Flanders
State of
the Art

Noise regulations for “musical activities” in Flanders

Measuring noise in venues and at events

DEPARTMENT OF
ENVIRONMENT
& SPATIAL
DEVELOPMENT

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INTRO

Since 1 January 2013, noise regulations for electronically amplified music, also called “musical activities”, have applied in Flanders. In addition to a concise overview of the applicable regulations, this document provides more information on the obligations for measuring the sound level at these “musical activities”.

The obligation applies to the event organiser and/or the venue operator, but also leads to some obligations for the sound engineer.

Would you like to know more? You can find more publications on noise regulations for “musical activities” on our web page. These are only available in Dutch.

Publication date
July 2024

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1 THE REGULATIONS GOVERNING "MUSICAL ACTIVITIES" IN A NUTSHELL

Since 1 January 2013, noise regulations for electronically amplified music, also called "musical activities", have applied in Flanders. In addition to a concise overview of the applicable regulations, this document provides more information on the obligations for measuring the sound level at "musical activities".

1.1 "WHAT IS A "MUSICAL ACTIVITY"?

Any form of electronic amplified music is a "musical activity" according to Title II of the VLAREM, the Flemish Environmental Safety Regulations (VLAREM II). That is, any public activity involving electronically amplified music, so both live performances and sets or events with pre-recorded music, are covered by the regulations. The noise regulations therefore apply to a café with ordinary background music, a party in a venue or tent, music at a dance performance, a live performance in a small or large venue, a festival, etc.

But it also includes playing electronically amplified music without a specific activity - such as a party or celebration - being organised. For example, playing music in your own home or background music in a restaurant is also considered a "musical activity". "Musical activities" involving only non-electronically amplified music (e.g. brass band, symphonic orchestra, chamber orchestra, etc., without amplification) are not covered by the regulations. In case of partial amplification, the noise regulations do apply.

1.2 NOISE REGULATIONS AT "MUSICAL ACTIVITIES" AND IN THE SURROUNDING AREA

When it comes to noise regulations for "musical activities", you may be faced with **two different types of regulations**. On the one hand, there are the noise regulations that apply to the "musical activity" itself. These originate in protecting attendees from hearing damage. The sound level is expressed as the magnitude $L_{Aeq,15min}$. On the other, there are the noise regulations that apply in the surroundings of the "musical activity". These originate in limiting potential nuisances in the surrounding area.

A "musical activity" must always meet both regulations, with the exception of some specific situations. So just because the "musical activity" meets the noise regulations determined for the "musical activity" itself, that does not mean it also automatically meets the surrounding area regulations and vice versa.

1.3 REGULATORY OVERVIEW

Using yes-no questions, you can find out what the legal requirements are for different types of "musical activities". The full regulations can be found in chapters 4.5, 5.32 and 6.7 of VLAREM II[1].

[1] Consult the Flemish Environmental Safety Regulations, VLAREM II (English version).

Are the activities involving electronically amplified music being organised at a private establishment?

The following are considered "musical activities" at private establishments:

- Activities in homes and their appurtenances and gardens (excluding holiday homes – due to changing holiday-makers, this is considered a public facility).
- A private party with closed guest list and a family character at its own private property/building that is not operated as a banquet hall/party venue or with other public character. For example, celebrating your own wedding in your garden. Or the annual staff party at your own company premises, which only staff members and possibly partners and children will attend.
- Rehearsal spaces where, based on the rental contract, only the musicians themselves are present. If the rehearsal space is open to spectators, it is no longer considered a private establishment.

If the location is rented out or made available to third parties or staff members, or if many parties are to be organised at the location and it is thus operated as a party venue, it is a public establishment. This applies, as provided for in Article 6.7.2. of Chapter 6.7 of VLAREM II, even if access is restricted by, for example, an invitation, ticket, membership, etc.

↓ YES

NO

"MUSICAL ACTIVITIES" AT PRIVATE ESTABLISHMENTS

- You do not need to request or do anything regarding the "musical activity". Of course, it would be nice if you give your neighbours some notice.
- No noise regulations apply to the activity itself.
- Noise regulations do apply for neighbours indoors. It is not possible to deviate from these noise regulations.
- The applicable legislation is contained in Chapter 6.7 of VLAREM II.

Are the "musical activities" taking place outdoors or in a tent? (not in private gardens, see "musical activities" in private establishments for this)

↓ YES

NO

"MUSICAL ACTIVITIES" OUTDOORS OR IN A TENT

- The **maximum permitted sound level** for the music is **85 dB(A)** $L_{Aeq,15min}$.
- You do not need to request or do anything regarding the "musical activity" in this case. However, you may need to apply for some other licences or permits from the municipality or the police to organise the party.
- Noise regulations do apply for neighbours indoors as well.
- Do you want to play louder music? Follow the procedure under **permission** ** and take necessary **additional measures** *.
- The applicable legislation is contained in Chapter 6.7 of VLAREM II.

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"MUSICAL ACTIVITIES" AT PUBLIC ESTABLISHMENTS (ROOM OR VENUE)

How often are "musical activities" organised at the same place? (regardless of who the organiser is)

Sometimes (occasionally, less than 12 times a year)

Often (more than 12 times a year)

Louder than 85 dB(A) $L_{Aeq,15min}$	**Quieter than or equal to 85 dB(A) $L_{Aeq,15min}$**	**Louder than 85 dB(A) $L_{Aeq,15min}$ but quieter than or equal to 95 dB(A) $L_{Aeq,15min}$**	**Louder than 95 dB(A) $L_{Aeq,15min}$**
The applicable legislation regarding electronically amplified music is contained in Chapter 6.7 of VLAREM II (also noise regulations for neighbours indoors).		The applicable legislation regarding electronically amplified music is contained in Chapter 4.5 (noise regulations in the outdoor surroundings and for neighbours indoors in case of a shared wall) Section 5.32.2 and Article 5.32.3.10 of VLAREM II.	
• Follow the procedure under **permission** ** and take necessary **additional measures** *. • It is also possible to file a notification or apply for an environmental permit instead of a permission, but this is not mandatory (see options under **often**).	• You do not need to request or do anything regarding the "musical activity". • The **maximum permitted sound level** for the music is **85 dB(A) $L_{Aeq,15min}$**. • Noise regulations do apply for neighbours indoors as well. • Do you still want to play louder music several times a year? Follow the procedure under **permission** ** and take necessary **additional measures** *.	• It is a 3rd-class establishment, a **notification** must at least be made to the Board of Mayor and Alderman (subsection 32.1.1 or 32.2.2 of the classification list). • The **maximum permitted sound level** at the establishment (music + other sounds) is **95 dB(A) $L_{Aeq,15min}$**. • Noise regulations also apply in the surrounding outdoor area or for neighbours indoors in case of a shared wall. • You must take the necessary **additional measures** *. • Do you still want to play louder music several times a year? Follow the procedure under **permission** ** and take necessary **additional measures** *. You can also apply for an environmental permit if you wish (see right).	• It is a 2nd-class establishment, an **environmental permit** must at least be applied for from the Board of Mayor and Alderman (subsection 32.1.2 of the classification list). • The **maximum permitted sound level** at the establishment (music + other sounds) is **100 dB(A) $L_{Aeq,60min}$**. • Noise regulations also apply in the surrounding outdoor area or for neighbours indoors in case of a shared wall. • You take the necessary **additional measures** * and prepare a **"sound plan"** in the case of a permanent sound system. • For new establishments, a **full acoustic inspection** must be prepared. • It is not possible to deviate from the noise regulations using a permission.

