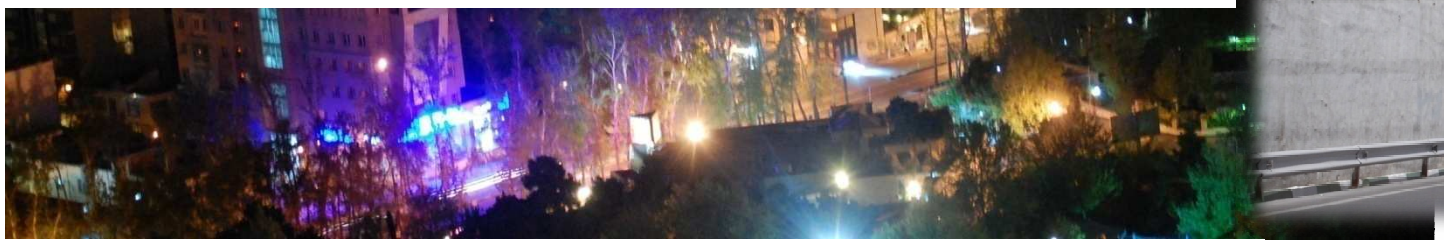

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شرکت کنترل کیفیت هوا
وابسته به شهرداری تهران
Air Quality Control Company
Subsidiary of Tehran's Municipality

The new Iran Heavy Duty Diesel Environmental Regulation

قوانین جدید آلایندگی موتورهای دیزل سنگین با کاربری زمینی یا متحرک

Karsten Mathies, TÜV Hessen
Prof. Vahid Hosseini, AQCC Tehran

19th ETH-Conference on Combustion Generated Nanoparticles
June 28th – July 1st, 2015 ETH Zürich, Switzerland

Private Public Partnership for elimination of ultrafine particle emissions in Iran

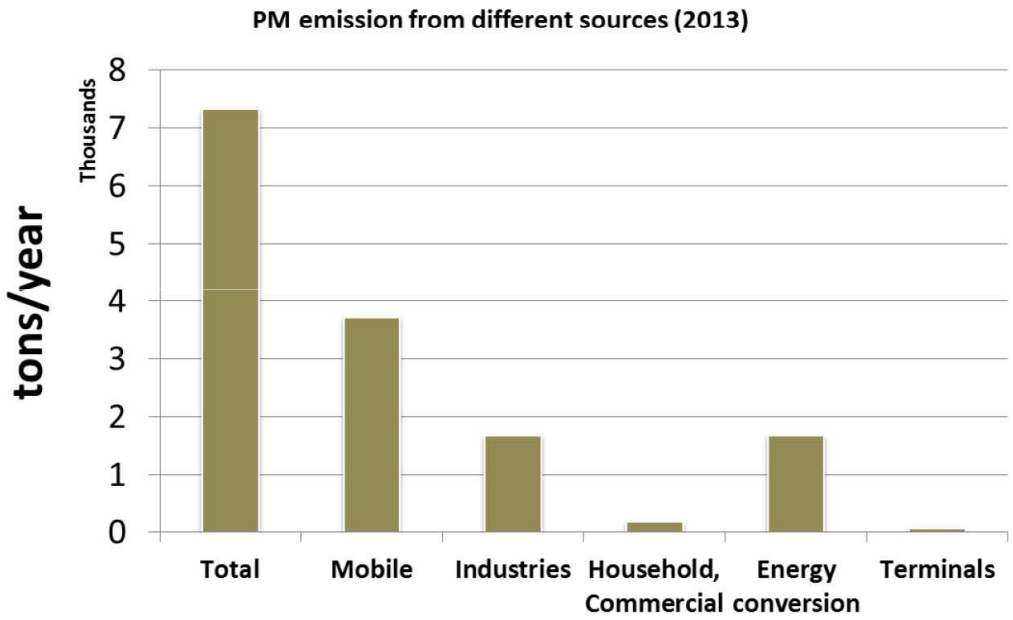
Proposals for Detailing the Cabinet of Ministry's Decision

