Audi
Supplier Evaluation

Technical audit of supplier (TAS)

Order: TR107999
Date: 01/29/2008
Page: 1

Audi AG, [redacted] Supplier Evaluation and Projects, D-85045 Ingolstadt

Supplier no.: 1283 **Index: 30 DUNS no.: 34-451-8522**

Address of supplier:
Robert Bosch GmbH
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D-70469 Stuttgart Feuerbach

Component description
Designation: Diesel high-pressure fuel pump CP4.X for 2.0l TDI, 2.7l TDI, 3.0 l TDI Common Rail
parts no.: 03L 130 755A

Product safety officer:
Name/function/location: named and entered in the B2B platform
Tel./mobile/e-mail

Result

Reason for initiating TAS: 0km and field failure of CP4.x pumps at Audi Györ, Neckarsulm, IN due to a metal chip in the intake valve;

Order: Inspection of the cleanliness program in pump manufacturing (report 4 on the market launch of A4 (B8) Limousine)

Summary/focus/potential for improvements

In order to validate customer deliveries, an optimized testing program during 100% functional testing has been in use since Nov. 2007 (since Jan. 2008 for 2.0l CR, as of Feb. 2008 for V6 TDI CR). Here, approx. one in every 1,000 pumps with a chip on the intake valve (cause of 0km and field failures) is selected. The particle size is greater than 300 pm and sporadically with values of 500 pm. The internal cleanliness specifications for component parts and ASSY pumps permit particles up to 400 pm. The regular cleanliness analyses and the results of the functional analysis show that the current cleanliness requirements are not being complied with and they are not sufficient to prevent the aforementioned failures. For the most part, the measures previously reported by Bosch have been implemented in full. Additional process analyses and optimizations are necessary and already installed as a CIP process with the goal of having a max. particle size of 400µm (e.g. small control loops, analysis center DNA). A significant improvement in component cleanliness is evident from the cleanliness analyses (see attachments 1 to 5).
Another basic tracking/consideration of the contamination situation while including the necessary nominal specifications is absolutely imperative in relation to achieving better cleanliness values while considering the pump failures involving particles as of 300µm.

Agreed measures

Self-audit: Yes No x Deadline:
Direct validation: Yes No x
Type of validation:

Other: Installation of a regular "zero-fault meeting" with Bosch, VW, and Audi; kick-off on 01/31/2008

Set the traffic light to yellow.

Escalation will be implemented in the event of a "red" evaluation. The supplier will soon be invited to a top quality meeting at Audi.

As part of a tech. audit, the supplier will verify the fulfillment of the legal requirements and the technical specifications of the VW Group in the production process.
Mandatory measures for improvement must be implemented by the deadlines specified and sent with a written statement to:
Audi AG, [redacted] Supplier Evaluation and Projects, D-85045 Ingolstadt

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Audi
Supplier evaluation

Audit record

Order: TR107999
Date: 01/29/2008
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Unit volume/time unit: High-pressure pump and main components

Pos.	Characteristic	D/TGD	CPK values[1]	100% check[2]	Random sample[3]	Product audit[4]	Reliability[5]	Remark
1	Functional testing of ASSY Pump	-	-	X	-	X	X	and also the detection of malfunctions that cause a chip
2	Cleanliness analysis of ASSY Pump	-	-	-	1 part per day per production line	X	X	For information about the test results and quality level, see attachments 1 and 2.
3	Cleanliness analysis Component parts: housing, flange, cylinder head	-	-	-	1 part per day per production line	X	X	For information about the test results and quality level, see attachments 3, 4 and 5.
4								
5								
6								
7								
8								
9								
10								

Requalification check[6] X Model test (MT)[7] X Initial sample check (ISIR)[8] X

Legend:
Re 1.: values entered, re 3.: size of random sample/unit, re 4. and 5.: frequency " n/time unit", re 2., 6., 7. and 8. : "x" implemented, "E" required but not available, therefore not applicable

[redacted] TAS 06/2006

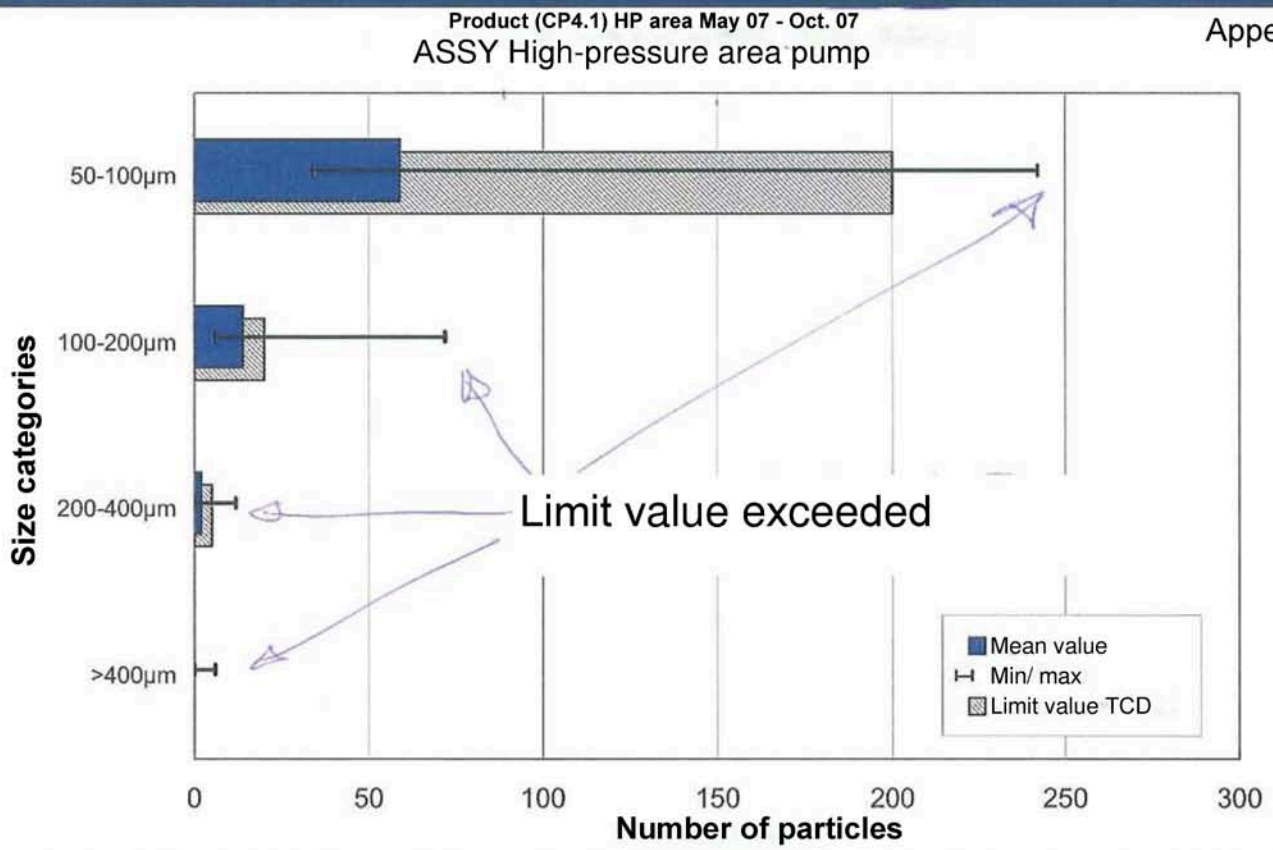
Audi	**Improvement program**	Order: TR107999 Date: 1/29/2008
Open or, in the case of TAS, additional problem areas identified/recommended measures	**Root cause analysis/supplier measures**	Deadline/status/ person responsible
Pump assembly: -The MU hole cover, which protects against chips, only partly covered the MU hole in the pump housing. The post-its currently used are tight (projected only approx. 1 mm beyond the edge of the hole) and do not have any reliable adhesive strength when used on aluminum. Obtain and use larger stickers with better adhesive strength. -At the assembly workstation (supply of pump housing as a first assembly step), mesh baskets with pump housings are mounted onto a roller conveyor. Here, contamination resulting from small chips and spots, potentially caused by the hoist used, the metal mesh baskets, the aluminum frame of the Plexiglas housing, and the way in which the fixtures interact with each other, must be identified on the roller conveyor and in the immediate vicinity. -At station 80 (bolting the overflow valve), considerable impact points at the clamping element with a danger of detaching metal particles must be identified.		

Audi	**Improvement program**	Order: TR107999 Date: 1/29/2008
Open or, in the case of TAS, additional problem areas identified/recommended measures	Root cause analysis/supplier measures	Deadline/status/ person responsible
Housing production: - After the pump housing underwent the washing process, large aluminum chips were sporadically found on the workpiece carriers. A consistent origins analysis and definition of measures is necessary here, including an examination and, if necessary, a new/modified definition of behavior/handling guidelines for maintenance and external staff who enter and leave the cleanliness area. Check/define the delivery specification for workpiece carriers (cleaning/cleanliness standard).		
Cylinder head: - The plastic protective covers used in packaging/transportation are available in different lengths to facilitate long versions on the base plate of the transport trolleys where particles stick. When reused, sticky particles may enter the heads. Ensure that the protective covers have an optimal length (OK - example identified during an on-side visit). Alternatively, thermoforming sheets similar to the pump housing can be used.		

Audi	**Improvement program**	Order: TR107999 Date: 1/29/2008
Open or, in the case of TAS, additional problem areas identified/recommended measures	Root cause analysis/supplier measures	Deadline/status/ person responsible
General: -Despite the relatively short transport routes, it is suggested to implement component sampling for the cleanliness analysis of individual parts in the assembly area shortly before installing the components, so that aspects of transportation and packaging can be recorded in the evaluation. -Planning of the control loop for locking parts after "not OK" results (e.g. cleanliness analysis) is to be completed immediately and put into practice. -Up to now, process changes were not transferred to the FMEA process. Continuous maintenance of FMEA, in connection with cross-plant access to FMEA, is an important resource for promptly making one-time findings available to everyone involved in the process.		

Residual dirt analysis of CP4

Appendix 1:



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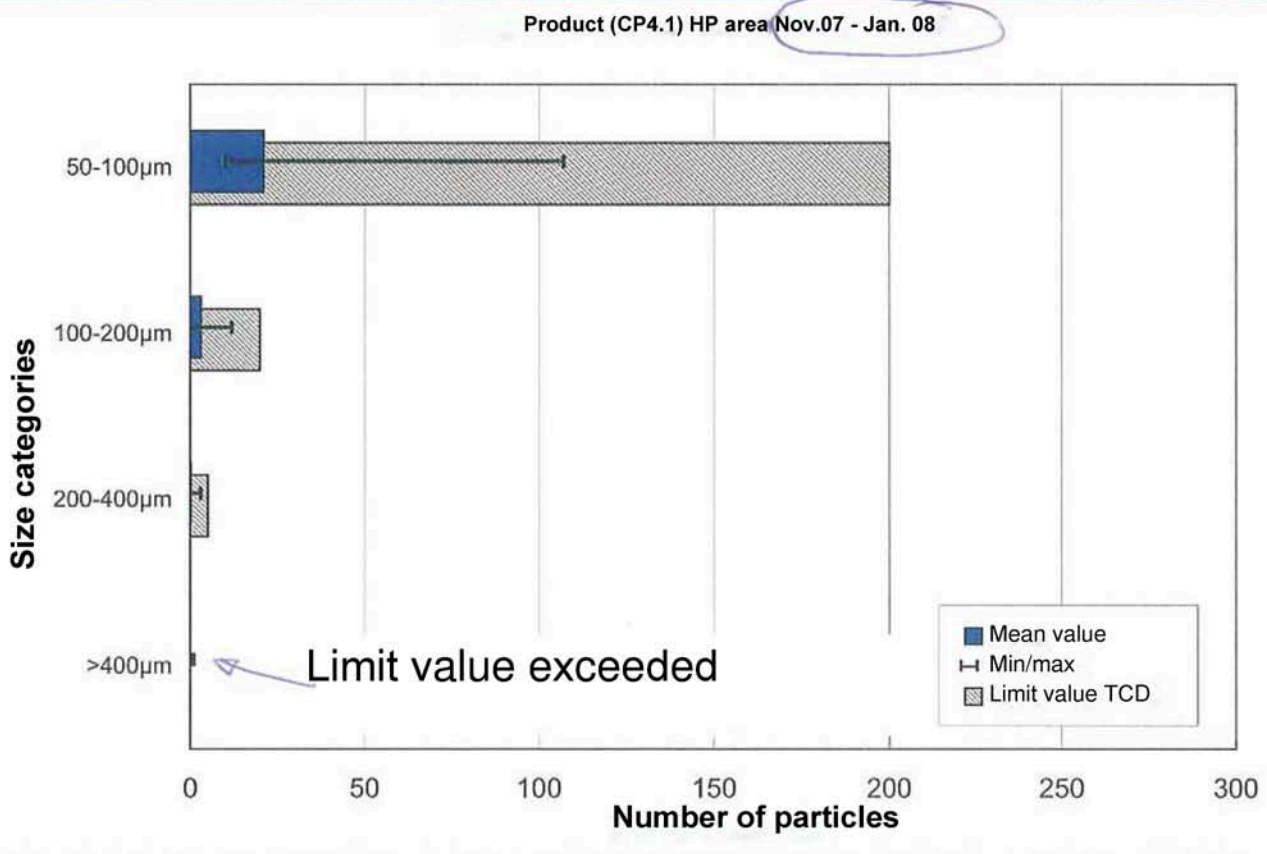
Residual dirt analysis of CP4



