

		CR pump CP4 - Findings report		Report no. 19427																																																															
				Date 11.01.2008																																																															
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Pump type: CP4.1S_348_2x5.25_REC_3.3_1.95_MT4.2	Customer: VW	Project: R4 2,0 BIN5	Project/ design sample version C / C2																																																																
Item number (TT no.) : 0445B21060_10	Production date: 689	Serial number: 4909	Factory - Line 011M FeP-M -																																																																
SAP no.: DS-164739	Samos no.: 577906	Customer order no.:	Engine/vehicle number 03LD/17266																																																																
Customer item number	Durability test type [customer]: Corrosion endurance test	Durability test conditions:	DSBFD no.: 19427																																																																
Mileage: 100000 km	Received by DS-PC/ EDI on: 17 Oct 2007	Transaction no. 2007 - CP4 / 0116	Confidentiality note Confidential																																																																
Complaint: None																																																																			
<h3>1. Subject</h3> <p>CP4 customer return KFT + 100,000km corrosion endurance test on dynamometer test rig; operated with US fuel, endurance test end</p>																																																																			
<h3>2. Conclusion</h3> <p>No hydraulic defects discovered. The pump was leak-tight in the low-temperature test at -25 °C. In the pump there were signs of rust which did not impair its function. The pump has passed the test.</p>																																																																			
<h3>3. Findings (visible findings)</h3> <table style="width: 100%;"> <tr> <td style="width: 60%;"></td> <td style="width: 20%;"> Rating legend </td> <td style="width: 20%;"> <table border="1"> <tr> <td>OK</td> <td style="background-color: green; text-align: center;">x</td> <td></td> <td></td> </tr> <tr> <td>non-critical</td> <td style="background-color: yellow; text-align: center;">x</td> <td></td> <td></td> </tr> <tr> <td>critical</td> <td></td> <td style="background-color: red; text-align: center;">x</td> <td></td> </tr> </table> </td> </tr> <tr> <td> 3.1 Drive Slight running marks detectable </td> <td></td> <td> <table border="1" style="float: right;"> <tr> <td style="background-color: green; text-align: center;">x</td> <td></td> <td></td> </tr> </table> </td> </tr> <tr> <td> 3.2 Drivetrain Marks from tight roller visible (Fig.1). Point rusting detectable on cam edge </td> <td></td> <td> <table border="1" style="float: right;"> <tr> <td></td> <td style="background-color: yellow; text-align: center;">x</td> <td></td> </tr> </table> </td> </tr> <tr> <td> 3.3 High pressure Moderate fatigue wear. Rusting visible at sealing point between intake valve and sealing disk (Fig. 2) </td> <td></td> <td> <table border="1" style="float: right;"> <tr> <td></td> <td style="background-color: yellow; text-align: center;">x</td> <td></td> </tr> </table> </td> </tr> <tr> <td> 3.4 Bearing Slight running marks visible </td> <td></td> <td> <table border="1" style="float: right;"> <tr> <td style="background-color: green; text-align: center;">x</td> <td></td> <td></td> </tr> </table> </td> </tr> <tr> <td> 3.5 Shaft seal Moderate running in of the shaft sealing ring on the cam shaft (Fig.3) </td> <td></td> <td> <table border="1" style="float: right;"> <tr> <td></td> <td style="background-color: yellow; text-align: center;">x</td> <td></td> </tr> </table> </td> </tr> <tr> <td> 3.6 Boreholes Slight wear visible </td> <td></td> <td> <table border="1" style="float: right;"> <tr> <td style="background-color: green; text-align: center;">x</td> <td></td> <td></td> </tr> </table> </td> </tr> <tr> <td> 3.7 Built-on components (metering unit, overflow valve, counting point) Rubber particles collected at overflow valve screen (Fig.4). Rust particles collected at metering unit screen (Fig.5) </td> <td></td> <td> <table border="1" style="float: right;"> <tr> <td></td> <td style="background-color: yellow; text-align: center;">x</td> <td></td> </tr> </table> </td> </tr> <tr> <td> 3.8 Miscellaneous </td> <td></td> <td> <table border="1" style="float: right;"> <tr> <td></td> <td></td> <td></td> </tr> </table> </td> </tr> </table>						Rating legend	<table border="1"> <tr> <td>OK</td> <td style="background-color: green; text-align: center;">x</td> <td></td> <td></td> </tr> <tr> <td>non-critical</td> <td style="background-color: yellow; text-align: center;">x</td> <td></td> <td></td> </tr> <tr> <td>critical</td> <td></td> <td style="background-color: red; text-align: center;">x</td> <td></td> </tr> </table>	OK	x			non-critical	x			critical		x		3.1 Drive Slight running marks detectable		<table border="1" style="float: right;"> <tr> <td style="background-color: green; text-align: center;">x</td> <td></td> <td></td> </tr> </table>	x			3.2 Drivetrain Marks from tight roller visible (Fig.1). Point rusting detectable on cam edge		<table border="1" style="float: right;"> <tr> <td></td> <td style="background-color: yellow; text-align: center;">x</td> <td></td> </tr> </table>		x		3.3 High pressure Moderate fatigue wear. Rusting visible at sealing point between intake valve and sealing disk (Fig. 2)		<table border="1" style="float: right;"> <tr> <td></td> <td style="background-color: yellow; text-align: center;">x</td> <td></td> </tr> </table>		x		3.4 Bearing Slight running marks visible		<table border="1" style="float: right;"> <tr> <td style="background-color: green; text-align: center;">x</td> <td></td> <td></td> </tr> </table>	x			3.5 Shaft seal Moderate running in of the shaft sealing ring on the cam shaft (Fig.3)		<table border="1" style="float: right;"> <tr> <td></td> <td style="background-color: yellow; text-align: center;">x</td> <td></td> </tr> </table>		x		3.6 Boreholes Slight wear visible		<table border="1" style="float: right;"> <tr> <td style="background-color: green; text-align: center;">x</td> <td></td> <td></td> </tr> </table>	x			3.7 Built-on components (metering unit, overflow valve, counting point) Rubber particles collected at overflow valve screen (Fig.4). Rust particles collected at metering unit screen (Fig.5)		<table border="1" style="float: right;"> <tr> <td></td> <td style="background-color: yellow; text-align: center;">x</td> <td></td> </tr> </table>		x		3.8 Miscellaneous		<table border="1" style="float: right;"> <tr> <td></td> <td></td> <td></td> </tr> </table>			
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 BOSCH 	CR pump CP4 - Findings report			Report no.	19427
				Date	11.01.2008
Department:	Person responsible:	Telephone:	Use	internal	
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4. Hydraulic function

	n [rpm]	p_rail [bar]	I_metering unit [A]	Delivery rate [l/h]	Delivery rate [l/h]
				New part	after testing
KL1-S	3375	500	0.4	12.09.2006 66.4	22.10.2007 65.7
Running limit	1000	1800	0.4	17.1	16.9
ST	200	200	0.4	3.9	3.8

x	
x	
x	

No defect could be discovered

5. Parts storage

Parts will be stored until end 06/2008 at RB and scrapped.

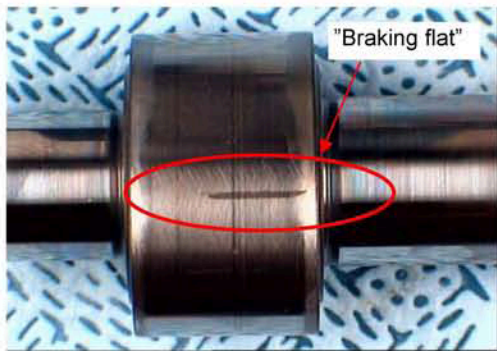


Fig. 1: Cam shaft

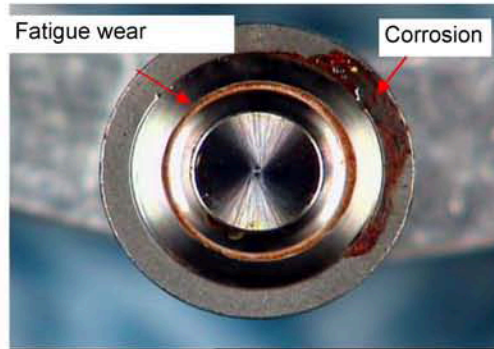


Fig. 2: Intake valve

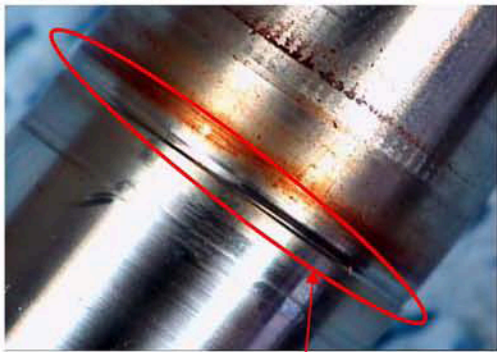


Fig. 3: Cam shaft - contact with shaft sealing ring



Fig. 4: Overflow valve

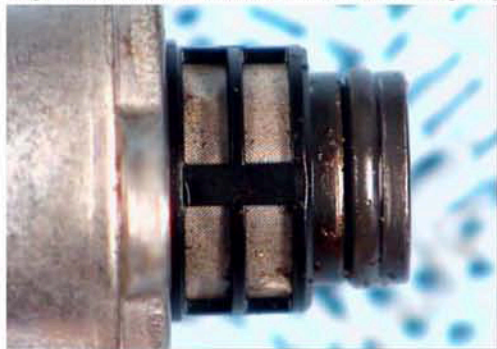


Fig. 5: Metering unit

Tested:		Telephone:		Date:	17.01.2008	Signature:	
Department:		Telephone:		Date:	17.01.2008	Signature:	
Department:		Telephone:		Date:	28.01.2008	Signature:	

Department:	Person responsible:	Telephone:	Use
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Pump type: CP4.1S_348_2x5.25_REC_3.3_1.95_MT4.2	Customer: VW	Project: R4 2.0 BIN5	Project/ design sample version B / B1
Item number (TT no.) : 0445B21060_02	Production date: 686	Serial number: 0163	Factory - Line 011M FeP-M
SAP no.: 30-101005-01	Samos no.: 584662	Customer order no.:	Engine/vehicle number 3LD16940
Customer item number	Durability test type [customer]: Engine test	Durability test conditions: Function	DSBFD no.: 20051
Mileage: 395 h	Received by DS-PC/EDI on: 20.12.2007	Transaction no. 2007-CP4_0183	Confidentiality note Confidential
VA/ETC no.: DS-172533	Durability test type [RB]:	Fuel:	

Complaint:

1. Subject

CP4 customer return
Findings at end of endurance test without complaint

2. Conclusion

Function

- Delivery rates after endurance test without significant quantity drift compared to new condition.
- Leakage at shaft seal at -25 °C in low-temperature leak test after endurance test, probably due to:
 - several wear marks on the camshaft
 - structured wear marks (steps, "criss-crossing")
 The various wear marks on the camshaft (see also the appendix) can be explained by the two following hypotheses:
 - dismantling and refitting of the flange (leak tightness cannot be guaranteed after refitting)
 - operation with different supply pressures and internal pressures or increased low-pressure pulsations (The operating conditions of this engine test are unknown.)

Components

- Roller support edges were mechanically damaged after C-coating (see also the appendix).
- Spalling of the C-coating on the case surface of the HP piston is non-critical for the function.
- Two impressions with a diameter of 6 mm are visible on the flange end face, probably from a stripping tool.
- The wear on the other components is minimal and without any significant items of note.

Result

- The pump **has passed** the endurance test.
- The items of note with regard to the camshaft and the roller support are ascribed to the customer's tests.

3. Findings (visible findings)

Rating legend

OK	x		
non-critical	x		
critical		x	

3.1 Drive

No items of note

x		
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3.2 Drivetrain

Lateral contact of the roller (see Fig.1) in the tappet (see Fig. 2)
Damage to the roller support edge and the roller borehole (see Fig. 3, Fig. 4 and appendix)

	x	
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3.3 High pressure

Spalling of C-coating on the case surface of the HP piston (see Fig. 5)

	x	
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3.4 Bearing

No items of note

x		
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				external	x

3.5 Shaft seal

Digging in of the shaft seal into the camshaft to a depth of approx. 5 µm and width of 100 µm (see Fig. 6 and appendix)

	x		
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3.6 Boreholes

Scoring in the tappet borehole (see Fig. 7) and on the tappet body (see Fig. 8)

	x		
--	---	--	--

3.7 Built-on components (metering unit, overflow valve, counting point)

No items of note

x			
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3.8 Miscellaneous

Flange end face with two imprints of diameter 6 mm (see Fig. 9)

	x		
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3.9 Pictures of visible findings

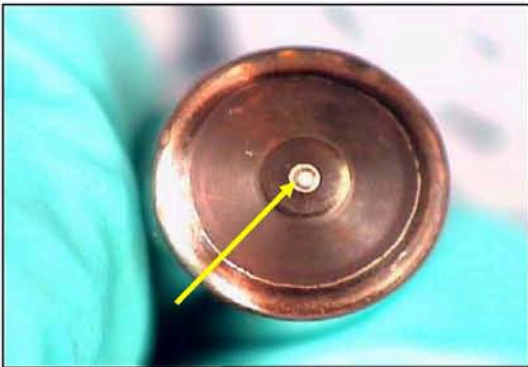


Fig. 1. End face of roller, housing side

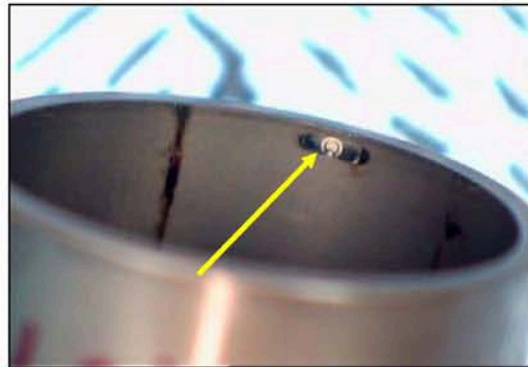


Fig. 2. Tappet body inside, housing side

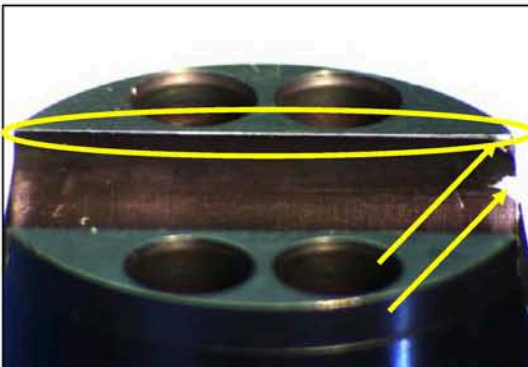


Fig. 3. Roller support, metering unit side at top in picture

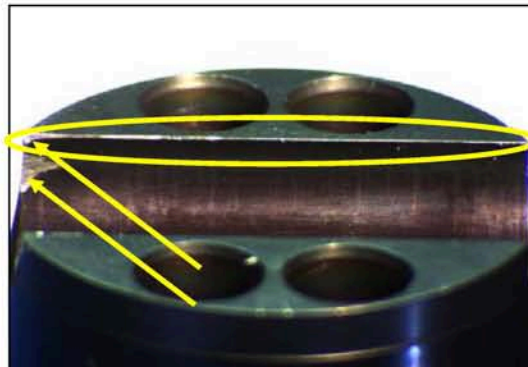


Fig. 4. Roller support, metering unit side at bottom in picture



Fig. 5. HP piston, high pressure side



Fig. 6. Camshaft, running area of shaft seal

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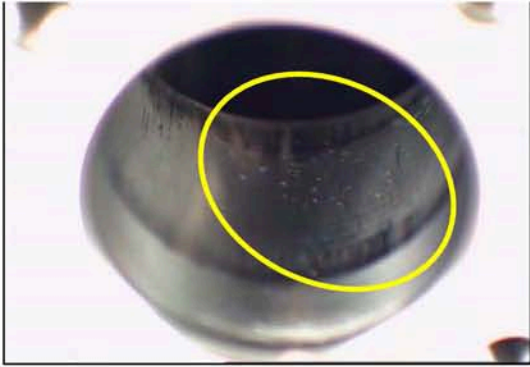


Fig. 7. Housing, tappet borehole

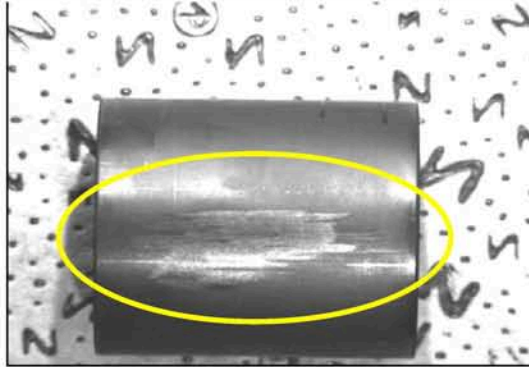


Fig. 8. Tappet body, case surface

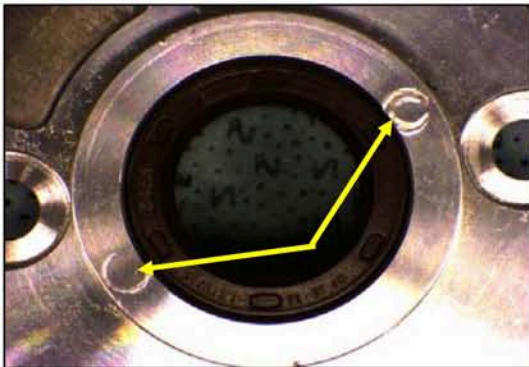


Fig. 9. Flange, end face

4. Hydraulic function

	n [rpm]	p _{rail} [bar]	l _{metering unit} [A]	Delivery rate [l/h]	Delivery rate [l/h]
				of new part	after testing
				10.07.2006	20.12.2007
Starting point	200	200	0.4	3.9	4
1000 rpm, p _{nom}	1000	1800	0.4	17.1	17.7
n _{max_p} , 500 bar	3375	500	0.4	66.9	67.9

x	
x	
x	

TCD test point running limit (1000 rpm, p_{nom} ≥ 15.5 or 15-2 l/h after running time) is fulfilled.
 No significant quantity drift compared to the as-delivered measurement.

5. Parts stor-age

The pump will be stored at RB until 06/2008 and then scrapped.

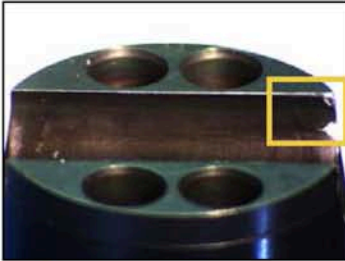
6. At-tachments

2007-CP4_0183 Findings on roller support 2007-CP4_0183 Findings on camshaft seal area

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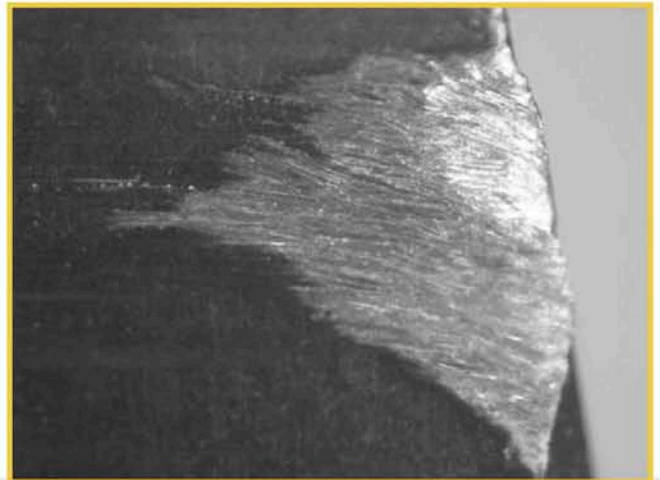
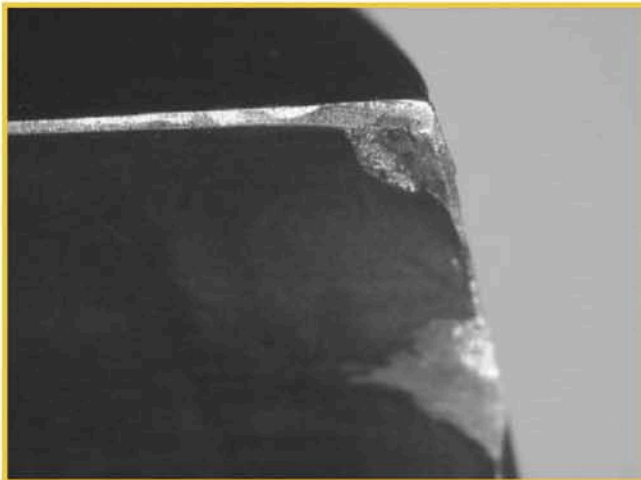
CP4 – Findings on VW R4 2.0 BIN5 / #686-0163

- ➔ **Pump:** B-sample, CP4.1S-348-2x5,25-REC, 0 445 010 060_02, #686-0163
- ➔ **Operating conditions.:** Engine test, function, running time 395, end of test
- ➔ **Inspection:** Roller support – roller borehole (picture above = direction of metering unit)



Mechanical manipulations

- ➔ at the edge of the roller borehole across the entire width
- ➔ at the edge of the roller borehole from the inside out



Diesel systems



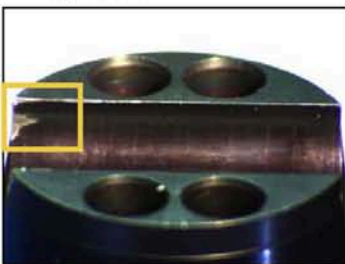
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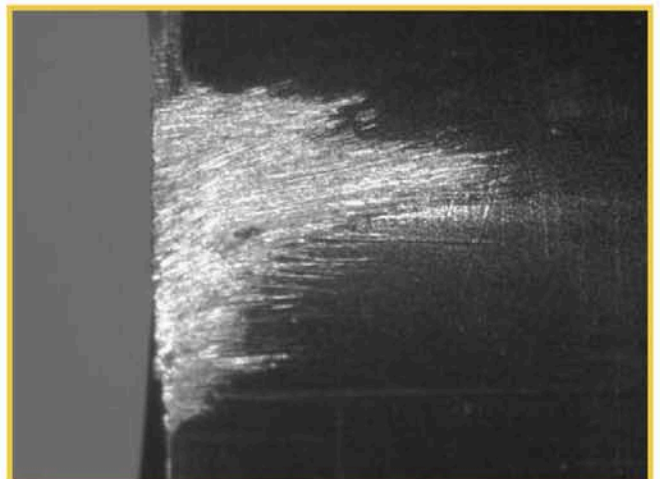
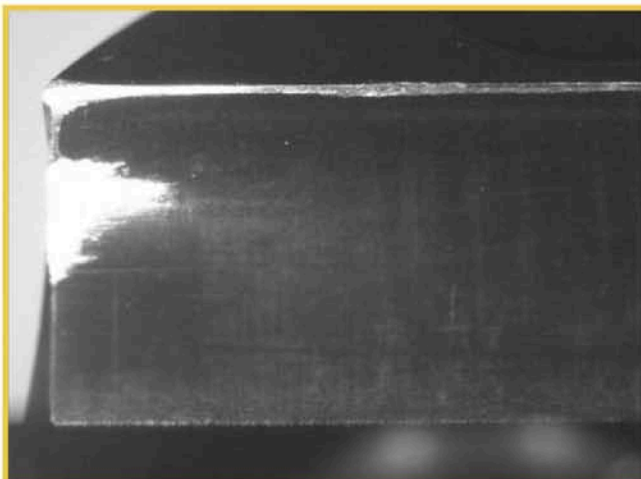
CP4 – Findings on VW R4 2.0 BIN5 / #686-0163

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Mechanical manipulations

- ➔ at the edge of the roller borehole across the entire width
- ➔ at the edge of the roller borehole from the inside out



