European Union Aviation Safety Agency

Comment Response Document (CRD) to Proposed Certification Memorandum CM-21.A-B-003 Issue 01 on Function and Reliability Flight Testing for VTOL-capable aircraft

1. Summary of the outcome of the consultation

EASA received 55 comments from 13 commentors, including 5 aircraft manufacturers and 4 civil aviation authorities.

Several commentors sought clarification regarding the maximum hours to be demonstrated when novel technologies and/or new engines are being used. Other commentors requested an alleviation in the number of flight hours or converting to the use of flight cycles instead, due to the currently short flight endurance. Respective clarification on the applicable flight hours/operation hours were introduced in the Certification Memorandum, while no alleviation beyond the use of integration benches or tied-down aircraft were deemed suitable at this stage .
Besides that, various clarifications and corrections were added based on the comments as to enhance the text.

Based on the received feedback and the improvements to the CM content its final publication is supported.

2. CRD table of comments, responses and resulting text

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

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

(b) **Partially accepted** — it means that 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 and the text will not be changed

(General Comments)	-

comment	*27* comment by: *DE-LBA* LBA has no comments.
response	Noted.

comment	*30* comment by: *FOCA (Switzerland)* Thank you for the opportunity to comment. We have no remarks on this document.
response	Noted.

comment	*33* comment by: *Eve Air Mobility* Attachment #1
response	Noted - See replies in the below sections

1.4. Definitions p. 4

comment	*1* comment by: *I R Phillis* Definitions, these are quite traditional referring to the engine and the air vehicle. The engine to be used for propulsion, similarly in the air vehicle it really only describes the use of lift or thrust to achieve vertical landing. Really think we are missing a trick here. If we consider a traditional rotorcraft then yes, the engine(s) will drive the rotors to provide lift. The rotor then does the lift and control. Well understood and easy to assess the affects of a control runaway or similar. Quite a different matter for a lot of VTOL where multiple engines are providing lift **but also control**. As a result a loss of an engine might not significantly affect overall lift performance but could result in a devastating loss of control. In VTOl we see far more complex flight control systems with engines now providing lift AND control. Gone are the traditional flight surfaces, as such I wonder if there ought to be some consideration to the relationship between lift, thrust and control? At test pilot school we will look at engine handling and performance then move on to handling qualities on traditional rotorcraft. This includes a phase measuring the affects of an AFCS control runaway. A valuable exercise as it covers rotor control power, effective hinge offset etc. and also the implementation of control authority within an AFCS/AP. As we develop flight test training for RPAS and VTOL aircraft we are seeing a far more complex problem, you can't just look at engines providing lift/thrust. Personally I believe the first major incident with one of these devices will not be loss of lift through loss of power (the traditional consideration for public transport Cat flying) but in a loss of flight control due to assymetric thrust, runaway or similar. Ian Phillis RW Test Pilot tutor Empire Test Pilots' School
response	Noted - This Certification Memorandum is detailing the determination of relevant Function and Reliability flight hours / operation hours of a production-representative aircraft to determine an appropriate aircraft design maturity under regular operational conditions. Critical failures for performance and related matters are to be demonstrated independently from these flight / operation hours. EASA makes a difference between "engine", as defined in this certification memorandum, and "lift/thrust unit" of which they are part (as defined in EASA MOC VTOL.2000 §7). As defined in EASA MOC VTOL.2000 §8 "The lift/thrust units can

	be functionally considered to be actuators of the flight control system and therefore part of the flight control function". The flight control function of the lift/thrust units is thus fully taken into account in the airworthiness certification of the type design.

comment	*3* comment by: *DGAC FR (Mireille Chabroux)* VTOL capable aircraft is defined as : "a VTOL capable aircraft is a power-driven, heavier-than-air aircarft..." DGAC-FR would like to know what the criteria in terms of static heaviness is to consider an airship as a VCA?
response	Noted - The definition continues identifying "[…] capable of performing vertical take-off and landing by means of lift and thrust units used to provide lift during take-off and landing". Furthermore, it is specified in the proposed CM that for its purpose, only those VTOL-capable aircraft to which the SC-VTOL applies are considered.

comment	*9* comment by: *Eve Air Mobility* **<u>Definition table</u>** • RATIONALE / REASON / JUSTIFICATION for the Comment: Adding the definition of the concept of "hours of operation", flight time, and flight hours, which is used across the document. It is particularly important when defining the F&R flight test programme. • PROPOSED TEXT: Flight hours or Flight time: Refer to hours flown in the aircraft, counting from liftoff to touchdown Operation hours: Refer to hours in an Integration bench, counting from engine start to engine shut down.
response	Partially accepted – Furthermore, usually the flight hours should include times from rotors/propellers turning. This should be aligned with definitions used in helicopter operations. Respective changes will be introduced in the text.

