

acoust IQ

Drone Noise Measurement meets Psychoacoustics

Regulations for drone noise are emerging across Europe and internationally, yet the level-based metrics proposed in current standards do not fully reflect the noise impact as perceived by residents. This white paper examines how acoust IQ enables standards-compliant outdoor drone noise measurements and extends the analysis to psychoacoustic parameters.

Background

Drones are increasingly used across a wide range of professional and private applications. As a result, residents are more and more confronted with drone noise. Both across Europe and worldwide there is a process of drafting regulations to standardize the acoustic measurement of drones. A

classification of drones into classes C0 to CX together with a recommended maximum sound power level for each class can be found in the *EU regulation 2019/945*, based on a sound power measurement in an anechoic chamber according to *EN ISO 3744*. The international standard *ISO 5305: Noise mea-*

Drone Applications at a Glance



Logistics

critical infrastructure such as hospitals, commercial delivery



Rescue and disaster relief

searching for missing persons, situation assessment



Security

border control, police, fire department



Monitoring

agriculture, industrial facilities, critical infrastructure



Media

entertainment, documentaries, sports broadcasting



Military

detection, communication, armed operations



Construction

creating models and maps



Private use

leisure, hobby



Environmental protection

observation and monitoring

measurements of UAS (unmanned aircraft systems) – first edition 2024-01 considers not only indoor but also outdoor measurements under real flight conditions. Similarly, the *Guidelines on Noise Measurement of Unmanned Aircraft Systems* by the European Union Aviation Safety Agency (EASA) released in June 2023 are based on real flight scenarios outdoors and focus particularly on the practical application e.g. by using just one microphone. Important topics currently being worked on include: developing and improving the standards for drone noise measurements, testing the practicability of acoustic measurements according to the given standards, setting reference values in urban areas, identifying the acoustic components that contribute to perceived noise impact and acoustic optimization of drones. acoust IQ can be especially helpful for carrying out measurements according to the EASA guidelines (using one microphone), but also for detailed acoustic analysis and optimization of drones following the ISO 5305 using multiple microphones. The acoust IQ cloud, being available in the enterprise version allows for multichannel over-the-air measurements, meaning that the single channels don't need to be connected via cables to a central analyzer. This makes acoust IQ for both the one-channel EASA measurements as well as the multichannel ISO 5305 measurements extremely efficient. Additionally, the possibility of calculating quickly psychoacoustic metrics and thus providing information about how the sound is perceived, is of huge advantage.



Figure 1: Inverted microphone on ground plate

Measurement Approach: Outdoor Setup According to EASA Guidelines

The EASA guideline refers to unmanned aircraft systems that have a maximum take-off mass of up to 600 kg operating in the low- and medium-risk categories. According to the EASA guideline, the test setup consists of a single microphone mounted on a ground plate (figure 1).

For the measurements, two flight conditions are specified:

Hover: Reference height of 25 m (reducible to 12 m if the required 15 dB signal-to-noise ratio cannot be achieved). Measurement duration: 30 seconds. Spatial tolerance: 8-degree cone. A minimum of 6 repetitions shall be conducted.

Level flight: Reference height of 50 m (reducible to 17 m). The measurement period shall encompass the 10 dB(A)-down in-

terval, defined as the time during which the sound level first rises to 10 dB(A) below its maximum value and subsequently falls below this threshold. Spatial tolerance: 10-degree cone. A minimum of 6 repetitions shall be conducted.

Figure 2 and 3 show for both conditions the side and top view including the required flight tolerances marked in yellow.

Why Psychoacoustic Analysis Matters for Drone Noise

Drone noise is more annoying to residents than noise from other traffic sources, such as conventional aircraft noise or road traffic noise. Due to the noise characteristics of drones, which often show strong tonal components, the actual noise impact on residents cannot be fully captured by the level-based metrics proposed in current regulations. That is why, when analyzing and optimizing drone noise, it is essential to look beyond standard level metrics and consider psychoacoustic parameters that represent human perception much more accurately. acoust IQ enables the analysis of the following psychoacoustic magnitudes:

- loudness according to DIN 45631 – the perceived intensity of a sound
- sharpness according to DIN 45692 – the impression of high-frequency sound components
- tonality according to ECMA-418 – the prominence of tonal elements

These parameters can be evaluated in realtime during the measurement of the drone or in post-processing.