Diesel systems



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EA11003EN-00933[3]

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CP4 – Findings on VW R4 2.0 BIN5 / #686-0163

Summary

Description of failure

- ➔ Leakage with R4 at the shaft seal in the low-temperature leak test at -25 °C and -30 °C
 - Shaft seal KACO Standard
 - R4 = fuel drips out of the flange
- ➔ Leak-tight in bubble test and function test

Pump data

- ➔ B-sample, CP4.1S-348-2x5,25-REC, 0 445 010 060_02, #686-0163

Analysis

- ➔ WLI measurement of the wear area at selected points
- ➔ WP measurement of the wear area around the circumference

Result

- ➔ a total of 3 dig-in marks of various depth detectable
- ➔ maximum dig-in depth of approx. 5 µm in depth and 100 µm in width (little wear)
- ➔ digging in is irregular, i.e. structure (jaggy marks)
- ➔ no defect and no wear detectable on the shaft saeal

Conclusion

- ➔ The low-temperature leakage is ascribed to the structured digging in

Diesel systems

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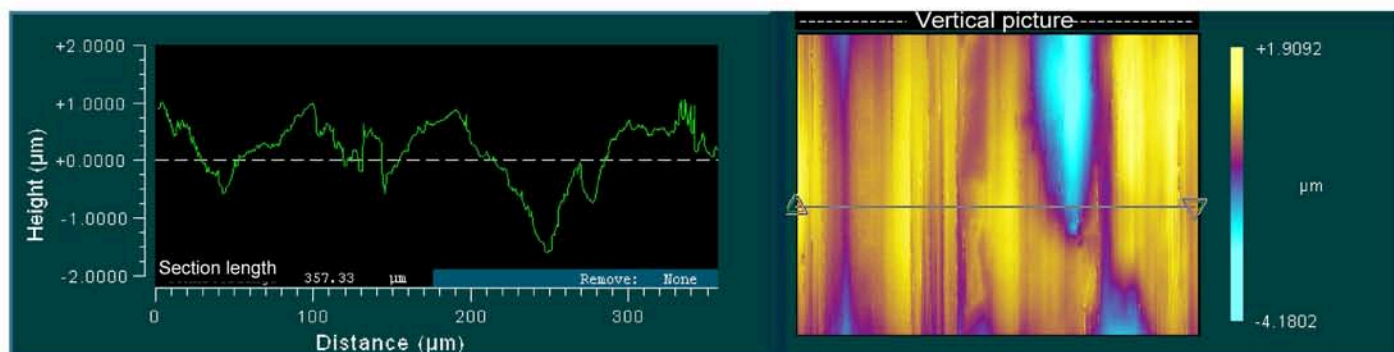
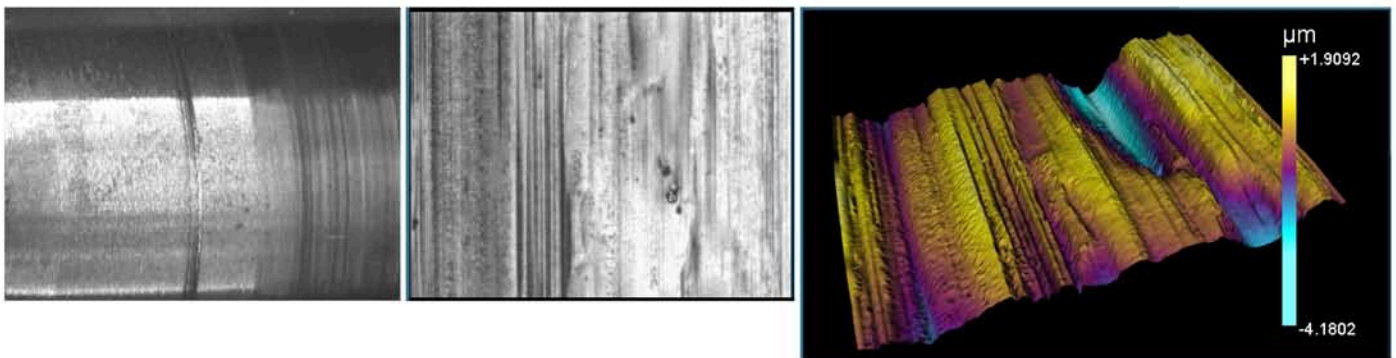


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CP4 – Findings on VW R4 2.0 BIN5 / #686-0163

- ➔ **Pump:** B-sample, CP4.1S-348-2x5,25-REC, 0 445 010 060_02, #686-0163
- ➔ **Operating conditions.:** Engine test, function, running time 395, end of test
- ➔ **Inspection:** Camshaft – running area of shaft seal (WLI measurement of individual point)



Diesel systems

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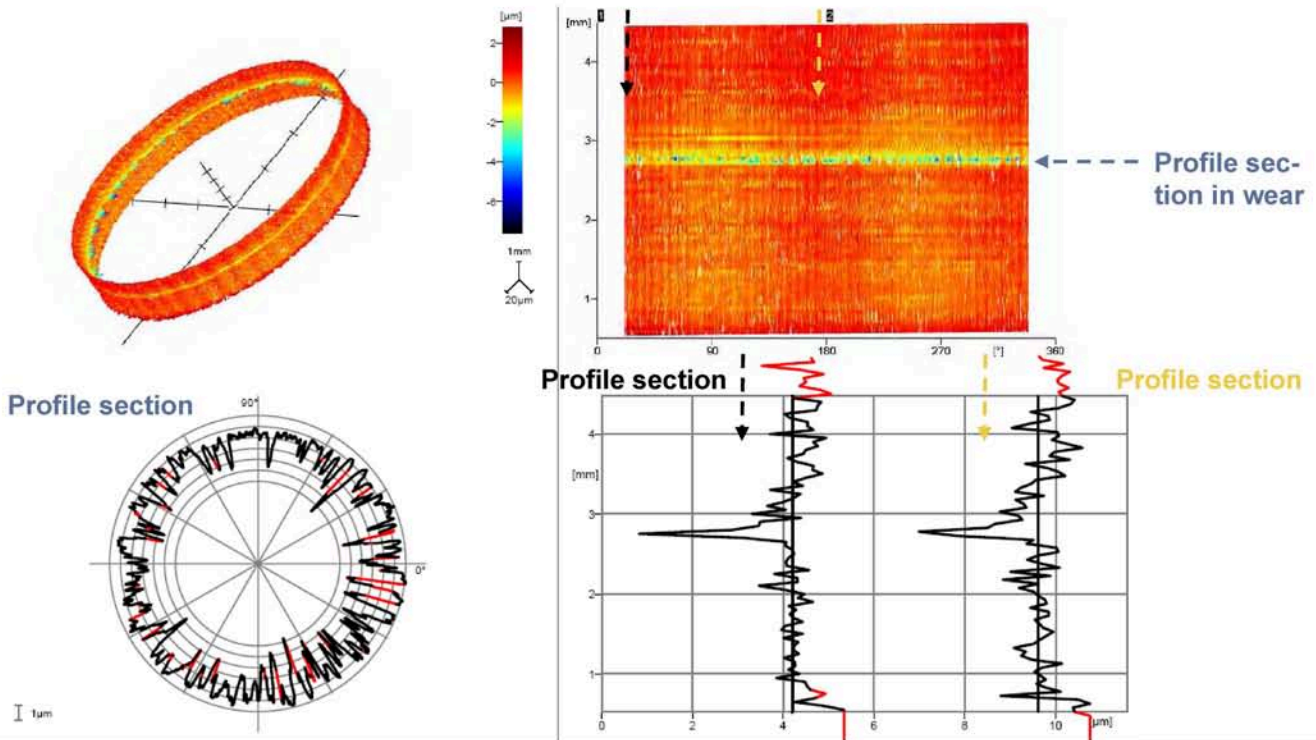
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CP4 – Findings on VW R4 2.0 BIN5 / #686-0163

- ➔ **Pump:** B-sample, CP4.1S-348-2x5,25-REC, 0 445 010 060_02, #686-0163
- ➔ **Operating conditions.:** Engine test, function, running time 395, end of test
- ➔ **Inspection:** Camshaft – running area of shaft seal (WP measurement around the circumference)



Diesel systems



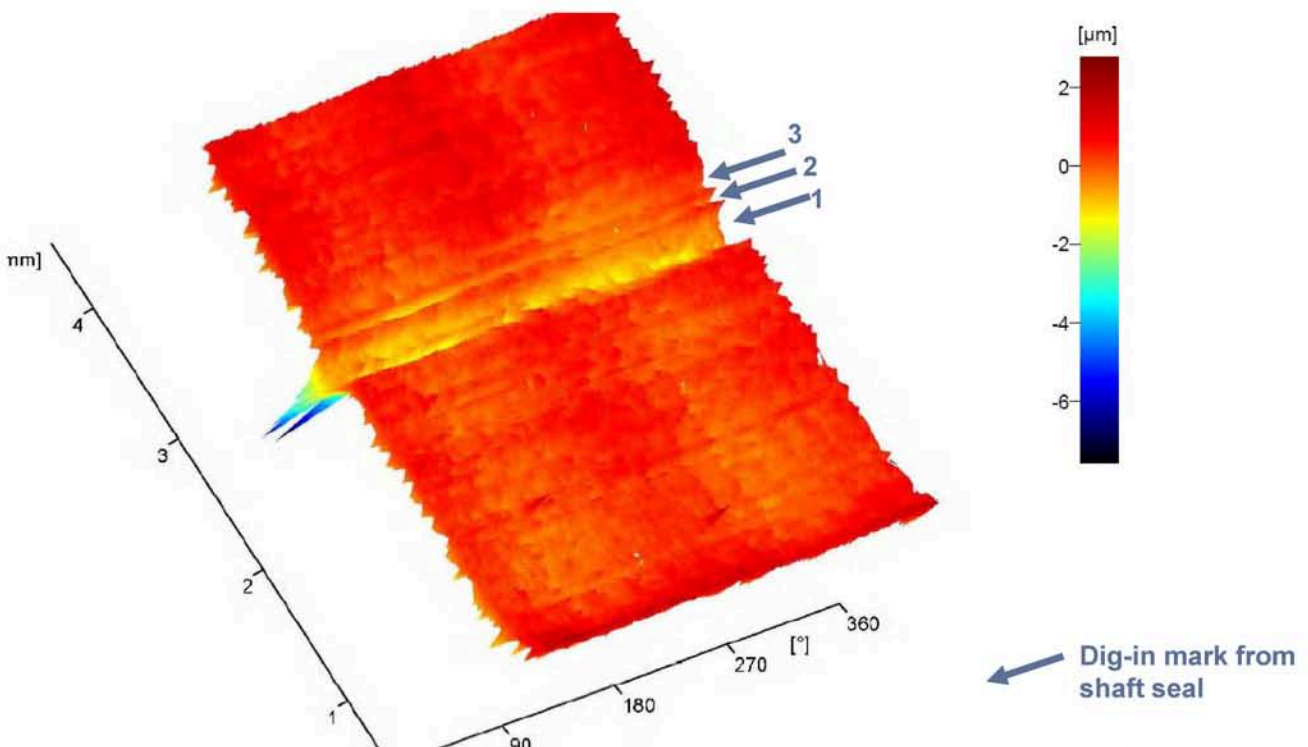
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CP4 – Findings on VW R4 2.0 BIN5 / #686-0163

- ➔ **Pump:** B-sample, CP4.1S-348-2x5,25-REC, 0 445 010 060_02, #686-0163
- ➔ **Operating conditions.:** Engine test, function, running time 395, end of test
- ➔ **Inspection:** Camshaft – running area of shaft seal (WP measurement around the circumference)



Diesel systems



BOSCH

4

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Department: Non-responsive content removed	Person responsible: Non-responsive content removed	Telephone: Non-responsive content removed	Use internal <input type="checkbox"/> external <input checked="" type="checkbox"/>
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Pump type: CP4.2HS_747_2x5625_REC_3.3_1.3	Customer: Audi	Project: W19 EU6/BIN5	Project/ design sample version C2 with AWP
Item number (TT no.) : 0445B20169_07	Production date: 782	Serial number: 4065	Factory - Line 0110 FeP - 01
SAP no.: DS-169124	Samos no.: 582246	Customer order no.:	Engine/vehicle number Engine V6N 105
Customer item number	Durability test type [customer]: Vehicle endurance test	Durability test conditions: 500 km with US Diesel Cetan 46	DSBFD no.: 19684
Mileage 3000 km	Received by DS-PC/EDI on: 15.11.2007	Transaction no. 2007-CP4_0204	Confidentiality note Confidential
VA/ETC no.: DS-169124	Durability test type [RB]:	Fuel: EN590 + USA	

1. Subject

CP4 customer return **without complaint**

Findings according to operational / field complaint (not CP4): cylinder scorcher cyl.

1 3000 km vehicle endurance test, including 500 km with US Diesel Cetan 46

Engine V6N 105

2. Conclusion

Function

- Delivery rates after endurance test or test show no significant quantity drift compared to new condition.

Components

- Wear due to cavitation erosion on the roller supports (HP piston contact area) is increased but non-critical.

- The wear on the other components is minimal and without items of note.

Result

- The pump **has passed** the endurance test.

3. Findings (visible findings)

Rating legend

OK	x		
non-critical	x		
critical			x

3.1 Drive

No items of note

x		
---	--	--

3.2 Drivetrain

Roller supports: Annular cavitation erosion on the HP piston contact area (see 3.10 Fig. 1 and 2)

	x	
--	---	--

3.3 High pressure

No items of note

x		
---	--	--

3.4 Bearing

No items of note

x		
---	--	--

3.5 Shaft seal

No items of note

x		
---	--	--

3.6 Boreholes

No items of note

x		
---	--	--

3.7 Built-on components (metering unit, overflow valve, counting point)

No items of note

x		
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3.8 O-rings

No items of note

x		
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3.9 Miscellaneous

No items of note

x		
---	--	--

3.10 Pictures

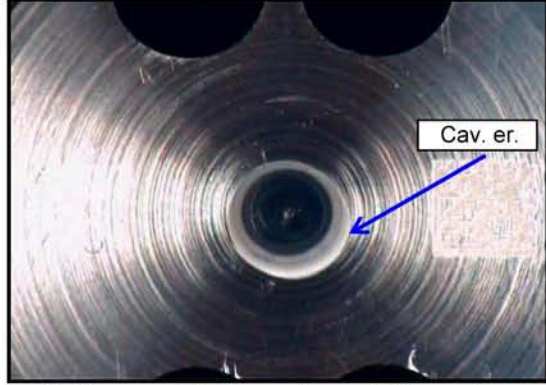
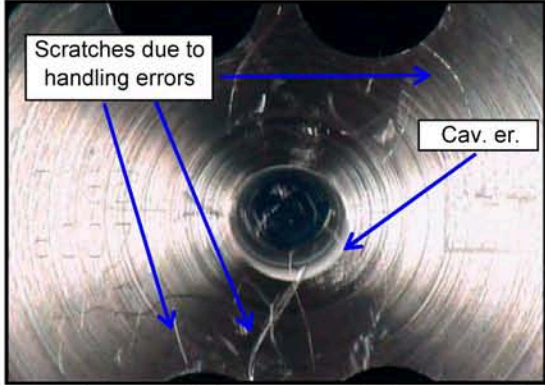


Fig. 1: Roller support left: annular cavitation erosion **Fig. 2:**

Roller support right: annular cavitation erosion

4. Hydraulic function

	n [rpm]	p_rail [bar]	l_metering unit [A]	Delivery rate [l/h]	Delivery rate [l/h]
				of new part	after testing
LG	1000	2000	0.4	15.02.2007 36.6	26.11.2007 36.6

x		
---	--	--

No significant change in volumetric efficiency; the volumetric efficiency lies within the tolerance specified for new parts in the TKU.



5. Parts storage

The pump will be scrapped by request of Audi.

6. Attachments

None

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 BOSCH 	CR pump CP4 - Findings report		Report no.	2007-CP4_0213	
			Date	24.06.2008	
Department:	Person responsible:	Telephone:	Use	internal	
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To:	Non-responsive content removed				
Attn. of:					
Pump type:	Customer:	Project:	Project/ design sample version		
CP4.2HS_747_2x5625_REC_3.3_1.3	Audi	W19 EU6/BIN5	C3		
Item number (TT no.):	Production date:	Serial number:	Factory - Line		
0445B20169_10	788	4242	0110 FeP - 01		
SAP no.:	Samos no.:	Customer order no.:	Engine/vehicle number		
DS-169109	582359		Engine 059 G V6N 138		
Customer item number	Durability test type [customer]:	Durability test conditions:	DSBFD no.:		
	Engine endurance test	Characteristic map operation	19677		
Mileage	Received by DS-PC/EDI on:	Transaction no.	Confidentiality note		
606 h	23.11.2007	2007-CP4_0213	Confidential		
VA/ETC no.:	Durability test type [RB]:	Fuel:			
		EN590			

1. Subject

CP4 customer return **without complaint**
 Findings after end of endurance test
 606h characteristic map operation
 Engine 059 G V6N 138

2. Conclusion

Function

- Delivery rates after endurance test or test show no significant quantity drift compared to new condition.

Components

- Wear due to cavitation erosion on the roller supports (HP piston contact area) is increased but non-critical.
- The wear on the other components is minimal and without items of note.

Result

- The pump **has passed the endurance test.**

3. Findings (visible findings)

Rating legend

OK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3.1 Drive

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.2 Drivetrain

Roller supports: Cavitation erosion on the HP piston contact area (see 3.10 Fig. 1 and 2)

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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3.3 High pressure

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.4 Bearing

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.5 Shaft seal

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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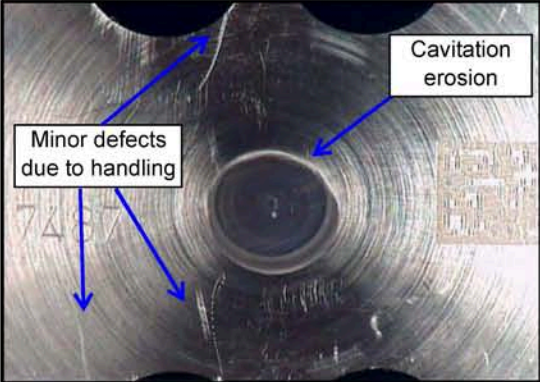
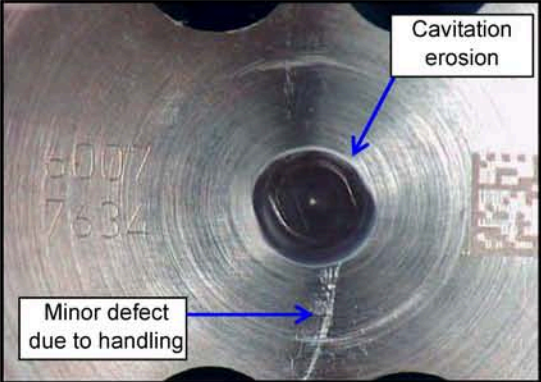
3.6 Boreholes

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.7 Built-on components (metering unit, overflow valve, counting point)

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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 BOSCH 	CR pump CP4 - Findings report			Report no.	2007-CP4_0213	
				Date	24.06.2008	
Department:	Person responsible:	Telephone:	Use	internal		
Non-responsive content removed				external		x
No items of note						
3.8 O-rings No items of note				<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.9 Miscellaneous No items of note				<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.10 Pictures						
						
Fig. 1: Roller support left: Cavitation erosion on the HP piston contact area			Fig. 2: Roller support right: Cavitation erosion on the HP piston contact area			
4. Hydraulic function						
				Delivery rate [l/h] of new part	Delivery rate [l/h] after testing	
	n [rpm]	p_rail [bar]	I_metering unit [A]	05.09.2007	05.12.2007	
LG	1000	2000	0.4	36.8	37.0	<input checked="" type="checkbox"/>
No significant change in volumetric efficiency; the volumetric efficiency lies within the tolerance specified for new parts in the TKU.						
5. Parts storage The pump will be scrapped by request of Audi.						
6. Attachments None						
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	BOSCH		CR pump CP4 - Findings report		Report no.	2007-CP4_0214
					Date	23.06.2008

Department:	Person responsible:	Telephone:		Use				
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internal	x							
external	x							

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Attn. of:

Pump type: CP4.2HS_747_2x5625_REC_3.3_1.3	Customer: Audi	Project: W19 EU6/BIN5	Project/ design sample version C2 with AWP
Item number (TT no.) : 0445B20169_07	Production date: 783	Serial number: 4436	Factory - Line 0110 FeP - 01
SAP no.: DS-169106	Samos no.: 582359	Customer order no.:	Engine/vehicle number Engine V6N 122
Customer item number	Durability test type [customer]: Vehicle durability test	Durability test conditions: US - warm test	DSBFD no.: 19675
Mileage 832 km	Received by DS-PC/EDI on: 23.11.2007	Transaction no. 2007-CP4_0214	Confidentiality note Confidential
VA/ETC no.: DS-169106	Durability test type [RB]:	Fuel: USA	

1. Subject

CP4 customer return **without complaint**

Findings according to operational / field complaint (not CP4) Cylinder scorcher cyl.

5 US - warm test

Engine V6N 122

2. Conclusion

Function

- Delivery rates after durability test or test show no significant quantity drift compared to new condition.

Components

- The wear on the components is minimal and without items of note.

Result

- The pump **has passed** the durability test.

