UAS NOISE MEASUREMENT – TEST REPORT

Ref.: [xxx]

Issue: [xxx]

Date of report: […]

UAS type/model/variant: [xxx]

Abbreviations / Acronyms

[List of abbreviations / acronyms used in this report, listed in alphabetical order]

References

[List of references]

Table of contents

[Update when populating this document]

Table of Contents

[1. Introduction 6](#_Toc128394795)

[2. Test description 7](#_Toc128394796)

[a. Description of the test site 7](#_Toc128394797)

[b. Test vehicle 7](#_Toc128394798)

[c. Test instrumentation 7](#_Toc128394799)

[i. Noise measuring equipment and setup 7](#_Toc128394800)

[ii. Weather data equipment 7](#_Toc128394801)

[iii. Equipment for UA positioning and speed assessment 8](#_Toc128394802)

[d. Test execution 8](#_Toc128394803)

[3. Test results 9](#_Toc128394804)

[a. Level-flight procedure 9](#_Toc128394805)

[b. Hover procedure (if applicable) 9](#_Toc128394806)

[4. Adjustments of measured noise to reference conditions 11](#_Toc128394807)

[a. Level-flight procedure 11](#_Toc128394808)

[b. Hover procedure (if applicable) 11](#_Toc128394809)

Table of Figures

[Insert here a table of figures]

Table of Tables

[Insert here a table of tables]

# Introduction

[Describe the overall objective of the noise test.

Describe the UAS(‘s) for which noise levels are reported, adding pictures/drawings as necessary. The following parameters must be described/reported here, as they will likely populate the online EASA UA Noise repository:

* UA design organization
* UA type designation
* UA model designation
* UA variant / version
* Any other relevant identifier of the UA (which would, for instance, impact the flight envelope).
* Type of UA (multicopter, fixed-wing with/without vertical take-off capability, helicopter, etc.)
* MTOM
* Dimensions unfolded with rotors (L x W x H)
* Maximum horizontal speed at sea level, without wind
* Number of rotors, and for each rotor:
  + Orientation (fixed horizontal, fixed vertical, tilting rotor)
  + Motor designation
  + Motor maximum power
  + Rotor maximum rpm
  + Rotor designation
  + Number of blades per rotor
  + Rotor blades diameter

If the Hover noise measurement procedure does not apply to this design, provide justification here.]

# Test description

# Description of the test site

[Description of the test site (location, elevation, local terrain, etc.) with pictures/sketches from above and from the ground, showing depictions of flight path and location of microphone. The description must show that there are no obstacles within the 75° half-angle from the microphone, and that there are no excessive sound absorption characteristics around the microphone].

# Test vehicle

[Description and pictures of the test vehicle. Show that it was acoustically conformed with the intended design. Show that if several configurations are possible, the noisiest one was tested and reported.]

# Test instrumentation

# Noise measuring equipment and setup

[Description of the entire noise acquisition chain used during the test, showing that it meets all requirements of the noise measurement procedure:

* + - * Microphone: manufacturer and type
      * Noise calibrator: manufacturer, type (must be Class 1), output level and frequency, and show it was calibrated within 6 months of the test (attach calibration certificate in appendix)
      * Noise data recorder and data analyzer: manufacturer and type (must be Class 1). If a Sound Level Meter is used to carry out these tasks, mention manufacturer and type.
      * Windscreen: close-up picture of the windscreen used during the test (must be shown to be undamaged).

Description of the test setup (microphone mounted inverted with its diaphragm 7 mm above a reflective plate of 40 cm diameter). Include pictures of the setup deployed in the field, showing plate installed flush with the ground (with sand if needed).]

# Weather data equipment

[Description of the instrumentation used to obtain temperature, relative humidity and wind speed/direction readings, how high above the ground it is installed, how far from the microphone, with pictures if possible.]

# Equipment for UA positioning and speed assessment

[Description of the method(s) used to establish positioning of the UAS – photographic scaling, external augmented DGNSS, UAS built-in navigation system, on their own or combined – showing that they meet the accuracy and sample rate requirements. The point being tracked for the purpose of height and lateral determinations must also be indicated.

* + - * If using the UAS built-in navigation system, add substantiation that the accuracy meets the requirement within the entire flight envelope of the test. Manufacturer specifications are not sufficient. Add the details and results of additional tests carried out to demonstrate accuracy requirements.
      * If using photographic scaling, describe the test setup (camera type/model, lens, focal length, etc.) including pictures from the test. Add details regarding the formulae used to derive position (height, lateral deviation) and/or speed if different from those of the guidelines and provide details regarding calibration of the camera setup (taking pictures of a known object at a known distance as per the guidelines). Add details substantiating that the accuracy of the method meets the requirements.
      * If using an external augmented DGNSS, describe the sensor installation on the UA (with pictures), and provide substantiation that the accuracy meets the requirements.

