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www.mplusp.eu

Wolfskamerweg 47 | Vught
PO box 2094
NL-5260 CB Vught
The Netherlands

MEMORANDUM

To Ministry of Infrastructure and the Environment, The Netherlands
Attn. Johan Sliggers

From Erik de Graaff and Gijsjan van Blokland
E-mail erikdegraaff@mp.nl
Telephone 073-6589050
Memo number MIenM.14.02.1/eg
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Pages 10

Subject **Tyre noise limits of EC/661/2009 and ECE R117: Evaluation based on sold tyres in the Netherlands**

1. Introduction

In the EU over 30% of the population is exposed to Lden and Lnight road traffic noise levels above the WHO thresholds (ref [1] and [2]). Figure 1 below shows the dominance of road traffic noise as environmental noise source in the EU27.

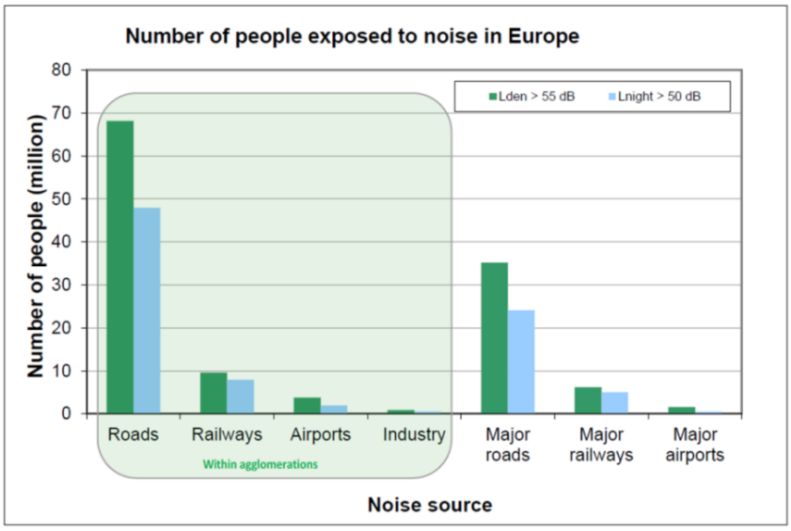

figure 1 Noise exposure of the EU 27 population to traffic noise with Lden>55 dB. Left within agglomerations with more than 250 000 inhabitants, right: along major infrastructures (Ref. EEA [2]).

The main source of road traffic noise is the noise generated by the tyre-to-road surface interaction. The optimal noise reduction potential of tyre/road noise can be achieved by low noise tyres and low noise road surfaces together.

The noise emission of tyres is regulated since 2001 by EU and ECE Regulations. In 2009 a tightening of limit values by about 2 to 5 dB was introduced by EC Regulation 661/2009 and ECE Regulation R117.02. They have come into force by November 2012 for new tyre types and will apply gradually also for existing tyre types starting November 2013 until May 2019.

This paper is the result of a study commissioned by the ministry of Infrastructure and the Environment in The Netherlands. Chapter 2 gives the study objectives and the investigation method. Chapter 3 deals with the used data for the study. Chapter 4 expands on the development of the tyre emission values over time and chapter 5 explores the distribution of the current tyre emission values relative to the present limit values. The final chapter 6 evaluates the present limit values for possible future tightening.

2. Study objectives and method of investigation

The Netherlands Ministry of Infrastructure and the Environment has contracted M+P Consulting Engineers to investigate the following topics:

- To investigate the effect of the present tyre Regulations on the exterior noise levels of tyres
- To compare the tyre noise levels in the present distribution with the limit values defined in the tyre Regulations
- Try to define the levels of present-day-technology and ambitious-technology on base of the distribution of levels found in the present tyre population.

It is the clients objective to support the evaluation of EC/661/2009 and R117.02 and to initiate a debate on a future strengthening of the tyre noise Regulations.

The research topics have been investigated in the following way.