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*** ADDITIONAL MEASURES**

Activities louder than 85 dB(A) $L_{Aeq,15min}$ but quieter than or equal to 95 dB(A) $L_{Aeq,15min}$

* You measure the sound level throughout the whole "musical activity" or install a sound level limiter.
* The sound level measured is visible to the person controlling the sound.
* The maximum permitted sound level is posted in the establishment.
* When the maximum permissible sound level is exceeded, it is immediately reduced until there is no further excess.

Additionally for **activities louder than 95 dB(A) $L_{Aeq,15min}$ but quieter than or equal to 100 dB(A) $L_{Aeq,60min}$**

* In addition to measuring, record the sound throughout the activity too (unless you have a sound level limiter installed).
* You provide free earplugs to the audience.

**** PERMISSION FOR PLAYING LOUDER MUSIC**

* You request a permission from the Board of Mayor and Aldermen including the desired maximum sound level (maximum 100 dB(A) $L_{Aeq,60min}$).
* According to the maximum permitted sound level allowed by the municipality, take the necessary **additional measures** *.
* Noise regulations in the neighbourhood/surroundings do not apply (except for "musical activities" less than 3 hours in 3rd-establishments); however, the Board of Mayor and Aldermen may impose some restrictive measures.
* Number of possible permissions:
  - For outdoor or tented activities, there is no limit on the number of activities for which permission can be given. The permission is linked to a 'special occasion', however.
  - For 3rd-class establishments, there is no restriction on permissions for activities lasting less than 3 hours and occurring between noon and midnight.
  - For all other activities, permissions are limited to 12 times per year (maximum 2 times per month, maximum 24 calendar days per year).
* You can request permission for multiple concrete activities in a single application.
* The Board of Mayor and Alderman can take various aspects into account when assessing the application, such as the capacity in the surroundings.

The above obligations are generally applicable in accordance with VLAREM regulations.

Alongside these obligations, additional obligations, conditions and/or measures may be imposed that apply to one specific establishment or "musical activity" or to several at the same time. For specific establishments or "musical activities", this can be done through the permission, notification or environmental permit for the operation of a classified establishment or activity. For multiple establishments and activities simultaneously and within a given territory, this can be done through the local police regulations. These additional measures are often imposed in line with the specific local situation and the capacity of the surroundings (e.g. a closing time, a complete acoustic inspection for an existing establishment, or measures resulting from this inspection).

2 FREQUENTLY USED TERMS

Some frequently used terms in noise regulations for “musical activities”.

2.1 WHAT IS SOUND?

Sound is created by vibrations in the air. When a sound source vibrates, the air molecules near that source vibrate along with it. The vibration continues, creating a sound wave that travels through the air. Human hearing is able to convert these vibrations or pressure changes into nerve impulses that are processed in the brain. The number of vibrations per second is the frequency expressed in Hertz (Hz).

In other words, sound is a variation in air pressure: the louder a sound, the greater the pressure. Setting air molecules into motion takes energy: the louder a sound, the more energy.

2.2 WHAT ARE DECIBELS?

The intensity of sound is expressed in decibels, abbreviated dB. The decibel is not a real unit, but instead a ratio of two values. In this case, the ratio of the air pressure in a given sound wave to the fixed reference pressure. The fixed reference pressure corresponds to the hearing threshold at 1,000 Hz (20 micropascal). By converting to decibels, this can easily be represented.

However, the decibel is not a linear scale. One example of a linear scale is distance expressed in metres, where 20m is double 10m, 40m is double 20m and so on. In the case of decibels, it is a logarithmic scale. A 3 dB increase is equivalent to a doubling of sound energy. As a result, the sound energy will increase much faster than the increase in decibels would suggest.

Activity	Decibels
Firearms, sirens, fighter jet (at close range)	up to 140 dB and above
Aircraft taking off at 50m distance	up to 140 dB and above
A mass of screaming children	110 – 120 dB
Live concert, festival	95 – 100 dB
Smartphone or portable music player at maximum level	90 – 115 dB
Petrol-powered lawn mowers and chainsaws	90 – 105 dB
Party, dance bar, disco	90 – 100 dB
Background music in restaurant or café	75 – 85 dB
Household appliances, shaver, alarm clock	70 – 85 dB
Noisy classroom, school bus, playground	70 – 85 dB
Office (printers, computers)	≈ 70 dB
Normal conversation	≈ 60 dB
Rain	≈ 50 dB
Quiet room, office	≈ 40 dB

Table 1: Indicative sound levels from different activities or places

2.3 WHAT IS THE RELATIONSHIP BETWEEN THE SOUND WE HEAR AND THE SOUND ENERGY OF THAT SOUND?

A difference of 1 dB between two sounds is barely perceptible, if at all, by humans. Starting at 3 dB, it is obvious to most people that two sounds differ from each other. Only from a difference of 10 dB most people do indicate that the sound is twice as loud.

However, the sound energy caused by the sound pressure exerted on the eardrum doubles when the sound level increases by 3 dB, and increases tenfold when it increases by 10 dB. Thus, what we perceive as a doubling of sound (a 10 dB increase) does not correspond to a doubling of sound energy, but rather to slightly more than ten times it!

So that also makes it the potential danger of high sound levels: you only register a difference in loudness when the sound energy is doubled, and thus the potential harmfulness being doubled. It is also the sound energy that determines the dose you are exposed to for a given time. In other words, every 3 dB increase in sound level means a halving of the time in which you can be exposed to high sound levels in a way that is safe for hearing.

