# Sound Level Measurements at Dance Festivals in Belgium

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**Summary**

The Flanders region (Belgium) introduced a law in 2013 about maximum levels at the ears of the audience during music events. This law states that, for large events, the sound level should not be above Leq = 100 dB(A) averaged over 60 minutes. As a derivative, for a short period of 15 minutes, the average should not be higher than Leq = 102 dB(A). In this paper results are shown in both dB(A) and dB(C) levels. The levels were measured at FOH (front of house) position at various dance events with the harder dance styles during the years 2012, 2013 and 2014. As a case study a short description is added about maintaining sound levels and audio quality at the Tomorrowland festival in Belgium.

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## 1. Introduction

The Belgium law for the maximum of sound levels at music events was composed between 2010 and 2012. After formal meetings with stakeholders, like promoters, sound engineers and researchers the law came into effect in 2013. The whole of 2012 was designated as a period for stakeholders to get accustomed on the new rules. The main incentive for the new law was to lower the chance on music induced hearing disorder.

In the Netherlands a covenant between national government and industry associations has been refreshed in October 2014. The maximum in Holland is set at Leq = 103 dB(A)@15 minutes.

## 2. Level restrictions

### 2.1 The law

The level restrictions in Belgium are valid for the Flanders region in Belgium, which excludes the Wallonian part and Brussels. An important aspect is that the rules are part of the collection of environmental rules (called VLAREM [1]). This makes them stronger for maintenance activities by local government. A fine for excess of sound levels is a good described trajectory for controlling bodies. For all music events there are 3 categories. The first one is below 85 dB(A), with no further obligations. This category is suitable for small bars, restaurants etcetera. The second category is for sound levels between 85 and 95 dB(A), suitable for small venues and small festivals. In this category the sound levels have to be measured, by the owner of the music license or there has to be a sound limiter. The third and highest category is up to 100 dB(A), at which sound level monitoring is necessary at FOH (front-of-house, the position for the sound console). The results must be archived for 30 days and also the promoter has to provide free earplugs for the audience.

### 2.2 Dynamic headroom

During discussion amongst stakeholders in the preliminary phase of this law, a demand for some kind of dynamic headroom came up. Measurement characteristics showed that there's a lot of dynamics in sound levels during a rock oriented festival (figure 1). A short time period (15 minutes) with a raise of sound level was possible while the *Leq = 100 dB@ 60 min*. was still guaranteed.

## 3. Measurement Results

### 3.1 The Law

Since the new level limits, sound engineers had to find their way in dealing with those restrictions. Being targetted by promoter, audience, consultant and government was not easy. From the industry the supply of various measurement computers for FOH (front-of-house) has inclined (figure 2).


Figure 2, measurement computer at FOH

Most of these systems have specific software for each country's regulations. At the "Belgium" screen layout both the values of Leq 60 min. and Leq 15 min. are displayed, added with extra information on demand about dB(C) and spectra. A few systems are capable for intelligent warning. This is build about a prediction algorithm based on the last preceeding minutes of measured information. With red and green dots the sound engineer can get close to the maximum level without risking a fine.

### 3.2 Measurement Setup

All measurements are done with a 10EaZy measurement computer with class 1 microphone. The microphone is placed at the FOH position, which is often in the middle of the audience area. Measurement height is 2 meters above the floor. The sound level results Leq in dB(A) and dB(A) were stored every 1 minute. All festivals had a program of Electronic Dance Music (EDM) of which hardcore and hardstyle dance were the most common types.

### 3.3 Measurement Results

For each festival the measurement data of each dance area and each day is transferred into a database for each year. In figure 3,4 and 5 the histograms are shown for each year. At the vertical scale the number of "Leq 1 minute" results is shown.

### 3.4 Comparison of Results

In table 1 the collection of data is summarized and presented as averages of the large amount of data for each year.

Table 1. Overview of averages for each year in dB(A).

| *2012* | *2013* | *2014* | *Description* |
|---|---|---|---|
| 98.0 | 98.1 | 97.1 | Arithmetical Mean |
| 2.9 | 2.8 | 2.6 | Stand.deviation |
| 98.9 | 98.9 | 97.8 | Leq |
| 98.4 | 98.5 | 97.4 | Median |
| | | | |
| 22717 | 43614 | 53740 | Minutes with data |

In table 2 the collection of data is summarized and presented as averages for each year in dB(C).

