

LOCAL APPROVAL OF DPF-SYSTEMS

for Option Fit and Retrofit of Diesel HDV

The Iranian Legislation requires DPF for all new Diesel vehicles, whereas implementation is timewise staggered depending on vehicle categories and import/domestic supply from September 2016 to April 2018. It also requires DPF-retrofit for public transport bus fleets and to fight the air pollution it is strongly recommended to extend this retrofit activity also to private HDV-fleets and as a follow up with little delay also to construction machines.

To guarantee that the use of DPF represents best available technology BAT, the highest possible level of reliability, safety and emission stability new governmental rules for the selection of DPF, the installation, the approval of the retrofitted vehicles and the periodic inspection and maintenance must be established and introduced soon.

During year 2015 an interdisciplinary stakeholder group has developed technical criteria for the approval of DPF equipped new vehicles which may be imported or domestic technology. While import technology will be more or less Euro-VI, based on newest engine technology with electronically controlled high-pressure injection and emission control systems, domestic technology must use existing Euro III or Euro IV technology and should be allowed to reach the emission targets by integrating existing DPF-systems. This so-called "Option-Fit" requires rules and quality criteria, which are very similar to "Retrofit" of in-use vehicles.

For "OEM emission control technology" the declaration of limit values for the main emission components CO, HC, NOx, PM and PN, to be fulfilled during a test cycle as part of the vehicle homologation are regarded to be the right way and European homologation will be accepted.

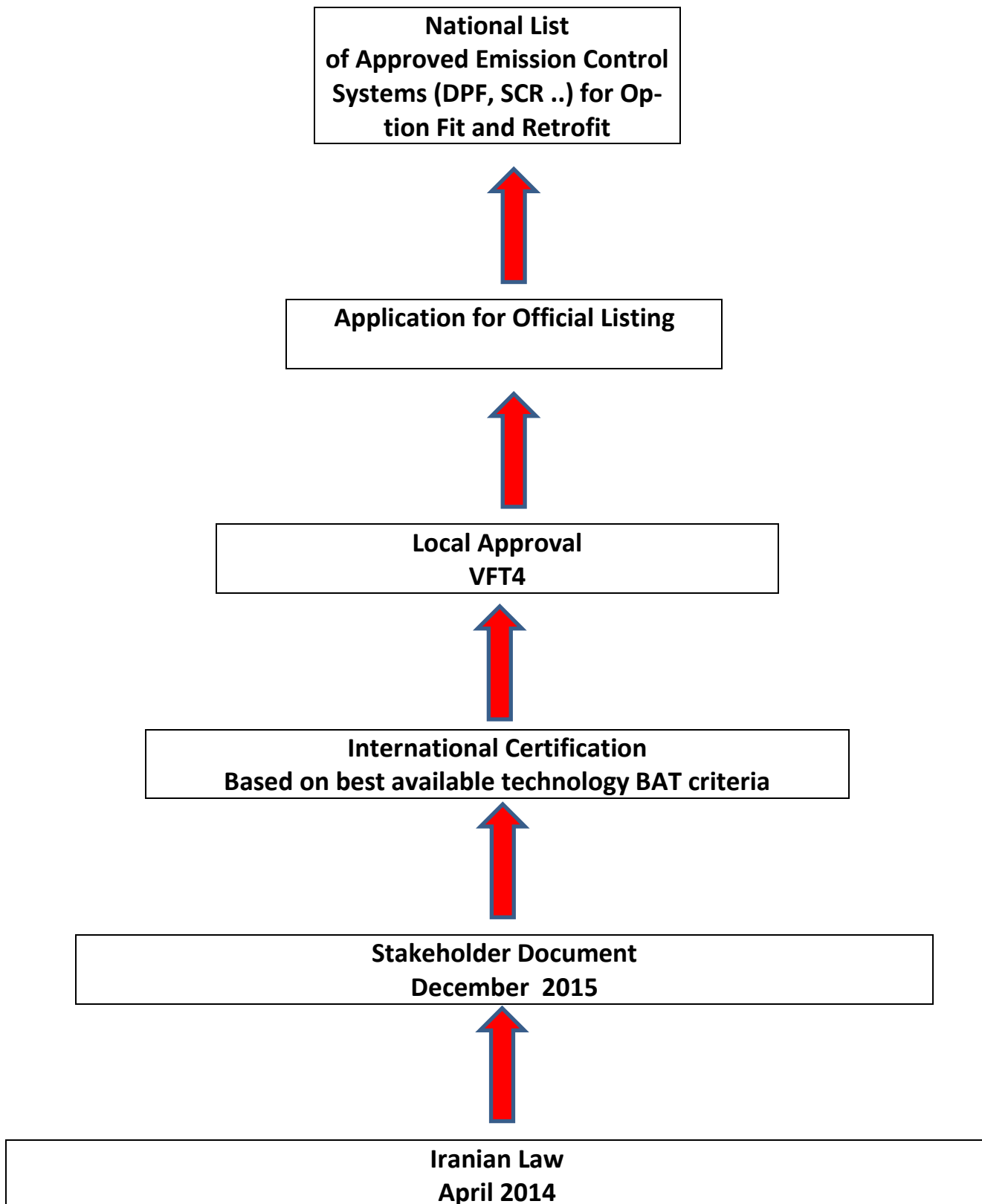
For the Option-Fit emission control solutions, however, based on available engine technology a simplified and immediately feasible entry into the DPF-technology has been opened:

