European Union Aviation Safety Agency

Comment-Response Document (CRD)

RELATED: ENVIRONMENTAL PROTECTION TECHNICAL SPECIFICATIONS APPLICABLE TO EVTOL POWERED BY MULTIPLE, VERTICAL, NON-TILTING, EVENLY DISTRIBUTED ROTORS

04.05.2023: BEGINNING OF COMMENTING PERIOD

06.07.2023: 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	*2* comment by: *Marcel de Ruiter* The consultation is fundamentally flawed. If the base line is heavy rotorcraft these are invariably powered by turbine engines. The frequency of sound of the turbine engine intake, turbine exhaust, the main rotor(s) and associated variation in frequency when the hot exhaust fumes hit the main rotor disc as well as the tail rotor are not present at electric aerial vehicles. The study should in principle look at the combined sound frequencies of the electric motors and the (multiple) rotors of these designs and the interference of said motors and rotors.
response	Noted. Thank you for your comment. Please note that the document for consultation is not a "study". The use of the EPNL metric results from psycho-acoustic studies carried out by EASA, showing that the EPNL is still the best metric capturing perceived annoyance of novel designs, as well as from the wish to ensure commonality with legacy ICAO Annex 16 Volume I procedures (Chapter 8 especially).

comment	*10* comment by: *Lilium* It is better to replace "eVTOL powered by multiple, vertical, non-tilting, evenly distributed rotors" - by "Multicopter", and provide more details about this term in section NVTOL.1005 - Definitions, where it can be better explained/defined types of aircraft, covered by this Noise requirements.
response	Not accepted. Thank you for your suggestion. However, a "Multicopter" is commonly defined as "a rotorcraft with more than two lift-generating rotors". It would also encompass designs with tilting rotors, which EASA intends to address through a separate EPTS. Therefore, the wording "Multicopter" cannot be used within this EPTS applicability.

comment	*21* comment by: *Volant Aerotech*

We are eVTOL companies Volant Aerotech(Shanghai),XPENG AEROHT(Guangzhou) and International Institute of Acoustic Technology(Suzhou) from China. We hope to discuss about the noise specifications applicable to eVTOL powered by multiple, vertical, non-tilting, evenly distributed rotors.

We understand that most of the contents are initiated from helicopters. Although FAA released 14 CFR Part 36 which added requirements for tiltrotors on 2/15/2023, it is very great that EASA firstly proposed the specifications for eVTOL powered by multiple, vertical, non-tilting, evenly distributed rotors even it is just a consultation paper at this stage.

Based on our current test data and limited knowledge, there are many differences between helicopters and eVTOL powered by multiple, vertical, non-tilting. So, is it reasonable to completely introduce helicopter specifications to these kinds of eVTOL? For example, we can define many kinds of profiles for take-off and approach procedures with different power configurations, especially for compound wings design eVTOL with multiple vertical rotors and horizontal propellers. So, is it absolutely objective to evaluate different kinds of eVTOL designs with the same standards?

The eVTOL is absolutely something new in the aviation industry. We hope all agencies could simplify the certification process and adopt relatively easy standards to help eVTOL to develop. As we discussed above, different kinds of eVTOL designs may have variable profiles and power options especially for take-off and approach test procedures, however, for the hover and overflight test procedures, they seem to be more fixed for all kinds of eVTOL designs as well as to be the typical application scenarios. Therefore, we suggest that we should focus on hover and overflight noise level in the early stage.

response

Noted.
Thank you for your comment and questions.
The construction of these EPTS from the procedures of ICAO Annex 16 Chapter 8 (more complex than Chapter 11 which would only have involved an overflight point) stems, among several reasons, from the current lack of knowledge of the typical noise signatures of such aircraft, hence the need to measure and regulate as many flight phases as possible (here: approach, take-off, overflight and hover) to avoid a situation where an eVTOL exhibits unexpected noisy flight phases that would have been overlooked by noise assessment.
Regarding the existence of several configurations / combinations to satisfy one set of requirements for a flight phase, in line with several other comments, EASA will modify the text of the EPTS to clarify that the noisiest configuration must be retained. It is understood that this may demand additional testing from the applicant to identify this noisiest configuration.

comment

23 comment by: *MJNewman Avinor*

Is this work coordinated with the dtandardisation work being carried out by ISO? There is an ISO CD 5305 for drones upto 150kg.

response

Noted.

Thank you for your question. EASA is aware of the ongoing work at ISO to develop the CD 5305 standard. Unfortunately, not only is this standard not yet finalized, but it is for the moment impractical for an easy implementation within the EASA frame, with too many technical aspects left open (e.g.: choice of test setup). For these reasons, EASA followed the rationale of establishing its own specific noise measurement procedures and limits.

comment *41* comment by: *EUROCONTROL*

The document appears to prescribe a single set of metrics, procedures etc. for all types of eVTOLs with specific characteristics (the vehicle must have multiple, vertical, non-tilting, evenly distributed rotors), but without any consideration of physical characteristics like dimensions, weight or number of rotors. By contrast, a previous consultation paper prepared by EASA on noise measurement guidelines for UAS ("Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category (Low and Medium Risk") was specifically targeting UAS with MTOM < 600kg; no such or similar constraint is presented in the current consultation paper.

The technical specification documentation proposed herein is largely based on Chapter 8 of ICAO Annex 16, with certain adaptations and extensions such as the introduction of a hover procedure. Such transposition of existing noise certification standards onto eVTOLs may not work for all vehicles falling under such broad definition. For noise certification purposes there should be one uniform set of rules and certification standards for all vehicles. However, the noise certification procedures should take into account the characteristics of eVTOLs (size, weight etc.), since the range of known/used eVTOLs in terms of size and weight is very large; what may be applicable or practically meaningful for vehicles on one end of the spectrum may not be at all practicable for vehicles on the opposite end.

For comparison, ICAO Annex 16 also presents two sets of standards in Chapter 8 for helicopters in general, and in Chapter 11 for helicopters with MTOM =< 3175 kg; the choice is then given to applicant to show compliance with Chapter 11 if the vehicle falls in that category. It should be noted that the Chapter 11 prescribes simplified procedures (no take-off or approach procedures) and fewer noise measurement points; crucially, it also relies on a different metric for the maximum noise levels not to be exceeded (EPNL in Chapter 8 versus SEL (L_{AE}) in Chapter 11 for 'light helicopters').

The possible solutions here are A) to add further dimension/weight/rotor count characteristics to specify a category of eVTOL vehicles the consulted material should be applicable to as-is; or B) adapt the procedures to account for the diverse set of vehicles to make the procedures universally applicable to all eVTOL vehicles; or C) by following the principles of Chapter 8 and Chapter 11 in ICAO Annex 16, introduce a new/separate set of standards within the proposed documentation that would be applicable for lighter and/or smaller vehicles.

NB The issue described above is different from the provision in NVTOL.1205(g), since this paragraph stipulates that deviations from the reference flight procedures should only be allowed if the design characteristics of the respective eVTOL prevent the

conduct of the flight procedures specified in NVTOL.1205. The document should also specify what (if any) deviations are allowed if the procedures are flyable by the given eVTOL (i.e. the design of the eVTOL in question permits the conduct of the procedures as prescribed by the specification) but when the noise measurements - even with correct execution of the procedure - do not lead to meaningful results due to insufficient signal-to-noise ratio on the measured sound levels of the eVTOL compared to the ambient noise levels.

response

Partially accepted.
Thank you for your comment and suggestions. Regarding the need to discriminate against weight class, please note that the "Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category (Low and Medium Risk)" only apply to unmanned products with 'Specific' category of operations (and Low and Medium risk classes). The types of products covered by the current EPTS (eVTOL with vertical non-tilting rotors) would typically fall into the 'Certified' category of operations and undergo a certification process at EASA. This framework is currently used by EASA to differentiate between the general denomination of air taxis and that of the smaller drones.
As far as having one set of rules to cover both air taxis and drones, EASA follows the rationale that the measurement procedures must be proportionate to the complexity of the design. EASA deems proportionate to require the rather intricate noise measurement procedures and metrics laid out in these EPTS considering the complexity of eVTOL designs. For simpler designs such as drones, especially those covered by the 'Specific' category of operations, such demanding procedures would be regarded as un-proportionate.
For the current EPTS, EASA did deliberately not follow the approach of ICAO Annex 16 Volume I where the lighter helicopter designs can be accommodated by the simpler Chapter 11 as opposed to the more complex Chapter 8. This is due not only to the proportionality considerations stated above, but also to the current lack of knowledge of the typical noise signatures of such aircraft, hence the need to measure and regulate as many flight phases as possible (here: approach, take-off, overflight and hover) to avoid a situation where an eVTOL exhibits unexpected detrimental noise signatures that would have been overlooked in the noise assessment.
As a result, EASA cannot strictly accept any of your A/B/C proposals. Nevertheless, as your comment translates the need from the community to obtain clarity on applicability for drones and eVTOL, some words of clarification will be added to the Introductory Note of the EPTS.

comment *42* comment by: *EUROCONTROL*

ON Introductory note, page 1 para 6
evenly distributed electric rotors" - evenly distributed around the vehicle's centre of gravity or geometrically in relation to each other?

response

Noted.
Thank you for your question, which seems to translate a recurring interrogation in several comments received. EASA will remove the mention of evenly distributed rotors in the applicability of these EPTS.

comment *43* comment by: *EUROCONTROL*

The technical specification proposed herein uses primarily the EPNL metric, through the transposition of the Annex 16 Chapter 8 for the methodology and maximum allowed noise levels for the arrival, take-off and overflight procedures. The hover procedure for eVTOLs (which is not transposed from ICAO Annex 16) is based on simple equivalent continuous A-weighted sound level (L_{Aeq}). As noted in GC1 above, ICAO Annex 16 Chapter 11 for light helicopters relies on the SEL (L_{AE}) metric. What is the rationale for basing the eVTOL noise certification on the EPNL metric? Is the assumption that the sound signature of eVTOLs is expected to contain one or more pure tones, especially in the higher frequency bands, that may have to be corrected for by using EPNL? Indeed, the straightforward use of A-weighting may not sufficiently reflect the potential annoyance of observers stemming from the dominant high-frequency content of eVTOLs. If we assume that A-weighting is inappropriate, some questions emerge:

1. Why is the simple A-weighting acceptable for the hover procedure where the proposed metric is L_{Aeq} , rather than using the EPNL metric like for all the other procedures (take-off, arrival, overflight)?
2. If the premise is that A-weighting does not account for the higher frequencies in a sufficient manner, could another weighting be more appropriate (e.g. D-weighting), instead of using the complicated method of EPNL calculation? I.e., for all procedures and maximum allowed levels, the potential metrics could be an L_{Deq} metric?

response

Noted.
Thank you for your questions. The use of the EPNL metric, while consistent with Chapter 8 of ICAO Annex 16, is the outcome of psycho-acoustical studies piloted by EASA which showed that it best correlates with perceived annoyance of conventional aircraft as well as air taxis. D-weighting was considered, as it also provides good correlation with perceived annoyance, but is unfortunately no longer supported in most modern-day all-in-one sound level meter solutions, hence the favouring of the default EPNL solution.
A-weighting was chosen by default for the Hover procedure. Nevertheless, EASA wants to point out that NVTOL.1410 (a) mentions the recommendation to store the recorded time traces “for subsequent analysis”, leaving the possibility open for different metrics or weightings should the need arise in the future.

comment

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

General
The Swedish Transport Agency supports the proposal, but encourages EASA to develop more stringent noise limits when more noise data on these new types of aircraft becomes available.

response

Noted.
Thank you for this positive message. EASA intends to precisely follow this logic, starting by default from the current noise limits of Chapter 8 of ICAO Annex 16, and collecting more data throughout similar projects to ultimately develop noise limits appropriate to the designs covered by these EPTS.

comment	*58* comment by: *LBA* LBA comment: LBA supports that technological advances have to be reflected in current requirements. Since it is currently not foreseeable when ICAO will implement corresponding environmental regulations for eVTOL aircraft, we welcome EASA's initiative to develop its own noise regulation for the European member states. However, since eVTOL will be used predominantly as an air taxi in urban areas, the more complex noise measurement procedure according to Chapter 8 is a correct approach that we very much welcome. Because is not apparent to us whether the hover noise is determined for information only, we would welcome it if a noise limit for hovering will also be set in the future. Especially in this operational scenario with a highly populated environment, a large number of people are expected to be exposed to this kind of noise. In this context, the reduction of noise during take-off and landing procedures as well as hovering is of particular importance.
response	Noted. Thank you for your comment. EASA intends to later establish noise limits related to the Hover procedure but first needs to collect data before being able to do so.

comment	*61* comment by: *UK CAA* **Page No:** 1 **Paragraph No:** Introductory Note, and throughout **Comment:** The noise technical specifications for the take-off, overflight and approach conditions are based on the Effective Perceived Noise Level (EPNL) noise metric (using procedures from Chapter 8 of ICAO Annex 16, Volume 1). The hover condition however specifies the measurement of LAeq averaged over 30 seconds. By comparison, the EASA "Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category" specify the measurement of A-weighted Sound Exposure Level (SEL) for the level-flight procedure. The Guidelines state that "The method is the outcome of several years of UA noise studies conducted by the Agency, with consideration for practical aspects as well as human perception of UA noise (psychoacoustics)". In terms of these UA noise studies, EASA Report FC06.SC02.D1 ("Determination of a human dose-response with respect to single events of Urban Air Mobility-type vehicles") presents dose-response relationships for UAM vehicles based on A-weighted SEL. Given the outcome of EASA's psychoacoustic research, the UK CAA believe the selection of the EPNL metric for the present EPTS procedure might therefore appear counterintuitive. **Justification:** Clarity is required on the rationale for adopting the EPNL metric given the outcome of EASA's recent psychoacoustic research with respect to UAM vehicles.
response	Noted. Thank you for your question. Psycho-acoustic studies piloted by EASA indicated that EPNL is the metric that generally correlates the best with the perceived annoyance

of both conventional and novel designs, which is why it was chosen within these EPTS. Regarding the Guidelines for drone noise measurement (within the 'Specific' category of operations), the adoption of the A-weighted SEL metric also results from "consideration for practical aspect". More precisely, while the EPNL might have been the preferred metric, EASA made the decision to use the A-weighted SEL for proportionality reasons, since this metric is by default implemented within the majority of Sound Level Meters available on the market. Given the complexity of eVTOL covered by the current EPTS, EASA considered proportionate to request the more intricate EPNL metric.

comment *62* comment by: *UK CAA*

Page No: 1

Paragraph No: Introductory Note, and throughout

Comment: The EPTS document acknowledges that the proposed specifications are based on content from Chapter 8 of ICAO Annex 16, Volume 1. In addition, the maximum allowable noise levels are kept identical to those of the most recent "heavy" helicopter limits from Chapter 8.

Chapter 11 of Annex 16 however provides an optional simplified certification procedure for "light" helicopters with a maximum certificated take-off mass of 3,175 kg or less. ICAO has previously acknowledged that Chapter 11 was implemented for light helicopters as a lower cost "screening" Standard with sufficient stringency such that compliance with Chapter 11 noise limits ensures a type design would also comply with the Chapter 8 noise limits (see Helicopter Noise Reduction Technology, Status Report, 21 April 2015.

To the UK CAA's knowledge, all current prototype designs of UAM vehicles covered by the proposed EPTS document have MTOMs below 3,175 kg. In addition, and as noted in the EASA press release of 04/05/2023, eVTOL UAM vehicles are expected to be quieter than heavy helicopters in certain phases of flight.

Given the lower take-off mass and expected lower noise levels of UAM compared to heavy helicopters, and also taking into consideration the UK CAA's separate comments regarding the outcome of EASA's recent psychoacoustic research (which favours SEL), the UK CAA believes the justification for using the more onerous and costly Chapter 8 procedures as the basis for the EPTS document (rather than Chapter 11) is unclear.

Justification: Clarity is requested on the rationale for adopting the more onerous Chapter 8 helicopter certification procedures rather than the simplified Chapter 11 procedure.

response Noted.
Thank you for your question. EASA did deliberately not follow the approach of ICAO Annex 16 Volume I where the lighter helicopter designs can be accommodated by the simpler Chapter 11 as opposed to the more complex Chapter 8. EASA believes that the current lack of knowledge of typical noise signatures of such aircraft mandates the need to cover as many flight phases as possible (here: approach,

take-off, overflight, and hover) to avoid a situation where an VTOL-capable-aircraft (VCA) exhibits unexpected noisy flight phases that would have been overlooked by noise certification only assessing overflight noise as is the case in Chapter 11.
Additionally, EASA believes that the current approach, which involves rather simple procedures for drones (according to the "Guidelines") and more complex procedures as laid out in the current EPTS for VCA , is proportionate to the complexity of the applicable designs.
As for explanation regarding the choice of metric, please refer to our response to Comment #61.

comment *63* comment by: *UK CAA*

Page No: 1

Paragraph No: Introductory Note, and throughout

Comment: The EPTS document acknowledges that the proposed specifications are based on content from Chapter 8 of ICAO Annex 16, Volume 1.