- The effect of the present tyre Regulations is assessed by comparing the shape and the width of the distribution of tyres presently on sale in the Netherlands with a similar distribution from an earlier study in 2007.
- Additionally, the noise values of present day tyre population are compared with the limit values defined in the current regulatory system. From the shape and the width of the distribution relative to the limit value an estimation is made for limit levels of present-day technology and for limit levels of ambitious-technology
- For this study the 50% percentile and the 20% percentile values are used as a definition of the two technological scenario's. This is in line with the approach used in developing limit values in other EU and ECE noise Regulations.

3. Data for the study

The source of data defining the Dutch situation in 2013 for this study is the tyre label information in the VACO tyre database. VACO is the Netherlands tyre branch organization. The data have been extracted per November 2013 (one year after the introduction of the new limits). The data base contains the data from around 60.000 tyres. For the purpose of this study a subset is extracted that emphasized tyres with a high market share. For each tyre category C1, C2 and C3 the most common

manufacturers/brands were identified and within a brand almost all common types in the most common tyre sizes. The resulting subset contained 760 C1 tyres, 172 C2 tyres and 372 C3 tyres.

This set is estimated to cover 90% of the tyres actually sold and thus it is assumed that shifts within this set represents shifts in the total market.

The data from the 2013 selection were compared with the following two sets of 2007 data:

- C1 tyres, data from an ETRTO inventory study [3],
- C2 and C3 tyres, data set consisted of a data set by FEHRL [4] with additional Dutch data [5].

These 2007 data sets were at that time an important source of data for the determination of the noise limits in the 2009 Regulations. Where relevant, the 2007 data set has been normalized with the 2013 data set. For instance the C1 tyres > 245 mm have been removed from the 2007 data set, since they are not available in the 2013 dataset either. The same holds for C2 traction tyres for they are also not present in the database.

4. Development of tyre noise emission between 2007 and 2013

The figures 2 below depict the average value in the 2007 and 2013 data set and the distribution of the 2007 set and the 2013 set over 1 dB noise classes.

The graphs show a positive trend towards lower noise levels. The average noise value of the 2013 data set, compared to the 2007 data set is reduced with 1.6 dB(A) for C1 tyres, with 1.4 dB(A) for C2 tyres and with 1.1 dB(A) for C3 tyres.

The distribution of noise values reflects this positive trend. In case of C1 tyres, it was found that tyres with noise levels >72 dB(A) more or less disappeared from the market. The fraction of tyres with levels around 68 dB(A) have increased considerably. The total distribution has not so much changed in width, but is moved to a lower level. This means that the lowest available noise value has also shifted to a lower level.

For C2 and C3 tyres the shifts in average level can be explained by the disappearance of relatively noisy tyres from the market (C2 around 75 and C3 around 77 dB). The lowest noise values found in the 2007 and the 2013 data set are approximately the same.

