RELATED: GUIDELINES ON NOISE MEASUREMENT OF UAS LIGHTER THAN 600 KG OPERATING IN THE SPECIFIC CATEGORY (LOW AND MEDIUM RISK)

13.10.2022: BEGINNING OF COMMENTING PERIOD

13.01.2023: END OF COMMENTING PERIOD

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1. Individual comments (and responses)

In responding to the comments, the following terminology is applied to attest EASA's position:

(a) **Accepted** — EASA agrees with the comment and any proposed change is incorporated into the text.

(b) **Partially accepted** — EASA either partially agrees with the comment or agrees with it but the proposed change is partially incorporated into the text.

(c) **Noted** — EASA acknowledges the comment, but no change to the text is considered necessary.

(d) **Not accepted** — EASA does not agree with the comment or proposed change.

(General Comments)	-

comment	*1* comment by: *LBA* LBA has no comments
response	Noted. No response needed

comment	*7* comment by: *Swedish Transport Agency, Civil Aviation Department (Transportstyrelsen, Luftfartsavdelningen)* **General** The notion "must" is used several times in the guidelines, for example in Subpart H – Reporting (p. 36-37) The applicant must report the following noise data/information related to the test UA, the following additional test information to the Agency. Since the guidelines are voluntary it would be preferable to use another notion than "must", for example "should" or "can". Otherwise, the document can be interpreted as compulsory rules instead of voluntary guidelines. If an obligation in guidelines is based on a rule in a regulation, it could be preferable to add a reference to the actual rule and regulation.
response	Noted. Thank you for this comment, which is fully acknowledged. Although there is no supporting regulation to these Guidelines, they have been developed with the mindset to be possibly turned into regulation in the future (hence the use of "must"). Although these Guidelines are

	offerred on a voluntary basis, we recommend that they be used to their full extent and not just partially.

comment	*8* comment by: *AOPA Sweden* AOPA Sweden Stockholm 23-01-10 AOPA Sweden notes that EASA has done a thorough work in establishing the formulas for determining the noice level of UAS. We can only hope that the work will be widely accepted and implemented in a way that an average operator will understand and able to follow the rules. Apart from that, we do not have any other comments on the NPA. Stockholm 23-01-10 AOPA Sweden Fredrik Brandel
response	Noted. Thank you for this supportive comment.

comment	*9* comment by: *Rigi Technologies SA* RigiTech would like to highlight: • Recognition of the efforts EASA is making in with the publication of these guidelines to harmonise the way UA noise is measured and reported, and would like to thank EASA for letting the industry and other stakeholders provide their inputs. • RigiTech committment in increasing acceptability of UAS operations, not only through an increase in safety, but also through the minimization of nuisance to people and animals due to noise emissions. • The importance of encouraging the UAS industry, in particular small and medium companies operating/manufacturing UAS in the open and specific (up to low and medium risk at least) categories of operations to harmonise their practices and aim at increasing the UAS acceptability.

In this sense, RigiTech considers it is important that credit can be taken from smaller steps in the right direction, which implies a certain level of flexibility, both in the costs implied and the methodology/equipment.

In this sense, RigiTech proposes the guidelines to accept a reduction of the precision margins required in the measurements (noise, weather, position, etc.) in order to allow the use of more economic equipment, maybe proportionate to the SAIL number of a drone. The costs of the noise measurement should be proportionate to the overall cost of the development of a UAS (which increases with redundancies, quality of the components, design verification requirements, etc.).

response

Noted.

Thank you for your comment and for the remarks, which are acknowledged. The procedures described in these Guidelines are the outcome of a compromise between accuracy/repeatability and cost of the measurement. They are likely the cheapest (in terms of equipment) that can be found amongst all UAS noise measurement standards to this date. Excessive compromising on the allowable test conditions can jeopardize the quality of resulting data.

comment

27 comment by: *DGAC*

First of all, these guidelines are very clear and provide everything necessary to reproduce the tests in the same conditions as described in the document.
As a consequence, the number of feedback point is reduced.
To provide feedback to EASA, the Technical Service of DGAC, the French Authority for Civil Aviation (https://www.stac.aviation-civile.gouv.fr/) has performed test with a DJI Phantom 4 equipped with RTK positionning system in december 2022.
A report should be written and shared with EASA and CAEP WG1 in a few months.

response

Noted.

Thank you for your supportive comment. The European Union Aviation Safety Agency (EASA) is eager to see the results obtained by DGAC-F on this tested drone.

comment

43 comment by: *Wing Aviation*

Attachment #1

Wing recognises the efforts EASA is making with the publication of these guidelines to harmonise the way UA noise is measured and reported, and would like to thank EASA for letting the industry and other stakeholders provide their inputs.

Social acceptance and sustainability are key enablers that will help unlock the immense potential of UAS, their operations, and associated services and **Wing is absolutely committed to minimising nuisance to people and animals due to noise emissions through both flight path optimisation and design**.

response

Noted.

Thank you for your supportive comment. EASA acknowledges Wing Aviation's commitment.

comment

44 comment by: *Wing Aviation*

Considering the lack of real-life experience on how precisely the reference noise evaluation metrics 'A-weighted sound exposure level' ('LAE') and 'A-weighted equivalent continuous sound pressure level ('LAeq') capture uninvolved people's annoyance or perceived loudness for UAS flight, Wing: -1) agrees with EASA on **focusing on the UAS level flyover and, where applicable, hover flight conditions**; -2) agrees with EASA on **not considering the proposed guidelines as applicable requirements for the design verification of UAS in the 'specific' category**; -3) urges caution in interpreting the results and drawing conclusions about whether and how to set noise limits for the UAS industry under Subpart D; and -4) encourages Member States to define UAS geographical zones in a sensible and proportionate manner.

response

Noted.

Thank you for this comment. EASA acknowledges Wing Aviation's position.

comment

45 comment by: *Wing Aviation*

The UAS noise measurement methodology proposed by EASA follows a similar approach to the FAA UAS noise level evaluation requirements (Title 14 CFR Part 36 Appendix J, §J36.3, and §J36.6). This raises several areas of potential concerns (see below):

Area of potential concern #1: From a cost standpoint, the complexity around the UAS noise measurement guidelines should be kept as low as practical. An adequate tradeoff between, on the one hand, accuracy and precision, and, on the other hand, simplicity and affordability, is absolutely essential to ensure the needed proportionality for their wide adoption by the industry in Europe. This is considered of paramount importance since, unlike class-marked UAS intended to be operated in the 'open' category or under a 'standard scenario', UA within scope of the proposed guidelines cannot be assumed to be mass-produced and, therefore, the economic perspective becomes critical, especially for **small and medium enterprises (SMEs)**.

As a way of illustration, the noise test campaign that Wing carried out in the U.S. in line with FAA guidance was close to $50,000. This included the additional cost associated with the RTK instrumentation setup and required data analysis, which exceeded $10,000 alone.

Area of potential concern #2: The noise measurement guidelines should allow for a certain degree of design changes before retest, as well as for the use of conservative values without formal retest when noise reduction measures are implemented. Indeed, unlike traditional aircraft, UAS manufacturers tend to refine their platforms on an annual or bi-annual basis and make a number of design improvements that may be categorised as acoustical changes. As a way of illustration, Wing made a number of changes in the past for the sole purpose of noise reduction which were categorised as acoustical changes by the FAA and de facto appreciably delayed the public positively experiencing the noise reduction introduced by these changes.

Area of potential concern #3: Considering both technical and economic efforts anticipated for each new noise testing campaign, Wing worries that, **if no additional flexibility is provided in certain areas**, the proposed guidelines may not meet their intended objectives and **discourage innovation / continuous UAS design improvement**.

For these reasons, Wing would like to propose a few adjustments to the proposed noise test methodology aiming at facilitating EASA's objective as regards its wide adoption by the industry in Europe on a voluntary basis.

response

Noted.

Thank you for this comment. Regarding the areas of potential concerns raised by Wing Aviation (in the same sequence):

- #1: Cost was considered with utmost attention when developing these Guidelines, with full consideration for the argument raised by Wing Aviation regarding the smaller production-scale in the 'Specific' category than in the 'Open' category. For this reason, the equipment required to perform a test according to these Guidelines is expected to be much lower than the ISO3744 scheme mandated by 2019/945 for the 'Open' category (e.g.: only one Class-1 microphone involved instead of twelve). Although EASA will not provide a precise cost associated to a test performed according to these Guidelines, the first order of magnitude collected from local noise measuring organizations (or by looking at the cost of such equipment online) is about 10 times lower than what Wing Aviation quotes from the test performed according to the FAA Guidance.
- #2: while Wing Aviation's point is noted, these Guidelines only deal with the measurement procedures and not with how to address design changes impacting noise.
- #3: these Guidelines only contain measurement procedures and do not mandate (or relieve) the need to re-test to establish Noise levels when a UAS design is modified. Nevertheless, not only is their implementation cost low (relative to other UAS noise measurement standards), but EASA also believes that if design innovation drives lower noise levels, then it is in all parties' best interests (local authorities and UAS

manufacturers/operators) to see those improvements reflected in the established noise levels.

comment 53 comment by: *Drone Alliance Europe*

DAE supports EASA's initiative to provide harmonised procedures to measure the noise produced by drones used in the low- and medium-risk operations of the 'specific' category.

response Noted.

Thank you for this supportive comment.

comment 54 comment by: *Drone Alliance Europe*

DAE members are committed to minimising the noise impact from UAS operations.

response Noted.