Reproducing and rearranging the accepted Annex 16, Volume I, Chapter 8 and Appendix 2 text makes the specification more difficult to follow, and to identify any differences that there might be.

It would be preferable to make direct references to specific paragraphs of Chapter 8 and Appendix 2 when such paragraphs are unchanged.

Justification: Enhanced clarity and better understanding leading to consistent implementation.

response Not accepted.
Thank you for your remark. The re-arranging of all paragraphs and sections arises from the need to harmonize these EPTS with other EASA material (e.g.: Special Conditions), including clear distinctions between requirements, Means of Compliance (MoC) and Interpretative Material (IM), which do not explicitly appear as such in ICAO Annex 16 and ETM.

comment *126* comment by: *Leonardo Helicopters*

Leonardo / Kopter would like to thank EASA for the publication of a very user-friendly document, compared with the format of existing rules. In particular, we appreciate the clickable cross-references and the presentation of the guidance material directly next to the associated rule.

To make this document even more user-friendly, you could also include a table of content embedded in the pdf file.

response Accepted.
Thank you for this encouraging comment. EASA will also make sure to incorporate the Table of Contents into the pdf file by turning all the Headings of the document into bookmarks.

comment	*127* comment by: *Leonardo Helicopters* In the past, EASA has addressed missing adequate certification specifications by issuing Certification Review Items / Special Conditions - either specific to a given project or generic for multiple applications. Will these EPTS be published as CRI-SC or have the same value? If not, could you please explain the practical differences?
response	Noted. Thank you for your question. EASA's current rulemaking framework (Article 76(3) of the Basic Regulation) allows the Agency to issue Certification Specifications (CS's) and detailed specifications (along with acceptable MoC's and Interpretative Material) for products not covered by ICAO Annex 16 Volume I. However, in absence of detailed environmental protection requirements adopted by the European Commission, and to accommodate the needs of ongoing applications, EASA issues these EPTS to illustrate to first applicants what is expected from them in terms of noise assessment. These EPTS are not to be confused with Special Conditions, which EASA is not allowed to issue for Environmental Protection under the current regulatory framework. Within the scope of a particular project application where these EPTS would apply, EASA would release a Certification Review Item (CRI) that would refer to these EPTS to cover the noise requirements.

comment	*135* comment by: *JCAB Aircraft Engineering and Certification Center* The EASA website states that "the use of electric propulsion tends to reduce noise compared to conventional aircraft, but the use of multiple rotors generates a unique sound. However, the use of multiple rotors produces a distinctive sound." Does the proposed standard take this "distinctive sound" into account? If not, is there a possibility that it will be taken into account in the future?
response	Noted. Thank you for your question. EASA has piloted a psycho-acoustic study to determine what noise metric correlates best with perceived annoyance. The study focused not only on conventional aviation but also on novel designs such as drones and VTOL-capable aircraft (VCA), with multiple rotors. The noise metrics chosen in these EPTS reflect the findings of that study and as such, EASA considers that they capture the distinctiveness of VCA sound signatures.

comment	*136* comment by: *JCAB Aircraft Engineering and Certification Center* Numerical values of noise limitation and positions of noise measurement seem to be based on ICAO Annex 16 Vol.1 Chapter 8. What is the intention of adopting ICAO Annex 16 Vol.1 Capter 8 instead of Capter 11?
response	Noted. Thank you for your question. Please refer to EASA's response to comment #62.

comment	*142* comment by: *AIRBUS HELICOPTERS* **Airbus Helicopters general comment :**

In its proposal “Environmental Protection Technical Specifications applicable to eVTOL powered by multiple, vertical, non-tilting, evenly distributed rotors”, EASA started from ICAO Annex 16, Volume I, Chapter 8 (H/C > 3.175T) & ICAO ETM for Heavy Helicopters, with adaptations: -on the height test limits to anticipate lower signal to noise ratio with eVTOLs expected to be quieter than helicopter -on the source noise corrections for which possibilities are very wide, with potential to identify various correlating parameters and to correct every sample (and not only integrated noise levels) -on the addition of a Hover noise measurement (without defined noise limits, pending data acquisition). The global proposal is very good, nevertheless, some general points shall be paid attention to (see further AH comments)

response

Noted.
Thank you for your comments. This one does not need addressing and EASA responds to your other comments where applicable.

comment

143 comment by: *AIRBUS HELICOPTERS*

Comment :
Propose a guideline on compliance demonstration to the RPM/pitch settings.

Justification for the comment :
Even for a fixed trajectory, the principle of defining and demonstrating worst conditions by the applicant is not clear in the EPTS. Indeed, there maybe multiple possible combinations of propeller RPMs/Pitch –when possible to control- to fly the proposed procedures. This could lead to extremely costly efforts for the manufacturer for compliance demonstration.

response

Partially accepted.
Thank you for your comment. EASA recognizes the lack of clarity regarding the need to report noise at the most critical configuration (where “configuration” is understood as a combination of rpm and any other parameters that may influence the noise levels whilst satisfying the requirements of the reference procedures). EASA will add specific wording in the corresponding requirements of NVTOL.1205 (Reference procedures) to demand that the noisiest configuration be identified to the satisfaction of the Agency and reported. However, due to the multiplicity of designs applicable to these EPTS, EASA cannot provide clear rpm settings that would satisfy the requirement, which means that the identification of such noisiest configuration (and its agreement by EASA) may require more activity. While EASA recognises the additional burden for the applicant, this need is driven by the multiplicity of designs and lack of available data.

comment

152 comment by: *General Aviation Manufacturers Association (GAMA)*

The General Aviation Manufacturers Association (GAMA) greatly appreciate the opportunity to provide comments on the Environmental Protection Technical Specification applicable to eVTOL powered by multiple, vertical, non-tilting, evenly distributed rotors.

GAMA's staff remain at the Agency's disposal at any time if there are any questions regarding any of the comments provided below.

response

Noted.
Thank you for this comment which does not need addressing.

comment

153 comment by: *General Aviation Manufacturers Association (GAMA)*

RATIONALE / REASON / JUSTIFICATION

The description of "vertical take-off and landing aircraft powered by multiple vertical, non-tilting, evenly distributed electric rotors" does not make it clear if the scope includes lift + cruise aircraft which quickly (60 – 120 seconds) transition to wing borne flight without use of tilting rotors (lift rotors used only for vertical take-off and landings and a separate propeller and wing lift is used at all other times), or is limited to only full time thrust borne aircraft like the volocopter configuration. If the lift and cruise configuration is not intended to be within the scope, it is suggested that the title be reworded to avoid confusion.

PROPOSED TEXT / ACTION

If the document is not intended to be applicable to aircraft which use wing lift during cruise flight (lift + cruise), it is suggested that the title of the document be modified to more accurately define the scope and exclude that configuration. An example of a proposed change would be: "Vertical take-off and landing aircraft powered by multiple vertical evenly distributed electric rotors that are used in all phases of flight" or "vertical take-off and landing aircraft powered by multiple vertical evenly distributed electric rotors, which do not use wing generated lift for the cruise phase of flight" .

response

Partially accepted.
Thank you for this comment and proposed resolution. We fully acknowledge the need to describe the applicability scope of these EPTS more accurately. However, please refer to Comment #125. EASA considers that VTOL-capable aircraft (VCA) designs with non-vertical, non-tilting rotors (like pusher-propellers) can still be covered by the current EPTS. Consequently, EASA will modify the NVTOL.1000 (Applicability) section to improve clarity on applicability, which will also include non-vertical rotors.

comment

154 comment by: *General Aviation Manufacturers Association (GAMA)*

RATIONALE / REASON / JUSTIFICATION

Considering that a level-playing field is being proposed by EASA, "vertical take-off and landing aircraft powered by multiple vertical, non-tilting, evenly distributed electric rotors" should have the same policy currently applicable to helicopters. However, EASA's recommendation use only the requirements of Chapter 8 (Helicopters) as a certification basis. Therefore, industry understanding is that Chapter 11 (Helicopters not exceeding 3175kg maximum certificated take-off mass) of Annex 16 of ICAO, volume I, is more appropriate for eVTOL aircraft considering that the MTOW of most of these aircraft falls within Chapter 11 (Helicopters not

exceeding 3175kg maximum certificated take-off mass) and not Chapter 8 (Helicopters). The proposal is to add Chapter 11, from ICAO Annex 16, volume I, as an option for the certification bases construction, and the means of compliance, based on eVTOL MTOW.

PROPOSED TEXT/ ACTION

The present noise technical specifications were based on the content of Chapter 8 and Chapter 11 of ICAO Annex 16 Volume I and associated Evaluation Method of Appendix 2 and Guidance Material from ICAO ETM, which applies to helicopters, to allow for a level playing-field and comparability of technology. The requirement paragraph and guidance material application is according to design MTOW. EASA should incorporate the inclusion of Chapter 11 requirements and guidance material to this document. Application will be driven by aircraft MTOW.

response: Not accepted.
Thank you for your comment and proposal. While recognizing its merit, EASA cannot accept it for the reasons provided in the response to Comment #62.

comment *158* comment by: *FAA, Aviation Safety*

response: Empty comment. Not addressed.

comment *159* comment by: *FAA, Aviation Safety*

response: Empty comment. Not addressed.

comment *160* comment by: *FAA, Aviation Safety*

response: Empty comment. Not addressed.

comment *161* comment by: *FAA, Aviation Safety*

response: Empty comment. Not addressed.

comment *189* comment by: *FAA, Aviation Safety*

response: Empty comment. Not addressed.

comment *190* comment by: *FAA, Aviation Safety*

response: Empty comment. Not addressed.

comment *192* comment by: *FAA, Aviation Safety*

response | Empty comment. Not addressed.

comment | *197* comment by: *Flughafen München GmbH*

first of all, I would like to thank you for this consultation paper.

As an airport operator, our primary focus lies in the data gathered during nighttime. Should the results prove favorable to us and enable us to operate eVTOLs during late hours, including the sensitive period after midnight, this particular aspect has the potential to change our business model significantly.
Because of that, please allow me to recommend to add the additional sub-point (8) regarding the section NVTOL.1710 - Additional test information, as published on your page 71.

The applicant should report the following additional test information to the Agency:
(a) For each run:
(8) The Time;

response | Accepted.
Thank you for your comment. EASA will add the requirement to report date and time of each test run in section NVTOL.1710 (“Additional test information”). However, please note that the proposed approach does not intend to investigate noise impacts of night operations.

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comment | *122* comment by: *US Federal Aviation Administration*

Re: The present noise technical specifications were initiated from the content of Chapter 8 of ICAO Annex 16 Volume I and associated Evaluation Method of Appendix 2 and Guidance Material from ICAO ETM, which applies to heavy helicopters, to allow for a level playing-field and comparability of technology.

FAA concurs that existing noise standards can be adaptable for supporting first, type certifications of similarly configured multi-rotor VTOL aircraft to the extent technologically practicable and economically reasonable. Establishing this EPTS provides a clear expectation of the required compliance test demonstration for VTOL applicants with similar designs to consider when planning for noise certification.

FAA acknowledges EASA's approach and is instituting analog standard adaptations with existing noise limits under Rules of Particular Applicability (RPA) in order to preserve progress in aircraft noise reduction policy to date.

response | Noted.

Thank you for this comment. EASA is grateful to the FAA for sharing this information and acknowledges the similarities in the overall logic between both agencies.

comment *123* comment by: *US Federal Aviation Administration*

Re: evenly distributed electric rotors

The meaning and intent of this phrase is unclear. How is EASA defining this phrase? Distributed propulsion has typically referred to multi-rotor configurations that rely on computer-controlled differences in power/thrust/RPM between the rotors but "evenly" suggests something more specific.

Also, the rule should include aircraft that are not all-electric.

What limitations stop this rule from being applicable to a quadcopter UAS like Matternet? With no weight limits the applicability of this rule extended well beyond eVTOLs/airtaxis.

Suggestion:
Use clear and concise language to identify the aircraft characteristics for which these guidelines would apply (use "distributed rotor" or “multi-ed rotor/propeller” and get rid of "evenly." Also include aircraft that are not all-electric.

response Accepted.
Thank you for this comment and proposal. Considering other similar comments, EASA will remove the reference to “evenly-distributed” rotors in the applicability and title of these EPTS.
EASA will also include aircraft that are not all-electric within the applicability of the EPTS. This means that EASA will remove the “electric” component from the applicability scope. EASA will also utilize the definition of VTOL-capable aircraft (VCA) set forth in Opinion 03/2023, which explicitly excludes rotorcraft and thus prevents any possible overlap with conventional helicopters (already covered by Chapters 8 or 11 of ICAO Annex 16 Volume I). Following the removal of the “electric” component from the applicability scope, EASA will delete the sentence from the Introductory Note of the final EPTS that “[b]ecause [VCA] do not emit nitric oxides, carbon monoxide, unburned hydrocarbons, visible smoke or non-volatile particulate matter during operation, no specifications for engine emissions are proposed within these EPTS” and that “[s]imilarly, the Agency does not propose any CO2 emissions or efficiency specifications for this design at this stage”.

Regarding whether these EPTS could apply to lighter drones, although no technical aspect would prevent it, consideration must be given to the category of operation. Within EASA scope, designs like the ones you are referring to would likely fall in the ‘Specific’ category of operations (and Low and Medium risk classes) and therefore be covered by the "Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category (Low and Medium Risk)". The types of products covered by the current EPTS would typically fall into the ‘Certified’ category of operations and undergo a certification process at EASA.

comment	*124* comment by: *US Federal Aviation Administration* Re: EASA proposes, as an interim measure, to issue these EPTS to illustrate to first applicants what is expected from them during the certification projects. If the rule is intended to be interim, please add text on the path of a long term rule (that would be generally applicable). Suggestion: Add a long term rule outline.
response	Partially accepted. Thank you for your question and request for clarification. The long-term rulemaking outline is by default to establish European Commission-adopted environmental protection requirements for products not yet covered by ICAO Annex 16 Volume I. This process can take many years and therefore cannot accommodate the needs of ongoing applications. EASA will add a short sentence to the Introductory Note to bring clarification. A more detailed outline will be added in the next EPAS outlining the dedicated rulemaking path.
comment	*125* comment by: *US Federal Aviation Administration* Re: The procedures are adapted to the characteristics of eVTOL aircraft with multiple vertical, non-tilting, evenly distributed rotors where necessary, for instance, by extending the lower test height limit to anticipate the lower noise signature of such designs, or by allowing a more refined source noise correction than for classic helicopters. In anticipation of innovative VTOL designs (of various mixed rotor, propeller, or fan designs, with alternative energy forms of propulsion), this rule would have wider VTOL application from less specific design limitations about fixed rotor/propeller/fan orientation and type of energy source, given that the multi-noise sources (cause) will still result in a cumulative noise (effect) at the ground. FAA anticipates a greater benefit in allowing more VTOL configurations applicable under this approach to certification. This rule establishes another VTOL noise certification standard for demonstrating noise compliance of VTOL, non-tilting configuration aircraft that can be applicable for broader OEM designs being developed or in existence. Suggestion: The procedures are adapted to the characteristics of VTOL aircraft with predominantly multiple rotors/propellers/fans (non-tilting) fixed configuration designs (e.g. multirotor with a pusher-prop).

response | Accepted.
Thank you for your remark and suggestion. After consideration for your comment and other similar comments, and also acknowledging that the term “vertical” would need a precise definition which may restrain the scope of these EPTS (e.g.; “vertical” with respect to the ground, or to the plane of the propellers), EASA will update the applicability of these EPTS to reflect your proposal and remove the restriction to vertical rotors.

NVTOL.1000 - Applicability p. 7

comment | *44* comment by: *EUROCONTROL*

Reference made to a section(?) titled "Identification of the issue" but no such section exists in the document

response | Accepted.
Thank you for your remark. EASA will correct the text accordingly.

comment | *79* comment by: *DGAC*

Typo "concern the"

response | Accepted.
Thank you for your remark. EASA will correct the text accordingly.

SUBPART A - GENERAL p. 7

comment | *128* comment by: *Leonardo Helicopters*

Chapter 8 of ICAO Annex 16 Volume I apply to normal (heavy) rotorcrafts. The implementation is accordingly complex and demanding, both in terms of test set-up, flight test effort and post-processing activities. For light rotorcrafts, Chapter 11 offers a leaner alternative, which could as well address such light VTOL aircrafts.

Did EASA consider the option to apply the less complex Chapter 11, for instance for VTOLs to be certified under the BASIC category, and to reserve Chapter 8 to VTOLs certified in the Enhanced category?

response | Noted.
Thank you for your question. Please refer to our response to Comment #62.

NVTOL.1100 - Applicable noise evaluation metrics p. 8

comment | *64* comment by: *UK CAA*

Page No: 8

Paragraph No: NVTOL.1100 – Applicable noise evaluation metrics

Comment: The UK CAA believes limiting the noise metric to EPNL for the evaluation of take-off, flyover and approach noise, misses an opportunity to acquire other noise metrics for future standard development, such as SEL (A and possibly D weighted).

