Beilage . 18

Test Report (Revision)

Project No.:

106 275 0130636

EEffG Test Cycle

This test was run acc. to EEffG Test Cycle (based on CEC F-98-08 Issue 7)
We have met the requirements of the CEC Guidelines

Investigation of deposit effects
in a common rail diesel engine

Test performed on behalf of

[redacted]

Dirty-Up and Clean-Up

with test fuel

Haltermann RF 79-07 Batch 8

and additive

[redacted]EEffG // P/N:[redacted]

Order-no.:

4AR/42471312-AR01

Table of Contents

1 General Items

Laboratory:	**APL Automobil-Prüftechnik Landau GmbH** **Am Hölzel 11** **76829 Landau** **Germany**
Laboratory Contact Person:	**Dipl.-Ing. Pascal Junges** phone: +49 (0) 6341 / 991-4641 ; email: pascal.junges@apl-landau.de
Customer:	[redacted]
Customers Contact Person:	**Dr. Florian Holub** phone: +43 (0) 664 6122872 ; email: florian.holub@omv.com
Order No.:	4AR/42471312-AR01
Test Fuel:	Haltermann RF 79-07 Batch 8
Fuel Supplier:	Haltermann GmbH
Date of Receipt:	April 15, 2015
Zinc (Treat rate):	Zn-Neodecanoate (1 mgZn/kgFuel)
Additives (Treat rate):	[redacted] EEffG // P/N [redacted]
Product Number:	[redacted]
Oil Code/Batch:	RL 236/3
Test Type:	EEffG Test Cycle (based on CEC F-98-08 Issue 7)
Date of last Accreditiation (CEC F-98-08):	August 05, 2014
Injector Type:	CEC Euro V Injectors
Injector Set:	AAF - (cleaned)
Test Length:	175 hrs
Project Number:	106 275 0130636
Engine Number:	422467
Engine Model:	WAJ3
Test Bench Number:	13
Start of Test:	April 24, 2015
End of Test:	May 08, 2015
Test Validity:	Valid

Test report contains 8 pages in total.

February 02, 2016

APL GmbH Dipl.-Ing. (FH) Thorsten Kaebernick
Team Manager

Dipl.-Ing. Pascal Junges
Project Engineer

2 Summary of Test Results

Test Type:	EEffG Test Cycle (based on CEC F-98-08 Issue 7)
Base Fuel:	Haltermann RF 79-07 Batch 8
Zinc (Treat Rate):	Zn-Neodecanoate (1 mgZn/kgFuel)
Additives (Treat Rate):	[redacted] EEffG // P/N [redacted]
Product Number:	992433
Test Length:	175 hrs coking cycles, soak periods and fuel consumption measurements
	- 112 hrs running time in coking cycle with test fuel
	- 32 hrs running time in clean-up cycle with additive
Engine Test hrs at Start of Test:	20 hrs
Injector Type:	CEC Euro V Injectors
Injector Set:	AAF - (cleaned)
Injector Set Run Time:	52 hrs
Injector Code Cyl. 1:	0606-05730
Injector Code Cyl. 2:	0606-05703
Injector Code Cyl. 3:	0606-05883
Injector Code Cyl. 4:	0606-05855

Fuel Consumption Result during Clean-Up

	Running Time h	BSFC g/kWh	Change of BSFC %
Start of Test	0	222,1	0,0%
End of Test (DU)	112	229,88	3,5%
End of Test (CU)	144	224,11	0,9%
Actual Value	-	-	2,6%
Set Point	-	-	>1,4%

During Clean Up run with use of additive [redacted] EEffG // P/N [redacted] a reduction in fuel consumption of 2,6% has been determined.

3 Test Description

3.1 Test Purpose

The indirect injection engine has now given way in the market almost entirely to more modern direct injection light duty diesel engines, for reasons of fuel economy, performance and low emissions. These engines are much more sophisticated than the earlier indirect injection types, and must retain all the precision of their calibration in order to maintain their design performance. The injectors, key components in the performance of the engine, are vulnerable to having their operation perturbed by fouling from the deposits resulting from combustion, and this will be even more so the case for vehicles under development for Euro V emission regulations.

This test was developed to demonstrate the propensity of some fuels to provoke fuel injector fouling in these modern engines, and also to demonstrate the ability of detergent fuel additives to prevent or control these deposits.

3.2 Test Hardware

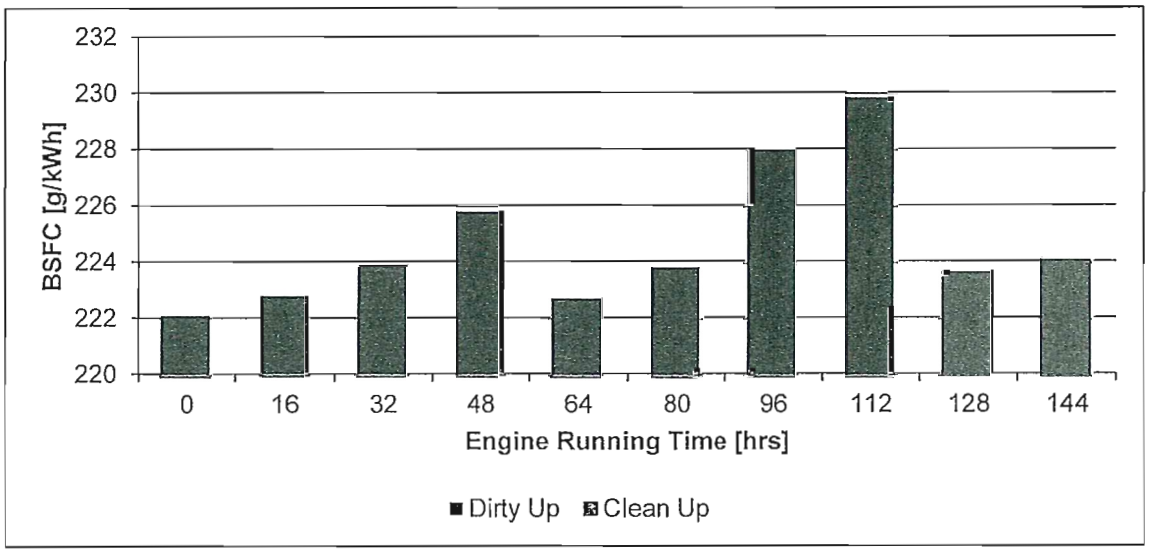
The engine used in this test is the PSA 'DW10B'. Special Euro V type injectors, that are prone to injector fouling, are used for this test.