Comment	*38* comment by: *Embraer S.A.* Embraer S.A. is pleased to offer the following comments on Proposed Certification Memorandum CM-21.A-B-003 Function and Reliability Flight Testing for VTOL-capable aircraft. Adding the definition of the concept of "hours of operation", flight time, and flight hours, which is used across the document. It is particularly important when defining the F&R flight test programme. Proposed: Flight hours or Flight time: Refer to hours flown in the aircraft, counting from liftoff to touchdown. Operation hours: Refer to hours in an Integration bench, counting from engine start to engine shut down.

Response	Partially accepted - see comment 9

2.2. Best practice and certification experience in Rotorcraft and Business Jets p. 4

comment	*13* comment by: *Eve Air Mobility* **Title** • RATIONALE / REASON / JUSTIFICATION for the Comment: Certification collected experience cover not only Jets but Business and Commercial aeroplanes. • PROPOSED TEXT: Best practice and certification experience in Rotorcraft, Business and Commercial Aeroplanes.
response	Partially accepted - Text is changed to refer more generically to "rotorcraft and aeroplanes".

comment	*14* comment by: *Eve Air Mobility* **Paragraph #3** • RATIONALE / REASON / JUSTIFICATION for the Comment: Change few words for better understanding and text hamonization across the document. • PROPOSED TEXT: In line with GM 21.A35(b)(2), and also GM 21.A.35(f)(1), at least half of the required F&R flight test hours are conducted on a single aircraft (the "main aircraft"), which is representative of the final type design configuration.....abnormal conditions.
response	Accepted - Text will be changed accordingly.

comment	*15* comment by: *Eve Air Mobility* **Paragraph #7** • RATIONALE / REASON / JUSTIFICATION for the Comment: Adding few words for better understanding of the meaning of 20% and 50% reduction factors. • PROPOSED TEXT: Reduction factors (from 20% for miscellaneous flights to 50% for intensive flights) are typically applied to the flying hours.....compliance with 21.A.35.
response	Partially accepted - The paragraph clarifies that "[…]to account for the differences in configuration and in operation[…]". The reduction factors thus refer to multiple facets, here called factors. The word "factor" will be removed as to clarify that there is no particular formula involved and detailed

comment	*26* comment by: *Eve Air Mobility* **Paragraph #1** • RATIONALE / REASON / JUSTIFICATION for the Comment: Same reason as above, with the addition to word "Flight", which is found in other parts of the CM. • PROPOSED TEXT: Over the years EASA has cumulated a wealth of experience in the F&R flight testing with rotorcraft, business and commercial aeroplanes, which deserves to be considered, along with observed best industry practice, in this certification memorandum.
response	Not accepted. The F&R activities, while being defined through the flight/operation hours, also encompass the experience gathered on the operability, maintainability, related information , etc.

comment	*31* comment by: *Eve Air Mobility* **Paragraph #4** • RATIONALE / REASON / JUSTIFICATION for the Comment: Adding consideration that in fact, manufacturers flight historically has also been taken into account. • PROPOSED TEXT: Flights for customer demonstration and pilot training are often combined with flights..... planned after entry into service. Manufacturers flights with this purpose are often used to comply with the requirements provisions, since such flights are representative of aircraft operation.
response	Noted - This is intrinsically addressed by the paragraph "Flying hours obtained with these other aircraft in flight activities not dedicated to the F&R Flight Testing, as for example certification and development, may be counted towards the required flight hours for compliance with 21.A.35. Not only the configuration of the aircraft is relevant, as already mentioned, but also the flights chosen, which should be close enough to the operational flights referred above."

comment	*39* comment by: *Embraer S.A.* Certification collected experience cover not only Jets but Business and Commercial aeroplanes. Proposed: Best practice and certification experience in Rotorcraft, ~~and~~ Business and Commercial Aeroplanes ~~Jets~~.
response	Partially accepted - see comment 13

comment	*40* comment by: *Embraer S.A.* Paragraph #1 Same reason as above, with the addition to word "Flight", which is found in other parts of the CM. Proposed: Over the years EASA has cumulated a wealth of experience in the F&R flight testing with rotorcraft, ~~and~~ business and commercial aeroplanes ~~jets~~, which deserves to be considered, along with observed best industry practice, in this certification memorandum.
response	Partially accepted - see comment 13 and 26