- Engine homologation must not be repeated
- DPF-Systems must be internationally certified in agreement with the standard SN 277206
- The DPF-system supplier must demonstrate application experience
- The DPF-supplier must have a professional local distributor, well instructed and equipped
- The Option-Fit DPF equipped vehicles must undergo a local approval test VFT4 of > 1000 operation hours, monitored electronically and inspected by an accredited laboratory.
- The DPF supplier must submit the Certificate of a successful VFT4 test to the authority, with this he be approved and listed on the official list of Option-Fit and Retrofit DPF-systems
- Approved and listed DPF-systems can be used for other applications within the same application frame (engine family, vehicle application family).

This follows the experience in countries like Switzerland, Germany, California and Chile, where retrofit of DPF has been introduced successfully over 20 years ago with the important advantage that VERT-certification today offers over 70 certified DPF systems from which more than 20 are sulfur-tolerant see www.vert-certification.eu and VERT-certified manufacturer grant a two year functionality guarantee.

The legal approval process

to receive official permission to use a certain emission control technology for option fit or retrofit



Iranian Law April 2014 with respect to Diesel with DPF

Act no 49952/12782

§3

Before Euro4 fuel is used all over the country, all manufacturers and importers are required to supply vehicles with active particulate filters which are not sensitive to sulfur content of fuel from March. 21, 2015.

§ 5

By March. 21, 2017, Ministry of interior (municipality's organizations) is required to take measures to prevent diesel engine vehicles entrance to the cities if they are without particulate filter. These measures can include prevention of entrance or toll taking for vehicles without particulate filters.

Iranian Legislation to protect the environment

	Activity	Executor	Supervisor	Time plan
1	Fuel			
1-2	Distributing Euro 4 fuel and diesel having maximum sulfur content of 40 ppm, in Tabriz (Jul. 23, 2014) in Esfahan and Shiraz (Sep. 23, 2014) , in Ahvaz and Mashhad (Nov. 23, 2014)	Ministry of Oil	Department of Environment	*
1-3	Standardization of fuel, at least in metropolises, according to Euro 4 and Euro 5 standards, and standardization of fuel in power plants based on Supreme Council of Department of Environment's act.	Ministry of Oil	Department of Environment	36 months
2	Moving vehicle			
2-1	Replacing public city vehicles' catalystr.	Homeland Ministry(via municipality)	Department of Environment	6 months
2-3	Using particulate filters for diesel heavy-duty vehicles	Homeland Ministry(For urbane public vehicles via municipality) -Ministry of Roads and Transportation	Department of Environment	24 months
4	New vehicles			
4-1	Diesel vehicle registration is complete, stipulating that the soot filter is used.	Traffic Police of Iran	Department of Environment	Mar. 21, 2015

Emission Limits timetable for locally produced on-road vehicles

Period	2014/08/23	2015	2016	2017	2018	2019	2020	2021	2022	2023
Petrol light vehicles	Euro 4					Euro 5				
Heavy-duty and Medium-duty vehicles	2015		2016							
	Euro 3			Euro 4			Most Up-to-date EU standard			
Motorcycles	Production based on Euro 3 standard since Sep. 23, 2014				Most Up-to-date EU standard					

This legislation is the basis for all DPF-related activities, retrofit as well as first fit in new vehicles. The terms "soot filters" and "particulate filters" are general terms targeting best available technology DPF. To define detailed specifications and implementation rules an international expert group was formed, called "stakeholder group" under the guidance of DOE and AQCC with TÜV SÜD.