Describe the procedures used to fly the UA during the test and how positioning/speed is established (in real-time or during post-processing), describing what system(s) is/are used during which phase.]

# Test execution

[General description of when the test procedures were performed, how many tests were necessary, an overview of the local conditions (e.g.: winds marginal, local background noise, etc.), when and how pre- and post-test noise calibrations were done, when and how ambient noise recordings were performed. If pre-test flights were conducted before the actual noise test and resulted in test procedures having to be adapted from their original intent (for example if the test height needed to be adapted to meet the 15 dB(A) UA-signal-to-ambient-noise ratio requirement), provide a general description of the main findings and justifications for these alterations.

If additional test procedures were conducted to establish a “k3” coefficient other than 25 (Δ3 adjustment factor), they must be extensively described here.]

# Test results

# Level-flight procedure

[Provide a comprehensive test log, preferably under table format, with the following information for each test run carried out (valid and invalid):

* + Test run identifier (number, etc)
  + Local or UTC time overhead the microphone
  + Validity of the run (yes/no) and if invalid, reason(s) for rejecting it
  + Weather conditions:
    - Ambient temperature
    - Ambient relative humidity
    - Ambient barometric pressure
    - Average wind speed and direction
  + UA positioning / speed:
    - Flight direction / heading
    - Weight (if relevant)
    - Height
    - Lateral deviation
    - Ground Speed
    - Motor performance parameters (e.g.: individual rpms) if available
  + Measured SEL(A) and maximum A-weighted noise level (LAmax).

Provide evidence of positioning/speed values:

* + through pictures for photographic scaling
  + if possible, screenshots of DGNSS or built-in UAS navigation system readings.

If dedicated test runs were performed to establish a “k3” coefficient other than 25 for airspeed adjustment, a separate table relevant to those runs must be displayed here, with the same amount of information.]

# Hover procedure (if applicable)

[Provide a comprehensive test log, preferably under table format, with the following information for each test run carried out (valid and invalid):

* + Test run identifier (number, etc)
  + Local or UTC time at 30-sec recording start
  + Validity of the run (yes/no) and if invalid, reason(s) for rejecting it
  + Weather conditions:
    - Ambient temperature
    - Ambient relative humidity
    - Ambient barometric pressure
    - Average wind speed and direction
  + UA positioning / speed:
    - Weight (if relevant)
    - Average height over 30-sec recording
    - Maximum deviation from average height during the 30-sec recording
    - Maximum deviation from vertical during the 30-sec recording
    - Average motor performance parameters (e.g.: individual rpms) over 30-sec recording if available
  + Measured LAeq.

Provide evidence of positioning/speed values:

* + through pictures for photographic scaling (one at beginning and one at the end of 30-sec recording)
  + if possible, screenshots of DGNSS or built-in UAS navigation system readings.]

# Adjustments of measured noise to reference conditions

# Level-flight procedure

[For every valid run of the level-flight procedure, provide the following adjustment-related information, preferably under table format:

* + Test run identifier (number, etc)
  + Value of “Δ1” (adjustment for propagation path length)
  + Value of “Δ2” (adjustment for differences in noise even duration)
  + Value of “Δ3” (adjustment for difference in airspeed).
    - Please provide details as to how the proxy for true airspeed was obtained from the combination of ground speed and wind speed, as per the formulae of the guidelines.
    - If a dedicated test procedure was conducted to establish a value for the correction factor (“k3”) different than 25, a separate description of the tests must be provided, as well as a separate table showing adjustments of all the corresponding test runs for sound propagation path length, differences in noise duration, and atmospheric absorption).
  + Value of “Δ4” (adjustment for differences in atmospheric absorption)
  + Value of SEL(A) adjusted with Δ1, Δ2, Δ3, and Δ4
  + Value of “final” SEL(A), average of adjusted SEL(A) of all valid runs
  + Associated values of standard deviation and 90% Confidence Interval.]

# Hover procedure (if applicable)

[For every valid run of the hover procedure (if applicable), provide the following adjustment-related information, preferably under table format:

* + Test run identifier (number, etc)
  + Value of “Δ1” (adjustment for propagation path length)
  + Value of “Δ4” (adjustment for differences in atmospheric absorption)
  + Value of LAeq adjusted Δ1 and Δ4
  + Value of “final” LAeq, average of adjusted LAeq of all valid runs
  + Associated values of standard deviation and 90% Confidence Interval.]