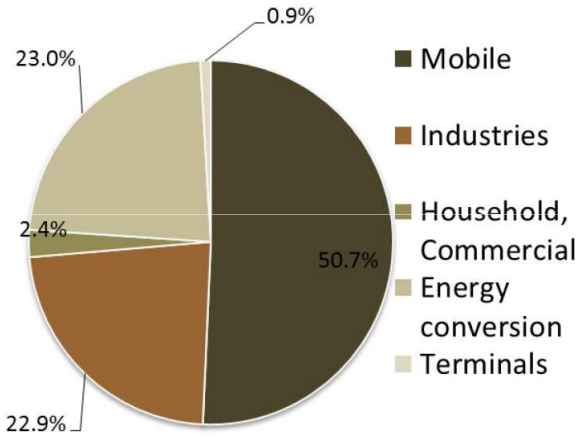
IRAN PEEV: Iran Particle Emission Enhanced Vehicles

Compression Ignition Commercial Vehicles DPF Proposal Regulation for new Heavy Duty Vehicles

Motivation

Tehran annual PM emission sources

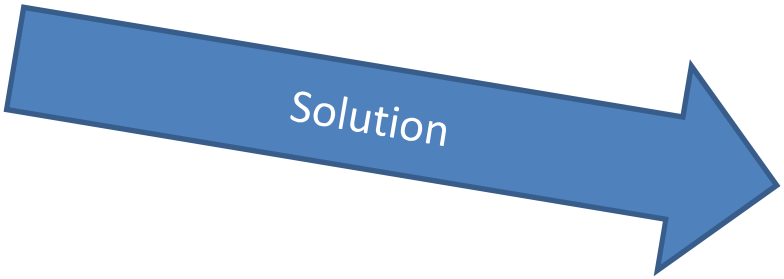




Reference: „Ultrafine particles, black carbon and soot emissions in Tehran“, **Vahid Hosseini, Ph.D. FCE, Sharif University of Technology, Tehran Air Quality Control Co., The first public private partnership (PPP) for clean diesel future in Iran, April 15th, 2015, BoostaneGoftegoo, Tehran, I.R. Iran**

Iran Status and Solution

- Can not introduce EURO VI within at least 2 years for Heavy Duty because of
  - Fuel quality
  - Technology Level in Industry
- Following Emission steps EURO 1-2-3-4-5-6 takes a long time and creates no benefit for Ultra-Fine-Particle Emission up to EURO VI
- Iran must act now, because of the PN particulate air pollution problem.



- **Solution: Not the holistic approach: from EURO III to EURO IV, but pick and choose elements from EURO emission regulations that match the requirements for Industry feasibility and UFP particle emission limitation:**
  - PN Emission Limit from EURO VI (& PN instrument and procedure definiton)
  - PM Emission Limit from EURO IV
  - Gaseous pollutant from EURO III
  - ++ stay with European regulation elements to use existing experience, known processes and lab equipment

How to implement a new HD DPF regulation: The stakeholder process

The solution for this problem can only be solved to get all major stakeholders to one negotiating table, to cover :

- How to define an emission legislation with PN Limit additional to a non current EURO HD standard
- The issue of potential high sulphur content diesel fuel of domestic production
- Protection of the national motor vehicle production
- Importation of European and Japanese engine manufacturers with “CKD” ”completely knocked down” vehicle production in Iran or from outside countries
- Interests of environmental Iran organizations like AQCC, the Air Quality Control Company of Tehran and “DOE” the Department of Environment” for Iran
- Interests of the Ministry of Industry
- Organisation for the domestic Industry and
- Representatives of the domestic and foreign engine producers.

