



## Warm-up report 2.0l R4 CR 105 kW in B8 Lim.

- Overview of field complaints, ZP7
- Status of current focuses

Page 2- 3

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Changes to previous report appear in blue

3/26/2008  
INFORMATION Redacted PURSUANT TO THE FREEDOM OF  
INFORMATION ACT (FOIA), 5 U.S.C. 552(B)(6)

# Warm-up report 2.0l R4CR 105kW in B8



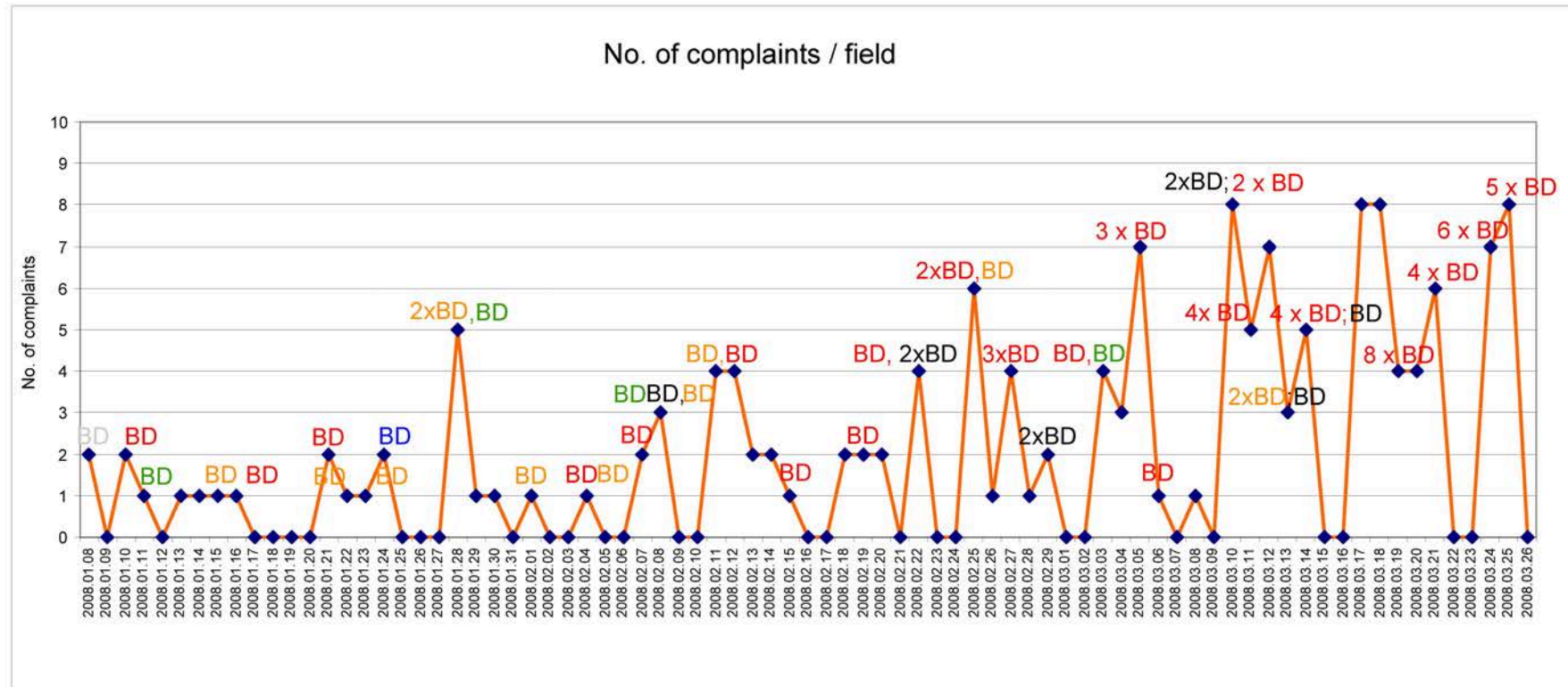
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## Overview of field complaints (2007-2008)

Veh. delivered Non-responsive content removed : 6287\* of which: 144 x complaints (14 cases reported outside [redacted])  
78 x breakdowns