comment	*41* comment by: *Embraer S.A.* Paragraph #3 Change few words for better understanding and text hamonization across the document. Proposed: In line with GM 21.A35(b)(2), and also GM 21.A.35(f)(1), at least half of the required F&R flight test hours ~~flying hours~~ are conducted on a single ~~one~~ aircraft (the "main aircraft"), which is representative of the final type design configuration.....abnormal conditions.
response	Accepted - see comment 14

comment	*42* comment by: *Embraer S.A.* Paragraph #7 Adding few words for better understanding of the meaning of 20% and 50% reduction factors. Proposed: Reduction factors (from 20% for miscellaneous flights to 50% for intensive flights) are typically applied to the flying hours.....compliance with 21.A.35.
response	Partially accepted - see comment 15

comment	*52* comment by: *Federal Aviation Administration* FAA comment: The FAA and EASA have a different opinion on the use of development aircraft time for F&R credit. The FAA finds that aircraft and engine conformity are often not sufficiently representative of the type design for those aircraft and flights. EASA applies percentages to certification credit for less conforming aircraft, whereas the FAA has typically only allowed this for certification flights with fully conforming aircraft and engines.

	The FAA recommends considering only allowing F&R credit for certification flights with test aircraft and engines that fully conform to type design. If F&R credit is allowed, the FAA recommends ensuring a process that applies engineering judgment and documentation of configuration for non-conforming parts.
response	Noted - EASA performs dedicated reviews of the applicants' proposals for consideration of such flight hours, as described in the following text in the Certification Memorandum: "Other aircraft (prototypes, pre-production, or production aircraft) are also used in the F&R Flight Testing, when their engines and systems can be considered sufficiently representative of the type-certificate-standard. In these cases, differences from the type-certification standard are documented and justified by the applicant in the test programme and submitted to EASA for agreement." We expect this established approach will provide for F&R compliance also in the case of VTOL-capable aircraft.

3.1. F&R Testing for VTOL-capable aircraft p. 5

comment	*16* comment by: *Eve Air Mobility* **Paragraph #6** • RATIONALE / REASON / JUSTIFICATION for the Comment: Changing and adding few words for better understanding and text harmonization across the document. • PROPOSED TEXT: Second, the Opinion 03/2023 recommends...the duration of the F&R flight testing shall be at least 150 flight hours, or as.....enters service.
response	Noted. The text has been modified to replace the reference to Opinion 03/2023 with the Commission Delegated Regulation (EU) 2024/1108.

comment	*17* comment by: *Eve Air Mobility* **Paragraph #7** • RATIONALE / REASON / JUSTIFICATION for the Comment: Based on the text, it is suggested that some rationalization using the relationship between flight cycle and flight hours could be accepted since the electrical VCA cannot accumulate the prescribed flight hours in the same rate as in conventional fixed or rotary wing airplanes (non-electrical powered). • PROPOSED TEXT: With the present Certification Memorandum, EASA intends.....for VTOL-capable aircraft, the applicant is encouraged to develop a F&R flight test programme to comply with the 21.A.35(f) which is proportionated with type envisioned to be certified (enhanced or basic), while preserving the equivalent F&R operation hours.
response	Not accepted. The Certification Memorandum follows the minimum number of 150 flight hours defined in point 21.A.35(f)(1)(i) of Annex I to Commission Regulation (EU) No

748/2012 to ensure that the aircraft operation is safe before it enters into service.
While EASA acknowledges the currently expected shorter flight legs of VCA, an extension of that flight range capability can be expected in future.
Furthermore, the intention of these test activities is to reasonably ensure the adequate function and reliability. Industry is aiming at significant number of commercial flight operations per day, combined with significant production rates of their aircraft, which would lead to respective high number of flight hours in service. Both dimensions would lead to significant fleet hours. Furthermore, no exposure time approach applies to the F&R substantiation, and small helicopters are undergoing similar scrutiny, sharing similar challenges regarding a limited endurance. To reflect the above aspects, a reference to flight cycles or similar parameters is not intended at this stage.

comment

43 comment by: *Embraer S.A.*

Paragraph #6
Changing and adding a few words for better understanding and text harmonization across the document.

Proposed:
Second, the Opinion 03/2023 recommends...the duration of the F&R flight ~~the function and reliability~~ testing shall be at least 150 flight hours, or as.....enters service.

response

Accepted – Please see comment 16

comment

53 comment by: *Federal Aviation Administration*

FAA comment: EASA and the FAA are aligned on the position that eVTOL aircraft must complete F&R and are not eligible for the low speed, level 1/2 airplane exception. The FAA position is that these aircraft are not airplanes and the exception does not apply. Regardless of this semantic difference, these are new-technology aircraft and an exception is not appropriate.

response

Noted – EASA appreciates the alignment and harmonized interpretation.