The stakeholder process produced proposal for „hard facts“ successfully after 2 PPP Stakeholder Meetings:

The stakeholder process II

Moderation and Drafting Proposal by TÜV SÜD

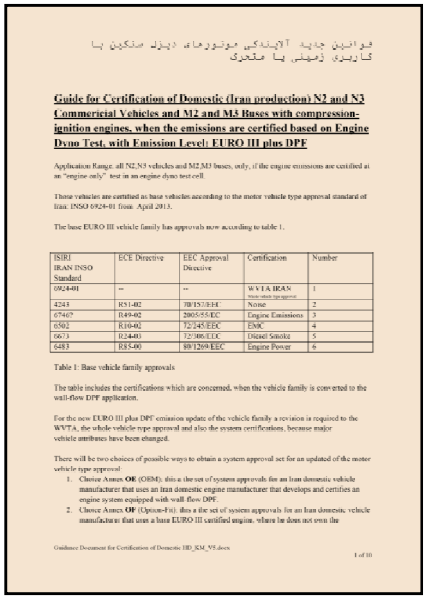
قوانین جدید آلایندگی موتورهای دیزل سنگین با کاربری زمینی یا متحرک

Stakeholders		
OEM International	OEM IRAN	Associations Authorities
Daimler Scania Iszuzu	Iran Khodro Diesel Saipa Diesel Bahman	DOE MOI AQCC VERT Iran manufacturing Association

Structure of Guidance Documents

Four Guidance Documents for the DPF Regulation drafted for discussion to outline the structure for new engine certification:

- **Heavy Duty Truck and Bus Iran Production**
- **Light Duty Commercial Vehicle Iran Production**
- **Heavy Duty Truck and Bus Import**
- **Light Duty Commercial Vehicle Import**



قوانین جدید آلایندگی موتورهای دیزل سنگین با گاربری زمینی یا متحرک

Guide for Certification of Domestic (Iran production) N2 and N3 Commercial Vehicles and M2 and M3 Buses with compression-ignition engines, when the emissions are certified based on Engine Dyno Test, with Emission Level: EURO III plus DPF

Application Range: all N2,N3 vehicles and M2,M3 buses, only, if the engine emissions are certified at an "engine-only" test in an engine dyno test-cell.

These vehicles are certified as base vehicles according to the motor vehicle type approval standard of Iran: INSO 6924-01 from: April 2013.

The base EURO III vehicle family has approvals now according to table 1.

ISIRI IRAN INSO Standard	ECE Directive	EEC Approval Directive	Certification	Number
6924-01	--	--	WVTA IRAN	1
4243	R51-02	70/157/EEC	Noise	2
6746?	R49-02	2005/55/EC	Engine Emissions	3
6502	R10-02	72/245/EEC	EMC	4
6673	R24-03	72/306/EEC	Diesel Smoke	5
6483	R85-00	80/1269/EEC	Engine Power	6

Table 1: Base vehicle family approvals

The table includes the certifications which are concerned, when the vehicle family is converted to the wall-flow DPF application.

For the new EURO III plus DPF emission update of the vehicle family a revision is required to the WVTA, the whole vehicle type approval and also the system certifications, because major vehicle attributes have been changed.

There will be two choices of possible ways to obtain a system approval set for an updated of the motor vehicle type approval:

1. Choice Annex **OR** (OBM): this a the set of system approvals for an Iran domestic vehicle manufacturer that uses an Iran domestic engine manufacturer that develops and certifies an engine system equipped with wall-flow DPF.
2. Choice Annex **OF** (Option-Fit): this a the set of system approvals for an Iran domestic vehicle manufacturer that uses a base EURO III certified engine, where he does not own the

Guidance Document for Certification of Domestic HD_IGM_VF.docx

1 of 10

BUS* TYPE M3 Class I & II with earlier application Date ***2001/85/EC Bus Directive**

