European Union Aviation Safety Agency

Notice of Proposed Amendment 2024-06(B)

in accordance with Article 6 of MB Decision 01-2022

Proposed AMC and GM
to the initial airworthiness requirements
for UAS subject to certification

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Proposed amendments

The amendments are arranged to show deleted, new and unchanged text as follows:

— deleted text is ~~struck through~~;

— new text is highlighted in blue;

— an ellipsis '[…]' indicates that the rest of the text is unchanged.

Where necessary, the rationale is provided in *italics.*

GM 21.A.35(b)(2) Flight Tests

OBJECTIVE AND CONTENT OF THE FUNCTION AND RELIABILITY (F&R) FLIGHT TESTING

1. OBJECTIVE

The objective of ~~this~~ the F&R flight testing is to expose the aircraft to a~~the~~ variety of uses, including training and operational suitability flights, if applicable, which are representative of the operations~~,~~ that are likely to be conducted ~~occur~~ when the aircraft, the UAS or the CMU is in routine service. This testing should provide ~~an~~ the assurance that the aircraft, the UAS or the CMU ~~it~~ performs its intended functions to the standard required for certification, and should continue to do so in service.

[…]

GM1 21.A.35(f)(~~2~~1)(i) Flight Tests

FLYING TIME FOR THE FUNCTION AND RELIABILITY (F&R) FLIGHT TESTING

For aeroplanes and helicopters, ~~A~~all flying carried out on an aircraft that is not significantly different from the final type design may count towards the 150-hour~~s~~ airframe flight time required by point 21.A.35(f)(~~2~~1)(i).

For aircraft with novel design features not widely used in industry at the time of application for the issue of a type certificate, additional flight hours and/or specific tests with integration benches may be required to confirm the adequate function and reliability of the aircraft. Such features may include among others, for example, novel propulsion systems, and fly-by-wire control incorporating new technologies or combined lift-thrust-control functions. The overall duration of the F&R flight testing required should, however, not exceed 300 hours.

GM2 21.A.35(f)(1)(i) Flight Tests

DETERMINATION OF THE REQUIRED AMOUNT OF FUNCTION AND RELIABILITY (F&R) FLIGHT TESTING HOURS AND OPERATION HOURS FOR VTOL-CAPABLE AIRCRAFT

(a) VTOL-CAPABLE AIRCRAFT CERTIFIED IN THE CATEGORY 'ENHANCED'

(1) Duration

The overall duration of the F&R flight testing should not be less than 150 flight hours. The following conditions apply:

(i) If the VTOL-capable aircraft incorporates any of the following, it should be subject to a further 150 hours of operation in addition to the minimum 150 flight hours of F&R flight testing:

(A) new technologies with safety-critical functions; and/or

(B) new engines of a type not previously used in type-certified aircraft.

(ii) Integration benches may be used to accrue these additional 150 hours of operation of point 1 following agreement with EASA. If integration benches are used, the same benches and test specimens should be used throughout the tests.

(iii) The duration of single flights should be representative of the intended operations of the aircraft, aligned with the aircraft's concept of operations and the applicable certification limitations and conditions.

(iv) The minimum number of energy refilling/consumption cycles of the energy storage system (ESS) to be accumulated during F&R flight testing should be agreed with EASA, if applicable.

(2) Aircraft configuration and use

The use of aircraft and their configuration for F&R flight testing should meet all the following conditions:

(i) At least 50 % of the required flight hours should be performed with the same aircraft (referred to as 'main aircraft' in the following text), and its configuration should be close to the final type design. Acceptable deviations from the final type design configuration should be described, justified, and agreed with EASA.

(ii) Other aircraft may be used for the remaining portion of the F&R testing if their configuration is close to the final type design. Acceptable deviations from the final type design configuration should be described, justified, and agreed with EASA.

(iii) If ESSs are swapped during normal operation, the number of different sets of ESSs for a particular testing and the initial state of health (SoH) or degradation condition, as and if applicable, for each ESS set should be agreed with EASA. The main aircraft should be operated with ESSs that are replaced only as per the proposed ICAs. If the ESSs are replaced before reaching their end of life, the replacement ESS should present similar ageing or degradation.

(iv) Not more than 30 % of the required flight hours may correspond to flights for development or flights used to demonstrate compliance with the applicable requirements of the certification basis and engine reliability and durability requirements. These flights should be agreed with EASA on a case-by-case basis.

