



## Mathematical Analysis of Noise in multi-plant Industries of tyre and the need to reduce Noise

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### Abstract

Industrial noise is often a term used in relation to environmental health and safety, rather than nuisance, as sustained exposure can cause permanent hearing damage. The problem of noise in the three industries around Tehran has been examined in this study; and noise measurement and survey studies have been carried out at three construction sites of tyre industry. Sound level meter equipment has been used to measure noise in the sites and when the machines are on, noise measured. It has been specified, during the surveys, that the noise levels detected in all the industries are much above the standard levels that is specified in the EPA standards. For reducing industrial noise in the sites, some methods suggested. Noise also acts synergistically with other hazards to increase the risk of harm to workers. In particular, noise and dangerous substances (e.g. some solvents) that have some tendencies towards ototoxicity may give rise to rapid ear damage.

**Keywords:** noise; standard; industrial noise; measurement.

### Introduction

Noise is one of the physical environmental factors affecting our health in today's world. Noise is generally defined as the unpleasant sounds which disturb the human being physically and physiologically and cause environmental pollution by destroying environmental properties [1].

The sound pressure level generated depends on the type of the noise source, distance from the source to the receiver and the nature of the working environment. For a given machine, the sound pressure levels depend on the part of the total mechanical or electrical energy that is transformed into acoustical energy.

Sound fields in the workplace are usually complex, due to the participation of many sources:

propagation through air (air-borne noise), propagation through solids (structure-borne noise), diffraction at the machinery boundaries, reflection from the floor, wall, ceiling and machinery surface, absorption on the surfaces, etc. Therefore any noise control measure should be carried out after a source ranking study, using identification and quantification techniques. The basic mechanism of noise generation can be due to mechanical noise, fluid noise and/or electromagnetic noise. The general effect of noise on the hearing of workers has been a topic of debate among scientists for a number of years [2, 3, 4]. Regulations limiting noise exposure of industrial workers have been instituted in many places. For example, in the U.S., the Occupational Noise Exposure Regulation states that industrial employers must limit noise exposure of their employees to 90 dBA for one 8-h period [5, 6].

This permitted maximum noise exposure dose is similar to the Turkey Standard, which is less than 75 dBA for one 7.5 h period [7].

Exposure to continuous and extensive noise at a level higher than 85 dBA may lead to hearing loss. Continuous hearing loss differs from person to person with the level, frequency and duration of the noise exposed [8]. Negative effects of noise on human beings are generally of a physiological and psychological nature. Hearing losses are the most common effects among the physiological ones. It is possible to classify the effects of noise on ears in three groups: acoustic trauma, temporary hearing losses and permanent hearing loss [9]. Blood pressure increases, heart beat accelerations, appearance of muscle reflexes, sleeping disorders may be considered among the other physiological effects. The psychological effects of noise are more common compared to the physiological ones and they can be seen in the forms of annoyance, stress, anger and concentration disorders as well as difficulties in resting and perception [10, 11,12]. In the figure 1, noise levels and range of industrial plant noise levels at operator’s position is shown.

