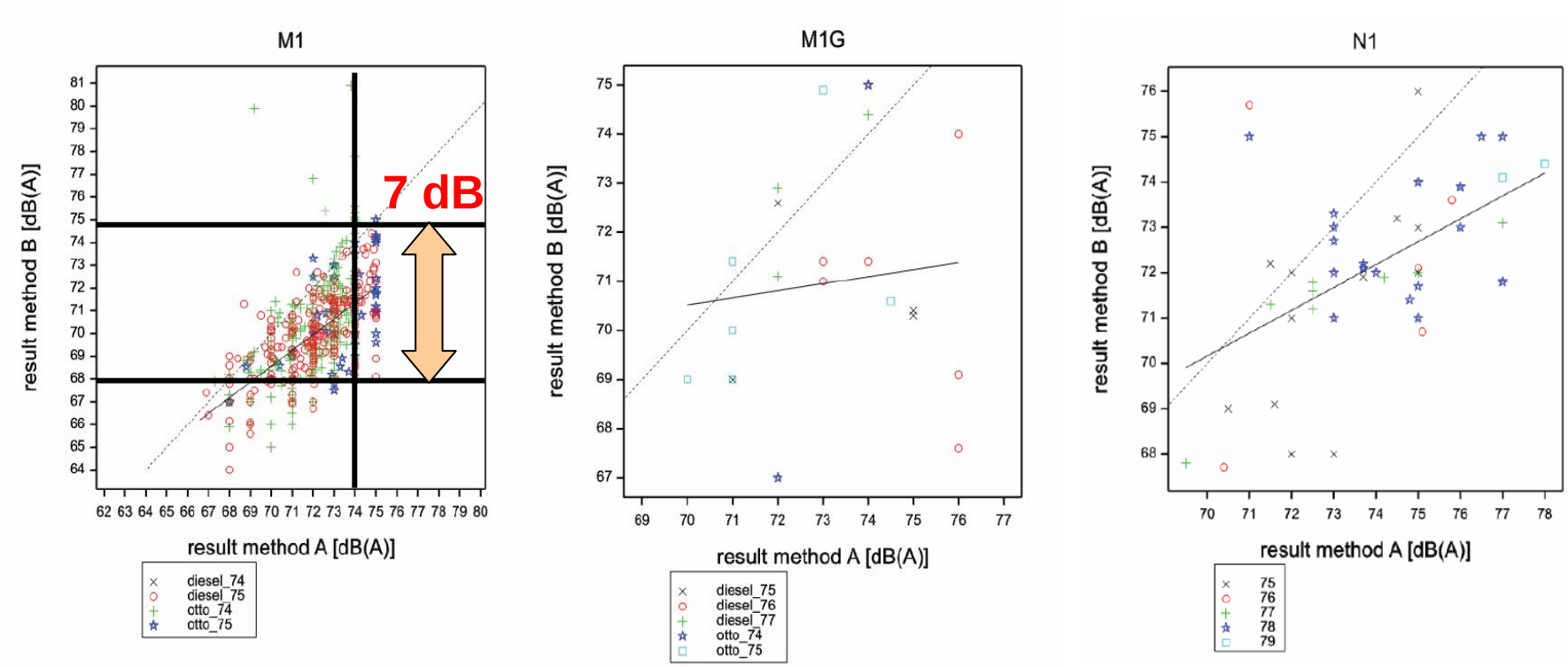
Informal document No. **GRB-53-20**
(53rd GRB, 15 to 17 February 2011
agenda item 3(b))

ECE R 51.02 Method B
Data Analysis of the Monitoring Phase of ECE/EU 2007-2010

53rd GRB Working Party on Noise
February 2011

INTERNATIONAL ORGANIZATION OF MOTOR VEHICLE MANUFACTURERS

Correlation Between the Method A and Method B



The correlation between method A and method B is very weak. As a trend the test results according to method B are in most cases somewhat lower. Analysis strategies which are based on average data - like TNO (1) and TNO (2) cannot be applied because they do not cover the dispersion of the data.

Vehicle Subcategories within M1 / N1 and their Introduction Dates

Date	Subcategory
1985	Direct Injected Diesel Engine
1985	Off Road Provisions
1985	High Performance Vehicles - Testing
1995	High Performance Vehicles - Limit +1 dB
1985	Split of N1 Category

These definitions for subcategories reflect the state-of-the-art at that time. After more than 25 years it is necessary to review these class definitions. The data analysis for consideration of limit values must then be based on the reviewed definitions to verify whether a differentiation is justified

