



## Analysis of sound level emitted by vehicle regarding age



S. Sancho<sup>a,\*</sup>, E. Gaja<sup>a</sup>, R. Peral-Orts<sup>b</sup>, G. Clemente<sup>c</sup>, J. Sanz<sup>c</sup>, E. Velasco-Sánchez<sup>b</sup>

<sup>a</sup>Acoustical Engineering Laboratory, E.T.S.I. Industriales, Technical University of Valencia, Spain

<sup>b</sup>Department of Mechanical Engineering, Miguel Hernandez University of Elche, Spain

<sup>c</sup>Dept. of Applied Statistics and Operational Research, and Quality, Technical University of Valencia, Spain

### ARTICLE INFO

#### Article history:

Received 10 March 2016

Received in revised form 8 May 2017

Accepted 15 May 2017

Available online 1 June 2017

#### Keywords:

Traffic noise

Mechanical wear

Noise maps

Technical inspection of vehicles

### ABSTRACT

Traditionally, road traffic has been considered the main noise source in urban and interurban areas. As a consequence, governments have developed some new regulations to assess and control these constantly growing noise sources [1]. At the same time, numerous research groups have analysed and studied the main characteristics of new models of vehicles as a noise source and how technological improvements can reduce the overall levels emitted by road traffic, considered as a linear source. However, the sound effect of mechanical wear of vehicles has not been deeply studied, neither analysed.

This paper aims to analyse the evolution of noise emissions of different vehicle types over time, based on the results of real technical inspections of vehicles.

Since August 2004, the Technical Inspection of Vehicles Centres (ITVs) located in the Valencian Region have been recording the noise emissions levels of millions of vehicles in static tests, in accordance with Decree 19/2004 [2] passed by the *Consell de la Generalitat* (Regional Council). This extensive data logging provides a great opportunity to evaluate sound characteristics of the vehicles of this region over the last 7 years. Therefore, in this paper, sound trend of different types of vehicles depending on the passing of the years is analysed. The purpose of this study is to determine the evolution of the sound level of vehicles over time and the influence on traffic noise prediction models used to develop noise maps.

© 2017 Elsevier Ltd. All rights reserved.

### 1. Introduction

The majority of studies on environmental acoustics and municipal sound maps point to the road traffic as the main noise source in urban and interurban environments. This clear localization of sound focus has resulted in a large number of studies and research work aiming at characterizing, analysing, testing and modelling the road traffic as a noise source [3–5]. Different authors have made progress in this sense while standards and European legislation establishes guidelines for standardizing the test methodologies needed to establish the noise performance of vehicles which are brought into the European area.

Efforts to assess noise emissions from road vehicles should not only rely on design and manufacturing phases. Over time, due to the use and improper vehicle maintenance, the initial sound emission levels can change. For this purpose, since August 2004, Decree 19/2004 of the Valencian Council, partially amended by Decree 43/2008, established the need for testing sound assessment of

motor vehicles registered in any municipal district in Valencia, at the same time vehicles were subjected to their regular, mandatory technical inspections.

This document determines the evolution of the loudness of different vehicles in the fleet according to age and improved technology by a quieter vehicles production.

On the other hand, at State level, the Royal Decree 711/2006 [6] was published, 5th revision of June 2006 Procedural Inspection Stations ITV Manual being subsequently reviewed in a 6th edition in January 2009 Procedural inspection of the ITV stations Manual. Both documents represent a common starting point for the entire national territory, including, the mandatory noise inspection emitted by 2 wheel motorcycles and mopeds.

As a result of this, today's Valencian ITV stations have a vast amount of information on techniques and sound conditions of vehicles currently in operation. This information has allowed relating the noise emission of different vehicle types to their age.

Article 4 of the legislation provides that the level of noise emitted by ICE vehicles is acceptable as long as it does not exceed the limit value of noise emission level (compiled at the technical car of the tested vehicle). This limit is obtained by adding 4 dBA to the noise emission level set in the homologation process of the vehicle for static or stationary testing [2], see Eq. (1),

\* Corresponding author.

E-mail addresses: [ssancho@fis.upv.es](mailto:ssancho@fis.upv.es) (S. Sancho), [egaja@fis.upv.es](mailto:egaja@fis.upv.es) (E. Gaja), [ramon.peral@umh.es](mailto:ramon.peral@umh.es) (R. Peral-Orts), [gclemente@eio.upv.es](mailto:gclemente@eio.upv.es) (G. Clemente), [jsanz@eio.upv.es](mailto:jsanz@eio.upv.es) (J. Sanz), [emilio.velasco@umh.es](mailto:emilio.velasco@umh.es) (E. Velasco-Sánchez).

$$L_{A,lim,inspeccion} = L_{A,homolog} + 4 \text{ dBA} \tag{1}$$

where:

$L_{A,lim,inspección}$ , is the limit value of sound emissions during technical inspection (ITV) expressed in dBA.

$L_{homolog}$ , is the sound level established in the vehicle homologation logbook for static tests.