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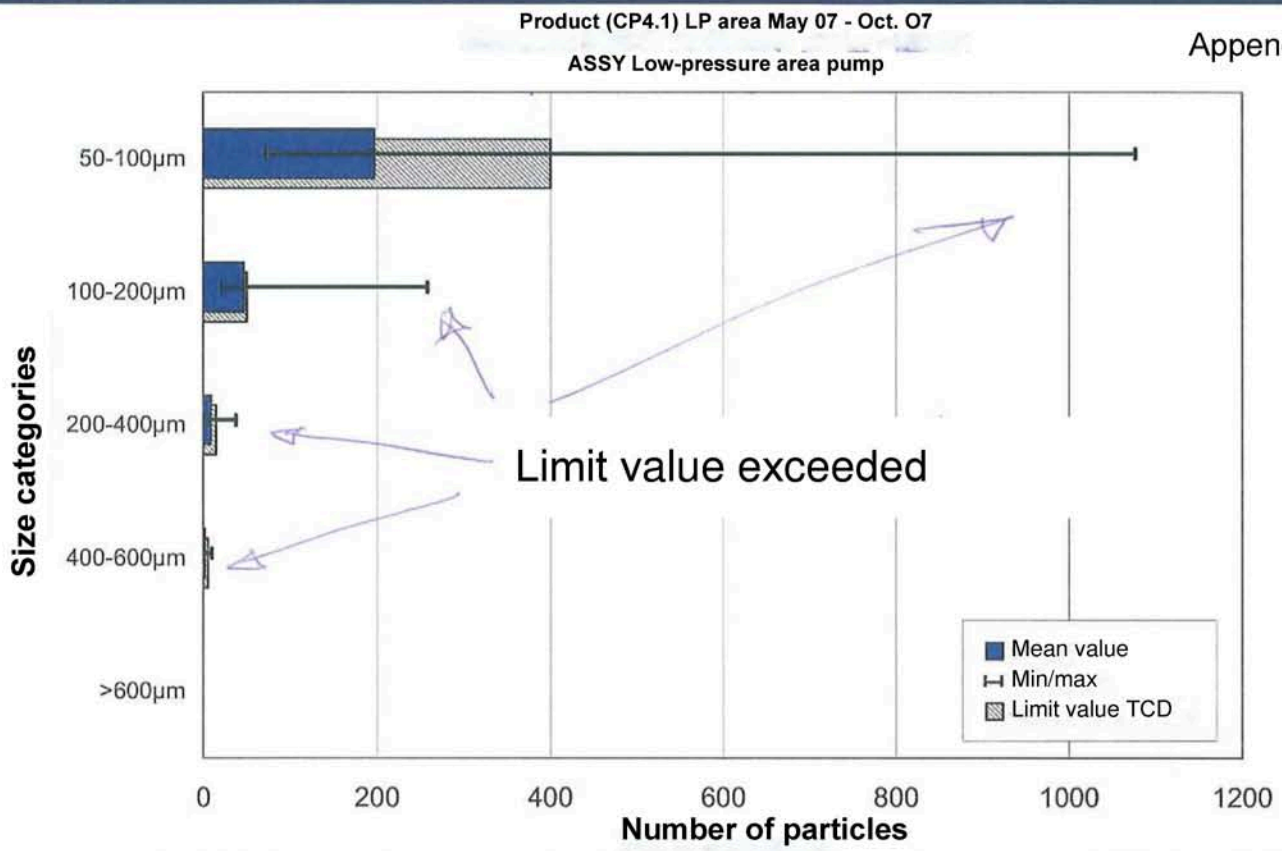
Residual dirt analysis of CP4

Appendix 2:



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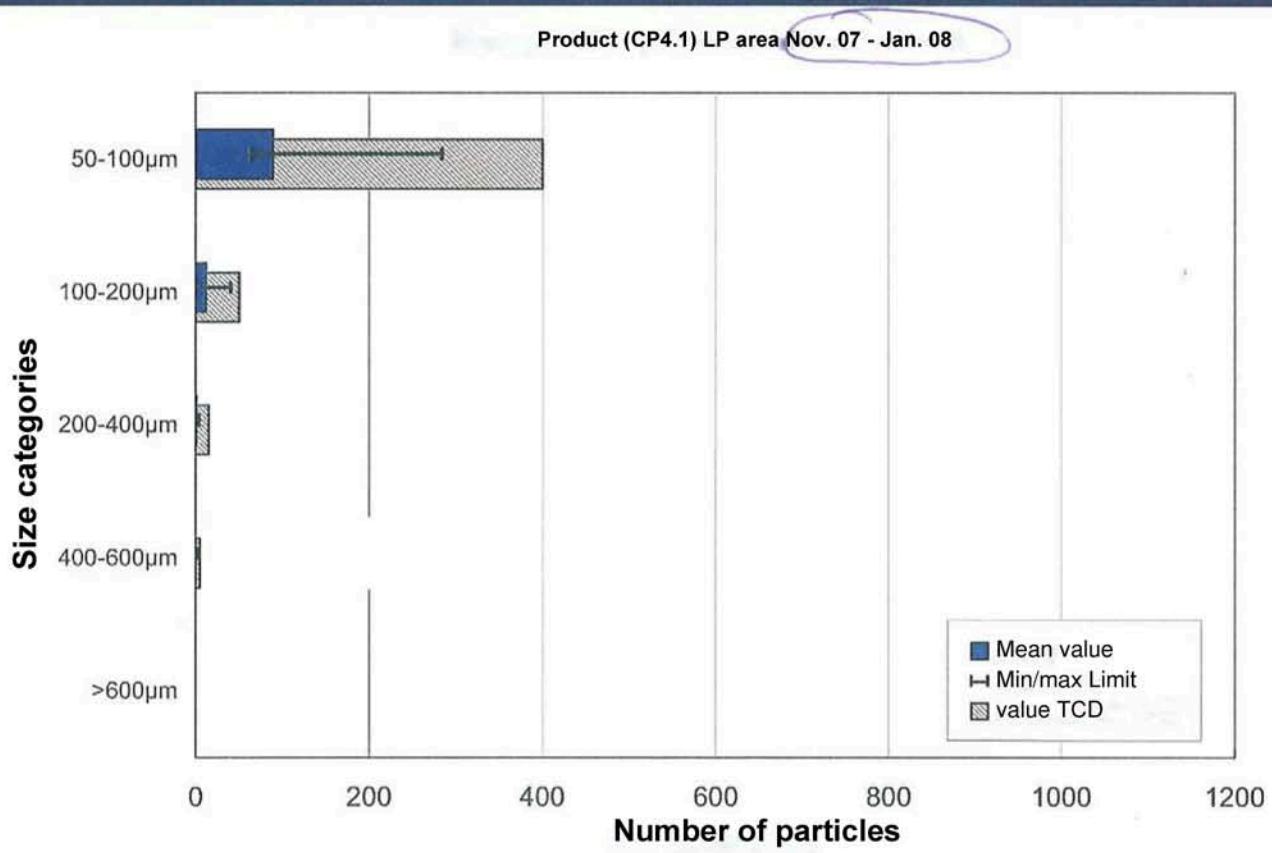
Residual dirt analysis of CP4



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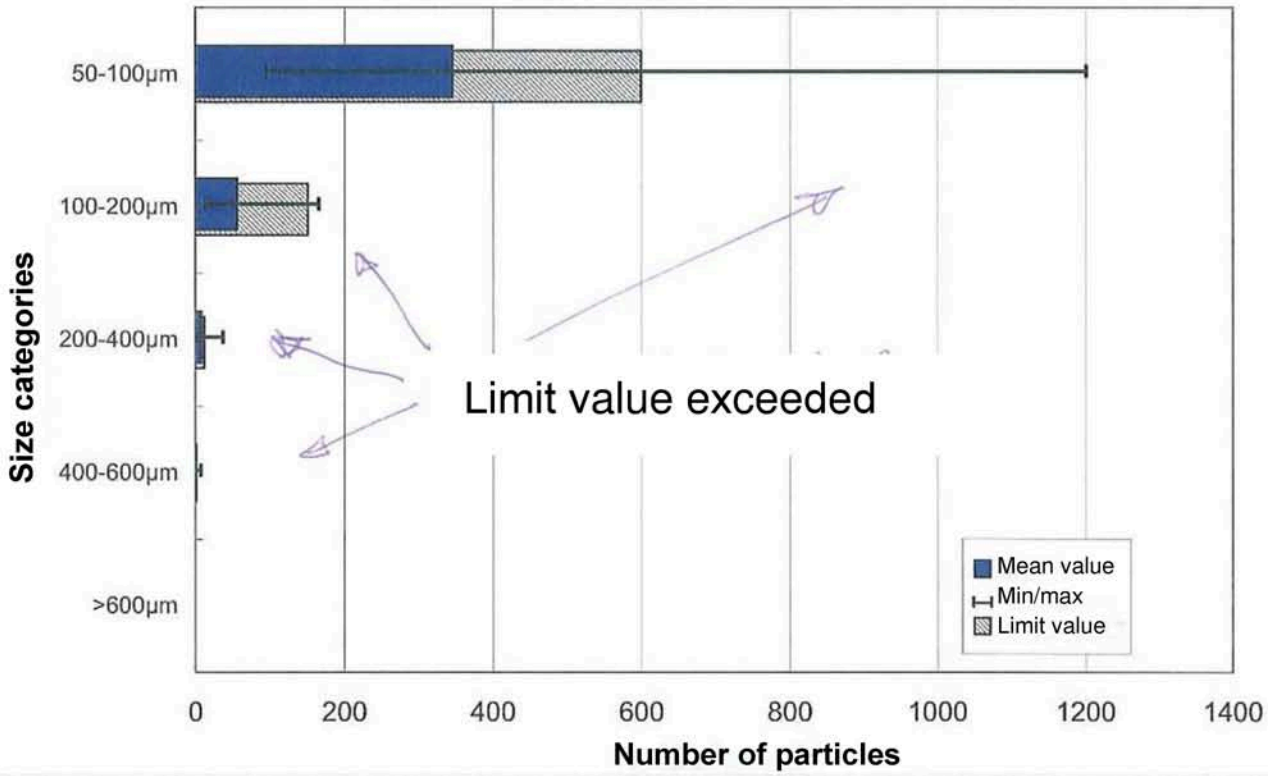
Residual dirt analysis of CP4

Component part

Housing May - Oct. 07

Appendix 3:



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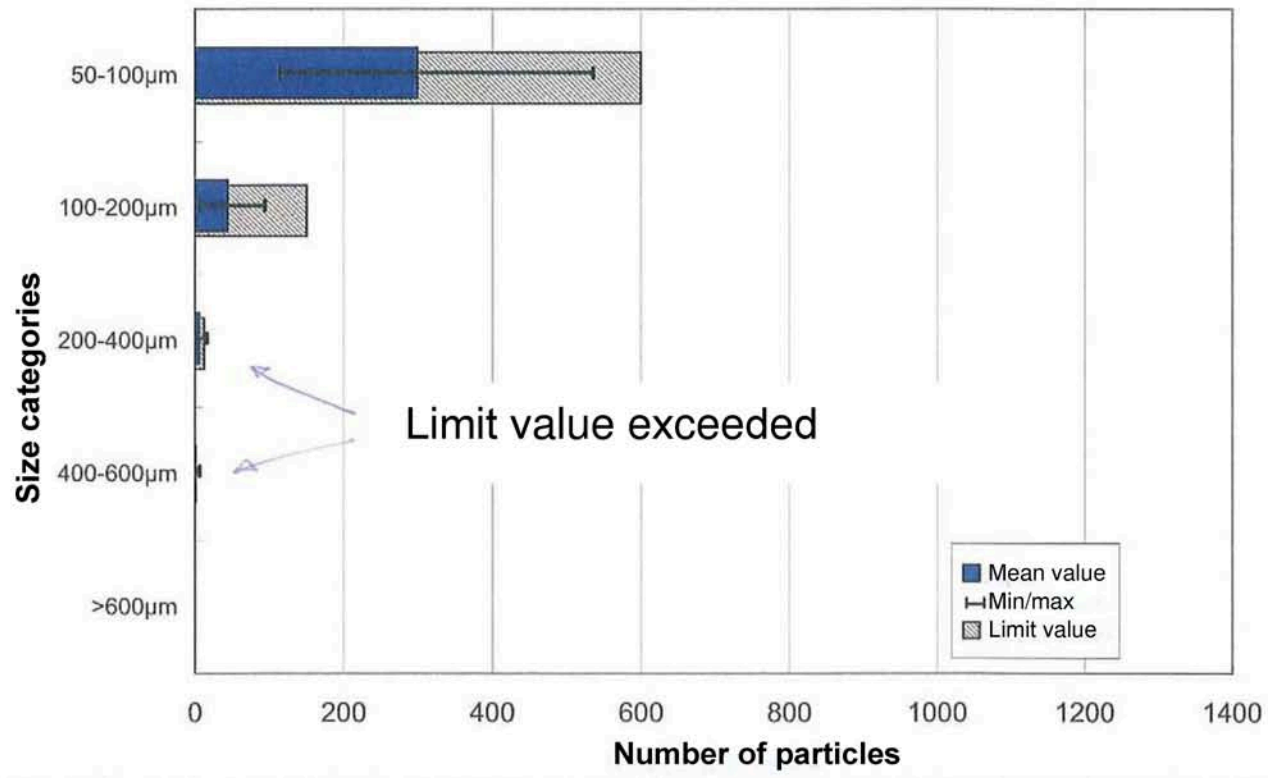
Residual dirt analysis of CP4

Housing Nov. 07 - Jan. 08



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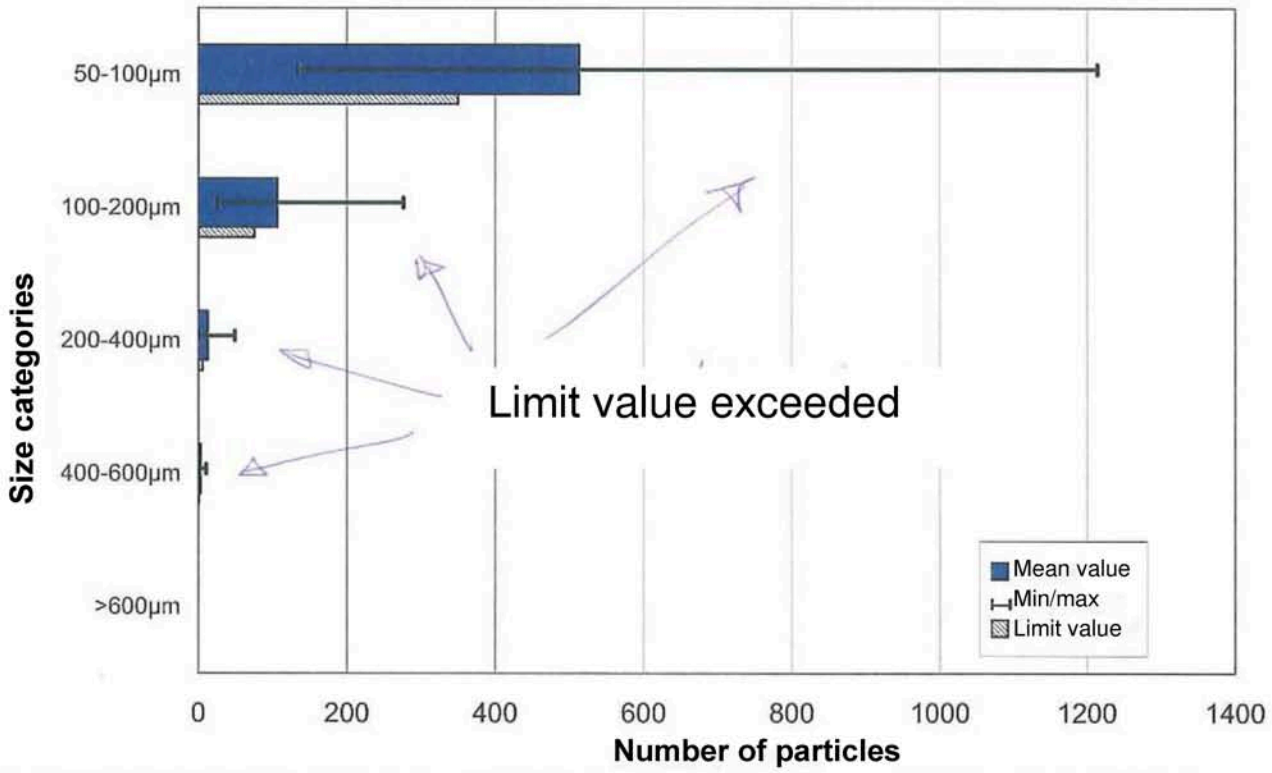
Residual dirt analysis of CP4

Component part **Flange May 07 - Oct. 07**

Appendix 4:



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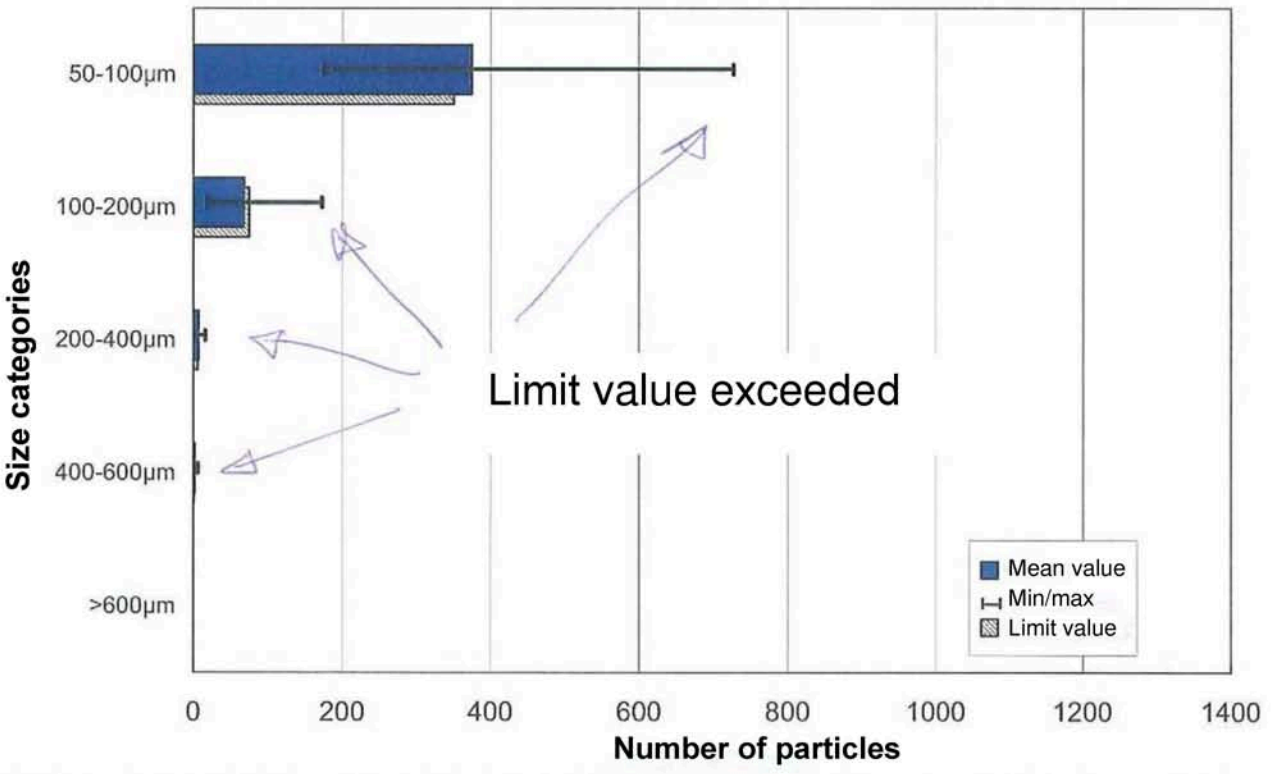
Residual dirt analysis of CP4

Flange Nov. 07 - Jan. 08



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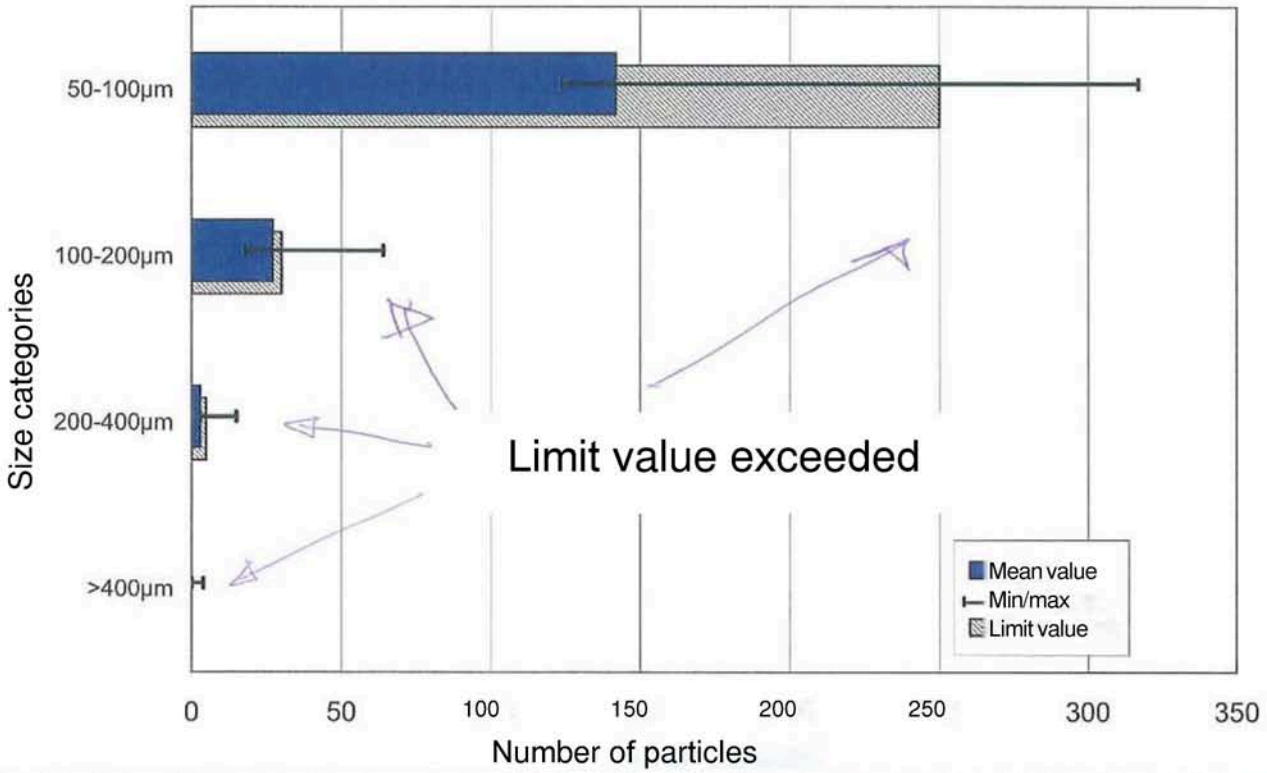
Residual dirt analysis of CP4

Component part **Cylinder head May - Oct. 07**

Appendix 5:



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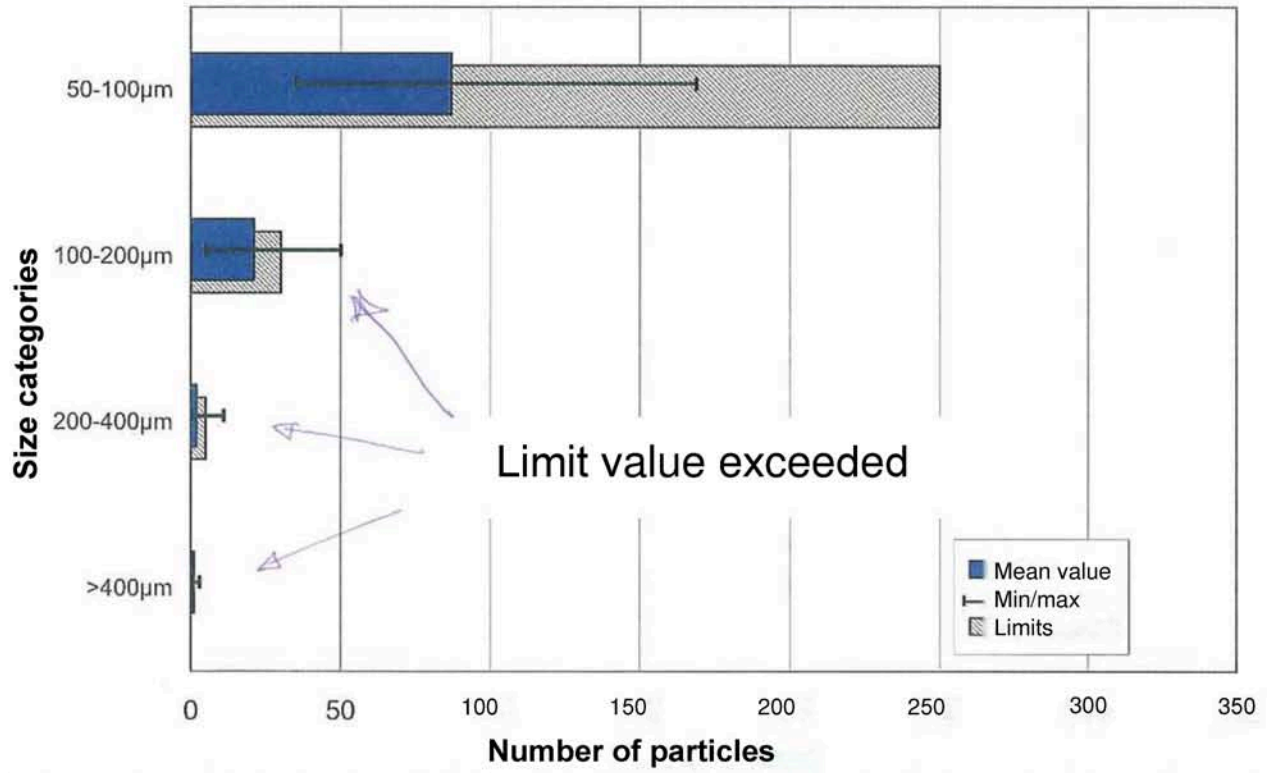
Residual dirt analysis of CP4

Cylinder head Nov.07 - Jan.08



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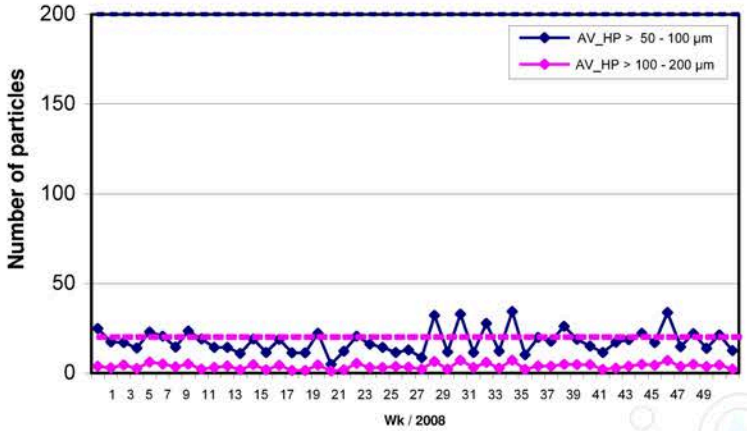
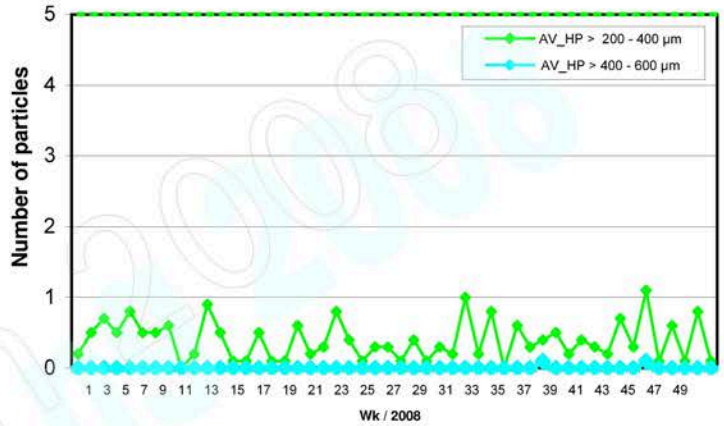
Cleanliness status CP4 FeP/JhP

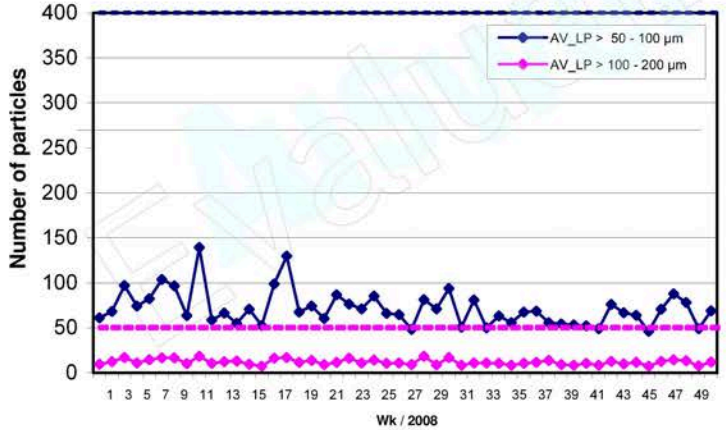
Cleanliness status FeP/JhP CP4, Status WK11/2009

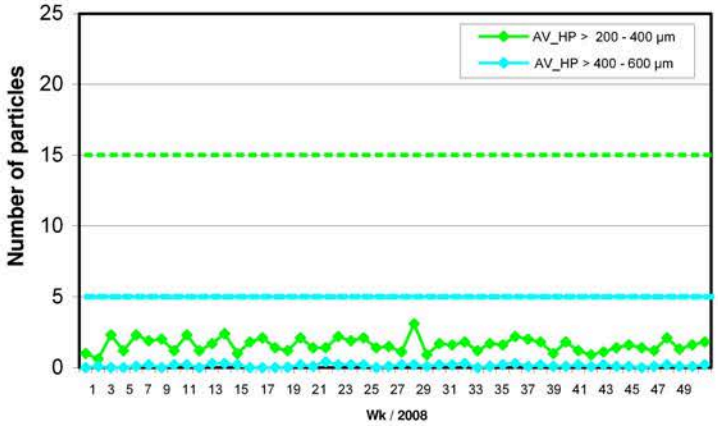
FeP: Residual contamination CP4 in the high-pressure range according to particle classes





FeP: Residual contamination CP4 in the low-pressure range according to particle classes





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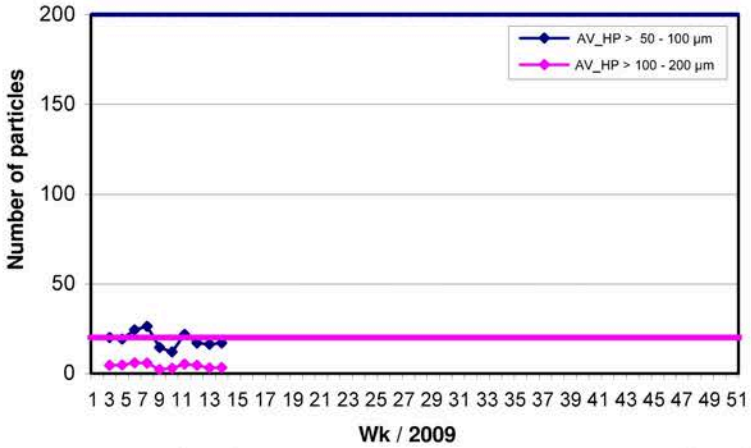

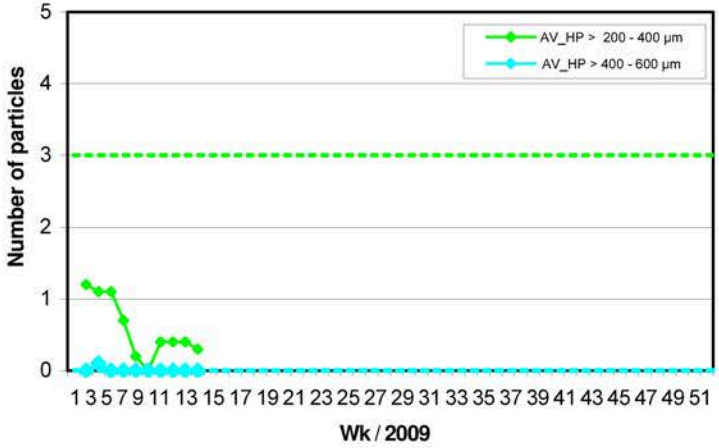

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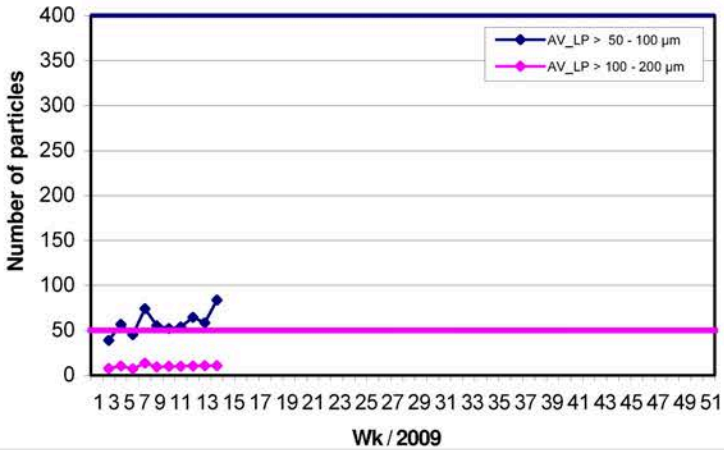

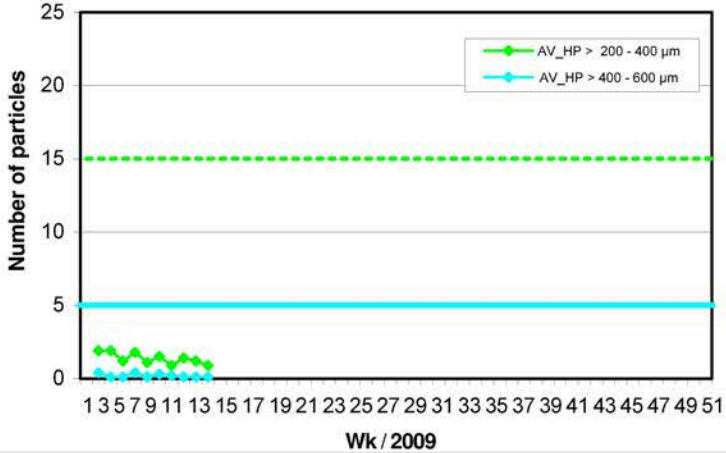

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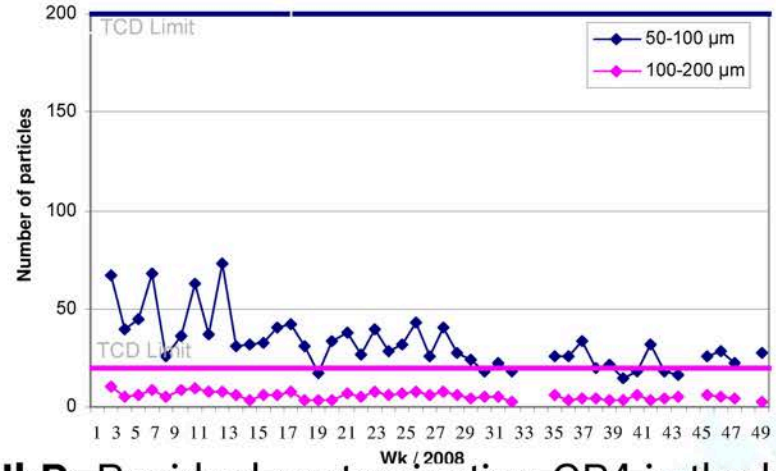
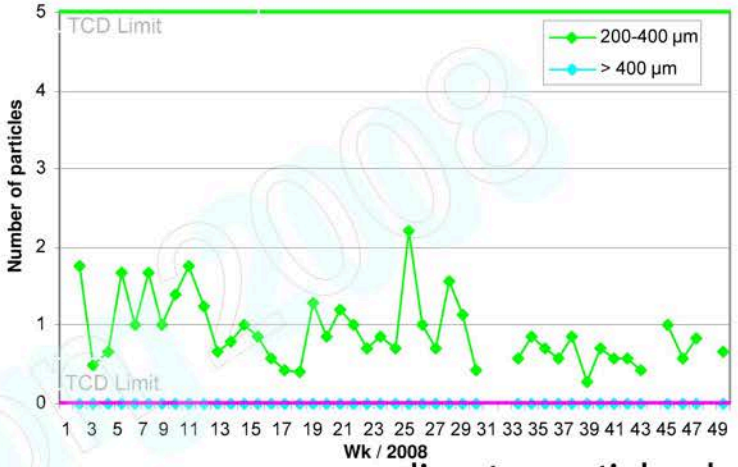
Cleanliness status FeP/JhP CP4, Status WK11/2009