Table 2. Overview of averages for each year in dB(C).

| *2012* | *2013* | *2014* | *Description* |
|---|---|---|---|
| 112.4 | 113.3 | 113.1 | Arithmetical Mean |
| 4.4 | 4.3 | 4.2 | Stand.deviation |
| 114.4 | 115.3 | 115.0 | Leq |
| 112.7 | 113.5 | 113.4 | Median |
| | | | |
| 22717 | 43614 | 53740 | Minutes with data |

Regarding the levels in table 1, there was a slight lowering of average dB(A) level in 2014. In the years 2012 and 2013 the focus of sound engineers was mainly at the Leq = 102 dB(A)@15 minutes target and not at the 100 dB(A) limit. The general communication and awareness about the Belgium limit was "102 dB(A)@15 minutes is the maximum". In 2014 there was more communication and attention, also from government and local inspection for the 100 dB(A)@60 minutes values.

The average Leq value in dB(C) is still the same. In EDM the bass part in the audio signal is important for the audience experience.

### 3.5 Compliance

Regarding the data, the Leq 1 minute results cannot be compared to local regulations. Therefore

the 15 minute Leq moving average has been calculated for each dance area at each event at every minute. The statistical distributions can be seen in figure 6, 7 and 8. Regarding the level limit which is set at 102 dB(A), all results up to Leq = 102.5 dB(A) (round off to 102) are correct with the law and higher levels means that the limit is exceeded. In table 3 the percentage of levels is shown which are within the official limit.

Table 3. Compliance within the limit for a 15 minute time period.

| *2012* | *2013* | *2014* | *Description* |
|---|---|---|---|
| 99.37% | 99.21% | 99.98% | ≤ 102.5 dB(A) |

In 2014 for example, the limit for 53740 minutes of measurement was exceeded during 11 minutes. The conclusion is that for all those events there were hardy any issues with level limits.

## 4. Controlling the sound levels

### 4.1 The Sound Guard

Measurement and control of sound levels at events has developed in the last 15 years, due to the growing festival industry. Increasingly the larger festivals use a Sound Guard to control all activities with sound levels and license aspects. The Sound Guard's key responsibilities are: communication, negotiation and mediation between the stakeholders. The Sound Guard is usually hired by the promoter but is sometimes engaged by other stakeholders suchs as the owner of the hall or the land.

### 4.2 The Audio Quality Manager

The constraints of the sound level limits lead to a new function within large events: the audio quality manager. Key responsibilities are: communication with sound engineers and sound guard and listen to the audio signal and watch the perception of the audience.

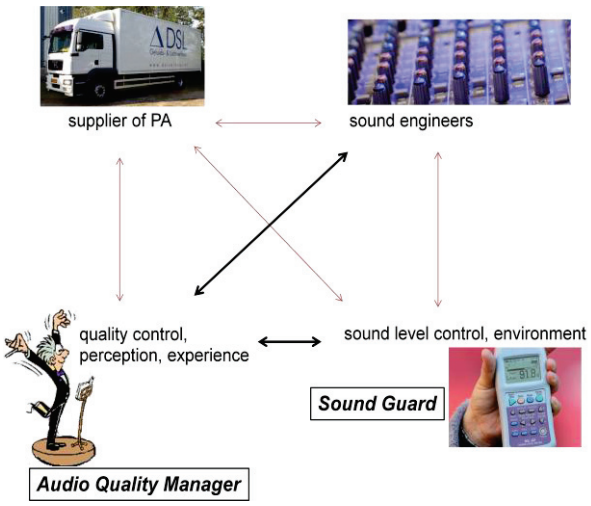


Figure 9, the sound control chain at large events.

The model with the Audio Quality Manager has been succesfully applied since 2012 at the Tomorrowland festival in Boom, Belgium.

## 5. Conclusions

Regarding the large collection of measurement data of 2012, 2013 and 2014 there's a slight lowering of Leq level at dance events in Belgium of 1 dB(A). The dB(C) value remains almost the same throughout the years.

### References

[1]http://www.lne.be/themas/hinder-en-risicos risicos/geluidshinder/beleid/muziek (2013)