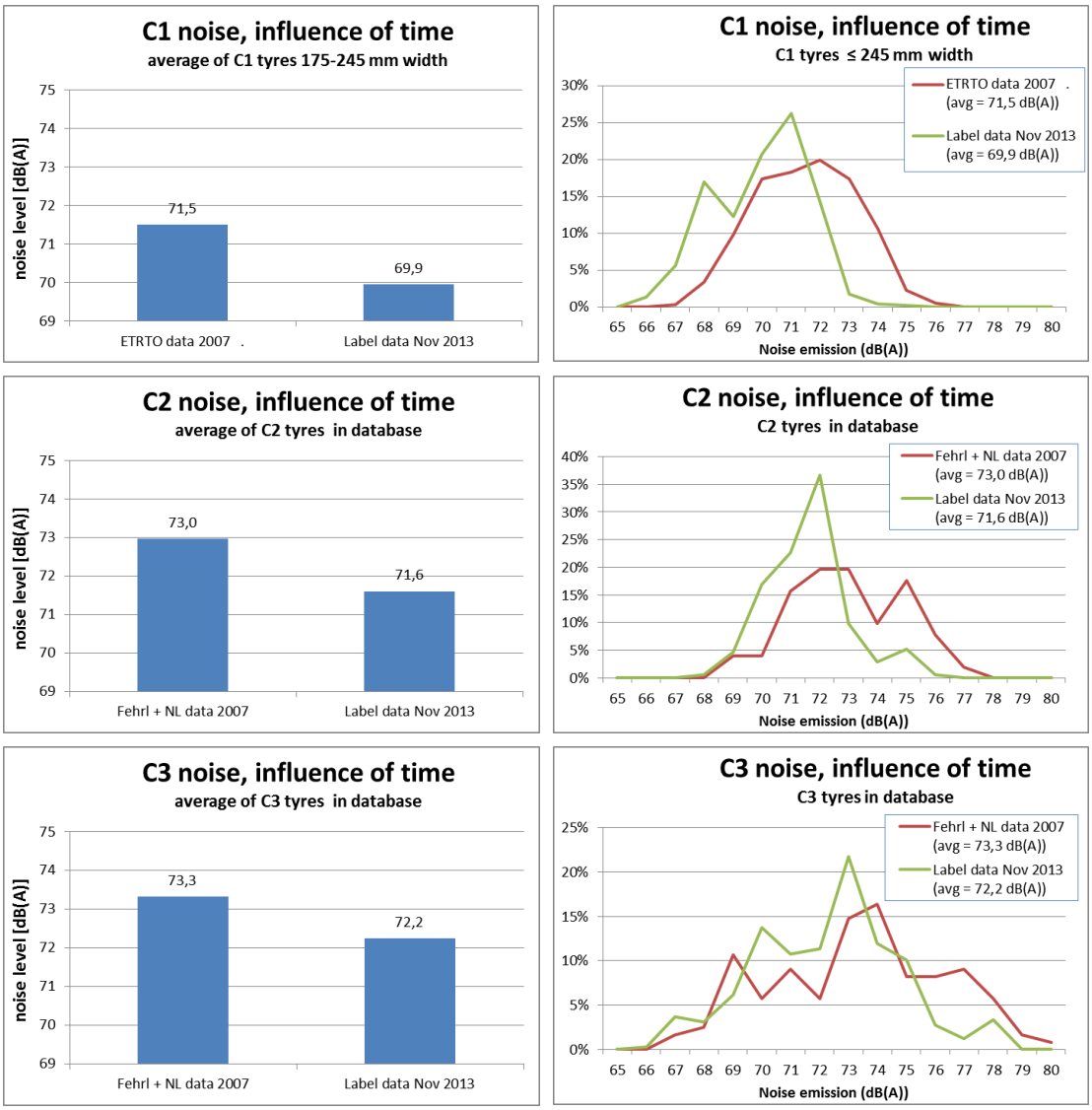

figure 2 Tyre noise data of 2013 compared to data of 2007. The left graphs show the effect on the average values. The right graphs show the distribution over noise classes of 1 dB.

5. Distribution of tyre noise emission values relative to current limit values

A more detailed insight into the developments in tyre noise levels relative to the limit values can be obtained by presenting not the absolute values but the margin to the limit value for that tyre, taking into account width and special characteristics effects.

In figure 3 the 2013 tyre noise values relative to their specific regulatory limit value are presented. In 2013 already about 85% to 95% of the tyres comply with the 2012 limit. The remaining 5 to 15% most probably exists of types that have been type approved before November 2012. Such tyres can legally be sold up to May 2019.

