

EA11003EN-01877[0]

**From:** Non-responsive content removed  
**To:** [REDACTED]

**CC:**  
**Date:** 8/1/2008 11:24:26 AM  
**Subject:** Diesel-HP pump malfunctions

INFORMATION Redacted PURSUANT TO THE FREEDOM OF  
 INFORMATION ACT (FOIA), 5 U.S.C. 552(B)(6)

Gentlemen,

The chemical's reputation is not at all bad!

-> >(Sterol Glucosides) ( or Sterol Glycosides) are carbohydrates (a sugar derivative)  
 Bio often brings that sort of thing with it. If only the fuel producers would filter their FAME (= biodiesel) properly before mixing for diesel, then this Stero..... and also most other rubbish would disappear, even everything that often causes problems in diesel filters.

This [REDACTED] diesel with Stero....however, "only" seals up filters! Would it be our HP pump problem in

[REDACTED]

Therefore and for various other reasons, please as discussed, always the diesel filter for case of damage.

-> Can Bosch say more than "only": "Has the case of damage pump been run on the test rig?"  
 Has the pump gotten more sluggish than when originally delivered?

What I'm trying to get at:

[REDACTED] has explained: He is under the impression that the HP pumps inside are "somehow stuck"! This observation would fit in very well with our damage hypothesis (black, organic mass in the filter).

Sticky pumps -> Sluggishness -> higher power consumption -> more output in the form of heat in the diesel

-> makes chem. reaction go even quicker

If this were the case, the chemist would need such a "sticky" pump, in order to investigate the possible source of the sticky substance\*

-> Since the diesel single-cylinder HP pumps are not showing any problems in the same markets, whereas the diesel twin-cylinder HP pumps are possibly diesel chemical reactors, which produce sticky substances, we should be looking into "differences".

Approach:

A chem. reaction requires: A reactive material -> components possibly out of diesel, one of up to 30,000!!!

Energy supply -> temperature / pressure

Time -> dwell time, way through pump

possibly catalysts -> materials

What is different between the types of pump?

Of course we are doing our diesel jobs, but strongly suspect that the cause most probably lies in / on the HP pump, and is only secondary to the diesel.

My jobs:

Until Monday inclusive, both diesel pumps that I have before me

EA11003EN-01877[1]

- a basic report (solid particulate matter in the diesel, FAME, other striking features)
- the amount required by Bosch shall be filled -> will go through [redacted] as an exception
- the samples go to Petrolab for further investigations.

(the latter will probably not produce anything at all for the time being, since there are no test procedures, which list the up to 30,000 individual components in diesel for us.

Even if there were, which of these components would it be?

For the time being we need a technical report on the cause of the malfunction of the HP pumps, then we need at least one pump in order to be able to identify the sticky substance\* and then conclude what we need to look for in the diesel.

Only then will we be able to try to identify a substance\* in the diesel.

There's absolutely no other way of doing it!!!!

(If anyone this that they can do it another way or a better way, they should take over the investigation work! )

Incidentally:

What Bosch analyzed in the diesel contamination was mainly with REM-EDX.

No-one can start anything with that, no usable reports,

nothing about the quantities (the quantity report leads to the approach of further investigations) and.....

one or more PET fibers in the fuel are also not unusual.

Procedure:

We shall let

- 1.) Petrolab investigate the important diesel parameters (lubricity, aromatics, RFA etc.)
- 2.) [Petrolab] then send us the samples back in order to keep them.
- 3.) The technicians work on the cause of the malfunction and as soon as we can draw conclusions from their results the diesel will go for detailed analysis.

NB:

I'm on holiday in weeks 32 and 33

\*Special analytical challenges!!!!

Kind regards

[redacted]

Audi AG, Neckarsulm

[redacted]

>

>Von: [redacted]

>Sent: Thursday, July 31, 2008 9:22 AM

>To: [redacted]

>Subject: RE: PCC 2008-0197 / Customer number. 2045 / Type 7L - Car suddenly stops. Engine doesn't start, engine warn light is active.

>

EA11003EN-01877[2]

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>  
>  
> \_\_\_\_\_ >

>From: Non-responsive content removed  
>Sent: Wednesday, June 25, 2008 6:32 PM  
>To: Non-responsive content removed

Cc:  
>Subject: RE: PCC 2008-0197 / Customer number. 2045 / Type 7L - Car suddenly stops. Engine doesn't start, engine warning light is active.

>  
>Hi Non-responsive content removed

>  
>The \_\_\_\_\_ generally have very good diesel, the HFRR - value is also very good.

>  
>However, there is a striking feature: The biodiesel part is imported. There were (are???) several problems with contamination.

>(Sterol Glucoside). Do you know the damage? Could the subsequent damage be from plugged fuel filters (at least here the engine warning light always comes on very quickly due to risk of leakage; pump/nozzle injector becomes slower and in extreme cases at most results in a breakdown as "worn out").

If so, is it possible to get the filters?

>Are there customer surveys asking which service stations customers have filled up at)?

>  
>  
>Non-responsive content removed

>  
>Thomas

>  
>  
>  
>  
>  
> \_\_\_\_\_

>From: Non-responsive content removed  
>Sent: Wednesday, June 25, 2008 1:56 PM

Non-responsive content removed

>Subject: RE: PCC 2008-0197 / Customer number. 2045 / Type 7L - Car suddenly stops. Engine doesn't start, engine warning light is active.

>  
>Hi both,  
>  
>According to the official list of the central laboratory, \_\_\_\_\_ has very good diesel fuel.  
>Lubricity is max 310 µm (460 µm acceptable according to EN590).

>  
>Non-responsive content removed, do you know of any current problems with \_\_\_\_\_ diesel?

>  
>Kind regards

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>  
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EA11003EN-01877[3]

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>

>Domicile/Sitz Ingolstadt

Court of Registry/Registergericht: Local court Ingolstadt

Commercial Register No./HRB Nr.: 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, Axel Strotbek, Werner Widuckel

>

Important note: The above information is automatically added to each e-mail.

This addition does not constitute representation that the content of this e-mail is legally relevant and/or is intended to be legally binding upon AUDI AG.

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.

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EA11003EN-02151[0]

Audi  
Vorsprung durch Technik



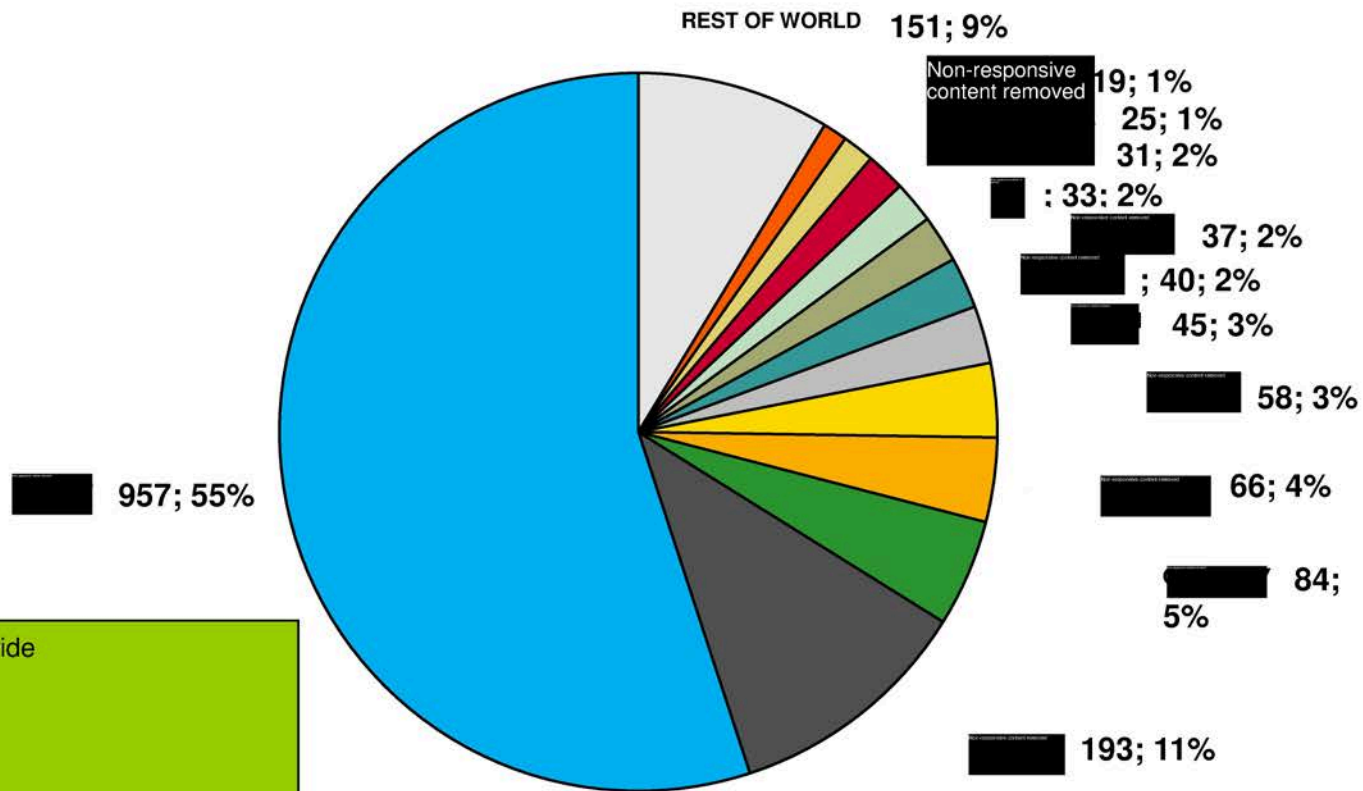
**Drivetrain damage - high-pressure diesel fuel pump CP4.2**

TOP meeting Bosch / Audi on July 12, 2010

EA11003EN-02151[1]

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

## Field failures of Audi V6-TDI by country SAGA – only exchanged pumps; 059\_/B\_)

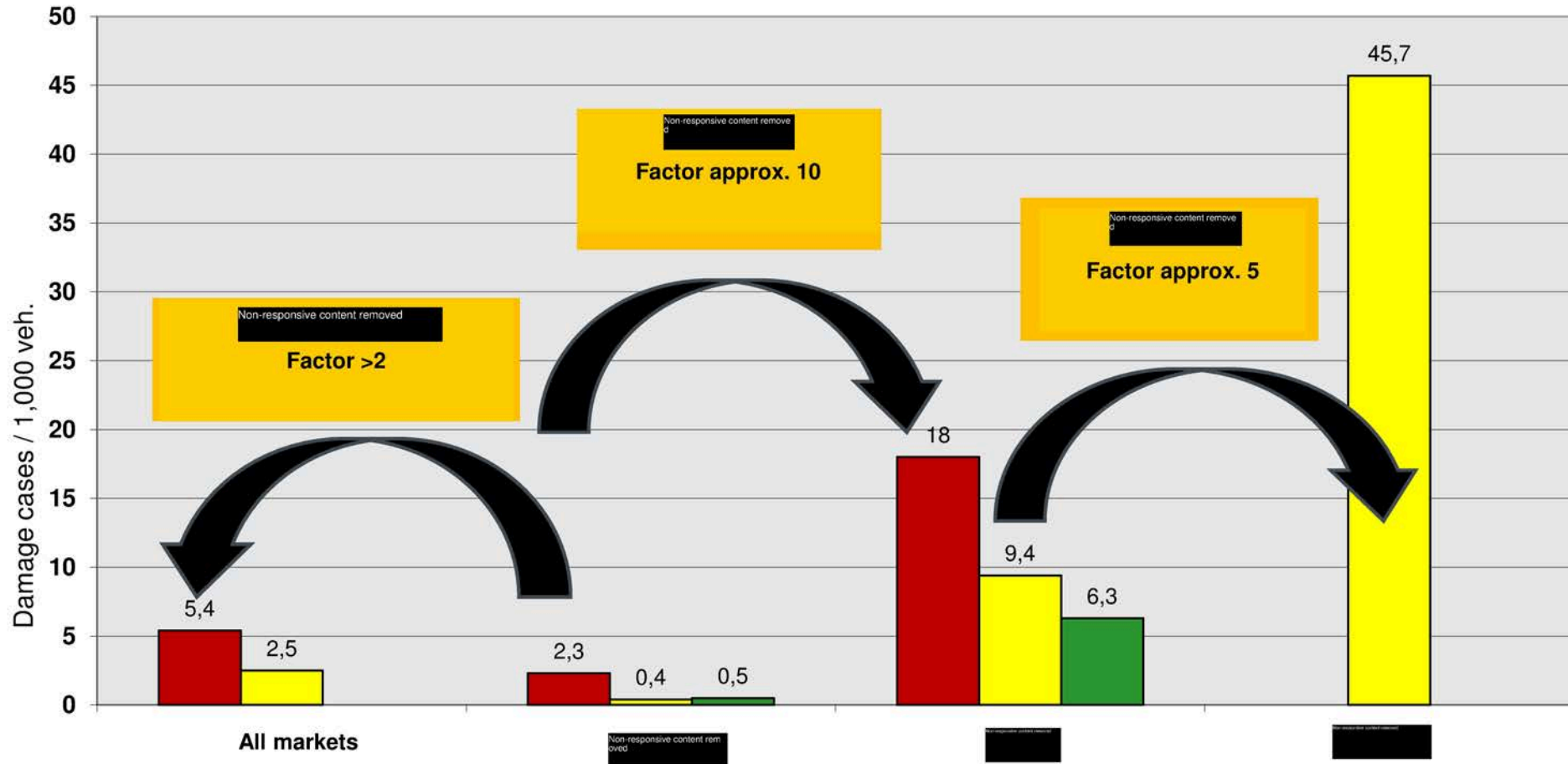


Total V6-TDI: 1,739 cases worldwide  
 MY08: 849 cases  
 MY09: 782 cases  
 MY10: 108 cases  
 (SAGA, status 7/4/2010)

EA11003EN-02151[2]

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

## MIS 09

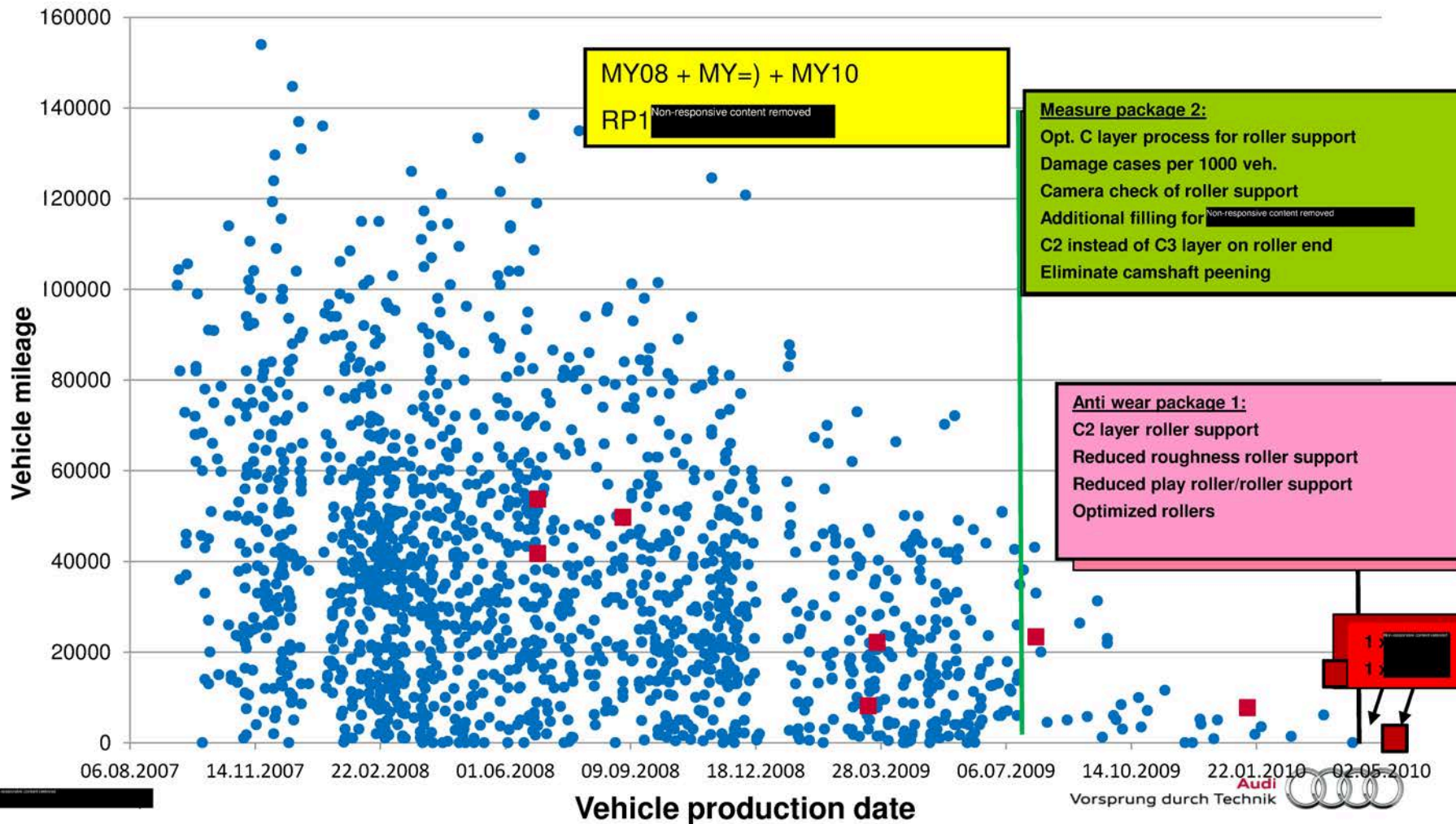


EA11003EN-02151[3]

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

## Mileage beyond vehicle production date all Audi V6-TDI

SAGA 059A\_/B\_

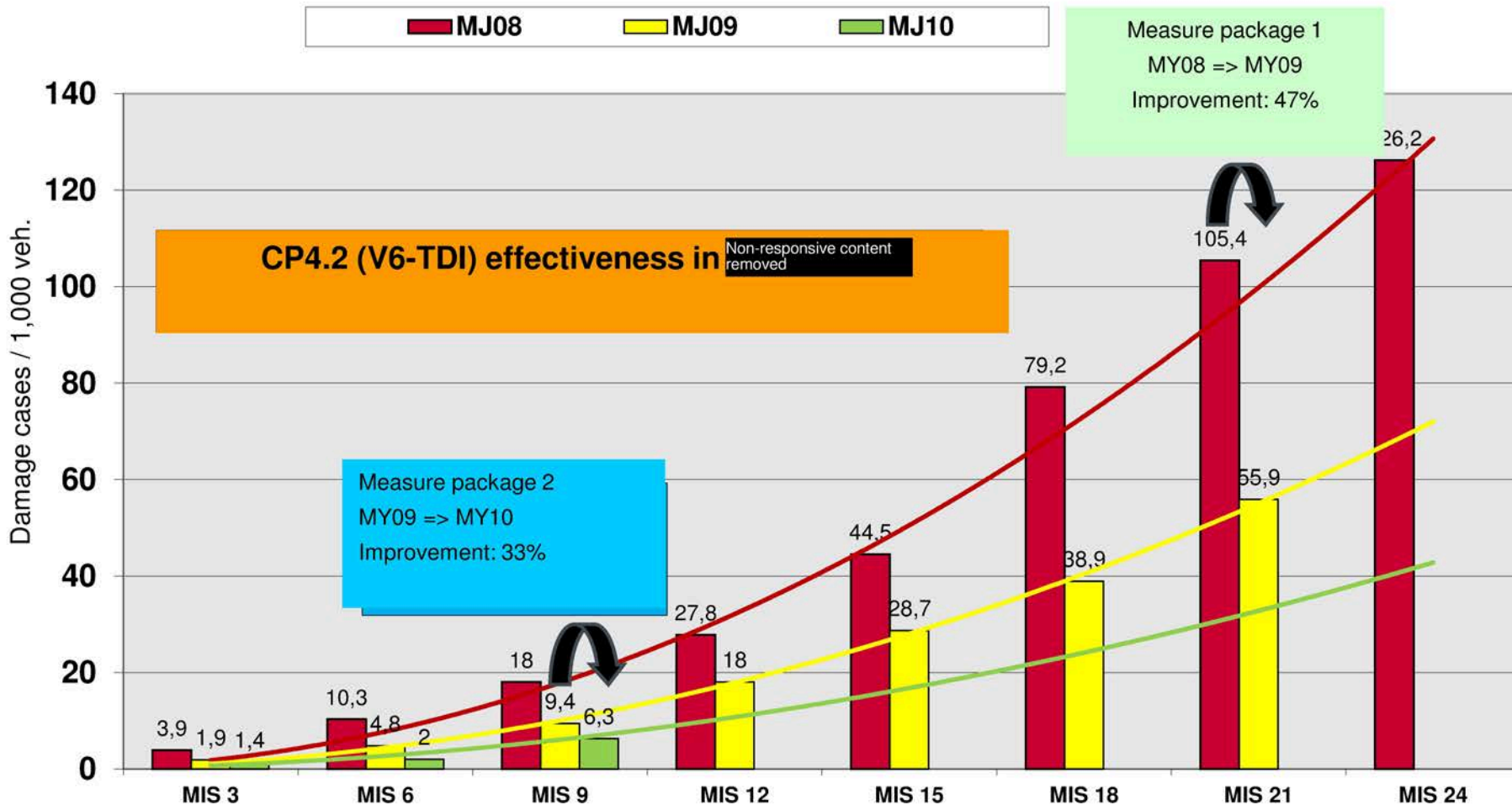




EA11003EN-02151[4]

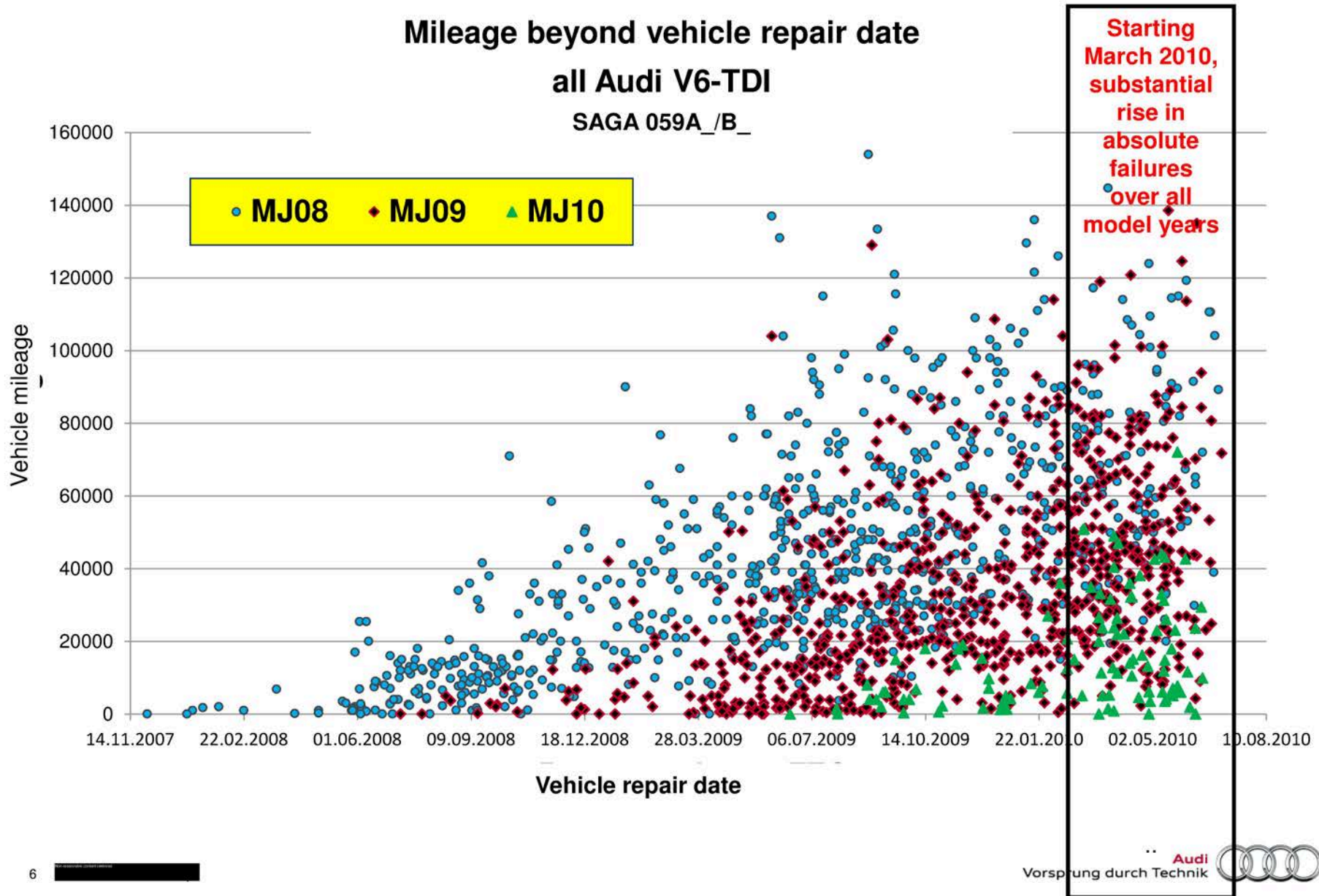
# Drivetrain damage - high-pressure diesel fuel pump CP4.2

CP4.2 - all V6-TDI model year comparison by MIS



EA11003EN-02151[5]

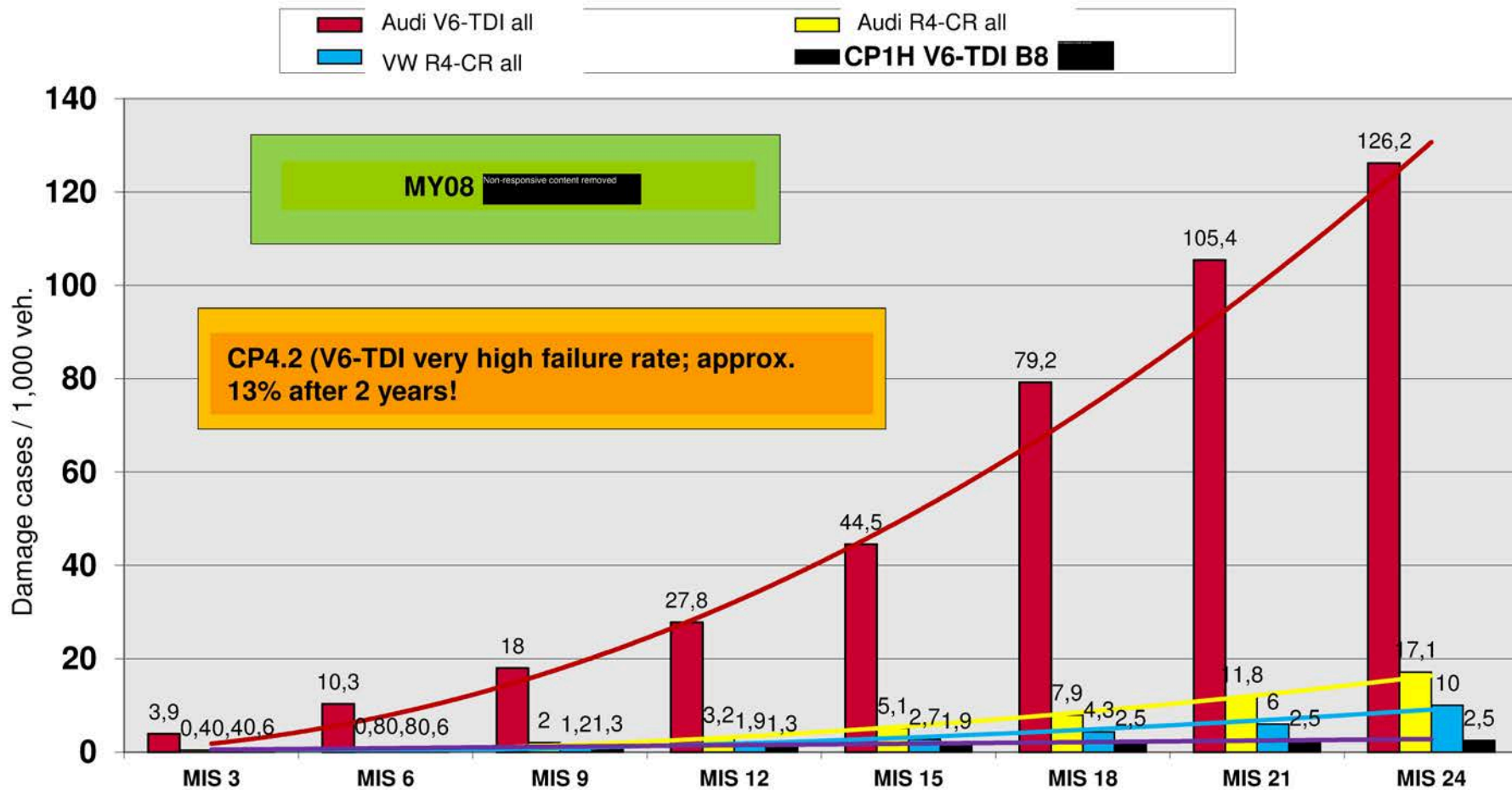
# Drivetrain damage - high-pressure diesel fuel pump CP4.2



EA11003EN-02151[6]

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

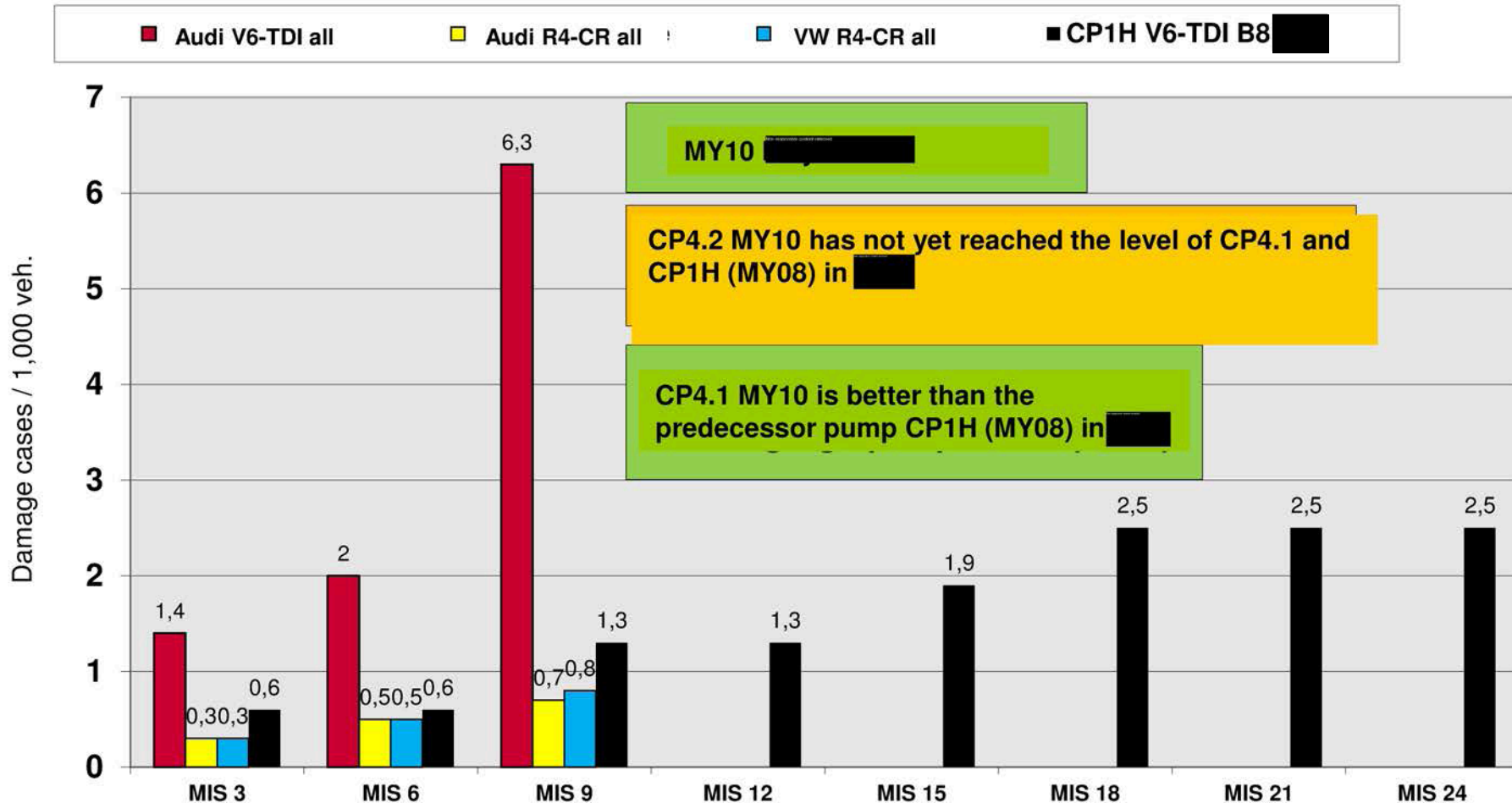
CP4.2 + CP4.1 + CP1H MY08 V6-/R4-TDI Audi/VW by MIS



EA11003EN-02151[7]

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

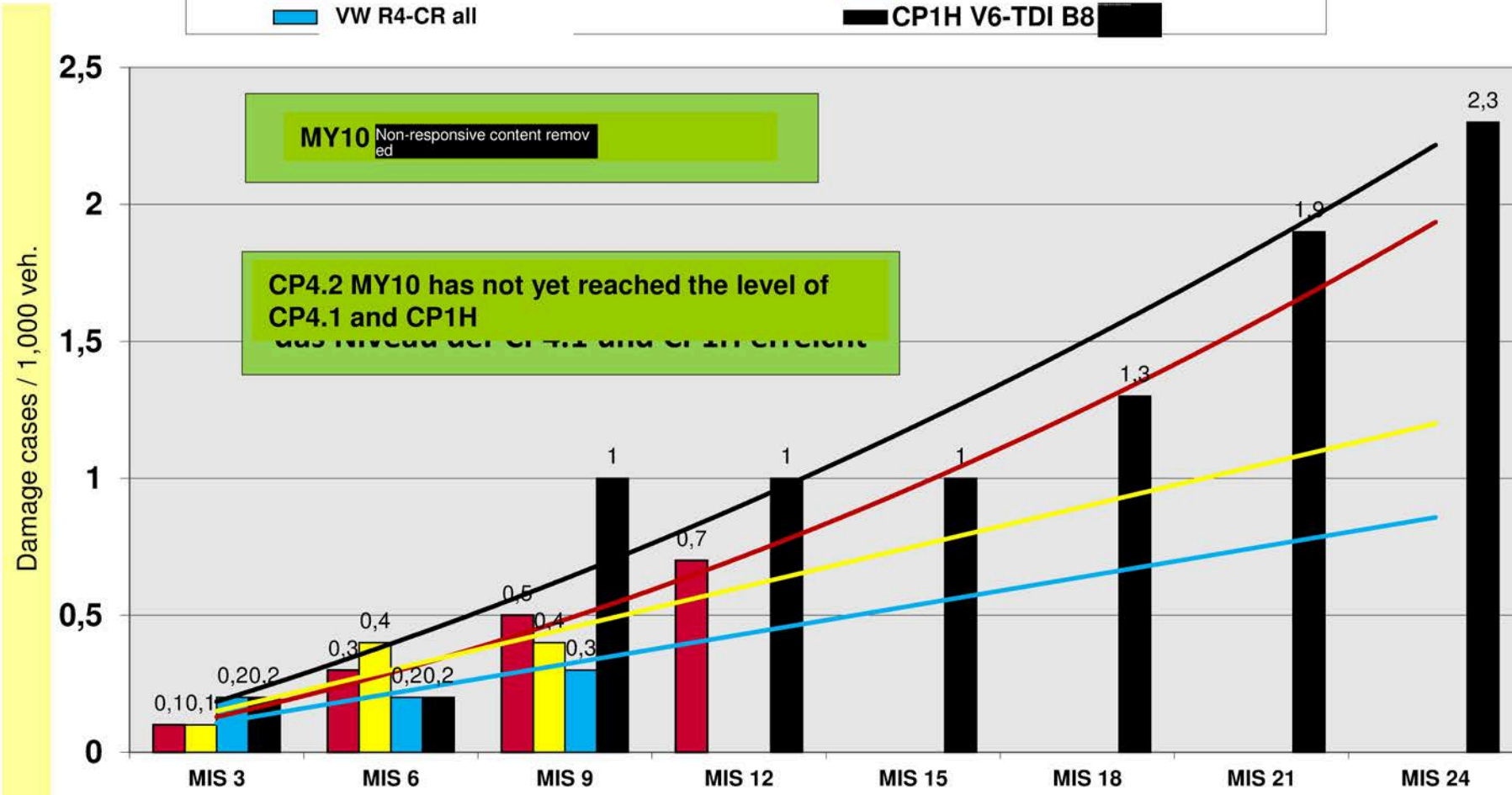
CP4.2 + CP4.1 MY10 and CP1H MY08 [REDACTED] V6-/R4-TDI Audi/VW



EA11003EN-02151[8]

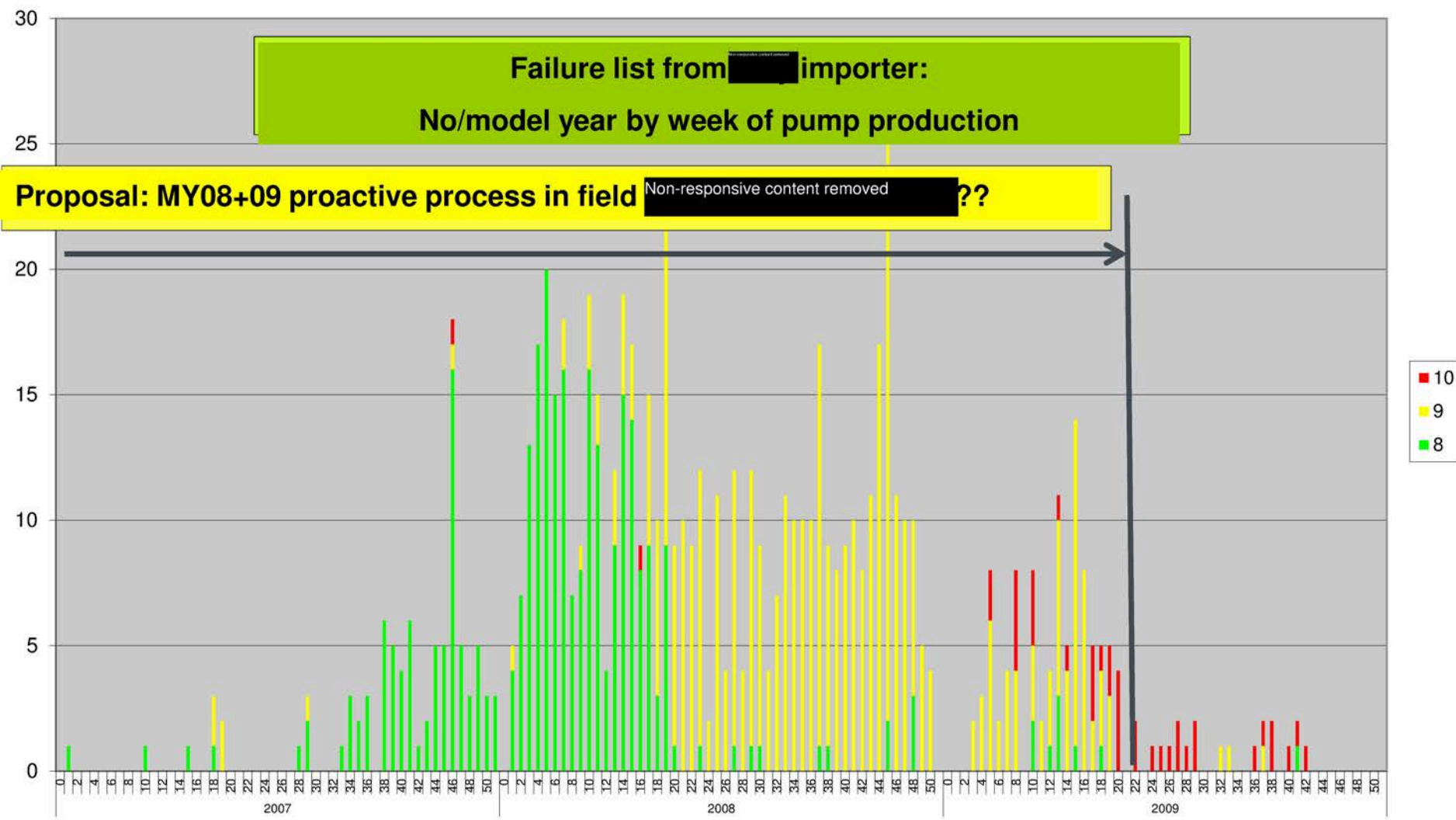
# Drivetrain damage - high-pressure diesel fuel pump CP4.2

CP4.2 + CP4.1 MY10 + CP1H MY08 Non-responsive content removed V6-/R4-TDI Audi/VW



EA11003EN-02151[9]

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



EA11003EN-02151[10]

