EGEA

EUROPEAN GARAGE EQUIPMENT ASSOCIATION

EGEA WG2 Meeting -Emissions

26.01.2016, Brussels

"Providing more influence, better information and stronger support to the Garage and Test Equipment Industry!"

Emissions Agenda

- Opening and welcome
- Up date of the European state of Art
- Initiative CITA / project SET2
- White paper/ EGEA recommendation regarding European Directive Roll out
- Any other business

Opening & Welcome

Activities WG 02

DIESEL	A	CZ	FIN	F	D	IRL	I	N	E	S	NL	GB
Procedure + plate value	OK	OK		OK	OK		OK			OK	OK	no
Plate value DB	OK	OK		OK	OK		OK			OK	OK	no
Plan _> DB	no	OK		OK	OK		OK			OK	OK	no
Opacimeter new spec	-	OK		OK	OK		no			no	no	no
Plan for new spec	-	OK		OK	OK		no			no	no	no
Route for approval		OK		OK	OK		OK			OK	OK	KO
Default threshold	1.0	0.3		0.7	0.5		1.5				0.7	1.5
EOBDTail pipe		1+1		1+1	1 or 2		TP			1 or 2	1 or 2	TP
EQ data collection		OK		OK			OK			OK		no
FAP anti tampering		OK		OK								no

Activities WG 02

PETROL	FRANCE	GERMANY	ITALY	AUSTRIA	UK
Route for approval	OK	OK	NO	OK	NO
EOBD vs Tail pipe	both	Eobd 1st	Tail pipe	Eobd 1st	Tail pipe
Electronic data collection	Mandatory	Not Mandatory	Mandatory	Not Mandatory	Not Mandatory
SET CITA recommendation	In discussion	NO	NO	NO	NO