Practical Example: Acoustic Impact of Propeller Blade Count

When looking at the acoustic impact of different numbers of propeller blades, an opposite effect on loudness and shar-

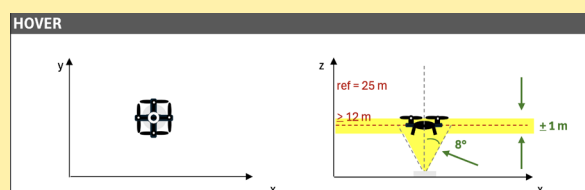


Figure 2: Top and side view for the two flight conditions "hover"

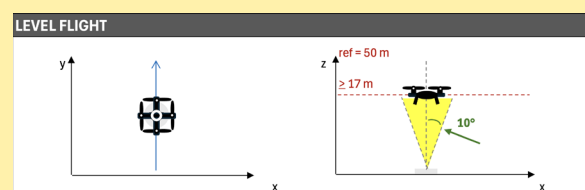


Figure 3: Top and side view for the two flight conditions "level-flight"

pness can be observed: while loudness decreases with more blades, the high-frequency components increase with more blades, which makes the sound sharper (figure 4) and can be very helpful for a targeted acoustic design. This example illustrates how acoust IQ supports not only the measurement

and documentation of drone noise, but also the acoustic optimization process itself, providing engineers with the psychoacoustic insights being the baseline for data-driven design decisions.

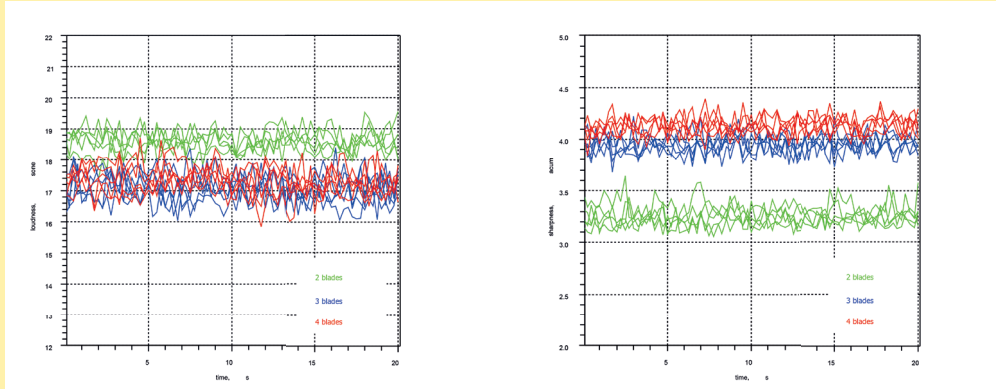


Figure 4: Loudness and Sharpness of propellers with different number of blades. Green: 2 blades, blue: 3 blades, red: 4 blades.

Conclusion

The regulatory landscape for drone noise is evolving rapidly, and practical measurement tools that combine standards compliance with psychoacoustic depth are becoming essential. acoust IQ offers a mobile, scalable platform that addresses this need:

- EASA-compliant outdoor measurements can be performed with a single mobile setup, eliminating the need for complex stationary infrastructure.
- In the Enterprise version acoust IQ allows for cloud controlled multichannel-measurements. Measurement data is streamed over-the-air to the cloud for later analysis. This reduces the setup time dramatically.

- Psychoacoustic analysis (Loudness, Sharpness, Tonality) reveals perceived noise characteristics that conventional level-based metrics miss entirely.
- The combination of app-based measurement control, cloud processing, and integrated reporting creates a seamless workflow from microphone to documentation.
- Whether for regulatory compliance, acoustic optimization, or research, acoust IQ provides the precision, flexibility, and psychoacoustic insight that drone noise assessment demands.

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Discover acoust IQ – the innovative solution that makes high-quality acoustic measurements simpler, more precise, and more efficient. With a unique combination of a Class 1 microphone, cloud integration, an iOS app, and a web application, acoust IQ takes acoustic measurement to the next level. acoust IQ is more than just a measuring device – it is a comprehensive platform that enhances, simplifies, and redefines conventional acoustic measurement methods.



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