JhP: Residual contamination CP4 in the high-pressure range according to particle classes





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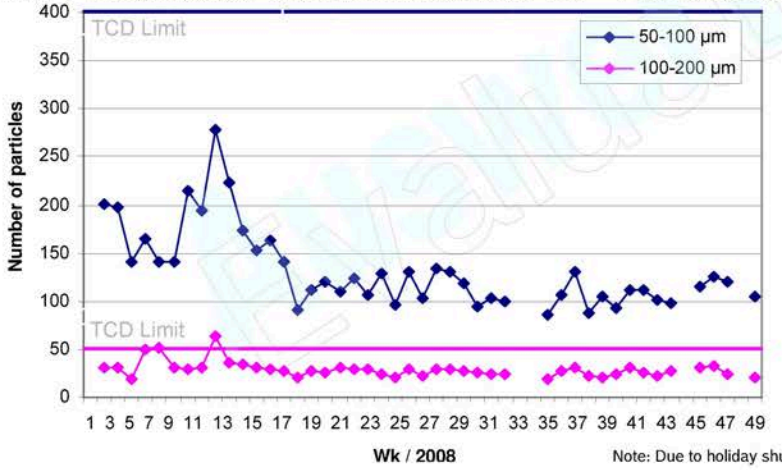
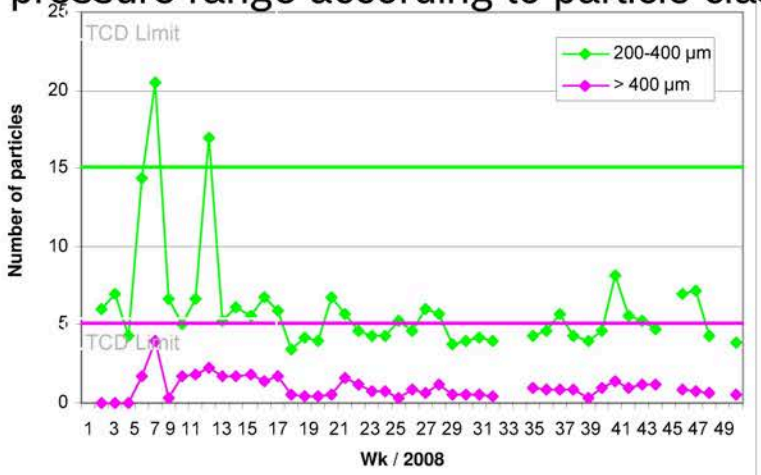
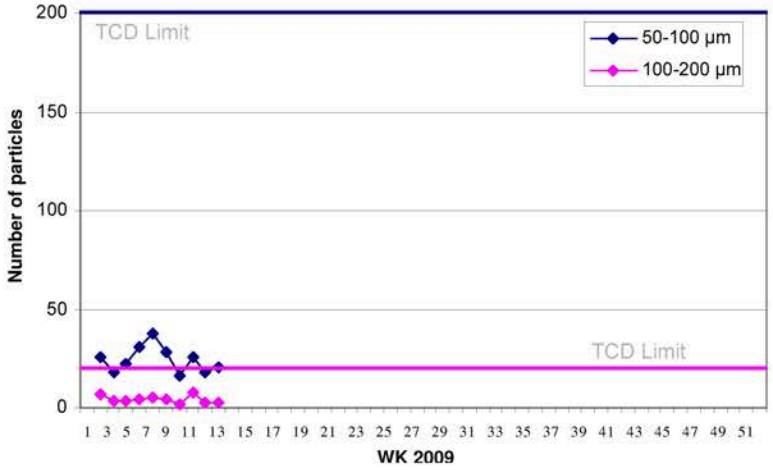


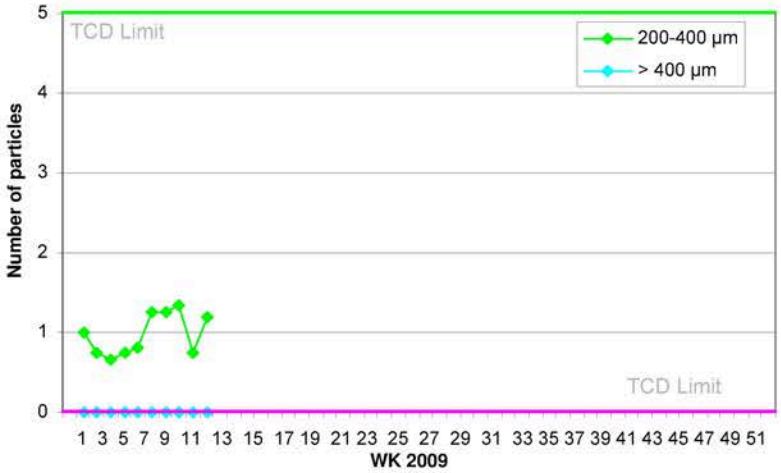
Note: Due to holiday shutdov



Cleanliness status Bosch FeP/JhP CP4, Status WK11

JhP: Residual contamination CP4 in the high-pressure range according to particle classes





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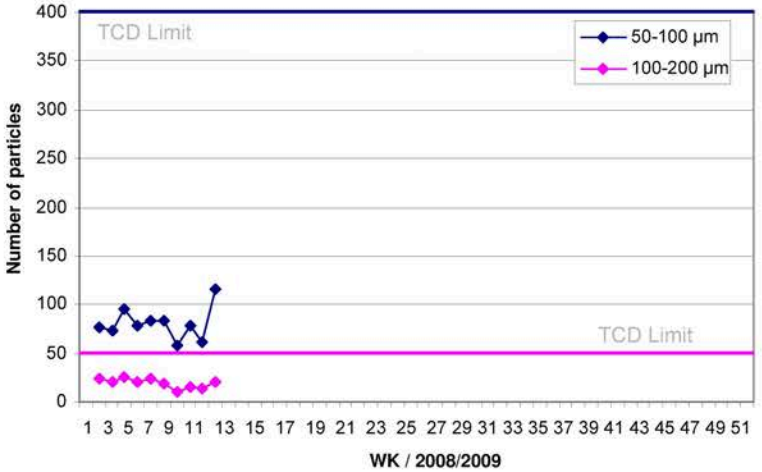
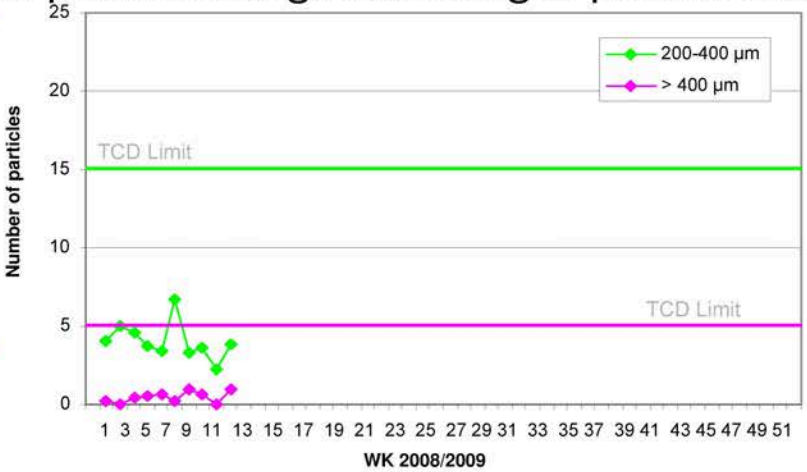
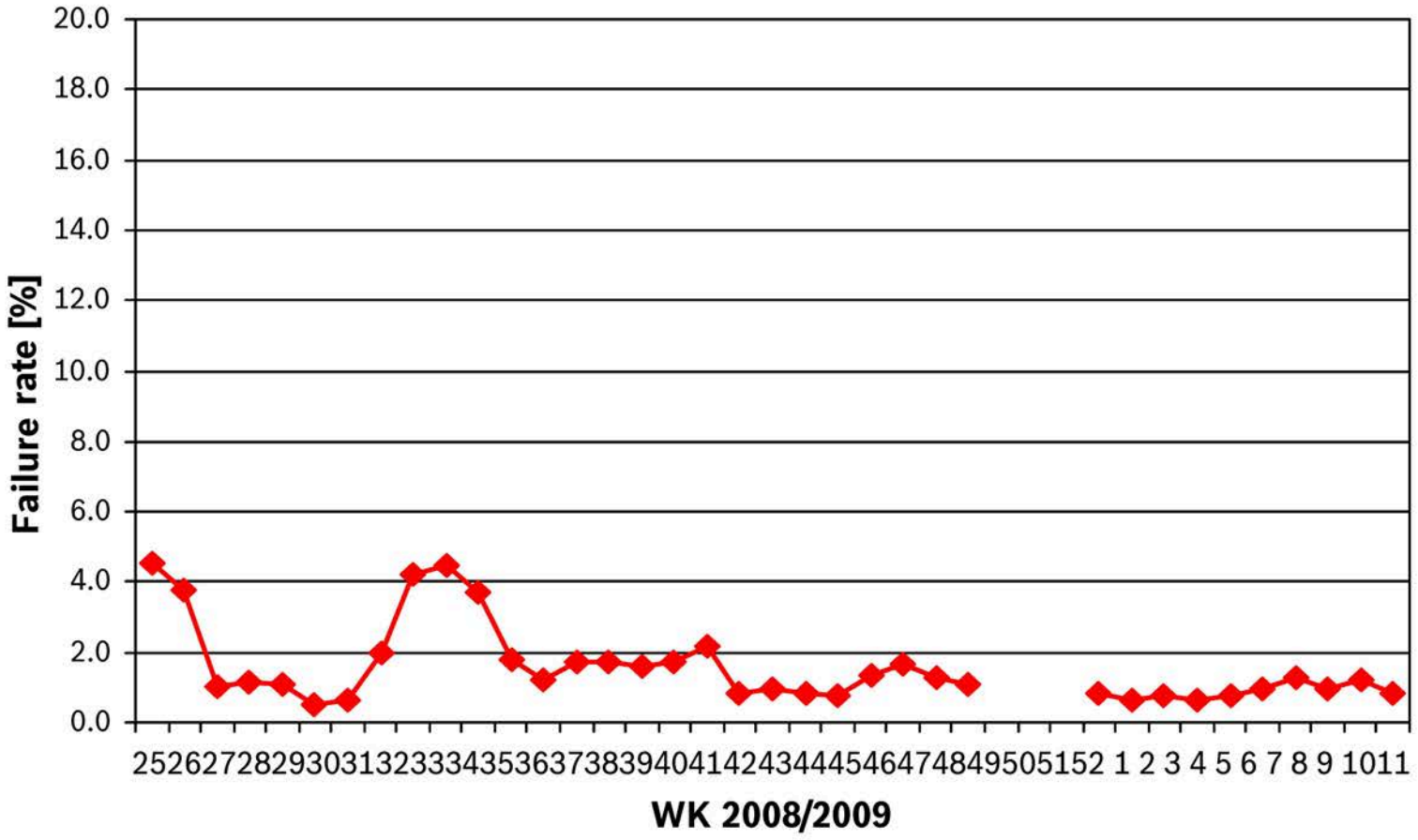




Cleanliness status FeP/JhP CP4, Status WK11/2009

FeP: Visual check of MU4 (Failure rate due to particles in %)