Stakeholder Document

The stakeholder process has been decided in January 2015, started in April 2015 and ended after five plenary sessions in October 2015. The final document was ready by February 29, 2016 under the title:

Department of the Environment Guidance Document for detailing the Heavy Duty Emission Legislation for the Introduction of DPF in IRAN from the Stakeholder Process.

The target was to introduce BAT-DPF countrywide as soon as possible fulfilling the legal requirement from 4/2014, irrespective of the sulfur content of the available fuel, but at the same time to permit the Iranian industry to build on existing technology in order to compete without delay with imported technologies.

This is still a recommendation and is actually waiting to be put in force by DOE in order to set up legally binding terms and conditions for the different DPF applications. However, It only deals with new vehicles, imported from abroad or produced in Iran and is in summary proposing the following two schemes split between import IVb and domestic production IVa, stipulating that domestic production will reach level IVb by Sept 2018:

IRAN IVa PEEV PARTICULATE EMISSION ENHANCED VEHICLE IRAN PRODUCTION VEHICLES							
VEHICLE CATEGORY:	BUS* TYPE M3 Class I & II <small>*2001/85/EC Bus Directive</small>					September 22nd, 2016	
Application Date Ending Sept.2018	Truck N2, N3 Bus* M2 Class A,B; M3 Class III (Coach)					March 21st, 2017	
ENGINE TYPE:	COMPRESSION IGNITION ONLY						
Application Type Date:	ISSUE LICENSE PLATE BY POLICE						
Reference Fuel:	max. 300ppm Sulphur						
Emission Limits:							
Test Cycle ⁽²⁾	CO [g/kWh]	NOx [g/kWh]	THC [g/kWh]	NMHC [g/kWh]	PM [g/kWh]	PN ⁽¹⁾ [#/kWh]	Smoke [m ⁻¹]
ESC	1,5	5,0	0,46	--	0.02	1E12	--
ETC	4,0	5,0	--	0,55	0.03	1E12	--
ELR ⁽³⁾	--	--	--	--	--	--	Notrequired

IRAN IVb PEEV PARTICULATE EMISSION ENHANCED VEHICLE IMPORT VEHICLES							
VEHICLE CATEGORY:	BUS* M2, M3 <small>*2001/85/EC Bus Directive</small>					September 22nd 2016	
Application Date Ending Sept. 2020	Truck N2, N3						
ENGINE TYPE:	COMPRESSION IGNITION ONLY						
Application Type Date:	ISSUE LICENSE PLATE BY POLICE						
Reference Fuel:	max. 100ppm Sulphur						
Emission Limits:							
Test Cycle ⁽²⁾	CO [g/kWh]	NOx [g/kWh]	THC [g/kWh]	NMHC [g/kWh]	PM [g/kWh]	PN ⁽¹⁾ [#/kWh]	Smoke [m ⁻¹]
ESC	1,5	3,5	0,46	--	0.02	1E12	--
ETC	4,0	3,5	--	0,55	0.03	1E12	--
ELR ⁽³⁾	--	--	--	--	--	--	Notrequired

This document defines the filtration quality only by a limit value for the particle number concentration at the free exhaust PN [# /kWh] following the EU-policy referring to UN-ECE-PMP (ECE-R49-06) and SN 277206 for particle size and solid phase measurement.

While this might be sufficient for an OEM oriented legislation, assuming that the manufacturer is developing the DPF system in all aspects under production-, operation-, safety-, reliability- and environmental-criteria is not sufficient for option fit solutions as we expect them in many applications in Iran where the manufacturer is not developing the DPF-system but is using an existing DPF- system, selected for and adapted to his existing engine.