Current focuses EGR 119 x, of which 52 x BD ; foreign body damage 17x, of which 12x BD; regulating throttle 10x of which 7x BD;  
Pleuel bearing thrown 5x of which 4 BD; oil level sensor 4x of which 0 BD



■ ->EGR   
 ■ ->Pleuel bearings   
 ■ ->Foreign body   
 ■ ->Liquid attack   
 ■ -> P pump   
 ■ ->Regulating throttle

# Warm-up report 2.0l R4CR 105kW in B8

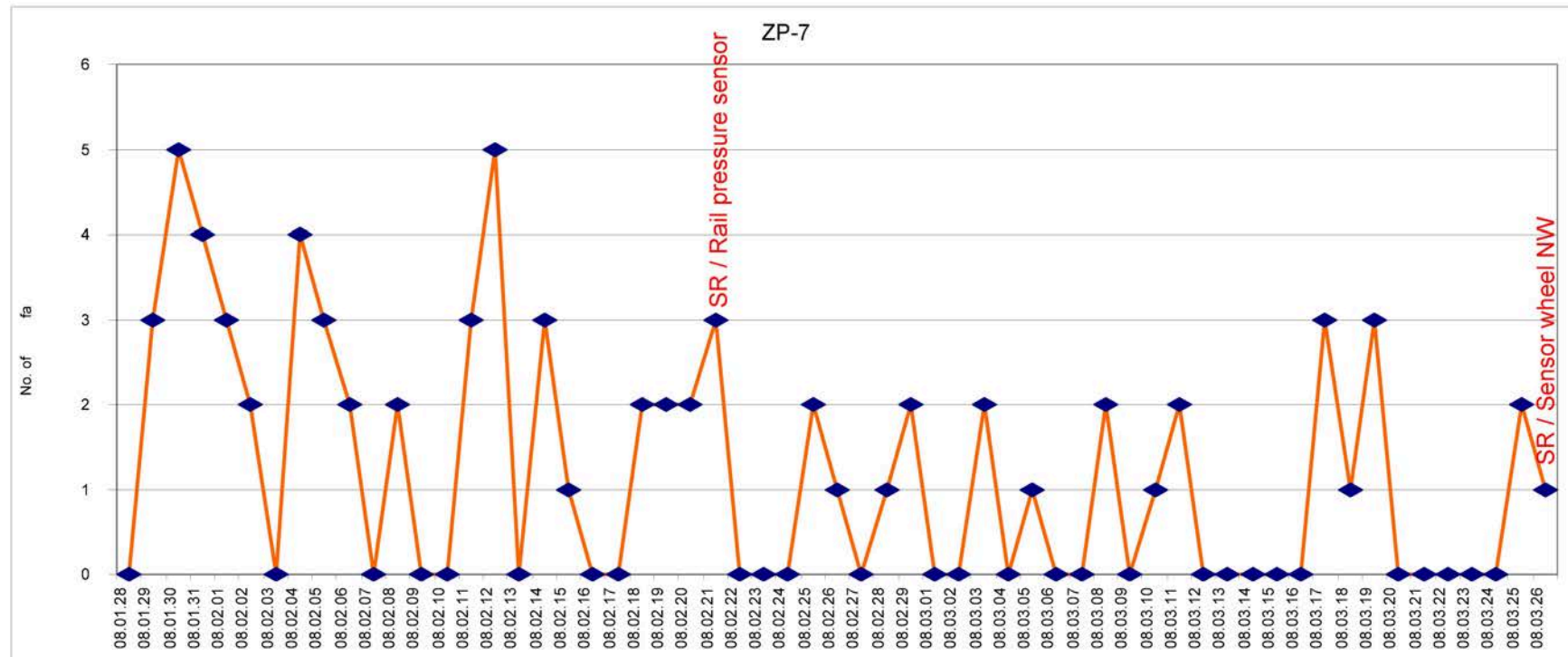


## Overview of complaints ZP-7 (2007-2008)

Engines delivered: 36653

of which: 123 complaints  
7 breakdowns

**Focuses of current month:** ATL function not OK; ATL noise; oil level sensor function not OK, sensor wheel NW



\*Updated 1x / week

# Warm-up report 2.0l R4CR 105kW in B8



## Rail pressure too low, pump noise

Wk 13/08

**Problem:** Rail pressure too low, pump noise

**Cause:** Power-train damage of high-pressure fuel pump  
(Design fault for all Bosch customers)

### Measures

**before** AHM failures (without effect)

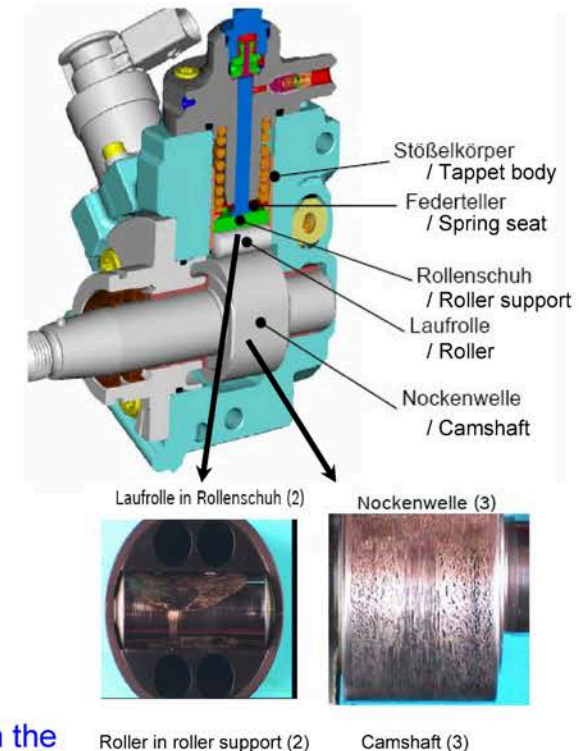
1. Click-clack check before delivery, D:05/10/2007
2. New switch process between flushing and inspection, D:05/30/2007
3. Noise measurement, D:06/18/2007
4. Optimization of test bench workflow, D:07/09/2007
5. CH assembly with 5° torsion suspension D:07/23/2007
6. Extension of high-load inspection point, D:10/01/2007
7. Friction coefficient check +/-10 °, D:12/13/2007
8. Tappet laser scan, D:12/21/2007

**Measures after** AHM failures:

1. Technical elimination measures with dates/persons responsible (for metal spatters in the roller, imperfections with elevations at outer edges of roller, etc.) expected of Bosch. D: 3/27/2008
2. Proposed concepts for distortion protection. T:Wk14/2008 (Meeting in WoB with TD).
3. Meeting with Bosch in Győr to examine the FFT booth once again and evaluate the recordings together. D:Wk14/2008
4. Fuel quality examination for all FFT booths. D:Wk14/2008
5. Assess storage concept of TD. D:Wk14/2008

### DESIGN FAULT!

This subject is being followed closely in the Group and all activities/measures are being discussed with Bosch during pump technical discussions.



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# CP4-XX/1-xx - Standard pump

## Recommendations for use of Diesel injection systems:

- **EU4 market and worse:**

Use of injection systems with appropriate anti-wear measures after required validation

- **EU5 market and better:**

Use of respective basic injection system for EN590 applications

The decisive factor for assessing the respective country is the minimum required exhaust standard of that country.