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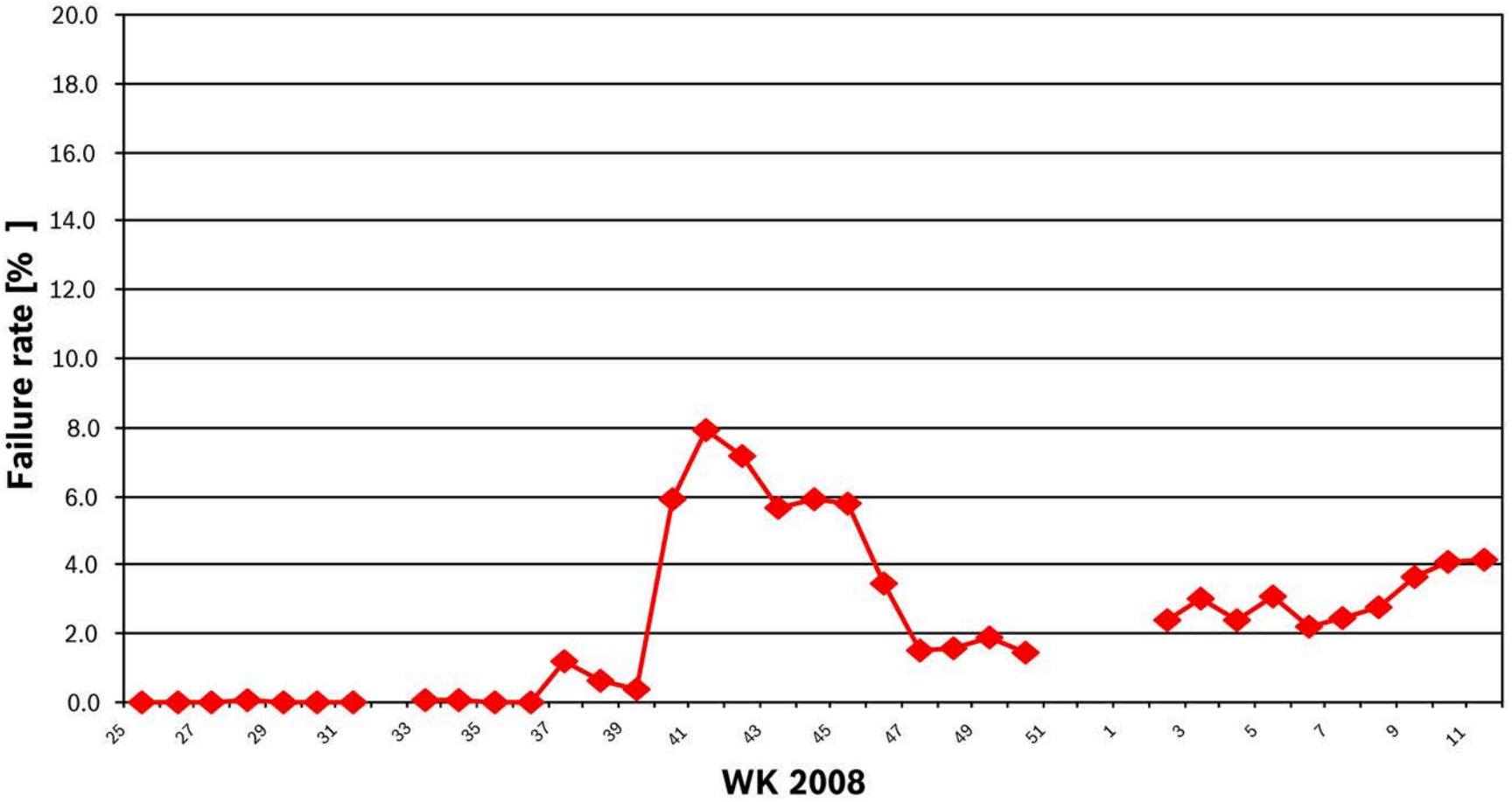
Cleanliness status Bosch FeP/JhP CP4, Status WK11

JhP: Visual check of MU4 (Failure rate due to particles in %)

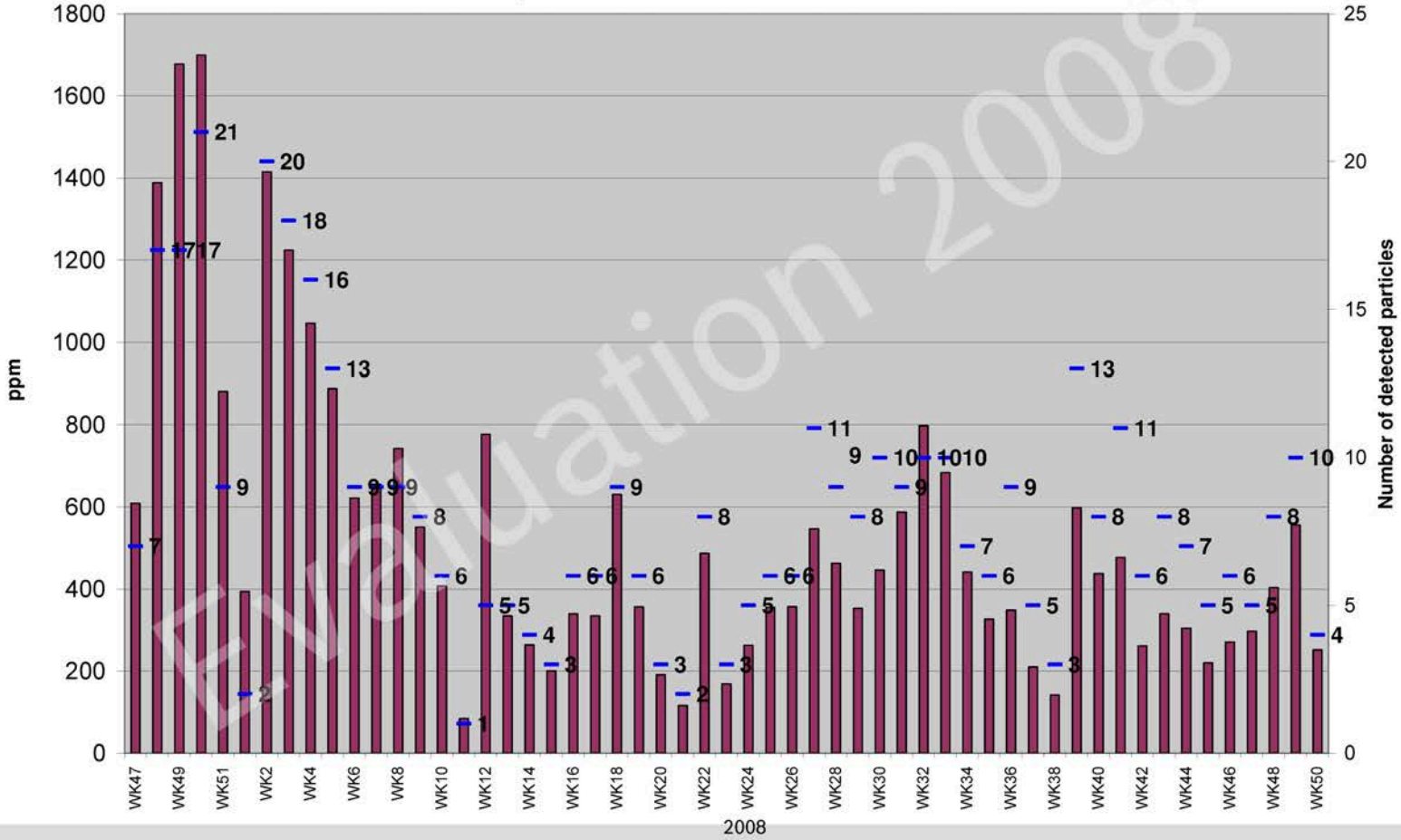


Note: Due to holiday shutdown, there is no data available for WK 32-33.

BOSCH

Cleanliness status FeP/JhP CP4, Status WK11/2009

FeP: CP4 product, internal rail pressure failures with particles detected in the intake valve / non-return valve



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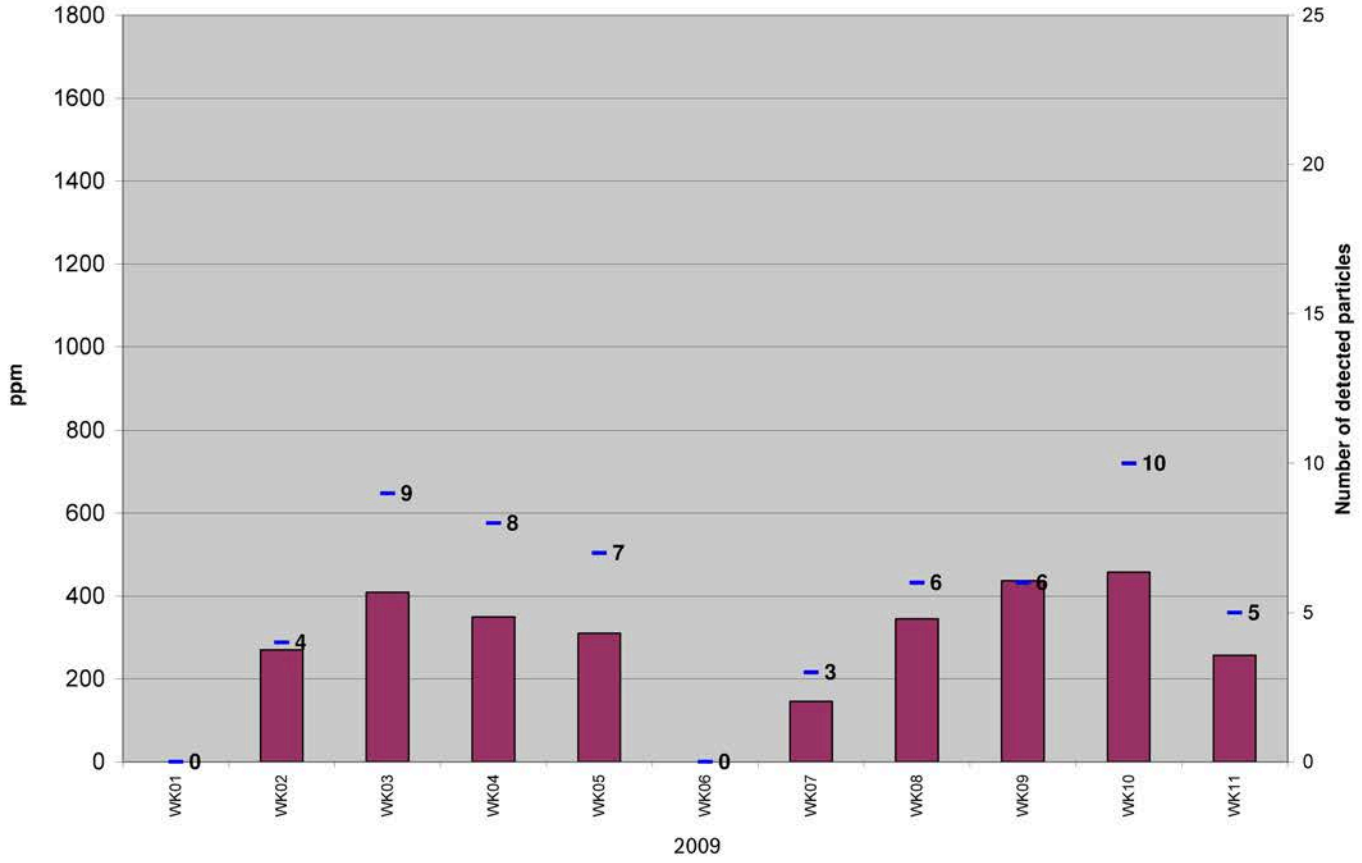