- **Evolution already known**

- **Diesel car:**

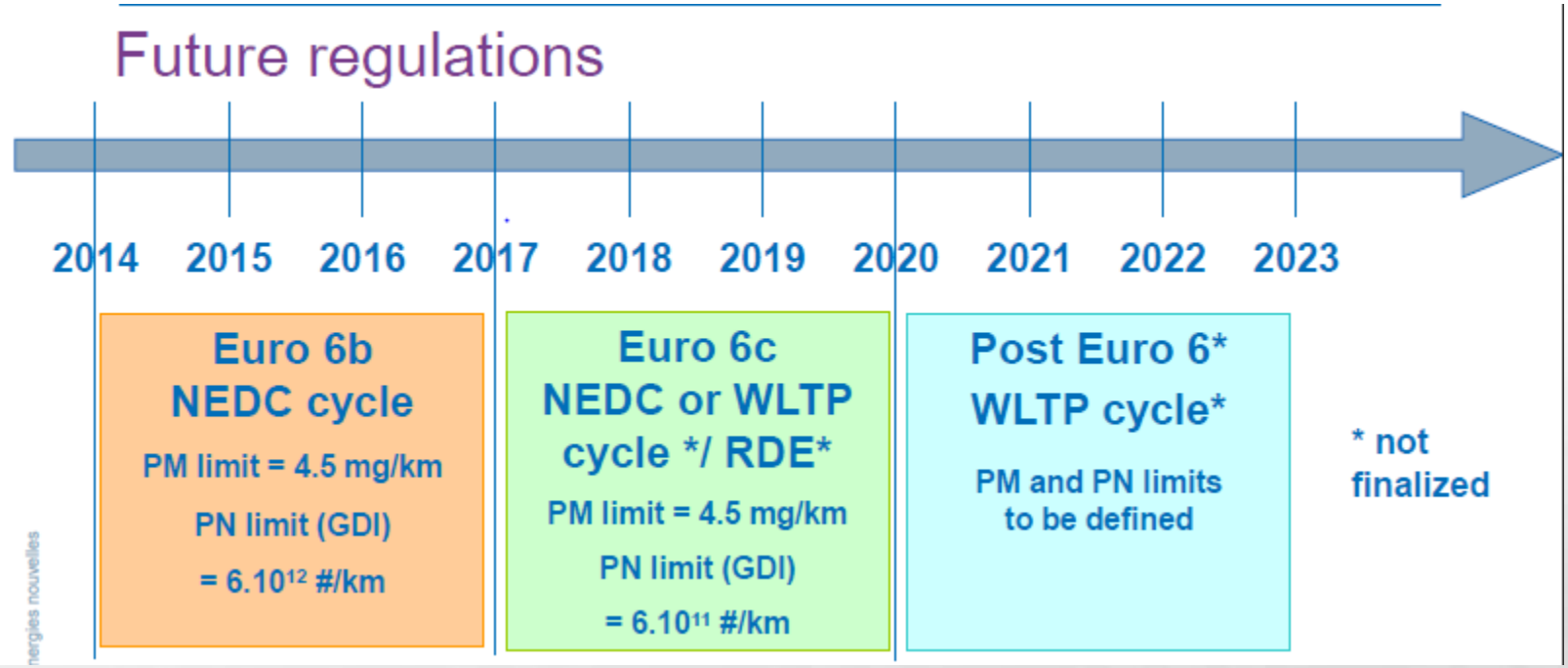
  New Opacimeters regulation: NFR10025

  - Is now ready to be published
    - New range down to 0.1 m-1
    - New filter for calibration in the lowest part of the range
    - New procedure : trigger on RPM; monitoring of RPM rising slope
    - Use of Vehicle's data base for plate value
    - Heated probe for trucks
    - New golden reference & car pack definition for approval

France

- **Evolutions Coming: related to the new law about "Energetic transition"**
  - Definition by end of 2016
  - Roll out by end of 2017
  - All cars to be tested from 1/2018
- **Diesel car:**
  - **Use of 5 gas analyzer**
    - NOx sensor has to be added (specification unknown)
    - No procedure excepted data collection (basic procedure & data transfer are unknown)
    - Data collection is expected to lead to a threshold definition
    - Approval process is not defined
- **Petrol car:**
  - **Petrol particulate measurement**
    - Measurement specification unknown
    - Procedure unknown & threshold unknown

Petrol particulate measurement



Petrol particulate measurement

A Euro 5 passenger vehicle equipped with a 1L6 stoechiometric SIDI engine has been tested for multiple operating conditions including several types of driving cycle (NEDC, WLTC, Artemis…).

This vehicle does not comply with the future Euro6b limit for particle number following the PMP measurement procedure, and the comparison of driving cycles showed that urban driving conditions lead to high number of particles emitted per kilometer (fig.1)

The size distribution, directly measured at the exhaust pipe (using the DMS500), confirms that urban driving conditions generate high concentrations of particles specially in accumulation mode (fig.2).