2.4 WHAT IS AN A-WEIGHTING?

The ear filters the sound, being the vibrating air, that falls upon it and converts it into actual human sensation. As a result, the lower frequencies (100 Hz, for example) will sound softer to the human ear than the higher frequencies (1000 Hz, for example). But a sound level meter does not automatically respond in the same way. A sound level meter with a 'flat' response will measure the strength of the low-frequency sound as loudly as the high-frequency sound. To allow comparison with the human ear, electronic filters called weighting curves were developed that perform a correction. There are four weighting curves: A, B, C and D. The A-weighting is used to simulate the sensitivity of the human ear (stronger attenuation in the low frequencies). At very high sound levels (100 dB and above), the human ear does not flatten the low frequencies as much and the C-weighting more closely approximates human hearing.
Sound is measured in decibels (dB). When sound is measured according to the A-weighting, it is expressed in dB(A).

2.5 WHAT IS A C-WEIGHTING?

As with the A-weighting, this is an electronic filter or weighting curve. In the case of the C-weighting, the low frequencies are attenuated less than in the case of A-weighting. This means the proportion of low frequencies (bass) will weigh more heavily in the overall sound level than is the case with A-weighting.

2.6 HOW DOES A SOUND LEVEL METER WORK?

A microphone, like the ear, records the instantaneous sound pressure (the sound pressure at a given moment) that changes very rapidly over time. Countless variations in sound pressure are recorded every second. This sound pressure is then filtered – for example, by A-weighting – to allow for comparison with the human ear. The vibrations reaching the microphone follow each other so quickly that the human ear cannot follow this, and it is necessary to further process and average out the recorded sound pressure over a period of time. In the context of noise regulations for "musical activities", the following methods apply:

- Slow time weighting (L_{Aslow}): the last measured value weighs the most, while older values disappear exponentially from the average in a 'slow' manner (1 second);
- The energetic average sound energy where the sound pressure is averaged out over a given period "T" ($L_{Aeq,T}$).

2.7 WHAT IS LAMAX,SLOW?

L_{Aslow} is the A-weighted sound pressure level measured with a slow time weighting (1 second). It reflects a current sound level (a sound level at a given time).
$L_{Amax,slow}$ is the maximum that this sound pressure level reaches. In other words, this is the highest value of all recordings of L_{Aslow} measured over a given period of time (for example, a performance). $L_{Amax,slow}$ is available at any time from the start of measurement. This makes it easy to monitor, but once the maximum is reached, it will not decrease. That makes it more difficult to account for the dynamics in the music. $L_{Amax,slow}$ is available on the simplest sound measurement devices.

2.8 WHAT IS THE EQUIVALENT CONTINUOUS SOUND PRESSURE LEVEL OR LAEQ?

The A-weighted equivalent continuous sound pressure level or L_{Aeq} represents the constant sound pressure level that has the same sound energy as all actually measured (but highly fluctuating) instantaneous sound pressure levels combined over a given period of time. In brief, the instantaneous sound level is measured for a given time and then an average is calculated over that time. This is an energetic average and not simply the average value of all the sound pressure levels.

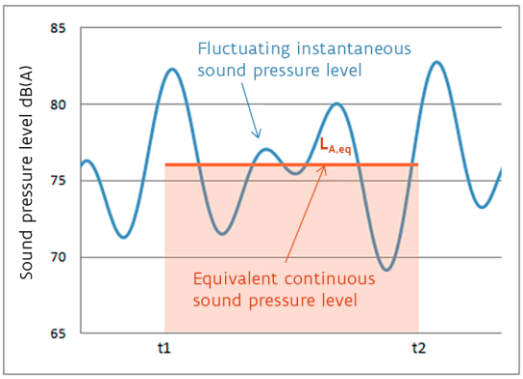

Figure 1: Equivalent continuous sound pressure level

It is a quantity that leaves some room for dynamics during a "musical activity" because it represents the sound level averaged over a longer period of time. In the case of noise regulations for "musical activities", this is 15 or 60 minutes. This allows loud passages to alternate with quieter moments.

What does this mean specifically? If music is permitted with a maximum sound level of 95 dB(A) $L_{Aeq,15min}$, then measurements must be taken for 15 minutes to know the sound level. During those 15 minutes, the music can be occasionally louder than 95 decibels, as long as it is also quieter than 95 decibels for a sufficiently long time. What matters is how loud the music is when averaged out during those 15 minutes. This means it is not so easy to quickly and 'at first hearing' assess whether or not music is exceeding this limit. Measuring and calculating such average values is mathematically quite complicated, but in practice, there are measurement devices that make these calculations immediately.

2.9 WHAT IS A MOVING AVERAGE?

A rolling or moving average is an average of a certain number of consecutive numbers in a time series. This average is recalculated each time new numbers are added to the time series. This recalculation always occurs after short time intervals – for example, every second.

What does this mean specifically for "musical activities"? The first $L_{Aeq,15min}$ is calculated over the period from the start to the last second of minute 15 of the measurement. The next $L_{Aeq,15min}$ over the period from second 1 through minute 15 + 1 second, the following over the period from second 2 through minute 15 + 2 seconds, and so on. And so this average moves along throughout the "musical activity", whereby you always factor in the sound level of the past 15 minutes.

2.10 WHAT IS A "SOUND PLAN"?

The purpose of a "sound plan" is to optimise sound distribution across the establishment. The "sound plan" must contain at least the following details:

1) The optimum arrangement and choice of speakers, taking into account the most efficient distribution of sound.
2) The measurement position.
3) The sound level at the measurement position and at least four other assessment locations.
4) The place where the sound level is controlled, the reference measurement position.
5) The floor plan to scale for the entire space accessible to the public.

The "sound plan" is mandatory for 2nd-class establishments with an environmental permit[2] and must be present at the establishment and available for inspection by the supervisory authority.

For short-term events at the licensed establishment for which an external sound system is used, it is not mandatory to prepare a "sound plan". The legislator makes this distinction so as not to require the operator or organiser to prepare a "sound plan" for every single event. This way, an event venue hosting a music group that brings its own sound system is not required to prepare a "sound plan" for each individual concert.

Of course, both the organiser or operator, the supervisor and the neighbourhood gain from optimising sound distribution. Therefore, it is recommended that for any "musical activity" producing high sound levels, the sound distribution should be as fine-tuned as possible.

2.11 WHAT IS AN ACOUSTIC INSPECTION?

The aim of a complete acoustic inspection is to identify and limit the impact of the establishment on its surroundings. It is only mandatory to prepare a complete acoustic inspection for a new establishment with "musical activity" that requires an environmental permit to operate a classified establishment or Class 2 activities[2].

The complete acoustic inspection shall include at least the following:

1) A clear description of the location and power of all appliances and installations that may have some impact on sound levels in the vicinity.
2) A detailed description of the measurement method and measurement conditions such that the measurement can always be repeated under the same conditions.
3) The sound levels measured at the establishment and in the surrounding area with clear indication of the monitoring stations. The acoustic inspection shall be carried out at the maximum power achieved during operation. This power shall be mentioned in the report.
4) The details included in Annex 4.5.2 of VLAREM II, including an assessment of sound levels measured relative to noise regulations in the surrounding area.