Thank you for this comment. EASA acknowledges DAE's commitment.

comment 55 comment by: *Drone Alliance Europe*

DAE agrees with EASA on 1) **focusing on the UAS level flyover** and, where applicable, **hover flight** conditions; and 2) **not considering the proposed guidelines as applicable requirements for the design verification of UAS in the 'specific' category**.

response Noted.

Thank you for this comment. EASA acknowledges DAE's commitment.

comment 56 comment by: *Drone Alliance Europe*

DAE would like to offer to EASA a few proposals for improvement aimed at facilitating the wide adoption of the noise measurement guidelines by the industry stakeholders in Europe on a voluntary basis.

response Noted.

Thank you for this comment.

comment	72 comment by: *FAA* The 600kg weight limit goes well beyond the weight of the ~25 kg package delivery drones that currently primarily inhabit the specifc catagory. The FAA generally agrees with the classification of multiple categories for UAS (low risk, specific, certified), but how was this weight limit decided?
response	Noted. Thank you for this question. 600 kg is the upper weight limit in EASA's Special Condition for Light-UAS Medium Risk. For consistency reasons, this number was also used for Noise. EASA commissioned dedicated noise tests (according to the measurement procedures of these Guidelines) on a 450-kg UAS to assess the feasibility of the current procedure at the higher weights. Initial results of this test campaign indicate that the measurement procedures are also appropriate for this kind of vehicle.

INTRODUCTORY NOTE p. 3

comment	*2* comment by: *Wingcopter GmbH* These "Guidelines on Noise Measurement ..." have - as stated - the objective to provide a first step into the process of a ANNEX TO DELEGATED REGULATION (EU) 2019/945 - PART 13 (for CE marking) and sure also to gather data (on voluntary base) for stakeholders in this industry (EASA - NAA - OEM - LUC/AOC). Based on this approach, the competent authorities can use this guideline to request a "noise statement". All good... However, until having an obligated/mandatory "noise certificate" (CE or TC) needed we will have the issue to separate objective from subjective measurement. For this purpose I am missing the following aspects to be installed: • There is no assessment or proof of the measurements required • There will be a transparent process needed to release any voluntary information before going "public"; until then it should be for inside EASA for plain data sourcing only • There is the aspect of competition when comparing data missing - at least as a note to be (EASA) aware of it • It needs to be more clear, when "voluntary stage" of this guideline will enter next level in "SUBPART G – COMPLIANCE PROCEDURE"

response

Noted.

Thank you for this comment. EASA acknowledges the points raised by Wingcopter. The following answers are provided:

- These Guidelines are a stand-alone text meant to cater only for the measurement procedures.
- There is currently no regulatory framework to make these procedures mandatory.
- In the low-medium risk class of the 'Specific' category, 2019/945 caters for a declarative process and as such does not require assessment or witnessing of the compliance.
- The procedure of notifying voluntary drone noise data and details of the online repository will be communicated together with the publication of the final guidelines.

comment

39 comment by: *Francesco MARULO*

Before entering in some specific comment, I am pleased to present some general view on this proposal and I do appreciate some feedback on these items.

First comments refers to the need of a specific rule when talking about UAS up to 600 Kg W_{TO}. Why not replicate or adjust, maybe with some small modifications, what is already used for light propeller airplanes o small helicopters?

The noise figure is a characteristic of a specific vehicle, not related to its flight characteristics and safety. Typically city transportation autorithies set their own limits (as experienced for airplanes at different airports, depending on the population density of the area) and they do not care about the airworthiness rules. Usually they use different acoustical indicators and different limits compared to those set by aviation agencies.

Why not tryin to simplify the procedure and instead of being so specific on sound absoprtion, for example, imposing to repeat a simple noise testing each year and, maybe including also a frequency measurement (one third octave measurement is something easily measurable by any modern sound level meter, or even smartphones)? This could be helpful, in some way, also for the safety of the vehicle (assessing no variation on the noise measurement year after year) other than measuring once a very detailed sound absorption?

Outside of this comment, is it possible to attach an example of a typical expected test report, asking for highlighting the differences with the "formal test report" and justifying those differences?

response

Noted.

Thank you for these detailed comments, which EASA answers as follows:

- When building these Guidelines, EASA considered existing light helicopters / airplane standards (e.g.: ICAO Annex 16). For proportionality and harmonization considerations, EASA adjusted those procedures (one example amongst many: the use of inverted microphone setup to remove variability due to ground reflections).
- EASA's objective with these Guidelines was to provide a harmonized measurement method allowing comparison between various designs. As such, EASA deemed paramount to normalize measurements for the effects of distance and atmospheric absorption for instance, which are implemented in a much simpler manner than the complex methods associated to Chapter 3 of ICAO Annex 16. EASA thinks that imposing regular repeats of noise tests is not proportionate. This does not prevent local authorities to carry out or enforce dedicated noise measurements as often as they deem necessary, but due to the Subsidiarity principle, EASA cannot mandate any rules at such granular levels.
- EASA is adding a template of a typical noise test report as a guideline that can be followed, as well as a spreadsheet that applicants/declarants can use to obtain the final noise levels and associated 90% confidence intervals according to the formulas specified in the Guidelines.

comment *42* comment by: *Skyports Air Mobility Ireland*

Skyports Air Mobility Ireland Limited (hereafter Skyports Drone Services) supports the principle of gaining a better understanding of the noise impacts of UAS and UAS operations and, where necessary, proportionately and reasonably mitigating their noise impacts on potentially affected populations; however, our conclusion is that while EASA's approach is well-intentioned, the proposals as drafted are disproportionate, unreasonable, makes unfounded assumptions, is not fit-for-purpose, lacks any clear understanding of how the criteria may end up working in practice and risks undermining the health and growth of the European UAS industry.

Skyports Drone Services is willing to work with EASA to help improve the proposals.

Our specific points as follows:

1. EASA is making an assumption that competent authorities have the capability and capacity i) to make a reasonable assessment of whether an OEM and/or operator must or should complete a noise assumption using the draft guidelines and ii) to understand and make any use of the results of those assessments. Some competent authorities in Europe have already been struggling just to complete the implementation of the IR 2019/947. What assessment has EASA made of the capability and capacity of competent authorities to reasonably apply these guidelines and manage the results in a meaningful way? Has EASA carried out an impact assessment of the guidelines not just on the industry but also on competent authorities and, if so, what were the results?

2. The contents of this document as drafted would be hugely disproportionate and unreasonable if applied in full or in part to any UA with an MTOW lower than 600kg operated in the Specific category that is not design verified (DV) or type certified (TC). Minor upgrades to a non-DV/TC UA, for example with new, more efficient propellers would mean that the noise assessment tests would need to be repeated; this would potentially need to be repeated in full every time the non-DV/TC aircraft were upgraded. This noise assessment, if required by a competent authority, would come at considerable cost to the OEM and/or operator. Not all specific category operations are commercial and could be for R&D purposes; the effect of these guidelines, if applied, would be to load on considerable costs when we are understood that EASA wants to help grow the European UAS industry, not undermine it with more costs disproportionate to the claimed benefits.

3. Should the guidance be applied in part or in full by a competent authority, a UAS operator like ourselves would have to outsource the noise assessment to a third party as we do not have the expertise or equipment in house. Further to our point above, this would cost thousands of Euros. If we had to do this for every UA in our fleet (since we do not use just one OEM) and then repeat this exercise for every minor upgrade we make to an UA and potentially to every operation (since EASA is aligning noise assessment criteria with risk profiles of operations), this would put us out of business.

4. The one-size fits all approach of bundling up all Low and Medium risk operations in the Specific category does not distinguish between the likelihood or unlikelihood of over-flight of populated areas. Given that noise impacts of UAS operations on people should be the factor in this consultation, it seems perverse that an unmanned aircraft and/or UAS operations over a controlled ground area or even sparsely populated area may be subject to the same requirements from a competent authority. This limited level of guidance to competent authorities on how the guidance may be applied is concerning, and should go further and be more aligned to Ground Risk Classes where population is a factor rather than an overall risk generalisation, which does not, in face, seem relevant.

5. EASA is strongly recommended to limit the criteria for noise assessment to unmanned aircraft subject to the DV/TC process, at least in the first instance because this would have the effect of linking to population, limit repeat assessments and limit costs. For example, a DV/TC aircraft would only be required for higher SAIL figure operations, which involve over-flight of populated areas. Once an unmanned aircraft has completed its noise assessment as part of the DV/TC process, the assessment would not need to be repeated, saving the industry the additional work and the costs of constantly repeating assessments for minor upgrades. This approach is consistent with IR 2019/947 and NPA 2022-06 (RMT.0230 Subtask C).

6. In our experience of operating in different jurisdictions around the world and EASA's approach is out of step with the international community, which risk putting European operators at competitive disadvantage.

7. Finally, EASA is recommended to look at the FAA's approach to noise assessment for unmanned aircraft TC (G-1). The FAA had a reasonable approach to measuring noise and other environmental impacts but in practice the criteria is very onerous. The FAA did not

understand the practicalities of implementation. It is Skyports Drone Services' assessment that EASA is making the same mistakes and does not appreciate the cost, bureaucratic and practical difficulties of the draft proposals.

response

Noted.