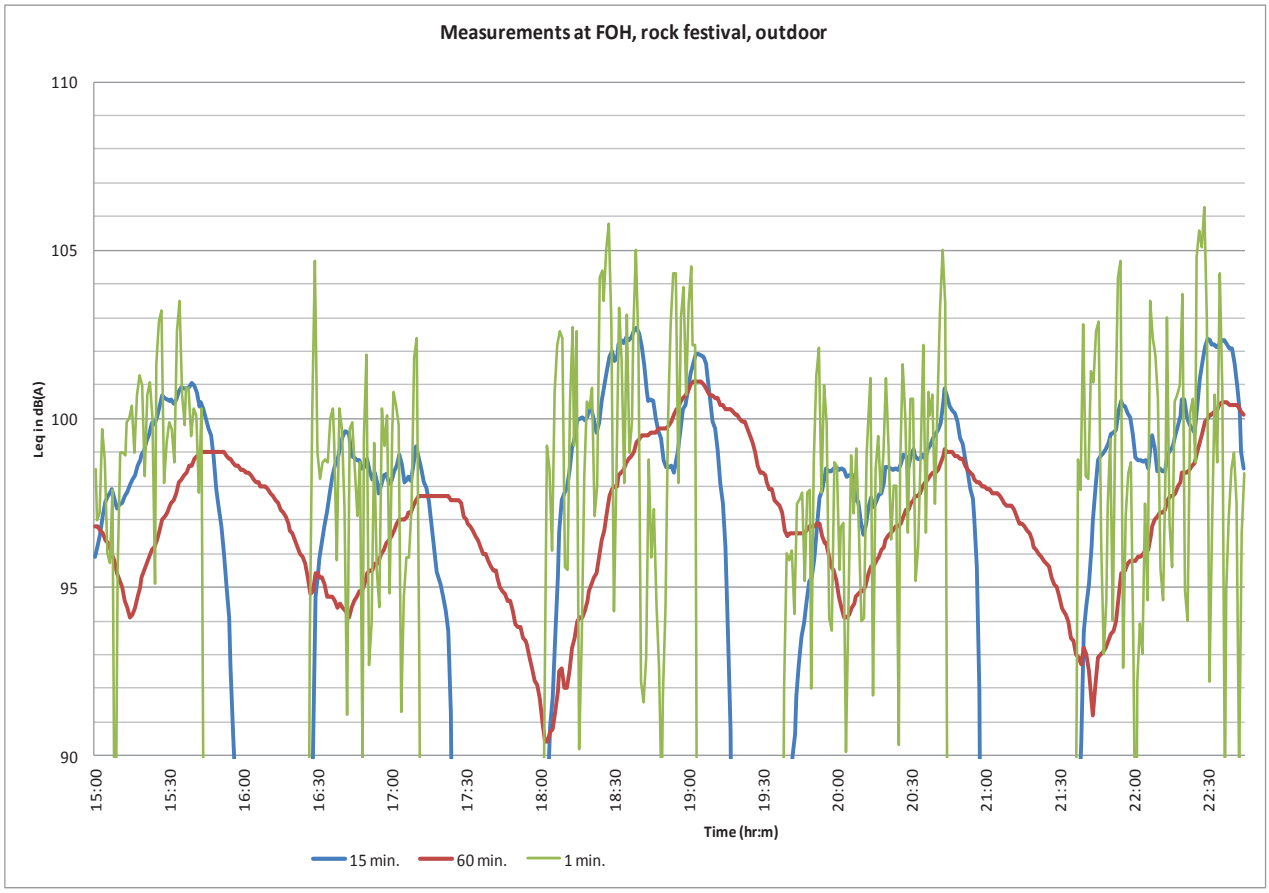


Figure 1, Measurement of the dynamic headroom between Leq 15 min. average and 60 min. average at rock festival

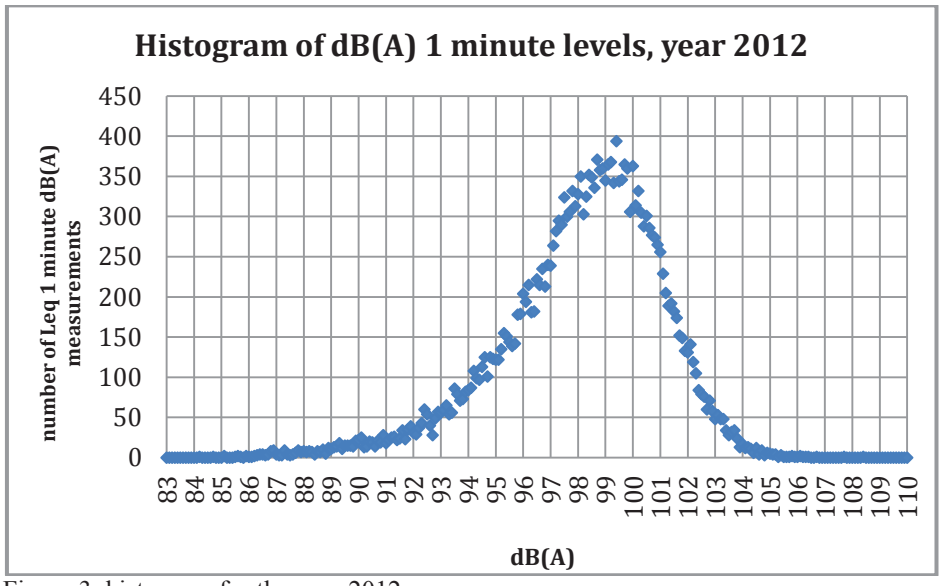


Figure 3, histogram for the year 2012.