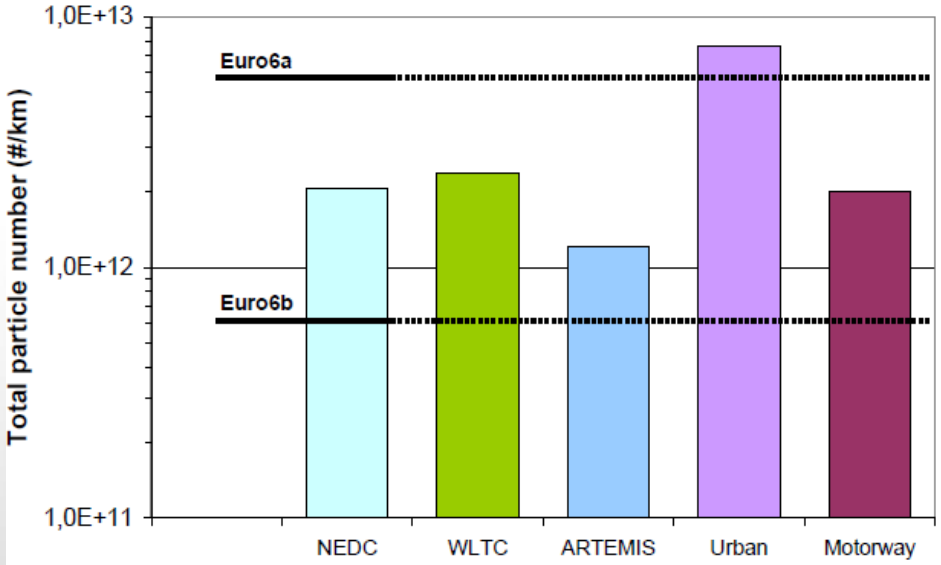


Fig.1 : Total Particle number (PMP)

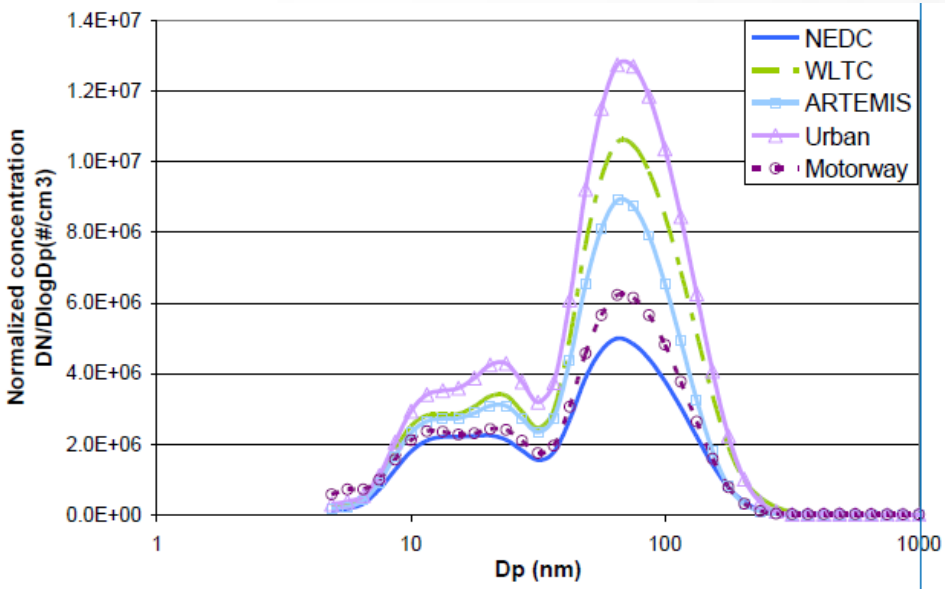
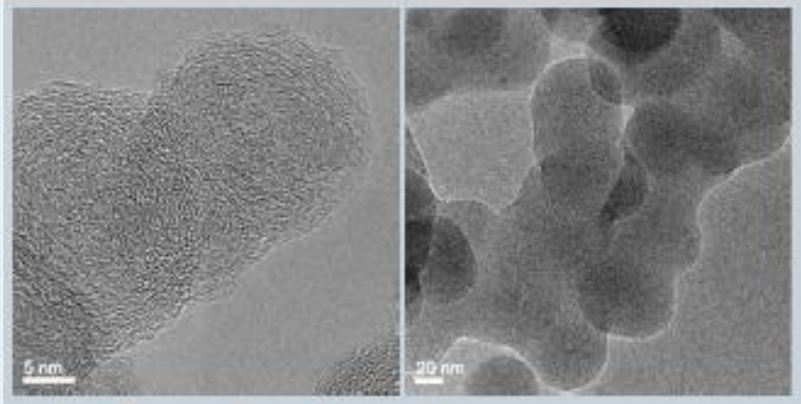
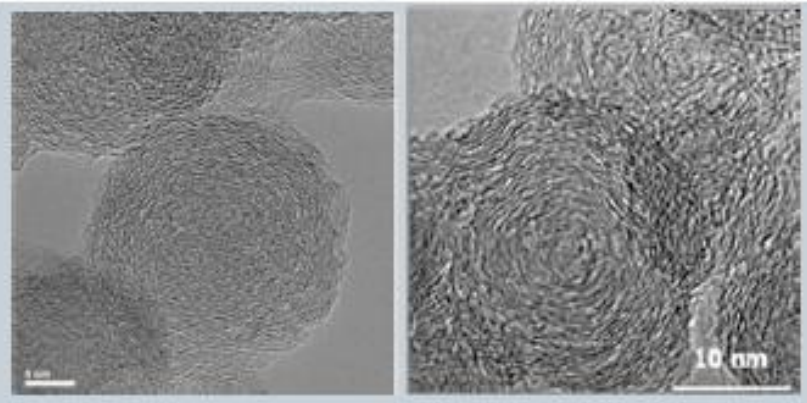