3.2.1. Duration p. 6

comment

4 comment by: *DGAC FR (Mireille Chabroux)*

In paragraph 2, it is written that:

"In addition to the minimum 150 flight hours of function and reliability flight testing, if the aircraft incorporates new technologies and safety critical functions, "

A further definition of the terms *"new technologies and safety critical functions"* would be welcome.

response

Partially accepted – EASA will clarify in the text that the emphasis is on the combination of new technologies when they incorporate safety critical functions. As regards the definition of "new technology", its application will evolve over time and

	will require due diligence of the involved parties. A detailed definition that would be updated regularly might require inadequate effort from industry and the Agency as to keep it publicly up-to-date.
comment	*7* comment by: *Lilium eAircraft GmbH* Could EASA confirm that the additional 150 h of operations due to new engines and the additional 150 h of operation due to new technologies and safety critical functions can be accrued concurrently, if the used integration rig is providing both a representative engine configuration as well as a representative configuration with respect to new technologies and safety critical functions (such as e.g. an iron bird exhibiting a full energy, propulsion and flight control configuration)?
response	Accepted - The text will be amended to provide clarity on the overall hours to be accrued. An aircraft that incorporates both "new technologies with safety critical functions" and "new engines of a type not previously used in a type certificated aircraft" should be subject to 150 hours of operation or flight in addition to the minimum 150 flight hours of F&R testing.
comment	*8* comment by: *Lilium eAircraft GmbH* The EASA CM does not provide any guidance on whether a fraction of the testing described in para. 3.2.1 may be accomplished after TC, but before EIS. Is this subject to EASA agreement?
response	Not accepted - Point 21.A.20(d) in Annex I to Commission Regulation (EU) No 748/2012 specifies that the applicant's declaration of compliance can only be provided after all flight tests in accordance with 21.A.35 have been accomplished. As such, the F&R tests need to be completed before TC issuance.
comment	*10* comment by: *Vertical Aerospace* Vertical Aerospace Recomendation: Clarity on: if both point 1 and 2 apply (new engines + new technologies) does this require 450 hours of F&R testing? Alternative Proposal on Text: If both conditions 1 and 2 apply, a minimum of 300 flight hours for function and reliability testing are required. Integration benches can be used for 150 of these hours in agreement with EASA.
response	Partially accepted - The text will be modified to clarify that if any or both of these conditions apply (new technologies with safety critical functions and new engines of a type not previously used in a type certificated aircraft) the F&R flight testing needs to include the minimum 150 flight hours plus the additional 150 flight hours, totalling 300 flight hours. See comment 7
comment	*11* comment by: *Vertical Aerospace* Integration Bench Testing - What is the expected scope here? Does it included the same ESS as aircraft, which loads, environment need to be applied to the SUT?
response	Noted – Thank you for the comment. The kind and scope of integration test benches can vary as to address any relevant domains identified by the applicant and agreed

with the Agency to be demonstrated to comply with the function and reliability objectives. These would need to be established at project level.

comment

12 comment by: *Vertical Aerospace*

Given the current capability and capacity of Energy Storage available to eVTOL designs, VA thinks that 150 hrs is unrealistic and unachievable. This number needs to be seriously reduced and based around flight-numbers rather than flight-hours, or some other subset of reasonable measurement. Even 75 hrs (half of the proposed 150) is unrealistic. This issue must be addressed to make the requirement realistic and achievable.

response

Not accepted - See comment 17

comment

18 comment by: *Eve Air Mobility*

Paragraph #1

- RATIONALE / REASON / JUSTIFICATION for the Comment:

Changing and adding few words for better understanding and text harmonization across the document.

- PROPOSED TEXT:

The overall required duration of the F&R flight testing should be no less than 150 flight hours.

response

Partially accepted - The text has been modified to take this comment into consideration.

comment

28 comment by: *Volocopter*

Volocopter would like to question the 150 flight hours duration on the following grounds

1) We would like to understand the safety consideration while proposing 150 flight hours for VTOL capable aircraft. The 150 flight hours is generally ok for aircraft operating with longer duration flights. But, it imposes disproportionate burden on aircraft that fly much shorter durations like our Volocity aircraft.