The full acoustic inspection is present at the establishment and available for inspection by the supervisory authority.

3 TO MEASURE IS TO KNOW

Experiencing sound is subjective. Music labelled 'too loud' by one person may be perceived as pleasant by another. The same sound level that you feel is 'acceptable' one day may be considered 'too loud' a day later. This is because perception of sound involves a variety of psychological and physical factors. What kind of music genre do you like? What mood are you in? How fresh or tired are you? How sensitive is your hearing? All of these things play a role in determining what you personally perceive as 'loud' or 'too loud'.

To know whether a given level is really within certain limits, you need to measure the sound. This section provides more information on how to do that.

[2] Establishments requiring an environmental permit with "musical activities" are classified under section 32.1.2° of VLAREM II.

4 WHEN DO I NEED TO TAKE A SOUND MEASUREMENT AND WHAT DO I NEED TO MEASURE?

If you organise a "musical activity" with a **maximum permitted sound level ≤ 85 dB(A) $L_{Aeq,15min}$** at a public establishment, then according to VLAREM II[5], you are not required to measure as an organiser or operator. If you still want to do so, you can measure the sound level either in $L_{Amax,slow}$ or $L_{Aeq,15min}$. What is the difference? Each sound level meter is equipped to measure $L_{Amax,slow}$. But to measure an equivalent sound level (L_{Aeq}), you need an integrating sound level meter and this is more expensive to buy. In case you want permission to play louder music on a special occasion, you need a device capable of measuring $L_{Aeq,15min}$ or you must use a sound level limiter. You can rent those, of course.

In accordance with VLAREM II[3], if you organise a "musical activity" with a **maximum permitted sound level > 85 dB(A) $L_{Aeq,15min}$ and ≤ 95 dB(A) $L_{Aeq,15min}$** at a public establishment, you must measure $L_{Aeq,15min}$ continuously at your own initiative and expense. As an alternative to a sound level meter, you may also use a sound level limiter.

In accordance with VLAREM II[4], if you organise a "musical activity" with a **maximum permitted sound level > 95 dB(A) $L_{Aeq,15min}$** at a public establishment, you must measure $L_{Aeq,15min}$ and $L_{Aeq,60min}$ continuously at your own initiative and expense and record $L_{Aeq,60min}$. As an alternative to a sound level meter, you may also use a sound level limiter.

"Musical activities" with a sound level **> 100 dB(A) $_{LAeq,60min}$** are **prohibited**.

Mandatory measurement of music by organiser in accordance with VLAREM II		
Maximum permitted sound level	**Private establishment**	**Public establishment**
≤ 85 dB(A) $L_{Aeq,15min}$	-	-
> 85 dB(A) $L_{Aeq,15min}$ and ≤ 95 dB(A) $L_{Aeq,15min}$	-	✓
> 95 dB(A) $L_{Aeq,15min}$ and ≤ 100 dB(A) $L_{Aeq,60min}$	-	✓

Table 2: Overview of the obligation to measure "musical activities" in VLAREM II.

There are no obligations for operators or organisers in VLAREM II to measure sound levels in the vicinity of the "musical activity".

If you organise a "musical activity" at a private establishment, then VLAREM II[5] does not impose a maximum permitted sound level and therefore you do not need to measure the sound level.

[3] In accordance with Article 5.32.2.2bis, §1, 3° for establishments with "musical activities" subject to notification (section 32.1.1°, class 3), Article 5.32.2.2bis, §2, 3° for establishments subject to environmental requirements with "musical activities" (section 32.1.1°, class 3) and Article 5.32.2.10, §3 for performance venues (section 32.2.2°, class 3) of VLAREM II.
[4] In accordance with Article 5.32.2.2bis, §2, 3° for establishments with "musical activities" requiring a notification (section 32.1.1°, class 3) of VLAREM II.
[5] In accordance with Article 6.7.3 for unclassified establishments of VLAREM II.

5 HOW DO I CHOOSE THE RIGHT SOUND LEVEL MEASUREMENT EQUIPMENT?

There are a number of elements that determine the quality of your sound level measurement. First and foremost, the choice of sound level measurement equipment is very important.

Sound level measurement equipment consists of three components:

- A measurement device, a sound level meter, whose characteristics determine what you can measure ($L_{Amax,slow}$, L_{Aeq}, etc.).
- A microphone whose characteristics determine the quality of measurement.
- The cable that connects both.

In order to provide a minimum guarantee for the quality of your measurement, Annex 5.32.2.2bis of VLAREM II requires that your sound level measurement equipment (i.e. microphone + cable + sound level meter) meets the accuracy requirements of an internationally accepted standard for class 2 sound level measurement equipment (NBN EN 60651 (1996) or more recent)[6].

In addition, the arrangement of the device and microphone and its operation also contribute to the quality of the measurement.

5.1 WHAT CONDITIONS DOES MY SOUND LEVEL MEASUREMENT EQUIPMENT NEED TO MEET?

The sound measurement and recording equipment you use when you organise a "musical activity" with a maximum permitted sound level > 85 dB(A) $L_{Aeq,15min}$ must meet the following requirements[7]:

- The equipment must meet the accuracy requirements set for Class 2 sound level measurement instruments in the NBN standards.
- The equipment must be installed such that it cannot be manipulated by third parties. This also applies to the measurement microphone.
- The measurement microphone should be installed such that it is not shielded from the sound to which visitors are exposed.
- The equipment must be equipped for measurement during the entire "musical activity".
- The measurement equipment can be inspected by the supervisory authorities at any time.

The person controlling the sound must be able to continuously monitor the sound level on an electronic display (see also 7.5).

It is recommended, but not mandatory, to measure in the vicinity of the reference measurement position as defined in VLAREM II[8], because the supervisor will also measure there (see also 6).

[6] Article 2 of Annex 5.32.2.2bis of VLAREM II states that the measurement and recording equipment must meet the accuracy requirements set for Class 2 measurement instruments. The most recent standard is NBN EN 61672 'Electro-acoustics – Sound level meters'. VLAREM also allows for the use of older sound level meters that may not meet the accuracy requirements of NBN EN 61672, but do meet those of NBN EN 60651. The standard is listed with the device specifications and defines the magnitudes and accuracy of the device.
[7] In accordance with Article 2 of Annex 5.32.2.2bis of VLAREM II.
[8] In accordance with Article 2 of Annex 5.32.2.2bis of VLAREM II.

The use of a sound level limiter as a substitute for a sound level meter is permitted by VLAREM II[9] (see also 5.2).

5.2 WHAT SHOULD I DEFINITELY LOOK FOR WHEN BUYING SOUND LEVEL MEASUREMENT EQUIPMENT?

The following are some basic characteristics that sound level measurement equipment must meet in order to perform measurements correctly.