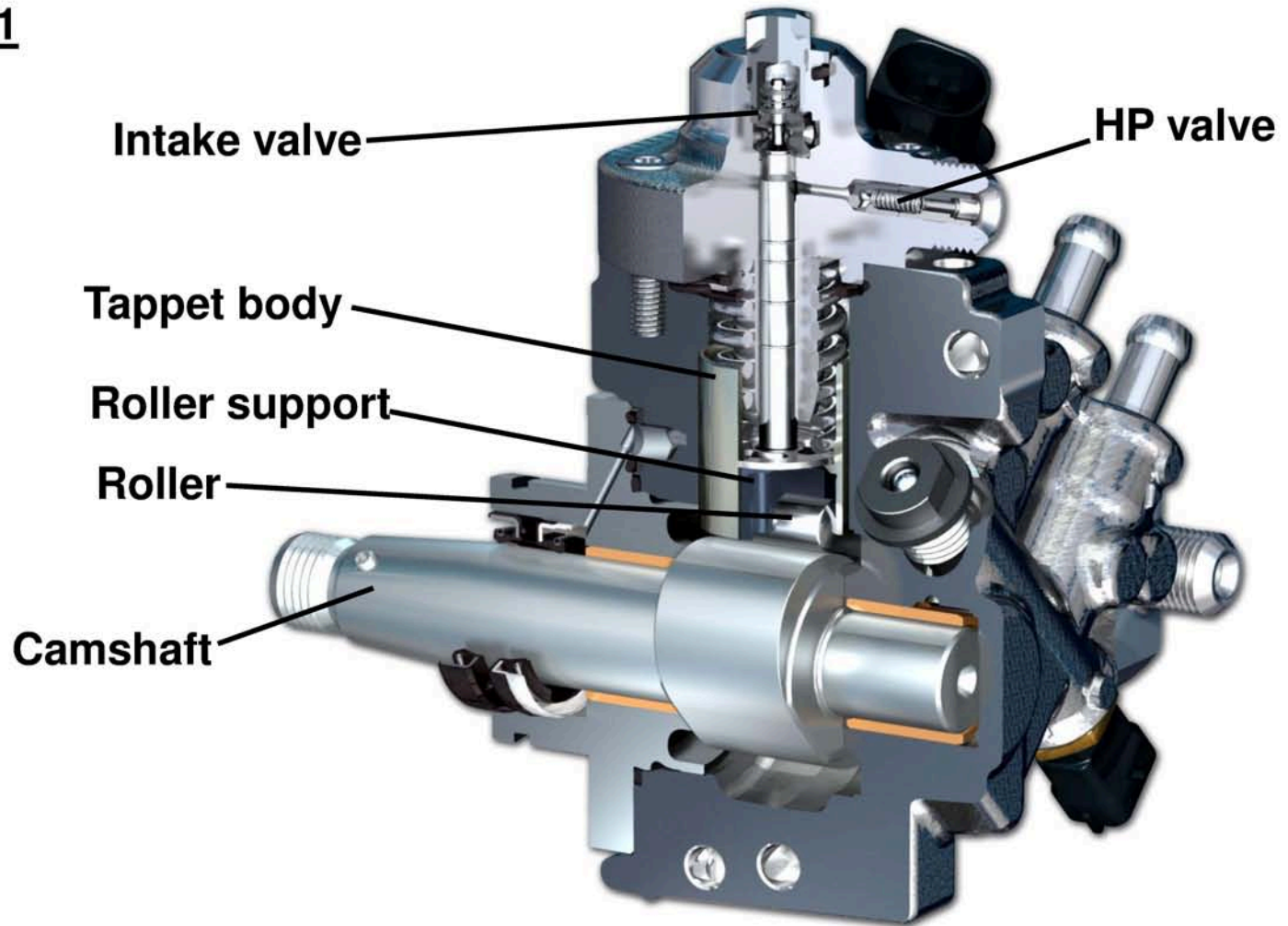
Based on the validation results, the use of the RP0 and RP1 (RP1+) anti-wear package and a water separator is recommended in all EU4 markets for the use of Bosch CP4.1 high-pressure fuel pumps.

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# CP4-XX/1-xx - Standard pump

## Bosch CP4.1



## CP4-XX/1-xx - Standard pump

## RP0: High-pressure plunger

**Objective**

- Lower wear of HP plunger
- Lower internal HP leakage

**Measure**

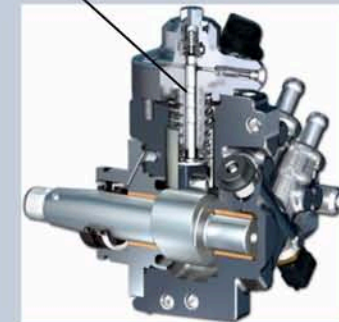
- Optimized C2 layer on HP plunger
- Reduced play between HP plunger and plunger guidance in cylinder head

**Impact**

- Increased robustness against abrasive wear.
- High hydraulic efficiency, even if low-viscosity fuels are used.