2) As an example, for our Volocity aircraft with a maximum technical possible operational flight endurance of less than 30 Minutes, it puts undue burden to show the same number of flight hours as a new type of long-range CS-25 aircraft with typical economical mission time above 6h flight time per sector. Practically for the hypothetical CS-25 aircraft, the required 150fh F&R Testing (TC'ed engine used) can be accomplished in 25 flights/cyles @ 6fh which can be easily implemented. The same for a VTOL capable aircraft would mean 150fh resulting in 300 flights.

3) For novel aircraft like ours, such a prescriptive approach without taking into consideration the design and operational characteristics would also lead to higher resource constraints (both time and cost).

4) Due to the high number of cycles imposed by the 150 hours requirement, this would already lead to testing towards fatigue for some individual components.

Based on the above, we propose an alternate text as shown below (the changes marked in bold are the additions from our side)

The overall duration of the function and reliability flight testing should be no less than 150 flight hours **unless the applicant demonstrates that the same objective can be reached by a means that should be described, justified, and agreed with EASA***

The following conditions apply:

1. In addition to the minimum 150 flight hours of function and reliability flight testing, if the aircraft incorporates new engines never used on any other aircraft, they should be subject to further 150 hours of operation. Integration benches may be used to accrue these additional 150 hours of operation in agreement with EASA. If integration benches are used, the same benches and test specimen should be used throughout the tests.
2. In addition to the minimum 150 flight hours of function and reliability flight testing, if the aircraft incorporates new technologies and safety critical functions, they should be subject to further 150 hours of operation. Integration benches may be used to accrue these additional 150 hours of operation in agreement with EASA. If integration benches are used, the same benches and test specimen should be used throughout the tests.
3. The duration of the single flights should be representative of the intended operations of the aircraft, aligned with the aircraft concept of operations and the certification limitations and conditions.
4. The minimum number of energy refilling/consumption cycles of the Energy Storage System (ESS) to be accumulated during the function and reliability flight testing should be agreed with the Agency, if applicable.

***Note: For aircraft with endurance below 1 flight hour, an option is to use a proportional number of sectors as an alternative to flight hours.**

response | Not accepted - See comment 17

comment | *36* comment by: *AIRBUS HELICOPTERS*

With regard to the second sentence of the bullet #1 of the paragraph 3.2.1 on page 6 : --Quote-- "*Integration benches may be used to accrue these additional 150 hours of operation in agreement with EASA.*" --Unquote--

Airbus Helicopters suggestion of change :
It is suggested to delete this sentence.

Justification for change :
The use of test benches for the accruement of engine hours may not subject the engines to the same demanding operating conditions as in normal operation because environmental conditions (rain, dust) are different and because other parts of the aircraft structure which may act dynamically on the engine are missing. Therefore, it is proposed to delete the ability to accrue engine hours on a test bench.

response	Not accepted - The term "integration benches" does not limit to engine test benches but should consider the particular aspects for which relevant F&R substantiation would be established in agreement with the Agency. The use of integration benches is limited to the 150 additional hours of operation, and does not extend to the minimum 150 flight hours to be demonstrated in flights which are representative of the intended operations of the aircraft.

comment	*37* comment by: *AIRBUS HELICOPTERS* With regard to the bullet #4 of the paragraph 3.2.1 on page 6 : --Quote-- "*The minimum number of energy refilling/consumption cycles of the Energy Storage System (ESS) to be accumulated during the function and reliability flight testing should be agreed with the Agency, if applicable*" --Unquote-- **Airbus Helicopters suggestion of new text :** *"The minimum number of energy refilling/consumption cycles of the Energy Storage System (ESS) to be accumulated during the function and reliability flight testing should be representative of at least 150 flight hours of aircraft operation and should be agreed with the Agency, if applicable"* **Justification for change :** The minimum number of ESS charging cycles should match the 150 flight hour requirement.
response	Not accepted. While the principle of exposing all relevant systems to the agreed F&R tests, some designs may require replacements before reaching the 150 flight hours. Therefore, the conditions should be agreed with the Agency as to ensure appropriate representativeness.

comment	*44* comment by: *Embraer S.A.* Paragraph #1 Changing and adding a few words for better understanding and text harmonization across the document. Proposed: The overall required duration of the F&R ~~function and reliability~~ flight testing should be no less than 150 flight hours.
response	Accepted - See comment 14