Overview of All M1 Data - Method B Results

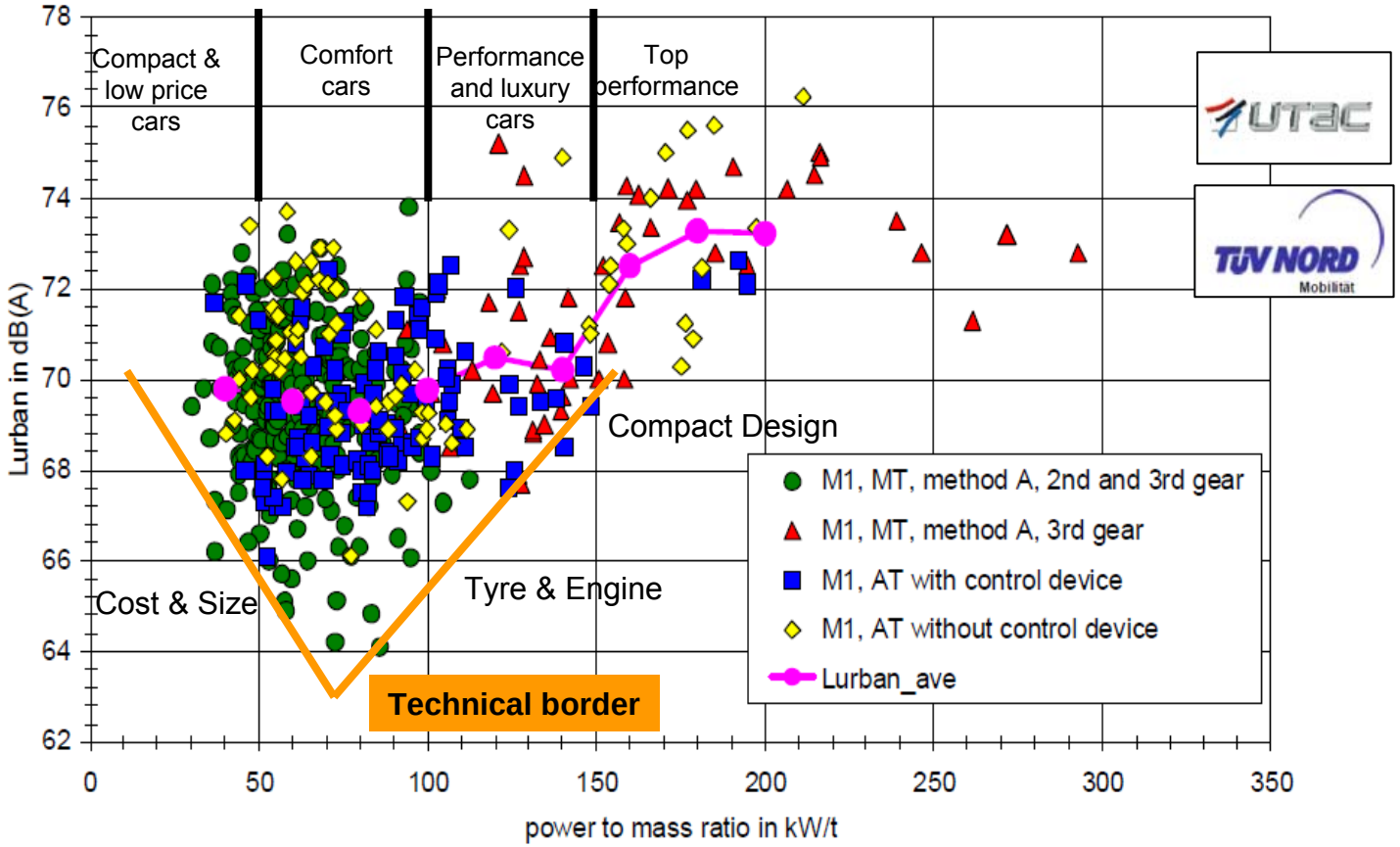
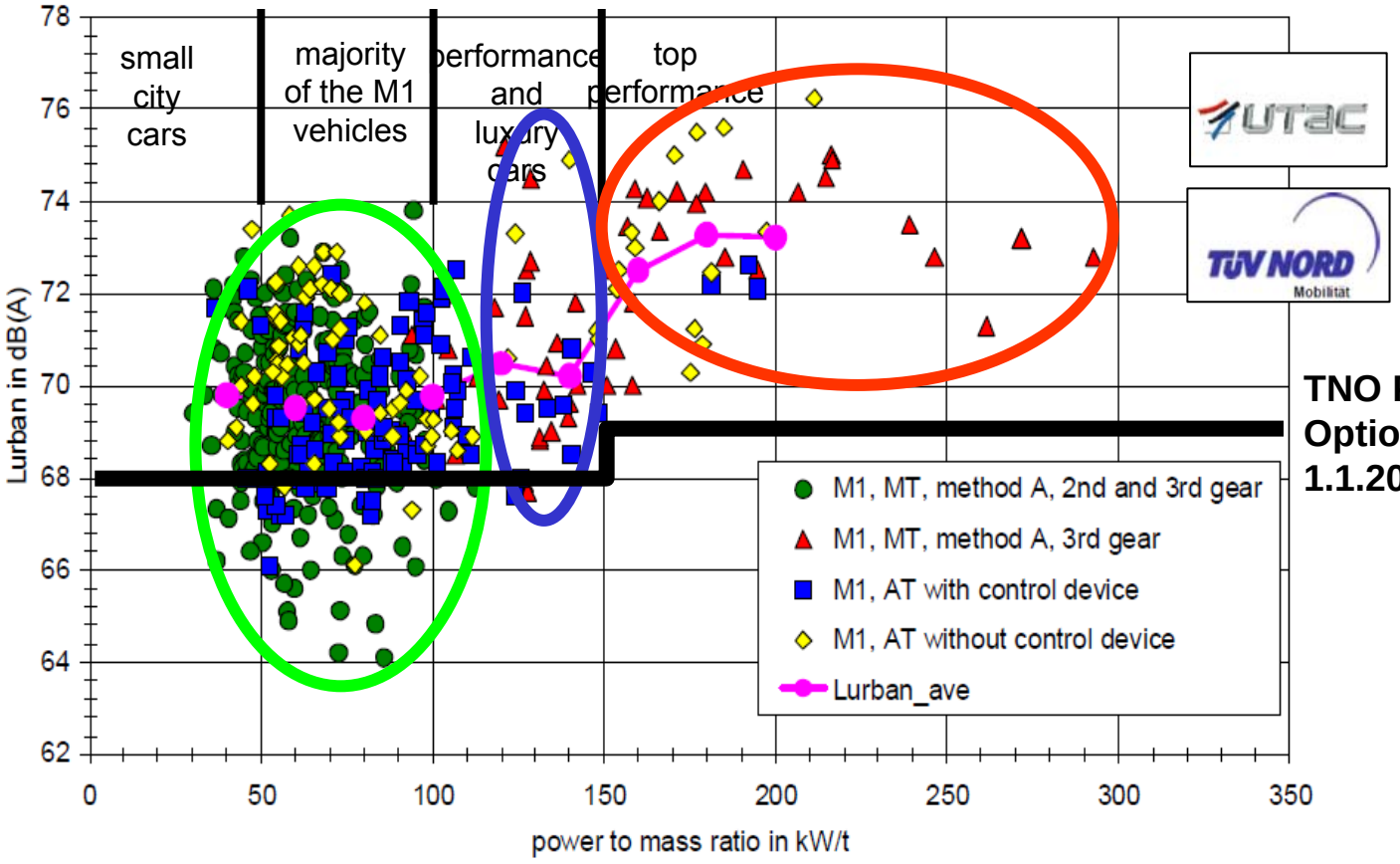