Fig.2 : Particle concentration

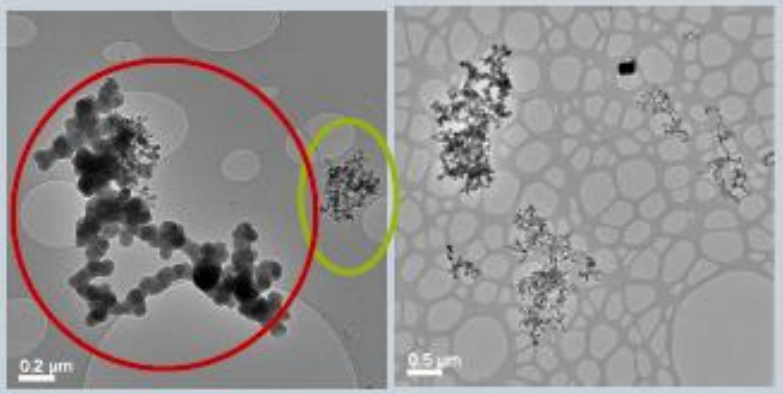
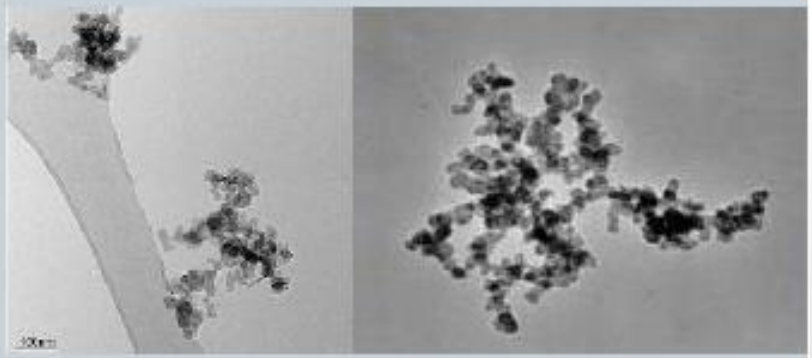
➔ **Nbr of Petrol particulates is x 100 time Diesel emission (Both engine OK)**

Petrol particulate measurement

Comparison GDI soot vs. Diesel soot (1/2)

	GDI soot	Diesel soot
Primary particles structure		
	▪ Graphitized and amorphous clusters coexist ▪ Diameter very scattered: • 10 - 70 nm for graphitized particles • 50 – 100 nm for amorphous particles	▪ Mainly graphitized ▪ Diameter : 20 – 40 nm

Comparison GDI soot vs. Diesel soot (1/2)

	GDI soot	Diesel soot
Soot particles aggregates		
	▪ Clusters with various sizes of primary particles ▪ Clusters with small primary particles ▪ Clusters with large primary particles	▪ Clusters with nearly constant diameter of primary particles

➔ **Engine and lab tests showed the presence of solid particles**

Initiative CITA / project SET2

- **Problem definition:**
  The pollutant of greater concern in terms of local air quality are NOx and particulate matter. The current periodic emission test is not able to evaluate the emission behavior regarding NOx, gross polluter will not be detected