## Affected components

High-pressure plunger





## CP4-XX/1-xx - Standard pump

## RP1: Roller / roller support

**Objective**

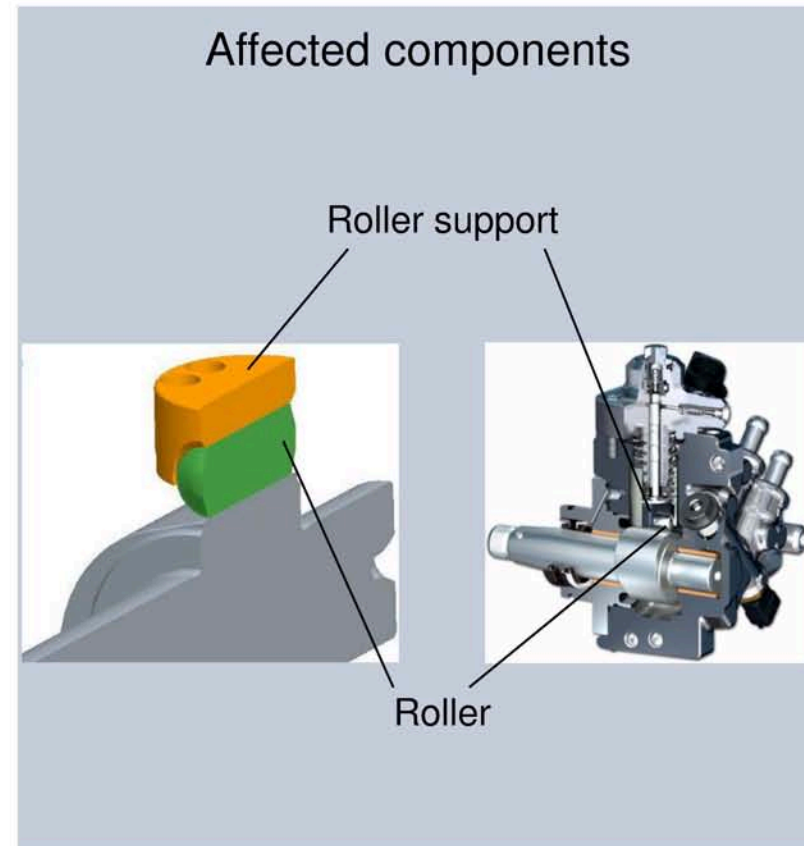
- Improved formation of lubricating film between roller support and roller to reduce the mixed friction proportion for fuels with low viscosity.

**Measure**

- Optimized C layer on C2.1 roller support:  
Reduction of roughness on surface
- Less play between roller and roller support

**Impact**

- Increase thickness of hydrodynamic lubricating film.



## CP4-XX/1-xx - Standard pump

## RP1+: Tappet assembly

**Objective:**

- Improved lubrication film formation on roller support and roller for reducing mixed friction proportion for fuels with low viscosity such as RP1
- Increased robustness against wear, reduction of cavitation erosion due to lower tilting in the tappet guide
- Reduced ticker tendency

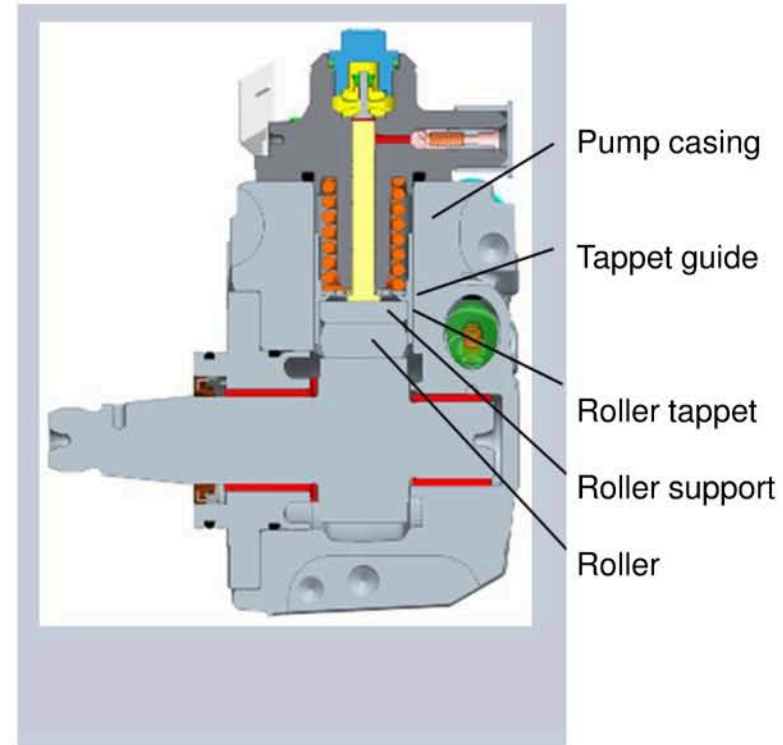
**Measure:**

- Optimized C-layer roller support C3.1; reduced surface roughness, harder substructure
- Low roller/roller support play
- Reduction of radial play of tappet to casing
- Reduction of axial play on the piston foot