Figure B 9 : Lurban versus power to mass ratio for M1 on road vehicles

Overview of All M1 Data - Method B Results



TNO Proposal Option 5 from 1.1.2015 on

Figure B 9 : Lurban versus power to mass ratio for M1 on road vehicles

Overview of All M1 Data - Method B Results

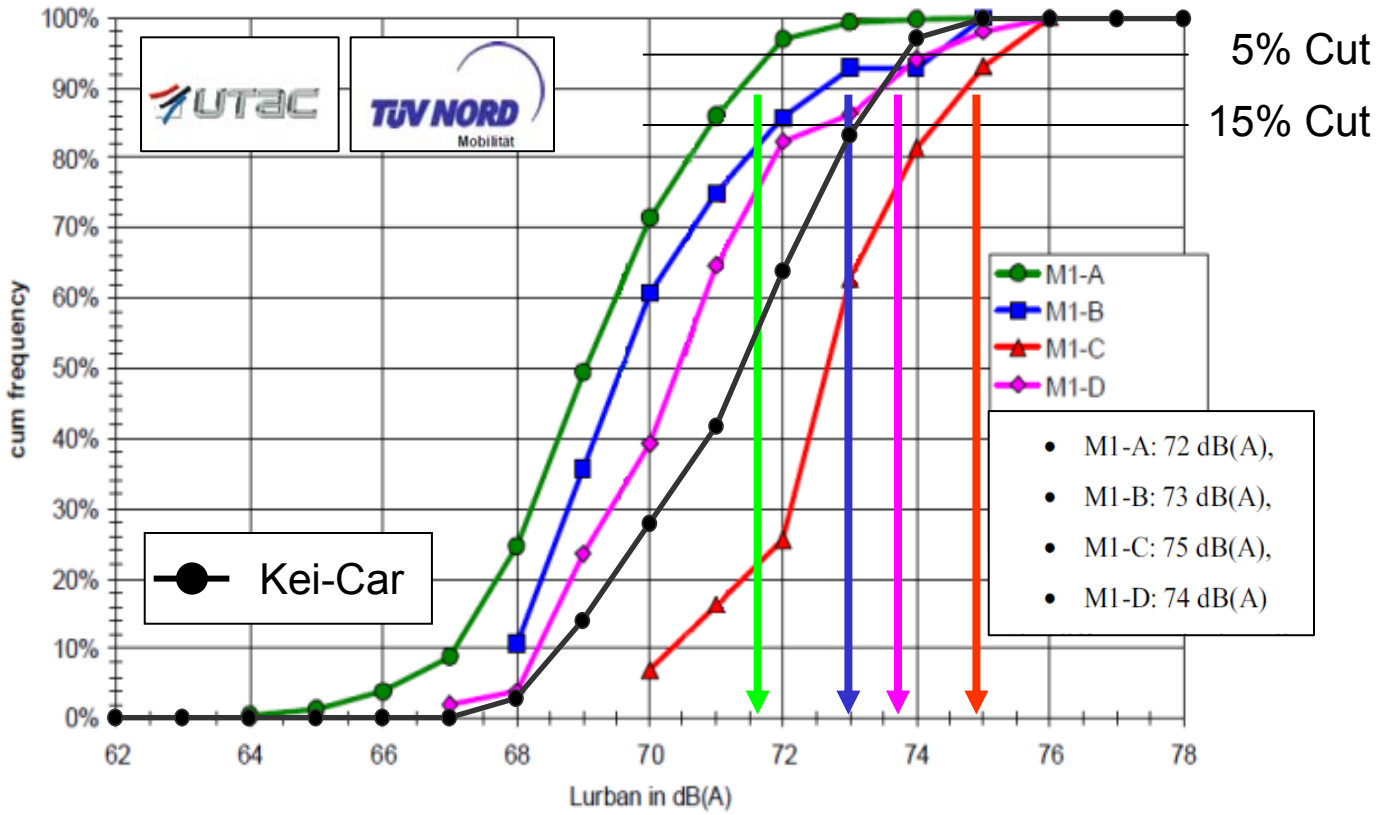


Figure B 10 : Cumulative frequency distributions and average Lurban values for the three proposed on road M1 vehicle classes

Overview of All N1 Data - Method B Results

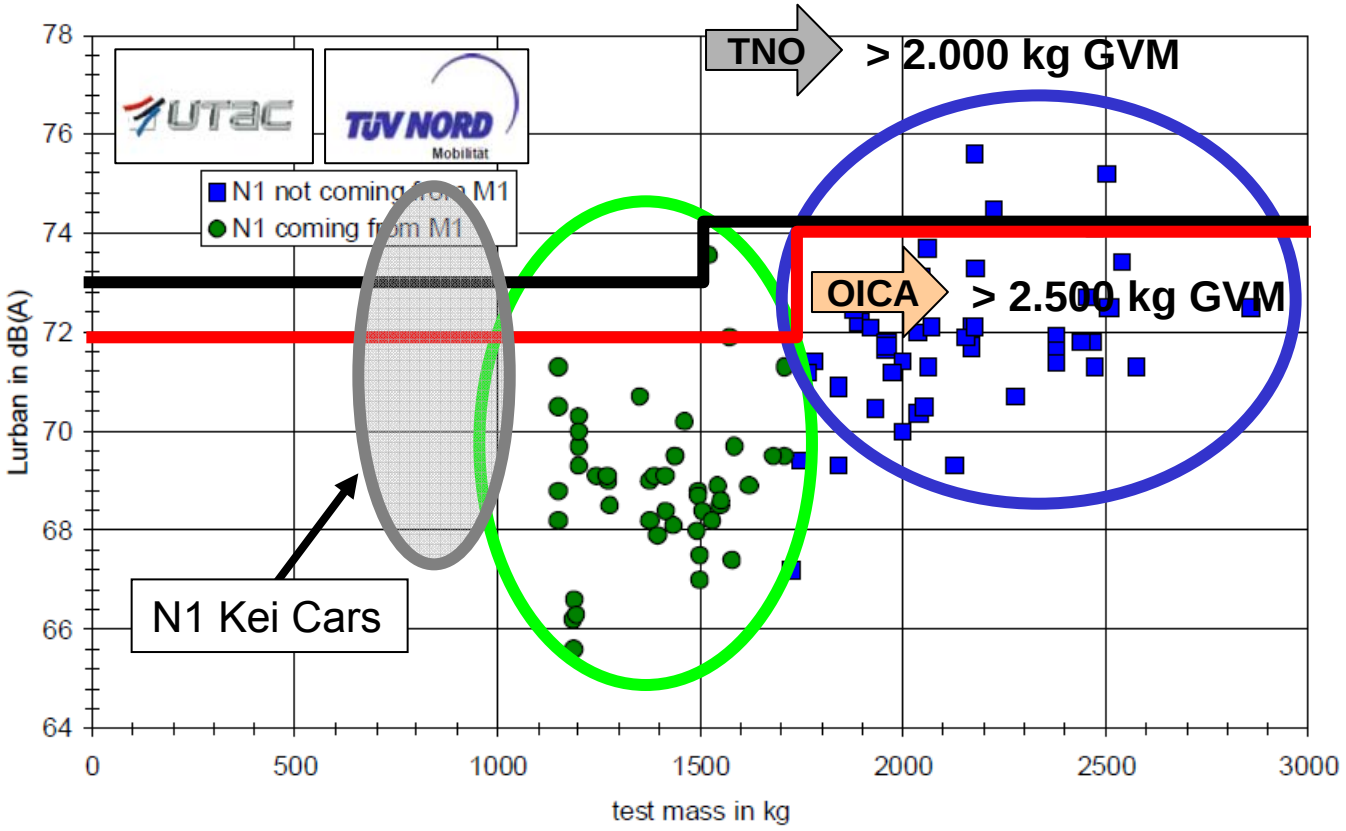
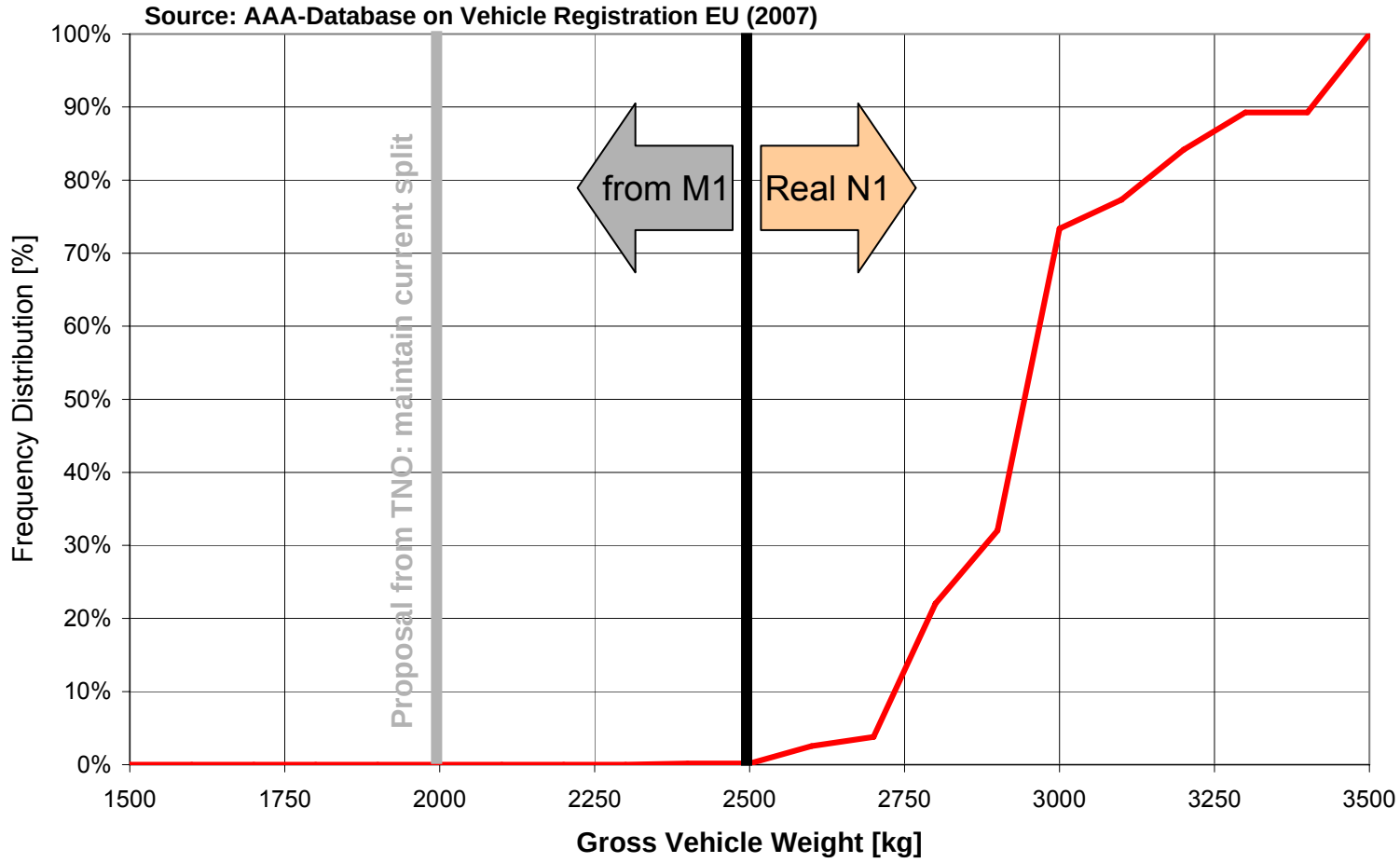