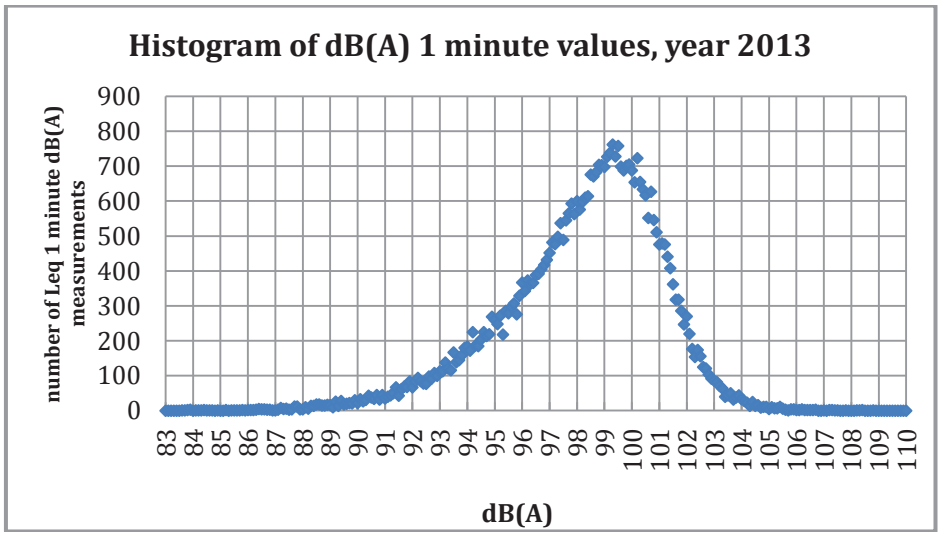


Figure 4, histogram for the year 2013.

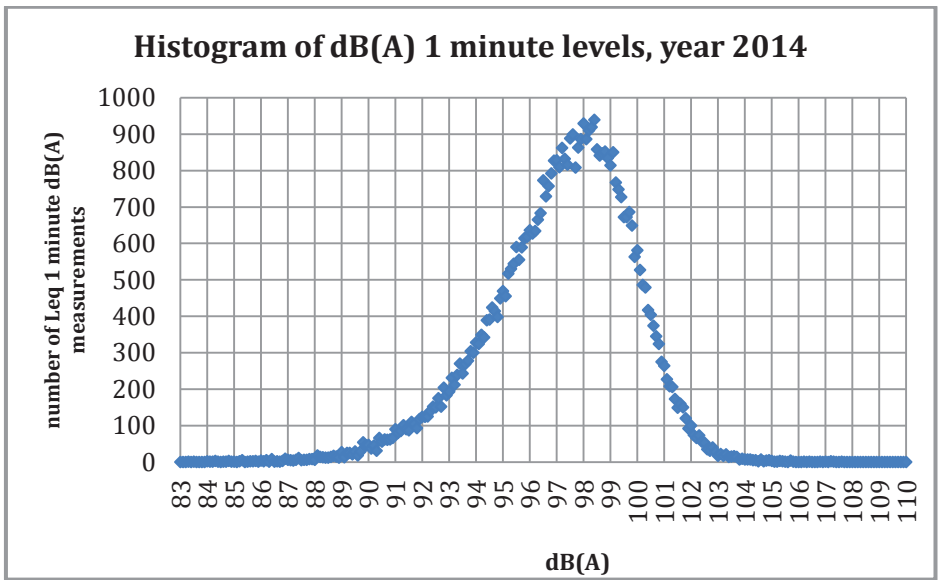


Figure 5, histogram for the year 2014.