Measurement device

! In any case, ask the supplier for proof that the measurement device meets the accuracy requirements set for class 2 sound level meters (in accordance with NBN EN 61672)[7].

This can be demonstrated using an independent calibration certificate for the entire measurement chain (i.e. microphone + cable + sound level meter) prepared by a European-accredited calibration laboratory. Also ask for a good and clear manual. Can the supplier not provide these two things? Then it is best to look for another supplier.

Your measurement device needs the following technical capabilities:

- time weighting: must be able to measure with a slow integration time, namely Slow (1 second). Devices that can measure with a slow integration time can usually also do so with a fast integration time, namely Fast (125 milliseconds);
- measurement range: for use during "musical activities", high sound levels must especially be measured. This is indicated by intervals, e.g. 30-100 dB, 60-130 dB. For "musical activities", choose a measurement range with an upper limit greater than 100 dB;
- frequency weighting: at least A-weighting;
- measurement over variable period (start/stop) needs to be possible;
- equipped to measure the sound pressure level (Lp) with the time weighting Slow;
- equipped with a 'max-hold' function so that the maximum can be displayed;
- equipped to measure the equivalent continuous sound level $L_{Aeq,15min}$. This is only the case with integrating sound level meters;
- deviation: maximum 1.4 dB at 1000Hz;
- ability to measure a moving average;
- display of sound level: continuous indication of the sound level in $L_{Aeq,15min}$ visible to the person controlling the sound. For this, the measurement device must have a simple, large and easy-to-read display. If this is not the case, you will need another external display;
- recording sound level: the sound level expressed in $L_{Aeq,60min}$ must be recorded so that you can save and print the measurement results. The device must have internal storage capacity for this, or an output for external storage with a capacity for at least one month's data. This is only required for "musical activities" with maximum permitted sound levels > 95 dB(A) $L_{Aeq,15min}$ and ≤ 100 dB(A) $L_{Aeq,60min}$. Ask how this data is stored. Preferably, this will be in the form of 1-second readings and not as a graph.

[9] In accordance with Article 5.32.2bis, §1, 3° for establishments with "musical activities" (section 32.1.1°, class 3), Article 5.32.2bis, §2, 3° (section 32.1.2°, class 2) and Article 5.32.3.10, §3 for performance venues (section 32.2.2°, class 3) of VLAREM II.

Measurement microphone

When choosing a measurement microphone, it is important that it meets at least the Class 2 conditions for microphones (in accordance with NBN EN 61672)[7]. Ask the supplier to prove this (see also *Measuring Device*).

It is also important that the measurement microphone has an **omnidirectional polar pattern**. This means that the measurement microphone picks up sound from all directions equally. It can either be a free field type or a diffuse field type of measurement microphone. In case you use a free field microphone, it should be pointed towards the dominant sound source (typically the main speaker or stage). In case you use a diffuse field microphone, you should not point it towards a specific sound source, but point it towards the ceiling (or the floor if the measurement microphone is suspended from the ceiling). Also provide an accompanying **windscreen**, which will help avoid interference sound and raise the quality of your measurement. If necessary, seek advice from the supplier on the choice of measurement microphone.

Sound level limiter

If you use a sound level limiter:

- You must be able to set it so that the sound level during "musical activities" meets the maximum permitted sound level.
- This eliminates the obligation to measure and record sound levels.

Keep in mind, however, that most sound level limiters limit music based on sound peaks rather than average sound levels. As a result, a sound level limiter limits the dynamics of music and is difficult to use with live music. When playing music during a party, for example, a sound level limiter is useful.

5.3 DO I BUY OR RENT SOUND LEVEL MEASUREMENT EQUIPMENT?

It is not always necessary to purchase sound level measurement equipment yourself. If you are organising a one-time or occasional "musical activity", ask first whether you can rent this equipment. For example, at the music equipment rental company or the municipal or provincial loan service. In municipalities, youth departments or event departments are often the contact point for this. You can rent it for a relatively low amount, especially when compared to the total amount of money you need to rent a music system. Sometimes, the devices are even provided by the municipality or province to organisers free of charge.

If you rent sound level measurement equipment, it is best to check the equipment with a calibration source (see 7.3), both when you pick it up and when you return it. Not only will this ensure that your measurement equipment is displaying the correct values, it also prevents disputes over possible microphone damage.

Depending on the nature of the venue and the number of "musical activities" organised, the purchase of sound level measurement equipment does make for a good investment.

5.4 CAN I USE A SMARTPHONE OR OTHER MEDIA DEVICE?

! There are several types of apps on the market that allow you to measure sound levels using a smartphone or other media device. Please note! This will not allow you to make any accurate measurements because a smartphone is not designed to carry out sound level measurements.

Nor does a smartphone or other media device come equipped with a microphone suitable for this purpose as standard. So keep in mind a deviation of a few decibels. They can give you an indication of the sound level, but do not meet the requirements for sound level measurement equipment as stated in VLAREM II[10].

However, the use of an app on a smartphone is permitted if its purpose is to display the data recorded by the actual sound level meter.

6 HOW DO I DETERMINE THE MEASUREMENT POSITION?

6.1 PRIVATE "MUSICAL ACTIVITIES"

If you organise a "musical activity" at a private establishment, then VLAREM II does not impose a maximum sound level and the determination of a measurement position is there for not applicable[11].

Do make sure you **do not unnecessarily increase the sound level**. Both to protect yourself and your guests from hearing damage and to reduce disturbance in the surroundings.

Be sure to respect the noise regulations in the surroundings. These do apply to private activities.

6.2 "MUSICAL ACTIVITIES" WITH A MAXIMUM PERMITTED SOUND LEVEL ≤ 85 dB(A) $L_{AEQ,15MIN}$

If you organise a "musical activity" with a maximum permitted sound level ≤ 85 dB(A) $L_{Aeq,15min}$, then you are not required to measure as an organiser or operator. Therefore, no measurement position is described in the text of Chapter 6.7 of VLAREM II.

! As an organiser or operator, you are **not required to measure** but a supervisor may check the sound level at the reference measurement position.

For this type of "musical activity", the **maximum permitted sound level applies at any place accessible to the public**[12]. This therefore means that the supervisor may check the sound level at any place accessible to the public.
Do you still want to install your own sound level meter to track sound levels? Then follow the guidelines as defined for "musical activities" with a maximum permitted sound level > 85 dB(A) $L_{Aeq,15min}$.

[10] In accordance with Article 2 of Annex 5.32.2bis of VLAREM II.
[11] In accordance with Article 6.7.3, §3 for unclassified establishments in VLAREM II.
[12] In accordance with Article 6.7.3, §2 for unclassified establishments in VLAREM II.