Figure B 12 : Method B results (Lurban) for N1/M2-A vehicles versus test mass

Split between N1 “from M1” and “Real N1”



N1 Offroad Vehicles

Category	Description	Total number of vehicles
M 1	Passenger car	653
M 1G	Pass. car – off-road	24
M 2	Medium-sized bus	28
M 3	Heavy bus	76
N 1	Van	52
N 1G	Van – off-road	3
N 2	Medium-sized truck	55
N 3	Heavy truck	100
N 3G	Heavy truck – off-road	39
Total		1030

Very few data available!

How to approach reliable sound levels ?

Proposal to split for N1G according to N1: divide between „coming from M1“ and „coming from N2“

N1G < 2.500 kg same value as M1G
N1G > 2.500 kg similar to N2G

74 dB for N1G < 2.500 kg

75 dB for N1G > 2.500 kg

"Pseudo-Equivalent" Limit Values - Comparison TNO vs ACEA Study

TNO OPTION 3	M1		M1 G	
	Value [dB(A)]	Criteria PMR	Value [dB(A)]	Criteria
	72	≤ 150 kW/t	73	Definitions as today in R.E.3
	73	> 150 kW/t		

	N1		N1 G	
	Value [dB(A)]	Criteria GVM	Value [dB(A)]	Criteria GVM
	73	≤ 2000 kg	74	≤ 2000 kg
	74	> 2000 kg		> 2000 kg

OICA Position for "Pseudo-Equivalent" Values	M1		M1 G	
	Value [dB(A)]	Criteria PMR	Value [dB(A)]	Criteria
	72	≤125 kW/t	74	incl. Hill Climbing & Wading Depth & Offroad R.E.3
	73	125 ... 150 kW/t		
	75	> 150 kW/t		

	N1		N1 G	
	Value [dB(A)]	Criteria GVM	Value [dB(A)]	Criteria GVM
	72	≤ 2500 kg	74	≤ 2500 kg
	74	> 2500 kg	75	> 2500 kg

"Pseudo-Equivalent" means that an introduction of the new test method with these values as new limits will nor improve nor degrade the **current** environmental situation. However these values mean a limit enforcement for approximately 10% of new vehicle types.

TNO Assessment of Influence of ECE R117 - Tyre Rolling Sound

- "Stricter limit values for tyre rolling noise will be in force for new types of tyres and from **1 November 2013** for new types of vehicles".

- "These new requirements will result in an (estimated) average **reduction of 3,8 dB(A) of the limit values for car tyres** and of approximately 3,3 dB(A) for the limit values for truck tyres".
- "From 1 November 2016 the stricter limit values will apply to all new vehicles and all new tyres (see also Appendix E). The spread of noise emission values in most tyre classes is approximately 5 to 6 dB(A) below the current limit values. The current average of the noise emission is in most cases approximately equal to or slightly higher than the future limit values".

- "This means that the introduction of the stricter limit values will result in the cut-off of the upper half or more of the tyre populations".
- "**Assuming that in the long run**, new tyre types with lower noise emission will be developed, a spread of approximately 5 dB below the future limit value will emerge. The average noise emission of tyres **may** then be 3,3 to 3,8 dB(A) lower than the current values".

TNO Assessment of Influence of ECE R117

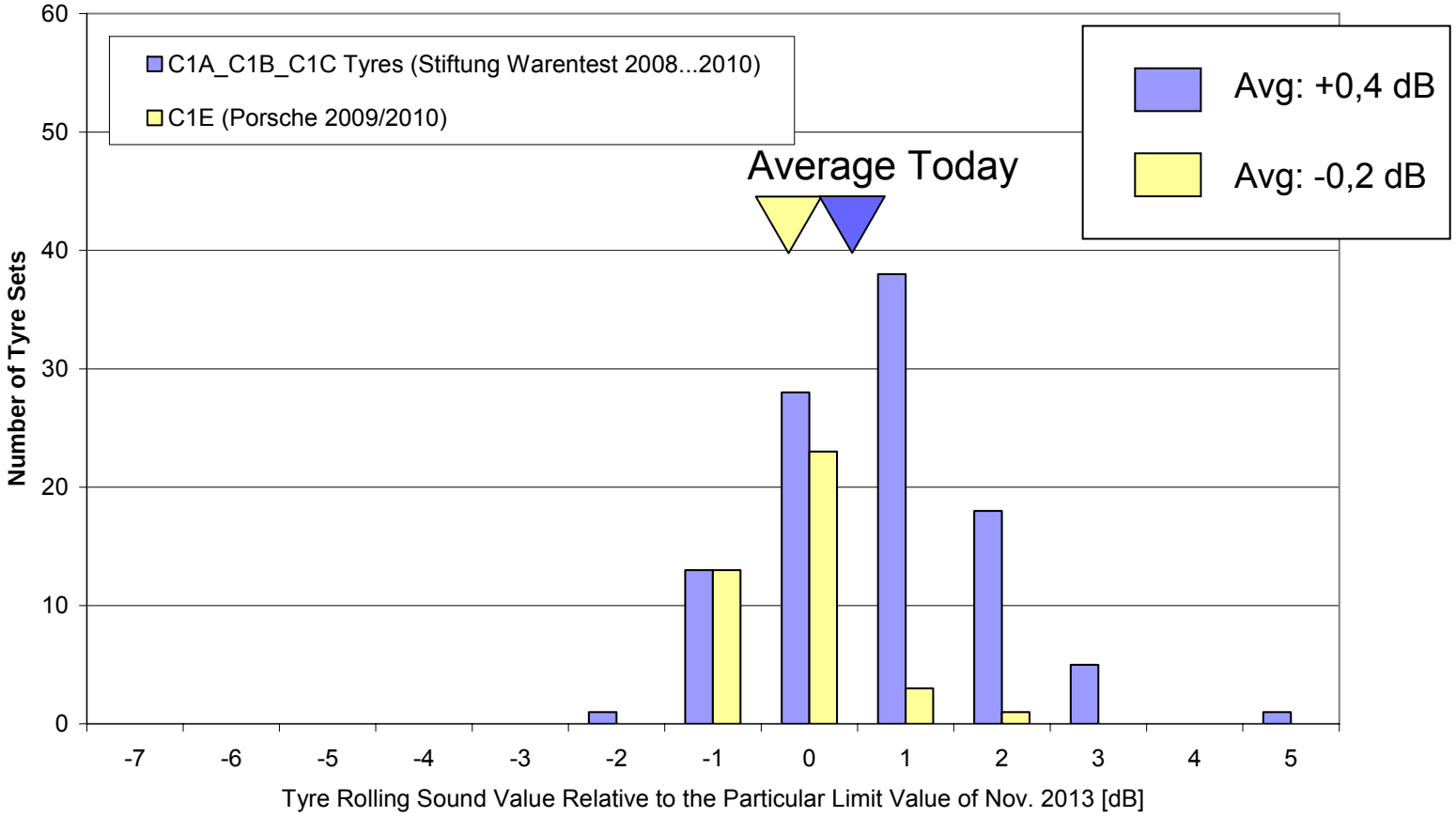
Current Applicable Tyre Limits				Applicable Limits from Nov. 2013 on						
Existing Tyre Class (2001/43/EC)	Nominal section width (mm)	Limit values in dB(A)	Limit values applicable from	Future Tyre Class (661/2009/EC)	Nominal section width (mm)	Limit values in dB(A)	Limit values applicable from	Market Share (ETRTO) [%]	Limit Reductions in dB(A)	Contrib
C1a	≤ 145	72	June 2007	C1a	≤185	70	Nov. 2013	3,3	**-2**	**-0,1**
C1b	>145 ≤165	73	June 2007	C1a	≤185	70	Nov. 2013	16,6	**-3**	**-0,5**
C1c	>165 ≤185	74	June 2007	C1a	≤185	70	Nov. 2013	29,3	**-4**	**-1,2**
C1d	>185 ≤215	75	June 2008	C1b	>185 ≤215	71	Nov. 2013	41,3	**-4**	**-1,7**
C1e	>215	76	June 2009	C1c	>215 ≤245	71	Nov. 2013	8,0	**-5**	**-0,4**
C1e	>215	76	June 2009	C1d	>245 ≤275	72	Nov. 2013	1,3	**-4**	**-0,1**
C1e	>215	76	June 2009	C1e	>275	74	Nov. 2013	0,2	**-2**	**0,0**