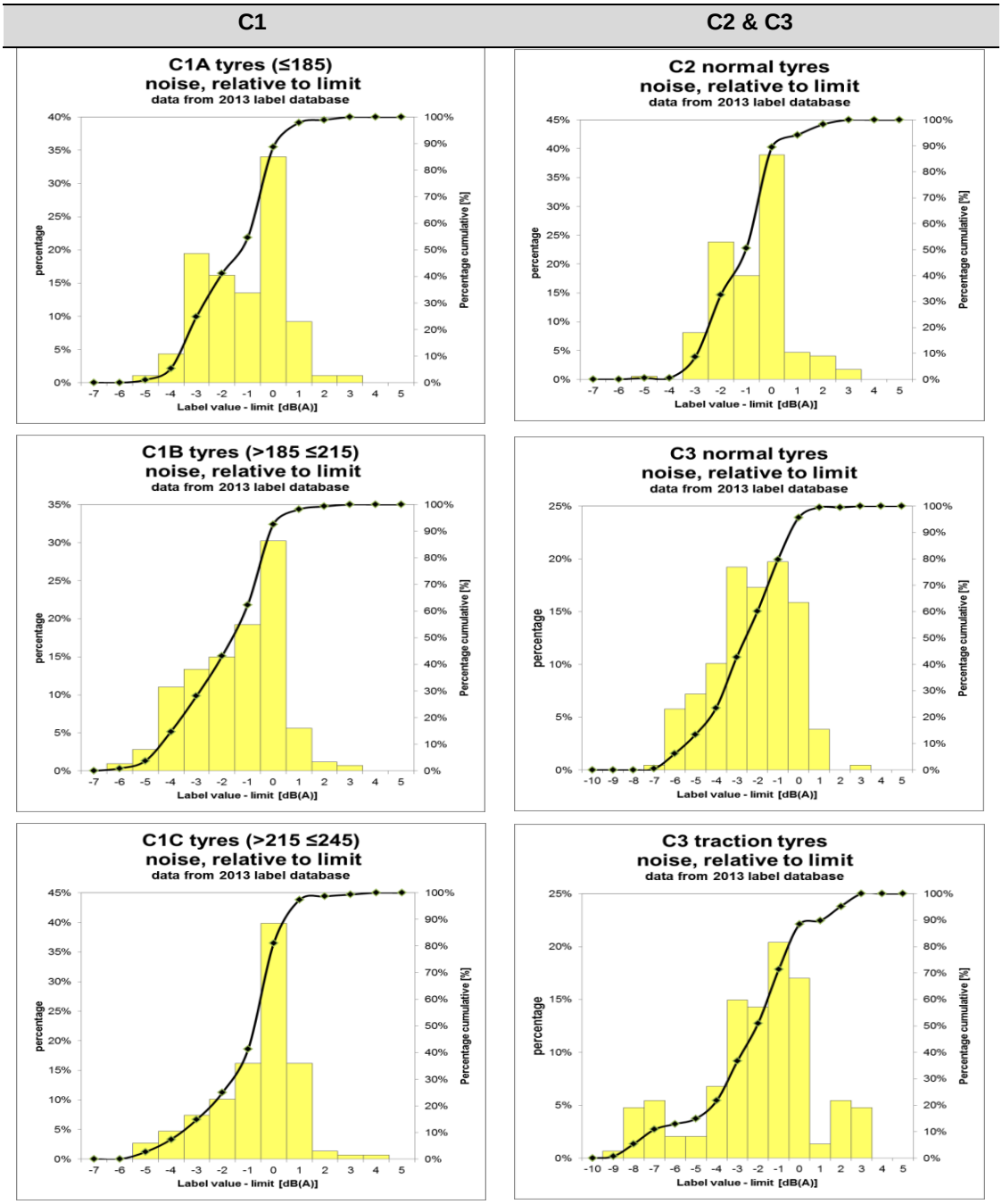

figure 3 Statistical distribution of tyre noise emission values relative to the limit. The limits may consist of the sum of the base limit plus a margin for special properties (snow use etc) if relevant.

The assumed mechanism driving to lower noise tyres can be derived from the shape of the distribution of values relative to the limit value. The 2007 data showed an almost perfect statistical "normal" distribution [5] demonstrating the reduced effectivity of the tyre noise regulatory system at that time.

The 2013 data however show a statistical “skewed” distribution with a small amount of values higher than the limit and a large amount of values close below the limit value. This indicates a process in which tyre types with a noise value that used to be over the limit have either been re-engineered to (just) fulfill the limit or have been replaced by new types.

Table 1 gives some statistical indicators of the distribution of noise values relative to the limit. The “best 50%” value gives the lowest noise value, for which at least 50% of the tyres complies with. The “best in class” value ranges from -5 dB(A) for C2 tyres to -9 dB(A) for C3 traction tyres.

table I *Statistical cutoff values of tyre noise emission values relative to the limit (in dB(A))*

Tyre (sub)class	“best 50%”	“best 20%”	“best 10%”	“best in class”
C1	-1	-3	-4	-6
C2	-1	-2	-3	-5
C3 normal	-2	-4	-5	-7
C3 traction	-2	-4	-7	-9

Additionally the effect of specific characteristics of tyres (snow tyres, extra load tyres etc.) on the reported noise levels have been investigated. From the data set of 2013 the tyres with such specific characteristics have been compared with similar non-specific tyres. In figure 4 the data that have been found in the 2013 database are related to the correction values implemented in the regulatory system.

