The 21st International Congress on Sound and Vibration

13-17 July, 2014, Beijing/China

HOW EFFICIENT IS NOISE LABELING OF TIRES?

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Since 2012 all new tires in Europe must be labeled. The label contains general information about tire performance concerning rolling resistance (that corresponds to fuel economy), noise emission and wet grip (only for passenger car tires). Measurements of noise performance of tires must be performed according to the Annex 3 of the Regulation No 117 of the Economic Commission for Europe of the United Nations. The regulation specifies pass-by method of tire/road noise measurements with vehicle tires rolling on the reference surface built according to the standard ISO 10844. The paper presents results of tire/road noise measurements performed at the Technical University of Gdansk for tires with different noise labels and discusses correlation between data stated in the labels and measured noise levels. The measurements were performed by CPX and drum method on different road surfaces or on replica road surfaces. ISO specified surface is not very typical for European road network so ranking of tires obtained on this surface may or may not be representative for real life applications.

1. Introduction

For many years certain industrial products have been marked with labels informing about their impact on the environment. Typically, this information allows to determine the energy efficiency of equipment (refrigerators, dishwashers), consumption of water (dishwashers), etc. EC Regulation 1222/2009 introduces mandatory labelling of tires with special stickers containing simplified, easy to understand information linked to the environmental impact and operational safety of the vehicle.

According to the Regulation of the European Parliament (No. 661/2009) tires are divided into classes C1, C2 and C3 for which there are different demands related to the labels. With some simplification one can say that the class C1 refers to car tires, class C2 to van tires and class C3 to trucks and buses. EC Regulation 1222/2009 requires that tire labels contain indicators evaluating tires in terms of rolling resistance, wet grip and external noise (that is noise emitted into the environment, and not to the cab of the vehicle). Each tire class has specific values of the reference parameters.

In terms of rolling resistance (energy efficiency) the label is based on the rolling resistance coefficient (RRC) expressed in kg/t (this is misleading as proper unit should be [N/kN]). Certain coefficient ranges are assigned to the energy efficiency classes indicated by the letters **A** - **G**. The ranges are different for tires class C1, C2 and C3. The letter **A** corresponds to the lowest rolling resistance and the letter **G** to the highest rolling resistance. For example passenger car tires (C1) with coefficient of rolling resistance ranging from 7.8 to 9.0 kg/t are assigned to class **C**.

Tire wet grip (compulsory only for class C1 tires) is classified according to a special procedure described in the Regulation UN/ECE No 117 and, like the rolling resistance coefficient is labelled with letters from **A** to **G**. The letter **A** indicates the best grip. One must observe that all label associated tests are carried out for new tires and that worn or partly worn tires may have less grip.

Tire/road noise emitted by tires of class C1, C2 and C3 is shown in a different way than energy efficiency and traction. Instead of letter marked classes, actual noise level "***N***" is expressed in decibels together with a pictogram symbolically showing whether the tire is quiet, loud, or "average". Classification into one of the three groups of noise is performed by comparing the noise of the tire with a threshold value (***LV***) .

A sample label for passenger car tire is shown in Fig. 1. In the upper left corner one can find its energy classification (Class A), corresponding to coefficient of rolling resistance in the range below 6.5 kg/t. In the upper right corner there is the wet grip classification (Class A), corresponding to the wet grip index $G \geq 1.55$. At the bottom of the label the information about tire/road noise (72 dB) and a pictogram indicating "average" noise performance of this tire are presented.

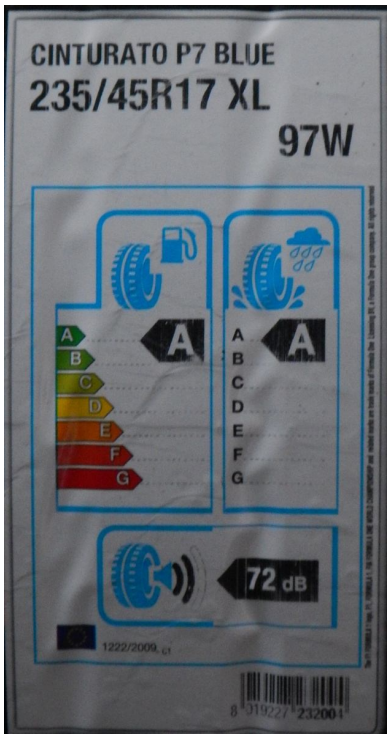

Figure 1. Label for passenger car tire.