6.3 "MUSICAL ACTIVITIES" WITH A MAXIMUM PERMITTED SOUND LEVEL > 85 dB(A) $L_{AEQ,15MIN}$

If you organise a "musical activity" with a maximum permitted sound level > 85 dB(A) $L_{Aeq,15min}$, this **sound level applies at the measurement position** as defined in VLAREM II[13]. Unless another measurement position is stipulated as a special condition in the notification or environmental permit.

Therefore, since the maximum permitted sound level applies at this measurement position, it should be seen first and foremost as the site of the supervisor's inspection. Of course, as an organiser or operator, it is recommended that you also choose this place yourself to monitor the sound level. This is to avoid any discussions about that later on. Also make sure that the supervisor can reach this measurement position.

When finding a suitable measurement position (the place where the microphone hangs), there are three main elements to consider: measurement height, distance from the speakers and distance from the stage or the centre of the room. Because these criteria vary from location to location, the regulations delineate a zone within which you can determine the measurement position yourself, depending on the specific situation.

6.3.1 Measurement height

To give you a choice between different methods of attachment, the measurement height is set between 1.5 and 3 metres above the floor. Remember that you should preferably measure just above the audience plane. Also respect a distance of at least 0.5 metres from the ceiling and walls to avoid influences from reflection[14].

There are several ways to attach a measurement microphone:

- Mounted on the measurement device, placed on a tripod.
- Mounted on a tripod and connected to the measurement device with an extension cable.
- Suspended from the ceiling and connected to the measurement device with an extension cable.

Always **ensure that the measurement device and measurement microphone cannot be manipulated by unauthorised persons**.

The measurement height is set between 1.5 and 3 metres above the floor because, on the one hand, the sound is shielded if you measure too low, for example behind the audience's back. On the other, because if you measure too high above the audience, you may be recording lower and therefore erroneous sound pressure levels. Especially in the higher frequencies. This is especially true when using a line array[15], which spreads the sound in a very focused manner across the audience area. That is, the speakers are set such that the desired sound level is achieved at the audience area. The higher above the audience area, the lower the sound level.

[13] In accordance with Article 2 of Annex 5.32.2.2bis of VLAREM II.
[14] In accordance with Annex 5.32.2.2bis of VLAREM II.
[15] A line array consists of a long column of speakers suspended below one another at a pre-calculated spread angle. This speaker system is also sometimes compared to a banana due to its characteristic shape. A sufficiently high and sturdy base is needed to hang the system from, so it cannot be used for every "musical activity".

Ideally, if you have the microphone suspended from the ceiling, the suspension height is at least 1 metre and at taller venues at least 2 metres. Too short a distance may give a distorted picture because the sound level rises rapidly just at the surface of a wall. This may mean you are measuring incorrectly. In rooms with low ceilings, this is not always possible, so respect at least a distance of 0.5 metres from the ceiling.

6.3.2 Distance from the speakers

! Those who can get to a very short distance from loudspeakers are at risk of being exposed to high to very high sound levels and suffering hearing damage[16]. So do **make sure the audience cannot get too close to the speakers – hearing damage is irreversible**.

Very close to a speaker (0.5 – 1.0 metres), the increase in sound level is difficult to predict exactly, but in any case, the sound level increases very rapidly. Of course, such a situation is to be avoided. This means that as an organiser or operator, you must ensure that the audience cannot come closer than 1 metre to the speaker. If this is nonetheless the case, the supervisor is justified in measuring closer to the speaker as well. Indeed, it should not be forgotten that a 3 dB(A) increase in sound level means a doubling of sound energy and thus also increases the risk of hearing damage. More information on this can be found earlier in this document under section 2.

This makes it very important to make sure the audience does not get too close to the speakers. Therefore, the recommendation is to set up the stage or venue so that the audience cannot possibly approach the speakers closer than 1 metre, and preferably stay 1.5 – 2 metres from the speakers.

6.3.3 Position in the venue

One important element in determining the measurement position is choosing a **position in the venue that well reflects the average audience exposure to the sound level**. In other words, the measurement position should be sited where the audience can get to and, moreover, centrally between the (main) speakers. The Front of House is suitable as measurement position in those cases where the Front of House is set up between the audience and in a central location between the speakers. If this is not the case, you need to find another measurement position, taking into account elements described above.

Below are some additional tips to help you choose a good measurement position.

- If speakers are spreading the music in a single direction across the audience (usually starting from the stage), choose a measurement position at 1/2 to 2/3 of the distance between the stage and the furthest point of the audience area with a maximum of 70 metres.
- If speakers are spreading the music in different directions across the audience, choose a measurement position centrally between the speakers, at the intersection of the imaginary axes through all the speakers.

The illustrations below show what this could mean for different types of room layouts, as well as outdoors or in a tent.

[16] How much higher depends on the nature of the sound source. Thus, a distinction is made between point sources and line sources (e.g. roads). Ideally, if we were to simplify a sound source to a point, we could say that the sound level increases by 6 decibels per halving of the distance. But a real sound source, such as a loudspeaker, is not an ideal point source. This increases the sound level slightly less than 6 decibels per halving of the distance; values of 3 – 5 dB(A) per halving of the distance are realistic at short distances from a speaker (0.5 – 2 metres). The farther you are from the source, the more other influences there will be, making this effect less pronounced.

