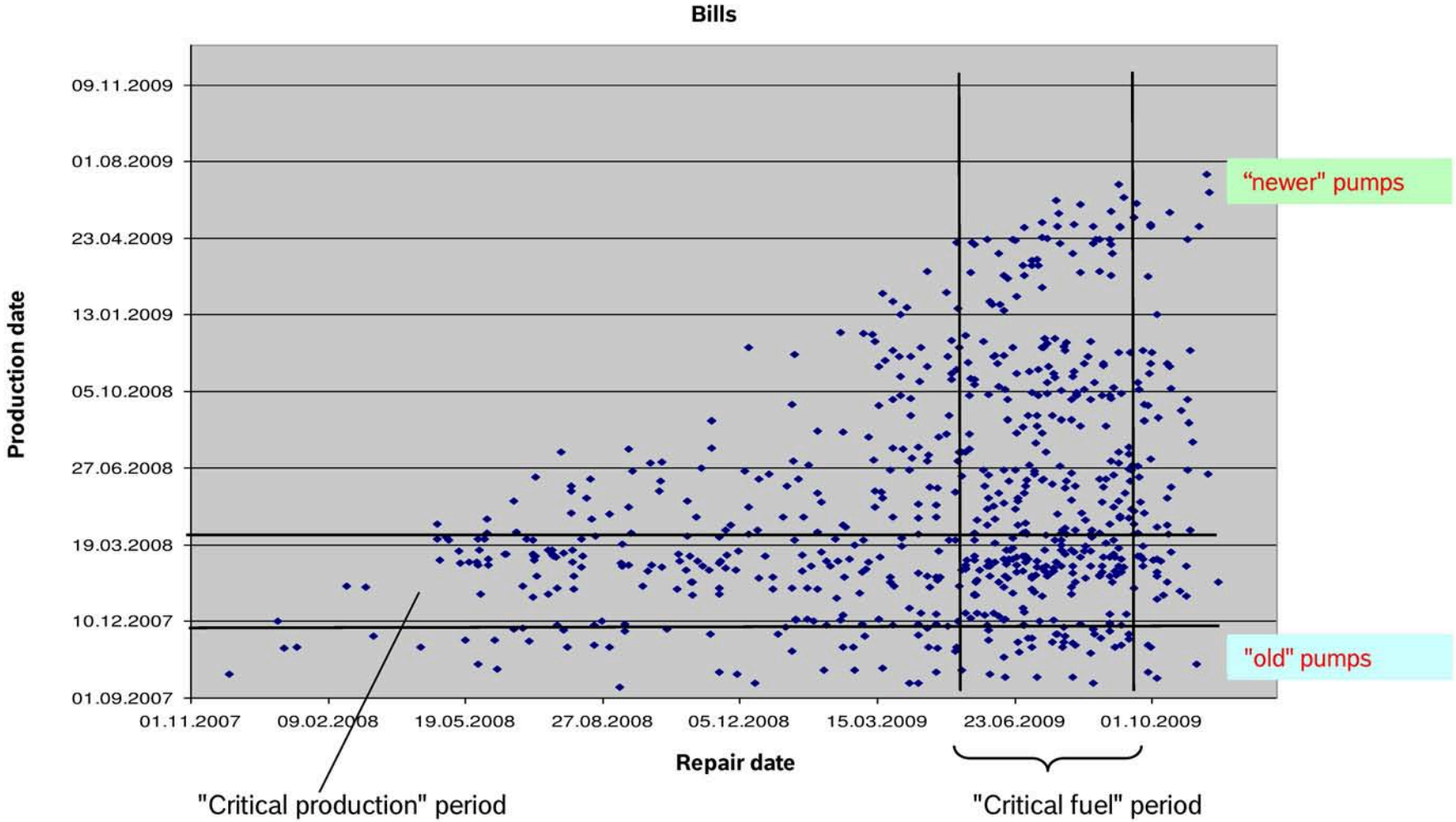
 

BOSCH

# AUDI CP4 Situation in the Field in [redacted]



Status: 12/2/2009







BOSCH

# Summary

- Status of new information since last update on 12/2/09:

  20 fuel samples were examined as part of a fuel survey in Northern Italy. The proportion of biodiesel was increased (implementation B7) in 07/2009. There is evidence of old fuel on the market; in 4 samples the oxidation stability was outside of tolerance levels and the TAN (acidity coefficient) is generally higher than usual by a factor of 2-3. Additional information from the analysis of the fuels and linings brought along by the FCT team Algae found in the first sample, which can form acid as metabolic by-product

  Signs of corrosion, black/brown coatings and polished camshafts. The new information also points to tribochemical wear on other faulty mechanisms (no. 2 + 3)

  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

# Summary

- Further action:

  Continuation of the detailed analysis of fuel injection systems replaced by FCT, including fuel and fuel filter Further analysis for influences as yet unspecified in the drawing in production is being carried out on the basis of reference samples. For this, 50 reference samples will be analyzed in detail (production data and visual inspection)

  Different problems between longitudinal and transverse installations and between Audi and VW. involving the same pump, are to be analyzed, in particular in relation to system differences (how does water reach the pump?)

  Evaluations will take the form of an Ishikawa diagram.

# Operating conditions / Environment / System

## Local FCT team in Italy

Status: 18 vehicles examined at local level 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: Free water found in the fuel in 3 vehicles.
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 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:
Oxidation stability was found to be outside the tolerance in 2 fuel samples
In the first analysis of the coatings, algae were found in the fuel.
Other coatings 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.

## Components

### Findings

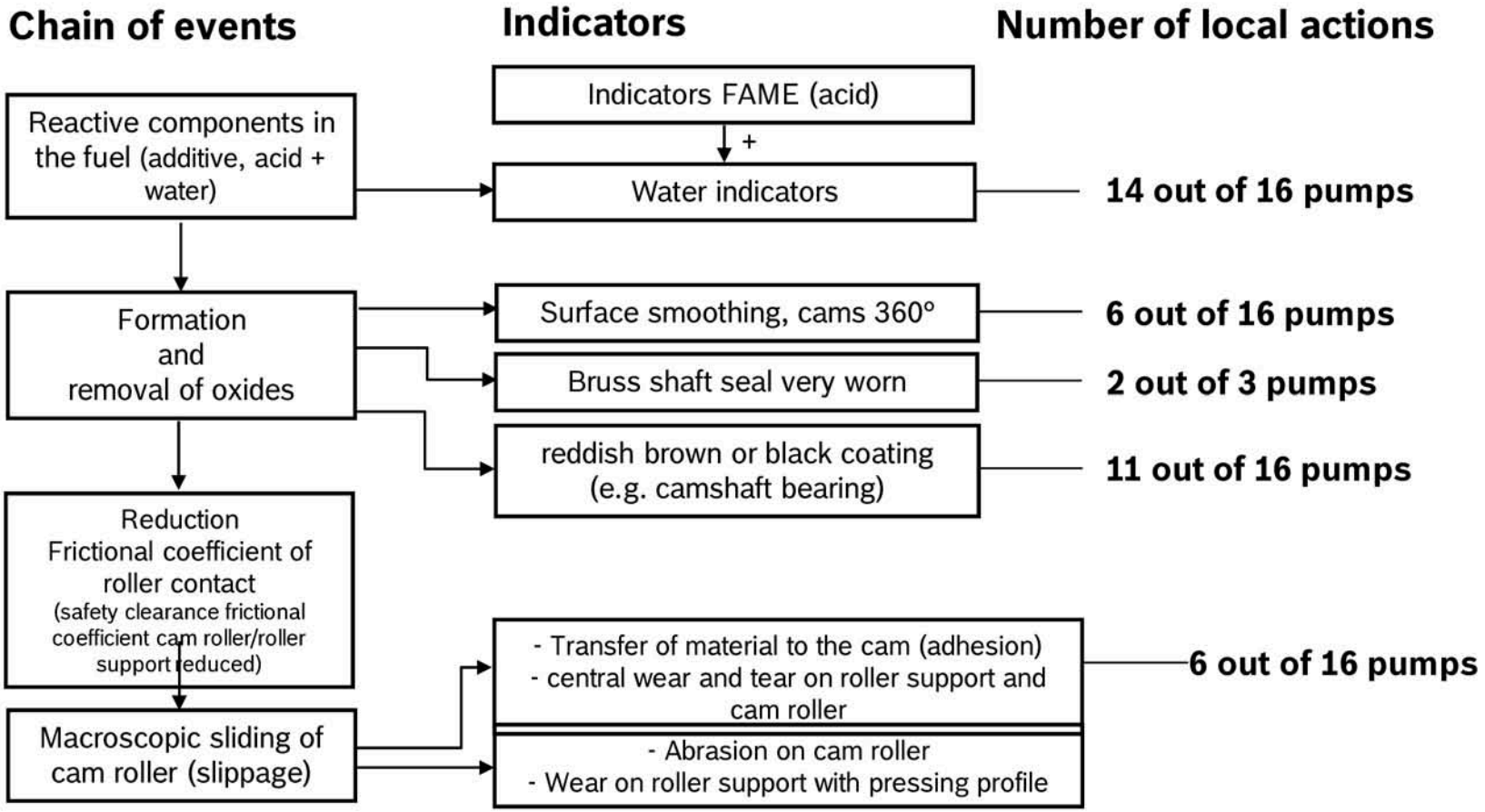
Status: 16 pumps analyzed.
Various damage hypotheses developed.

Result: The analysis of the pumps produced the following picture
- 14/16 signs of corrosion
- 11/16 black coating on cams and bearings (under analysis)
- 6 camshafts smoothed (polished)
- 16/16 feature two tappets turned by 90°
- 2/3 Bruss shaft seals very worn

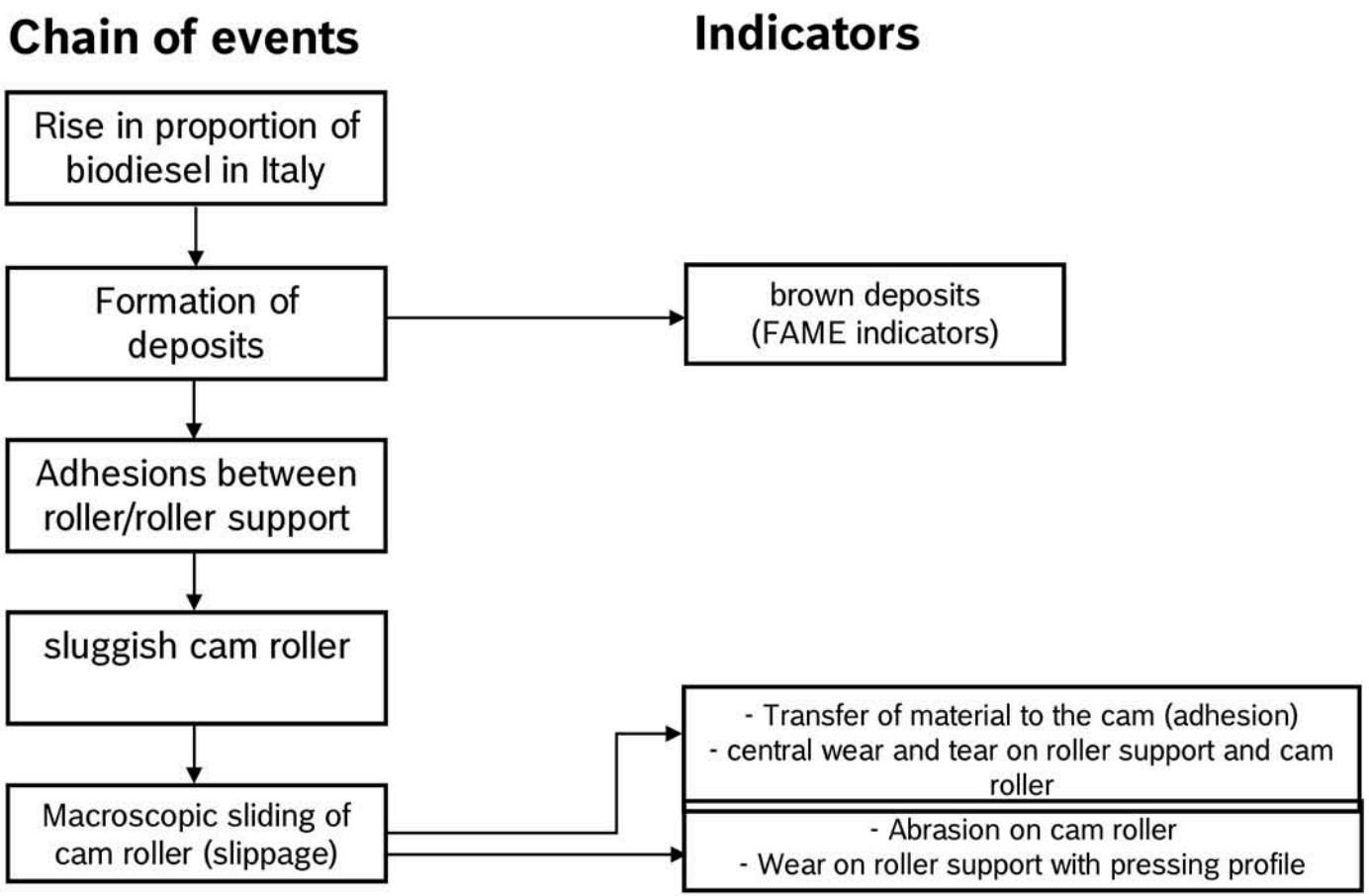
Most probable damage hypothesis is therefore tribochemical wear and jammed roller due to residue (such as soaps) -> anti-algal products

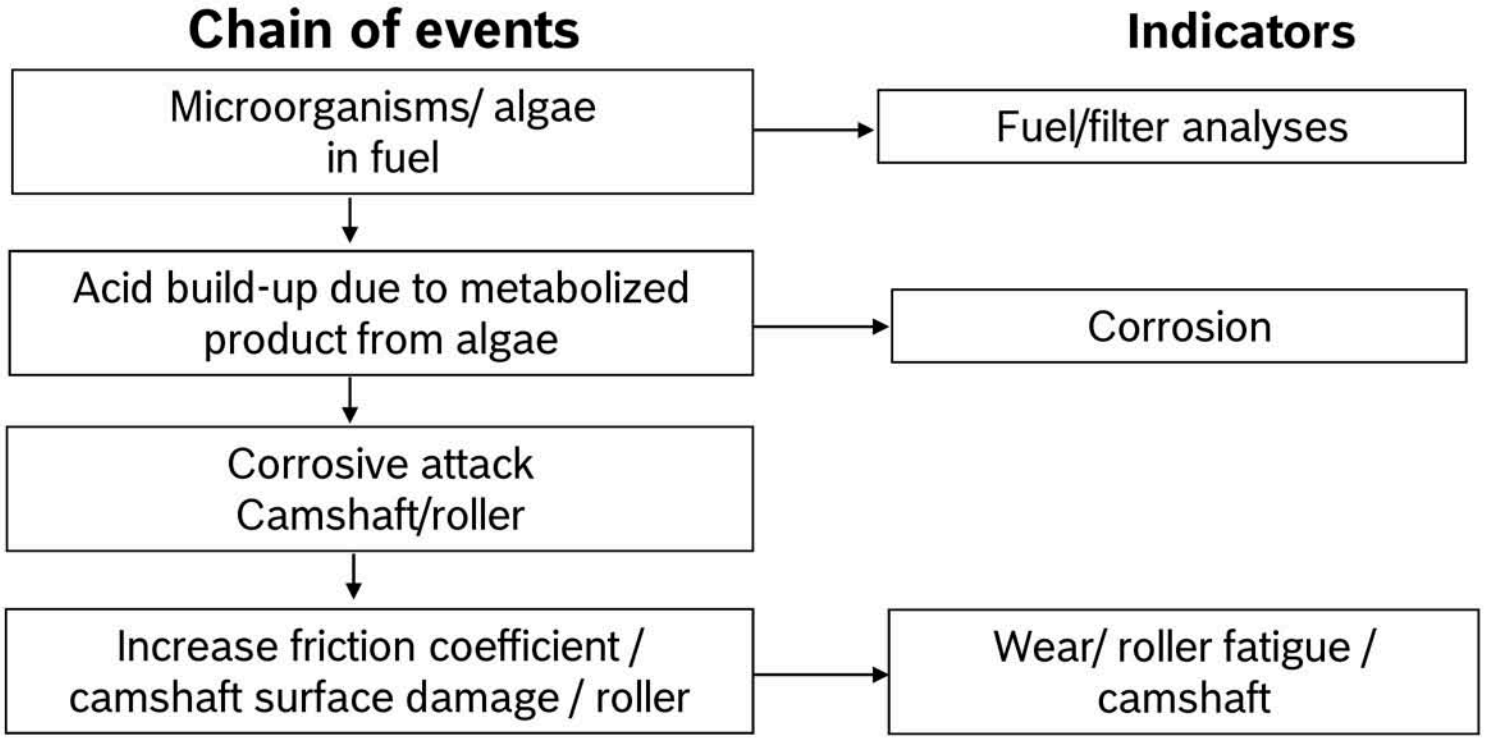
# Failure hypothesis: Fuel additives -> Tribochemicals



# Failure hypothesis 3: Biodiesel -> adhesions



# Failure hypothesis: Algae* -> Corrosion




*In cases of microbiological growth in fuels, there must always be a free water phase. The microorganisms live in water and feed from the 'organic' material in the boundary layer between the water and fuel.

## Operating conditions / Environment / System

## Obtain 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 week 50. |
| Special features: | none |

# AUDI CP4 Situation in the Field in [redacted]

Status: 12/10/2009

**AQUA: Active quality analysis**
Status: 10/09-20.11.09 15 :10
Source/user: [redacted]

**Audi, market:** [redacted]
**MY 2008 – 2010, Offset: all (max. 3)**
**Customer no. / Groups: High-pressure fuel pump**

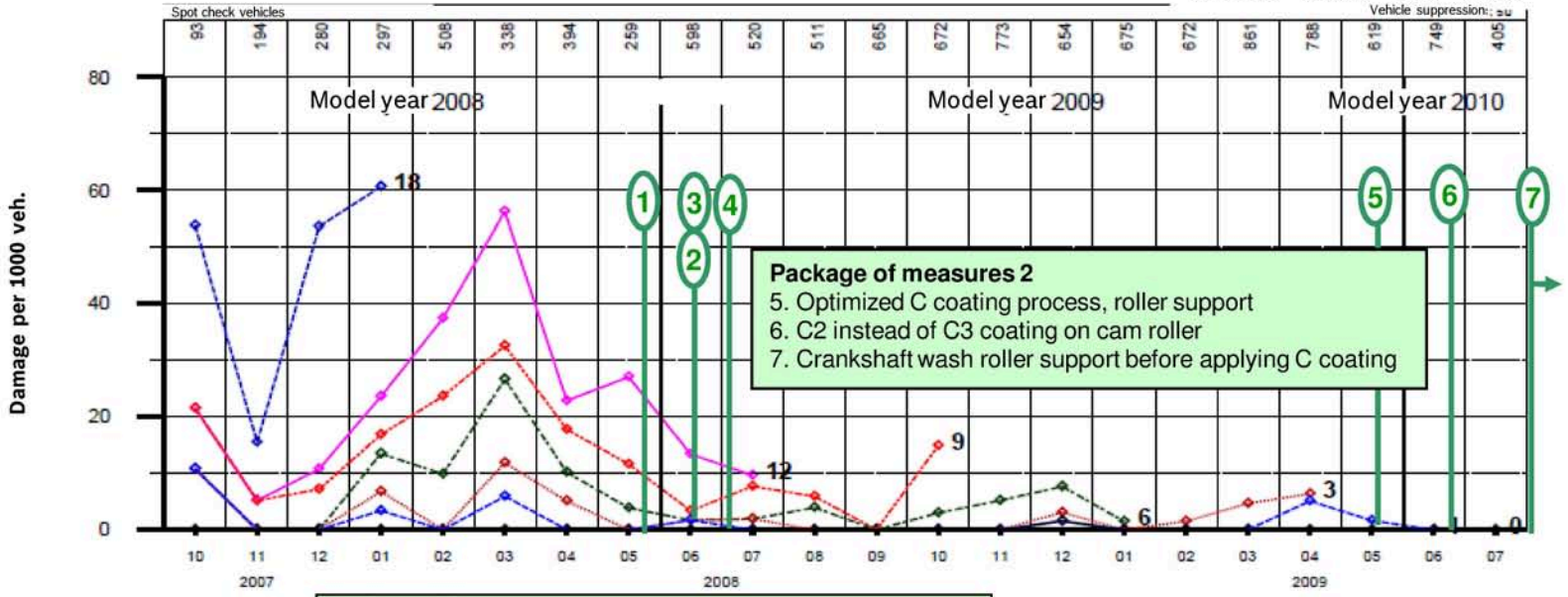
**Confidential**
Without PR numbers
CUSTOMER NO. 2374

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 | Replacement | LB | 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




**Package of measures 2**
5. Optimized C coating process, roller support
6. C2 instead of C3 coating on cam roller
7. Crankshaft wash roller support before applying C coating

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

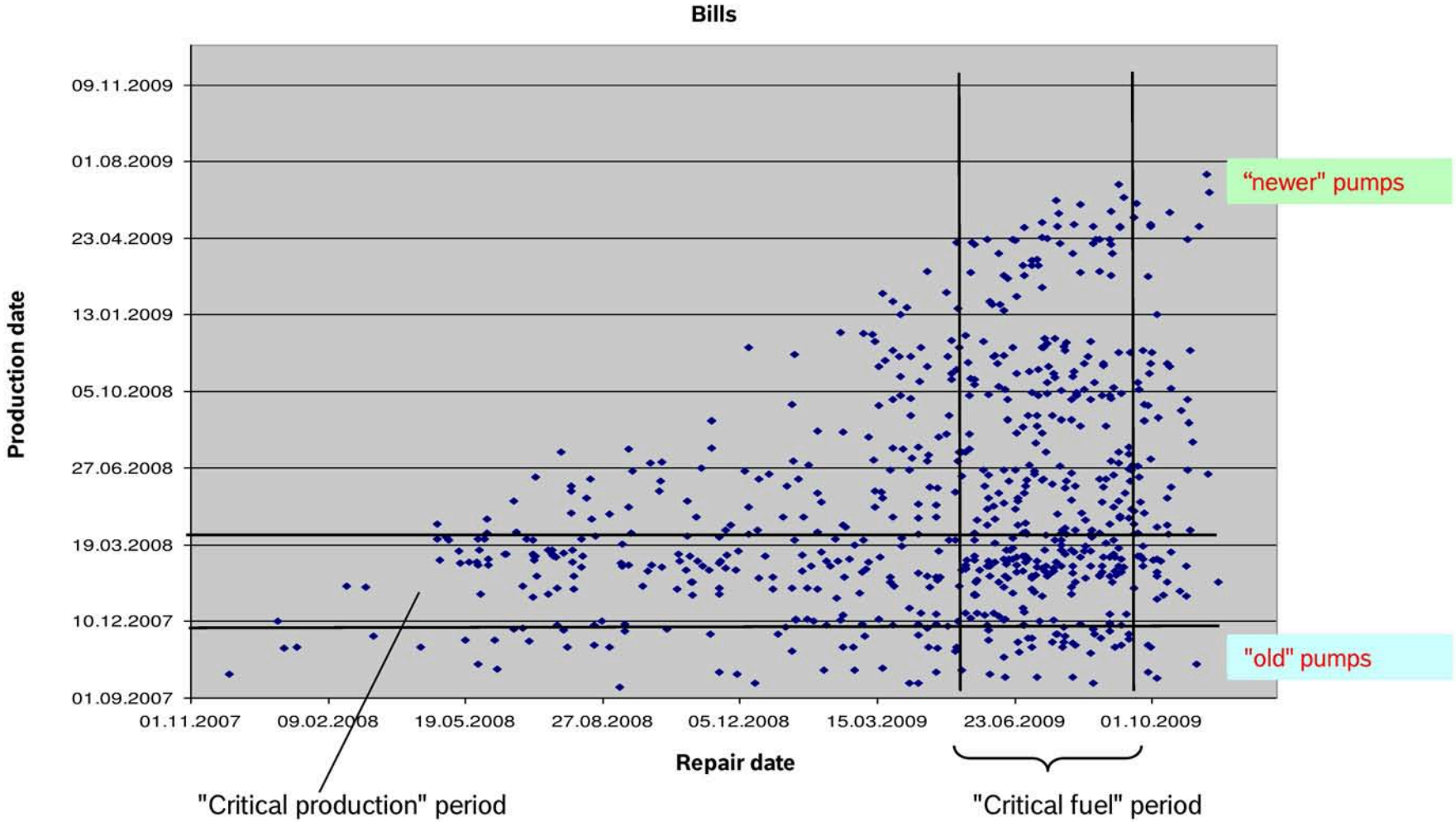
Vehicles: 3.389+12.041+5.434=20.864

CP42 AU all engine codes V5 ITA 08-10

# AUDI CP4 Situation in the Field in [redacted]



Status: 12/10/2009







BOSCH

# Summary

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

  Other analyses in the fuel samples from local factions in [redacted] support the results from the fuel survey in Northern [redacted] 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 (cam 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 (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 week 01/2010

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

  Mechanism whereby the tappet is turned, cam roller lifted from the camshaft depending on the engine vibrations on the pump drive,
  is to be examined on the engine with AUDI. Specialist meeting 12.01.2010

# Operating conditions / Environment / System

## Local FCT team in [redacted]

Status: 18 vehicles examined at local level 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

# 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 coatings 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 more worn than indicated in sample
45 out of 54 pumps have signs of corrosion
11 out of 54 pumps have brown fuel deposits

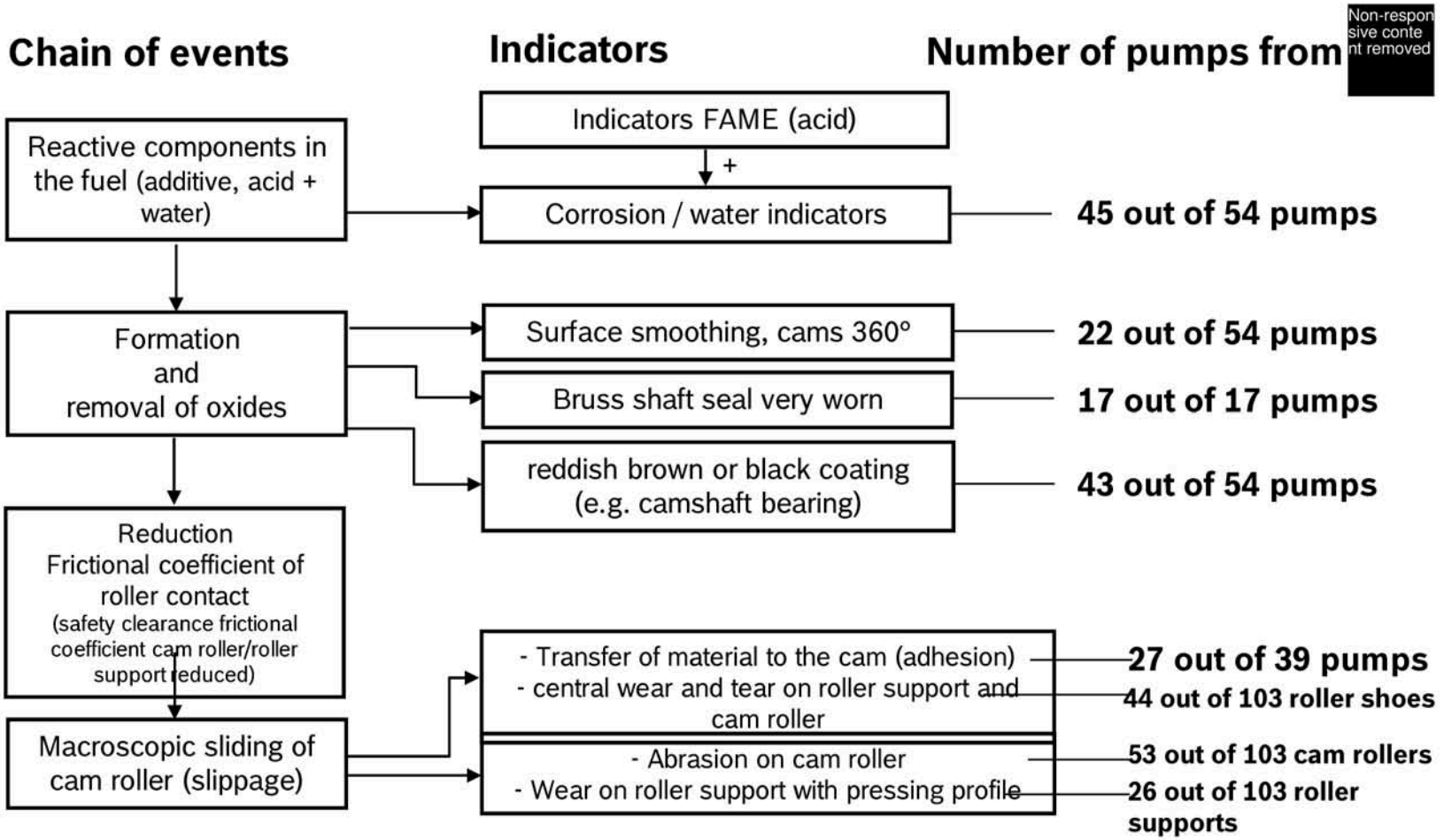
45 out of 52 drivetrain failures have turned tappet bodies
22 out of 54 pumps have surface smoothing on the cam
9 out of 52 drivetrain failures have fatigue damage on the cam
3 out of 54 pumps have pitting on the cam

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

1 x fuel sample tank: Algae1 x washcloth with striations

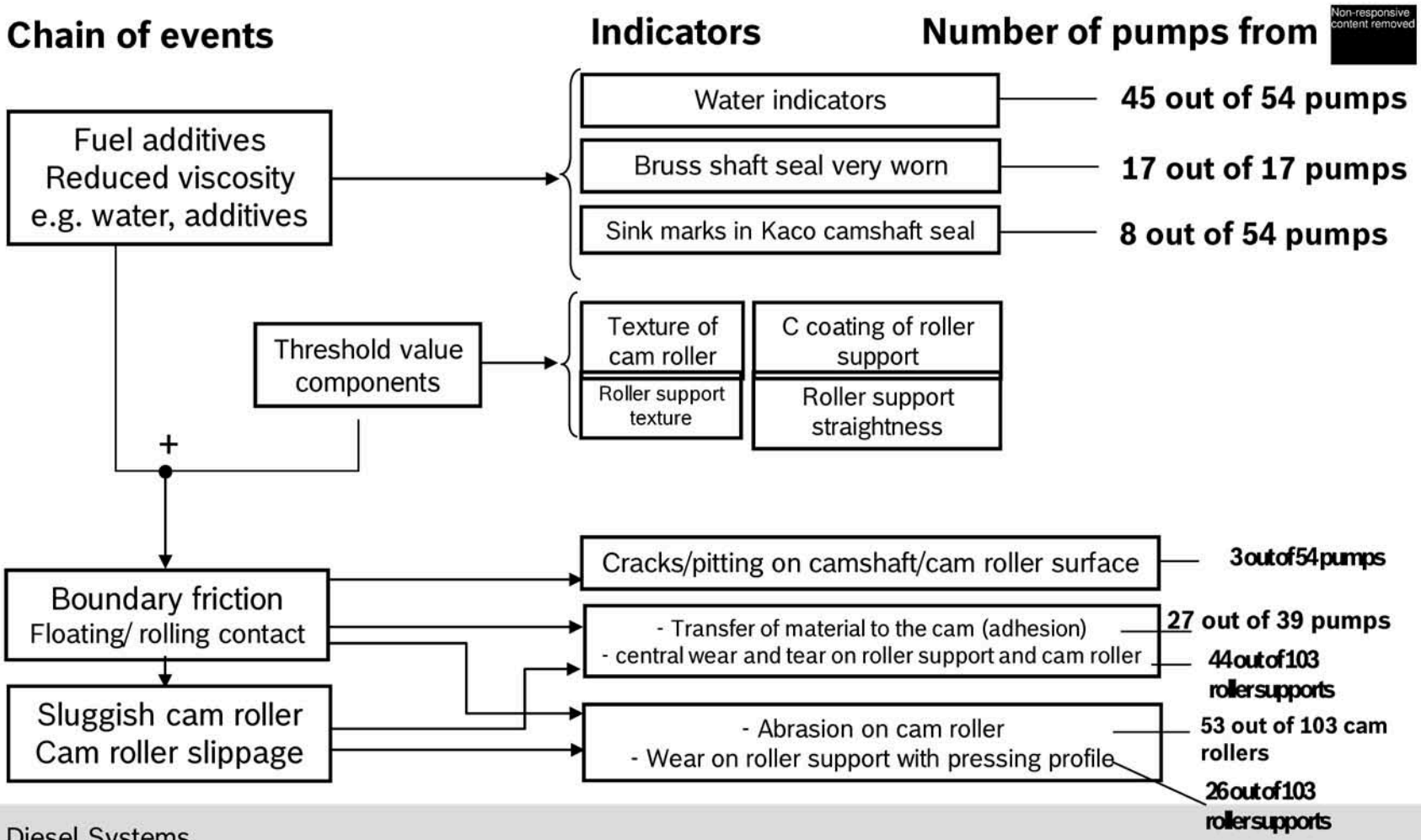
# Validation CP4: Analysis system for drivetrain damage in [Non-responsive content removed]

## Failure hypothesis 4: Fuel additives -> Tribochemicals



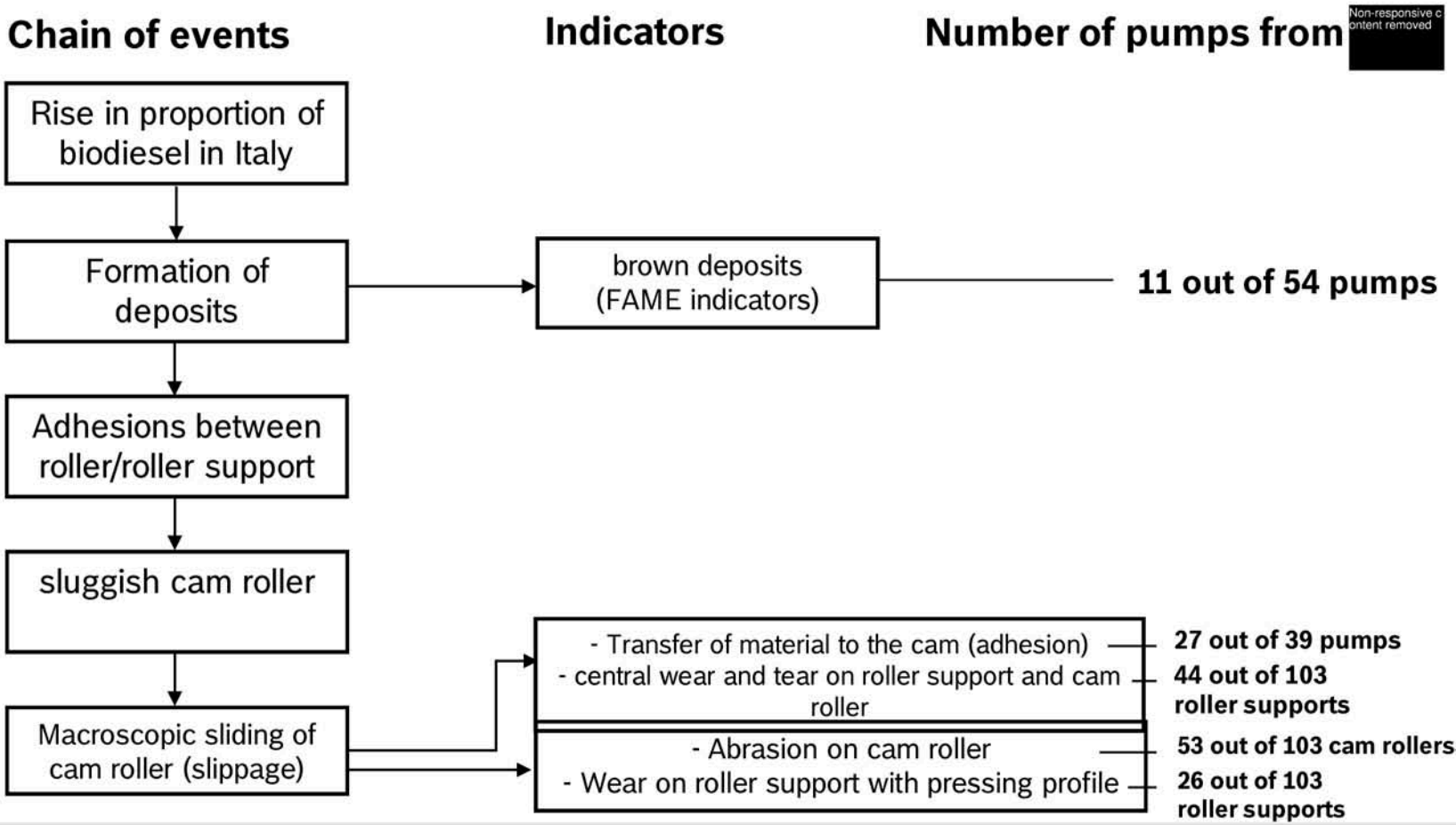
# Validation CP4: Analysis system for drivetrain damage in [redacted]

## Failure hypothesis 6: Fuel viscosity -> Boundary friction



# Validation CP4: Analysis system for drivetrain damage in [redacted]

## Failure hypothesis 3: Biodiesel -> adhesions



## Operating conditions / Environment / System

## Obtain 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 week 03/2010. |
| Special features: | none |

# AUDI CP4 Situation in the Field in [redacted]

Status: 12/16/2009

**AQUA: Active quality analysis**
Status: 10/09-20.11.09 09 :14
Source/user: Non-responsive content removed

**Audi, market:** [redacted]

**MY 2008 – 2010, Offset: all (max. 2)**

**Customer no. / Groups: High-pressure fuel pump**

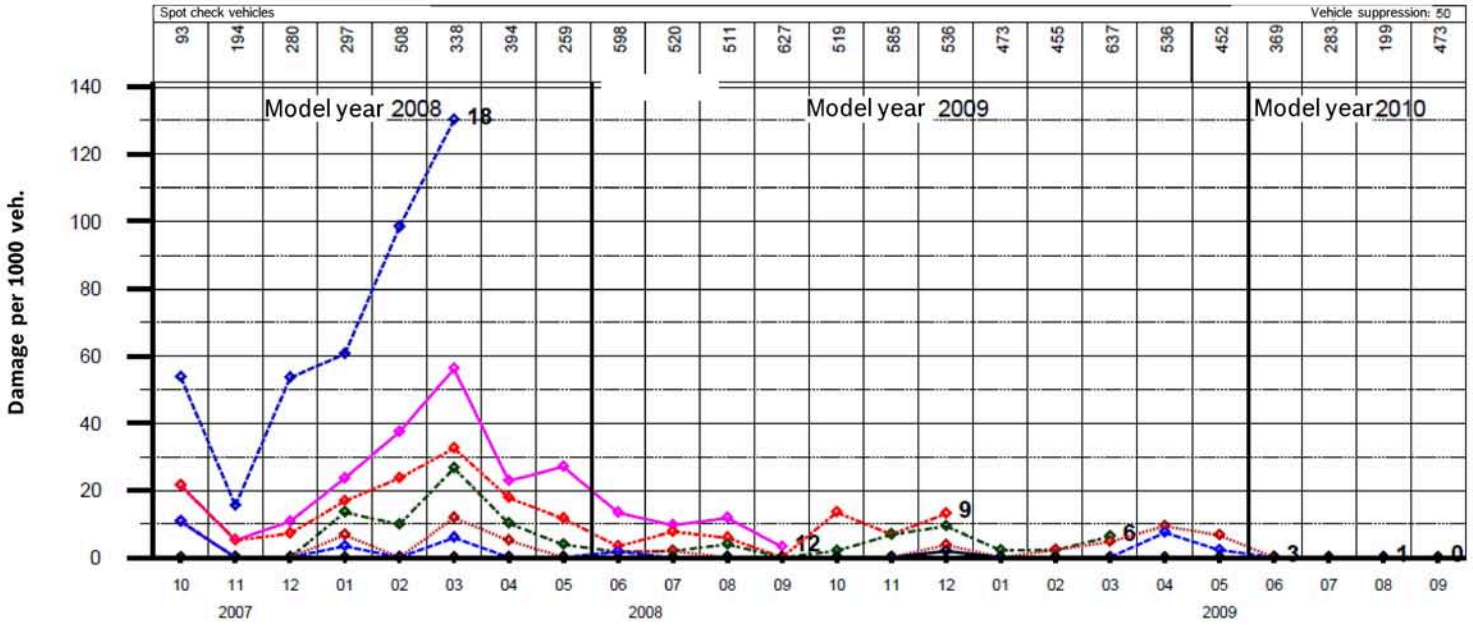
**Confidential**
Without PR numbers
CUSTOMER NO. 2374

**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 | LB | 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 % | | |

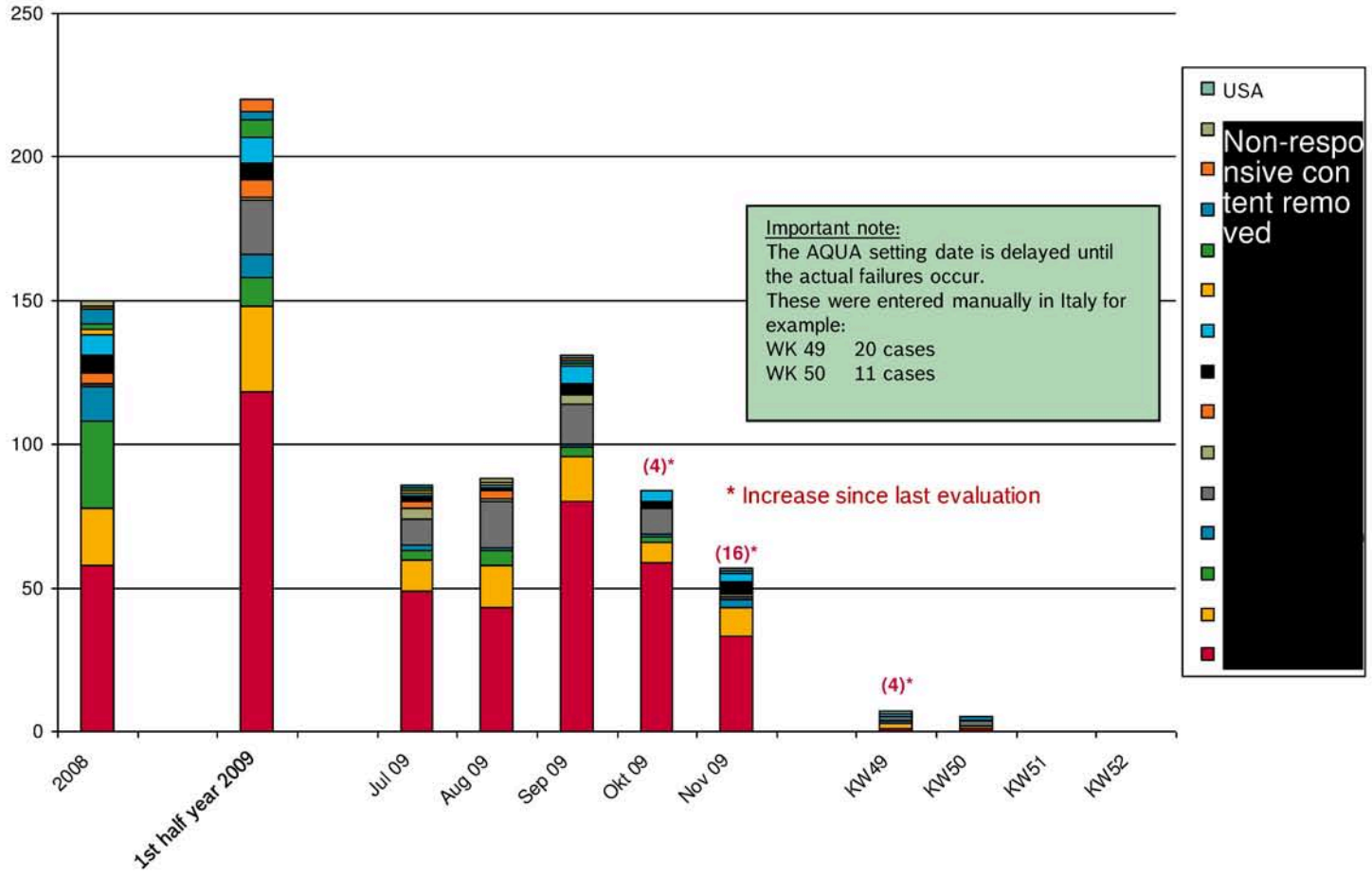
MEC ERR MAJOR LEAK MINOR




Vehicles: : 3.389+9.366+4.312=17.067; Sold: 3.386+9.211+2.973=15.570;Stp.: 2.335+6.347+2.249=10.931 MY:2008+2009+2010 =Total