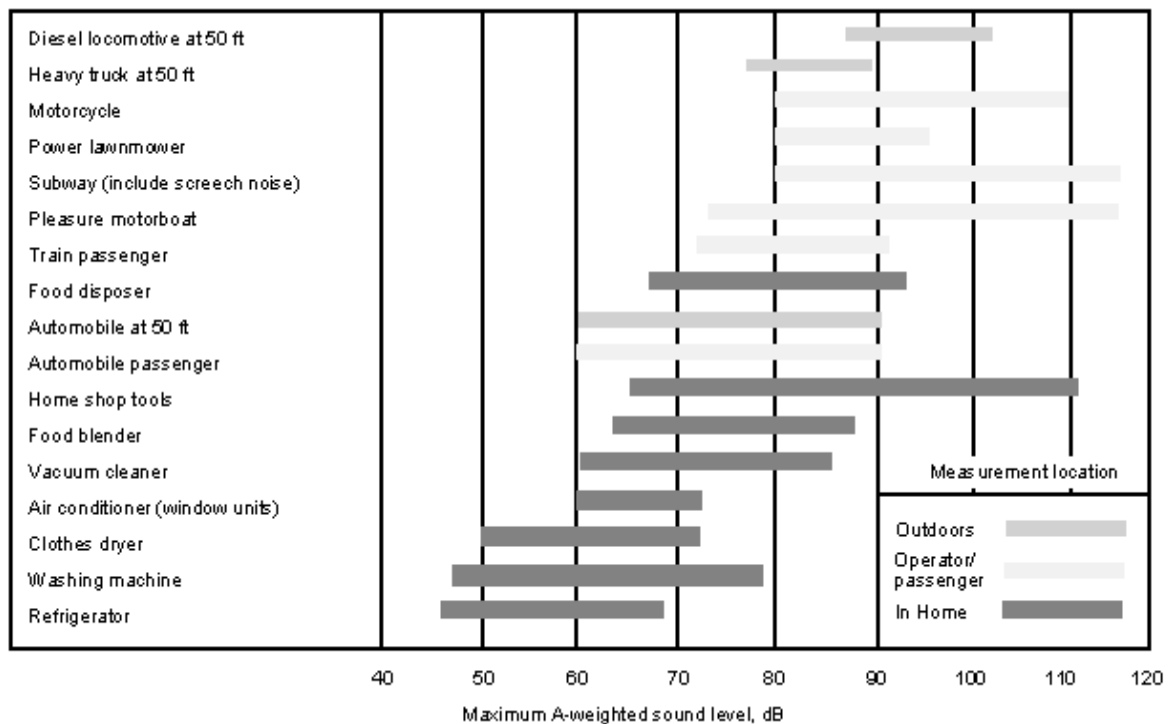


Figure 1. Range community noise levels (5).

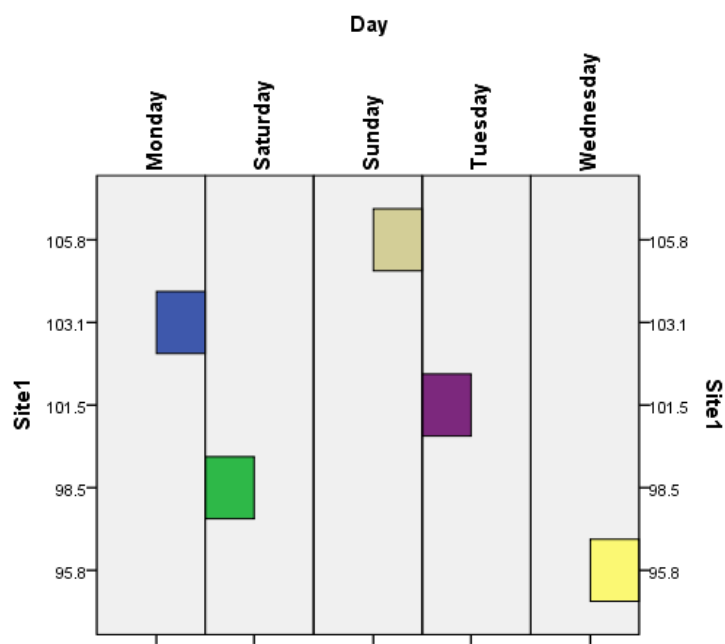
A great majority of people working in industry are exposed to noise. Therefore, in this study, the effects of noise on human beings have been investigated with respect to the level of noise they are exposed to. In this context, measurement studies have been conducted at three sites in Tehran.

### Material and Methods

Actual noise levels in these industries have been measured and their maximum and minimum values have been placed in the associated Tables. A sound level measuring instrument (TES 1353 Sound Level Meter) was used in these measurements. Measurements results have been recorded by holding the instrument at a height of 1.5m from ground in living and working environments of the workers for five days from Saturday to Wednesday in order to determine the noise levels to which the workers are exposed. The measuring information is shown in table 1.

**Table 1- measuring noise information in working days**

Day	Site 1	Site 2	Site 3
Saturday	98.5	94.5	95.1
Sunday	105.8	91.5	91.8
Monday	103.1	96.6	92.5
Tuesday	101.5	98.1	93.8
Wednesday	95.8	93.4	96.5



**Figure 2. Range of industrial plant noise levels at operator's position in site 1 (5).**

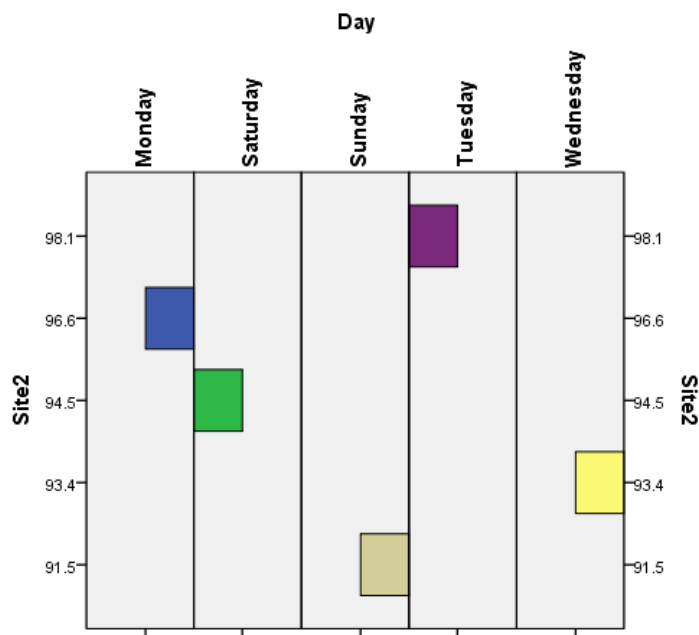


Figure 3. Range of industrial plant noise levels at operator's position in site 2 (5).

