

## **“Outside the Law” Acoustics**

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**Abstract:** Often Engineers, and other technicians, are faced with situations whose legal framework is not clear or up-to-date, given the latest scientific developments in the field. This situation also frequently occurs with Acoustical Engineers (here understood in a broad sense: all technicians who work and have responsibilities in the area of Acoustics). The aim of this communication it is analyses the "Outside the Law" (*Contra Legem*) acoustics situations and present, in a reasoned way, what actions are judged more appropriate, given the Engineer's ethical and deontological duties. The analysis and reasoning will be followed by practical examples for an easier understanding of the *Contra Legem* situations and of the recommended actions. The recommended actions should be understood only as an indication, according the authors experience and sensibility, and each Engineer/Technician, with responsibilities, should form his/her own opinion and define accordingly his/her steps. The authors hope this work can be useful, helping to make the difficult “out-of-law” decisions that need to be made.

**Keywords:** Acoustics; Out-of-law.

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### **Introduction**

Typically, the publication rate of scientific papers is faster than the publication rate of standards, and in turn the publication rate of standards is faster than the publication rate of legislation.

In opposite, the rule strength is typically higher in legislation, because involves a political decision. Secondly the rule strength of standard, because it was approved by a wide range of technicians. Lastly the rule strength of scientific papers because they were approved, normally, by few technicians (referees).

It is, therefore, quite natural to find legislation, in force, outdated in relation to the most recent associated standards, or to find standards, in force, outdated in relation to the most recent associated scientific papers.

The purpose of this paper is to discuss "Outside the Law" acoustics situations (*Contra Legem*), to guide the Acoustical Engineers (here understood in a broad sense, therefore any technician with similar responsibilities) for the best way of action on special situations, within a growing framework of the Acoustical Engineer's responsibilities towards society.

### **Follow the law strictly?**

Does the Acoustical Engineer have to follow exactly what is established in national acoustics legislation, regardless of what is established in more recent standards and scientific papers?

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The answer to this question is not consensual, there are several people who will say yes and several people who will say no.

Even for people who say yes, there seems to be a rule: Such decisions will have to be exceptional and well-founded.

Against the above, seems that the better answer to the previous question is:

Only in exceptional and duly justified cases, the Acoustical Engineer can and should make decisions "against" the national acoustical law.

It is important to ask another question:

If does not exist standards and scientific publications that support the Acoustical Engineer decision, may or should her/him, take that decision?

In an exceptional case and duly well-founded (without standards or scientific papers support the reasoning becomes even more important) it is believed that the best response is: **YES**.

### **Powers and duties of acoustical engineer**

In some countries (for example Portugal, it is enough, in some cases, to have a "Term of Responsibility", from a legally qualified technician, attesting compliance with acoustics legislation, for an administrative approval of specific acoustical studies. But in some countries such as Turkey, the legal basis is more important than the technical staff's competence. In particular, since the solution of the incompatibilities with the administration is evaluated in administrative courts, "being in the legislation" becomes important.

Such "power" of the "legally qualified Technician", here understood in a broad sense as Acoustical Engineer, makes more relevant the good capacity of Acoustical Engineer to properly manage normal situations, under the acoustic law, and even more the exceptional "Out of Law" acoustic situations.

In this context, assumes superior relevance the ethical and deontological issues.

It is usual to consider that an Engineer, in general and particularly an Acoustical Engineer, must have the following virtues:

- Self-direction (self-understanding, courage and perseverance, integrity).
- Orientation for the General Good (general good for customers and the society in general).
- Teamwork (cooperation, listening).
- Proficiency (competence, diligence).

Therefore, the Acoustical Engineer must have the necessary "Proficiency" and "Self-direction" in order to be able to decide, in a reasoned manner, when the current national acoustics legislation should and should not be strictly followed, based on an "Orientation for the General Good", listening (considering) the opinion of other colleagues and/or institutions.

Case the Acoustical Engineer decides *Contra Legem*, assumes major importance the explanation and justification of such decision.

In the following chapter are presented two specific examples of acoustic situations "Out of Law", and the associated actions considered more appropriate are discussed.

## Examples of "out of law" situations

### Example 1 for Portugal

Knowing that the document (WHO, 2009) establishes  $L_{night, outside} = 30$  dB(A) as the limit for No Observed Effect Level (NOEL), and knowing that the most demanding limit of the Portuguese Noise Law (Decree-Law 9/2007) for the night period is  $L_{night, outside} = 45$  dB(A), should the Acoustical Engineer "require", *Contra Legem*, the fulfilment with  $L_{night, outside} \leq 30$  dB(A)?

It is believed, as a rule, but of course with the possibility of special exceptions, that the best response is: **NO**.

Once the definition of national legal acoustic limits may have a significant influence on economic terms, the decision on these limits must be political and based on different aspects in addition to the available technical/scientific information on the subject.