It is common knowledge that tire/road noise is very much dependent on properties of road surfaces, most notably texture and open voids contents[1]. Road surface used for noise testing of tires according to present regulations is described in ISO 10844:1994. The surface was designed in such a way that it is very "quiet" to facilitate measurements of engine and power train noise but at the same time it is not representative for traffic. So called "ISO" surface was designed to combine a smooth megatexture and smooth texture at the wavelengths range 15-50 mm, with a relatively rough texture at wavelengths equal to or smaller than 10 mm. Mentioned above properties help to avoid texture impact noise emission and at the same time to reduce aerodynamic noise emission like for example air pumping. Unfortunately, standard issued in 1994 allowed for considerable variations in test surface properties that could lead to 5 dB differences in measured noise levels[2].

A tire rolling on very smooth road surface may emit very different noise than the same tire rolling on rough or medium rough road surface. Also tire ranking on very smooth surface is usually

different than tire ranking on more common road surfaces like SMA8 or Dense Asphalt Concrete with 12 mm chippings.

2. Test tires and test road surfaces

Test tires used for experiments reported in this paper are described in Table 1. The tires were tested on two roadwheel facilities (the one with the drum of 1.7 m diameter is presented in Fig. 2) of the Technical University of Gdańsk (TUG) and on the road with test trailer Tiresonic Mk. 4 shown in Fig. 3. Trailer measurements were carried out according to ISO/DIS 11819-2.

Table 1. Test tires.

Manufacturer	Model	Size	Rubber hardness [Sh]	Labels		
				Rolling resistance	Wet grip	Noise
Michelin	Primacy HP	225/60R16	68	E	B	70
Wanli	S-1200	195/60R15	70	E	E	73
Continental	Contiecocontact	195/60R15	69	B	B	71
Michelin	Promacy HP	225/60R16	70	E	B	70
Vredestein	Wintrac Extreme	205/55R16 M+S	75	E	C	69
Vredestein	Quatrac 3	195/50R15 M+S	69	E	C	68
Yokohama	W-drive M+S	195/50R15 M+S	67	F	A	74
AVON	ZV5	195/65R15	68	C	C	71
Goodyear	Efficient Grip Performance	195/65R15	73	B	A	69
Bridgestone	Ecopia EP001S	195/65R15	60	A	A	69
Dunlop	Sport Blue Response	195/65R15	70	B	A	68
Michelin	Energy Saver + EV Green	195/55R16	68	A	A	70

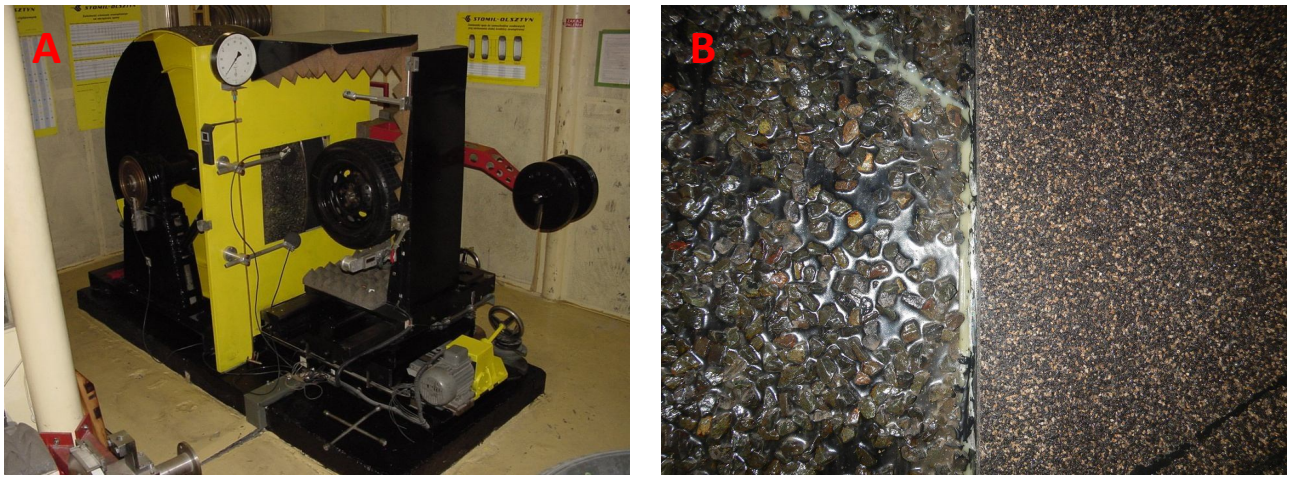

Figure 2. TUG's roadwheel facility with 1.7 m drum covered by replica of coarse surface dressing (A) and poroelastic road surface PERS-HET (B).