It is recommended to require that noise levels in SEL, in addition to EPNL, be evaluated and reported on.

Justification: The acquisition of additional data can inform future standard development.

response

Noted.
Thank you for your comment and suggestion. EASA believes that the current provisions of NVTOL.1410 (a)(2), which recommend that the acoustic signals (time traces) be recorded and stored for subsequent analysis, will enable the applicant to later report other metrics if needed.

comment *88* comment by: *US Federal Aviation Administration*

Re: The A-weighted continuous sound pressure level (LAeq) as defined in NVTOL.1110

No more than one form of frequency-weighting should be used for this noise certification test. This will produce uncertainty for the manufacturer as they determine how to optimize their aircraft for noise emissions.

Suggestion: Use 30-second PNLT-based Leq for the hover procedure.

response

Not accepted.
Thank you for your comment and suggestion. EASA appreciates your concern, although one could argue that manufacturers are not supposed to tailor their design to take advantage of a particular noise metric but should rather strive to lower noise as a whole. EASA still recognizes merit in your suggestion, considering that a noise measuring organization capable of assessing the EPNL at Approach, Overflight and Take-Off would be fully prepared to obtain a 30-second averaged PNLT at Hover. However, EASA considers that the additional measurement of Hover noise is a building block towards providing local authorities with the means to assess and regulate noise at the local scale and produce noise impact assessments, by capturing a phase with a noise signature likely different than in the take-off, overflight or approach procedures. EASA assumes that local authorities can easily implement an A-weighted Leq (e.g. through noise monitoring stations), whereas a 30-second PNLT-based Leq would require far more investments. Please also note that through the current provisions of NVTOL.1410 (a)(2), which recommend that the acoustic signals (time traces) be recorded and stored for subsequent analysis, applicants would still be able to later produce such metrics should it become necessary.

comment *145* comment by: *AIRBUS HELICOPTERS*

COMMENT :

This point needs further attention. It is suggested to define an alternate metric for eVTOL.

JUSTIFICATION FOR COMMENT :
Taking similar metric (EPNL) as for Helicopters/Commercial Airplanes while it is not clearly shown that this metric is most suited for eVTOL (with multiple tones) annoyance quantification should be discussed, since this metric also raise some difficulties when trying to make the link between certification and operational noise assessments.

response: Not accepted.
Please refer to Comment #135 for EASA's answer regarding the choice of the EPNL metric.

comment *162* comment by: *FAA, Aviation Safety*

response: Empty comment. Not addressed.

comment *163* comment by: *FAA, Aviation Safety*

response: Empty comment. Not addressed.

NVTOL.1105 - Calculation of Effective Perceived Noise Level p. 8

comment *66* comment by: *UK CAA*

Page No: 8

Paragraph No: NVTOL.1105 (a) (1) – Calculation of Effective Perceived Noise Level

Comment: The term "certificated noise level" is used here when referring to noise levels calculated according to the procedures of the EPTS document.

The EPTS document specifies noise technical specifications and maximum allowable noise levels, rather than "certificated noise levels".

Justification: Clarity

Proposed Text: The UK CAA suggests "certificated noise level" should be replaced with "measured noise level" or similar

response: Accepted.
Thank you for pointing out this inconsistency. EASA will modify the EPTS to reflect your proposal.

comment *89* comment by: *US Federal Aviation Administration*

It appears that upper case "I" is used for the index of frequency (1/3 octave bands). This is a dis-harmonization from conventional nomenclature/symbology used in ICAO Annex 16, Vol. I, Appendix 2. For guidance which draws so heavily from the Annex, such dis-harmonization is confusing. When combined with additional indices, later in this document, the equations become difficult or impossible to manage/interpret.

Recommend restoring conventional symbology used in Annex.

response

Not accepted.
Thank you for your comment. EASA understands where the confusion might have arisen: the index for 1/3-octave band frequency is a lower-case “L” (which may have been confused with an upper-case “i”). However, EASA made this choice of nomenclature because of the need to use lower-case “i” to designate the index of a test run in section NVTOL.1600 (“Adjustments of the measured sound levels”), consistently with the “Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category (Low and Medium Risk)” which already adopted this convention. Despite the possible confusion, EASA deems it rigorous to be clearly designating test runs with their own indices, a practice not currently followed within Annex 16. EASA also believes this provides a clearer path to the reader (whom we must assume is not necessarily familiar with Volume I of Annex 16) as for the various steps needed to obtain the final noise levels to be reported.

NVTOL.1110 - Calculation of A-weighted continuous sound pressure level p. 14

comment

67 comment by: *UK CAA*

Page No: 14

Paragraph No: NVTOL.1110 – Calculation of A-weighted continuous sound pressure level

Comment: The stated definition of equivalent continuous sound pressure level (LAeq) refers to “a reference duration of one second”, the origin of which is unclear. Also, the word “equivalent” is missing from the section title.

Justification: Unfamiliar definition of equivalent continuous sound pressure level.

Proposed Text: The UK CAA recommends a definition of equivalent continuous sound pressure level consistent with ISO 1996-1:2016 is used. In addition, it is suggested to replace the title “Calculation of A-weighted continuous sound pressure level” with “Calculation of A-weighted equivalent continuous sound pressure level”

response

Accepted.
Thank you for your corrections and suggestions. EASA will reflect your proposal in the final version of the EPTS.

comment

90 comment by: *US Federal Aviation Administration*

Re: one-third-octave-banded

The past-participle verb form "banded" is distracting and awkward to read.

Suggestion: Change to "banded" to "band."

response: Accepted.
Thank you for your comment and suggested action. EASA will reflect your proposal in the final version of the EPTS.

IM1 NVTOL.1105 - Calculation of Effective Perceived Noise Level p. 14

comment *164* comment by: *FAA, Aviation Safety*

response: Empty comment. Not addressed.

NVTOL.1200 - Reference noise measurement points p. 16

comment *11* comment by: *Lilium*

It is not clear why the aircraft height is at 50 m for Hover reference procedure? Is it possible to explain this?

response: Noted.
Thank you for your open question. With consideration for several other comments, EASA will modify the Hover procedure to a height of 25 m in the final EPTS, out of consideration for good signal-to-noise ratio. Please note that a test height tolerance will still apply.

comment *26* comment by: *Nico/Anotec*

point (d)(1):
"the origin of the measurement array is defined **on the ground, at a height of H=50 m** vertically below the ...." ==> This description is confusing. It would be more logical to use the same way as used for the other conditions (A)-(c), i.e. "...on the ground, vertically below..... Delete "at a height of H=50m"

response: Accepted.
Thank you for your comment and suggested correction. EASA will incorporate your suggestion into the final text of the EPTS.

comment *68* comment by: *UK CAA*

Page No: 16

Paragraph No: NVTOL.1200 (d) – Reference noise measurement points

Comment: An array of 12 reference noise measurement points is defined for the hover reference procedure. ICAO has previously acknowledged that difficulties in the measurement of hover noise for helicopters make it poorly suited for certification purposes, in particular due to the high sensitivity to wind conditions leading to limited repeatability of test results. In addition, ICAO has acknowledged that hover conditions for helicopters might be reasonably correlated with certification take-off, due to the fact that both conditions are characterised by high main rotor thrust (see Helicopter Noise Reduction Technology, Status Report, 21 April 2015).

Given the possible wide variability of measured hover results and the present lack of specified maximum allowable noise levels for the hover condition, the justification for specifying an additional hover procedure in the EPTS document remains unclear.

It is also noted that the reference hover procedure published by EASA in "Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category" specifies a single noise measurement location vertically below the UA, whereas the EPTS document specifies measurement points located laterally at 60, 70 and 75 degrees in each compass direction. Reasons for the different hover measurement methodologies adopted in the two EASA documents are unclear.

Justification: Clarity required on (i) the rationale for requiring the additional complexity (and therefore cost) of a 12 microphone array to fulfil the proposed hover reference procedure, and (ii) the rationale for the different methods of hover measurement taken between the two EASA documents.

response

Partially accepted.
Thank you for this comment and associated questions.

- First, following this comment, EASA will modify the EPTS to also request a central microphone at the origin of the microphone array for the Hover procedure.
- Regarding the remaining differences with the Hover noise procedure of the "Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category", EASA considers that the additional measuring points will help to inform local authorities for the regulation of noise close to vertiports, while still being proportionate to the complexity of the design (on the contrary, requiring a Hover noise measurement with several microphones for the UAS of the 'Specific' category would have been unproportionate). Please note that, at the light of other comments, EASA will adapt the hover noise measurement array by requesting only two microphones per 90° direction (corresponding to 30° and 60° directivity).
- Regarding your question as for why EASA would mandate a hover noise measurement prone to uncertainty: EASA is aware of reported difficulties in measuring helicopter hover noise with consistency, but still wishes to maintain a Hover noise reporting requirement for VTOL-capable aircraft (VCA). EASA has acquired experience with drone noise measurement at Hover in the recent years, which has proved to produce acceptable variability (90% Confidence Interval within ± 1.5 dB(A)) even under wind conditions above 5 kts. EASA hopes that this conclusion would translate to VCA too.

comment *87* comment by: *Boeing*

THE PROPOSED TEXT STATES:
"a first set of three reference noise measurement points is located on the ground, aligned in the same direction, at distances of 1.73 x H, 2.75 x H and 3.73 x H from the origin of the measurement array, where H=50 m."

REQUESTED CHANGE:
"a first set of three reference noise measurement points is located on the ground, aligned in the same direction, at distances of **1.0 x H,** 1.73 x H, ~~**2.75 x H**~~ and 3.73 x H from the origin of the measurement array, where H=50 m."

JUSTIFICATION:
Boeing requests clarification from EASA to understand the criteria used to determine the three microphone distances listed for hover.

Rotorcraft noise is known to be highly dependent on the location of the observer. Having a wider range in microphone locations would lead to a fuller understanding of sound directivity.

Boeing recommends that EASA consider a wider range for measured distances for the hover condition to better capture the noise characteristics of the vehicles. For example, since the overflight conditions are measured with a lateral offset equal to the height of the aircraft, it may be of interest to gather measurements at 1 x H, 1.73 x H and 3.73 x H, which would correspond to 45°, 60° and 75° from the vehicle respectively.

response

Partially accepted.
Thank you for this contribution and for the suggested text. With consideration for other comments related to the same topic, EASA will make the changes to the reference noise measurement points to reflect some of your proposal, namely at distances of 0.58 x H and 1.73 x H to capture directivities at 30° and 60° respectively.

comment *133* comment by: *JCAB Aircraft Engineering and Certification Center*

The proposed noise standard for eVTOL aircraft includes the addition of data acquisition on hovering. We would like to hear the background the decision to set the altitude at which the aircraft is to hover for data acquisition at 50 meters.

response

Noted.
Thank you for your question. Please refer to Comment #11.

comment *146* comment by: *AIRBUS HELICOPTERS*

COMMENT :
Proposal is to review the hover noise measurement procedure.

JUSTIFICATION FOR COMMENT :
Adding Hover noise measurement to support eVTOL assessment in the vicinity of Take-Off and Landing infrastructures is tricky, since most discussions with experts agree on the difficulty to measure such a flight condition for helicopters (repeatability, …). The proposed reference procedure does not match HC hover noise measurement guideline (CAEP12, WG1_8_FL01) of 30m, 60m, 90m height, measurement @150m/500ft, every 30° (+45° values as recommendations). Additionally, even if it implies also some difficulties, why not recommending inverted microphone on ground plate for such measurement?

response

Partially accepted.
Thank you for your comment which, along with other comments related to the same topic, has triggered to revise the Hover noise measurement procedure.
EASA will bring the following modifications to the final version of the EPTS:

- Height relocated from 50 m to 25 m.
- Microphones mounted inverted on reflective ground plates.

EASA justifies the remaining differences to your proposal as follows:

- EASA is aware of the CAEP WG1 Helicopter hover noise measurement guidelines but cannot require so many measured heights and directivities, considering especially that the noise signatures of VTOL-capable aircraft (VCA) is expected to be lower than that of helicopters, which would lead to almost inaudible aircraft noise at some of the positions listed in the helicopter hover guidelines.
- Please refer to Comment #68 for additional information as for why EASA maintains the reporting requirement of VCA hover noise despite the difficulties described by ICAO CAEP WG1 for helicopter hover noise measurement.

comment

155 comment by: *General Aviation Manufacturers Association (GAMA)*

NVOTL.1200 Section (d)
NVOTL.1205 Section (f)

RATIONALE / REASON / JUSTIFICATION

Considering that a level-playing field is being proposed by EASA, “vertical take-off and landing aircraft powered by multiple vertical, non-tilting, evenly distributed electric rotors” should have the same policy currently applicable to helicopters. Therefore, the introduction of an additional certification point (hover condition) into a requirement derived from helicopters is not recommended since it increases certification test complexity and there is not enough study to support measurement procedures.

PROPOSED TEXT / ACTION

Remove 'hover measurement points' from the Consultation Paper proposal and future requirements.

response

Not accepted.

	Thank you for your comment and proposal. However, EASA considers that the added complexity of the VTOL-capable aircraft (VCA) hover noise procedure is justified, given the current lack of knowledge on VCA noise. If the hover condition produces a noise signature different enough to cause significantly more annoyance than the other three phases of approach, overflight and take-off, EASA believes that it would be a mistake not to capture it. Please note that the hover procedure is only a reporting requirement and not subjected to a noise limit, as the latter can only be established after collecting enough data. Please also note that the statement of "level-playing field" of the Introductory Note refers to the ability to compare VCA noise with helicopters in a fair manner but does not prevent the addition of a measurement procedure.

Figure 4: top view of the reference noise measurement points of the hover procedure p. 17

comment	*7* comment by: *Christian Rau* While the hover procedure should already provide isotropy (invariance under rotations), I wonder if this assumption could be better satisfied by also including a random (uniformly distributed) rotation of the mic positions in the setup.
response	Noted. Thank you for your comment. Given how little data is currently available regarding VTOL-capable aircraft (VCA) noise at Hover, EASA is not yet convinced that isotropy can be assumed for such designs and believes that measuring the noise in four directions (with respect to the aircraft heading) is necessary. On the other hand, EASA believes that imposing a random rotation of the microphone setup, whilst perhaps interesting from a scientific standpoint, would be extremely costly to VCA applicants.

Figure 3: side view of the reference noise measurement points of the hover procedure p. 17

comment	*12* comment by: *Lilium* 1. Proposed 70 and 75 deg are extremely close in term of directivity. It would be advised to aim for 50 deg, 60 deg and 70 deg. 2. Above proposal would require rephrasing of d) 2) to: "a first set of three reference noise measurement points is located on the ground, aligned in the same direction, at distances of 1.20 x H, 1.73 x H and 2.75 x H from the origin of the measurement array, where H=50 m."
response	Partially accepted. Thank you for your comment and proposal. Please see our response to Comment #87 for details.
comment	*29* comment by: *Nico/Anotec* At the measurement point 3.73H the distance will be 185m if H=50m. This is a considerable distance at a low elevation angle and excess ground effects may occur.

We found that the measured sound levels at such setup may vary various dB in mid to high frequencies, depending on the type of ground between origin and measurement point. For consistent results a soft ground should be prescibed for the whole distance, not only close to the mike. However, this may give issues with finding an appropriate test site with sufficient soft ground.

response

Partially accepted.
Thank you for your comment. Please refer to our response to Comments #87 and #146 for detail.
In short, EASA will make the following modifications to the final EPTS:

- H will be changed from 50 m to 25 m.
- Horizontal distances will be modified to match 30° and 60° directivities.
- Inverted ground plate measurements will be mandated.

IM1 NVTOL.1200 - Reference noise measurement points p. 17

comment *80* comment by: *DGAC*

I would suggest to add microphones in order to measure noise radiated in lower angle from 0 to 50°.
At least at 0 and 30°.
Noise radiated below the aircraft can be higher than for high angles
If you wish to limit the number of microphones, here are suggestions:
- remove microphone at 75° (not huge difference with 70°)
- use only one line, and makes the aircraft rotate

For low angles, recommendation to use of plate mounted microphone to limit gound impedance effect (see CAEP13_WG1_2_IP02 presentation).

response

Partially accepted.
Thank you for your contribution and proposals. Please see our response to Comments #87 and #146 for more details. Please also note that yawing the aircraft by steps of 90° instead of using the entire array of microphones is a possibility (would require 3 measuring stations instead of 9).