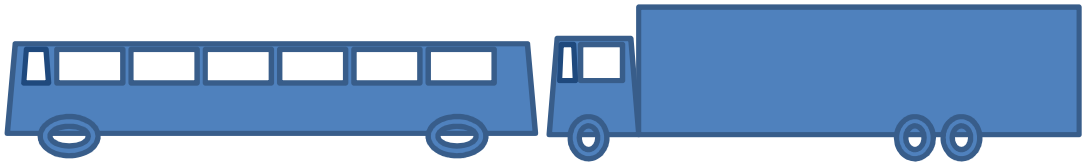
IRAN III PEEV PARTICULATE EMISSION ENHANCED VEHICLE IRAN PRODUCTION VEHICLES		
VEHICLE CATEGORY: Application Date	BUS* TYPE M3 Class I & II *2001/85/EC Bus Directive	June 23rd, 2016
	Truck N2, N3 Bus* M2 Class A,B; M3 Class III (Coach)	March 21st, 2017
ENGINE TYPE:	COMPRESSION IGNITION ONLY	
Application Type Date:	ISSUE LICENSE PLATE BY POLICE	
Reference Fuel:	EURO III; 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	2,1	5,0	0,66	--	0.02	1E12	--
ETC	5,45	5,0	--	0,78	0.03	1E12	--
ELR***	--	--	--		--	--	Not required

*1) Definition of particle number measurement equipment and result calculation from ECE-R49-06, annex 4

*2) Test cycles according to ECE-R49-05, annex 4A: ESC, ETC



IRAN III PEEV PARTICULATE ENHANCED ENVIRONMENTAL VEHICLE						
VEHICLE CATEGORY:	**All Heavy Duty N2, N3, M2 and M3**					
ENGINE TYPE:	**COMPRESSION IGNITION ONLY**					
Deterioration Factors DF* **:						
Test Cycle	**CO [-]**	**NOx [-]**	**THC [-]**	**NMHC [-]**	**PM [-]**	**PN [-]**
ESC	**1,1**	**1,05**	**1,05**	**--**	**1,1**	**1,0**
ETC	**1,1**	**1,05**	**1,05**	**--**	**1,1**	**1,0**

* DPF Durabilty from ECE-R132 or FOEN/SN277206 Approval
**Emission Durabilty or Fixed DF from table

From EURO III

From EURO VI

Euro III PEEV for Iran

- IRAN follows EU system for WVTA whole vehicle type approval system
- Heavy Duty Emissions are a system approval and follow 2005/55/EC as base
- There will be two choices of possible ways to obtain a system approval set for an updated of the motor vehicle type approval:
- Choice Annex OE (OEM): this a the set of system approvals for an Iran domestic vehicle manufacturer that uses an Iran domestic engine manufacturer that develops and certifies an engine system equipped with wall-flow DPF.
- Choice Annex OF (Option-Fit): this a the set of system approvals for an Iran domestic vehicle manufacturer that uses a base EURO III certified engine, where he does not own the engineering rights and production and engine certification, but engineers the wall-flow DPF application for the vehicle application. This may include minor engine modifications, deleting of certified catalysts (DOC), mufflers and exhaust components.

Type OF (Option-Fit DPF) System Approvals

The new approval according to Annex **OF** required for the DPF equipped vehicle families are shown in table 2:

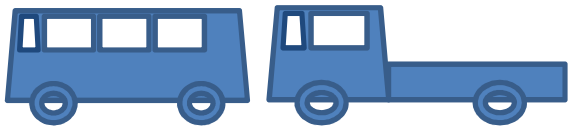
ISIRI IRAN INSO Standard	DOE Approval	ECE Directive Equivalent	EEC Approval Directive Equivalent	Certification	Number
6924-02 ۶۹۲۴-۰۲	--	--	--	WVTA IRAN Whole vehicle type approval	1
4243 ۴۲۴۳	--	R51-02	70/157/EEC	Noise *2)	2
6746	--	R49-02	2005/55/EC	Base Engine EURO III	3
6746-01 Annex OF	--	--	--	DPF Application Emissions	4
6502 ۶۵۰۲	--	R10-02 (R10-03)*1)	72/245/EEC	EMC vehicle	5
		R10-03		EMC DPF Control *1)	
~~6673~~	--	~~R24-03~~	~~72/306/EEC~~	~~Diesel Smoke~~	6
--	Required (only for FBC)	--	SNR277206 / FOEN Approval	In case of FBC application Approval	7
6483 ۶۴۸۳	--	R85-00	80/1269/EEC	Engine Power	8