Therefore, the Acoustical Engineer can not, and should not, substitute the legislator, and must confine himself to the strict application of the acoustic national limits in force.

Although the above mentioned, the Acoustical Engineer must also consider the following examples of Portuguese Court Judgments related to the human right to rest

*"The General Noise Regulation was not intended to resolve conflicts that may arise between the right of ownership of the establishment, where it develops noise activity, and the rights to the physical and moral integrity of people, to health, to the environment and to quality of life".*

*"The offense of the right to rest, to sleep, is not excluded simply because the activity in question has been authorized administratively - the legal consecration of a maximum noise level only means that the Administration can not authorize the installation of equipment, nor to grant licensing of activities that do not respect that limit".*

In view of this fact, the Acoustical Engineer can and should inform the Client, especially when it corresponds to an economic activity, that the strict compliance with the administrative acoustic limits does not exclude the right of opposition by someone who considers to be being disturbed from the activity noise.

Therefore, the Acoustical Engineer must decide together with the Client the best limit to verify, obviously taking into account the national legal noise limit applicable.

For the sake of transparency, and if it was agreed with the Client a more restricted limit, it is recommended to express this clearly in the "Term of Responsibility".

### Example 2 for Portugal

In Annex K of ISO 1996-2: 2017 it is stated:

*"The test for the presence of a prominent discrete-frequency spectral component (tone) typically compares the time-average sound pressure level in some one-third-octave band with the time-average sound pressure levels in the adjacent two one-third-octave bands. For a prominent discrete tone to be identified as present, the time-average sound pressure level in the one-third-octave band of interest is required to exceed the time-average sound pressure levels of both adjacent one-third-octave bands by some constant level difference. The constant level difference may vary with frequency. Possible choices for the level differences are: 15 dB in low-frequency one-third-octave bands (25 Hz to 125 Hz), 8 dB in middle-frequency bands (160 Hz to 400 Hz) and 5 dB in high-frequency bands (500 Hz to 10 000 Hz)".*

In the number 1 of Annex I of Portuguese Decree-Law 9/2007 the following is established

"The method for detecting tonal noise characteristics within the evaluation time interval consists in checking, in the one-third octave spectrum, whether the sound level of one band exceeds that of adjacent bands by 5 dB(A) or more, in which case the noise should be considered tonal".

Assume that in a certain situation it is verified that the noise, due to a certain activity, has a sound level, in 63 Hz 1/3 octave band, 10 dB(A) higher than the adjacent bands.

The Acoustics Engineer shall consider that it is a Tonal Noise, in line with the Portuguese Decree-Law 9/2007 [difference greater than 5 dB (A)], or shall consider that it is Not a Tonal Noise, in line with ISO 1996-2: 2017 Annex K?

It is believed that, as rule, the best answer is: **NOT A TONAL NOISE**.

Although to some extent this example is similar to Example 1, a possible *Contra Legem* decision, in this case, does not have the same negative "legislator substitution" as in Example 1, since we are not using a new method, we are only using the most recent version of the method established in the current legislation. In addition, the fact that we are in the opposite direction in terms of economic effects (criterion of the new version less strict than the criterion of the previous version).

As explained in Example 1, however, some care should be taken in the use of less stringent criteria, since compliance with scientifically established acoustic limits does not exclude the right of opposition by someone who considers that is being disturbed by noise arising from the activity.

Thus, in the case of an *in situ* Acoustics Assessment with noise measurements, the recommendation is to check also if the person that is experiencing the specific noise situation, considers, or not, the noise as annoying. Reference should be made in this respect to standard ISO/ TS 15666: 2003. It is also important to note the desirability of a signed Declaration regarding the existence, or not, of acoustic discomfort, from the person experiencing the specific noise situation.

If the answer is that there is noise discomfort, and the legal acoustic limit is not fulfilled considering the criterion for determining the tonal characteristics of Portuguese Decree-Law 9/2007, then the tendency should be to follow the legal criterion.

If the answer is that there is no discomfort to noise, and once again the legal acoustic limit is not fulfilled considering the criterion of determination of the tonal characteristics of DL 9/2007, then the tendency should be to follow, *Contra Legem*, the criterion of the new version of the method of determination of tonal characteristics established in ISO 1996-2: 2017.

### **Example 1 for Turkey**

Can the acoustic engineers use the initiative in case of user abuse of the criteria defined in the Regulation?

With respect to application experience and based on scientific basis: **YES**

In Turkey, noise control criteria are determined by Regulation on Assessment and Management of Environmental Noise (RAMEN) (Official Gazette Number 2010/27601) which was harmonized with the European Commission Environmental Noise Directive (2002/49/EC). According to the criteria determined in the regulation, the operating noise level of the background must be less than 5 dBA.