NVTOL.1205 - Reference procedures p. 18

comment *27* comment by: *Nico/Anotec*

Figure 3: The point at 3.73H will be at 185m if H=50m. This is a considerable distance, where the effect of the ground in the propagation will not be negligible at mid to high frequencies. The difference between soft and hard ground can be various dB as we found in earlier studies. It will therefore be important to include that the whole ground between origin of array and measurement points should be soft, like prescribed for near-mike ground. However, this may pose issues with finding a good test site with sufficient extensions with such properties.

response

Partially accepted.
Thank you for your comment. Please refer to our answer to Comment #29.

comment *28* comment by: *Nico/Anotec*

point (f)(1):
Reference measurement point at a reference height of 50m.
This is confusing. The measurement point is on the ground (=0)

response

Noted.
Your confusion arises from our system of cross-references used within the document: the words “reference noise measurement points” belong to the cross-reference to section NVTOL.1200. EASA will modify the final EPTS by setting all cross-references within quote marks. In this specific case, the final text will read as follows:
“
(1) the aircraft is stabilized in a stationary flight directly above the origin of the measurement array specified in paragraph “(d)(1)” of “NVTOL.1200 - Reference noise measurement points” at the reference height of …
”

comment *60* comment by: *XPENG AEROHT*

For the vehicle which is designed to operate at a lower altitude, for example, 30m at most time, far below the test height of 150m in the overflight reference procedure defined the NVTOL.1405 - Reference procedures. The altitude of 30m is also lower than the allowable height tolerances specified in (d)(3) of NVTOL.1405 - Flight test procedures. Besides, the allowable height tolerances are used when the differences between the aircraft sould level and background noise level are not large enough, which seems is not applicable in this case. Is it necessary to remain the test height of 150m in overflight reference procedure or could test at the height of 30m? Will the MAXIMUM ALLOWABLE NOISE LEVELS of SUBPART D need to be modified because the noise levels at 30m and 150m are significantly different？

response

Noted.
Thank you for your comment and questions.
EASA is aware that typical operational heights of VTOL-capable aircraft (VCA) can be in the range of 30 m. However, EASA will maintain a 150 m reference height in order for VCA applicants to compare their design to that of conventional helicopters from a noise standpoint. The maximum allowable noise levels of Subpart D do not need updating, since the reference height remains 150 m. Nevertheless, the flight test procedures of NVTOL.1405 allow for a wide height tolerance, and the adjustment procedures of NVTOL.1600 specify that the corresponding noise levels be adjusted to 150 m for the overflight procedure.

comment *69* comment by: *UK CAA*

Page No: 18

Paragraph No: NVTOL.1205 (b) (1) – Reference procedures

Comment: Referring to “the “centre of the smallest enclosing circle” as defined in Subpart B, MOC VTOL.2105, Section 8 of the Second Publication of Proposed Means of Compliance with the Special Condition VTOL” makes it very difficult to understand.

It is recommended to reproduce in full the definition in Subpart B, MOC VTOL.2105, Section 8 given in MOC-2 SC-VTOL.

Justification: To improve clarity

response

Accepted.
Thank you for your comment and suggestion. EASA will add the figure from the Special Condition VTOL to improve clarity.

comment

81 comment by: *DGAC*

For take-off procedure (c)
By definition, this kind of aircraft is designed for vertical take-off. Some manufacturers prefer not using this operating condition, to save battery autonomy. Nevertheless, as they may be used in urban environment, vertical take-off may be more representative and should generate highest noise level. In addition, vertical take-off is in line with EASA document PTS-VPT-DSN about vertiport technical specification.
Therefore, I would recommend to apply vertical trajectory for take-off.

response

Not accepted.
Thank you for your comment and suggestion. EASA has considered including vertical take-off and/or landing as part of the noise certification procedure of VTOL-capable aircraft (VCA), but ultimately decided to stick to the legacy procedures of ICAO Annex 16 Volume I Chapter 8 (with adaptations) to allow a fair comparison of VCA designs with conventional helicopters. EASA believes that the added Hover noise procedure will provide good correlation with vertical take-off and landing phases and will cater for unexpected noise signatures that the Approach, Take-Off, and Overflight points would fail to capture.

comment

82 comment by: *DGAC*

A comment on § (c)(4): maybe not easy to guarantee maximum rpm during take-off as each rotor of multipropeller aircraft is controlled by central unit, not manually.
If possible, it could be useful to control RPM history on each propeller after the test, to identify variation that could affect noise levels.

response

Noted.
Thank you for your comment. EASA acknowledges this aspect and believes that the specifications of NVTOL.1600 (b)(9), which are to be discussed and agreed on a project basis, and deliberately left as open as to allow source-noise correction at every noise readout time (as opposed to the EPNL-vs-parameter correction of Chapter 8 of ICAO Annex 16 Volume I), cater for RPM histories not manually controlled. Nevertheless, please note that, even if the RPM schedule is controlled by a central unit, EASA expects the RPM schedules on the reference procedures specified in NVTOL.1205 to be deterministic (the RPM schedules during the test procedures of NVTOL.1405 could on the other hand vary from test point to test point).

Additionally (please refer to Comment #92), the provisions of NVTOL.1205(g) allow to depart from the reference procedures if the design so requires and with agreement of the Agency.

comment *83* comment by: *DGAC*

For approach procedure (e):
The 6° slope has been chosen as the one generating the highest noise level for helicopters. It should be different for eVTOL.
More over, it seems that this 6° slope is inconsistant with EASA PTS-VPT-DSN, which considers vertical take-off and landing (see "PTS VPT-DSN.D.485 Reference volume Type 1" or figure D27).
Maybe open the way to the vertical landing or angle with the highest noise level.

response Not accepted.
Thank you for your comment, information, and suggestion. EASA is aware that the 6° descent angle was chosen for international helicopters noise certification because it coincides with typical maximum BVI (Blade Vortex Interaction) noise. EASA does not have yet evidence or data supporting the choice of another angle. Consequently, EASA will keep the current descent angle of 6°, which will ensure commonality with existing legacy helicopter noise standards.

comment *91* comment by: *US Federal Aviation Administration*

Re: rate with the batteries at maximum State of Charge

It seems impractical to require a new and/or fully-recharged battery set for each individual run. If the intent is to ensure consistency between passes and applicants, respectively, the specified max power of the electric motors should take into account performance throughout a discharge cycle and their decline in performance over charge cycles. That being said, requiring minimum specification power where applicable would ensure this is the case.

Suggestioni: Take out or revise this requirement out.

response Not accepted.
Thank you for your comment and suggestion. Please note that this requirement is part of a section regarding reference procedures (NVTOL.1205). The maximum state of charge for batteries is required when the applicant determines/calculates the noise profile that satisfies the requirements of NVTOL.1205. Nothing in the EPTS test procedures (NVTOL.1405) demands that all test runs be conducted with batteries at maximum state of charge. EASA considers that the source-noise correction requirements of NVTOL.1600 (b)(9) cater for the adjustment of noise signatures from test conditions (where noise is possibly lowered due to a lower power output) to reference conditions.

comment *92* comment by: *US Federal Aviation Administration*

eVTOL aircraft may not be able to follow a single stabilized airspeed or RPM during a nominal takeoff or landing. The FAA supports the addition of NVTOL.1205(g) to accommodate novel design characteristics.

response

Noted.
Thank you for this supportive comment.

comment

129 comment by: *Leonardo Helicopters*

Paragraph (c)(4) + (d)(4) + (e)(4)

Comment:
The rule seems to assume a uniform control law of all rotor rpms - i.e. a higher lift/thrust is reached with an increase of the rpm of all rotors. The control law may actually reach a higher lift/thrust with a rpm increase of only some of the rotors, while other rotors are kept at a reduced rpm - for instance when governed by an internal health monitoring system adjusting each rotor's rpm to a measured temperature or vibration level. In such cases, can the rule be applied, what rpm combination(s) will need to be tested, and how can you ensure the repeatability of the measurements?

Suggested Resolution:
Reformulate the rule to ensure the repeatability of the measures, considering the possible rpm variations within airworthiness limitations - e.g. (c)(4) "rotors are set at the loudest rpm combination that allows maintaining a steady climb within airworthiness limitations."

response

Partially accepted.
Thank you for your comment and suggestion. EASA will add a requirement to the final version of the EPTS specifying that, if the design allows for combinations of different rpm values between rotors, aircraft attitudes, control surfaces, or external appendages, whilst still meeting the other requirements of NVTOL.1205, then the noisiest configuration must be identified in agreement with the Agency and its noise reported. Although similar to your proposal, this edit will apply to any combinations of parameters relevant to noise, not just the rpm.

comment

140 comment by: *Volocopter-Policy & Regulatory Affairs*

NVTOL.1205- c.4, e.4: 'It is stated that 'each rotor is set to its maximum rpm that allows maintaining a steady climb/approach'. This is not applicable. RPMs are outputs that are controlled by a deterministic Flight Control System and not directly controllable by pilot.

response

Noted.
Thank you for your comment. Please note that section NVTOL.1205 refers to reference procedures which, even in the presence of a Flight Control System for the individual rotor rpm, are expected to be deterministic (unlike the test procedures specified in NVTOL.1405).

comment

141 comment by: *Volocopter-Policy & Regulatory Affairs*

NVTOL.1205-c.2:"The aircraft is stabilized at the power for maximum climb rate with the batteries at maximum State ". This is not applicable as available power does not depend on the status of battery charge.

response

Noted.
Thank you for your comment. Please note that the EPTS intend to cover a variety of designs within its applicability scope. There might be designs for which the available power might depend on the battery state of charge. When this requirement is not applicable to a given design, the provision of NVTOL.1205(g) allows for the necessary deviation to the requirement.

comment

144 comment by: *AIRBUS HELICOPTERS*

COMMENT :
For approach condition, but also for overflight, there is a high probability that 6° angle for approach and/or high speed for overflight would not necessarily be critical conditions. Proposal is to review/adapt the proposed critical conditions.

JUSTIFICATION FOR COMMENT :
Being very similar to helicopters (on purpose, which allows for keeping similar noise limits in a first step), there is a risk to generate unfair comparisons with helicopters for which the worst conditions are selected (e.g 6° Approach prone to BVI noise generation, which may/will likely not be critical for eVTOLs, or High speed overflight that will definitely be less critical for winged eVTOLs –though not yet concerned by such EPTS-). On the other hand, community associations may find insufficient to set-up noise limits equivalent to the one of helicopters, for eVTOL vehicles supposed to operate always in noise-sensitive areas and with a higher flight density.

response

Not accepted.
Thank you for your comment and the elaborate justification. Nevertheless, EASA will maintain the 6° approach descent angle in the final version of the EPTS. Please refer to Comment #83 for detail.

comment

147 comment by: *AIRBUS HELICOPTERS*

COMMENT :
Could EASA precise whether this is the intention of the “maximum RPM” requirement?

JUSTIFICATION FOR COMMENT :
"each rotor is set to its maximum rpm that allows maintaining a steady climb”: this sentence is not so clear and should be clarified. Indeed, individually, each rotor may (will) not be at his maximum RPM to fly the prescribed Take-Off/Overflight/Approach procedures, as Rotors/propellers will be design to meet much more severe conditions. RPM requirement may be redundant when added with the definition of flight condition, depending on control laws logic. Most of the time, eVTOL will be piloted by advanced prescribed control laws setting speed and climb rate objectives (for example). Then, each rotor RPM will be controlled automatically to fly such a procedure, without any possible direct modification by the pilot/operator. Paragraph (g) seems to indicate some room to discuss these procedures (including RPM), but there is no clear mention to identify worst conditions.

response

Noted.

Thank you for your comment. EASA will add a requirement to the final version of the EPTS specifying that, if the design allows for multiple combinations of rpm, attitudes, control input and surfaces, etc, whilst still meeting the other requirements of NVTOL.1205, then the noisiest configuration must be identified in agreement with the Agency and its noise reported. The requirement for "maximum rpm" will be removed.

comment *156* comment by: *General Aviation Manufacturers Association (GAMA)*

RATIONALE / REASON / JUSTIFICATION

The requirements and procedures laid out in NVOTL.1205, including take-off, approach, or overflight reference procedures, are incompatible with other eVTOL designs currently under development such as lift+cruise configuration aircraft which quickly transition to wing borne flight without use of tilting rotors.

PROPOSED TEXT / ACTION

GAMA requests EASA to clarify the scope of the proposed document as to expressly exclude lift+cruise aircraft, in line with GAMA's CRT comment 153. GAMA believes that noise technical specifications applicable to lift+cruise aircraft should benefit from additional discussion and be addressed in future new or revised proposals.

GAMA offers the Agency its support to initiate discussions for technical specifications applicable to these types of aircraft and calls for the usefulness of organizing dedicated workshops on the topic or other means to engage industry in specific discussions.

response Not accepted.
EASA considers these EPTS to also apply to lift-and-cruise aircraft as long as the rotors are non-tilting. EASA will clarify the applicability (and title) of these EPTS, especially by removing the reference to "vertical" rotors. Please refer to Comment #125 for more detail. EASA nevertheless thanks GAMA for offering support and discussions for establishing such technical specifications.

comment *165* comment by: *FAA, Aviation Safety*

response Empty comment. Not addressed.

NVTOL.1210 - Reference atmospheric conditions p. 19

comment *1* comment by: *Marcel de Ruiter*

These atmospheric condition vary considerably from standard atmosphere, 1013.2 and 15C.

Noise travels considerably slower in higher temperature air due to diminished density.

There are more days in the entire EU where the temperture is considerably below 25C than above.

response
Noted.
Thank you for your comment. EASA's proposed reference atmospheric conditions are well aligned with ICAO legacy noise regulations and allow a fair comparison with other aircraft designs.

comment *8* comment by: *Christian Rau*

please correct the misprint ";." in (g) (1)

response
Accepted.
Thank you for your comment. EASA will correct the final version of these EPTS according to your suggestion.

comment *45* comment by: *EUROCONTROL*

ICAO Annex 16, Chapter 8 stipulates the same conditions in 8.6.1.5 however points a), b), c) prescribe "constant" conditions, whereas the proposed documentation omits this word in NVTOL.1210 points a), b) and c). Is there a reason for this?

response
Accepted.
Thank you for your remark. EASA will modify the final version of these EPTS to reflect that the conditions are "constant".

comment *166* comment by: *FAA, Aviation Safety*

response
Empty comment. Not addressed.

Table 3: maximum allowed noise levels of the aircraft as a function of MTOM p. 20

comment *3* comment by: *Initiative gegen Fluglaerm in Rheinhessen e.V.*

The Airbus 380 has nearly similar max. EPNdB as eVTOL >=80.0
These values just support flight industry as the can be fulfilled easily. It doesn't save human from further air noise pollution.
These eVTOL will fly in and over cities and will cause massive noise.
Max. EPNdB should follow WHO recommondations for noise!

These limits are ridiculous and unhealthy.

response
Noted.
Thank you for your comment. EASA is well aware of WHO recommendations for noise, but please note that those are not based on single-noise events (the scope of these EPTS) but on cumulated noise events, making them impossible to apply for the current EPTS. Since your comment does not offer any proposal nor reference to support any other limits, EASA will keep the current noise limits which have been obtained through the extensive work performed in ICAO CAEP WG1. Once EASA has gained experience with several VTOL-capable aircraft (VCA) projects, the noise

limits might be revised accordingly. Please also note that, in virtue of the EU subsidiarity principle, the noise limits set forth in these EPTS only pertain to the overall design of the applicable product; local operations however may be further regulated by national or local authorities, even if the design under consideration is approved by EASA.

SUBPART D - MAXIMUM ALLOWABLE NOISE LEVELS p. 20

comment *22* comment by: *Volant Aerotech*

In EASA document, a hover noise assessment has been developed. However, the maximum allowable noise level for hover hasn't been defined yet. EVTOL companies in China understand that more test data should been collected in the future, and we all commit to cooperate with EASA and other agencies to improve related specifications.