Thank you for this elaborated comment. EASA takes good note of all the different points raised by Skysport, which are addressed in the same sequence:

1. These Guidelines are to be currently considered as stand-alone noise measurement procedures for voluntary application. Moreover (please refer to EASA's answer to Comment#2), they are tailored to be used as part of a declarative process.
2. EASA has considered proportionality and cost aspects as key aspects for the construction of these guidelines. In that respect, the procedures included in these Guidelines are much cheaper (in terms of equipment cost) than any other UAS noise standard currently available.
3. Skysports' comment is noted. It should be noted that the application of the EASA drone noise guidelines is on a voluntary basis.
4. Skysports' concern is noted. As already mentioned, these Guidelines only cover the noise measurement procedure. Skysports' example (operations over sparsely populated areas) is only one particular case which would fall under the prerogative of NAA's / local authorities in light of the Subsidiarity principle. Moreover, carrying on this example, the population density works opposite to the perceived annoyance of UAS noise (as research clearly shows), mostly due to the typically low local background noise (the same noise level is perceived more annoying in rural than in urban areas).
5. This point is noted.
6. These Guidelines only offer a noise measurement standard, perhaps ahead of some other international authorities. EASA is bound to Article 1 of the Basic Regulation (2018/1139), which mentions the aim to "contribute to a high, uniform level of environmental protection", hence the need to establish a harmonized means to measure UAS noise of the Specific category across the EU.
7. EASA's Noise UAS Guidelines aim at addressing the 'Specific' category only, not the administrative aspects. With regards to the practical difficulties of implementing these measurement procedures, those Guidelines are the outcome of 4 years of dedicated noise studies; they are a compromise between the need to obtain accurate and repeatable measurements on one side, and proportionality (including cost) on the other side. Most of all, they have been put to the test several times during actual measurement campaigns.

comment *57* comment by: *Drone Alliance Europe*

DAE would like to request clarification on the objective(s) of EASA's intended online public repository. The guidelines are silent on how the resulting noise dataset may be used in 1) community noise modeling and 2) the establishment of community noise significance thresholds (or the establishment of operational levels that correspond to noise). DAE believes that the definition of noise-related policy should include further engagement with UAS operators and Original Equipment Manufacturers (OEMs), among other stakehodlers.

response

Noted.

Thank you for this comment. For the time being, the outcome of UAS noise tests (test results and report) can be voluntarily submitted to EASA in a way to be specified at the time of the publication of the final guidelines. The online public drone noise repository details will be communicated at a later stage.

comment

65 comment by: *LHD*

Comment

LHD supports the transparent approach determined by the establishment of a public register as the most effective solution to guide the regulation of noise in the UAS context. The guideline is missing a precise reference to allow reporting to the Agency noise level results

Suggested resolution

Include an EASA point of contact to report and collect noise level results

response

Accepted.

Thank you for this comment. The online public drone noise repository details will be communicated together with the final drone noise measurement guidelines.

comment

73 comment by: *FAA*

“It is recommended that the resulting noise levels be reported to the Agency, who later intends to build an online public repository available to the operator for the statement of

compliance of the UAS with the Union and national rules related to environmental protection and to the competent authority in order to assess this statement."
Question: Does this mean, in the future, EASA intends to use noise levels created in line with these guidelines for certification purposes?

response

Noted

Thank you for this comment. The drone noise measurement guidelines are intended for voluntary application to establish UAS noise levels in a harmonized fashion. As no regulatory limits are defined in respect of these guidelines, they cannot as such be used for drone certification.

Noise.UAS.210 Applicable noise evaluation metrics p. 5

comment

14 comment by: *UK CAA*

Page No: 5

Paragraph No: Noise.UAS.210 (a) and (b) Applicable noise evaluation metrics

Comment:

We believe supplemental reporting of maximum A frequency-weighted sound levels (L_{ASmax}) for the reference level-flight and hover procedures should also be recommended in the guidance.

Justification:

Since users of the guidance would be recording L_{ASmax} levels anyway, requesting the provision of these metrics would incur little additional cost but provide significant added benefit for the end user.

Proposed Text:

Add the following text to Noise.UAS.210 (a) and Noise.UAS.210 (b):

"*Supplemental reporting of the L_{ASmax} level is also recommended*."

In addition, we recommend new text is added where necessary to SUBPART G and SUBPART H (and elsewhere) to describe the adjustment and reporting of reference L_{Asmax} levels.

response

Accepted.

Thank you for this constructive comment and recommendation. EASA will incorporate your suggested text to the consolidated version of the Guidelines.

Noise.UAS.220 Noise evaluation metrics definitions p. 5

comment

15 comment by: *UK CAA*

Page No: 5 and 6

Paragraph No: Noise.UAS.220 (a) and (b) Noise evaluation metrics definitions

Comment:

The current definitions in (a) and (b) state that the integrals are approximated from periodically sampled measurements of L_{AS}. There is no technical reason to approximate L_{AE} and L_{Aeq} since modern instrumentation allows L_{AE} and L_{Aeq} to be measured directly or determined precisely from periodically sampled measurements of short-term L_{Aeq} (e.g. from one second L_{Aeq} samples).

Justification:

The current definitions appear to be based on an arguably outdated definition of L_{AE} provided in Appendix 4 of ICAO Annex 16. In theory however, there is no time constant (SLOW time-weighting) applied to the measurement of L_{AE} and L_{Aeq}.

Proposed Text:

The UK CAA suggests the following amendments:
Remove the existing text "*The above integral is approximated from periodically sampled measurement as*:" from Noise.UAS.220 (a) and (b) and replace with "*The above integral can be determined from periodically sampled measurement as follows:*"
Remove "$L_{AS}(k)$" from the equations for L_{AE} and L_{Aeq} and replace with "$L_{Aeq}(k)$".
Remove the definition "$L_{AS}(k)$ is the time varying A-frequency-weighted SLOW-time-weighted sound level…" and replace with a suitable definition of $L_{Aeq}(k)$.

response

Partially accepted.

Thank you for this comment. EASA will incorporate your suggested text to the consolidated version of the Guidelines with the following modifications:

- Your suggested text ("the above integral…") will be incorporated as is.
- "LAS(k)" will remain in the equations and will not be replaced with "$L_{Aeq}(k)$" as suggested, as EASA considers the latter to already be integrated over time.

- While EASA recognizes the argument that no time constant should in theory be applied to the measurement of L_{AE} and L_{eq}, EASA chooses to maintain SLOW-time weighting for all measurements and reporting within the procedures of these Guidelines for standardization reasons. EASA will clarify it directly in the first given definition of L_{AE} in the consolidated version of the Guidelines.

comment

74 comment by: *FAA*

“"The A-weighted equivalent continuous sound pressure level, LAeq, is defined as the level, in dB(A), of the time integral of squared A-weighted sound pressure, pA, over a given time period, with reference to the square of the standard reference sound pressure, p0, of 20 µPa and a reference duration of one second."”
Comment: The Laeq is a 30 second average. A reference duration of 1 second is not meaningful.
Proposed resolution:
The A-weighted equivalent continuous sound pressure level, LAeq, is defined as the level, in dB(A), of the time integral of squared A-weighted sound pressure, pA, over a given time period, with reference to the square of the standard reference sound pressure, p0, of 20 µPa. ~~and a reference duration of one second.~~

response

Accepted.

Thank you for this comment and for catching this typo. EASA will incorporate your suggested modification to the consolidated version of the Guidelines.

Noise.UAS.310 Reference noise measurement points p. 6

comment

71 comment by: *Michael Schmähl* - TUM School of Engineering and Design

Noise.UAS.310 defines the location of the single microphone position which the document suggests to use for level flight. Many UAS (including those in the specific class) are highly integrated configurations which holds especially for eVTOL configurations. In many cases propellers/rotors interact aerodynamically with inflow disturbances (e.g. pusher configurations) or with other propellers/rotors. These interaction mechanisms first and foremost lead to unsteady loading of propeller blades which can significantly affect the overall noise emission. Also close proximities between propellers and airframe can lead to significant sound contributions of scattered sound or sound due to fluctuating forces from the airframe which is propagated into the far field. The super positioning of different sound

sources (propellers/rotors and airframe contributions) can lead interference in the far field noise emissions. Potentially noise peaks can occure at specific noise emission directions.

Due to the complexity of noise emissions from UAS (especially eVTOLs) to the far-field, it is questionably in how far one single microphone position is sufficient to represent the overall noise emissions. A recent publication of mine (https://mediatum.ub.tum.de/doc/1693144/1693144.pdf) deals with the noise emissions of a cargo eVTOL UAS which would fall under the specific class (and contains measurement data). Due to pronounced interaction effects the noise emission directivity of this UAS is very inhomogeneous. For level flyovers at a distance of 30 m a maximum SPL of ca. 50 dB(A) is recorded for a microphone positioned vertically below the flight path (as suggested by guidelines draft). In contrast, a sideward positioned microphone would record SPL of up to 70 dB(A) at the same microphone/UAS distance. Consequently, the SPL delta between a vertically below and a sideward positioned microphone is 15 – 20 dB(A).

Therefore, I plead for a higher number of microphone positions (at least two) to avoid future UAS designs minimizing noise emissions under this initial guideline's conditions regardless of an potentially overall sound power of the vehicle.

response

Noted.