To cover the different requirements of these two application schemes the stakeholder document splits the DPF-systems in two categories:

Provisions for „OEM`s“ and „Option-Fit“

Choice Annex OE (OEM): this is a set of system approvals for an Iran domestic vehicle manufacturer using an Iran domestic engine who develops and certifies an engine system equipped with wall-flow DPF.

Choice Annex OF (Option-Fit): this is a the set of system approvals for an Iran domestic vehicle manufacturer that uses a base EURO HD certified engine, but engineers the wall-flow DPF application for the vehicle application.

DPF-Systems which qualify for Option-Fit must fulfil the same requirements as for Retrofit. The following approval scheme is therefore recommended for both categories and requires in principle the following 4 steps

1. International Certification

Particle filter systems operating on mobile internal combustion engines must fulfil a large number of requirements regarding filtration of health effecting solid nanoparticles, reduction of toxic gaseous substances, avoiding formation of secondary emission, reliability, useful life, ash cleaning, safety issues, electronic control etc. To guarantee conformity of production the manufacturer must be audited and in-use-compliance tests must be performed. There are worldwide only a few certification schemes developed over the past two decades, which fulfil all these requirements:

- VERT certification; based on SN 277206; includes sulfur tolerant systems
- FOEN certification, based on SN 277206
- CARB verification; based on PM-mass
- REC certification; EU oriented

VERT has by far the most demanding performance criteria with >97% reduction of PN and requires the most severe endurance tests and safety monitoring, has the longest history and is dominating the market. Over 70 filter systems are certified by VERT (see www.vert-certification.eu) therefore the largest technological portfolio is available for a new market like Iran where CARB and REC could not offer any systems given the high fuel sulfur content.

- ➔ For these reasons any DPF-systems to be used as option fit or retrofit in Iran must be VERT-certified, listed on the international VERT Filter List and provide VERT-certificate

2. Local approval

Local conditions might be different from VERT certification conditions with respect to altitude, fuel quality, lubrication oil quality, vehicle operation, engine technology, driver habits, inspection & maintenance culture. Local approval does not refer to the DPF-system only but to the combination of a selected DPF with the engine in a given vehicle. Testing this combination provides very useful information on the quality of the filter system selection, the match of filter/engine, the regeneration type selected and the overall integration in the vehicle environment.

In the VERT-systematics the local approval test is called VFT4 and is attached to this document.

VFT4 is a 500 operation hours tests with electronic monitoring of temperatures and backpressure and an emission measurement by independent VERT-inspectors before and after. No deterioration is permitted during this period. Filtration as well a backpressure and noise must fulfil VERT-criteria

- ➔ Local Approval Report signed by VERT and manufacturer and certificate must be provided

See attached

- Appendix 1: Local Approval Procedure
- Appendix 2: Local Approval Certificate

3. Application for Official Listing

The DPF-system manufacturer can apply for official listing of his emission control system by submitting

- Valid VERT certification
- Report on Local Approval Test performed by an accredited laboratory
- Local Approval Certificate for counter signature by the authority
- Audit report on his local distributor organization
- Report on long endurance experience with the selected DPF-system

4. Listing on the National List of Approved Emission Control Systems

With official listing on the homepage of the responsible Iranian authority (DOE) this approval will receive a legal validity and will be available for enforcement.

This procedure reflects the legal procedure of most countries where the actual testing and certification is delegated to independent professionals (like TÜV or VERT), accredited by the government but the government itself checks conformity of tests results with kea performance criteria and issues a list of filter systems or other emission control components which have demonstrated to qualify for the emission legislation. This approval usually has a limited validity (in Switzerland 5 years) which means that after a fixed period the procedure must be repeated unless the manufacturer is using identical technology, proven by manufacturing conformity documentation.

VERT-Acceptance Test for Retrofit

Retrofit requires professional skill, care and control. Retrofit is often performed on individual vehicles and even if it concerns small fleets, the individual vehicles may be of different age, different specification, different emission status and different maintenance conditions.

Since the filter integrator must guarantee for perfect function during 2 years (acc. to VERT), he needs to document the technical status after installation and finally the government needs a documentation of the modification of the vehicle in order to adapt the official permits accordingly.

For this reason the VERT-Acceptance Test has been developed in cooperation of the Swiss Road Authority ASTRA

See attached

- Appendix 3: VERT Retrofit Acceptance Test

This acceptance test can be performed by handheld instruments, which each filter integrator will have available, and which must be officially calibrated at least once a year.