But, in some cases the disability can not be relieved even though 5 dBA criteria are provided. In this case the presence of tonality is assessed. However, tonality was not addressed in the regulation. As a result the Acoustic Engineers are using the initiative as *Contra Legem* for the solution.

In Turkey, although not as fast as up to scientific studies, legislation is renewed rapidly. Since 1983 there have been 15 changes, updates or auxiliary documents. Disruptions could occur due to the variability in the definitions and supervisory factors. For example, open / closed space elements that are not clearly defined in the old regulations but now they are described in full detail in the current regulation.

Despite this, the operators' choice of materials etc. there are elements that are not defined in the Regulation. In this case, the Acoustical Engineer decides how to evaluate the installation.

### **Example 2 for Turkey:**

Can technical solutions be developed by acousticians on issues where no implementation proposal is provided by the Regulation?

With both sides (complainant and complaine) not to the victim condition: **YES**

Background noise measurements are also one of the most important factors in noise control in Turkey. However, in some cases (such as hospitals' intensive care unit ventilation units, etc.) it is not possible to close the source and take measurements. In this case, the "acoustic shadow zone", which is mentioned in many scientific studies and is also included in the regulation, is used. Despite being defined in the legislation, no use case / proposal has been submitted.

Measurements were taken from a point that was not affected by the sound of the noise source but which had the same environmental conditions (temperature, humidity, etc.) and one hour representing the same time zone, and the discomfort could be evaluated.

On this basis, this can qualified as *Contra Legem* but it is regarded as a useful issue for the solution.

### **The importance and difficulty of analyzing acoustical discomfort.**

It should be noted that acoustical discomfort is a highly relevant issue for society.

In Portugal, for example, is in first place in the ranking of environmental complaints submitted to the the Portuguese Ombudsman.

On the other hand, the consequences of acoustic discomfort may be very serious for society. as the following news reports attest ([http://www.cmjornal.pt/portugal/detalhe/mata\\_vizinho\\_barulhento\\_a\\_tiro](http://www.cmjornal.pt/portugal/detalhe/mata_vizinho_barulhento_a_tiro); January 3<sup>rd</sup> 2015 ):

*"Kills noisy neighbor with a gun shot".*

Similarly, extreme incidents are occurring in Turkey, too. In these circumstances, careful analysis of acoustic discomfort by all stakeholders, including the Acoustical Engineer, is particularly relevant.

The Acoustical Engineer must have well present that the person bothered by certain noise becomes, somehow, a "specialist" in the hearing of that noise, so if the Acoustic Engineer can not hear the noise that the complainant reports does not necessarily mean that noise does not exist, may only mean that the Acoustical Engineer is less "accustomed" to hear that noise.

Of course, in some particular cases the noise problem may exist only in the complainant's head, and the Acoustical Engineer should be prepared to treat such situations with exemption, sobriety, and understanding.

Noise is a complex phenomenon not only in psychological terms but also in physical terms. If discomfort is experienced in the lying position, then the normal standing position is not the best position to analyse the discomfort that is experienced in the lying position.

The Acoustical Engineer should be aware that the Equivalent Continuous Sound Level (Average Energy Value), Weighted A,  $L_{Aeq}$ , is, since 1982-1987 (ISO 1996, 1982-1987), the reference parameter for human disturbance due to noise, assuming, as a rule, that the higher the value of this parameter the greater the probability of acoustic disturbance, however, such parameter and rule are not universal. Note the following points which are only exemplary and do not include all the limitations of the current methods.

1. The A frequency weighting is not the most suitable for sounds with higher sound intensity (Pierre, 2004), in particular for Low Frequency sounds that require other type of analysis (Waye, 2006).
2. The Energy Average Value,  $L_{Aeq}$ , is not in some cases the best form of limitation. In some European countries there are not only limits of  $L_{Aeq}$  but also limits of Maximum Value (EEA, 2010).
3. Not always a noise with higher  $L_{Aeq}$  value means more human acoustical discomfort, not only due to specific physical characteristics (impulsivity, tonality, etc.) but also due to the fact that for a less intense noise it is typically more difficult to identify the origin of this noise, which can generate a particular increase of discomfort.

## Conclusions

The authors hope to have had the certain "Proficiency" and "Self-direction" to treat in the best way, with "Orientation for the General Good", this controversial theme. The authors also hope that this article can, in its own way, help the Acoustical Engineers to form their own opinion (the final objective of this paper) on Acoustics "Out of Law", even if that opinion may be different from the opinion expressed in this paper.

Although the strict compliance of the national administrative acoustic law normally carries less risks for the Acoustical Engineer, she/he should not forget that the courage and the orientation for the general good are part of the Engineer's virtues.

Not to forget also that the right courage will not always be in the direction of *Contra Legem*, it will also, often, in the directions of the humility of the strict compliance of the current legislation.

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ICONST 2018