3.2.2. Aircraft configuration and use p. 6

comment	*19* comment by: *Eve Air Mobility* **Item 1** • RATIONALE / REASON / JUSTIFICATION for the Comment: Changing and adding few words for better understanding and text harmonization across the document. Replacement of "overall flight time" by "required flight hours"

	was found necessary to keep coherence with proposed definition of flight hours/time. • PROPOSED TEXT: 1. At least 50 % of the required flight hours should be performed with a single aircraft (referred to as "main aircraft" in the following text), and its configuration.....agreed with EASA.
response	Partially accepted - Text has been changed accordingly

comment	*20* comment by: *Eve Air Mobility* **Item 3** • RATIONALE / REASON / JUSTIFICATION for the Comment: Same as previous item. • PROPOSED TEXT: 3. No more than 30% of the required flight hours may correspond to flights....on a case-by-case basis.
response	Accepted - see comment 19

comment	*21* comment by: *Eve Air Mobility* **Note** • RATIONALE / REASON / JUSTIFICATION for the Comment: Adding the wording, in consideration of a possible credit of endurance test operation hours for credit in F&R, provided it is demonstrated to have a degree of severity, higher than the operational F&R, and in agreement with EASA. • PROPOSED TEXT: Note: Total credit of Engine endurance testing for F&R operation hours is considered inadequate with respect to point 3. above, since it requires a specific flight test setup (always at the engine limits) that might not be achievable during F&R flight testing. However, partial credit, in test bench or aircraft ground test prepared for this purpose, can be taken into account for test bench operation hours, provided it is more severe than a typical aircraft operation, as agreed with EASA.
response	Partially accepted - The wording of the note will be revised to provide flexibility in particular cases while it is in general considered inadequate.

comment	*34* comment by: *AIRBUS HELICOPTERS* With regard to the first sentence of the bullet #3 of the paragraph 3.2.2 on page 7 : -- Quote -- "No more than 30% of the overall flight time may correspond to flights for development or used to demonstrate compliance with applicable SC-VTOL requirements and engine reliability and durability requirements." -- Unquote -- **Airbus Helicopters suggestion for new text :**

	"*3. No more than 30% of the overall flight time may correspond to flights for development or used to demonstrate compliance with applicable SC-VTOL requirements and engine reliability and durability requirements, unless it is demonstrated that these flights were carried out with a configuration close to the final type design*." **Justification for change :** To enhance consistency between bullet #3 and other bullets #1 and #2 of the paragraph 3.2.2 with regard to the recognition of any flight with a configuration close to the final type design.
response	Not accepted - As explained in point 2.2 of the proposed Certification Memorandum, reduction factors are applied to account not only for differences in configuration but also in operation.

comment	*45* comment by: *Embraer S.A.* Item 1 Changing and adding few words for better understanding and text harmonization across the document. Replacement of "overall flight time" by "required flight hours" was found necessary to keep coherence with proposed definition of flight hours/time. Proposed: 1. At least 50 % of the required flight hours ~~overall flight time~~ should be performed with a single ~~the same~~ aircraft (referred to as "main aircraft" in the following text), and its configuration.....agreed with EASA.
response	Partially accepted - see comment 19

comment	*46* comment by: *Embraer S.A.* Item 3 Changing and adding few words for better understanding and text harmonization across the document. Replacement of "overall flight time" by "required flight hours" was found necessary to keep coherence with proposed definition of flight hours/time. Proposed: 3. No more than 30% of the required flight hours ~~overall flight time~~ may correspond to flights....on a case-by-case basis.
response	Accepted - see comment 19

comment	*47* comment by: *Embraer S.A.* Note Adding the wording, in consideration of a possible credit of endurance test operation hours for credit in F&R, provided it is demonstrated to have a degree of severity, higher than the operational F&R, and in agreement with EASA. Proposed:

	Note: Total credit of Engine endurance testing for F&R operation hours is considered inadequate with respect to point 3. above, since it requires a specific flight test setup (always at the engine limits) that might not be achievable during F&R flight testing. However, partial credit, in test bench or aircraft ground test prepared for this purpose, can be taken into account for test bench operation hours, provided it is more severe than a typical aircraft operation, as agreed with EASA.
response	Partially accepted - see comment 21

3.2. Category Enhanced p. 6

comment	*54* comment by: *Federal Aviation Administration* FAA comment: EASA has differing requirements for enhanced and basic (section 3.2 and 3.3) category. It is not typical to define different requirements for different categories of aircraft. FAA 21.35 does not specify different time requirements for different categories of aircraft; however, different advisory circulars allow different interpretation of this time requirement. These aircraft will likely have a drive system endurance requirement, something not required of part 25 airplanes, so some reduction in F&R hours may be valid to achieve transport-equivalent safety targets.
response	Noted – Thank you for your comment.