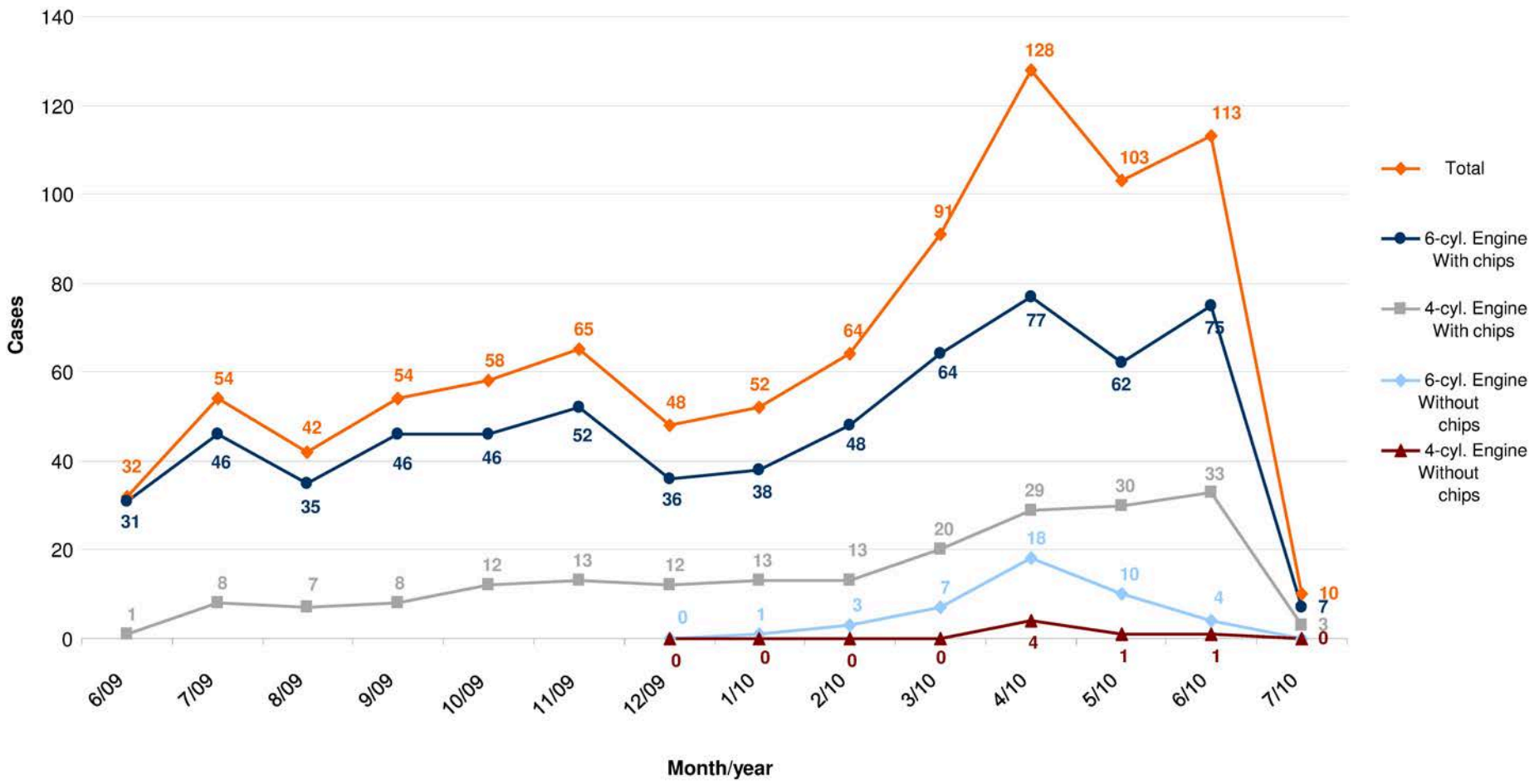
## Drivetrain damage - high-pressure diesel fuel pump CP4.2

# Backup

EA11003EN-02151[11]

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

Failure of CR high-pressure Diesel pump - damage cases per month (as of 07/10 Wk 26)





EA11003EN-02151[12]

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

AQUA: Aktive Qualitäts-Analyse

Stand 05/10-12 06 10 13:38  
 Quelle/Use Non-responsive content removed

Audi, \*, Markt: [redacted]

Vertraulich

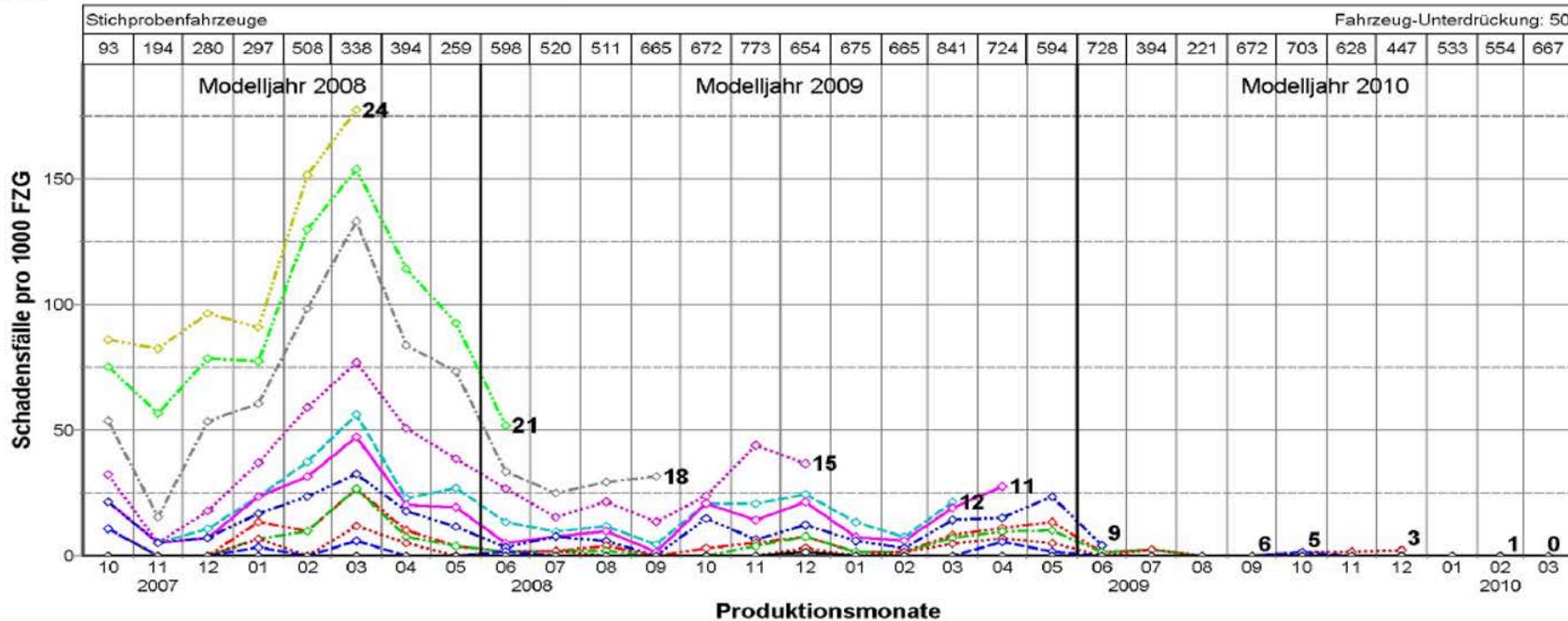
MJ 2008 - 2010, Offset: alle (Max: 2)

KDNR

ohne PR-Nummern  
 2374

KDNR / Gruppen: Hochdruckpumpe

MJ	MIS0	MIS1	MIS3	MIS5	MIS6	MIS9	MIS11	MIS12	MIS15	MIS18	MIS21	MIS24	MJ	Tausch	LB	SA 10	SA 17	
2008	0,0	1,7	3,9	9,0	10,3	18,0	23,6	27,8	44,5	79,2	105,4	126,2	2008	100,0 %	83,3 %	76,5 %	13,7 %	
2009	0,1	0,9	1,9	3,8	4,8	9,4	14,5	18,0	28,7	38,9	55,9		2009	98,8 %	81,7 %	81,3 %	12,5 %	
2010	0,0	0,2	1,4	2,0	2,0	6,3	10,4						2010	100,0 %	84,2 %	73,7 %	15,8 %	
Diff%	-100,00	-78,42	-27,47	-47,60	-58,93	-33,49	-28,17											MECFEH SCHWER



Fahrzeuge: 3.389+12.041+10.864=26.294; Verkauf: 3.388+11.958+9.663=25.009; Stp.: 2.335+7.730+6.666=16.731; MJ: 2008+2009+2010=Gesamt

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EA11003EN 02151[13]

de	en
AQUA: Aktive Qualitäts-Analyse	AQUA: Active quality analysis
Non-responsive content removed	
Vertraulich	Confidential
Stand	Status
MJ 2008 -2010, Offset: alle (Max: 2)	MY 2008 -2010, Offset: all (Max: 2)
ohne PR-Nummern	Without PR numbers
Quelle/ User SAGA-Gew / NILP, RC	Source/ User SAGA wght. / NILP, RC
KDNR / Gruppen: Hochdruckpumpe	CNR / Groups: High-pressure fuel pump
KDNR	CNR
Tausch	Exchange
Diff%	Diff%
MECFEH SCHWER	MECFAIL SERIOUS
Stichprobenfahrzeuge	Sample vehicles
Fahrzeug-Unterdrückung	Vehicle elimination
Modelljahr 2008	Model year 2008
Modelljahr 2009	Model year 2009
Modelljahr 2010	Model year 2010
Schadensfälle pro 1000 FZG	Damage cases per 1000 veh.
Produktionsmonate	Production month
Fahrzeuge:	Vehicles:
Verkauft:	Sold:
Stp:	Stp:
=Gesamt	=Total

EA11003EN-02151[14]

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

AQUA: Aktive Qualitäts-Analyse

Stand 05/10-12.06.10 13:58

Quelle/User

Audi, \*, Markt: AUDI (freigegebene Maerkte)

MJ 2008 - 2010, Offset: alle (Max: 6)

KDNR / Gruppen: Hochdruckpumpe

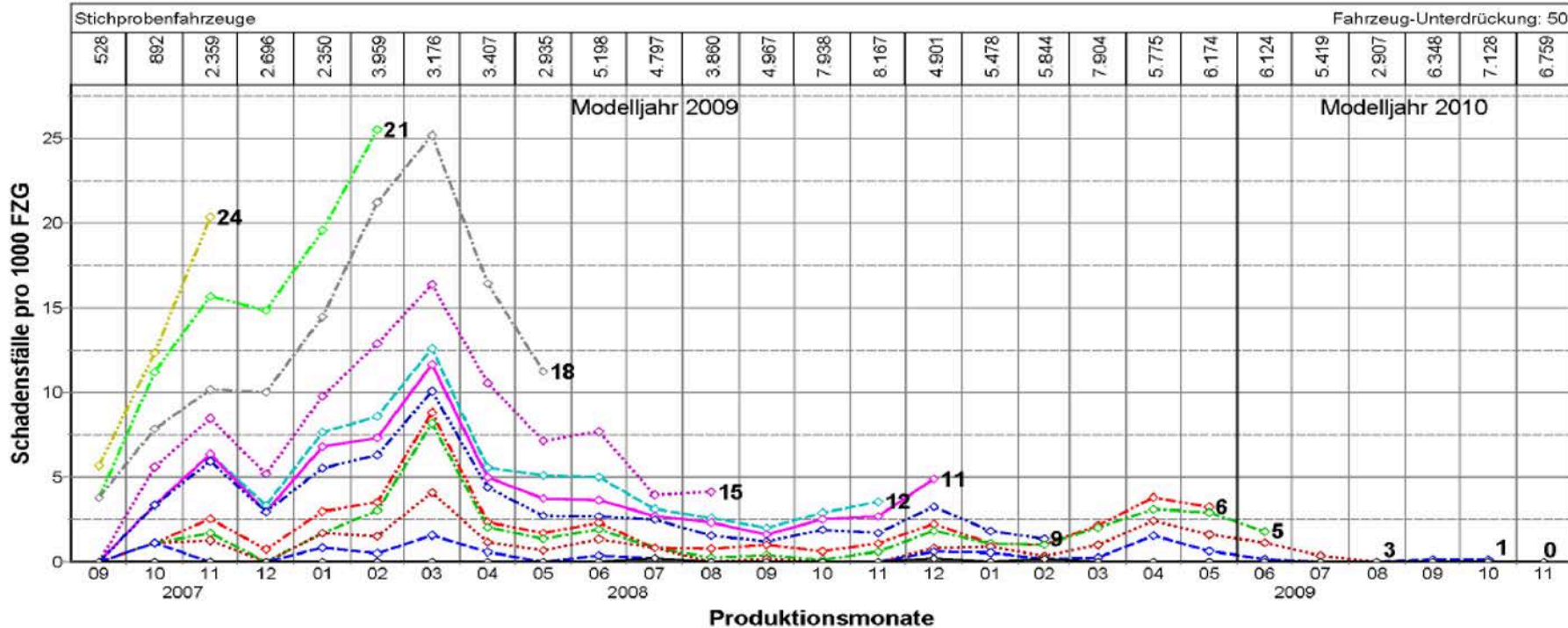
Vertraulich

ohne PR-Nummern

KDNR

2374

MJ	MIS0	MIS1	MIS3	MIS5	MIS6	MIS9	MIS11	MIS12	MIS15	MIS18	MIS21	MIS24	MJ	Tausch	LB	SA 10	SA 17	
2008	0,0	0,6	1,5	2,7	3,3	5,4	6,3	7,0	10,2	15,9	20,2	22,9	2008	98,5 %	65,7 %	77,3 %	11,7 %	
2009	0,0	0,3	0,7	1,3	1,7	2,5	3,3	3,9	5,5	9,8			2009	95,8 %	57,6 %	73,5 %	16,6 %	
2010	0,0	0,1	0,8	1,2	1,2								2010	91,4 %	56,9 %	67,2 %	20,7 %	
Diff%	-100,00	-61,69	2,29	-11,49	-29,96													MECFEH SCHWER



Fahrzeuge: 30.295+95.285+92.844=218.424;Verkauf: 30.244+94.857+82.400=207.501;Stp.: 21.579+69.553+66.652=157.784;MJ: 2008+2009+2010=Gesamt

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EA11003EN 02151[15]

de	en
AQUA: Aktive Qualitäts-Analyse	AQUA: Active quality analysis
Audi, Markt: AUDI (freigegebene Maerkte)	Audi, market: AUDI (approved markets)
Vertraulich	Confidential
Stand	Status
MJ 2008 -2010, Offset: alle (Max: 6)	MY 2008 -2010, Offset: all (Max: 6)
ohne PR-Nummern	Without PR numbers
Quelle/ User SAGA-Gew / NILP, RC	Source/ User SAGA wght. / NILP, RC
KDNR / Gruppen: Hochdruckpumpe	CNR / Groups: High-pressure pump
KDNR	CNR
Tausch	Exchange
Diff%	Diff%
MECFEH SCHWER	MECFAIL SERIOUS
Stichprobenfahrzeuge	Sample vehicles
Fahrzeug-Unterdrückung	Vehicle elimination
Modelljahr 2009	Model year 2009
Modelljahr 2010	Model year 2010
Schadensfälle pro 1000 FZG	Damage cases per 1000 veh.
Produktionsmonate	Production month
Fahrzeuge:	Vehicles:
Verkauft:	Sold:
Stp:	Stp:
=Gesamt	=Total

EA11003EN-02151[16]

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

AQUA: Aktive Qualitäts-Analyse

Stand 05/10-28.05.10 14:07  
 Quelle/User Non-responsive content removed

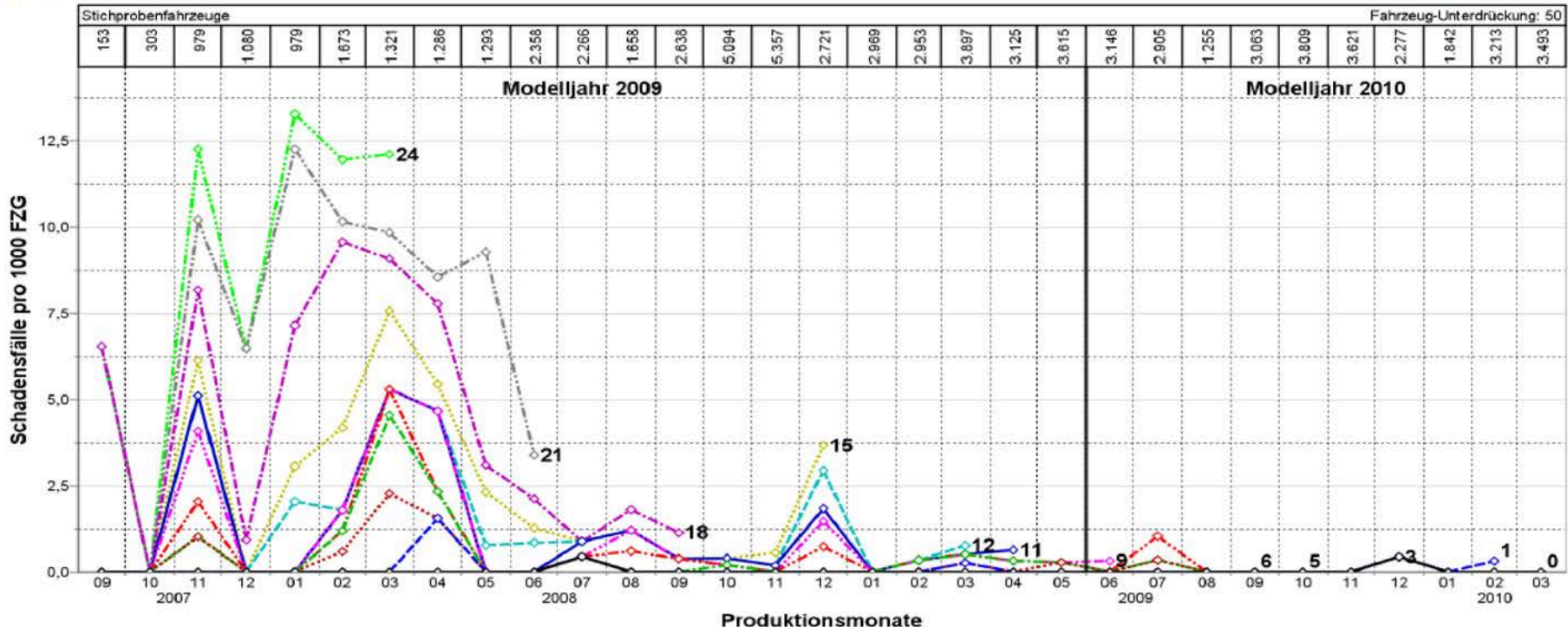
Audi, \*, Markt: [Redacted]

MJ 2008 - 2010, Offset: alle (Max: 2)

**Vertraulich**  
 ohne PR-Nummern  
 KDNR 2374

KDNR / Gruppen: Hochdruckpumpe

MJ	MIS0	MIS1	MIS3	MIS5	MIS6	MIS9	MIS11	MIS12	MIS15	MIS18	MIS21	MIS24	MJ	Tausch	LB	SA 10	SA 20	
2008	0,0	0,2	0,8	1,4	1,6	2,3	2,4	2,7	4,1	6,7	9,2	10,3	2008	96,8 %	47,9 %	74,5 %	3,2 %	
2009	0,0	0,1	0,1	0,2	0,3	0,4	0,5	0,7	0,9	1,5	3,5		2009	90,0 %	44,0 %	76 %	4 %	
2010	0,0	0,1	0,1	0,1	0,3	0,5	0,5						2010	50,0 %	50,0 %	50 %	25 %	
Diff%	25,05	33,30	47,17	-36,93	-1,73	39,03	1,34											MECFEH GERAEU



Fahrzeuge: 10.185+43.183+40.803=94.171;Verkauft: 10.181+43.066+37.229=90.476;Stp.: 8.685+37.729+33.239=79.653;MJ: 2008+2009+2010=Gesamt

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EA11003EN 02151[17]

de	en
AQUA: Aktive Qualitäts-Analyse	AQUA: Active quality analysis
Non-responsive content removed	
Vertraulich	Confidential
Stand	Status
MJ 2008 -2010, Offset: alle (Max: 2)	MY 2008 -2010, Offset: all (Max: 2)
ohne PR-Nummern	Without PR numbers
Quelle/ User SAGA-Gew / NILP, RC	Source/ User SAGA wght. / NILP, RC
KDNR / Gruppen: Hochdruckpumpe	CNR / Groups: High-pressure pump
KDNR	CNR
Tausch	Exchange
Diff%	Diff%
MECFEH GERAEU	MECFAIL NOISE
Stichprobenfahrzeuge	Sample vehicles
Fahrzeug-Unterdrückung	Vehicle elimination
Modelljahr 2009	Model year 2009
Modelljahr 2010	Model year 2010
Schadensfälle pro 1000 FZG	Damage cases per 1000 veh.
Produktionsmonate	Production month
Fahrzeuge:	Vehicles:
Verkauft:	Sold:
Stp:	Stp:
=Gesamt	=Total

EA11003EN-02151[18]

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

AQUA: Aktive Qualitäts-Analyse

Stand 05/10-12.06.10 13:58

Quelle/User Non-responsive content removed

Audi, \*, Markt: Non-responsive content removed

MJ 2008 - 2010, Offset: alle (Max: 4)

KDNR

Vertraulich

ohne PR-Nummern

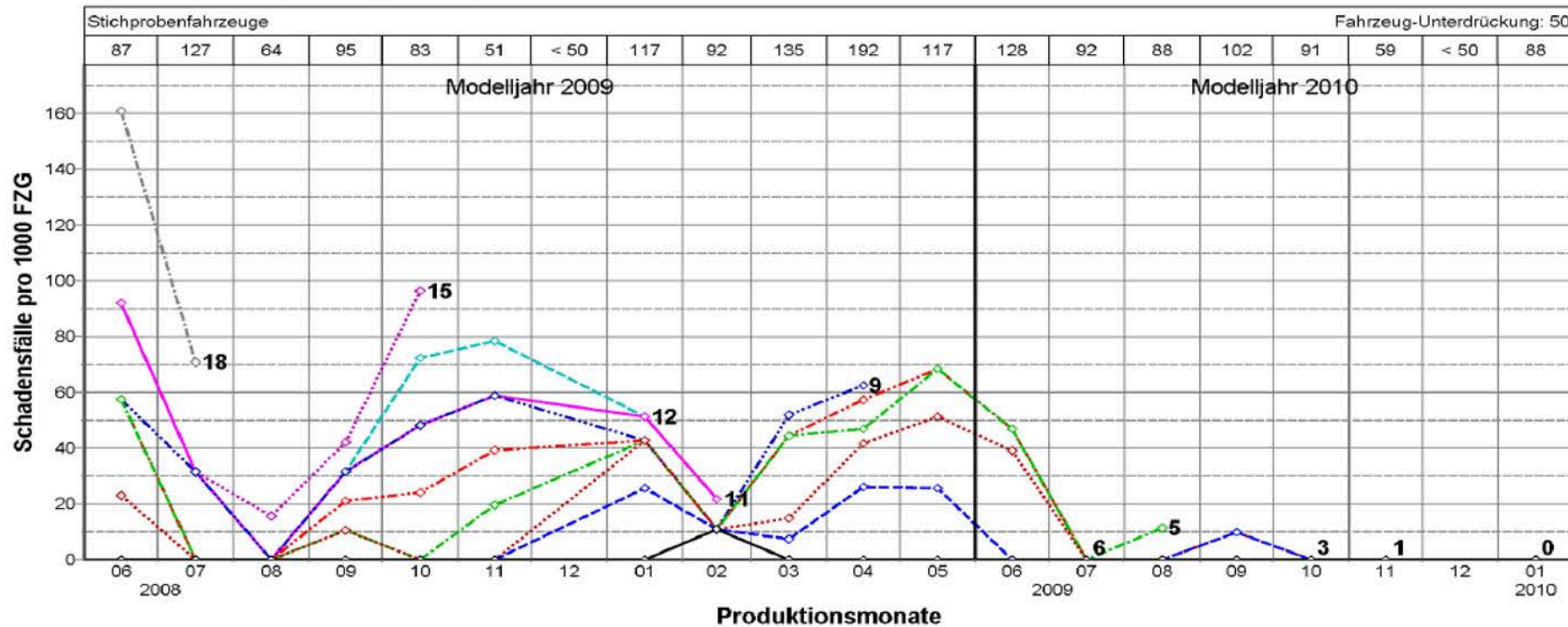
2374

KDNR / Gruppen: Hochdruckpumpe

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

MJ	MIS0	MIS1	MIS3	MIS5	MIS6	MIS9	MIS11	MIS12	MIS15	MIS18	MJ	Tausch	LB	SA 10	SA 17	SA 18	SA 50
2009	0,8	11,9	22,0	32,2	37,3	45,7	50,7	54,7	64,0	95,2	2009	90,6 %	24,7 %	49,4 %	34,1 %	7,1 %	7,1 %
2010	0,0	3,3	12,5	17,2	17,2						2010	100,0 %	41,7 %	58,3 %	41,7 %		
Diff%	-100,00	-72,16	-43,04	-46,50	-53,80												

MECFEH SCHWER LEICHT UNDICH



Fahrzeuge: 1+2.074+2.026=4.101;Verkauf: 1+2.071+1.571=3.643;Stp.: 0+1.181+936=2.117;MJ: 2008+2009+2010=Gesamt

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EA11003EN-02151[19]

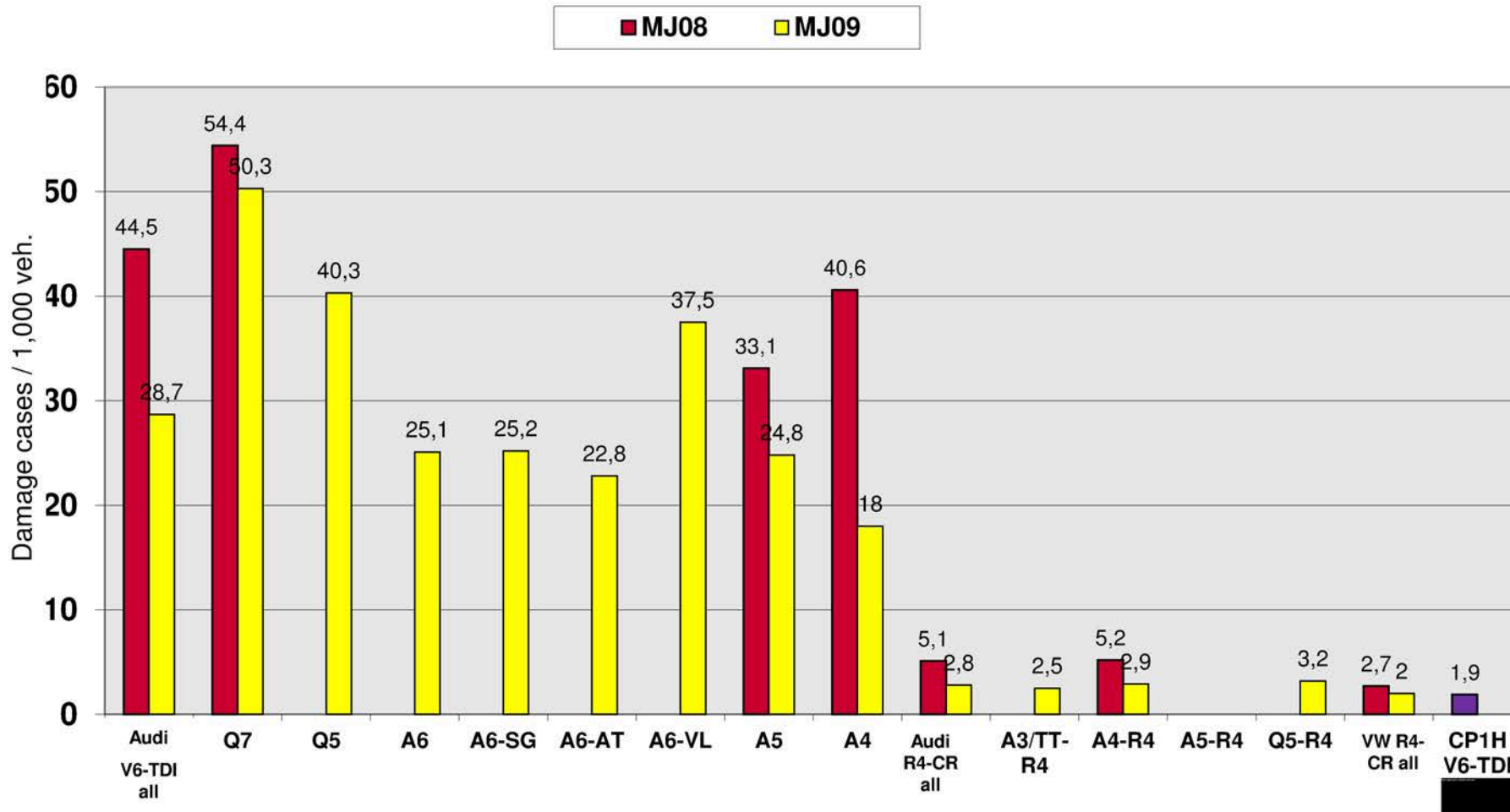
de	en
AQUA: Aktive Qualitäts-Analyse	AQUA: Active quality analysis
<b>Non-responsive content removed</b>	
Vertraulich	Confidential
Stand	Status
MJ 2008 -2010, Offset: alle (Max: 4)	MY 2008 -2010, Offset: all (Max: 4)
ohne PR-Nummern	Without PR numbers
Quelle/ User SAGA-Gew / NILP, RC	Source/ User SAGA wght. / NILP, RC
KDNR / Gruppen: Hochdruckpumpe	CNR / Groups: High-pressure pump
KDNR	CNR
Tausch	Exchange
Diff%	Diff%
MECFEH SCHWER LEICHT UNDICH	MECFAIL SERIOUS SLIGHT LEAK
Stichprobenfahrzeuge	Sample vehicles
Fahrzeug-Unterdrückung	Vehicle elimination
Modelljahr 2009	Model year 2009
Modelljahr 2010	Model year 2010
Schadensfälle pro 1000 FZG	Damage cases per 1000 veh.
Produktionsmonate	Production month
Fahrzeuge:	Vehicles:
Verkauft:	Sold:
Stp:	Stp:
=Gesamt	=Total



EA11003EN-02151[20]

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

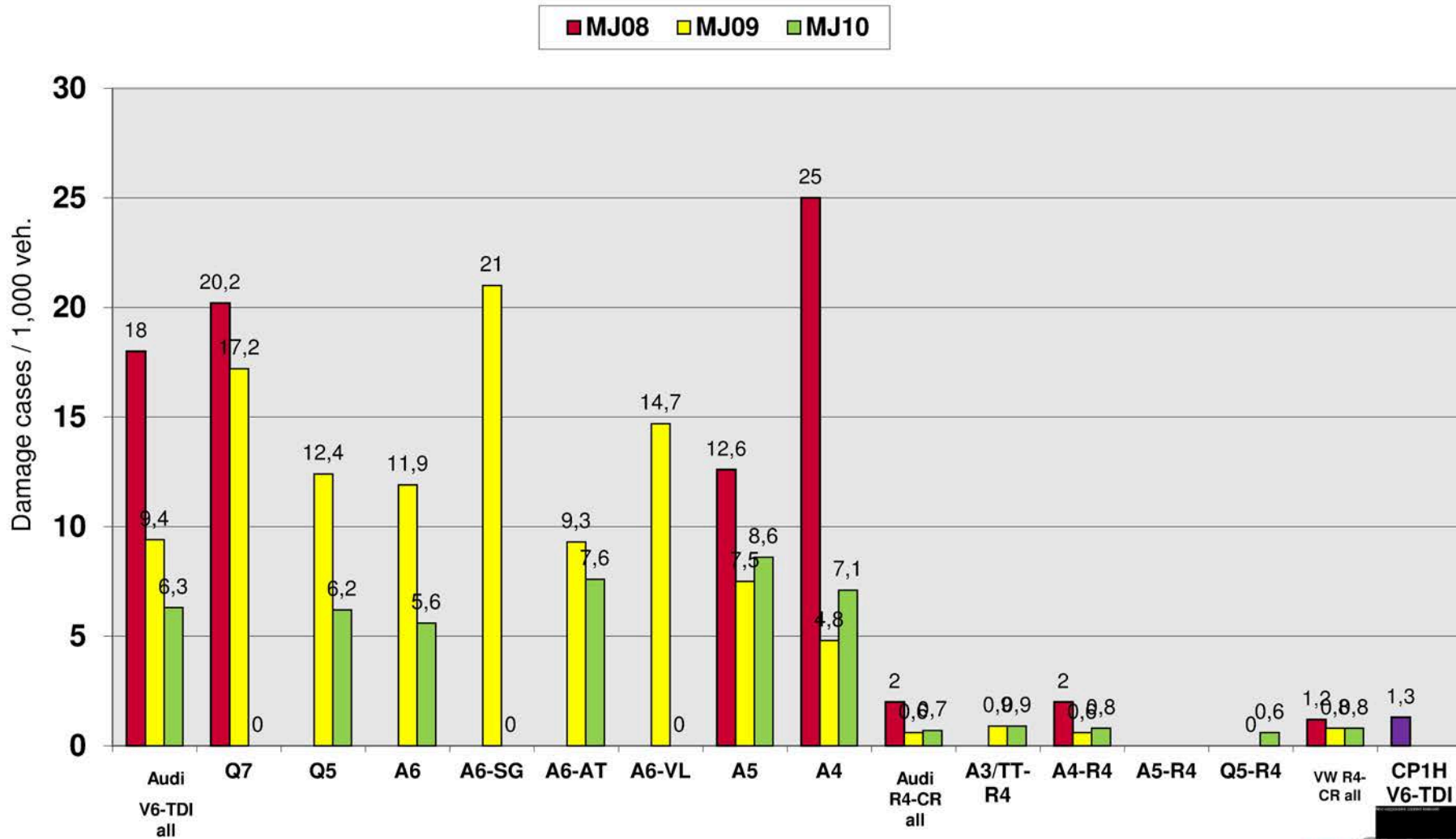
CP4.2 [redacted] type/model year comparison MIS15



EA11003EN-02151[21]

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

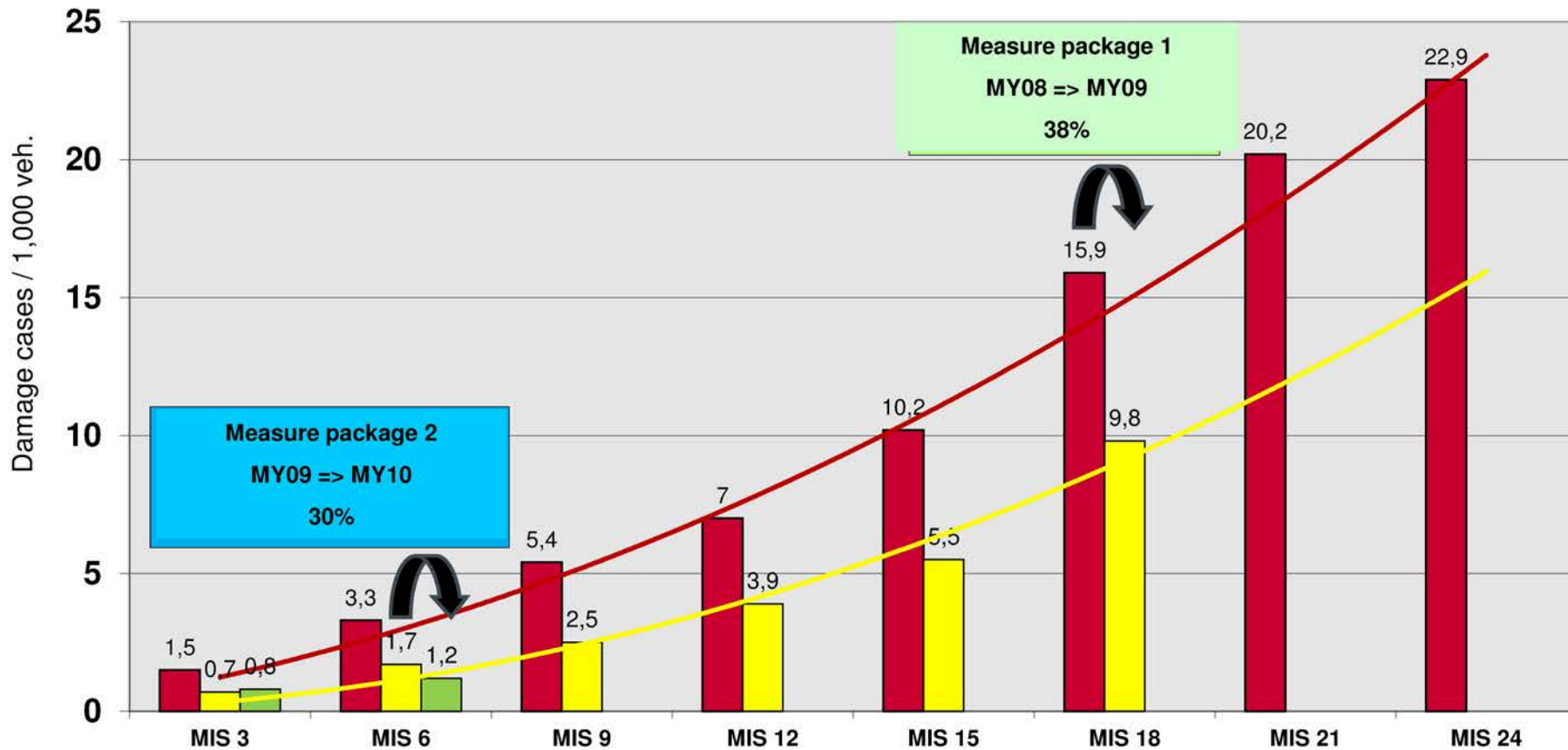
CP4.2 type/model year comparison MIS9



EA11003EN-02151[22]

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

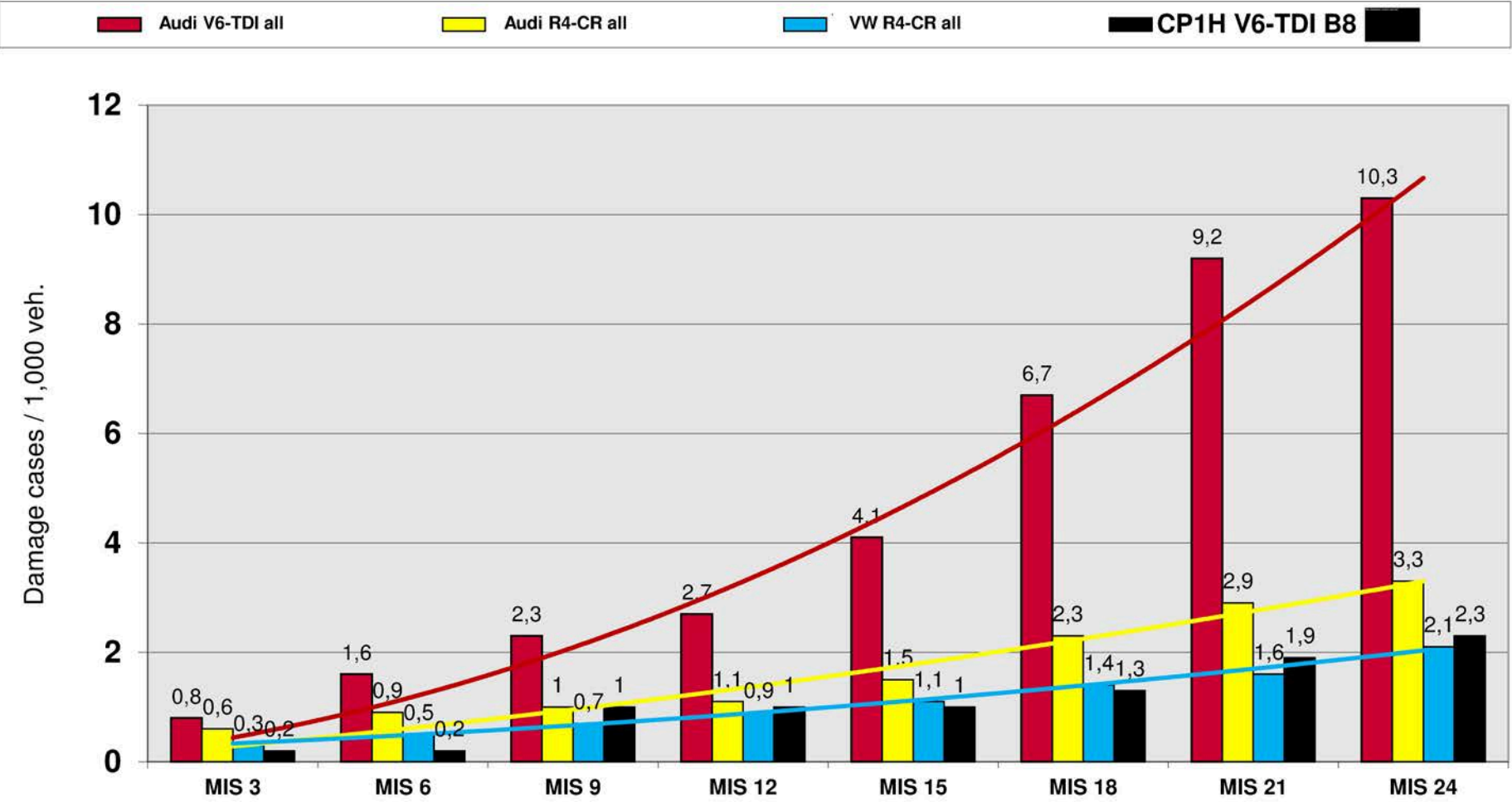
CP4.2 all markets - all V6-TDI model year comparison by MIS