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

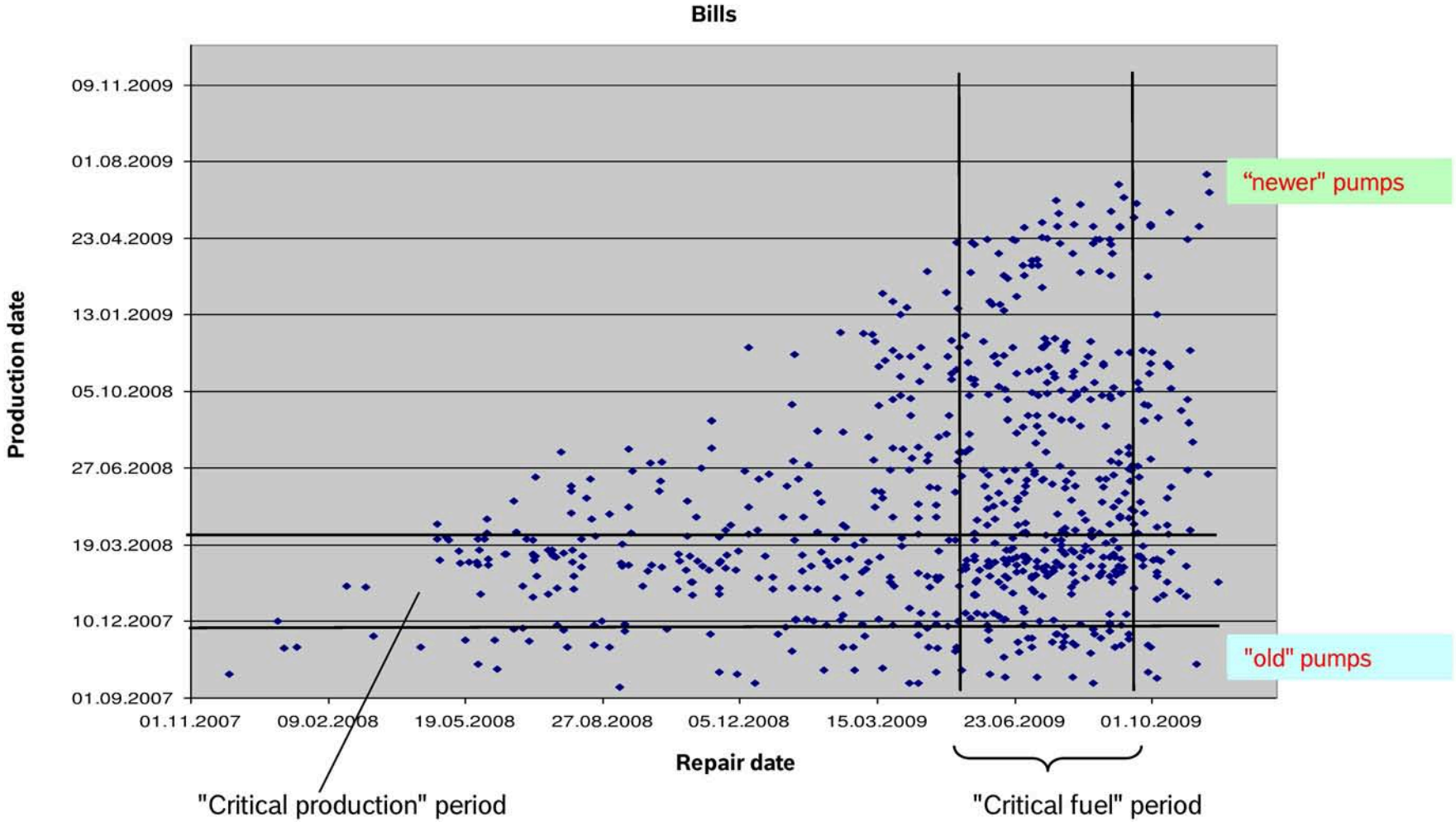
**Bills for high-pressure fuel pump CP4.2 V6-TDI Audi**
**(after setting date in AQUA)**








BOSCH








BOSCH

# Summary

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

  Other analyses in the fuel samples from local factions in [redacted] support the results from the fuel survey in Northern [redacted] 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 (cam 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 (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 week 01/2010

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

  Mechanism whereby the tappet is turned, cam roller lifted from the camshaft depending on the engine vibrations on the pump drive,
  is to be examined on the engine with AUDI. Specialist meeting 12.01.2010

## Operating conditions / Environment / System

### Local FCT team in [redacted]

| | |
|---|---|
| Status: | 18 vehicles examined at local level 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.<br>2/4 cases of drivetrain damage from damaged parts stores systems.<br>7/7 analyses of low pressure circuits showed nothing unusual. |
| Special features: | In 3 vehicles, free water (>> 200 ppm) found in fuel.<br>4 vehicles with deposits in the tank (swirl pot)<br>- 1x reddish, sticky coatings,<br>- 1x white flocculation,<br>- 2x dark/ black particles |

# 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 coatings 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 more worn than indicated in sample
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 shoes are worn in the middle
29 out of 103 roller supports are completely worn
26 out of 103 roller supports are work in the shape of the press profile

1 x fuel sample tank: Algae1 x washcloth with striations

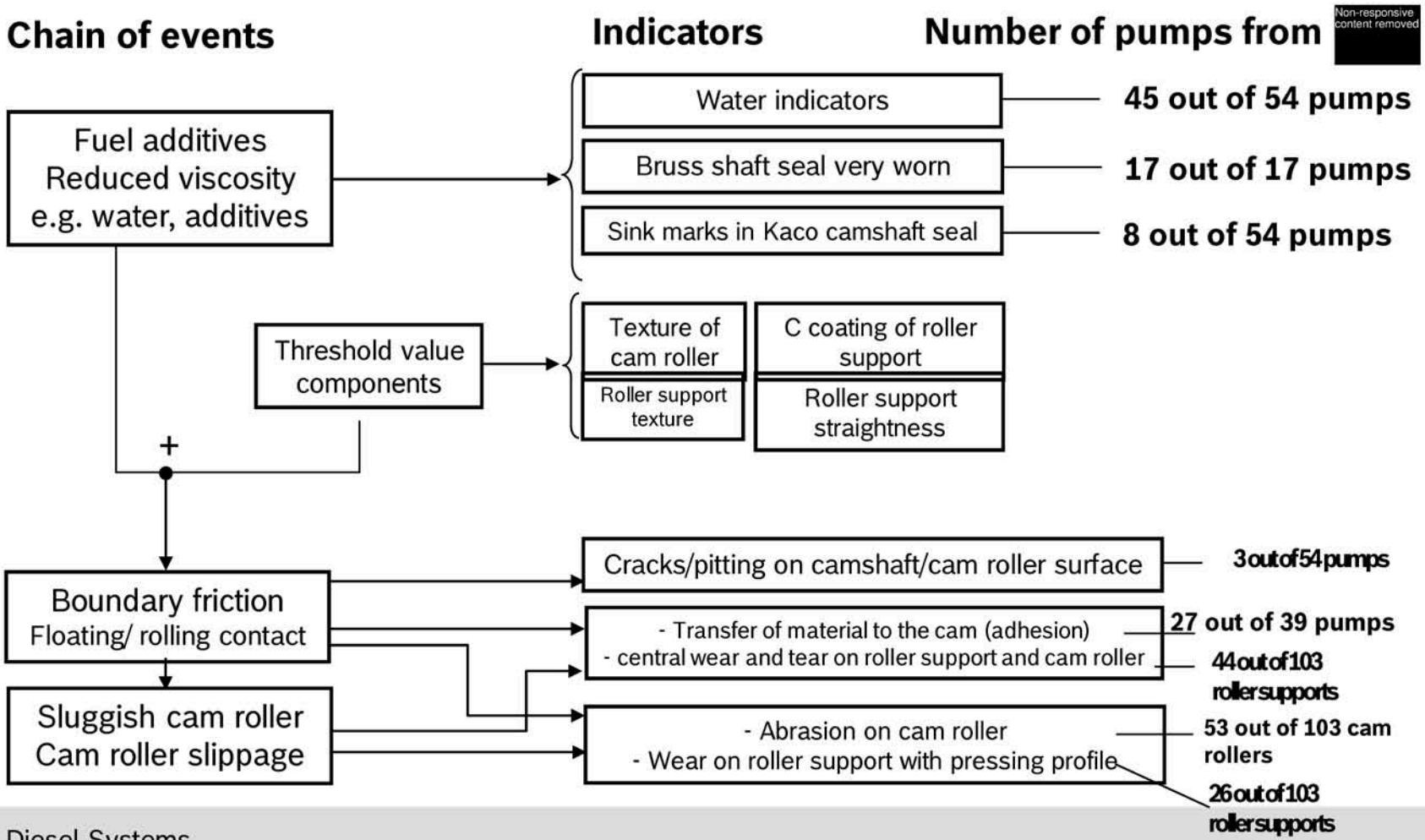
# Validation CP4: Analysis system for drivetrain damage in [redacted]

## Failure hypothesis 4: Fuel additives -> Tribochemicals

| Chain of events | Indicators | Number of pumps from [redacted] |
|---|---|---|
| Reactive components in the fuel (additive, acid + water) | Indicators FAME (acid) + Corrosion / water indicators | 45 out of 54 pumps |
| Formation and removal of oxides | Surface smoothing, cams 360° | 22 out of 54 pumps |
| | Bruss shaft seal very worn | 17 out of 17 pumps |
| | reddish brown or black coating (e.g. camshaft bearing) | 43 out of 54 pumps |
| Reduction Frictional coefficient of roller contact (safety clearance frictional coefficient cam roller/roller support reduced) | - Transfer of material to the cam (adhesion)<br>- central wear and tear on roller support and cam roller | 27 out of 39 pumps<br>44 out of 103 roller shoes |
| Macroscopic sliding of cam roller (slippage) | - Abrasion on cam roller<br>- Wear on roller support with pressing profile | 53 out of 103 cam rollers<br>26 out of 103 roller supports |

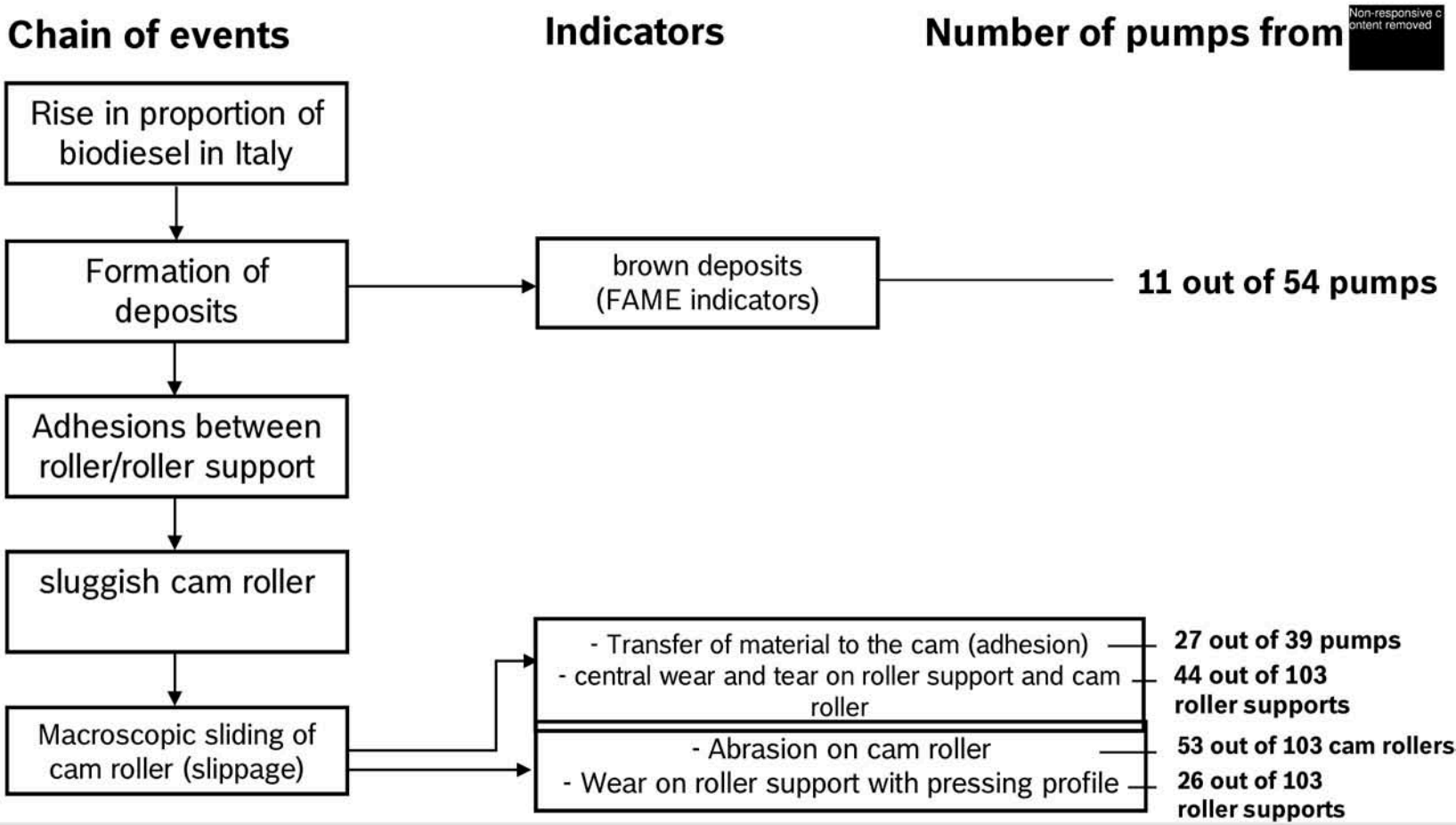
# Validation CP4: Analysis system for drivetrain damage in [redacted]

## Failure hypothesis 6: Fuel viscosity -> Boundary friction



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

## Failure hypothesis 3: Biodiesel -> adhesions



## Operating conditions / Environment / System

## Obtain 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 week 03/2010. |
| Special features: | none |

# AUDI CP4 Situation in the Field in [redacted]

Status: 12/16/2009

**AQUA: Active quality analysis**
Status: 10/09-20.11.09 09 :14
Source/user: Non-responsive content removed

**Audi, market:** [redacted]

**MY 2008 – 2010, Offset: all (max. 2)**

**Customer no. / Groups: High-pressure fuel pump**

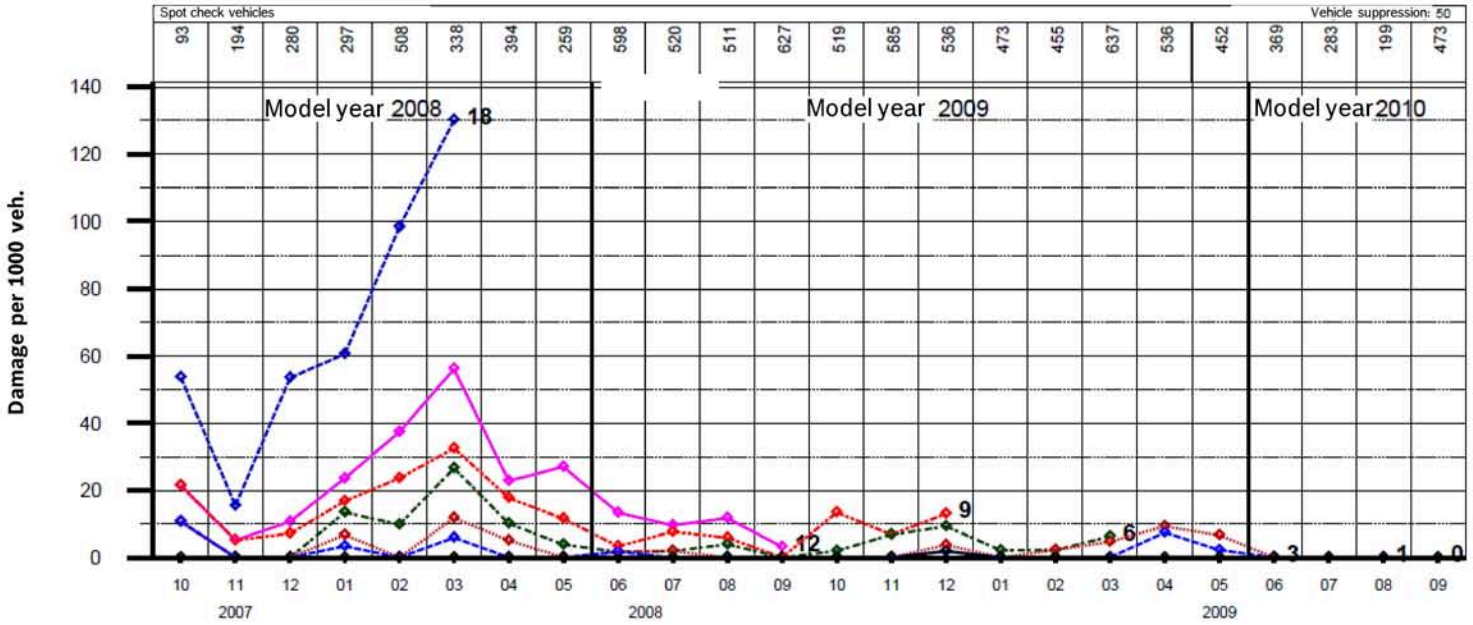
**Confidential**
Without PR numbers
CUSTOMER NO. 2374

**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 | LB | 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 % | | |

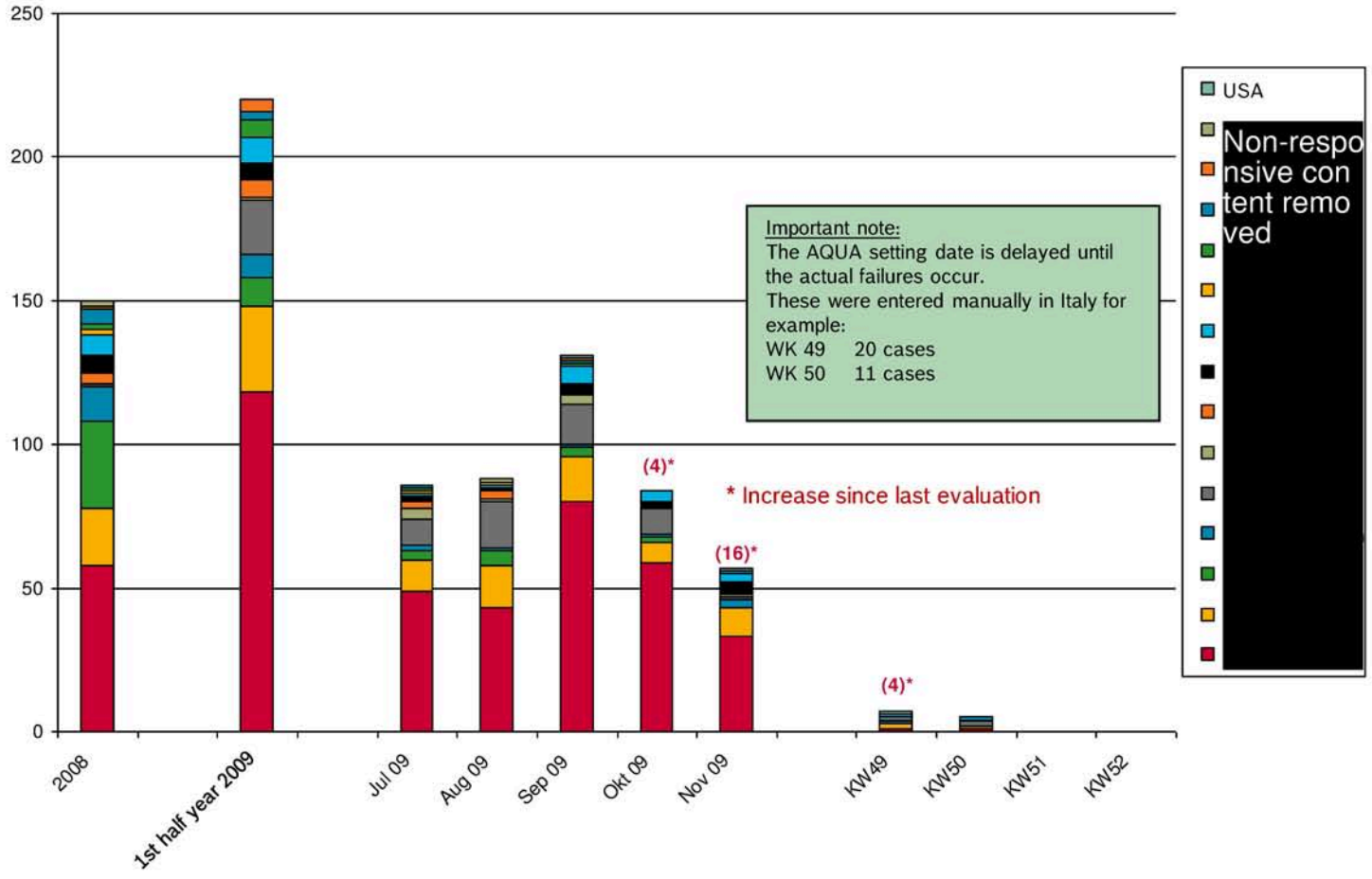
MEC ERR MAJOR LEAK MINOR




Vehicles: : 3.389+9.366+4.312=17.067; Sold: 3.386+9.211+2.973=15.570;Stp.: 2.335+6.347+2.249=10.931 MY:2008+2009+2010 =Total

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

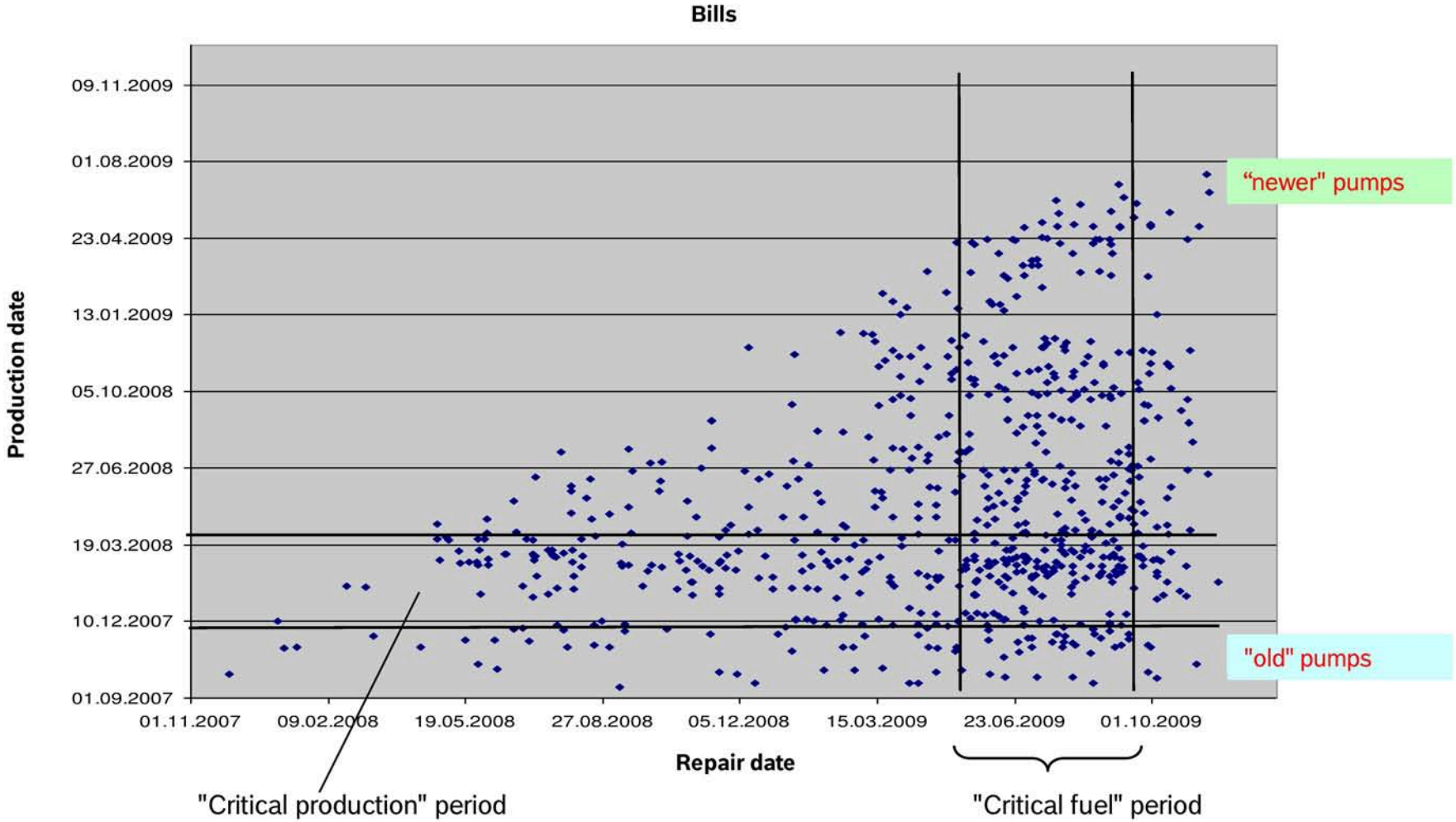
**Bills for high-pressure fuel pump CP4.2 V6-TDI Audi**
**(after setting date in AQUA)**








BOSCH



# Summary

- Status of new information since last update on 1/13/2010 (changes in blue):

Other analyses in the fuel samples from local factions 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).
Further detailed analysis of the fuel samples and fuel filters will be complete by 1/22/10.
The analyses in relation to pumps, fuel samples and particles/ reside 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 additive naphtha to clean the fuel injection system in service. High concentrations of naphtha have a negative impact on lubrication and therefore on the CP4 drive. Verification of influence through tests run by Bosch.

# Summary

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 (cam roller surface texture, ripple in roller support, roundness with Fourier analysis, local adhesion of coating with temperature analysis) will be completed by 1/27/10.

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.

# Summary

- 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 MJ09.

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.

# Summary

Further action:

Implement examinations

- of the flow and pressure conditions in the tappet chamber of both pump types.
- Influence of the low pressure circuit.
- the tappet position when stopping (position of cam roller with cam TDC)
  Initial analysis showed that the tappet position can be just below or at the upper tolerance in approx. 10% of cases after the engine is switched off. At restart the roller must start from the instable position when at upper tolerance. The tappet could be turned in this case.

Investigations to be concluded by M.02/2010

# 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 (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 week 02/2010. The latest information shows that the roughness of the roller support is the decisive parameter in increasing robustness.
  According to a simulation, narrowing tolerance $R_V$ from1.3 to 0.6 µm increases the safety factor of the frictional coefficient by approx. 50 to 80%.

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

# Summary

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

- Implementation of anti-wear package for pump ( reduction in roughness $R_V$ to 0.6 µm, Changeover to C2, reduction in play between cam roller/ roller support from max. tolerance by 10 µm). D. 07/2010

- New date requested by Audi: Release WK 09/10; SOP vehicle WK 18/10.

# Summary

- Proof of the effectiveness of the anti-wear package for the pump through a reappear test with critical fuels (kerosene, water, biofuel) Date: end February 2010

  The following reappear tests have been defined and have already been started in some cases:
  - FCF (fuel contaminated FAME) corresponds to old biodiesel
  - WCF (water contaminated fuel)
  - Overload test with Arctic Diesel

The trials will be carried out to compare the C3 coating version with the targeted solution with the C2 coating. The aim is to evaluate the results achieved to that point in WK 8/2010.

- Final validation required after definition of boundary fuel for RoW.
- RoW vehicle testing at AUDI ( 5-10 vehicles) will be carried out with pumps fitted with the anti-wear package. Date: asap
- A further objective is to enable the anti-wear package on a provisional basis in customer service worldwide.

# Summary

Because basic test EN590 / GDK 570 has been completed at Bosch and the C coating is now standard (small volume) for other customers, Audi is demanding that supplementary validation with critical fuels should be complete for WK 8/2010 and release by Audi and Bosch for WK 9/2010, so that the vehicle SOP can take place in WK 18/2010.

Before the next task force meeting (1/27/2010) Bosch is to check whether the date is feasible with Development and Production.

The information gathered to date indicates an increase in robustness in relation to poor fuel quality (viscosity). Accordingly, the differences between CP4.2 and CP4.1 and the [redacted] problem are not completely resolved. This requires further measures

(see page 9)

# Summary

- Return of the requested 40 good pumps from [redacted] and 20 good pumps [redacted] has agreed to WK 03/2010.
  These pumps are urgently required in order to confirm the failure mechanism on intact parts of the drive.
  First returns announced from [redacted] ( 5 pumps ) and [redacted] ( 4 pumps ). 4 pumps from [redacted] are to be delivered on 1/25/2010; other deliveries ([redacted]) are outstanding.
- Mechanism whereby the tappet is turned, cam roller lifted from the camshaft depending on the engine vibrations on the pump drive,
  is to be examined on the engine with AUDI. On 1/12/2010, a specialist meeting on this subject
  was held:
  Measurement technology from RB was recognized, common measurement of oscillation and impact on turned tappet in CP4.2 will be examined on the engine with kerosene.
  Start of engine trials at AUDI WK 11/2010 Date brought forward to WK 4/2010.

# Summary

- Status of new information since last update on 1/13/2010 (changes in blue):

Other analyses in the fuel samples from local factions in [redacted] support the results from the fuel survey in Northern [redacted] and the analyses from the problematic pumps. The mineral oil industry in Non-responsive content removed confirms in principle the poor fuel results (water, aged biofuel).
Further detailed analysis of the fuel samples and fuel filters will be complete by 1/22/10.
The analyses in relation to pumps, fuel samples and particles/ reside 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 additive naphtha to clean the fuel injection system in service. High concentrations of naphtha have a negative impact on lubrication and therefore on the CP4 drive. Verification of influence through tests run by Bosch.

# Summary

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 (cam roller surface texture, ripple in roller support, roundness with Fourier analysis, local adhesion of coating with temperature analysis) will be completed by 1/27/10.

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.

# Summary

- 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 MJ09.

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.

# Summary

Further action:

Implement examinations

- of the flow and pressure conditions in the tappet chamber of both pump types.
- Influence of the low pressure circuit.
- the tappet position when stopping (position of cam roller with cam TDC)
  Initial analysis showed that the tappet position can be just below or at the upper tolerance in approx. 10% of cases after the engine is switched off. At restart the roller must start from the instable position when at upper tolerance. The tappet could be turned in this case.

Investigations to be concluded by M.02/2010

# 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 (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 week 02/2010. The latest information shows that the roughness of the roller support is the decisive parameter in increasing robustness.
  According to a simulation, narrowing tolerance $R_V$ from1.3 to 0.6 µm increases the safety factor of the frictional coefficient by approx. 50 to 80%.

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

# Summary

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

- Implementation of anti-wear package for pump ( reduction in roughness $R_V$ to 0.6 µm, Changeover to C2, reduction in play between cam roller/ roller support from max. tolerance by 10 µm). D. 07/2010

- New date requested by Audi: Release WK 09/10; SOP vehicle WK 18/10.

# Summary

- Proof of the effectiveness of the anti-wear package for the pump through a reappear test with critical fuels (kerosene, water, biofuel) Date: end February 2010

  The following reappear tests have been defined and have already been started in some cases:
  - FCF (fuel contaminated FAME) corresponds to old biodiesel
  - WCF (water contaminated fuel)
  - Overload test with Arctic Diesel

The trials will be carried out to compare the C3 coating version with the targeted solution with the C2 coating. The aim is to evaluate the results achieved to that point in WK 8/2010.

- Final validation required after definition of boundary fuel for RoW.
- RoW vehicle testing at AUDI ( 5-10 vehicles) will be carried out with pumps fitted with the anti-wear package. Date: asap
- A further objective is to enable the anti-wear package on a provisional basis in customer service worldwide.

# Summary

Because basic test EN590 / GDK 570 has been completed at Bosch and the C coating is now standard (small volume) for other customers, Audi is demanding that supplementary validation with critical fuels should be complete for WK 8/2010 and release by Audi and Bosch for WK 9/2010, so that the vehicle SOP can take place in WK 18/2010.

Before the next task force meeting (1/27/2010) Bosch is to check whether the date is feasible with Development and Production.

The information gathered to date indicates an increase in robustness in relation to poor fuel quality (viscosity). Accordingly, the differences between CP4.2 and CP4.1 and the [redacted] problem are not completely resolved. This requires further measures

(see page 9)

# Summary

- Return of the requested 40 good pumps from Italy and 20 good pumps [redacted] has agreed to WK 03/2010.
  These pumps are urgently required in order to confirm the failure mechanism on intact parts of the drive.
  First returns announced from [redacted] ( 5 pumps ) and [redacted] ( 4 pumps ). 4 pumps from [redacted] are to be delivered on 1/25/2010; other deliveries ([redacted]) are outstanding.
- Mechanism whereby the tappet is turned, cam roller lifted from the camshaft depending on the engine vibrations on the pump drive,
  is to be examined on the engine with AUDI. On 1/12/2010, a specialist meeting on this subject
  was held:
  Measurement technology from RB was recognized, common measurement of oscillation and impact on turned tappet in CP4.2 will be examined on the engine with kerosene.
  Start of engine trials at AUDI WK 11/2010 Date brought forward to WK 4/2010.

EA11003EN-01929[0]

Audi
Vorsprung durch Technik

# Drivetrain damage, high pressure diesel fuel pump CP4.2

# Drivetrain damage, high pressure diesel fuel pump CP4.2

Summary of activities:

- Current CoD: V6-TDI Audi (V8-TDI – 1 case in [redacted]; V12-TDI – 2 cases in [redacted])
  Status 18.01.2010 987 bills worldwide (500[redacted], of which …
  - MY08 612 units (325 [redacted] = critical production period
  - MY08 353 units (169 [redacted] = after package of measures 1
  - MY08 22 units (6 [redacted]) = after package of measures 2

  Changeover of statistics from AQUA (not all markets recorded) to SAGA (all markets; only parts replacement evaluated)
- Definition of poor quality fuels for testing anti wear package v. series:
  - kerosene (low viscosity and lubrication)
  - "Old" diesel with 20% portion of biodiesel (B20)
  - Worst-case fuel VW Group / Bosch (still to be defined)
- New definition of anti wear package due to new information (Bosch):
  - Changeover from C3 coating of roller support to C2.1 coating (C3-coating causes a deterioration in the initial roughness; decreased roughness of Rv = 0.6 µm instead of 1.3 µm increases the calculated safety factor by approx. 50 %)
  - Reduction in play of cam roller/roller support (increases the calculated safety factor by approx. 16%)
- Testing of anti wear package v. series
  - Testing of series status with poor quality fuels (Jan. 2010)
  - Testing of anti wear package with poor quality fuels (Feb 2010; production of test pumps in Jan 2010)
  - Details of effectiveness and possible Q release in WK 09 ➔ target SOP WK 18/10 (parts provisionally for customer service worldwide)



[redacted]

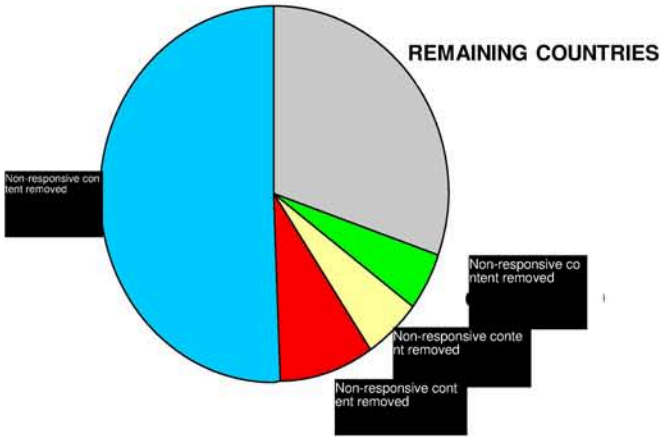
# Drivetrain damage, high pressure diesel fuel pump CP4.2

| Country | Total 1/18/10 | Increase 1/11.- 1/18/10 |
|---|---|---|
| Non-responsive content removed | 500 | 4 |
| | 86 | |
| | 53 | 3 |
| | 50 | 1 |
| | 40 | |
| | 31 | 2 |
| | 30 | 1 |
| | 29 | |
| | 29 | 1 |
| | 19 | |
| | 11 | |
| | 9 | |
| | 9 | |
| | 9 | |
| | 9 | |
| | 7 | |
| | 7 | |
| | 6 | |
| | 5 | 1 |
| | 5 | |
| | 5 | |

| Country | Total 1/18/10 | Increase |
|---|---|---|
| Non-responsive content removed | 4 | |
| | 4 | |
| | 4 | |
| | 3 | |
| | 3 | |
| | 2 | |
| | 2 | |
| | 2 | |
| | 2 | |
| | 2 | |
| USA | 2 | |
| Non-responsive content removed | 1 | |
| | 1 | |
| | 1 | |
| | 1 | |
| | 1 | |
| | 1 | |
| | 1 | |
| | 1 | |
| | 1 | |
| Total | 987 | 13 |

Non-responsive content removed

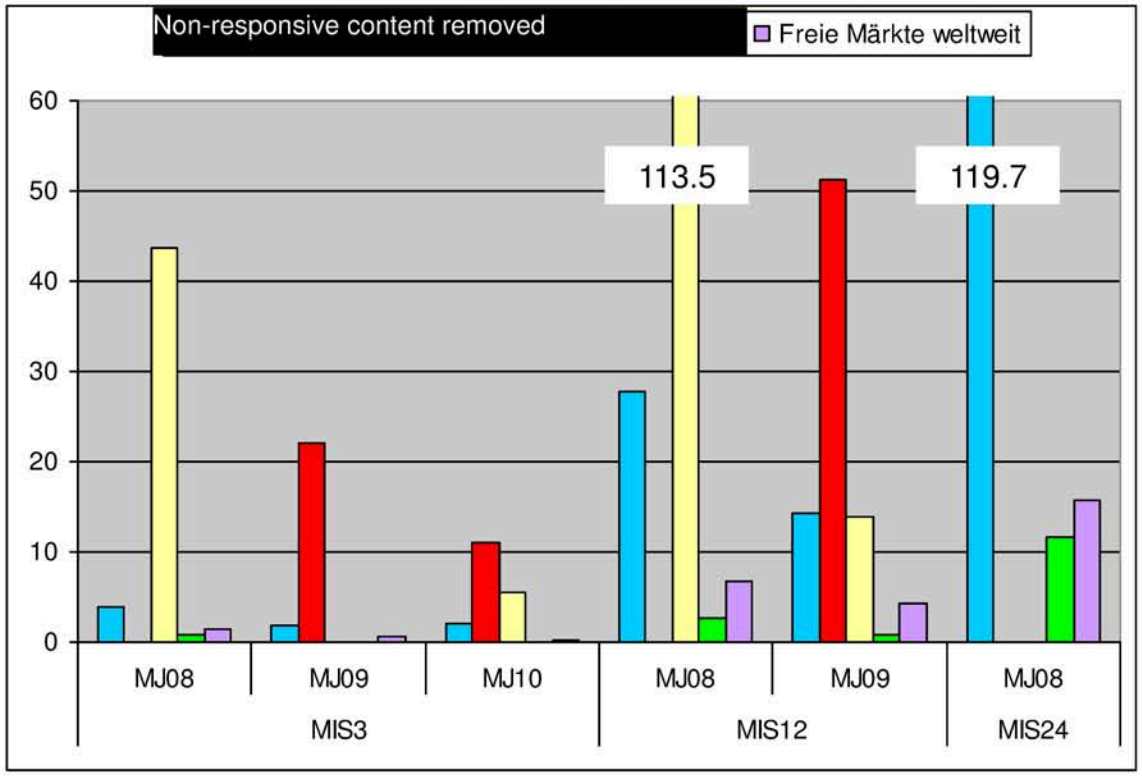
**Breakdown of absolute failure statistics worldwide (SAGA)**




**The countries and failures shown in red are also shown overleaf in relative terms (from MOP/MIS)**

# Drivetrain damage, high pressure diesel fuel pump CP4.2

| Cases of damage per 1,000 vehicles | MIS3 | | | MIS12 | | MIS24 |
|---|---|---|---|---|---|---|
| | MY08 | MY09 | MY10 | MY08 | MY09 | MY08 |
| Non-responsive content removed | 3.9 | 1.9 | 2.1 | 27.8 | 14.3 | 119.7 |
| | | 22 | 11.1 | | 51.3 | |
| | 43.7 | 0 | 5.6 | 113.5 | 13.9 | |
| | 0.8 | 0.1 | 0.1 | 2.7 | 0.8 | 11.6 |
| Free markets worldwide | 1.5 | 0.7 | 0.3 | 6.7 | 4.3 | 15.7 |




**Note: MY2008 no deliveries to** [redacted]



[redacted]

# 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 cam roller/roller support, 100% avoidance of melt and metal spatter)
   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 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/ reside 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 [redacted] on 1/25/2010. Pumps from [redacted] still outstanding.
  1 in 4 pumps has signs of previous damage to the cam roller/ camshaft in 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 cam roller was at a significant slope on the cam and there were signs of corrosion on the cam roller. These signs of damage indicate sluggish cam 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 (cam 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 Non-responsive cont ent removed than the CP4.1.
- The MIS 12 (MY08) of CP4.2 is approximately 10 times higher in Non-responsive c ontent removed than in Non-responsive content rem oved
- The MIS 12 (MY08) of CP4.2 is approximately 2 times higher in Non-responsive content removed 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 cam 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 cam roller with 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 Neckarsulm in week 5/2010.

# 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 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 $R_V$ from1.3 to 0.8 µm increases the safety facto 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.

Rawness 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 GDK 570 for C2 coating is complete.

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

Further action:

➔ Because the anti-wear package was positively validated by the end of week 8/2010 with boundary samples and critical fuels (Kerosene, Arctic Diesel, WCF, FCF), 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.

# 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 cam roller/roller support, 100% avoidance of melt and metal spatter)
   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 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/ reside 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 [redacted] on 1/25/2010. Pumps from [redacted] still outstanding.
  1 in 4 pumps has signs of previous damage to the cam roller/ camshaft in TDC, same res[redacted]ump 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 cam roller was at a significant slope on the cam and there were signs of corrosion on the cam roller. These signs of damage indicate sluggish cam 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 (cam 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 Non-responsive content removed
- 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 cam 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 CI

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 cam roller with 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 week 5/2010

# 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 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 $R_V$ from1.3 to 0.8 µm increases the safety facto 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.

Rawness 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 GDK 570 for C2 coating is complete.

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

Further action:

➔ Because the anti-wear package was positively validated by the end of week 8/2010 with boundary samples and critical fuels (Kerosene, Arctic Diesel, WCF, FCF), 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.