3.2.3. Flight test programme p. 7

comment	*5* comment by: *DGAC FR (Mireille Chabroux)* It is written in 5: "*5. Information about the flight crew composition, which should include, where possible, an operator's own flying and maintenance crews.*". Could EASA clarify what the sentence " where possible, an operator's own flying and maintenance crews " means?
response	Noted. The point is reflecting current guidance to Part 21, suggesting that the participation of operator’s crews in the F&R testing should be reflected in the F&R test programme. It is not expected to have the aircraft operated independently by an operator and its maintenance crews. The text will be amended to provide more clarity.

3.3.1. Duration p. 7

comment

22 comment by: *Eve Air Mobility*

Paragraph #1

- RATIONALE / REASON / JUSTIFICATION for the Comment:

Changing and adding few words for better understanding and text harmonization across the document.

- PROPOSED TEXT:

The overall required duration of the F&R flight testing should be no less than 150 flight hours.
The following conditions apply:

response

Partially accepted - See comment 18.

comment

48 comment by: *Embraer S.A.*

Paragraph #1

Changing and adding few words for better understanding and text harmonization across the document.

Proposed:

The overall required duration of the F&R ~~function and reliability~~ flight testing should be no less than 150 flight hours.
The following conditions apply:

response

Partially accepted - see comment 18

3.3.2. Aircraft configuration and use p. 7

comment

23 comment by: *Eve Air Mobility*

Item 1

- RATIONALE / REASON / JUSTIFICATION for the Comment:

Changing and adding few words for better understanding and text harmonization across the document. Replacement of "overall flight time" by "required flight hours" was found necessary to keep coherence with proposed definition of flight hours/time.

- PROPOSED TEXT:

1. At least 50% of the required flight hours should be performed with a single aircraft (referred to as "main aircraft" in the following text) and its configuration should be close to the final type design.

response	Accepted - The text has been amended accordingly.

comment	*24* comment by: *Eve Air Mobility* **Item 3** • RATIONALE / REASON / JUSTIFICATION for the Comment: Same as previous item. • PROPOSED TEXT: 3. No more than 50% of the required flight hours may correspond to flights.....reliability and durability requirements.
response	Accepted - The text has been modified accordingly.

comment	*25* comment by: *Eve Air Mobility* **Note** • RATIONALE / REASON / JUSTIFICATION for the Comment: Adding the wording, in consideration of a possible credit of endurance test operation hours for credit in F&R, provided it is demonstrated to have a degree of severity, higher than the operational F&R, and in agreement with EASA. • PROPOSED TEXT: Note: Total credit of Engine endurance testing for F&R operation hours is considered inadequate with respect to point 3. above, since it requires a specific flight test setup (always at the engine limits) that might not be achievable during F&R flight testing. However, partial credit, in test bench or aircraft ground test prepared for this purpose, can be taken into account for test bench operation hours, provided it is more severe than a typical aircraft operation, as agreed with EASA.
response	Partially accepted - see comment 21

comment	*35* comment by: *AIRBUS HELICOPTERS* With regard to the bullet #3 of the paragraph 3.3.2 on page 7 : -- Quote -- "*No more than 50% of the overall flight time may correspond to flights for development or used to demonstrate compliance with applicable SC-VTOL requirements and engine reliability and durability requirements.*" -- Unquote -- **Airbus Helicopters suggestion for new text :** "*3. No more than 50% of the overall flight time may correspond to flights for development or used to demonstrate compliance with applicable SC-VTOL requirements and engine reliability and durability requirements, unless it is demonstrated that these flights were carried out with a configuration close to the final type design*." **Justification for change :** To enhance consistency between bullet #3 and other bullets #1 and #2 of the paragraph 3.3.2 with regard to the recognition of any flight with a configuration close to the final type design.

response	Not accepted - See response to comment 34.

comment	*49* comment by: *Embraer S.A.* Item 1 Changing and adding few words for better understanding and text harmonization across the document. Replacement of "overall flight time" by "required flight hours" was found necessary to keep coherence with proposed definition of flight hours/time. Proposed: 1. At least 50% of the required flight hours ~~the overall flight time~~ should be performed with a single ~~the same~~ aircraft (referred to as "main aircraft" in the following text) and its configuration should be close to the final type design.
response	Partially accepted - see comment 19

comment	*50* comment by: *Embraer S.A.* Item 3 Changing and adding few words for better understanding and text harmonization across the document. Replacement of "overall flight time" by "required flight hours" was found necessary to keep coherence with proposed definition of flight hours/time. Proposed: 3. No more than 50% of the required flight hours ~~overall flight time~~ may correspond to flights.....reliability and durability requirements.
response	Accepted - see comment 19