3. Findings (visible findings)

Rating legend

OK	x		
non-critical	x		
critical		x	

3.1 Drive

No items of note

x		
---	--	--

3.2 Drivetrain

No items of note

x		
---	--	--

3.3 High pressure

No items of note

x		
---	--	--

3.4 Bearing

No items of note

x		
---	--	--

3.5 Shaft seal

No items of note

x		
---	--	--

3.6 Boreholes



No items of note



x		
---	--	--



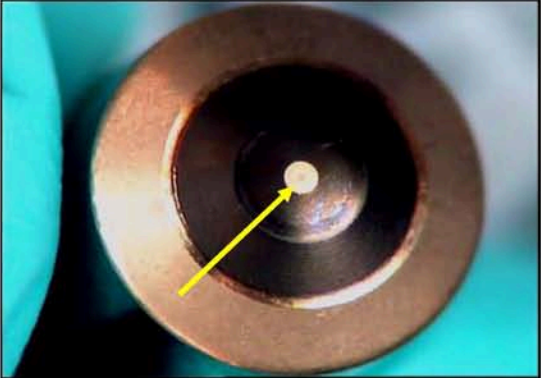
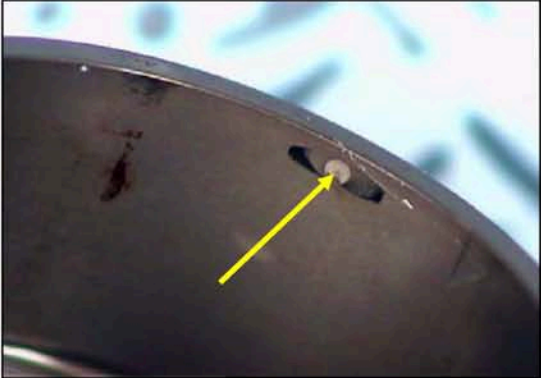
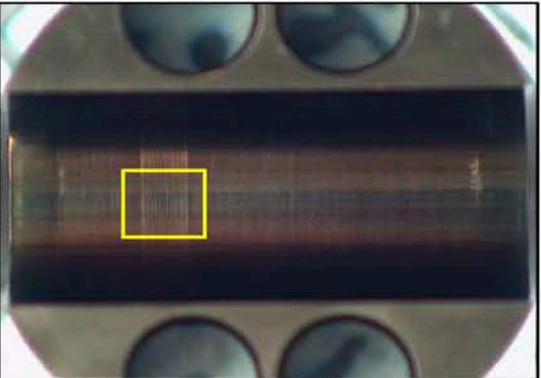
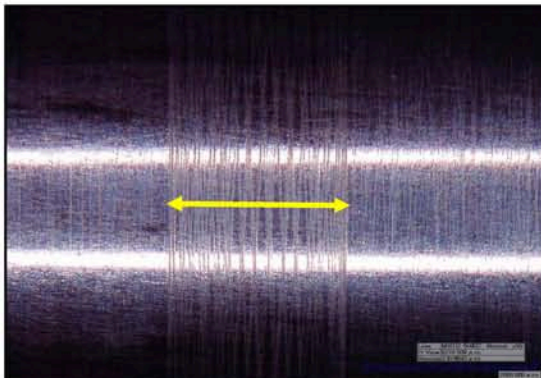
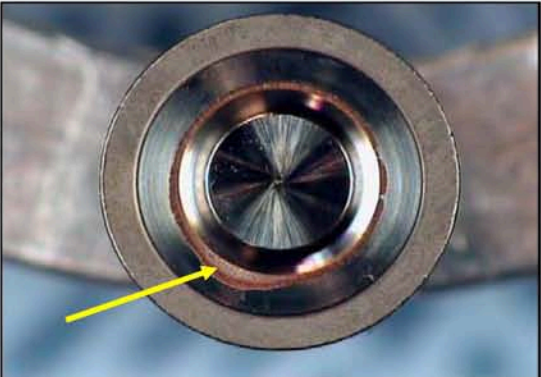
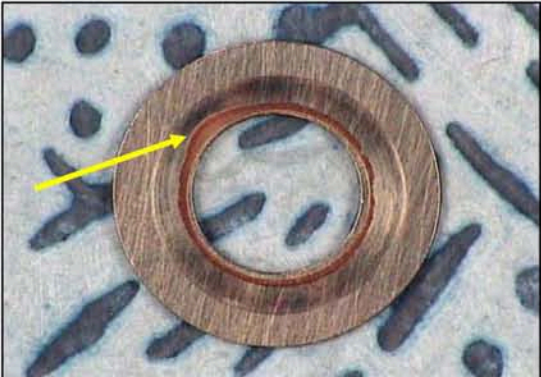
3.7 Built-on components (metering unit, overflow valve, counting point)

No items of note

x		
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 BOSCH 	CR pump CP4 - Findings report				Report no.	2007-CP4_0214	
					Date	23.06.2008	
Department:	Person responsible:			Telephone:	Use	internal	
Non-responsive content removed						external	x
3.8 O-rings No items of note						<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.9 Miscellaneous No items of note						<input checked="" type="checkbox"/>	<input type="checkbox"/>
4. Hydraulic function							
				Delivery rate [l/h] of new part	Delivery rate [l/h] after testing		
	n [rpm]	p_rail [bar]	l_metering unit [A]	15.03.2007	05.12.2007		
LG	1000	2000	0.4	36.9	37.4	<input checked="" type="checkbox"/>	<input type="checkbox"/>
No significant change in volumetric efficiency; the volumetric efficiency lies within the tolerance specified for new parts in the TKU.							
5. Parts storage The pump will be scrapped by request of Audi.							
6. Attachments None							
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 BOSCH 		CR pump CP4 - Findings report		Report no.	2008-CP4_0078												
				Date	09.06.2008												
Department:	Person responsible:	Telephone:	Use	internal													
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To:	Non-responsive content removed																
Attn. of:																	
Pump type:	Customer:	Project:	Project/ design sample version														
CP4.1S_348_2x5.25_REC_3_3_1.95_MT4.2	VW	R4 2,0 BIN5	D / D														
Item number (TT no.) :	Production date:	Serial number:	Factory - Line														
0445B21060	250407	0214	011M FeP-M														
SAP no.:	Samos no.:	Customer order no.:	Engine/vehicle number														
30-101008-05	587822		CBE0000079														
Customer item number	Durability test type [customer]:	Durability test conditions: Internal Release Durability Test / Oil Consumption Durability Test	DSBFD no.:														
	Engine endurance test		20172														
Mileage:	Received by DS-PC/ EDI on:	Transaction no.	Confidentiality note														
638 h	04.02.2008	2008-CP4_0078	Confidential														
VA/ETC no.:	Durability test type [RB]:	Fuel:															
DS-174530																	
Complaint:																	
<p>1. Subject</p> <p>CP4 customer return Findings at end of endurance test without complaint</p>																	
<p>2. Conclusion</p> <p>Function</p> <ul style="list-style-type: none"> - Delivery rates after endurance test without significant quantity drift compared to new condition. - Low-temperature leakage (formation of droplets) at the cylinder head screw plug from -30 °C (not tested at -25 °C). Low-temperature leak tightness verified at the shaft seal, metering unit and housing down to -40 °C. <p>Components</p> <ul style="list-style-type: none"> - The scoring under the C-coating in the roller support is non-critical because the C-coating is intact. The most probable cause is particle ingress by the cooling lubricant medium during the grinding process. The remedy used since Jan 08 is filtering of the cooling lubricant medium with silica gel (the production data of the pump is 25.04.2007). Picture of scoring defect was taken in Feb 08 in the visible inspection catalog of the roller support production operations. - The slightly asymmetrical wear of the intake valve sealing faces with brownish deposits is non-critical. - The O-ring of the screw plug shows a notch in the sealing area on the inside facing the screw. The width of the notch of approx. 170 µm is outside the tolerance of 150 µm. - The wear on the other components is minimal and without any significant items of note. <p>Result</p> <ul style="list-style-type: none"> - The low-temperature leakage at the screw plug in the cylinder head is ascribed to an unacceptably wide notch in the O-ring. Further analyses and measures will be carried out by the quality assurance department responsible for the purchased parts. - The pump has passed the endurance test with restrictions. 																	
<p>3. Findings (visible findings)</p> <p>Rating legend</p> <table border="1"> <tr> <td>OK</td> <td>x</td> <td></td> <td></td> </tr> <tr> <td>non-critical</td> <td></td> <td>x</td> <td></td> </tr> <tr> <td>critical</td> <td></td> <td></td> <td>x</td> </tr> </table>						OK	x			non-critical		x		critical			x
OK	x																
non-critical		x															
critical			x														
3.1 Drive				<table border="1"> <tr> <td>x</td> <td></td> <td></td> </tr> </table>		x											
x																	
No items of note																	
3.2 Drivetrain				<table border="1"> <tr> <td></td> <td>x</td> <td></td> </tr> </table>			x										
	x																
Lateral tapering of the roller (see Fig.1) in the tappet (see Fig. 2) Scoring under the C-coating in the roller support (see Fig. 3 and the magnification in Fig. 4)																	
3.3 High pressure				<table border="1"> <tr> <td></td> <td>x</td> <td></td> </tr> </table>			x										
	x																
Wear in intake valve area toward the cylinder head (intake valve plate see Fig. 5, intake valve sealing disk see Fig 6)																	
3.4 Bearing				<table border="1"> <tr> <td>x</td> <td></td> <td></td> </tr> </table>		x											
x																	
No items of note																	

 BOSCH 		CR pump CP4 - Findings report		Report no.	2008-CP4_0078
Department: Non-responsive content removed		Person responsible: Non-responsive content removed		Date	09.06.2008
Telephone: Non-responsive content removed		Use		internal	<input checked="" type="checkbox"/>
				external	<input checked="" type="checkbox"/>
3.5 Shaft seal No items of note					<input checked="" type="checkbox"/> <input type="checkbox"/>
3.6 Boreholes Cavitation erosion in the tappet borehole at the bottom in the direction of the power unit chamber (see Fig. 7)					<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
3.7 Built-on components (metering unit, overflow valve, counting point) No items of note					<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
3.8 Miscellaneous O-ring of screw plug in cylinder head slightly twisted and with notch on the inside (see Fig. 8) WLI measurement on O-ring of screw plug on cylinder head with notch (see Fig. 9)					<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
3.9 Pictures of visible findings					
					
<p>Fig. 1. End face of roller, housing side</p>			<p>Fig. 2. Tappet body inside, housing side</p>		
					
<p>Fig. 3. Roller support, roller borehole</p>			<p>Fig. 4. Magnification of Fig. 3: Scoring under the C-coating</p>		
					
<p>Fig. 5. Intake valve, sealing face toward the sealing disk</p>			<p>Fig. 6. Intake valve sealing disk, sealing face toward the intake valve</p>		

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Fig. 7. Housing, tappet borehole at bottom

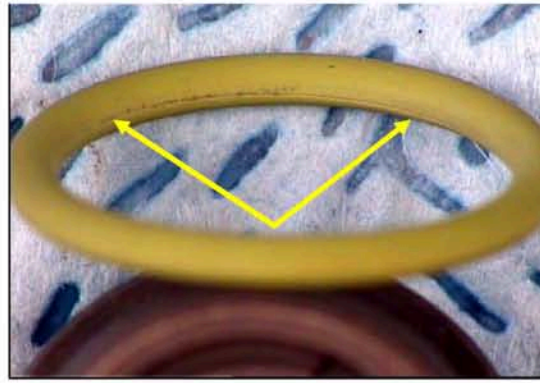


Fig. 8. O-ring of screw plug on cylinder head inside

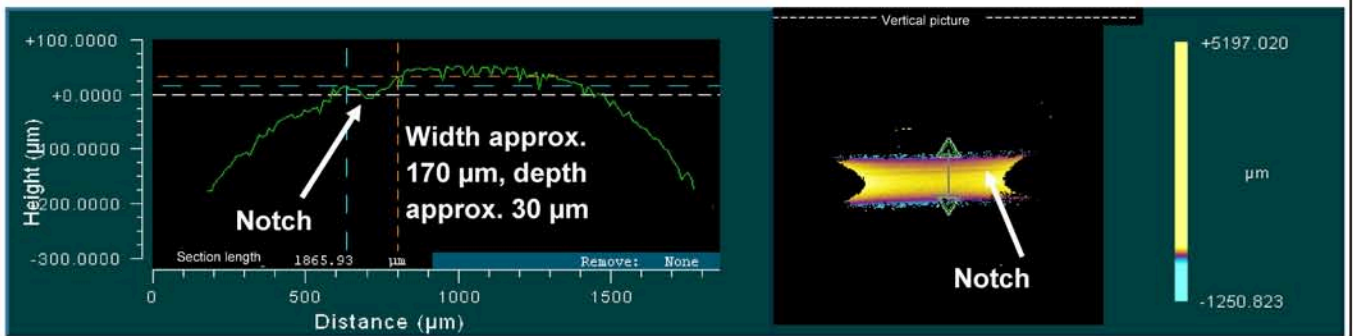


Fig. 9. WLI measurement of O-ring notch, profile section

4. Hydraulic function

	n [rpm]	p_rail [bar]	l_metering unit [A]	Delivery rate [l/h]	Delivery rate [l/h]
				of new part	after testing
				25.04.2007	11.02.2008
Starting point	200	200	0.4	3.9	3.8
1000 rpm, p_nom	1000	1800	0.4	17.9	18
n_max_p, 500 bar	3375	500	0.4	66.1	66.7

x		
x		
x		

TCD test point running limit (1000rpm, p_nom ≥ 15.5 or 15-2 l/h after r4unning time) is fulfilled.
 No significant quantity drift compared to the as-delivered measurement.



5. Parts storage

The pump will be stored at RB until 09/2008 and then scrapped.

6. Attachments

None

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 BOSCH 	CR pump CP4 - Findings report		Report no.	2008-CP4_0177													
			Date	16.06.2008													
Department:	Person responsible:	Telephone:	Use	internal													
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To:	Non-responsive content removed																
Attn. of:																	
Pump type:	Customer:	Project:	Project/ design sample version														
CP4.1S_348_2x5.25_REC_3.3_1.95_X	VW	R4 2,0 BIN5	B / B1														
Item number (TT no.) :	Production date:	Serial number:	Factory - Line														
0445B21060_05	688	4786	0110 FeP - 01														
SAP no.:	Samos no.:	Customer order no.:	Engine/vehicle number														
30-101005-01	590400,001		VW315780090														
Customer item number	Durability test type [customer]:	Durability test conditions:	DSBFD no.:														
	Vehicle endurance test	WL1+KL4	20455														
Mileage:	Received by DS-PC/EDI on:	Transaction no.	Confidentiality note														
98820 km	26.02.2008	2008-CP4_0177	Confidential														
VA/ETC no.:	Durability test type [RB]:	Fuel:															
DS-176929		US DK MY04															
Complaint:																	
<p>1. Subject</p> <p>CP4 customer return Findings at end of durability test without complaint</p>																	
<p>2. Conclusion</p> <p>Function</p> <ul style="list-style-type: none"> - Delivery rates after endurance test without significant quantity drift compared to new condition. - Low-temperature leak tightness after endurance test down to -25 °C verified <p>Components</p> <ul style="list-style-type: none"> - The cavitation erosion of roller support backs and high-pressure pistons is non-critical. - The rust on the cylinder head has not penetrated the interfaces and therefore is non-critical. - The axial wear of the flange bearing is non-critical but far greater than on comparable pumps. - The wear on the other components is minimal and without any significant items of note. <p>Result</p> <ul style="list-style-type: none"> - The pump has passed the endurance test. 																	
<p>3. Findings (visible findings)</p> <p style="text-align: right;">Rating legend</p> <table style="float: right;"> <tr> <td>OK</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>non-critical</td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>critical</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>						OK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
OK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>														
critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>														
3.1 Drive			<input checked="" type="checkbox"/>														
No items of note																	
3.2 Drivetrain			<input type="checkbox"/>														
Slight cavitation erosion on the roller support backs (see Fig. 1)			<input checked="" type="checkbox"/>														
Slight cavitation erosion (ring) on the dome of the HP piston (see Fig. 2)																	
3.3 High pressure			<input type="checkbox"/>														
Rust on the outside of the cylinder head (see Fig. 3) and on the housing support face (see Fig. 4)			<input checked="" type="checkbox"/>														
3.4 Bearing			<input type="checkbox"/>														
Flanged axial bearing with smoothing and discoloration (see Fig. 5)			<input checked="" type="checkbox"/>														
3.5 Shaft seal			<input type="checkbox"/>														
Slight digging in of the shaft seal into the camshaft (see Fig. 6)			<input checked="" type="checkbox"/>														
3.6 Boreholes			<input checked="" type="checkbox"/>														
No items of note																	

Department:	Person responsible:	Telephone:	Use	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">internal</td> <td style="width: 50%;"></td> </tr> <tr> <td>external</td> <td style="text-align: center;">x</td> </tr> </table>	internal		external	x
internal								
external	x							
Non-responsive content removed								

3.7 Built-on components (metering unit, overflow valve, counting point)
 No items of note

x	
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3.8 Miscellaneous
 Return connection with minor defect (see Fig. 7)

	x
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3.9 Pictures of visible findings

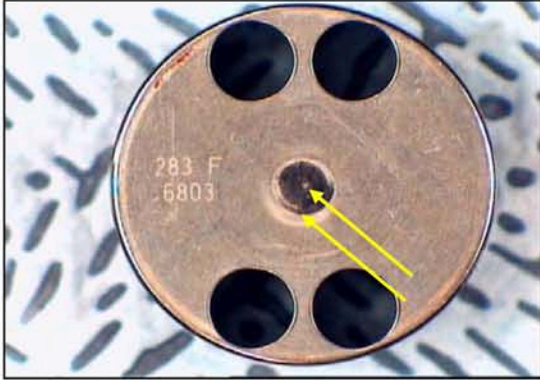


Fig. 1: Roller support, piston contact surface (cavitation)

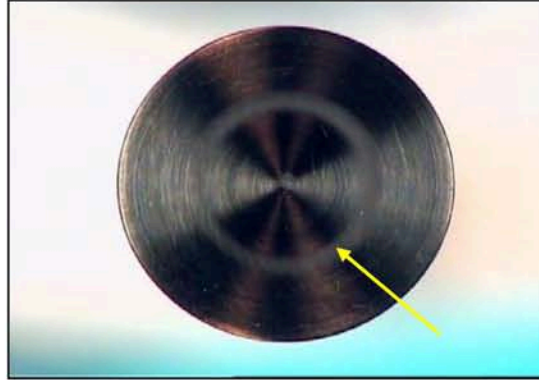


Fig. 2: HP piston, dome (cavitation ring)



Fig. 3: Cylinder head, surface (rust)

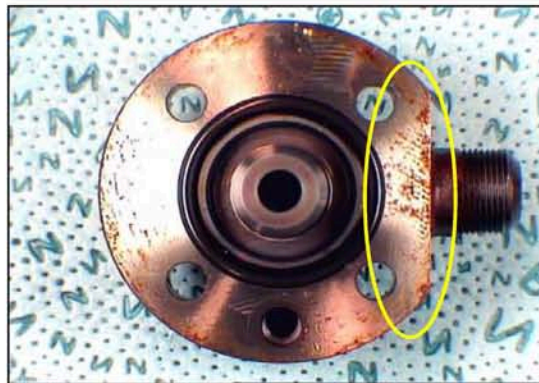


Fig. 4: Cylinder head, housing support face (rust)

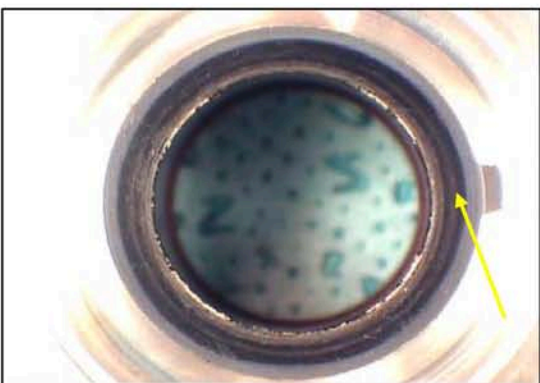


Fig. 5: Flanged bearing, axial (smoothing)

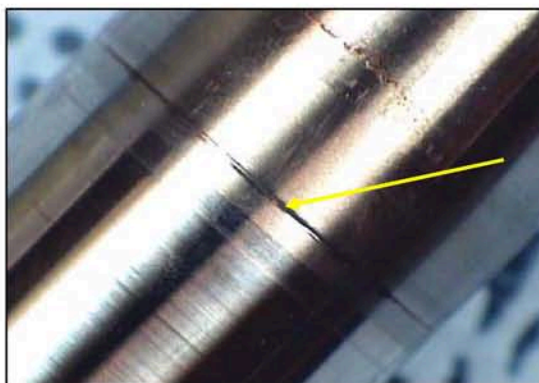


Fig. 6: Camshaft, running area of shaft seal

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Fig. 7: Return connection (with minor defect)

4. Hydraulic function

	n [rpm]	p_rail [bar]	I_metering unit [A]	Delivery rate [l/h]	Delivery rate [l/h]
				of new part	after testing
				20.09.2006	28.02.2008
Starting point	200	200	0.4	3.9	3.9
1000 rpm, p_nom	1000	1800	0.4	17.7	17.5
n_max_p, 500 bar	3375	500	0.4	66.8	66.7

x	
x	
x	

TKU test point LG (1000rpm, p_nom ≥ 15.5 or 15-2 l/h after running time) is fulfilled.
 No significant quantity drift compared to the as-delivered measurement.



5. Parts storage

The pump will be stored at RB until 09/2008 and then scrapped.

6. At-tachments

None

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 BOSCH 	CR pump CP4 - Findings report		Report no.	2008-CP4_0183													
			Date	17.06.2008													
Department:	Person re-sponsible:	Telephone:	Use	internal													
Non-responsive content removed				external	x												
To:	Non-responsive content removed																
Attn. of:																	
Pump type:	Customer:	Project:	Project/ design sample ver-sion														
CP4.1S_348_2x5.25_REC_3,3_1.95_MT4.2	VW	R4 2.0 BIN5	D / Series														
Item number (TT no.) :	Production date:	Serial number:	Factory - Line														
445010508	090707	0453	0110 FeP - 01														
SAP no.:	Samos no.:	Customer order no.:	Engine/vehicle number														
30-101008-05	590274001	CBE0000544	CBE0000544														
Customer item number	Durability test type [customer]:	Durability test conditions:	DSBFD no.:														
CBE0000544	Engine endurance test	unknown	20473														
Mileage:	Received by DS-PC/EDI on:	Transaction no.	Confidentiality note														
981 h	26.02.2008	2008-CP4_0183	Confidential														
VA/ETC no.:	Durability test type [RB]:	Fuel:															
DS-176923																	
Complaint:																	
<p>1. Subject</p> <p>CP4 customer return Findings at end of endurance test without complaint</p>																	
<p>2. Conclusion</p> <p>Function</p> <ul style="list-style-type: none"> - Delivery rates after endurance test without significant quantity drift compared to new condition. - Low-temperature leak tightness after endurance test down to -30 °C verified <p>Components</p> <ul style="list-style-type: none"> - Wear marks (smoothing) on the camshaft, roller and in the roller support non-critical. - Oxidation marks in the wear region of the spring cup, tappet body, tappet spring, cylinder head and intake valve probably due to contact with corrosive medium. - Metering unit connector housing with melted area on the surface probably due to contact with or too close a proximity to hot engine parts. - The wear on the other components is minimal and without any significant items of note. <p>Result</p> <ul style="list-style-type: none"> - The pump has passed the endurance test. 																	
<p>3. Findings (visible findings)</p> <p style="text-align: right;">Rating legend</p> <table border="1" style="float: right;"> <tr> <td>OK</td> <td>x</td> <td></td> <td></td> </tr> <tr> <td>non-critical</td> <td></td> <td>x</td> <td></td> </tr> <tr> <td>critical</td> <td></td> <td></td> <td>x</td> </tr> </table>						OK	x			non-critical		x		critical			x
OK	x																
non-critical		x															
critical			x														
<p>3.1 Drive</p> <p>No items of note</p>			<table border="1"> <tr> <td>x</td> <td></td> <td></td> </tr> </table>			x											
x																	
<p>3.2 Drivetrain</p> <p>Camshaft with narrow bright mark on the cam on the housing side (see Fig. 1), roller with fine circumferential mark on the housing side (see Fig. 2) matching the cam Roller support with fine scoring on the C-coating (see Fig. 3) matching the roller</p>			<table border="1"> <tr> <td></td> <td>x</td> <td></td> </tr> </table>				x										
	x																
<p>3.3 High pressure</p> <p>No items of note</p>			<table border="1"> <tr> <td>x</td> <td></td> <td></td> </tr> </table>			x											
x																	
<p>3.4 Bearing</p> <p>No items of note</p>			<table border="1"> <tr> <td>x</td> <td></td> <td></td> </tr> </table>			x											
x																	
<p>3.5 Shaft seal</p> <p>No items of note</p>			<table border="1"> <tr> <td>x</td> <td></td> <td></td> </tr> </table>			x											
x																	

Department:	Person responsible:	Telephone:	Use	internal	
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3.6 Boreholes

No items of note

x	
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3.7 Built-on components (metering unit, overflow valve, counting point)

Metering unit plug housing with melted areas (see Fig. 4)

x	
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3.8 Miscellaneous

Oxidation marks in the wear region of the spring cup (see Fig. 5) toward the tappet body (see Fig. 6) Oxidation marks in the wear region of the spring cup (see Fig. 7) toward the tappet spring (see Fig. 8) Oxidation marks in the wear region of the tappet spring (see Fig. 9) toward the cylinder head (see Fig. 10) Oxidation marks in the wear region of the intake valve (see Fig. 11) toward the sealing disk (see Fig. 12)

x	
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3.9 Pictures of visible findings

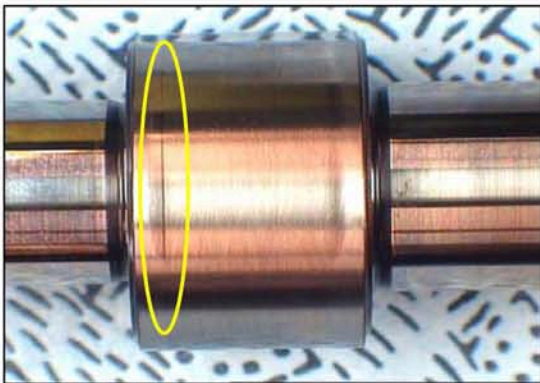


Fig. 1. Camshaft (smoothing mark)