- **Solution:**
  Develop applicable test methods to test after treatment systems (based on NOx measurement) during periodic emission tests for petrol and diesel

- **Value Proposition:**
  CITA can make a recommendation to the EC to improve the current periodic emission test and shape future legislation

- **Benefits**
  - Improve air quality in urban areas
  - Fulfill the emission thresholds set by the EC for urban areas
  - Improve reputation of CITA
  - Increase the efficiency of periodic emission test done by independent bodies

Initiative CITA / project SET2

- **Key objectives and benefits**
  - **Develop applicable test methods for after treatment systems (based on NOx measurement) during periodic emission tests (petrol and diesel vehicles)**
    - Clear results (precision and clear Pass/Fail criteria)
    - No time consumable
    - Single open solution which can be implemented throughout Europe and which can be rapidly rolled out during 2017/2018 as a binding requirement for EU-MS
    - High accuracy of results
    - Positive Cost/Benefit ratio
    - PTI test methods should reflect the type approval requirements and should always be in line with the new technologies as they are introduced into the market
  - **Methodology**
    - Identify possible test methods including test equipment
    - Select the 3 most promising methods
    - Identify defective NOx after treatment systems including EURO 6
    - Evaluate these methods (Field tests)
    - Cost benefit analysis
    - Recommend the most applicable method

Initiative CITA / project SET2

- **Key deliverables and milestones**

Define and agree the key objectives	02/12/15
Preparing documents for BP (short version)	22/01/16
Provide overview of current methods and equipment	23/01/16
General approval of BP (incl. estimation of maximum costs)	29/01/16
Select the most promising methods	30/01/16
Kick Off meeting (expected)	17/02/16
Final approval of BP	28/02/16
Perform necessary tests	30/05/16
Finalize project inclusive report	30/08/16

Initiative CITA / project SET2

- **Batch 1: Lab tests & desk based analysis**
  - **Synthesis of the actual NOx test procedure and their pass & fail criteria:**
  - **State of art of knowledge regarding NOx measurement Device/Equipment and engine load simulation technologies, based on existing scientific documents**
  - **Estimation on precision and repeatability criteria between various engine load stimulation:**
    - NEDC (analysis of approval test records: order of magnitude; dispersion of value for same engine load/ repeatability (regarding process, regarding vehicle)
    - ASM (analysis of approval test records: order of magnitude; engine load, dispersion of value for the same engine load/ repeatability (regarding process, regarding vehicle,)
    - Fast Idle, Free acceleration, high RPM : study on available studies
    - Other ways to obtain engine loading
    - Analysis of the gap from Vehicle status vs principle of stimulating
  - **Test of Euro 6 de NOx system (NOx trap, SCR): NEDC cycle and static test (Fast Idle, free acceleration) for operating and non-operating system (Empty urea fluid tank, NOx trap) on 2 vehicles equipped with one of these 2 technologies**
  - **State of art of NOx measurement technologies: Electro-chemical, Zirconia multilayer ceramics…**
  - **Evaluation (matrix) of the findings and definition of a practical field test procedure content of the most promising method.**

Initiative CITA / project SET2

- **Batch 2: Field tests**
  - **Choose of the appropriate state of the art test equipment and principle of measurement :**
  - **Definition of a field test, content of:**
    - 1st approach: functional component test (EGR) and OBD
    - 2nd approach: NOx threshold definition in combination with the load simulation and condition of the engine
    - *Double-check with deep examination of **some** faulty vehicles identified during field tests if available*
  - **Suitable test method matching with PTI constraints in term of :**
    - Easy to perform
    - Precision and clear Pass/Fail criteria and repeatable results
    - Single Open solution which can be implemented throughout Europe
    - Repeatable results, Positive Cost/Benefit ratio
    - Solution which can be rapidly rolled out during 2017/2018
  - **Impact of engine RPM limitation Comparison of OBD read out (fault codes, RC Status, real time values, status information) versus the tailpipe emission test (NOx value, EGR valve status)**

Initiative CITA / project SET2

- *Double-check with deep examination of some faulty vehicles identified during field tests if available*

- **Deep examination of some faulty vehicles flagged during field test campaign (depending on liaising with independent repairer associations across EU):**
  - (5 vehicles= 1/10 of faulty vehicles considering 5% faulty vehicles over 1000 tests)
  - negotiation with the owner for vehicle/engine for real deep examination/ fixing
  - deep after-treatment equipment examination by technicians
  - vehicle repair

→ Independent Repairers Associations across EU : how ?