comment	*51* comment by: *Embraer S.A.* Note Adding the wording, in consideration of a possible credit of endurance test operation hours for credit in F&R, provided it is demonstrated to have a degree of severity, higher than the operational F&R, and in agreement with EASA. Proposed: Note: Total credit of engine endurance testing for F&R operation hours is considered inadequate with respect to point 3. above, since it requires a specific flight test setup (always at the engine limits) that might not be achievable during F&R flight testing. However, partial credit, in test bench or aircraft ground test prepared for this purpose, can be taken into account for test bench operation hours, provided it is more severe than a typical aircraft operation, as agreed with EASA.
response	Partially accepted - See comment 21

comment	*56* comment by: *Federal Aviation Administration* FAA comment: FAA recommends specifying the operating conditions to be tested.

response | Noted. As regards specifying the operating conditions, EASA intends to follow existing Guidance Material to 21.A.35 to receive a representative test programme from the applicant in line with paragraph 3.2.3 of the Certification Memorandum.

3.3. Category Basic p. 7

comment | *55* comment by: *Federal Aviation Administration*

FAA comment:

EASA has differing requirements for enhanced and basic (section 3.2 and 3.3) category. It is not typical to define different requirements for different categories of aircraft.

FAA 21.35 does not specify different time requirements for different categories of aircraft; however, different advisory circulars allow different interpretation of this time requirement.

These aircraft will likely have a drive system endurance requirement, something not required of part 25 airplanes, so some reduction in F&R hours may be valid to achieve transport-equivalent safety targets.

response | Noted. Thank you for your comment.

3.3.3. Flight Test Programme p. 8

comment | *2* comment by: *TCSP*

To my mind, this certification memorandum does not reflect the variety of vertiports especially of their individual wind and space situations adequately.
Vertiports are intended to be built inside major cities, close to other main hubs of transportation such as train or subway stations or congress centers.
Over the last decades in many major cities so called wind channels had been created by the architecture of skyscrapers, the layout of skylines and streets itself. In summary, inside cities you have a very difficult and mostly instable wind situations and at the same time there is no place to correct the effect of unstable wind to the VTOL. There is a high risk of crashing into buildings.
This situation is novel compared to normal aircraft and rotorcraft, which land on an airport which are mostly located outside inner city centres. Heliports inside the cities are not comparable to future vertiports since hospitals are designed to address the needs of a heliport and are built on huge areasl. So either they are on the top of a high building or on a huge yard to avoid instable wind conditions. And even there difficulties are reported from time to time. Now with VTOL the idea is to bring people to high density populated areas and there you definitely have instable wind conditions. Of course, someone could argue that this is the same if in case of an emergency when an ambulance helicopter needs to land inside the city. But in those case the police is blocking the traffic and is creating a larger free area to avoid accidents caused by mishaps during the landing. But this is not the case with the intended way of operation for VTOLs.
So vertiports inside the city centres will be located in areas which are narrow and have somtimes extremely instable wind conditions which might affect safe landing.

	These difficult wind and space situations inside inner cities are, to my mind, not adequately addressed in 3.3.3 item 3 and not really well defined by the term "a range of representative ambient operating conditions".
response	Not accepted - The F&R activities are not replacing the specific compliance demonstrations for relevant environmental conditions like demonstrated cross winds, controllability, vertiport dimensions, emergency situations like critical failures for performance etc. For details about the required compliance demonstrations, please refer to Special Condition VTOL and its related means of compliance.

comment	*32* comment by: *Eve Air Mobility* **Item 3** • RATIONALE / REASON / JUSTIFICATION for the Comment: Adding information to give opportunity to the applicant to prepare foreseen operational scenarios in an appropriate manner to set conditions that could replicate such scenarios, without the need to move to different environment. • PROPOSED TEXT: 3. a range of representative ambient operating conditions and vertiports, in a real or simulated scenarios.
response	Not accepted - As per sections 3.2.3. and 3.3.3.the applicant should make a proposal of a range of representative ambient operating conditions and vertiports in the flight test programme. Their representativeness should be justified by the applicant and agreed with EASA.

comment	By email comment by: *Inline Policy* I have a question on EASA's Proposed Certification Memorandum CM-21.A-B-003, does this apply to drones as well?
response	Noted – The Certification Memorandum is not directly applicable. EASA is developing dedicated guidance for Unmanned Aircraft Systems, addressing the different risk classes undergoing type certification. However, commonalities exist and would be adequately considered in case of overlapping needs.