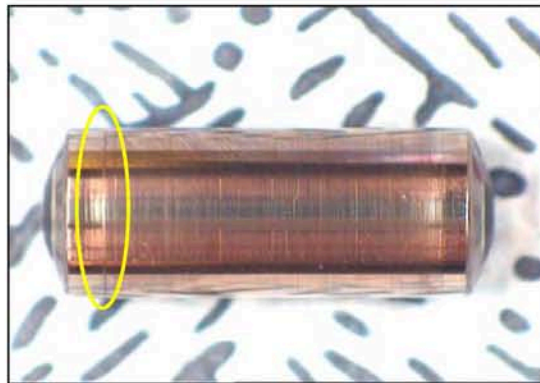


Fig. 2. Roller (circumferential mark)

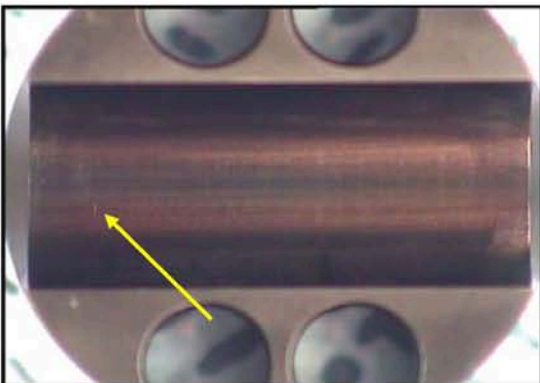


Fig. 3. Roller support (fine scoring)

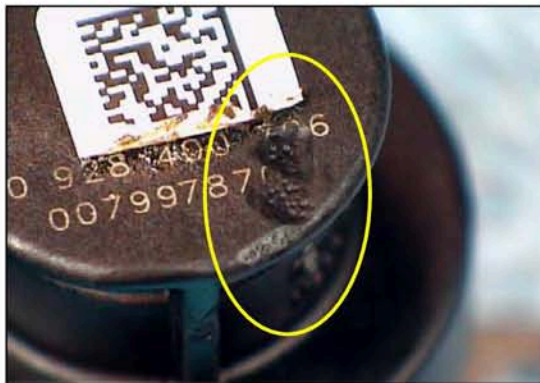


Fig. 4. Metering unit, plug housing (melted areas)

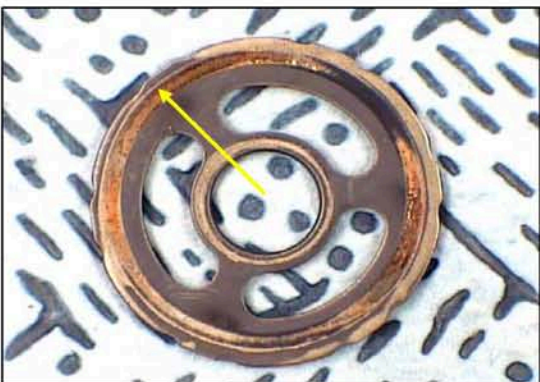


Fig. 5. Spring cup, tappet side (oxides)

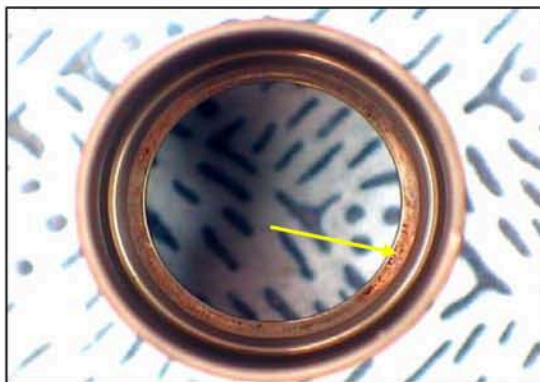


Fig. 6. Tappet collar, spring cup side (oxides)



Fig. 7. Spring cup, spring side (oxides)

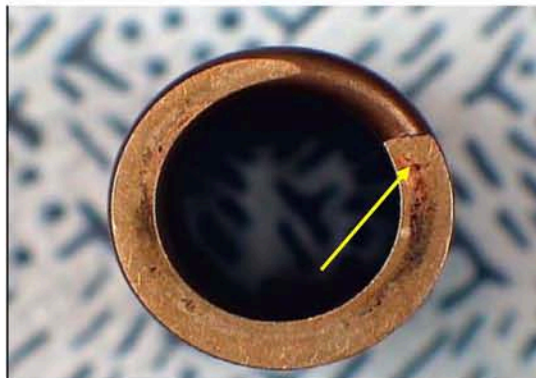


Fig. 8. Tappet spring, spring cup side (oxides)

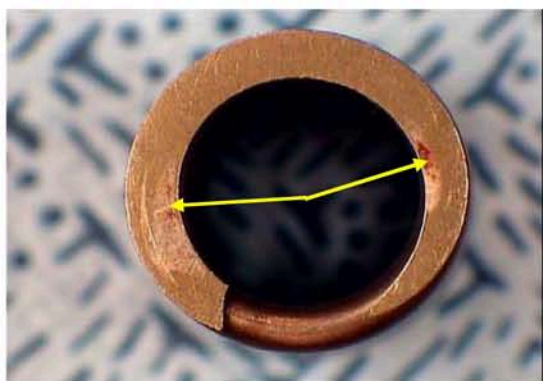


Fig. 9. Tappet spring, cylinder head side (oxides)

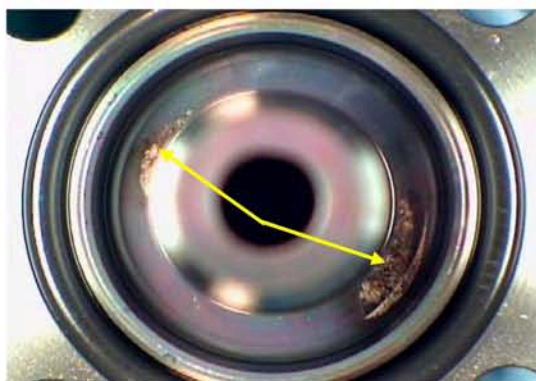


Fig. 10. Cylinder head, spring side (oxides)

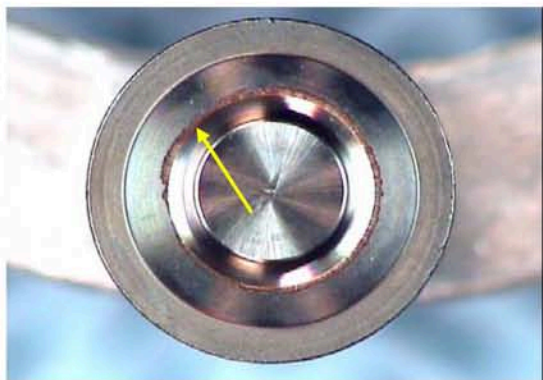


Fig. 11. Intake valve (oxides)

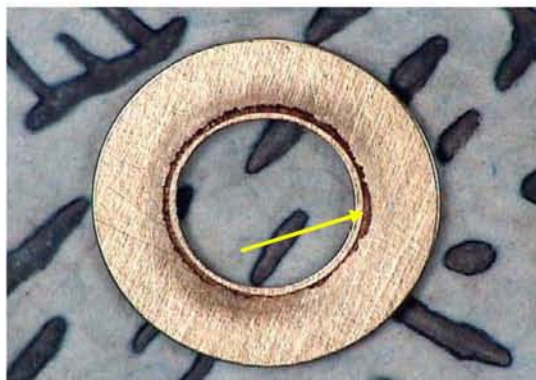




Fig. 12. Sealing disk (oxides)


4. Hydraulic function

	n [rpm]	p _{rail} [bar]	I _{metering unit} [A]	Delivery rate [l/h]	Delivery rate [l/h]
				of new part	after testing
				06.07.2007	07.03.2008
Starting point	200	200	0.4	3.9	4.2
1000 rpm, p _{nom}	1000	1800	0.4	18.3	17.7
n _{max_p} , 500 bar	3375	500	0.4	67.4	66.6

x		
x		
x		

TCD test point running limit (1000rpm, p_{nom} ≥ 15.5 or 15-2 l/h after running time) is fulfilled.
 No significant quantity drift compared to the as-delivered measurement.

 BOSCH 	CR pump CP4 - Findings report			Report no.	2008-CP4_0183	
				Date	17.06.2008	
Department:	Person responsible:	Telephone:	Use	internal	<input type="checkbox"/>	
Non-responsive content removed				external	<input checked="" type="checkbox"/>	
<p>5. Parts storage</p> <p>The pump will be stored at RB until 09/2008 and then scrapped.</p>						
<p>6. At-tachments</p> <p>None</p>						
<p>Non-responsive content removed</p>						

	CR pump CP4 - Findings report		Report no.	2008-CP4_0184										
			Date	17.06.2008										
Department:	Person responsible:	Telephone:	Use	internal										
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To:	Non-responsive content removed													
Attn. of:	Non-responsive content removed													
Pump type:	Customer:	Project:	Project/ design sample version											
CP4.1S_348_2x5,25_REC_3.3_1,95_MT4,2	VW	R4 2,0 BIN5	B / B											
Item number (TT no.) :	Production date:	Serial number:	Factory - Line											
0445B21060_06	689	4148	0110 FeP - 01											
SAP no.:	Samos no.:	Customer order no.:	Engine/vehicle number											
30-101008-05	590399.001	O3LD/17088	O3LD/17088											
Customer item number	Durability test type [customer]:	Durability test conditions:	DSBFD no.:											
O3LD/17088	Vehicle endurance test	WL1 + KL4 + Winnipeg	20470											
Mileage:	Received by DS-PC/EDI on:	Transaction no.	Confidentiality note											
100026 km	26.02.2008	2008-CP4_0184	Confidential											
VA/ETC no.:	Durability test type [RB]:	Fuel:												
DS-176928														
Complaint:														
1. Subject														
CP4 customer return Findings at end of endurance test without complaint														
2. Conclusion														
Function														
- Delivery rates after endurance test without significant quantity drift compared to new condition. - Low-temperature leak tightness after endurance test down to -25 °C verified														
Components														
- The axial wear of the flange bearing is non-critical but greater than on comparable pumps. - The surface of the cylinder head is oxidized in spite of the guard cap. However, the rust has not penetrated into the interface areas. - Slight digging in of the shaft seal is non-critical and no longer relevant because it is an old sample version. - The wear on the other components is minimal and without any significant items of note.														
Result														
- The pump has passed the endurance test.														
3. Findings (visible findings)														
			Rating legend	{ OK <table border="1"><tr><td>x</td><td></td><td></td></tr><tr><td></td><td>x</td><td></td></tr><tr><td></td><td></td><td>x</td></tr></table> non-critical critical		x				x				x
x														
	x													
		x												
3.1 Drive	No items of note			<table border="1"><tr><td>x</td><td></td><td></td></tr></table>		x								
x														
3.2 Drivetrain	No items of note			<table border="1"><tr><td>x</td><td></td><td></td></tr></table>		x								
x														
3.3 High pressure	No items of note			<table border="1"><tr><td>x</td><td></td><td></td></tr></table>		x								
x														
3.4 Bearing	Flanged bearing with smoothing and discoloration axially over complete area (see Fig. 1)			<table border="1"><tr><td></td><td>x</td><td></td></tr></table>			x							
	x													
3.5 Shaft seal	Slight structured digging in of the shaft seal into the camshaft (see Fig. 2)			<table border="1"><tr><td></td><td>x</td><td></td></tr></table>			x							
	x													
3.6 Boreholes	No items of note			<table border="1"><tr><td>x</td><td></td><td></td></tr></table>		x								
x														
3.7 Built-on components (metering unit, overflow valve, counting point)	No items of note			<table border="1"><tr><td>x</td><td></td><td></td></tr></table>		x								
x														
3.8 Miscellaneous	Rust on the outside of the cylinder head (see Fig. 3) and on the housing support face (see Fig. 4)			<table border="1"><tr><td></td><td>x</td><td></td></tr></table>			x							
	x													

 BOSCH 	CR pump CP4 - Findings report	Report no.	2008-CP4_0184
		Date	17.06.2008

Department:	Person responsible:	Telephone:	Use	internal	
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3.9 Pictures of visible findings

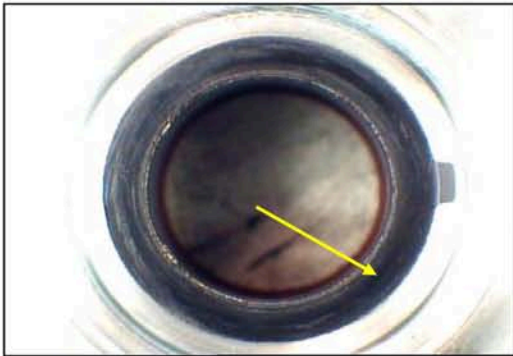


Fig. 1. Flanged bearing, axial (smoothing)

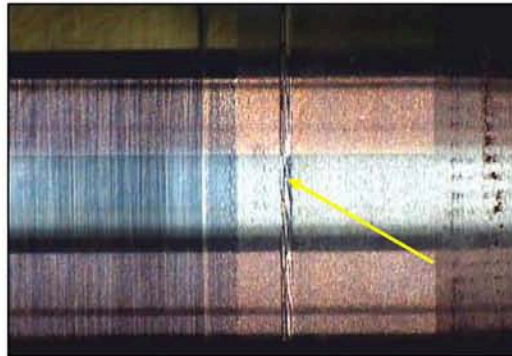


Fig. 2. Camshaft, running area of shaft seal



Fig. 2. Cylinder head, surface (rust)

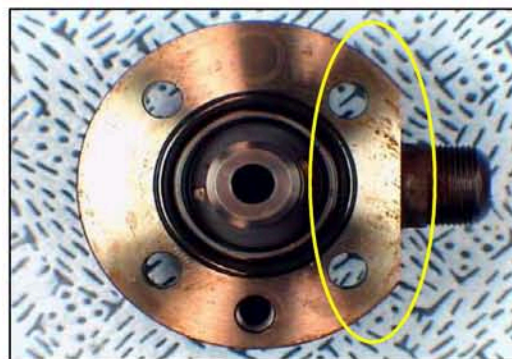


Fig. 4. Cylinder head. Housing support (rust)

4. Hydraulic function

	n [rpm]	p _{rail} [bar]	I _{metering unit} [A]	Delivery rate [l/h]	Delivery rate [l/h]
				of new part	after testing
Starting point	200	200	0.4	25.09.2006 3.9	28.02.2008 3.9
1000 rpm, p _{nom}	1000	1800	0.4	17.6	17.6
n _{max_p} , 500 bar	3375	500	0.4	67	67.3

x		
x		
x		

TCD test point running limit (1000 rpm, p_{nom} ≥ 15.5 or 15-2 l/h after running time) is fulfilled.
 No significant quantity drift compared to the as-delivered measurement.


5. Parts storage

The pump will be stored at RB until 09/2008 and then scrapped.

6. Attachments

None

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 CR pump CP4 - Findings report		Report no.	2008-CP4_0186													
		Date	17.06.2008													
Department:	Person responsible:	Telephone:	Use	internal												
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To:	Non-responsive content removed															
Attn. of:																
Pump type:	Customer:	Project:	Project/ design sample version													
CP4.1S_348_2x5.25_REC_3,3_1.95_MT4.2	VW	R4 2.0 BIN5	C / C													
Item number (TT no.) :	Production date:	Serial number:	Factory - Line													
0445B21060_11	692	4335	0110 FeP - 01													
SAP no.:	Samos no.:	Customer order no.:	Engine/vehicle number													
30-101008-01	590284.001	O3LD/18097	O3LD/18097													
Customer item number	Durability test type [customer]:	Durability test conditions:	DSBFD no.:													
O3LD/18097	Vehicle endurance test	QS-DL 1/3 Mix	20471													
Mileage:	Received by DS-PC/EDI on:	Transaction no.	Confidentiality note													
126398 km	26.02.2008	2008-CP4_0186	Confidential													
VA/ETC no.:	Durability test type [RB]:	Fuel:														
DS-176926		US DK MY04														
Complaint:																
<p>1. Subject</p> <p>CP4 customer return Findings at end of endurance test without complaint</p>																
<p>2. Conclusion</p> <p>Function</p> <ul style="list-style-type: none"> - Delivery rates after endurance test without significant quantity drift compared to new condition. - Low-temperature leak tightness after endurance test down to -30°C verified <p>Components</p> <ul style="list-style-type: none"> - The axial wear of the flanged bearing is non-critical but greater than on comparable pumps. - The wear on the other components is minimal and without any significant items of note. <p>Result</p> <ul style="list-style-type: none"> - The pump has passed the endurance test. 																
<p>3. Findings (visible findings)</p> <p style="text-align: right;">Rating legend</p> <table border="1" style="float: right;"> <tr> <td>OK</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>non-critical</td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>critical</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>					OK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
OK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>													
non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>													
critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>													
3.1 Drive			<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>													
No items of note																
3.2 Drivetrain			<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>													
No items of note																
3.3 High pres-sure			<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>													
No items of note																
3.4 Bearing			<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>													
Flanged axial bearing with smoothing and discoloration (see Fig. 1)																
3.5 Shaft seal			<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>													
No items of note																
3.6 Boreholes			<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>													
No items of note																
3.7 Built-on components (metering unit, overflow valve, counting point)			<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>													
No items of note																

 BOSCH 	CR pump CP4 - Findings report		Report no.	2008-CP4_0186
			Date	17.06.2008

Department:	Person responsible:	Telephone:	Use	internal	
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3.8 Miscellaneous
No items of note

x	
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3.9 Pictures of visible findings

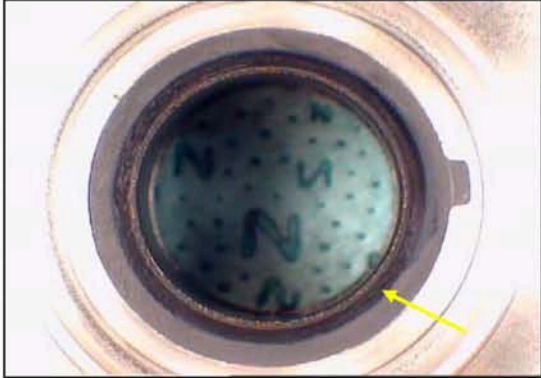


Fig. 1. Flange bearing, axial (smoothing)

4. Hydraulic function

	n [rpm]	p_rail [bar]	I_metering unit [A]	Delivery rate [l/h]	Delivery rate [l/h]
				of new part	after testing
				19.12.2006	28.02.2008
Starting point	200	200	0.4	3.9	3.9
1000 rpm, p_nom	1000	1800	0.4	17.3	17
n_max_p, 500 bar	3375	500	0.4	67.1	67.4

x	
x	
x	

TCD test point running limit (1000 rpm, p_nom ≥ 15.5 or 15-2 l/h after running time) is fulfilled.
No significant quantity drift compared to the as-delivered measurement.



5. Parts storage



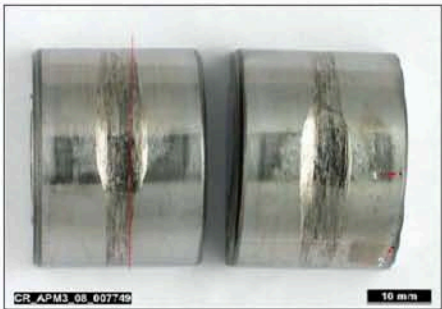
The pump will be stored at RB until 09/2008 and then scrapped.

6. Attachments

None

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 BOSCH 		CR pump CP4 - Findings report		Report no.	2008-CP4_0266
				Date	28.04.2008
Department:	Person responsible:	Telephone:	Use	<input type="checkbox"/> internal	<input checked="" type="checkbox"/> external
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To:	Non-responsive content removed				
Attn. of:					
Pump type: CP4.1S_348_2x5.25_REC_3.3_1.95_MT4.2	Customer: VW	Project: R4 2.0 BIN5	Project/ design sample version D / Serie		
Item number (TT no.): 445010508	Production date: 230807	Serial number: 0119	Factory - Line 0110 FeP - 01		
SAP no.: 30-101008-05	Samos no.:	Customer order no.:	Engine/vehicle number 03L130755A		
Customer item number	Durability test type [customer]: Vehicle endurance test	Durability test conditions: USA test of Jetta Variant	DSBFD no.:		
Mileage 23927 km	Received by DS-PC/EDI on: 26.03.2008	Transaction no. 2008-CP4_0266	Confidentiality note Confidential		
VA/ETC no.:	Durability test type [RB]	Fuel:			
Complaint: Engine switch-off					
1. Subject					
<ul style="list-style-type: none"> - CP4 customer return: Failure of test vehicle 1K59M029. - USA test of Jetta Variant - Pump from VW taken apart with the following findings: Drivetrain damage and metering unit O-ring sheared off. 					
2. Conclusion					
Function					
<ul style="list-style-type: none"> - Switching off of the engine because of lack of pressure build-up and delivery rate due to a particle in the intake valve. Particle identified by SEM and EDX as a wear particle from the roller. The cause of this is drivetrain damage with severe removal of material from the roller and cam track by transverse running roller. 					
Components					
<ul style="list-style-type: none"> - Roller support: Local C-coating abrasion in the middle of the running face. Adhesion of the C-coating in the area of the damage is OK. Spalling and flaking indicate increased local loading. - Roller: Central adhesive wear around the circumference and severe removal of material due to turning through 90° relative to cam track. Adhesive wear between roller support and roller due to transfer of the C-coating onto the roller can be verified. No detectable indication of surface breakdown (fatigue). - Camshaft: Abrasive sliding wear on the camshaft. No detectable indication of surface breakdown (fatigue). Sporadic corrosive attack detectable at the edge of the cam track along the machining score marks. - Tappet borehole: The annular brownish coverings were identified by means of SEM and EDX as wear particles from the camshaft with corroded surface. - Tappet fields: Wear on the inside diameter probably due to transverse running tappet assembly. - Metering unit: O-ring for inner seal cut wrongly. This defect profile is known already and owed to incorrect installation. 					
Result:					
<ul style="list-style-type: none"> - Given the damage profiles, the most probable cause of the drivetrain damage is the local abrasion of the C-coating by the roller. Because of the damage it is no longer possible to detect any direct causes, but material fatigue can be ruled out. Other investigations with damage analysis indicate the two following faults as possible causes of the damage to the C-coating and therefore of the subsequent damage: <ul style="list-style-type: none"> - Elevation on the roller due to impressed particles, e.g. from the production process - Metal splashes on or in the C-coating surface 					
<ul style="list-style-type: none"> - The pump has not passed the endurance test. 					