The test can be performed at vehicle standstill and requires less than one hour.

The document, signed by both, the vehicle owner and the filter system supplier or integrator is a legally binding guarantee document, as it may be needed in case of failures or suspected problems. In addition this document is accepted by the road authority to adapt the driving permit of the vehicles. For this authority the prove of conformity is the listing code of the filter system in the national list of approved DPF systems, which must be part of the information on the individual filter identification plate.

Appendix 1

VERT Filter Test VFT4 – Local Approval Procedure with/without FBC

Validity: 1st Jan. 2017

VFT4 is a special part of the international VERT DPF-certification, which is required to confirm the functionality of a VERT-certified Particle Filter System in a new environment with particularly demanding conditions like high altitude, high sulfur fuels, special operating conditions or retrofitted to vehicles which are pre-Euro3 or do not comply with EU-emission regulations. VFT4 might be requested by the local authority or the local operator of the vehicles. Like all VERT-tests, VFT4 is based on SN 277206 and reflects best available technology BAT.

VFT4 was developed by VERT in cooperation with emission control authorities of China, Chile, Columbia, Iran and Israel and is now accepted as a basis for recognizing Diesel particulate trap systems by many authorities.

This VFT4 test must be performed with a representative filter system of the respective filter system family including regenerating aids and filter control units. Prior to this a full VERT certification procedure VFT1 + VFT2 + VSET + VFT3 must have been successfully completed, the filter system must be listed in the VERT filter list.

Test-Candidates:

- Particle Filter System: to be supplied by the filter manufacturer with detailed technical description and a VERT-conformity document duly signed by the filter manufacturer
- Vehicle: to be selected and operated by the filter manufacturer or a local fleet operator
- Fuel Additive: to be supplied by the filter manufacturer with detailed technical description including composition, safety data sheet, mixing and preconditioning procedures. FBC-concentration must be adapted by the filter manufacturer to the operation profile and not changed during the test.
- The filter must be installed on the vehicle by or under supervision of the filter manufacturer.
- After installation the filter and the electronic control unit must be officially sealed by the VERT-inspector

Test Conditions and Test Sequence

- System control and measurements shall be performed by a VERT inspector twice: at the beginning of the test and after 10'000 km or 500 hours of uninterrupted regular operation.
- Fuel: local market fuel selected by the fleet operator
- Lubrication oil: selected by the fleet operator, preferably LowSAPS
- Filter-conditions: new

Measurements and system controls acc. to SN 277206 and VERT rules

- Check cleanliness, leakages, lose parts, noise etc.
- Check all connections, cables, sensors, FBC dosing
- Check alarm functions
- Measurement of emissions PN, NO, NO₂, O₂, CO, HC_{IR}, CO₂, Opacity
- Measurement of operation parameters: engine RPM, exhaust temperature, filter backpressure
- Measurement of noise: 1 m from exhaust opening at 45° against flow direction at intermediate RPM
- All measurements without filter and with filter or upstream/downstream filter
- Operation points: low idle, high idle, intermediate speed at idle, part load e.g. at torque converter stall and free acceleration only for opacity measurement.
- Simulate alarm situations by creating high backpressure
- Download data of electronic control unit
- Interview the driver and the workshop manager

Reporting acc. to attached VERT example – English hardcopy and electronic copy

- Identification data of vehicle and filter system
- Weather, time, present witnesses
- Pictures
- General observations
- Measured data and interpretation
- Signed by VERT inspector and vehicle operator

Procedure: application with the form D1 of SN 277206 duly signed by the filter manufacturer. This form contains all important system parameters and will be treated strictly confidential - addressed to the VERT Certification

After approval of the test report by the VERT certification officer the test report shall be submitted by the filter manufacturer to the local approval authority for listing in the official filter list.