# Task force summary

- Status of new information since last update on 1/22/2010 (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 cam roller/roller support, 100% avoidance of melt and metal spatter)
   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 Northern Italy 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/ reside 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 Italy 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 concluded in week 8/2010

# 1. Summary of analysis

- Return of the requested 40 good pumps from Non-responsive content removed and 20 good pumps from Non-responsive content removed
  First returns received from Non-responsive content removed (5 pumps) and Non-responsive content removed (11 pumps).
  1 in 4 pumps has signs of previous damage to the cam roller/ camshaft in 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 Non-responsive content removed (sister pump of drivetrain damage after 1,600 km),
  where the cam roller was at a significant slope on the cam and there were signs of corrosion on the cam roller.
  These signs of damage indicate sluggish cam rollers in conjunction with poor quality fuel.
  Detailed analyses of 2 previously damaged pumps from Italy confirm a sluggish (immobile) cam roller due to poor quality fuel when the pump starts. Photo of the prior damage in the middle of the cam roller is identical with features of Non-responsive content removed failures. Further analyses of other returns are planned.

# 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 (cam 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.

Analysis results indicate no further deviations except for spatter of metal.

# 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 sticking cam roller with potential to transfer material to the camshaft can only be produced under load (pressure) and with poor quality fuel.

Based on the new hypothesis of a sticking cam roller when starting with poor quality fuel, subsequent investigations will concentrate on the differences in pressure build-up/pressure pattern between CP4.1 and CP4.2

Other measurements are to be carried out on the engine for this purpose. A date is under discussion with VW/AUDI.

# 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. T. 2/24/2010
- the tappet position when stopping (position of cam 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. T. 2/9/2010

# 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 cam roller with TDC with critical fuel (Arctic diesel). D.2/9/2010
Measurements need to be carried out using kerosene on the complete engine at AUDI in week 5/2010.
Date for trials with kerosene was brought forward in consultation with AUDI, date for trials with Arctic diesel pushed back.
First results with kerosene indicate an immobile cam roller (flattening) and
in one case an increased twisting of the cam roller by 6 degrees.
Further evaluations will be completed by 09.02.10.

# 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 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 $R_V$ from1.3 to 0.8 µm increases the safety factor of the frictional coefficient by approx. 50%.

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

EA113 CBEN/CBFB/CBFD/CBFE/CBFF/CBFG/CBFH/CBFJ/CBFK/CBFL/CBFM/CBFN/CBFP/CBFR/CBFS/CBFT/CBFU/CBFV/CBFW/CBFX/CBFY/CBFZ/CCAA/CCAB/CCAC/CCAD/CCAE/CCAF/CCAG/CCAH/CCAJ/CCAK/CCAL/CCAM/CCAN/CCAP/CCAR/CCAS/CCAT/CCAU/CCAV/CCAW/CCAX/CCAY/CCAZ/CCBA/CCBB/CCBC/CCBD/CCBE/CCBF/CCBG/CCBH/CCBJ/CCBK/CCBL/CCBM/CCBN/CCBP/CCBR/CCBS/CCBT/CCBU/CCBV/CCBW/CCBX/CCBY/CCBZ/CCCA/CCCB/CCCC/CCCD/CCCE/CCCF/CCCG/CCCH/CCCJ/CCCK/CCCL/CCCM/CCCN/CCCP/CCCR/CCCS/CCCT/CCCU/CCCV/CCCW/CCCX/CCCY/CCCZ/CCDA/CCDB/CCDC/CCDD/CCDE/CCDF/CCDG/CCDH/CCDJ/CCDK/CCDL/CCDM/CCDN/CCDP/CCDR/CCDS/CCDT/CCDU/CCDV/CCDW/CCDX/CCDY/CCDZ/CCEA/CCEB/CCEC/CCED/CCEE/CCEF/CCEG/CCEH/CCEJ/CCEK/CCEL/CCEM/CCEN/CCEP/CCER/CCES/CCET/CCEU/CCEV/CCEW/CCEX/CCEY/CCEZ/CCFA/CCFB/CCFC/CCFD/CCFE/CCFF/CCFG/CCFH/CCFJ/CCFK/CCFL/CCFM/CCFN/CCFP/CCFR/CCFS/CCFT/CCFU/CCFV/CCFW/CCFX/CCFY/CCFZ/CCGA/CCGB/CCGC/CCGD/CCGE/CCGF/CCGG/CCGH/CCGJ/CCGK/CCGL/CCGM/CCGN/CCGP/CCGR/CCGS/CCGT/CCGU/CCGV/CCGW/CCGX/CCGY/CCGZ/CCHA/CCHB/CCHC/CCHD/CCHE/CCHF/CCHG/CCHH/CCHJ/CCHK/CCHL/CCHM/CCHN/CCHP/CCHR/CCHS/CCHT/CCHU/CCHV/CCHW/CCHX/CCHY/CCHZ/CCJA/CCJB/CCJC/CCJD/CCJE/CCJF/CCJG/CCJH/CCJJ/CCJK/CCJL/CCJM/CCJN/CCJP/CCJR/CCJS/CCJT/CCJU/CCJV/CCJW/CCJX/CCJY/CCJZ/CCKA/CCKB/CCKC/CCKD/CCKE/CCKF/CCKG/CCKH/CCKJ/CCKK/CCKL/CCKM/CCKN/CCKP/CCKR/CCKS/CCKT/CCKU/CCKV/CCKW/CCKX/CCKY/CCKZ/CCLA/CCLB/CCLC/CCLD/CCLE/CCLF/CCLG/CCLH/CCLJ/CCLK/CCLL/CCLM/CCLN/CCLP/CCLR/CCLS/CCLT/CCLU/CCLV/CCLW/CCLX/CCLY/CCLZ/CCMA/CCMB/CCMC/CCMD/CCME/CCMF/CCMG/CCMH/CCMJ/CCMK/CCML/CCMM/CCMN/CCMP/CCMR/CCMS/CCMT/CCMU/CCMV/CCMW/CCMX/CCMY/CCMZ/CCNA/CCNB/CCNC/CCND/CCNE/CCNF/CCNG/CCNH/CCNJ/CCNK/CCNL/CCNM/CCNN/CCNP/CCNR/CCNS/CCNT/CCNU/CCNV/CCNW/CCNX/CCNY/CCNZ/CCPA/CCPB/CCPC/CCPD/CCPE/CCPF/CCPG/CCPH/CCPJ/CCPK/CCPL/CCPM/CCPN/CCPP/CCPR/CCPS/CCPT/CCPU/CCPV/CCPW/CCPX/CCPY/CCPZ/CCRA/CCRB/CCRC/CCRD/CCRE/CCRF/CCRG/CCRH/CCRJ/CCRK/CCRL/CCRM/CCRN/CCRP/CCRR/CCRS/CCRT/CCRU/CCRV/CCRW/CCRX/CCRY/CCRZ/CCSA/CCSB/CCSC/CCSD/CCSE/CCSF/CCSG/CCSH/CCSJ/CCSK/CCSL/CCSM/CCSN/CCSP/CCSR/CCSS/CCST/CCSU/CCSV/CCSW/CCSX/CCSY/CCSZ/CCTA/CCTB/CCTC/CCTD/CCTE/CCTF/CCTG/CCTH/CCTJ/CCTK/CCTL/CCTM/CCTN/CCTP/CCTR/CCTS/CCTT/CCTU/CCTV/CCTW/CCTX/CCTY/CCTZ/CCUA/CCUB/CCUC/CCUD/CCUE/CCUF/CCUG/CCUH/CCUJ/CCUK/CCUL/CCUM/CCUN/CCUP/CCUR/CCUS/CCUT/CCUU/CCUV/CCUW/CCUX/CCUY/CCUZ/CCVA/CCVB/CCVC/CCVD/CCVE/CCVF/CCVG/CCVH/CCVJ/CCVK/CCVL/CCVM/CCVN/CCVP/CCVR/CCVS/CCVT/CCVU/CCVV/CCVW/CCVX/CCVY/CCVZ/CCWA/CCWB/CCWC/CCWD/CCWE/CCWF/CCWG/CCWH/CCWJ/CCWK/CCWL/CCWM/CCWN/CCWP/CCWR/CCWS/CCWT/CCWU/CCWV/CCWW/CCWX/CCWY/CCWZ/CCXA/CCXB/CCXC/CCXD/CCXE/CCXF/CCXG/CCXH/CCXJ/CCXK/CCXL/CCXM/CCXN/CCXP/CCXR/CCXS/CCXT/CCXU/CCXV/CCXW/CCXX/CCXY/CCXZ/CCYA/CCYB/CCYC/CCYD/CCYE/CCYF/CCYG/CCYH/CCYJ/CCYK/CCYL/CCYM/CCYN/CCYP/CCYR/CCYS/CCYT/CCYU/CCYV/CCYW/CCYX/CCYY/CCYZ/CCZA/CCZB/CCZC/CCZD/CCZE/CCZF/CCZG/CCZH/CCZJ/CCZK/CCZL/CCZM/CCZN/CCZP/CCZR/CCZS/CCZT/CCZU/CCZV/CCZW/CCZX/CCZY/CCZZ/CDAA/CDAB/CDAC/CDAD/CDAE/CDAF/CDAG/CDAH/CDAJ/CDAK/CDAL/CDAM/CDAN/CDAP/CDAR/CDAS/CDAT/CDAU/CDAV/CDAW/CDAX/CDAY/CDAZ/CDBA/CDBB/CDBC/CDBD/CDBE/CDBF/CDBG/CDBH/CDBJ/CDBK/CDBL/CDBM/CDBN/CDBP/CDBR/CDBS/CDBT/CDBU/CDBV/CDBW/CDBX/CDBY/CDBZ/CDCA/CDCB/CDCC/CDCD/CDCE/CDCF/CDCG/CDCH/CDCJ/CDCK/CDCL/CDCM/CDCN/CDCP/CDCR/CDCS/CDCT/CDCU/CDCV/CDCW/CDCX/CDCY/CDCZ/CDDA/CDDB/CDDC/CDDD/CDDE/CDDF/CDDG/CDDH/CDDJ/CDDK/CDDL/CDDM/CDDN/CDDP/CDDR/CDDS/CDDT/CDDU/CDDV/CDDW/CDDX/CDDY/CDDZ/CDEA/CDEB/CDEC/CDED/CDEE/CDEF/CDEG/CDEH/CDEJ/CDEK/CDEL/CDEM/CDEN/CDEP/CDER/CDES/CDET/CDEU/CDEV/CDEW/CDEX/CDEY/CDEZ/CDFA/CDFB/CDFC/CDFD/CDFE/CDFF/CDFG/CDFH/CDFJ/CDFK/CDFL/CDFM/CDFN/CDFP/CDFR/CDFS/CDFT/CDFU/CDFV/CDFW/CDFX/CDFY/CDFZ/CDGA/CDGB/CDGC/CDGD/CDGE/CDGF/CDGG/CDGH/CDGJ/CDGK/CDGL/CDGM/CDGN/CDGP/CDGR/CDGS/CDGT/CDGU/CDGV/CDGW/CDGX/CDGY/CDGZ/CDHA/CDHB/CDHC/CDHD/CDHE/CDHF/CDHG/CDHH/CDHJ/CDHK/CDHL/CDHM/CDHN/CDHP/CDHR/CDHS/CDHT/CDHU/CDHV/CDHW/CDHX/CDHY/CDHZ/CDJA/CDJB/CDJC/CDJD/CDJE/CDJF/CDJG/CDJH/CDJJ/CDJK/CDJL/CDJM/CDJN/CDJP/CDJR/CDJS/CDJT/CDJU/CDJV/CDJW/CDJX/CDJY/CDJZ/CDKA/CDKB/CDKC/CDKD/CDKE/CDKF/CDKG/CDKH/CDKJ/CDKK/CDKL/CDKM/CDKN/CDKP/CDKR/CDKS/CDKT/CDKU/CDKV/CDKW/CDKX/CDKY/CDKZ/CDLA/CDLB/CDLC/CDLD/CDLE/CDLF/CDLG/CDLH/CDLJ/CDLK/CDLL/CDLM/CDLN/CDLP/CDLR/CDLS/CDLT/CDLU/CDLV/CDLW/CDLX/CDLY/CDLZ/CDMA/CDMB/CDMC/CDMD/CDME/CDMF/CDMG/CDMH/CDMJ/CDMK/CDML/CDMM/CDMN/CDMP/CDMR/CDMS/CDMT/CDMU/CDMV/CDMW/CDMX/CDMY/CDMZ/CDNA/CDNB/CDNC/CDND/CDNE/CDNF/CDNG/CDNH/CDNJ/CDNK/CDNL/CDNM/CDNN/CDNP/CDNR/CDNS/CDNT/CDNU/CDNV/CDNW/CDNX/CDNY/CDNZ/CDPA/CDPB/CDPC/CDPD/CDPE/CDPF/CDPG/CDPH/CDPJ/CDPK/CDPL/CDPM/CDPN/CDPP/CDPR/CDPS/CDPT/CDPU/CDPV/CDPW/CDPX/CDPY/CDPZ/CDRA/CDRB/CDRC/CDRD/CDRE/CDRF/CDRG/CDRH/CDRJ/CDRK/CDRL/CDRM/CDRN/CDRP/CDRR/CDRS/CDRT/CDRU/CDRV/CDRW/CDRX/CDRY/CDRZ/CDSA/CDSB/CDSC/CDSD/CDSE/CDSF/CDSG/CDSH/CDSJ/CDSK/CDSL/CDSM/CDSN/CDSP/CDSR/CDSS/CDST/CDSU/CDSV/CDSW/CDSX/CDSY/CDSZ/CDTA/CDTB/CDTC/CDTD/CDTE/CDTF/CDTG/CDTH/CDTJ/CDTK/CDTL/CDTM/CDTN/CDTP/CDTR/CDTS/CDTT/CDTU/CDTV/CDTW/CDTX/CDTY/CDTZ/CDUA/CDUB/CDUC/CDUD/CDUE/CDUF/CDUG/CDUH/CDUJ/CDUK/CDUL/CDUM/CDUN/CDUP/CDUR/CDUS/CDUT/CDUU/CDUV/CDUW/CDUX/CDUY/CDUZ/CDVA/CDVB/CDVC/CDVD/CDVE/CDVF/CDVG/CDVH/CDVJ/CDVK/CDVL/CDVM/CDVN/CDVP/CDVR/CDVS/CDVT/CDVU/CDVV/CDVW/CDVX/CDVY/CDVZ/CDWA/CDWB/CDWC/CDWD/CDWE/CDWF/CDWG/CDWH/CDWJ/CDWK/CDWL/CDWM/CDWN/CDWP/CDWR/CDWS/CDWT/CDWU/CDWV/CDWW/CDWX/CDWY/CDWZ/CDXA/CDXB/CDXC/CDXD/CDXE/CDXF/CDXG/CDXH/CDXJ/CDXK/CDXL/CDXM/CDXN/CDXP/CDXR/CDXS/CDXT/CDXU/CDXV/CDXW/CDXX/CDXY/CDXZ/CDYA/CDYB/CDYC/CDYD/CDYE/CDYF/CDYG/CDYH/CDYJ/CDYK/CDYL/CDYM/CDYN/CDYP/CDYR/CDYS/CDYT/CDYU/CDYV/CDYW/CDYX/CDYY/CDYZ/CDZA/CDZB/CDZC/CDZD/CDZE/CDZF/CDZG/CDZH/CDZJ/CDZK/CDZL/CDZM/CDZN/CDZP/CDZR/CDZS/CDZT/CDZU/CDZV/CDZW/CDZX/CDZY/CDZZ/CEAA/CEAB/CEAC/CEAD/CEAE/CEAF/CEAG/CEAH/CEAJ/CEAK/CEAL/CEAM/CEAN/CEAP/CEAR/CEAS/CEAT/CEAU/CEAV/CEAW/CEAX/CEAY/CEAZ/CEBA/CEBB/CEBC/CEBD/CEBE/CEBF/CEBG/CEBH/CEBJ/CEBK/CEBL/CEBM/CEBN/CEBP/CEBR/CEBS/CEBT/CEBU/CEBV/CEBW/CEBX/CEBY/CEBZ/CECA/CECB/CECC/CECD/CECE/CECF/CECG/CECH/CECJ/CECK/CECL/CECM/CECN/CECP/CECR/CECS/CECT/CECU/CECV/CECW/CECX/CECY/CECZ/CEDA/CEDB/CEDC/CEDD/CEDE/CEDF/CEDG/CEDH/CEDJ/CEDK/CEDL/CEDM/CEDN/CEDP/CEDR/CEDS/CEDT/CEDU/CEDV/CEDW/CEDX/CEDY/CEDZ/CEEA/CEEB/CEEC/CEED/CEEE/CEEF/CEEG/CEEH/CEEJ/CEEK/CEEL/CEEM/CEEN/CEEP/CEER/CEES/CEET/CEEU/CEEV/CEEW/CEEX/CEEY/CEEZ/CEFA/CEFB/CEFC/CEFD/CEFE/CEFF/CEFG/CEFH/CEFJ/CEFK/CEFL/CEFM/CEFN/CEFP/CEFR/CEFS/CEFT/CEFU/CEFV/CEFW/CEFX/CEFY/CEFZ/CEGA/CEGB/CEGC/CEGD/CEGE/CEGF/CEGG/CEGH/CEGJ/CEGK/CEGL/CEGM/CEGN/CEGP/CEGR/CEGS/CEGT/CEGU/CEGV/CEGW/CEGX/CEGY/CEGZ/CEHA/CEHB/CEHC/CEHD/CEHE/CEHF/CEHG/CEHH/CEHJ/CEHK/CEHL/CEHM/CEHN/CEHP/CEHR/CEHS/CEHT/CEHU/CEHV/CEHW/CEHX/CEHY/CEHZ/CEJA/CEJB/CEJC/CEJD/CEJE/CEJF/CEJG/CEJH/CEJJ/CEJK/CEJL/CEJM/CEJN/CEJP/CEJR/CEJS/CEJT/CEJU/CEJV/CEJW/CEJX/CEJY/CEJZ/CEKA/CEKB/CEKC/CEKD/CEKE/CEKF/CEKG/CEKH/CEKJ/CEKK/CEKL/CEKM/CEKN/CEKP/CEKR/CEKS/CEKT/CEKU/CEKV/CEKW/CEKX/CEKY/CEKZ/CELA/CELB/CELC/CELD/CELE/CELF/CELG/CELH/CELJ/CELK/CELL/CELM/CELN/CELP/CELR/CELS/CELT/CELU/CELV/CELW/CELX/CELY/CELZ/CEMA/CEMB/CEMC/CEMD/CEME/CEMF/CEMG/CEMH/CEMJ/CEMK/CEML/CEMM/CEMN/CEMP/CEMR/CEMS/CEMT/CEMU/CEMV/CEMW/CEMX/CEMY/CEMZ/CENA/CENB/CENC/CEND/CENE/CENF/CENG/CENH/CENJ/CENK/CENL/CENM/CENN/CENP/CENR/CENS/CENT/CENU/CENV/CENW/CENX/CENY/CENZ/CEPA/CEPB/CEPC/CEPD/CEPE/CEPF/CEPG/CEPH/CEPJ/CEPK/CEPL/CEPM/CEPN/CEPP/CEPR/CEPS/CEPT/CEPU/CEPV/CEPW/CEPX/CEPY/CEPZ/CERA/CERB/CERC/CERD/CERE/CERF/CERG/CERH/CERJ/CERK/CERL/CERM/CERN/CERP/CERR/CERS/CERT/CERU/CERV/CERW/CERX/CERY/CERZ/CESA/CESB/CESC/CESD/CESE/CESF/CESG/CESH/CESJ/CESK/CESL/CESM/CESN/CESP/CESR/CESS/CEST/CESU/CESV/CESW/CESX/CESY/CESZ/CETA/CETB/CETC/CETD/CETE/CETF/CETG/CETH/CETJ/CETK/CETL/CETM/CETN/CETP/CETR/CETS/CETT/CETU/CETV/CETW/CETX/CETY/CETZ/CEUA/CEUB/CEUC/CEUD/CEUE/CEUF/CEUG/CEUH/CEUJ/CEUK/CEUL/CEUM/CEUN/CEUP/CEUR/CEUS/CEUT/CEUU/CEUV/CEUW/CEUX/CEUY/CEUZ/CEVA/CEVB/CEVC/CEVD/CEVE/CEVF/CEVG/CEVH/CEVJ/CEVK/CEVL/CEVM/CEVN/CEVP/CEVR/CEVS/CEVT/CEVU/CEVV/CEVW/CEVX/CEVY/CEVZ/CEWA/CEWB/CEWC/CEWD/CEWE/CEWF/CEWG/CEWH/CEWJ/CEWK/CEWL/CEWM/CEWN/CEWP/CEWR/CEWS/CEWT/CEWU/CEWV/CEWW/CEWX/CEWY/CEWZ/CEXA/CEXB/CEXC/CEXD/CEXE/CEXF/CEXG/CEXH/CEXJ/CEXK/CEXL/CEXM/CEXN/CEXP/CEXR/CEXS/CEXT/CEXU/CEXV/CEXW/CEXX/CEXY/CEXZ/CEYA/CEYB/CEYC/CEYD/CEYE/CEYF/CEYG/CEYH/CEYJ/CEYK/CEYL/CEYM/CEYN/CEYP/CEYR/CEYS/CEYT/CEYU/CEYV/CEYW/CEYX/CEYY/CEYZ/CEZA/CEZB/CEZC/CEZD/CEZE/CEZF/CEZG/CEZH/CEZJ/CEZK/CEZL/CEZM/CEZN/CEZP/CEZR/CEZS/CEZT/CEZU/CEZV/CEZW/CEZX/CEZY/CEZZ/CFAA/CFAB/CFAC/CFAD/CFAE/CFAF/CFAG/CFAH/CFAJ/CFAK/CFAL/CFAM/CFAN/CFAP/CFAR/CFAS/CFAT/CFAU/CFAV/CFAW/CFAX/CFAY/CFAZ/CFBA/CFBB/CFBC/CFBD/CFBE/CFBF/CFBG/CFBH/CFBJ/CFBK/CFBL/CFBM/CFBN/CFBP/CFBR/CFBS/CFBT/CFBU/CFBV/CFBW/CFBX/CFBY/CFBZ/CFCA/CFCB/CFCC/CFCD/CFCE/CFCF/CFCG/CFCH/CFCJ/CFCK/CFCL/CFCM/CFCN/CFCP/CFCR/CFCS/CFCT/CFCU/CFCV/CFCW/CFCX/CFCY/CFCZ/CFDA/CFDB/CFDC/CFDD/CFDE/CFDF/CFDG/CFDH/CFDJ/CFDK/CFDL/CFDM/CFDN/CFDP/CFDR/CFDS/CFDT/CFDU/CFDV/CFDW/CFDX/CFDY/CFDZ/CFEA/CFEB/CFEC/CFED/CFEE/CFEF/CFEG/CFEH/CFEJ/CFEK/CFEL/CFEM/CFEN/CFEP/CFER/CFES/CFET/CFEU/CFEV/CFEW/CFEX/CFEY/CFEZ/CFFA/CFFB/CFFC/CFFD/CFFE/CFFF/CFFG/CFFH/CFFJ/CFFK/CFFL/CFFM/CFFN/CFFP/CFFR/CFFS/CFFT/CFFU/CFFV/CFFW/CFFX/CFFY/CFFZ/CFGA/CFGB/CFGC/CFGD/CFGE/CFGF/CFGG/CFGH/CFGJ/CFGK/CFGL/CFGM/CFGN/CFGP/CFGR/CFGS/CFGT/CFGU/CFGV/CFGW/CFGX/CFGY/CFGZ/CFHA/CFHB/CFHC/CFHD/CFHE/CFHF/CFHG/CFHH/CFHJ/CFHK/CFHL/CFHM/CFHN/CFHP/CFHR/CFHS/CFHT/CFHU/CFHV/CFHW/CFHX/CFHY/CFHZ/CFJA/CFJB/CFJC/CFJD/CFJE/CFJF/CFJG/CFJH/CFJJ/CFJK/CFJL/CFJM/CFJN/CFJP/CFJR/CFJS/CFJT/CFJU/CFJV/CFJW/CFJX/CFJY/CFJZ/CFKA/CFKB/CFKC/CFKD/CFKE/CFKF/CFKG/CFKH/CFKJ/CFKK/CFKL/CFKM/CFKN/CFKP/CFKR/CFKS/CFKT/CFKU/CFKV/CFKW/CFKX/CFKY/CFKZ/CFLA/CFLB/CFLC/CFLD/CFLE/CFLF/CFLG/CFLH/CFLJ/CFLK/CFLL/CFLM/CFLN/CFLP/CFLR/CFLS/CFLT/CFLU/CFLV/CFLW/CFLX/CFLY/CFLZ/CFMA/CFMB/CFMC/CFMD/CFME/CFMF/CFMG/CFMH/CFMJ/CFMK/CFML/CFMM/CFMN/CFMP/CFMR/CFMS/CFMT/CFMU/CFMV/CFMW/CFMX/CFMY/CFMZ/CFNA/CFNB/CFNC/CFND/CFNE/CFNF/CFNG/CFNH/CFNJ/CFNK/CFNL/CFNM/CFNN/CFNP/CFNR/CFNS/CFNT/CFNU/CFNV/CFNW/CFNX/CFNY/CFNZ/CFPA/CFPB/CFPC/CFPD/CFPE/CFPF/CFPG/CFPH/CFPJ/CFPK/CFPL/CFPM/CFPN/CFPP/CFPR/CFPS/CFPT/CFPU/CFPV/CFPW/CFPX/CFPY/CFPZ/CFRA/CFRB/CFRC/CFRD/CFRE/CFRF/CFRG/CFRH/CFRJ/CFRK/CFRL/CFRM/CFRN/CFRP/CFRR/CFRS/CFRT/CFRU/CFRV/CFRW/CFRX/CFRY/CFRZ/CFSA/CFSB/CFSC/CFSD/CFSE/CFSF/CFSG/CFSH/CFSJ/CFSK/CFSL/CFSM/CFSN/CFSP/CFSR/CFSS/CFST/CFSU/CFSV/CFSW/CFSX/CFSY/CFSZ/CFTA/CFTB/CFTC/CFTD/CFTE/CFTF/CFTG/CFTH/CFTJ/CFTK/CFTL/CFTM/CFTN/CFTP/CFTR/CFTS/CFTT/CFTU/CFTV/CFTW/CFTX/CFTY/CFTZ/CFUA/CFUB/CFUC/CFUD/CFUE/CFUF/CFUG/CFUH/CFUJ/CFUK/CFUL/CFUM/CFUN/CFUP/CFUR/CFUS/CFUT/CFUU/CFUV/CFUW/CFUX/CFUY/CFUZ/CFVA/CFVB/CFVC/CFVD/CFVE/CFVF/CFVG/CFVH/CFVJ/CFVK/CFVL/CFVM/CFVN/CFVP/CFVR/CFVS/CFVT/CFVU/CFVV/CFVW/CFVX/CFVY/CFVZ/CFWA/CFWB/CFWC/CFWD/CFWE/CFWF/CFWG/CFWH/CFWJ/CFWK/CFWL/CFWM/CFWN/CFWP/CFWR/CFWS/CFWT/CFWU/CFWV/CFWW/CFWX/CFWY/CFWZ/CFXA/CFXB/CFXC/CFXD/CFXE/CFXF/CFXG/CFXH/CFXJ/CFXK/CFXL/CFXM/CFXN/CFXP/CFXR/CFXS/CFXT/CFXU/CFXV/CFXW/CFXX/CFXY/CFXZ/CFYA/CFYB/CFYC/CFYD/CFYE/CFYF/CFYG/CFYH/CFYJ/CFYK/CFYL/CFYM/CFYN/CFYP/CFYR/CFYS/CFYT/CFYU/CFYV/CFYW/CFYX/CFYY/CFYZ/CFZA/CFZB/CFZC/CFZD/CFZE/CFZF/CFZG/CFZH/CFZJ/CFZK/CFZL/CFZM/CFZN/CFZP/CFZR/CFZS/CFZT/CFZU/CFZV/CFZW/CFZX/CFZY/CFZZ/CGAA/CGAB/CGAC/CGAD/CGAE/CGAF/CGAG/CGAH/CGAJ/CGAK/CGAL/CGAM/CGAN/CGAP/CGAR/CGAS/CGAT/CGAU/CGAV/CGAW/CGAX/CGAY/CGAZ/CGBA/CGBB/CGBC/CGBD/CGBE/CGBF/CGBG/CGBH/CGBJ/CGBK/CGBL/CGBM/CGBN/CGBP/CGBR/CGBS/CGBT/CGBU/CGBV/CGBW/CGBX/CGBY/CGBZ/CGCA/CGCB/CGCC/CGCD/CGCE/CGCF/CGCG/CGCH/CGCJ/CGCK/CGCL/CGCM/CGCN/CGCP/CGCR/CGCS/CGCT/CGCU/CGCV/CGCW/CGCX/CGCY/CGCZ/CGDA/CGDB/CGDC/CGDD/CGDE/CGDF/CGDG/CGDH/CGDJ/CGDK/CGDL/CGDM/CGDN/CGDP/CGDR/CGDS/CGDT/CGDU/CGDV/CGDW/CGDX/CGDY/CGDZ/CGEA/CGEB/CGEC/CGED/CGEE/CGEF/CGEG/CGEH/CGEJ/CGEK/CGEL/CGEM/CGEN/CGEP/CGER/CGES/CGET/CGEU/CGEV/CGEW/CGEX/CGEY/CGEZ/CGFA/CGFB/CGFC/CGFD/CGFE/CGFF/CGFG/CGFH/CGFJ/CGFK/CGFL/CGFM/CGFN/CGFP/CGFR/CGFS/CGFT/CGFU/CGFV/CGFW/CGFX/CGFY/CGFZ/CGGA/CGGB/CGGC/CGGD/CGGE/CGGF/CGGG/CGGH/CGGJ/CGGK/CGGL/CGGM/CGGN/CGGP/CGGR/CGGS/CGGT/CGGU/CGGV/CGGW/CGGX/CGGY/CGGZ/CGHA/CGHB/CGHC/CGHD/CGHE/CGHF/CGHG/CGHH/CGHJ/CGHK/CGHL/CGHM/CGHN/CGHP/CGHR/CGHS/CGHT/CGHU/CGHV/CGHW/CGHX/CGHY/CGHZ/CGJA/CGJB/CGJC/CGJD/CGJE/CGJF/CGJG/CGJH/CGJJ/CGJK/CGJL/CGJM/CGJN/CGJP/CGJR/CGJS/CGJT/CGJU/CGJV/CGJW/CGJX/CGJY/CGJZ/CGKA/CGKB/CGKC/CGKD/CGKE/CGKF/CGKG/CGKH/CGKJ/CGKK/CGKL/CGKM/CGKN/CGKP/CGKR/CGKS/CGKT/CGKU/CGKV/CGKW/CGKX/CGKY/CGKZ/CGLA/CGLB/CGLC/CGLD/CGLE/CGLF/CGLG/CGLH/CGLJ/CGLK/CGLL/CGLM/CGLN/CGLP/CGLR/CGLS/CGLT/CGLU/CGLV/CGLW/CGLX/CGLY/CGLZ/CGMA/CGMB/CGMC/CGMD/CGME/CGMF/CGMG/CGMH/CGMJ/CGMK/CGML/CGMM/CGMN/CGMP/CGMR/CGMS/CGMT/CGMU/CGMV/CGMW/CGMX/CGMY/CGMZ/CGNA/CGNB/CGNC/CGND/CGNE/CGNF/CGNG/CGNH/CGNJ/CGNK/CGNL/CGNM/CGNN/CGNP/CGNR/CGNS/CGNT/CGNU/CGNV/CGNW/CGNX/CGNY/CGNZ/CGPA/CGPB/CGPC/CGPD/CGPE/CGPF/CGPG/CGPH/CGPJ/CGPK/CGPL/CGPM/CGPN/CGPP/CGPR/CGPS/CGPT/CGPU/CGPV/CGPW/CGPX/CGPY/CGPZ/CGRA/CGRB/CGRC/CGRD/CGRE/CGRF/CGRG/CGRH/CGRJ/CGRK/CGRL/CGRM/CGRN/CGRP/CGRR/CGRS/CGRT/CGRU/CGRV/CGRW/CGRX/CGRY/CGRZ/CGSA/CGSB/CGSC/CGSD/CGSE/CGSF/CGSG/CGSH/CGSJ/CGSK/CGSL/CGSM/CGSN/CGSP/CGSR/CGSS/CGST/CGSU/CGSV/CGSW/CGSX/CGSY/CGSZ/CGTA/CGTB/CGTC/CGTD/CGTE/CGTF/CGTG/CGTH/CGTJ/CGTK/CGTL/CGTM/CGTN/CGTP/CGTR/CGTS/CGTT/CGTU/CGTV/CGTW/CGTX/CGTY/CGTZ/CGUA/CGUB/CGUC/CGUD/CGUE/CGUF/CGUG/CGUH/CGUJ/CGUK/CGUL/CGUM/CGUN/CGUP/CGUR/CGUS/CGUT/CGUU/CGUV/CGUW/CGUX/CGUY/CGUZ/CGVA/CGVB/CGVC/CGVD/CGVE/CGVF/CGVG/CGVH/CGVJ/CGVK/CGVL/CGVM/CGVN/CGVP/CGVR/CGVS/CGVT/CGVU/CGVV/CGVW/CGVX/CGVY/CGVZ/CGWA/CGWB/CGWC/CGWD/CGWE/CGWF/CGWG/CGWH/CGWJ/CGWK/CGWL/CGWM/CGWN/CGWP/CGWR/CGWS/CGWT/CGWU/CGWV/CGWW/CGWX/CGWY/CGWZ/CGXA/CGXB/CGXC/CGXD/CGXE/CGXF/CGXG/CGXH/CGXJ/CGXK/CGXL/CGXM/CGXN/CGXP/CGXR/CGXS/CGXT/CGXU/CGXV/CGXW/CGXX/CGXY/CGXZ/CGYA/CGYB/CGYC/CGYD/CGYE/CGYF/CGYG/CGYH/CGYJ/CGYK/CGYL/CGYM/CGYN/CGYP/CGYR/CGYS/CGYT/CGYU/CGYV/CGYW/CGYX/CGYY/CGYZ/CGZA/CGZB/CGZC/CGZD/CGZE/CGZF/CGZG/CGZH/CGZJ/CGZK/CGZL/CGZM/CGZN/CGZP/CGZR/CGZS/CGZT/CGZU/CGZV/CGZW/CGZX/CGZY/CGZZ/CHAA/CHAB/CHAC/CHAD/CHAE/CHAF/CHAG/CHAH/CHAJ/CHAK/CHAL/CHAM/CHAN/CHAP/CHAR/CHAS/CHAT/CHAU/CHAV/CHAW/CHAX/CHAY/CHAZ/CHBA/CHBB/CHBC/CHBD/CHBE/CHBF/CHBG/CHBH/CHBJ/CHBK/CHBL/CHBM/CHBN/CHBP/CHBR/CHBS/CHBT/CHBU/CHBV/CHBW/CHBX/CHBY/CHBZ/CHCA/CHCB/CHCC/CHCD/CHCE/CHCF/CHCG/CHCH/CHCJ/CHCK/CHCL/CHCM/CHCN/CHCP/CHCR/CHCS/CHCT/CHCU/CHCV/CHCW/CHCX/CHCY/CHCZ/CHDA/CHDB/CHDC/CHDD/CHDE/CHDF/CHDG/CHDH/CHDJ/CHDK/CHDL/CHDM/CHDN/CHDP/CHDR/CHDS/CHDT/CHDU/CHDV/CHDW/CHDX/CHDY/CHDZ/CHEA/CHEB/CHEC/CHED/CHEE/CHEF/CHEG/CHEH/CHEJ/CHEK/CHEL/CHEM/CHEN/CHEP/CHER/CHES/CHET/CHEU/CHEV/CHEW/CHEX/CHEY/CHEZ/CHFA/CHFB/CHFC/CHFD/CHFE/CHFF/CHFG/CHFH/CHFJ/CHFK/CHFL/CHFM/CHFN/CHFP/CHFR/CHFS/CHFT/CHFU/CHFV/CHFW/CHFX/CHFY/CHFZ/CHGA/CHGB/CHGC/CHGD/CHGE/CHGF/CHGG/CHGH/CHGJ/CHGK/CHGL/CHGM/CHGN/CHGP/CHGR/CHGS/CHGT/CHGU/CHGV/CHGW/CHGX/CHGY/CHGZ/CHHA/CHHB/CHHC/CHHD/CHHE/CHHF/CHHG/CHHH/CHHJ/CHHK/CHHL/CHHM/CHHN/CHHP/CHHR/CHHS/CHHT/CHHU/CHHV/CHHW/CHHX/CHHY/CHHZ/CHJA/CHJB/CHJC/CHJD/CHJE/CHJF/CHJG/CHJH/CHJJ/CHJK/CHJL/CHJM/CHJN/CHJP/CHJR/CHJS/CHJT/CHJU/CHJV/CHJW/CHJX/CHJY/CHJZ/CHKA/CHKB/CHKC/CHKD/CHKE/CHKF/CHKG/CHKH/CHKJ/CHKK/CHKL/CHKM/CHKN/CHKP/CHKR/CHKS/CHKT/CHKU/CHKV/CHKW/CHKX/CHKY/CHKZ/CHLA/CHLB/CHLC/CHLD/CHLE/CHLF/CHLG/CHLH/CHLJ/CHLK/CHLL/CHLM/CHLN/CHLP/CHLR/CHLS/CHLT/CHLU/CHLV/CHLW/CHLX/CHLY/CHLZ/CHMA/CHMB/CHMC/CHMD/CHME/CHMF/CHMG/CHMH/CHMJ/CHMK/CHML/CHMM/CHMN/CHMP/CHMR/CHMS/CHMT/CHMU/CHMV/CHMW/CHMX/CHMY/CHMZ/CHNA/CHNB/CHNC/CHND/CHNE/CHNF/CHNG/CHNH/CHNJ/CHNK/CHNL/CHNM/CHNN/CHNP/CHNR/CHNS/CHNT/CHNU/CHNV/CHNW/CHNX/CHNY/CHNZ/CHPA/CHPB/CHPC/CHPD/CHPE/CHPF/CHPG/CHPH/CHPJ/CHPK/CHPL/CHPM/CHPN/CHPP/CHPR/CHPS/CHPT/CHPU/CHPV/CHPW/CHPX/CHPY/CHPZ/CHRA/CHRB/CHRC/CHRD/CHRE/CHRF/CHRG/CHRH/CHRJ/CHRK/CHRL/CHRM/CHRN/CHRP/CHRR/CHRS/CHRT/CHRU/CHRV/CHRW/CHRX/CHRY/CHRZ/CHSA/CHSB/CHSC/CHSD/CHSE/CHSF/CHSG/CHSH/CHSJ/CHSK/CHSL/CHSM/CHSN/CHSP/CHSR/CHSS/CHST/CHSU/CHSV/CHSW/CHSX/CHSY/CHSZ/CHTA/CHTB/CHTC/CHTD/CHTE/CHTF/CHTG/CHTH/CHTJ/CHTK/CHTL/CHTM/CHTN/CHTP/CHTR/CHTS/CHTT/CHTU/CHTV/CHTW/CHTX/CHTY/CHTZ/CHUA/CHUB/CHUC/CHUD/CHUE/CHUF/CHUG/CHUH/CHUJ/CHUK/CHUL/CHUM/CHUN/CHUP/CHUR/CHUS/CHUT/CHUU/CHUV/CHUW/CHUX/CHUY/CHUZ/CHVA/CHVB/CHVC/CHVD/CHVE/CHVF/CHVG/CHVH/CHVJ/CHVK/CHVL/CHVM/CHVN/CHVP/CHVR/CHVS/CHVT/CHVU/CHVV/CHVW/CHVX/CHVY/CHVZ/CHWA/CHWB/CHWC/CHWD/CHWE/CHWF/CHWG/CHWH/CHWJ/CHWK/CHWL/CHWM/CHWN/CHWP/CHWR/CHWS/CHWT/CHWU/CHWV/CHWW/CHWX/CHWY/CHWZ/CHXA/CHXB/CHXC/CHXD/CHXE/CHXF/CHXG/CHXH/CHXJ/CHXK/CHXL/CHXM/CHXN/CHXP/CHXR/CHXS/CHXT/CHXU/CHXV/CHXW/CHXX/CHXY/CHXZ/CHYA/CHYB/CHYC/CHYD/CHYE/CHYF/CHYG/CHYH/CHYJ/CHYK/CHYL/CHYM/CHYN/CHYP/CHYR/CHYS/CHYT

# 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 boundary samples and critical fuels (Kerosene, Arctic Diesel, WCF, FCF), series launch for all CP4.2 pumps from Audi / VW (V6-, V8-, V12-TDI) agreed.
  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.

# AUDI CP4 Situation in the field in [redacted]

Status: 2/3/2010

**AQUA: Active quality analysis**
Status: 10/09-16.01.10 08 :43
Source/user: S[redacted]

**Audi, market:** [redacted]
**MY 2008 – 2010, Offset: all (max. 3)**
**Customer no. / Groups: High-pressure fuel pump**

**Confidential**
Without PR numbers
CUSTOMER NO. 2374

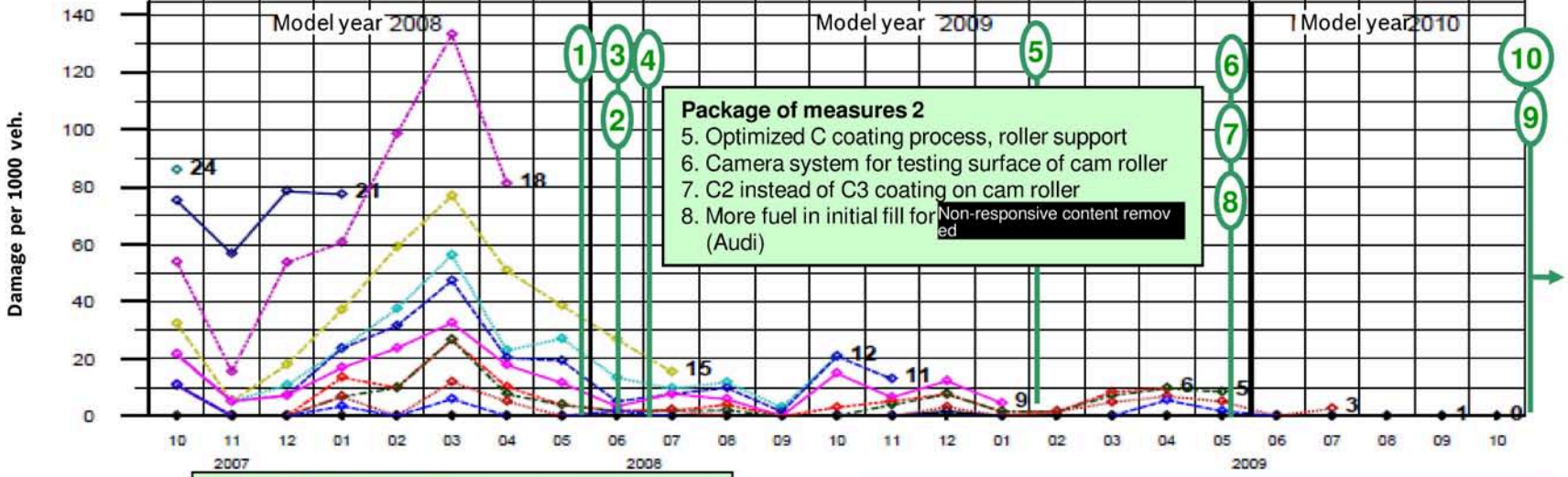
CAMA|CAMB|CAMD|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CATA|CATB|CCLA|CCMA|CCWA|CCWB|CDYA|CDYB|CDYC|CGK

| 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 | Replacement | LB | 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 LEAK MINOR
Vehicle suppression:

Stichpro Spot check vehicles
93 194 280 297 508 338 394 259 598 520 511 665 672 773 654 675 665 841 724 594 728 394 221 672 703




**Package of measures 2**
5. Optimized C coating process, roller support
6. Camera system for testing surface of cam roller
7. C2 instead of C3 coating on cam roller
8. More fuel in initial fill for [redacted] (Audi)

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

**Package of measures 3**
9. Crankshaft wash roller support (Jan 2009)
10. Introduction of anti-wear package 1, SOP Bosch (March 2010)

Vehicles: 3.389+12.041+6.[redacted]13.841** 2008-

# Protocol/Notes

Non-responsive content removed

11 February 2010 Date

**AUDI AG**

85045 Ingolstadt

Germany

Dear Mr. Non-responsive content removed

We would like to inform you of the following:

**A6 V6 TDI 2,7l – [redacted] market, high-pressure fuel pump damage (CP4)**

**Cases of damage:** **7, all LB**
Mileage between 235 km and 5900 km

**Customer complaint:** Engine dies while vehicle is running and will not start again.

**Workshop observation:** Fuel pressure in rail is just 7 bar; the normal pressure is 180 to 220 bar. The complete fuel system is full of metal splinters from the high-pressure fuel pump. In 2 cases the roller is broken as a consequence of the roller cam follower, causing valve malfunction and leading to the total destruction of the engine.