Thank you for this comment and for sharing your paper. The presence of only one microphone within the current Guidelines is the outcome of proportionality. We consider that eVTOL designs will, in their great majority, fall into the 'Certified' category and will therefore undergo a more complex measurement scheme.

comment

75 comment by: *FAA*

“"For the reference level-flight procedure, the reference noise measurement point is located on the ground, 50 m vertically below the UA, when the UA flies the reference level-flight procedure defined in Noise.UAS.320(b). For the reference hover procedure, the reference noise measurement point is located on the ground, 25 m vertically below the UA, when the UA flies the reference hover procedure defined in Noise.UAS.320(c)."
Comment: The 50 and 25 meter requiremnts are better described by the word "height" than "point." Also, "50 m vertically below the UA" is backwards wording. The aircraft should be tasked with flying over the microphone location at a height of 50m, not the other way around. Lastly, "reference level flight procedure" is mentioned at the beginning and end of the sentence, which is redundant. This whole sentence could use a rework.
Proposed resolution:
"In accordance with the reference level flight procedure defined in Noise.UAS.320(b), the UA must fly over the microphone at a height of 50 m.

In accordance with the reference hover procedure defined in Noise.UAS.320(c), the UA must hover over the microphone at a height of 25 m."

response

Rejected.

Thank you for this comment. While EASA clearly recognizes merit in FAA's suggested text, the definition of the "reference noise measurement point" in the Guidelines was the outcome of internal work with our rulemaking officers, who pointed inconsistencies within the interchangeable use of the concepts of "noise measurement point" and "microphone position".

Noise.UAS.320 Reference procedures p. 6

comment

4 comment by: *Wingcopter GmbH*

Noise.UAS.320 Reference procedures name tow (2) variants of emission situations

- level-flight procedure (b)
- hover procedure (c)

It is typical for VTOLs / Hybrids to have a very different noise charactersitcs in the A-weighted sound exposure level (L_{AE}) when doing the transition/conversion form "multi-copter mode" / "vertical flight" to "fixedwing mode" / "horizontal flight".
As this can result in even higher results of dB(A) this should be part of the Noise.UAS.320.

However, I do not know any additional efforts and complexity needed to get this in an objective way established for the guideline and criteria.

And,
what about noise levels in case of

- OEI / MEI
- recovery from max. descend to max. climb
- ...

UA are configured to operate at MTOM not at max. power level = not at max. noise emission level.

response

Noted.

Thank you for this comment. EASA has the following responses:

- EASA did consider the inclusion of transition/conversion phases within the measurement scheme, but as you assumed, EASA deemed it too complicated to be standardized.
- EASA also considered “OEI/MEI”, “recovery from max. descend to max. climb” phases but disregarded them for similar reasons.
- “UA are configured to operate at MTOM not at max. power level”: this is precisely why EASA asks the noise levels to be established at MTOM so that results allow for a fair comparison.

comment

31 comment by: *Bell*

For some UAS designs, noise generated for the fastest speed at which the level flight can be safely maintained…, as specified in Noise.UAS.320(b)(2)(i), may be significantly different than noise generated for the fastest normal operating speed. For such designs, the reference speed as specified in Noise.UAS.320(b)(2)(i) may be considered an emergency procedure and inconsistent with published performance of the aircraft. Consider also that Annex 16 prescribes Take-off reference speed in terms of “normal operation” for subsonic jet aeroplanes and propeller-driven aeroplanes over 8618 kg. Likewise, the reference airspeed allowed in Annex 16 for helicopters level flight (0.9 Vh, etc.) is consistent with “normal operation”.

Specify the reference ground speed in Noise.UAS.320(b)(2)(i) as follows: the fastest normal operating speed at which the level flight can be ~~safely~~ maintained under the reference atmospheric conditions;

response

Accepted.

Thank you for your comment and for the proposed text. We will incorporate it into our consolidated Guidelines.

comment

76 comment by: *FAA*

The FAA agrees with the 50 m flyover and 25 m hover reference heights. For flyover, 50 m is close to the operational height of specific categroy aircraft and is close enough to the microphone to obtain a 15 dBA separation between ambient noise levels and LAmax, requiring less corrections for the recorded noise levels. For hover, 25 meters should elimiate hover in ground effects (HIGE) and downwash on the microphone for most aircraft in the specific category.

response

Noted.

Thank you for your supportive comment.

comment

77 comment by: *FAA*

Noise.UAS.320(a): “"The noise levels must be determined under the reference atmospheric conditions defined in Noise.UAS.330 for the reference procedure defined in (b)."

Comment: Both flyover and hover must be done at reference conditions.

Proposed resolution: The noise levels must be determined under the reference atmospheric conditions defined in Noise.UAS.330 for the reference procedure defined in (b) and (c).

response

Accepted.

Thank you for capturing this typo and suggesting a correction. EASA will incorporate it into the consolidated version of the Guidelines.

comment

78 comment by: *FAA*

Noise.UAS.320(b): “(2) the reference ground speed VGref is:
(i) the fastest speed at which the level flight can be safely maintained under the reference atmospheric conditions;
(ii) maintained throughout the flight;”

Comment: "The FAA has found from its UAS testing ""fastest speed"" can be interpreted differently. Many aircraft have only one set speed, cruise speed, but this is not reflective of the fasted speed the aircraft is capable of.

Also, why is the reference speed a ground speed rather than an airspeed? How will aircraft be tested that are controlled by airspeed?"

response

Noted.

Thank you for your comment and valuable insight, which is also very much aligned with Comment #31. EASA’s resolution of Comment #31 also addresses FAA’s concern in the present comment.

EASA chose ground speed over airspeed because it can be measured by external means (especially if using photographic scaling method), making it easier to relate reference speed to test speed.

SUBPART C - REFERENCE CONDITIONS AND PROCEDURES p. 6

comment

30 comment by: *Bell*

Reference procedures, noise test, and noise test equipment published in EASA UAS noise measurement guidelines differ from FAA NPRM FAA-2021-0710 Noise Certification Standards: Matternet Model M2 Aircraft. Inconsistent noise measurement guidelines / certification standards will negatively impact the associated workload on manufacturers, operators, and certification authorities.

It is recommended to coordinate with other certification authorities to develop UAS noise measurement guidelines that will inform the development of a future harmonized noise certification standard and requirement without undue cost.

response

Noted.

Thank you for your comment. EASA acknowledges the differences with the FAA NPRM for the Matternet M2. However, the underlying rulemaking scope is different: Matternet M2 is a program seeking FAA Certification, whereas EASA Guidelines are more general and cover the Specific category.

EASA's objective when publishing these Guidelines is also to offer it to ICAO CAEP WG1 informing the work towardsa common procedure at ICAO level.

Noise.UAS.520 Test environment conditions p. 7

comment

16 comment by: *UK CAA*

Page No: 9

Paragraph No: Noise.UAS.520 (d)(2) Test environment conditions

Comment:

The definition of "in the vicinity of the noise measurement point" at sub-paragraph (d)(2) is open to interpretation. It is not clear whether this is intended to mean the same maximum distance (2,000m) permitted in MoC1 Noise.UAS.520 Test environment conditions for official airport meteorological stations.

The UK CAA believes a maximum permitted distance should be specified in sub-paragraph (d)(2) that is either consistent with MoC1 Noise.UAS.520 (a) or, if a distance shorter than 2,000m is specified, a suitable justification for the variation should also be provided.

Justification:

Current text is ambiguous.

response

Noted.

Thank you for your comment, which echoes comments 28 and 32 and class for clarification. EASA will address your comment in the consolidated Guidelines as follows:

- If the weather measurements are obtained from equipment used by the measuring organization (wind and temperature/relative humidity sensors), this equipment must be within 50 meters of the noise measurement point.
- If a nearby weather station is used (e.g.: from a local airfield), it must be within 2,000m of the noise measurement point.

comment

23 comment by: *AIRBUS*

PAGE / PARAGRAPH / SECTION :
Pages 7 to 9
SUBPART E – NOISE TEST
Noise.UAS.520 Test environment conditions

COMMENT:
Globally the environmental conditions requested are more stringent than for helicopters, which make sense with the expected noise sensitivity to wind, for such low weight vehicles.

RATIONALE / REASON :
As a remark, these conditions may be difficult to reach in certain areas.

response

Noted.

Thank you for your comment. In light of Comment 28 which also mentions stringency of the wind speeds window, the Guidelines will be updated as follows:

- 30-sec averaged allowable wind speed limits will be raised from 4.1 m/s to 5.1 m/s (8 to 10 kts), and allowable cross-wind speeds from 2.1 m/s to 2.6 m/s (4 to 5 kts) for the level-flight procedure, and from 2.1 to 2.6 m/s (4 to 5 kts) for the hover procedure (a 20% tolerance increase).
- An additional IM will explain that wind gusts can be the cause of repeatability issues due to automatic rpm or positioning corrections from the UAS.

- This IM will also recommend that, when wind gusts are present, if any significant rpm spool-up or spool-down is detected, or if any automated spatial adjustment of the drone is observed, then the run should be rejected and repeated.

comment

28 comment by: *DGAC*

The allowable average wind speed and the allowable average crosswind component are well described in (3) (pages 8-9). However, it is not precised if these allowable values are measured at 1.2m or 10m (the two sensors location to be provided). It should be mentioned.

During our day of testing, it appears to be difficult to obtain acceptable wind conditions. It is clear that the wind will influence the UAS behaviour and therefore, its radiated noise. Therefore, several hours or days could be needed to reach the right conditions. It should be taken into account in the duration of future tests.