Note: Engine endurance testing is typically carried out on a specific engine test bed, thus not fully representative of the aircraft integration and operation use. Therefore, it is usually considered inadequate with respect to point (iv) above.

(3) F&R flight test programme

The F&R flight test programme should include:

(i) a continuous operation schedule for the main aircraft described in point (a)(2)(i), as though it were in service, which is aligned with the aircraft's concept of operations and the applicable certification limitations and conditions;

(ii) both routine operations and simulation of selected abnormal operating conditions;

(iii) a range of representative ambient operating conditions and vertiports;

(iv) the proposed ICAs' line maintenance activities, and any maintenance tasks delegated to the pilot;

(v) information about the flight crew composition, which should include, where possible, the participation of an operator's own flying and maintenance crews.

(b) VTOL-CAPABLE AIRCRFAT CERTIFIED IN THE CATEGORY 'BASIC'

(1) Duration

The overall duration of the F&R flight testing should not be shorter than 150 flight hours, with the following conditions:

(i) Reserved.

(ii) Reserved.

(iii) The duration of the single flights should be representative of the intended operations of the aircraft, aligned with the aircraft's concept of operations and the applicable certification limitations and conditions.

(iv) The minimum number of energy refilling/consumption cycles of the energy storage system (ESS) to be accumulated during the F&R flight testing should be agreed with EASA, if applicable.

(2) Aircraft configuration and use

The use of aircraft and their configuration for F&R flight testing should meet the following conditions:

(i) At least 50 % of the required flight hours should be performed with the same aircraft (referred to as 'main aircraft' in the following text) and its configuration

should be close to the final type design. Acceptable deviations from the final type design configuration should be described, justified, and agreed with EASA.

(ii) Other aircraft may be used for the remaining portion of the F&R flight testing if their configuration is close to the final type design. Acceptable deviations from the final type design configuration should be described, justified, and agreed with EASA.

(iii) Not more than 50 % of the required flight hours may correspond to flights for development or used to demonstrate compliance with applicable SC-VTOL requirements and engine reliability and durability requirements.

Note: Engine endurance testing is typically carried out on specific engine test bed, thus not fully representative of the aircraft integration and operation usage. Therefore, it is usually considered inadequate with respect to point (iii) above.

(3) F&R flight test programme

The F&R flight test programme should include:

(i) a continuous operation schedule for the main aircraft as described in point (b)(2)(i), as though it were in service, which is aligned with the aircraft's concept of operations and the applicable certification limitations and conditions;

(ii) both routine operations and simulation of selected abnormal conditions, according to their probability estimated in certification;

(iii) a range of representative ambient operating conditions and vertiports;

(iv) the proposed ICAs' first line maintenance activities, and any maintenance tasks delegated to the pilot;

(v) information about the flight crew composition, which should include, where possible, operator's own flying and maintenance crews.

(c) F&R Test Report

The F&R test report should provide, as a minimum, an accurate and comprehensive record of:

(1) the actual duration of the F&R test campaign, following point (a)(1) or (b)(1) as per the applicable aircraft category;

(2) the actual aircraft used and their configuration, following point (a)(2) or (b)(2) as per the applicable aircraft category, including:

(i) the justification for any differences in configuration from the type-certification standard;

(ii) if different sets of ESSs were used: their number, their initial and final SoH or degradation condition, as and if applicable;

(iii) the line maintenance activities performed on each aircraft during the test campaign, including the date and the associated flight, as well as any additional maintenance activity;

(3) the corresponding flight test programme, by reference, prepared following point (a)(3) or (b)(3) as per the applicable aircraft category;

(4) a log of the individual flights performed, identifying:

(i) the date and time;

(ii) the aircraft used;

(iii) the ESS present when different sets are used in the F&R testing, including the initial and final state of charge (SoC) or energy content and SoH;

(iv) the flight crew;

(v) the flight time;

(vi) the purpose of the flight (e.g. compliance with certification requirement VTOL.XXXX);

(vii) any relevant maintenance activities performed before or after the flight, as per the prepared ICAs, as well as any additional maintenance;

(viii) any other actions performed on the aircraft;

(ix) any malfunction, anomaly, or any other discrepancy from the expected behaviour of the aircraft and its systems and components;

(x) other data which could be of technical interest (e.g. mass and CG);

(5) if integration benches are used in accordance with point (a)(1)(ii):

(i) the detailed description of the bench configuration;

(ii) the individual bench operation(s), including the dates and times of start and stop;

(iii) the maintenance activities performed as per the prepared ICAs as well as any additional maintenance carried out during the test campaign;

(iv) any other actions performed on the bench;

(v) any malfunction, anomaly, or any other discrepancy from the expected behaviour during the bench operation.