EA11003EN-02151[23]

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

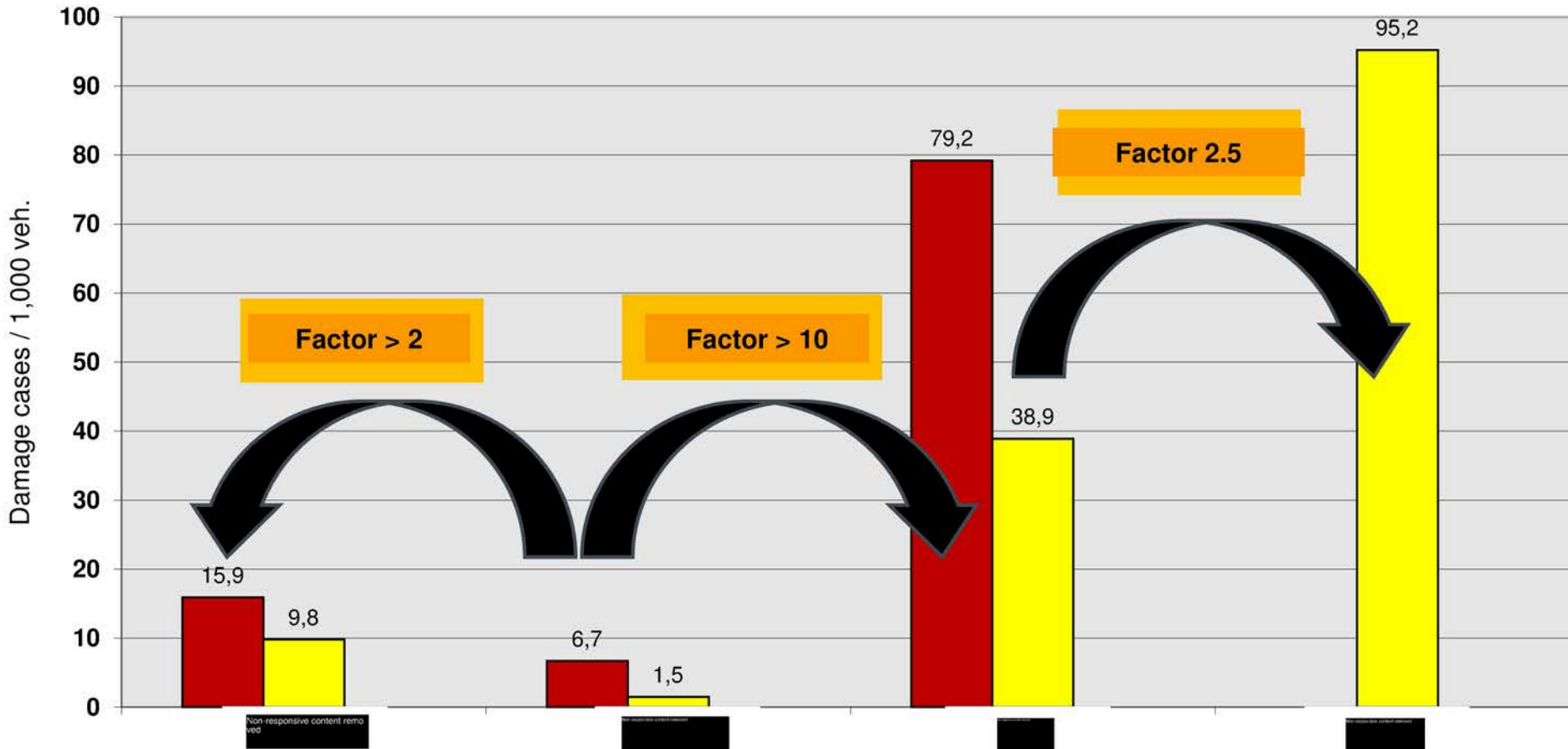
CP4.2 + CP4.1 + CP1H MY08 Non-responsive content remove V6-/R4-TDI Audi/VW by MIS



EA11003EN-02151[24]

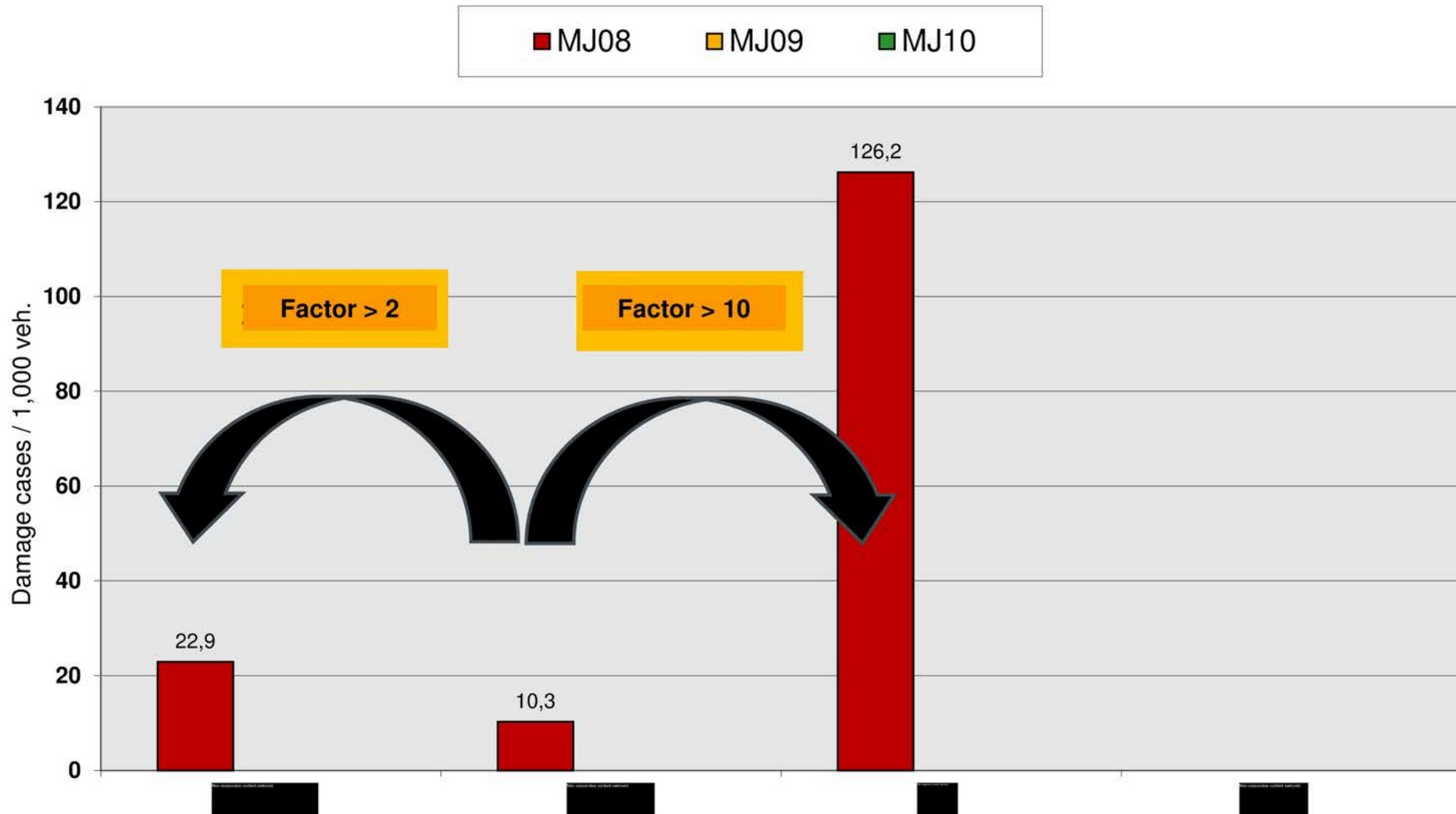
# Drivetrain damage - high-pressure diesel fuel pump CP4.2

## MIS 18



EA11003EN-02151[25]

# Drivetrain damage - high-pressure diesel fuel pump CP4.2 MIS 24



EA11003EN-02154[0]



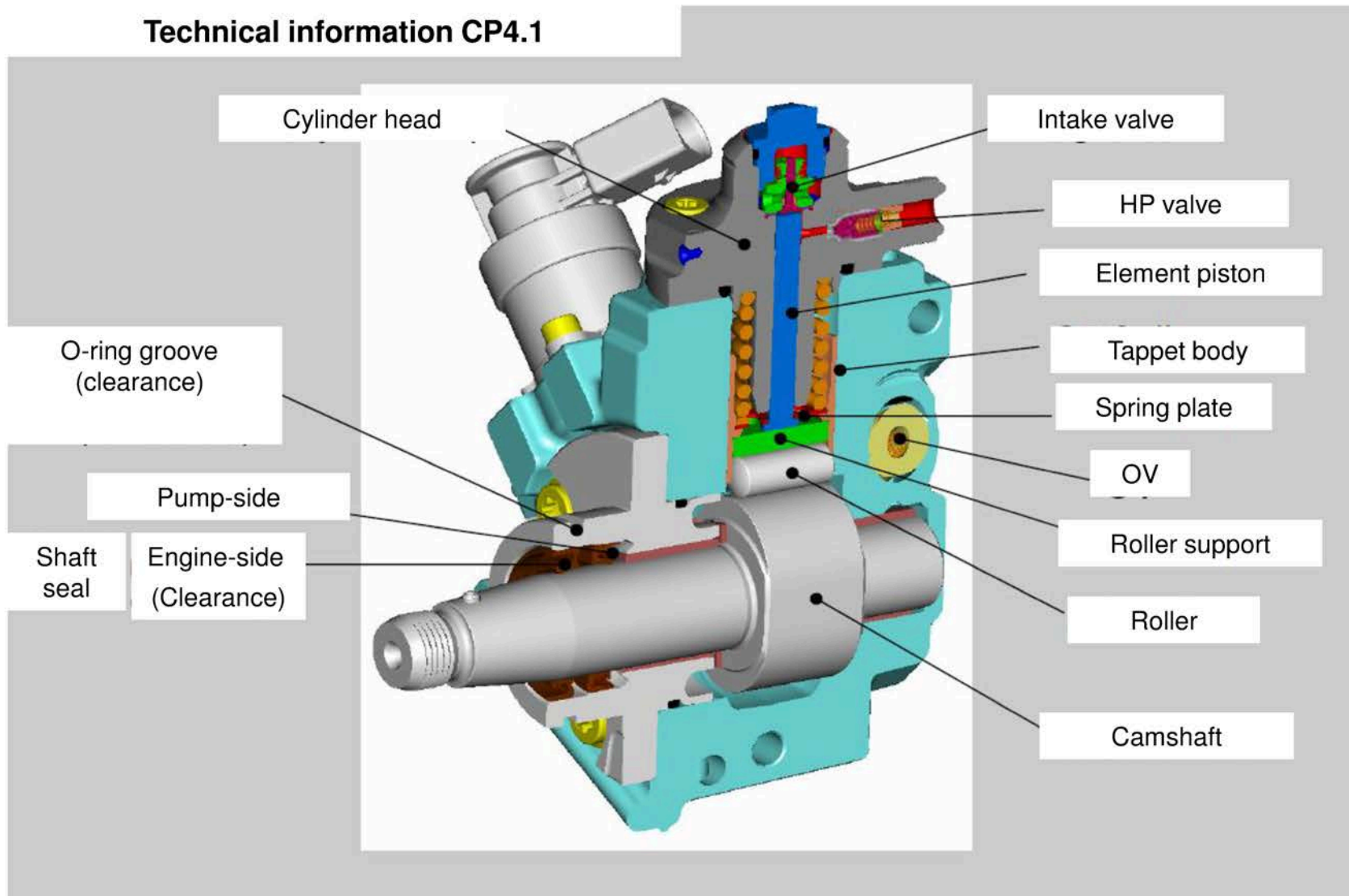
**Drivetrain damage - high-pressure diesel fuel pump CP4**

APS Friday, August 13, 2010 NEW

EA11003EN-02154[1]

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

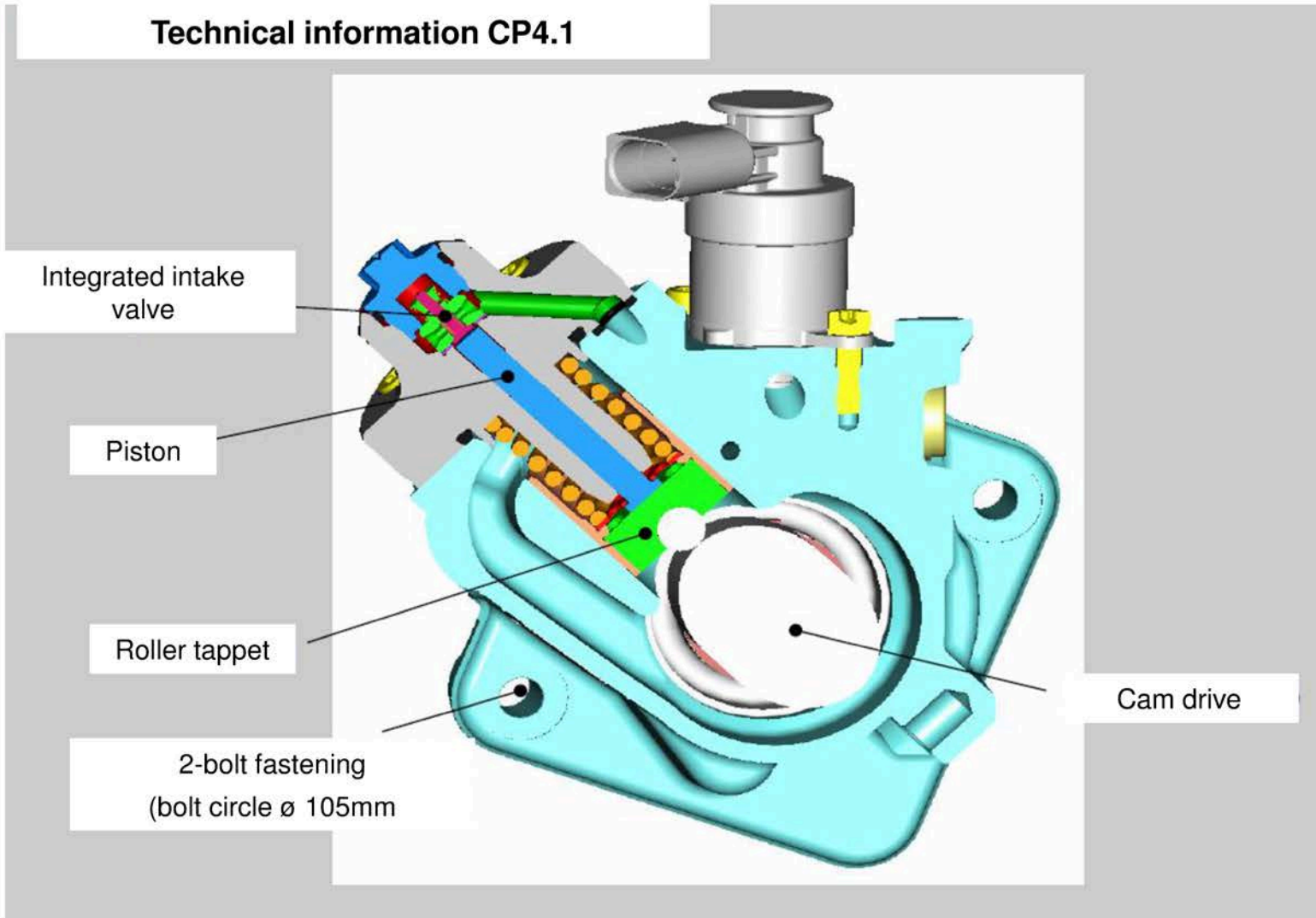
## Technical information CP4.1





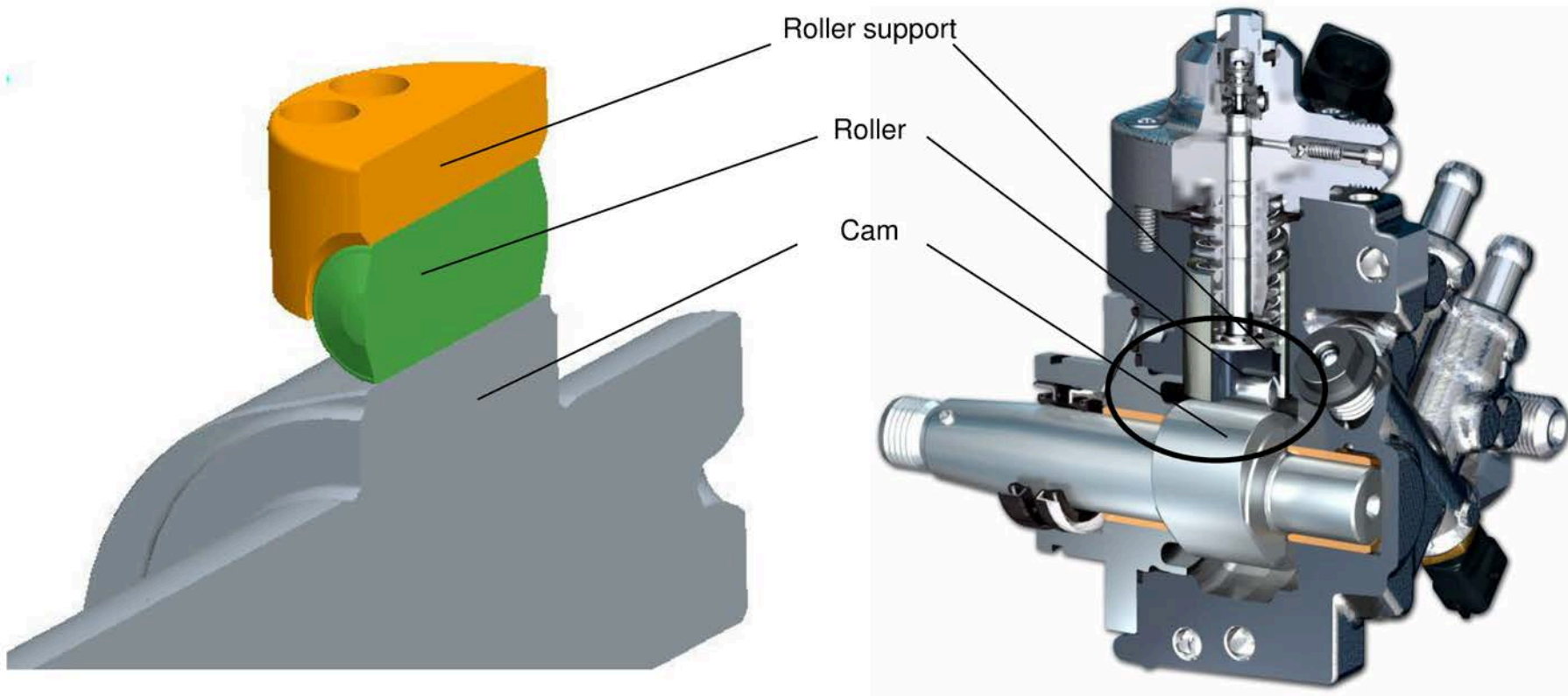
EA11003EN-02154[2]

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



EA11003EN-02154[3]

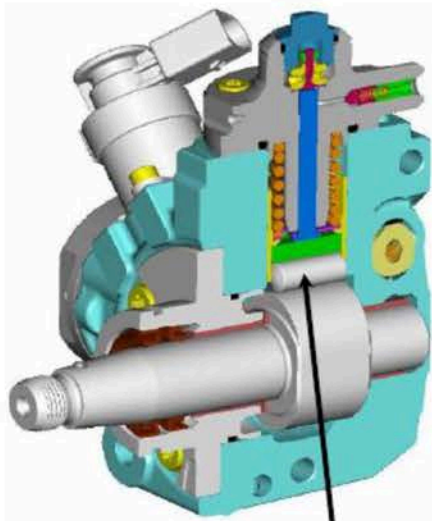
# Drivetrain damage - high-pressure diesel fuel pump CP4.2



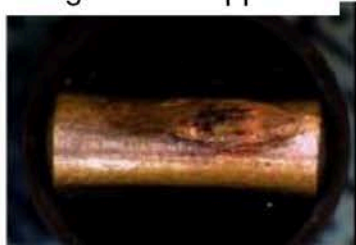
EA11003EN-02154[4]

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

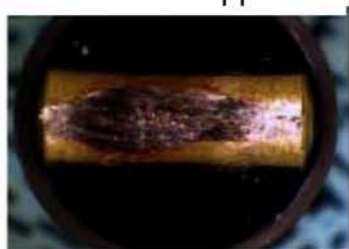
CP4.2 high-pressure fuel pump



Right roller tappet



Left roller tappet



EA11003EN-02154[5]

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

CP4.2 Audi [REDACTED]

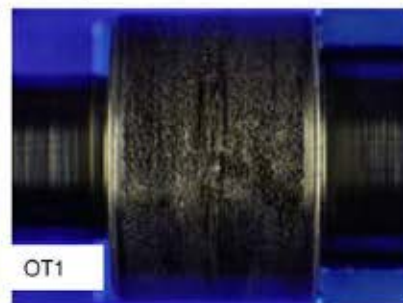
2010-CP4\_0644

Failed pump field [REDACTED]; delivery date unknown

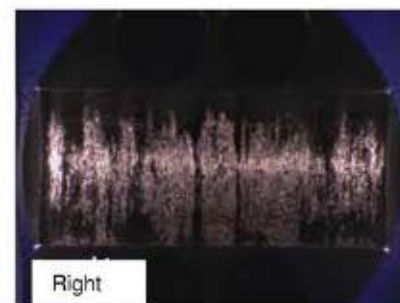
0445 010 611; DoM: 100121 BPT 1190; Chg-Index 05; 059 130 755 AH



Left



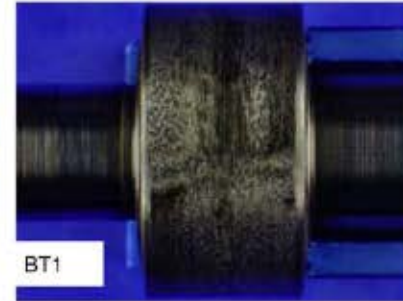
OT1



Right



Left



BT1



Right

Diesel Systems

1

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**BOSCH**

EA11003EN-02154[6]

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

### Status of CP4 drivetrain damage @ VW Audi

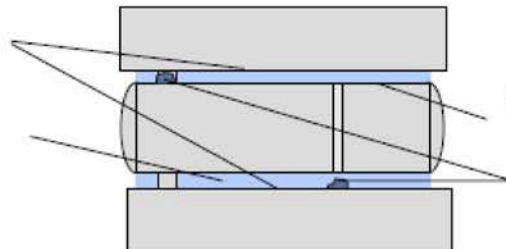
### CP4 drivetrain damage: Damage mechanism

- Impermissible high mixed friction between roller and roller support result in "local" contact during operation
- The C layer is destroyed (wear and deposit of the C layer), the friction coefficient between roller and roller support increases
- When friction coefficient of roller-roller support > Friction coefficient roller-cam -> Brake plates
- Abrasive wear, particle formation -> Drivetrain damage

**Amplification factors:** Fuel with low viscosity; elevated points on roller (such as fusing) and in roller (such as metal spatters); surface of roller/roller support

Roller support surface

Hydrodynamic lubricating  
film =  $f$  (play, surface, fuel)



Roller support surface

Elevated points  
(metal spatters on roller support; fusing on roller)

EA11003EN-02154[7]

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

### Causes / analyses:

Production slippage at Bosch (micro-geometric deviations) result in a sluggish roller and, particularly in connection with fuel irregularities in certain markets, to failure of the pump drivetrain.

Lack of robustness of CP4 with regard to varying fuel quality around the world.

### Actions implemented:

- Straight-edge test on eyeglass cloth Wk19 / 2008
- Roller from new second supplier Wk20 / 2008
- Optimized C layer on roller support (approx. 80% effectiveness with regard to fault) Wk23 / 2008 – Q-Obs.(1)  
June 2008
- Additional opt. (carbon holder for 2 plants) C layer roller support ( >> 95%) Wk16 / 2009
- C2 instead of C3 layer on roller end (reduction of fusing) Wk21 / 2009 – Q-Obs.(2)  
June 2009
- Camera system (prototype) for optimized screen display of surface  
faults in roller support; introduction for subset Wk26 / 0209

EA11003EN-02154[8]

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

## Task Force – Anti Wear Packages @ CP4

### Anti wear package 1

#### Task

Increase lubricating film between roller support and roller for fuels with low viscosity (reduce mixed friction share and temperatures)

#### Measures

- Reduction of roughness in roller support through conversion to C2 layer
- Prevention of metal spatters (no metal spatters occur with the C2 as a result of the process)
- Reduction of play between roller and roller support (smaller roller support bore)
- Reduction of roller roughness
- Optimize trailing edge of roller (stiffness)

#### Result

RP1 increases lubricating film by factor of 2 (derived from diagnosis results)

RP1 in series for all CP4.2 at Audi since Wk15

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3

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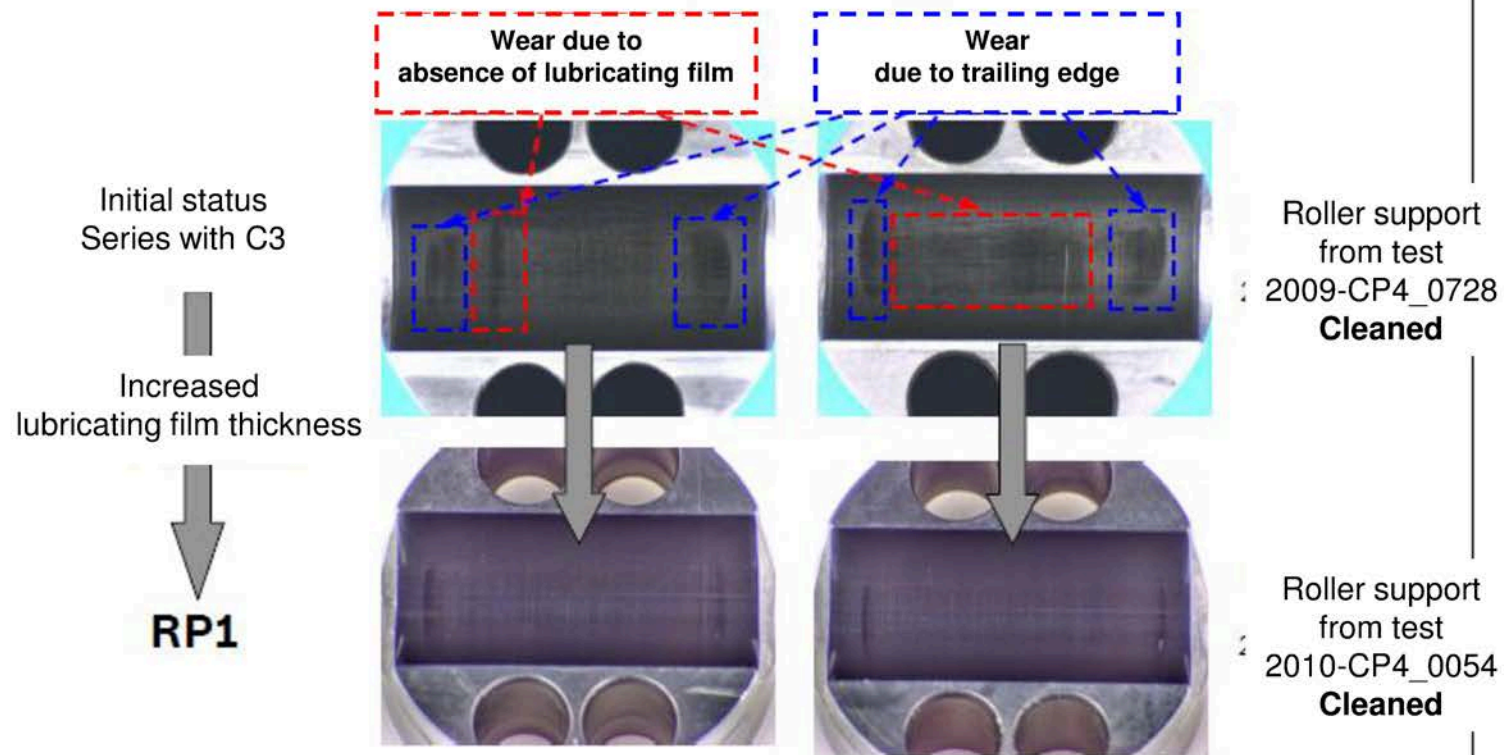
EA11003EN-02154[9]

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

## Task Force – Anti Wear packages @ CP4

### Anti wear package RP1

Proof of effectiveness through overload test (150 h with low viscosity)



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EA11003EN-02154[10]

## Drivetrain damage - high-pressure diesel fuel pump CP4.1

### Anti wear package 2

#### Task

Reduce local temperature in right roller support to level of CP4.1

→ Avoid fuel decomposition, deposit formation → reduced lubrication, increased friction

#### Measures

- Opt. arrangement of inlet & return position (exchange inlet/return connections)
- Introduce robust flange (increase overflow profiles)

#### Result

Reduction of temperature in lubrication gap by 24°C (from 136°C to 111°C @ 80l/h @ 70°C inlet)

→ This is the same level as CP4.1

→ Improvements to roller support - see slide 4

Trial passed at R.B.; Trial / safeguarding at Audi in process

Series use for all V6-TDI (due to changed inlet/return lines) Wk45/2010

EA11003EN-02154[11]

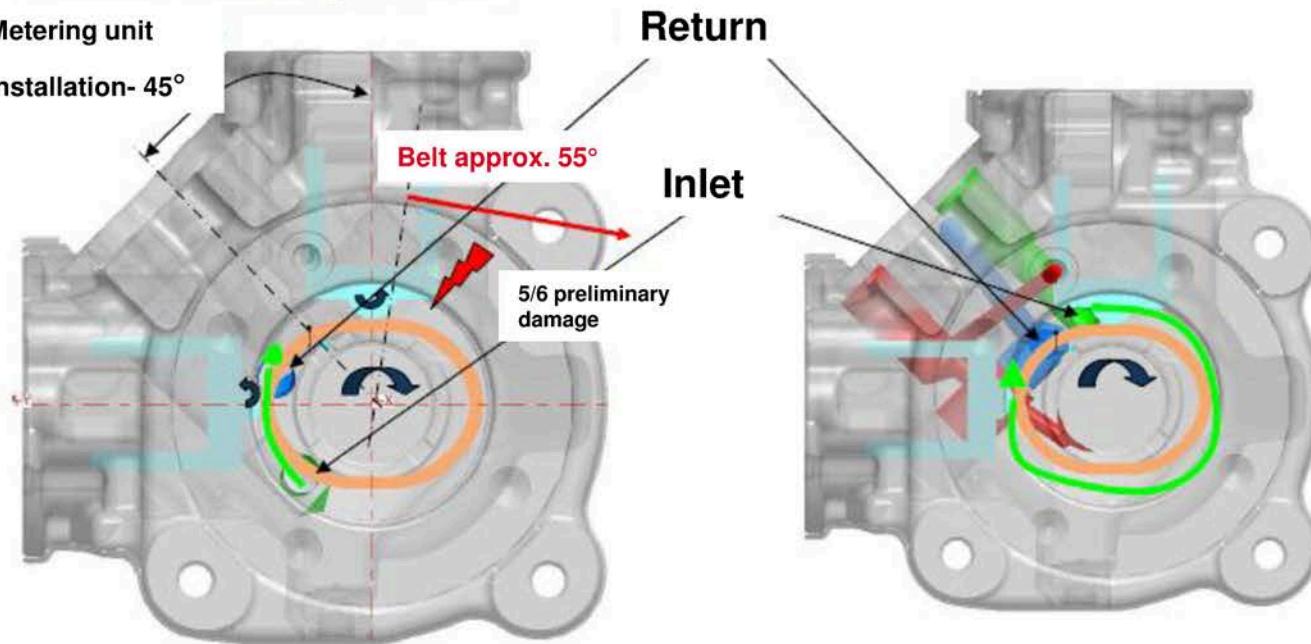
# Drivetrain damage - high-pressure diesel fuel pump CP4.2

## Task Force – Anti Wear packages @ CP4

### Anti wear package 2

Metering unit

installation- 45°



Fuel goes directly to return

CP4.2 EFP cw Audi W19

Fuel is circulated once

CP4.2-EKP cw **RP2** for Audi W19

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8

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**BOSCH**

Audi  
Vorsprung durch Technik

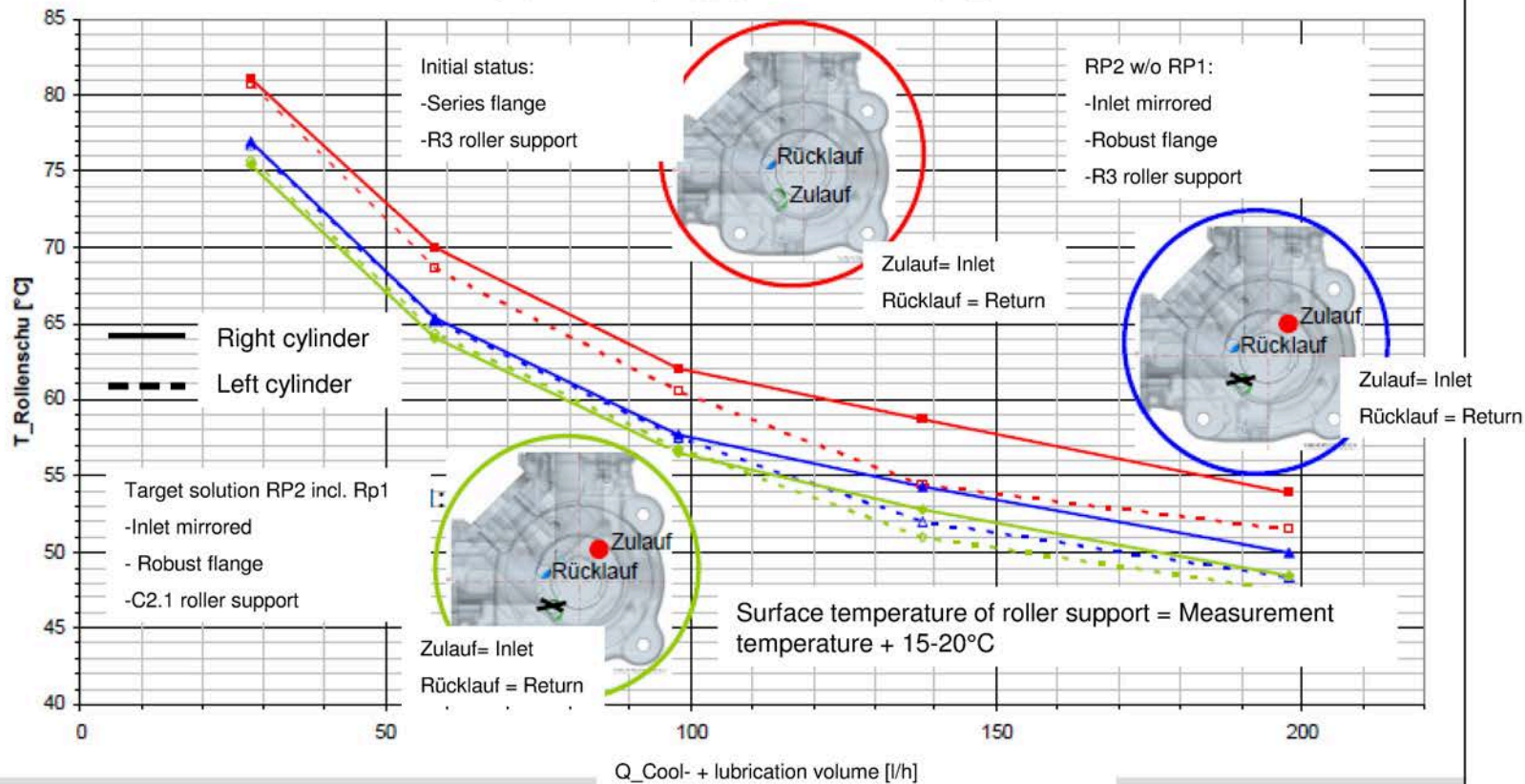


# Drivetrain damage - high-pressure diesel fuel pump CP4.2

## Task Force – Anti Wear packages @ CP4

### CP4.2 Audi W19: Roller support temperature as f(coolant/lubricant volume)

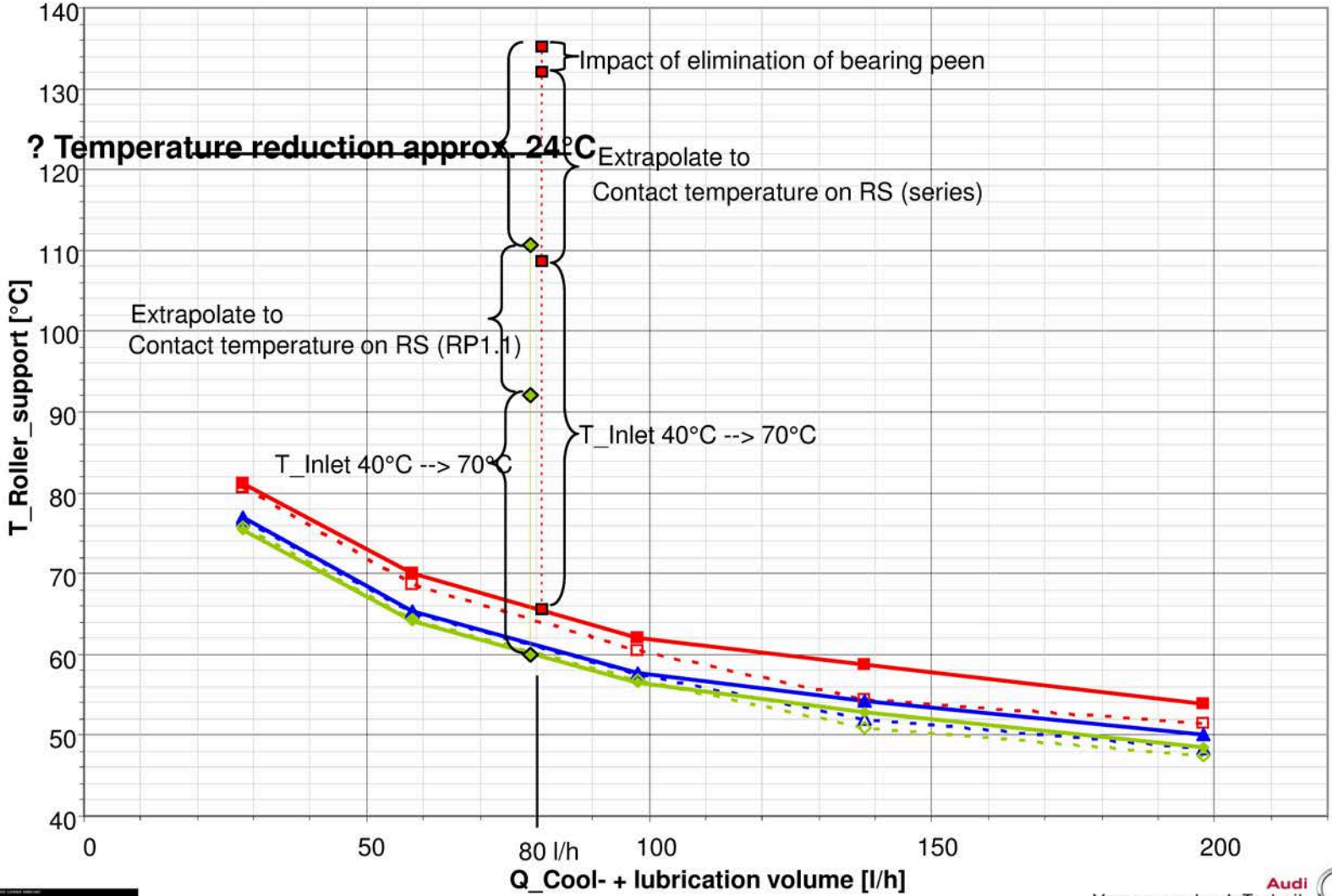
Robust flange; n=1000 rpm; p\_Rail= 2300 bar; T\_All=40°C



EA11003EN-02154[13]

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

**CP4.2 Audi W19: Roller support temperature as f(coolant/lubricant volume)**  
 Robust flange; n=1000 rpm; p\_Rail= 2300 bar; T\_All=40°C



EA11003EN-02154[14]