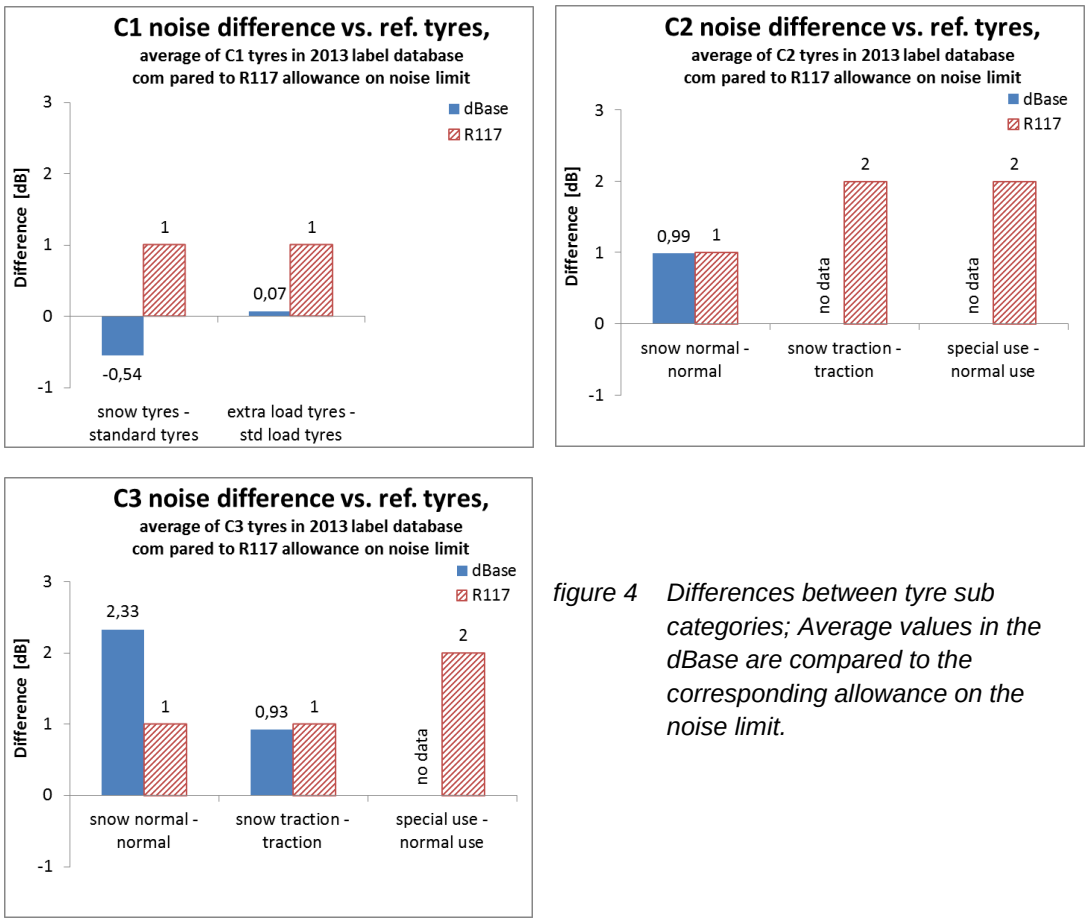

figure 4 *Differences between tyre sub categories; Average values in the dBase are compared to the corresponding allowance on the noise limit.*

For C1 tyres the +1 dB correction for snow tyres and extra load tyres overestimates the actual effect of such specific characteristics observed in the 2013 data set. Snow tyres were found to exhibit about 0.5 dB lower values compared to standard tyres. Extra load tyres have an almost equal level compared to standard load tyres.

For C2 tyres the +1 dB correction for snow tyres is well in line with the data in the database. For special use tyres there is a lack of relevant data entry fields in the database. C2 traction tyres are not available in the database, as already mentioned.