In (d)(2), it is mentioned that the temperature, the relative humidity, the wind speed and the atmospheric pressure should be measured "in the vicinity of the noise measurement point". It could be useful to precise an order of magnitude of the reasonnable distance.

In (e), the accuracy of the temperature and pressure sensors is specified. What about the accuracy of wind measurement sensor ?

In the atmospheric conditions, there is no verification to prevent temperature profile inversion.

response

Noted.

Thank you for your comment and for providing valuable feedback after applying our procedure in the field. EASA has the following responses:

- Regarding wind speed limits, please refer to our response to Comment #23. The limits will apply regardless of the height of the wind sensor (from 1.2m to 10m).
- Please refer to our response to Comment #16 for a clarification of the “vicinity” of the weather sensor.
- In line with most chapters of ICAO Annex 16, EASA does not specify any wind measurement sensor accuracy.
- Regarding temperature inversions, EASA foresees the majority of target test heights to be low enough so that temperature inversions between ground and UAS are unlikely to happen and do not need monitoring.

comment

29 comment by: *Francesco MARULO*

The statement "no excessive sound absorption characteristics" seems too much vague. Later in the document some specifications are given on the sound absorption characteristics. To avoid confusion, this statement could refer to the specific paragraph where more details are reported. For example:

(a) The noise measurement point must be located on a relatively flat terrain, which has no excessive sound absorption characteristics (see page xx, or see §§UAS.XXX)

response

Partially accepted.

Thank you for your comment. Please refer to our response to Comment #5, which also addresses the present comment.

comment

32 comment by: *Francesco MARULO*

Referring to comma (d)(2) the statement "in the vicinity of the noise measurement point" appears again too vague. Could be it possible to have a specific definition as for (d)(1)? During some airplane noise testing, somebody argued about the position of the meteo station, highlighting the problem of polluting noise mesaurement. In my personal view, I am very much confident that respecting the height (between 1.2m and 10m) is more than enough. But the height is attributed to the wind speed and wind direction measurement, and what about the other environmental parameters (temperature, relative humidity and atmospheric pressure)? Therefore being more specific, could be beneficial for the test itself.

response

Noted.

Thank you for your comment. Please refer to our response to Comment #16 for a clarification of the “vicinity” of the weather sensor. The weather sensor is considered to be measuring temperature, relative humidity, wind speed and wind direction. It may consist of several sensor units, or just one unit, as long as they are all properly positioned.

comment

66 comment by: *LHD*

Comment

The update of wording mandating 75° angle for overflight and hover conditions would allow a significant simplification in finding suitable localities for testing especially in terms of wind.

Suggested resolution

add wording "or lower angles (from axis) for hover measurements as agreed by Authority".

response

Rejected.

Thank you for your comment and for suggesting an alternate text. However, EASA has the following responses:

- EASA does not see how this proposal would simplify the test setup. The measurement procedure is tailored such that the same microphone installation can be used for both level-flight and hover procedures. Therefore, if the 75° condition is met for the level-flight procedures (and already induced the constraints of finding a suitable site), it will automatically be met for the hover procedure.
- Moreover, EASA does not see evidence for the proposal simplifying the research for a suitable test site as far as wind is concerned.
- Finally, since these Guidelines are expected to be used in cases where witnessing by EASA (or NAA / local authority) is not systematically foreseen, the statement “as agreed by Authority” cannot be used.

comment 79 comment by: *FAA*

Noise.UAS.520(a): “"The noise measurement point must be located on a relatively flat terrain, which has no excessive sound absorption characteristics."

Comment: The ground should be "relatively level and flat," not just relatively flat. This has been and issue during FAA UAS testing.

Proposed resolution: The noise measurement point must be located on a relatively level and flat terrain, which has no excessive sound absorption characteristics.

response Accepted.

Thank you for your comment and suggested clarification. It will be incorporated into the consolidated version of these Guidelines.

comment 80 comment by: *FAA*

More strict ground requirements should be imposed around the microphone. The FAA imposed a 25 ft radius around the microphone where grass must be cut to under 3 inches.

response Rejected.

Thank you for your comment. EASA considers that inverted-microphone setups over a reflective plate do not necessitate ground requirement as strict as 4ft microphone setups, the latter being prone to more variability due to local ground reflections.

comment	81 comment by: *FAA* Noise.UAS.520(d), MoC1 Noise.UAS.520(a) Comment : At some test sites 4 ft could be in the grass. Since UAS are very sensitive to wind and the wind data is being used for corrections, measurements should be done above 10 ft. Also for this reason, airport met stations should not be allowed as they can be unreliable and inaccurate. Requiring portable met stations is a relatively cheap and reliable solution. Proposed resolution: Delete section on airport met stations and revise met station height from 4 ft (1.2 m) to 10 ft (3 m).
response	Partially accepted. Thank you for your comment. For proportionality reasons, and consistently with several chapters of ICAO Annex 16, EASA will maintain the possibility to use airport met stations. Also out of proportionality, EASA will allow portable 1.2-m (or higher) weather stations. However, EASA notes FAA's helpful point that this might result in wind/temperature/relative humidity measurements to be performed in (overgrown) grass. EASA will therefore revise the Guideline text to require that the weather sensor(s) be installed above trimmed vegetation when applicable.

SUBPART D - NOISE LIMITS (RESERVED) p. 7

comment	*22* comment by: *Rigi Technologies SA* Attachment #2 RigiTech considers that caution will be needed in interpreting the results and drawing conclusions about whether and how to set noise limits for the UAS industry. From EASA study on societal acceptance of UAM, 2021 (https://www.easa.europa.eu/sites/default/files/dfu/uam-full-report.pdf), section 3.2.7. Noise, a tendency to accept noises at similar volumes when these are known rather than unfamiliar noises is observed. As UAS and UAM become more frequent, the social acceptance in terms of noise should increase. Additionally, from the attached file "AiRMOUR_Masterclass_Stakeholder engagement on UAM & public perceptions" summarizing an analysis on public perceptions of UAM in the context of AiRMOUR project, it can be observed that the acceptability of UAS depends on the purpose of their operation. Therefore, before establishing any strict limit, RigiTech considers

the need of differentiating limts based on the nature and social value of the operations of the UAS.

Finally, it is considered that establishing different limits based on geographical and time criteria. For example, it is not the same to operate an UAS in a rural environment at night than during a rush hour inside a dense city.

response

Noted.

Thank you for this comment and for providing additional references. EASA has the following response:

-
- The guidelines stipulate a harmonized method to establish noise levels for drones. As such, no conclusions are drawn on limits nor are they intended to be part of the guidelines.

Noise.UAS.530 Flight test procedures p. 9

comment

5 comment by: *Swedish Transport Agency, Civil Aviation Department (Transportstyrelsen, Luftfartsavdelningen)*

IM1 Noise. UAS.520 Test environment conditions, page 9
Instead of describing what is *not* recommended (excessive absorption, first mentioned on page 7, Noise.UAS.520 Test environment conditions), describe what is recommended. Asphalt? Flat grass?

response

Accepted.

Thank you for your comment. EASA will add a sentence in the corresponding IM listing examples of typical acceptable types of ground.

comment

6 comment by: *Swedish Transport Agency, Civil Aviation Department (Transportstyrelsen, Luftfartsavdelningen)*

MoC3 Noise.UAS.530 Flight test procedures, page 12
Consider whether the requirement of 15 dB lower ambient noise could result in difficulties with the signal-to-noise-ratio. Are the lowest altitudes (17 meters / 12 meters) always sufficient? One other solution could be to offer a possibility to adjust the noise measurement when the ambient noise is between 15- 10 dB lower than the noise measured from the UA.

response

Partially accepted.

Thank you for your comment and the suggested modifications, for which EASA has the following responses:

- EASA recognizes the need to facilitate noise measurement campaigns. However, the proposal to subtract ambient noise from UA noise cannot be implemented for the following reasons:
  - It would make the entire procedure far more complex than it currently is, requiring the use of a separate analyzer (with its own qualification requirements, as standard Sound Level Meters would not be able to support such procedures) and complex calculation on the side (with possible filtering of data into 1/3-octave bands, similarly to what is done for large aircraft).
  - It could give an unfair advantage to noisy designs, for which there would be an interest to deliberately test in high background noise locations and take advantage of the subtraction.
- Nevertheless, EASA fully acknowledges your point, and the unfair difficulties in meeting the current requirement that would arise for the quietest designs. For this reason, EASA will adapt the requirements to the following:
  - The lower heights limit (17m/12m respectively for level-flight/hover procedures) and signal-to-noise requirements (15 dB) remain.
  - However, if at the lower height limit (17m/12m), the UA noise is measured between 10 and 15 dB higher than ambient noise, it is permitted to decrease the test height by the amount necessary to meet a 15 dB signal-to-noise ratio, whilst remaining above 10m (for both level-flight and hover).
  - If then meeting the 15 dB signal-to-noise ratio is still impossible, a quieter test site must be found. To maintain quality in the data, and in line with legacy standards of ICAO Annex 16, EASA will not allow signal-to-noise ratios lower than 15 dB.

comment

10 comment by: *Rigi Technologies SA*

In (c)(6) "if the UA design permits multiple configurations...".

In general, hybrid VTOL UAS that switch between a multicopter and a fixed-wing configuration, the noise is significantly higher during the multicopter phases than the fixed-wing phases.

RigiTech suggests that if this is accepted by EASA, applicants can directly focus on the noise measurement in multicopter phases with simplified explanations.

response

Noted.