TNO Estimation Avg Reduction **-3,8**

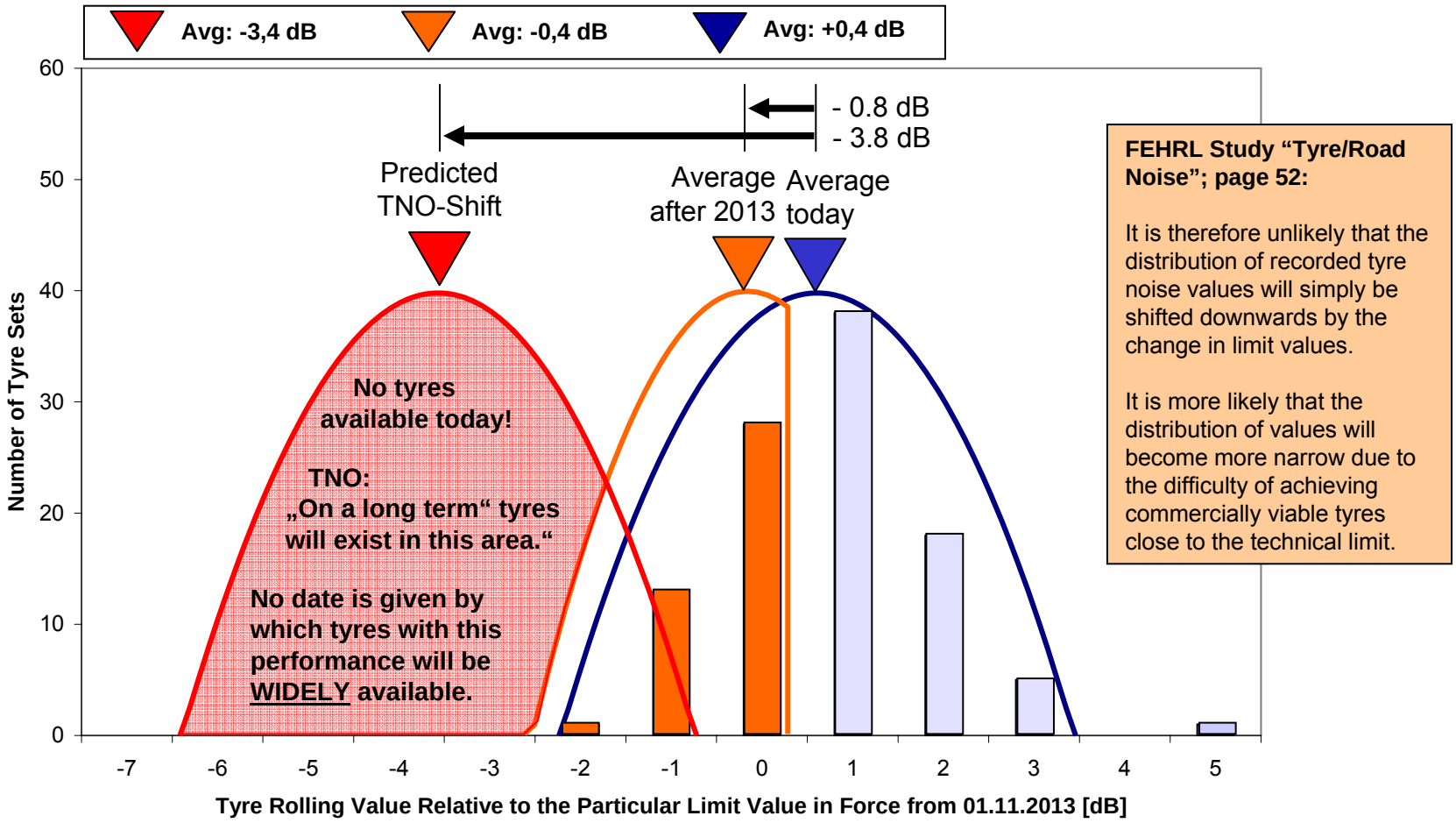
The TNO estimation for an average limit reduction neglects the circumstance that the limit reduction for some tyres is only 2 dB.

It is better to assess the tyre distribution curve as a difference between the tyre rolling sound value and the applicable limit value for a tyre from 2013 on.

TNO Assessment of Influence of ECE R117



TNO Assessment of Influence of ECE R117 - from 2013/2016 on



FEHRL Study “Tyre/Road Noise”; page 52:

It is therefore unlikely that the distribution of recorded tyre noise values will simply be shifted downwards by the change in limit values.

It is more likely that the distribution of values will become more narrow due to the difficulty of achieving commercially viable tyres close to the technical limit.

