COMMENT RESPONSE DOCUMENT

EASA SC-RPAS.FCS-01
[Published on the 30-06-2016 and officially closed for comments on the 21-07-2016]

Commenter 1 : EUROUSC (Mr. Filippo Tomasello) – date 10-06-2016

Comment # 1

Paragraph No: All

Comment:
Unless I was wrong, I have found in it no mention of the software assurance level.

Justification:
One could think that AMC 20-115C would apply
https://www.easa.europa.eu/system/files/dfu/Annexes%20I%20to%20VI%20to%20ED%20Decision%202013-026-R.pdf
or SC-RPAS.1309 https://www.easa.europa.eu/system/files/dfu/SC-RPAS.1309-01_Iss02.pdf
I am not sure that either document will lead to same result for DAL, but I may be wrong.
Since in Flight Controls for drones most probably software is present, it would be appreciated if the Agency could add some guidance text to allow readers to better understand what to do, at least in terms of related applicable documents

Proposed Text (if applicable): N/A

EASA response: Noted.
The comment pertains to documents that are applicable to all systems. The special condition RPAS Flight Control Systems containing proposed Requirements and associated AMCs are specific to the flight control system and should not be considered in isolation of the other Requirements applicable to the RPAS. The Certification basis to be applied on any project will include in particular the SC-RPAS.1309. The SC-RPAS.1309 references the AMC 20-115 as guidance but also the following industry documents that are used as acceptable guidance to defined the minimum acceptable level of Software DAL:
– ED-12C / DO-178C, Software considerations in airborne systems and equipment certification
– ED-79A / ARP4754A, Guidelines for development of civil aircraft and systems
– ED-135 / ARP4761, Guidelines and methods for conducting the safety assessment process on civil airborne systems and equipment.
– ED-80 / DO-254, Design assurance guidance for airborne electronic hardware

Commenter 2 : Eurocontrol (Mr. Dominique Colin) – date 06-10-2016

Comment # 1

Paragraph No: All

Comment: EASA should not deviate from the ICAO terminology, hence using GCS should be removed from the document and replaced by RPS (Remote Pilot Station), which is its official name. In the same spirit, the Manual on RPAS from ICAO (Doc 10019) should be in the reference list.

Justification: N/A

Proposed Text (if applicable): N/A

EASA response:

Noted
As far as possible, the terminology used in special conditions are derived from existing standard.
For the draft Flight control Special Conditions published for public consultation, terminology is derived from RPAS standards (CS-LUAS draft, CS-LURS, STANAGs) in particular STANAG 4617 edition 1. This was done because one of the main input for the special condition is the STANAG 4617. To avoid any confusion, definitions have been included in the book 2 of the special conditions.

Commenter 3 : Airbus DS (Mr Maurice Labonde – date 20-07-2016)

Comment # 1

Paragraph No: SC-RPAS.FC.1328 (a)(2)(i)

Comment: Original Text *(2) Limit values of protected flight parameters must be compatible with:*
(i) RPA structural limits,
A speed margin to cope with a head-on gust should be demonstrated

Justification: N/A

Proposed Text (if applicable): (i) RPA structural limits **for VC + 20,…,35 KCAS** should be demonstrated

EASA response:

Noted.

Margins are dependent on a given design and of the level of uncertainties associated with a given applicant demonstration:
Rather than changing the current wording to add a specific numerical value for the margin EASA will ensure on a case by case basis that appropriate margin are taken when demonstrating compliance to 1328(a)(2)(i) so that it can be shown that the envelope protection is compatible with RPA structural limits in for any operating conditions for which certification is requested (included but not limited to gust).

Commenter 3 : Airbus DS (Mr Maurice Labonde – date 20-07-2016)

Comment # 2

Paragraph No: SC-RPAS.FC.1329 (e)

Comment: Original text: "The system must be designed so that any adjustment, within the range of adjustment available to the flight crew, cannot produce hazardous loads on the RPA or create hazardous deviations in the ***flight path*** under any flight condition appropriate to its use, either during normal operation or in the event of a malfunction, assuming that corrective actions begins within a reasonable period of time."
In Semi-automatic and Manual modes there could not be a predefined flight path so the expression "intended flight path" would be better to cover all circumstances (Automatic, Semi-automatic and Manual modes)

Justification: N/A

Proposed Text (if applicable): "The system must be designed so that any adjustment, within the range of adjustment available to the flight crew, cannot produce hazardous loads on the RPA or create hazardous deviations in the ***intended flight path*** under any flight condition appropriate to its use, either during normal operation or in the event of a malfunction, assuming that corrective actions begins within a reasonable period of time."

EASA response:
Not accepted.
Current wording "Flight path" is derived from CS-LURS.
CS25.1329(g) is using the same wording. To be consistent with other certification specification, EASA intents to keep wording as it is

Commenter 3 : Airbus DS (Mr Maurice Labonde – date 20-07-2016)

Comment # 3

Paragraph No: SC-RPAS.FC.1329 (i)

Comment:
Original text: *"Use of active flight controls for load alleviation, stability augmentation, and/or flutter suppression must comply with the control system stability requirements. (See AMC associated to SC-RPAS.FC1329.i)"*
Flutter suppression systems can produce "Limit Cycle Oscillations" (LCOs), reducing the "High Cycle Fatigue" (HCF) Performance such, that the certified No. of flight cycles cannot be kept.