Outdoors or in a tent

In an indoor space

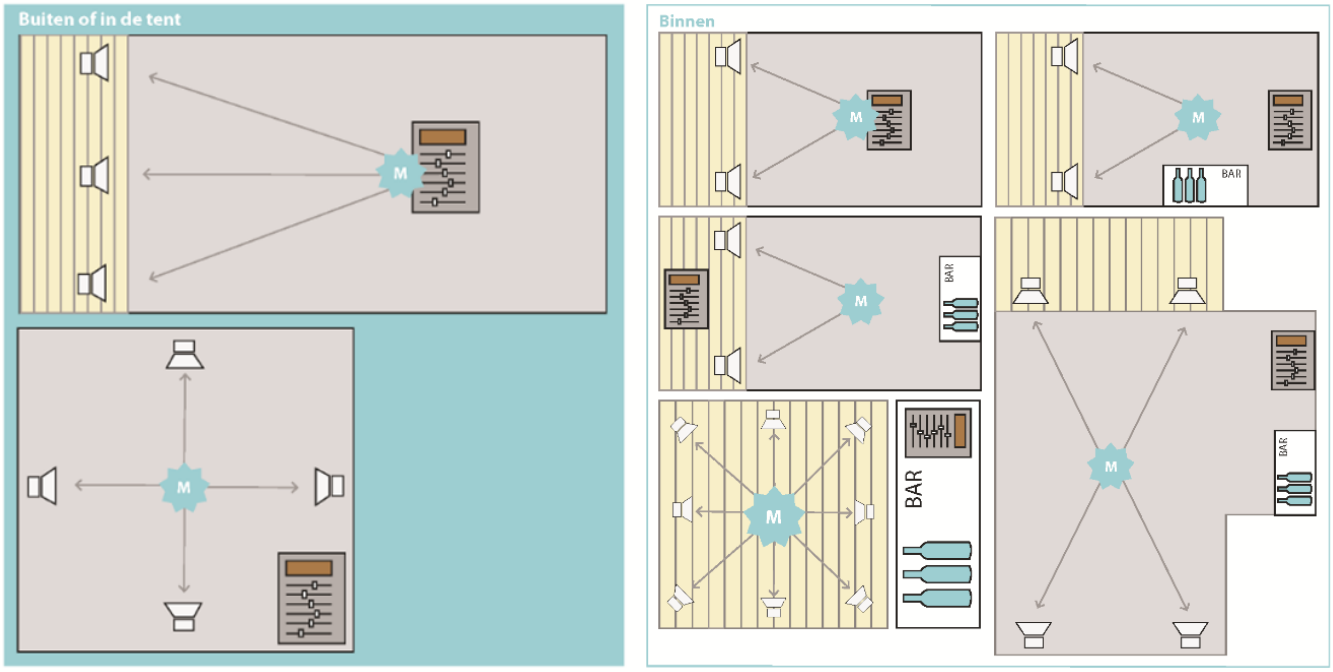

Figure 2: Examples of measurement positions at “musical activities”.

Multiple stages

In case there are multiple stages during the “musical activity”, measure the sound level in the vicinity of each stage separately.

6.3.4 Correction factor

In some cases, such as when using a stand, it will not be possible to adhere to the measurement height as defined in VLAREM II. You need to make sure that the microphone is not in the field of vision of the back rows of the audience. In this case, you can determine the sound level at a number of points in the venue prior to the “musical activity”. For example, just above the audience area and at the place where you want to hang the measurement microphone. When tuning your sound system, you must then take into account the difference between the two. For example: you know that the difference in sound level just above the audience area and the place where the measurement microphone is hanging is 3 dB(A). If the maximum permitted sound level is 100 dB(A) $L_{Aeq,60min}$, the sound level at the location where the measuring microphone is hanging may not exceed 97 dB(A). Keep in mind that the supervisor will carry out the inspection at a height between 1.5 and 3 metres above the floor[17]. It is recommended that a correction factor is determined in consultation with the supervisory authority. Or at least to be able to demonstrate why you are hanging the measurement microphone elsewhere and why this is a more representative place than the position determined in VLAREM II.

[17] In accordance with Annex 5.32.2.2bis of VLAREM II.

7 HOW DO I PERFORM A SOUND LEVEL MEASUREMENT?

7.1 ACCURACY OF SOUND LEVEL MEASUREMENT EQUIPMENT

As an organiser or operator, in most cases you measure with a Class 2 sound level meter. Inspection by supervisors is mandatory with a Class 1 sound level meter[18]. As the name suggests, a Class 1 sound level meter is more accurate than a Class 2 sound level meter.

! When purchasing a sound level meter, have regard to the deviation specified. **Keep this deviation in mind when taking measurements**.

For example, if your sound level meter has a deviation of 2 decibels, it means that you should build in a margin of 2 decibels while measuring. If you want to maintain a maximum permitted sound level of 95 dB(A) $L_{Aeq,15min}$, for example, in that case you cannot be sure you are not going over this maximum until you are maintaining a sound level of 93 dB(A) $L_{Aeq,15min}$.

You can ask the supplier of your device to demonstrate what its deviation is. For this, it is best to ask them for an independent calibration certificate for the entire measurement chain, prepared by a European-accredited calibration laboratory (see also 5.2). You can also compare the accuracy of your device to a Class 1 sound level meter. We will discuss this further in 7.3.

7.2 INSTALLATION OF SOUND LEVEL MEASUREMENT EQUIPMENT

! **Check carefully that the measurement device and measurement microphone are correctly installed**. A supervisor will also report you if he or she finds that you are deliberately manipulating the equipment so that lower sound levels are measured.

First and foremost, the sound level measurement equipment must be installed according to the supplier's or lessor's instructions. Have particular regard to microphone placement. Mount the measuring device with microphone securely on a tripod. You can also use a device with a detachable microphone, which is then hung from the ceiling of the venue with an extension cable, for example, or mounted on a tripod. This offers the advantage that the measurement device and measurement microphone can be located in different places (see also 6.3).

You can also use an external display that shows the sound level. This is because the person controlling the sound must have a view of the sound level at the measurement position, but the most ideal place for reading the sound level is not always the most ideal place to install the measurement microphone.

When attaching cables, be careful not to over-tighten them. This is because a crimped wire can affect the measurement. Provide your microphone with an accompanying windscreen, which will give added protection.

[18] In accordance with Annex 4.5.1, Article 3 of VLAREM II.

Choose the measurement position in accordance with the principles described in Chapter 6. This is where the measurement microphone will be attached; you can place the measurement device itself in another place at the establishment. Make sure there are no elements shielding the microphone. For verification, check that there is a direct line of sight from the measurement microphone to the speakers – then you will know that the sound is not being obstructed by any obstacles.

! Provide a simple and clear manual with the sound level measurement equipment for those who need to work with it.

For operators of establishments where "musical activities" are regularly organised by external organisers, it may be useful – among other things with regard to liability – to establish some house rules for taking measurements. Some elements you can include in this:

- The house technicians will verify that the measurement is being performed by the guest technicians and that it is being done correctly. A log will be kept of this.
- For each "musical activity", a printout of the measured values should be inserted into a folder or a file should be kept in a digital folder.
- Names of DJs and guest technicians are kept on a per-session basis.
- Etc ...

7.3 CALIBRATION OF SOUND LEVEL MEASUREMENT EQUIPMENT

There are no obligations related to calibration of Class 2 sound level meters in VLAREM II. Class 1 sound level meters do require mandatory calibration by means of a calibrator or calibration source for each measurement or series of measurements[19]. A calibrator is a standard sound source that emits a constant tone (usually 94 dB(A) at 1000 Hz) that you can use to test the accuracy of your measurement device. A calibration source that emits a continuous sound also exists for Class 2 sound level meters.

If the setup of your measurement microphone allows it, it is **recommended that you regularly check your device with such a calibration source to ensure that it's still functioning properly**. Ideally, do this before each new "musical activity". If, after checking with your calibration source, you doubt the accuracy of your measurement device, it is best to contact the supplier.