Thank you for your comment. Please also refer to Comment #67. The word “configurations” was not intended to be understood or limited to “fixed-wing” versus “multicopter”, but rather various angles of attack, rpm, or any devices that could be deployed and increase the noise footprint.

More specifically, EASA acknowledges that some hybrid designs may generate their lift either from the rotating parts or from the airfoil. For the purpose of reporting noise from level-flight procedure, the guidelines stipulate the noisiest configuration must be reported.

comment

11 comment by: *Rigi Technologies SA*

Noise.UAS.530(d)(6):

The allowable lateral deviation in the hover test procedure should be increased from 6 degrees to 10 degrees to be consistent with the flyover test procedure. For a target altitude of 25 m, a 10 degree deviation from the target position results in only 1.5% difference in the sound propagation path length.

response

Partially accepted.

Thanks for your comment. EASA recognizes the argument and substantiation. However, the hover procedure is more sensitive to the distance adjustment (20 x $\log_{10}$) than the level-flight procedure (12.5 x $\log_{10}$). As a result, EASA will consider this proposal by updating the Guidelines, but still limit the vertical deviation within 8° to limit the resulting noise uncertainty within 0.1 dB(A) (the same logic was followed when allowing a 10° lateral deviation for the level-flight procedure).

comment

12 comment by: *Rigi Technologies SA*

Noise.UAS.530(e):

In MoC3(b) to Noise.UAS.530, the required ratio between the UA maximum A-frequency-weighted sound level (L_AS_max) and the baground noise A-weighted sound level should be reduced from 15 dB(A) to 10 dB(A) to allow to be flown closer to the reference altitudes.

response

Rejected.

Thank you for your comment. Please refer to Comment #6 for EASA’s response.

comment

13 comment by: *Rigi Technologies SA*

MoC2 to Noise.UAS.550:

A performance-based approach should be followed and any method for measuring UA spatial positioning should be accepted as long as it has an accuracy of:

- +- 2 m for lateral position - for a target altitude of 25 m, a 2 m error in lateral position would still put the aircraft within the 10º cone; and
- +- 4 m for vertical position - for a target altitude of 25 m, a 4 m error in the altitude measurement would result in, at most, 1.5 dB(A) error in the sound level measurement.

response

Partially accepted.

Thank you for your comment and for the suggestion of a performance-based approach on the accuracy of the positioning. Your proposal put in perspective of ongoing discussions within ICAO CAEP WG1, as well as on-the-field experience gained by EASA, will drive the following changes to the Guidelines:

- The requirement for the accuracy of the positioning methodology will be ±1.5m.
- The built-in positioning of the UAS will be allowed as part of MoC2 (DGNSS) as long as it meets the accuracy requirement above.

comment

17 comment by: *UK CAA*

Page No: 10

Paragraph No: Noise.UAS.530 (c)(4) and (d)(5) Flight test procedures

Comment:

At sub-paragraphs (c)(4) and (d)(5), the permitted height windows for the level-flight and hover procedures are relatively large and overall adjustment values of up to 6dB are permitted, potentially allowing relatively large adjustment errors to be introduced in the normalisation process. By comparison, the ICAO Annex 16, Chapter 11 test height window is relatively small (150m ± 15m, with a maximum permitted adjustment of 2dB).

The range of the height test windows for the level-flight and hover procedures should be reduced, to better align with the relative tolerance specified in Chapter 11 of ICAO Annex 16.

If the UA is still too quiet to measure accurately at the lower limit of the height window, the guidance should simply require an alternative quieter test site to be chosen.

Justification:

Tightening the height test windows would help minimise the potential for large adjustment errors to be introduced in the normalisation process.

response

Rejected.

Thank you for your comment and proposal. While EASA fully recognizes the need to limit allowable height windows to improve accuracy, practical constraints must also be considered. Having been on the field to conduct UAS noise measurements according to the procedures of these Guidelines, situations were sometimes witnessed where the noise of small UA's could barely meet the 15 dB ambient noise-to-signal ratio criterion at 17m above the microphone despite a rather quiet test site.

comment

18 comment by: *UK CAA*

Page No: 10

Paragraph No: Noise.UAS.530 (d)(3) Flight test procedures

Comment:

The UK CAA believes the definition of L_{Aeq} at sub-paragraph (d)(3) is inaccurate.

Justification:

In theory there is no time constant (SLOW time-weighting) applied to the measurement of L_{Aeq}.

Proposed Text:

The UK CAA recommends the existing text at Noise.UAS.530 (d)(3) is replaced with "*the L_{Aeq} must result from the A-weighted equivalent continuous sound pressure level averaged over 30 seconds*"

response

Accepted.

Thank you for your comment and proposal. EASA will update the Guidelines according to your proposed text.

comment

19 comment by: *UK CAA*

Page No: 13

Paragraph No: IM3 Noise.UAS.530 Flight test procedures

Comment:

We believe the reference to Noise.UAS.530 sub-paragraph "(d)(4)" in the first sentence for the hover procedure is incorrect.

Justification:

Typo

Proposed Text:

The UK CAA suggest replacing "(d)(4)" with "(d)(5)"

response

Accepted.

Thank you for your comment and for identifying this typo. EASA will update the Guidelines with your proposed text.

comment

24 comment by: *AIRBUS*

PAGE / PARAGRAPH / SECTION :
Pages 9 to 14
SUBPART E – NOISE TEST
Noise.UAS.530 Flight test procedures

COMMENT:
The Flyover measurement procedure is a derivative of noise measurements for light Helicopters (ICAO, Annex16, Chapter 11), intending to measure dB SEL, with adaptations on the vehicle Height –to improve signal to noise ratio-, on a single ground plate microphone.

The ground plate microphone configuration makes sense, but will make the comparison to other vehicles (e.g Helicopters) more difficult.

RATIONALE / REASON :
As a remark, comparison to other vehicles like helicopters will be more difficult.

response

Noted.

Thank you for your comment. EASA considers that the main advantage of the ground-plate setup being accuracy and repeatability, the drawback being the difficulty to compare the resulting UA noise to that of helicopters. EASA decided to favor accuracy/repeatability over the consistency with helicopter noise measurements, acknowledging that most designs

foreseen in the low-to-medium risk class of the 'Specific' UAS category will not be comparable to helicopters in terms of size and operations.

comment

25 comment by: *AIRBUS*

PAGE / PARAGRAPH / SECTION :
Page 10
SUBPART E – NOISE TEST –
Noise.UAS.530 Flight test procedures

(c) (6) if the UA design permits multiple configurations in terms of control input and surfaces, the noisiest configuration must be selected and maintained throughout the entire flight. **If the configuration producing the highest noise cannot easily be identified, all possible configurations must be tested and the noisiest one retained for reporting**;

COMMENT:
Clarification and detailed recommendations from EASA regarding last sentence "if the configuration…." would be welcomed

RATIONALE / REASON :
Different interpretations of the sentence can influence the understanding regarding expected effort to be performed.

response

Noted.

Thank you for your comment. While the objective remains to cater all possible cases throughout this requirement, EASA will clarify the Guidelines and specify in an additional IM that "configurations" can refer to possible combinations of rpm, angles of attack, how the lift is achieved, or if additional elements are deployed.

comment

33 comment by: *Francesco MARULO*

(c)(1) Let's imagine the following condition: 8 number of flights recorded during the measurement on the test site, 4 with headwind direction and 4 with a tailwind direction. When post processing the data, one flight test, for some reason, become not useful, for example one headwind direction. To have the same number for headwind and tailwind, we have to discard a valid tailwind measurement. Which should be the criteria for identifying the discarded test?

This means that we have seven valid tests, but an equal number of headwind and tailwind measurements. Therefore one tailwind measurement has to be cancelled. How should it be selected?

response

Noted.

Thank you for your comment and for bringing this particular example to our attention. EASA will clarify that, in the case of having to discard an invalid test run during post-processing, the associated (paired) run conducted in the opposite direction must also be discarded.

comment

40 comment by: *Francesco MARULO*

(c)(4) for the level flight procedure:
a tolerance on the height between 17m to 150 m appears to be quite large. Is it necessary to ve such big tolerace?

response

Noted.

Thank you for your comment. Please refer to Comment #17 for an answer to your question.

comment

46 comment by: *Wing Aviation*

In point (c)(3), the term 'test vehicle' is used to refer to the UA used for the test. We would like to propose its replacement with 'UA' as in the rest of Section.UAS.530.

response

Accepted.

Thank you for your comment and for the suggested modification. EASA will update the text of the Guidelines according to your proposal.

comment

47 comment by: *Wing Aviation*

In point (d)(6), the allowable lateral deviation in the hover test procedure should be increased from 6 degrees to 10 degrees to be consistent with the flyover test procedure. For a target altitude of 25 m, a 10 degree deviation from the target position results in only 1.5% difference in the sound propagation path length.

response

Partially accepted.