Justification: N/A

Proposed Text (if applicable): Use of active flight controls for load alleviation, stability augmentation, and/or flutter **and HCF Performance** suppression must comply with the control system stability requirements. (See AMC associated to SC-RPAS.FC1329.i)

EASA response:

Not Agreed

SC-RPAS.FC must be used in conjunction with CS-VLA and this airworthiness code includes CS-VLA.629, which requires to show that the airplane is free from flutter, control reversal and divergence. It must be ensured that the airplane is designed with adequate damping tolerance when approaching diving speed. Thus, in complying with this requirement an adequate damping will preclude any limit cycle oscillations and therefore its side effects as well.

Commenter 3 : Airbus DS (Mr Maurice Labonde – date 20-07-2016)

Comment # 4

Paragraph No: SC-RPAS.FC.FW 677 Trim systems

Comment: A/C fatigue life has to be protected against "Limit Cycle Oscillations" related to control surface free-play. The application of sufficient aerodynamic loading would help to avoid LCOs resp. HCF damages.

Justification: N/A

Proposed Text (if applicable):
New wording: Trimming has to be managed such, that static loading is suppressing free-play related LCOs- so far possible- to keep the HCF Perf.

EASA response:
Not Agreed

SC-RPAS.FC must be used in conjunction with CS-VLA and this airworthiness code includes CS-VLA.629, which requires to show that the airplane is free from flutter, control reversal and divergence. It must be ensured that the airplane is designed with adequate damping tolerance when approaching diving speed. Thus, in complying with this requirement an adequate damping will preclude any limit cycle oscillations and therefore its side effects as well. Certainly free-play can lead to instabilities; however, EASA considers that CS-VLA.629(e) already addresses this risk (quote): “For longitudinal, lateral and directional controls, freedom from flutter, control reversal, and divergence up to VD must be shown after the failure, malfunction, or disconnection of any single element in any tab control system.” Additionally, CS-VLA.1529 requires a Maintenance Manual where (i) tolerances and adjustments necessary for proper functioning of the airplane and (ii) methods of balancing control surfaces, and maximum permissible values of play at hingepins and control circuit backlash must be addressed.

Commenter 3 : Airbus DS (Mr Maurice Labonde – date 20-07-2016)

Comment # 5

Paragraph No: SC-RPAS.FC.FW 745 Nose/Tail-wheel steering

Comment: Safe ground operation is depending also on the dynamic stability of the system. Coupling mechanisms among steering, braking, gear- A/C modes has to be avoided.

Justification: N/A

Proposed Text (if applicable):
New wording: Nose/Tail-wheel steering. A coupling mechanism among steering, braking, gear- A/C modes has to be avoided.

EASA response:
Partially agreed.

Although it is a desirable objective to avoid coupling during fixed wing aircraft operation on ground between aircraft mode and mechanical systems, it may not be possible to avoid such coupling with all type of RPAS. Coupling shall be avoided if it results in adverse effects including inadequate directional control. The current set of RPAS special conditions is deemed complete with regards to this issue. No further change is anticipated at this stage.

Commenter 3 : Airbus DS (Mr Maurice Labonde – date 20-07-2016)

Comment # 6

Paragraph No: None

Comment:
The professional handling of failure cases is requesting to elaborate a Failure Mode Manual. The systematical analysis of all system failures recruited from hydraulics, mechanics, electric / electronics, sensors losses and computer errors have to be addressed including their probabilities of occurrence. All FM analyses should be done vs these listings from all disciplines.

Justification: N/A

Proposed Text (if applicable): None

EASA response:

Noted.

The comment pertains to principles that are applicable to all systems. The special condition RPAS Flight Control Systems containing proposed Requirements and associated AMCs are specific to the flight control system and should not be considered in isolation of the other Requirements applicable to the RPAS. The Certification basis to be applied on any project will include in particular the SC-RPAS.1309. The SC-RPAS.1309 references the AMC 20-115 as guidance but also the following industry documents that are used as acceptable guidance to defined the minimum acceptable level of Software DAL:

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– ED-80 / DO-254, Design assurance guidance for airborne electronic hardware

Commenter 3 : Airbus DS (Mr Maurice Labonde – date 20-07-2016)

Comment # 7

Paragraph No: None

Comment:
The analyses of actuator failure modes have to be based on conservative inputs for the remaining actuator damping. These inputs should come from Lab: Hydraulics- resp. gear damping in "End of Life" status. At this, realistic minimum damping values will be made available. "Iron Bird" Testing should be done to determine phase shifts being useful to get appropriate stability margins for flutter. NYQUIST demonstration should be made available providing gain & phase margins for stability investigation.

Justification: N/A

Proposed Text (if applicable): None

EASA response:

Noted.

The proposed wording corresponds to a possible design solution and verification methods to meet the certification objective.

However, in general, EASA (to the possible extent) does not mandate a particular technical solution but rather define certification objectives.

For instance, there may be acceptable aircraft design where the margin to flutter are guaranteed using balanced surfaces and/or the dynamic stiffness provided by redundant active actuators or a periodic damping check could be used to guarantee a minimum. Other examples may also be acceptable.

It is under the responsibility of aircraft manufacturer to demonstrate the appropriate limitations associated with a given design.