**Effect:**

- Increased thickness of the hydrodyn. lubrication film
- Reduced wear depths and cavitation erosion
- Reduced impact speed of piston on RS

## Affected components

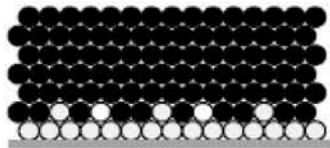


# CP4-XX/1-xx - Standard pump

## Comparison of roller support layer systems

Schematic diagram of layer structure of friction-reducing anti-wear layer

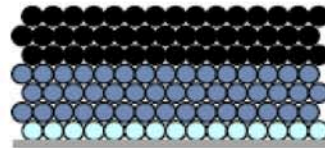
C2.1 layer (RP1)



**Component**

- K1 layer
- Transition of K1 adhesive layer
- Adhesive layer 1

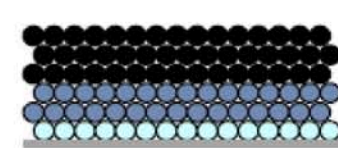
C3 layer, standard



**Component**

- K1 layer
- K2 layer (thick)
- Adhesive layer 2 (smoother, thinner)

C3.1 layer, RP1+



**Component**

- K1 layer opti.
- K2 layer opti.(thinner)
- Adhesive layer 2 (smoother)

- Carbon layer type 1
- Carbon layer type 2

- Adhesive layer type 1
- Adhesive layer type 2



## CP4-XX/1-xx - Standard pump

## OV-b

**Task**

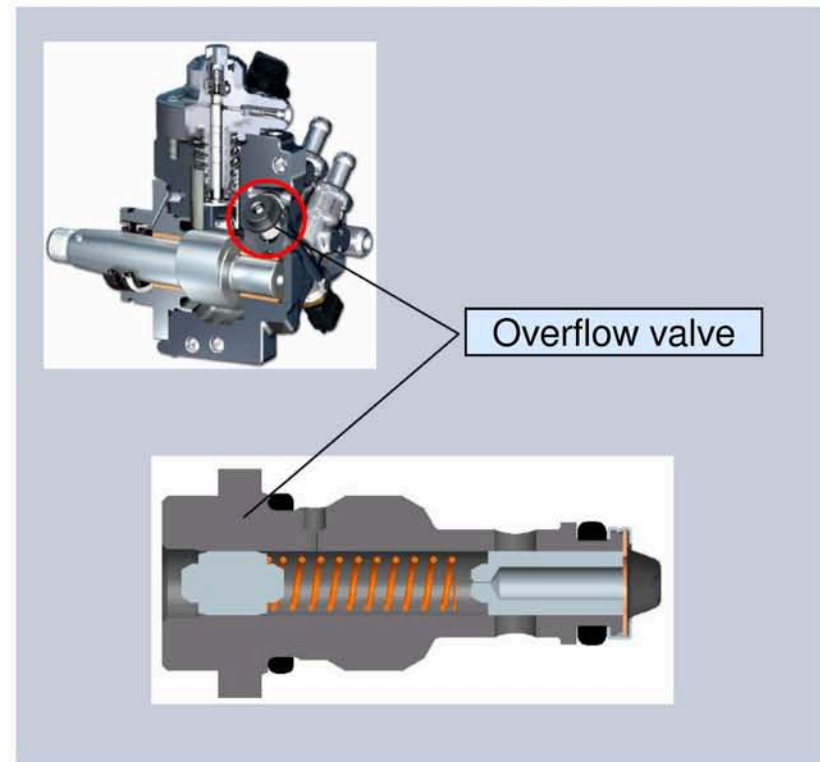
→ Prevention of vapor bubble formation in the cam space.