 BOSCH 		CR pump CP4 - Findings report		Report no.: 2008-CP4_0266 Date: 28.04.2008												
Department: Non-responsive content removed	Person responsible: Non-responsive content removed	Telephone: Non-responsive content removed	Use: internal <input type="checkbox"/> external <input checked="" type="checkbox"/>													
3. Findings (visible findings)			Rating legend: <table border="1"> <tr> <td>OK</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>non-critical</td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>critical</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>		OK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>													
critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>													
3.1 Drive No item of note			<table border="1"> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>									
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
3.2 Drivetrain - Severe wear of the cam (Fig. 1) and roller (Fig. 3) due to turning of the roller through 90°. - Roller support locally worn (Fig. 5) and circumferential mark on the roller (Fig. 4).			<table border="1"> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>									
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>														
3.3 High pressure - Intake valve leakage due to a chip (Fig. 11 and 12) clamped in the valve seat. - Outside of the high-pressure piston borehole with wear mark (Fig. 10) from the tappet fields.			<table border="1"> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>									
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>														
3.4 Bearing - Many wear particles pressed into in the radial bearing surface (Fig. 13) and oxidized (Fig. 14).			<table border="1"> <tr> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>									
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>														
3.5 Shaft seal No items of note			<table border="1"> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>									
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
3.6 Boreholes - Tappet borehole with scoring by wear particles (Fig. 17) which are oxidized on the surface (Fig. 18). - Wear particles in the metering unit borehole (Fig. 19)			<table border="1"> <tr> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>									
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>														
3.7 Built-on components (metering unit, overflow valve, counting point) Metering unit O-ring twisted and sheared off (Fig. 20).			<table border="1"> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>									
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>														
3.8 Miscellaneous No items of note			<table border="1"> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>									
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
3.9 Pictures of visible findings																
																
Fig. 1. Cam cut																



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				external	<input checked="" type="checkbox"/>

Fig. 3. Roller with mark from 90° twist

Fig. 4. Roller, circumferential wear mark

Fig. 5. Roller support, roller borehole

Fig. 6. SEM magnification of Fig. 5 (hardness test points)

Fig. 7. Point 1 from Fig. 6

Fig. 8. Point 2 from Fig. 6

Fig. 9. Tappet spring, inside diameter

Fig. 10. Cylinder head, high-pressure piston borehole outside

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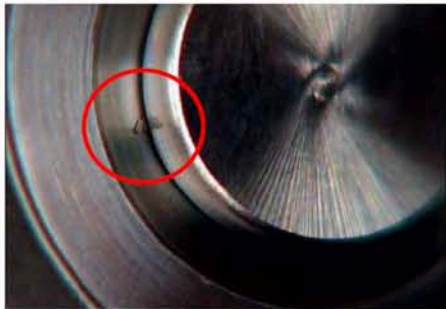


Fig. 11. Intake valve, chip between piston and plate

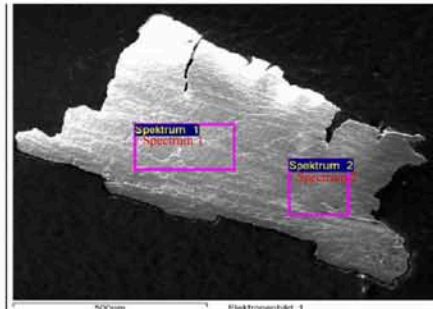


Fig. 12. Chip between intake valve piston and intake valve plate

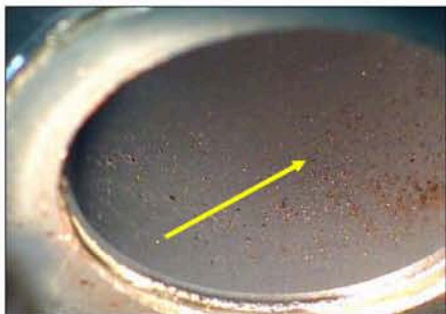


Fig. 13. Flange, bearing bush radial



Fig. 14. Detail from Fig. 9, oxidized particles on the surface

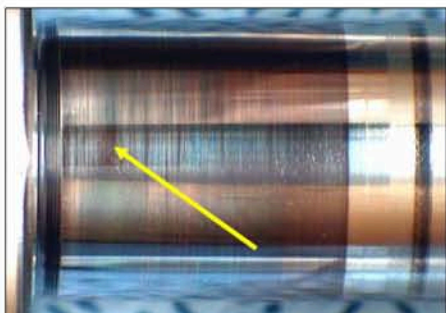


Fig. 15. Cam shaft, flanged bearing area

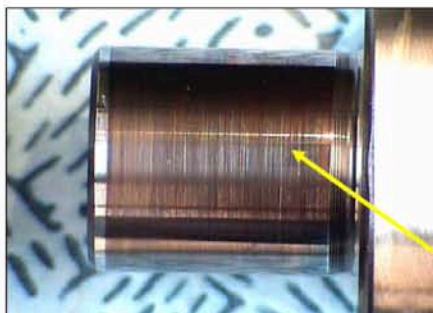




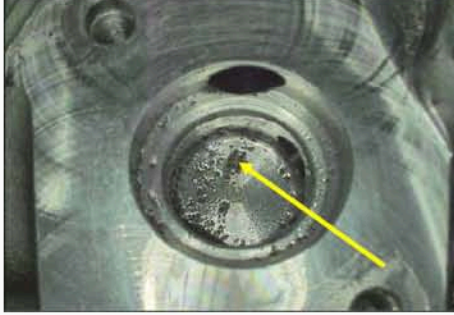

Fig. 16. Cam shaft, housing support area



Fig. 17. Tappet borehole



Fig. 18. Tappet borehole, oxidized wear particles

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			Date	28.04.2008	
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<p>Fig. 19. Housing, metering unit borehole</p>			<p>Fig. 20. Metering unit, O-ring toward cylinder head</p>		
<p>5. Parts distribution</p> <p>The pump will be stored at RB until 06/2008 and then scrapped.</p>					
<p>6. Appendix</p> <p>None</p>					
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 BOSCH 	CR pump CP4 - Findings report		Report no.	2008-CP4_0307
			Date	19.05.2008

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Pump type: CP4.1S_348_2x5.25_REC_3,3_1,95_MT4.2	Customer: VW	Project: R4 2.0 BIN5	Project/ design sample ver-sion D / Series
Item number (TT no.) : 445010508	Production date: 090707	Serial number: 0478	Factory - Line 0110 FeP - 01
SAP no.: DS-184197	Samos no.: 597894	Customer order no.:	Engine/vehicle number CBE 000568
Customer item number	Durability test type [customer]: Vehicle durability test	Durability test conditions: Verification vehicle/durability test vehicle US market	DSBFD no.: 21150
Mileage 41830 km	Received by DS-PC/EDI on: 08.04.2008	Transaction no. 2008-CP4_0307	Confidentiality note Confidential

1. Subject

CP4 customer return

Test conditions: Verification vehicle/durability test vehicle US market

Findings type: Findings after end of durability test

2. Conclusion

Function:
The delivery rates after the durability test lie within the specification limits.

Components:
no significant wear on the components.

Result:
The pump **has passed** the durability test.

3. Findings (visible findings)

Rating legend

OK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3.1 Drive No item of note	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2 Drivetrain No wear visible	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3 High pressure No wear visible	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4 Bearing No item of note	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.5 Shaft seal No item of note	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.6 Boreholes No item of note	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.7 Built-on components (metering unit, overflow valve, counting point) No item of note	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.8 O-rings No item of note	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

 BOSCH 	CR pump CP4 - Findings report		Report no.	2008-CP4_0307
			Date	19.05.2008

Department:	Person responsible:	Telephone:	Use	internal	
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4. Hydraulic function



	n [rpm]	p_rail [bar]	l_metering unit [A]	Delivery rate [l/h] of new part	Delivery rate [l/h] after testing		
				12.07.2007	07.04.2008		
ST	200	200	0.4	3.9	3.8	x	
LG	1000	1800	0.4	18	17.9	x	
KL-1S	3375	500	0.4	66	67.8	x	

No hydraulic defects discovered

5. Parts storage

The parts will be stored until 11/2008 at RB.

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 BOSCH 	CR pump CP4 - Findings report		Report no.	2008-CP4_0331
			Date	24.06.2008
Department:	Person responsible:	Telephone:	Use	
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			external	<input checked="" type="checkbox"/>
To:	Non-responsive content removed			
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Pump type:	Customer:	Project:	Project/ design sample version	
CP4.1S_348_2x5.25_REC_3_3_1.95_MT4.2	VW	R4 2.0 BIN5	C / C	
Item number (TT no.) :	Production date:	Serial number:	Factory - Line	
0445B21060_11	692	4343	011M FeP-M -	
SAP no.:	Samos no.:	Customer order no.:	Engine/vehicle number	
30-101008-05	599005.003	3LDP18102	3LDP18102	
Customer item number	Durability test type [customer]:	Durability test conditions:	DSBFD no.:	
3LDP18102	Vehicle endurance test	VW351780088 / KL4	21229	
Mileage:	Received by DS-PC/EDI on:	Transaction no.	Confidentiality note	
117627 km	15.04.2008	2008-CP4_0331	Confidential	
VA/ETC no.:	Durability test type [RB]:	Fuel:		
		US field		

1. Subject

CP4 customer return
 Findings at end of endurance test without complaint
 Test conditions: VW351780088 / KL4

2. Conclusion

Function

- Delivery rates after endurance test without significant quantity drift compared to new condition.
- Low-temperature leak tightness after endurance test down to -30 °C verified.

Components

- The cavitation erosion between roller support backs and high-pressure pistons is noncritical.
- The wear on the other components is minimal and without any significant items of note.

Result

- The pump **has passed** the endurance test.

3. Findings (visible findings)

Rating legend

OK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3.1 Drive

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.2 Drivetrain

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3 High pres-sure

Cavitation erosion in the center and around the center of the high-pressure piston (see Fig. 1)

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3.4 Bear-ing

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.5 Shaft seal

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.6 Boreholes

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.7 Built-on components (metering unit, overflow valve, counting point)

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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 BOSCH 	CR pump CP4 - Findings report		Report no.	2008-CP4_0331
			Date	24.06.2008

Department:	Person responsible:	Telephone:	Use	internal	
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3.8 Miscellaneous
No items of note

x	
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3.9 Pictures of visible findings

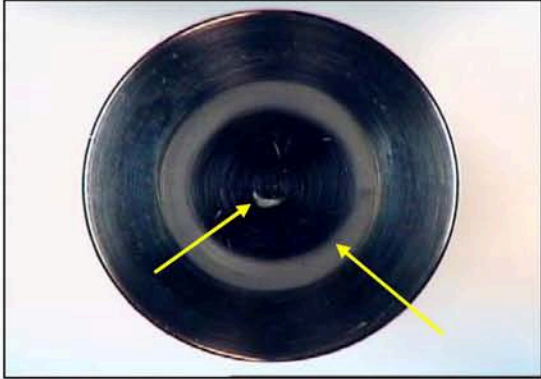


Fig. 1. High-pressure piston, piston foot (cavitation)

4. Hydraulic function

	n [rpm]	p_rail [bar]	I_metering unit [A]	Delivery rate [l/h]	Delivery rate [l/h]
				of new part	after testing
Starting point	200	200	0.4	19.12.2006 66.4	14.04.2008 66.3
1000 rpm, p_nom	1000	1800	0.4	17.3	17.3
n_max_p, 500 bar	3375	500	0.4	3.9	3.9

x	
x	
x	

TKU test point LG (1000 rpm, p_nom ≥ 15.5 or 15-2 l/h after LZ) is fulfilled.
No significant quantity drift compared to the as-delivered measurement.



5. Parts storage

The pump will be stored at RB until 09/2008 and then scrapped.

6. Attachments

None

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 BOSCH 		CR pump CP4 - Findings report		Report no.	2008-CP4_0332
				Date	20.06.2008
Department:	Person responsible:	Telephone:	Use	internal	
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To:	Non-responsive content removed				
Attn. of:					
Pump type:	Customer:	Project:	Project/ design sample version		
CP4.1S_348_2x5,25_REC_3,3_1,95_MT4,2	VW	R4 2.0 BIN5	B / B1		
Item number (TT no.) :	Production date:	Serial number:	Factory - Line		
0445B21060_05	689	4943	011M FeP-M		
SAP no.:	Samos no.:	Customer order no.:	Engine/vehicle number		
30-101008-05	599005.004		3LDB17267		
Customer item number	Durability test type [customer]:	Durability test conditions:	DSBFD no.:		
	Vehicle endurance test	Field test	21228		
Mileage:	Received by DS-PC/EDI on:	Transaction no.	Confidentiality note		
114225 km	15.04.2008	2008-CP4_0332	Confidential		
VA/ETC no.:	Durability test type [RB]:	Fuel:			
DS-185068		US field			

1. Subject

CP4 customer return
Findings at end of endurance test without complaint

2. Conclusion

Function

- Delivery rates after endurance test without significant quantity drift compared to new condition.
- Low-temperature leak tightness after endurance test down to -25 °C verified

Components

- Cavitation erosion in the contact area of the high-pressure piston with the roller support is less than 10 µm.
- A particle impression is detectable alongside the sealing seat of the intake valve piston toward the intake valve plate.
- Marks from a crooked installation are detectable on the metering unit and in the metering unit borehole. The risk of O-ring damage is confirmed by complaints in the 0 km range and is being tracked via 8D.
- The screen of the overflow valve is inverted and loaded with a reddish covering.
- From tests (see appendix CP4-2659) it can be assumed that the inversion of the screen was caused by high loading and increased pressure.
- The analysis of the covering (see appendix CR/ARA 2008-0557) indicates that the covering is comprised of polymer carbonyl compounds (in particular ester with /and small fractions of soap), which in their totality are untypical of pure Diesel aging products. Without detailed information about the fuel composition, quality and additives it is impossible to characterize the carbonyl compounds more closely.
- The wear on the other components is minimal and without any significant items of note.

Result

- Polymer carbonyl compounds are insoluble in the fuel and can therefore form deposits on components and lead to functional restrictions and even failures. The damage to the overflow valve screen is ascribed to this cause.
- A possible reinforcement factor for the cavitation erosion is a temporary lowering of the pump inside pressure due to a malfunction of the overflow valve.
- The pump **has passed** the endurance test.

3. Findings (visible findings)

Rating legend

OK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3.1 Drive

No items of note

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3.2 Drivetrain



Cavitation erosion on the roller support backs on the piston foot support (see Fig. 1 and Fig. 2)
WLI measurement of the wear region (see Fig. 3)

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3.3 High pressure

Cavitation erosion on the HP piston foot in the middle (see Fig. 4 and Fig. 5)
and in a wear ring around the middle (See Fig. 6), WLI measurement of HP piston foot (see Fig. 7 and 8)

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Mark from a particle on the edge of the sealing area of the intake valve piston (see Fig. 9) toward the intake valve plate (see Fig. 10)

3.4 Bearing
 No items of note

3.5 Shaft seal
 No items of note

3.6 Boreholes
 Marks from installation of the metering unit in the metering unit borehole (see Fig. 11)

3.7 Built-on components (metering unit, overflow valve, counting point)
 Marks from installation on the magnet core on the outside of the metering unit (see Fig. 12)
 Overflow valve screen inverted (see Fig. 13) and with locally reddish covering (see Fig. 14)

3.8 Miscellaneous
 No items of note

3.9 Pictures of visible findings

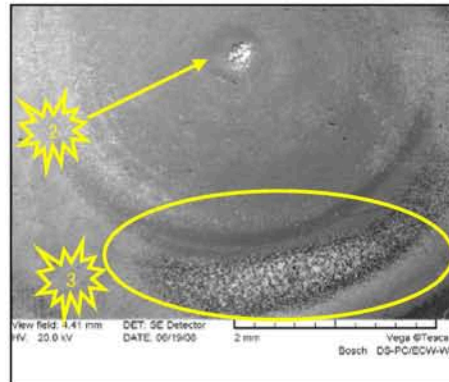
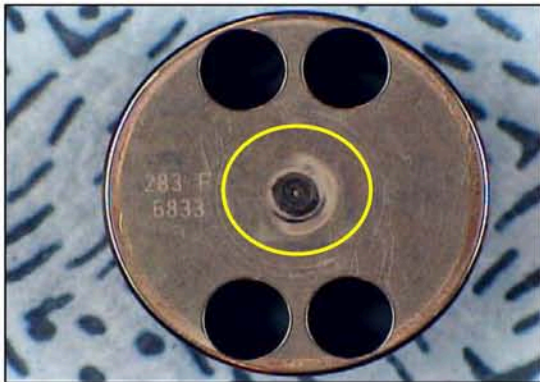


Fig. 1. Roller support, piston contact surface (cavitation) **Fig. 2. SEM picture of the center of the roller support**

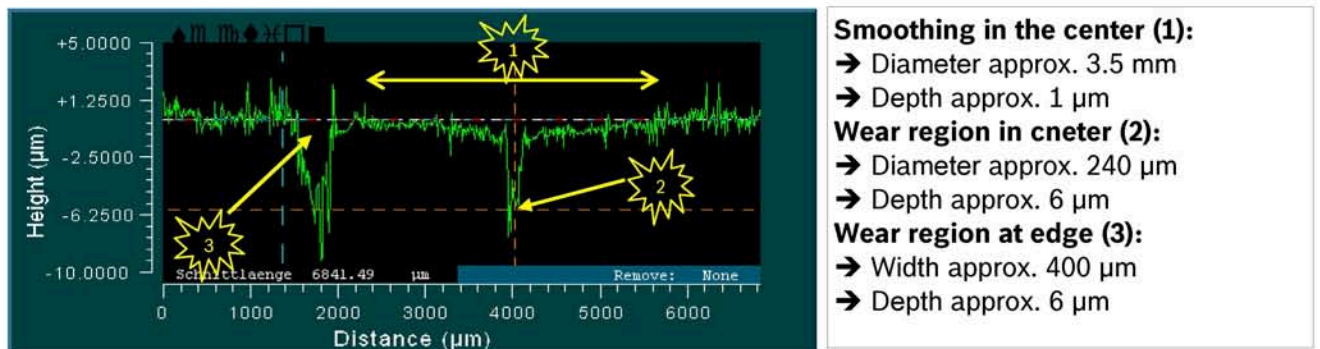
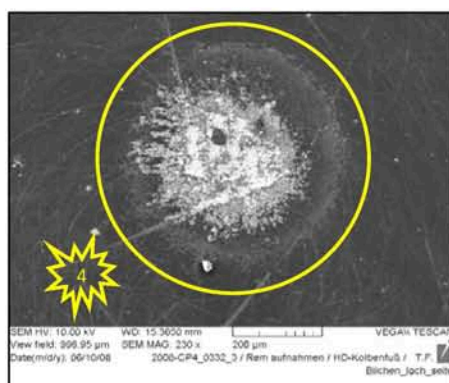
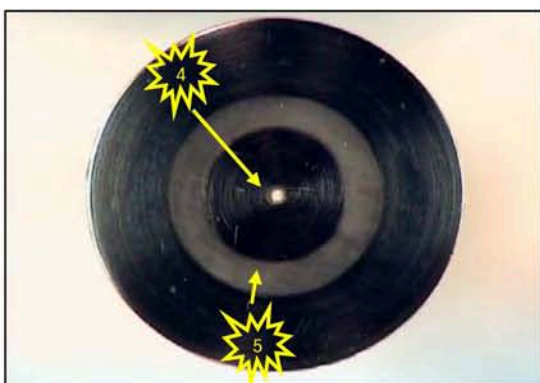


Fig. 3. WLI measurement of roller support, piston contact surface





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			Date	20.06.2008
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Fig. 4. HP piston foot (cavitation)

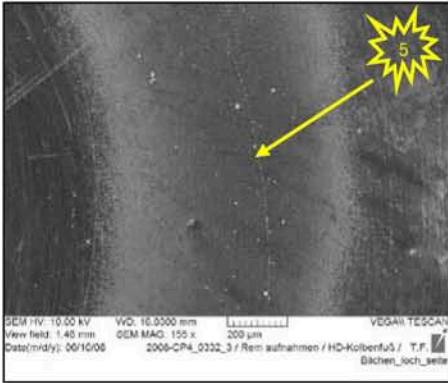


Fig. 5. SEM picture of the center of the piston foot

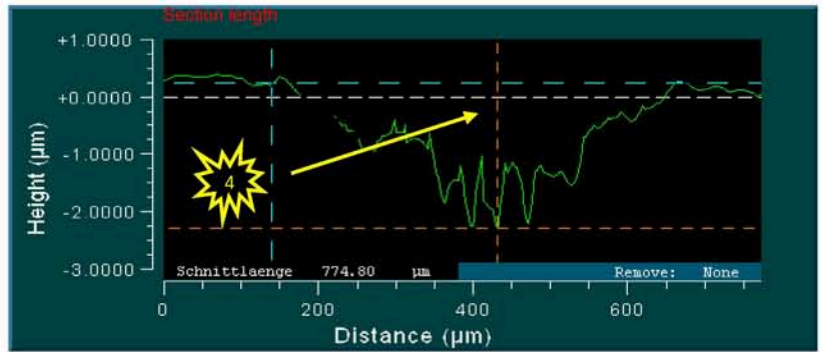
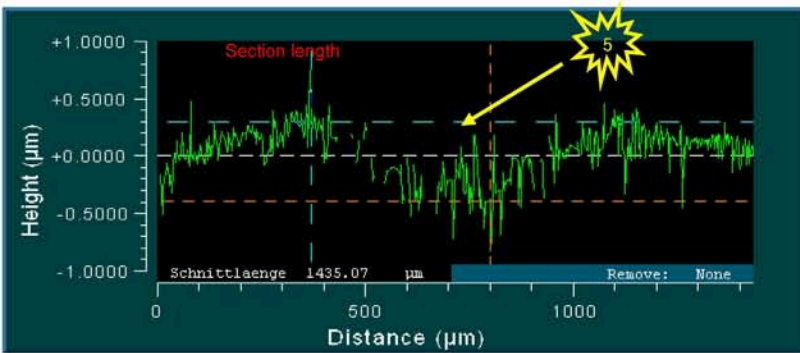


Fig. 6. SEM picture of the ring area

Fig. 7. WLI measurement of HP piston foot center



- Wear region in center (4):**
- ➔ Diameter approx. 510 µm
 - ➔ Depth approx. 2.5 µm
- Wear region at edge (5):**
- ➔ Width approx. 700 µm
 - ➔ Depth approx. 0.7 µm

Fig. 8. WLI measurement of HP piston foot ring area

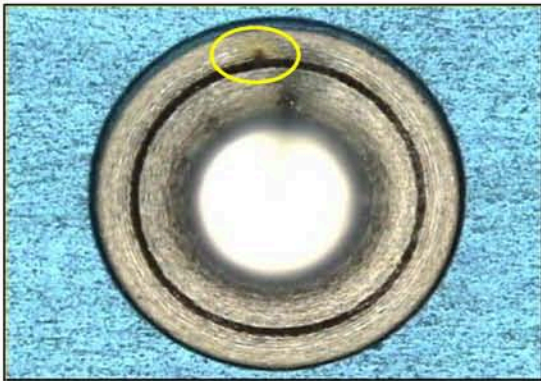


Fig. 9. Intake valve piston, sealing area (impression)

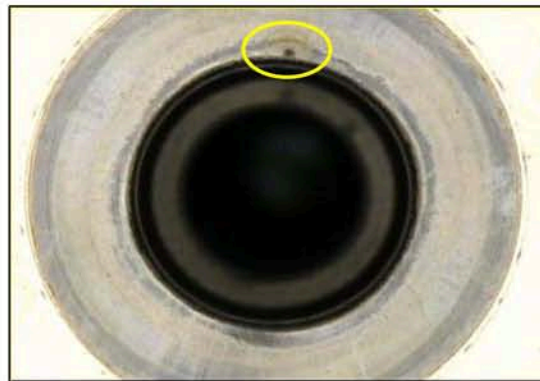


Fig. 10. Intake valve plate, sealing edge (impression)

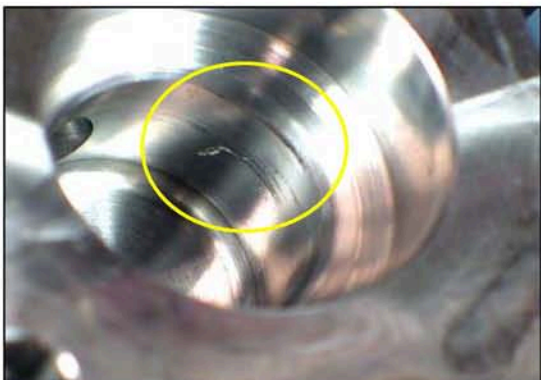



Fig. 11. Housing, metering unit borehole (scrape mark)



Fig. 12. Metering unit, magnet core on outside (scrape mark)

 BOSCH 	CR pump CP4 - Findings report	Report no.	2008-CP4_0332
		Date	20.06.2008

Department:	Person responsible:	Telephone:	Use	internal	
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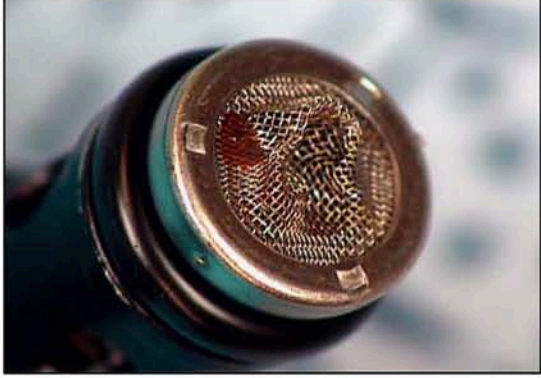


Fig. 13. Overflow valve, screen (damage)



Fig. 14. Overflow valve, screen (covering)

4. Hydraulic function

	n [rpm]	p_rail [bar]	I_metering unit [A]	Delivery rate [l/h]	Delivery rate [l/h]
				of new part	after testing
				15.09.2006	14.04.2008
Starting point	200	200	0.4	3.9	3.9
1000 rpm, p_nom	1000	1800	0.4	16.8	16.7
n_max_p, 500 bar	3375	500	0.4	65.5	66.8

x	
x	
x	

TCD test point running limit (1000rpm, p_nom ≥ 15.5 or 15.2 l/h after running time) is fulfilled.
 No significant quantity drift compared to the as-delivered measurement.