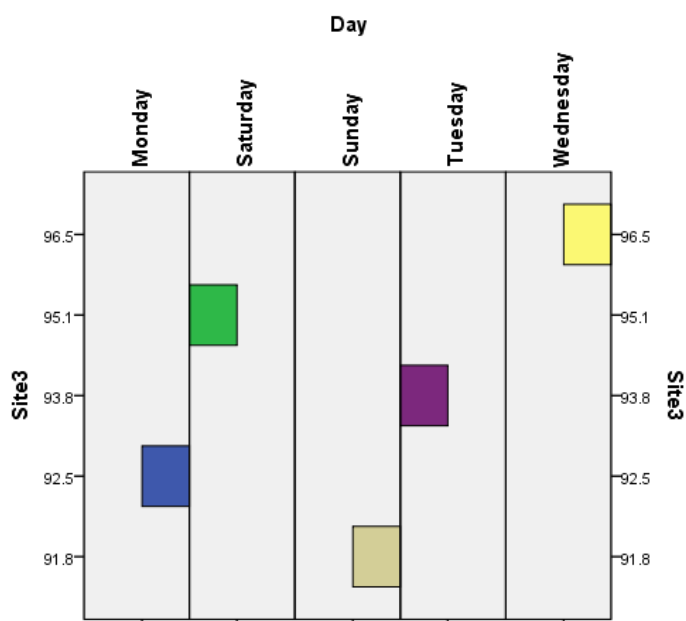


Figure 4. Range of industrial plant noise levels at operator's position in site 3 (5).

### Noise Measurement Results

As shown in Table 2, the highest noise among these industries was detected at the site 1 (105.8 dBA) and site 2 (98.1 dBA) and site 3 (96.5 dBA). Comparison of these results with the standards taking place in the Noise Control Regulation shows that none of the industries subject to this survey are meeting the associated standards.

**Table 2. Noise measurements results**

Industries	Maximum noise dBA	Minimum noise dBA
Site 1	105.8	85.6
Site 2	98.1	81.5
Site 3	96.5	76.8

## Conclusion

Finally, based on the inputs and measurements carried out, the amount of noise generated by industries was obtained. Table3, defined standard for urban areas is provided.

**Table3. The EPA standard for the maximum level of noise in urban areas in terms of dBA (5)**

<i>Area</i>	<i>Day (7.00 to 22.00)</i>	<i>Night (22.00 to 7.00)</i>
Residential	55	45
<i>Residential-Commercial</i>	60	55
<i>Commercial</i>	65	50
<i>Residential-Industrial</i>	70	60
<i>Industrial</i>	75	65

It has been determined during our measurements that the noise levels in all the above industries are much above the noise level of 75 dBA specified in Noise Control Regulation.

## Recommendations

1. The problem of noise should be taken into consideration during their establishment phases (construction of the building, allocation of the machinery, etc.).
2. Use of the latest technology should be provided in the industries.
3. Authorized persons should arrange the working periods for workers according to the level of noise in workplaces.
4. New workers who will work at noisy workplaces should be subject to hearing tests and other tests regarding related illnesses.
5. Suitable protection accessories should be provided for the workers who will work in noisy environments and they should be trained on regular usage of such accessories.
6. Hearing tests should be performed periodically each month at noisy workplaces.
7. Employers and workers should be trained on noise and its effects on human health.

8- To reduce noise at machines, standards have been drawn up which deal with the planning and design of low-noise machines (ISO/TR 11688 Parts 1, 2), the collection and evaluation of emission data (ISO 11689) and noise-related requirements for noise control devices and materials (silencers, enclosures, noise absorbers, baffles). The standard ISO/TR 11688-1 gives an overview of the principles and methods a design engineer needs to design a low-noise machine or to communicate with an acoustic professional.

The following approach is specified for the design engineer:

1. Specification of the design task (standards, state of the art, requirements for noise).
2. Concept phase (principles for solving the problem, comparison and selection of concepts, machine acoustics)
3. Detail design (calculations, detail drafts)
4. Investigations on prototype (measurement, evaluation, measures, comparison with requirements).

Inherently noisy operations, such as street repair, municipal trash collection, factory operation, and aircraft traffic, should be curtailed at night and early morning to avoid disturbing the sleep of the community.

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