Figure 3. Test trailer Tiresonic Mk. 4 designed and manufactured by TUG.

During laboratory tests two replica road surfaces and one experimental road surface were used. The replicas were designated "*GRB-S*" (replica of dense asphaltic concrete with 12 mm aggregate) and "*APS-4*" (replica of very coarse surface dressing with 12 mm aggregate). Experimental road surface was of poroelastic type[3,4] and it was designated "*PERS*". Road tests were carried on SMA-8 (Stone Mastic Asphalt with 8 mm max. aggregate size).

3. Results of drum measurements

Results of laboratory measurements for test speed 80 km/h are presented in Fig. 4. Red bars correspond to the noise values presented on the labels, while other bars show A-weighted Sound Pressure Levels obtained on coarse surface APS-4, dense asphalt concrete GRB-S and very smooth poroelastic road surface PERS. It is clearly visible (Fig. 5) that there is no correlation between noise information from tire labels and results of noise measurements on the roadway facilities. Systematic differences of about 30 dB between values reported on the labels and results of laboratory measurements are caused by the test methods particularities (close proximity of microphone in case of drum measurements and 7.5 m distance in case of pass-by method). Fig. 5 indicates that present label system is not a representative one.

4. Results of road measurements

Tire/road noise measurements were performed also by the CPX method on the road connecting Gdańsk to the Walesa airport. Number of tested tires was limited to 9 pieces due to time restrictions. Results are presented in Fig. 6. Noise levels measured on the road are not correlated to the noise values specified on tire labels (see Fig. 7) both for speed 50 km/h and 80 km/h. Differences between absolute levels are not important, as they are caused by different distances from the

tire(s) to the microphone. Ranking of the tires is however very meaningful and very different for labels and measurements. One must note, that while replica road surfaces on the roadwheel facility may be considered to be somewhat "special", the road surface SMA8 is very typical for road network in Europe.