- **EGEA survey : Available equipment? Available procedure? Available volunteer?**

  - MAHA MET 6.3: measurement of separately NO and NO_2 and give real NOx values.
  - Sensors Inc. SEMTECH-NOx: NO, NO_2
  - Sensors Inc. SEMTECH-DS: NO, NO_2, O_2, CO, CO_2, HC
  - SAXON-Junkalor Infralyt ELD
  - Capelec CAP3050 : NOx, O_2
  - Bosch: BEA 050, 055, 060, with NO
  - Brain Bee: AGS-688: NO.
  - Automotive Test : P555: NO, NO_2
  - AVL DiTEST: AVL DITEST CDS/MDS
  - ACTIA: Actigas AT505: NO, NO_2 extension
  - TEN : INNOVA 2800+NOx
  - TEXA GASBOX AUTOPOWER

Suggestion of procedure without Dyno

Current & potential initiatives on emissions at EU level: round-up session / DIESEL

- **White paper: what content?**
  - **DIRECTIVE 2014/45/EU, (3 april 14):**

    Use of plate value push to a release of:

    - The **hardware of opacimeter** : to make sure that the lowest level would be covered (down to 0.1 m-1)
    - **Calibration means**

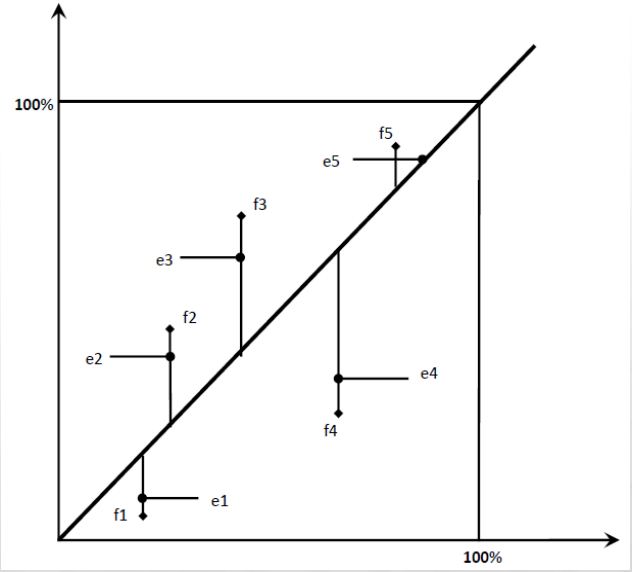
  - **Related items :**
    - **Tigger** on opacity value is less pertinent:
      - use of RPM trigger is a Must
        - Indirect way or EOBD
        - A way to fight fraud & procedure cheating
    - **Limited RPM** vehicle

Current & potential initiatives on emissions at EU level: round-up session / DIESEL

- **Hardware of opacimeter :**
  - Range : down to 0.1 m-1
  - Minimal value displayed: 0.10m-1 below this value the display is: <0.10m-1
  - Resolution 0.01 m-1

  - Accuracy: 0.05 m-1 from 0.10m-1 up to 0.5 m-1
  - Accuracy: 0.15 m-1 from 0.51m-1 up to 1.5 m-1
  - Accuracy: 0.25 m-1 from 1.51m-1 up to 3 m-1
  - Accuracy: 0.5 m-1 from 3.01m-1 up to 9 m-1