Another way to calibrate your device is to compare its performance with a Class 1 sound level meter. You can do this by playing either a music track or a standard sound signal such as red noise or pink noise. The red or pink noise has the advantage that its properties are known, which makes it easier to compare. Such sound sources are also used, for example, when testing sound level measurement devices. The red noise or pink noise is then measured simultaneously with the two devices. You can use the same principle to check whether there is a difference between the measurement results for your device and the Class 1 device. Then you can take account of the difference between the two during your "musical activity". A Class 1 sound level meter is more accurate because of its higher quality and consequently higher price. Moreover, mandatory regular calibration of the measurement equipment keeps the measurement results more stable. As a result, they show fewer deviations than Class 2 sound level meters.

[19] In accordance with Article 3 of Annex 4.5.1 of VLAREM II.

In some municipalities, organisers' Class 2 sound level meter is checked by the responsible municipal department (environmental department, youth department, etc.) or by the police before the start of the event using a Class 1 sound level meter. You can ask about this.

Finally, you can also have your device calibrated, say annually, by an environmental expert recognised in the discipline of sound and vibrations. Of course, this comes at a cost. More information: List of recognised experts in sound and vibration (only in Dutch).

7.4 STARTING THE SOUND LEVEL MEASUREMENT

! Start the sound level measurement at the time when the "musical activity" is accessible to the public. You also measure background music and sound check.

7.5 POINTS FOR CONSIDERATION WHILE MEASURING

7.5.1 Continuous measurement of the sound level

! Measure the sound level continuously with a rolling or moving average (see also 2).

During a "musical activity" with a maximum permitted sound level > 85 dB(A) $L_{Aeq,15min}$ and ≤ 95 dB(A) $L_{Aeq,15min}$, it is mandatory to measure $L_{Aeq,15min}$ always and continuously. For "musical activities" with a maximum sound level > 95 dB(A) $L_{Aeq,15min}$, it is additionally mandatory to measure $L_{Aeq,60min}$ always and continuously[20].

Continuous measurement of the sound level – moving average		
Maximum permitted sound level	**$L_{Aeq,15min}$**	**$L_{Aeq,60min}$**
≤ 85 dB(A) $L_{Aeq,15min}$	-	-
> 85 dB(A) $L_{Aeq,15min}$ and ≤ 95 dB(A) $L_{Aeq,15min}$	✓	-
> 95 dB(A) $L_{Aeq,15min}$ and ≤ 100 dB(A) $L_{Aeq,60min}$	✓	✓

Table 2: Overview of the obligation of continuous measurement of the moving average.

[20] In accordance with Article 5.32.2.2bis, §1, 3° for establishments with "music activities" subject to notification (section 32.1.1°, class 3), Article 5.32.2.2bis, §2, 3° for establishments subject to environmental requirements with "music activities" (section 32.1.1°, class 3) and Article 5.32.2.10, §3 for performance halls (section 32.2.2°, class 3) of VLAREM II.

7.5.2 Display of the sound level

! You are required to continuously display the sound level in $L_{Aeq,15min}$ during the "musical activity" to at least the person controlling the sound at the Front of House[20].

Mandatory monitoring of the sound level allows the person controlling the sound to monitor the sound level throughout the "musical activity" and thus avoid exceeding the standard. There are also a number of systems through which you can also keep the audience informed of the prevailing sound level. The choice as to whether or not to use these is left to the organiser.
Please note! In any case, you are required to display the maximum permitted sound level in $L_{Aeq,15min}$ and $L_{Aeq,60min}$ in a clearly visible place for the audience at the entrance and at the Front of House[20].

7.5.3 Adjusting the sound level

! You are obliged as an operator or organiser to keep the sound level under control[20].

The noise regulations require you to adjust the sound level if it exceeds the maximum permitted sound level. The supervisor may also file a report on the basis that the sound level is not being adjusted if it exceeds the permitted sound level. So intervene immediately if you detect abnormal values or the measurement device fails. Keep in mind any correction factor you may have used (see also 6.3.4).

7.5.4 Recording the sound level

! The sound level for "musical activities" with a maximum permitted sound level > 95 dB(A) $L_{Aeq,15min}$ should not only be measured, but also recorded. You must keep the data recorded, expressed in $L_{Aeq,60min}$, available to the supervisory authority for a period of at least one month[21].

This way, the supervisor has the opportunity to request measurement data from a "musical activity" for one month if, for example, there have been complaints. It is not required by VLAREM II to provide this data to the supervisor on one's own initiative. It is possible that the local authority will impose this in the permission from the Board of Mayor and Aldermen, notification or environmental permit.

The noise regulations do not specify whether you must keep the data digitally – for example, a record of 1-second readings – or in the form of a printout, for example a graph. It is clearer for both yourself and the supervisor if the device keeps track of 1-second readings.

The data recorded does not give any direct grounds for issuing an official report for exceeding the standard, because enforcement must take place based on determinations with a certified Class 1 sound level meter. However, the data recorded can be used to show that the sound level was not immediately adjusted by the person controlling the sound. And this can be fined. The supervisory authority can also use the data recorded to impose special conditions upon the permission from the Board of Mayor and Aldermen, notification or environmental permit at a subsequent edition. For example, in case of repeated excesses or complaints.

[21] In accordance with Article 5.32.2.2, §2, 3° for establishments requiring environmental protection with "music activities" (section 32.1.1°, class 3) of VLAREM II.

7.5.5 Using a sound level limiter

It is permitted to use a sound level limiter instead of a sound level meter.

If you use a sound level limiter, this eliminates the obligation to measure and record sound levels[20]. Of course, you still have to meet the other conditions. A sound level limiter is adjusted by the supplier or environmental expert recognised in the discipline of sound and vibrations. So basically, at the start of the "musical activity", you just need to turn the device on. Keep in mind, however, that a sound level limiter limits based on sound peaks rather than average sound levels. As a result, a sound level limiter limits the dynamics of music and is difficult to use with live music. When playing music during a party, for example, a sound level limiter is useful.

7.6 ENDING THE SOUND LEVEL MEASUREMENT

You end the sound level measurement when the music stops or when all the audience has left the venue.

COLOPHON

Published by
Toon Denys
Department of Environment & Spatial Development
Koning Albert II-laan 15 bus 547, B-1210 Brussels
www.omgevingvlaanderen.be

Composition and Editing
Department of Environment and Spatial Development, Policy Development and Legal Support Division
bjo.omgeving@vlaanderen.be

Cover photo
Shutterstock

Publication date
July 2024

Catalogue number
D/2024/3241/242

DEPARTMENT OF
ENVIRONMENT
& SPATIAL
DEVELOPMENT

postal address
Koning Albert II-laan 15 bus 547
1210 Brussel

omgeving.vlaanderen.be