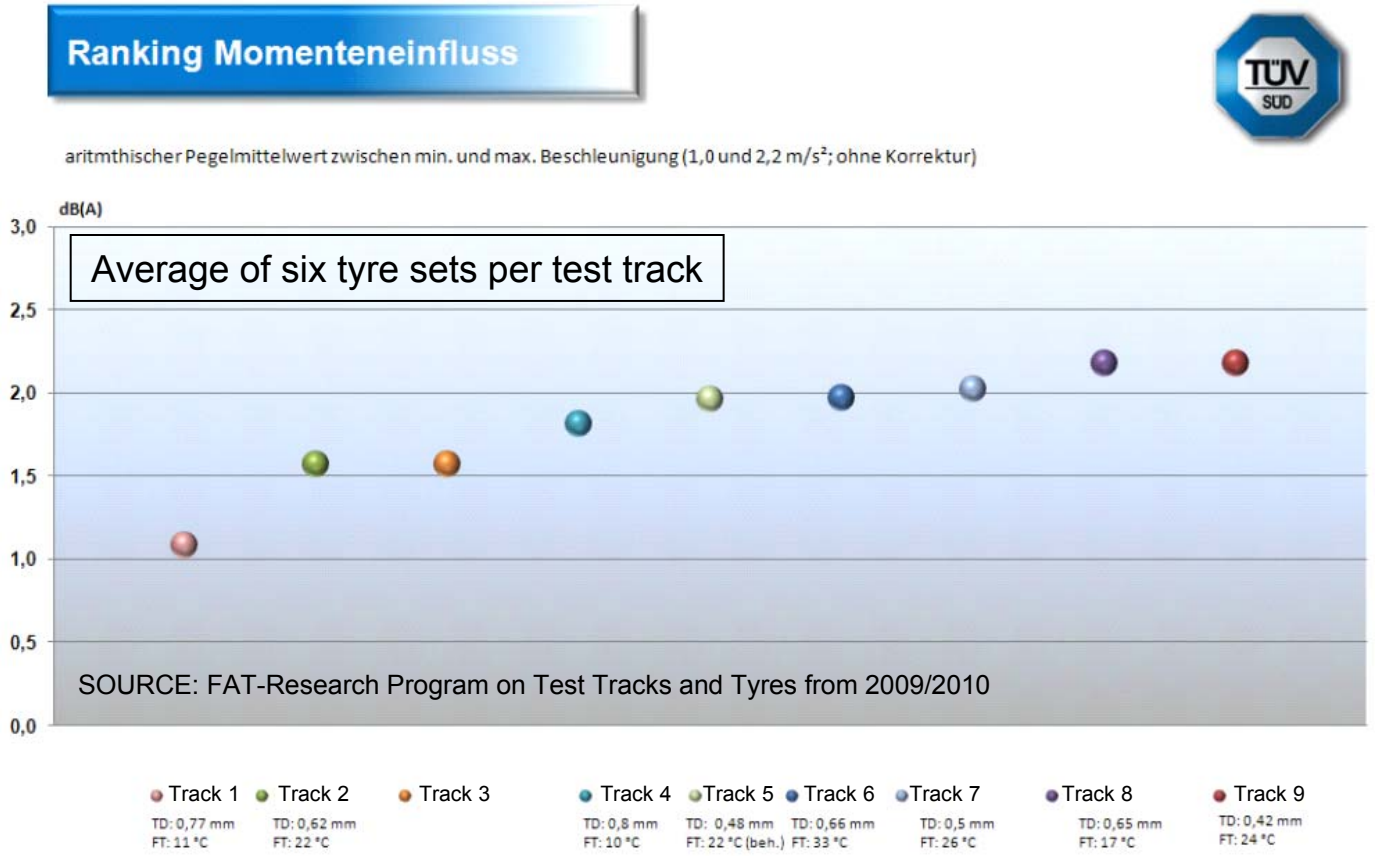
Impact of ECE R117 on Vehicle Type Approval according to Method B of ECE R51

TNO Caluculation Scheme from Appendix E - To Assess the Impact of 661/2009/EC from 11/2013 on

	Actual Status							Prediction 2010						
	L_urb [dB]	L_wot [dB]	L_crs [dB]	L_roll_crs [dB]	L_pt_crs [dB]	L_pt_wot [dB]	kp	L_roll_crs [dB]	L_crs [dB]	Delta [dB]	L_wot [dB]	Delta [dB]	L_urb [dB]	**Delta [dB]**
					Tyre Regulation Effect Estimated by TNO			**-3,8**	dB					Effect on Vehic
M1	**70,0**	70,8	68,1	**66,6**	62,6	68,3	0,29	**62,8**	65,7	-2,4	69,4	-1,4	68,3	**-1,7**
From November 2013 on:					Confirmed impact on tyre population			**-0,8**	dB					Effect on Vehic
M1	**70,0**	70,8	68,1	**66,6**	62,8	68,7	0,29	**65,8**	67,5	-0,6	70,5	-0,3	69,7	**-0,4**
From November 2013 on:					Confirmed impact on tyre population			**-0,8**	dB					Effect on Vehic
M1	**72,0**	73,3	69	**66,6**	65,3	72,3	0,3	**65,8**	68,6	-0,4	73,1	-0,2	71,8	**-0,2**
From November 2013 on:					Confirmed impact on tyre population			**-0,2**	dB					Effect on Vehic
M1	**74,9**	76,3	69,5	**69,0**	59,9	75,4	0,2	**68,8**	69,3	-0,2	76,3	0,0	74,9	**-0,1**

The impact of the tyre regulation ECE R117 with more stringent limit values from Nov. 2013 on has a little impact for normal cars and can be neglected for high performance cars.

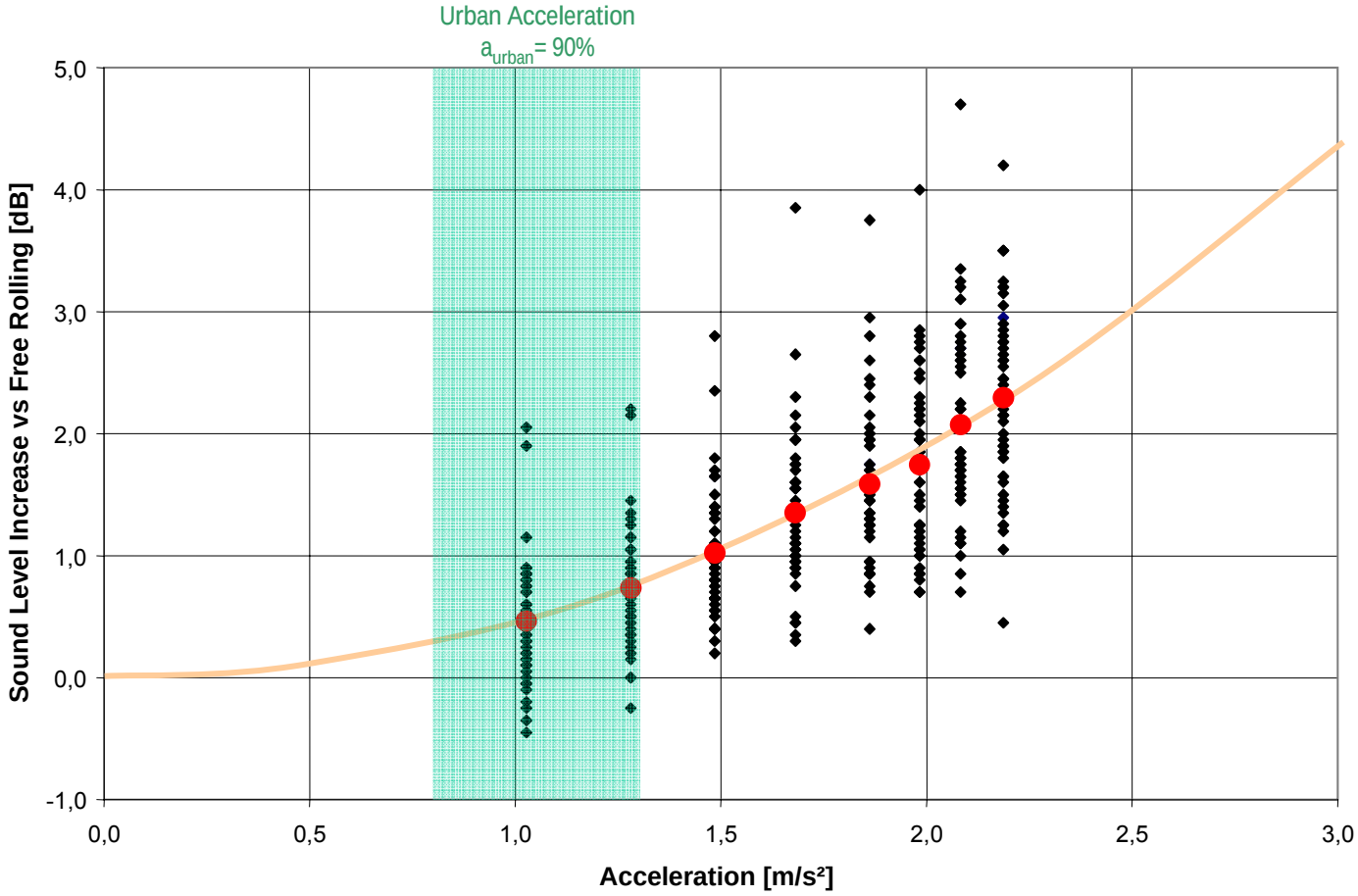
Torque Influence in the Acceleration Range 1.0 m/s²…2.2 m/s²