  - Absolute deviation <0.15m-1
  - Ratio of relative deviation <1.5

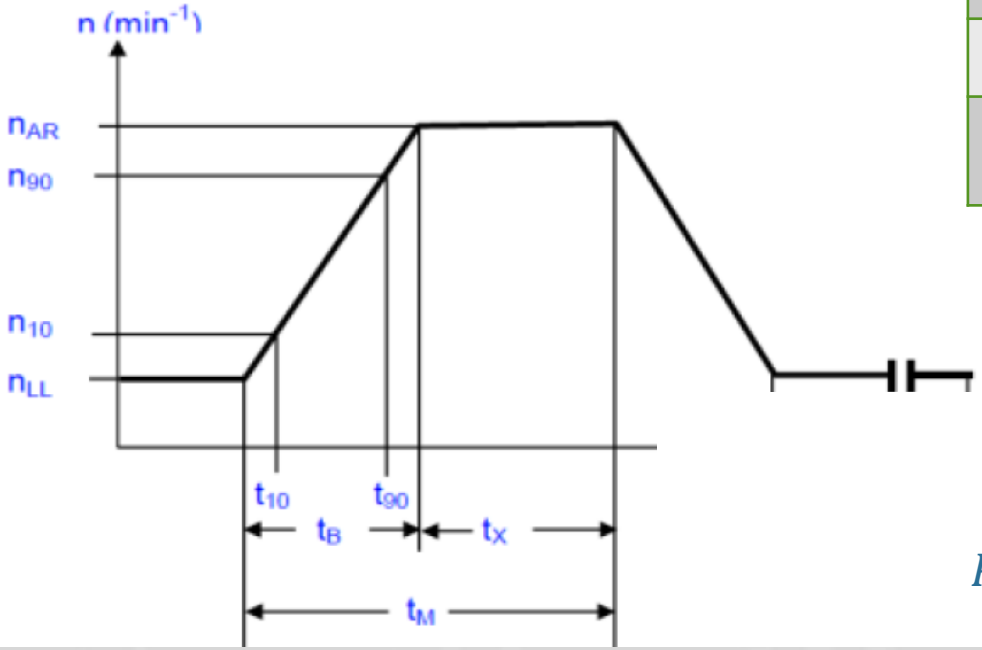


- **Calibration means**
  - 5 Filters : 5/10/20/40/60 % (5% (0.119m-1) /10% (0.245m-1)

$$\frac{|e1|+|e2|+|e3|+|e4|+|e5|}{5} \leq 0{,}15 m^{-1}$$

Current & potential initiatives on emissions at EU level: round-up session / DIESEL

- **Tigger & Limited RPM vehicle:**
  - **Trigger on RPM**
  - **RPM monitoring :**
    - Vehicle data base (Germany …)
    - Rising time / Slope monitoring



nLL RPM idle	tB Acceleration time
n_{AR} RPM Cut off speed	t_X Measurement windows
n_{10} n_{LL}+10%n_{LL}	t_M Pedal maintain time
n_{90} n_{AR}-10%n_{AR}	t_{LT}time between 2 accelerations

$$t_b = \frac{(n_{AR} - n_{LL}) \times (t_{90} - t_{10})}{(n_{90} - n_{10})}$$

Rising time:
- 2s for LV
- 4s for HV

$$Pb = \frac{n_{AR} - nLL}{tb}$$

Slope:
- 2000 tr/min/s for LV
- 1000 tr/min/s for HV

Current & potential initiatives on emissions at EU level: round-up session / DIESEL

- **Other:**

  - **Fast pass & Fast Fail**
  - **Variation monitoring between Results of Free accelerations:**
    - Δ >0.25 m-1 ->KO
  - **Smoke temperature monitoring: at beginning of test**
    - (30° with new vehicle)
  - **Heated probe or tailpipe extension :**
    - Trucks
    - Bus

PTI Directive 2014/45/EU – Motorcycle emission testing

- State of play in various Member States
- Existing and future test methods

EGEA

EUROPEAN GARAGE EQUIPMENT ASSOCIATION

Thank you

"Providing more influence, better information and stronger support to the Garage and Test Equipment Industry!"