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

## Task Force – Anti Wear packages @ CP4

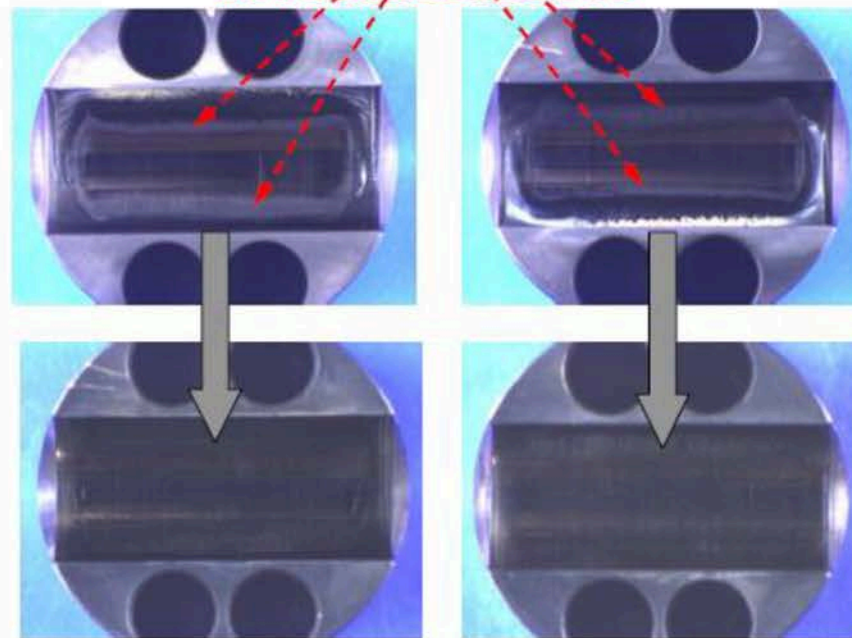
### Anti wear package RP2

Proof of effectiveness through overload test (150 h with low viscosity)

Initial status  
Series with C3 layer

Reduction  
Deposit formation

RP2



Roller support  
from test  
2009-CP4\_0728  
**uncleaned**

Roller support  
from test  
2010-CP4\_304/305  
**uncleaned**

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10

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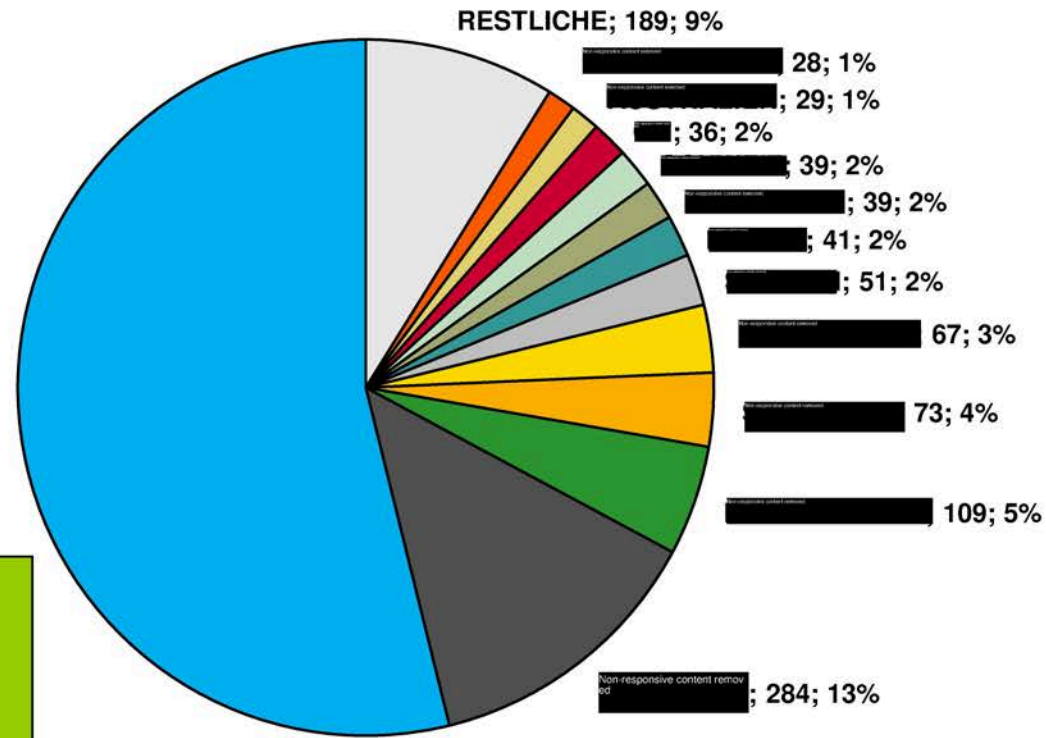
EA11003EN-02154[15]

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

## Field failures of Audi V6-TDI by country (SAGA – only exchanged pumps; 059\_/B\_

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1150; 54%

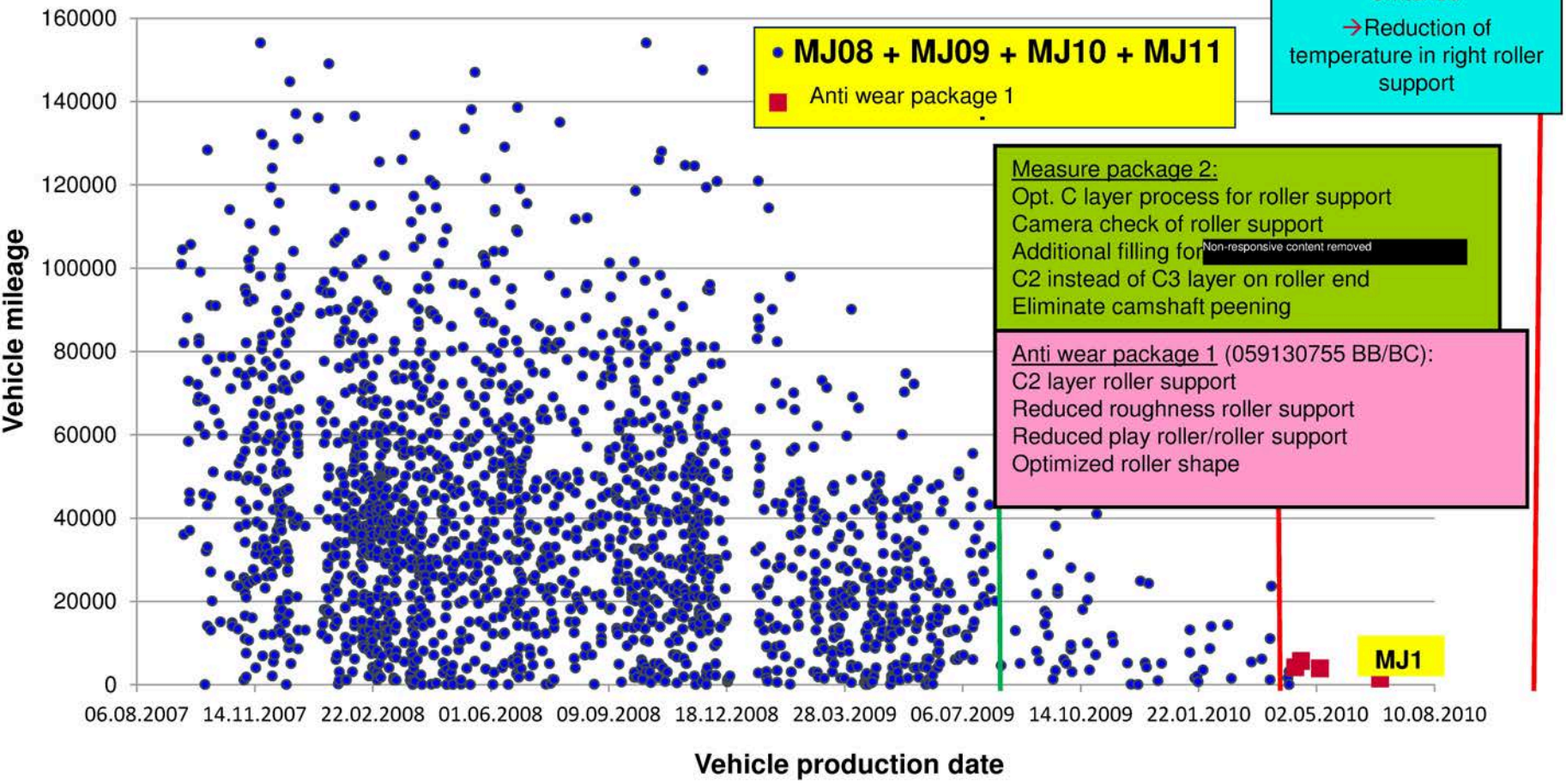


Total V6-TDI: 2,135 cases worldwide  
 MY08: 935 cases  
 MY08: 935 cases  
 MY09: 1,018 cases  
 MY10: 181 cases  
 MY11: 1 case  
 (SAGA, status 9/5/2010)

EA11003EN-02154[16]

# Drivetrain damage - high-pressure diesel fuel pump CP4

Worldwide field failures of CP4.2 high-pressure fuel pump  
 Effectiveness of measures  
 All Audi V6-TDI / SAGA 059A\_/B\_



• MJ08 + MJ09 + MJ10 + MJ11  
 ■ Anti wear package 1

**Anti wear package 2:**  
 Inlet/return connections switched  
 → Reduction of temperature in right roller support

**Measure package 2:**  
 Opt. C layer process for roller support  
 Camera check of roller support  
 Additional filling for [redacted]  
 C2 instead of C3 layer on roller end  
 Eliminate camshaft peening

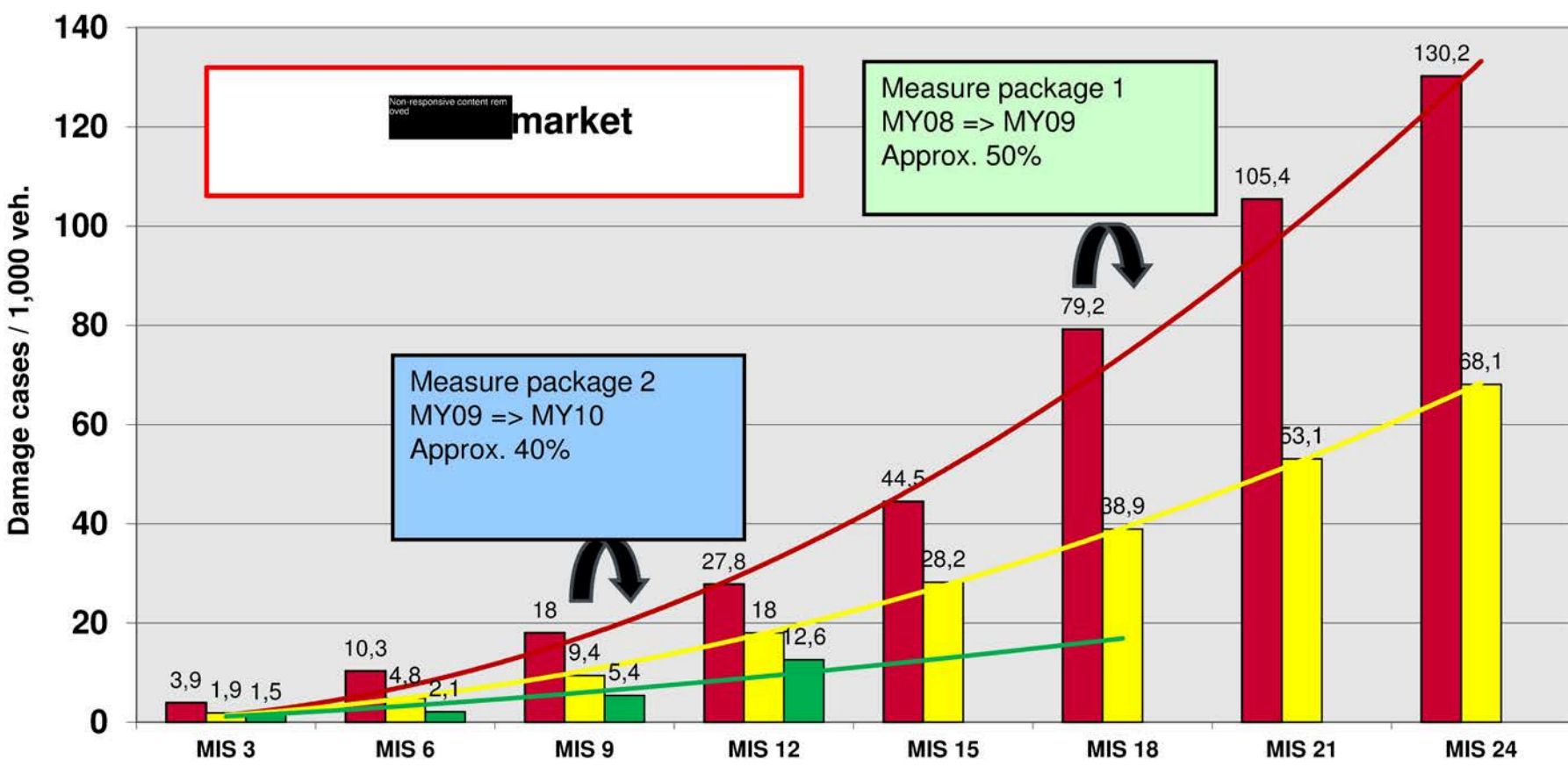
**Anti wear package 1 (059130755 BB/BC):**  
 C2 layer roller support  
 Reduced roughness roller support  
 Reduced play roller/roller support  
 Optimized roller shape

MJ1

EA11003EN-02154[17]

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

CP4.2 all Audi V6-TDI – Model year comparison by MIS

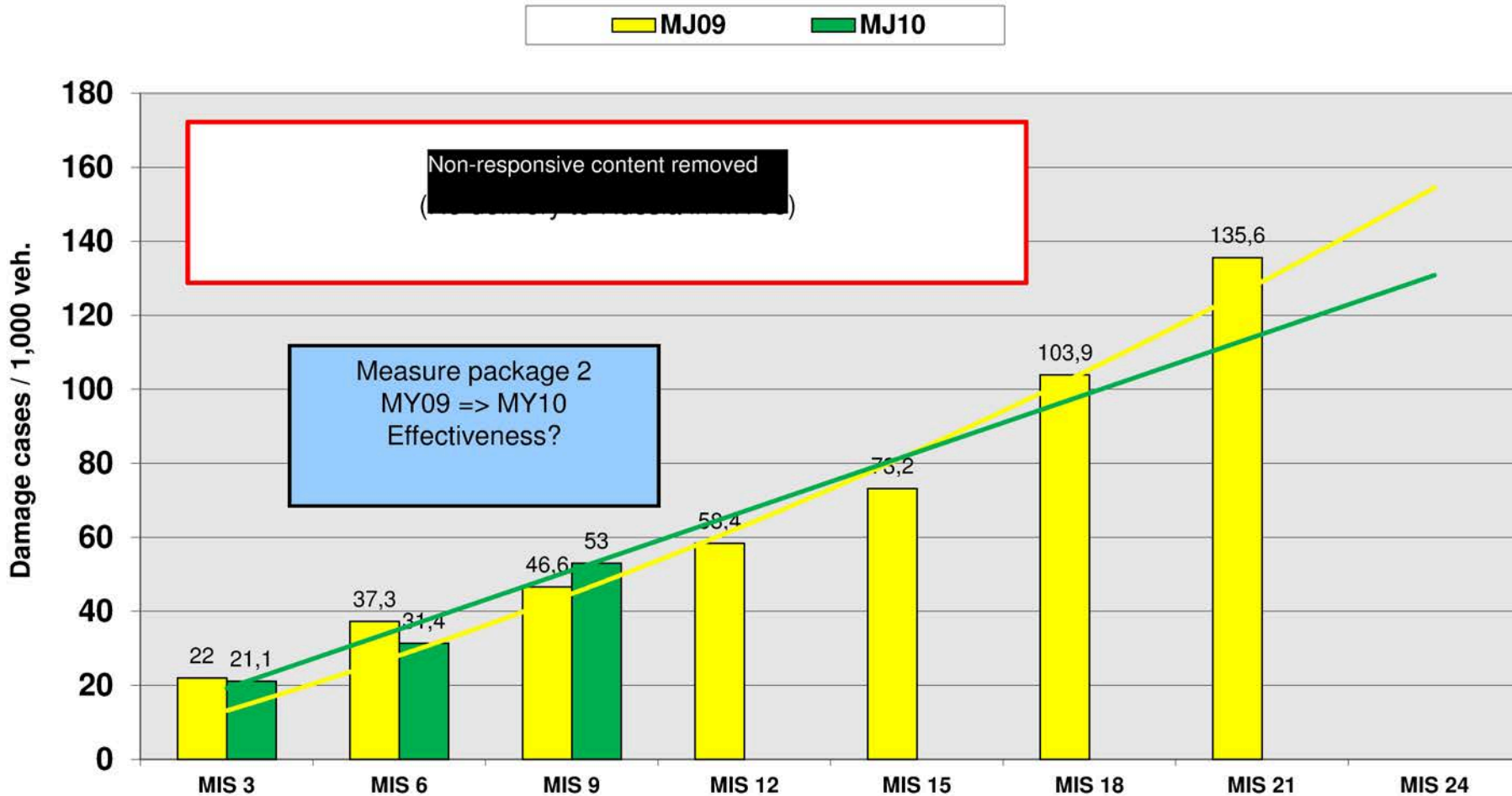




EA11003EN-02154[18]

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

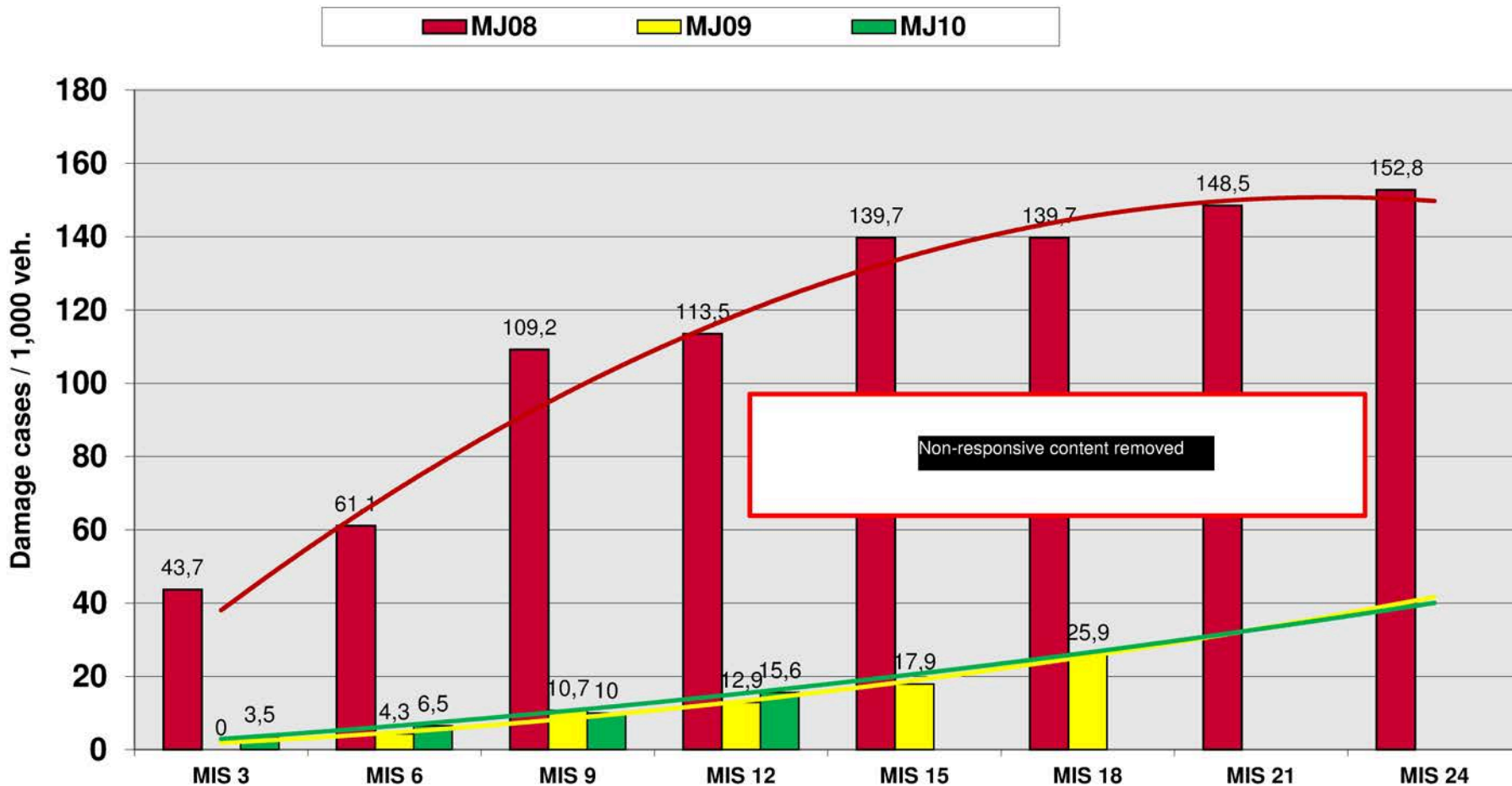
CP4.2 all Audi V6-TDI – Model year comparison by MIS



EA11003EN-02154[19]

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

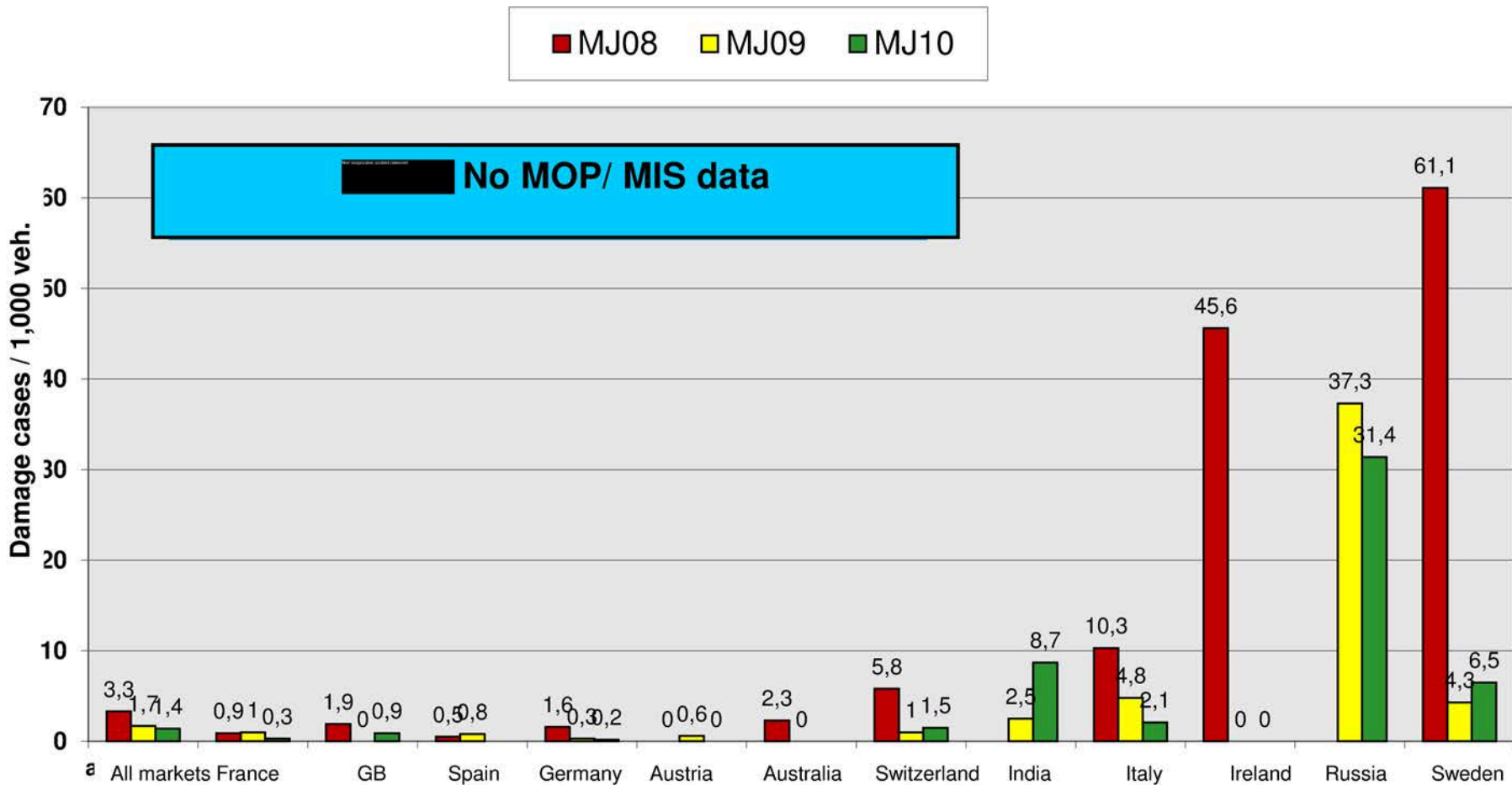
CP4.2 all Audi V6-TDI – Model year comparison by MIS



EA11003EN-02154[20]

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

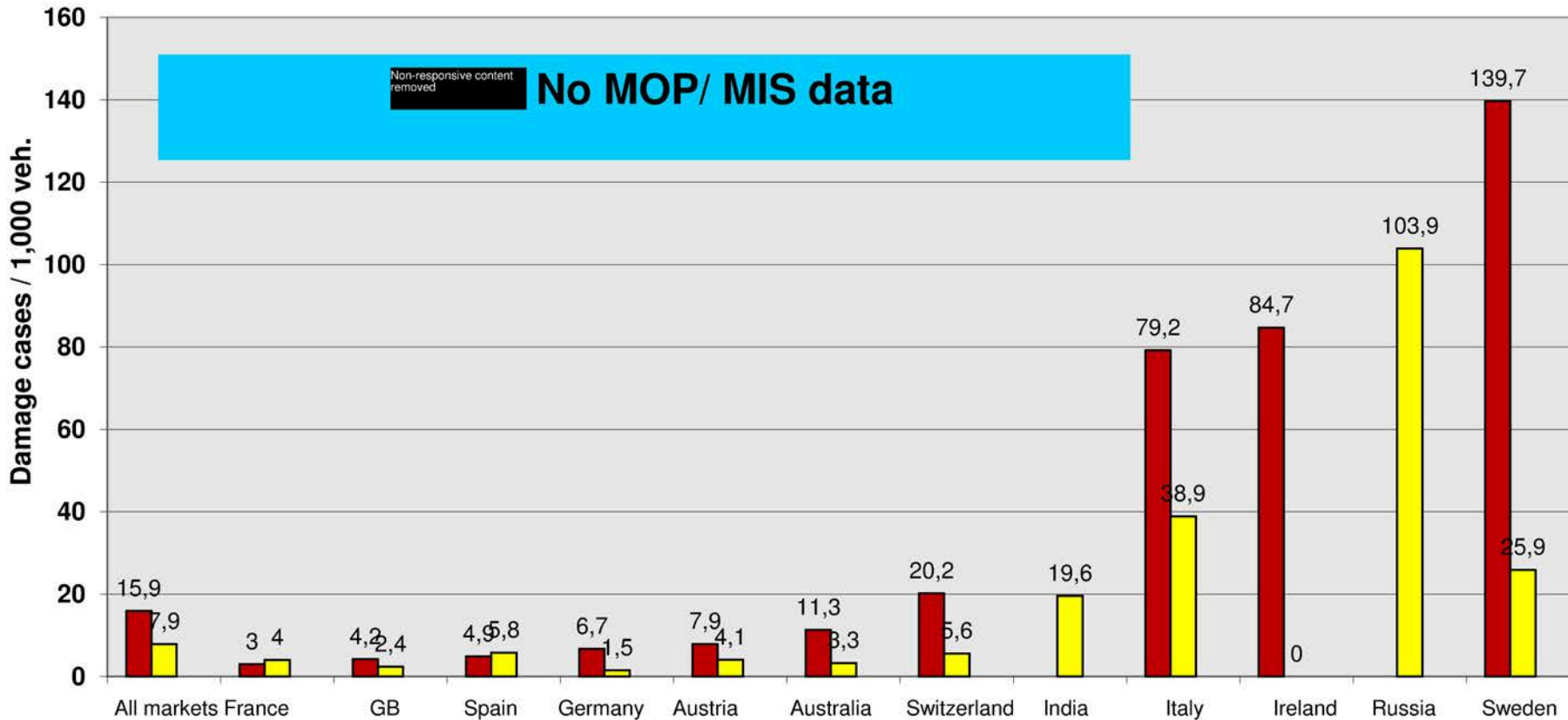
## MIS 6 new



EA11003EN-02154[21]

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

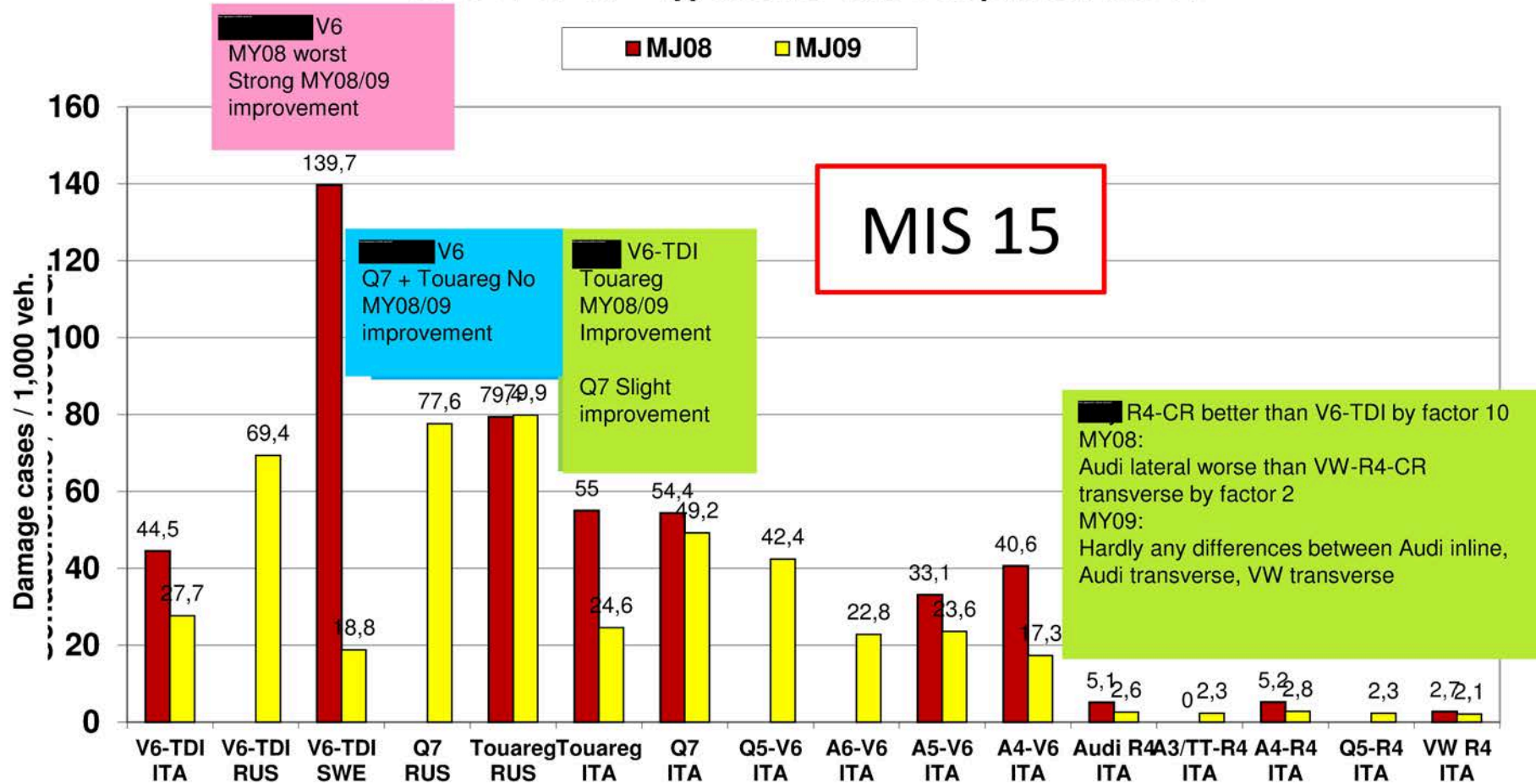
## MIS 18 new



EA11003EN-02154[22]

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

CP4.2 + CP4.1 – Type/Model Year Comparison MIS 15

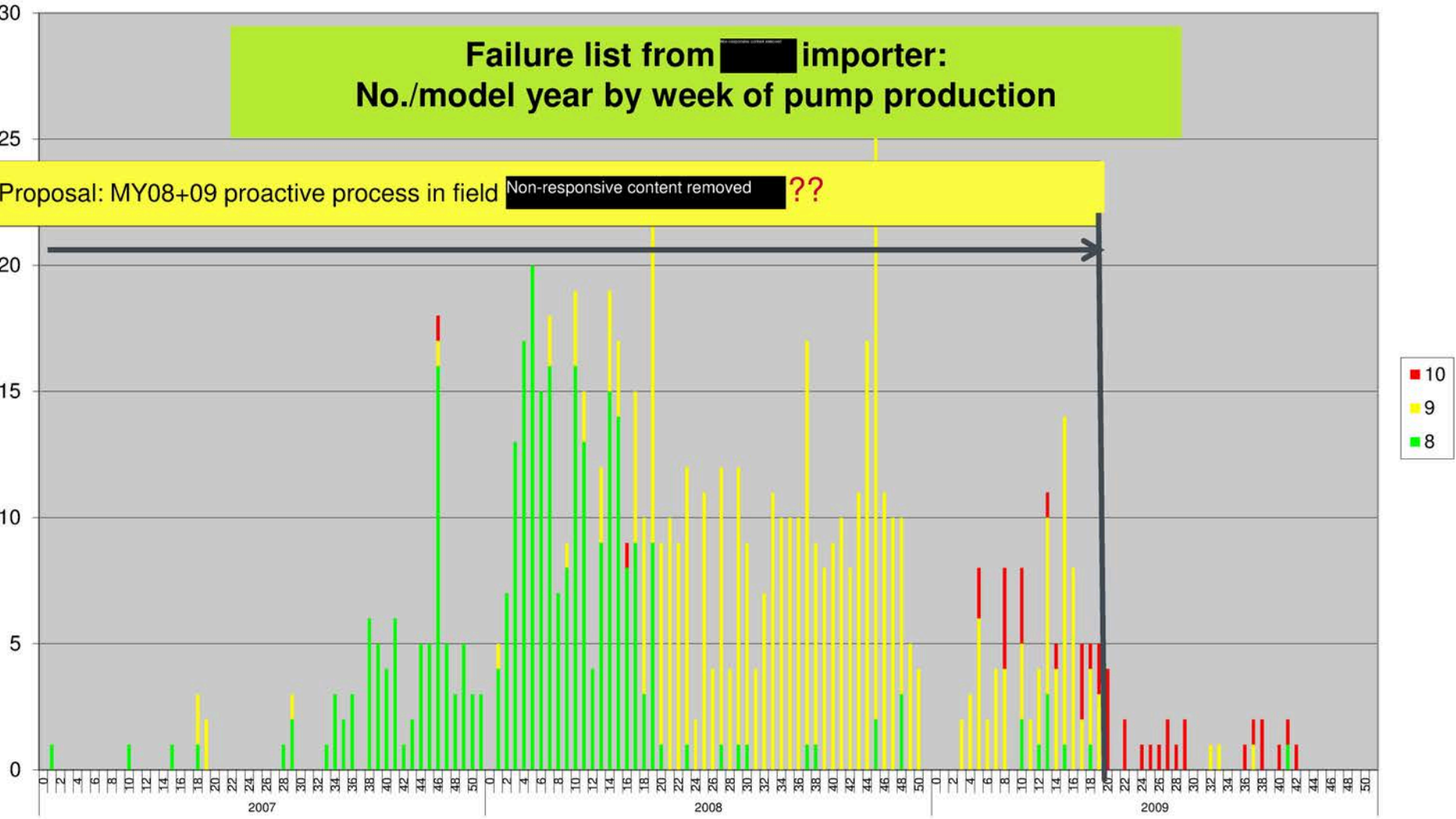


EA11003EN-02154[23]

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

Failure list from [redacted] importer:  
No./model year by week of pump production

Proposal: MY08+09 proactive process in field [redacted] Non-responsive content removed ??



