REAL World Advanced Technologies foR Diesel Engines

EUROPEAN COMMISSION
Horizon 2020
H2020-MG-2014-2015
GA No. 636380

Deliverable No.	REWARD 2.7	
Deliverable Title	Engine test dyno assessment	
Deliverable Type	REPORT	
Dissemination level	Confidential – member only (CO)	
Written By	Michelangelo Perin Massimo Asti	2017-11-07
Status	**Final**	2017-12-12
Checked by	Marco Tonetti	2017-12-04
Submitted to Executive Board	Submitted to meeting EB26	2017-12-04
Approved by Executive Board (EB)	Approved and accepted by all members of the Executive Board at meeting EB26	2017-12-11

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Acknowledgement:

The author(s) would like to thank the partners in the project for their valuable comments on previous drafts and for performing the review.

Project partners:

1 - AVL - AVL List GmbH – AT
2 - REN - Renault SAS - FR
3 - VCC - Volvo Car Corporation - SE
4 - CRF - CRF SCpA - IT
5 - CNRIM - Instituto Motori – Consiglio Nazionale delle Ricerche (CNR) - IT
6 - JM - Johnson Matthey Plc - UK
7 - RIC - Ricardo Plc - UK
8 - SCF - Schaeffler AG - DE
9 - LMM - Le Moteur Moderne - FR
10 - DELPHI - Delphi Automotive Systems Luxembourg S.A. - LU
11 - UNR - Uniresearch BV - NL
12 - IFPEN - IFP Energies Nouvelles - FR
13 - VIF - Virtual Vehicle Research Center - AT
14 - CTH - Chalmers Tekniska Högskola - SE
15 - CTU - Czech Technical University - CZ
16 - UPVLC - Universitat Politecnica de Valencia – Motores Termicos – ES

Disclaimer:
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 636380.

Publishable Executive summary

The Task 2.3 "Engine technologies and strategies integration" is devoted to integration of new engine and after-treatment technologies into the 1,6L engine and their assessment and calibration on dyno. Different after-treatment solutions have been tested in order to select the best performing architecture to be employed in the demo vehicle.

Leveraging on previous WP2 activities, the after-treatment system for the CRF demo vehicle has been defined. Core of the system is the SCR on Filter (SCRF) positioned in close-coupled with AdBlue dosing and mixing.
The use of SCRF, allowing to bring SCR component in close coupled position, proved to be able to give efficiency benefits related to the hotter position compared to the typical underfloor position of SCR converters.
The AdBlue dosing and mixing section were designed in order to provide an optimal distribution of ammonia over the whole inlet face of the filter together with a good engine exhaust backpressure. SCRF substrate were also optimized to guarantee the backpressure target and the component robustness against critical soot regenerations.
To perform these tasks, a methodology for SCRF system characterization in terms of NOx reduction efficiency, NH3 storage, system flow resistance and substrate thermal robustness has been defined at test bench.
Different solutions of mixer and substrates have been evaluated, selecting the best ones in terms of overall performance.

Final solution consists in a 'U-Shape' canning specifically developed in order to allow the installation in close-coupled position in the FCA B-Family diesel engines (1,6L and 2,0L).
A small underfloor component is also applied to enlarge the SCRF operating window at higher exhaust gas temperatures and to guarantee NH3, CO and HC reduction at tailpipe.
The selected architecture equipped with JM catalysts, showed an high NOx reduction efficiency in a wide range of temperature and confirmed to be the most promising solution for the B-SUV demo vehicle.

Regarding the first catalytic component, the choice is among Diesel Oxidation Catalysts (DOC), Passive NOx Absorber (PNA) (which in the rest of the document will be called Diesel Cold Start Concept (dCSC ™ according to JM's nomenclature) and NOx Storage Catalyst (NSC).
dCSC ™ is a very attractive solution because of the easy NOx management (passive). Nevertheless, the tests showed that it does not have a sufficient NOx storage capacity when the vehicle is operated in very long and heavy urban conditions.
Compared to DOC+SCRF, the NSC+SCRF needs a reduced exhaust gas heating and therefore it can offer a better Fuel Consumption in low engine loads and/or cold conditions. The capability to manage active DeNOx events in those conditions needs to be verified on road. Therefore both solutions (DOC and NSC) will be tested on the demo vehicle.

The standard FCA 1,6L 4 cylinder diesel engine has been assembled with the above described new ATS and with the engine technologies defined in the WP3.
Engine control strategies have been updated and calibrated in order to manage the new contents.

The new engine has been fully calibrated at dyno bench, over the whole operating area in warm and cold conditions. Considerable emissions and BSFC reduction (up to 4%) have been achieved compared to the current production 1,6L Eu6 engine.
An exhaust gas heating calibration has also been performed and it will be used on vehicle when an SCRF heating is needed.