Proposed by Volant Aerotech(Shanghai, China), XPENG AEROHT(Guangzhou, China) and International Institute of Acoustic Technology(Suzhou, China)

response Noted.
Thank you for your comment and for offering your future cooperation.

comment *46* comment by: *EUROCONTROL*

Subpart D is replicated from ICAO Annex 16, Chapter 8 section 8.4.2 (max noise levels applicable to helicopters certified after 21/03/2002). The top MTOM bracket is for MTOM >= 80,000 kg, which is significantly higher than any eVTOL currently in operation. Is it expected that the entire scale of MTOM would be applicable to eVTOLs?

response Noted.
Thank you for your question. In absence of any substantial VTOL-capable aircraft (VCA) noise dataset, EASA decided to utilize the limit lines of ICAO Annex 16, Chapter 8 Section 8.4.2. EASA nevertheless reserves the right to establish different limit lines in the future, with a possibly different variation against MTOM.

comment *47* comment by: *EUROCONTROL*

Subpart D – Maximum Allowable Noise Levels, para 4

There is no maximum allowable noise level for the hover procedure, what is the reason for this?

response Noted.
Thank you for your question. EASA does not yet have a robust enough set of noise data and annoyance studies of VTOL-capable aircraft (VCA) hover noise that would enable establishing reasonable noise limits. EASA expects that the Hover noise reporting requirement of these EPTS will contribute to establishing such datasets.

comment	*84* comment by: *DGAC* The formulas are not consistant with subpart D that mentions -3 EPNdB for half mass. More over, 0.788 should be replaced by 0.625.
response	Not accepted. Thank you for your comment. The numbers in Subpart D work according to the description: - Halving of mass: $9.9673 \times \log_{10}(1/2) = -3$ EPNdB. - $87.0314 + 9.9673 \times \log_{10}(0.788) = 86$ EPNdB at Take-Off. The same works for Overflight and Approach.

comment	*93* comment by: *US Federal Aviation Administration* These limits may lack stringency for lower weight aircraft since there are no weight limits. Are the proposed air vehicles expected to exceed 3175 kg? Will EASA release separate simplified procedures for air vehicles less than 3175 kg? I.e., Create a lower set of noise requirements like Annex 16 Chapter 8 vs Chapter 11 requirements.
response	Noted. Thank you for your comment and question. EASA does not intend to follow the Annex 16 rationale with separated Chapters 8 and 11 according to weight (keeping in mind also that the separation is not mandatory: light helicopters are still allowed to certify to Chapter 8 if they so choose). Please refer to Comment #62 for more detail.

comment	*148* comment by: *AIRBUS HELICOPTERS* **COMMENT :** Please review and clarify **JUSTIFICATION FOR COMMENT :** Noise limits. “decreasing linearly with the base-10 logarithm of the aircraft maximum certificated take-off mass at a rate of 3 EPNdB per halving of mass”. This 10.log law as a function of MTOW is a basic principle established for helicopters and commercial airplanes. How do we ensure this will provide a fair limitation for these new VTOL architectures?
response	Noted. Thank you for your question. EASA has retained the same $10.\log_{10}(\text{MTOM})$ relationship as Chapter 8 of ICAO Annex 16 Volume I for commonality. Once EASA gains more experience with VTOL-capable aircraft (VCA) projects and their public acceptability, and if the datasets support another relationship, EASA will consider modifying the current noise limit lines.

comment	*157* comment by: *General Aviation Manufacturers Association (GAMA)* **RATIONALE / REASON / JUSTIFICATION**

Considering that a level-playing field is being proposed by EASA, “vertical take-off and landing aircraft powered by multiple vertical, non-tilting, evenly distributed electric rotors” should have the same policy currently applicable to helicopters. However, the industry understanding is that currently applicable Chapter 8 Helicopters rules of Annex 16 of ICAO, volume I, which establishes Trade-offs provided by Chapter 8.5, should also be provided for eVTOL aircraft noise certification.

PROPOSED TEXT / ACTION

Suggestion to add the paragraph below at the end of the Subpart D requirements - proposal extract from ICAO Annex 16, Volume I, Chapter 8, paragraph 8.5:

"If the noise level limits are exceeded at one or two measurement points:
a) the sum of excesses shall not be greater than 4 EPNdB;
b) any excess at any single point shall not be greater than 3 EPNdB; and
c) any excess shall be offset by corresponding reductions at the other point or points."

response

Not accepted.
Thank you for your comment and proposal. EASA is aware of the noise limit trade-offs within Chapter 8 of ICAO Annex 16 Volume I but decided not to carry them over to the current EPTS. While the construction of these EPTS from Chapter 8 was done to allow comparability with helicopters (at least in the short term), EASA expects VTOL-capable aircraft (VCA) to be noticeably quieter than helicopters and to not need noise limit trade-offs.

comment *167* comment by: *FAA, Aviation Safety*

response

Empty comment. Not addressed.

comment *175* comment by: *Bundesvereinigung gegen Fluglärm e.V.*

An estimation EPNdB to dB(A) is EPNdB=dB(A)+13 (https://www.adv.aero/randomizer/dezibel-db/). This means, that a value of 84 EPNdB for a light eVTOL correlates with a dB(A)-value of 71 dB(A). The height of the overflight is defined to 150m. For unmanned drones this is the typical flight level if flying in U-Spaces. So a noise of 71 dB(A) and more (up to 96 dB(A) for a heavy drone at approach) is a realistic expectation. At the typical flight level for VFR-flights close to airports of 300m a noise of 65 dB(A) for light aircrafts can be expected. Such noise levels are not acceptable in urban and residual areas. It can be accepted only for unsettled areas (e.g. for supply of mountain huts and islands) and for IFR-flights between airports. But also for these flights the noise (peak) should be limited to not more than 75 dB(A) or 88 dB EPNdB at a distance of 150 m.

For urban and residual areas only non annoying noise can be accepted. The limit for annoying noise outdoor (disruption of voice communication) is 50 dB(A) peak. This implies a EPNdB limit independent of weight and kind of operation of not more than 63 EPNdB and a minimum operation altitude of 150 m.

response

Noted.

Thank you for your question. In absence of any substantial VTOL-capable aircraft (VCA) noise dataset, EASA decided to utilize the limit lines of ICAO Annex 16 Volume I, Chapter 8 Section 8.4.2. EASA nevertheless reserves the right to establish different limit lines in the future, with a possibly different variation against MTOM.

IM1 SUBPART D Maximum Allowable Noise Levels p. 20

comment *24* comment by: *MJNewman Avinor*

Putting in the mass of todays regular civil helicopters indicates that they meet the noise criteria by ca 5dB. The noise limits are too weak and should be lowered by at least 10dB. An aditional requirement for the maximum difference between C and A weighted noise levels of 15 dB should be applied to avoid excessive low frequency noise.

response Noted.
Thank you for your comment. Please refer to Comment #46.

NVTOL.1400 - Test environment conditions p. 21

comment *13* comment by: *Lilium*

Proposal: The anemometer should have a specified accuracy for the strength and direction.
(i) The requested accuracy of the temperature, the relative humidity and anemometer sensors should be equal to or better than the following values:
(1) ±0.5°C for the temperature;
(2) ±3% for the relative humidity or ±0.5°C for both the dry bulb and the dew point temperatures when the relative humidity is measured with a psychrometer.
(3) ±0.3 m/s and ±3 deg for the wind strength and direction respectively.

response Accepted.
Thank you for your proposal. EASA will integrate it into the final version of the EPTS.

comment *85* comment by: *DGAC*

(a) Typo "points respectively"

response Partially accepted.
This is not a typo but an unfortunate result of the cross-reference system. EASA will fix the final version of the EPTS by putting all cross-references within quote marks. The final text of this section that you pointed out will read as follows:
“
(a) For the take-off, overflight and approach procedures specified respectively in paragraphs “(c)”, “(d)” and “(e)” of “NVTOL.1205 – Reference procedures”, three noise measurement points are set up at the locations of the three reference noise measurements points specified in paragraphs “(a)”, “(b)” and “(c)” of “NVTOL.1200 - Reference noise measurement points” respectively (one central and two lateral points).

”

comment *86* comment by: *DGAC*

(j) (6) average crosswind component at 10 m above the ground limited to 4 kt is difficult to obtain in real conditions.
I will suggest to set at least 5 kt.

response Accepted.
In line with several other comments, EASA will modify the EPTS and raise the crosswind component limit from 4 kt to 5kt. EASA will also clarify the EPTS by setting a separate wind speed limit requirement at 5 kt for the hover procedure.

comment *94* comment by: *US Federal Aviation Administration*

Re: the average wind speed at 10 m above the ground should not exceed 5.1 m/s (10 kt);
the average crosswind component at 10 m above the ground should not exceed 2.1 m/s (4 kt); and

This should be more prescriptive to stop any confusion. Recommend adding the wording on the right to all test series.

Suggested chagne: The 30 second, average wind speed, centered on the time the aircraft's closest point of approach to the center microphone, measured at 10 m above the ground should not exceed 5.1 m/s (10 kt);
Sub-bullet: the crosswind component of the average wind speed should not exceed 2.1 m/s (4 kts);

response Accepted.
Thank you for your comment and suggested improvement to the text. EASA will incorporate your proposal within the final version of the EPTS.

comment *134* comment by: *JCAB Aircraft Engineering and Certification Center*

We understand that the applicant will be faced with a quite burdensome in selecting a noise test site. Does EASA provide a service such as recommending noise test sites to applicants? Because there are newcommers in eVTOL, JCAB is interested whether EASA plans to assist them for their noise tests.

response Noted.
Thank you for your question. Within the scope of an VTOL-capable aircraft (VCA) certification, EASA is responsible for ensuring that the requirements set forth in these EPTS are met. This will involve, among other things, participation to the noise test campaign. However, EASA does not have in its remit to recommend noise test sites. In line with noise certification of conventional aviation, the task of finding an appropriate test site lies with the applicant.

comment *149* comment by: *AIRBUS HELICOPTERS*

COMMENT :
Proposal to provide additional rationale

JUSTIFICATION FOR COMMENT :
Test Environment conditions are very similar to the ones specified in Annex16 Chapter 8. Slight differences are nevertheless identified, e.g, a maximum cross wind <4kt. Is it by intention, and because EASA thinks that eVTOL noise may be more sensitive to wind conditions?

response
Noted.
Thank you for your question. While this was the original intention, EASA will account for other similar comments and some experience already gathered with repeatability of drone noise according to wind speed. EASA will modify the EPTS to raise the crosswind component limit from 4 kt to 5kt. EASA will also clarify the EPTS by setting a separate wind speed limit requirement at 5 kt for the hover procedure.

MoC1 NVTOL.1400 - Test environment conditions p. 22

comment *70* comment by: *UK CAA*

Page No: 22

Paragraph No: NVTOL.1400 (j) (6) – Test environment conditions

Comment: It is stated that “the average crosswind component should not exceed 4 kt”, whereas the limitation for helicopters is 5 kt.

Justification: Commonality with Chapter 8 of ICAO Annex 16, Volume 1, opens up the test window (note that exceedance of wind limits is one of the most common reasons for rejecting test runs)

Proposed Text: UK CAA suggests replace with the following text:

“the average crosswind component at 10 m above the ground should not exceed 2.6 m/s (5 kt); and”

response
Accepted.
Thank you for your comment and suggestion. In line with several similar comments received, EASA will bring your proposal into the final version of the EPTS.

MoC2 NVTOL.1400 - Test environment conditions p. 22

comment *168* comment by: *FAA, Aviation Safety*

response
Empty comment. Not addressed.

NVTOL.1405 - Flight test procedures p. 24

comment *14* comment by: *Lilium*

For the hover procedure (f) the heading of the aircraft with respect to the wind and the microphones is not specified. Several heading should be tested during the hover to cover directivity uncertainties.

response Not accepted.
Thank you for your comment and proposal, which is already catered for in the current EPTS. The reference procedure for the hover point, specified in NVTOL.1200 (d), demands 4 lines of microphones rotated 90° from one another. Alternatively, IM1 of NVTOL.1200 allows the possibility of several measurement series with only one line of microphones and rotation of the aircraft heading by steps of 90° from one series to the next. This will ensure that hover noise is acquired in 4 different headings.

comment *19* comment by: *Volant Aerotech*

In the NVTOL.1205 – Reference procedures on Page 18, the (c) (2) and (3), it clearly defines the reference take-off profile with the best rate of climb speed, Vy, or the lowest approved speed for the climb after take-off. Therefore, the definition of "within +50m, -110m" seems useless or over constrained for the profile. In the similar helicopter airworthiness document from FAA, there is no "within +50m, -110m" requirement for the take-off profile. Generally speaking, it seem it has over constraints for the take-off procedure.

By the way, it has to be mentioned that in the NVTOL.1205 – Reference procedures (e) the approach reference procedure on Page 19, the best rate of climb speed, Vy, or the lowest approved speed for the approach is required. So, EASA gives up the requirement of 394 feet (120m) vertically below the reference approach flight path in FAA document and it seems reasonable to limit the conditions within +50m, -80m, of the reference height above the central noise reference point.

Proposed by Volant Aerotech(Shanghai, China), XPENG AEROHT(Guangzhou, China) and International Institute of Acoustic Technology(Suzhou, China)

response Noted.
Thank you for your comment.
The second part of your comment exhibited the fact that EASA did not specify any reference height for the approach point. EASA will therefore add into NVTOL.1205 (e)(2) of the final version of these EPTS that the aircraft should be "stabilized and following a 6.0° approach path passing above the central reference noise measurement point […] at a height of 120 m".
However, the first part of your comment seems to relate to the noise certification reference procedure. While the reference procedures of NVTOL.1205 are deterministic, the test procedures of NVTOL.1405 must allow for some tolerance, since it cannot be expected that the aircraft will fly exactly the reference procedures of NVTOL.1205 during the test. Therefore, the tolerance "within +50m, -110m of the reference height" of NVTOL.1405 (c)(3) (for the take-off procedure) caters precisely for that (although EASA will rephrase it to change the amount of

tolerance and introduce the concept of targeted test height, prompted by other comments). Within these EPTS, EASA decided to provide a wider height tolerance than for helicopter noise certification according to ICAO Annex 16 Volume I, especially towards the low end, to allow quiet aircraft to have their noise signature properly captured over local ambient noise (c.f. NVTOL.1405 (h)).

comment *30* comment by: *Nico/Anotec*

point (c)(3)/(d)(3)/(e)(3):
In my opinion a limit should be applied to the angular velocity around overhead to avoid losing signal if the lowest heights are chosen and the speed is too high.

response Accepted.
Thank you for your comment and suggestion. In line with the fastest angular velocity already applied for conventional aircraft certification, which is typically found for heavy turbojet aircraft, EASA will update the EPTS and add that, whenever the applicant establishes a targeted test height below the reference height, the angular velocity of the acoustic emission angle should remain below 40°/second (which corresponds to the highest angular velocity for a typical “fast” jet aircraft at the approach certification point, the closest to the microphone).

comment *31* comment by: *Nico/Anotec*

points (c)/(d)/(e):
it is surprising to see that no limit is set for the vertical deviations around the chosen test height.
As it is written now it seems not possible to reject a run based on such deviation, as long as it is within 40m and 200m.

response Noted.
Thank you for your comment. To be precise, EASA have set limits on the allowable vertical deviations between test and reference heights, but they have been kept deliberately wide. The main reason for doing so was to accommodate the expected low noise of such designs and have their noise signature properly captured over local ambient noise (c.f. NVTOL.1405 (h)). Nevertheless, to bracket the heights during a noise test, EASA will modify the final version of the EPTS and introduce the concept of a target test height that the applicant should establish in agreement with the Agency prior to starting the actual acquisition of the noise test runs. While the tolerance between targeted test height and reference height will remain wide, the actual test height of each test run will need to be within ±10% of the targeted test height. Additionally, new specifications on angular velocity (c.f. Comment #30) will also restrain test height tolerance.

comment *32* comment by: *Nico/Anotec*

point (d)(1):
runs should be performed in equal numbers with **identical** tailwind and headwind components.
This is virtually impossible to achieve. They will be similar, but not identical....

response Noted.

Thank you for your comment. EASA will modify the text in the final EPTS to read:
"(1) a minimum of six valid runs should be acquired, with the number of valid runs made with a headwind component equal to the number of valid runs made with a tailwind component, and the test runs should be conducted in pairs of opposite flight direction;"

comment *33* comment by: *Nico/Anotec*

point (i):
it is not clear if such source correction should be measured for the individual test conditions and how these should be flown (same flight path angle as reference?)

response

Noted.
Thank you for your question. EASA has left the text regarding source noise correction deliberately open in this EPTS to accommodate all possible designs. The details that you are referring to would be part of exchanges between applicant and the Agency within the scope of a given project.

comment *72* comment by: *UK CAA*

Page No: 25

Paragraph No: NVTOL.1405 (f) (6) – Flight test procedures

Comment: The current text describes the permitted vertical deviation from the "measured height averaged" over the 30 seconds of noise recording. Figure 5 (page 27) however uses the term "target height" when illustrating the +/-1m height tolerance for each run. It is unclear if the tolerance of +/-1m applies to the instantaneous height variations around the measured average height or around the target (reference) height.