Thank you for your comment and proposal. Please refer to Comment #11 for EASA's answer.

comment

48 comment by: *Wing Aviation*

	In point (e), the required ratio between the UA maximum A-frequency-weighted sound level (LASmax) and the background noise A-weighted sound level should be reduced from 15 dB(A) to 10 dB(A) to allow UA to be flown closer to the reference altitudes.
response	Rejected. Thank you for your comment and proposal. Please refer to Comment #12.

comment	*49* comment by: *Wing Aviation* In point (b) of MoC3 Noise.UAS.530, the required ratio between the UA maximum A-frequency-weighted sound level (LASmax) and the background noise A-weighted sound level should be reduced from 15 dB(A) to 10 dB(A) to allow UA to be flown closer to the reference altitudes.
response	Rejected. Thank you for your comment and proposal. Please refer to Comment #12.

comment	*58* comment by: *Drone Alliance Europe* In point (c)(3), the term 'test vehicle' is used to refer to the UA used for the test. DAE would like to propose its replacement with 'UA' as in the rest of Section.UAS.530.
response	Accepted. Thank you for your comment and for the suggested modification. EASA will update the text of the Guidelines according to your proposal.

comment	*59* comment by: *Drone Alliance Europe* In point (d)(6), the allowable lateral deviation in the hover test procedure should be increased from 6 degrees to 10 degrees to be consistent with the flyover test procedure. For a target altitude of 25 m, a 10 degree deviation from the target position results in only 1.5% difference in the sound propagation path length.
response	Partially accepted. Thank you for your comment. Please refer to Comment #11 for EASA’s answer.

comment	*60* comment by: *Drone Alliance Europe* In point (e), the required ratio between the UA maximum A-frequency-weighted sound level (LASmax) and the background noise A-weighted sound level should be reduced from 15 dB(A) to 10 dB(A) to allow UA to be flown closer to the reference altitudes
response	Rejected. Thank you for your comment and proposal. Please refer to Comment #12.

comment	*61* comment by: *Drone Alliance Europe* In point (b) of MoC3 Noise.UAS.530, the required ratio between the UA maximum A-frequency-weighted sound level (LASmax) and the background noise A-weighted sound level should be reduced from 15 dB(A) to 10 dB(A) to allow UA to be flown closer to the reference altitudes
response	Rejected. Thank you for your comment and proposal. Please refer to Comment #12.

comment	*67* comment by: *LHD* Comment Noise.UAS.530(c)(6) asks to consider the loudest configuration permitted by "the UA design". Some UA designs may permit a number of configurations (e.g. attitudes, angles of attacks, RPMs) which are indeed louder, but are not practical nor economic nor actually practiced (e.g. combination of high RPM and high wing angle of attack, meaning high thrust against high aerodynamic drag). Considering such configurations would yield higher noise levels which are not representative of actual operations. Could a UAS manufacturer exclude such configurations - e.g. by specifying attitude, rpm combination range, etc in the operations manual or other design data set documents? Suggested resolution Reformulate Noise.UAS.530(c)(6) to allow the exclusion of non-practical / non-economical configurations.
response	Partially accepted. Thank you for your comment and for your suggestion. Please refer to Comments #31 and #25 for background information. EASA will update the Guidelines to reflect that, when several configurations are possible, only those that are compatible with the definition of the

	fastest operating speed in “normal” conditions will have to be assessed for noise. This will be clarified in a dedicated IM.
comment	82 comment by: *FAA* Noise.UAS.530(c)(4) : (4) the UA must be flown at a height between 17 m and 150 m above the noise measurement point; Comment : The 17 m minimum height should have caveats for if you are HIGEs or creating downwash on the microphone. Proposed resolution: A caveat about HIGE and downwash.
response	Accepted. Thank you for your comment and suggestion. EASA will add a requirement that the test height must be such that there is no occurrence of Hover in Ground Effect (HIGE) or downwash effect over the microphone.
comment	83 comment by: *FAA* Noise.UAS.530(c): Comment : There should be a height tolerance for the flyover test to keep the confidence interval low (like there is for the hover test). Proposed resolution: An additional bullet point with a 10% height tolerance for flyover.
response	Rejected. Thank you for your comment and proposal, which are in line with Comment #17. Please refer to EASA’s answer to comment #17.
comment	84 comment by: *FAA* Noise.UAS.530(d): Comment: The hover test should be done in the noisiest configuration, like with flyover (articulated rotor or new technology). Proposed resolution: A bullet point stating the aircraft should be in its noisiest configuration for hover testing.

response	Accepted. Thank you for your comment and suggestion. EASA will update the Guidelines according to your suggestion.

comment	85 comment by: *FAA* MoC3 Noise.UAS.530(b): “In such a case, the background noise sound level on the test site should be reduced as much as practical and the target test speed should be progressively decreased.” Comment: Allowing a lower test speed to accommodate a longer 10 dB down duration may set a bad precedent. It may allow applicants to test at sites with higher than acceptable ambient levels. Proposed resolution: In such a case, the background noise sound level at ~~on~~ the test site should be reduced as much as possible. ~~practical and the target test speed should be progressively decreased.~~
response	Accepted. Thank you for your comment and suggestion. EASA will incorporate your proposed modifications into our consolidated version of the Guidelines.

comment	86 comment by: *FAA* MoC3 Noise.UAS.530(b): “Moreover, the UA must be flown within its allowable operational range based on its design and the local restrictions at the test site.” Comment: Local restrictions should not change test reference conditions, like testing at a lower speed than what is required by the definition of Vgref. Proposed resolution: Moreover, the UA must be flown within its allowable operational range based on its design. ~~and the local restrictions at the test site.~~
response	Accepted. Thank you for your comment and suggestion. EASA will modify the text of the Guidelines according to your proposal.

Noise.UAS.540 Noise measurement	p. 14

comment	*34*	comment by: *DGAC*
	In (b), it is mentioned that sensor sensitivity has to be checked at least every hour during test. Based on our experience on outdoor noise measurement, the sensitivity controlled at the beginning and at the end of the test (as described in Annex 16), appears to remain within 0.5 dB(A). Maybe, checking the sensitivity every hour is too much.	
response	Accepted. Thank you for your comment and suggestion. Considering that a typical UAS noise test is expected to last less than one hour, EASA will accept your suggestion and thereby remove this specification.	

Noise.UAS.550 Spatial positioning and speed measurement p. 15

comment	*20*	comment by: *UK CAA*
	Page No: 16 **Paragraph No:** Noise.UAS.550 (d)(1) Spatial positioning and speed measurement **Comment:** The requirement at sub-paragraph (d)(1) for an augmented GNSS receiver that is independent of any built-in navigation system appears excessive in the case of UAs that may already have augmented GNSS navigation systems built-in. The UK CAA suggests allowing UAs that already have navigation systems with built-in augmented GNSS to use their built-in positioning systems for the tests. **Justification:** The current requirement may add an unnecessary additional cost for the end user.	
response	Accepted. Thanks for your comment and suggestions. Please refer to Comment #13 for EASA's answer.	

comment	*36*	comment by: *DGAC*

	At the end of page 23, the calibration procedure based on digital camera is mentioned to be described in Section 3.2.2.5 of the ICAO Doc 9501-Volume. Unless, I am mistaken, I did not find it there.
response	Noted. Thank you for your comment. EASA is referring to the ICAO's ETM (9501) 3rd edition, Amendment 1 (from 21/02/2020). Section 3.2.2.5 corresponds to the calibration of the photographic scaling method ("The calibration of the image scaling system is used to determine the focal length of the digital camera/lens system…").

Comment	*50* comment by: *Wing Aviation* In point (a), the terms 'test vehicle', 'flying vehicle', and 'vehicle' are used to refer to the UA used for the test. We would like to propose their replacement with 'UA' as in the rest of Section Noise.UAS.550.
response	Accepted. Thank you for your comment. Please refer to Comment #46.

Comment	*51* comment by: *Wing Aviation* In the last paragraph of point (a) of MoC2 Noise.UAS.550, the terms 'test vehicle', 'flying vehicle', and 'vehicle' are used to refer to the UA used for the test. We would like to propose their replacement with 'UA' as in the rest of Section Noise.UAS.550.
response	Accepted. Thank you for your comment. Please refer to Comment #46.

Comment	*52* comment by: *Wing Aviation* In MoC2 Noise.UAS.550, a **performance-based approach** should be followed and any method for measuring UA spatial positioning should be accepted as long as it has an accuracy of: -1) ±2 m for lateral position – for a target altitude of 25 m, a 2 m error in lateral position would still put the aircraft within the 10 degree cone; and -2) ±4 m for vertical position – for a target altitude of 25 m, a 4 m error in the altitude measurement would result in, at most, 1.5 dB(A) error in the sound level measurement.
Response	Partially accepted.

	Thank you for your comment. Please refer to Comment #13.

Comment	*62* comment by: *Drone Alliance Europe* In point (a) of MoC1 Noise.UAS.550, the terms 'test vehicle', 'flying vehicle', and 'vehicle' are used to refer to the UA used for the test. DAE would like to propose their replacement with 'UA' as in the rest of Section Noise.UAS.550.
response	Accepted. Thank you for your comment. Please refer to Comment #46.

Comment	*63* comment by: *Drone Alliance Europe* In the last paragraph of point (a) of MoC2 Noise.UAS.550, the terms 'test vehicle', 'flying vehicle', and 'vehicle' are used to refer to the UA used for the test. DAE would like to propose their replacement with 'UA' as in the rest of Section Noise.UAS.550.
response	Accepted. Thank you for your comment. Please refer to Comment #46.

Comment	*64* comment by: *Drone Alliance Europe* Related to MoC2 Noise.UAS.550: A **performance-based approach** should be followed and any method for measuring UA spatial positioning should be accepted as long as it has an accuracy of: -1) ±2 m for lateral position – for a target altitude of 25 m, a 2 m error in lateral position would still put the aircraft within the 10 degree cone; and -2) ±4 m for vertical position – for a target altitude of 25 m, a 4 m error in the altitude measurement would result in, at most, 1.5 dB(A) error in the sound level measurement.
Response	Partially accepted. Thank you for your comment. Please refer to Comment #13.