For C3 tyres the +1 dB correction for snow-normal tyres underestimates the actual effect of such characteristic. The observed difference between snow-normal tyres and “normal” types of the same size is 2.3 dB. The 1 dB correction for C3 snow-traction tyres is well in line with the data.

For special use tyres there is no information available due to a lacking data entry field in the database.

6. Evaluation of tyre noise levels relative to the limits

From the statistical evaluation, comparing the status of November 2013 with 2007 data, it can be seen that the 2012 tightening of limits has had a significant impact on the tyre population. On average the noise emission levels have been reduced by 1.6 dB in case of C1, by 1.4 dB in case of C2 and by 1.1 dB in case of C3.

The regulatory correction of +1 dB or +2 dB for the limit of snow tyres could not always be confirmed by the data of this dataset. In case of C1 tyres the actual found difference between snow tyres and standard tyres appeared to be -0.5 dB rather than +1 dB. For C3 normal tyres the actual found effect appeared to be +2.3 dB rather than +1 dB. For C2 normal tyres and C3 traction tyres the +1 dB in the regulation is well in line with the differences found in the dataset. The +1 dB regulatory correction for C1 extra load tyres could not be supported by the dataset either, as the latter shows a difference close to 0 dB.

From the distribution of noise levels it can be derived that for C2 and C3 categories the most noisy types have been removed and mainly replaced by tyres just fulfilling the limit. For C1 tyres the whole population seems to have been shifted; not only the most noisy types have been removed but also the amount of most silent tyres has been significantly increased. Already in 2013 around 90% of the tyres on the market fulfill the 2012 limit.

Since 90% of the tyres sold in the Netherlands fulfil the 2012 limits it would be interesting to see what the threshold values could be in the near future. Therefore, it is calculated what emission value the best 50% tyres and the best 20% tyres have at the moment (see table II).

table II *Present tyre noise limits and calculated tyre noise emission values based on the "Best 20%" and the "Best 50% " values as given in table I.*

		Current EU and ECE Regulations	Current best 50% tyres in the NLs	Current best 20% tyres in the NLs
Tyre class	specification	Limits and correction values (dB(A))	Noise emission and correction values(dB(A))	Noise emission and correction values (dB(A))
C1	C1A ≤ 185	70	69	67
	C1B >185 ≤ 215	71	70	68
	C1C >215 ≤ 245	71	70	68
	C1D >245 ≤ 275	72	no data	no data
	C1E >275	74	no data	no data
	Snow/XL/snow XL tyres	+1	0	0
C2	Normal tyres	72	71	70
	Traction tyres	73	no data	no data
	Snow normal tyres	+1	+1	+1
	Snow traction tyres	+2	no data	no data
	Special tyres	+2	no data	no data
C3	Normal tyres	73	71	69
	Traction tyres	75	73	71
	Snow tyres	+1	+2	+2
	Snow traction tyres	+1	+1	+1
	Special tyres	+2	no data	no data

According to various studies, millions of Europeans will profit from less noise from more quiet tyres. TNO [6] concludes that a gradually shift to more quiet tyres would result in significant benefits to society at negligible costs. The "Best 20%" values as presented in the third column of table II would be ambitious for 2020 limits. Discussion for future tyre noise limits should of course be supported by more extensive impact analysis and take into account safety and sustainability issues. It is up to the EU and ECE to perform such analyses and coordinate discussions to tighten the tyre noise limits in their Regulations.

7. References

[1] European Environmental Agency; “The European environment – state and outlook 2010”; http://www.eea.europa.eu/soer

[2] http://www.eea.europa.eu/data-and-maps/figures/estimated-percentage-of-population-exposed-to-different-road-trafic-noise-levels

[3] ETRTO, “European Tyre Industry Contribution to Revision of Directive 2001/43”; January 2007

[4] FEHRL, Study SI2.408210 “tyre/road noise”, 2006

[5] E. de Graaff, GJ. van Blokland; “Exterior noise, grip and rolling resistance levels of C1, C2 and C3 tyres in relation to the tyre noise directive (EU directive 2001/43/EC) and consumer interests.” Internoise 2007

[6] S. van Zyl ea.; “Potential benefits of Triple-A tyres in the Netherlands”; TNO report 2014 R10735; June 2014