Table 4: Newly required vehicle family approvals

*1) For new vehicle EMC approval including electronic DPF Control additional EMC approvals are not required

*2) Noise comparison test allowed

Those vehicles use base EURO III certified engines, that are obtained in this base EURO III condition. In order certify and possibly verify the emissions of those engines, the base engine certification remains intact. Possible engine and vehicle changes are certified with the other approvals, DPF emissions are certified with ISIRI 6746 Annex OF

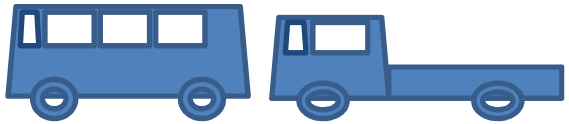


IRAN IV PEEV* PARTICULATE EMISSION ENHANCED VEHICLE : IMPORT VEHICLES		
VEHICLE CATEGORY: Application Date	N1 Light Duty Vehicles	May 22nd,2015
ENGINE TYPE:	COMPRESSION IGNITION ONLY; CDY CERT.	
Application Type Date:	ISSUE LICENSE PLATE BY POLICE	
Reference Fuel:	EURO IV; max. 10ppm Sulphur	

Emission Limits in TYPE I (NEDC) Test:

Vehicle category	Group	Reference weight (RW) [kg]	CO [g/km]	NOx [g/km]	HC+NOx [g/km]	PM [g/km]	PN [#/km]
N1 Diesel	I	RW≤1305	0,50	0,25	0,30	0,005	6E11
	II	1305<RW≤ 1760	0,63	0,33	0,39	0,005	6E11
	III	1760<RW	0,74	0,39	0,46	0,005	6E11
N2, M2 Diesel	-	all	0,74	0,39	0,46	0,005	6E11

*EURO 5b 715/2007/EC or higher emission level acceptable (with PN Number E/M limit)



IRAN IV PEEV PARTICULATE EMISSION ENHANCED VEHICLE					
VEHICLE CATEGORY:	**All Light Duty N1, N2, M2**				
ENGINE TYPE:	**COMPRESSION IGNITION ONLY**				
Deterioration Factors DF* ** for TYPE I NEDC Test:					
Test Cycle	CO [-]	NOx [-]	HC+NOx [-]	PM [-]	PN [-]
NEDC	1,1	1,0	1,0	1,2	1,0

* DPF Durabilty from ECE-R132 or FOEN/SN277206 Approval
**Emission Type V Durabilty 80.000 km or Fixed DF from table

From EURO IV

From EURO VI

Summary and Outlook

- IRAN has made in depth homework on emission monitoring, inventories, source apportionment and health effects. From this they have drawn a crystal-clear conclusion about PN being the air pollutant number one.
- This leads to the target to eliminate PN emission from all Diesel engines with DPF Technology as soon as possible. This must be implemented for all vehicles, domestic and import and also retrofitted to public transport buses.
- Fuel will remain a problem for some time. It is requested to come up with solutions for the current fuel quality situation. Waiting for ULSD is not an option.

New HD Emission legislation for Iran **"Euro III PEEV"** developed out of European regulation elements (EURO III to EURO VI) with the PN measurement from EURO VI being the most important.
We see this DPF OEM Emission regulation as a role model for more countries with air pollution problems.

A Stakeholder process was used to adapt the regulation to the requirements, built a forum for discussion and broaden the support for the regulation.

Summary and Outlook II

With "Euro III PEEV" we will speed up introduction of low PN emitting Heavy Duty Vehicles, fulfill exactly what is required and – important – that we can implement it within the shortest possible time.

- **We are open for : Exchange of emission regulation experience and ideas**
- **We offer: Help for Your emission regulation projects**

- **This shift we see as a big step forwards towards improving air quality**

TÜV Hessen / Automotive

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