Sound increase under acceleration condition due to the torque effect on tyres.

The influence is approx. 35% of the overall sound emission of the tyre at a speed of 50 km/h.

Torque Effect - Sound Level Increase as Function of Acceleration



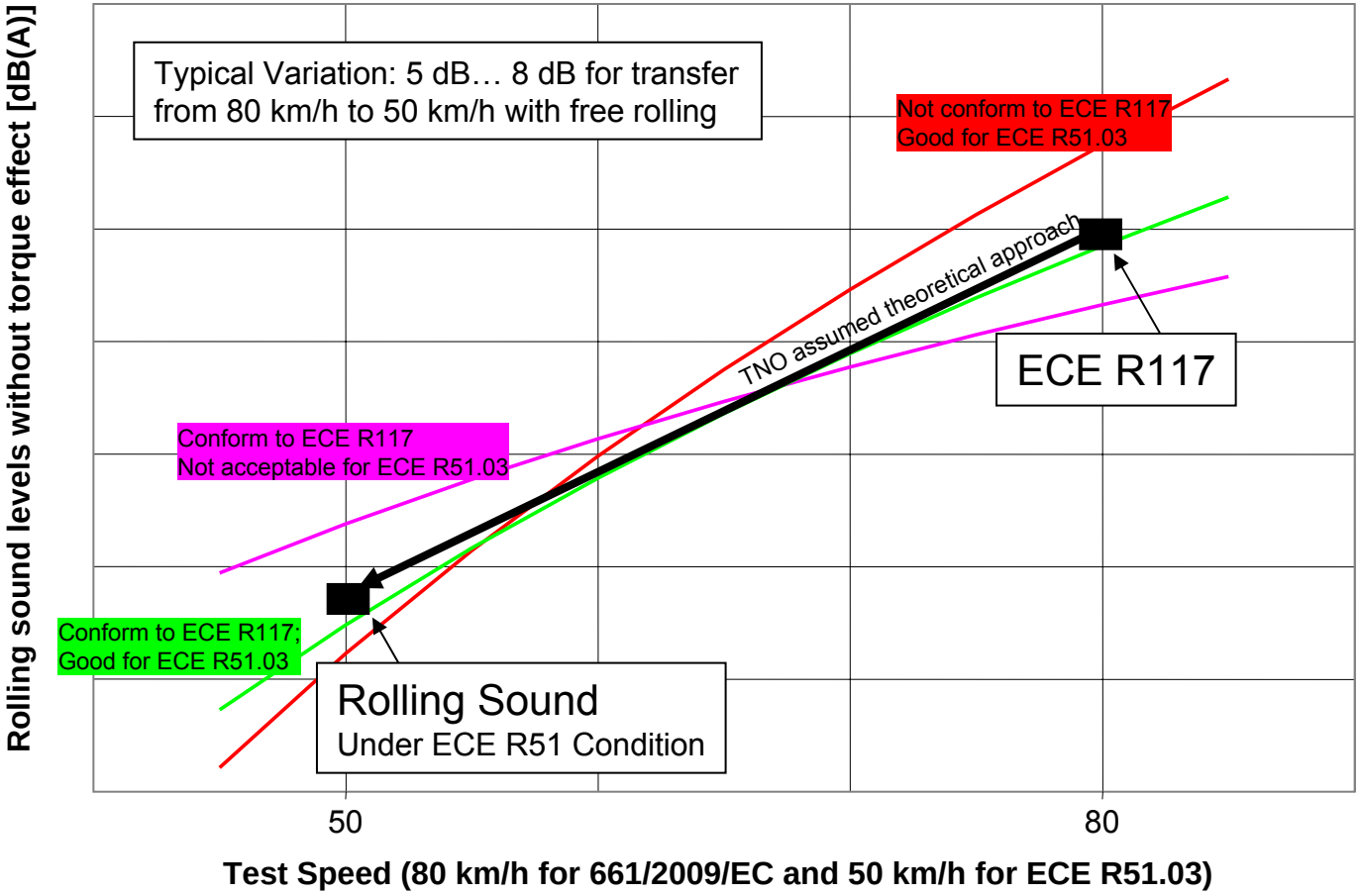
The sound level increase under torque is a function of acceleration, tyre design test track.

Increasing the maximum physical acceleration to 3 m/s² will make the torque effect a highly important noise source in the type approval test.

Tyre manufacturer will be forced to optimize the tyre rolling sound based on a wrong excitation model.