**Causes:** Very probable CP4.2 drivetrain damage (see splinter pattern). Considering the



sensitivity of the diesel high-pressure pump, this is not surprising as the latest [redacted] fuel standard (valid as of 01.01.10) does not limit the water content in diesel. This is not found in any other market.

**Measure:** Following package of measures 1 (June 08) and 2 (June 09), a new washing process preceded the
C coating of the roller support.
Robustness package 1 would then bring about a significant improvement that would go into series production in April (more information will be available at the Bosch-Audi TOP meeting on 12.02.10).

**Note:** The market launch of A6 with V6 TDI took place in Sept.09.

2 vehicles have already been converted and one customer is planning to convert.


High-pressure pump with removable
Fuel dosing valve


broken roller cam follower.

With best wishes

Non-responsive content removed

Audi
Vorsprung durch Technik

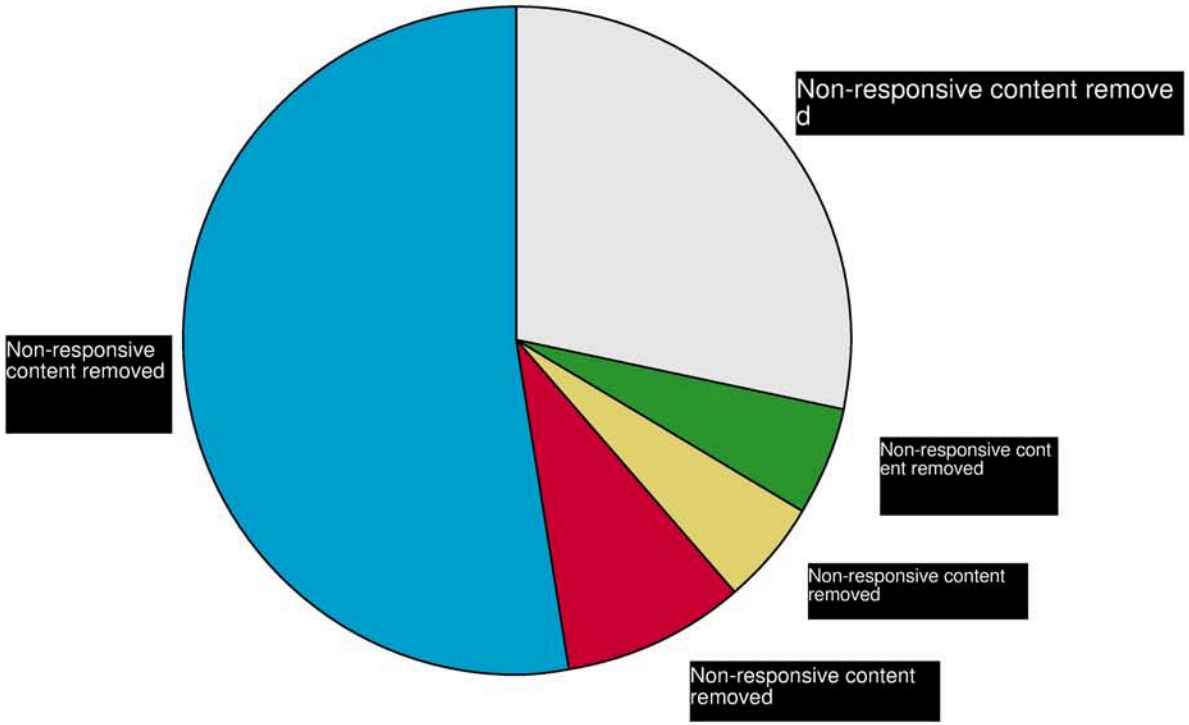
# Drivetrain damage, high pressure diesel fuel pump CP4.2

# Drivetrain damage, high pressure diesel fuel pump CP4.2

**Summary:**

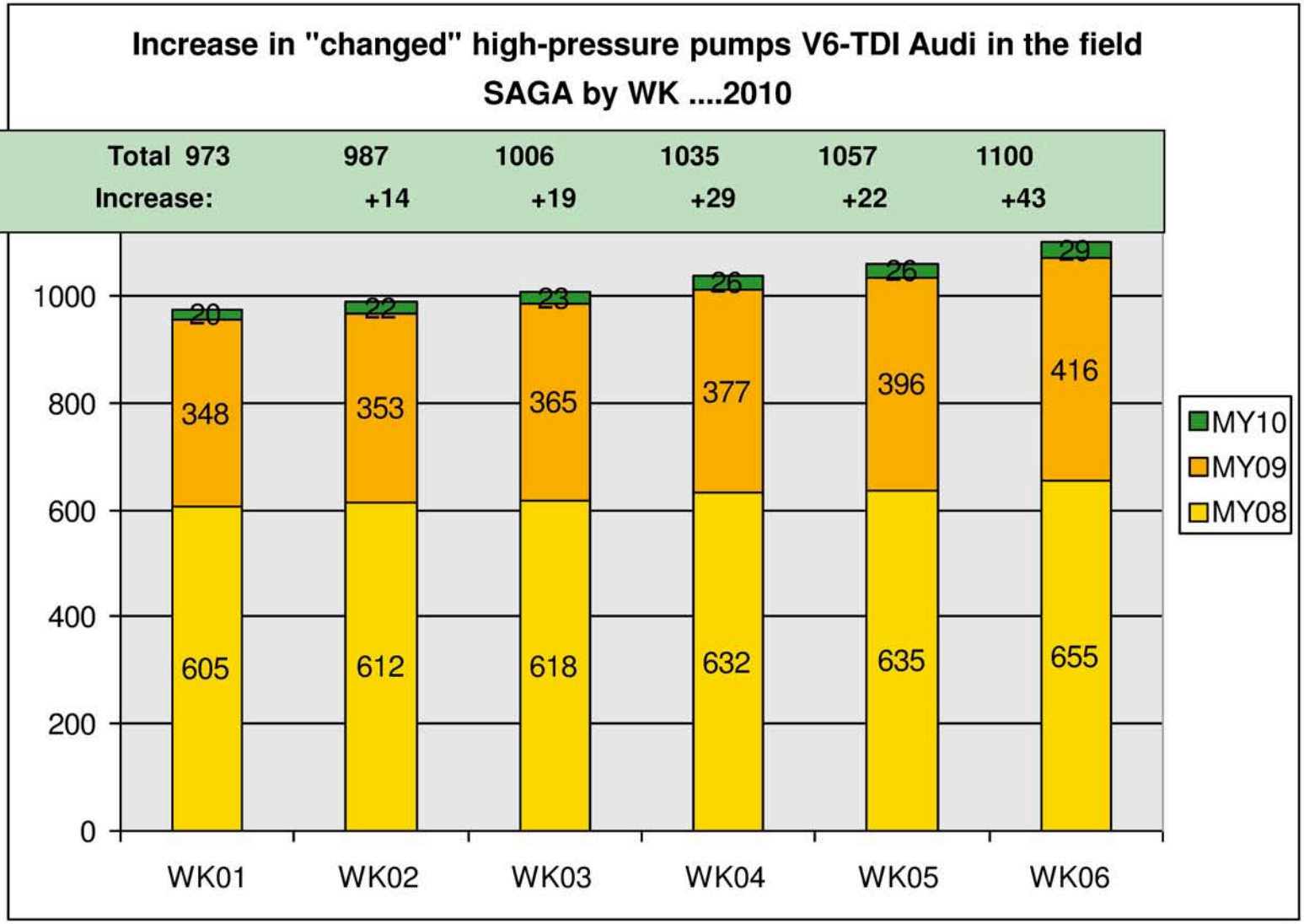
- Current damage, Audi:
  - V6-TDI – [redacted] 1,100 cases (increase +43), of which 579 (+35) [redacted] ➔ Total/ increase see slide 3
  - V8-TDI – 1 case in [redacted]
  - V12-TDI – 3 cases (+1) [redacted]
- Anti wear package 1 (RP1):
  - is defined and used at Bosch from WK 09 onwards
  - The effect (thicker film of lubricant) is aimed at fuels with lower viscosity and lubrication
  - Failures [redacted] and EU4 [redacted] ([redacted] …) with CP4.2 problems will probably be reduced therefore
- Anti wear package 2 (RP2):
  - Because of the good pumps removed in Italy and analyzed at Bosch have existing damage in some cases, it is assumed that a "sticking CP4 cam roller when the engine is started" is the case.
  - Bosch is requested to define the RP2 in the coming weeks, depending on the results of the ongoing engine measurements.

# Drivetrain damage, high pressure diesel fuel pump CP4.2



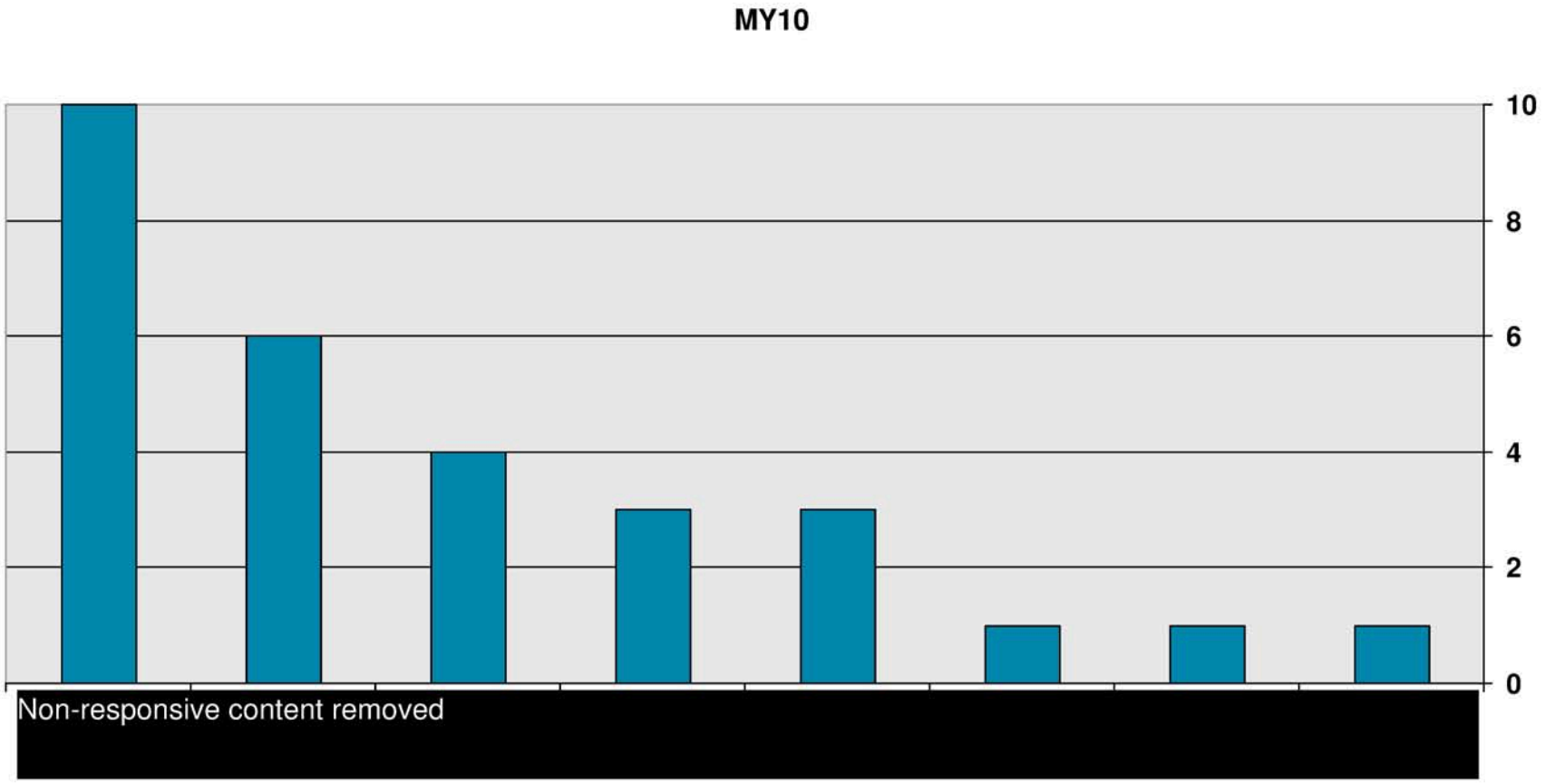

Non-responsive content removed

# Drivetrain damage, high pressure diesel fuel pump CP4.2




Non-responsive content removed

# Drivetrain damage, high pressure diesel fuel pump CP4.2




Non-responsive content removed

# Task force summary

- Status of new information since last update on 2/17/2010 (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 melt and metal spatter)
   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

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

A further 9 good pumps received from [redacted]
2 out of 9 pumps display previous damage to cam roller and camshaft.
1 of these 2 pumps has significant rust scars on the camshaft. These clearly occurred during operation (indicating the presence of water in the fuel)
A total of 31 good pumps were received from [redacted] ... with prior damage and ...

6 good pumps received from [redacted] of which ...

The next returns of good pumps from Italy shall begin from DoM 09.2009 in order to check pumps from the period following the use of the critical biodiesel fuel for prior damage.

# 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 sticking cam roller with potential to transfer material to the camshaft can only be produced under load (pressure) and with poor quality fuel.
  Based on the new hypothesis of a sticking cam roller when starting with poor quality fuel, subsequent investigations will concentrate on the differences in pressure build-up/pressure pattern between CP4.1 and CP4.2
  Other measurements are to be carried out on the engine for this purpose. WK 10

# 4. Summary of anti-wear package 1.

In the QALT (High Accelerated Lifetime Test) an error pattern occurs under extremely stringent test conditions (engine speed, temperature, pressure, Arctic diesel or kerosene) that is not known in the field.
This error pattern prevents the calculated improvement in robustness from being proven by anti-wear package 1 (RP1).

➔Further action:

Through analysis of the microgeometries and other reappear tests, proof is to be provided by 3/3/10 that the introduction of the RP1 will not generate any new errors or risks. Production preparations and sampling are running to plan.

On 3/3/2010 a joint broadly-based test program for RP1 will be agreed which, once complete, will enable a decision to be taken about the forthcoming new releases in the Non-responsive content removed market, such as Non-responsive content removed etc.

# 5. Summary of anti-wear package 2 (LLPx)

Objective:

- An additional anti-wear package RP2 is required for rest of the world use. RP2 is a combination of anti-wear package 1 plus a C-coated pump piston plus measures for the improved start-up of the cam roller when starting the engine with poorly lubricating fuel.
- Increased robustness against fuel deposits in the roller support through constructive change to the roller support (open roller support)
- Elimination of differences in increased failure rate from CP4.2 to CP4.1

Hypotheses:

- Cam roller sticks in the roller support
- Cam roller stuck in roller support
- Lubrication impaired by coatings

Further analysis:

- Analyses of the factors influencing build-up of coating, attempts to move forward with biofuel / Arctic diesel / kerosene, schedule to be drawn up by ???

# 5. Summary of anti-wear package 2 (LLPx)

Schedule:

| | |
|---|---|
| → Design of open roller support | complete |
| → Creation of functional sample | WK 9 |
| → Stribeck curves (measurement of frictional coefficients) functional tests | WK 10 |
| → Creation of series construction, inc. clip | WK 10 |
| → Examination of feasibility of implementation in series with previous production technology | WK 10 |
| → Endurance running test program under testing with Biodiesel / Arctic diesel / kerosene | by WK 18 |
| → Creation of a joint secure concept RB/AUDI | ??? |

# 5. Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)** | +** | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Adhesion, Lubrication | - | (-) | +* | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* RP2: Depending on analyses Differences between CP4.2 and CP4.1
and of the result of FCF and WCF test with RP1
Measured to be defined in the next 8 weeks

** piston coated with C (USA)

# Task force summary

- Status of new information since last update on 2/17/2010 (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 cam roller/roller support, 100% avoidance of melt and metal spatter)
   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

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

A further 9 good pumps received from [redacted]
2 out of 9 pumps display previous damage to cam roller and camshaft.
1 of these 2 pumps has significant rust scars on the camshaft. These clearly occurred during operation (indicating the presence of water in the fuel).
A total of 31 good pumps were received from [redacted] ... with prior damage and ...

6 good pumps received from [redacted] of which ...

The next returns of good pumps from [redacted] shall begin from DoM 09.2009 in order to check pumps from the period following the use of the critical biodiesel fuel for prior damage.

# 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 Non-responsive content removed than in Non-responsive content removed
- The MIS 12 (MY08) of CP4.2 is approximately 2 times higher in Non-responsive content removed 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 sticking cam roller with potential to transfer material to the camshaft can only be produced under load (pressure) and with poor quality fuel.
  Based on the new hypothesis of a sticking cam roller when starting with poor quality fuel, subsequent investigations will concentrate on the differences in pressure build-up/pressure pattern between CP4.1 and CP4.2
  Other measurements are to be carried out on the engine for this purpose. WK 10

# 4. Summary of anti-wear package 1.

In the QALT (High Accelerated Lifetime Test) an error pattern occurs under extremely stringent test conditions (engine speed, temperature, pressure, Arctic diesel or kerosene) that is not known in the field.
This error pattern prevents the calculated improvement in robustness from being proven by anti-wear package 1 (RP1).

➔Further action:
Through analysis of the microgeometries and other reappear tests, proof is to be provided by 03.03.10 that the introduction of the RP1 will not generate any new errors or risks. Production preparations and sampling are running to plan.

On 03.03.2010 a joint broadly-based test program for RP1 will be defined which, once complete, will make it possible to assess effectiveness for RoW markets, such as Non-responsive content removed, etc.

# 5. Summary of anti-wear package 2 (LLPx)

Objective:

➔ An additional anti-wear package RP2 is required for rest of the world use. RP2 is a combination of anti-wear package 1 plus a C-coated pump piston plus measures for the improved start-up of the cam roller when starting the engine with poorly lubricating fuel.

- ➔ Increased robustness against fuel deposits in the roller support through constructive change to the roller support (open roller support)
- ➔ Elimination of differences in increased failure rate from CP4.2 to CP4.1

Hypotheses:

- ➔ Cam roller sticks in the roller support
- ➔ Cam roller stuck in roller support
- ➔ Lubrication impaired by coatings

Further analysis:

- ➔ Analyses of the factors influencing build-up of coating, attempts to move forward with biofuel / Arctic diesel / kerosene, schedule to be drawn up by ???

# 5. Summary of anti-wear package 2 (LLPx)

Schedule:

| | |
|---|---|
| ➔ Design of open roller support | complete |
| ➔ Creation of Functional sample | WK 9 |
| ➔ Stribeck curves (measurement of frictional coefficients) functional tests | WK 10 |
| ➔ Creation of series construction, inc. clip | WK 10 |
| ➔ Examination of feasibility of implementation in series with previous production technology | WK 10 |
| ➔ Continuous running test program under testing with Biodiesel / Arctic diesel / kerosene | by WK 18 |
| ➔ Creation of a joint secure concept RB/AUDI | ??? |

# 5. Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)** | +** | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Adhesion, Lubrication | - | (-) | +* | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* RP2: Depending on analyses Differences between CP4.2 and CP4.1
and of the result of FCF and WCF test with RP1
Measured to be defined in the next 8 weeks

** piston coated with C (USA)

# Management summary

- Anti-wear package 1 for increasing robustness with low viscosity and poorly lubricating fuels was released by Audi/Bosch on 3/3/2010.
  Increase in robustness established via Stribeck curves.
  Frictional coefficient with "poor quality fuel" improved by up to 50% at low speeds.
  Fundamental proof of function and service life in QALT proven on test bench.
- Proof of effectiveness in direct comparison with current series is started in other QALTs using boundary same and rest of world fuel.
- Anti-wear package 2 to increase robustness to fuel deposits (biofuel) will be completed according to plan.
  Concentration on temperature differences in the roller support area so as to understand why deposits only occur in the roller support in the case of CP4.2.
- Because of positive experience with good pumps, 10 good pumps are to be obtained from Non-responsive content removed

# Task force summary

- Status of new information since last update on 2/24/2010 (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 melt and metal spatter)
   Implementation decision by RB/AUDI after positive completion of validation
   Release of RP1 by Audi / Bosch on 3.3.2010.
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

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

Status of good pumps: 20 good pumps from [redacted] of which 6 already damaged
7 good pumps from [redacted] 2 of which already damaged
(fine brake plates indicate low viscosity)

The next returns of good pumps from [redacted] shall begin from DoM 09.2009 in order to check pumps from the period following the use of the critical biodiesel fuel for prior damage.

More good pumps requested

10 CP4.2 good pumps, [redacted]
10 CP4.2 good pumps, [redacted]
10 CP4.1 good pumps, [redacted]



Diesel Systems



BOSCH

# 4. Summary of anti-wear package 1.

- Anti-wear package released by Audi/RB on 3/3/2010
  Simultaneous start of improvements, Güntert cam roller with better roughness (rollers are smoother) and optimized form with 13000 cam rollers.

- Robustness at RB with boundary fuel for rest of world validated as standard at the same time as the introduction of the RP1 in WK10.
  The aim is to provide proof of the effectiveness of the current series for fuels used in rest of world.
  Audi creates a schedule for vehicle/engine validation by 10.3.2010

# 5. Summary of anti-wear package 2 (LLPx)

Objective:

- An additional anti-wear package RP2 is required for rest of the world use. RP2 is a combination of anti-wear package 1 plus a C-coated pump piston plus measures for the improved start-up of the cam roller when starting the engine with poorly lubricating fuel.
- Increased robustness against fuel deposits in the roller support through constructive change to the roller support (open roller support)
- Concentration on checking temperature differences CP4.1/CP4.2 to investigate coating build-up with CP4.2 only.

Hypotheses: Based on coating build-up

- Cam roller sticks in the roller support
- Cam roller stuck in roller support
- Lubrication impaired by coatings

Further analysis:

- Analyses of the factors influencing build-up of coating, attempts to move forward with Biofuel / Arctic diesel / kerosene,

# 5. Summary of anti-wear package 2 (LLPx)

Schedule:

| | |
|---|---|
| ➔ Design of open roller support | complete |
| ➔ Creation of functional sample | WK 9 |
| ➔ Stribeck curve (measurement of frictional coefficients) functional tests | WK 10 |
| ➔ Creation of series construction, inc. clip | WK 10 |
| ➔ Examination of feasibility of implementation in series with previous production technology | WK 10 |
| ➔ DL program under testing with Biodiesel/Arctic Diesel / kerosene | by WK 18 |
| ➔ Creation of a joint secure concept RB/AUDI | tbd |

# 5. Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)** | +** | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Adhesion, Lubrication | - | (-) | +* | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* RP2: Depending on analyses Differences between CP4.2 and CP4.1
and of the result of FCF and WCF test with RP1
Measured to be defined in the next 8 weeks

** piston coated with C (USA)

# Management summary

- Anti-wear package 1 for increasing robustness with low viscosity and poorly lubricating fuels was released by Audi/Bosch on 3.3.2010.
  Increase in robustness established via Stribeck curves.
  Frictional coefficient with "poor quality fuel" improved by up to 50% at low speeds.
  Fundamental proof of function and service life in QALT proven on test bench.
- Proof of effectiveness in direct comparison with current series is started in other QALTs using boundary same and rest of world fuel.
- Anti-wear package 2 to increase robustness to fuel deposits (biofuel) will be completed according to plan.
  Concentration on temperature differences in the roller support area so as to understand why deposits only occur in the roller support in the case of CP4.2.
- Because of positive experience with good pumps, 10 good pumps are to be obtained from other Non-responsive content removed countries Non-responsive content removed

# Task force summary

- Status of new information since last update on 2/24/2010 (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 cam roller/roller support, 100% avoidance of melt and metal spatter)
   Implementation decision by RB/AUDI after positive completion of validation
   Release of RP1 by Audi / Bosch on 3/3/2010.
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

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

Status of good pumps: 20 good pumps from [redacted], of which 6 already damaged
7 good pumps from [redacted], 2 of which already damaged
(fine brake plates indicate low viscosity)

The next returns of good pumps from [redacted] shall begin from DoM 09.2009 in order to check pumps from the period following the use of the critical biodiesel fuel for prior damage.

More good pumps requested

10 CP4.2 good pumps, [redacted]
10 CP4.2 good pumps,
10 CP4.1 good pumps,

# 4. Summary of anti-wear package 1.

- Anti-wear package released by Audi/RB on 3.3.2010
  Simultaneous start of improvements, Güntert cam roller with better roughness (rollers are smoother) and optimized form with 13000 cam rollers.

- Robustness at RB with boundary fuel for rest of world validated as standard at the same time as the introduction of the RP1 in WK10.
  The aim is to provide proof of the effectiveness of the current series for fuels used in rest of world.
  Audi creates a schedule for vehicle/engine validation by 10.3.2010

# 5. Summary of anti-wear package 2 (LLPx)

Objective:

- An additional anti-wear package RP2 is required for rest of the world use. RP2 is a combination of anti-wear package 1 plus a C-coated pump piston plus measures for the improved start-up of the cam roller when starting the engine with poorly lubricating fuel.
- Increased robustness against fuel deposits in the roller support through constructive change to the roller support (open roller support)
- Concentration on checking temperature differences CP4.1/CP4.2 to investigate coating build-up with CP4.2 only.

Hypotheses: Based on coating build-up

- Cam roller sticks in the roller support
- Cam roller stuck in roller support
- Lubrication impaired by coatings

Further analysis:

- Analyses of the factors influencing build-up of coating, attempts to move forward with Biofuel / Arctic diesel / kerosene,

# 5. Summary of anti-wear package 2 (LLPx)

Schedule:

| | |
|---|---|
| ➔ Design of open roller support | complete |
| ➔ Creation of functional sample | WK 9 |
| ➔ Stribeck curve (measurement of frictional coefficients) functional tests | WK 10 |
| ➔ Creation of series construction, inc. clip | WK 10 |
| ➔ Examination of feasibility of implementation in series with previous production technology | WK 10 |
| ➔ DL program under testing with Biodiesel / Arctic Diesel / kerosene | by WK 18 |
| ➔ Creation of a joint secure concept RB/AUDI | tbd |

# 5. Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication (+)** | +** | + | | |
| Kerosene | viscosity (+) | + | | | |
| Old biofuel | Adhesion, Lubrication | - | (-) | +* | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* RP2: Depending on analyses Differences between CP4.2 and CP4.1
and of the result of FCF and WCF test with RP1
Measured to be defined in the next 8 weeks

** piston coated with C (USA)

# Management summary (changes marked in blue)

- Anti-wear package 1 for increasing robustness with low viscosity and poorly lubricating fuels was released by Audi/Bosch on 3.3.2010. RB SOP in WK 10/2010, effective at AUDI in WK 11/2010.
  Fundamental proof of function and service life in QALT proven on test bench.
- Effectiveness of RP1 for RoW in direct comparison with current series will be determined with Arctic Diesel in further test bench tests starting start of WK 11/2010.
  Initial information start WK 14/2010
- Anti-wear package 2 not yet fully defined. Measures in preparation to prevent fuel deposits (biofuel) and to balance concept-related differences between V6 and R4 pump.
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from [redacted] countries [redacted].

# Task force summary

- Status of new information since last update on 3/3/2010 (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 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 1.1 (C2 coating, reduced play on roller/roller support, 100% avoidance of fusing and metal spatter, reduced surface roughness of roller and optimized form)
   Implementation decision by RB/AUDI after positive completion of validation
   Release of RP1 by Audi/ Bosch on 3.3.2010, Introduction at Bosch WK 10/10.
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

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

Status of good pumps: 20 good pumps from [redacted] of which 6 already damaged
7 good pumps from [redacted] 2 of which already damaged
(fine braking flats indicate low viscosity)

The next returns of good pumps from [redacted] shall begin from DM 09.2009 in order to check pumps from the period following the use of the critical biodiesel fuel for prior damage.

More good pumps requested

10 CP4.2 good pumps, [redacted]
10 CP4.2 good pumps,
10 CP4.1 good pumps,

# 4. Summary of anti-wear package 1.

- Anti-wear package from Audi/RB released on 3.3.2010.
  RB SOP in WK 10/2010, effective at AUDI in WK 11/2010.
- In order to evaluate the increase in robustness of RP1 in comparison with previous series,
  Endurance running bench tests are carried out with Arctic Diesel starting from 15.03.2010.
  Initial evaluation of results in WK 14/2010.
- Simultaneous start of improvements, Güntert roller with better roughness (rollers are smoother) and optimized form with 13000 rollers.
  Subsequent measurements on the aforementioned batch confirmed the optimized form and improvements in roughness. Task force decision: immediate conversion in series.

# 5. Summary of anti-wear package 2 (LLPx)

Objective:

- An additional anti-wear package RP2 is required for rest of the world use. RP2 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.
- Increased robustness against fuel deposits in the roller support through constructive change to the roller support (open roller support)
- Concentration on checking temperature differences CP4.1/CP4.2 to investigate coating build-up with CP4.2 only.

Hypotheses: Based on coating build-up

- Roller sticks in the roller support
- Roller stuck in roller support
- Lubrication impaired by coatings

Further analysis:

- Analyses of the factors influencing build-up of coating, attempts to move forward with biofuel / arctic diesel / kerosene.

# 5. Summary of anti-wear package 2.

## Schedule **scope** open roller support:

- Design of open roller support complete
- Functional sample produced Week 9
- Stribeck curve (measurement of frictional coefficients) functional tests — WK 10
- Creation of series construction, inc. clip — WK 10
- Examination of feasibility of implementation in series with previous production technology — WK 10
- ER program under testing with biodiesel / arctic Diesel / kerosene — by WK 15

## Summary of anti-wear package 2.

- Definition technology /changes / measures — tbd.
- Creation of a joint secure concept RB/AUDI — tbd.

# 5. Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | Lubrication | (+)** | +** | + | |
| Kerosene | Viscosity | (+) | + | | |
| Old biofuel | Adhesion, Lubrication | - | (-) | +* | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* RP2: Depending on analyses Differences between CP4.2 and CP4.1 and of the result of FCF and WCF test with RP1 Measures to be defined in the next 8 weeks

** C coated piston (USA)

Audi
Vorsprung durch Technik

# Drivetrain damage high-pressure diesel fuel pump CP4.2

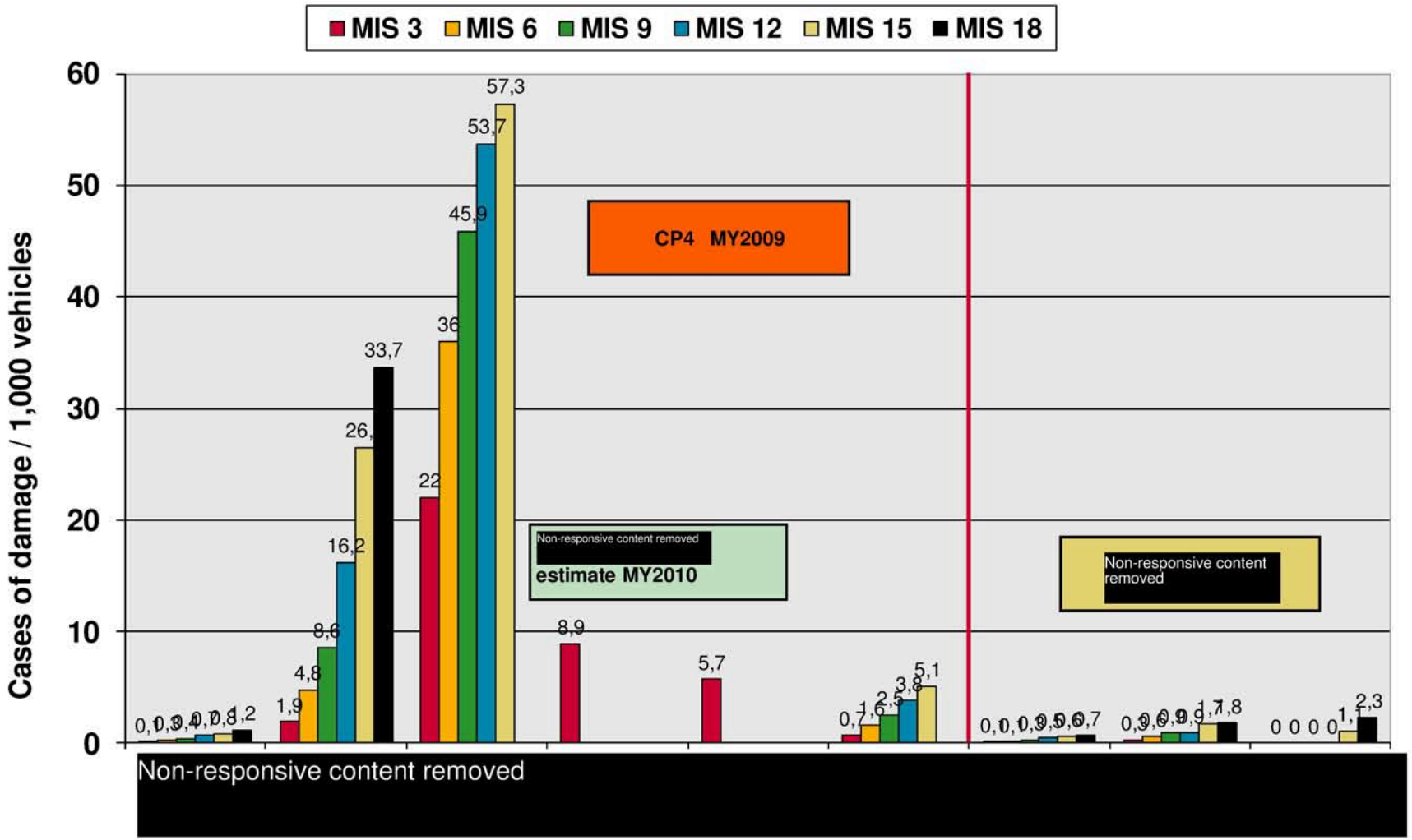
# Drivetrain damage high-pressure diesel fuel pump CP4.2

**Summary:**

- Current damage, Audi:
  - V6-TDI – [redacted] 1,199 cases
  - V8-TDI – 1 case in [redacted]
  - V12-TDI – 3 cases in [redacted]
- Anti-wear package 1 (RP1.1)
  - in series at **Bosch since this week WK10**
  - The effect (thicker film of lubricant) is aimed at fuels with lower viscosity and lubrication
  - Failures [redacted] and EU4 [redacted] with CP4.2 problems will probably be reduced therefore
  - Test rig tests for evaluating the improvement potential RP1 vs. series production start in early WK11.
  - Interim evaluation of the results end of WK14
- Anti-wear package 2 (RP2):
  - Because of the good pumps removed in [redacted] and analyzed at Bosch have existing damage in some cases, it is assumed that a "sticking CP4 roller when the engine is started" is the case.
  - Measures for a better start-up of the roller when starting the engine with poorly lubricating fuel
  - Failure theories for the concept-related differences between CP4.1 and CP4.2 must be confirmed in tests.
- [redacted] → see failure rate page 3.
  - Design studies and deadline planning are in progress.

# Drivetrain damage high-pressure diesel fuel pump CP4.2

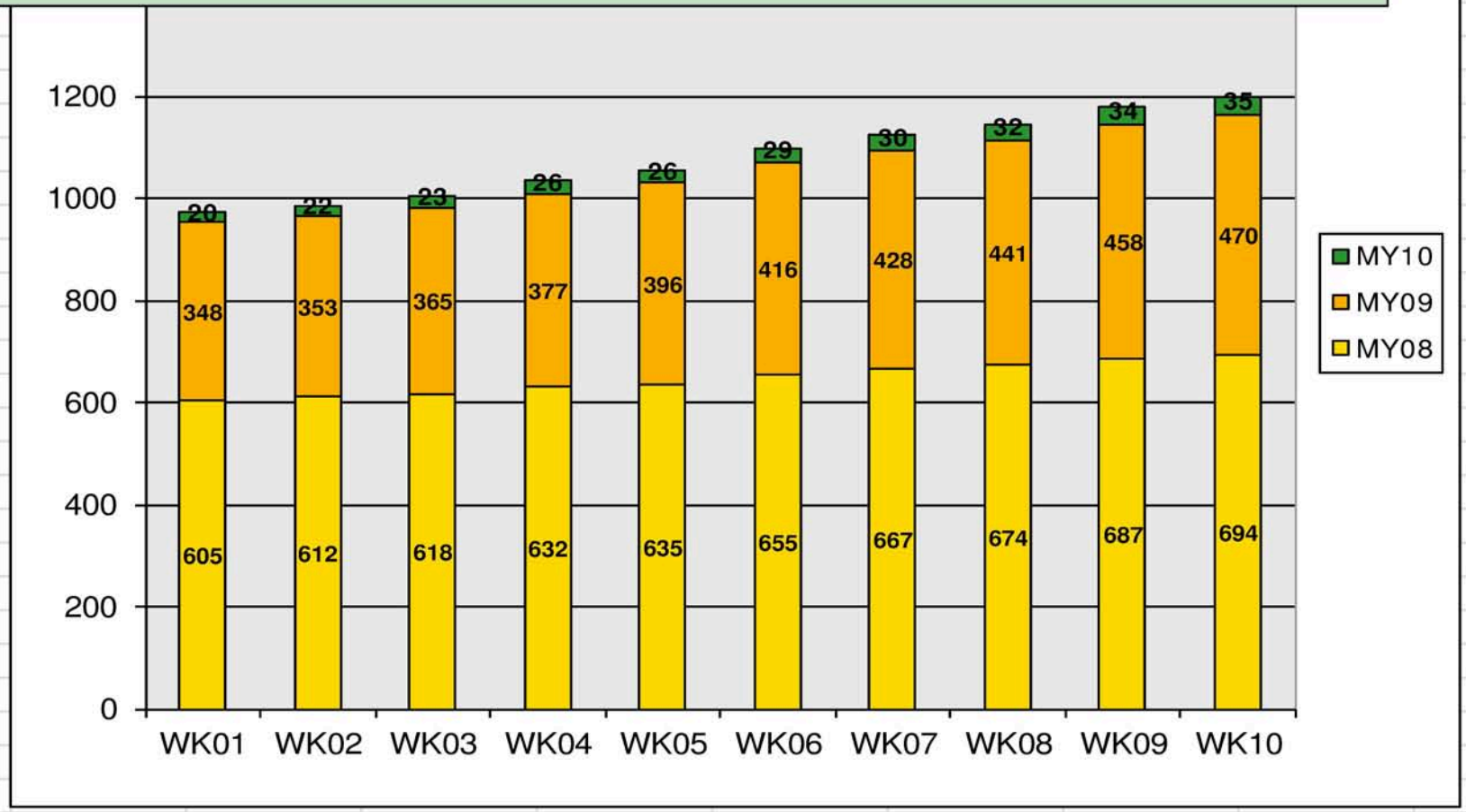
## CP4.2 country comparison - 2009 (*2010) and CP1H model year 2008



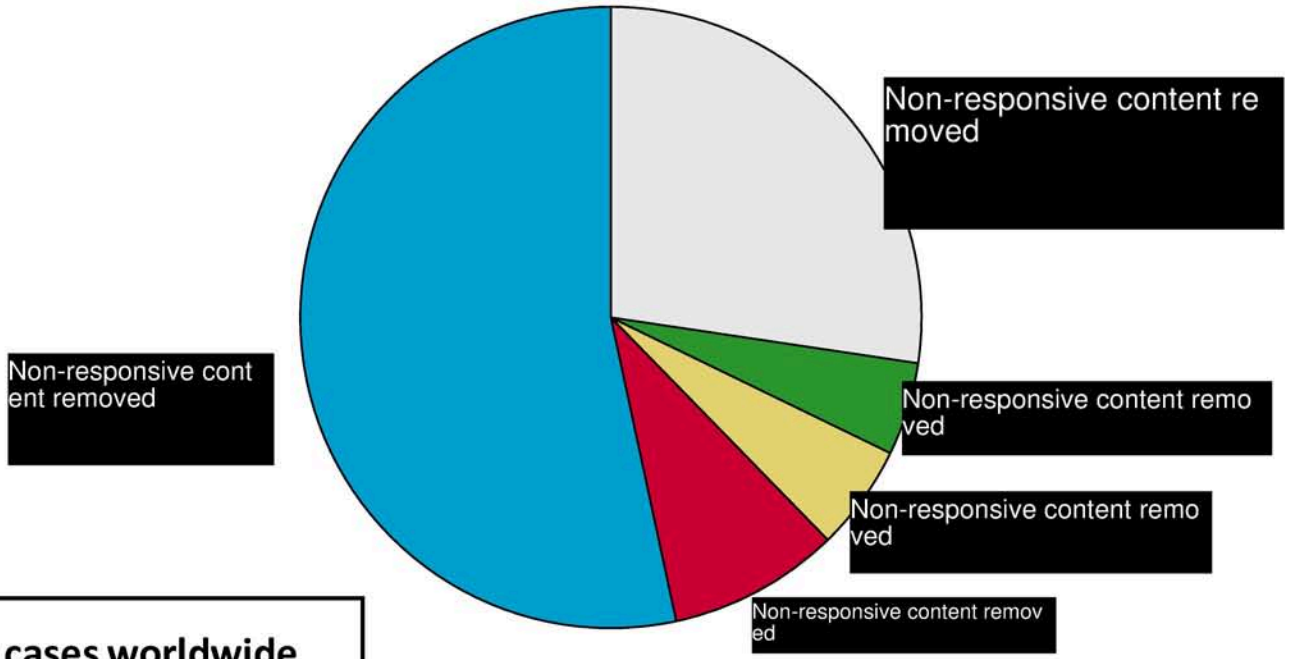
# Drivetrain damage high-pressure diesel fuel pump CP4.2

## Increase in changed high-pressure pumps V6-TDI Audi in the field SAGA by WK....2010

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total | 973 | 987 | 1006 | 1035 | 1057 | 1100 | 1125 | 1147 | 1179 | **1199** |
| Increase: | | +14 | +19 | +29 | +22 | +43 | +25 | +22 | +32 | **+20** |



# Drivetrain damage high-pressure diesel fuel pump CP4.2




**Total 1,199 cases worldwide**
(SAGA, status 03/14/2010)

# Management summary (changes marked in blue)

- Effectiveness of RP1 for RoW in direct comparison with current series will be determined with Arctic diesel in further test bench tests starting start of WK 11/2010.
  Initial information start WK 14/2010
- Anti-wear package 2 not yet fully defined. Measures in preparation to prevent fuel deposits (biofuel) and to balance concept-related differences between V6 and R4 pump.
  Concentration on temperature reduction in the area of the roller support of the CP4.2.
  Deposits can only occur if temperatures rise on a localized basis.
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from [redacted] countries [redacted]
- Summary of the results on 3/22/2010 in Ingolstadt with [redacted]

# Task force summary

- Status of new information since last update on 3/3/2010 (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 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 1.1 (C2 coating, reduced play on cam roller/roller support, 100% avoidance of melt and metal spatter, reduced surface roughness of roller and optimized form)
   Implementation decision by RB/AUDI after positive completion of validation
   Release of RP1 by Audi/ Bosch on 3.3.2010, Introduction at Bosch WK 10/10.
5. Definition of anti-wear package 2. Concentration on temperature reduction in the area of the roller support to reduce risk of deposits

# 1. Summary of analysis

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

Status of good pumps: 26 good pumps from [redacted] of which 6 already damaged
7 good pumps from [redacted], 2 of which already damaged
(fine brake plates indicate low viscosity)

The next returns of good pumps from [redacted] shall begin from DoM 09.2009 in order to check pumps from the period following the use of the critical biodiesel fuel for prior damage. Pumps are under delivery

More good pumps requested

10 CP4.2 good pumps, [redacted]
10 CP4.2 good pumps, [redacted]

# 4. Summary of anti-wear package 1.

- Anti-wear package from Audi/RB released on 3/3/2010.
  RB SOP in WK 10/2010, effective at AUDI in WK 11/2010.4
- In order to evaluate the increase in robustness of RP1 in comparison with previous series, continuous test bench tests are carried out with Arctic diesel starting from 15.03.2010.
  Initial evaluation of results in WK 14/2010.
- Simultaneous start of improvements, Güntert cam roller with better roughness (rollers are smoother) and optimized form with 13000 cam rollers. Subsequent measurements on the aforementioned batch confirmed the optimized form and improvements in roughness. Task force decision: immediate conversion in series.