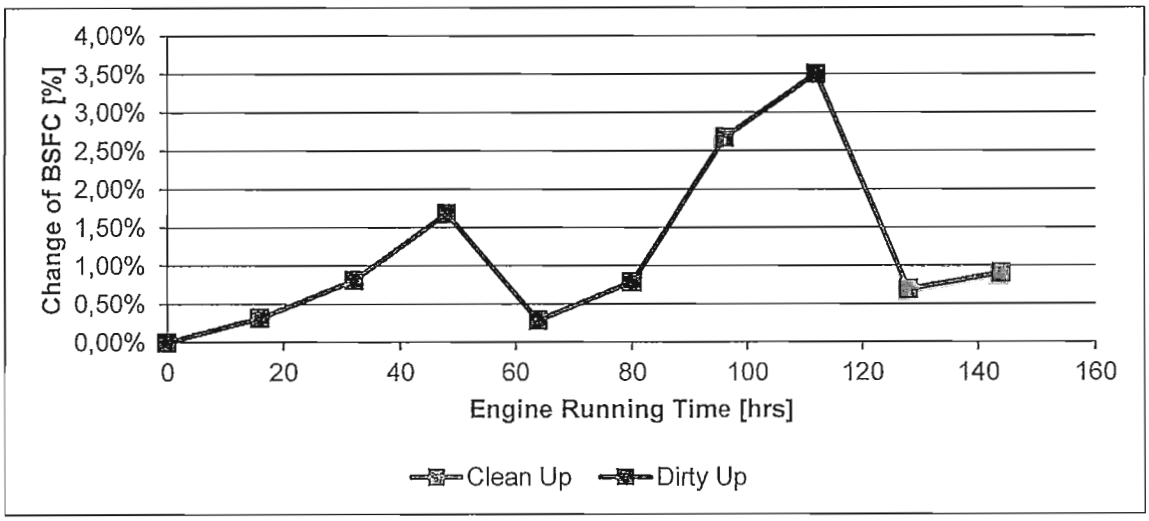
3.3 Test Protocol and Cycles

The test procedure consists of alternating sequences of eight hours of engine operation and four hours of engine stopped. Please refer to Section 7 in the CEC F-098-08 test procedure for details. The Test is separated into dirty-up and clean-up sequences. After two coking and soaking periods a fuel consumption measuremt is performed following an increase in fuel consumption of 2,6-3,0% the clean-up sequence begins with the test fuel and additve. After 5 additional coking sequences the decrease in fuel consumption is determined.

4 Fuel Consumption Measurements

	Time h	Speed 1/min	Torque Nm	Fuel Cons. mg/strk	Spec. Fuel Cons. g/kWh	Change of BSFC %
Dirty-Up	0	3500	212,03	42,21	222,1	0,00%
	16	3500	212,1	42,36	222,8	0,32%
	32	3500	212,03	42,56	223,9	0,81%
	48	3500	212,03	42,89	225,83	1,68%
	64	3500	212,03	42,34	222,74	0,29%
	80	3500	211,83	42,5	223,85	0,79%
	96	3500	212,13	43,32	228,04	2,67%
	112	3500	211,97	43,65	229,88	3,50%
Clean-Up	128	3500	212,03	42,51	223,64	0,69%
	144	3500	212,2	42,62	224,11	0,90%





5 Operational Data

5.1 Operational Data Stage 4

Parameter	Unit	Average	Std. Dev.	Min	Max	Target Value
Engine Speed Dyno	rpm	3500,0	0,0	3500,0	3500,0	3500 ± 10
Torque	Nm	212,0	0,3	210,7	212,7	212 ± 6
Coolant Out	°C	97,0	0,1	96,9	97,2	97 ± 2
Fuel Temp Hpp Inlet	°C	32,9	0,3	31,8	33,7	32 ± 2
Intake Air Temp	°C	23,0	0,3	22,3	23,6	23 ± 5
Boost Air after Intercooler	°C	50,0	0,1	49,9	50,1	50 ± 2

Blowby at SoT: 61,5 l/min

Oil Consumption for Complete Test Run: 6,91 g/h

5.2 Operations Outside Specified Limits

None

5.3 Unusual Occurrences

1) after 32 hrs engine run time: IBC switch
2) at 54 hrs: repair of air hose because of leakage at turbine inlet
3) after 64 hrs engine run time: IBC switch

6 Fuel Analysis

ASTM D7111	Zn mg/kg	Cu mg/kg
IBC 1 DU	1,02	<0,05
IBC 2 DU	1,01	<0,05
IBC 3 DU	1,00	<0,05
Start of DU	0,93	<0,05
End of DU	0,96	<0,05
Start of CU	0,13	<0,05
Start of CU	0,07	<0,05

Analysis carried out by:

APL Chemical & Physical Laboratory
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