Justification: Clarity is required on the permitted vertical deviations.

response

Accepted.
Thank you for your comment and suggestion. EASA will update Figure 7 in the final version of the EPTS to make the depiction consistent with the text and avoid confusion. Please note that EASA will also modify the specifications of the other flight test procedures (take-off, overflight and approach) and introduce the concept of targeted test height for them too: while there will still be a rather wide tolerance band between targeted test height and reference height, the actual test height of each individual run will have to be within ±10% of the targeted test height at take-off, overflight and approach, and within ±1m at hover.

comment 195 comment by: *Boeing*

Page No: 25

Paragraph No: NVTOL.1405 (f)

Comment: THE PROPOSED TEXT STATES:
"(1) a minimum of six runs should be performed;

(2) the aircraft should be set to maintain a stabilized hovering position during 30 seconds at the vertical above the noise measurement point; "

Justification: Boeing requests clarification on two items:
1) In other conditions proposed in the consultation paper, runs with both head- and tailwind were requested, as the wind direction has been shown to influence the noise levels of rotorcraft. What is the reasoning behind omitting the wind requirement for hover, as the noise signature will also be affected by relative wind direction and resulting change in vehicle attitude? Further, EASA may consider wind direction guidance to ensure more consistent measurements between applicants.
2) EASA might want to consider adding a yawing maneuver in the hover procedure. This seems to have applicability in the real world, and would not add much complexity to the existing procedure. Varying the rotor rpm significantly in a yaw condition will almost definitely affect the emitted noise and may thus be of interest.

response

Noted.
Thank you for your questions and suggestions.
Regarding question 1), the wind requirement for hover has not been omitted, but it is related to a general wind direction. EASA believes that the microphone arrangement specified in NVTOL.1200 (d), covering four directivities rotated 90° from one another, combined with stricter wind speed restrictions than for the other points (5 kt maximum wind speed instead of 10 kt for the other points) will provide sufficient consistency in noise measurements.
As for question 2), while recognizing that yawing manoeuvres will likely take place during regular VTOL-capable aircraft (VCA) operations, EASA is is stipulating constant conditions for the purposes of noise assessmentin line with these EPTS which excludes yawing.

comment

73 comment by: *UK CAA*

Page No: 25

Paragraph No: NVTOL.1405 (i) – Flight test procedures

Comment: The applicant is advised to consider undertaking additional noise testing to develop sensitivity curves of EPNL versus TAS, or PNLTM versus TAS, or PNLT versus TAS. No rationale has been given for the development of these additional noise sensitivity curves, e.g. it is unclear for what or whose purpose this is for. In addition (and although it will be understood by most readers), no definition of "TAS" has previously been given in the document.

Justification: Clarity requested on the rationale for conducting additional testing to acquire noise sensitivity curves.

response

Noted.
Thank you for your comment and question. First, EASA will modify the text of the final EPTS to define "TAS" for clarity.
Regarding why the applicant is expected to develop these specific noise sensitivity curves (noise vs TAS), with the current and limited knowledge on VTOL-capable

aircraft (VCA) noise, EASA believes that TAS is a parameter that cannot be neglected for source noise correction, even if it does not end up being the retained correlating parameter when following the specifications of NVTOL.1600 (b)(9).

comment *95* comment by: *US Federal Aviation Administration*

Re: the rpm of each individual rotor should not vary from its average value by more than ±3% during the 10 dB-down period.

A 3% tolerance may be too limiting for this class of aircraft, especially during approach and takeoff. An appropriate baseline RPM tolerance should be carefully considered and established here. That being said, section NVTOL.1205(g) should be added to this section as well to accommodate aircraft with novel design characteristics which may require a larger RPM tolerance. The method of determining the "average value (RPM)" should also be considered.

Suggestion: Add a bullet point like NVTOL.1205(g) to this section.

response Accepted.
Thank you for your comment and proposal. EASA will modify the text of the final EPTS by adding a statement similar to NVTOL.1205 (g) to section NVTOL.1405 (Flight test procedures).

comment *96* comment by: *US Federal Aviation Administration*

Re: the true airspeed should not vary from the reference airspeed specified in paragraph (d)(3) of
NVTOL.1205 – Reference procedures by more than ±9 km/h (±5 kt) throughout the 10 dB-down
period;

EASA should consider the possibility that aircraft in this category may need to decelerate to land inside the 10 dB down times (set deceleration/acceleration limits and approach/takeoff paths through flight software). Again, the FAA supports the addition of NVTOL.1205(g) to this section to accommodate aircraft with novel design characteristics.

Suggestion: Add a bullet point like NVTOL.1205(g) to this section to add allowance for an aircraft designed to have these flight characteristics.

response Accepted.
See the answer to Comment #95.

comment *97* comment by: *US Federal Aviation Administration*

14 CFR part 36 and Annex 16 require helicopters to do some test passes over-gross (percentage above MTOW). Is this something that EASA will require for aircraft covered by this rule?

Suggestion: Require some test passes at or over MTOW.

response

Partially accepted.
Thank you for your comment. EASA does not foresee the need to demand test runs above MTOM but will indicate it as a possibility should the applicant wish to do so to cater for possible future weight increase of the same design. Also, even if no weight loss is expected as the noise test progresses with typical VTOL-capable aircraft (VCA) designs, EASA will also add a specification that any test run where the mass of the UA is lower than 90 percent of its MTOM should be rejected.

comment

98 comment by: *US Federal Aviation Administration*

The allowance for test dimension requirements (height for example) is too generous. Overflight (150 m), approach have error allowances of 'test environment conditions being within +50 m, -110 m of the reference height'. That is a different format and larger magnitude of height tolerance compared to the normal +/- requirements. At the Hover height (50 m), the aircraft is allowed to get an average height (over the 30 seconds of recording) between 25 and 100 meters above the microphone. This variation in height should also not be allowed.

Has EASA considered the effect (error) of correcting data from 40m to 150 m using the simplified method of EPNL calculation? Was a lower reference height (because this class of aircraft are much quieter than traditional large helicopters) or different calculation adjustment method considered to provide more accurate noise levels and precise results across different applicants?

Additionally, the current tolerances should be specified as target test height tolerances. On top of this, a test tolerance should be added to more tightly cluster the data and decrease confidence interval.

Suggestions:

- Possibly revise reference height or adjustment methods.
- Clarify the range as a target test tolerance and add a test height tolerance of 10%.

response

Partially accepted.
Thank you for your comment, question, and proposed resolutions.
Regarding the magnitude of test height tolerances, EASA has deliberately left them wider than for current helicopter noise certification in ICAO Annex 16 to cater for an expected noise signature lower than conventional helicopters and to meet the signal-to-ambient-noise ratio specification of NVTOL.1405 (h).
To your other question, EASA did consider the possible errors when adjusting measured noise to reference-day conditions from 40 m to 150 m, which is why the adjustment procedures specified in NVTOL.1600 (b) follow those of the Integrated procedure of Appendix 2 of ICAO Annex 16 Volume I. EASA has left no possibility to use the Simplified method of adjustment.

EASA will however integrate partially your proposed solution into the final version of the EPTS and clearly define the concept of targeted test height: for all 4 procedures (take-off, overflight, approach, and hover), the applicant will have to establish a targeted test height with agreement of the Agency, prior to executing the actual noise measurements. This targeted test height will need to be within a rather wide tolerance of the reference test height. Additionally, when performing the noise test runs, the actual test height of each run will have to be within a rather narrow tolerance of the targeted test height (±10% for take-off, overflight, and approach, ±1m for hover).

comment *130* comment by: *Leonardo Helicopters*

Paragraphs (c)(3) + (d)(3) + (e)(3)

Comments:
Basically, new aircraft are expected to be quieter than classic helicopters. It is assumed, considering discussions on the EASA Noise.UAS guidelines*, that the -110m value has been defined to enable a sufficient ratio to background noise, but why is a value of +50 m allowed for upward trajectory deviation?
* *Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category (Low and Medium Risk)*

Proposed Resolution:
Define the same limit as for helicopters (ICAO Annex 16 Vol. 1 Chapter 8) for upper value:

- take-off: not applicable
- flyover: +9m

approach: trajectory at 5.5° angle

response Partially accepted.
Thank you for your comment and suggestion. You have correctly identified the rationale for allowing a wide tolerance on the lower test height (to ensure a sufficient signal-to-ambient-noise ratio).
Please refer to Comment #98 for our answer. Please also refer to Comment #53 regarding the bracketing of descent angle at Approach: EASA will specify that the descent angle during the test must remain between 5.5° and 6.5°.

comment *139* comment by: *Volocopter-Policy & Regulatory Affairs*

NVTOL.1405- c.5, d.5, e.5: Clarification is needed regarding how the +-3% criteria should be employed. This could be challenging to meet if peak to peak around mean RPM over a period of time (representing a 10 dB-down period) is taken into account. VC suggests considering a metric, such as standard deviation, to measure RPM variation. In addition, the limit value must be determined with the applicant after trial flight tests have been conducted.

response

Noted.
Thank you for your comment and contribution. EASA will leave the ±3% criterion in the final version of the EPTS, which is already an expansion of the original ±1% of Chapter 8 of ICAO Annex 16 Volume I. On a specific project, the provisions of the future NVTOL.1405 (g) (see Comment #95) may enable deviations if agreed by the Agency.

comment *150* comment by: *AIRBUS HELICOPTERS*

COMMENT :
This point needs further attention.

JUSTIFICATION FOR COMMENT :
RPM tolerances "the rpm of each individual rotor should not vary from its average value by more than ±3% during the 10 dB-down period". Depending on the eVTOL flight control system, this target may be very difficult to achieve since these vehicles will mostly be RPM-controlled (variable RPM Control).

response

Noted.
Thank you for your comment. Please refer to Comment #139.

comment *151* comment by: *AIRBUS HELICOPTERS*

COMMENT :
Refering also to NVTOL1600 on these adjustment procedures, it would be appreciated to get experience feedbacks from EASA on this topic after preliminary testing campaigns.

JUSTIFICATION FOR COMMENT :
"Source noise adjustments should consider additional testing to develop sensitivity curves". It is expected that many parameters would vary in parallel when trying to establishing TAS variations, making very difficult for the applicant to find appropriate source noise corrections, while maintaining 90% confidence interval below 1.5EPNdB.

response

Noted.
Thank you for your comment. EASA will not share detailed information of a particular project with the public. However, as experience is gained from projects, EASA may update these EPTS in the future to reflect lessons learned and possibly develop guidance (Interpretative Material or possibly Means of Compliance) to the source noise adjustment requirements of NVTOl.1600 (b)(9).

comment *169* comment by: *FAA, Aviation Safety*

response

Empty comment. Not addressed.

comment *170* comment by: *FAA, Aviation Safety*

response

Empty comment. Not addressed.

MoC1 NVTOL.1405 - Flight test procedures p. 26

comment	*34* comment by: *Nico/Anotec* point (b): the lateral measurement points should be shifted such to maintain the same elevation angle. Apart from source noise directivity issues this is especially important for the signal-to-noie ratio. If we lower the test height because of low SNR at the centre mike, this will most likely alos be an issue at the sideline mikes. There the problem would remain if not shifted inwards.
response	Accepted. Thank you for your comment and suggestion. EASA will add specifications as part of MoC1 to NVTOL.1405 (“Flight test Procedures”) to the final version of the EPTS that, if the target height is modified, the sideline microphones should be relocated to maintain elevation angles identical to those of the reference setup.

comment	*48* comment by: *EUROCONTROL* Adjustment of test height and speed in relation to background noise levels: this is a very important part of the specification that partially mitigates the concerns regarding the wide range of eVTOL performance as described in GC1.
response	Noted. Thank you for your supportive comment.

IM2 NVTOL.1405 - Flight test procedures p. 27

comment	*15* comment by: *Lilium* (4) Rotor speed. Original: "An alternative envelope for individual rpm variations can be proposed by the applicantin coordination with the Agency.". Corrected: "An alternative envelope for individual rpm variations can be proposed by the Applicant in coordination with the Agency."
response	Accepted. Thank you for your typo correction, which EASA will integrate into the final version of the EPTS.

comment	*49* comment by: *EUROCONTROL* In section (a) Take-off profile, last paragraph: "The reference climb angle, γ, is based (…)" should probably read "The reference climb angle, γ_R, is based (…)"
response	Accepted. Thank you for your typo correction, which EASA will integrate into the final version of the EPTS.

comment	*50* comment by: *EUROCONTROL* Figures 6, 7 and 8 all contain the same label "Reference take-off flight path projection" - Fig. 7 should read "Reference overflight path projection" and Fig. 8 should probably read "Reference approach flight path projection".
response	Accepted. Thank you for your typo correction, which EASA will integrate into the final version of the EPTS.

Figure 5: depiction of allowable flight boundaries for the hover procedure p. 27

comment	*74* comment by: *UK CAA* **Page No:** 27 **Paragraph No:** MoC2 NVTOL.1405 – Flight test procedures, Figure 5 **Comment:** Figure 5 depicts the boundary of the aircraft flight path for the hover procedure situated directly above a "Noise measurement point", which could be misleading. **Justification:** There is no hover measurement point specified directly below the aircraft. **Proposed Text:** In Figure 5, the UK CAA suggests replacing the text "Noise measurement point" with "Origin of the measurement array"
response	Accepted. Thank you for this comment and suggestion. EASA will fix the figure in the final version of the EPTS to bring clarity.

Figure 6: Comparison of measured and reference take-off profiles p. 28

comment	*99* comment by: *US Federal Aviation Administration* Re: Figure 6: Comparison of measured and reference take-off profiles The flight test procedure sections do a good job of describing the variations, but some use of the figure's labeling should be used in defining the variation limits. See Figure 6, the distance Fr – F should have a limit defined. For examples; Fr – F not to exceed 10%. Lateral deviation and tolerance could also be shown in the diagram. Suggestion: Add variation limits to the figures
response	Accepted. Thank you for your comment and suggestion. EASA will incorporate your suggestions and revise the figures in the final version of the EPTS, which will

	however not depict the lateral deviations and tolerances to keep the figures comprehensible.
comment	*171* comment by: *FAA, Aviation Safety*
response	Empty comment. Not addressed.

Figure 7: Comparison of measured and reference overflight profiles p. 30

comment	*17* comment by: *Volant Aerotech* A slip of the pen in Figure 7. "Reference take-off flight path projection" should be changed to "Reference overflgiht flight path projection". Proposed by Volant Aerotech(Shanghai, China), XPENG AEROHT(Guangzhou, China) and International Institute of Acoustic Technology(Suzhou, China)
response	Accepted. Thank you for this comment and suggestion. EASA will fix the figures in the final version of the EPTS accordingly.

IM3 NVTOL.1405 - Flight test procedures p. 30

comment	*35* comment by: *Nico/Anotec* point (b)(1): Typo: .... flight path/height determination **will should** account
response	Accepted. Thank you for your comment. EASA will fix the typo in the final version of the EPTS.
comment	*36* comment by: *Nico/Anotec* point (b)(3): Typo (some text seems to be missing): however, **would alleviate the should take** the wind direction into account
response	Accepted. Thank you for your comment. EASA will fix the typo in the final version of the EPTS.
comment	*51* comment by: *EUROCONTROL* Figures 6, 7 and 8 all contain the same label "Reference take-off flight path projection" - Fig. 7 should read "Reference overflight path projection" and Fig. 8 should probably read "Reference approach flight path projection".
response	Accepted.

Thank you for this comment and suggestion. EASA will fix the figures in the final version of the EPTS accordingly.

Figure 8: Comparison of measured and reference approach profiles p. 31

comment *18* comment by: *Volant Aerotech*

A slip of the pen in Figure 8. "Reference take-off flight path projection" should be changed to "Reference approach flight path projection".

Proposed by Volant Aerotech(Shanghai, China), XPENG AEROHT(Guangzhou, China) and International Institute of Acoustic Technology(Suzhou, China)

response Accepted.
Thank you for this comment and suggestion. EASA will fix the figures in the final version of the EPTS accordingly.

IM4 NVTOL.1405 - Flight test procedures p. 31

comment *52* comment by: *EUROCONTROL*

Figures 6, 7 and 8 all contain the same label "Reference take-off flight path projection" - Fig. 7 should read "Reference overflight path projection" and Fig. 8 should probably read "Reference approach flight path projection".

response Accepted.
Thank you for this comment and suggestion. EASA will fix the labels in those figures in the final version of the EPTS accordingly.

comment *53* comment by: *EUROCONTROL*

Figure 8 shows two approach angles, 6deg for reference approach path relative to point Er, and γ for measured approach path relative to point E. NVTOL.1205 Reference procedures, section (e)(2) stipulates that "the aircraft is stabilised and following a 6.0deg approach path". NVTOL.1405 Flight test procedures section (e) does not mention any deviations or tolerances allowed for the approach path angle. Therefore, angle γ for measured approach path should be the same as for reference approach path, i.e. 6deg.

response Noted.
Thank you for your comment, which indeed points to a missing piece of information within our EPTS that leads to an unintended interpretation. EASA will address your comment by specifying in IM4 NVTOL.1405 for the “Approach flight test procedure” that the descent angle during the test has to remain between 5.5° and 6.5°.

comment *100* comment by: *US Federal Aviation Administration*

Re: "however, would alleviate the should take"

	Recommendation: please reword
response	Accepted. EASA will correct the typo in the final version of the EPTS.

comment	*101* comment by: *US Federal Aviation Administration* 6 degree approach angle is shown in Figure 8, but not explicitly shown in the text. A tolerance should also be prescribed. Suggestion: If 6 degree approach angle is required, it should be described in the text, together with variation limits.
response	Accepted. Thank you for your comment and suggestion. Please refer to Comment #53.

comment	*172* comment by: *FAA, Aviation Safety*
response	Empty comment. Not addressed.

NVTOL.1410 - Noise measurement p. 32

comment	*37* comment by: *Nico/Anotec* point (b)(1): requiring a calibration check every hour during the test seems excesive to me, considering the very stable measurement systems that are used nowadays. Proposed to put "at regular intervals".
response	Accepted. Thank you for your suggestion and substantiation. EASA will modify the EPTS according to your proposal.

comment	*173* comment by: *FAA, Aviation Safety*
response	Empty comment. Not addressed.