EA11003EN-02154[24]

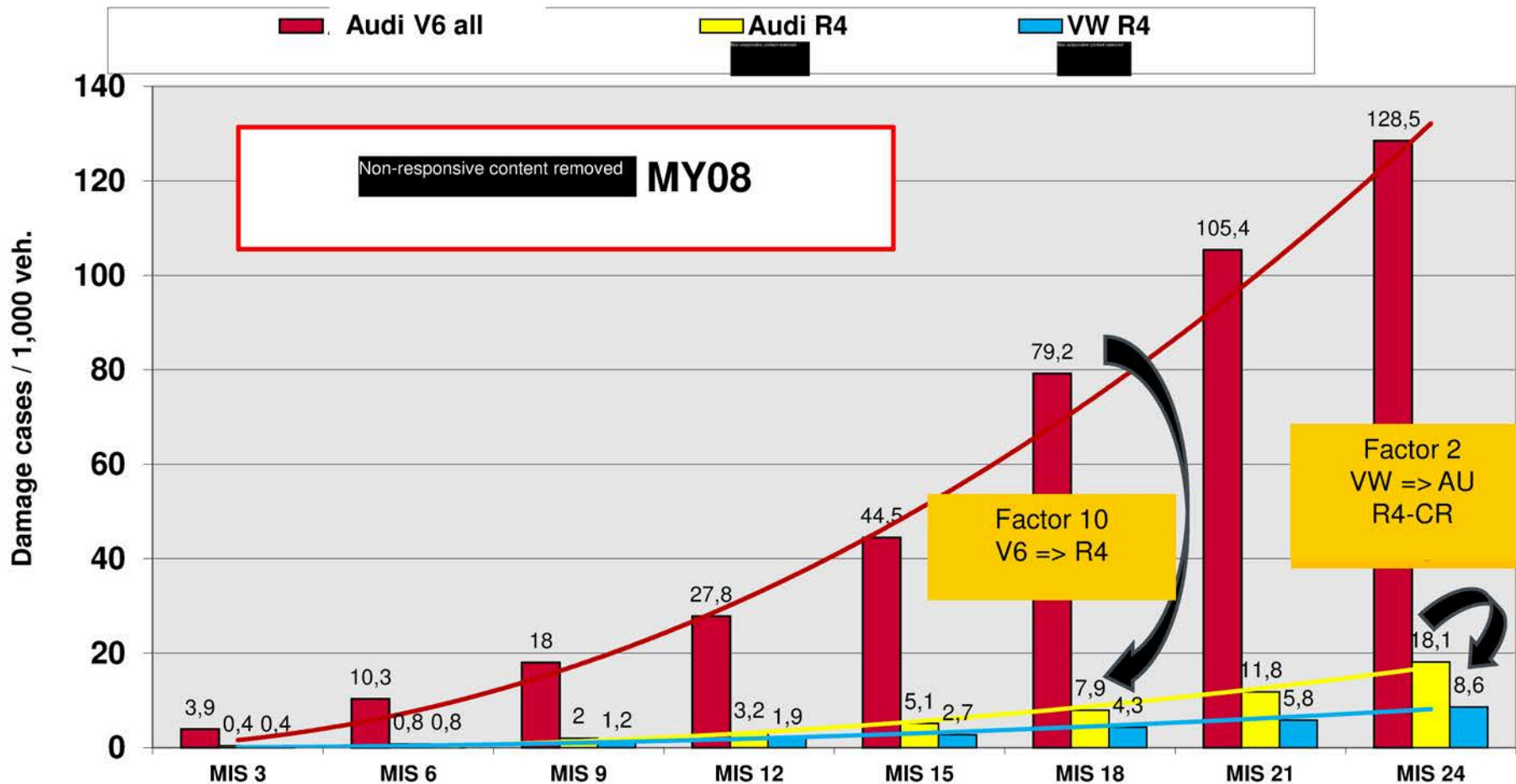
## Drivetrain damage - high-pressure diesel fuel pump CP4.2

# Backup

EA11003EN-02154[25]

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

Comparison of CP4.2 / CP4.1 – V6-/R4-TDI – Audi/VW by MIS

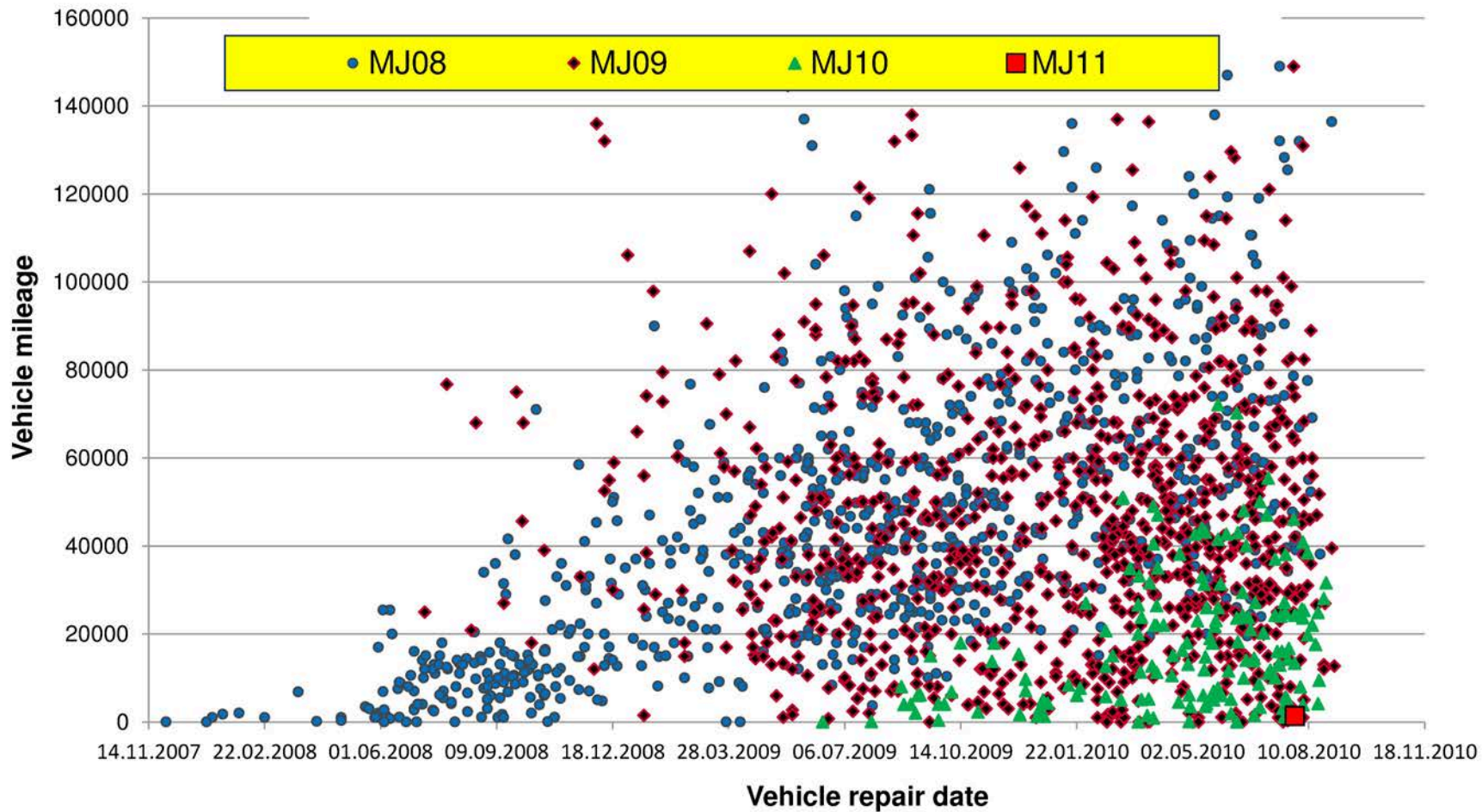




EA11003EN-02154[26]

# Drivetrain damage - high-pressure diesel fuel pump CP4

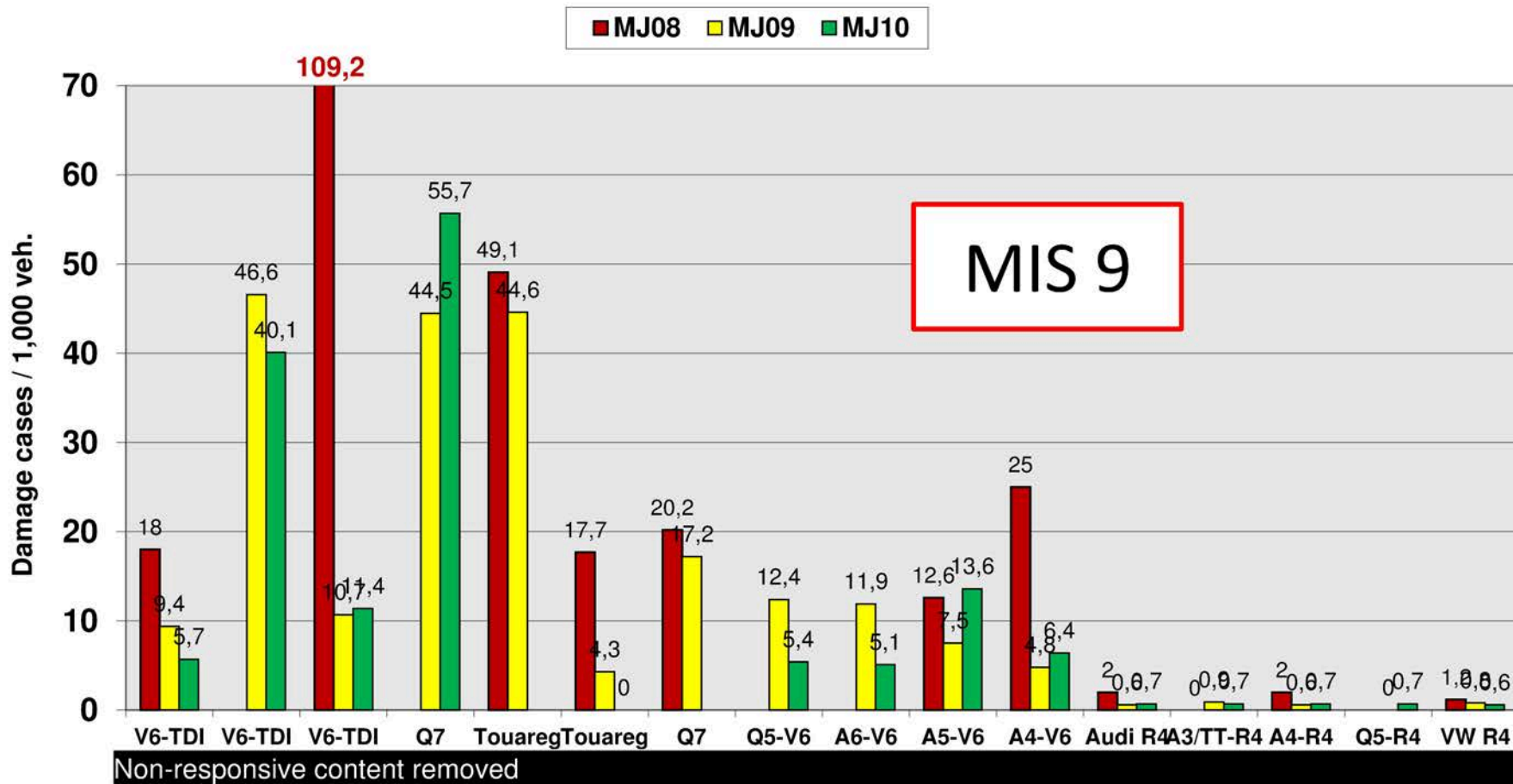
Mileage beyond vehicle production date  
All Audi V6-TDI  
SAGA 059A\_/B\_



EA11003EN-02154[27]

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

CP4.2 + CP4.1 – Type/Model Year Comparison MIS9



EA11003EN-02155[0]



**"Power loss" of high-pressure fuel pump, Touareg V6 TDI**

FPQ 09.21.2010

EA11003EN-02155[1]

## Product Quality Forum

### - "power loss" of high-pressure fuel pump, Touareg V6 TDI

**Problem:** Powertrain damage to Bosch high-pressure fuel pumps CP4.2  
2135 cases of damage worldwide in low-quality fuel regions (1,150 in [REDACTED] 284 in [REDACTED])

**Cause:** [REDACTED] Non-responsive content removed  
- aged biofuel in conjunction with high proportion of fuel additives  
- low fuel viscosity and poor lubricity

**Analysis:** [REDACTED]  
- High temp on the right roller support leads to deposits formed from decomposition of the additives  
- Deposits impede formation of the lubricant film between roller and roller support  
- "Flat spots" cause powertrain damage due to stationary roller of the pump  
- Reduction in the frequency of damage by 80% from MY08 to MY10 through measures packages  
[REDACTED]  
- Aforementioned fuel properties lead to accelerated component wear  
- High temperature on the right roller support leads to further reduction of fuel viscosity  
- Abrasive wear due to thin lubricant film between roller and roller supports

**Measures:**  
Robustness package 1 (RP1) Since CW 15/2010  
- including C2 instead of C3 coating on roller support; narrowing roller clearance in series for roller support; roller shape optimization  
- Increasing lubricant film thickness between roller and roller support  
- support 8 failures in [REDACTED] Non-responsive content removed to date

Robustness package 2 (RP2)  
- Reduction in temperature at the right roller support by Opt. Inflow and return lines of the high-pressure fuel pump  
- No deposit formation and further lubricant film thickness  
- Effectiveness proven in Raff test

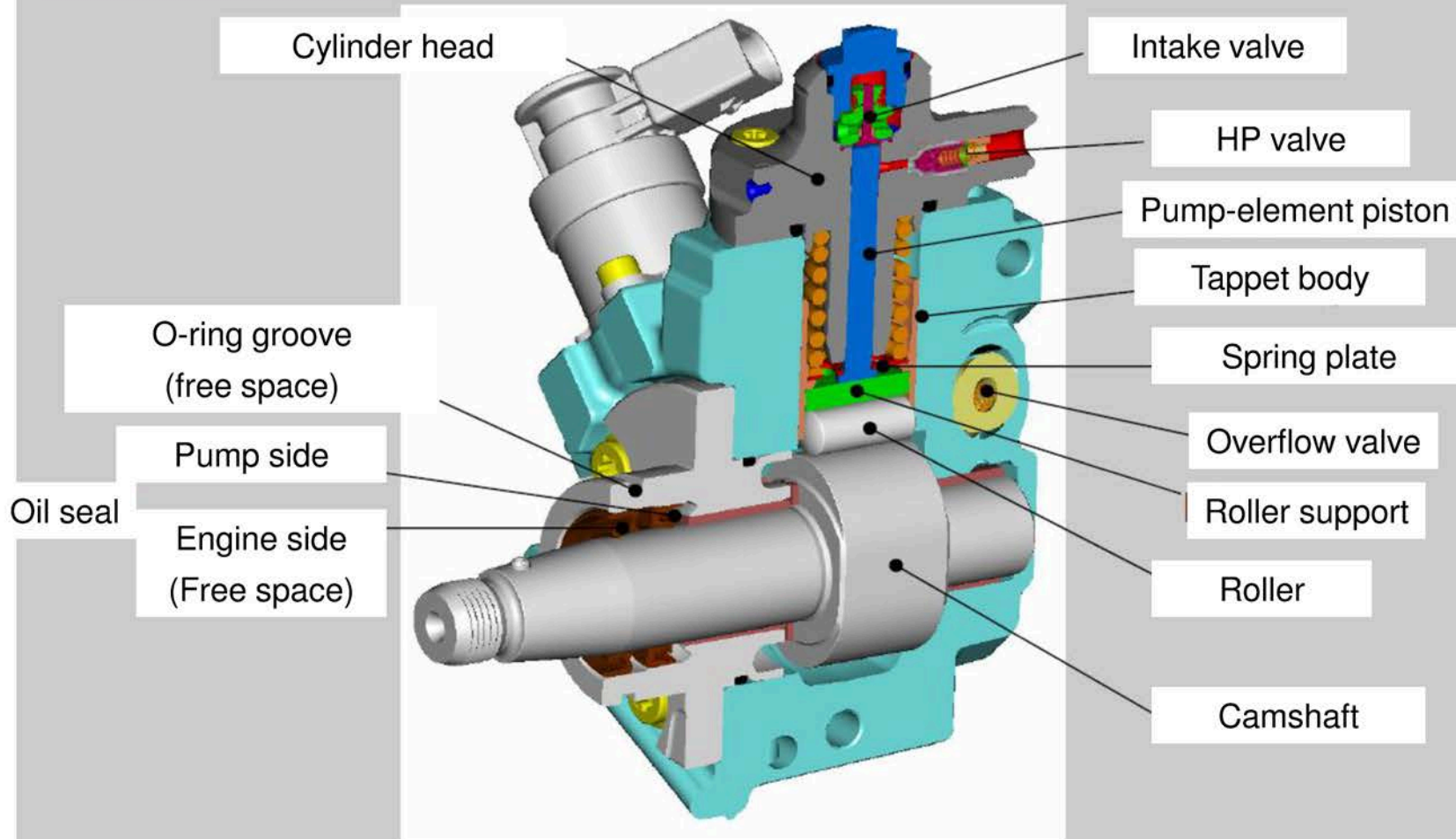
**Dates:** Series RP 2 starting from CW 45/2010 for all V6 TDI

EA11003EN-02155[2]

# Product Quality Forum

- "power loss" of high-pressure fuel pump, Touareg V6 TDI

## Technical information CP4.1



EA11003EN-02157[0]



## Status of V6TDI power loss of high-pressure fuel pump

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09.29.2010

EA11003EN-02157[1]

## Status of V6TDI power loss of high-pressure fuel pump

**Problem:** Powertrain damage to Bosch high-pressure fuel pumps CP4.2

3400 SF V6TDI Audi + VW worldwide since MY2008 in poor-quality fuel regions

Focus [Non-responsive content removed]

3 failures in the Touareg NF Q AL USA

End-of-line failures [Non-responsive content removed] / 1 failure in the Q-AL in [Non-responsive content removed] (Q7 after 18,000 km)

No increased damage rates in [Non-responsive content removed] (except [Non-responsive content removed])

**Cause:** [Non-responsive content removed] - Aged biofuel in conjunction with high proportion of fuel additives  
[Non-responsive content removed] - low fuel viscosity and poor lubricity

Q-AL USA: - in analysis

[Non-responsive content removed] - low fuel viscosity and poor lubricity

- related issue: First-filled fuel [Non-responsive content removed]

EA11003EN-02157[2]

## Status of V6TDI power loss of high-pressure fuel pump

- Analysis:** [REDACTED]
- High temp on the right roller support leads to deposits formed from decomposition of the additives
  - Deposits impede formation of the lubricant film between roller and roller support
  - "Flat spots" cause powertrain damage due to stationary roller of the pump
  - Reduction in the frequency of damage by 70% from MY08 to MY10 through measures packages
- [REDACTED]
- Poor viscosity and lubricity lead to accelerated wear of components
  - High temperature on the right roller support leads to further reduction of fuel viscosity
  - Abrasive wear due to thin lubricant film between roller and roller supports
- [REDACTED]
- Poor viscosity and lubricity like [REDACTED]
  - 2 of 5 pumps show heavy deposits and flat spots after 20 km vehicle start run

Q AL USA: - Analysis is under progress



EA11003EN-02157[3]

## Status of V6TDI power loss of high-pressure fuel pump

### Measures:

Robustness package 1 (RP1) **Since CW 15/2010** in series

- including C2 instead of C3 coating on roller support; narrowing roller clearance for roller support; roller shape optimization
- Increasing lubricant film thickness between roller and roller support
- 8 failures in Non-responsive content removed to date

Robustness package 2 (RP2)

- Reduction in temperature at the right roller support by opt. Inflow and return lines of the high- pressure fuel pump
- Thus, the same temperature level as CP4.1 on 4 cylinder TDI
- No deposit formation and further lubricant film thickness
- Effectiveness proven in Raff test

Process analysis:

- First-filled fuel in Non-responsive content removed does not meet group specification

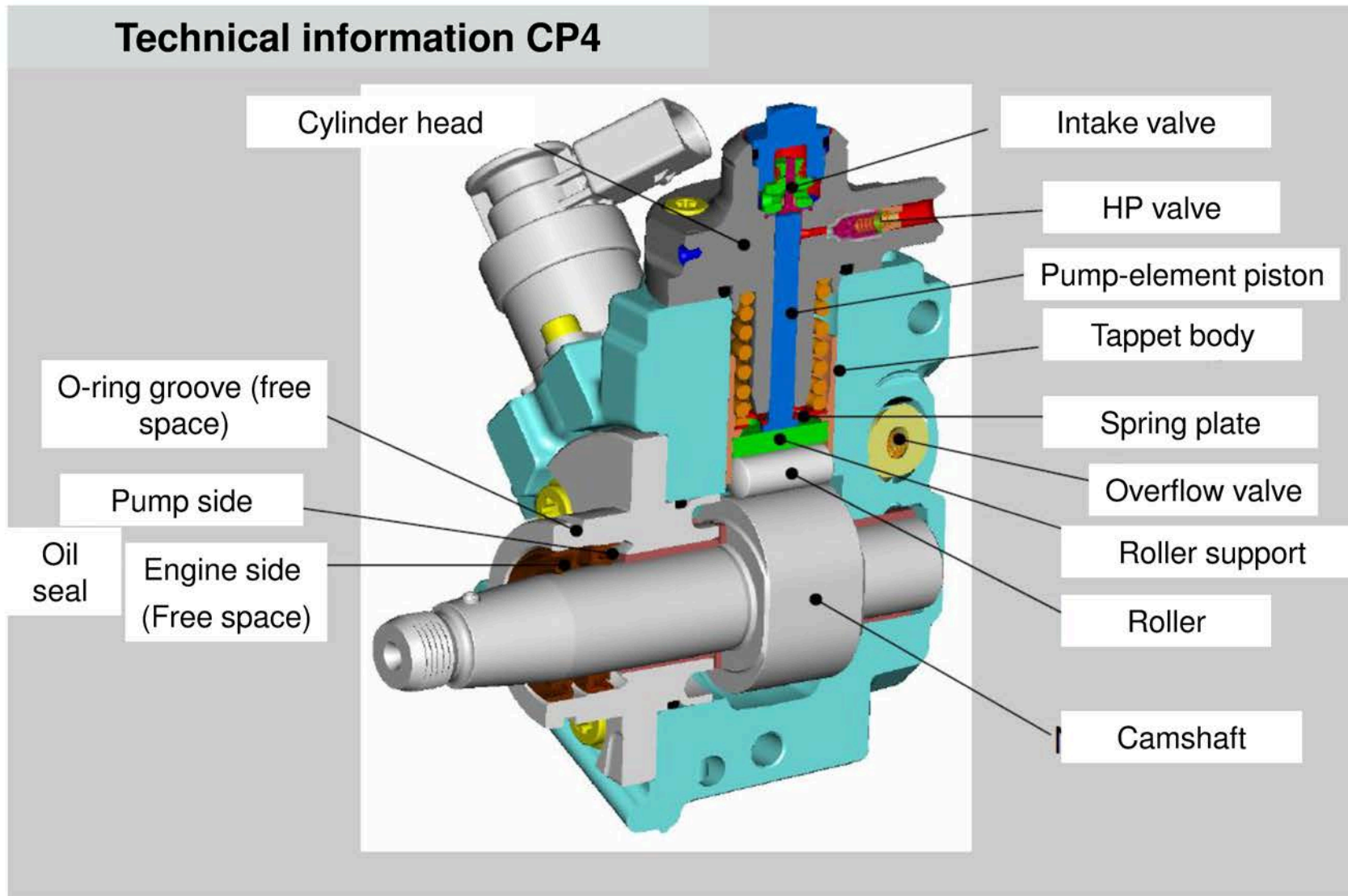
**Dates:** Application of RP 2 starting **from CW 45/2010** for all V6 TDI

Verification in progress,   release scheduled in CW40/2010

EA11003EN-02157[4]

# Status of V6TDI power loss of high-pressure fuel pump

## Technical information CP4



EA11003EN-02157[5]

**Product Quality Forum - "power loss" of high-pressure fuel pump,  
Touareg V6 TDI**

# Backup

EA11003EN-02157[6]

## Product Quality Forum

"power loss" of high-pressure fuel pump, Touareg V6 TDI

### Robustness package 1

#### Task

Increasing lubricant film between the roller support and roller for fuels with lower viscosity (reduction of mixed friction proportions and temperatures)

#### Measures

- Reduction of roughness in the roller support by switching to C2 coating
- Prevention of metal chips (metal chips do not occur in C2 based on the process)
- Reduction in clearance between the roller of roller support (smaller roller support hole)
- Reduction of the roller roughness
- Optimization of the edge rounding of the roller support (trimming)

#### Result

RP1 raises the lubricant film by a factor of 2 (derived from finding results)

RP1 for all CP4.2 since CW15/2010 in series for all V6TDI.

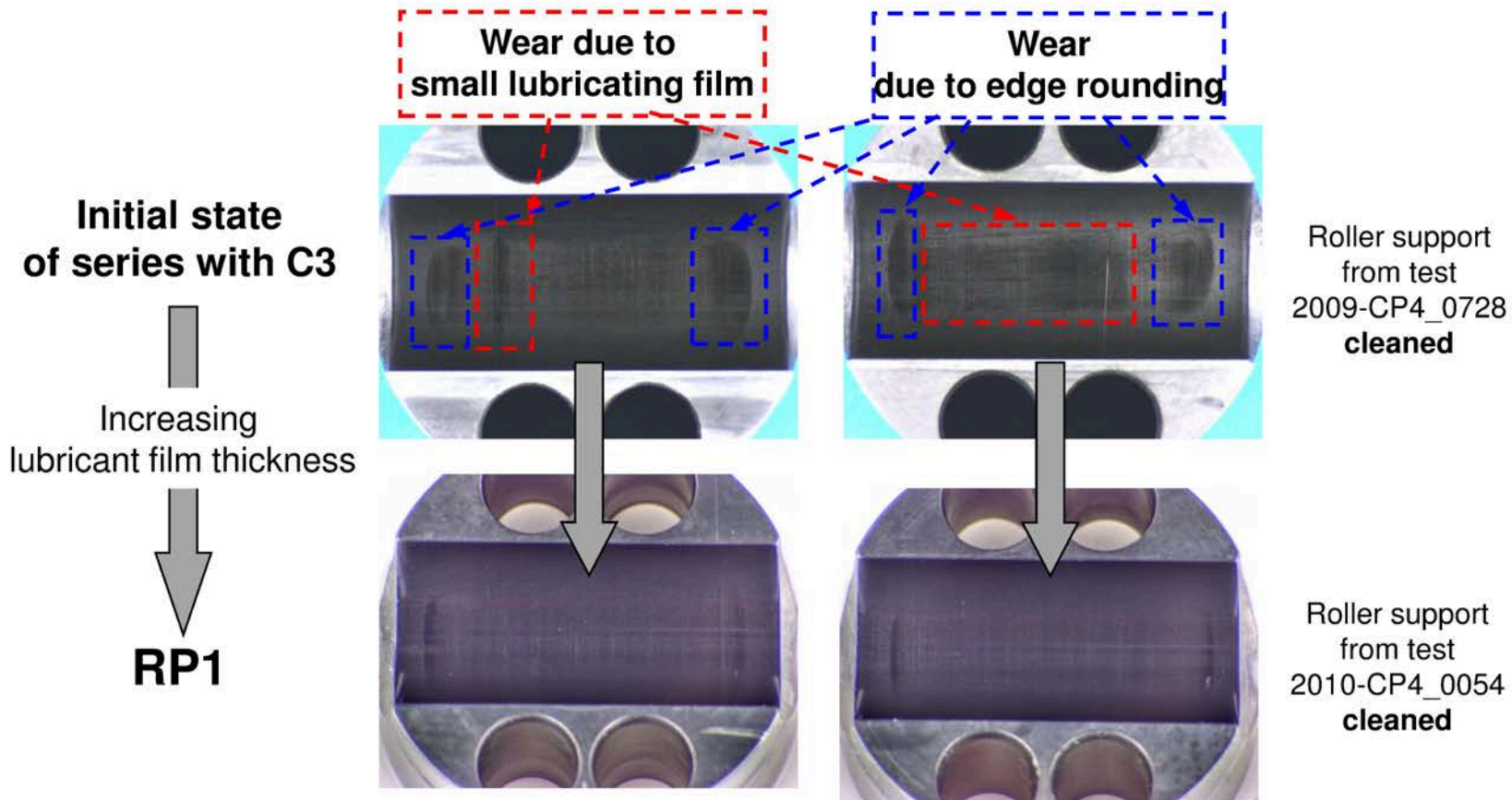
EA11003EN-02157[7]

## Product Quality Forum

### "power loss" of high-pressure fuel pump, Touareg V6 TDI

## Robustness package RP1

Proof of effectiveness through overload test (150 h at low viscosity)



EA11003EN-02157[8]

## Product Quality Forum

"power loss" of high-pressure fuel pump, Touareg V6 TDI

## Robustness package 2

### Task

Reduction of local temperature in the right roller support to the level of CP4.1

→ Prevention of fuel decomposition, formation of deposits

### Measures

- Optimized Arrangement of inflow / return position (swapping the inflow / return ports)

### Result

Reduction of temperature in the lubrication gap by 24 °C (from 136 °C to 111 °C at 80 l/h at 70 °C inflow)

→ Thus, the same temperature level as CP4.1 (single plunger pump)

→ Prevention of fuel decomposition→, significantly less formation of deposits on roller support

Testing passed for R.B.; testing / verification at Audi in progress

Series launch of all V6-TDI (due to changes in forward and return flow lines)

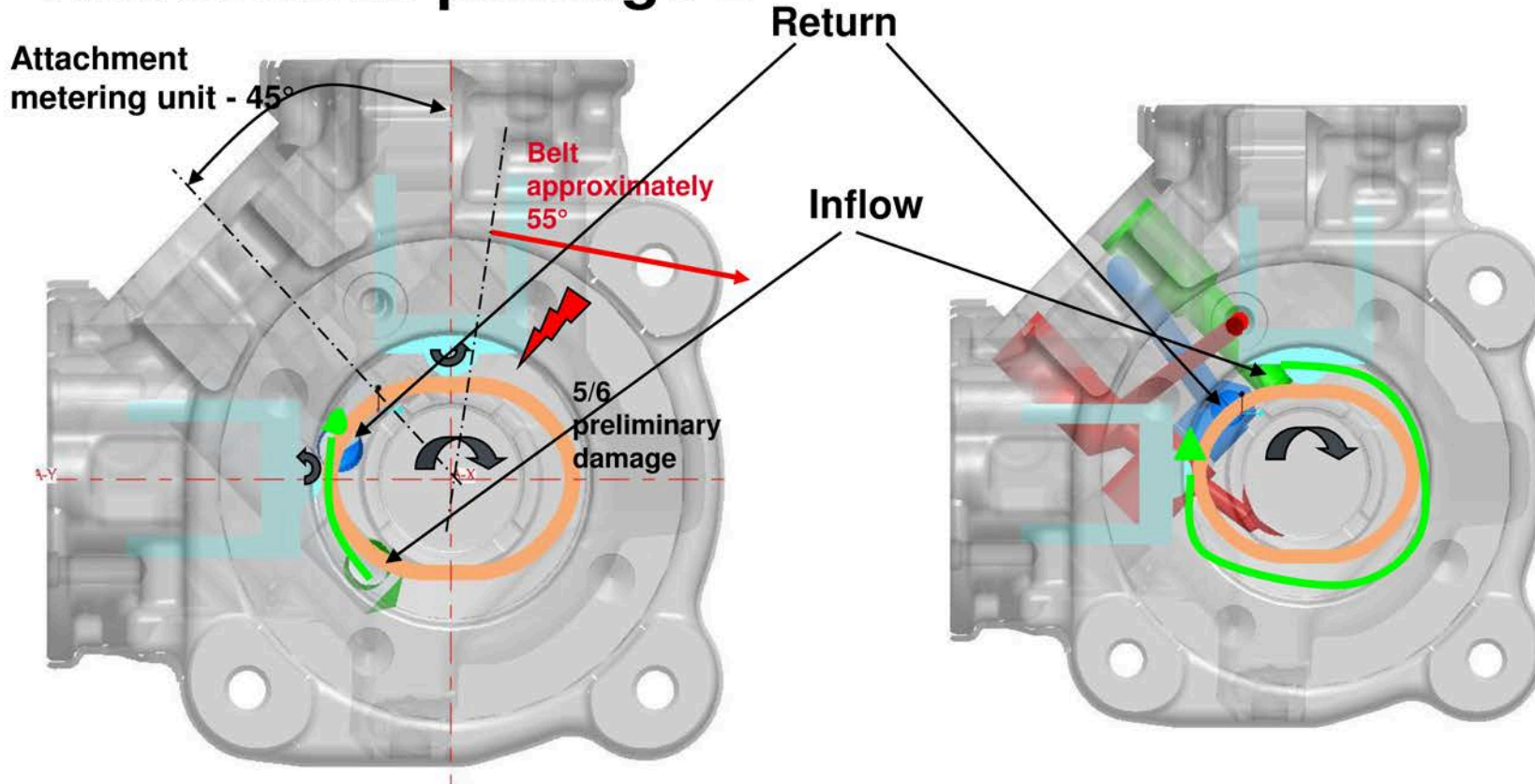
WK45/2010

EA11003EN-02157[9]

## Product Quality Forum

"power loss" of high-pressure fuel pump, Touareg V6 TDI

## Robustness package 2



Fuel goes directly to the return line

CP4.2 / V6 TDI

Fuel is pumped over once

CP4.2 with **RP2** in V6TDI

EA11003EN-02157[10]

# Product Quality Forum

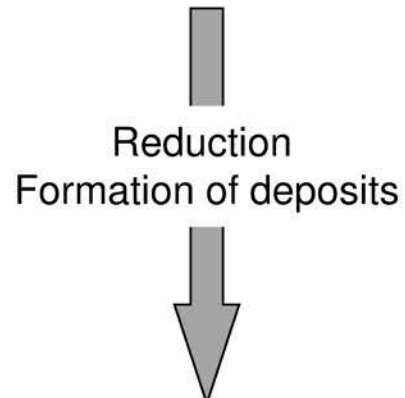
## "power loss" of high-pressure fuel pump, Touareg V6 TDI

### Robustness package RP2

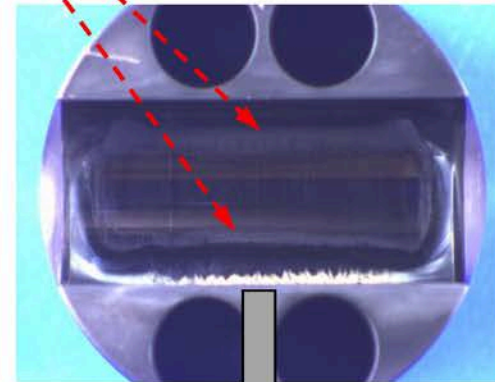
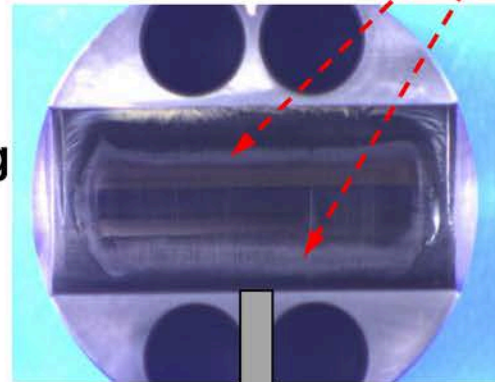
Proof of effectiveness through overload test (150 h at low viscosity)

**Hard, solid deposits**

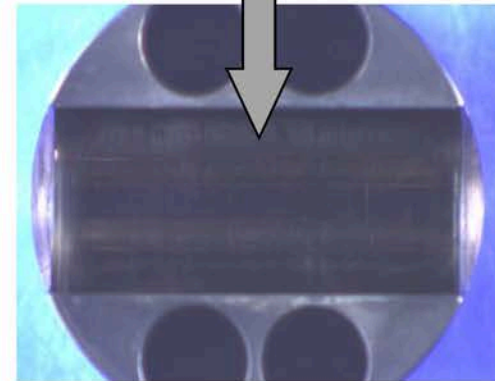
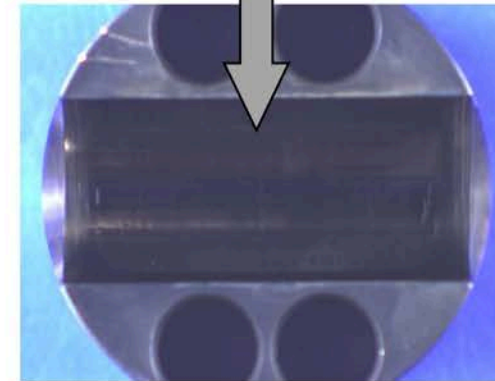
**Initial state**  
**Series with C3 coating**



**RP1+ RP2**



Roller support  
from test  
2009-CP4\_0728  
**uncleaned)**



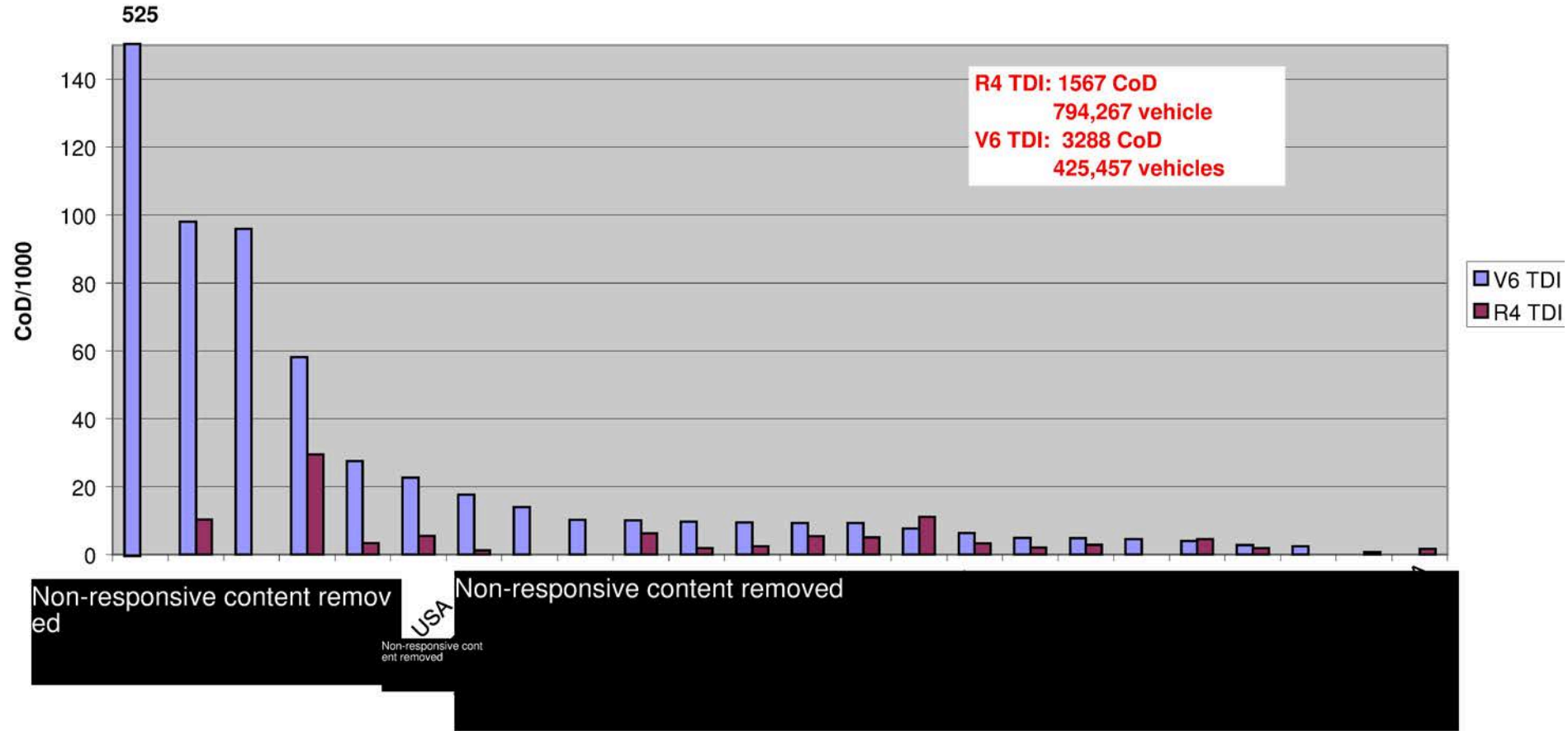
Roller support  
from test  
2010-CP4\_304/305  
**uncleaned)**



EA11003EN-02159[0]

# High-pressure diesel pump

V6 / R4 TDI comparison  
MY08 - 11



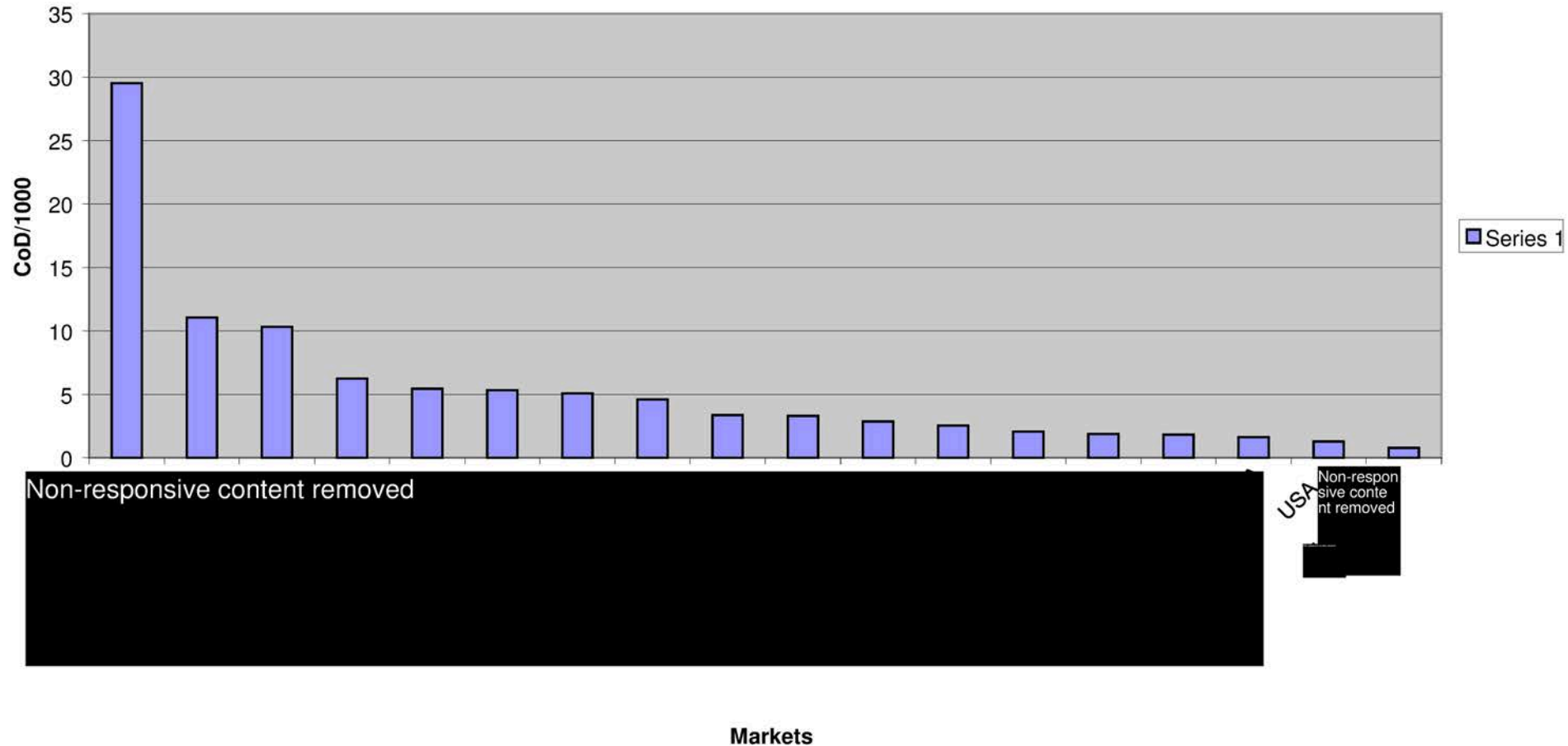
\* No R4 TDI in the market

Markets

EA11003EN-02159[1]