# 5. Summary of anti-wear package 2.

Objective:

- An additional anti-wear package RP2 is required for rest of the world use. RP2 is a combination of anti-wear package 1 plus a C-coated pump piston plus measures for the improved start-up of the cam roller when starting the engine with poorly lubricating fuel.
- Increased robustness against fuel deposits in the roller support through constructive change to the roller support (open roller support)
- Concentration on checking temperature differences CP4.1/CP4.2 to investigate coating build-up with CP4.2 only.
- Hypotheses: Based on coating build-up
- Cam roller sticks in the roller support
- Lubrication impaired by deposits (reinforcement factor)

Further analysis:

- Concentration on reducing the fuel temperature in the area of the roller support of the CP4.2, clockwise rotation.

# 5. Summary of anti-wear package

➔ Various failure mechanisms are responsible for the failure in the different markets:

1. Markets with poor lubrication and viscosity
   The effective remedy is to increase the lubrication gap between the cam roller and roller support (contents of RP1).
   Increasing the lubrication gap also reduces the temperature and supports RP2.

2. Markets with build-up of deposits primarily from biofuels, but also additives
   One effective remedy is to reduce the temperature on the roller support.
   Mixed friction can lead to a major localized increase.
   (contents of RP2)

# 5. Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)** | +** | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Sticking,... | - | (-) | +* | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* RP2: Depending on analyses Differences between CP4.2 and CP4.1
and of the result of FCF and WCF test with RP1
Measured to be defined in the next 8 weeks

** piston coated with C (USA)

# Management summary (changes marked in blue)

- Effectiveness of RP1 for RoW in direct comparison with current series will be determined with Arctic diesel in further test benches starting start of WK 11/2010.
  Initial information start WK 15/2010
- 3 possible part scopes for anti-wear package 2 (see slides 5+6) are defined with the aim of significantly reducing the temperature on the roller support so that no fuel deposits can occur (biofuel).
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other Non-responsive content removed Non-responsive content removed
- Summary of the results on 3/22/2010 in Ingolstadt with Non-responsive content removed
  Confirmation of the procedure with RP1 and RP2.
  Evaluation of increase in robustness with RP1 by WK 15, first functional results and evidence for RP2 in WK 15.
  AUDI requires a roadmap for future pump generations from RB (higher pressure).

**Description of problem:**

We have two different problems that require different measures in the field

1. [redacted] new information

   Mixed friction in the roller support leads to high localized temperatures
   The cause of the mixed friction can be the quality of the fuel, poor ventilation and poor lubrication.
   Deposits occur as a result of the high temperatures due to poor quality biodiesel or additives in the roller support which cause the cam roller to stick in the roller support when it starts.
   CP4.1 pumps from [Non-responsive content removed] do not have these deposits (evaluation from failure pumps)
   Overload tests (Arctic diesel, 2300 bar, 90 °C, 600 rpm) indicate the same effect. Clockwise rotating CP4.2 displays previous damage to the right roller support in 5 out of 6 good pumps with deposits.
   Anti-clockwise rotating pumps are far less affected (8/12 cylinders)

## Description of problem:

2. Non-responsive content removed

In fuels with low viscosity and/or lubrication properties e.g. kerosene, water in fuel, Arctic diesel, etc. the hydrodynamic film of lubricant is significantly reduced, which primarily leads to fatigue in the roller in the roller support because the roller/roller support system runs under mixed friction for a long time.

Good pumps from Non-responsive content removed display no deposits and, in the case of failed pumps, almost always feature abrasive wear rather than turned tappets.

# Status of task force on 3/22/2010

**RP1** measures to increase the lubrication gap in the roller support with lower viscosity and poor lubrication properties
(RP1 also reduces the temperature in the roller support, proven with Q alt Arctic diesel test, no deposits like those on CP4.1 with C2)

- Reduction in roughness in the roller support due to changeover to C2 coating
- Secure prevention of metal spatter
- Reduction of play between cam roller and roller support
- Reduction in roughness of cam roller
- Optimization of the slope of the edge on the cam roller (slackening)

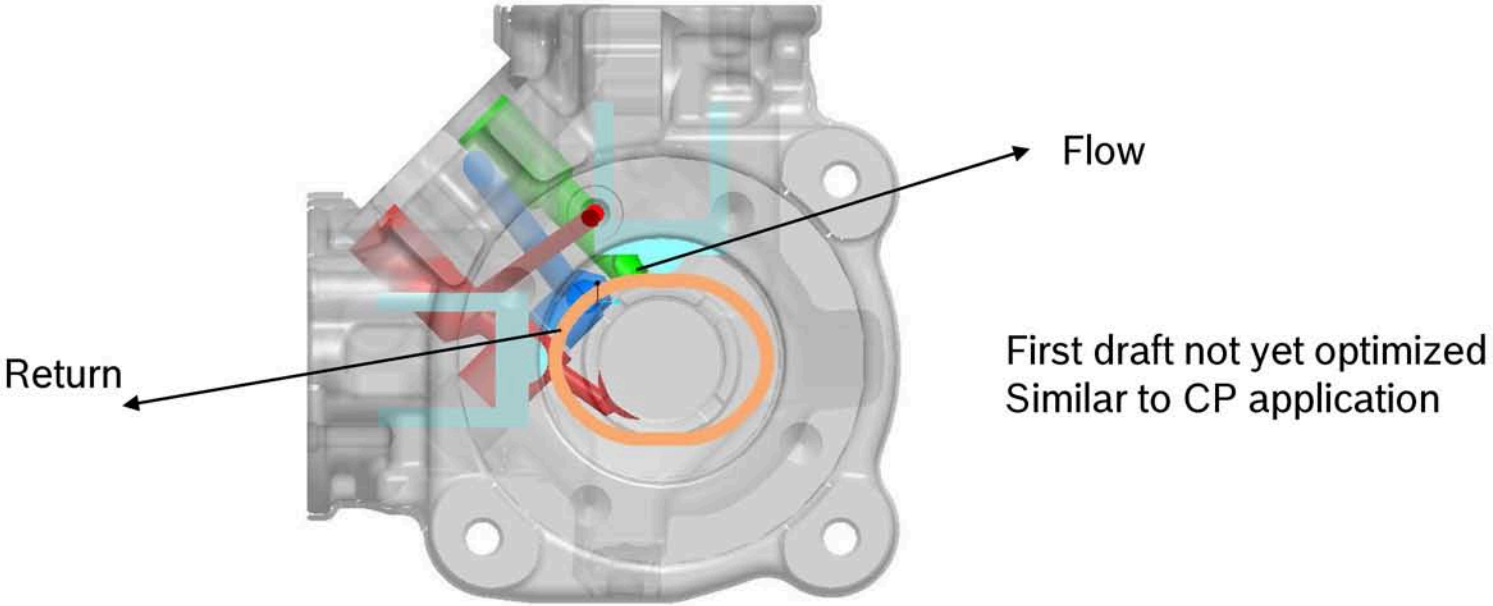
RP1 introduced at RB starting from WK 10
Effective at Audi starting from WK 12

Effectiveness proven in individual parts
Increase in lubrication gap proven
**Statistical verification with a total of 12 pumps by the end of WK 14** in Qalt endurance run
(2300 bar, 600 rpm, 90 °C Arctic diesel)

**RP2** measures to reduce the temperature in the CP4.2

1. Better local cooling of the critical roller support with fuel
   (inlet moved to the temperature critical point)
   Establishment of a similar status for flow/return as in CP4.1
2. Examination of volume balance via cam follower compensation hole
3. Increase the internal pressure in the pump against exhaust gases from fuels with lower boiling points (kerosene, petrol mix)



# Status of task force on 3/22/2010

**RP2** measures to reduce the temperature in the CP4.2
First estimate:

1. Better local cooling of the critical roller support with fuel
   (inlet moved to the temperature critical point)
   Establishment of a similar status for flow/return as in CP4.1

| | |
|---|---|
| 1. Functional checks (pump, system) | 4 weeks |
| 3. Development of a test for quality of old biofuel, kerosene | parallel |
| 2. Evidence of effectiveness in quality of old biofuel, kerosene | 8 weeks |
| 3. Implementation of production | 3 months after function |
| | **Total, 4 months** |

2. Examination of volume balance via tappet hole
   Is checked and implemented at the same time the flow line is laid
3. Increase the internal pressure in the pump against exhaust gases from fuels with lower boiling points (kerosene, petrol mix)

| | |
|---|---|
| 1. Functional checks (pump, system) | 4 weeks |
| 2. Function in combination with optimized flow line | 1 week |
| 2. Evidence of effectiveness. quality of old fuel, cavitation | 8 weeks |
| 3. 500h stress test for shaft seal | 3 months after function |
| 3. Production implementation | 1 month in parallel |
| | **Total, 4 months** |

**Adequate customer sample after functional tests by RB after 4 weeks**

# Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)** | +** | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Sticking,... | - | (-) | +* | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* RP2: Depending on analyses Differences between CP4.2 and CP4.1
and of the result of FCF and WCF test with RP1
Measured to be defined in the next 8 weeks

** piston coated with C (USA)

# Management summary (changes marked in blue)

- Effectiveness of RP1 for RoW in direct comparison with current series will be determined with Arctic diesel in further test bench tests starting start of WK 11/2010.
  Initial information start WK 14/2010
- Anti-wear package 2 not yet fully defined. Measures in preparation to prevent fuel deposits (biofuel) and to balance concept-related differences between V6 and R4 pump.
  Concentration on temperature reduction in the area of the roller support of the CP4.2.
  Deposits can only occur if temperatures rise on a localized basis.
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other Non-responsive content removed
- Summary of the results on 22.3.2010 in Ingolstadt with Non-responsive content removed
  The packages of measures RP1 and RP2 have been confirmed.
  Proof of the effectiveness of RP1 as well as the endurance running test (12 pumps) will be discussed on 16.04.2010 with Non-responsive content removed
  Initial investigations to prove the effectiveness of RP2 will be shown.

# Task force summary

- Status of new information since last update on 3/17/2010 (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 1.1 (C2 coating, reduced play on cam roller/roller support, 100% avoidance of melt and metal spatter, reduced surface roughness of roller and optimized form)
   Implementation decision by RB/AUDI after positive completion of validation
   Release of RP1 by Audi/ Bosch on 3.3.2010, Introduction at Bosch WK 10/10.
5. Definition of anti-wear package 2. Concentration on temperature reduction in the area of the roller support to reduce risk of deposits

# 1. Summary of analysis

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

Status of good pumps: 26 good pumps from [redacted] 7 of which already damaged
of which 13 with smoothing
7 good pumps from [redacted] 2 already damaged
(fine brake plates indicate low viscosity)

The next returns of good pumps from [redacted] shall begin from DoM 09.2009 in order to check pumps from the period following the use of the critical biodiesel fuel for prior damage.
More good pumps requested 10 CP4.2 good pumps, [redacted]
10 CP4.2 good pumps, [redacted]

- New evaluations of field failure data indicate a massive decrease in failures since DoM July 2009, also in [redacted] data is up-to-date) Total of 56 failures known since pump DoM 7/2009.

# 4. Summary of anti-wear package 1.

- Anti-wear package from Audi/RB released on 3/372010.
  RB SOP in WK 10/2010, effective at AUDI in WK 11/2010.
- In order to evaluate the increase in robustness of RP1 in comparison with previous series, endurance running bench tests are carried out with Arctic diesel starting from 3/15/2010.
  Initial evaluation of results in WK 14/2010.
- Simultaneous start of improvements, Güntert cam roller with better roughness (rollers are smoother) and optimized form with 13000 cam rollers.
  Subsequent measurements on the aforementioned batch confirmed the optimized form and improvements in roughness. Task force decision: immediate conversion in series.

# 5. Summary of anti-wear package 2.

Objective:

- An additional anti-wear package RP2 is required for rest of the world use. RP2 is a combination of anti-wear package 1 plus a C-coated pump piston plus measures for the improved start-up of the cam roller when starting the engine with poorly lubricating fuel.
- Increased robustness against fuel deposits in the roller support through constructive change to the roller support (open roller support)
- Concentration on checking temperature differences CP4.1/CP4.2 to investigate coating build-up with CP4.2 only.

Hypotheses: Based on coating build-up

- Cam roller sticks in the roller support
- Lubrication impaired by deposits (reinforcement factor)

Further analysis:

Concentration on reducing the fuel temperature in the area of the roller support of the CP4.2, clockwise rotation.

# 5. Summary of anti-wear package

- Various failure mechanisms are responsible for the failure in the different markets:

1. Markets with poor lubrication and viscosity
   The effective remedy is to increase the lubrication gap between the cam roller
   and roller support
   Increasing the lubrication gap also reduces the temperature
   and supports RP2

2. Markets with build-up of deposits primarily from biofuels, but also additives
   One effective remedy is to reduce the temperature on the roller support. Mixed friction can lead to a major localized increase. (contents of RP2)

# 5. Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | | (+)* | +* | + |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Sticking,... | - | (-) | + | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* piston coated with C (USA)

# Management summary (changes marked in blue)

- Effectiveness of RP1 for [redacted] in direct comparison with current series will be determined with Arctic diesel in further test bench tests starting start of WK 11/2010. Initial information start WK 15/2010.
- Anti-wear package 2 will be definitively define by end WK16 and mainly consists of measures to reduce the temperature on the roller support of the clockwise V6-TDI 2-piston pump (purging less good than with anti-clockwise or 1-piston pump), C coating on piston, RP1 and possible increase in pressure level in low pressure circuit.
  Key points of the schedule are defined.
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from [redacted]
- Significant reduction in CP4.2 failures in [redacted] from DoM pump July 09 (see slide 9).
- First returns from [redacted] (AUDI Q verification run) indicate major build-up of deposits, heavier than [redacted] and blocking strips on the cam roller.
- Latest analyses indicate that the deposits on [redacted] pumps may consist of degradation products from additives

# Task force summary

- Status of new information since last update on 3/24/2010 (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 robustness package 1.1 (C2 coating, reduced play on roller/roller support, 100% avoidance of melt and metal spatter, reduced surface roughness of roller and optimized form))
   Implementation decision by RB/AUDI after positive completion of validation
   Release of RP1 by Audi/ Bosch on 3.3.2010, Introduction at Bosch WK 10/10.
5. Definition of anti-wear package 2. Concentration on temperature reduction in the area of the roller support to reduce risk of deposits

## 1. Summary of analysis

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

Status of good pumps: 26 good pumps from [redacted] 7 of which already damaged
of which 13 with smoothing
7 good pumps from [redacted], 2 already damaged
(fine brake plates indicate low viscosity)

The next returns of good pumps from [redacted] shall begin from DoM 09.2009 in order to check pumps from the period following the use of the critical biodiesel fuel for prior damage.

More good pumps requested
10 CP4.2 good pumps, [redacted]
10 CP4.2 good pumps, [redacted]

- New evaluations of field failure data indicate a massive decrease in failures since DoM July 2009, also in [redacted] data is up-to-date) Total of 6 failures known since pump DoM 7/2009.

# 4. Summary of anti-wear package 1.

- Anti-wear package from Audi/RB released on 3/3/2010.
  RB SOP in WK 10/2010, effective at AUDI in WK 11/2010.
- In order to evaluate the increase in robustness of RP1 in comparison with previous series, edurance running bench tests are carried out with Arctic diesel starting from 15.03.2010.
  Initial evaluation of results in WK 14/2010.
- Simultaneous start of improvements, Güntert cam roller with better roughness (rollers are smoother) and optimized form with 13000 cam rollers. Subsequent measurements on the aforementioned batch confirmed the optimized form and improvements in roughness. Task force decision: immediate conversion in series.

# 5. Summary of anti-wear package 2.

Objective:

- An additional anti-wear package RP2 is required for rest of the world. RP2 is a combination of anti-wear package 1 plus a C-coated pump piston plus measures for the improved start-up of the cam roller when starting the engine with poorly lubricating fuel.
- Package of measures:
  Relocation of the feed in pump interior
  Introduction of a robust flange (more internal volume)
- Key points of schedule:
  Proof of function (temperature measurements on roller support) and final definition of RP2 by WK 16
  Test bench test RP2 (endurance run) by WK 24
  Ready for production by WK 28
  Verification and validation by AUDI under clarification

# 5. Summary of anti-wear package

- Various failure mechanisms are responsible for the failure in the different markets:

1. Markets with poor lubrication and viscosity
   The effective remedy is to increase the lubrication gap between the cam roller
   and roller support
   Increasing the lubrication gap also reduces the temperature
   and supports RP2

2. Markets with additives in fuel
   ➔ I disagree: Delete this section!

# 5. Summary of robustness package

- **Delete the whole slide – not finalized!**
- **Procedure for RoW release**

  Different - possibly alternating - fuel conditions currently do not allow national releases by Bosch (see [redacted]
  environmental influences must be tested and verified through continuous vehicle tests @ OEM (water, height, temperatures, etc.)

- **That is why RB release* involves tested boundary fuels (incl. RoW fuel)**

| | |
|---|---|
| Viscosity | -> Arctic diesel |
| Additives | -> Arctic diesel |
| Biofuels | -> open |
| Lubrication | -> GDK650 |
| Vapour pressure | -> Kerosene |
| RoW fuel_1 | -> Combination viscosity, lubrication, vapour pressure, water (no additives) |

*Same as current release process Release for tested fuel EN590 and not national release, e.g. Germany

# 5. Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)* | +* | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Sticking,... | - | (-) | + | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* piston coated with C (USA)

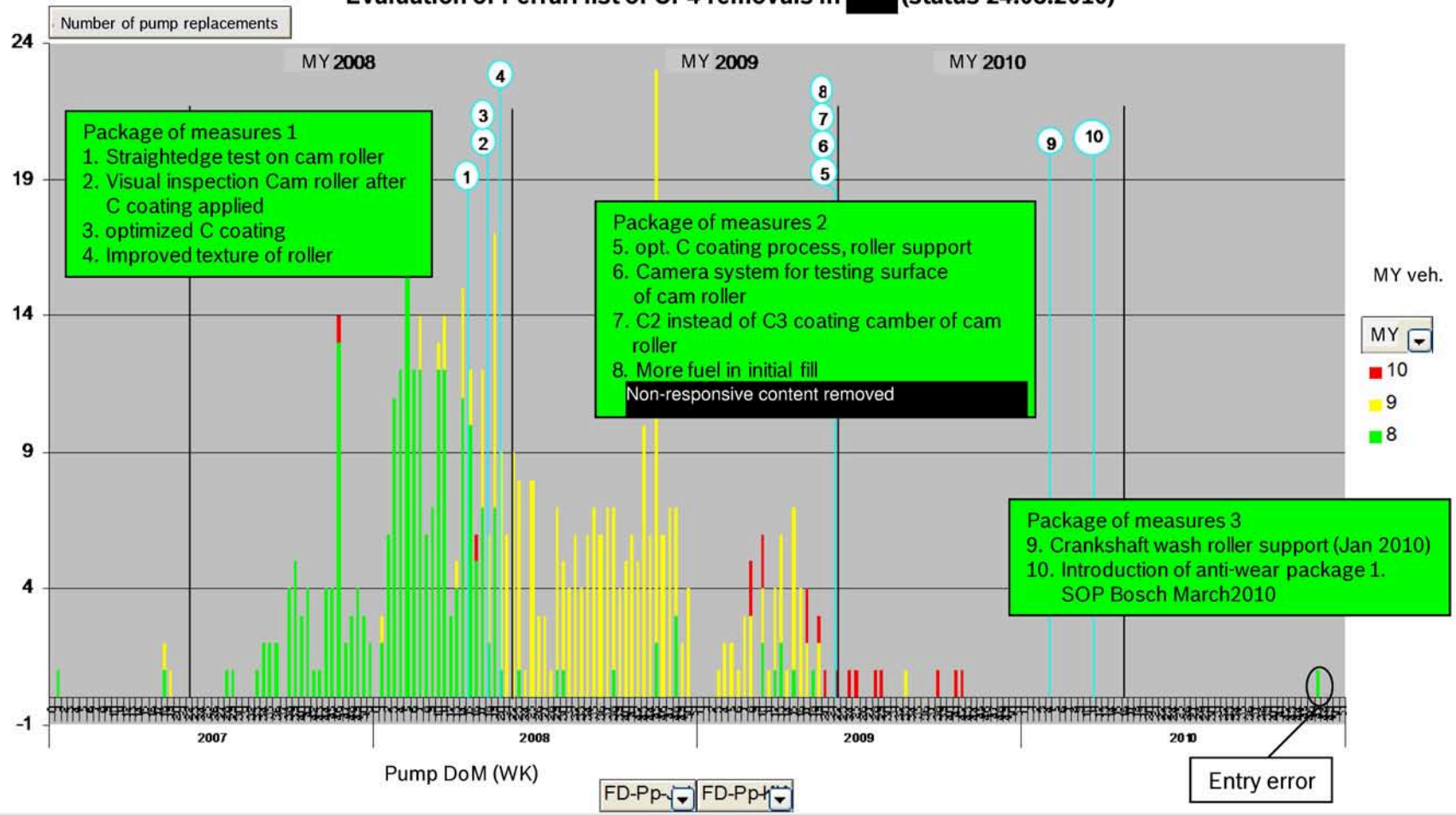
# AUDI-CP4 Situation in the field in [redacted]



3/31/2010

Engine (all) Model (all)

## Evaluation of Ferrari list of CP4 removals in [redacted] (status 24.03.2010)








BOSCH

# Management summary (changes marked in blue)

- Effectiveness of RP1 for RoW in direct comparison with current series will be determined with Arctic diesel in further test bench tests starting start of WK 11/2010.
  Initial information start WK 14/2010
- Anti wear package 2 is defined as a concept and mainly involves steps to reduce the temperature on the roller support of the clockwise rotating pump (poorer purging than in the anticlockwise pump).
  Key points of the schedule are defined.
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other [redacted]
- Significant reduction in CP4.2 failures in [redacted] from FD pump July 09 (see slide 9).
- First returns from [redacted] (AUDI Q verification run) show strong build-up of coating, similar to [redacted]
- Latest analyses indicate that the deposits consist of degradation products from additives.

# Task force summary

- Status of new information since last update on 3/24/2010 (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 1.1 (C2 coating, reduced play on cam roller/roller support, 100% avoidance of melt and metal spatter, reduced surface roughness of roller and optimized form)
   Implementation decision by RB/AUDI after positive completion of validation
   Release of RP1 by Audi/ Bosch on 3/3/2010, Introduction at Bosch WK 10/10.
5. Definition of anti-wear package 2. Concentration on temperature reduction in the area of the roller support to reduce risk of deposits

# 1. Summary of analysis

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

Status of good pumps: 26 good pumps from [redacted] 7 of which already damaged
of which 13 with smoothing
7 good pumps from [redacted] 2 already damaged
(fine brake plates indicate low viscosity)

The next returns of good pumps from [redacted] shall begin from DoM 09.2009 in order to check pumps from the period following the use of the critical biodiesel fuel for prior damage.

More good pumps requested 10 CP4.2 good pumps, [redacted]
10 CP4.2 good pumps, [redacted]

- New evaluations of field failure data indicate a massive decrease in failures since DoM July 2009, also in [redacted] data is up-to-date) Total of 6 failures known since pump DoM 7/2009.

# 4. Summary of anti-wear package 1.

- Anti-wear package from Audi/RB released on 3/3/2010.
  RB SOP in WK 10/2010, effective at AUDI in WK 11/2010.
- In order to evaluate the increase in anti-wear of RP1 in comparison with previous series, endurance running bench tests are carried out with Arctic diesel starting from 3/15/2010.
  Initial evaluation of results in WK 14/2010.
- Simultaneous start of improvements, Güntert cam roller with better roughness (rollers are smoother) and optimized form with 13000 cam rollers.
  Subsequent measurements on the aforementioned batch confirmed the optimized form and improvements in roughness. Task force decision: immediate conversion in series.

# 5. Summary of anti-wear package 2.

Objective:

➔ An additional anti-wear package RP2 is required for rest of the world. RP2 is a combination of anti-wear package 1 plus a C-coated pump piston plus measures for the improved start-up of the cam roller when starting the engine with poorly lubricating fuel.

➔ Package of measures:

Relocation of the feed in pump interior

Introduction of a robust flange (more internal volume)

➔ Key points of schedule:

| | |
|---|---|
| Proof of function (temperature measurements on roller support) | by WK 16 |
| Test bench test RP2 (endurance run) | by WK 24 |
| Ready for production | by WK 28 |

Verification and validation by AUDI at the same time





BOSCH

# 5. Summary of anti-wear package

- Various failure mechanisms are responsible for the failure in the different markets:

1. Markets with poor lubrication and viscosity
   The effective remedy is to increase the lubrication gap between the cam roller and roller support (contents of RP1).
   Increasing the lubrication gap also reduces the temperature and supports RP2

2. Markets with additives in fuel
   Latest analyses indicate that the deposits consist of degradation products from additives to the fuel.
   It is probable that additives were added in Italy at introduction B7.

# 5. Summary of anti wear-package

- **Procedure for RoW release**

  Different - possibly alternating - fuel conditions currently do not allow national releases by Bosch (see [redacted]) environmental influences must be tested and verified through continuous vehicle tests @ OEM (water, height, temperatures, etc.)

- **That is why RB release* involves tested boundary fuels (incl. RoW fuel)**

| | |
|---|---|
| Viscosity | -> Arctic diesel |
| Additives | -> Arctic diesel |
| Biofuels | -> open |
| Lubrication | -> GDK650 |
| Vapour pressure | -> Kerosene |
| RoW fuel_1 | -> Combination viscosity, lubrication, vapour pressure, water (no additives) |

*Same as current release process Release for tested fuel EN590 and not national release, e.g. [redacted]

# 5. Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)* | +* | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Sticking,... | - | (-) | + | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* piston coated with C (USA)





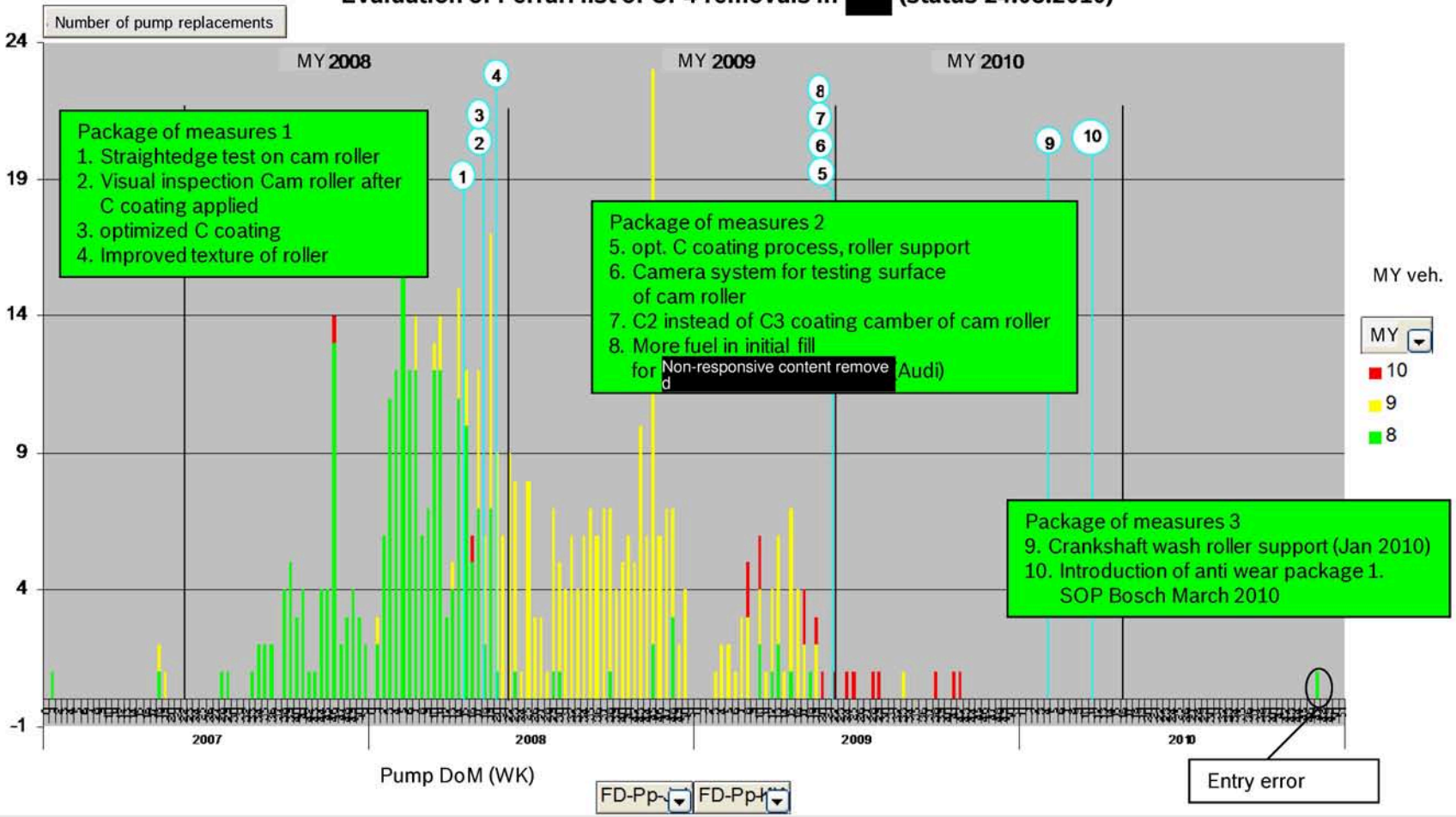
BOSCH

# AUDI-CP4 Situation in the field in [redacted]

3/31/2010

Engine (all) Model (all)

## Evaluation of Ferrari list of CP4 removals in [redacted] (status 24.03.2010)








BOSCH

# Management summary (changes marked in blue)

- Effectiveness of RP1 for rest of world in direct comparison on the basis of other test benches at RB, proven
- Anti-wear package 2 design confirmed. Temperature benefit will be proven by WK 17.
- It has been proven that the temperature on the Audi CP4.2, clockwise rotation, is 15-20 °C higher on the right roller support than on the anticlockwise pump and CP4.1.
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other [redacted]
- Clear decline in CP4.2 failures in [redacted] from FD pump, July 09
  First returns from [redacted] (AUDI Q assurance pass) show strong build-up of coating, stronger than in [redacted] and blocking strips on cam roller.
- Latest analyses indicate that the deposits on [redacted] pumps may consist of degradation products from additives
- Meeting in Ingolstadt on 4/16/2010 confirms further procedure with RP2.
  Release procedure for RoW was presented.
  It was proposed that the risk should be shared until testing is complete.

# Task force summary

- Status of new information since last update on 3/31/2010 (changes in blue):

RP1 introduced and effectiveness proven
RP2 design defined, proof of effectiveness and detailed schedule for series implementation planned
Earliest RB SOP in WK 28
Further investigations into the influence of the camshaft geometry and surface are running until WK 19 and are also to be tested in QHALT2.
Audi will produce an engine and vehicle verification plan.

# Summary of anti-wear package 2.

Objective:

➔An additional anti-wear package RP2 is required for rest of the world. RP2 is a combination of anti-wear package 1 plus a C-coated pump piston plus measures for the improved start-up of the cam roller when starting the engine with poorly lubricating fuel.

➔Package of measures:

Relocation of the feed in pump interior

Introduction of a robust flange (more internal volume)

➔Key points of schedule:

Proof of function (temperature measurements on roller support)

and final definition of RP2 by WK 17

Test bench test RP2 (QHALT2 ) by WK 24

Ready for production by WK 28

Verification and validation by AUDI under discussion

# Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)* | +* | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Sticking,... | - | (-) | + | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* piston coated with C (USA)

# Management summary (changes marked in blue)

- Effectiveness of RP1 for Non-responsive content removed in direct comparison on the basis of other test benches at RB, proven
- Anti-wear package 2 design confirmed. Temperature benefit will be proven by WK 17.
- It has been proven that the temperature on the Audi CP4.2, clockwise rotation, is 15-20 °C higher on the right roller support than on the anticlockwise pump and CP4.1.
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other Non-responsive content removed
- Clear decline in CP4.2 failures in [redacted] from FD pump, July 09
  First returns from Non-responsive content removed (AUDI Q assurance pass) show strong build-up of coating, stronger than in [redacted] and blocking strips on cam roller.
- Latest analyses indicate that the deposits on Italian pumps may consist of degradation products from additives
- Meeting in Ingolstadt on 4/16/2010 confirms further procedure with RP2.
  Release procedure for RoW was presented.
  It was suggested that risk should be shared until the end of testing, no agreement on this with AUDI to date.

# Task force summary

- Status of new information since last update on 3/31/2010 (changes in blue):

RP1 introduced and effectiveness proven
RP2 design defined (please specify RP2 measures, including OV). Proof of effectiveness and detailed schedule
for series implementation planned
Earliest RB SOP in WK 28
RP2 requires ZP4 changes to the engine and is therefore not reverse compatible unless other engine parts are replaced. Scope and schedule under discussion at AUDI
Further investigations into the influence of the camshaft geometry and surface are running until WK 19 and are also to be tested in QHALT2.
Audi will produce an engine and vehicle verification plan.

# Summary of anti-wear package 2.

Objective:

- An additional anti-wear package RP2 is required for rest of the world. RP2 is a combination of anti-wear package 1 plus a C-coated pump piston plus measures for the improved start-up of the cam roller when starting the engine with poorly lubricating fuel.
- Package of measures:
  Relocation of the feed in pump interior
  Introduction of a robust flange (more internal volume)
- Key points of schedule:
  Proof of function (temperature measurements on roller support) and final definition of RP2 — by WK 17
  Test bench test RP2 (QHALT2 ) — by WK 24
  Ready for production — by WK 28
  Verification and validation by AUDI under discussion

# Summary of anit-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)* | +* | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Sticking,... | - | (-) | + | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* piston coated with C (USA)

# Management summary (changes marked in blue)

- Effectiveness of RP1 [redacted] in direct comparison on the basis of other test benches at RB, proven
- Anti-wear package 2 design confirmed. Temperature benefit will be proven by WK 17.
- It has been proven that the temperature on the Audi CP4.2, clockwise rotation, is 15-20 °C higher on the right roller support than on the anticlockwise pump and CP4.1.
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other [redacted]
- Clear decline in CP4.2 failures in [redacted] from FD pump, July 09
  First returns from [redacted] (AUDI Q assurance pass) show strong build-up of coating, stronger than in [redacted] and blocking strips on cam roller.
- Latest analyses indicate that the deposits on [redacted] pumps may consist of degradation products from additives
- Meeting in Ingolstadt on 16.4.2010 confirms further procedure with RP2.
  Release procedure for RoW was presented.
  It was suggested that risk should be shared until the end of testing, no agreement on this with AUDI to date.

# Task force summary

- Status of new information since last update on 3/31/2010 (changes in blue):

RP1 introduced and effectiveness proven
RP2 design defined, (optimized flow / return position to reduce the roller support temperature, robust flange, C coating on pump piston). An optimized overflow valve is integrated in the verification concept.
Proof of effectiveness and detailed schedule for series implementation planned.
Earliest RB SOP in WK 28
RP2 requires ZP4 changes to the engine and is therefore not reverse compatible unless other engine parts are replaced. Scope and schedule under discussion at AUDI
Further investigations into the influence of the camshaft geometry and surface are running until WK 19 and are also to be tested in QHALT2.
Audi will produce an engine and vehicle verification plan.

# Summary of anti-wear package 2.

Objective:

- An additional anti-wear package RP2 is required for rest of the world. RP2 is a combination of anti-wear package 1 plus a C-coated pump piston plus measures for the improved start-up of the cam roller when starting the engine with poorly lubricating fuel.
- Package of measures:
  Relocation of the feed in pump interior
  Introduction of a robust flange (more internal volume)
- Key points of schedule:

| | |
|---|---|
| Proof of function (temperature measurements on roller support) and final definition of RP2 | by WK 17 |
| Test bench test RP2 (QHALT2 ) | by WK 24 |
| Ready for production | by WK 28 |
| Verification and validation by AUDI under discussion | |

# Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)* | +* | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Sticking,... | - | (-) | + | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* piston coated with C (USA)

# Management summary (changes marked in blue)

- Effectiveness of anti-wear package 2 proven by temperature measurements.
- Preparation for production on the basis of the defined design for RP2
  Started for RB and Audi
- Effectiveness of RP1 for rest of world in direct comparison on the basis of other test benches at RB, proven
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other [redacted]
- Clear decline in CP4.2 failures in [redacted] from FD pump, July 09
  First returns from [redacted] (AUDI Q assurance pass) show strong build-up of coating, stronger than in [redacted] and blocking strips on cam roller
- Latest analyses indicate that the deposits on [redacted] pumps consist of degradation products from additives
- It was suggested that risk should be shared until the end of testing, no agreement on this with AUDI to date.
- Suggestion from task force meeting: Report should be produced every 14 days instead of every 7 days

# Task force details as backup

- Status of new information since last update on 4/21/2010 (changes in blue):

RP1 introduced and effectiveness proven.
RP2 design defined, (optimized flow / return position to reduce the roller support temperature, robust flange, C coating on pump piston). Effectiveness proven through temperature measurements. Detailed scheduling for series implementation planned
Earliest RB SOP in WK 28.
An optimized overflow valve is integrated in the verification concept. The behaviour of the valve was reproduced through simulation and appropriate measures are derived and defined from this. Implementation dates are under discussion.

RP2 requires ZP4 changes to the engine and is therefore not reverse compatible unless other engine parts are replaced. Scope and schedule under discussion at AUDI.
Further investigations into the influence of the camshaft geometry and surface are running until WK 19 and are also to be tested in QHALT2.
Audi will produce an engine and vehicle verification plan.

# Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)* | +* | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Sticking,... | - | (-) | + | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* piston coated with C (USA)

# Management summary (changes marked in blue)

- Effectiveness of anti-wear package 2 proven by temperature measurements.
- Preparation for production on the basis of the defined design for RP2
  Started for RB and Audi
- Effectiveness of RP1 for rest of world in direct comparison on the basis of other test benches at RB, proven
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other Non-responsive content removed
- Clear decline in CP4.2 failures in Non-responsive content removed from FD pump, July 09
  First returns from Non-responsive content removed (AUDI Q verification run) show strong build-up of coating, stronger than in [redacted] and blocking strips on cam roller
- Latest analyses indicate that the deposits on Non-responsive content removed pumps consist of degradation products from additives
- It was suggested that risk should be shared until the end of testing, no agreement on this with AUDI to date.
- Suggestion from task force meeting (AUDI and RB participants): Report should be produced every 14 days instead of every week.

# Task force details as backup

- Status of new information since last update on 4/21/2010 (changes in blue):

RP1 introduced and effectiveness proven.
RP2 design defined, (optimized flow / return position to reduce the roller support temperature, robust flange, C coating on pump piston). Effectiveness proven through temperature measurements. Detailed scheduling for series implementation planned
Earliest RB SOP in WK 28.
An optimized overflow valve is integrated in the verification concept. The behaviour of the valve was reproduced through simulation and appropriate measures are derived and defined from this. Implementation dates are under discussion.

RP2 requires ZP4 changes to the engine and is therefore not reverse compatible unless other engine parts are replaced. Scope and schedule under discussion at AUDI.
Further investigations into the influence of the camshaft geometry and surface are running until WK 19 and are also to be tested in QHALT2.
Audi will produce an engine and vehicle verification plan.

# Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)* | +* | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel | Sticking,... | - | (-) | + | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* piston coated with C (USA)

EA11003EN-01969[0]

Audi
Vorsprung durch Technik

# Drivetrain damage, high pressure diesel fuel pump CP4.2

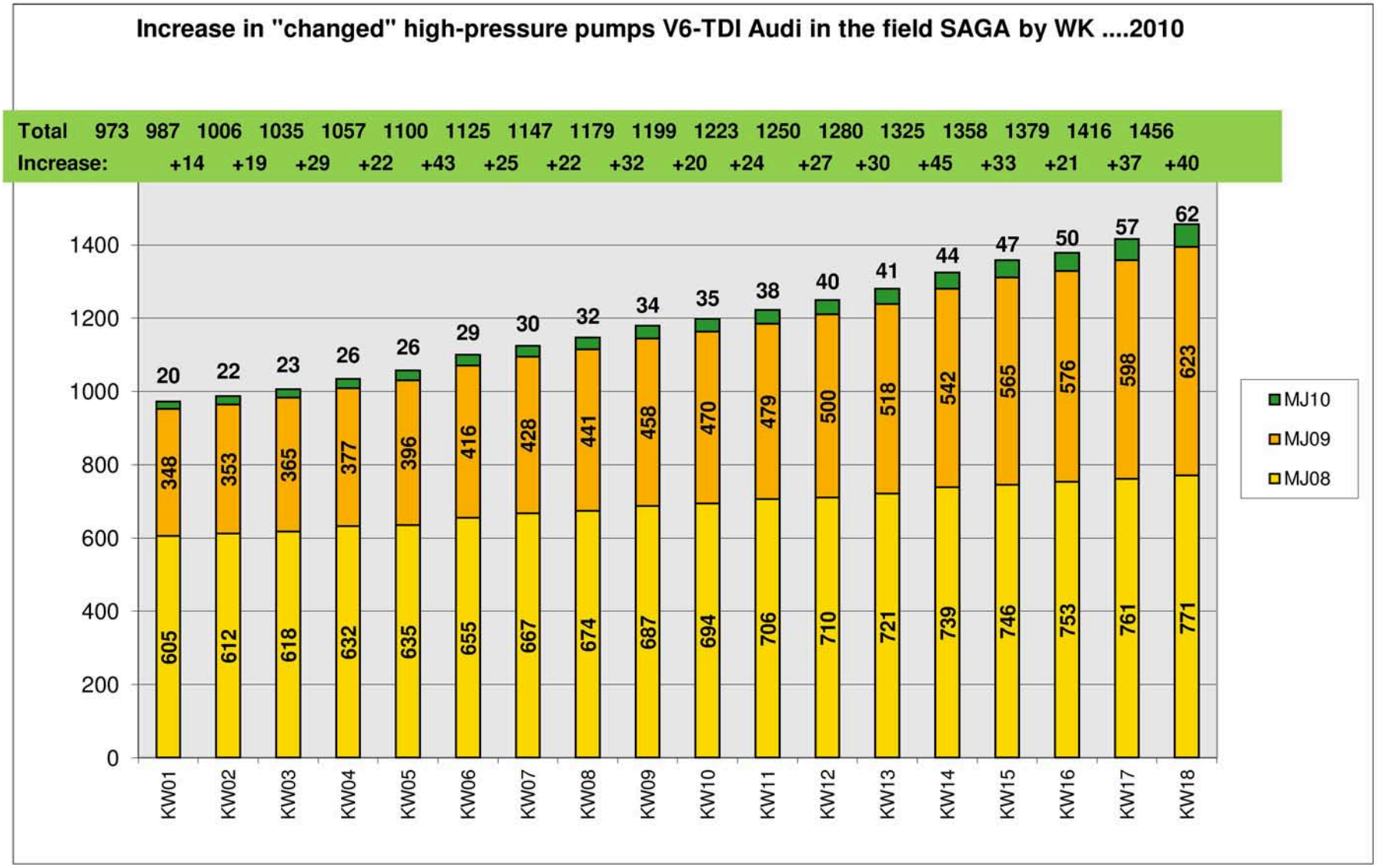
Status 5/11/2010

# Drivetrain damage, high pressure diesel fuel pump CP4.2

**Summary:**

- Current cases of damage Audi only (part change SAGA):
  - V6-TDI – [redacted] 1,456 cases
  - V8-TDI – no drivetrain damage
  - V12-TDI – 4 cases in [redacted]
  - R4-CR– [redacted] 627 cases
- Package of measures 1:
  - → Process improvements (C coating optimizations; straightedge check,...)
  - → Introduction approx. MY09
  - → Improvement approx. 50% [redacted]
- Package of measures 2:
  - → Process improvements (C coating optimization; camera check. C2 coating instead of C3 on cam roller cone,...)
  - → Introduction approx. MY10
  - → Improvement approx. 20% [redacted] and approx 75% [redacted]
- Anti-wear package 1 (RP1.1):
  - → C2 instead of C3 coating, roller support (depth of roughness, spatter); geometry of cam roller; reduced play cam roller / roller support; camshaft not shot blasted.
  - → Effect: thicker film of lubricant aimed at fuels with lower viscosity and lubrication
  - → Introduction April 2010 → Effectiveness in the field: open
- Anti-wear package 2 (RP2):
  - → Effect: Balancing of concept-related differences between CP4.2 (2 piston pumps) and CP4.1 (1 piston pump) → Temperature + purging in pump interior
  - → Introduction 3/4 quarter 2010

# Drivetrain damage, high pressure diesel fuel pump CP4.2

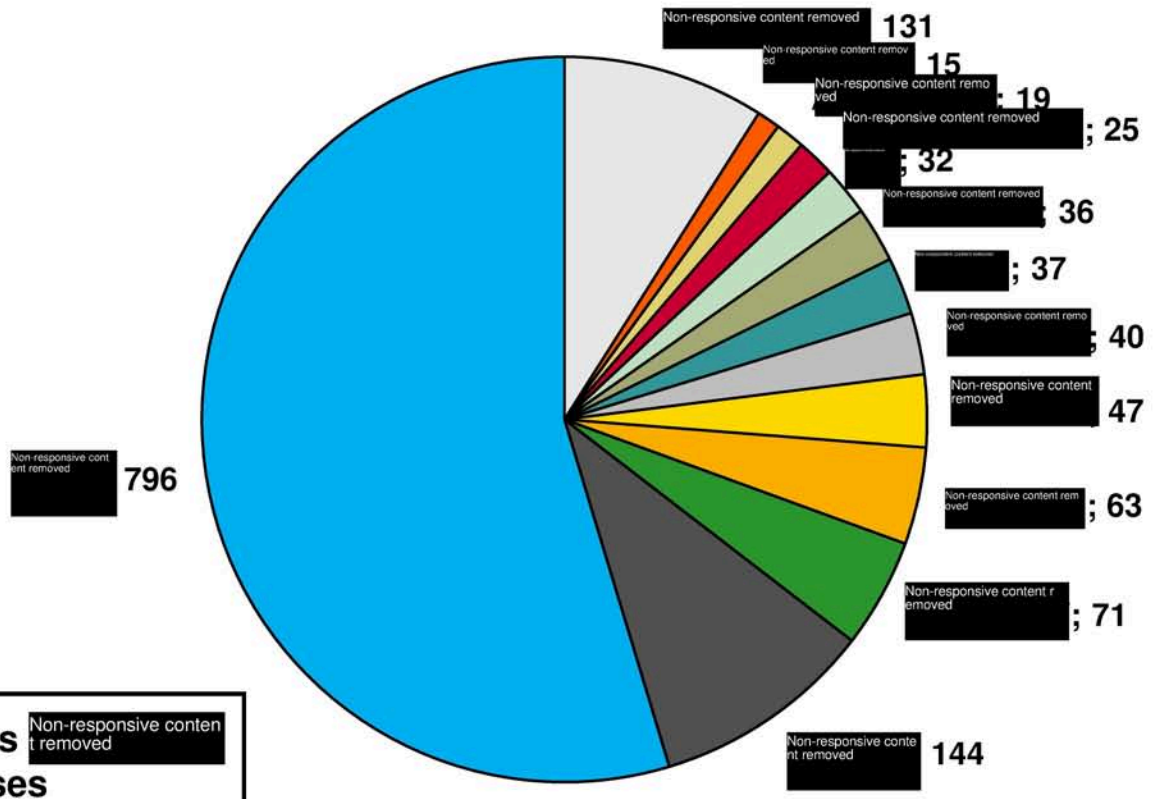



 Non-responsive content removed 

# Drivetrain damage, high pressure diesel fuel pump CP4.2

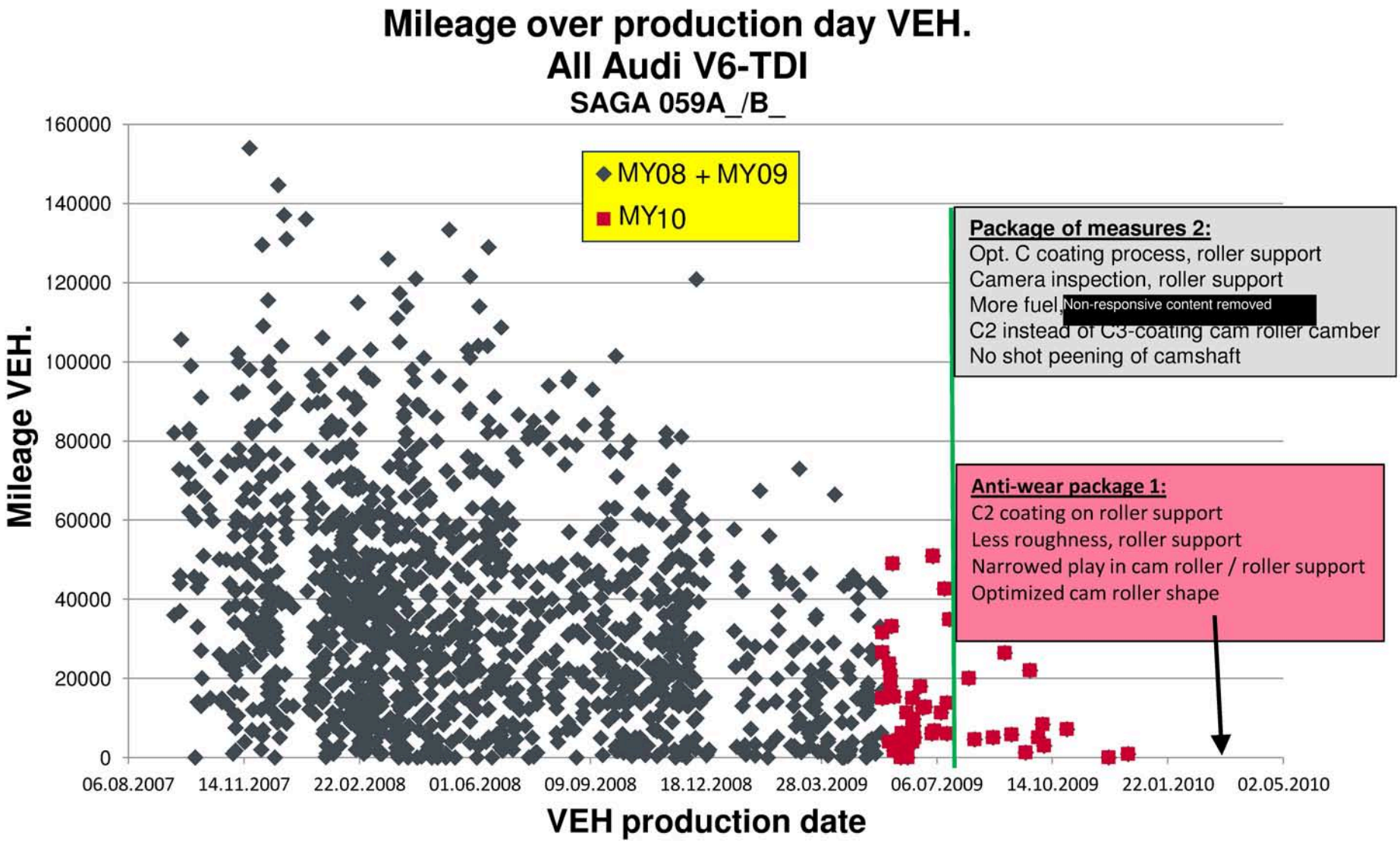
## AUDI V6-TDI failures in the field, broken down by country

(SAGA – replaced pumps only, 059A_/B_)




**TOTAL V6-TDI: 1.456 cases**
**MY08: 771 cases**
**MY09: 623 cases**
**MY10: 62 cases**

# Drivetrain damage, high pressure diesel fuel pump CP4.2



# Drivetrain damage, high pressure diesel fuel pump CP4.2

**AQUA: Active quality analysis**
Status: 03/10-14.04.10 02 :02
Source/user: [redacted]

**Audi, *, market: AUDI (approved markets )**
**MY 2008 – 2010, Offset: all (max. 5)**
**Customer no. / Groups: High-pressure fuel pump**

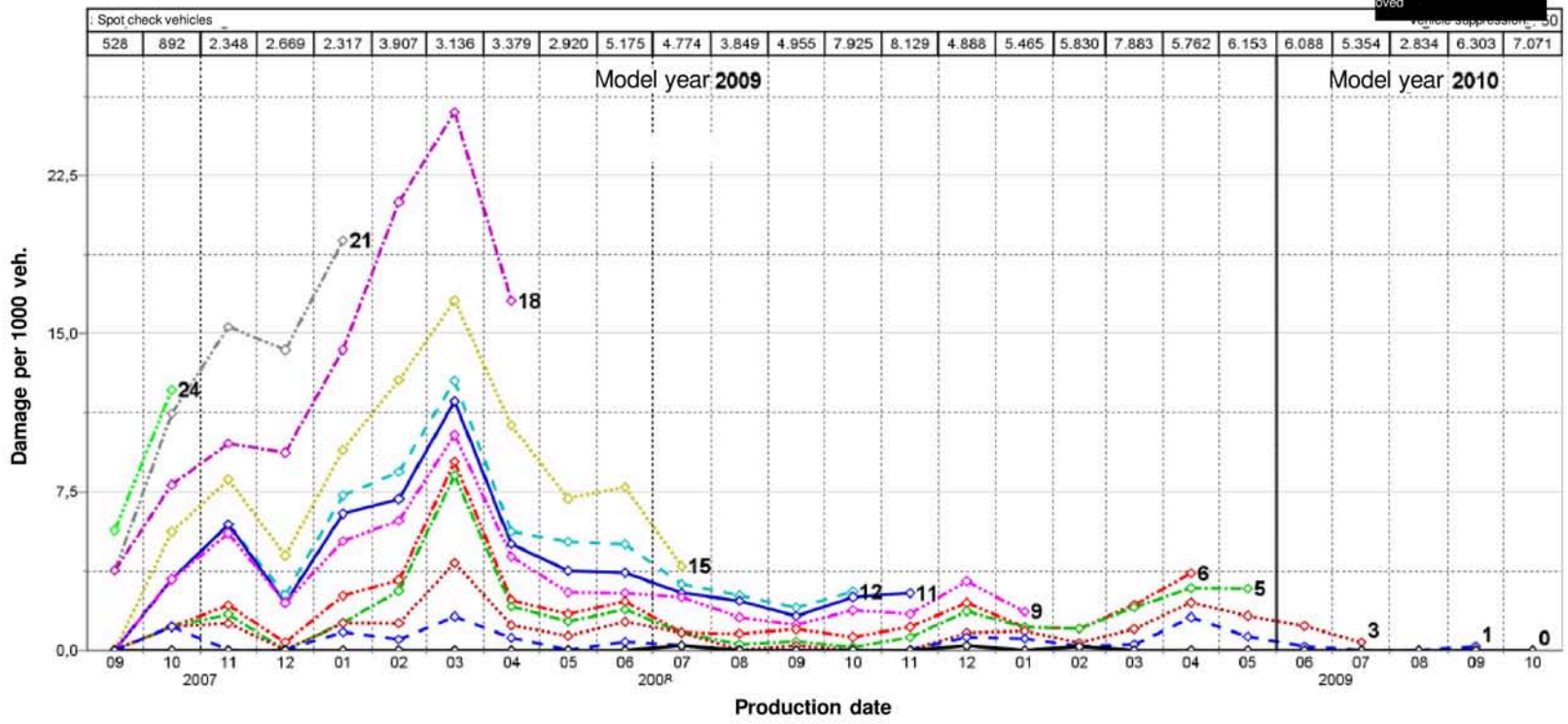
**Confidential**
Without PR numbers
CUSTOMER NO. 2374

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

| MY | MIS0 | MIS1 | MIS3 | MIS5 | MIS6 | MIS9 | MIS11 | MIS12 | MIS15 | MIS18 | MIS21 | MIS24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | 0,0 | 0,6 | 1,5 | 2,6 | 3,1 | 5,3 | 6,1 | 6,8 | 10,1 | 16,0 | 20,6 | 23,9 |
| 2009 | 0,0 | 0,3 | 0,7 | 1,3 | 1,6 | 2,4 | 3,1 | 3,7 | 5,2 | 7,5 | | |
| 2010 | 0,0 | 0,1 | 0,9 | 1,4 | 1,4 | | | | | | | |
| Diff% | -100,00 | -62,12 | 20,68 | 3,90 | -17,57 | | | | | | | |

| MY | Replacement | LB | SA 10 | SA 17 |
|---|---|---|---|---|
| 2008 | 98,3 % | 67,1 % | 77,1 % | 12,6 % |
| 2009 | 94,4 % | 55,8 % | 72,4 % | 16,9 % |
| 2010 | 89,5 % | 57,9 % | 65,8 % | 23,7 % |

[redacted]




Vehicles29.950+94.780+77.322=202.052; Sold: 29.887+94.134+65.522=189.543;Stp.: 21.375+69.346+53.269=143.990;MY:2008+2009+2010 =Total

CP42 A4,A5,Q5,A6,Q7aMKB Frei80

# Drivetrain damage, high pressure diesel fuel pump CP4.2

**AQUA: Active quality analysis**
Status: 03/10-10.04.10 13 :03
Source/user: [redacted]

**Audi, *,market:** [redacted]

**MY 2008 – 2010, Offset: all (max. 2)**

**Customer no. / Groups: High-pressure fuel pump**

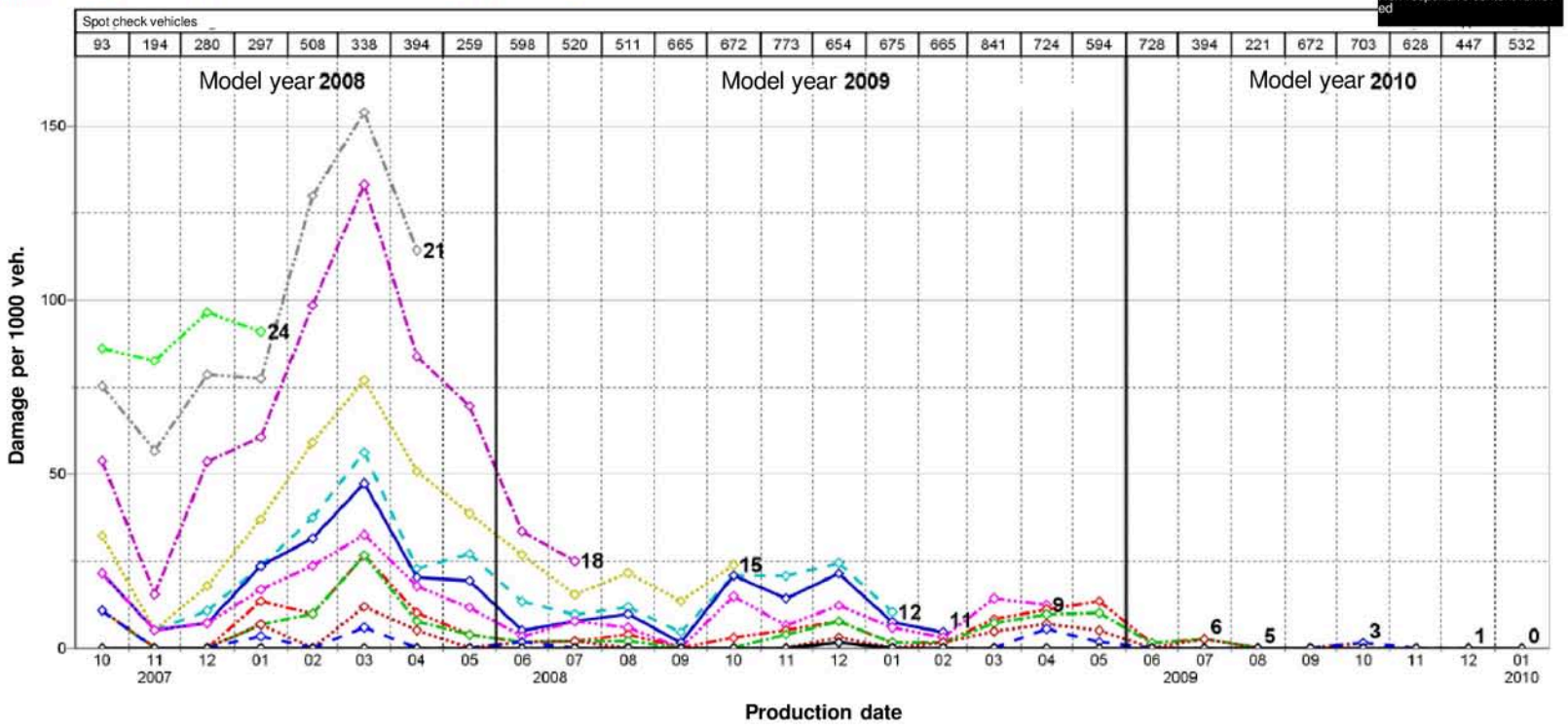
**Confidential**
Without PR numbers
CUSTOMER NO. 2374

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

| MY | MIS0 | MIS1 | MIS3 | MIS5 | MIS6 | MIS9 | MIS11 | MIS12 | MIS15 | MIS18 | MIS21 | MIS24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | 0,0 | 1,7 | 3,9 | 9,0 | 10,3 | 18,0 | 23,6 | 27,8 | 44,5 | 79,2 | 104,7 | 122,3 |
| 2009 | 0,1 | 0,9 | 1,9 | 3,8 | 4,8 | 9,0 | 12,9 | 16,4 | 25,0 | 31,7 | | |
| 2010 | 0,0 | 0,2 | 1,2 | 2,1 | 2,1 | 2,1 | | | | | | |
| Diff% | -100,00 | -72,59 | -37,93 | -44,21 | -56,28 | -76,74 | | | | | | |

| MY | Replacement | LB | SA 10 | SA 17 |
|---|---|---|---|---|
| 2008 | 100,0 % | 83,2 % | 76,4 % | 14,6 % |
| 2009 | 98,3 % | 85,0 % | 79,8 % | 13,9 % |
| 2010 | 100,0 % | 100,0 % | 66,7 % | 22,2 % |

[redacted]




Vehicles3.389+12.041+9.271=24.701; Sold: : 3.388+11.868+7.857=23.113;Stp.: 2.335+7.730+5.427=15.492;MY:2008+2009+2010 =Total

CP42 A4,A5,Q5,A6,Q7 aMKB IT 80

# Management summary (changes marked in blue)

- Anti-wear package 2 will reduce the temperature to the level of CP4.1 on the roller support. Proof with QHALT2 planned for WK 24/2010
- Preparation for production on the basis of the defined design for RP2
  Started for RB and Audi
- Effectiveness of RP1 for rest of world in direct comparison on the basis of other test benches at RB, proven
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other rest of world countries [redacted]
- 3 failures in [redacted] with RP1 pumps (repeat repair) Local analysis with Bosch support in WK 20/2010.
- Clear decline in CP4.2 failures in [redacted] from FD pump, July 09
  First returns from [redacted] (AUDI Q assurance pass) show strong build-up of coating, stronger than in [redacted] and blocking strips on cam roller
- Latest analyses indicate that the deposits on [redacted] pumps consist of degradation products from additives
- It was suggested that risk should be shared until the end of testing, no agreement on this with AUDI to date.

# Task force details as backup

- Status of new information since last update on 4/28/2010 (changes in blue):

RP1 introduced and effectiveness proven
RP2 design defined, (optimized flow / return position to reduce the roller support temperature, robust flange, C coating on pump piston). Anti-wear package 2 will reduce the temperature to the level of CP4.1 on the roller support. Proof with QHALT2 planned for WK 24/2010. Detailed scheduling for series implementation planned
Earliest RB SOP in WK 28
An optimized overflow valve is integrated in the assurance concept for acoustic reasons. The behaviour of the valve was reproduced through simulation and appropriate measures are derived and defined from this. Introduction date agreed between RB & Audi.
RP2 requires changes to the engine (new flow & return lines) and is therefore not reverse compatible. Scope and schedule under review at AUDI
Further investigations/ QHALT2 test on the influence of the camshaft geometry and surface will be carried out by WK 22
Audi engine and vehicle assurance plan is in place.

# Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2* | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)* | +* | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel / Additives | Deposits / Sticking | - | (+) | + | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* piston coated with C (USA)

# Management summary (changes marked in blue)

- Anti-wear package 2 (optimized flow/ return position for reducing the roller support temperature + robust flange). Anti-wear package 2 will reduce the temperature to the level of CP4.1 on the roller support. Effectiveness through temperature measurements and Q-HALT2 endurance run.
- Audi and Bosch have agreed to examine the low pressure fuel system in terms of the purging and lubrication volume.
- Ready for production in large volume at Bosch for RP2 starting WK 34.
- Use at AUDI under discussion due to the need to obtain the necessary low pressure hoses (target WK 45/2010)
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from [redacted] Prior damage to good pumps only found in [redacted] (except for 1 case in [redacted].
- 9 failures in [redacted] with RP1 pumps (8 x repeat repair) Use at local level yielded no striking features. Pump and fuel are under analysis, target date WK 27.
- It was suggested that risk should be shared for [redacted] markets until the end of testing, as yet no agreement reached on this
- Next Audi-Bosch Top meeting 7/12/2010.

# Task force details as backup

An optimized overflow valve is integrated in the verification concept for acoustic reasons. The behaviour of the valve was reproduced through simulation and appropriate measures are derived and defined from this. Introduction date agreed between RB & Audi.
No other striking features after the measure was introduced.

Audi engine and vehicle verification plan is in place.
Bosch series readiness for V6 TDI starting in WK 32

Negotiations on who will bear costs to be held on 7/7/2010

# Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2 | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)* | +* | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel / Additives | Deposits / Sticking | - | (+) | + | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* piston coated with C (USA)

# Management summary (changes marked in blue)

- Anti-wear package 2 (optimized flow/ return position for reducing the roller support temperature + robust flange). Anti-wear package 2 will reduce the temperature to the level of CP4.1 on the roller support. Effectiveness proven through temperature measurements and Q-HALT2 endurance running.
- Audi and Bosch have agreed to examine the low pressure fuel system in terms of the purging and lubrication volume of the CP4.2.
- Ready for production in large volume at Bosch for RP2 starting WK 34.
- Use at AUDI under discussion due to the need to obtain the necessary low pressure hoses (target WK 45/2010)
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other [redacted]
- 9 failures in [redacted] with RP1 pumps (8 x repeat repair) Use at local level yielded no striking features. Pump and fuel are under analysis, target date WK 27.
- It was suggested that risk should be shared for [redacted] markets until the end of testing, as yet no agreement reached on this.
- Next Audi-Bosch Top meeting 7/12/2010.

# Task force details as backup

An optimized overflow valve is integrated in the verification concept for acoustic reasons. The behaviour of the valve was reproduced through simulation and appropriate measures are derived and defined from this. Introduction date agreed between RB & Audi.
No other striking features after the measure was introduced.

Audi engine and vehicle verification plan is in place.
Bosch series readiness for V6 TDI starting in WK 32

Negotiations on who will bear costs to be held on 7/7/2010

# Summary of anti-wear package 1.2.

## Effectiveness of robustness system:

| Fuel quality | Problem | Series | RP1 | RP2 | Water separator |
|---|---|---|---|---|---|
| EN590/GDK520 | | +** | ++** | ++ | |
| GDK650 | lubrication | (+)* | +* | + | |
| Kerosene | viscosity | - | (+) | + | |
| Old biofuel / Additives | Deposits / Sticking | - | (+) | + | |
| Water > 200ppm | Lubrication. Viscosity, Corrosion | - | - | - | + |

* piston coated with C (USA)

# Management summary (changes marked in blue)

- Anti-wear package 2 (optimized flow / return position to reduce the roller support temperature) reduces the temperature to the level of the CP4.1 roller support. Effectiveness proven through temperature measurements and test bench endurance running.
- Audi and Bosch have agreed to examine the low pressure fuel system in terms of the purging and lubrication volume of the CP4.2.
- Initial measurements by Audi Development on random B8 – and Q7 functional vehicles in NSU produced values in line with the Audi / Bosch (TKU) test regulations.
- Joint measurements by Audi/Bosch in Italy starting 7/26/2010
- Ready for production in large volume at Bosch for RP2 starting WK 34.
- Use at Audi planned from WK 45/2010 onwards (schedule critical new LP hoses)
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from [redacted] Pumps in flow.
- 9 failures (8 x repeat repairs) in [redacted] and 2 failures in Italy with RP1 pumps Use at local level yielded no striking features. Pumps and fuels are being analyzed; planned date of WK 27 must be postponed by about 4 weeks because of the delay in returning the pumps / fuels.
- It was suggested that risk should be shared for [redacted] markets until the end of testing, as yet no agreement reached on this. Follow-up discussions planned for September 2010.

# Task force details as backup

An optimized overflow valve (OV) is integrated in the verification concept for acoustic reasons. The behaviour of the valve was reproduced through simulation and appropriate measures are derived and defined from this. Introduction date agreed between RB & Audi.
No other striking features after the measure was introduced.

Audi engine and vehicle verification plan is in place.
Series launch at Audi planned from WK 45 as scope of RP2.

Bosch to delivery 60 pumps with RP1/2 by WK 31/32 as a preliminary measure for preliminary use in customer service in Non-responsive content removed for repeat cases.

Negotiations on costs RP1 / RP2 / OV mid-August.

# Management summary (changes marked in blue)

- Anti-wear package 2 (optimized flow / return position to reduce the roller support temperature) reduces the temperature to the level of the CP4.1 roller support. Effectiveness proven through temperature measurements and test bench endurance running.
- Audi and Bosch have agreed to examine the low pressure fuel system in terms of the purging and lubrication volume of the CP4.2.
  - Initial measurements by Audi Development on random B8 – and Q7 functional vehicles in [redacted] produced values in line with the Audi / Bosch (TKU) test regulations.
  - Joint measurements by Audi/Bosch in [redacted] starting 7/26/2010
- Ready for production in large volume at Bosch for RP2 starting WK 34.
- Use at Audi planned from WK 45/2010 onwards (schedule critical new low pressure hoses)
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other [redacted]. Pumps in flow.
- 9 failures (8 x repeat repairs) in [redacted] and 2 failures in [redacted] with RP1 pumps Use at local level yielded no striking features. Pumps and fuels are being analyzed; planned date of WK 27 musbe postponed by about 4 weeks because of the delay in returning the pumps / fuels.
- It was suggested that risk should be shared for [redacted] markets until the end of testing, as yet no agreement reached on this. Follow-up meeting scheduled for September 2010.

# Task force details as backup

An optimized overflow valve (OV) is integrated in the verification concept for acoustic reasons The behaviour of the valve was reproduced through simulation and appropriate measures are derived and defined from this. Introduction date agreed between RB & Audi.
No other striking features after the measure was introduced.

Audi engine and vehicle verification plan is in place.
Series launch at Audi planned from WK 45 as scope of RP2.

Bosch to delivery 60 pumps with RP1/2 by WK 31/32 as a preliminary measure for preliminary use in customer service in Non-responsive content removed for repeat cases.

Negotiations on costs RP1 / RP2 / OV mid-August.

# Management summary (changes marked in blue)

- Anti-wear package 2 (optimized flow / return position to reduce the roller support temperature) reduces the temperature to the level of the CP4.1 roller support. Effectiveness proven through temperature measurements and test bench endurance running.
- Audi and Bosch have agreed to examine the low pressure fuel system in terms of the purging and lubrication volume of the CP4.2.
  - Initial measurements by Audi Development on random B8 – and Q7 functional vehicles in [redacted] produced values in line with the Audi / Bosch (TKU) test regulations.
  - Joint measurements by Audi/Bosch in [redacted] starting 7/26/2010
- Ready for production in large volume at Bosch for RP2 starting WK 34.
- Use at Audi planned from WK 45/2010 onwards (schedule critical new low pressure hoses)
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other [redacted]. Pumps in flow.
- 9 failures (8 x repeat repairs) in [redacted] and 2 failures in [redacted] with RP1 pumps Use at local level yielded no striking features. Pumps and fuels are being analyzed; planned date of WK 27 musbe postponed by about 4 weeks because of the delay in returning the pumps / fuels.
- It was suggested that risk should be shared for [redacted] markets until the end of testing, as yet no agreement reached on this. Follow-up meeting scheduled for September 2010.

# Task force details as backup

An optimized overflow valve (OV) is integrated in the verification concept for acoustic reasons The behaviour of the valve was reproduced through simulation and appropriate measures are derived and defined from this. Introduction date agreed between RB & Audi.
No other striking features after the measure was introduced.

Audi engine and vehicle verification plan is in place.
Series launch at Audi planned from WK 45 as scope of RP2.

Bosch to delivery 60 pumps with RP1/2 by WK 31/32 as a preliminary measure for preliminary use in customer service in [redacted] for repeat cases.

Negotiations on costs RP1 / RP2 / OV mid-August.

# Management summary (changes marked in blue)

- Anti-wear package 2 (optimized flow / return position to reduce the roller support temperature) reduces the temperature to the level of the CP4.1 roller support. Effectiveness proven through temperature measurements and test bench endurance running.
- Audi and Bosch have agreed to examine the low pressure fuel system in terms of the purging and lubrication volume of the CP4.2.
- Initial measurements by Audi Development on random B8 – and Q7 functional vehicles in [redacted] produced values in line with the Audi / Bosch (TKU) test regulations.
- Joint measurements by Audi/Bosch in [redacted] starting 7/26/2010
- Ready for production in large volume at Bosch for RP2 starting WK 34.
- Use at Audi planned from WK 45/2010 onwards (schedule critical new LP hoses).
- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other [redacted] Pumps in flow.
- 9 failures (8 x repeat repairs) in [redacted] and 2 failures in [redacted] with RP1 pumps Use at local level yielded no striking features. Pumps and fuels are being analyzed; planned date of WK 27 must be postponed by about 4 weeks because of the delay in returning the pumps / fuels.
- It was suggested that risk should be shared for [redacted] markets until the end of testing, as yet no agreement reached on this. Follow-up discussions planned for September 2010.

# Task force details as backup

An optimized overflow valve (OV) is integrated in the verification concept for acoustic reasons. The behaviour of the valve was reproduced through simulation and appropriate measures are derived and defined from this. Introduction date agreed between RB & Audi.
No other striking features after the measure was introduced.

Audi engine and vehicle verification plan is in place.
Series launch at Audi planned from WK 45 as scope of RP2.

Bosch to delivery 60 pumps with RP1/2 by WK 31/32 as a preliminary measure for preliminary use in customer service in [redacted] for repeat cases.

Negotiations on costs RP1 / RP2 / OV mid-August.

# Management summary (changes marked in blue)

- Anti-wear package 2 (optimized flow / return position to reduce the roller support temperature) reduces the temperature to the level of the CP4.1 roller support. Effectiveness proven through temperature measurements and test bench endurance running.
  Confirmation of effectiveness through endurance running in IAV by AUDI.
  Use at Audi planned from WK 45/2010 onwards (schedule critical new LP hoses)

- Audi and Bosch have agreed to examine the low pressure fuel system in terms of the purging and lubrication volume of the CP4.2.
  - Initial measurements by Audi Development on B8 – and Q7- functional vehicles in NSU produced values in line with the (TKU) test regulations.
  - Joint measurements by Audi/Bosch in [redacted] starting 7/26/2010.
    Measurements on 4 vehicles in [redacted] indicate no deviations from TKU. Further measurements on 6-cylinder and 4-cylinder vehicles in progress.

# Management summary (changes marked in blue)

- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from [redacted] Pumps have arrived at RB. Results will be available by 8/11/10.
- 15 failures (14 x repeat repairs) in [redacted] and 3 failures in [redacted] with RP1 pumps Use at local level in [redacted] yielded no striking features. Pumps and fuels are under analysis, result expected by 8/11/10.
- Bosch will deliver 60 pumps with RP1/2 on a provisional basis by WK34 for provisional use in customer service in [redacted] in the event of repeat cases.
- It was suggested that risk should be shared for [redacted] markets until the end of testing, as yet no agreement has been reached. Follow-up meeting scheduled for September 2010.
- Negotiations on costs RP1 / RP2 / OV mid-August because of TOP-ÄKO on 9/1/2010.

# Management summary (changes marked in blue)

- Anti-wear package 2 (optimized flow / return position to reduce the roller support temperature) reduces the temperature to the level of the CP4.1 roller support. Effectiveness proven through temperature measurements and test bench endurance running.
  Confirmation of effectiveness through endurance running in IAV by AUDI. Use at Audi planned from WK 45/2010 onwards (schedule critical new LP hoses)

- Audi and Bosch have agreed to examine the low pressure fuel system in terms of the purging and lubrication volume of the CP4.2.
  - Initial measurements by Audi Development on B8 – and Q7- functional vehicles in [redacted] produced values in line with the (TKU) test regulations.
  - Joint measurements by Audi/Bosch in [redacted] starting 7/26/2010.
    Measurements on 4 vehicles in [redacted] indicate no deviations from TKU. Further measurements on 6-cylinder and 4-cylinder vehicles in progress.

# Management summary (changes marked in blue)

- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from [redacted]. Pumps have arrived at RB. Results will be available by 8/11/10.
- 11 failures (10 x repeat repairs) in [redacted] and 3 failures in [redacted] with RP1 pumps. Use at local level in [redacted] yielded no striking features. Pumps and fuels are under analysis, result expected by 8/11/10.
- Bosch will deliver 60 pumps with RP1/2 on a provisional basis by WK34 for provisional use in customer service in [redacted] in the event of repeat cases.
- It was suggested that risk should be shared for [redacted] markets until the end of testing, as yet no agreement has been reached. Follow-up meeting scheduled for September 2010.
- Negotiations on costs RP1 / RP2 / OV mid-August because of TOP-change of design on 9/1/2010.

# Management summary (changes marked in blue)

- Anti-wear package 2 (optimized flow / return position to reduce the roller support temperature) reduces the temperature to the level of the CP4.1 roller support. Effectiveness proven through temperature measurements and test bench endurance running.
  Confirmation of effectiveness through endurance running in IAV by AUDI. Use at Audi planned from WK 45/2010 onwards (schedule critical new LP hoses)

- Audi and Bosch have agreed to examine the low pressure fuel system in terms of the purging and lubrication volume of the CP4.2.
  - Initial measurements by Audi Development on B8 – and Q7- functional vehicles in [redacted] produced values in line with the (TKU) test regulations.
  - Joint measurements by Audi/Bosch in [redacted] starting 7/26/2010. Measurements on 4 vehicles in [redacted] indicate no deviations from TKU. Further measurements on 6-cylinder and 4-cylinder vehicles also yielded no deviations from TKU.
    Further investigations are in progress

# Management summary (changes marked in blue)

- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from Non-responsive content removed The pumps have arrived. The pump analyses are delayed because of the need for detailed investigations.
- 15 failures (14 x repeat repairs) in Non-responsive content removed and 3 failures in Non-responsive content removed with RP1 pumps. Use at local level in Non-responsive content removed yielded no striking features. Some fuel parameters were threshold values in terms of EN 590.
- Bosch will deliver 60 pumps with RP1/2 on a provisional basis by WK34 for provisional use in customer service in Non-responsive content removed in the event of repeat cases.
- It was suggested that risk should be shared for Non-responsive content removed markets until the end of testing, as yet no agreement has been reached. Follow-up meeting scheduled for September 2010.
- Negotiations on costs for RP1 / RP2 / OV will be held in September.

# Management summary (changes marked in blue)

- TOP Q meeting between RB and AUDI held on 9/15/2010.
  Worldwide in total 2135 AUDI V6-TDI failures (MY08-MY11, CP4.2), for country-by-country breakdown see Appendix. Total failure rate since vehicle production date 08/2009 steeply declining see Appendix.
  Since vehicle production date 06/2009 no failures in Q7 and VW Touareg in [redacted], but a disproportionate increase in [redacted].
  RP1 introduced since 04/2010, effectiveness in the field still not sufficient.
  RP2 effective measure against drivetrain damage, proven by Qalt endurance run at RB and AUDI with Arctic diesel, [redacted] fuel and current vehicle endurance running test (e.g. [redacted] AUDI road test)
  SOP planned for WK 45 / 2010.

- Plan to deploy local team in [redacted] for systematic analysis of cause of failure with support from RB.

# Management summary (changes marked in blue)

- Joint implementation of additional statistical measurements on LP circuit agreed.
  Examination of influential factors for inlet volume of pump under boundary conditions (temperature, fuel type, battery voltage, etc.)
  D. 9/30/2010

- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from other Non-responsive content removed. The pumps have arrived and have been analyzed:

Non-responsive content removed (11 pumps): 1 with prior damage due to water in fuel.
Non-responsive content removed (12 pumps): No prior damage:
Non-responsive content removed (8 pumps): No prior damage:
(46 pumps): 11 with prior damage due to poor fuel and water

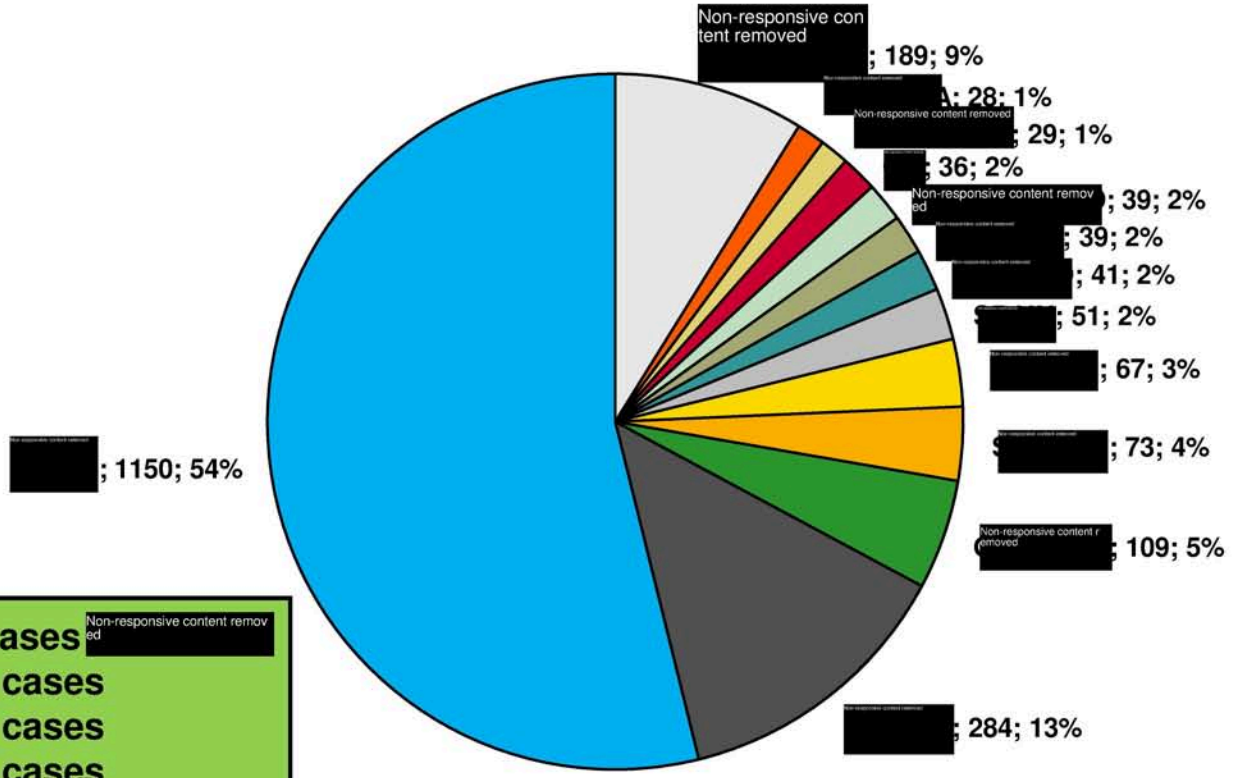
# Management summary (changes marked in blue)

- The results of the findings relating to failures in [redacted] indicate horizontal abrasion of the cam roller and camshaft, a typical pointer towards the use of low-viscosity fuels (e.g. kerosene).
- Provisional delivery of 80 pumps [redacted] 40, [redacted] 40) with RP2 complete Replacement in faulty vehicles in order to prove effectiveness in actual operation
- It was suggested that risk should be shared for [redacted] markets until the end of testing, as yet no agreement has been reached. Follow-up meeting scheduled for September 2010.
- Negotiations on costs for RP1 / RP2 / OV will be held in September

# Drivetrain damage, high pressure diesel fuel pump CP4.2

## AUDI V6-TDI failures in the field, broken down by country

**(SAGA - replaced pumps only, 059A_/B_)**

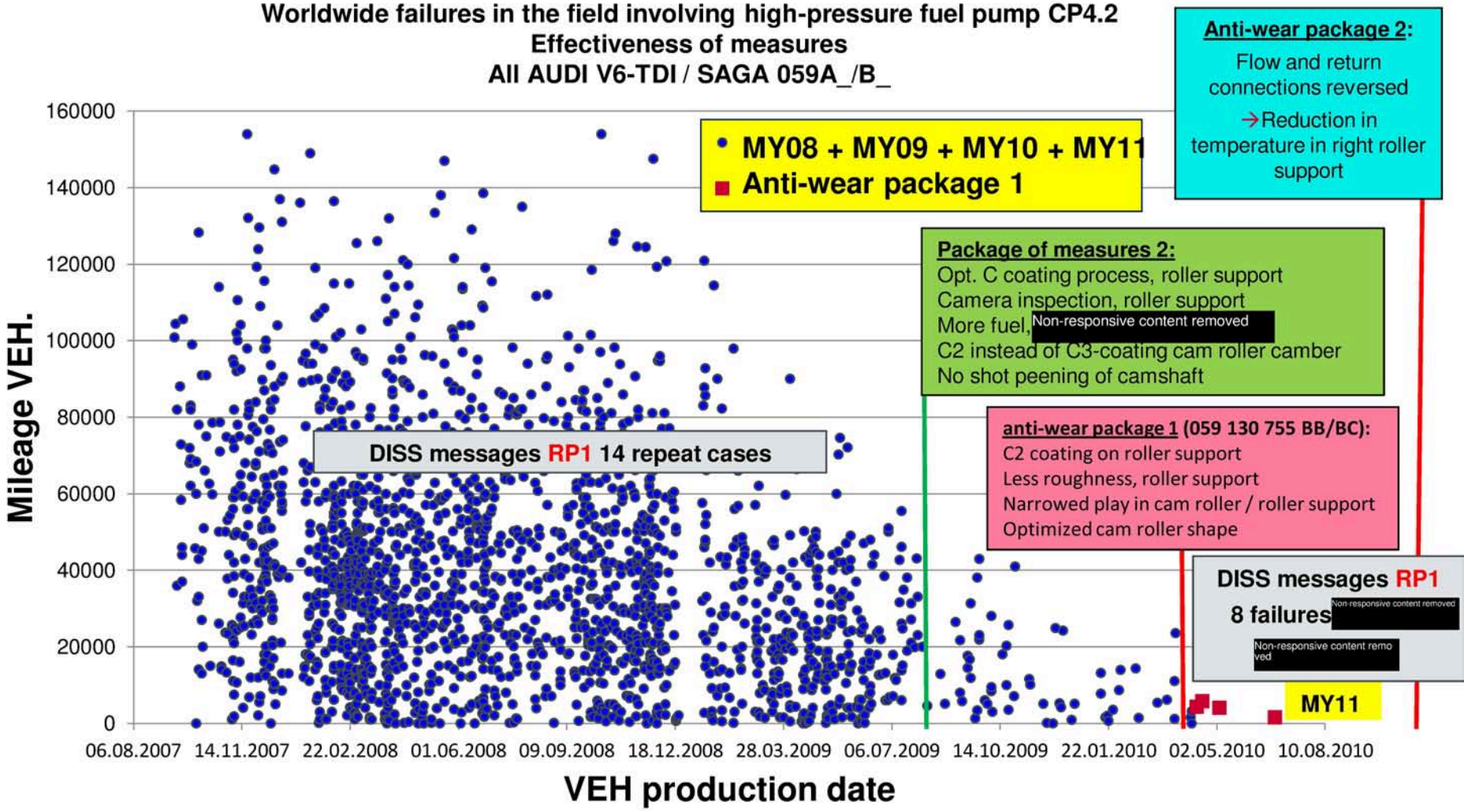



**TOTAL V6-TDI: 2.135 cases**
**MY08: 935 cases**
**MY09: 1.018 cases**
**MY10: 181 cases**
**MY11: 1 case**
(SAGA, Stand 05.09.2010)



Audi
Vorsprung durch Technik

# Drivetrain damage, high pressure diesel fuel pump CP4



# Management summary (changes marked in blue)

- TOP Q meeting between RB and AUDI held on 9/15/2010.
  Worldwide in total 2,135 AUDI V6-TDI failures (CP4.2), for country-by-country breakdown see Appendix. Total failure rate since vehicle production date 08/2009 steeply declining see Appendix.
  Since vehicle production date 06/2009 no failures in Q7 and VW Touareg in [redacted] but a disproportionate increase in [redacted]
  RP1 introduced since 04/2010, effectiveness in the field still not sufficient.
  RP2 effective measure against drivetrain damage, proven by QHALT2 endurance run at RB and AUDI with Arctic diesel, [redacted] fuel and current vehicle endurance running test (e.g. [redacted] AUDI road test)
  SOP planned for WK 45 / 2010.