5. Parts storage

The pump will be stored at RB until 09/2008 and then scrapped.

6. Attachments

Covering analysis CR/ARA 2008-0557
 Results of function test for screen inversion (excerpt from CP4_2659_VN4450_03)

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**BOSCH**

CR/ARA

Corporate Sector Research and Advance Engineering Applied Research 1 - Analytics

CR/ARA analysis report

analysis no.: 2008-0557


dated 04.06.2008 Version 1

Order: **2008-CP4_0332 coating analysis / VW
USA vehicle test / pump #689-4943**

Client: **Non-responsive content removed**
Receipt of samples: 20.05.2008

**Analysis
responsibility:** **Non-responsive content removed**

EA11003EN-00945[5]

BOSCH 	Analysis report	Issue/supplement 1	Page 2/9
	CR/ARA	Analysis no. 2008-0557	Author [REDACTED]

Client:
Plant/Dept.:
Crates/boxes:
PSP element:

Non-responsive content removed

Telephone:
Telefax:
Received:

Non-responsive content removed

c.c.:

Order: 2008-CP4_0332 coating analysis / VW USA vehicle test / pump #689-4943

Process: IR/UV/VIS spectrometry, scanning electron microscope (SEM), EDS/WDS

Personnel: Non-responsive content removed

Problem/task:

The covering on the screen of the overflow valve is to be analyzed to determine its composition and origin.

Can a statement be made concerning the extent of the screen loading?

Result:

The covering on the screen of the overflow valve is comprised of polymer carbonyl compounds (in particular ester with/and small fractions of soap), which in their totality are untypical of pure Diesel aging products. The small traces of salt-like components of the covering (sodium chloride) are of secondary importance in this case.

Conclusion:



Without detailed information about the fuel composition, quality and additives it is impossible to characterize the carbonyl compounds more closely.

However, the polymer carbonyl compounds are insoluble in the fuel and therefore form deposits on the system's components. They can lead therefore to functional restrictions and even total failure.

Given the position of the coverings at the edge of the screen and the small area of the coverings it is unlikely that the screen will be pressed in as a result of pressure surges.

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Non-responsive content removed

BOSCH 	Analysis report	Issue/supplement 1	Page 3/9
	CR/ARA	Analysis no. 2008-0557	Author 

List of contents

1. Samples and other information about the order.....	4
2. Individual results of the methods used.....	5
2.1. FTIR (Fourier Transform Infrared Spectrometry)	5
2.2. Scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS).....	6
Appendix.....	8
2.3. Appendix on FTIR (Fourier Transform Infrared Spectrometry)	8
2.4. Appendix on SEM/EDS	9



EA11003EN-00945[7]

BOSCH 	Analysis report	Issue/supplement 1	Page 4/9
	CR/ARA	Analysis no. 2008-0557	Author 

1. Samples and other information about the order

Common rail pump CP4 (pump #689-4943) with covering on the screen of the overflow valve after test on VW vehicle over 114 225 km in the USA

We have no information about the fuel used (quality, composition, additives).

BOSCH 	Analysis report	Issue/supplement 1	Page 5/9
	CR/ARA	Analysis no. 2008-0557	Author 

2. Individual results of the methods used

2.1. FTIR (Fourier Transform Infrared Spectrometry)

Objective:

Identification of the composition of the covering on the screen of an overflow valve of a CP4 pump.

Sample preparation:

The covering was isolated from the screen of the overflow valve with a preparation needle and applied to a sample holder (potassium bromide glass) and measured, then it was rinsed on the sample holder with dichloromethane and measured again.

Measurement procedure:

The coverings were measured in transmission mode on an IR microscope of the Equinox-55-1 spectrometer (SOP OA-G-08-001) from the Bruker company.

Evaluation of the measurements:

The IR spectra obtained were evaluated with the help of computer-assisted databases and our own and commercial spectrum collections.



Measurement results:

According to the IR spectra, the covering is comprised mainly of polymer carbonyl compounds (in particular ester, and small fractions of soap). Attached to the covering were hydrocarbons with/and small fractions of aliphatic ester. Polymer carbonyl compounds are also to be found already in the attached elements.

Assessment:

Without detailed information about the fuel used in the USA for this test we are unable to clearly assign the polymer carbonyl compounds.



BOSCH 	Analysis report	Issue/supplement 1	Page 6/9
	CR/ARA	Analysis no. 2008-0557	Author 

2.2. Scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS)

Objective:

Analysis of the covering on the screen of the overflow valve to determine its composition and origin

Sample preparation and measurement procedure:

The covering was analyzed in the rinsed state on the KBr glass sample holder of the IR spectroscope (see 2.1). The tests were conducted with the SEM (Supra 55VP, made by Zeiss) with an accelerating voltage of 20 kV, and with the interconnected EDS system (INCA Energy, made by Oxford Instruments). With the EDS it is possible to analyze only the chemical elements of the material as present. Due to the nature of the system, EDS analyses of light elements up to approx. fluorine display a high level of measurement uncertainty.

Measurement results:

The covering is comprised mainly of organic constituents (carbon (C) and oxygen (O)). Traces of sodium (Na) and chlorine (Cl) were also found. The measurement peaks of potassium (K) and bromine (Br) originate from the potassium bromide sample holder.

Assessment:

The exact determination of the organic constituents is performed by means of FTIR analysis. The traces of Na and Cl could point to salt deposits.

BOSCH 	Analysis report	Issue/supplement 1	Page 7/9
	CR/ARA	Analysis no. 2008-0557	Author 

2.3. Light microscope

Objective:

Statement concerning the degree of screen loading

Assessment of whether the screen was damaged as the result of the covering being formed.

Measurement results:


A photographic report was produced (photographic report: 2008-0557.pdf). The first two pictures show an overview picture taken from above and from the side. Fig. 3 to 6 show the coverings and the screen load in different degrees of magnification.

In the pictures taken with the light microscope it is evident that there is no covering in the middle of the screen. Coverings are visible only at the edge of the screen. The optical impression of the covering suggests an organic composition.

Assessment:

Given the position of the coverings (at the edge of the screen) and the small area of the coverings it is unlikely that the screen will be pressed in as a result of pressure surges.

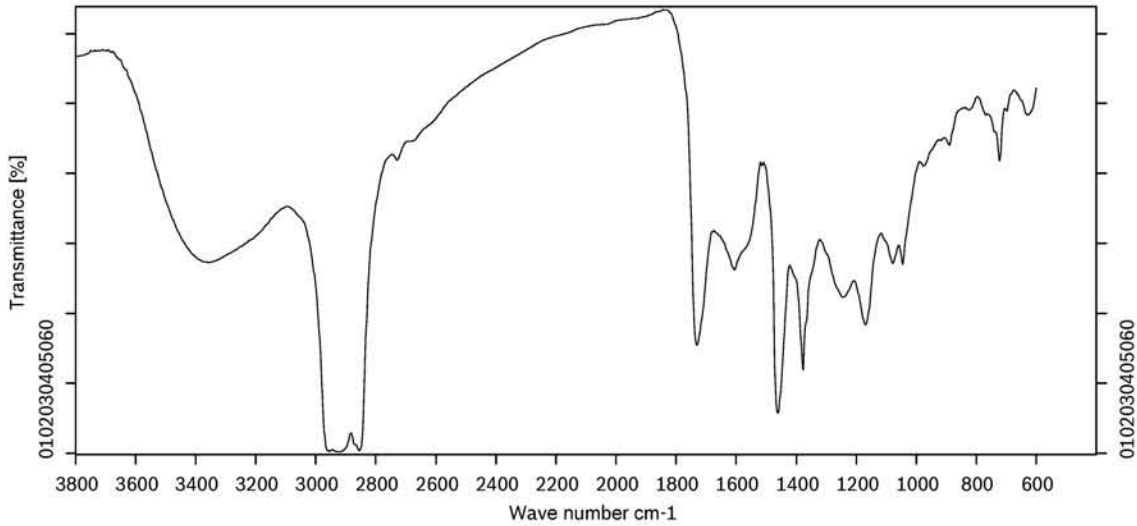
Non-responsive content removed

BOSCH 	Analysis report	Issue/supplement 1	Page 8/9
	CR/ARA	Analysis no. 2008-0557	Author [REDACTED]

Appendix

2.4.Appendix on FTIR (Fourier Transform Infrared Spectrometry)

20.05.2008 12:06:28



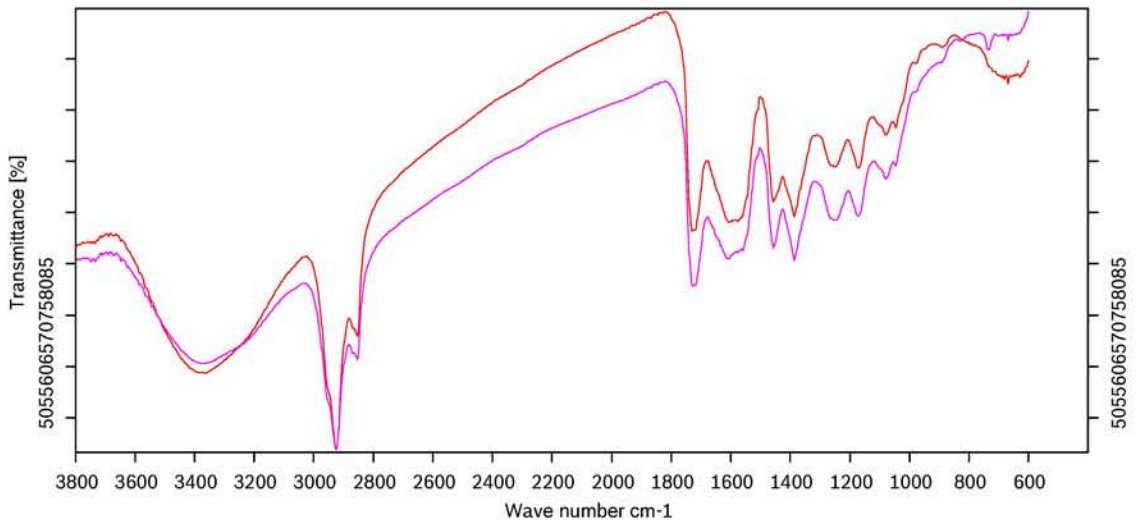
Sample designation: CP4 CR pump with brown, oily deposit directly in the overflow valve

Measurement method: Equinox-I-Mikroskop-Transmission-MCT.XPM

Person responsible: [REDACTED]

File name: 2008-0557-1.0

20.05.2008 12:02:19 PM




Sample designation: CP4 CR pump with deposit in the overflow valve CH2Cl2 insoluble, solid

Sample designation: CP4 CR pump with deposit in the overflow valve CH2Cl2 insoluble, solid

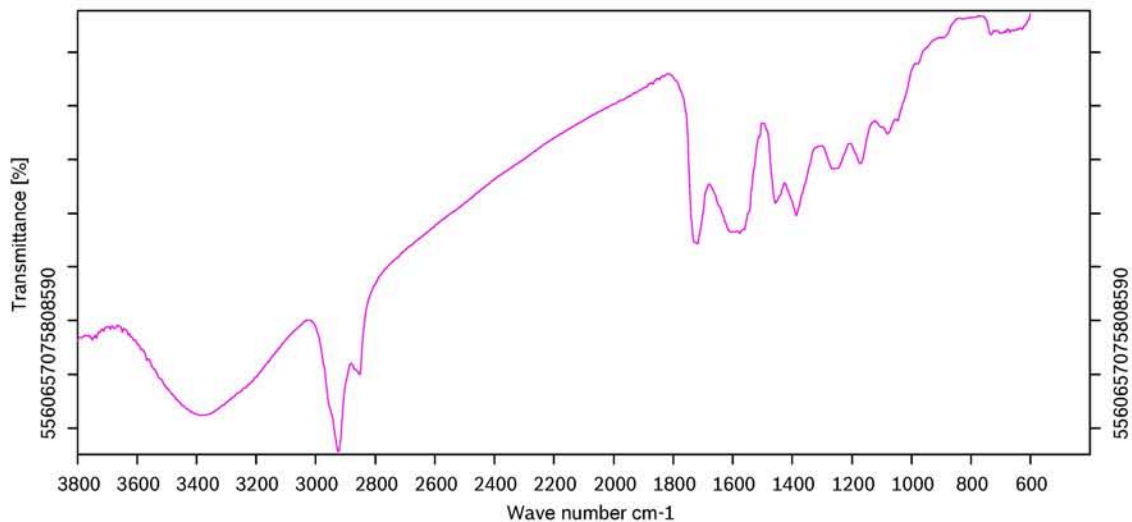
Measurement method: Equinox-I-Mikroskop-Transmission-MCT.XPM

Person responsible: [REDACTED]

File name: 2008-0557-1.4

BOSCH 	Analysis report	Issue/supplement 1	Page 9/9
	CR/ARA	Analysis no. 2008-0557	Author [REDACTED]

20.05.2008 12:04:30 PM



Sample designation: CP4 CR pump with deposit in the overflow valve Rinsed several times with CH₂Cl₂ Insoluble

Measurement method: Equinox-I-Microscope-Transmission-MCT.XPM

Person responsible: [REDACTED]

File name: 2008-0557-1.7

2.5. Appendix on SEM/EDS

An EDS report (EDS_2008-0557.pdf) was drawn up. It will be added separately to the analysis report.

A photographic report (Bilder_2008-0557.pdf) was drawn up. It will be added separately to the analysis report.

Order: 2008-CP4_0332 Analysis of the covering

Person responsible:Mr. ██████████

Screen of the overflow valve

Analysis no.:2008-0557

Date of printing:03.06.2008



Fig. 1

CR_ARA_M_08_0871

overview from the top



Fig. 2

CR_ARA_M_08_0872

Side view

Order: 2008-CP4_0332 Analysis of the covering

Person responsible: Mr. ██████████

Screen of the overflow valve

Analysis no.: 2008-0557

Date of printing: 03.06.2008

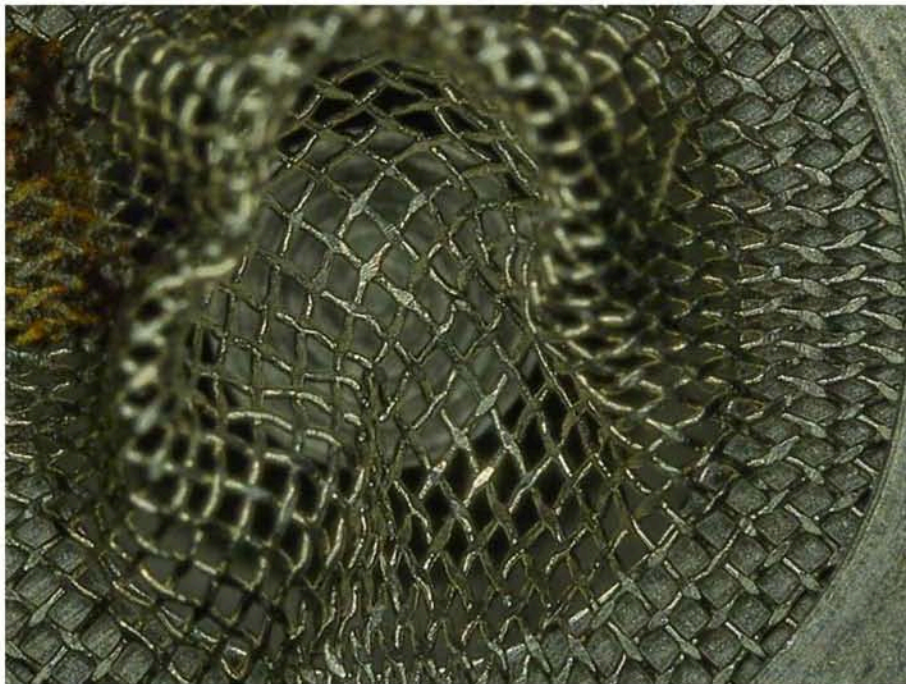


Fig. 3

CR_ARA_M_08_0882

Middle of screen

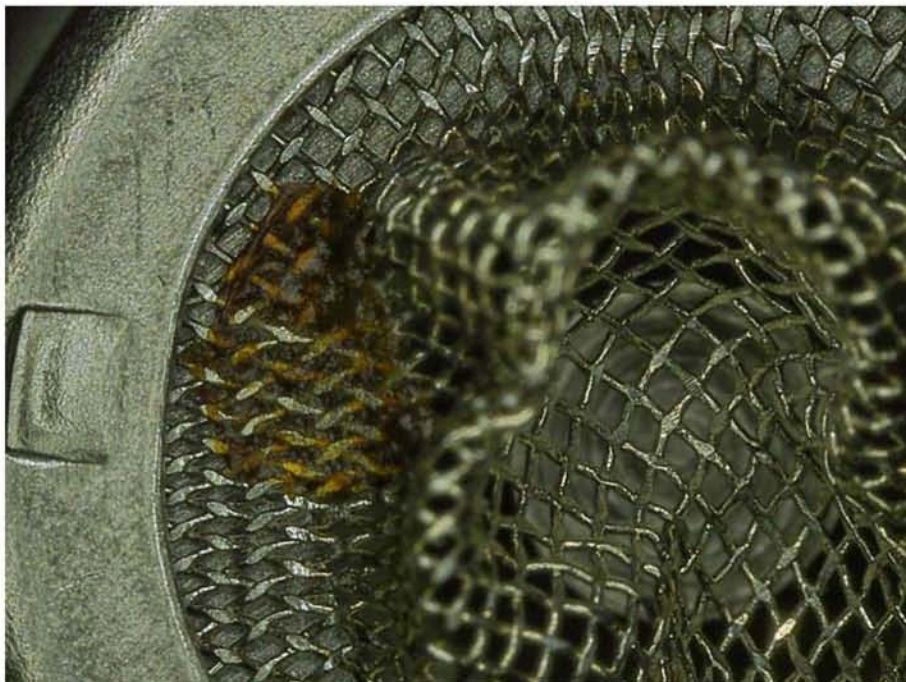


Fig. 4

CR_ARA_M_08_0883

Covering at the edge

Order: 2008-CP4_0332 Analysis of the covering

Person responsible: Mr. ██████████

Screen of the overflow valve

Analysis no.: 2008-0557

Date of printing: 03.06.2008



Fig. 5

CR_ARA_M_08_0884

Covering at the edge (100-fold magnification)



Fig. 6

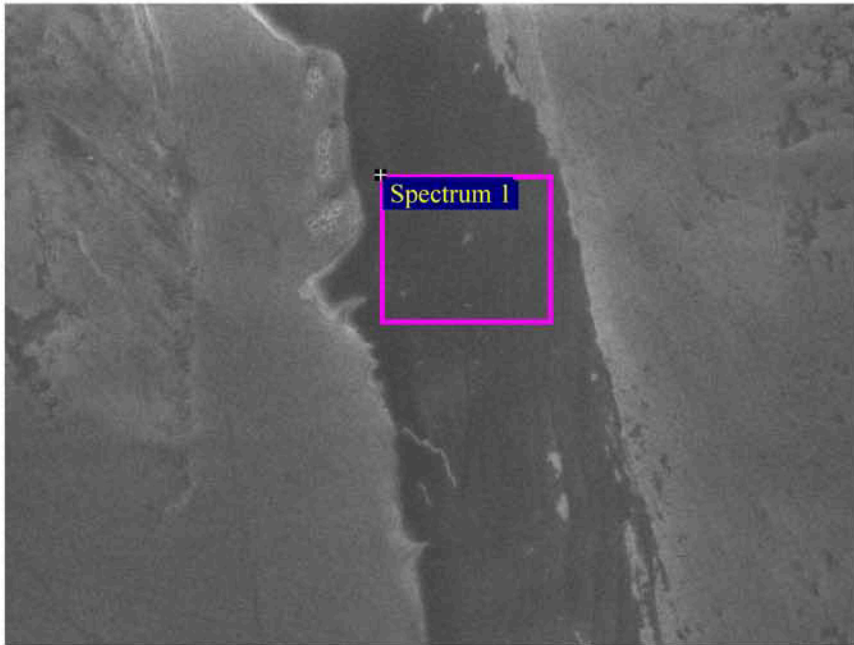
CR_ARA_M_08_0885

Covering at the edge (200-fold magnification)



Project: 2008-0557
Owner: [REDACTED]
Area: Covering on KBr

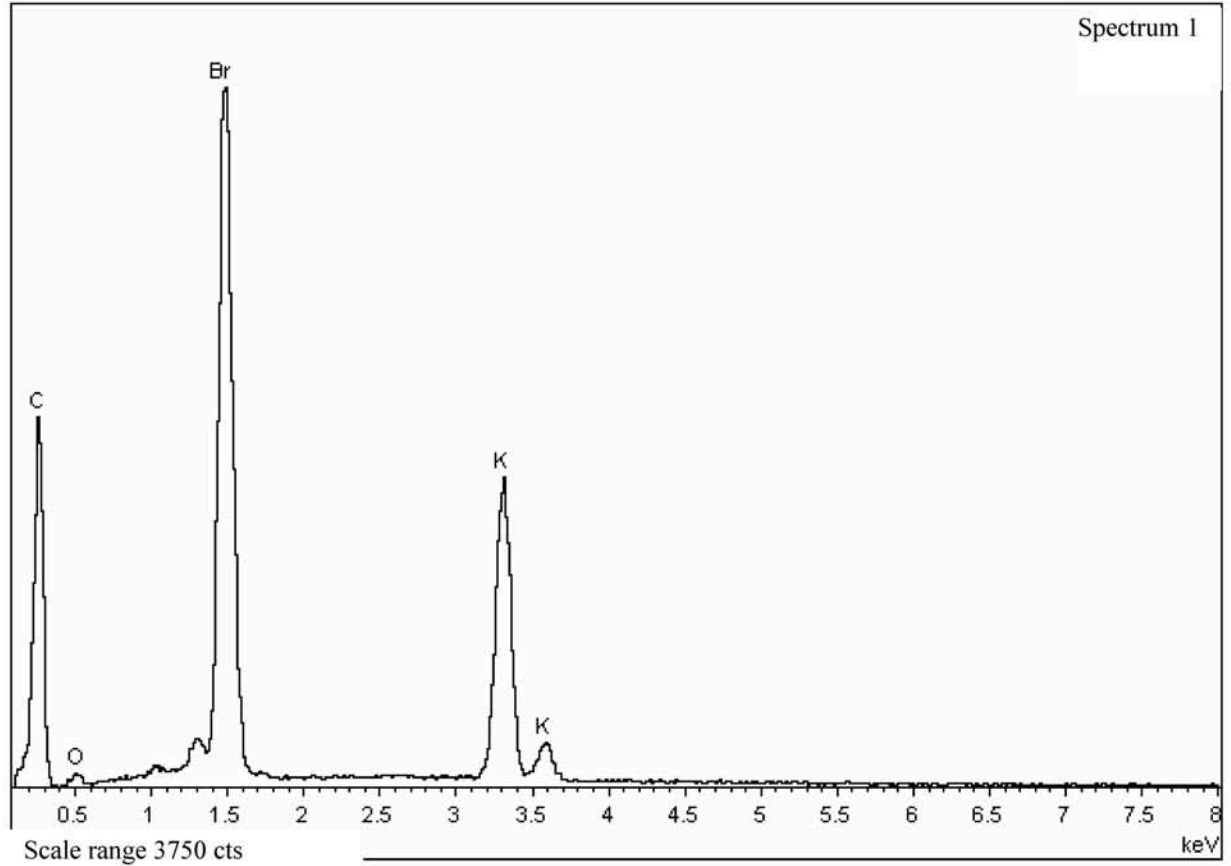
Sample: Covering on KBr
Type: Specification
ID:



100µm

Electron image 1

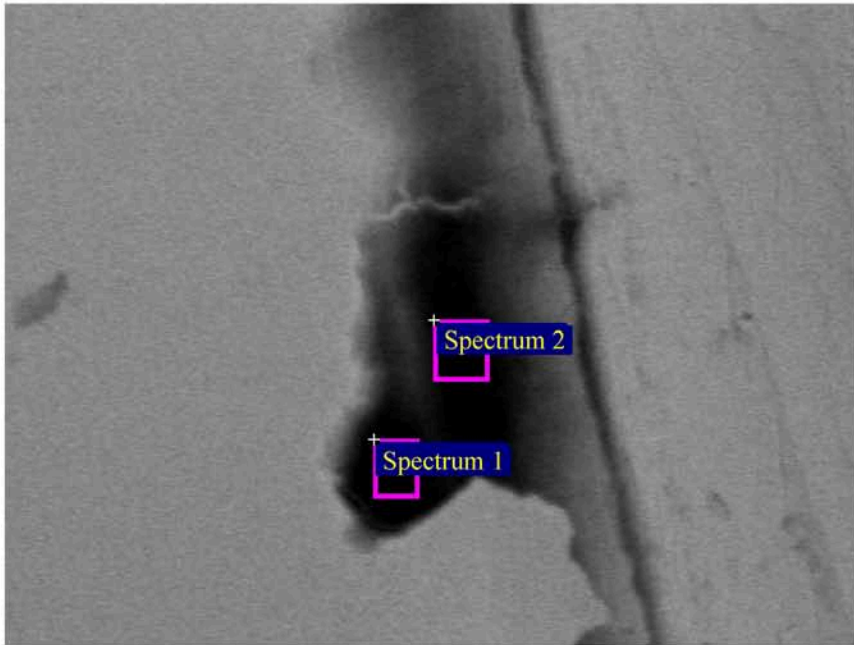
Magnification: 334 X
Accelerating voltage (kV): 20.00
Process time: 6





Project: 2008-0557
Owner: XXXXXXXXXX
Area: Covering on KBr 2

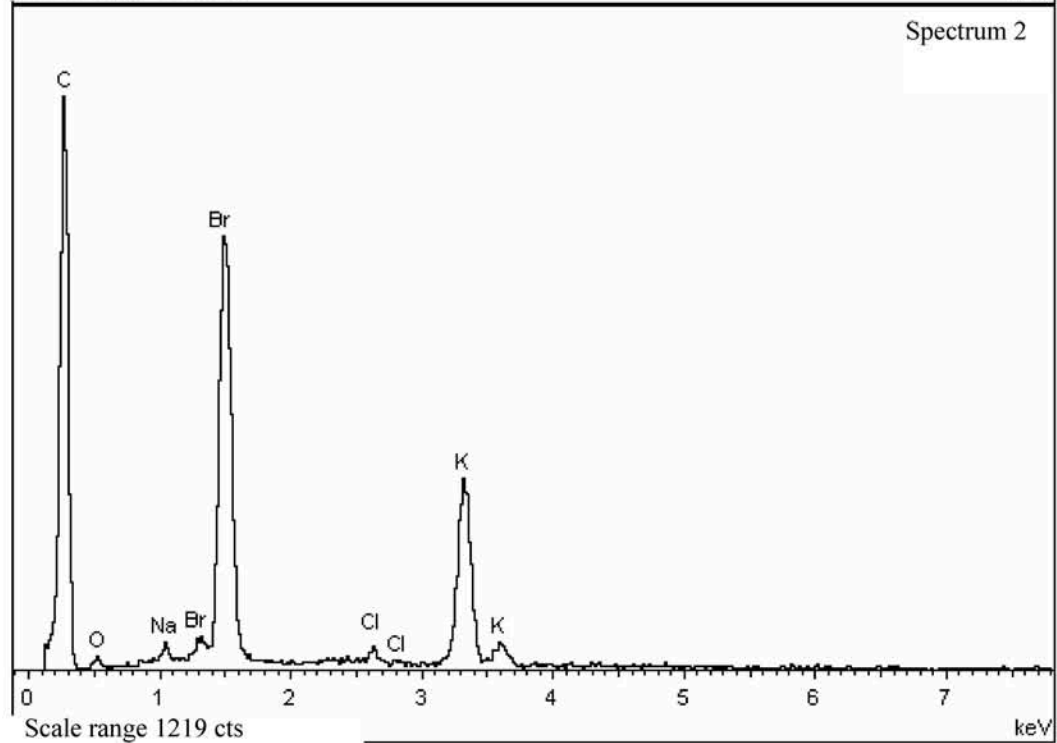
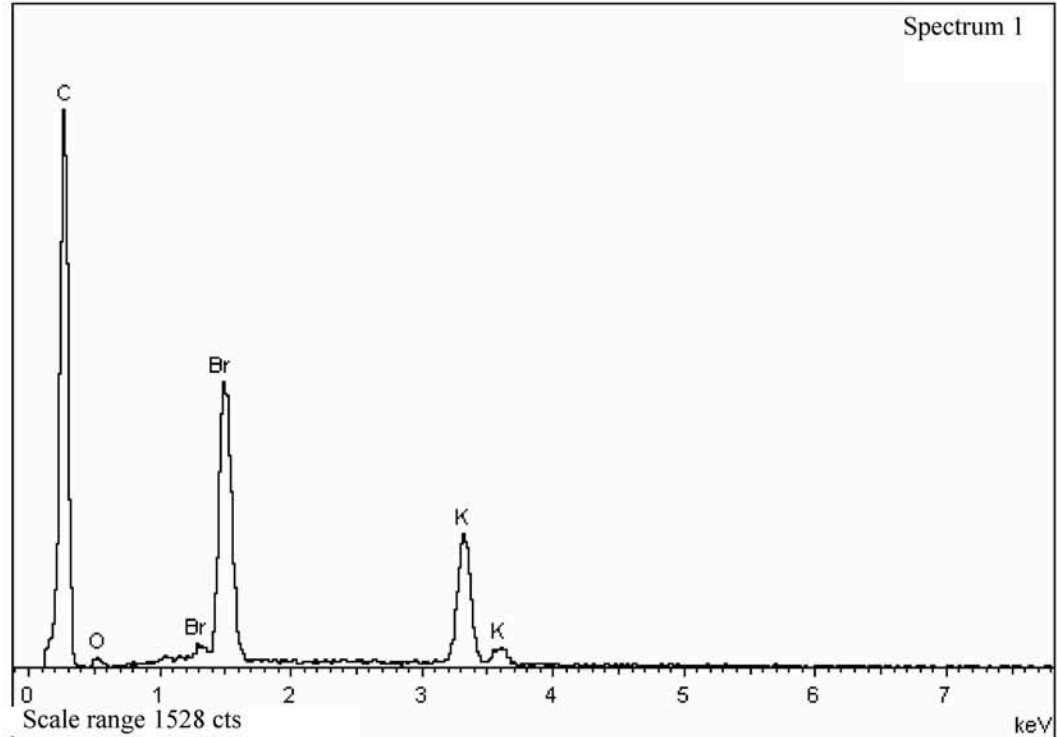
Sample: Covering on KBr
Type: Specification
ID:



100µm

Electron image 1

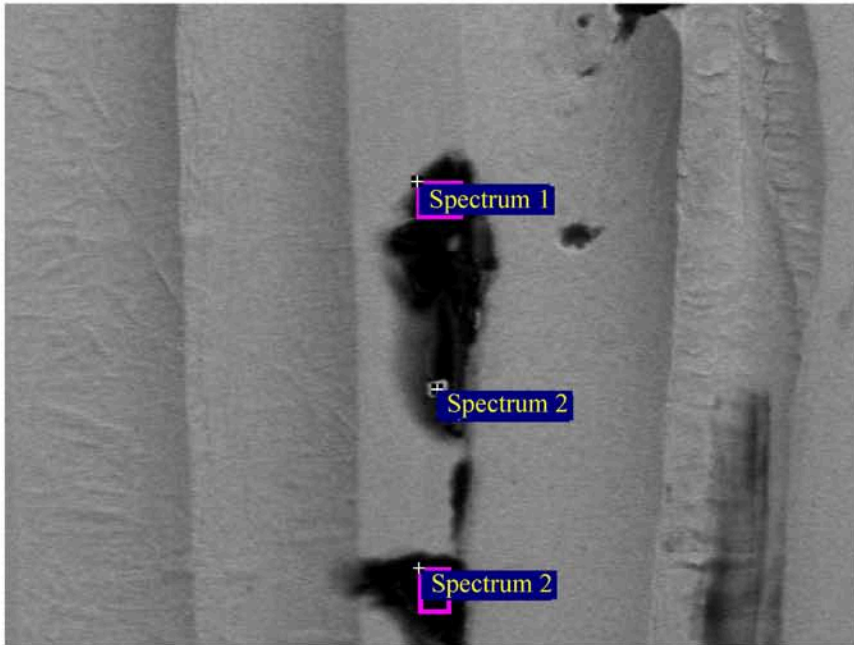
Magnification: 412 X
Accelerating voltage (kV): 20.00
Process time: 6





Project: 2008-0557
Owner: XXXXXXXXXX
Area: Covering on KBr 3

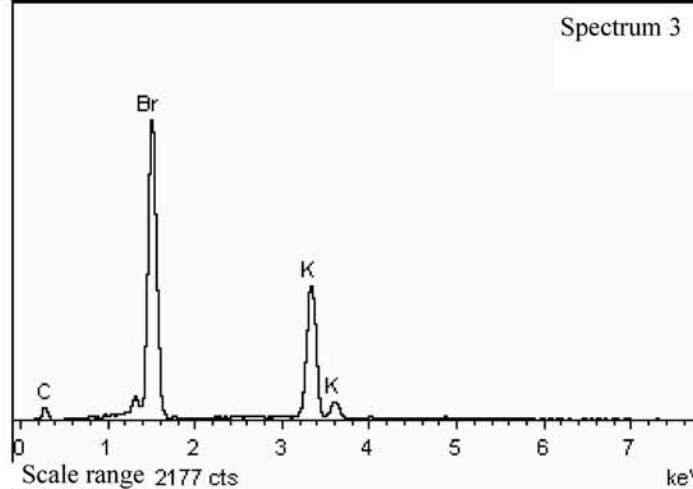
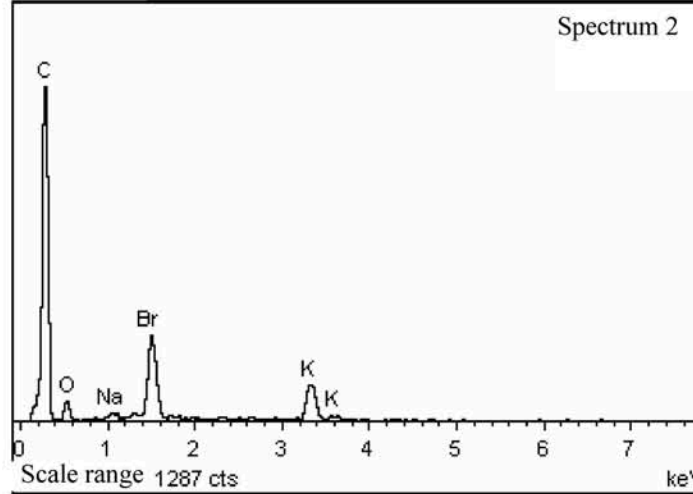
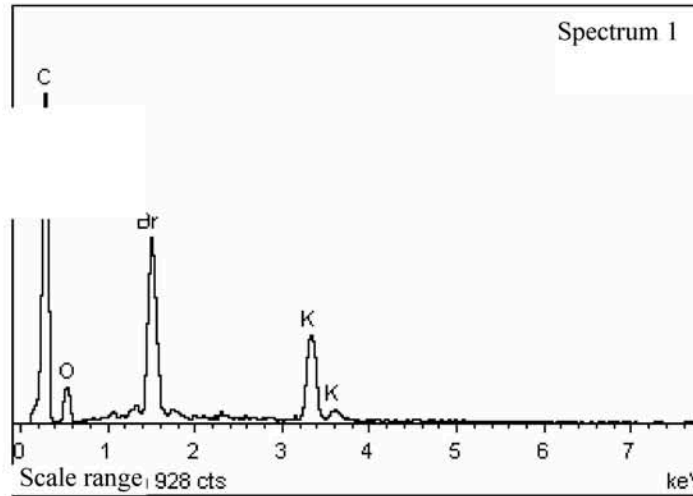
Sample: Covering on KBr
Type: Specification
ID:



200µm

Electron image 1

Magnification: 258 X
Accelerating voltage (kV): 20.00
Process time: 6



Inversion test on overflow valve screen

Task:

- Determination of the static pressure at which a fully covered overflow valve is deformed.

Procedure:

- On the flow test stand; the pre-pressure was set, the metering unit upstream from the test sample was first closed and then opened step by step. At certain pressure values the prepared overflow valve was taken out and assessed.

Results:

- Inversion of the screens occurs at a static pressure of approx. 21 to 25 bar_{rel} with a fully covered screen.

Diesel systems

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1

Inversion test on overflow valve screen

Test procedure

- Covering of the screen with a latex glove in order to simulate loading over the complete area



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2

Inversion test on overflow valve screen

Test parts

- Part 30 – Loading over the complete area:
Beginning of deformation: $p_1=11.5 \text{ bar_rel}$ (at 9.5 bar_rel still OK)



- Part 31 – Loading over the complete area:
Beginning of deformation: $p_1=11.5 \text{ bar_rel}$ (at 10.5 bar_rel still OK)



Diesel systems

3

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Inversion test on overflow valve screen

Test parts

- Part 34 – Loading over the complete area:
Beginning of deformation: $p_1=10.5 \text{ bar_rel}$ (at 7.5 bar_rel still OK)



- Part 35 – Loading over the complete area:
Beginning of deformation: $p_1=13 \text{ bar_rel}$ (at 10.5 bar_rel still OK)




Diesel systems

4

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BOSCH

 CR pump CP4 - Findings report		Report no.	2008-CP4_0333	
		Date	27.06.2008	
Department:	Person responsible:	Telephone:	Use	internal
Non-responsive content removed			external	x
To:	Non-responsive content removed			
Attn. of:				
Pump type:	Customer:	Project:	Project/ design sample version	
CP4.1S_348_2x5.25_REC_3.3_1.95_MT4.2	VW	R4 2.0 BIN5	C / C	
Item number (TT no.):	Production date:	Serial number:	Factory - Line	
0445B21060_11	692	4338	011M FeP-M -	
SAP no.:	Samos no.:	Customer order no.:	Engine/vehicle number	
30-101008-05	599005.005		3LDP18095 / VW351780092	
Customer item number	Durability test type [customer]:	Durability test conditions:	DSBFD no.:	
	Vehicle endurance test	CS operation KL4	21227	
Mileage:	Received by DS-PC/EDI on:	Transaction no.	Confidentiality note	
159350 km	15.04.2008	2008-CP4_0333	Confidential	
VA/ETC no.:	Durability test type [RB]:	Fuel:		
DS-185069		US field		

1. Subject

CP4 customer return
 Findings at end of endurance test without complaint
 Test conditions: CS operation KL4

2. Conclusion

Function

- Delivery rates after endurance test without significant quantity drift compared to new condition.
- Low-temperature leak tightness after endurance test down to -30 °C verified

Components

- Cavitation erosion in the contact area of the high-pressure piston with the roller support is distinctly greater than on the previous return pumps but comparable with other USA vehicle tests.
- Marks from a crooked installation are detectable on the metering unit and in the metering unit borehole. The risk of O-ring damage is confirmed by complaints in the 0-km range and is being tracked via 8D.
- The wear on the other components is minimal and without any significant items of note.

Result

- The pump **has passed** the endurance test.

3. Findings (visible findings)

Rating legend

OK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3.1 Drive

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
-------------------------------------	--------------------------	--------------------------

3.2 Power train

Cavitation erosion on the roller support backs (see Fig. 1)

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
--------------------------	-------------------------------------	--------------------------

3.3 High pres-sure

Cavitation erosion in the center and around the center of the high-pressure piston (see Fig. 2)

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
--------------------------	-------------------------------------	--------------------------

3.4 Bearing

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
-------------------------------------	--------------------------	--------------------------

3.5 Shaft seal

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
-------------------------------------	--------------------------	--------------------------

3.6 Boreholes

Metering unit borehole with scrape marks caused by metering unit installation (see Fig. 3)

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
--------------------------	-------------------------------------	--------------------------

3.7 Built-on components (metering unit, overflow valve, counting point)

Metering unit magnet core with scrape marks on the outside caused by installation (see Fig. 4)

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
--------------------------	-------------------------------------	--------------------------

3.8 Miscella-neous

No items of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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 BOSCH 	CR pump CP4 - Findings report	Report no.	2008-CP4_0333
		Date	27.06.2008

Department:	Person responsible:	Telephone:	Use	internal	
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3.9 Pictures of visible findings

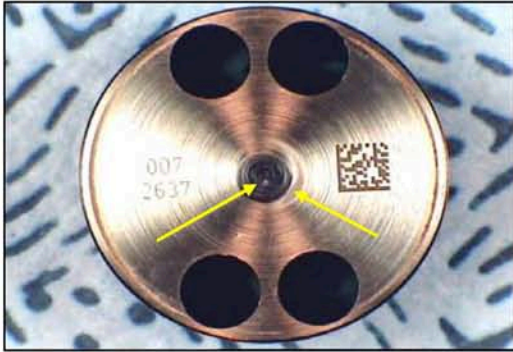


Fig. 1. Roller support, piston contact surface (cavitation)

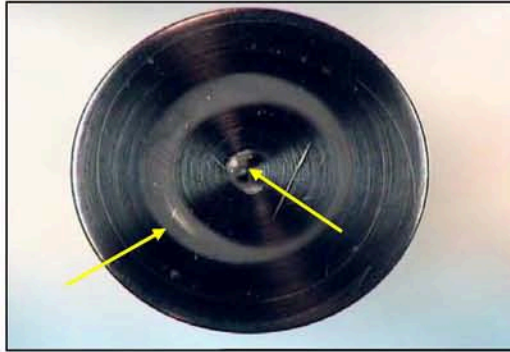


Fig. 2. High-pressure piston, piston foot (cavitation)

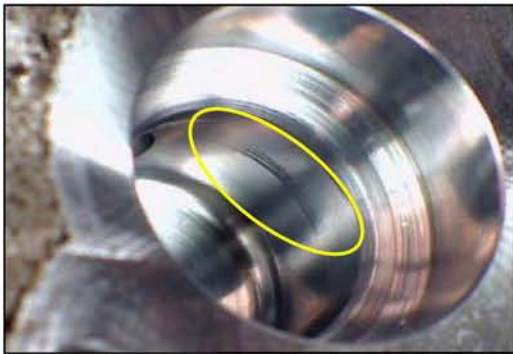


Fig. 3. Housing, metering unit borehole (scrape marks)

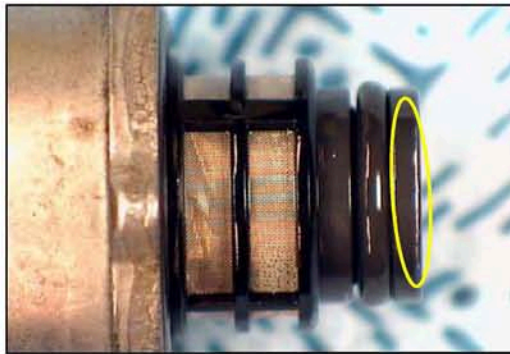


Fig. 4. Metering unit, magnet core on outside (scrape marks)

4. Hydraulic function

	n [rpm]	p _{rail} [bar]	I _{ZME} [A]	Delivery rate [l/h]	Delivery rate [l/h]
				of new part	after testing
				19.12.2006	14.04.2008
Starting point	200	200	0.4	65.8	66.4
1000 rpm, p _{nom}	1000	1800	0.4	17.1	16.1
n _{max_p} , 500 bar	3375	500	0.4	3.9	3.8

x		
x		
x		

TCD test point running limit (1000 rpm, p_{nom} ≥ 15.5 or 15-2 l/h after running time) is fulfilled.
 No significant quantity drift compared to the as-delivered measurement.



5. Parts storage

The pump will be stored at RB until 09/2008 and then scrapped.

6. Attachments

None

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 BOSCH 	CR pump CP4 - Findings report		Report no.	2008-CP4_0583
			Date	24.11.2008
Department:	Person responsible:	Telephone:	Use <input type="checkbox"/> internal <input checked="" type="checkbox"/> external	
Non-responsive content removed				
To:	Non-responsive content removed			
Attn. of:				
Pump type: CP4.2HS_747_2x5,63_REC_3,3_1,3_MT2,0	Customer: AUDI	Project: W19 BIN5	Project/ design sample version / Series	
Item number (TT no.): 445010613	Production date: 080122	Serial number: 0901	Factory - Line 0110 FeP - 01	
SAP no.: 30-100495-06	Samos no.: 708388.006	Customer order no.:	Engine/vehicle number / 716-9-8023	
Customer item number	Durability test type [customer]: Vehicle endurance test	Durability test conditions: Quality verification tours	DSBFD no.: 21959	
Mileage 9845 km	Received by DS-PC/EDI on: 17.07.2008	Transaction no. 2008-CP4_0583	Confidentiality note Confidential	
VA/ETC no.: DS-194045		Fuel: EN590		

1. Subject

CP4 customer return without complaint

Findings on the pump after vehicle endurance test. Clarification of whether the beginnings of drivetrain damage exist (the pump was replaced for inspection as a precaution).
 Test conditions: Quality verification tours in Germany (tours in the USA were planned to follow). Twin pump to failure pumps for quality verification tours in the USA.

2. Conclusion

Function

- The volumetric efficiency of the return measurement is OK. There is no significant drift compared to the measurement of new parts (for details see 4.). **Visible findings**

The following signs of the beginnings of drivetrain damage were found:

- On the roller on the left is a local wear zone in the middle (approx. 5mm x 2mm, see section 3.10, Fig. 1 and appendix 4).
- Notable on the camshaft are pronounced smoothing marks in the middle of the cam (in the middle of the cam ascent, ~5mm wide, see section 3.10, Fig. 2).
- Detectable in the cam descent directly after the pressure release is an "oscillation mark" of the roller (see appendix 3). As already communicated in the technical discussion held on 27.08.08, these wear phenomena are possibly the result of high rotary drive oscillations of the engine (cause: wrong tensioning roller on the engine). The oscillations are transferred to the pump, resulting in slipping of the roller on the cam. The subject will be dealt with further by EHC2-Ambrock.
- Notable again on both rollers are process-related C-coating flaws in the coating runout (non-critical, see 3.10, Fig. 3, 4).
- All other components display only the usual running marks for the period in operation (rating green).

The pump is still OK.

