A-Weighting vs C-Weighting vs Z-Weighting: Which to Use

A complete guide to frequency weighting in sound measurement. Learn when to use A-weighting (dBA), C-weighting (dBC), and Z-weighting (dBZ), and how to choose the right one for noise complaints, occupational safety, and acoustic research.

Author: Lubor Šimůnek · Published: May 2, 2026 · Productivity

Online version: https://appstoryo.com/en/blog/a-weighting-vs-z-weighting-sound-measurement



If you have ever looked at a sound level meter app and noticed options like dBA, dBC, or dBZ, you have encountered frequency weighting. These letters after the dB reading fundamentally change what your measurement means, how it relates to human hearing, and whether your data will be accepted by regulatory agencies or courts.

Choosing the wrong frequency weighting can invalidate an entire noise survey. This guide explains what each weighting does, when to use it, and how to switch between them in practice.

Download NoiseLedger free on iOS

What Is Frequency Weighting?

Sound is made up of vibrations at many different frequencies simultaneously. The human ear does not hear all frequencies equally — we are most sensitive to frequencies between roughly 1000 Hz and 5000 Hz (the speech range) and much less sensitive to very low or very high frequencies. A 50 Hz tone at 60 dB sounds much quieter to us than a 2000 Hz tone at 60 dB, even though both carry the same acoustic energy.

Frequency weighting is a mathematical filter applied to the raw sound measurement to

account for this uneven perception. Different weighting curves emphasize or de-emphasize certain frequency ranges, producing a result that better represents a specific aspect of the sound. The three primary weighting curves are A-weighting, C-weighting, and Z-weighting. Each serves a distinct purpose, and the right choice depends entirely on what you are measuring and why.

A-Weighting (dBA)

A-weighting is the most widely used frequency weighting in sound measurement. It was designed to approximate the frequency response of the human ear at moderate listening levels (around 40 phons) and has been adopted as the default weighting for virtually all noise regulations worldwide.

How A-Weighting Works

The A-weighting curve significantly reduces the contribution of low frequencies to the overall measurement. At 50 Hz, it applies approximately -30 dB of attenuation. At 1000 Hz, the curve applies zero correction (0 dB), and between 1000–6000 Hz it provides a slight boost before rolling off at very high frequencies. In practical terms, A-weighting tells you how loud a sound *seems* to the average human listener.

When to Use A-Weighting

- **Workplace noise compliance.** Both OSHA and NIOSH base their exposure limits on A-weighted measurements. If you are measuring noise for occupational health purposes, you must use dBA.
- **Environmental noise monitoring.** Municipal noise ordinances, construction noise limits, and environmental impact assessments almost universally specify A-weighting.
- **Noise complaints.** If you are documenting noise for a complaint to your landlord, local council, or housing authority, dBA is the standard they will expect and understand.
- **Traffic noise.** Road, rail, and aircraft noise studies use A-weighting as their primary metric.
- **General sound level surveys.** When in doubt, A-weighting is the safe default choice because it is universally recognized and understood.

NoiseLedger supports A-weighting as its default measurement mode, giving you instant dBA readings directly comparable to regulatory limits.

Download NoiseLedger free on iOS

C-Weighting (dBC)

C-weighting provides a much flatter frequency response than A-weighting, particularly in the low-frequency range. It only applies about -3 dB at 31.5 Hz and is essentially flat from 50 Hz to 8000 Hz, making it far more sensitive to low-frequency noise energy.

How C-Weighting Works

The C-weighting curve was originally designed to represent the human ear's response at high sound pressure levels (around 100 phons), where our hearing becomes more linear across frequencies. The practical result is that dBC readings will always be equal to or higher than dBA readings for the same sound source. The difference between dBC and dBA (often written as C–A) is a useful diagnostic: a large C–A difference (greater than 10 dB) indicates significant low-frequency content that A-weighting is not capturing.

When to Use C-Weighting

- **Peak and impulse noise measurement.** Many regulations specify C-weighting for peak sound pressure levels (Lpeak), including OSHA's 140 dBC peak limit for impulse noise. Gunshots, explosions, and impact noises are measured in dBC.
- **Low-frequency noise assessment.** If someone complains about bass rumble from a nightclub, an HVAC system, or industrial machinery, C-weighting captures the offending energy that A-weighting would mask.
- **Music venues and entertainment.** Concert sound levels and DJ monitoring often use C-weighting because music has substantial bass content.
- **Hearing protector selection.** The C–A difference helps determine whether low frequencies dominate, influencing the type of hearing protection needed.
- **Diagnostic screening.** Comparing dBA and dBC readings of the same source reveals the frequency character without a full spectral analysis.

Z-Weighting (dBZ)

Z-weighting stands for "zero weighting" — it applies no frequency filtering whatsoever. The measurement is flat (within ±1.5 dB) from 10 Hz to 20,000 Hz, capturing all acoustic energy equally. Z-weighting was standardized in IEC 61672:2003 to replace the older "Linear" or "Flat" designations that varied between manufacturers.