- Plan to deploy local team in [redacted] for systematic analysis of cause of failure with support from RB.

# Management summary (changes marked in blue)

- Joint implementation of additional statistical measurements on LP circuit agreed.
  Examination of influential factors for inlet volume of pump under boundary conditions (temperature, fuel type, battery voltage, etc.)
  D. 9/30/2010

- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from [redacted]. The pumps have arrived and have been analyzed:

| | | |
|---|---|---|
| [redacted] | (11 pumps): | 1 with prior damage due to water in fuel. |
| [redacted] | (12 pumps): | No prior damage: |
| [redacted] | (8 pumps): | No prior damage: |
| | (46 pumps): | 11 with prior damage due to poor fuel and water |

# Management summary (changes marked in blue)

- The results of the findings relating to failures in [redacted] indicate horizontal abrasion of the cam roller and camshaft, a typical pointer towards the use of low-viscosity fuels (e.g. kerosene).

- Provisional delivery of 80 pumps ([redacted] 40, [redacted] 40) with RP2 complete Replacement in faulty vehicles in order to prove effectiveness in actual operation

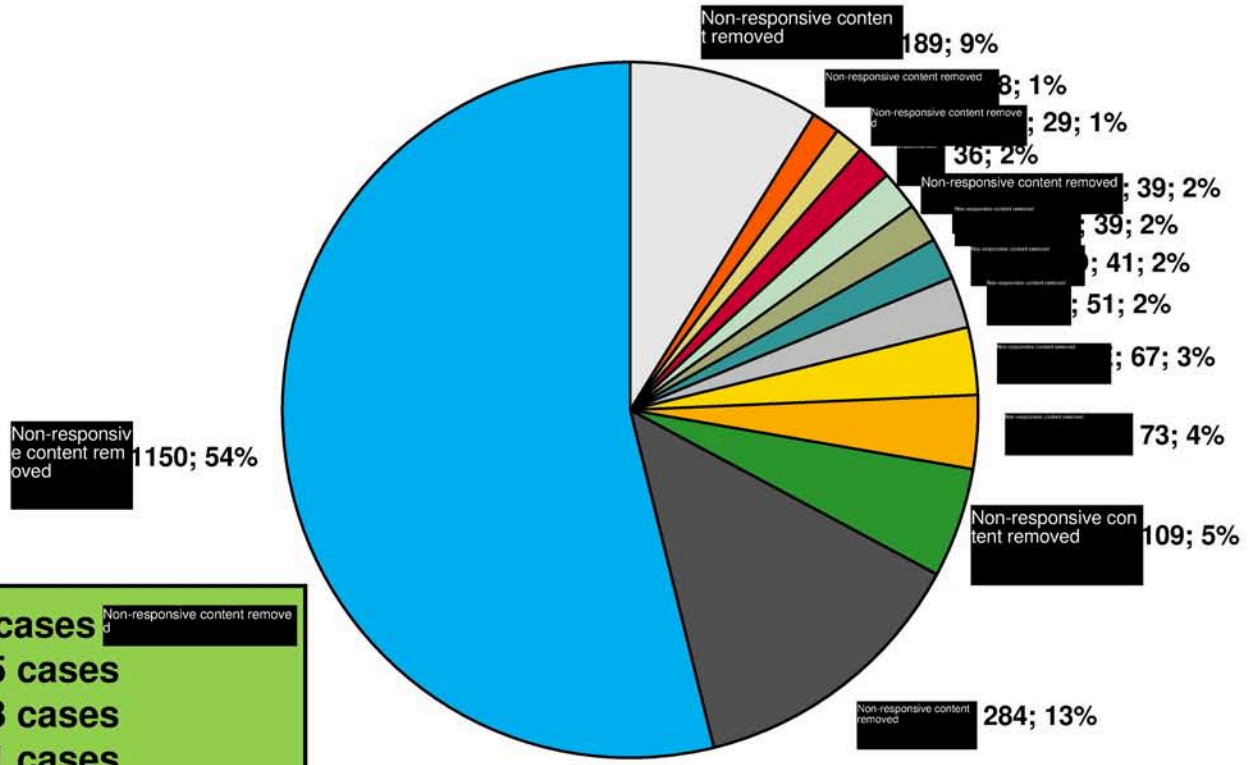
- It was suggested that risk should be shared for [redacted] markets until the end of testing, as yet no agreement has been reached. Follow-up meeting scheduled for September 2010.

- Negotiations on costs for RP1 / RP2 / OV will be held in September

# Drivetrain damage, high pressure diesel fuel pump CP4.2

## AUDI V6-TDI failures in the field, broken down by country

**(SAGA - replaced pumps only, 059A_/B_)**

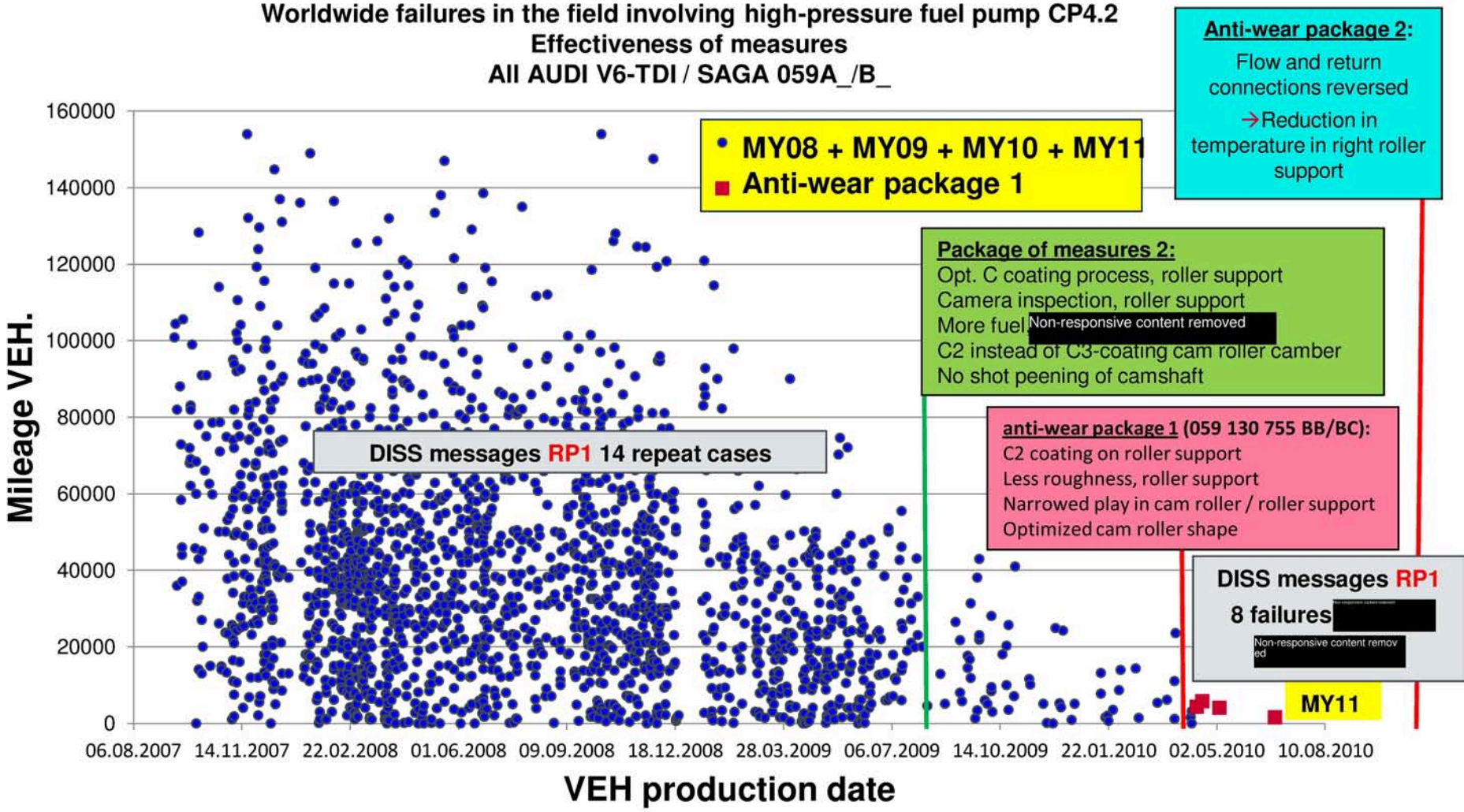



**TOTAL V6-TDI: 2.135 cases**
**MY08: 935 cases**
**MY09: 1.018 cases**
**MY10: 181 cases**
**MY11: 1 case**
(SAGA, Stand 05.09.2010)



Non-responsive content r emoved

# Drivetrain damage, high pressure diesel fuel pump CP4





Non-responsive content removed

# Management summary (changes marked in blue)

- TOP Q meeting between RB and AUDI held on 9/15/2010.
  Worldwide in total 2135 AUDI V6-TDI failures (MY08-MY11, CP4.2), for country-by-country breakdown see Appendix. Total failure rate since vehicle production date 08/2009 steeply declining see Appendix.
  Since vehicle production date 06/2009 no failures in Q7 and VW Touareg in [redacted] but a disproportionate increase in [redacted]
  RP1 introduced since 04/2010, effectiveness in the field still not sufficient.
  RP2 effective measure against drivetrain damage, proven by Continuous Qalt at RB and AUDI with Arctic diesel, [redacted] fuel and continuous vehicle running test (e.g. [redacted] AUDI road test)
  SOP planned for WK 45 / 2010.

- Plan to deploy local team in [redacted] for systematic analysis of cause of failure with support from RB.

# Management summary (changes marked in blue)

- Joint implementation of additional statistical measurements on LP circuit agreed.
  Examination of influential factors for inlet volume of pump under boundary conditions (temperature, fuel type, battery voltage, etc.)
  D. 9/30/2010

- Because of positive information derived with "good pumps", 10 good pumps are to be obtained from [redacted] The pumps have arrived and have been analyzed:

[redacted] (11 pumps): 1 with prior damage due to water in fuel.
[redacted] (12 pumps): No prior damage:
[redacted] (8 pumps): No prior damage:
(46 pumps): 11 with prior damage due to poor fuel and water

# Management summary (changes marked in blue)

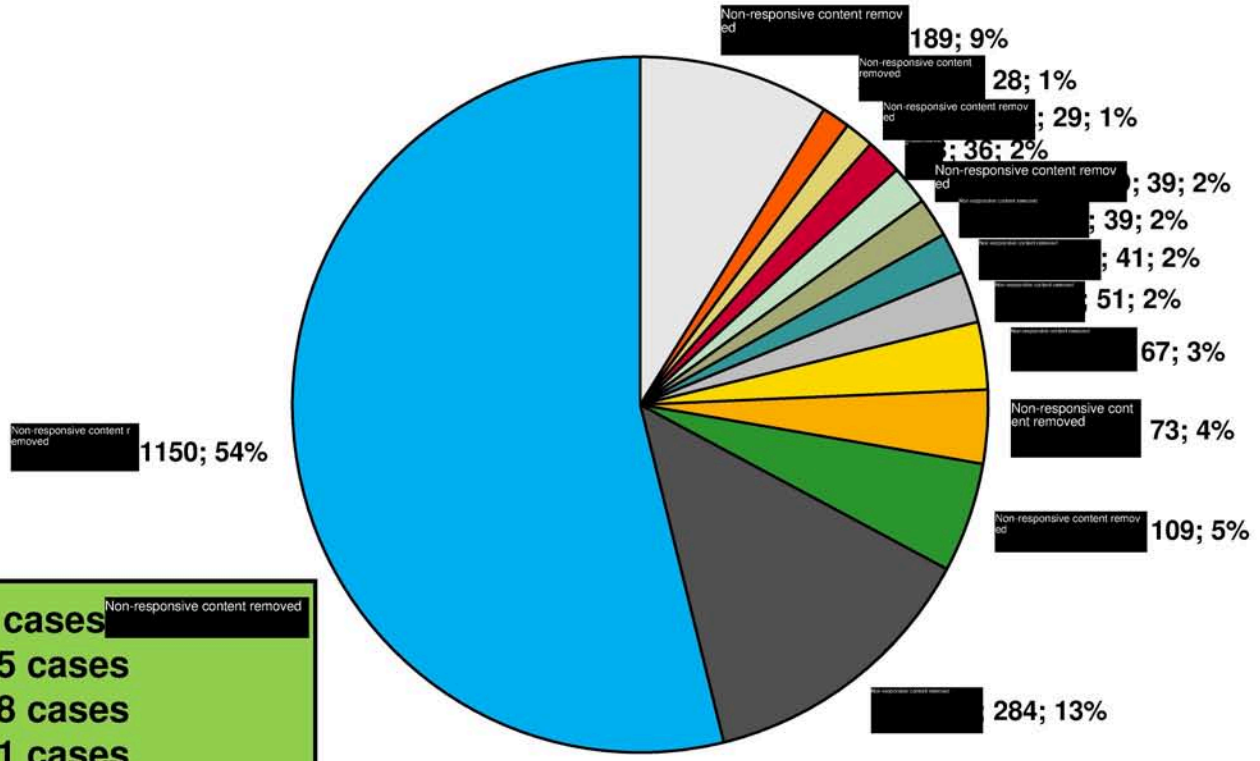
- The results of the findings relating to failures in [redacted] indicate horizontal abrasion of the cam roller and camshaft, a typical pointer towards the use of low-viscosity fuels (e.g. kerosene).
- Provisional delivery of 80 pumps ([redacted] 40, [redacted] 40) with RP2 complete Replacement in faulty vehicles in order to prove effectiveness in actual operation
- It was suggested that risk should be shared for [redacted] markets until the end of testing, as yet no agreement has been reached. Follow-up meeting scheduled for September 2010.
- Negotiations on costs for RP1 / RP2 / OV will be held in September

# Drivetrain damage, high pressure diesel fuel pump CP4.2

## AUDI V6-TDI failures in the field, broken down by country

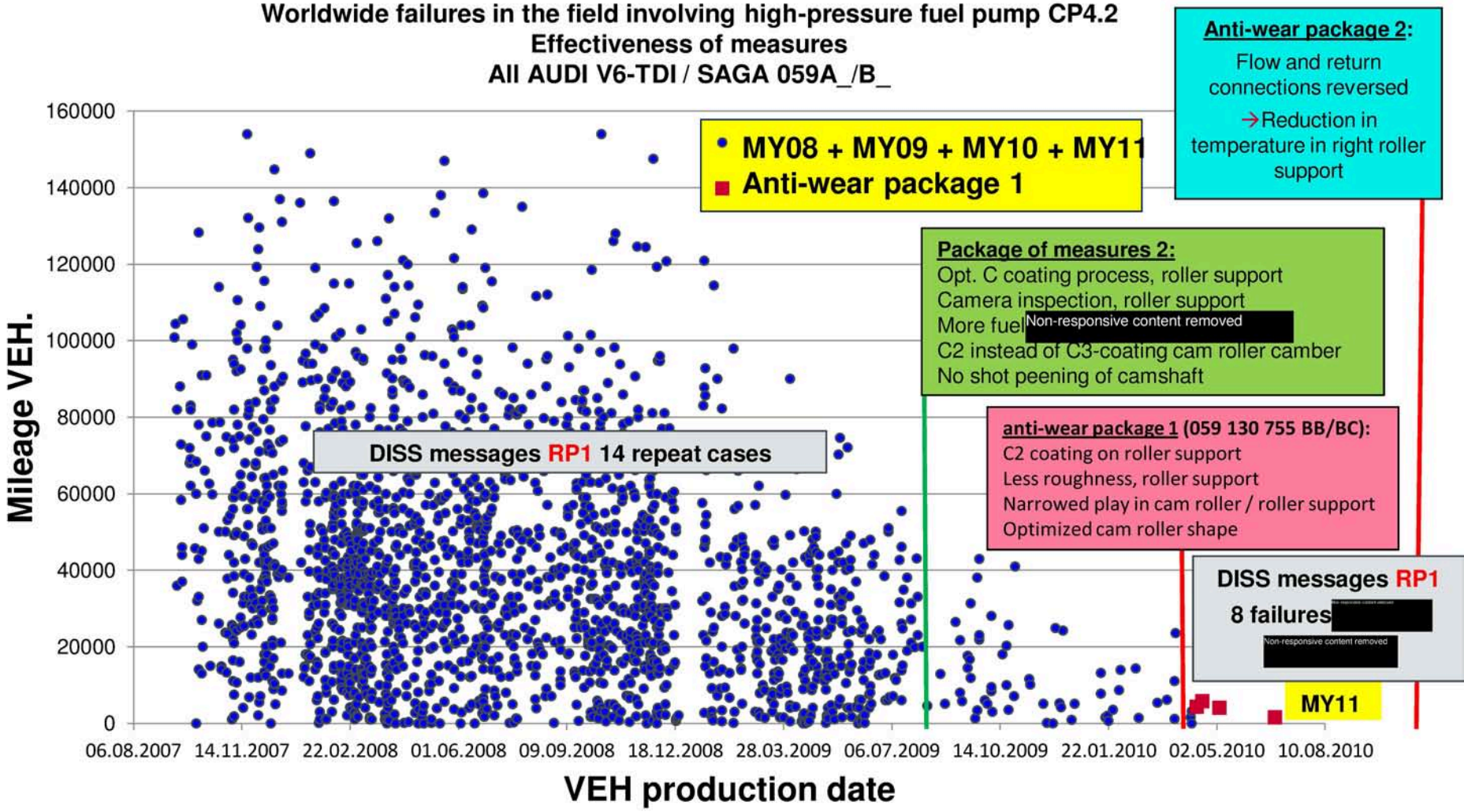
**(SAGA - replaced pumps only, 059A_/B_)**




**TOTAL V6-TDI: 2.135 cases**
**MY08: 935 cases**
**MY09: 1.018 cases**
**MY10: 181 cases**
**MY11: 1 case**
(SAGA, Stand 05.09.2010)

Non-responsive content removed

# Drivetrain damage, high pressure diesel fuel pump CP4



# Management summary (changes marked in blue)

- TOP Q meeting between RB and AUDI held on 10/28/2010.
  Non-responsive content removed in total 2,135 AUDI V6-TDI failures (CP4.2), for country-by-country breakdown see page 5. Total failure rate since vehicle production date 08.2009 declining, see page 6.
  Since vehicle production date 06.2009 no failures in Q7 and VW Touareg in Non-responsive content removed but a disproportionate increase in Non-responsive content removed
  RP1 introduced since 04.2010, effectiveness in the field still not sufficient.
  RP2 (temperature reduction in right roller support) introduced in 29.10.2010, effectiveness in the field is still to be proven (1st failure in Non-responsive content removed on 11/11/2010)

- The results of the findings relating to failures in Non-responsive content removed indicate horizontal abrasion of the cam roller and camshaft, a typical pointer towards the use of low-viscosity fuels (e.g. kerosene).

- Deployment of local team in Non-responsive content removed since 11/8/2010 for systematic analysis of cause of failure with support from RB.

# Management summary (changes marked in blue)

- USA testing
  - 2 failures of the Touareg NF Bin5 in Q-AL, 1 vehicle with previously damaged high-pressure fuel pump

- Analysis
  - Both failures after 10,000 km with Master 04 (since 9/1/2010)
    **(Q7 with same data as Master 05 and all Touaregs with Master 03 no striking features)**
  - Fuel temperature in inlet upstream of high-pressure fuel pump:
    Average driving temperature approx. 50 °C
    Subsequent to max. temperature peaks up to approx. 100 °C
  - Pre-pump volume of tank electric fuel pump control at engine start:
    - Master 03: Full pumping from start (200 l/h) until non-critical temperatures are reached
    - Master 04: requirement-based pumping (130 l/h) due to CO2 reduction and coagulation
  - Hypothesis: High-pressure fuel pump is not sufficiently washed with fresh fuel when performing a warm start with poor quality fuel (low boiling point, poor viscosity).
  - Bosch TKU will be fulfilled with Master 3,4 and 5.

- Measures
  - **Master 05** with full pumping when engine started and at fuel temperature >70 °C (same as Q7)
  - Bin5 dataset changed for market launch
  - EU5/EU4 changed for WK 45

# Management summary (changes marked in blue)

**Problem:**

At engine start

→ Mixed friction between roller and roller support with poor quality fuel results in a delay in starting the roller (flattening)

→ which in turn leads to a failure of the high-pressure pump

Other measures above and beyond TKU may be introduced.

Optimization of cooling and lubrication of high-pressure fuel pump when starting the engine.

- Control of the electric fuel pump with terminal 15
- Electric fuel pump control in afterrun with hot fuel temperatures for cooling the CP4
- Electric fuel pump control through door contact (also for 6 bar tank system)

**Dates:**

- SW specification 2 bar tank system by the end of WK 45
  Objective: To attain field action in [redacted] (beginning of 2011)
- SW specification 6 bar tank system by the end of WK 47

# Management summary (changes marked in blue)

- Pumps taken from the end of the line in the [Non-responsive content removed] plant had a thick deposit and pre-existing damage. Pumps in [Non-responsive content removed] were also slightly discoloured. Vehicle measurements will take place shortly in [Non-responsive content removed]

- Pumps removed when the engines were delivered to the [Non-responsive content removed] plant had no build-up of deposits or other damage.
  Accordingly, the damage most probably occurs during assembly and commissioning in [Non-responsive content removed] and not in the engine plant in [Non-responsive content removed]

- Production in [Non-responsive content removed] was halted by [Non-responsive content removed] on 11/9/10.
  102 repair shop complaints, 79 warranty bills, of which
  8 x with RP1 of approx. 4,300 vehicles.

- Further action: From each of 12 assembly lines in 8 car plants 5 pumps will be removed and analyzed (60 in all) In addition processes will be jointly analyzed at local level in the plants.
  25 of these pumps have already been delivered to Bosch.

# Management summary (changes marked in blue)

- Provisional delivery of 130 pumps ([redacted] 40, [redacted] 40, [redacted] 50) with RP2 complete Of these 30 have been installed in [redacted] respectively so far. Replacement in faulty vehicles in order to prove effectiveness in actual operation. First failure of RP2 on 11/11/2010 in [redacted] approx. 2,000 km after installation. Analysis running.

- It was suggested that risk should be shared for EU-4 markets until the end of testing. No agreement was reached in follow-up talks in September 2010 either.

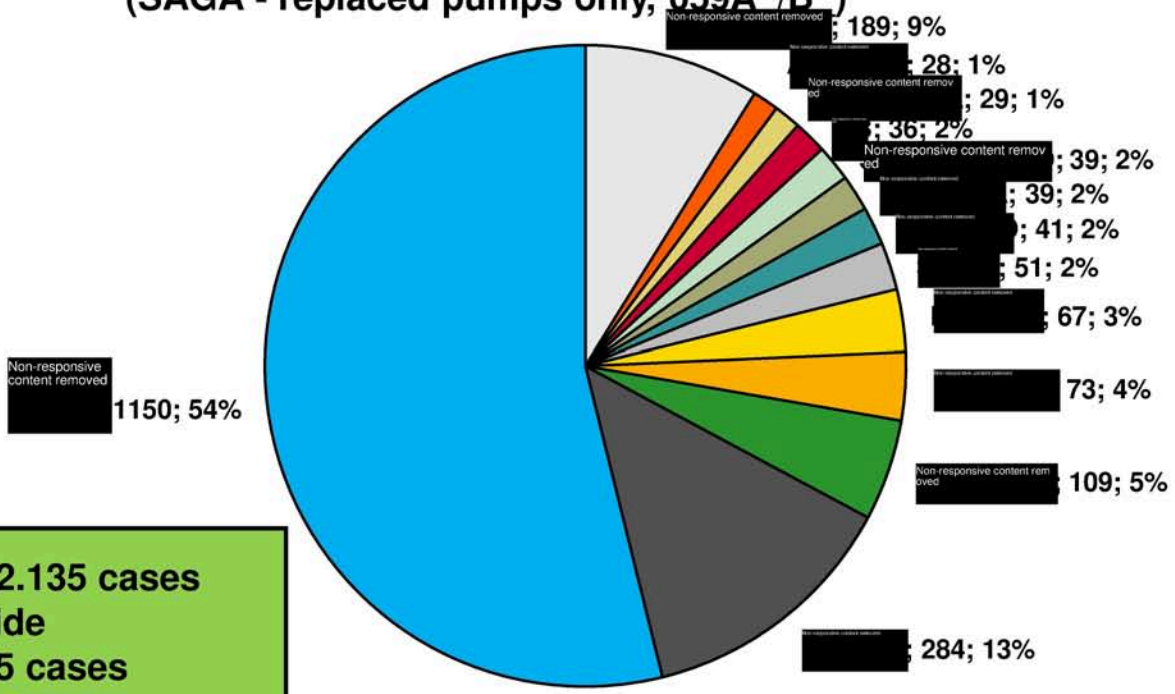
- Negotiations on who would cover the costs of RP1/OV were held in September. No agreement reached. Bosch will cover the cost of RP2.

- Preventive measures are planned in the field (approx. 34,000 vehicles) for the markets of [redacted] until RP2 is launched. Audi has already ordered replacement pumps; first deliveries have been made.

## AUDI V6-TDI failures in the field, broken down by country

(SAGA - replaced pumps only, 059A_/B_)




**TOTAL V6-TDI: 2.135 cases worldwide**

**MY08: 935 cases**

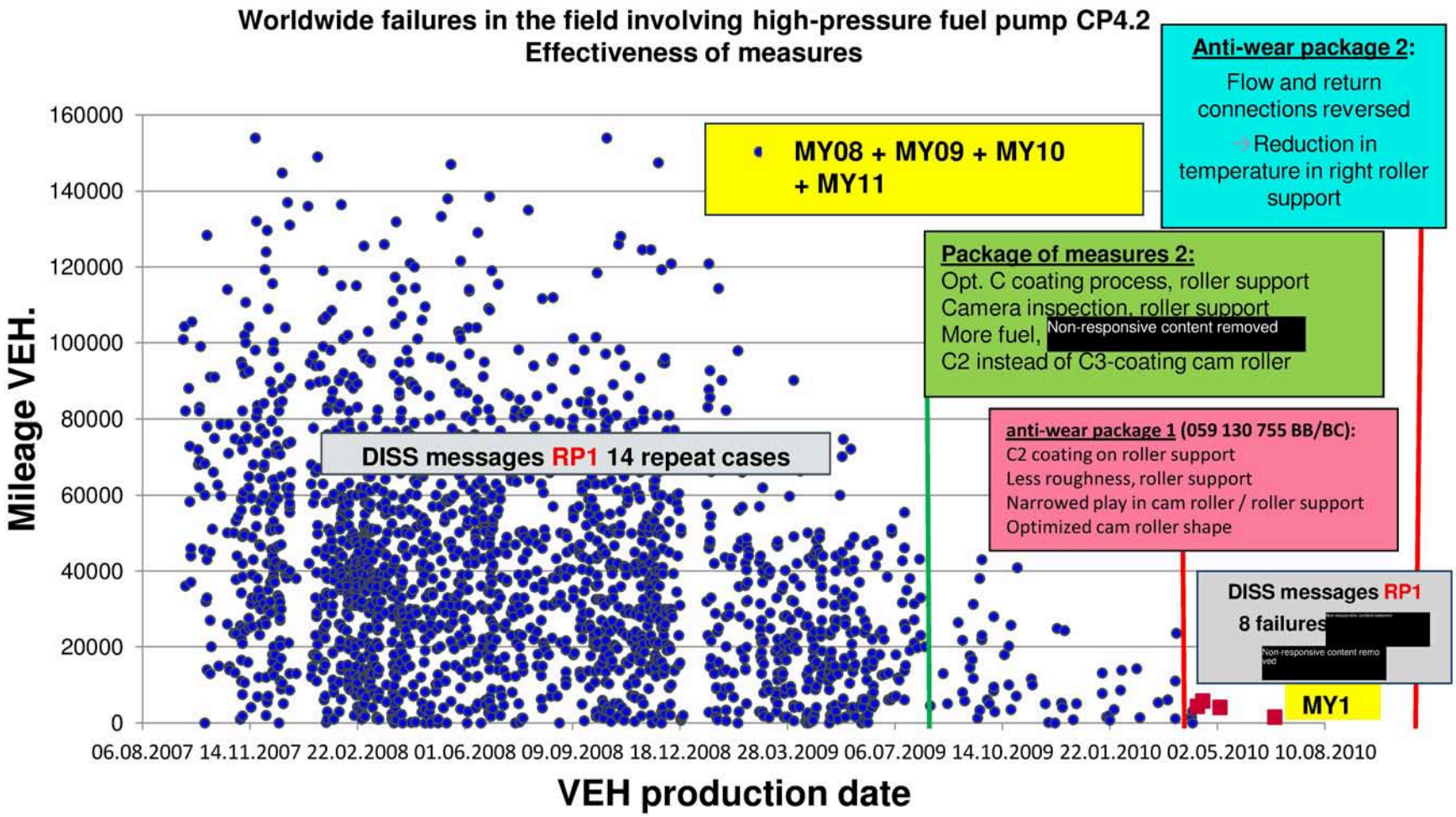
**MY09: 1.018 cases**

**MY10: 181 cases**

# AUDI CP4 Situation in the Field





BOSCH

# Management summary (changes marked in blue)

- TOP Q meeting between RB and AUDI held on 10/28/2010.
  Status at the beginning of September: 2,135 AUDI V6-TDI failures Non-responsive content removed in total (CP4.2), for a breakdown by country see page 5. Total failure rate since vehicle production date 08.2009 declining, see page 6.

- Since vehicle production date 06.2009 no failures in Q7 and VW Touareg in Non-responsive content removed but a disproportionate increase in Non-responsive content removed
  RP1 introduced since 04.2010, effectiveness in the field still not sufficient.
  RP2 (temperature reduction in right roller support) introduced in 10/29/2010, effectiveness in the field is still to be proven (1st failure in Non-responsive content removed on 11/11/2010)

- The results of the findings relating to failures in Non-responsive content removed indicate horizontal abrasion of the cam roller and camshaft, a typical pointer towards the use of low-viscosity fuels (e.g. kerosene).

- Deployment of local team in Non-responsive content removed since 11/8/2010 for systematic analysis of cause of failure with support from RB.



BOSCH

# Management summary (changes marked in blue)

- USA testing: Failure of 4 VW Touaregs.
  Changes in software can lead to a failure to reach the required level of cooling and lubrication when starting the engine. In addition, when starting the engine, fuel inlet temperatures of up to 120 °C (TKUmax = 90 °C) can arise, possibly leading to the vaporization of the fuel and to deposits in connection with poor quality fuels.
  All Touaregs are also affected.

- Measures:
  AUDI has reversed the software changes for USA.
  Non-responsive content removed Touareg and Cayenne to follow by end of 2010.
  Additional control of electric fuel pump at "Terminal 15-ON" and subsequently completed in all Audis. Implementation in 2 bar low-pressure systems by end of 2010, planned for 6 bar low-pressure systems.

# Management summary (changes marked in blue)

- Pumps taken from the end of the line in the [redacted] plant had a thick deposit and pre-existing damage. Pumps in [redacted] were also slightly discoloured. Vehicle measurements will take place shortly in [redacted]

- Pumps removed when the engines were delivered to the [redacted] plant had no build-up of deposits or other damage.
  Accordingly, the damage most probably occurs during assembly and commissioning in [redacted] and not in the engine plant in [redacted].

- Production in [redacted] A6 2.7l remain closed. New vehicle project Q7 3.0 l [redacted] will not be released. 103 repair shop complaints, 79 warranty bills or which 8 x with RP1 out of approx. 4,300 vehicles.

- Further action: From each of 12 assembly lines in 8 car plants 5 pumps will be removed and analyzed (60 in all). In addition processes will be jointly analyzed at local level in the plants.
  25 of these pumps have already been delivered to Bosch.



BOSCH

# Management summary (changes marked in blue)

- Provisional delivery of 130 pumps [redacted] 40, [redacted] 40, [redacted] 50) with RP2 complete Of these 30 have been installed in [redacted] respectively so far. Replacement in faulty vehicles in order to prove effectiveness in actual operation. First failure of RP2 on 11/11/2010 in [redacted] approx. 2,000 km after installation. Vehicle checked in WK 46 by local Audi/Bosch team.

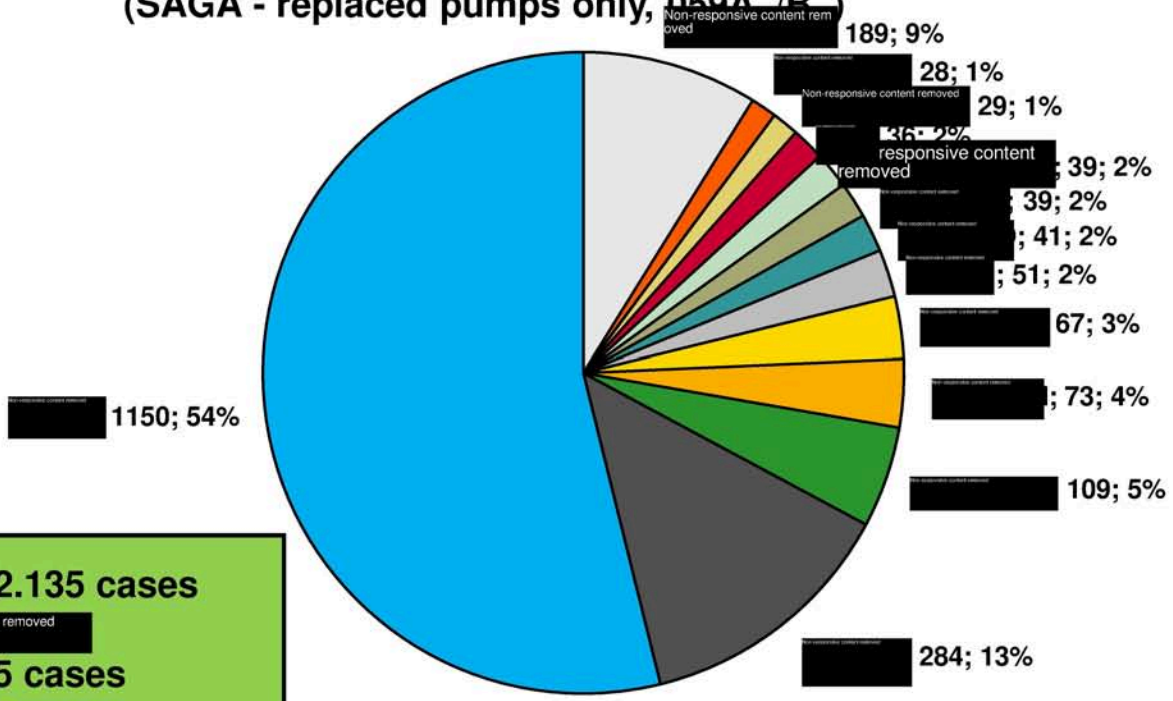
- It was suggested that risk should be shared for EU-4 markets until the end of testing. No agreement was reached in follow-up talks in September 2010 either.

- Negotiations on who would cover the costs of RP1/OV were held in September. No agreement reached. Bosch will cover the cost of RP2.

- Preventive measures are planned in the field (approx. 34,000 vehicles) for the markets of [redacted] until RP2 is launched. Audi has already ordered replacement pumps; first deliveries have been made.

## AUDI V6-TDI failures in the field, broken down by country

(SAGA - replaced pumps only, 059A…/B…)




**TOTAL V6-TDI: 2.135 cases**

Non-responsive content removed

**MY08: 935 cases**
**MY09: 1.018 cases**
**MY10: 181 cases**

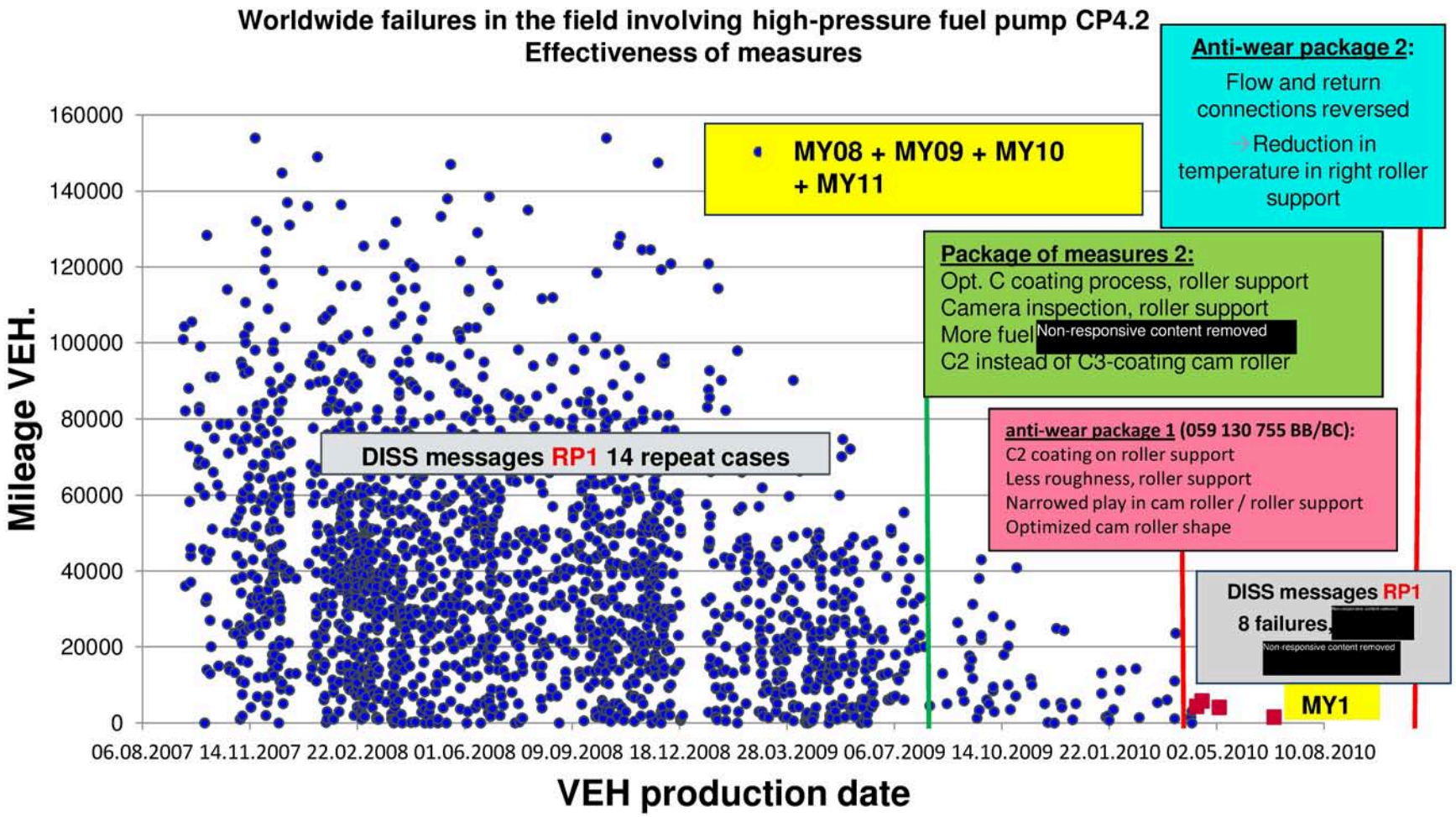




BOSCH

# AUDI CP4 Situation in the Field










BOSCH

# Management summary (changes marked in blue)

- TOP Q meeting between RB and AUDI held on 10/28/2010.
  Total worldwide failures 2,635 AUDI V6-TDI, 6 x V8-TDI and 12 x V12-TDI (CP4.2), for a breakdown by country see see page 7.
  For the development of the failure situation see page 6.

- Since vehicle production date 06/2009 no failures in Q7 and VW Touareg in Non-responsive content removed but a disproportionate increase in Non-responsive content removed
  RP1 introduced since 04/2010, effectiveness in the field still not sufficient.
  RP2 (temperature reduction in right roller support) introduced in 10/29/2010, effectiveness in the field is still to be proven (1st failure in Non-responsive content removed on 11/11/2010)

- The results of the findings relating to failures in Russia indicate horizontal abrasion of the cam roller and camshaft, a typical pointer towards the use of low-viscosity fuels (e.g. kerosene).

- Deployment of local team in Non-responsive content removed since 11/8/2010 for systematic analysis of cause of failure with support from RB.

# Management summary (changes marked in blue)

- USA testing
  - 2 failures of the Touareg NF Bin5 in Q-AL, 1 vehicle with previously damaged high-pressure fuel pump

- Analysis
  - Both failures after 10,000 km with Master 04 (since 9/1/2010)
    **(Q7 with same data as Master 05 and all Touaregs with Master 03 no striking features)**
  - Fuel temperature in inlet upstream of high-pressure fuel pump.

    Average driving temperature approx. 50 °C
    Subsequent to max. temperature peaks up to approx. 100 °C
  - Pre-pump volume of tank electric fuel pump control at engine start:
    - Master 03: Full pumping from start (200 l/h) until non-critical temperatures are reached
    - Master 04: requirement-based pumping (130 l/h) due to CO2 reduction and coagulation
  - Hypothesis: High-pressure fuel pump is not sufficiently washed with fresh fuel when performing a warm start with poor quality fuel (low boiling point, poor viscosity).

- Measures
  - **Master 05** with full pumping when engine started and at fuel temperature >70 °C (same as Q7)
  - Bin5 dataset changed for market launch
  - Non-responsive content removed changed for WK 45

# Management summary (changes marked in blue)

**Problem:**

At engine start

→ Mixed friction between roller and roller support with poor quality fuel results in a delay in starting the roller (flattening)

→ which in turn leads to a failure of the high-pressure pump

Other measures above and beyond TKU may be introduced.

Optimization of cooling and lubrication of high-pressure fuel pump when starting the engine.