The test procedure to determine the level of noise emitted by vehicles is based on testing of stationary vehicles [7], in accordance with Community Directives 81/334/EEC, 84/372/EEC and 84/424/EEC, adapted by Royal Decree 2028/1986, of June 6th (BOE 236, of October 2, 1986), for automobiles; Directive 1997/24 / EC of the European Parliament and of the Council of 17th June on certain components and characteristics of two or three-wheel motor vehicles, and Directive 2002/24/EC of the European Parliament and of the Council of 18th March on the approval of motor vehicles with two or three wheels.

During the years, sound tests have been conducted, a total of 6 million vehicles in different categories have passed through the ITV stations. Table 1 shows the number of vehicles that have passed inspection every year since 2007, as well as the mean value of the Sound Pressure Level ( $L_p$ ) tested during the whole year. The date of 2007 was considered as the starting point for the database, because the previous years, 2005 and 2006, had some shortcomings.

## 2. Methodology

Prior to using the data provided by AECOVA-ITV (Asociación de Entidades Concesionarias de la Comunidad Valenciana para ITVs), an exploratory analysis of the data is done consisting of descriptive evidence to prove the existence of a small number of vehicles older than 50 years, but which have unique characteristics regarding noise measurements that could affect the behavioural patterns of today’s vehicles. Therefore, it was decided to only consider vehicles under thirty years old in the study, more specifically those that were registered after 1980.

**Table 1**  
Amount of vehicles tested per year.

Year of inspection	Sound pressure level, dBA	Number of tested vehicles
2007	83.64	1,034,479
2008	83.32	1,078,506
2009	83.09	1,250,777
2010	82.76	1,230,901
2011	82.51	1,330,821
Total	83.03	5,925,484

Since the purpose of this study is the influence of the vehicle noise emissions in urban traffic conditions, as a reference the following types of vehicles have been analysed from the entire fleet.

- Entire fleet. In this section, all vehicles tested in ITV stations from 2007 to 2011 were included.
- Motorcycles. Two- or three-wheeled motor vehicle of all capacities.
- Light vehicles. Cars and others self-powered motor vehicle used for passenger transportation and with no more than 9 passenger capacity.
- Buses. Passenger vehicles with more than 9 passenger capacity.
- Trucks. Commercial carrier vehicle with an independent cabin uses for cargo transportation.
- Others (including crossovers, vans and any other tested vehicle not included on the other categories)

Fig. 1 shows the age of vehicles subjected to the noise emissions test. Bear in mind that light vehicles, the most numerous type of vehicles tested, are required to pass inspection after 4 years from new.

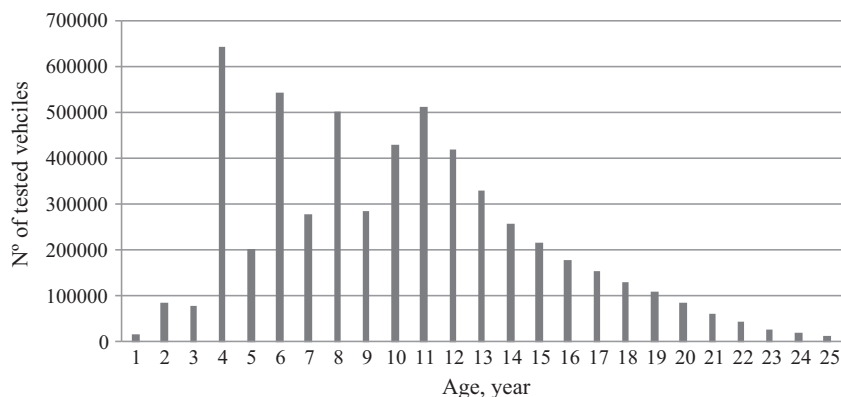
According to these data, the average age of vehicles that have passed inspection in the last five years is 10.1 years, see Fig. 1. The age was obtained with the difference between the tested year and the register year of the vehicles.

During those years, the distribution by types of vehicles is shown in Fig. 2, where light vehicles are particularly predominant.

The study and forecasts are made using linear regression models, selecting the previous comparison with alternative dimensional models using the sums of squares explained by each model. In each case, the fits obtained are expressed by the linear model coefficients and the corresponding correlation coefficients between variables are adjusted, meaning statistical relationships between the Sound Pressure Level and the age of tested vehicles. Remember that the coefficient of the independent variable of the model obtained is the average noise increase per year elapsed.

For a graphical representation of each model that is easy to interpret, adjustments to the values of the mean and median of the measured noise of vehicles registered in the same year versus age of those same vehicles are made. The values obtained with these settings are in all cases consistent with those obtained by making the setting with individualized data for each vehicle but in the case of the means, are easier to interpret graphically.

Next, and in order to check the possible effects of technological improvements by engines and silencers on vehicle noise pollution, an average noise adjustment of baseline vehicles registered in the same year against the year of registration is carried out, also for vehicles registered since 1980. In this study, only the register years



**Fig. 1.** Distribution of the number of analysed vehicles according to testing age.

Download English Version:

<https://daneshyari.com/en/article/5010812>

Download Persian Version:

<https://daneshyari.com/article/5010812>

[Daneshyari.com](https://daneshyari.com)