# CoD/1000

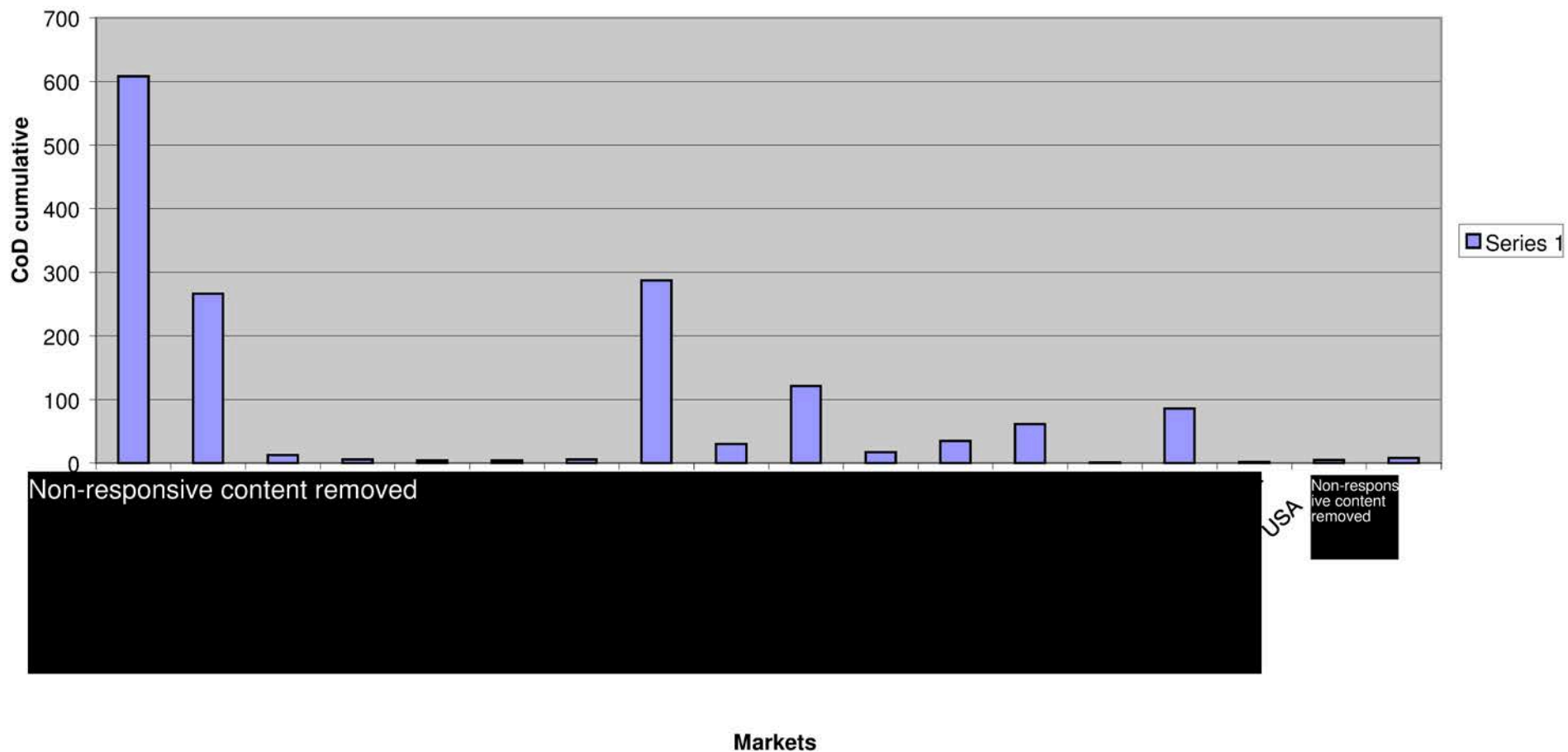
R4 TDI comparison between countries  
MY08-11  
1567 CoD for 794,267 vehicles  
CoD/1000



EA11003EN-02159[2]

### CoD cumulative

R4 TDI comparison between countries  
MY08-11  
1567 CoD for 794,267 vehicles  
CoD cumulative



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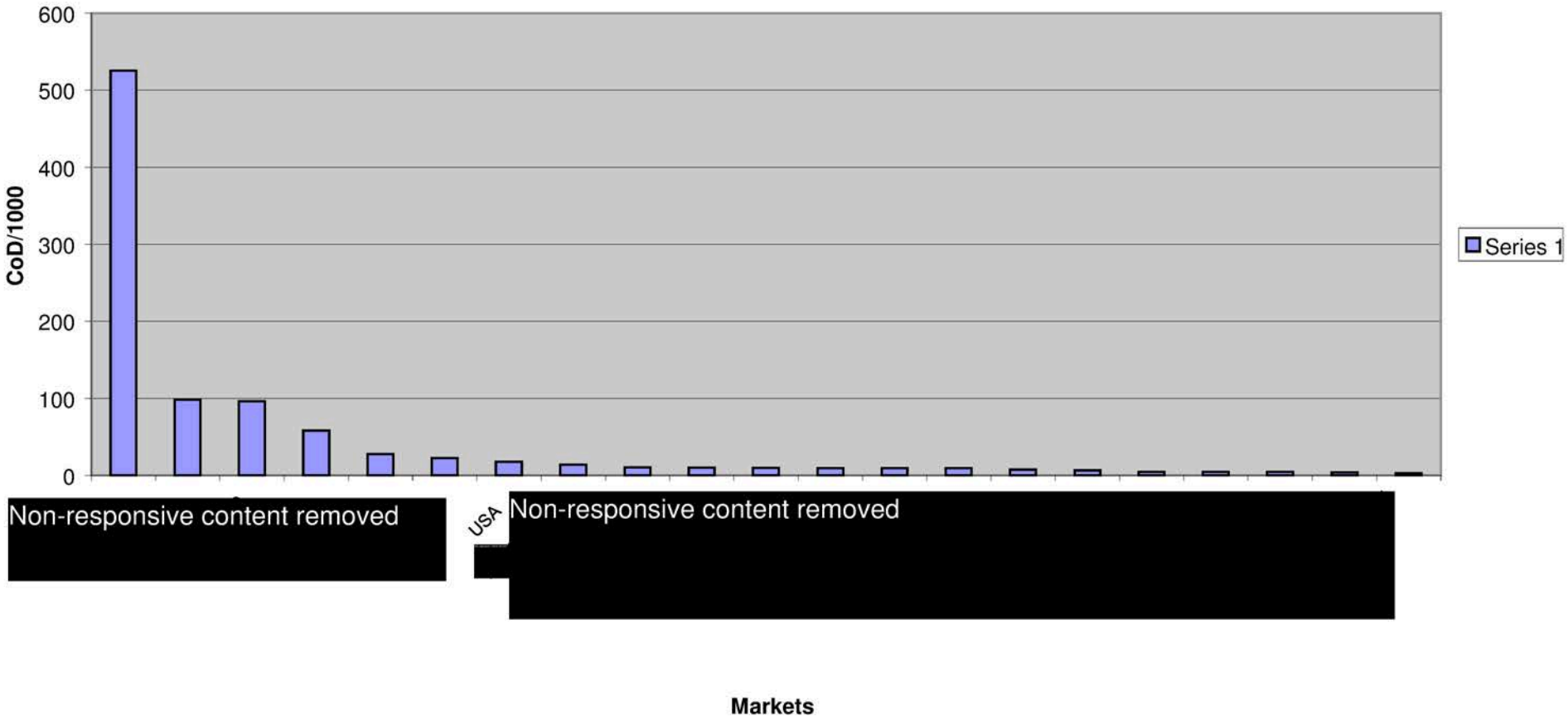
USA

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EA11003EN-02159[3]

# CoD/1000

V6 TDI comparison between countries  
MY08-11  
3,288 CoD for 425,457 vehicles  
CoD/1000



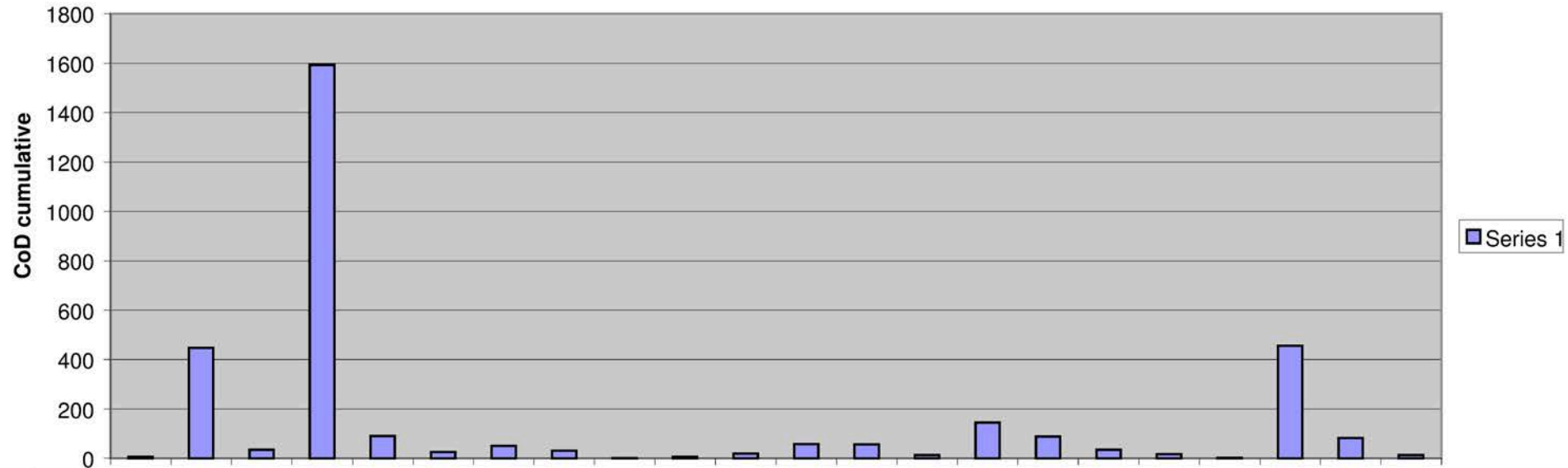
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USA Non-responsive content removed

EA11003EN-02159[4]

# CoD cumulative

V6 TDI comparison between countries  
MY08-11  
3,288 CoD for 425,457 vehicles  
CoD cumulative



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USA

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Markets

EA11003EN-02161[0]



**R4-CR Drivetrain damage to HDP CP4.1**

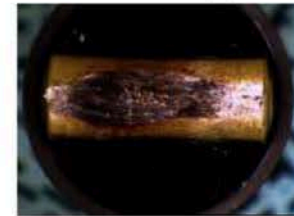
03.04.2011

EA11003EN-02161[1]

## R4-CR Drivetrain damage to HDP CP4.1

High-pressure diesel pump in CR injection systems at 1,800 bar (EU5) from 2007

Left roller tappet



**Drivetrain** is the "sensitive heart" of the pump:

- Roller
- Roller support
- Twin camshafts

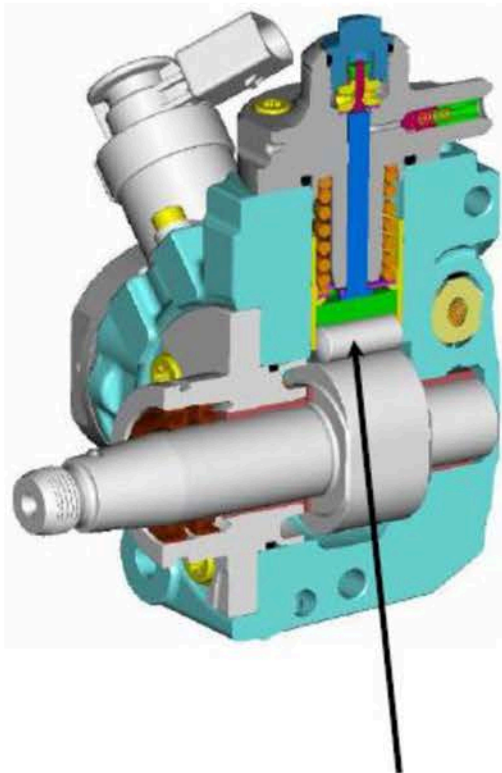
The **roller** with a very smooth surface should be able to over the entire service life and at all operating conditions:

- slide easily in the C-coated roller support
- roll without slipping on the very smooth cam

This does not happen in all situations, **drivetrain damage** occurs:

- **Stiffness** of roller in the roller support due to production discrepancies (mostly eliminated)
- **Critical fuel qualities** in various markets worldwide,  
Specially:

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EA11003EN-02161[2]

## R4-CR Drivetrain damage to HDP CP4.1

- ▶ **Complaint:** Drivetrain damage to Bosch high-pressure fuel pump CP4.1
- ▶ **Affected models:** All vehicles of the Group with 2.0l R4-CR
- ▶ **Affected markets:** Worldwide, especially Non-responsive content removed
- ▶ **Concerned period:** Since Bosch launch of HPP CP4.1 in R4-CR (first use in 2007)
- ▶ **Field damage MY08-10:** ~ 1,550 Audi cases / all kinds of damage (630,000 vehicles sold)  
~ 2,850 Audi cases / all kinds of damage (1,250,000 vehicles sold)
- ▶ **Analysis / cause:**
  - ▶ **Worldwide:** Model years '08 and '09 poor production quality Bosch
  - ▶ **Italy:** Aged biodiesel '08, '09 in [REDACTED]
  - ▶ Non-responsive content removed Poor fuel quality with high kerosene or gasoline content and poor lubricity, also higher water content in [REDACTED]
- ▶ **Hardware measures:**
  - ▶ **Measures package 1&2 :** MP1 (7/'08), MP2 (7/'09)
  - ▶ **Robustness package 1:** RP1 (CW45/'10 for US and EU4 markets)
  - ▶ **Robustness package 1:** RP1 (scheduled in WK13/'11 for RdW markets)
- ▶ **Software measures:** Similar to V6 TDI on clarification at VW [REDACTED] (EFP activation before engine start)



EA11003EN-02161[3]

### R4-CR Drivetrain damage to HDP CP4.1

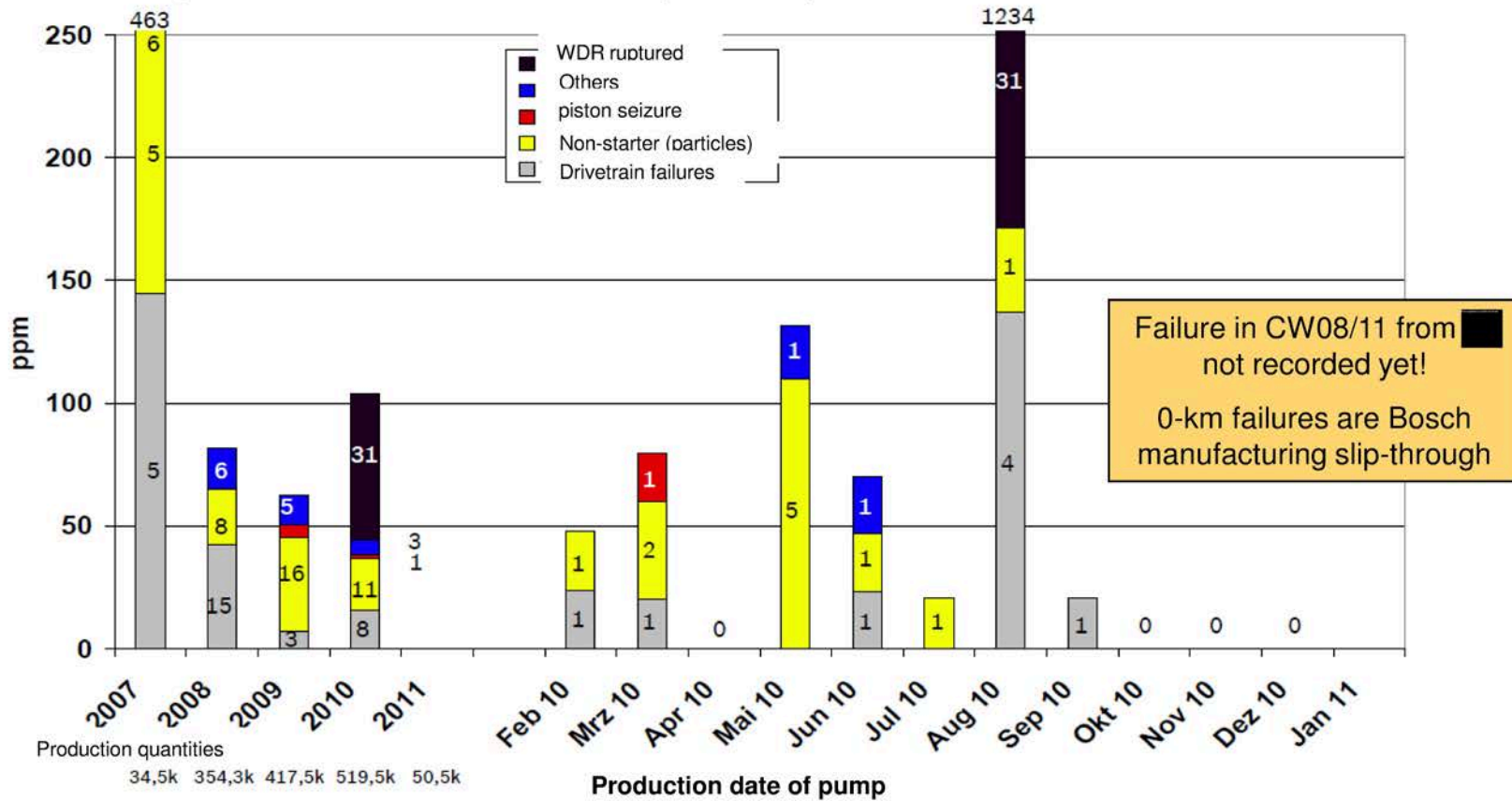
Q status CP4 Audi Győr

Status: IQIS 02.28.2011

## Q-Status CP4 Audi Győr

Stand: IQIS 28.02.2011

### CP4.1, CP4.2 0 km Audi complaints; ΣFeP + JhP



Diesel Systems

Vertraulich 02.03.2011 | © Robert Bosch GmbH 2009. Alle Rechte vorbehalten, auch bzgl. jeder Verfügung, Verwertung.



Audi Vorsprung durch Technik



# **Status EA189 2,0l high-pressure fuel pump 4 cylinder HPFP (1 piston) – USA market**

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# Status EA189 2,0l high-pressure fuel pump 4 cylinder HPFP (1 piston) – USA market

## Description of problem:

Failure of the high-pressure fuel pump 4 cylinder HPFP (1 piston) in the EA189 2,0l CR

## Affected:

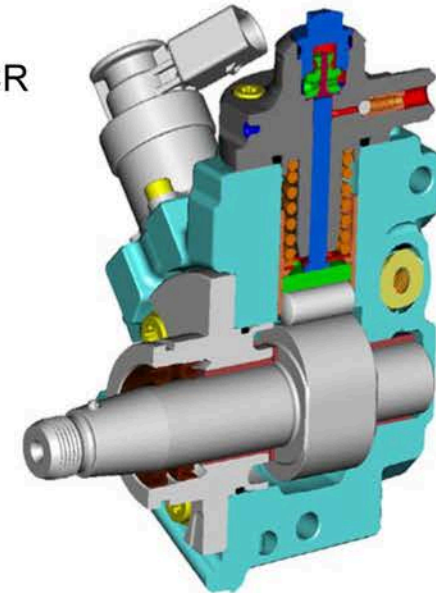
- 130 000 sold vehicles Volkswagen (Jetta, Golf), AUDI (A3)
- 403 - calculations (proportion LB: Ø 27%)

## Analyses (80 damaged parts):

- Powertrain damage, cause can no longer be determined (degree of damage) 35%
- Powertrain damage and failure due to unsuitable fuel 25%
- OK according to specification 28%
- Various causes of failure (sand, corrosion, contamination) 7%

## Initiated measures: (for all CP4.1 variants)

- Straightedge check of roller, optimization of C-coating roller shoe 06/08
- C2.1 instead of C3 coating roller dome, camera check of roller shoe 06/09
- Introduction of robustness package RP1 at CW 45/10 (not for EU5 variants)



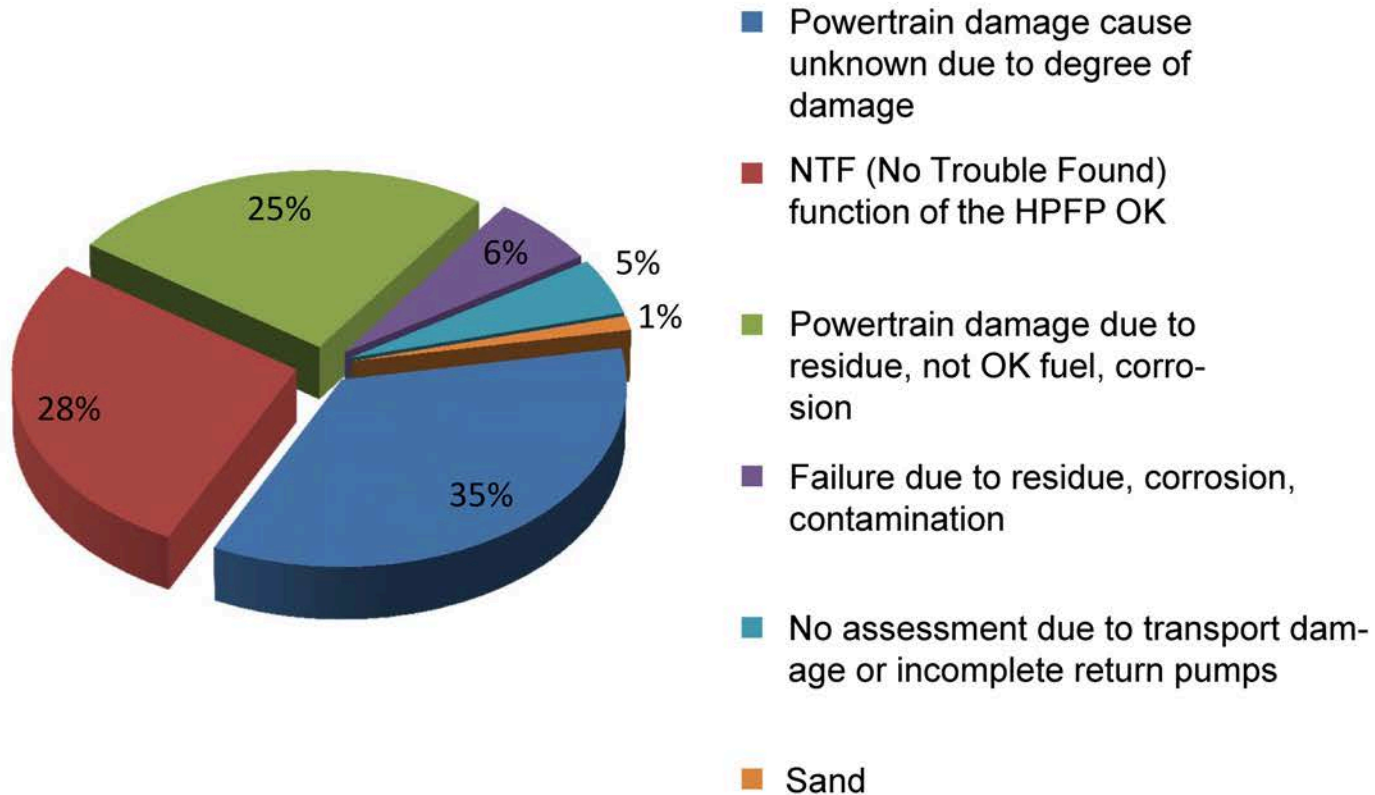
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# Status EA189 2,0l high-pressure fuel pump 4 cylinder HPFP (1 piston) – USA market

Result from 80 diagnostic 8-D reports

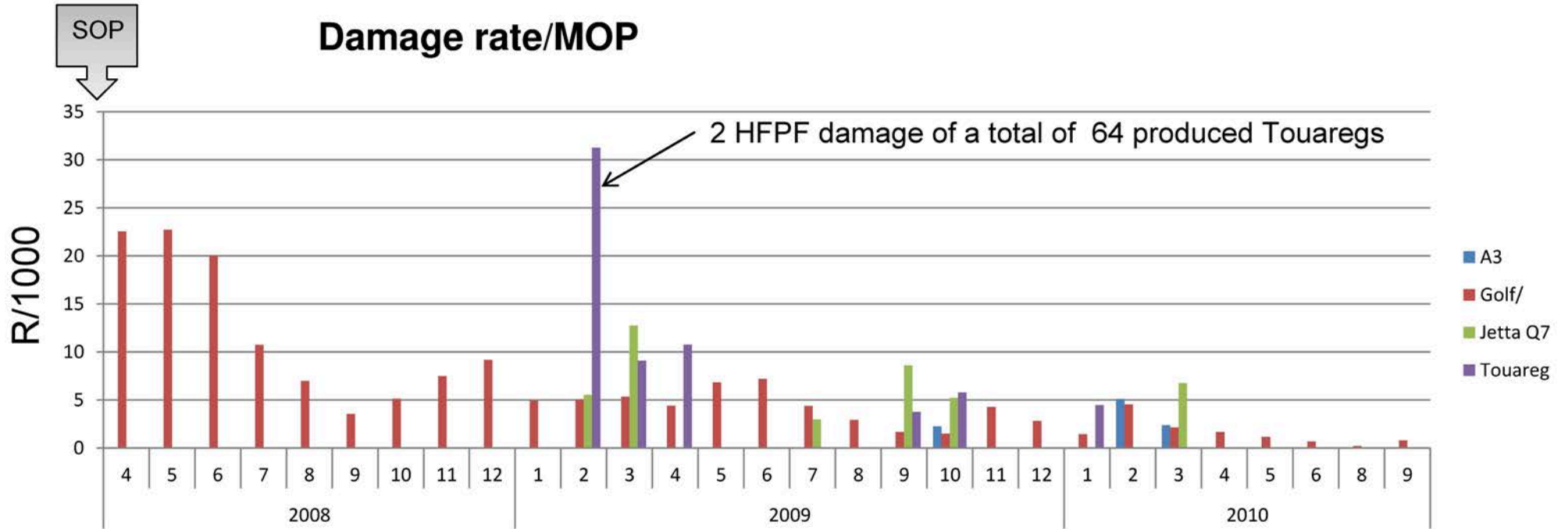


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EA11003EN-02164[3]

# Status EA189 2,0l high-pressure fuel pump 4 cylinder HPFP (1 piston) – USA market



Optimization of coating process (roller shoe)

Change to coating C3 to C2.1 (roller domes)

Tolerance optimization and coating change C3 to C2.1 (Roller shoe)

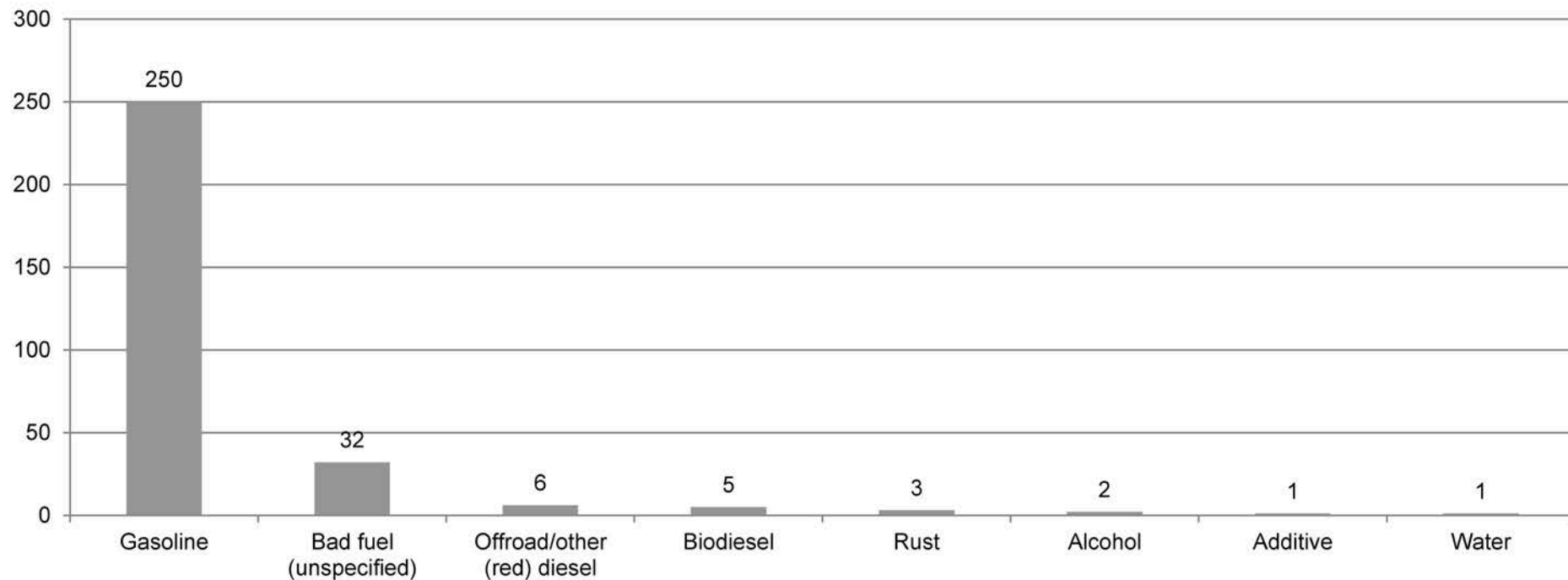
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# Status EA189 2,0l high-pressure fuel pump 4 cylinder HPFP (1 piston) – USA market

## Cases of damage due to misfuelling/bad fuel



- confirmed misfuelling (gasoline)
- unspecified/unsuitable diesel fuels (comment from warranty claim systems: “misfuel”, “contaminated”, “bad fuel”, “milky”, “smells bad”)

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# Status EA189 2,0l high-pressure fuel pump 4 cylinder HPFP (1 piston) – USA market

# BACKUP

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# Status EA189 2,0l high-pressure fuel pump 4 cylinder HPFP (1 piston) – USA market

EA189 2,0l high-pressure fuel pump 4 cylinder HPFP (1 piston) – USA market

German / English  
 AQUA: Aktive Qualitäts-Analyse=AQUA: Active quality analysis  
 VW, Markt: Vereinigte Staaten=VW, market: United States  
 Vertraulich=Confidential  
 Stand=Status  
 HJ 2008 -2010, Offset: alle (Max: 6)=MY 2008 -2010, Offset: all (Max: 6)  
 ohne PR-Nummern=Without PR numbers  
 Quelle/ User SAGA-Gew =Source/ User SAGA Weighted  
 Teilenummer: =Part number:  
 Tausch=Exchange  
 Diff%=Diff%

German / English  
 MECFEH UNDICHT GERAEU SCHWER =MECFAIL LEAK  
 NOISE HEAVY  
 Stichprobenfahrzeuge=Sample vehicles  
 Fahrzeug-Unterdrückung=Vehicle elimination  
 Herstellerjahr 2008=Year of manufacture 2008  
 Herstellerjahr 2009=Year of manufacture 2009  
 Herstellerjahr 2010=Year of manufacture 2010  
 Schadensfälle pro 1000 FZG=Damage cases per 1000 veh.  
 Produktionsmonate=Production month

AQUA: Aktive Qualitäts-Analyse

Stand 04/11-18.05.11 10:12

Quelle/User

VW, Markt: VEREINIGTE STAATEN

HJ 2008 - 2010, Offset: alle (Max: 6)

Teilenummer: 03L130755%

EA189 2,0l

Vertraulich

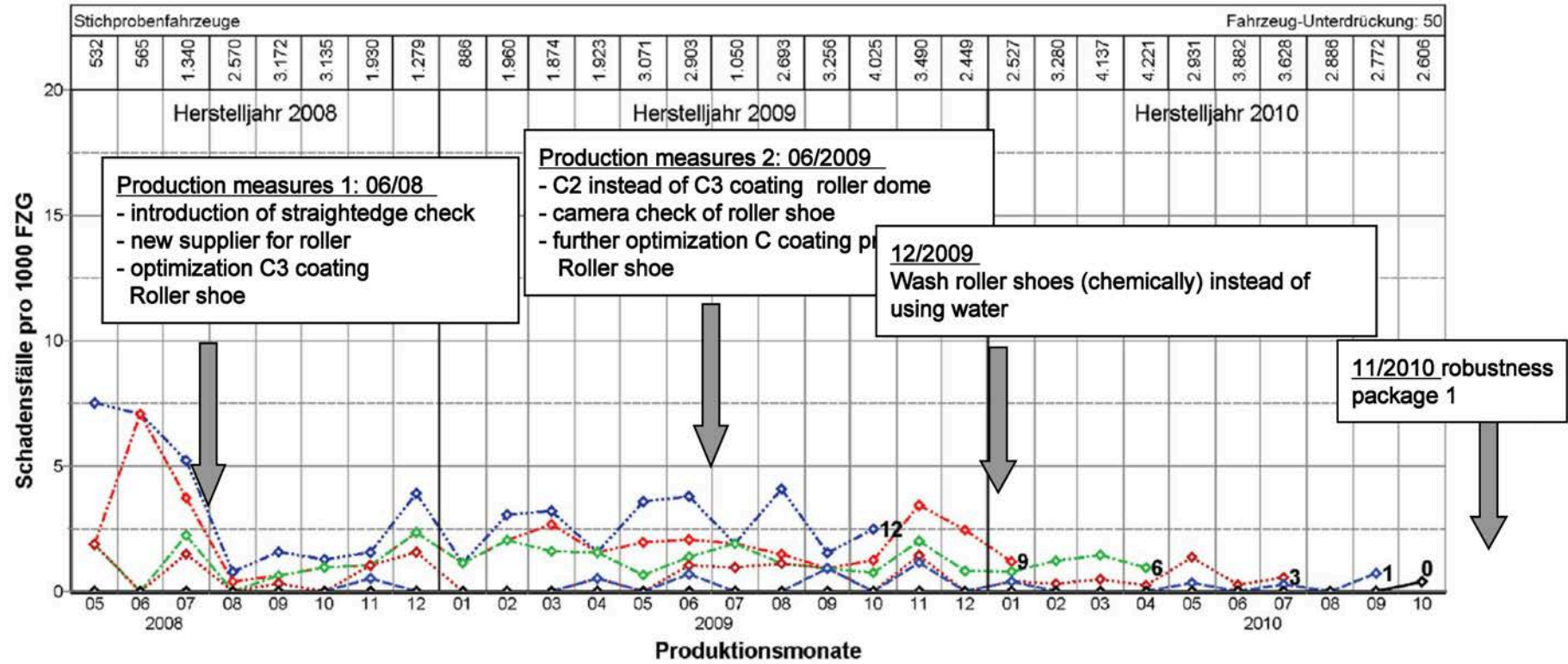
ohne PR-Nummern

Teilenummer 03L130755%

HJ	MIS0	MIS1	MIS3	MIS6	MIS9	MIS12
2008	0,0	0,1	0,5	1,0	1,4	2,3
2009	0,0	0,3	0,5	1,3	1,9	3,1
2010	0,0	0,2	0,5	1,4	2,6	3,1
Diff%		-42,13	0,63	8,53	37,17	

HJ	Tausch	LB	SA 10	SA 50	SA 20	SA 17
2008	100,0 %	29,3 %	94,6 %	3,4 %	1,4 %	,7 %
2009	100,0 %	27,5 %	96,9 %	2,5 %	,6 %	
2010	100,0 %	26,8 %	94,4 %	2,8 %	1,4 %	1,4 %

MECFEH UNDICHT GERAEU SCHWER



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Verkauf: 21.399+36.617+54.951=112.967; Stp.: 14.569+29.580+38.584=82.733; HJ: 2008+2009+2010=Gesamt

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HDP-USA  
 \*Introduction of measures - Bosch





German / English  
 AQUA: Aktive Qualitäts-Analyse=AQUA: Active quality analysis  
 VW, Markt: Markt Europa=VW, market: European market  
 Vertraulich=Confidential  
 Stand=Status  
 HJ 2008 - 2010, MIS von/bis: 0 -24, Offset: alle (Max: 6)=MY 2008 - 2010, MIS von/to: MY 0 -24, Offset: all (Max: 6)  
 ohne PR-Nummern=Without PR numbers  
 Quelle/ User SAGA-Gew =Source/ User SAGA Weighted  
 Teilenummer.=Part number:  
 Tausch=Exchange  
 Diff%=Diff%...

German / English  
 MECFEH UNDICH GERAUEU SCHWER =MECFAIL LEAK  
 NOISE HEAVY  
 Stichprobenfahrzeuge=Sample vehicles  
 Fahrzeug-Unterdrückung=Vehicle elimination  
 Herstellerjahr 2008=Year of manufacture 2008  
 Herstellerjahr 2009=Year of manufacture 2009  
 Herstellerjahr 2010=Year of manufacture 2010  
 Schadensfälle pro 1000 FZG=Damage cases per 1000 veh.  
 Produktionsmonate=Production month

# Status EA189 2,0l high-pressure fuel pump 4 cylinder HPFP (1 piston) – USA market

AQUA: Aktive Qualitäts-Analyse

Stand 04/11-16.05.11 15:46

Quelle/User Non-responsive content removed

VW, Markt: Markt

HJ 2008 - 2010, MIS von/bis: 0 - 24, Offset: alle (Max: 6)

Teilenummer: 03L130755%

EA189 2,0l

Vertraulich

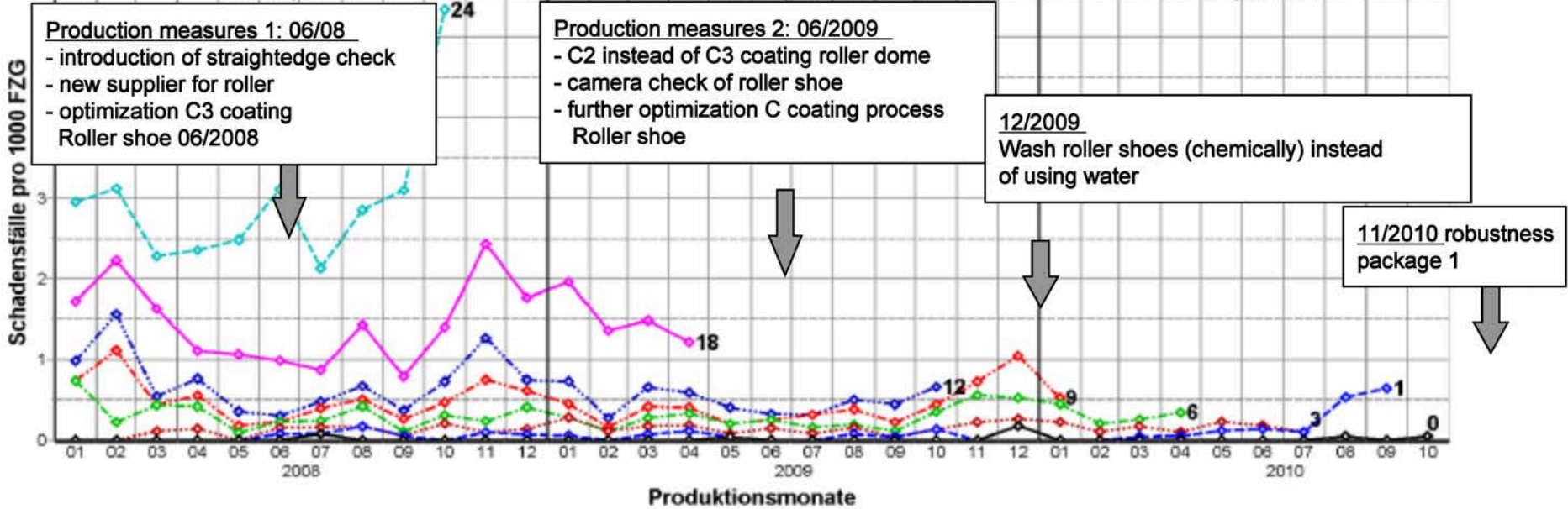
ohne PR-Nummern

Teilenummer 03L130755%

HJ	MIS0	MIS1	MIS3	MIS6	MIS9	MIS12	MIS18	MIS24	HJ	Tausch	LB	SA 10	SA 50	SA 17	SA 20
2008	0,0	0,1	0,1	0,3	0,5	0,7	1,4	3,6	2008	99,4 %	43,6 %	69,4 %	6,0 %	16,1 %	7,3 %
2009	0,0	0,1	0,1	0,3	0,4	0,6	1,4		2009	99,5 %	32,7 %	64,1 %	8,0 %	12,5 %	13,8 %
2010	0,0	0,2	0,3	0,4	0,5				2010	100,0 %	42,3 %	45,2 %	29,8 %	17,3 %	6,7 %
Diff%	-8,35	256,46	97,07	60,66	25,14										

MECFEH UNDICH SCHWER GERAUEU

Stichprobenfahrzeuge												Fahrzeug-Unterdrückung: 50																					
4.084	4.484	9.205	14.426	11.267	13.175	12.653	11.906	19.020	19.279	21.344	14.733	17.837	18.389	28.978	27.182	24.882	27.642	12.656	28.166	27.015	22.676	17.918	11.466	13.419	19.642	23.525	20.370	17.541	22.350	10.080	20.782	23.279	20.177
Herstelljahr 2008												Herstelljahr 2009																					



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Verkauf: 258.771+365.086+305.679=929.536; Stp.: 155.556+262.803+224.493=642.852; HJ: 2008+2009+2010=Gesamt

g EA189\_2,0\_HDP

\*Introduction of measures - Bosch

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# Quality measures for 4 cylinder HFPF