IM1 NVTOL.1410 - Noise measurement p. 34

comment	*102* comment by: *US Federal Aviation Administration* Re: The sound levels may vary mainly due to environmental factors and the internal warm-up as

recommended for most noise measurement instruments.

The sound levels do not vary due to instrumentation warm-up, but the measured or indicated values may.

Suggestion: revise

response: Accepted.
Thank you for your comment and suggestion. EASA will bring your suggested correction to the final version of the EPTS.

comment *174* comment by: *FAA, Aviation Safety*

response: Empty comment. Not addressed.

MoC1 NVTOL.1415 - Spatial positioning and speed measurement p. 35

comment *38* comment by: *Nico/Anotec*

point (b)(2) vs. point (d):
TAS is not (always) measured, and certainly not by a GNSS system...

response: Noted.
Thank you for your comment and for bringing this point. EASA will modify the text in (b) to specify that "the following parameters should be measured or derived", which will then leave the possibility open for the TAS to be derived (and not directly measured).

NVTOL.1415 - Spatial positioning and speed measurement p. 35

comment *103* comment by: *US Federal Aviation Administration*

The means of establishing flight paths (and thus data correction) seems to require GPS monitoring during flights, is this correct? Although photoscaling or other methods may not be preferred, they are allowed in part 36 and the Annex and should carry over to this rule.

Suggestion: Add a statement allowing photscaling or other EASA approved equivalent procedures.

response: Not accepted.
Thank you for your comment and suggestion. EASA confirms that the requirements set forth in NVTOL.1415 mandate the use of augmented DGNSS to measure the flight path during the test procedures of NVTOL.1405. While EASA considered your proposal, we maintain the position to not allow photo scaling for the following reasons:

- Augmented DGNSS achieve a higher accuracy than photo scaling.

- Todays' prices of augmented DGNSS are comparable to those of quality digital cameras, and even if more expensive, EASA considers the extra costs proportionate to the complexity of the designs covered by these EPTS.
- Considering the relatively open test height tolerance in NVTOL.1405 which may allow some vehicles to be tested rather close to the ground, capturing their speed and position accurately with a photo scaling method might prove challenging and detrimental to the accuracy of the measurement. Another limitation of photographic scaling is the need to obtain sharp images with small apertures, which often prohibits testing in low light conditions (e.g. just after sunrise). Such limitations do not exist with augmented DGNSS.

comment *176* comment by: *FAA, Aviation Safety*

response Empty comment. Not addressed.

NVTOL.1505 - Microphone system characteristics and set-up p. 37

comment *54* comment by: *EUROCONTROL*

Section a) prescribes a mounted set-up with the sensing element at 1.2m above local ground surface. There is a notable difference between this specification and the one provided in another material EASA published for public consultation: "Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category (Low and Medium Risk)". In the latter, Noise.UAS.620 - Microphone characteristics and set-up, section a) point (3) specified that the microphone must be "mounted in an inverted position such that the microphone diaphragm is 7 mm above and parallel to a ground plate (…)". The justification for this provided in MoC1 Noise.UAS.620 - Microphone characteristics of the same document is minimising "interference effects of reflected sound waves inherent in pole-mounted microphone installations". The question that emerges here is why the certification measurement set-up should be allowed to be potentially affected by such interferences.

response Noted.
Thank you for your question. While the use of inverted microphones above ground plates was considered, EASA preferred to maintain commonality with the measurement setup of Chapter 8 of ICAO Annex 16 Volume I to ensure a fair comparability of the resulting noise levels and the use of identical noise limits. For the Hover procedure however, which is only a reporting requirement at the current stage and for which no noise limits apply, EASA will modify the microphone setup specified in NVTOL.1505 (b) to inverted microphone mounted on ground plates.

comment 196 comment by: *Boeing*

Page:37
Paragraph: NVTOL.1505(a)

THE PROPOSED TEXT STATES:

"Each microphone should be a 12.7 mm diameter pressure type, protected with a grid, mounted with the sensing element 1.2 m above the local ground surface and oriented for grazing incidence, i.e. with the sensing element substantially in the plane defined by the predicted reference flight path of the aircraft and the measuring station."

REQUESTED CHANGE:
"Each microphone should be a 12.7 mm diameter pressure type, protected with a grid, mounted ~~with the sensing element 1.2 m above the local ground surface and oriented for grazing incidence, i.e. with the sensing element substantially in the plane defined by the predicted reference flight path of the aircraft and the measuring station~~ in an inverted position such that the microphone diaphragm is 7 mm above and parallel to a circular metal plate. This white-painted metal plate shall be 40 cm in diameter and at least 2.5 mm thick, and shall be placed horizontally and flush with the surrounding ground surface with no cavities below the plate. The microphone shall be located three-quarters of the distance from the center to the edge along a radius normal to the line of flight of the test aircraft.

JUSTIFICATION:
Ground plane microphones should be used for both certification and data-gathering measurements for eVTOL aircraft.
Ground plane microphones greatly reduce scattering effects caused by sound waves reflecting off of the ground, much increasing the quality and repeatability of certification measurements. With a large number of distributed rotors, and correspondingly complex tonal noise, avoiding ground bounce effects will be critical for data quality.
Each testing facility has different natural ground characteristics that impact the sound measured by 1.2 m pole mounted microphones. In order to accurately describe this effect, several measurements are taken to establish the ground impedance characteristics. The addition of the ground characterization effort adds much complexity to an otherwise simple noise test. As potentially multiple eVTOL applicants will be using the proposed (or similar) rules, it is pertinent to establish a measurement system that provides consistent measurements without having to conduct large surveys and ground impedance characterization studies. Because the ground characteristics are removed from a ground plane measurement the measurements become more repeatable between tests.
Already existing guidance in ICAO ETM Chapter 5, GM A6 4.4.1 clearly states the importance of using ground plane microphones, and can serve as a starting point for a ground plane measurement system in the proposed consultation. For example, the round ground plates used in ICAO Annex 16, Vol. 1, Chapter 10 certification (and further described in ICAO Annex 16, Vol. 1, App 6, and SAE ARP4055) greatly simplifies installation, and ground preparation for the noise test campaign.

response

Partially accepted.
Thank you for your suggestion and justification. EASA will incorporate your suggested microphone setup for the hover noise procedure specified in NVTOL.1205 (f), but will keep the current setup for the take-off, overflight, and approach procedures to ensure commonality with Chapter 8 of ICAO Annex 16 Volume I and enable a fair comparison of the noise of designs covered by these EPTS to that of helicopters.

comment *75* comment by: *UK CAA*

Page No: 37

Paragraph No: NVTOL.1505 (a) – Microphone system characteristics and setup

Comment: The specified microphone mounting method in the EPTS document is with the diaphragm mounted 1.2 m above the local ground surface and oriented for grazing incidence.

By comparison, the mounting method adopted by EASA in "Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category" is a ground plane (inverted) microphone setup. It is widely accepted that this configuration greatly minimises the interference effects of reflected sound waves compared to a 1.2m pole-mounted microphone installation (this is noted in the EASA Guidelines).

With a new Technical Specification for a new category of aircraft, the UK CAA believes now is the time to be ambitious. While utilising a 1.2m pole-mounted microphone installation maintains commonality with ICAO Annex 16 Volume 1 Chapter 8, it presents a missed opportunity to adopt the superior ground plane microphone installation. Furthermore, where the proposal goes beyond Chapter 8, i.e. hover measurements, this would be at the greatest risk of interference effects from a 1.2m microphone. There is therefore a strong case to adopt a ground plane (inverted) microphone setup throughout the document, or alternatively at least for the hover condition (even if the latter results in two different microphone setups in the EPTS). Commonality with the Chapter 8 noise limits could be achieved if necessary either by subtracting 6dB from the ground plane measurements or by adding 6dB to the current noise limits.

Justification: Clarity required on the rationale for adopting the technically inferior pole-mounted microphone configuration rather than the ground plane (inverted) microphone configuration.

response

Partially accepted.
Thank you for your comment, proposal and information. Please refer to EASA's answer to Comment #196. Especially, a simple subtraction of 6 dB from ground-

plate microphones does not provide results equal to those acquired by 1.2-m microphones.

comment *104* comment by: *US Federal Aviation Administration*

The word "input" was inserted here when copying the Annex text from A2.3.5.4. This change is awkward, as this is not the typical English language way of describing acoustical energy impinging on the microphone. It doesn't seem to help any understanding or clarity of the specification in item (c).

Suggestion: take out the word "input"

response Accepted.
Thank you for your comment and suggested wording. EASA include your proposal into the final version of the EPTS.

comment *105* comment by: *US Federal Aviation Administration*

Re: The free-field frequency response of each microphone system should be applied to the measured one-third octave band sound pressure levels determined from the output of the analyzer.

This language is similar to Annex 16, V1, APP2, section 3.9.4, but might be misleading. The Annex follows this requirement with 3.9.5 which specifies at which incidence angles the corrections for free field microphone response must be obtained and applied. The Annex also follows this with 3.9.6, which provides requirements for corrections for windscreen insertion effects vs. incidence angle. Because the standard prefers a pressure-field microphone, including Table 6, which references free-field normal incidence, is misleading.

Suggest this requirement be replaced with something like (at a minimum): "One-third octave band corrections for the effects of the free-field frequency response at grazing incidence... ...shall be applied to measured one-third octave band sound pressure levels..." The Annex should be followed followed closely to limit confusion.

response Accepted.
Thank you for your comment and proposal. EASA will use your suggested text in NVTOL.1505 (a)(6). As for the other requirements of Section 3.9 of Appendix 2 of Annex 16 Volume I, they have also been carried over into these EPTS but have been placed at different locations and do not follow the exact same sequence as in Annex 16.

MoC1 NVTOL.1505 - Microphone system characteristics and set-up p. 38

comment *177* comment by: *FAA, Aviation Safety*

response Empty comment. Not addressed.

comment	*178* comment by: *FAA, Aviation Safety*
response	Empty comment. Not addressed.

NVTOL.1510 - Recording and reproducing system p. 39

comment	*55* comment by: *EUROCONTROL* Section (c) seems to contain an embedded paragraph that is probably meant to be separate: the part starting with "Adjustments of the measured sound levels
response	Noted. Thank you for your comment. Please refer to Comment #28: the reason for the confusion comes from the system of cross-references used within this document, that quotes entire headings (and which may look confusing when found in the middle of sentences). EASA will fix the final version of the EPTS by adding quote marks (“”) around each cross-reference to clearly distinguish actual text from cross-references.

comment	*181* comment by: *FAA, Aviation Safety*
response	Empty comment. Not addressed.

MoC2 NVTOL.1505 - Microphone system characteristics and set-up p. 39

comment	*106* comment by: *US Federal Aviation Administration* RE: "The free-field frequency response…" and "by using an electrostatic actuator in..." This is misleading. The electrostatic actuator can be used to obtain the pressure response characteristics of the individual microphone, which are usually very close to the 90-degree or "grazing" incidence free-field response... Given pressure response and published manufacturer's data, the 1/3 octave band free-field response corrections can be applied for grazing incidence, but overall free-field response is typically not directly available from electrostatic actuator testing. Also, the term "free-field" without any qualifying text might be misinterpreted to mean zero-degree - or "normal" incidence. Recommendation: It would be clearer to specify "free-field grazing incidence response" rather than just "free-field response". Further, the distinction between response values and correction values for such response effects should be clearly stated. Although this requirement is worded similarly to Annex 16, V1, APP 2, Section 3.9.5, without the expanded context provided in the Annex, the presentation of this requirement seems suboptimal.

response	Accepted. Thank you for your comment and proposed solution. EASA will adopt your proposed wording in the final version of the EPTS.

comment	*179* comment by: *FAA, Aviation Safety*
response	Empty comment. Not addressed.

IM1 NVTOL.1505 - Microphone system characteristics and set-up p. 39

comment	*107* comment by: *US Federal Aviation Administration* The sideline microphones in the right-hand portion of Figure 9 are angled in a way that might mislead readers to interpret grazing incidence incorrectly: the angle between the indicated microphone preamp body axis and the sound ray impinging on the microphone diaphragm is obviously and substantially less than 90 degrees. Recommendation: Edit the diagram to more accurately show grazing incidence
response	Accepted. Thank you for your comment. EASA will update the right-hand diagram of Figure 12 to better depict sound rays with grazing (≈90°) incidence.

comment	*180* comment by: *FAA, Aviation Safety*
response	Empty comment. Not addressed.

MoC1 NVTOL.1510 - Recording and reproducing system p. 40

comment	*108* comment by: *US Federal Aviation Administration* Re: (a).....or any other analogue recording equipment The specified microphones themselves could be considered to be "analog audio recording equipment" Recommend deleting this phrase
response	Accepted. Thank you for your comment and suggested correction. EASA will modify the final version of the EPTS to reflect your proposal.

comment	*182*	comment by: *FAA, Aviation Safety*
response	Empty comment. Not addressed.	

MoC2 NVTOL.1510 - Recording and reproducing system p. 40

comment	*109*	comment by: *US Federal Aviation Administration*

RE: Additionally, the lowest input level value at which the non-linearity tests to satisfy the specifications of

This definition of post-detection background noise levels is sub-optimal. The statement reads as: "...the lowest ...level... at which the ...linearity tests... have been conducted should be considered as the post-detection…"

The intent may have been to say that the lowest level at which the linearity criterion was successfully established can be considered to be the post-detection.

response

Partially accepted.
Thank you for your comment and substantiation. Actually, EASA wanted to convey the requirement that the lowest noise level at which non-linearity was tested is to be considered post-detection, even if no non-linearity was detected. For example, if the applicant tested down to 40 dB at the 10 kHz band without detecting any onset of non-linearity, then 40 dB would still have to be considered as the post-detection noise at 10 kHz.
Nevertheless, at the light of your comment, EASA realizes that this requirement can create confusion and will remove it. EASA believes that the requirement that the "highest steady sinusoidal sound pressure level applied to the input of the measurement system, exclusive of the microphone systems, at which the non-linearity exceeds ±0.4 dB, is used as "post-detection noise"" is sufficient and achieves the same objective.

IM1 NVTOL.1510 - Recording and reproducing system p. 41

comment	*110*	comment by: *US Federal Aviation Administration*

Re: The lower limit of a digital recording system's usable dynamic range is determined by amplitude nonlinearity
due to quantization error rather than by the presence of a noise floor, the latter

This is a very broad statement, and might not always be the case.

	Suggest softening the statement with words like "sometimes", "frequently", or "typically".
response	Accepted. Thank you for your comment and suggested text, which EASA will integrate into the final version of the EPTS.

comment	*183* comment by: *FAA, Aviation Safety*
response	Empty comment. Not addressed.

IM2 NVTOL.1510 - Recording and reproducing system p. 41

comment	*111* comment by: *US Federal Aviation Administration* Re: Attenuators should have fixed repeatable steps. An important concept was omitted when this language was brought over from the Annex: Switched or variable attenuators need to have fixed, repeatable steps. Fixed attenuators exist that do not change the amount of attenuation applied to the signal, and would not need to be covered by this specification. Add "switched or variable attenuators"
response	Accepted. Thank you for your comment and proposal. EASA will correct the text according to your proposal in the final version of the EPTS.

comment	*184* comment by: *FAA, Aviation Safety*
response	Empty comment. Not addressed.

MoC1 NVTOL.1515 - Analysis system p. 42

comment	*112* comment by: *US Federal Aviation Administration* Re: .....seconds after the onset and 0.5 and 1 second after interruption. The Annex text from which this slow exponential time-averaging specification is taken (A2,3.7.4) has been updated in the latest published revision - 8th Edition, amendment 13 - to include different limits on the combined rising and falling response at all four half-second time-increments relative to onset or interruption of the signal. The revised Annex text reads: 3.7.4 When SLOW time-averaging is performed in the analyser, the response of the one-third octave band analysis system to a sudden onset or interruption of a constant sinusoidal signal at the respective one-third octave nominal midband frequency shall be measured at sampling instants

0.5, 1, 1.5, and 2 seconds after both onset and the interruption. The rising response shall be -4 +/- 1 dB at 0.5 seconds, -1.75 +/- 0.75 dB at 1 second, -1 +/- 0.5 dB at 1.5 seconds and -0.5 +/0.5 dB at 2 seconds relative to the steady-state level. The sum of the rising and corresponding falling shall be -6.5 +/- 1 dB at both 0.5 and 1 seconds. The sum of the rising and falling responses shall be -6.5 dB or less at 1.5 seconds and -7.5 dB or less at 2 seconds, and subsequent times relative to the steady-state levels. This equates to an exponential averaging process (SLOW Weighting) with a nominal 1-second time constant.

Recommend the previous changes be reflected.

response

Accepted.
Thank you for your comment and suggested modification, which EASA will incorporate into the final version of the EPTS.

comment *185* comment by: *FAA, Aviation Safety*

response

Empty comment. Not addressed.