3. Findings (visible findings)

Rating legend

OK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
non-critical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
critical	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3.1 Drive

No item of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
-------------------------------------	--------------------------	--------------------------

3.2 Drivetrain

Roller on the left: local wear zone in the middle (see 3.10 Fig. 1 and 6. Appendix 4)
 Camshaft: a) Smoothing marks in the middle of the cam 41 in the cam ascent (see section 3.10, Fig. 2)
 b) "Oscillation mark" of the roller in the cam descent (pressure release) (see 6. Appendix 4)
 Rollers: C-coating flaws in the coating runout (see 3.10 Fig. 3, 4)

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
--------------------------	-------------------------------------	--------------------------

3.3 High pres-sure

No item of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
-------------------------------------	--------------------------	--------------------------

3.4 Bearing

No item of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
-------------------------------------	--------------------------	--------------------------

3.5 Shaft seal

No item of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
-------------------------------------	--------------------------	--------------------------

3.6 Boreholes

No item of note

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
-------------------------------------	--------------------------	--------------------------

 BOSCH 	CR pump CP4 - Findings report		Report no.	2008-CP4_0583
			Date	24.11.2008

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

3.7 Built-on components (metering unit, overflow valve, counting point)

No item of note

x		
---	--	--

3.8 O-rings

No item of note

x		
---	--	--

3.9 Miscellaneous

No item of note

x		
---	--	--

3.10 Pictures of visible findings

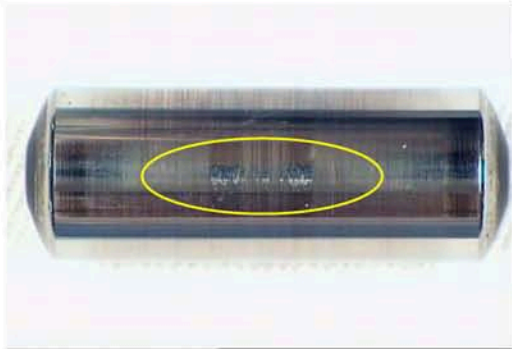


Fig. 1 Roller on the left, wear zone in the middle

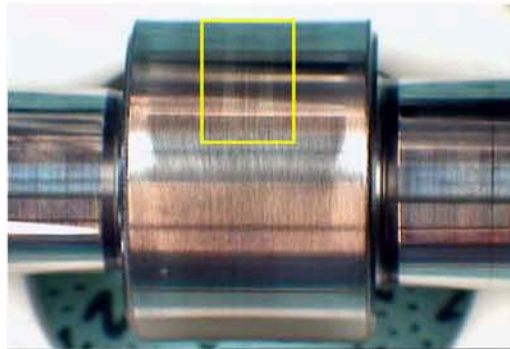


Fig. 2 Camshaft, smoothing marks on the cam ascent

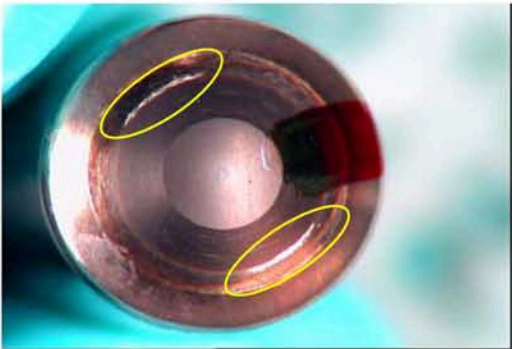


Fig. 3 Roller on the left, C-coating flaws in coating runoff

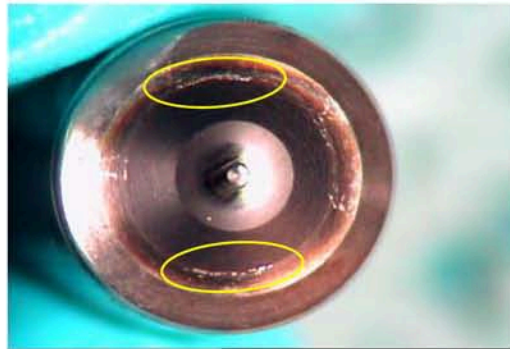


Fig. 4 Roller on the right, C-coating flaws in coating runoff

4. Hydraulic function

	n [rpm]	p_rail [bar]	l_metering unit [A]	Delivery rate [l/h]	Delivery rate [l/h]
				of new part	after testing
LG	1000	2000	0.4	37.6	37.8

x		
---	--	--

No significant change in volumetric efficiency; the volumetric efficiency lies within the tolerance specified for new parts in the TCD.

5. Parts storage

The pump will be stored at Bosch.

6. Attachments

Appendix 1-4: Excerpt from slide set " EHC2_0350_Ambrock"

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Audi -CP4 drivetrain damage

US verification with CP4.2 according to 0 445 010 0613/ 059 130 755 AG for V6 BIN5

3 failures in **quality verification**(no failures in test vehicles, page 9)

- 1 x Q7 (40 000 km; FD 071130; SN 626)
- 1 x Q7 (62 300 km; FD 071130; SN 633)
- 1 x Touareg (2723 km; FD 080122; SN 900)

Analysis

- Cause can no longer be determined due to damage progress on the component
- Both Q7 had tensioning roller 059 109 243 P (W19) instead of 0 57 109243 M (W24)

Preventive replacement performed on 6 vehicles with low mileage.

Analysis

- 1 pump with items of note
 - 1x Q7 (9845 km; FD080122; SN901) with small braking flats on the roller & Zig-zag marks on the camshaft (page 10,11,12)

Hypothesis (2 x US Q7; 1 x Q7 replacement pump)

Strong rotary drive oscillations lead to unnaturally intensive slipping between the roller & and cam and cause braking flats.

Diesel systems

1

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BOSCH

CP4 – findings on Audi W19 EU6/BIN5

Summary

Vehicle data

- □ Vehicle: Q7 716-98023
- □ Mileage 9845 km in [redacted] (testing in the USA planned to follow)
- □ Reason for removal Twin pump to test failures in the USA
Precautionary pump replacement in order to obtain findings

Pump data

- □ TT no. Pump 0 445 010 611
- □ Production date of pump 22.01.2008
- □ Number 0901

Item of note in the findings

- □ Local wear on the roller and smoothing marks on the camshaft

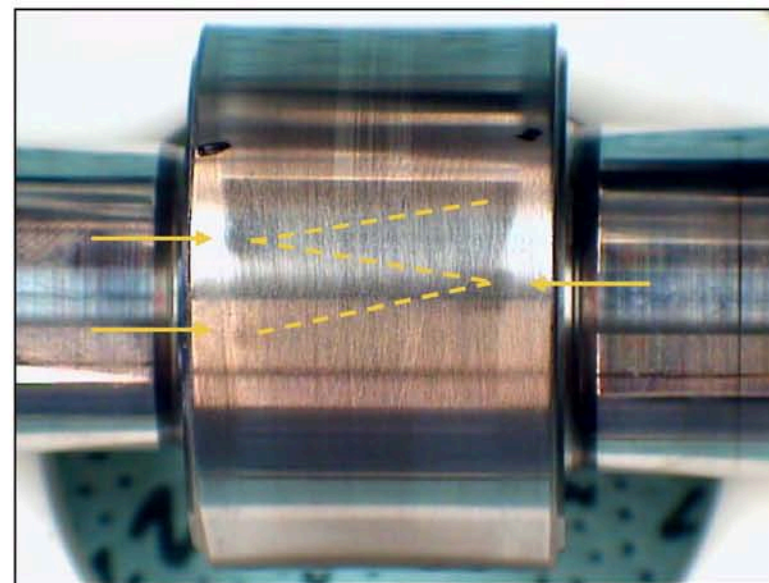
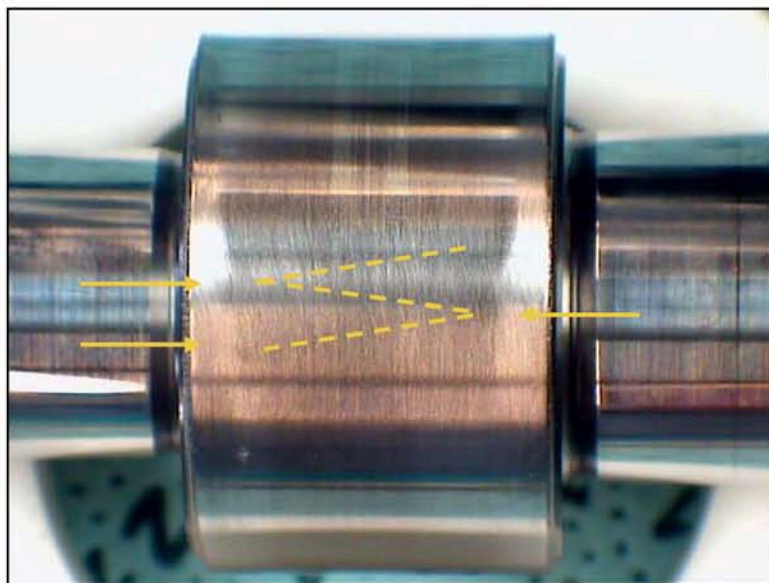
Hypothesis:

- □ Slipping of the roller on the cam due to high rotary drive oscillations which were transferred from the engine to the pump

Diesel systems

CP4 –findings on Audi W19 EU6/BIN5

- **Pump:** D-sample, CP4.2HS-747-2x5,63-REC, 0 445 010 613, #080122-0901
- **Operating conditions.:** Vehicle endurance test (Q7: 716-98023), EN590, mileage 9845 km, endurance test end
- **Inspection:** Cams intake side or descent – contact pattern of the roller



→ Semicircular imprint = Turning point of the roller

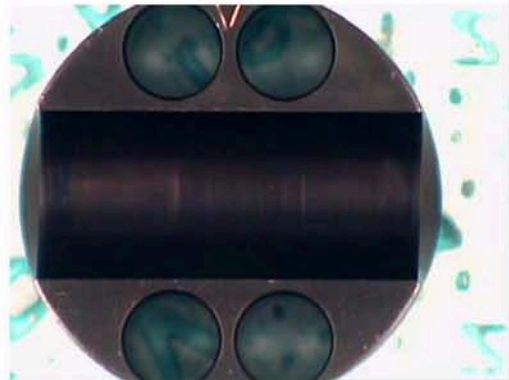
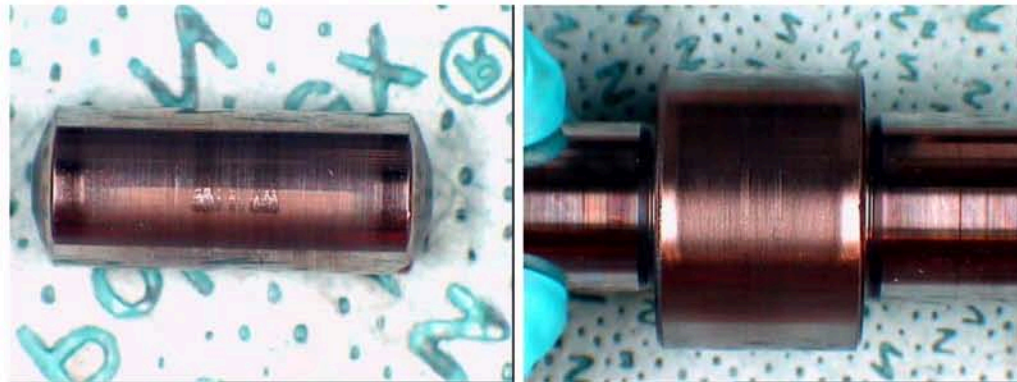
- - - Reconstructed roller axis

Diesel systems

Audi - CP4 drivetrain damage



Pump from preventive replacement

D-sample, CP4.2HS-747-2x5,625-REC, 0 445 010 613, #080122-0901



Diesel systems



 BOSCH 	CR pump CP4 - Findings report		Report no.	2010-CP4_0324	
			Date	20.05.2010	
Department:	Person responsible:	Telephone:	Use	internal	
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			Confidentiality note Confidential		
To:	Non-responsive content removed				
Attn. of:					
Pump type: CP4.1S_398_2x6_REC_3.3_1.95_MT4,2	Customer: VW	Project: R4 2.0 EA 189_2	Project/ design sample version C / C		
Item number (TT no.) : 0445B21116_11	Production date: 982	Serial number: 4959	Factory - Line 011M FeP-M		
Running time ACTUAL [h] 1020 h	Fuel: Biodiesel US B20		MAP no. DS-245455		
SAP no.: 30-052021-04	Samos no.: 773079	Customer order no.:	Engine C3LF/21235		
Customer item number 03L 130 755 D	DSBFD no.: 27778	Durability test type [customer]: Engine endurance test	Durability test conditions: Oil consumption endurance test +polycyclic endurance test+oil consumption endurance test with B20		

1. Subject

CP4 customer return **without complaint**
 Engine C3LF/21235
 Durability test conditions: Oil consumption endurance test, polycyclic endurance test and oil consumption endurance test with B20, running time: 1020 h

2. Conclusion

Function
 The pump function is within the specification limits. There is no significant drift compared to the as-delivered measurement.

Components
 The wear on the other components is minimal and without any significant items of note.

Result
 The pump **has passed** the endurance test.

3. Findings (visible findings)

3.1 Drive
No significant wear

3.2 Drivetrain
No significant wear

3.3 High pressure
No significant wear



3.4 Bearing
No significant wear






3.5 Shaft seal
No significant wear



Rating legend

OK	x		
non-critical	x		
critical			x

	x		
	x		
	x		
	x		
	x		

 BOSCH 	CR pump CP4 - Findings report			Report no.	2010-CP4_0324	
				Date	20.05.2010	
Department:	Person responsible:	Telephone:	Use	internal		
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				Confidentiality note		
				Confidential		
3.6 Boreholes No significant wear				<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.7 Built-on components (metering unit, overflow valve, counting point) No significant wear				<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.8 O-rings No significant wear				<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.9 Miscellaneous No significant wear				<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.10 Pictures						
4. Hydraulic function The pump function is within the specification limits. There is no significant drift compared to the as-delivered measurement.						
				Delivery rate [l/h] of new part	Delivery rate [l/h] after testing	
	n [rpm]	p_rail [bar]	I_ZME [A]	19.04.2009	26.04.2010	
ST	200	200	0.4	4.5	4.53	<input checked="" type="checkbox"/>
LG	1000	1800	0.4	20.11	20.17	<input checked="" type="checkbox"/>
5. Parts storage The pump will be scrapped by request of the customer.						
6. Attachments None						
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		CR pump CP4 - Findings report		Report no.	2011-CP4_0674
				Date	23.09.2011
Department:	Person responsible:	Telephone:	Use	internal	
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				Confidentiality note	
				Confidential	
To:	Non-responsive content removed				
Attn. of:	Non-responsive content removed				
Pump type:	Customer:	Project:	Project/ design sample ver-sion		
CP4.1S_348_2x5,25_REC_3,3_1,95_MT4,2	VW	R4 low	Series/ Series		
Item number (TT no.) :	Production date:	Serial number:	Factory - Line		
0445010508	081210	0451	0110 FeP		
Running time ACTUAL	Fuel:		MAP no.		
31874 km	US field		DS-287408		
SAP no.:	Samos no.:	Customer order no.:	Engine/vehicle number		
30-102939-09	747394		VW361MECM015-OS; NCS (Jetta)		
Customer item number	DSBFD no.:	Durability test type [customer]:	Durability test conditions:		
03L 130 755 A	32183	Vehicle endurance test	Quality endurance test USA		
Complaint: Drivetrain damage					
1. Subject					
<p>CP4 customer return with drivetrain damage Pump with RP0 and RP1 Test conditions: Quality verification USA with VW361MECM015-OS; NCS (Jetta) in Florida.</p>					
2. Conclusion					
Function					
Because of the drivetrain damage it was impossible to carry out a hydraulic return measurement and function test.					
Components					
<p>- There is Category IV drivetrain damage: Abrasively worn roller around the circumference with central braking flat. The cam of the camshaft displays flattened areas and dug-in areas caused by the transverse roller. On the running face of the roller support, the C-coating is worn off across the entire width and in some cases up as far as an edge (see 3.10 Fig. 1 to 6). On account of the abrasive wear of the drivetrain parts and the resulting particles, the following components display intensive abrasive wear probably as consequential damage:</p> <ul style="list-style-type: none"> - housing and flange bearing bushing damaged radially and axially by particles and particle impressions (see 3.10 Fig. 7 to 10). There are particle impressions on the piston foot and piston foot contact surface. - The wear on the other components is minimal and without any significant items of note. 					
Result					
<p>The pump has not passed the endurance test. The cause of the drivetrain damage can no longer be traced on account of the extreme wear of the drivetrain parts. It can be assumed however that the drivetrain parts failed originally on account of a central braking flat and that the other components were damaged as the result of the resulting particles or material transfer. Causes for the braking flats are probably the properties of the fuel and/or an insufficient quantity of coolant/lubricant or air and/or water in the fuel, which presumably led to a sluggish or blocked roller.</p>					
3. Findings (visible findings)			Rating legend		OK  non-critical  critical 
3.1 Drive					
No items of note					

 BOSCH 	CR pump CP4 - Findings report		Report no.	2011-CP4_0674	
			Date	23.09.2011	
Department:	Person re-sponsible:	Telephone:	Use	internal	
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			Confidentiality note Confidential		

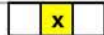
3.2 Drivetrain

- Camshaft: local abrasion in the middle and sporadic digging in in the running direction of the cam track from roller turned through 90° in combination with standing and transverse roller.
- Roller: central braking flat
- Roller: large areas with spalling.
- Roller support: C-coating is worn off completely across the entire width and up as far as an edge.
- Tappet bore-hole and tappet body: Running face damaged by scoring and particles.



3.3 High pressure

- Piston foot: Particle impressions.
- Piston foot support surface on the roller support: Particle impressions.



3.4 Bear-ing

Housing and flanged bearing bushing: damaged radially and axially by particles and particle impressions.



3.5 Shaft seal

No items of note



3.6 Boreholes

No items of note



3.7 Built-on components (metering unit, overflow valve, counting point)

No items of note



3.8 O-rings

No items of note



3.9 Miscella-neous

No items of note



3.10 Pictures

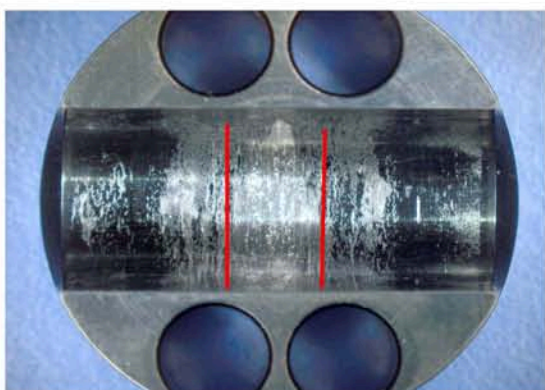


Fig. 1: Roller support, original damage caused by braking flat

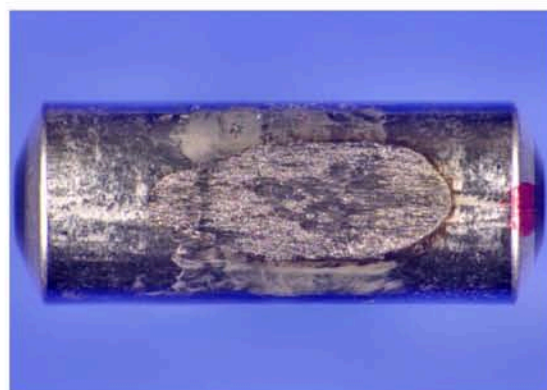


Fig. 2: Roller, running face



Fig. 3: Roller support, running face with braking flat

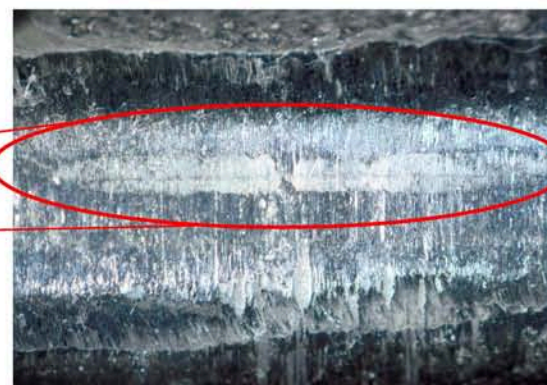




Fig. 4: Roller, braking flats detail

 BOSCH 	CR pump CP4 - Findings report		Report no.	2011-CP4_0674	
			Date	23.09.2011	
Department:	Person responsible:	Telephone:	Use	internal	<input type="checkbox"/>
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			Confidentiality note Confidential		

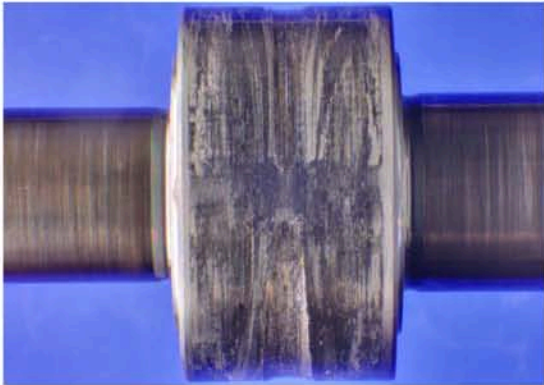


Fig. 5: Camshaft, cam track running face BDC

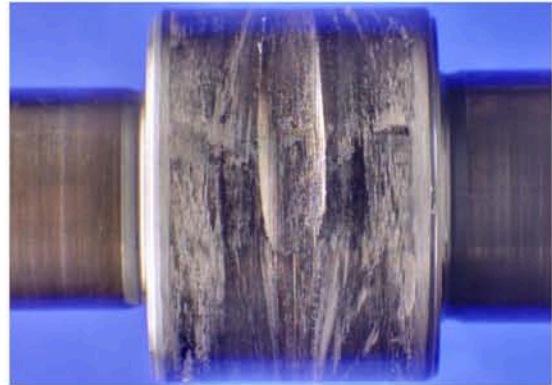


Fig. 6: Camshaft, cam track running face TDC

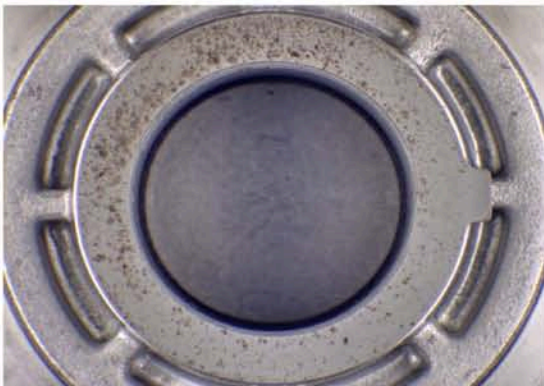


Fig. 7: Flanged bearing bushing axial, particle impressions



Fig. 8: Flanged bearing bushing, damage caused by particles

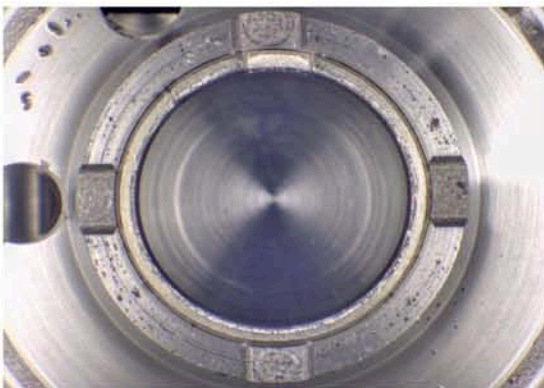


Fig. 9: Housing bearing bushing axial, particle impressions



Fig. 10: Housing bearing bushing, damage caused by particles

4. Hydraulic function

Because of the drivetrain damage it was impossible to carry out a hydraulic return measurement and function test.

5. Parts storage

By request of the customer, the pump parts will remain with Robert BOSCH GmbH and will be disposed of after a reasonable time.

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