Finally, the F&R test report should analyse the above records and assess the need to introduce modifications to the design or procedures (AFM, ICAs).

GM 21.A.35(f)(1)(ii) Flight Tests

FLYING TIME FOR THE FUNCTION AND RELIABILITY (F&R) TESTING

All flying carried out with engines and associated systems not significantly different from the final type-certificate standard may count towards the 300-hour~~s~~ airframe flight time required by point 21.A.35(f)(1)(ii).

[…]

GM1 21.A.35(f)(2) Flight Tests

DETERMINATION OF REQUIRED AMOUNT OF FUNCTION AND RELIABILITY (F&R) FLIGHT TESTING HOURS FOR UAS AND CMUs

(a) GENERAL

The following guidance may evolve with further experience gathered in type certification of UAS and CMUs.

EASA will specify the necessary amount of flight hours, integration bench tests or other relevant methods to determine the appropriate function and reliability of the type design, including its CMU as applicable, considering the respective concept of operations.

Specific consideration should be given to the UAS configuration and any existing data providing substantiation of its function and reliability. If the design includes systems already in use in other type-certified aircraft of a similar concept of operations and certification standard, the respective reduction of the flight hours identified hereafter could be considered.

The use of integration test benches that appropriately reflect the intention of an operationally representative exposure of a UA and CMU may be agreed with EASA to complement the flight hours by hours of operation, in particular when the flight endurance is either very limited (e.g. shorter than 1 hour) or extremely long (e.g. several days).

(b) TYPE CERTIFICATION OF A CMU

It is possible to type-certify a CMU separately from a UA. The appropriate function and reliability need to be demonstrated also for the CMU. Aspects like the qualification with a particular UA, the operation of one UA per CMU or several UA per one CMU, handover of a UA between different CMU, etc., should be considered when determining the required flight hours to confirm the CMU's function and reliability.

A CMU might require portions of the F&R flight testing to employ specific technologies or a combination of technologies to appropriately simulate and record the operational environment while demonstrating its function and reliability. This might, for example, encompass simulation of the UA, simulation of the C2 link, simulation of air traffic, etc., if adequate. However, the amount of the actual F&R flight test hours with a UA would need to be specified by EASA.

If a single CMU is utilised to control several UA, the minimum amount of actual flight hours with relevant UA dedicated to demonstrating this capability should be agreed with EASA.

Portions of the F&R demonstration may be conducted on integration benches or by simulation, as agreed with EASA.

(c) UAS OPERATED IN THE 'CERTIFIED' CATEGORY

For UAS that require a type certificate for the 'certified' category of operations, the following approach, derived from aircraft certified with pilot on board, should be applied:

(1) Duration

The overall duration of the F&R flight testing should not be shorter than 150 flight hours. The following conditions apply:

(i) If the UAS incorporates any of the following, it should be subject to a further 150 hours of operation in addition to the minimum 150 flight hours of F&R flight testing:

(A) new technologies with safety-critical functions; and/or

(B) new engines of a type not previously used in a type-certified aircraft.

(ii) 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 specimens should be used throughout the tests.

(iii) The duration and distance of the single flights should be representative of the intended operations of the UAS, aligned with the UAS concept of operations and the applicable certification limitations and conditions.

(iv) The minimum number of energy refilling/consumption cycles of the energy storage system (ESS) to be accumulated during the F&R flight testing should be agreed with EASA, if applicable.

(2) UAS configuration and use

The use of UAS and their configuration for the F&R flight testing should meet the following conditions:

(i) At least 50 % of the overall flight time should be performed with the same UAS (referred to as 'main UAS' in the following text), and its configuration should be close to the final type design. Acceptable deviations from the final type design configuration should be described, justified, and agreed with EASA.

(ii) Other UAS may be used for the remaining portion of the F&R testing if their configuration is close to the final type design. Acceptable deviations from the final type design configuration should be described, justified, and agreed with EASA.