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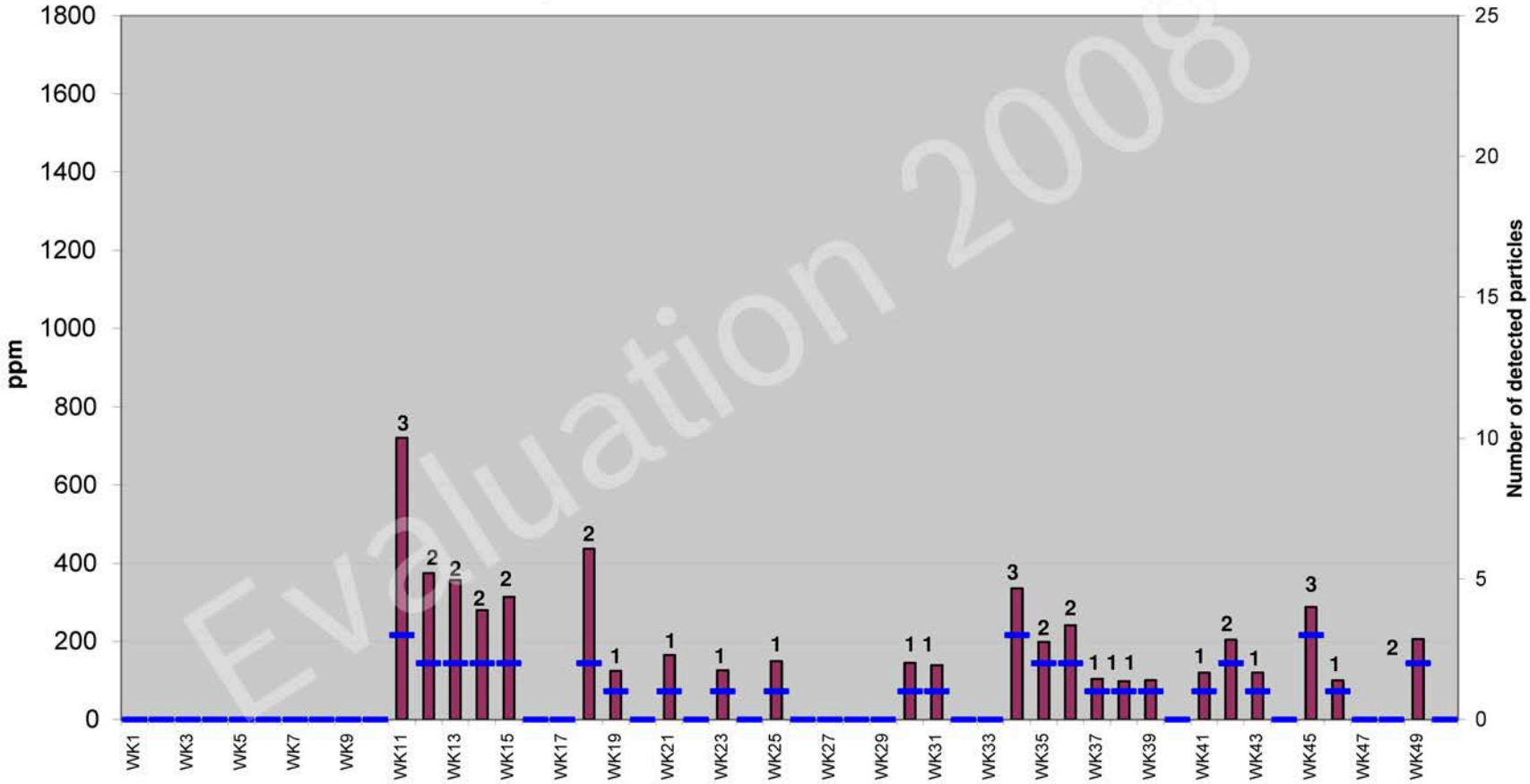

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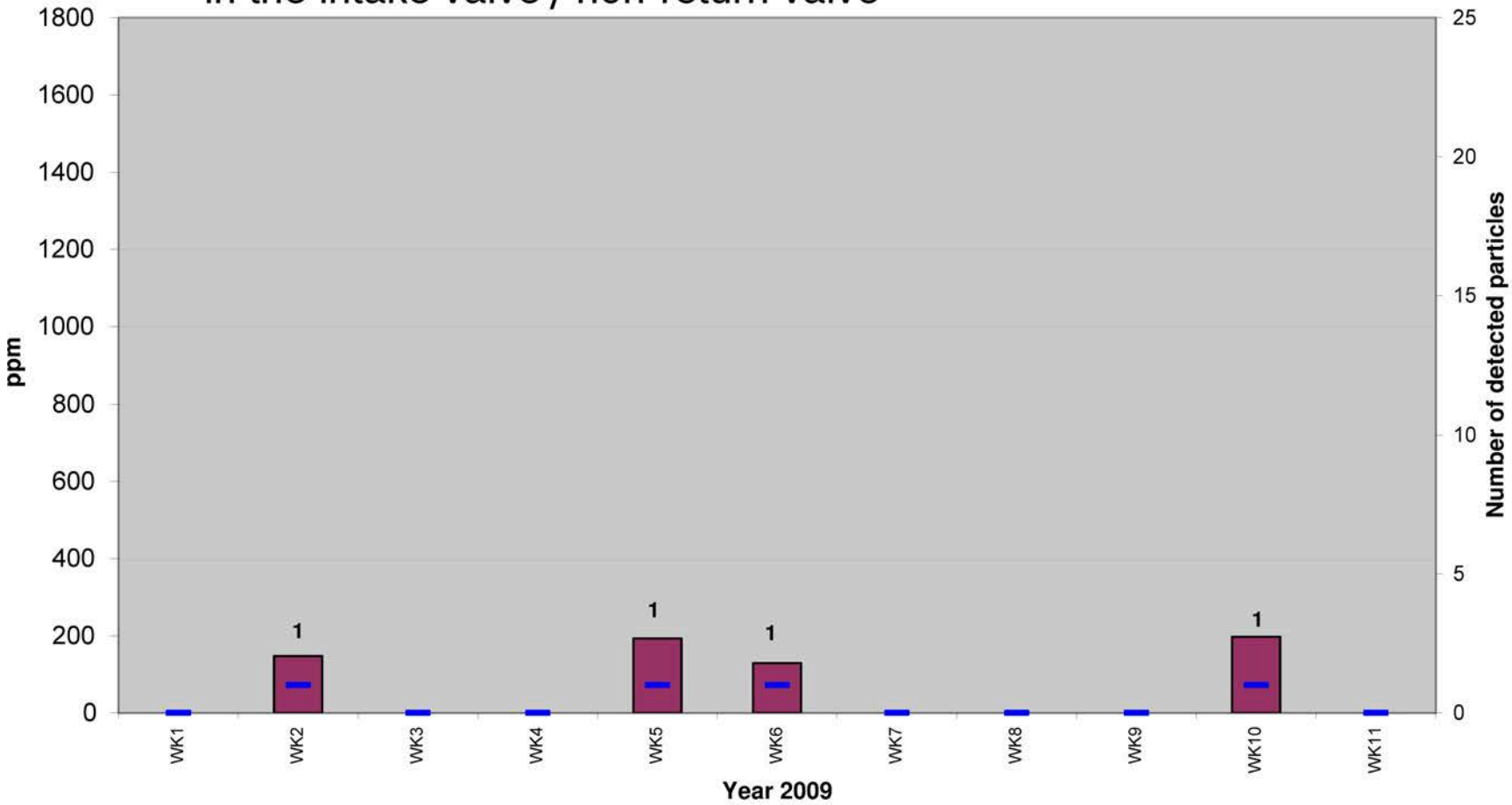
Cleanliness status Bosch FeP/JhP CP4, Status WK11

JhP: CP4 product, internal rail pressure failures with particles detected in the intake valve / non-return valve



Diesel Systems

[redacted] M2.13 | 01.28.2009

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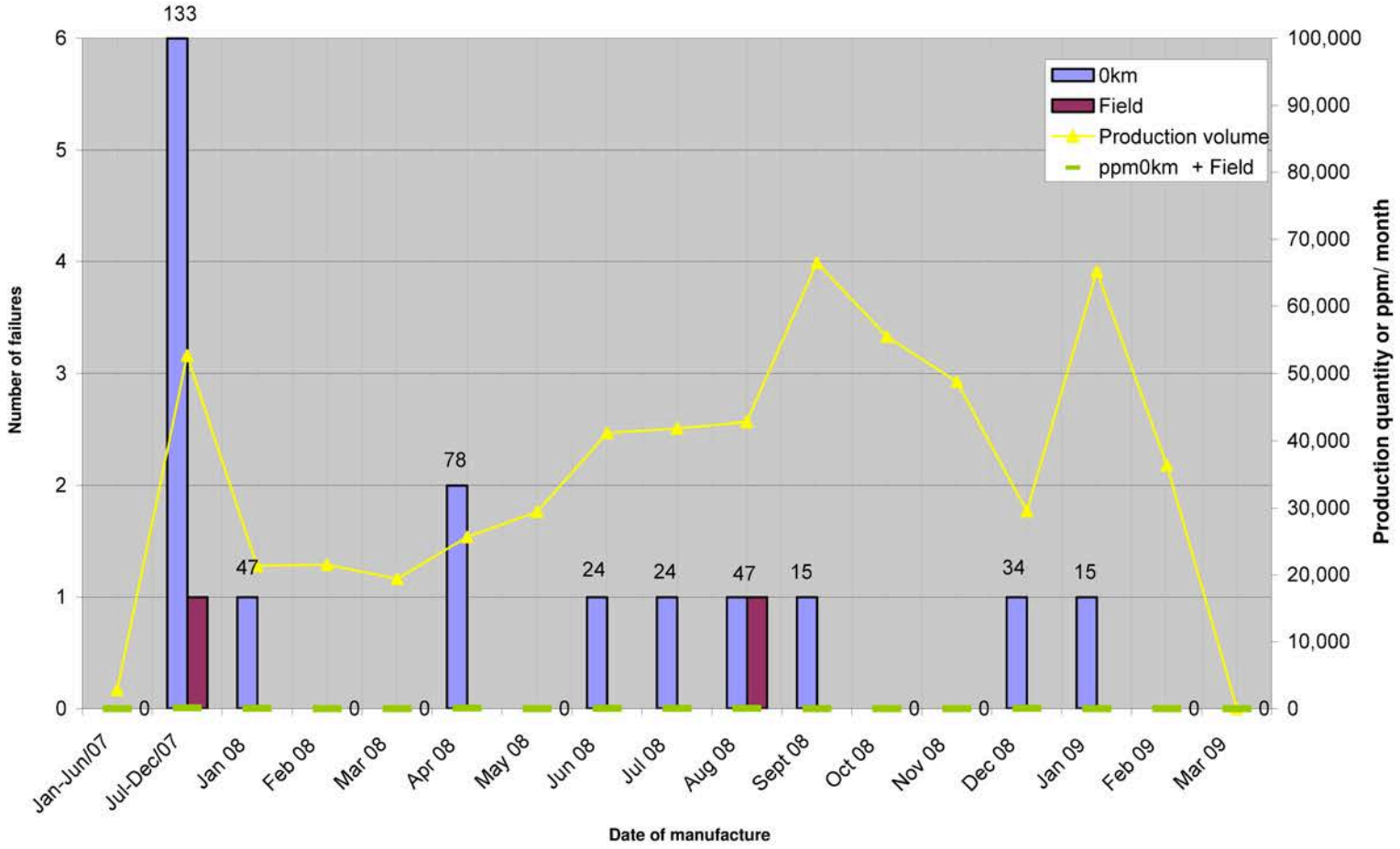
Cleanliness status FeP/JhP CP4, Status WK11/2009

FeP: Particle complaints confirmed in CP4 at VW/Audi



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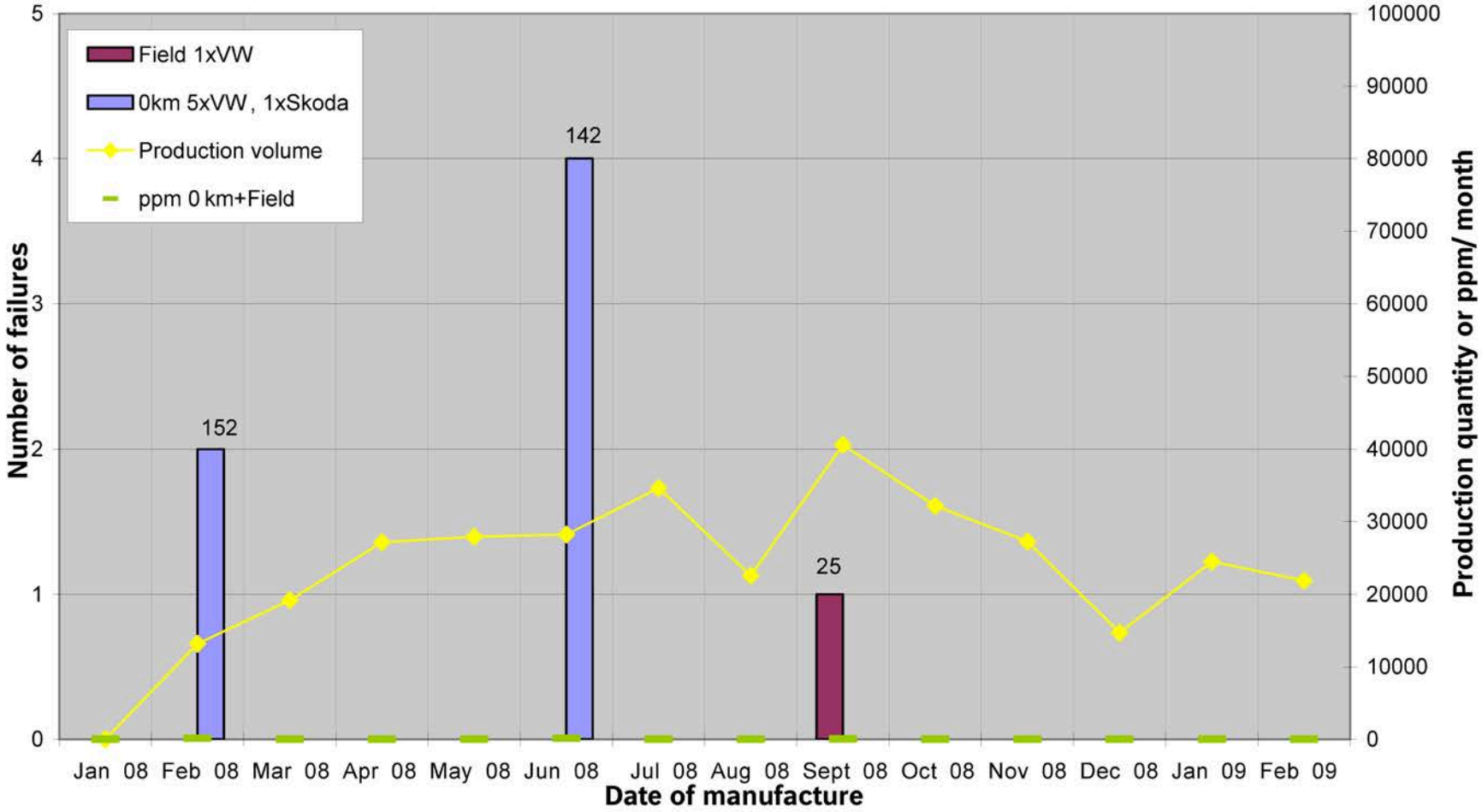
Cleanliness status Bosch FeP/JhP CP4, Status WK11