**Measure**

→ Increasing the overflow valve opening pressure.

**Effect**

→ Increased fuel pressure level in the cam space.

**Affected components**

## CP4-XX/1-xx - Standard pump

Cost for introduction of anti-wear packages:

<p>█</p> <p>Unit planning over entire product life</p>	<p>Total █ systems</p>	<p>Of which █ systems without RP0 (AWP)</p>	<p>Of which █ systems with RP0 (AWP)</p>
2011 - 2016	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed
Costs of change for standard pump with RP1+ and RP0	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed
Costs of change for standard pump with RP1+ and elimination of RP0	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed

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Engine development

Engine test center • Drive electronics • Engine management • Diesel engine development • Vehicle integration drive • Gearbox development • Petrol engine development



# CP4-XX/1-xx - Standard pump

Gen1/ 2 Unit planning	Total CR systems	Of which CR systems with RP0 (AWP)	Of which CR systems without RP0 (AWP)
2011	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed
2012	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed
2013	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed
2014	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed
2015	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed
2016	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed
<b>Total:</b>	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed
Costs of change for standard pump with RP1+ and RP0	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed
Costs of change for standard pump with RP1+ and elimination of RP0	Non-responsive content removed	Non-responsive content removed	Non-responsive content removed

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## Engine development



# CP4-XX/1-xx - Standard pump

## Dates:

### Introduction of CP4.1 anti-wear measures

- Introduction of RP1 anti-wear package and strainer before intake valve in all AWP CP4.1 pump versions completed by Wk 45/2010.
- Comprehensive introduction of RP1+ anti-wear package for all Bosch CP4.1 types planned for 03/2011.

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**AUDI AG**

Memo to [Non-responsive content removed]

Subject: V6 TDI deployment scenario for [Redacted]

Coordinated with Messrs. [Non-responsive content removed]

Due to the critical fuel quality and the associated problems with the HPP4 the back-conversion of the HPP from CP4.2 to CP1H will be developed for the V6 TDI Gen1 engine generation in combination with EU4 application for the following models:

- Audi Q7
- VW Touareg
- Audi C6 CKD
- VW Phaeton

Timelines and part supply are currently being clarified.  
Objective: Application dates line in second half of 2011.

As an interim solution4 the Q7 V6 TDI [Redacted] and VW Touareg Gen1 will have the following measures:

- HPP anti wear package 2
- SW measures to improve fuel supply during engine start

will be employed in production again starting early 2011.

Signed

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12/14/2010

Copy: Messrs.

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EA11003EN-01858[0]

Audi  
Vorsprung durch Technik



**Bills for High-Pressure Fuel Pump CP4.2 Audi V6-TDI**

EA11003EN-01858[1]

## Bills for High-Pressure Fuel Pump CP4.2 Audi V6-TDI

(after **setting date** in AQUA)

	2008	1st half 2009	Jul 09	Aug 09	Sep 09	Oct 09	Nov 09	WK 49	WK 50	WK 51	WK 52	Total
Non-responsive content removed	58	118	49	43	80	57	23	0				428
	20	30	11	15	16	6	8	2				108
	30	10	3	5	3	2	0	0				53
	12	8	2	1	1	1	3	0				28
	1	19	9	16	14	9	1	0				69
	0	1	4	1	3	0	1	0				10
	4	6	2	3	0	0	0	0				15
	6	6	2	1	4	1	2	0				22
	7	9	1	1	6	4	2	1				31
	2	0	1	1	0	0	0	0				4
	2	6	1	0	1	0	0	0				10
	5	3	1	0	1	0	0	0				10
	1	4	0	0	1	0	0	0				6
	2	0	0	1	0	0	0	0				3
USA	0	0	0	0	1	0	1	0				2
<b>Total</b>	<b>150</b>	<b>220</b>	<b>86</b>	<b>88</b>	<b>131</b>	<b>80</b>	<b>41</b>	<b>3</b>				<b>799</b>

EA11003EN-01858[2]

# Bills for High-Pressure Fuel Pump CP4.2 Audi V6-TDI

Bills for High-Pressure Fuel Pump CP4.2 V6-TDI Audi  
(subsequent to **setting date** in AQUA)