IM1 NVTOL.1515 - Analysis system p. 43

comment *186* comment by: *FAA, Aviation Safety*

response

Empty comment. Not addressed.

NVTOL.1520 - Calibration systems p. 45

comment *113* comment by: *US Federal Aviation Administration*

Re:.... it is important to note which system is used so that the bandwidth error adjustment can be properly determined.

Although the text in this section is taken almost directly from ETM CH4, Section 4.3.1, GM A2 3.7.3 2), the ETM text is presented as guidance material under the subheading: "Determination of bandwidth error adjustments", and in that context, the statement about how "important" it is to note the filter design base system is tempered by the smaller scope that is assumed there, rather than here, where it appears under the scope of general "Analyser specifications", and by extension, seems to over-present the importance of performing such corrections.

To the contrary, the practice of applying corrections for filter integrated response, or "bandwidth error" is becoming deprecated, because the errors for contemporary digital filter implementations are typically extremely small, and the process of determination of such corrections can be extremely error-prone in itself, potentially resulting in the introduction of larger errors into the data than would have existed

without such corrections. Also, the method chosen by the applicant for determination of system frequency response corrections can often account for any such bandwidth errors, negating the need for applying an additional correction.

Recommend deleting the referenced text and joining with the last sentence with something like: "...the use of test frequencies calculated by a different base-number system than that for which the analyser was designed can result in erroneous values for the bandwidth error corrections."

response

Accepted.
Thank you for your comment, suggestion, and extensive substantiation. EASA will integrate your suggestion into the final version of the EPTS.

comment *114* comment by: *US Federal Aviation Administration*

Re:....to its nominal output value.

The first part of this specification matches the Annex requirement provided in A2.3.8.2, including the tolerable amount of variation, but in the Annex, the variation is allowed relative to the previous calibration of the acoustic calibrator, while here it is relative to the nominal calibrator output. The class 1 requirements provided in IEC 60942 allow the tolerance of the acoustic calibrator output to vary from nominal by 0.25 dB, so this specification could actually be interpreted as being tighter than IEC class 1.

Recommend rewording to match the Annex requirement in A2.3.8.2.

response

Accepted.
Thank you for your comment, substantiation, and suggestion. EASA will follow your recommended correction and will make the corresponding modification to the final version of the EPTS.

comment *187* comment by: *FAA, Aviation Safety*

response

Empty comment. Not addressed.

NVTOL.1600 - Adjustments of the measured sound levels p. 46

comment *76* comment by: *UK CAA*

Page No: 47

Paragraph No: NVTOL.1600 (b) (3) – Adjustment of the measured sound levels

Comment: The equation for $SPL_{ref,I,j}(I,k)$ assumes that there is no provision for a zero-attenuation adjustment window, as there is for Chapter 8 of ICAO Annex 16 Volume I (see 4.2.3.2.1 of ETM).

The UK CAA suggests EASA makes a provision for a zero-attenuation adjustment window

Justification: Simplification of adjustment procedure

response

Not accepted.
Thank you for your comment and proposal. While we are aware of the existence of this zero-attenuation window from the ETM, EASA has decided not to implement it for VTOL-capable aircraft (VCA), partly due to the current lack of knowledge of typical noise signatures of such vehicles, which might turn out quite different from helicopters.

comment

77 comment by: *UK CAA*

Page No: 48

Paragraph No: NVTOL.1600 (c) (2) – Adjustment of the measured sound levels

Comment: The component term "LAIq,i,j" is used. This should presumably be "LAeq,i,j" instead.

Justification: Typo

Proposed Text: The UK CAA suggests "LAIq,i,j" is replaced with "LAeq,i,j"

response

Accepted.
Thank you for your comment and catching this typo. EASA will integrate your suggested correction to the final version of the EPTS.

comment

115 comment by: *US Federal Aviation Administration*

Re: b(1).....to the ith test run of

Strongly recommend against using index variable i here, which is conventionally reserved in Annex for the index of frequency (the 1/3 octave band), and is used later in this document in the same manner, with index i being used simultaneously to apply to frequency band and test run number. See specification NVTOL.1600 (b)(3) in this document.

Recommendation: Change the variable to something different

response

Not accepted.
Thank you for your comment and suggestion. While we recognize having departed from the subscript convention of Annex 16, EASA will maintain the use of the lower

case “i” index to refer a particular test run, to the lower case “j” index to designate the noise measurement station (centre, sideline, etc), lower case “k” to refer to a time-sequence readout sample, and lower case “l” to designate a one-third octave band frequency index (from 1 to 24 – 50Hz to 10kHz).

comment

116 comment by: *US Federal Aviation Administration*

Re: ..... SPLref,i,j(l,k) = SPLi,j(l,k) + 0.01 [αi,j(l).QKi,j(k) - αref(l).QrefKref,i,j(k)] + 20 log10(QKi,j(k) / QrefKref,i,j(k)), where...

this is extremely confusing as it is similar to, but glaringly different from the equation provided in A2.8.3.2.1 for determining the reference-condition 1/3 octave band SPLs.

response

Noted.
Thank you for your comment. While EASA recognizes having adopted a different convention on subscripts than that of ICAO Annex 16 Volume I, we intend to maintain it within the EPTS (see our answer to Comment #115 for detail regarding the chosen subscript conventions).

comment

117 comment by: *US Federal Aviation Administration*

Re: (b)(3)....SPLref,i,j(l,k) is the adjusted spectrum of the ith test run, of the jth reference noise measurement
point, at the kth measured instant in time and the lth 1/3-octave band;

The indexing of test run number and microphone position (i and j in this case) would best be done externally to this equation, which is complex enough in its own right. The confusion inherent in including index i for test run does not aid in comprehension of the equation or of the process involved. Furthermore, index i (lower case) has been reserved in the Annex for designation of 1/3 octave band number, and is usually associated with k (lower case) to identify the time-sequence spectrum in which the SPL occurs. Substituting lower case l for the frequency band index in this document, and introducing the additional indices in these equations is making things more complicated than they already are.

Strongly recommend excising the indexing of test run sequence and microphone position from this part of the discussion on reference condition SPLs. Recommend restoring lowercase i as the index of 1/3 octave band number for frequency, to harmonize with established, internationally-agreed conventions in terminology and symbology - and addressing individual runs and microphones in a different manner external to this section.

response

Not accepted.
Thank you for this elaborated comment and while we fully appreciate the introduced discrepancy with ICAO material, EASA will maintain the current subscript convention within the EPTS.

comment

118 comment by: *US Federal Aviation Administration*

Re: (b)(8) ....The value of EPILref,i,j is set equal to EPNITOref,i,j, EPILOVref,i,j or EINLAPref,i,j according to the
reference procedure under consideration (take-off, overflight or approach respectively).

The highlighted sentence is either full of errors in nomenclature and symbology, or the meaning and intent of the unusual symbols, "EPIL", "EPNI", and "EINL" are extremely unclear. Since these symbols do not appear anywhere else in the document, the FAA assumes these are typographical errors.

NOTE: This entire section needs an overhaul for harmonization with conventions used in ICAO Annex 16, Vol. I, Appendix 2, and for general clarity.

response

Accepted.
Thanks for your comment and for pointing these multiple typos. EASA will correct them in the final version of the EPTS.

comment

119 comment by: *US Federal Aviation Administration*

Re: (c)(2).... LAeqref,i,j is the reference hover sound level of....

a) Good to include a hover condition test - there is draft guidance for similar testing for helicopters being developed in ICAO Working Group 1 for inclusion in the Annex and ETM. It might be advisable to ensure that the guidance in this document is harmonized with that internationally-developed material;

b) It is noted that A-weighted levels are specified for hover testing here, whereas Tone-corrected, Perceived Noise Level (PNLT) and Effective Perceived Noise Level (EPNL) are used for all other operations included for noise certification flight testing - is this because the hover testing requires time-averaging for 30 seconds, vs. the 0.5 second duration associated with PNLT or the time-integration over the -10 dB points for the EPNL? It seems that a PNLT-based 30-second Leq could be defined and applied, although this might not harmonize with the draft ICAO hover guidance material;

c) The adjustment for difference between test and reference sound propagation distances should be evaluated carefully, especially for larger eVTOLs and lower hover heights - minimum far-field distance testing should be included in the guidance to establish that the eVTOL aircraft is far enough away from the microphone at all measured and adjusted distances to perform as a monopole, point-source, in order

to be able to apply the conventional, "inverse-square law", 6 dB per distance-doubling, spherical spreading adjustment of 20log times the ratio of distances. The measurement and adjustment to reference conditions of such aircraft at closer distances than for conventional helicopters may require additional considerations and processing to adequately determine these kinds of adjustments.

response

Partially accepted.
Thank you for your comment.
Regarding point a), EASA has considered the work already performed in ICAO WG1 related to helicopter hover noise measurement guidelines. This has especially been reflected in the wind speed limits.
Regarding point b), EASA has also been considering other metrics, but has favoured the A-weighted equivalent continuous sound pressure level to facilitate the work of noise monitoring in vertiports for instance, where it is likely that such measurements would be acquired with simple metrics like A-weighted Leq. EASA is nevertheless recommending that the applicant retains the time traces of all recordings so as to derive the noise levels of other metrics or units should the need arise in the future.
Regarding c), EASA will follow your recommendation and add requirements to ensure that the flight test vehicle remains within the far field, which we consider to be satisfied when the height above the microphone is more than twice the diameter of the smallest enclosing circle (in most designs, this will also satisfy the condition that the height be more than twice the largest wavelength under consideration – in this case, the one that corresponds to 50 Hz). This will be reflected not only for the hover procedure, but also for the take-off, overflight, and approach procedures.

comment

120 comment by: *US Federal Aviation Administration*

Re: (c)(3) ....the origin of the measurement array as....

If the origin of the array is not co-located with the microphone diaphragm of interest, then this is a needless approximation. Slant distance is conventionally defined as the sound propagation distance between the aircraft coordinates at time of emission and the receiving microphone coordinates.

Recommendation: Make the origin of each measurement the microphone diaphragm

response

Accepted.
Thank you for your comment and for catching this unintended inconsistency. EASA will modify the EPTS to reflect that "$SR_{i,j}$" is the distance between the j^{th} reference noise measurement point and the centre of gravity of the aircraft during the i^{th} run, averaged over the 30 seconds of the measurement duration. EASA will also simplify the definition of "$SR_{ref,j}$" according to the same principle.

comment

131 comment by: *Leonardo Helicopters*

Comments:

The proposed specification asks to perform source noise adjustment, but without proposing a method for determining or measuring this correction. Does EASA expect the applicant to use the mach number? How could it apply for a VTOL with rpms varying separately on each rotor?

Proposed Resolution:
Considering that this specification has been drafted for a very specific aircraft architecture, it is suggested to at least to propose a metrics or a list of parameters which can be used for noise source adjustment.

response

Not accepted.
Thank you for your comment and proposal. Given the variety of designs covered by the current EPTS as well the relative lack of knowledge of associated key noise correlating parameters, EASA will leave the current text of the EPTS as it stands concerning source noise correction, which has been set deliberately open to accommodate various scenarios. The applicant will be typically expected to provide substantiation for the choice of the correlating parameter(s) for source noise correction, subject to agreement by the Agency.

comment *188* comment by: *FAA, Aviation Safety*

response

Empty comment. Not addressed.

comment *191* comment by: *FAA, Aviation Safety*

response

Empty comment. Not addressed.

comment *193* comment by: *FAA, Aviation Safety*

response

Empty comment. Not addressed.

MoC1 NVTOL.1600 - Adjustments of the measured sound levels p. 50

comment *39* comment by: *Nico/Anotec*

Last Good Band:
inconsistent use of "high frequency bands". By definition these are from 800Hz onwards, but for LGB it seems to start at 630Hz

response

Noted.
Thank you for your comment. EASA considers that both definitions (“Last good band” and “high frequency bands”) are consistent with one another. Especially, the statement that the last good band “is the highest frequency unmasked band within the range of 630 Hz to 10 kHz inclusive, below which there are no masked high frequency bands” still makes it possible to have a last good band at 630 Hz: in such a case, 630 Hz is unmasked, 800 Hz is masked (by definition) and there cannot be any “masked high frequency bands” equal to or lower than 630 Hz because “high

frequency bands" can only be higher than 800 Hz inclusive. EASA will therefore maintain the current text in the EPTS.

MoC3 NVTOL.1600 - Adjustments of the measured sound levels p. 63

comment *132* comment by: *Leonardo Helicopters*

Comment:
The proposed specification asks to perform source noise adjustment, but without proposing a method for determining or measuring this correction. Does EASA expect the applicant to use the mach number? How could it apply for a VTOL with rpms varying separately on each rotor?

Proposed Resolution:
Considering that this specification has been drafted for a very specific aircraft architecture, it is suggested to at least to propose a metrics or a list of parameters which can be used for noise source adjustment.

response Not accepted.
Please refer to Comment #131 (identical).

NVTOL.1605 - Satisfying maximum allowable noise levels p. 65

comment *9* comment by: *Christian Rau*

Is it common terminology to speak of a "single-sided Student's t distribution"? I doubt this, though I can understand what is meant here.

response Noted.
Thank you for your comment. Although this language is also used in ICAO Environmental Technical Manual, Volume I, EASA will replace the wording "single-sided" with "one-tailed", which seems to be more commonly used.

comment *40* comment by: *Nico/Anotec*

It is not clear how the noise levels of the 3 measurement points are used: averaged, individually checked against limit?

response Noted.
Thank you for your comment. Although the display might differ from the legacy ICAO Annex 16 Volume I, EASA considers that the language and thought process is clear in the current EPTS. Starting in reverse:

- NVTOL.1605 (a) names the final "$EPNL_{TOref}$, $EPNL_{OVref}$, $EPNL_{APref}$" values, specifying that they cannot exceed the noise limits of Subpart D.
- NVTOL.1605 (c) specifies that these values are obtained by averaging the reference sound levels associated to each i^{th} run (e.g.: $EPNL_{TOref}$ obtained from averaging individual $EPNL_{TOref,i}$).
- NVTOL.1600 (b)(10) specifies that the reference sound levels associated to each i^{th} run (for our example, $EPNL_{TOref,i}$) are obtained by averaging the

reference EPNL of the given i^{th} run over all three "j" microphone positions (in our example: $EPNL_{TOref,i,j}$) obtained from NVTOL.1600(b)(8).

comment *78* comment by: *UK CAA*

Page No: 66-67

Paragraph No: NVTOL.1605 (f) – Satisfying maximum allowable noise levels

Comment: The term "LAEref" is used (with various prefixes or suffixes) several times. This should presumably be "LAeqRef" instead.

Same comment applies to NVTOL.1700 – Noise data, subparagraph (d) (1) on page 70.

Justification: Typo

Proposed Text: The UK CAA suggests "LAEref" is replaced with "LAeqRef"

response Accepted.
Thank you for your comment and for catching these inconsistencies. EASA will fix those occurrences in the final version of the EPTS.

IM1 NVTOL.1605 - Satisfying maximum allowable noise levels p. 67

comment *56* comment by: *EUROCONTROL*

Section (f) regarding the hover procedure talks about the average sound level with a metric descriptor L_{AEref_av} , which implies the input metric is L_{AE} (also known as Sound Exposure Level or SEL). This is inconsistent with the previous parts of the specification where the metric associated with the hover procedure is prescribed to be the equivalent A-weighted continuous sound level i.e. L_{Aeq} ; see NVTOL.1110 - Calculation of A-weighted continuous sound pressure level, and NVTOL.1405 - Flight test procedures, paragraph (f)(3).

response Noted.
Thank you for your comment and please refer to Comment #78 for detail. Those were typos that EASA will fix in the final version of the EPTS.

comment *121* comment by: *US Federal Aviation Administration*

Recommend an example of calculating the confidence level. If the ETM is not going to be referenced in this section, the process should be fully shown.

response Accepted.
Thank you for your comment and suggestion. EASA will add a section to IM1 of NVTOL.1605 in the final version of the EPTS and provide a worked example of the calculation of the 90% Confidence Interval.

comment	*137* comment by: *JCAB Aircraft Engineering and Certification Center* In the hovering phase, no numerical criteria are indicated. Is the intention of establishing this phase to consider the necessity of setting a regulation value for hovering and holding in the vicinity of Vertiport? Is EASA planning to collect such data from Certification Projects for each type of aircraft, analyze the noise data, and decide whether or not to set the maximum allowable noise value for hovering?
response	Noted. Thank you for your questions. Please note that EASA would not intend to regulate noise in the vicinity of vertiports, as it is not part of our mandate. EASA intends that Hover noise only be a reporting requirement in the short term and might develop associated noise limits in the future. However, the hover noise data may inform an analysis of noise in the vicinity of vertiports by the respective competent authorities.

comment	*194* comment by: *FAA, Aviation Safety*
response	Empty comment. Not addressed.