SOURCE: FAT-Research Program on Test Tracks and Tyres from 2009/2010

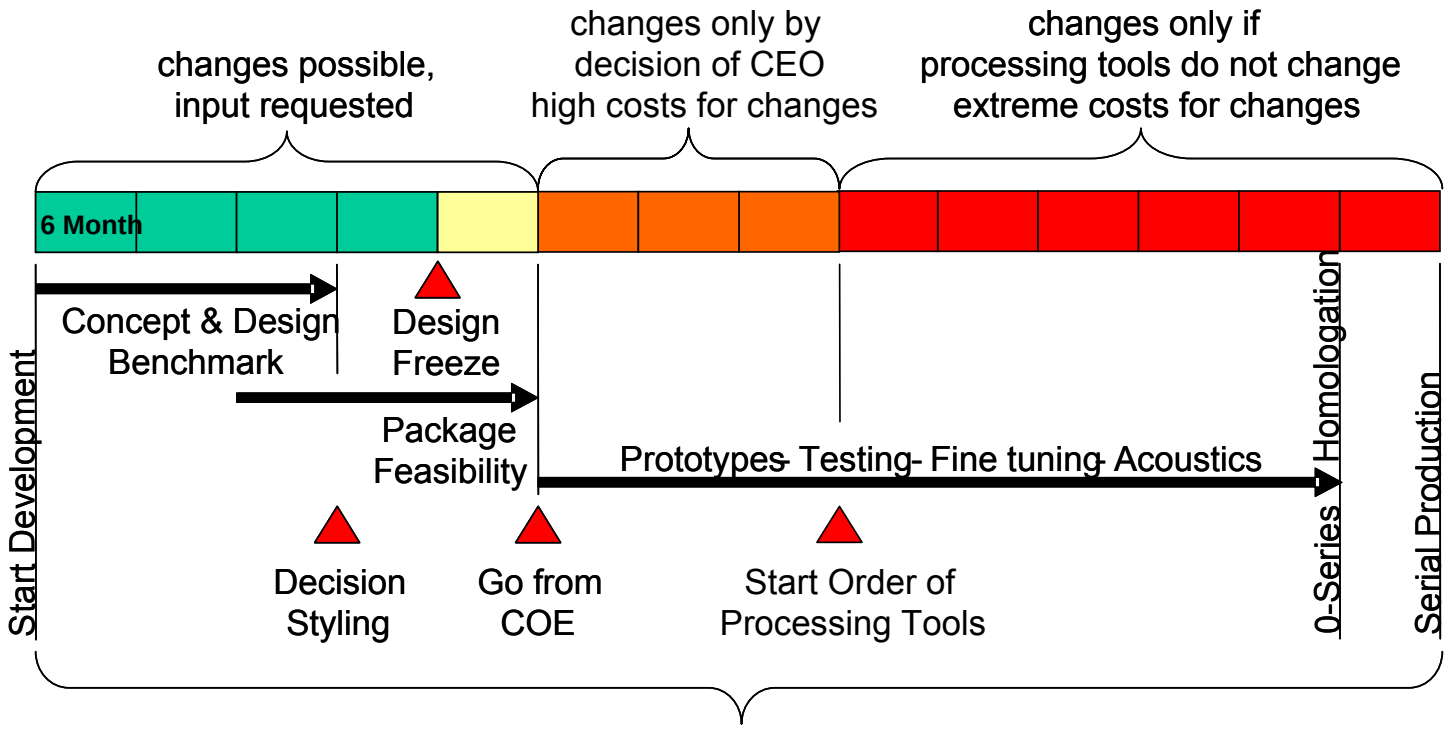
Additional Development Criteria - Slopes of tyres under free rolling



Tyres that fulfill the specifications of ECE R117 will not automatically be suitable for approval under ECE R51.

Thus vehicle OEMs will have to assess available tyres according to ECE R51 and determine whether this tyres are applicable.

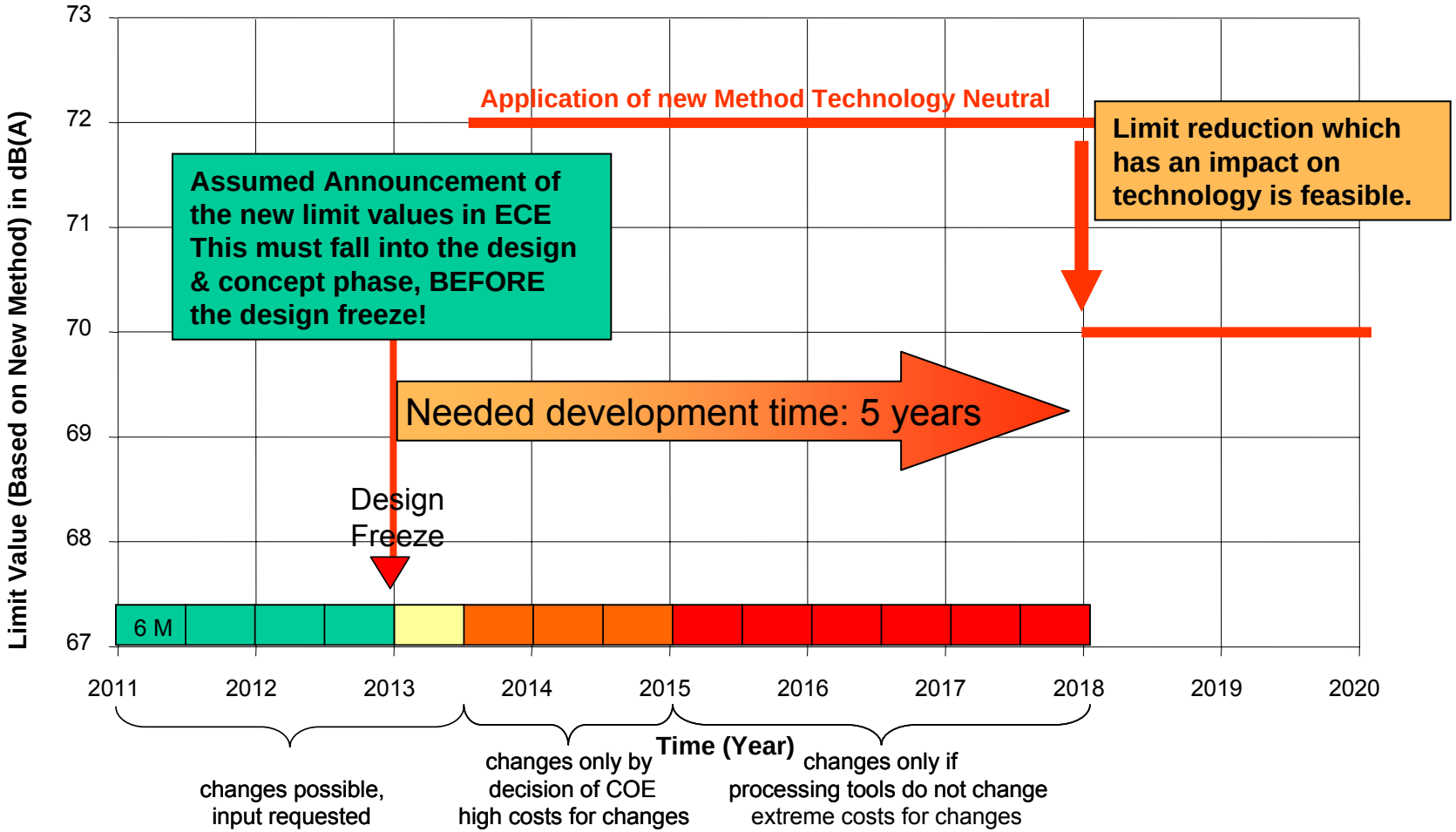
Development Cycles for Vehicles (typically M1/N1)



Total development phase is seven years

If future requirements are known latest five years before serial production they can be included in the concept phase. The requirements can be reached in a cost efficient way.

Compatibility of Regulations and Development Cycles



Conclusions

- **The definition of "Pseudo-Equivalent" sound levels is based on the**
  - combination of revised vehicles sub-classes adapted to the technical progress.
  - analysis of the monitoring data for the revised sub-categories using a 10% cut.
  - The proposed values are:

OICA Position for "Pseudo-Equivalent" Values	M1		M1 G	
	Value [dB(A)]	Criteria PMR	Value [dB(A)]	Criteria
	72	≤125 kW/t	74	incl. Hill Climbing & Wading Depth & Offroad R.E.3
	73	125 ... 150 kW/t		
	75	> 150 kW/t		

N1		N1 G	
Value [dB(A)]	Criteria GVM	Value [dB(A)]	Criteria GVM
72	≤ 2500 kg	74	≤ 2500 kg
74	> 2500 kg	75	> 2500 kg

- **The impact of new limit values for tyre rolling sound after 2013 can be disregarded, because the effect is very little for normal cars and can be neglected for the other M1/N1 sub-classes.**

- **The proposal to increase the acceleration border from 2 m/s² to 3 m/s² is opposed by OICA for its extreme adverse impact specially for the tyre development and because it is a very unrealistic test condition, not in line with the scope of the new test method.**

- **A lead time of at least 5 year for stricter requirements are necessary for the development work. Stricter requirements must recognize the technical feasibility per time and acknowledge the potential impact of emission and safety regulations.**