- Control of the electric fuel pump with terminal 15
- Electric fuel pump control in afterrun with hot fuel temperatures for cooling the CP4
- Electric fuel pump control through door contact (also 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

# Management summary (changes marked in blue)

- Pumps taken from the end of the line in the [Non-responsive content removed] plant had a thick deposit and pre-existing damage. Pumps in [Non-responsive content removed] were also slightly discoloured. Vehicle measurements will take place shortly in [Non-responsive content removed]

- Pumps removed when the engines were delivered to the the [Non-responsive content removed] plant had no build-up of deposits or other damage.
  Accordingly, the damage most probably occurs during assembly and commissioning in [Non-responsive content removed] and not in the engine plant in [Non-responsive content removed]

- Production in [Non-responsive content removed] A6 2.7l remain closed. New vehicle project Q7 3.0 l [redacted] will not be released. 103 repair shop complaints, 79 warranty bills or which 8 x with RP1 out of approx. 4,300 vehicles.

- Further action: From each of 12 assembly lines in 8 car plants 5 pumps will be removed and analyzed (60 in all) In addition processes will be jointly analyzed at local level in the plants. 25 of these pumps have already been delivered to Bosch.

# Management summary (changes marked in blue)

- Provisional delivery of 130 pumps [Non-responsive content removed] 40, [redacted] 40, [Non-responsive content removed] 50) with RP2 complete. Of these 30 have been installed in [redacted] and [Non-responsive content removed] respectively so far. Replacement in faulty vehicles in order to prove effectiveness in actual operation.
  First failure of RP2 on 11/11/2010 in [Non-responsive content removed] approx. 2,000 km after installation. Vehicle checked in WK 46 by local Audi/Bosch team.

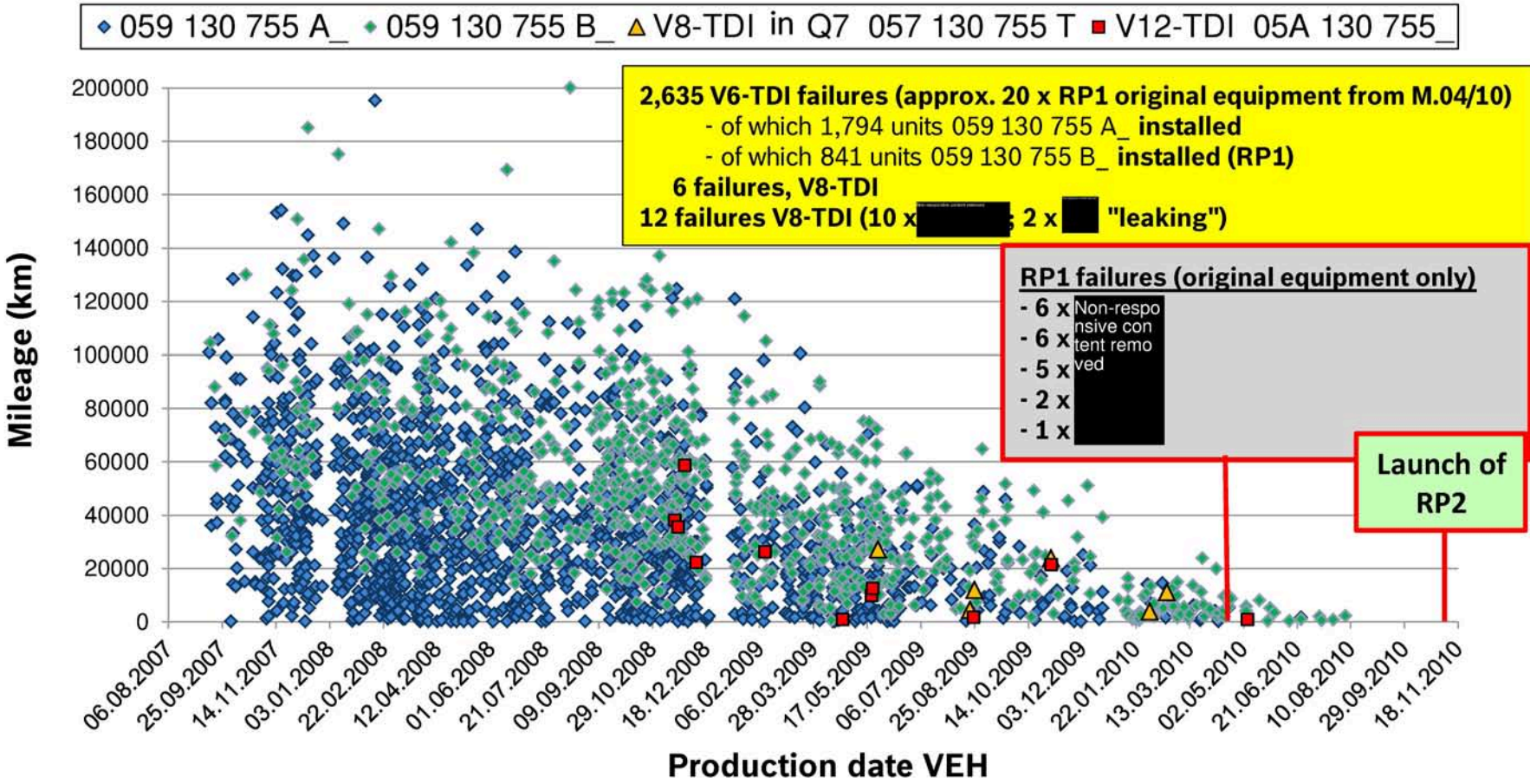
- It was suggested that risk should be shared for EU-4 markets until the end of testing. No agreement was reached in follow-up talks in September 2010 either.

- Negotiations on who would cover the costs of RP1/OV were held in September. No agreement reached. Bosch will cover the cost of RP2.

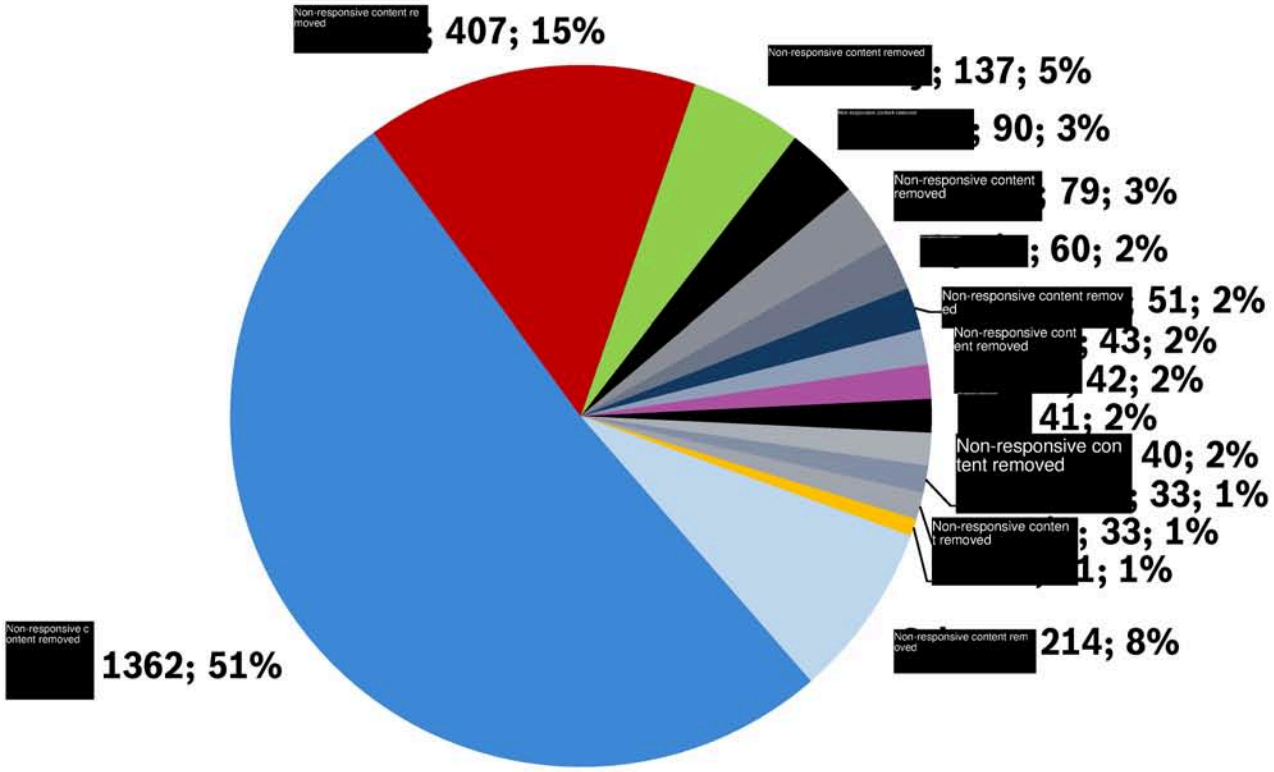
- Preventive measures are planned in the field (approx. 34,000 vehicles) for the markets of [Non-responsive content removed] until RP2 is launched. Audi has already ordered replacement pumps; first deliveries have been made.

# All bills for high-pressure fuel pumps V6/V8/V12-TDI Audi

( SAGA Status 16.11.2010 )



# Field failures V6/V8/V12 TDI (Audi only) by country



# Management summary (changes marked in blue)

- TOP Q meeting between RB and AUDI held on 28.10.2010.
  Total worldwide failures 2,635 AUDI V6-TDI, 6 x V8-TDI and 12 x V12-TDI (CP4.2), for a breakdown by country see see page 7.
  For the development of the failure situation see page 6.

- Since vehicle production date 06.2009 no failures in Q7 and VW Touareg in Non-responsive content removed but a disproportionate increase in Non-responsive content removed
  RP1 introduced since 04.2010, effectiveness in the field still not sufficient.
  RP2 (temperature reduction in right roller support) introduced in 10/29/2010, effectiveness in the field is still to be proven (1st failure in Non-responsive content removed on 11/11/2010).

- The results of the findings relating to failures in Non-responsive content removed indicate horizontal abrasion of the cam roller and camshaft, a typical pointer towards the use of low-viscosity fuels (e.g. kerosene).

- Deployment of local team in Non-responsive content removed since 11/8/2010 for systematic analysis of cause of failure with support from RB.

# Management summary (changes marked in blue)

- USA testing
  - 2 failures of the Touareg NF Bin5 in Q-AL, 1 vehicle with previously damaged high-pressure fuel pump

- Analysis
  - Both failures after 10,000 km with Master 04 (since 9/1/2010)
    **(Q7 with same data as Master 05 and all Touaregs with Master 03 no striking features)**
  - Fuel temperature in inlet upstream of high-pressure fuel pump.

    Average driving temperature approx. 50 °C
    Subsequent to max. temperature peaks up to approx. 100 °C
  - Pre-pump volume of tank electric fuel pump control at engine start:
    - Master 03: Full pumping from start (200 l/h) until non-critical temperatures are reached
    - Master 04: requirement-based pumping (130 l/h) due to CO2 reduction and coagulation
  - Hypothesis: High-pressure fuel pump is not sufficiently washed with fresh fuel when performing a warm start with poor quality fuel (low boiling point, poor viscosity).

- Measures
  - **Master 05** with full pumping when engine started and at fuel temperature >70 °C (same as Q7)
  - Bin5 dataset changed for market launch
  - EU5/EU4 changed for WK 45

# Management summary (changes marked in blue)

**Problem:**

At engine start

→ Mixed friction between roller and roller support with poor quality fuel results in a delay in starting the roller (flattening)

→ which in turn leads to a failure of the high-pressure pump

Other measures above and beyond TKU may be introduced.

Optimization of cooling and lubrication of high-pressure fuel pump when starting the engine.

- Control of the electric fuel pump with terminal 15
- Electric fuel pump control in afterrun with hot fuel temperatures for cooling the CP4
- Electric fuel pump control through door contact (also for 6 bar tank system)

**Dates:**

- SW specification 2 bar tank system by the end of WK 45
  Objective: To attain field action in [redacted] (beginning of 2011)
- SW specification 6 bar tank system by the end of WK 47

# Management summary (changes marked in blue)

- Pumps taken from the end of the line in the [Non-responsive content removed] plant had a thick deposit and pre-existing damage. Pumps in [Non-responsive content removed] were also slightly discoloured. Vehicle measurements will take place shortly in [Non-responsive content removed]

- Pumps removed when the engines were delivered to the the [Non-responsive content removed] plant had no build-up of deposits or other damage.
  Accordingly, the damage most probably occurs during assembly and commissioning in [Non-responsive content removed] and not in the engine plant in [Non-responsive content removed]

- Production in [Non-responsive content removed] A6 2.7l remain closed. New vehicle project Q7 3.0 l [Non-responsive content removed] will not be released. 103 repair shop complaints, 79 warranty bills or which 8 x with RP1 out of approx. 4,300 vehicles.

- Further action: From each of 12 assembly lines in 8 car plants 5 pumps will be removed and analyzed (60 in all) In addition processes will be jointly analyzed at local level in the plants. 25 of these pumps have already been delivered to Bosch.

BOSCH

# Management summary (changes marked in blue)

- Provisional delivery of 130 pumps [redacted] 40, [redacted] 40, [redacted] 50) with RP2 complete. Of these 30 have been installed in [redacted] respectively so far. Replacement in faulty vehicles in order to prove effectiveness in actual operation. First failure of RP2 on 11/11/2010 in [redacted] approx. 2,000 km after installation. Vehicle checked in WK 46 by local Audi/Bosch team.

- It was suggested that risk should be shared for EU-4 markets until the end of testing. No agreement was reached in follow-up talks in September 2010 either.

- Negotiations on who would cover the costs of RP1/OV were held in September. No agreement reached. Bosch will cover the cost of RP2.

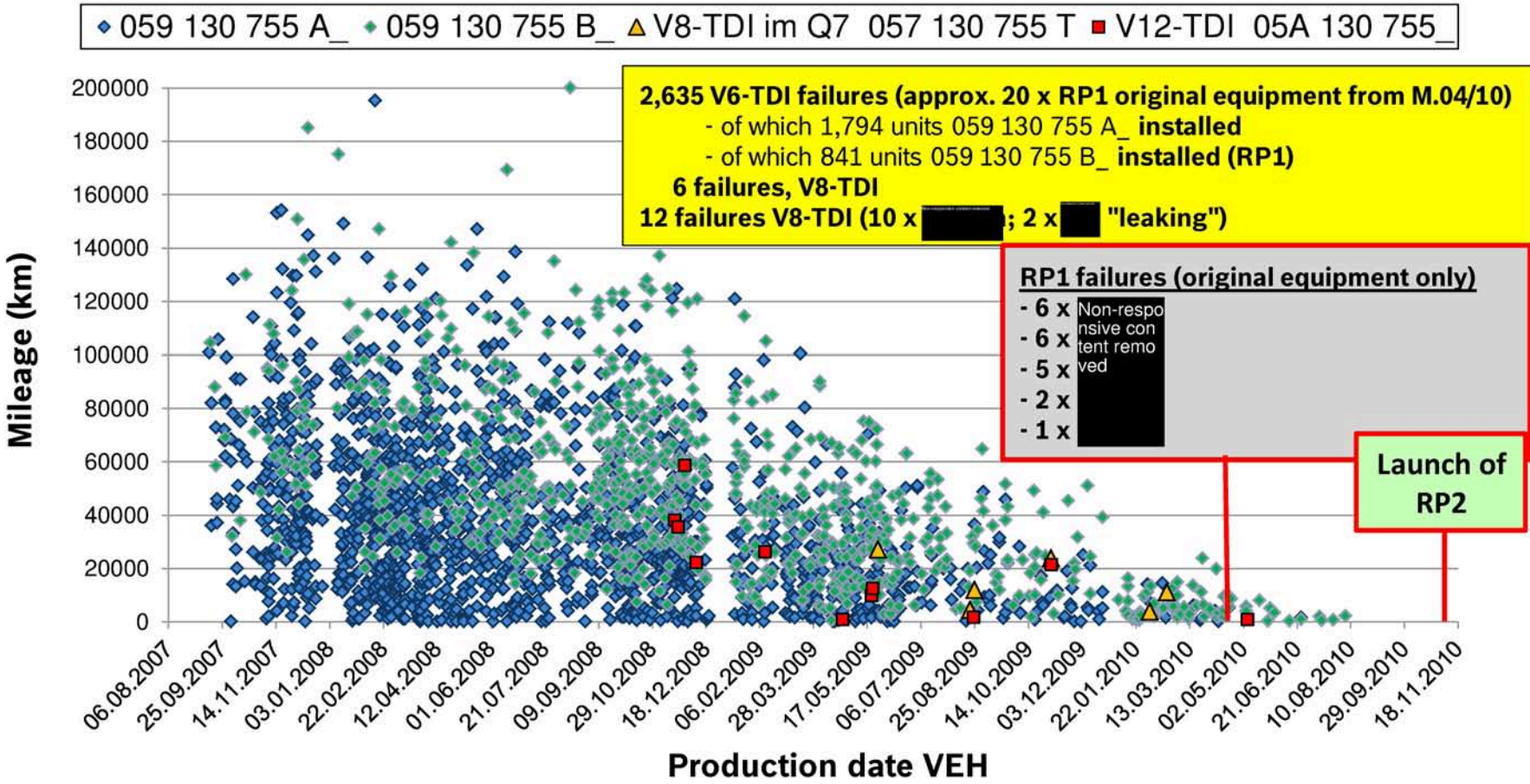
- Preventive measures are planned in the field (approx. 34,000 vehicles) for the markets of [redacted] until RP2 is launched. Audi has already ordered replacement pumps; first deliveries have been made.

BOSCH

# All bills for high-pressure fuel pumps V6/V8/V12-TDI Audi

( SAGA Status 16.11.2010 )

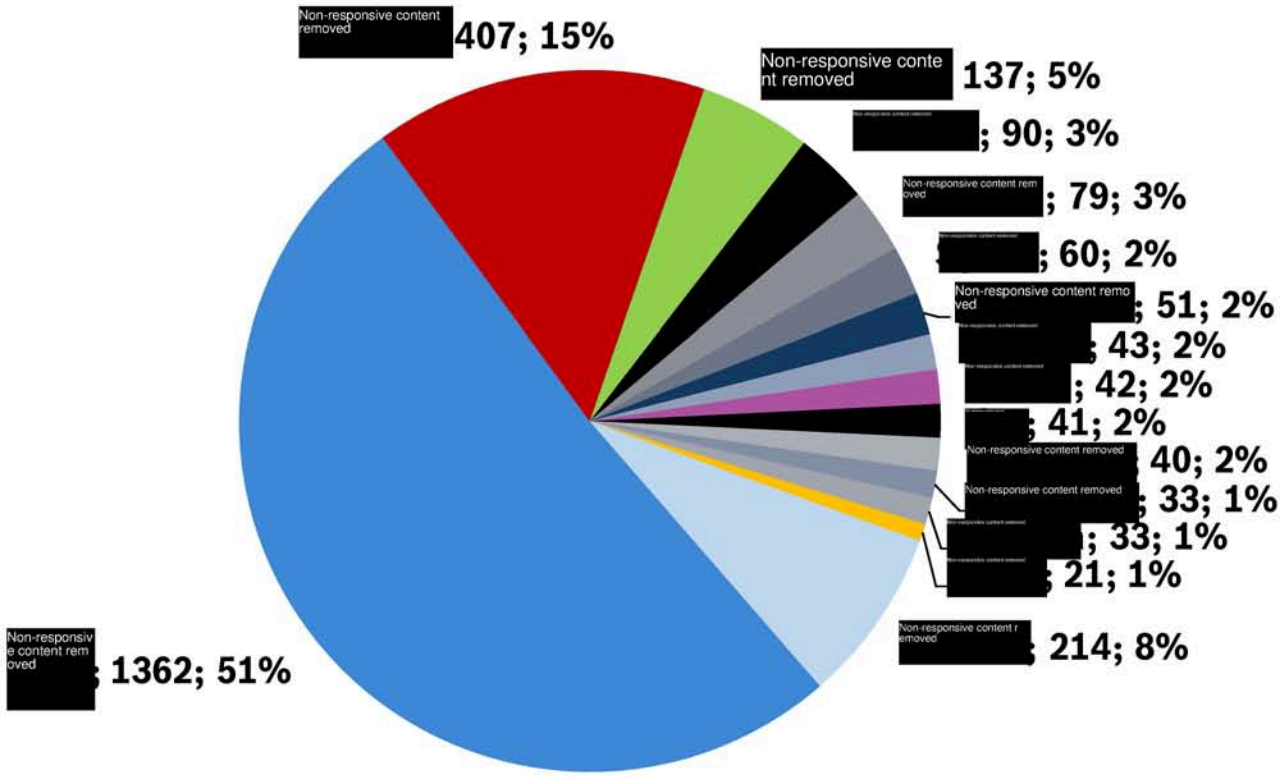




BOSCH

# Field failures V6/V8/V12 TDI (Audi only) by country



# Management summary (changes marked in blue)

- Since vehicle production date 08.2009 there have been no failures involving the Q7 and VW Touareg in [redacted] the last V6-TDI failure was in April 2010; however, there has been a disproportionately high rise in [redacted]
  RP1 introduced since 04.2010, effectiveness in the field still not sufficient.
  RP2 (temperature reduction in right roller support) introduced since 10/29/2010.

- The results of the findings relating to failures in [redacted] indicate horizontal abrasion of the cam roller and camshaft, a typical pointer towards the use of low-viscosity fuels (~~e.g kerosene~~; supposition - as of today no indication or evidence).

- No major striking features found when a local team was deployed in [redacted] (with the support of RB) in WK 50. Final report in WK 03/11

- Provisional delivery of 130 pumps [redacted] 40, [redacted] 40, [redacted] 50) with RP2 complete Installation quota in [redacted] 100%, [redacted] > 75%, [redacted] under investigation.

BOSCH

# Management summary (changes marked in blue)

- Trials have shown that some fuels produce a lot of foam when the tank contains <6l
  due to recirculation with the tank pump. Video recordings by Audi and Bosch show that the level of foaming depends on the quality of the fuel.
  The extent to which the foam/fuel mix causes preliminary damage to the fuel pump is under analysis.

- Simulation and trials confirmed that, if there is air in the high-pressure part of the high-pressure fuel pump, one plunger of the pump can pump air for a time. In the trial, the CP4.2 only vented itself automatically in the high-pressure range after 4 FL accelerations. During operation with just "one" plunger, deviations in rail pressure occur under the same environmental conditions as in Italy.

# Management summary (changes marked in blue)

## Analysis of commissioning in the car plants

- **Changchun:** Pumps taken from the end of the line had a thick deposit and pre-existing damage.
  Pumps removed when the engines were delivered to the the [Non-responsive content removed] plant had no build-up of deposits or other damage. Thus the damage most probably occurs during assembly and commissioning in [Non-responsive content removed] and not in the engine plant in [Non-responsive content removed]

- Production in [Non-responsive content removed] A6 2.7l remains closed until the robust [Non-responsive content removed] pump is installed in the 2nd HY 2011 blocked. New vehicle project Q7 3,0l EU4 starting as an interim solution with electric pump control software measure and RP2 from around February 2011 in [Non-responsive content removed]
  102 repair shop complaints, 79 warranty bills, of which 8 x with RP1 of approx. 4,300 vehicles (status Nov 2010).

# Management summary (changes marked in blue)

→ Non-responsive content removed

**Pumps** displayed slight discolorations.

→ Non-responsive content removed

6 out of 10 removed pumps have deposits, standing or braking lines.
7 of 7 tappet assemblies taken from the line for so-called direct runners (vehicles requiring no reworking) display no striking features. 1 of 4 additional pumps analyzed from vehicle reworking (reworking in the bodywork area), 1 pump displayed brown deposits on the cam roller.
Detailed investigation of the reworking and commissioning process, including measurement pump, completed. Date WK 2011

→ Non-responsive content removed

No sign of preliminary damage in the pumps.

→ Non-responsive content removed

No sign of preliminary damage in the pumps.

# Management summary (changes marked in blue)

- It was suggested that risk should be shared for Non-responsive content removed markets until the end of testing. No agreement was reached in follow-up talks in September 2010 either.
- Negotiations on who would cover the costs of RP1/OV were held in September. No agreement reached. Bosch will cover the cost of RP2.
- Preventive measures are planned in the field (approx. 34,000 vehicles) for the markets of Non-responsive content removed until RP2 is launched. Audi has already ordered replacement pumps; first deliveries have been made.

# Management summary (changes marked in blue)

- Since vehicle production date 08.2009 there have been no failures involving the Q7 and VW Touareg in [redacted] the last V6-TDI failure was in April 2010; however, there has been a disproportionately high rise in [Non-responsive content removed]
  RP1 introduced since 04.2010, effectiveness in the field still not sufficient.
  RP2 (temperature reduction in right roller support) introduced since 10/29/2010.

- The results of the findings relating to failures in [Non-responsive content removed] indicate horizontal abrasion of the cam roller and camshaft, a typical pointer towards the use of low-viscosity fuels.

- No major striking features found when a local team was deployed in [Non-responsive content removed] (with the support of RB) in WK 50. Final report in WK 03/2011

- Provisional delivery of 130 pumps [Non-responsive content removed] 40, [Non-responsive content removed] 40, [Non-responsive content removed] 50) with RP2 complete Installation quota in [redacted] 100%, [Non-responsive content removed] > 75%, [Non-responsive content removed] under investigation.

# Management summary (changes marked in blue)

- Trials have shown that some fuels produce a lot of foam when the tank contains <6l due to recirculation with the tank pump. Video recordings by Audi and Bosch show that the level of foaming depends on the quality of the fuel.
  The extent to which the foam/fuel mix causes preliminary damage to the fuel pump is under analysis.

- Simulation and trials confirmed that, if there is air in the high-pressure part of the high-pressure fuel pump, one piston of the pump can pump air for a time. In the trial, the CP4.2 only vented itself automatically in the high-pressure range after 4 FL accelerations. During operation with just "one" piston, deviations in rail pressure occur under the same environmental conditions as in Italy.

BOSCH

# Management summary (changes marked in blue)

## Analysis of commissioning in the car plants

- [redacted]: Pumps taken from the end of the line had a thick deposit and pre-existing damage.
  Pumps removed when the engines were delivered to the the[redacted] plant had no build-up of deposits or other damage. Thus the damage most probably occurs during assembly and commissioning in[redacted] and not in the engine plant in[redacted]

- New vehicle project Q7 3,0l [redacted] starting as an interim solution with electric pump control software measure and RP2 from around February 2011 in[redacted]
  102 repair shop complaints, 79 warranty bills, of which 8 x with RP1 of approx. 4,300 vehicles (status Nov. 2010).

# Management summary (changes marked in blue)

→ Non-responsive content removed

**Pumps** displayed slight discolorations.

→ Non-responsive conte nt removed

6 out of 10 removed pumps have deposits, standing or braking lines.
7 of 7 tappet assemblies taken from the line for so-called direct runners (vehicles requiring no reworking) display no striking features. 1 of 4 additional pumps analyzed from vehicle reworking (reworking in the bodywork area), 1 pump displayed brown deposits on the cam roller.
Detailed investigation of the reworking and commissioning process, including measurement pump, completed. Date WK 2011

→ Non-responsive content rem oved

No sign of preliminary damage in the pumps.

→ Non-responsive conten t removed

No sign of preliminary damage in the pumps.

# Management summary (changes marked in blue)

- It was suggested that risk should be shared for [redacted] markets until the end of testing. No agreement was reached in follow-up talks in September 2010 either.
- Negotiations on who would cover the costs of RP1/OV were held in September. No agreement reached. Bosch will cover the cost of RP2.
- Preventive measures are planned in the field (approx. 34,000 vehicles) for the markets of [redacted] until RP2 is launched. Audi has already ordered replacement pumps; first deliveries have been made.

# Management summary (changes marked in blue)

- Extreme tests show that air inside the pump, as well as low viscosity, poor lubricating fuels, is a further critical factor for CP4.2. The discoloration on the rollers is demonstrably due to oxidization.
  The focus is therefore on the following targets

  - The CP4.2 must be made self-ventilating
  - Suitable automotive measures to reduce the ingress of air into the low pressure system may have a positive effect
  - The CP4.2 is to be made generally more robust against air - as with a CP1.H or competitor pumps

The ingress of air can result from the lack of sufficient ventilation during initial commissioning or the build-up of foam in the tank. Critical failure countries all share a lack of foam breaker [redacted] parts of USA). Nonetheless, the Audi tanks are state-of-the-art and are mostly identical to those of the competitors Also, DIN EN590 does not specify a foam breaker in sufficient detail. Foaming fuel is also to be expected in EN590 markets

# Management summary (changes marked in blue)

- Provisional; delivery of 130 RP2 pumps [redacted] one failure reported in [redacted] to date
- Currently one further failure in OEM RP2 in [redacted] with 12,000 km, vehicle production date Nov. 2010; pump and fuel have been requested.
- Software measures for optimized electric fuel pump control (e.g. additional control of electric fuel pump when "terminal 15 on") are to be introduced at Audi. Series launched from approx. week 11/2011 with the exception of Q7 old and Touareg from approx. WK 22/2011

# Management summary (changes marked in blue)

Improvement measures:

- Audi:
  A check will be made to see whether the dry-running of the swirl pot on RB Q7 is a one-off error or can happen repeatedly. First the cause needs to be found.
- Audi/Bosch
  What is the status of possible lower deviations in rail pressure under the aspect of air? Non-responsive content removed
- Bosch:
  - A fully vented CP4 is to be introduced (integrated overflow valve)
  - Lubrication holes in the roller support will be examined
  - The possibility of a larger cam roller diameter will be examined.
  - Support patterns (cambers) of cam roller, roller support will be optimized
  - The tapered edge on the roller support is optimized.
  - The causes of the drivetrain damage at Bosch determined during final inspection in the plans are to be determined and eliminated.

# Management summary (changes marked in blue)

➔ Extreme tests show that air inside the pump, as well as low viscosity, poor lubricating fuels, is a further critical factor for CP4.2. The discoloration on the rollers is demonstrably due to oxidization.
The focus is therefore on the following targets

- The CP4.2 must be made self-ventilating
- Suitable automotive measures to reduce the ingress of air into the low pressure system may have a positive effect
- The CP4.2 is to be made generally more robust against air - as with a CP1.H or competitor pumps

The ingress of air can result from the lack of sufficient ventilation during initial commissioning or the build-up of foam in the tank. Critical failure countries also all share a lack of foam breaker [redacted]. Nonetheless, the Audi tanks are state-of-the-art and are mostly identical to those of the competitors Also, DIN EN590 does not specify a foam breaker in sufficient detail. Foaming fuel is also to be expected in EN590 markets

Non-responsive content removed

# Management summary (changes marked in blue)

- Provisional; delivery of 130 RP2 pumps [redacted] one failure reported in [redacted] to date
- Currently one further failure in OEM RP2 in [redacted] with 12,000 km, vehicle production date Nov. 2010; pump and fuel have been requested.
- Software measures for optimized electric fuel pump control (e.g. additional control of electric fuel pump when "terminal 15 on") are to be introduced at Audi. Series launched from approx. week 11/2011 with the exception of Q7 old and Touareg from approx. WK 22/2011

# Management summary (changes marked in blue)

Improvement measures:

- Audi:
  A check will be made to see whether the dry-running of the swirl pot on RB Q7 is a one-off error or can happen repeatedly.
  First the cause needs to be found.
- Audi/Bosch
  What is the status of possible lower deviations in rail pressure under the aspect of air?
- Bosch:
  - A fully vented CP4 is to be introduced (integrated overflow valve)
  - Lubrication holes in the roller support will be examined
  - The possibility of a larger cam roller diameter will be examined.
  - Support patterns (cambers) of cam roller, roller support will be optimized
  - The tapered edge on the roller support is optimized.
  - The causes of the drivetrain damage at Bosch determined during final inspection in the plans are to be determined and eliminated.

EA11003EN-02011[0]

**From:** Non-responsive content removed
**To:**
**CC** Non-responsive content removed
**Date:** 2/23/2011 06:05:00 PM
**Subject:** RE: Weekly report
**Attachments:** Wochenbericht 17 02 2011_3.ppt

Dear Non-responsive content removed

This type of communication and cooperation is no longer acceptable.

2 hours before this report was sent, we sat together in a meeting room at Bosch and agreed how we would continue to work together.
Then this report appears ...

You suggest that it has been definitively established that the ingress of air through our tanks has caused the CP4 to fail.

If it is really the case that all series of all our tank systems, which are very similar to the "exemplary competitor" and even use identical parts in some cases, cause the CP4 to fail, then this high-pressure fuel pump is absolutely unsuitable for Audi.

I see this as an attempt to shift the blame from the CP4, which cannot be completely vented because of your design, to our tank system.

I can only explain your reaction by assuming that the pressure from your Non-responsive content removed is so great that you are reduced to such an approach.

I shall immediately inform Non-responsive content removed so that they can contact [redacted] to ensure that we can continue to work in a normal way in a joint task force.

Alternatively, you should decide that we should abandon our cooperation.

With best wishes

Non-responsive content removed
AUDI AG
Non-responsive content removed



**From:** Non-responsive content removed
**Sent:** Wednesday, 23 February 2011 03:30 PM

EA11003EN-02011[1]

**To:** Non-responsive content removed
**Cc:**
**Subject:** Re: Weekly report

Dear Non-responsive content removed

I cannot give my approval.

With best wishes

Non-responsive content removed

AUDI AG

Non-responsive content removed

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

Important note: Die vorgenannten Angaben werden jeder E-Mail automatisch hinzugefuegt und lassen keine Rueckschluesse auf den Rechtscharakter der E-Mail zu.
Important Notice: The above information is automatically added to this e-mail. This addition does not constitute a representation that the content of e-mail is legally relevant and/or is intended to be legally binding upon AUDI AG.

**From:** Non-responsive content removed
**Sent:** Wednesday, 23 February 2011 03:24 PM
**To:** Non-responsive content removed
**Subject:** RE: Weekly report

Dear Non-responsive content removed

Attached once again please find the revised version. Please let us have your approval.

Best regards

Non-responsive content removed

Robert Bosch GmbH

Non-responsive content removed

Domicile: Stuttgart, Register Court: District Court of Stuttgart, HRB 14000;
Chair of the Supervisory Board Hermann Scholl; Directors: Franz Fehrenbach, Siegfried Dais;
Bernd Bohr, Rudolf Colm, Volkmar Denner, Wolfgang Malchow, Peter Marks,

EA11003EN-02011[2]

[redacted]

125 Bosch 1886–2011

**From:** Non-responsive content removed
**Sent:** Tuesday, 22 February 2011 12:05 PM
**To:** Non-responsive content removed
**Cc:** [redacted]
**Subject:** Weekly report

Dear Non-responsive content removed

Attached please find the revised weekly report.

<<Wochenbericht 17 02 2011_5.ppt>>

With best wishes

Non-responsive content removed

[redacted]

# Management summary (changes marked in blue)

- Although it was not possible to produce drivetrain damage during the task force. RB has now succeeded in producing drivetrain damage on vehicle Q7 with a very small amount of fuel and without foam breaker on a test bench with targeted air feed after restart Extreme tests with small amount of fuel in the tank when static (stationary tank) indicates a massive build-up of foam with fuels without foam breaker with residual amounts of fuel of 4-7 l. Fuel analyses in the relevant countries, Non-responsive content removed and, partly the USA indicate no foam breaker. This is the first time that a common denominator has been found, a strong indicator that these trials are linked with the field. Fuels with poor viscosity and lubrication are still a massive reinforcing factor.

Further measures:

Bosch is to investigate the precise link between air and drivetrain damage and options for venting the CP4 faster in the event of the external ingress of air.

Audi is currently examining the prevention of air ingress from the low pressure system.

# Management summary (changes marked in blue)

- Provisional; delivery of 130 RP2 pumps Non-responsive content removed one failure reported in Non-responsive content removed to date
- Currently one further failure in OEM RP2 in Non-responsive content removed with 12,000 km, vehicle production date Nov. 2010; pump and fuel have been requested.
- Software measures for optimized electric fuel pump control (e.g. additional control of electric fuel pump when "terminal 15 on") are to be introduced at Audi. Series launched from approx. week 11/2011 with the exception of Q7 old and Touareg from approx. WK 22/2011

# Management summary (changes marked in blue)

Improvement measures:

- Audi:
  A check will be made to see whether the dry-running of the swirl pot on RB Q7 is a one-off error or can happen repeatedly. First the cause needs to be found.
- Audi is to examine ways to reduce or prevent air ingress in the pump.

- Audi/Bosch
  What is the status of possible lower deviations in rail pressure under the aspect of air? Non-responsive content removed
- Bosch:
  Bosch is to examine ways to vent the CP4 in the case of external air ingress.
  Bosch is to examine further increases in WWU robustness on roller support

EA11003EN-02013[0]

**From:** Non-responsive content removed
**To:**
**CC**
**Date:** 2/23/2011 6:30:00 PM
**Subject:** Re: Weekly report
**Attachments:** [redacted] 17 02 2011_3.ppt
17 02 2011_4.ppt

Dear Bosses,

Below please find a mail I have composed but, after consultation with Non-responsive content removed, have not yet sent.

Attachment 2 is our corrected proposal for the weekly report, which was not accepted by Bosch and which is now replaced with Attachment 1.

Additional comment by Non-responsive content removed

A letter is on the way to VW (Audi) management, "threatening" to reverse the implemented measures such as RP1 and drilled OV by 1 March if VW/Audi refuses to pay the higher price.

For this reason Non-responsive content removed wishes to ignore the weekly report for the moment.

With best wishes

Non-responsive content removed

From: Non-responsive content removed
Sent: Wednesday, 23 February 2011 6:06 PM
Cc: Non-responsive content removed
Subject: RE: Weekly report

==========

Dear Non-responsive content removed

This type of communication and cooperation is no longer acceptable.

2 hours before this report was sent, we sat together in a meeting room at Bosch and agreed how we would continue to work together.

Then this report appears ...

You suggest that it has been definitively established that the ingress of air through our tanks has caused the CP4 to fail.

If it is really the case that all series of all our tank systems, which are very similar to the "exemplary competitor" and even use identical parts in some cases, cause the CP4 to fail, then this high-pressure fuel pump is absolutely unsuitable for Audi.

This naturally begs the question why a CP4.2 should fail 10 times more often than a CP4.1 with the same tank system?

I see this as an attempt to shift the blame from the CP4, which cannot be completely vented because of your design, to our tank system.

I can only explain your reaction by assuming that the pressure from your Non-responsive content removed is so great that you are reduced to such an approach Non-responsive content removed /delete)).

I shall immediately inform Non-responsive content removed so that they can contact Non-responsive content removed to ensure that we can continue to work in a normal way in a joint task force.

Alternatively, you should decide that we should abandon our cooperation.

With best wishes
EA11003EN-02013[2]

ENTIRE PAGE CONFIDENTIAL

EA11003EN-02013[3]

Non-responsive content removed

AUDI AG

Non-responsive content removed

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

Important note: Die vorgenannten Angaben werden jeder E-Mail automatisch hinzugefuegt und lassen keine Rueckschluesse auf den Rechtscharakter der E-Mail zu.
Important Notice: The above information is automatically added to this e-mail. This addition does not constitute a representation that the content of this e-mail is legally relevant and/or is intended to be legally binding upon AUDI AG.

From: Non-responsive content removed
Sent: Wednesday, 23 February 2011 3:30 PM
To: Non-responsive content removed
Cc:
Subject: Re: Weekly report

Dear Non-responsive content removed

I cannot give my approval.

With best wishes

Non-responsive content removed

AUDI AG

Non-responsive content removed

EA11003EN-02013[4]

Non-responsive content removed



---

From: Non-responsive content removed
Sent: Wednesday, 23 February 2011 03:24 PM
To: Non-responsive content removed
Subject: RE: Weekly report

Dear Non-responsive content removed

Attached once again please find the revised version. Please let us have your approval.

Best regards

Non-responsive content removed

Robert Bosch GmbH
Non-responsive content removed

---

From: Non-responsive content removed
Sent: Tuesday, 22 february 2011 12:05 PM
Non-responsive content removed

Subject: Weekly report

Dear Non-responsive content removed

Attached please find the revised weekly report.

<>

With best wishes

Non-responsive content removed

AUDI AG
Non-responsive content removed

# Management summary (changes marked in blue)

- Although it was not possible to produce drivetrain damage during the task force. RB has now succeeded in producing drivetrain damage on vehicle Q7 with a very small amount of fuel and without foam breaker on a test bench with targeted air feed after restart Extreme tests with small amount of fuel in the tank when static (stationary tank) indicates a massive build-up of foam with fuels without foam breaker with residual amounts of fuel of 4-7 l. Fuel analyses in the relevant countries, [redacted] Non-responsive content removed and, partly the USA indicate no foam breaker. This is the first time that a common denominator has been found, a strong indicator that these trials are linked with the field. Fuels with poor viscosity and lubrication are still a massive reinforcing factor.

Further measures:

Bosch is to investigate the precise link between air and drivetrain damage and options for venting the CP4 faster in the event of the external ingress of air.

Audi is currently examining the prevention of air ingress from the low pressure system.

# Management summary (changes marked in blue)

- Provisional; delivery of 130 RP2 pumps Non-responsive content removed one failure reported in Non-responsive content removed to date
- Currently one further failure in OEM RP2 in Non-responsive content removed with 12,000 km, vehicle production date Nov. 2010; pump and fuel have been requested.
- Software measures for optimized electric fuel pump control (e.g. additional control of electric fuel pump when "terminal 15 on") are to be introduced at Audi. Series launched from approx. week 11/2011 with the exception of Q7 old and Touareg from approx. WK 22/2011

# Management summary (changes marked in blue)

Improvement measures:

- Audi:
  A check will be made to see whether the dry-running of the swirl pot on RB Q7 is a one-off error or can happen repeatedly. First the cause needs to be found.
- Audi is to examine ways to reduce or prevent air ingress in the pump.

- Audi/Bosch
  What is the status of possible lower deviations in rail pressure [redacted] under the aspect of air?
- Bosch:
  Bosch is to examine ways to vent the CP4 in the case of external air ingress.
  Bosch is to examine further increases in WWU robustness on roller support

# Management summary (changes marked in blue)

➔ Extreme tests show that air inside the pump, as well as low viscosity, poor lubricating fuels, is a further critical factor for CP4.2. The discoloration on the rollers is demonstrably due to oxidization.
The focus is therefore on the following targets

- The CP4.2 must be made self-ventilating
- Suitable automotive measures to reduce the ingress of air into the low pressure system may have a positive effect
- The CP4.2 is to be made generally more robust against air - as with a CP1.H or competitor pumps

The ingress of air can result from the lack of sufficient ventilation during initial commissioning or the build-up of foam in the tank. Critical failure countries also all share a lack of foam breaker [redacted]. Nonetheless, the Audi tanks are state-of-the-art and are mostly identical to those of the competitors Also, DIN EN590 does not specify a foam breaker in sufficient detail. Foaming fuel is also to be expected in EN590 markets

Non-responsive content removed

# Management summary (changes marked in blue)

- Provisional; delivery of 130 RP2 pumps [redacted] one failure reported in [redacted] to date
- Currently one further failure in OEM RP2 in [redacted] with 12,000 km, vehicle production date Nov. 2010; pump and fuel have been requested.
- Software measures for optimized electric fuel pump control (e.g. additional control of electric fuel pump when "terminal 15 on") are to be introduced at Audi. Series launched from approx. week 11/2011 with the exception of Q7 old and Touareg from approx. WK 22/2011

# Management summary (changes marked in blue)

Improvement measures:

- Audi:
  A check will be made to see whether the dry-running of the swirl pot on RB Q7 is a one-off error or can happen repeatedly.
  First the cause needs to be found.
- Audi/Bosch
  What is the status of possible lower deviations in rail pressure under the aspect of air? Non-responsive content removed
- Bosch:
  - A fully vented CP4 is to be introduced (integrated overflow valve)
  - Lubrication holes in the roller support will be examined
  - The possibility of a larger cam roller diameter will be examined.
  - Support patterns (cambers) of cam roller, roller support will be optimized
  - The tapered edge on the roller support is optimized.
  - The causes of the drivetrain damage at Bosch determined during final inspection in the plans are to be determined and eliminated.