Valid only with
VERT-stamp
and validity-
dates

VERT[®]-Local Approval Certificate for IRAN

No	LA123/07.17	3. July 2017
DPF-System	HABAKUK Filter Substrate Regeneration Electronic Monitor	VERT-Certificate B423/2/17 Corierite, 200 cpsi FBC Infineum F7993 ECU XX 277
Manufacturer DPF-System	HABAKUK, Esfahan Imamsquare	
Engine-Family	Diesel Euro III V = 4-6 ltr No EGR	
Vehicle-Family	City-Bus 12 m	

We herewith apply to be listed in the national list of approved Retrofit and Option Fit DPF-applications in Iran and we accept rules and conditions as being published by DOE

Manufacturer DPF-System

Date

Signature

.....
Name

Certified by the VERT[®]

Approved by DOE for listing

.....
Name

.....
Name

.....
Name

Appendix 3

VERT[®] Acceptance Test Report for PFS

Particle filter	
Manufacturer (Brand)	
Type	
Certification/Conformity number (VFT3 test number)	
Serial number	
Fitting Date	
Data logger	
Type and serial number	
Additive dosage system	
Type and serial number	
FBC-supplier and FBC specification	
Vehicle / Machine	
Category (construction, bus, truck, pick-up, car ..)	
Manufacturer	
Type	
Manufacturing year	
Chassis number	
Engine	
Manufacturer	
Type	
Manufacturing year	
Rated power [kW]	
Operating hours or km	
Measurements without PFS	
Opacity K-value [1/m] during free acceleration	
Noise [dBA] in near-field 45°/0.5 m at RPM [1/min]	
Measurements with PFS	
Opacity K-Value [1/m] during free acceleration	
Noise [dBA] in near-field 45°/0.5 m at RPM [1/min]	
Back-pressure [mbar] at RPM [1/min] and load [%]	
Opacimeter	
Manufacturer, Type	
Sound Level Meter	
Manufacturer, Type	
Safety-Check	
Thermal Insulation and heat shield installed	
Distance to inflammable material	
Test-Date and Responsibilities	
Test date	
Test center	
VERT [®] label running number	
Retrofitter stamp Date/ Signature of the PFS retrofitter	
Operator stamp Date/ Signature of the operator	

Please note:

- The vehicle owner retains the original together with the vehicle registration certificate..
- A copy of this form should be submitted with the original vehicle registration certificate to the pertinent vehicle licensing authority.
- For registration in the VERT database, submit this document to TTM ttm.a.mayer@bluewin.ch

What is Best Available Technology BAT with Respect to Traffic Related Emission of Ultrafine Solid Particles ?

Can the definition of BAT replace DPF by PFF or SCR or DOC
and how is DPF defined?

1. The Priority: why has the elimination of traffic related particle emission priority over NOx-reduction?

The Government of the Islamic Republic of Iran has taken decisions (April 2014, [1]) to clean the air in highly populated cities from Toxic Air Contaminants TAC which are a health burden for the society, in particular for children, pregnant women and elderly. The main source of TAC in Tehran is traffic and mainly Diesel engines [2]. The most toxic substance within Diesel emissions are ultrafine solid particles, consisting of soot and metal ash. These particles enter the blood system from the lungs, they trigger cardiovascular and cerebrovascular mortality and cancer; in 2012 WHO has classified them carcinogenic No.1 as asbestos [3]. They are responsible for 95% of traffic related mortality [4]. In Tehran die probably 25 people every day and overall cost to the society due to these health effects are > 1000 € per inhabitant per year [5]. NOx-emissions however, are not a critical TAC in Tehran, but they should be reduced in due time.

2. The EU Emission Principle Rec.15/Art.12 R 595/2009 [6]

The following two slides summarize the « EU-Philosophie » based on R595 containing the main requirements of parliament and council of the EU-ministers in 2008 to introduce Euro 5/VI

Particle Number limit (Recital 15.)	Particle Number limit (Article 12.)
<ul style="list-style-type: none"> • In order to achieve these environmental objectives, it is appropriate to indicate that the particle number limits are likely to reflect the highest levels of performance currently obtained with particle filters by using the best available technology. 	<ul style="list-style-type: none"> • 1. After the completion of the relevant parts of the PMP of the UN/ECE, conducted under the auspices of the World Forum for Harmonisation of Vehicle Regulations, the Commission shall, without lowering the level of environmental protection within the Community: • (a) introduce as an additional control upon emissions of particulate matter particle number based limit values set at a level appropriate to the technologies actually being used at that time to meet the particulate mass limit; • (b) adopt a measurement procedure for particle number.