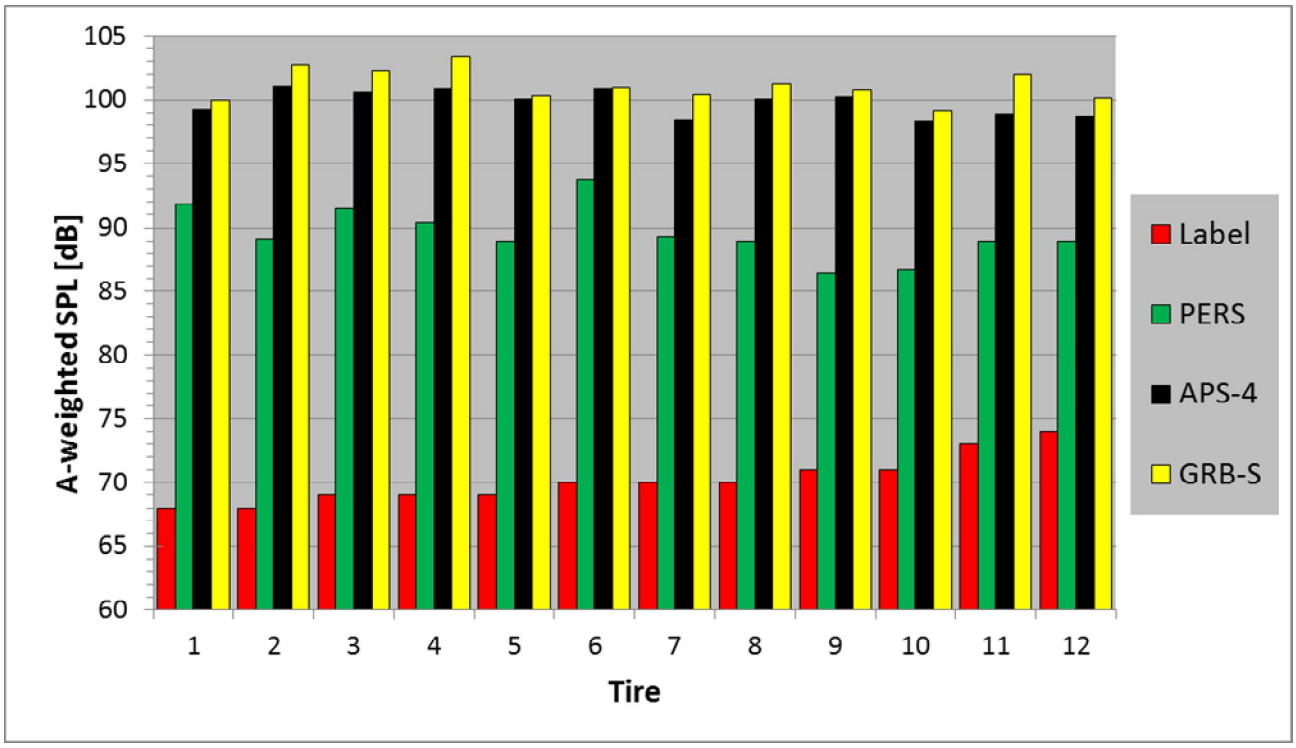

Figure 4. Results of laboratory measurements.

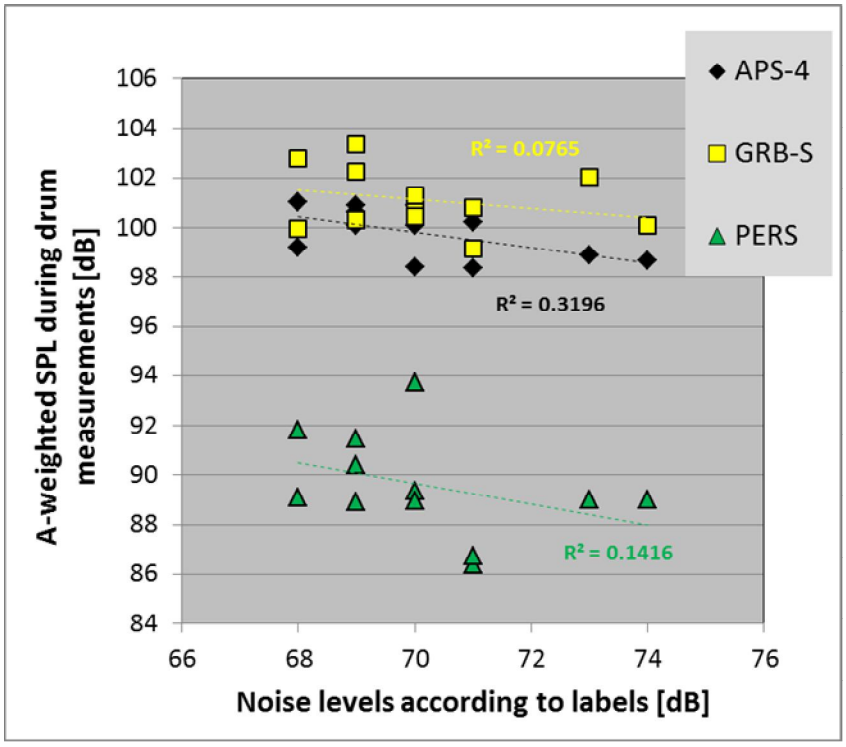

Figure 5. Correlation between noise levels from tire labels and results of laboratory measurements.