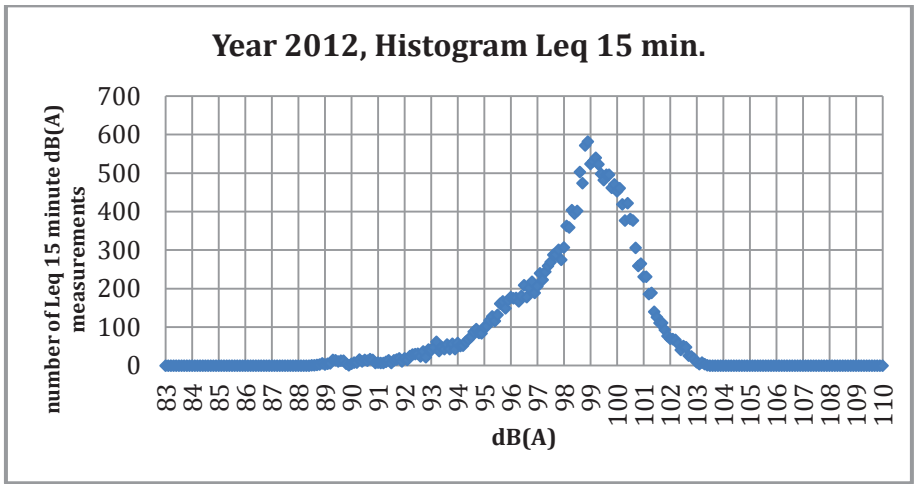


Figure 6, histogram for the year 2012 with 15 min.values

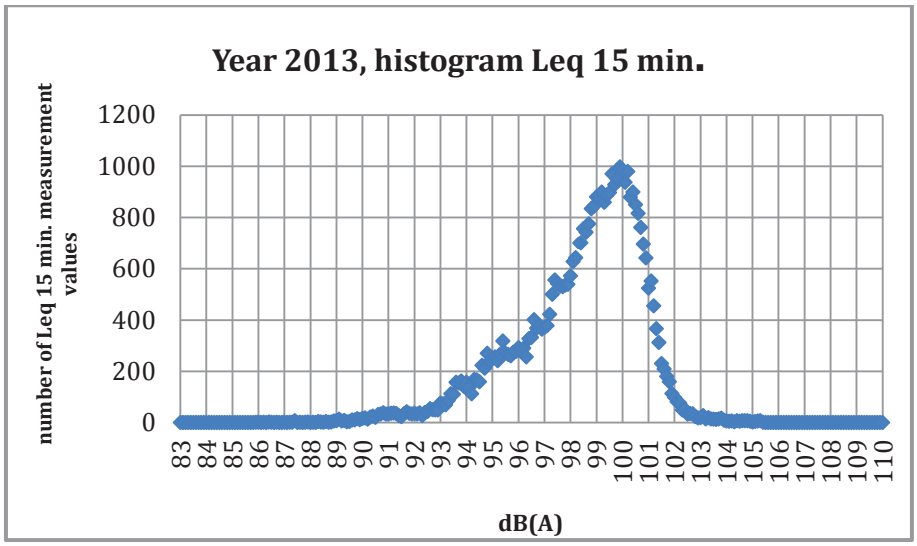


Figure 7, histogram for the year 2013 with 15 min.values

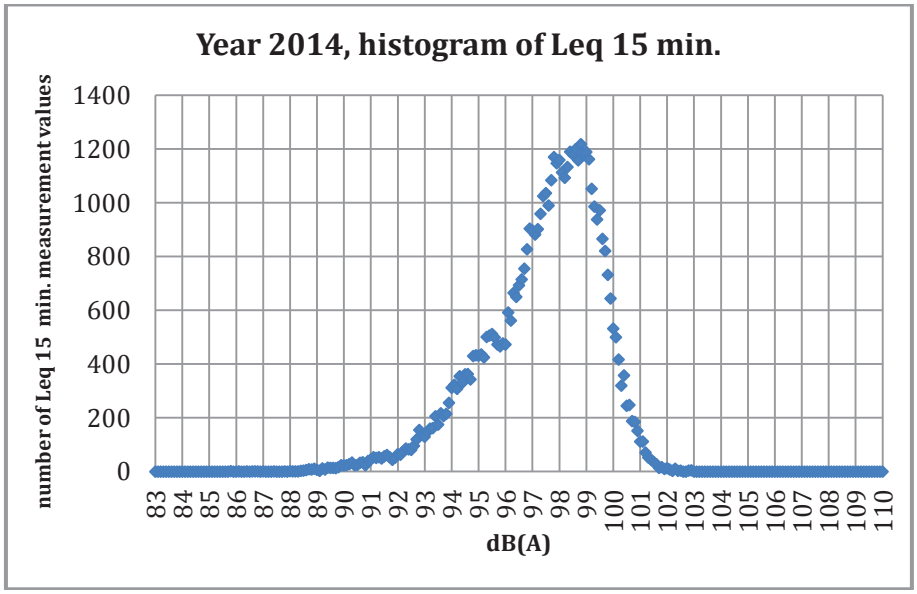


Figure 8, histogram for the year 2014 with 15 min.values