## Status CP4 Triebwerksschäden, Stand KW03/11

Nr.	Maßnahmen zur Vermeidung von Triebwerksschäden English	Einführung FeP		Einführung JhP		
		Tagesdatum	KW	Tagesdatum	KW	
1	k 1 No reuse of tappets after OK press-in process	10.05.2007	KW19/07	31.01.2008	KW04/08	
2	k 2 Click-clack test before shipment	10.05.2007	KW19/07	31.01.2008	KW04/08	
3	k 3 Click-clack test	14.05.2007	KW20/07	31.01.2008	KW04/08	
4	l 4 Delta T and Delta Tmax check on test bench	23.05.2007	KW21/07	31.01.2008	KW04/08	
5	n 5 Click-clack test at end of assembly line	29.05.2007	KW22/07	31.01.2008	KW04/08	
6	n 6 New switch process between flushing and inspection	30.05.2007	KW22/07	31.01.2008	KW04/08	
7	n 7 In-process noise measurement	18.06.2007	KW25/07	31.01.2008	KW04/08	
8	e 8 Elimination of repeat test on friction coefficient test bench	20.06.2007	KW25/07	01.12.2007	KW48/07	
9	z 9 Optimize test bench flow (n&gt;500 1/min)	09.07.2007	KW28/07	31.01.2008	KW04/08	
10	u 10 Cylinder head assembly with 5° torsion suspension	23.07.2007	KW30/07	01.12.2007	KW48/07	
11	u 11 Dry pressing in of tappet body	23.07.2007	KW30/07	06.02.2008	KW05/08	
12	u 12 Uncoated spring plate (customer C)	23.07.2007	KW30/07	31.01.2008	KW04/08	
13	e 13 Introduction of delay time during assembly of roller tappet	28.08.2007	KW35/07	06.02.2008	KW05/08	
14	f 14 Extension of high-load inspection point	01.10.2007	KW40/07	31.01.2008	KW04/08	
15	f 15 Inspection point V7.2 (customer C)	16.11.2007	KW46/07	31.01.2008	KW04/08	
16	v 16 Improved visual inspection of roller support	13.12.2007	KW50/07	31.01.2008	KW04/08	
17	s 17 Friction coefficient test +/- 10°	13.12.2007	KW50/07	07.02.2008	KW05/08	
18	s 18 Tappet location scanning in assembly	21.12.2007	KW51/07	07.02.2008	KW05/08	
19	f 19 New visual inspection catalog for roller support	02.01.2008	KW01/08	20.01.2008	KW02/08	
20	f 20 Inspection program V7.2 (VW), visual inspection catalog for roller support	11.01.2008	KW02/08	31.01.2008	KW04/08	
21	f 21 Inspection program V7.2 (Audi)	01.02.2008	KW05/08	31.01.2008	KW04/08	
22	l 22 Conversion of roller for types ...507/...508	17.03.2008	KW12/08	31.01.2008	KW04/08	
23	f 23 Straight-edge check, visual inspection catalog for roller support	07.04.2008	KW15/08	07.04.2008	KW14/08	
24	f 24 Cleaning cloth for straight-edge check	01.05.2008	KW18/08	01.05.2008	KW17/08	
25	s 25 Visual inspection of roller after C coating	01.05.2008	KW18/08	01.05.2008	KW17/08	
26	s 26 Optimization of C coating (roller support)	01.05.2008	KW18/08	01.05.2008	KW17/08	
27	l 27 Conversion of roller for types ...611/...613 to second supplier	15.05.2008	KW20/08	03.11.2009	KW44/08	
28	n 28 New wash and transport frame for roller	29.10.2008	KW44/08	29.10.2008	KW44/08	
29	n 29 Changed RS pickup tool for pressing in tappet body	24.11.2008	KW48/08	06.05.2009	KW19/09	
30	s 30 Carbon covers/holders in N plant for roller	12.12.2008	KW50/08	12.12.2008	KW50/08	
31	s 31 Carbon covers/holders in O plant for roller	16.03.2009	KW12/09	16.03.2009	KW12/09	
32	e 32 Camera system to detect metal spatters on roller support		KW19/09		Rollenschuh wird aus FeP zugeliefert	
33	o 33 System installed/trial. Series implementation mid-06/2009 soonest	Teilstückzahl	KW25/09	RS wird aus FeP zugeliefert		
34	f 34 Introduction of C2.1 layer instead of C3 layer on roller front (VW/Audi)	23.05.2009	KW22/09	23.05.2009	KW22/09	
35	f 35 Optimized substrate holder to avoid fusing on roller, earliest	Aktivität ei		nicht		
36	e 36 CS washing of roller supports instead of watery washing	Zielfüh	02.12.2009	KW49/09	02.12.2009	KW49/09
37	e 37 Introduction of RP1 anti wear package at FeP and JhP (2-stamper)		09.03.2010	KW10/10	09.03.2010	KW10/10
			26.10.2010	KW43/10	18.11.2010	KW45/10



**German / English**  
 Einführung FeP= Introduction FeP  
 Einführung JhP= Introduction JhP  
 Tagesdatum = Date  
 Legende=Legend  
 Maßnahme eingeführt=Measure introduced  
 Einführung im Plan=Implementation on schedule  
 Einführungstermin überschritten=Implementation deadline passed  
 Umsetzung nicht zielführend, bzw. Effektivität wird geprüft=Implementation not effective or effectiveness being checked

Legende	
<span style="background-color: #90EE90; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	Maßnahme eingeführt
<span style="background-color: #FFFF00; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	Einführung im Plan
<span style="background-color: #FF0000; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	Einführungstermin überschritten
<span style="background-color: #D3D3D3; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	Umsetzung nicht Zielführend, bzw. Effektivität wird geprüft



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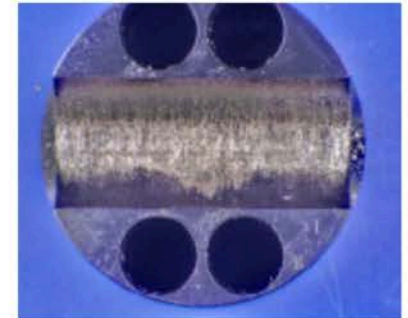
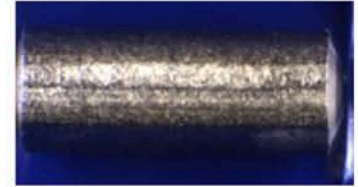


## Damage mechanism on 4 cylinder HFPP

---

### General cause of 4 cylinder HFPP powertrain damage:

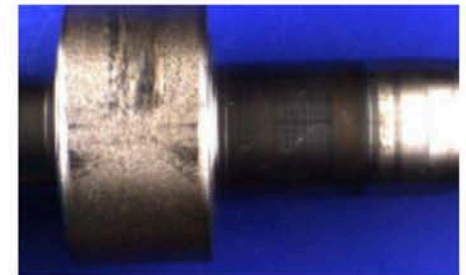
- Inadmissible high mixed friction between the roller and the roller shoe has caused local contact when in operation.
- The C coating of the roller shoe is shattered (wear and the C coating is worn), the friction value increases between the roller and the roller shoe.
- Stiff roller
- Reinforcement factors: Fuel with lower viscosity, raised areas on the roller (melt points) and in the roller shoe (metal splashes), surface of roller/roller shoe



### Following HFPP powertrain damage:

- Swarf formation in the high-pressure fuel pump motor
- Distribution of the swarf throughout the entire fuel system
- Malfunctioning on the HFPP, pressure control valve, RDS, injectors, DHV

⇒ **breakdown**

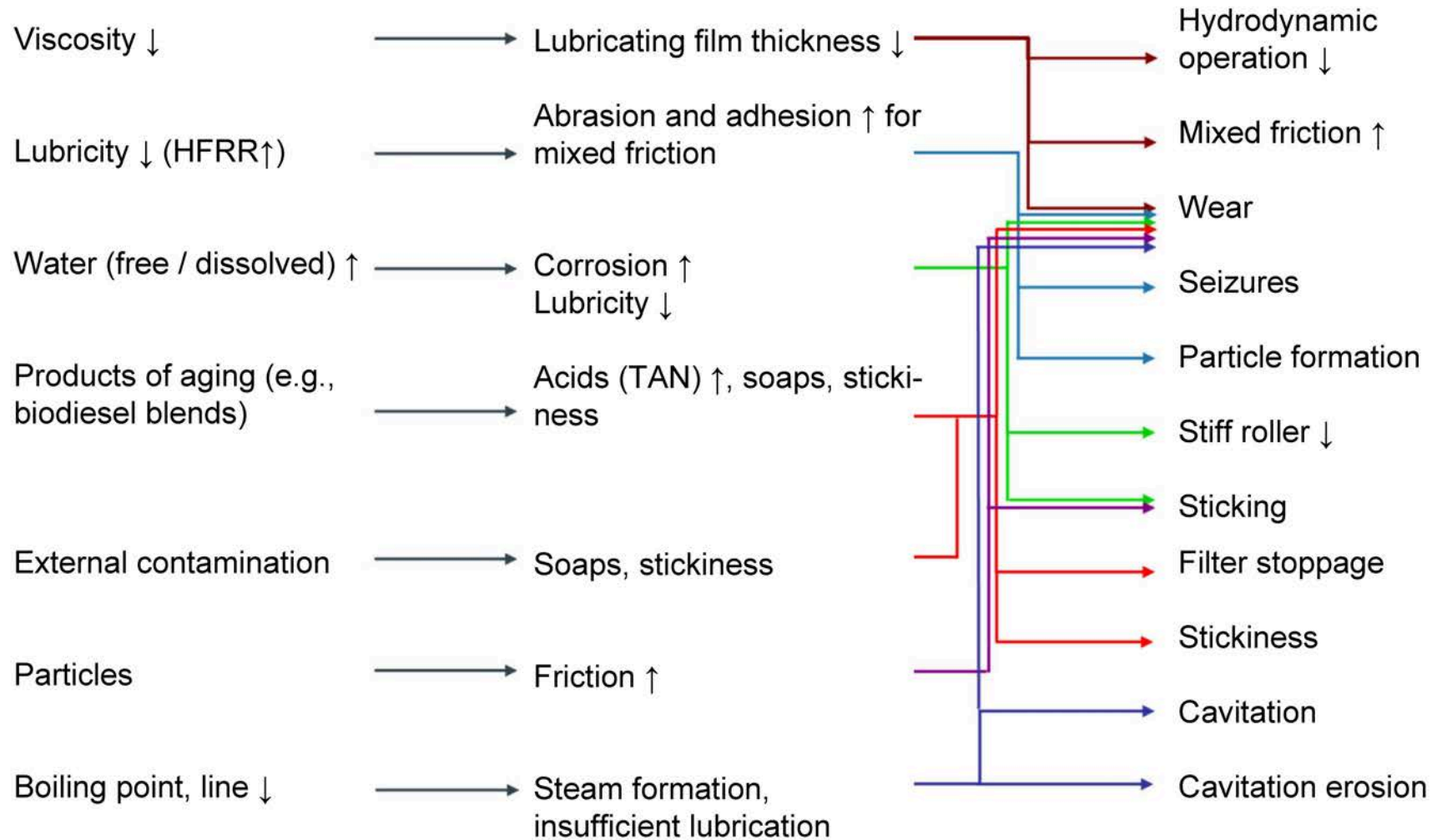


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# Fuel influences on the HFPF



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# Robustness package on 4 cylinder HFPF

## CP4 Performance

Stand: 06.07.2010

### Anti wear package 0

#### Task/impact

-> Reduce wear, avoid piston seizures

#### Measures

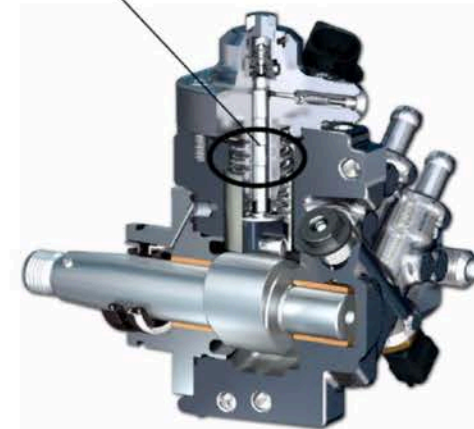
-> C layer on pump piston

#### Result

-> Improved resistance to wear, reduced wear

Affected drive unit/components

Pump piston



Diesel Systems

2

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**BOSCH**

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# Robustness package on 4 cylinder HFPP

## CP4 Performance

Stand: 06.07.2010

### Anti wear package 1

#### Task/impact

- > Increase lubricating film between roller support and roller for low-viscosity fuels, to reduce mixed friction share and thus temperature

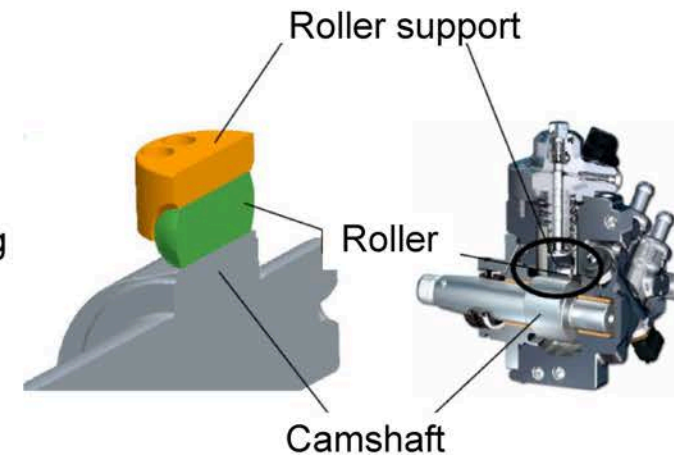
#### Measures

- > CC2 coating to reduce friction on roller support surface and avoid metal spraying
- > Lower gap/tolerance between roller and RS through reduced roller support bore
- > Reduced roughness of roller surface
- > Optimized roller end

#### Result

- > Increase of lubricating film thickness (approx. factor of 2), proven by test results

Affected drive unit/components



Diesel Systems

3

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# Robustness package on 4 cylinder HFPF

## CP4 Performance

Stand: 06.07.2010

### Anti wear package 2

#### Task/impact

-> Reduction of local temperatures in area of right tappet during counter-clockwise rotation CP4-xx/2

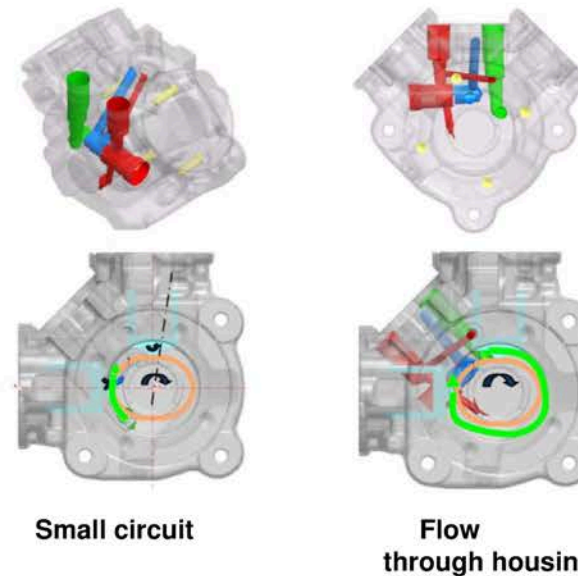
#### Measures

-> Optimized lubricant flow in pump housing by changing lubricant supply and return bore

#### Result

-> Significant drop in temperature (>15°C)

#### Change of supply flow and return bore



4

Diesel Systems

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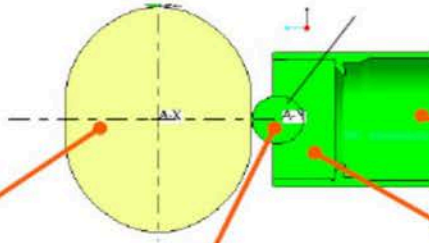
# Materials - Bosch 4 cylinder HFPF

## Information on materials, CP4 powertrain

### Technical data on CP4 powertrain parts

Hertzian pressure:

- Roller cams 2000 N/mm<sup>2</sup>
- Roller shoe 200 N/mm<sup>2</sup>



	Nockenwelle	Laufrolle	Rollenschuh	Stößelkörper
Werkstoff	Wälzlagerstahl 100Cr6	Schnellarbeits-stahl DMo5	Wälzlagerstahl 100Cr6	Wälzlagerstahl 100Cr6
Härte	> 650 HV	> 780HV	> 650HV	> 650 HV
Gefüge	Bainit	Martensit	Bainit	Martensit
Oberflächen	-----	DLC Verschleiß- schutz (>2500HV)	DLC Verschleiß- schutz (>2500HV)	Mangan- Phosphat

**German / English**  
 Nockenwelle=Camshaft  
 Laufrolle=Roller  
 Rollenschuh=Roller support  
 Stößelkörper=Tappet body

Wälzlagerstahl 100Cr6=  
 Bearing steel 100Cr6

Schnellarbeitsstahl DMo5=  
 High-speed steel DMo5

Bainit=Bainite  
 Martensit=Martensite  
 DLC Verschleißschutz  
 (>2500HV)=  
 DLC anti-wear protection  
 (>2500HV)  
 Mangan-Phosphat=  
 Magnesium phosphate

**German / English**  
 Werkstoff=Material  
 Härte=Hardness  
 Gefüge=Structure  
 Oberflächen=Surfaces

1

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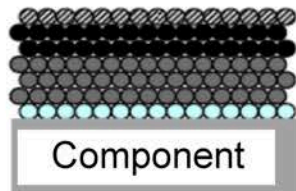
# Materials - Bosch 4 cylinder HFPF

## Information on materials, CP4 powertrain

Comparison of C2.1 and C3 series version with C3.1

### Layer structure

c3 layer

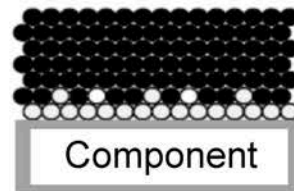


- C1 protective layer with hardness gradient
- C2 layer
- Adhesive layer 1

- Carbon 1 layer (=C1)
- Carbon 2 layer (=C2)

Series @ Audi since SOP 07.2007

c2.1 layer

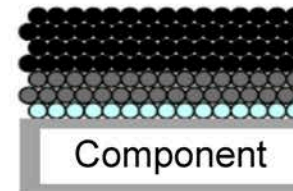


- C1 protective layer with constant hardness
- Transition layer
- Adhesive layer 1

- Adhesive layer 1
- Adhesive layer 2

RP1 @ series since CW15.2010

c3.1 layer



- C1 layer with constant hardness
- C2 layer
- Adhesive layer 2

developing



**BOSCH**



Audi  
Vorsprung durch Technik



Q Circle 19.05.2011  
Status V6TDI Bosch CP4.2  
USA Audi

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## Current situation CP4.2 USAUnit

### Volume:

- ▶ V6 TDI CP4.2: 10,903 vehicles sold in the field  
(6,951 Q7, 2,601 Touareg GP and 1,351 Touareg  
NF)

### Problem:

- ▶ The main focus of the investigation by the NHTSA is the sudden failure of the engine  
- "Stalling" in connection with CP4 powertrain damage.
- ▶ Investigation upgraded to an EA (Engineering Analysis).
- ▶ Initiation of a peer review: Competition is challenged to reveal damage statistics for high-pressure pump

### Analysis:

- ▶ Fuel contaminated with petroleum directly by the gas station or due to accidental fueling (Touareg only) plays a significant role in the failures. The authorities can understand this analysis.
- ▶ The question from the NHTSA is why the only complaints available are from VW and Audi customers. All diesel applications have the same general conditions in relation to customers and gas station infrastructure.

Main reason for peer review and continuation of investigation as EA.

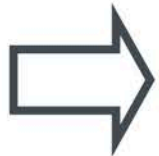
## Current situation CP4.2 USA

- ▶ **Q7 MY '09 '10**                      2bar tank system, accidental fueling prevention system
  - ▶ 3,582 vehicles sold / 21 bills CP4.2    0.58% billing rate
- ▶ **Touareg GP MY '09 '10** 2bar tank system
  - ▶ 2,601 vehicles sold / 17 bills CP4.2   □ 0.65% billing rate



### Significant improvement in USA in MY 11:

- ▶ Introduction of **RP1** from MY 11
  - ▶ Introduction of 6bar tank system (pressure previously built up when engine started)
- ▶ **Q7 MY11**                      **RP1**, 6bar tank system, accidental fueling prevention system
    - ▶ 3,369 vehicles sold in USA, **only 1 bill CP4.2!**
  - ▶ **Touareg NF**                  **RP1**, 6bar tank system
    - ▶ 1,351 vehicles sold in USA, **only 2 bills CP4.2!**



- ▶ Further improvement expected with RP2 (incorporated from WK 45/10)
- ▶ **No powertrain damage known with V6TDI Gen2 worldwide.**
- ▶ Launch of V6TDI Gen2 in USA from WK22/12

## Backup

## Current situation CP4.2 USA

### Competition in USA

#### CP3

- 
- ▶ Daimler V6 Diesel worldwide also newest engine generation, always with CP3
    - ▶ Changeover to CP4.2 open
  - ▶ BMW R6 Diesel in USA still with engine series M57 □ Installation of CP3
    - ▶ Current changeover to new N57 engine series with CP4.2

#### CP4.2

- 
- ▶ GM has been using CP4.2 in USA since the end of 2009 (V8 Diesel)
    - ▶ Gear drive and large pump stroke, transmission 1:1

Ford has been using CP4.2 in USA since 2009 (V8 Diesel)

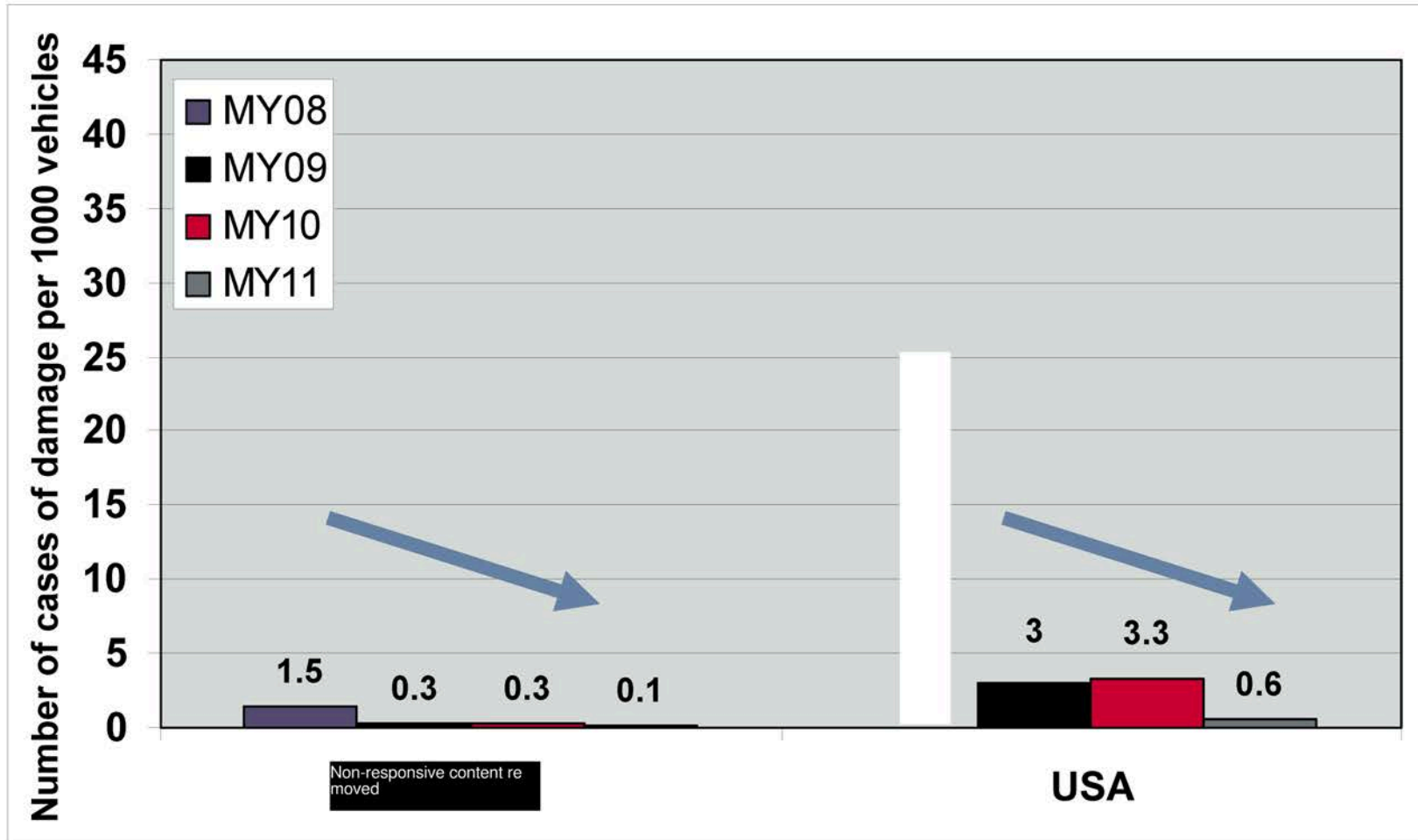
- ▶ Gear drive and large pump stroke, transmission 1:1

#### CP4.1

- 
- ▶ VW/Audi 4-cylinder segment has had no competition in USA for some time
  - ▶ Fiat and Isuzu recently entered US market with CP4.1

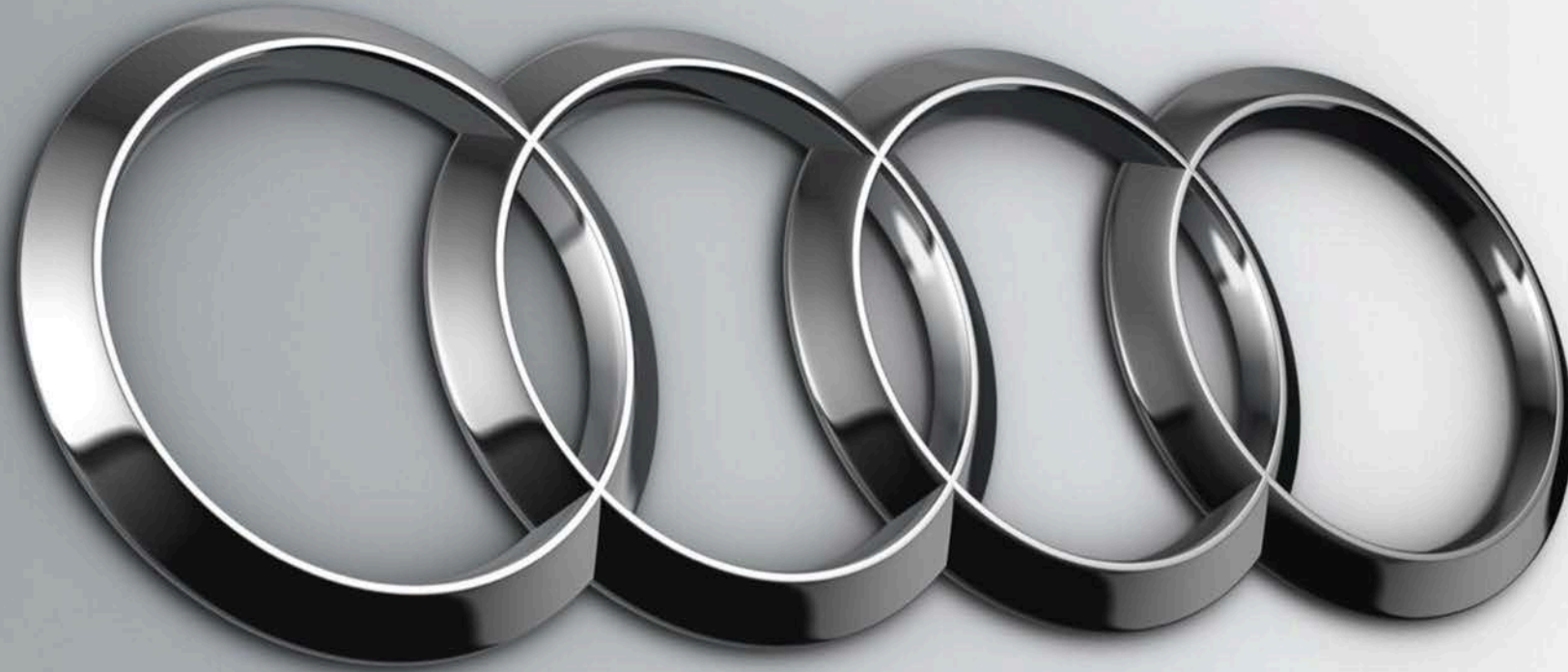
### Current situation CP4.2 USA

MIS 6 values for AUDI V6TDI (model years: '08,'09,'10, '11)



EA11003EN-02166[0]

Audi  
Vorsprung durch Technik



## Status report on on-field failures CP4.2

05.03.2011, Non-responsive content removed

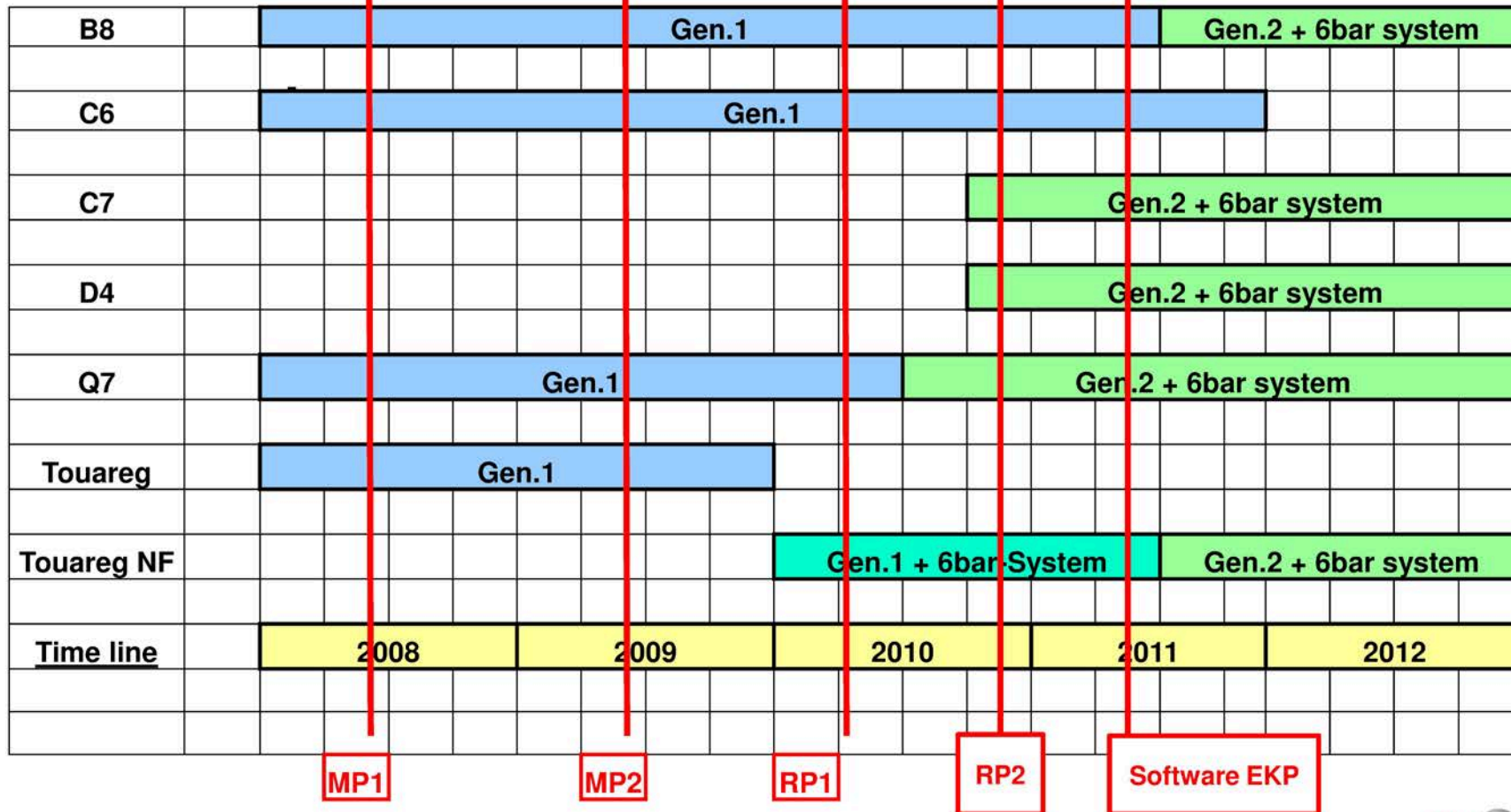


EA11003EN-02166[1]

## Status report on on-field failures CP4.2

### Application scenario for measures and robustness packages in the V6 TDI engine generations

Vehicle type



So far, no drivetrain damage to engine of 2<sup>nd</sup> generation reported by

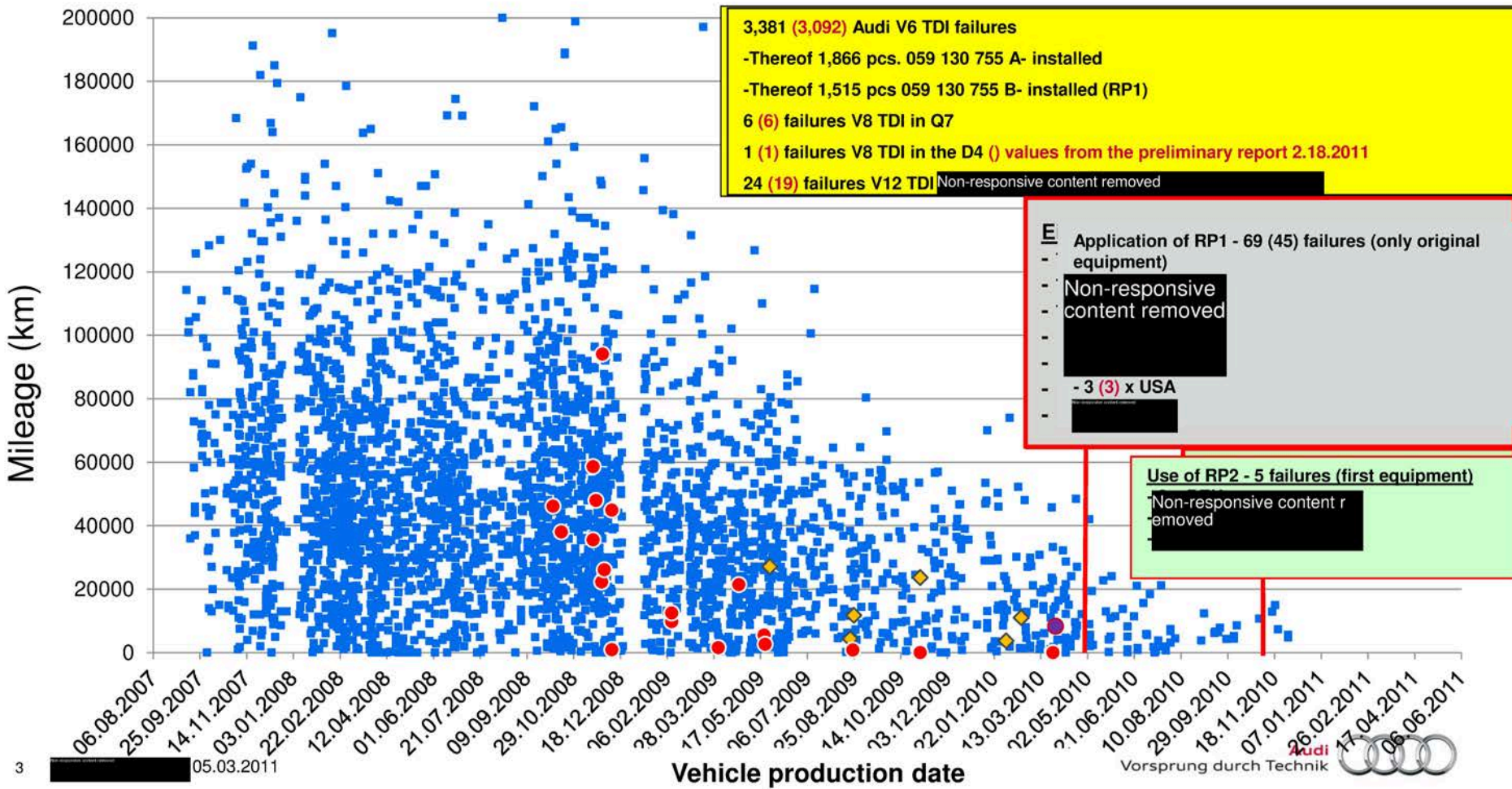
EA11003EN-02166[2]

### Status report on on-field failures CP4.2

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

SAGA as of 05.03.2011

■ 059 130 755 A+B  
 ◆ 057 130 755 T ( V8 in Q7)  
 ▶ 057 130 755 S (V (V8 in D4)  
 ▶ 05A 133 755 (V12)

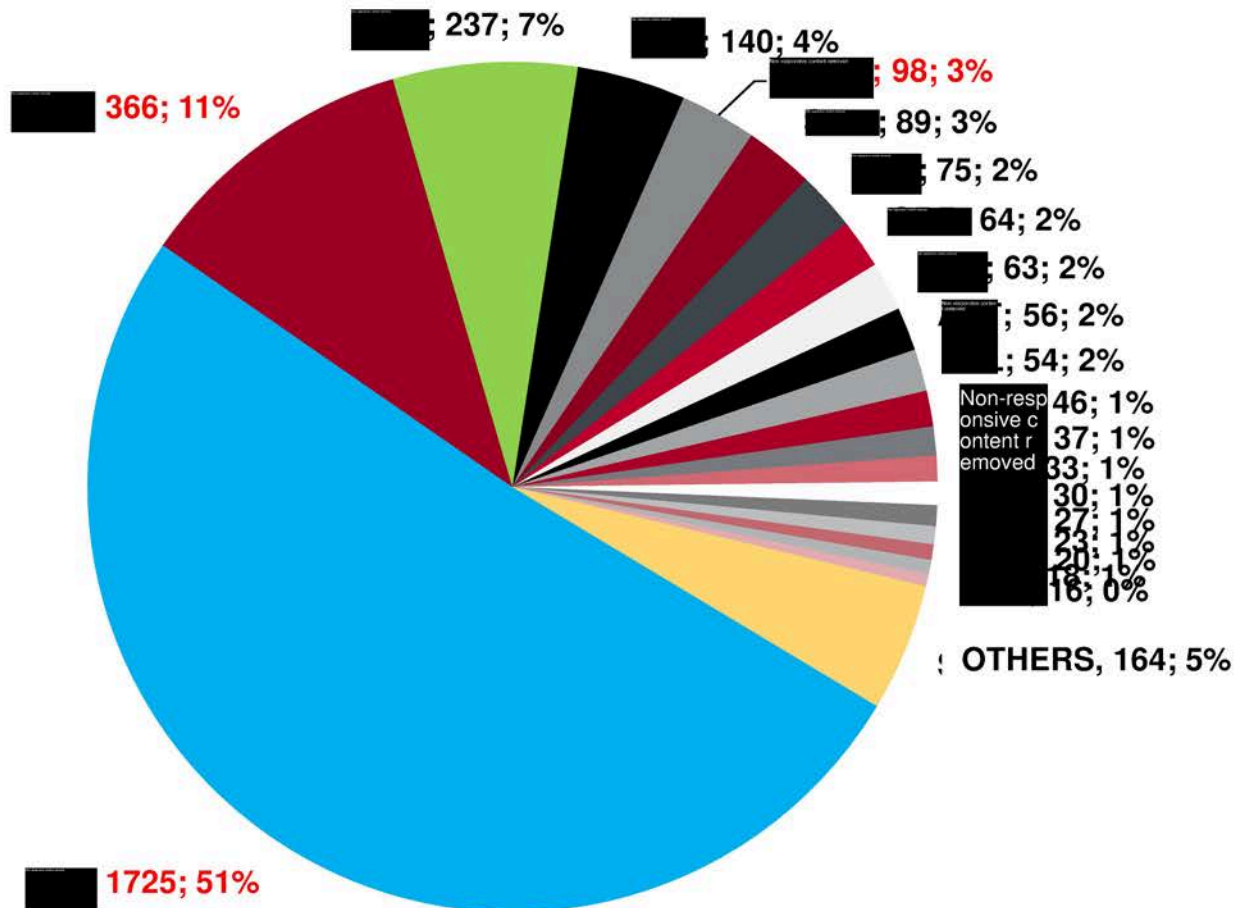


EA11003EN-02166[3]

## Status report on on-field failures CP4.2

### All bills of high-pressure fuel pumps of Audi V6 TDI by country

SAGA as of 05.03.2011



EA11003EN-02166[4]

# Status report on on-field failures CP4.2

AQUA: Aktive Qualitäts-Analyse

Stand 03/11-03.05.11 18:06  
Quelle/User SAGA-Gew /

Audi, Markt:

MJ 2008 - 2011, Offset: alle (Max: 3)