JhP: Particle complaints confirmed in CP4 at VW/Audi



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Cleanliness status FeP/JhP CP4, Status WK11/2009

FeP/JhP: Measures for reducing residual contamination: Housing and flange manufacturing for CP4

No.	Measure to reduce residual dirt	Housing	Flange	Introduction FeP		Introduction JhP	
				Date	WK	Date	WK
1	Detachment of joint bore Metering unit CH	x		2/7/2008	6	2/18/2008	8
2	Housing holder on robot gripper	x		2/15/2008	7	2/20/2008	8
3	Ventilation of vacuum chamber, dry cleaning system	x		2/14/2008	7	3/3/2008	10
4	Housing holder on onward transport	x		2/15/2008	7	2/22/2008	8
5	Processing, clamping concept	x		02/8/2008	10	2/20/2008	8
6	Chamfer on 90 degree cutting (external contour)	x		02/8/2008	10	2/20/2008	8
7	Outlet, processing of clamping concept (external contour)	x		02/8/2008	10	2/20/2008	8
8	Optimized version of gripper pins (housing holder in dry cleaning system)	x		2/6/2008	10	3/10/2008	11
9	Floating housing holder (in x, y and z direction in the dry cleaning system)	x		2/15/2008	7	3/10/2008	11
10	MU barreling out “acute-angled” intersection	x		4/10/2008	15	6/15/2008	24
11	O-ring recess, cyl. intake Head	x		4/10/2008	15	4/18/2008	16
12	Axial “lubrication indent with inclined cast	x		1.Q. 2009		1.Q. 2009	
13	Processing of installation clamping surface	x		Q3 2009		Q3 2009	
14	Chamfer towards tappet	x		3/10/2008	11	3/3/2008	10
15	“Press” chamfer to the sleeve	x		3/12/2008	11	3/12/2008	11
16	Incorporation of a radial groove		x	postponed		postponed	
17	Deburring of the outward size 19 chamfer edge		x	2/15/2008	7	3/12/2008	11
18	Replacement of the cast casting stamp in “embossed”	x		5/5/2008	19	5/5/2008	19
19	Cleaning chamber is flushed after every cleaning process (3 cleaning levels)		x	2/15/2008	7	2/20/2008	8
20	Application of 45 degree chamfer to blank	x		1.Q. 2009		1.Q. 2009	
21	Cast optimization in clamping concept	x		1.Q. 2009		1.Q. 2009	
22	Cast chamfer on DMC surface	x		Q1 2009		Q1 2009	
23	Discharge treatment Clamping concept	x		Q1 2009		Q1 2009	
24	Use of ball cutter to improve burr situation, cylinder head intake for MU	x		4/20/2009	17	4/20/2009	17

Legend: Introduced | Introduction to plan | Introduction date has passed | Implementation is not effective/ effectiveness will be checked

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Cleanliness status FeP/JhP CP4, Status WK11/2009

FeP/JhP: Measures for reducing residual contamination: Assembly and preassembly of CP4

No.	Statemen Measure to reduce residual dirt	Pre-assembly cylinder head	Assembly	Introduction FeP		Introduction JhP	
				Deadline	WK	Deadline	WK
1	Optimization of the press stamp to avoid particles as the stamp moves backwards		x	2/18/2008	8	3/27/2008	13
2	Milk runner: Statement concerning empty gripper container from filling with suction gun		x	2/23/2008	8	3/5/2008	10
3	Clearing of the metering unit support in the area of the MU strainer to avoid picking up particles		x	2/18/2008	8	3/5/2008	10
4	Reduction of the area of the support of the MU lubrication unit to avoid picking up particles		x	2/18/2008	8	3/5/2008	10
5	Masking MU and intake bore to avoid particles from being picked up during transport and handling in main assembly		x	12/19/2007	51	1/31/2008	5
6	Remove pinch points on housing supports to prevent production of particles		x	3/18/2008	12	4/16/2008	16
7	Reduction flange surface for avoiding absorption of particles		x	3/10/2008	11	3/5/2008	10
8	Workpiece support: Reduction of the area of the support of the roller tappet as a mandrel to avoid picking up particles		x	2/29/2008	9	3/14/2008	11
9	Housing delivered in a blister pack instead of steel frame to avoid producing particles		x	3/14/2008	11	3/7/2008	10
10	Fix the control console position to avoid collisions with the station frame		x	3/14/2008	11	4/4/2008	14
11	Clad the guide rails of the safety door to avoid carrying particles on roller tappets		x	3/7/2008	10	4/17/2008	16
12	Masking intake bore in the cylinder head to avoid particles from being picked up during transport and handling in main assembly	x		2/19/2008	8	3/5/2008	10
13	Pneumatic purging of pre-assembled cylinder head to remove particles from assembly processes in return intake valve and intake valve	x		3/5/2008	10	4/17/2008	16
14	Optimize the cylinder head geometry to avoid the creation of splintering during the screwing process	x		~~6/18/2008~~ ~~9/15/2008~~ partial from Wk 40; complete from 10/13/2008	~~25~~ ~~38~~ 40	~~6/18/2008~~ ~~9/15/2008~~ partial from Wk 40; complete from 10/13/2008	~~25~~ ~~38~~ 40
15	Optimize the EOL test (better detection of functional testing)		x	6/9/2008	24	7/21/2008	30
16	Improved bolting process locking screw> monitoring by the laser measurement system	x		4/30/2009	18	4/30/2009	18
17	Addition of the MU with reduced degree of freedom		x	5/31/2009	22	5/31/2009	22

Legend: Introduced | Introduction to plan | Introduction date has passed | Implementation is not effective/ effectiveness will be checked

BOSCH

EA11003EN-00561[0]

From: Non-responsive content removed
To:
CC:
Date: 02.21.2009 2:15:05 AM
Subject: RE: Newest failure-list status as on 01.27.2009

Thank you Non-responsive content removed I discussed the issue of increased inlet just now in a meeting with my people

With best wishes
Non-responsive content removed

>
>AUDI HUNGARIA MOTOR Kft.
Non-responsive content removed

>
>
>
>_____
>From: Non-responsive content removed
>Sent: Thursday, January 29, 2009, 3:07 PM
To Non-responsive content removed
>C
>Subject: RE: Newest failure-list status as on 01.27.2009
>
Hello
>
>My answer is given below.
>
>With best regards
>
>
> < File: Status CP4 Triebwerksschäden-2009-KW03.pdf >> < Date: EHC_0566 Non-responsive conten removed , Status CP4 Triebwerksschäden, 26-01-2009.pdf >>
>_____
>From: Non-responsive content removed
>Sent: Wednesday, January 28, 2009, 11:15 AM
Non-responsive content removed

>Subject: RE: Newest failure-list status as on 01.27.2009
>

>
>Can we do some tests in the short term here at the plant, so as to dispense with installation of other not OK pumps? Non-responsive content removed No, there is no particularly poor quality batch.

>Is it a lot that we can specify? Non-responsive content removed No, there is no

specific batch to be specified.

>What does "Bosch internal failures impact us" mean? What happened at Bosch? What are the corrective measures adopted and when will they be implemented? [redacted] See Appendix 1, page 4 and 5, but we (and Bosch?) actually do everything to prevent drivetrain damage to CP4; only problem is that it is almost impossible to state the cause of damage (unless you observe corrosion caused by moisture).

>Does the process monitoring bring about something? [redacted] Assurance that all measures to avoid failure were implemented (completion message is lacking in detail, statement only: "Everything is implemented"); in principle you can also make this statement at your own responsibility based on the former list / tasks, but please do not ask me now for details, that was before my "break".

>Obviously, there are major variations in the product. [redacted]

I accept that there are variations, but are they major? There are many possible influencing factors in the components.

>

>Can you imagine that the problem is creating a stir at our place. [redacted] Yes !

>

>>Example of a scenario, what we're now discussing in expert meetings with Technical Development TE and Bosch (and Tuesday 02.10. in the week after next [redacted] at Bosch):

>Some Bosch employees (but not all) and me too (but not [redacted]) want to (re)introduce tougher final test program CP4 outside the final customer specification at the end of line of Bosch. Objective: To "touch upon" surface elevations within the hydrodynamic lubricant film, with the result that the pump fails at Bosch, and not at our place or at the customer, e.g. in [redacted] with a "thin" low-viscosity fuel. Risk: x ppm pumps could be pre-damaged, although experts at Bosch mostly don't think so. Test with 23 pumps (= 46 tappets) with a loading profile higher than planned profile was OK. It's a balancing act between fault prevention and fault generation.

>

>=> See Appendix 2 Set of slides (please do not forward this yet, it is planned by Bosch management for Mr. [redacted]. I have "objected" to it because he is over-optimistic and does not take into account the internal failures at Bosch - so-called Slide 4 from Appendix 1).

>

>

>With best regards

[redacted]

>

>AUDI HUNGARIA MOTOR Kft.

[redacted]

>

>

[redacted]

Non-responsive content removed

>Subject: Newest failure-list status as on 01.27.2009
>
>Hello all,
>
>Further increases in CP7 failures B8 and now also A6, but only in Neckarsulm, i.e. an IN-typical phenomenon is eliminated, the A6-R4 failure needs to be investigated.
>In my opinion, "the increased internal failures of Bosch would reach as far as Audi until the end of last year."
>According to the clarification of the process chain at the line in 2008, neither the filling procedure before first start-up in IN nor the ventilation method has changed at the end in Györ.
>
>My proposal to Bosch:
>We will retest the process chain in cooperation with Bosch from the cold test of Györ through the hot test up to first start-up in IN and Neckarsulm (the basis should be the tests from spring of last year).
>Requirement is the support and co-preparation by Non-responsive content removed in Györ and Non-responsive content removed and Non-responsive content removed or the concerned dept.) in the plants.
>
>Other on-field failures, especially in Touareg (and even - see engine map "CoD per 1000")

>Three on-field failures once again in Jetta USA!!!
>The Q7 does not show any drivetrain damage.
>
>Summary:
>
>Almost no failures up to date of manufacture WK20 / May 2008, except (see also engine map effectiveness of actions):
>1 x A4 R4-TDI Non-responsive content removed
>1 x Q7 V6-TDI
>1 x Q7 V6-TDI
>1 x A5 V6-TDI
>7 x CP7 IN
>2-3 x CP7 NSU
>
> < File: Non-responsive content removed_ Liste Triebwerkschäden CP4 27.01.09.xls >>
>
>With best regards
>
Non-responsive content removed
>
>
>
>AUDI AG
Non-responsive content removed

>Sent: Tuesday, January 20, 2009, 6:31 PM

EA11003EN-00561[3]

Non-responsive content removed

>Subject: RE: Newest failure-list status as on 01.20.2009
>
>Hello all,
>
>Find attached the latest list of failures.>
>Several VW pumps (messages) have been added to it over the holidays, also EC USA Failure 162,000 km.
>
>I redid the sorting (pump type, country, vehicle identification no.), so that the pumps are easier to find.
>I had to update the various tables and graphics as well.
>
>The measures effective from date of manufacture May 8 is further confirmed; some individual on-field cases (low mileage), but especially CP7 IN failures in IV / 2008 are available.
>
>Non-responsive content removed process further as discussed and consider in Friday's weekly report.
>
> < File: Non-responsive content removed _ Liste Triebwerkschäden CP4 20.01.09.xls >> >
>
>
>With best regards
>

Non-responsive content removed