How Z-Weighting Works

With Z-weighting, the sound level meter applies no perceptual correction. A 50 Hz tone at 70 dB reads as 70 dBZ, and a 4000 Hz tone at 70 dB also reads as 70 dBZ. The measurement represents pure acoustic energy without any human-hearing approximation, making Z-weighting the most objective measurement but also the least intuitive for understanding perceived loudness.

When to Use Z-Weighting

- **Acoustic research.** When you need to know the actual physical sound pressure level without any perceptual bias, Z-weighting provides the ground truth.
- **Equipment testing and calibration.** Testing loudspeakers, microphones, and audio equipment requires flat measurements to characterize performance.
- **Building acoustics.** Measuring transmission loss through walls, floors, and windows often requires unweighted data for frequency band analysis.
- **Source characterization.** When you need to understand the full frequency content of

a noise source before deciding which regulatory weighting applies.

- **Scientific measurements.** Any application where you need raw, unfiltered acoustic data for post-processing or comparison with theoretical models.

NoiseLedger supports Z-weighting alongside A-weighting, allowing you to capture unfiltered acoustic data for technical analysis. Combined with the FFT spectrum view, you get both the overall unweighted level and the detailed frequency breakdown in a single session.

Download NoiseLedger free on iOS

Quick Comparison Table

Parameter	A-Weighting (dBA)	C-Weighting (dBC)	Z-Weighting (dBZ)
Frequency response	Heavily filters low frequencies	Nearly flat, slight roll-off below 31 Hz	Completely flat 10–20,000 Hz
Simulates	Human hearing at moderate levels	Human hearing at loud levels	No perceptual simulation
Best for	Noise complaints, OSHA, general monitoring	Peak/impulse noise, low-freq assessment	Research, calibration, raw data
Regulatory use	Most noise laws and standards	Peak limits, entertainment noise	Rarely required by regulation
Low-freq sensitivity	Low (attenuates bass heavily)	High (mostly flat response)	Full (no filtering)
Typical reading vs dBZ	Lower (especially with bass-heavy noise)	Slightly lower or equal	Reference level
NoiseLedger support	Yes	No	Yes

Which Weighting Should You Use?

The decision comes down to your measurement purpose. Here is a practical decision framework.

Use A-Weighting (dBA) When:

- You are measuring for OSHA, NIOSH, or any workplace noise regulation
- You are documenting a noise complaint for local authorities
- You are conducting an environmental noise survey
- You are not sure which weighting to use (dBA is the safest default)

Use C-Weighting (dBC) When:

- You are measuring peak or impulse noise (gunshots, hammering, explosions)
- The noise source has strong low-frequency content (bass music, HVAC rumble)
- Local regulations specifically require dBC (common for entertainment venues)
- You want to screen for low-frequency issues by comparing dBC to dBA

Use Z-Weighting (dBZ) When:

- You are conducting acoustic research or scientific measurements
- You are testing or calibrating audio equipment
- You need raw, unfiltered data for post-processing or frequency analysis
- You are measuring building acoustics (sound insulation, reverberation)

A Practical Example

Imagine your neighbor's music is bothering you at night. Start with A-weighting to get a reading you can compare to your local noise ordinance. If the dBA reading seems low but the bass is clearly audible, switch to Z-weighting to capture the full unfiltered energy, then check the FFT spectrum in NoiseLedger to see where the low-frequency peaks sit. This gives you both the regulatory measurement and the technical evidence to explain why the noise is problematic.

Download NoiseLedger free on iOS

Frequently Asked Questions

What is the most common frequency weighting?

A-weighting (dBA) is by far the most commonly used frequency weighting worldwide. It is specified by OSHA, NIOSH, the EPA, the EU Environmental Noise Directive, and virtually every municipal noise ordinance. If a noise measurement is quoted without specifying the weighting, it is almost always A-weighted.

Can I switch between weightings in NoiseLedger?

Yes. NoiseLedger supports both A-weighting and Z-weighting, and you can switch between them in the app settings. This allows you to take A-weighted measurements for regulatory comparison and Z-weighted measurements for technical analysis. The FFT spectrum view provides detailed frequency information regardless of the selected weighting.

Does frequency weighting affect the dB reading?

Yes, significantly. The same sound source will produce different dB readings depending on which weighting you select. For noise with strong low-frequency content, A-weighting will show a noticeably lower reading than Z-weighting because it filters out much of the bass energy. For example, a sound that measures 80 dBZ might read only 65 dBA if it is predominantly low-frequency. Understanding this difference is crucial for interpreting measurements correctly.

Cite as: Lubor Šimůnek (2026). *A-Weighting vs C-Weighting vs Z-Weighting: Which to Use*. AppStoryo, lapnito.cz s.r.o.. https://appstoryo.com/en/blog/a-weighting-vs-z-weighting-sound-measurement
© 2026 lapnito.cz s.r.o.