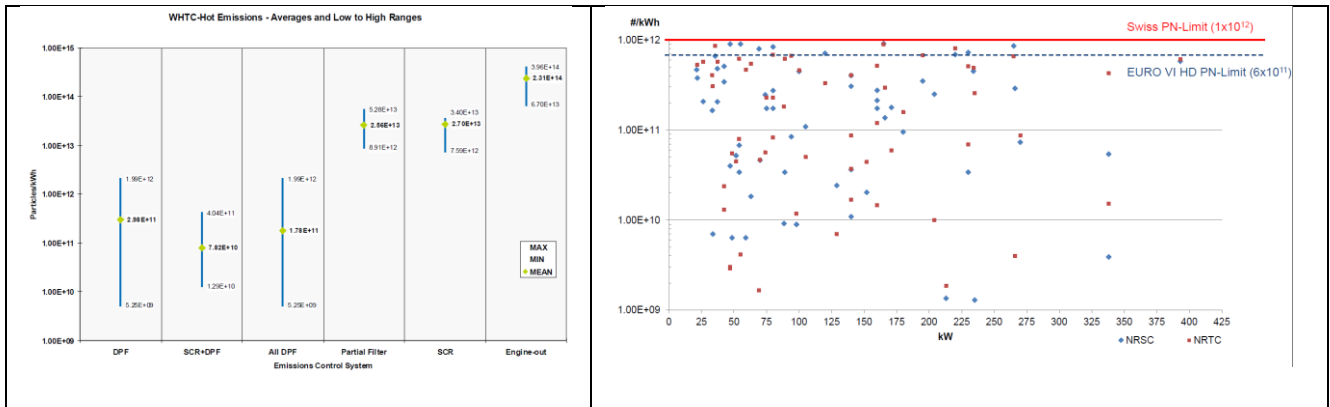
- The main environmental objective are **reduction of UFP**
- Elimination of UPF needs **particle filters**
- To evaluate the quality of these DPF, **the PN-criterion** must be introduced
- Limit values for PN shall be established and enforced, which reflect **best available technology BAT**

3. What is BAT in physical and chemical terms?

Which emission limit can be reached by available (and affordable) particle filters ?

This question is answered by the **Parkin-Report**, a statistic survey made by the British Department of Transport for the EU-commission in 2009 – [7]:

- SCR and PFF can reduce PN moderately by less than one order of magnitude
- while DPF can **reduce PN more than four orders of magnitude** of PN (left diagram)



which is very well supported by the much larger Swiss statistics (right diagram) [8]

This statistic was the basis

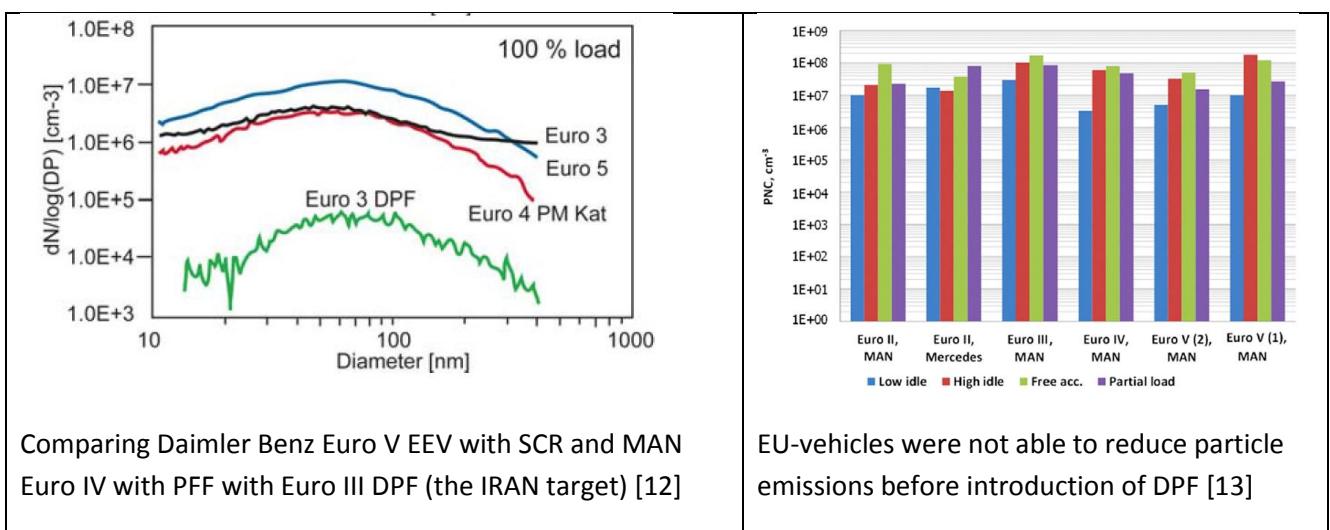
- for the introduction of PN in addition of PM
- for the definition of the PN limit value of 6×10^{11} particle/kWh which could be reduced in further steps by a factor of ten - **this defines DPF**
- for **replacement of EEV by Euro VI** – EEV can no longer be offered on the EU-marked since 2014
- for the selection of DPF and not PFF by the industry