(iii) If ESSs are swapped during normal operation, the number of different sets of ESSs for this testing and the initial state of health (SoH) or degradation condition, as and if applicable, for each set should be agreed with EASA. The main UAS should be operated with ESSs that are replaced only as per the proposed ICAs. If the ESSs are

replaced before reaching their end of life, the replacement ESS should present a similar ageing or degradation.

(iv) Not more than 30 % of the overall flight time may correspond to flights for development or used to demonstrate compliance with applicable requirements of the certification basis and engine reliability and durability requirements. These flights should be agreed with EASA on a case-by-case basis.

Note: Engine endurance testing is considered inadequate with respect to point (iv) above, since it requires a specific flight test set-up (always at the engine limits) that might not be achievable during F&R flight testing.

(3) F&R flight test programme

The F&R flight test programme should include:

(i) a continuous operation schedule for the main UAS described in point (c)(2)(i), as though it were in service, which is aligned with the UAS concept of operations and the applicable certification limitations and conditions;

(ii) both routine operations and simulation of selected abnormal operating conditions;

(iii) a range of representative ambient operating conditions and airports, heliports, vertiports, airfields or operating sites, as applicable;

(iv) the proposed ICAs' line maintenance activities, and any maintenance tasks delegated to the UAS crew;

(v) information about the UAS crew composition, which should include, where possible, operator's own flying and maintenance crews.

(d) UAS OPERATED IN THE 'SPECIFIC' CATEGORY REQUIRING A TYPE CERTIFICATE (AS PER ARTICLE 40 OF REGULATION (EU) No 945/2019)

For UAS operated in the 'specific' category requiring a type certificate, the guidance provided in Section **ERROR! REFERENCE SOURCE NOT FOUND.**' should be used as far as applicable.

A shorter duration of the F&R flight testing may be agreed with EASA considering the complexity of the design of the UAS and the risk of the operation.

Note: A minimum amount of 50 hours for specific assurance and integrity level (SAIL)[1] V, 100 hours for SAIL VI.

AMC1 21.A.308(a);(b) Eligibility of a component for installation in a CMU

IDENTIFICATION OF CMU COMPONENTS THAT ARE CRITICAL, AND MEANING OF 'CRITICAL'

[1] As defined in the AMC to Article 11 of Commission Implementing Regulation (EU) 2019/947.

CMU components that are identified as critical in accordance with point 21.A.308(a) should be listed in the ICAs.

For the purpose of point 21.A.308(a) and (b), when it is mentioned that a CMU component 'is critical for the intended UAS operation', it means that:

(a) any failure, malfunction or defect of that CMU component may result in a hazardous or catastrophic failure condition; or

(b) the compromised protection from intentional unauthorised electronic interaction (IUEI) due to a non-conformity of that CMU component may result in a threat condition that has a potentially hazardous or catastrophic safety effect on the intended UAS operation.

When assessing the safety effect or threat condition of a CMU component identified in point 21.A.308(a) and (b), the design approval holder (DAH) may assume that the installer will conduct any specific verification activities on the component or release documentation, as identified in the ICAs, before installing it in the CMU.

GM1 21.A.308(a);(b) Eligibility of a component for installation in a CMU

Examples:

(a) A CMU uses a screen to display alerts to the flight crew. The malfunction of not alerting the crew with the correct colour scheme may result in a hazardous or catastrophic failure condition. To mitigate this risk, the design data may include detailed configuration settings and the ICAs may contain instructions and specific verification activities with regard to the component. When assessing the safety effect of the screen in accordance with point 21.A.308(a) and (b), the DAH may assume that the installer will conduct those specific verification activities on the screen, as identified in the ICAs, before installing it in the CMU and may determine that the component is not critical.

(b) A CMU design includes a COTS component that connects two or more networks (e.g. a network router connecting the CMU with different C2 links) that may result in a threat condition with a hazardous safety effect. To mitigate this threat condition, the CMU design data may include the deactivation or specific configuration of certain connectivity functions of that COTS component to ensure protection against IUEI. When the installer of that component is able to verify that the COTS device complies with the design data (e.g. deactivation or specific configuration) in accordance with the DAH's ICAs and does not compromise protection against IUEI, the DAH may determine that the component is not critical.

GM2 21.A.308(b) CMU component that is part of a higher-level assembly

An EASA Form 1 is not required for a CMU component when that component is an element of a higher-level assembly for which an EASA Form 1 is not required.