KDNR / Gruppen: Hochdruckpumpe

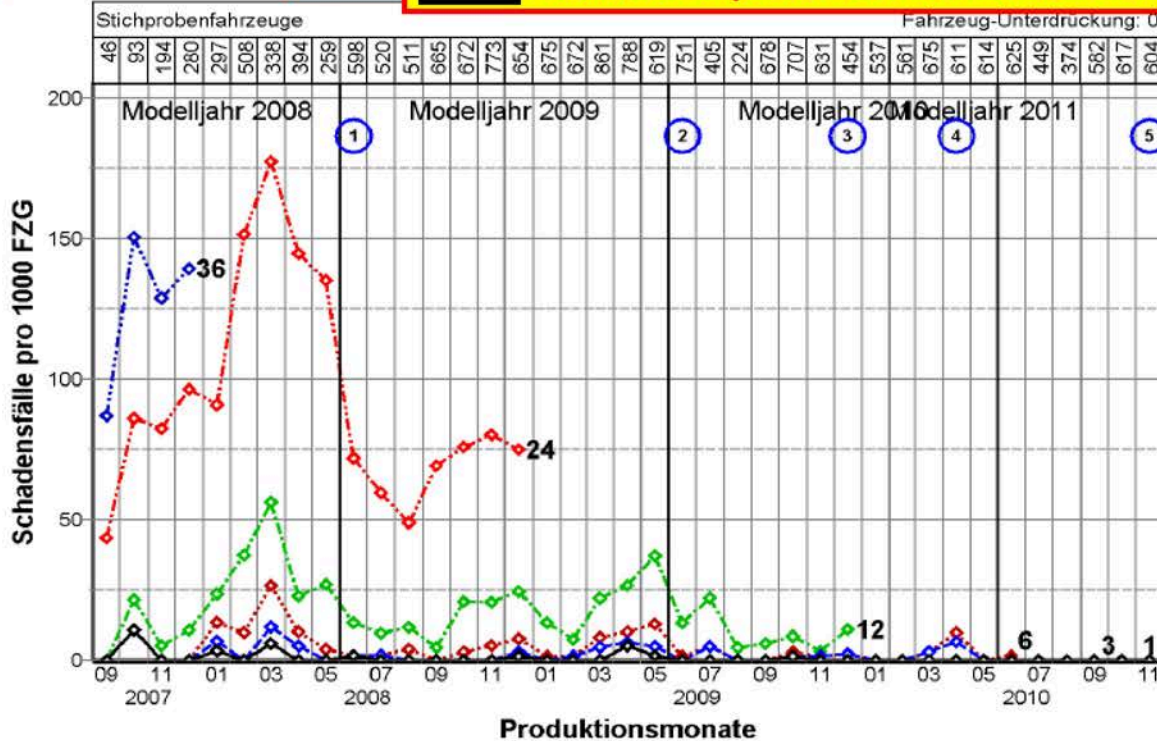
Vertraulich

ohne PR-Nummern  
KDNR 2374

CAMA|CAMB|CAMD|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CATA|CATB|CCLA|CCMA|CCWA|CCWB|CDTA|CDTB|CDUA|CD

MJ	MIS1	MIS3	MIS6	MIS12	MIS24	MIS36	MJ	Tausch	LB	SA 10	SA 18	SA 17	SA 50
2008	1,7	3,9	10,3	27,8	130,2	185,9	2008	97,9 %	84,5 %	81,3 %	2,8 %	11,1 %	4,4 %
2009	0,9	1,9	4,8	18,0	69,3		2009	91,6 %	83,8 %	87,4 %	1,6 %	8,9 %	1,4 %
2010	0,1	1,8	2,5	11,0			2010	81,8 %	83,3 %	91,7 %	1,5 %	3,8 %	2,3 %
2011	0,0	0,0	1,9				2011	100,0 %	66,7 %	66,7 %	33,3 %		
Diff%	-100,00	-100,00	-24,63										

Continual improvement from MY08 → to MY11



- 1. Neuer Lieferant Laufrolle  
Optimierung C-Schicht-Prozess Rollenschuh
- 2. Entfall Strahlen Nockenwelle  
C2- statt C3-Schicht laufrollenkuppe  
Kamera-Prüfung Rollenschuh  
Weitere Optimierung C-Schicht-Prozess Rollenschuh  
Mehrbetankung für
- 3. KW-Waschen Rollenschuh vor C-Beschichten
- 4. Robustheitspaket 1  
C2- statt C3-Schicht Rollenschuh  
Einengung Spiel Laufrolle / Rollenschuh  
Optimierung Laufrollenform  
==> Erhöhung Schmierfilmdicke
- 5. Robustheitspaket 2  
Zu- und Rücklaufanschlüsse vertauscht  
Robuster Flansch  
==> Reduzierung Temperatur im rechten Rollenschuh

Fahrzeuge: 3.389+12.041+11.312+9.399=36.141; Verkauft: 3.388+12.037+11.281+7.446=34.152; Stp.: 2.335+7.730+7.181+5.015=22.261; MJ: 2008+2009+2010+2011=Gesamt

CP42 AU V6 alle Gen1



EA11003EN-02166[5]

de	en
AQUA: Aktive Qualitäts-Analyse	AQUA: Active quality analysis
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Vertraulich	Confidential
Stand	Status
MJ 2008 -2011, Offset: alle (Max: 3)	MY 2008 -2011, Offset: all (Max: 3)
ohne PR-Nummern	without PR numbers
Quelle/ User SAGA-Gew / NILP, RC	Source / User SAGA Gew / NILP, RC
KDNR / Gruppen: Hochdruckpumpe	CNR / groups: High-pressure pump
KDNR	CNR
Tausch	Exchange
Diff%	% difference
MECFEH LEICHT SCHWER UNDICH	MECFEH LIGHT-WEIGHT LEAKING
Stichprobenfahrzeuge	Sample vehicles
Fahrzeug-Unterdrückung	Vehicle elimination
Modelljahr 2008	Model year 2008
Modelljahr 2009	Model year 2009
Modelljahr 2010	Model year 2010
Modelljahr 2011	Model year 2011
Schadensfälle pro 1000 FZG	Cases of damage per 1000 vehicles
Produktionsmonate	Production months
1 Haarlinealprüfung Laufrolle	1 hairline testing of roller

EA11003EN-02166[6]

1 Haarlinealprüfung Laufrolle	1 hairline testing of roller
neuer Lieferant Laufrolle	New supplier of roller
Optimierung C-Schicht-Prozess Rollenschuh	Optimization of C coating process for roller shoes
2 Entfall Strahlen Nockenwelle	2 Omission of jets on camshaft
C2- statt C3-Schicht Laufrollenkuppe	C2 instead of C3 coating on roller tip
Kamera-Prüfung Rollenschuh	Camera inspection of roller supports
Weitere Optimierung C-Schicht-Prozess Rollenschuh	Further optimization of C coating process for roller supports
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3 KW-Waschen Rollenschuh vor C-Beschichten	3 CW washing of roller supports before C-coating
4 Robustheitspaket 1	4 Robustness Package 1
C2- statt C3-Schicht Rollenschuh	C2 instead of C3 coating on roller support
Einengung Spiel Laufrolle / Rollenschuh	Narrowing of roller clearance / roller supports
Optimierung Laufrollenform	Optimization of roller shape
=> Erhöhung Schmierfilmdicke	=> Increasing lubricant film thickness
5 Robustheitspaket 2	5 Robustness Package 2
Zu- und Rücklaufanschlüsse vertauscht	Inflow and return ports swapped
Robuster Flansch	Robust flange
=> Reduzierung Temperatur im rechten Rollenschuh	=> Reduction in the temperature of the right roller support
Fahrzeuge:	Vehicles:
Verkauft:	Sold:
Stp:	Stp:
M#J:2008+2009+2010+2011=Gesamt	M#Y: 2008 +2009 +2010 +2011 = Total
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EA11003EN-02166[7]

# Status report on on-field failures CP4.2

AQUA: Aktive Qualitäts-Analyse

Stand 03/11-03.05.11 18:05

Quelle/User SAGA-Gew /

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MJ 2008 - 2011, Offset: alle (Max: 4)

KDNR / Gruppen: Hochdruckpumpe

Vertraulich

ohne PR-Nummern

KDNR

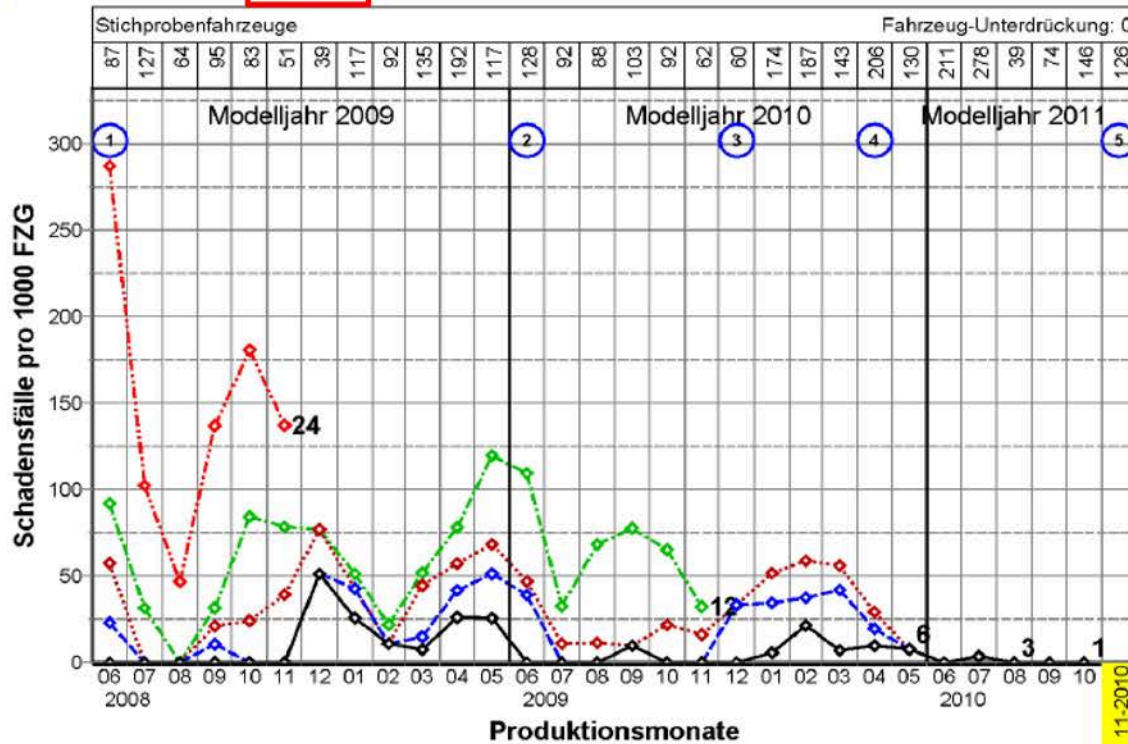
2374

CAMA|CAMB|CAMD|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CATA|CATB|CCLA|CCMA|CCWA|CCWB|CDTA|CDTB|CDUA|CD

MJ	MIS1	MIS3	MIS6	MIS12	MIS24	MJ	Tausch	LB	SA 10	SA 17	SA 18	SA 50
2009	11,9	22,0	37,3									
2010	7,4	22,2	33,6									
2011	1,1	1,1	3,1			2011	100,0 %	0,0 %	100 %			
Diff%	-84,46	-94,82	-90,91									

No improvement from MY09 → to MY10 / major improvement from MY10 → to MY11

MECFEH SCHWER LEICHT UNDICHT



- 1 **Haarlinealprüfung Laufrolle**  
Neuer Lieferant Laufrolle  
Optimierung C-Schicht-Prozess Rollenschuh
- 2 **Entfall Strahlen Nockenwelle**  
C2- statt C3-Schicht laufrollenkuppe  
Kamera-Prüfung Rollenschuh  
Weitere Optimierung C-Schicht-Prozess Rollenschuh  
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- 3 **KW-Waschen Rollenschuh vor C-Beschichten**
- 4 **Robustheitspaket 1**  
C2- statt C3-Schicht Rollenschuh  
Einengung Spiel Laufrolle / Rollenschuh  
Optimierung Laufrollenform  
==> Erhöhung Schmierfilmdicke
- 5 **Robustheitspaket 2**  
Zu- und Rücklaufanschlüsse vertauscht  
Robuster Flansch  
==> Reduzierung Temperatur im rechten Rollenschuh

Fahrzeuge: 1+2.074+2.027+1.977=6.079; Verkauf: 1+2.073+2.016+1.269=5.359; Stp.: 0+1.181+1.487+1.154=3.822; MJ: 2008+2009+2010+2011=Gesamt

CP42 AU V6 alle Gen1+2 Non-responsive content removed

EA11003EN-02166[8]

de	en
AQUA: Aktive Qualitäts-Analyse	AQUA: Active quality analysis
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Vertraulich	Confidential
Stand	Status
MJ 2008 -2011, Offset: alle (Max: 4)	MY 2008 -2011, Offset: all (Max: 4)
ohne PR-Nummern	without PR numbers
Quelle/ User SAGA-Gew / NILP, RC	Source / User SAGA Gew / NILP, RC
KDNR / Gruppen: Hochdruckpumpe	CNR / groups: High-pressure pump
KDNR	CNR
Tausch	Exchange
Diff%	% difference
MECFEH LEICHT SCHWER UNDICH	MECFEH LIGHT-WEIGHT LEAKING
Stichprobenfahrzeuge	Sample vehicles
Fahrzeug-Unterdrückung	Vehicle elimination
Modelljahr 2008	Model year 2008
Modelljahr 2009	Model year 2009
Modelljahr 2010	Model year 2010
Modelljahr 2011	Model year 2011
Schadensfälle pro 1000 FZG	Cases of damage per 1000 vehicles
Produktionsmonate	Production months



EA11003

EN-02166[9] Produktionsmonate	Production months
1 Haarlinealprüfung Laufrolle	1 hairline testing of roller
neuer Lieferant Laufrolle	New supplier of roller
Optimierung C-Schicht-Prozess Rollenschuh	Optimization of C coating process for roller shoes
2 Entfall Strahlen Nockenwelle	2 Omission of jets on camshaft
C2- statt C3-Schicht Laufrollenkuppe	C2 instead of C3 coating on roller tip
Kamera-Prüfung Rollenschuh	Camera inspection of roller supports
Weitere Optimierung C-Schicht-Prozess Rollenschuh	Further optimization of C coating process for roller supports
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3 KW-Waschen Rollenschuh vor C-Beschichten	3 CW washing of roller supports before C-coating
4 Robustheitspaket 1	4 Robustness Package 1
C2- statt C3-Schicht Rollenschuh	C2 instead of C3 coating on roller support
Einengung Spiel Laufrolle / Rollenschuh	Narrowing of roller clearance / roller supports
Optimierung Laufrollenform	Optimization of roller shape
=> Erhöhung Schmierfilmdicke	=> Increasing lubricant film thickness
5 Robustheitspaket 2	5 Robustness Package 2
Zu- und Rücklaufanschlüsse vertauscht	Inflow and return ports swapped
Robuster Flansch	Robust flange
=> Reduzierung Temperatur im rechten Rollenschuh	=> Reduction in the temperature of the right roller support
Fahrzeuge:	Vehicles:
Verkauft:	Sold:
Stp:	Stp:
M#J:2008+2009+2010+2011=Gesamt	M#Y: 2008 +2009 +2010 +2011 = Total
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EA11003EN-02166[10]

# Status report on on-field failures CP4.2

AQUA: Aktive Qualitäts-Analyse

Stand 04/11-03.05.11 18:07

Quelle/User SAGA-Gew /

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MJ 2008 - 2011, Offset: alle (Max: 2)

KDNR / Gruppen: Hochdruckpumpe

Vertraulich

ohne PR-Nummern

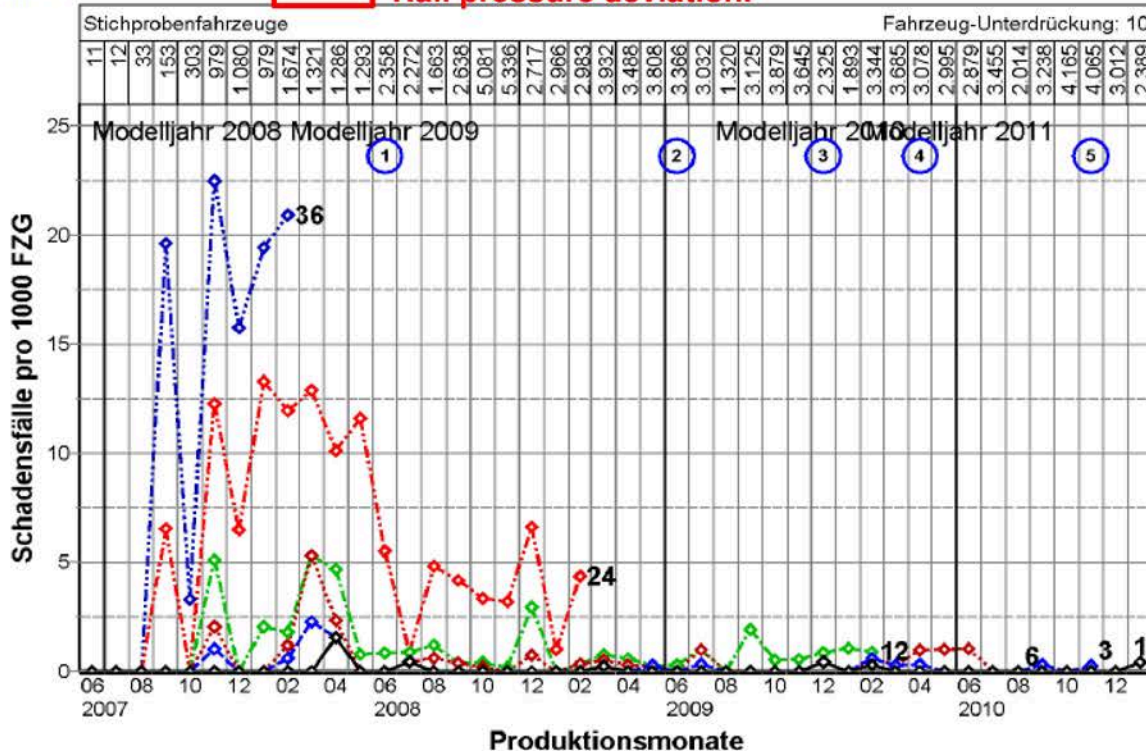
KDNR

2374

CAMA|CAMB|CAMD|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CATA|CATB|CLA|CCMA|CCWA|CCWB|CDTA|CDTB|CDUA|CD

MJ	MIS1	MIS3	MIS6	MIS12	MIS24	MIS36	MJ	Tausch	LB	SA 10	SA 50	SA 17	SA 20
2008	0,2	0,8	1,6	2,7	10,7	18,3	2008	96,9 %	50,3 %	84,7 %	8,0 %	3,7 %	1,8 %
2009	0,1	0,1	0,3	0,7	3,7		2009	91,8 %	51,1 %	88,5 %	3,8 %	4,9 %	2,7 %
2010	0,1	0,2	0,3										
2011	0,0	0,2	0,5										
Diff%	-25,79	15,08	47,49										

**D: Improvement from MY08 → to MY09 / then stagnation due to ambient noises, rest k.F.f. / Rail pressure deviation.**



- 1 **Haarlinealprüfung Laufrolle**  
Neuer Lieferant Laufrolle  
Optimierung C-Schicht-Prozess Rollenschuh
- 2 **Entfall Strahlen Nockenwelle**  
C2- statt C3-Schicht laufrollenkuppe  
Kamera-Prüfung Rollenschuh  
Weitere Optimierung C-Schicht-Prozess Rollenschuh  
Mehrbetankung für Non-responsive content removed
- 3 **KW-Waschen Rollenschuh vor C-Beschichten**
- 4 **Robustheitspaket 1**  
C2- statt C3-Schicht Rollenschuh  
Einengung Spiel Laufrolle / Rollenschuh  
Optimierung Laufrollenform  
==> Erhöhung Schmierfilmdicke
- 5 **Robustheitspaket 2**  
Zu- und Rücklaufschlüsse vertauscht  
Robuster Flansch  
==> Reduzierung Temperatur im rechten Rollenschuh

Fahrzeuge: 10.186+43.184+44.032+44.902=142.304; Verkauft: 10.184+43.153+43.978+38.281=135.596; Stp.: 8.686+37.622+37.482+33.729=117.519; MJ: 2008+2009+2010+2011=Gesamt P42 AU V6 alle Gen1+

EA11003EN 02166[11]

de	en
AQUA: Aktive Qualitäts-Analyse	AQUA: Active quality analysis
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Vertraulich	Confidential
Stand	Status
MJ 2008 -2011, Offset: alle (Max: 2)	MY 2008 -2011, Offset: all (Max: 2)
ohne PR-Nummern	without PR numbers
Quelle/ User SAGA-Gew / NILP, RC	Source / User SAGA Gew / NILP, RC
KDNR / Gruppen: Hochdruckpumpe	CNR / groups: High-pressure pump
KDNR	CNR
Tausch	Exchange
Diff%	% difference
MECFEH LEICHT SCHWER UNDICH	MECFEH LIGHT-WEIGHT LEAKING
Stichprobenfahrzeuge	Sample vehicles
Fahrzeug-Unterdrückung	Vehicle elimination
Modelljahr 2008	Model year 2008
Modelljahr 2009	Model year 2009
Modelljahr 2010	Model year 2010
Modelljahr 2011	Model year 2011
Schadensfälle pro 1000 FZG	Cases of damage per 1000 vehicles
Produktionsmonate	Production months

EA11003EN-02166[12]

1 Haarlinealprüfung Laufrolle	1 hairline testing of roller
neuer Lieferant Laufrolle	New supplier of roller
Optimierung C-Schicht-Prozess Rollenschuh	Optimization of C coating process for roller shoes
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Kamera-Prüfung Rollenschuh	Camera inspection of roller supports
Weitere Optimierung C-Schicht-Prozess Rollenschuh	Further optimization of C coating process for roller supports
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3 KW-Waschen Rollenschuh vor C-Beschichten	3 CW washing of roller supports before C-coating
4 Robustheitspaket 1	4 Robustness Package 1
C2- statt C3-Schicht Rollenschuh	C2 instead of C3 coating on roller support
Einengung Spiel Laufrolle / Rollenschuh	Narrowing of roller clearance / roller supports
Optimierung Laufrollenform	Optimization of roller shape
=> Erhöhung Schmierfilmdicke	=> Increasing lubricant film thickness
5 Robustheitspaket 2	5 Robustness Package 2
Zu- und Rücklaufanschlüsse vertauscht	Inflow and return ports swapped
Robuster Flansch	Robust flange
=> Reduzierung Temperatur im rechten Rollenschuh	=> Reduction in the temperature of the right roller support
Fahrzeuge:	Vehicles:
Verkauft:	Sold:
Stp:	Stp:
M#J:2008+2009+2010+2011=Gesamt	M#Y: 2008 +2009 +2010 +2011 = Total
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EA11003EN-02166[13]

# Status report on on-field failures CP4.2

**AQUA: Aktive Qualitäts-Analyse**  
 Stand 03/11-03.05.11 18:08  
 Quelle/User SAGA-Gew /

Audi, Markt: AUDI

**Vertraulich**  
 ohne PR-Nummern  
 KDNR 2374

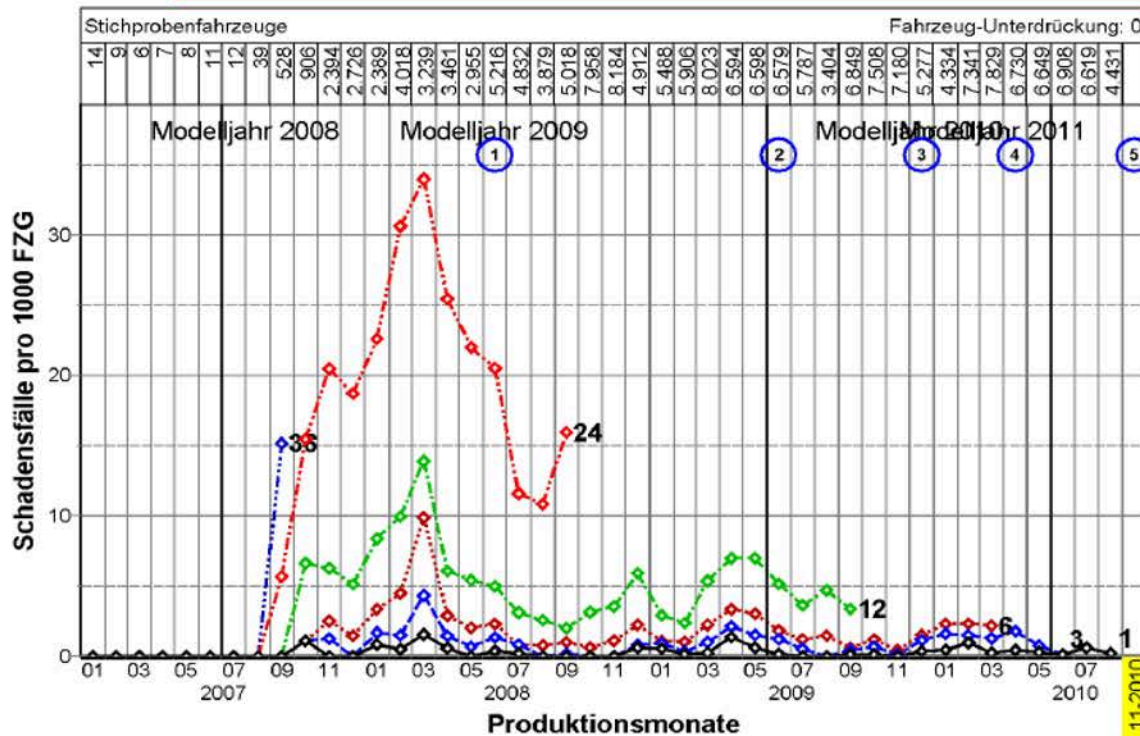
MJ 2008 - 2011, Offset: alle (Max: 6)

KDNR / Gruppen: Hochdruckpumpe

CAMA|CAMB|CAMD|CANA|CANB|CANC|CAND|CASA|CASB|CASC|CASD|CATA|CATB|CCLA|CCMA|CCWA|CCWB|CDTA|CDTB|CDUA|CD

MJ	MIS1	MIS3	MIS6	MIS12	MIS24	MIS36	MJ	Tausch	LB	SA 10	SA 50	SA 18	SA 17
2008	0,5	1,6	3,9	8,0	24,9	37,9	2008	97,4 %	63,6 %	82,8 %	4,7 %	2,3 %	8,8 %
2009	0,3	0,7	1,6	4,2	15,9		2009	92,2 %	58,9 %	83,3 %	2,4 %	2,4 %	10,3 %
2010	0,3	1,0	1,6	4,1			2010	85,7 %	48,7 %	85,0 %	3,3 %	1,1 %	7,9 %
2011	0,2	0,2											
Diff%	-47,36	-83,61											

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- Haarlinealprüfung Laufrolle**  
 Neuer Lieferant Laufrolle  
 Optimierung C-Schicht-Prozess Rollenschuh
- Entfall Strahlen Nockenwelle**  
 C2- statt C3-Schicht laufrollenkuppe  
 Kamera-Prüfung Rollenschuh  
 Weitere Optimierung C-Schicht-Prozess Rollenschuh  
 Mehrbetankung für
- KW-Waschen Rollenschuh vor C-Beschichten**
- Robustheitspaket 1**  
 C2- statt C3-Schicht Rollenschuh  
 Einengung Spiel Laufrolle / Rollenschuh  
 Optimierung Laufrollenform  
 ==> Erhöhung Schmierfilmdicke
- Robustheitspaket 2**  
 Zu- und Rücklaufanschlüsse vertauscht  
 Robuster Flansch  
 ==> Reduzierung Temperatur im rechten Rollenschuh

Fahrzeuge: 30.700+98.019+102.882+102.681=334.282; Verkauft: 30.654+97.876+102.435+81.466=312.431; Stp.: 21.891+71.099+78.100+65.188=236.278; MJ: 2008+2009+2010+2011

EA11003EN-02166[14] en	de
AQUA: Aktive Qualitäts-Analyse	AQUA: Aktive Qualitäts-Analyse
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Vertraulich	Vertraulich
Stand	Stand
MJ 2008 -2011, Offset: alle (Max: 6)	MJ 2008 -2011, Offset: alle (Max: 6)
ohne PR-Nummern	ohne PR-Nummern
Quelle/ User SAGA-Gew / NILP, RC	Quelle/ User SAGA-Gew / NILP, RC
KDNR / Gruppen: Hochdruckpumpe	KDNR / Gruppen: Hochdruckpumpe
KDNR	KDNR
Tausch	Tausch
Diff%	Diff%
MECFEH LEICHT SCHWER UNDICH	MECFEH LEICHT SCHWER UNDICH
Stichprobenfahrzeuge	Stichprobenfahrzeuge
Fahrzeug-Unterdrückung	Fahrzeug-Unterdrückung
Modelljahr 2008	Modelljahr 2008
Modelljahr 2009	Modelljahr 2009
Modelljahr 2010	Modelljahr 2010
Modelljahr 2011	Modelljahr 2011
Schadensfälle pro 1000 FZG	Schadensfälle pro 1000 FZG
Produktionsmonate	Produktionsmonate
1 Haarlinealprüfung Laufrolle	1 Haarlinealprüfung Laufrolle

EA11003EN 02166[15]

1 Haarlinealprüfung Laufrolle	1 Haarlinealprüfung Laufrolle
neuer Lieferant Laufrolle	neuer Lieferant Laufrolle
Optimierung C-Schicht-Prozess Rollenschuh	Optimierung C-Schicht-Prozess Rollenschuh
2 Entfall Strahlen Nockenwelle	2 Entfall Strahlen Nockenwelle
C2- statt C3-Schicht Laufrollenkuppe	C2- statt C3-Schicht Laufrollenkuppe
Kamera-Prüfung Rollenschuh	Kamera-Prüfung Rollenschuh
Weitere Optimierung C-Schicht-Prozess Rollenschuh	Weitere Optimierung C-Schicht-Prozess Rollenschuh
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3 KW-Waschen Rollenschuh vor C-Beschichten	3 KW-Waschen Rollenschuh vor C-Beschichten
4 Robustheitspaket 1	4 Robustheitspaket 1
C2- statt C3-Schicht Rollenschuh	C2- statt C3-Schicht Rollenschuh
Einengung Spiel Laufrolle / Rollenschuh	Einengung Spiel Laufrolle / Rollenschuh
Optimierung Laufrollenform	Optimierung Laufrollenform
=> Erhöhung Schmierfilmdicke	=> Erhöhung Schmierfilmdicke
5 Robustheitspaket 2	5 Robustheitspaket 2
Zu- und Rücklaufanschlüsse vertauscht	Zu- und Rücklaufanschlüsse vertauscht
Robuster Flansch	Robuster Flansch
=> Reduzierung Temperatur im rechten Rollenschuh	=> Reduzierung Temperatur im rechten Rollenschuh
Fahrzeuge:	Fahrzeuge:
Verkauft:	Verkauft:
Stp:	Stp:
M#J:2008+2009+2010+2011=Gesamt	M#J:2008+2009+2010+2011=Gesamt

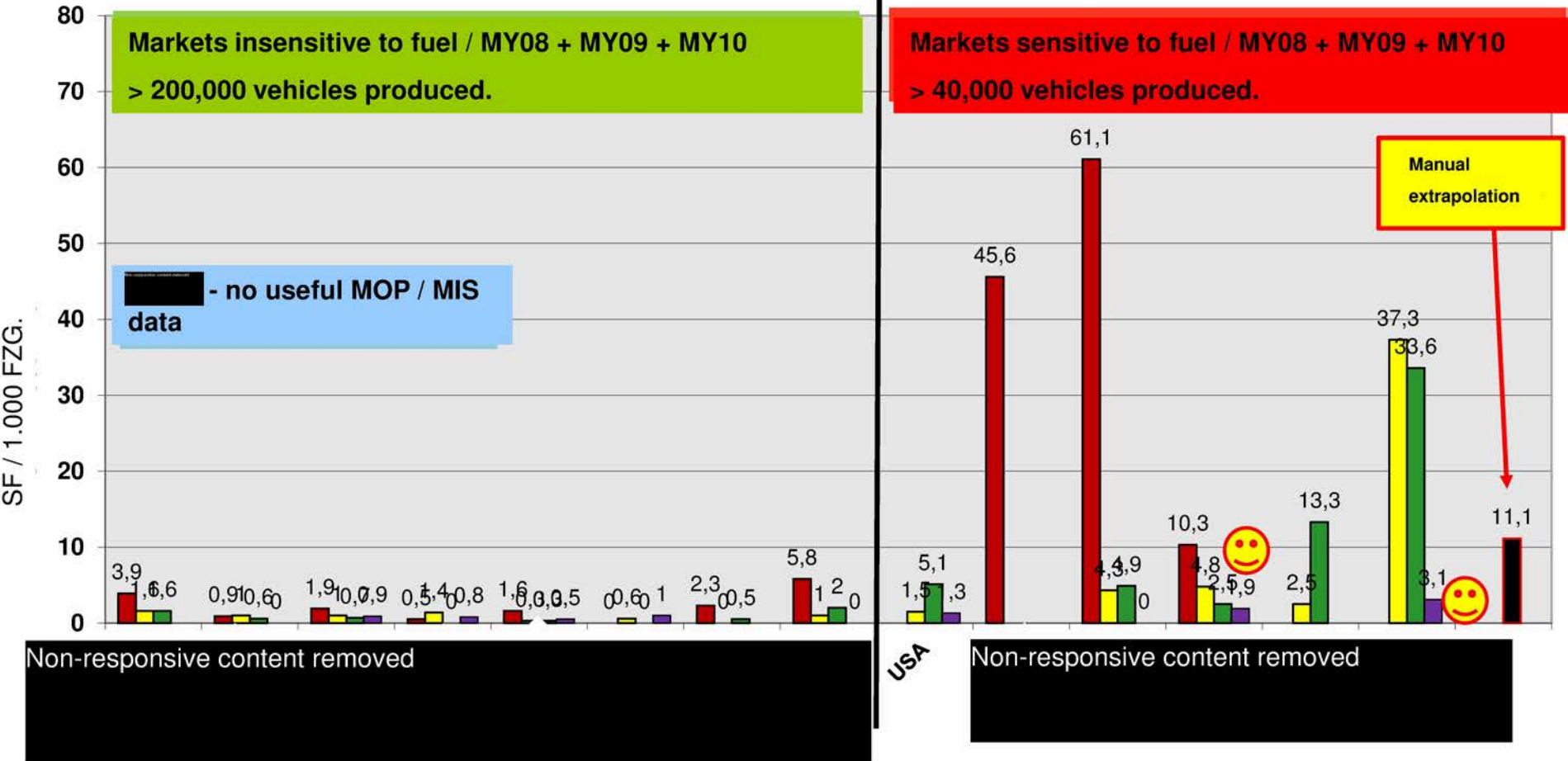
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EA11003EN-02166[16]

Status report on on-field failures CP4.2

MIS 6 - all Audi V6 TDI (CP4.2)

MJ08 MJ09 MJ10 MJ11



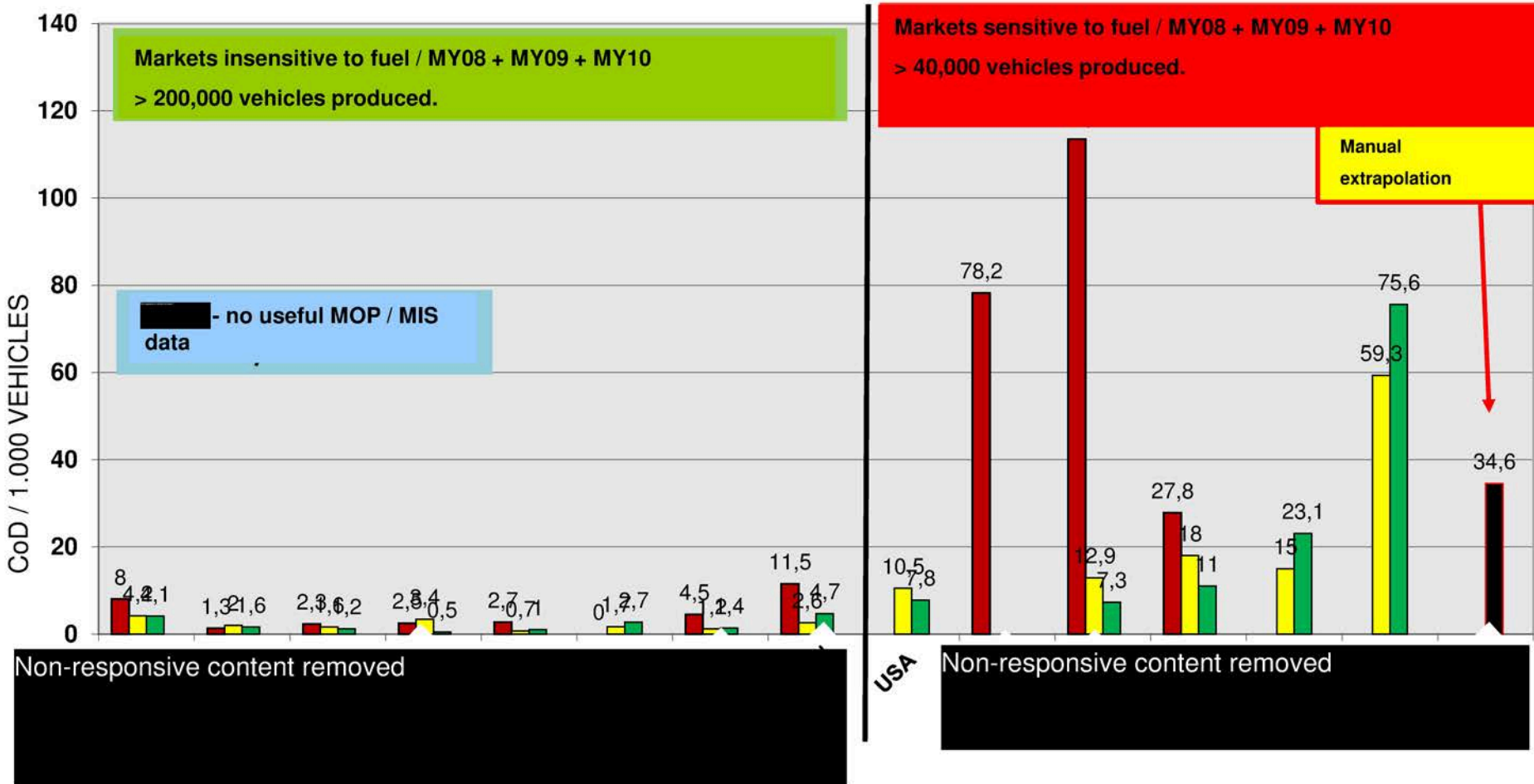


EA11003EN-02166[17]

## Status report on on-field failures CP4.2

### MIS 6 – all Audi V6-TDI (CP4.2)

■ MJ08   
 ■ MJ09   
 ■ MJ10   
 ■ MJ11



EA11003EN-02166[18]

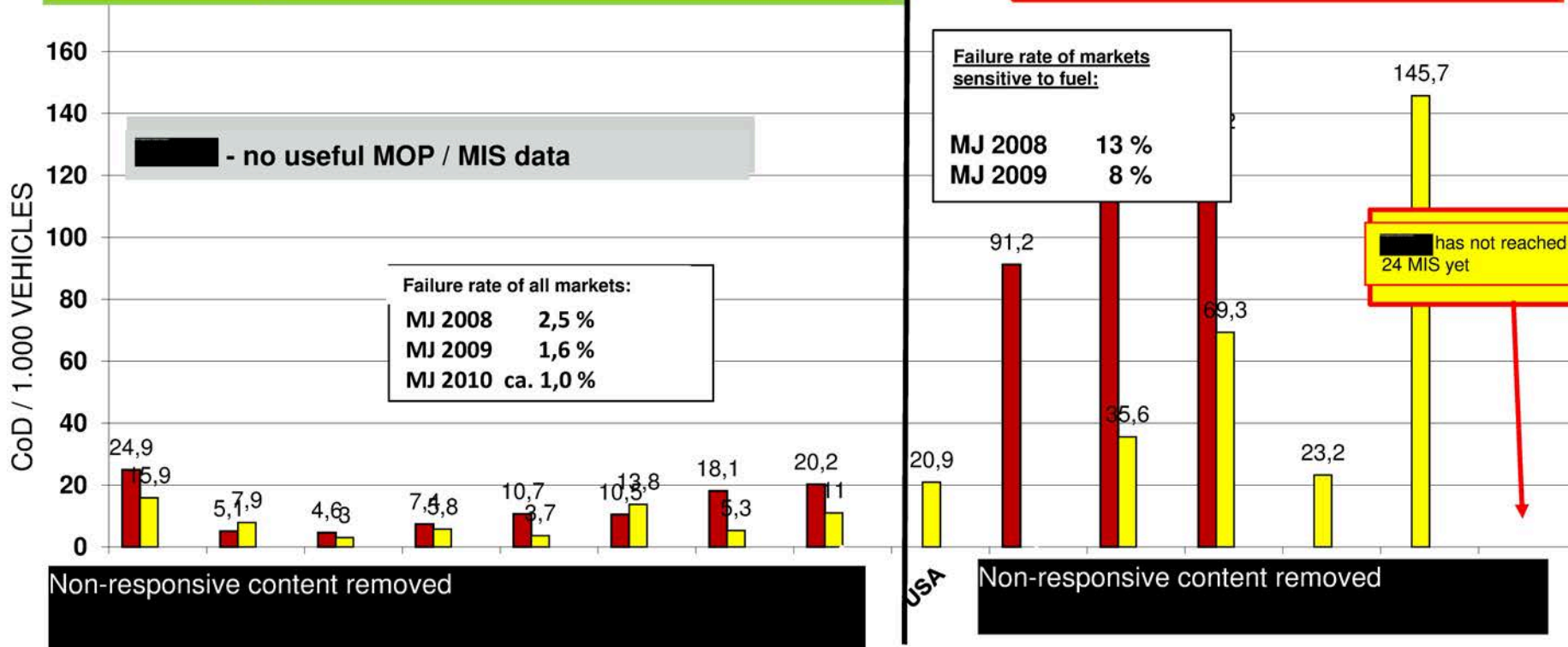
## Status report on on-field failures CP4.2

### MIS 24 - all Audi V6 TDI (CP4.2)

■ MJ08 ■ MJ09 ■ MJ10 ■ MJ11

Markets insensitive to fuel / MY08 + MY09 + MY10  
> 200,000 vehicles produced.

Markets sensitive to fuel / MY08 + MY09 + MY10  
> 40,000 vehicles produced.



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EA11003EN-02166[19]

## Status report on on-field failures CP4.2

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(based on approximately 4,500 sold vehicles)