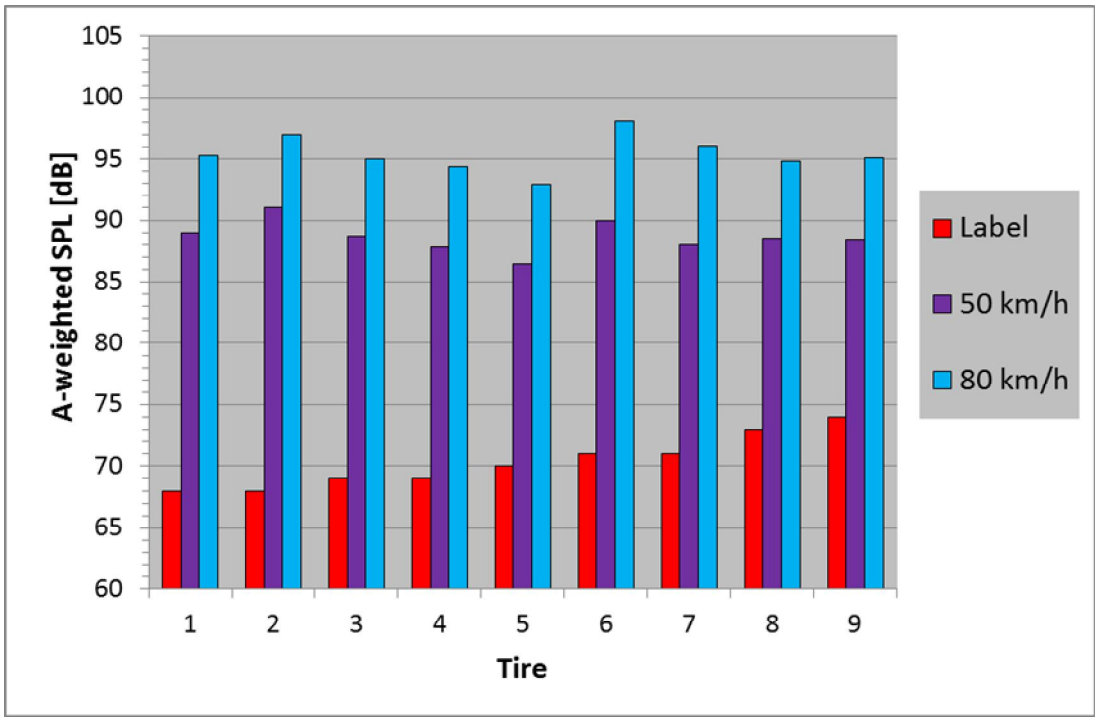

Figure 6. Results of CPX measurements.

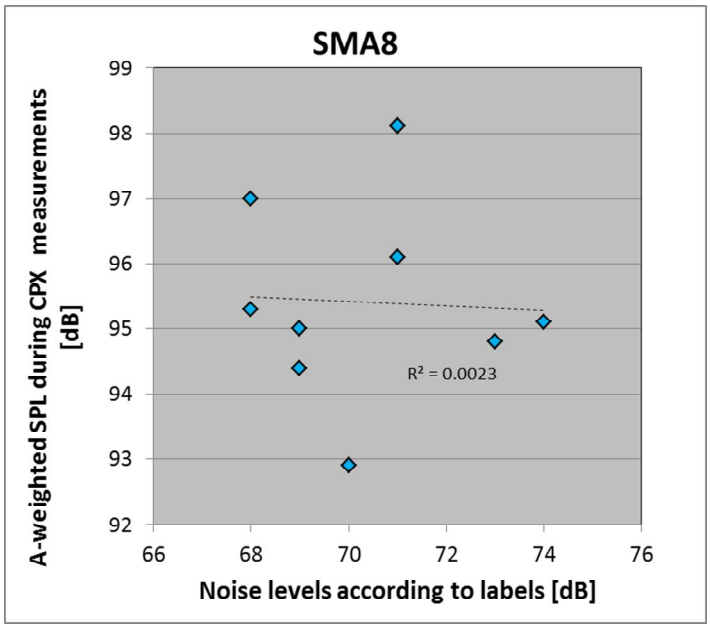

Figure 7. Correlation between noise levels from tire labels and results of CPX measurements.

5. Conclusions

Comparison of noise data shown on tire labels and results of measurements performed both by laboratory and CPX methods show that there is no correlation between those values. What follows, a tire that is advertised as very quiet, may not be quiet at all (for example tire designated "*2*" on Fig. 4 and Fig. 6). Probably one reason is that during labelling tests tires roll on reference surface

that is not representative for existing road network. There may also be other reasons related to the procedures of selection of tires for testing by the manufacturers. According to the authors, it is necessary to revise the method of tire noise labelling. One of the obvious change would be to test tires on a different reference surface, for example on SMA8 or SMA12, that is very common nowadays.

6. Acknowledgements

This paper was prepared within the Polish-Norwegian project LEO sponsored by NCBiR, Poland and the 7th Framework Programme "PERSUADE".

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