Noise.UAS.610 Noise measurement system	p. 25

comment	*21* comment by: *UK CAA* **Page No:** 25 and 26 **Paragraph No:** Noise.UAS.610 Noise measurement system **Comment:** There is currently no requirement in the guidance to have the performance of the noise measurement system periodically verified by a nationally recognised laboratory. The only external 'calibration' requirement (at a single sound pressure level and single frequency) is at sub-paragraph (b) of Noise.UAS.640 Sound calibrator which states "*The sound calibrator output must have been determined by a standardizing laboratory within 6 months of each noise test*". **Justification:** The performance of the noise measurement system (e.g. sound level meter) should be periodically verified by a nationally recognised calibration agency in order to provide traceable results. By comparison, ISO 20906 (Acoustics — Unattended monitoring of aircraft sound in the vicinity of airports) states "*The recommended time interval for testing of system performance is once a year. The maximum allowable interval is two years*." **Proposed Text:** The UK CAA recommends inserting a new sub-paragraph (d) in Noise.UAS.610 that states: "*To demonstrate conformance to the class 1 specifications of IEC 61672-1, the performance of the noise measurement system must have been tested by a standardizing laboratory within 12 months of each noise test*."
Response	Accepted. Thank you for your comment, for a thorough read and for the associated suggestion (as well as for providing additional references). EASA will include your suggested text into the consolidated version of the Guidelines.

Noise.UAS.620 Microphone characteristics and set-up	p. 26

comment	*26* comment by: *AIRBUS*

PAGE / PARAGRAPH / SECTION :
Pages 26 to 28
SUBPART F – NOISE TEST EQUIPMENT -
Noise.UAS.620 Microphone characteristics and set-up

COMMENT:
The Hover measurement procedure may be of interest for drones operations, but would like to remind that Hover is currently not a test condition in the Noise certification scheme of helicopters, particularly due to repeatability issues.
Could EASA clarify this topic?

RATIONALE / REASON :
Additional clarification is welcomed

response

Noted.

Thanks for your comment and question. EASA included the Hover point to provide a flight phase that would exhibit a noise signature typically different than the one for level-flights, while still being relevant to typical noise exposure of populations. EASA is aware of the repeatability issues encountered in the Hover point for helicopters. However, the noise studies conducted by EASA suggested that UAS hover noise are able to achieve the desired repeatability with the current measurement procedure.

comment

38 comment by: *DGAC*

On page 26, there is a mistake on the figure reference : it is not figure 1 but figure 6.

response

Accepted.

Thank you for your comment and for catching this typo. EASA will include the correction into the consolidated version of the Guidelines.

comment

68 comment by: *LHD*

Comment

It is proposed a simplification of the requirement, so that microphones with diameters smaller than 1/2 " (e.g. 1/4 ") can also be used

Suggested resolution

Reword the requirement for microphone "(1) a 12.7 mm maximum diameter pressure type"

response

Rejected.

Thank you for your comment and suggestion. EASA understands that the inverted-microphone setup over a reflective ground plate is originally found and substantiated in SAE AIR1672 (Rev.C, 2020-12). The test setup foreseen in that standard only caters for 12.7mm microphone diameters, those being the only types of microphones tested to justify that the setup was working as intended. Therefore, since there is no substantiation that the inverted setup, while achieving the same results, can be used with any other dimensions of microphones, EASA will only authorize 12.7mm diameters for the microphone.

comment

69 comment by: *LHD*

Comment

It is proposed a simplification of the requirement, allowing plate diameter dimensions of more than 40 cm especially since larger dimensions are not disadvantageous from an acoustic point of view

Suggested resolution

Reword the requirement as follows "the plate must have a diameter of 40 cm or more"

response

Accepted.

Thank you for your comment and proposed modification, which seems aligned with ongoing discussions at ICAO CAEP WG1 level. EASA will incorporate it into the consolidated version of the Guidelines.

comment

87 comment by: *FAA*

“If a windscreen is used…”

Comment: A windscreen should be used at all times or at least above 5 kts.

Proposed resolution: Require windscreens above 5 kts of wind.

response

Rejected.

Thank you for your comment and suggestion. EASA will nevertheless not require the use of windscreens above 5 kts, the main reason being that the current rulemaking scope foresees the possibility to use these Guidelines without any witnessing involved (voluntary declarative process). Over time, windscreens can get damaged or clogged, thereby impacting their insertion loss, but EASA will not always have the possibility to assess that they are in an

	acceptable state. Therefore, EASA prefers to keep the current text, where the use of a windscreen is recommended above 5 kts of wind, and recommendations are provided to ensure it is not damaged or clogged. EASA also wants to mention that not using a windscreen in windy conditions would result by default in conservative noise levels.

Noise.UAS.630 Recording and reproducing equipment p. 28

comment	*70* comment by: *LHD* Comment (b) The acoustical signals must be stored using a recording and reproducing system or computer-based system both with a permanent data storage device. The recording and reproducing systems must comply with the specifications in Subpart F at the recording speeds, data sampling rates, the frequency bandwidths and recording channels selected and used for the test. However, there is no explicit specification in the document, neither in Subpart F nor elsewhere, of the recording speeds, data sampling rates, the frequency bandwidths and recording channels. Suggested resolution Propose specifications of the recording speeds, data sampling rates, frequency bandwidths and recording channels.
response	Accepted. Thank you for your comment. EASA realizes that the text has led to a misunderstanding from your part: it says that the recording/reproducing systems must meet the requirements of Subpart F **"at"** the settings (sampling rates, bandwidths, etc) used by the applicant during the test. It is not intended to specify what those sampling rates, bandwidths, etc must be. To avoid this misunderstanding, EASA will slightly reformulate the sentence: "For the recording speeds, data sampling rates, the frequency bandwidths and recording channels selected and used for the test, the recording and reproducing systems must comply with the specifications in Subpart F".

Noise.UAS.710 Adjustments of the measured sound levels p. 29

comment	*35*	comment by: *Francesco MARULO*
	The adjustment component for the difference in the atmospheric absorptions appears to be a truly academic exercise. It is so important to require such precision? Please refer to my general comment, where I would like to have a global comment on the "engineering" applicability of some absolute precision to something which may be treated with a totally different approach.	
response	Noted. Thank you for your comment. EASA addressed most of its aspects in Comment #39. EASA considers that accounting for atmospheric absorption is mandatory to satisfy the quality of data. Consistently with ICAO Annex 16 measurement standards, it is paramount to have a method that allows a fair comparison of UAS designs, hence the need to “normalize” measured noise to reference conditions.	

comment	*37*	comment by: *DGAC*
	On page 31, the adjustement component for the difference of airspeeds, mentions cos(alpha_wind + alpha_UA). Colleagues are used to correct with cos(alpha_wind - alpha_UA). Even if the text below precise the direction "where the wind is coming from" and the direction "towards where the UA is heading", a figure could be helpful to prevent confusion.	
response	Accepted. Thank for your comment. EASA will add a figure to prevent confusion. Additionally, following separate feedback and internal reconsideration, EASA will remove the requirement to correct the measured wind speed to a height of 10 m when calculating the Δ_3 adjustment for differences in airspeed, due to the approximation of the provided formula. Regardless of the height at which wind speed and direction are measured, as long as it between 1.2 and 10 m, wind speed and direction will be used directly into the Δ_3 adjustment.	

comment	88	comment by: *FAA*
	Noise.UAS.710(d) Comment: Is there any data to support the accuracy of the D3 correction with fixed wing aircraft and/or rotorcraft?	

response

Noted.

Thank you for your question. EASA derived the value of D_3=25 from a commissioned test campaign.

Additionally (see comment #37), EASA removes the requirement to correct the measured wind speed to a height of 10 m when calculating the Δ_3 adjustment for differences in airspeed.

SUBPART H - REPORTING p. 36

comment

3 comment by: *Wingcopter GmbH*

Until implementation and/or changing the voluntay to the abligated character the arguments for testing a "type" (before and CE or TC) needs to be reflected.
In other words: needs to clearly have criteria when there is still the need to measure indivirual SERIAL NUMBERS / BUILTS.

EASA sure knows the rlevant drivers for noise - these need to be a prerequisite on each UA measured to stay **FROZEN**

Noise.UAS.820 UA information is listing the necessary UA being reported.
The procedure to be allowed to use this data "after the test" (NAA, Authorizations, ...) is missing.

No need to explain the charm of changing propellers (or other parts) after a test for performance reasons etc.

response

Noted.

Thank you for your comment. EASA acknowledges the points raised in this comment, but they fall outside of the strict scope of these Guidelines.

comment

89 comment by: *FAA*

Noise.UAS.820

Comment: Aircraft configuration and weight should be tracked for all passes.

Proposed resolution: Include aircraft configuration and weight in the list of required information.

response	Accepted. Thank you for your comment. EASA will change the consolidated text of the Guidelines to capture your proposal.

2. **Appendix A - Attachments**

 Wing's Position paper EASA's drone noise measurement guidelines.pdf

Attachment #1 to comment #43

 AiRMOUR_Masterclass_Stakeholder engagement on UAM & public perceptions.pdf

Attachment #2 to comment #22