Besides high filtration these DPF do also reduce toxic chemical substances like PAH and Nitro-PAH and their technical quality is guaranteed by technical standards like the Swiss SN 277206 and certification systems like www.VERTE-certification.eu

4. The Parkin Report is still optimistic with respect to SCR (EEV) and PFF (partial flow filters)

(because of very limited data and use of the German Anlage XXVII protocol which overestimates the performance of PFF by far)

- Open cell catalysts (SCR, DOC) cannot reduce PN emission – see M.Mariqc / FORD, HEI 2009 [9, 10]
- PFF can reduce PN-emission by 10-30% but at the same time acts as store and release systems – see [11]



Comparing Daimler Benz Euro V EEV with SCR and MAN Euro IV with PFF with Euro III DPF (the IRAN target) [12]

EU-vehicles were not able to reduce particle emissions before introduction of DPF [13]

- SCR does not reduce PN nor PM – see [12] in cooperation with Daimler Benz
- All technologies Euro II to Euro V including DOC, PFF, SCR do not reduce PN – see [13]
- SCR can produce additional particles instead of eliminate them – see [14]

5. Emission risks with EEV containing SCR-technology

SCR depends on the correct injection of Adblue – a solution of urea and water – and the catalyst temperature. At low exhaust temperatures, as they usually prevail in city driving this system is out of function and the very high raw engine NO_x concentrations are emitted. This can lead to NO_x-emissions, which are several times higher than even today's engines NO_x emissions [15]. The risk for higher NO_x in cities instead of lower NO_x is very high and European cities do actually suffer from this risk.

SCR function furthermore depends on the correct refill of Adblue, which requires the respective infrastructure. Without re-fill the engine will operate normal and the cost will be lower which is a strong temptation for operators to manipulate the system, as has been observed in Iran already.

6. The urgent need for Inspection and Maintenance

Modern engines with emission control by aftertreatment have better fuel economy and higher performance. But stability of the emission level, high fuel economy and good performance are only guaranteed over time with proper maintenance. Maintenance however, must be regular and monitored by periodic independent inspection. I&M is even more important with this new emission control technology. For this purpose new handheld instruments have been provided and new test protocols for a quick check on roadworthiness even roadside and for information on preventive repair - an important cost reduction tool. Regular I&M is the only way to not only clean the air but keep the air clean from toxic air contaminants

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Acronyms:

BAT	Best Available Technology
EEV	Enhanced environmentally friendly – an outdated European emission definition, related to Euro III
EU	European Union
DOC	Diesel Oxidation Catalyst
DPF	Diesel Particle Filter
I&M	Inspection & Maintenance
NOx	Sum of Nitrogen Oxides
PFF	Partial Flow Filter
PM	Particulate Matter Mass
PN	Particle Number per cc; per km; per kWh
SCR	Selective Catalytic Reaction: the NOx reduction process with a reductant like Adblue
SN	Swiss Norm
TAC	Toxic Air Contaminant
UFP	Ultrafine Particles (< 500 nm)
VERT	Verification of Emission Reduction Technologies – a nonprofit organization
WHO	World Health Organization

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The VERT Association publishes on its web site information on the topic of particle filter retrofitting. The site also has a comprehensive database of already retrofitted vehicles and machines. The VERT Filter List documents the certified filter systems and their manufacturer: www.VERT-dpf.eu.

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